September 29, 2005

Mr. Jeffrey S. Forbes
Vice President Operations
Arkansas Nuclear One
Entergy Operations, Inc.
1448 S. R. 333
Russellville, AR 72801

SUBJECT: ARKANSAS NUCLEAR ONE, UNIT 2 (ANO-2) - RE: REQUEST FOR RELIEF FROM THE REQUIREMENTS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) BOILER AND PRESSURE VESSEL CODE (CODE) CONCERNING AUTHORIZATION TO USE NEW DESIGN OF MECHANICAL NOZZLE SEAL ASSEMBLY (MNSA-2) (TAC NO. MC2306)

Dear Mr. Forbes:

By letter dated March 11, 2004, as supplemented by letters dated November 19 and December 20, 2004, and January 24, January 31, and February 1, 2005, Entergy Operations, Inc. (EOI or the licensee), requested relief from ASME Code, Section XI, requirements for IWA-4170 required repairs. In its March 11, 2004, letter, EOI requested that the MNSA-2s installed on the pressurizer be approved by the Nuclear Regulatory Commission (NRC) as permanent repairs. The request was withdrawn by letter dated December 20, 2004. In its January 24, 2005, letter, EOI explained that the ANO-2 pressurizer would be replaced in 2006 and that the previous application was being superseded by an application for a one-cycle extension for temporary use of the MNSA-2s. EOI requested NRC staff to also approve use of the new design of the MNSA in temporary applications on other locations in the reactor coolant system (RCS) that exhibit leakage due to primary water stress corrosion cracking (PWSCC) at ANO-2.

Initially, you proposed to use MNSA-2 as a repair to restore nozzle or heater sleeve integrity and prevent leakage for two operating cycles. The staff approval of the relief request is documented in a letter dated July 3, 2002. Pursuant to 50.55a(a)(3)(i) to Title 10 of the *Code of Federal Regulations* (10 CFR), EOI requested NRC's authorization to extend use of the improved design of the MNSA, designated as MNSA-2, in applications at the affected pressurizer instrument nozzles and heater sleeves. The request was made in order to repair leaks attributed to PWSCC that have been and may be detected while performing inspections during refueling outages. The typical repair of these nozzles or heater sleeves of this type uses a half-nozzle replacement with external weld repair. These repairs would extend RCS drain-down activities or require a de-fueled condition, and significantly increase worker radiation exposure to perform extensive field machining and temper bead welding activities. With this application, the licensee has proposed to extend the use of the affected MNSAs by one additional operating cycle.

With respect to the two modified instrument nozzles, the socket weld between the inserted new nozzle, and the old nozzle is the new pressure boundary. Cracks in the "J"-groove welds have the potential to show leakage at the surface of the pressurizer in the annulus region between the old nozzle and the base material, and if the socket weld were to crack, the leakage would be observed at the socket weld. Since the MNSA-2 is a mechanical device designed to replace the function of partial penetration J-groove welds that attach Alloy 600 nozzles or heater sleeves to the pressurizer, the proposed MNSA-2 repair is appropriate for applications when evidence of leakage is found on the surface of the pressurizer. If the evidence of leakage is at the socket weld, the proposed MNSA-2 repair would not be appropriate and normal weld repair techniques would be required.

EOI informed NRC that five pressurizer heater sleeve nozzles were found leaking during the 16th refueling outage walkdown following shutdown and MNSA-2s were installed on these nozzles during the outage. One additional pressurizer heater sleeve nozzle was found leaking during the heat up walkdown in preparation for power ascension. ANO-2 was shut down to install a MNSA-2 on this nozzle. No other leaking nozzles were found.

The NRC staff evaluated the information provided in the submittals and determined that the proposed alternative as requested by letter dated January 24, 2005, as supplemented by letters dated January 31 and February 1, 2005, would provide an acceptable level of quality and safety for one additional operating cycle. Therefore, EOI's proposed alternative is authorized, pursuant to 10 CFR 50.55a(a)(3)(i). This authorization is valid until the fall of 2006 refueling outage (2R18) when the ANO-2 pressurizer will be replaced. The NRC staff finds that the additional stress and fatigue levels for the presently installed MNSA-2s is within the criteria previously approved by the NRC staff, and that the existing MNSA-2 design is adequate for one additional operating cycle.

The NRC staff's safety evaluation is enclosed.

Sincerely,

/RA/
David Terao, Chief, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure: Safety Evaluation

cc w/encl: See next page

With respect to the two modified instrument nozzles, the socket weld between the inserted new nozzle, and the old nozzle is the new pressure boundary. Cracks in the "J"-groove welds have the potential to show leakage at the surface of the pressurizer in the annulus region between the old nozzle and the base material, and if the socket weld were to crack, the leakage would be observed at the socket weld. Since the MNSA-2 is a mechanical device designed to replace the function of partial penetration J-groove welds that attach Alloy 600 nozzles or heater sleeves to the pressurizer, the proposed MNSA-2 repair is appropriate for applications when evidence of leakage is found on the surface of the pressurizer. If the evidence of leakage is at the socket weld, the proposed MNSA-2 repair would not be appropriate and normal weld repair techniques would be required.

EOI informed NRC that five pressurizer heater sleeve nozzles were found leaking during the 16th refueling outage walkdown following shutdown and MNSA-2s were installed on these nozzles during the outage. One additional pressurizer heater sleeve nozzle was found leaking during the heat up walkdown in preparation for power ascension. ANO-2 was shut down to install a MNSA-2 on this nozzle. No other leaking nozzles were found.

The NRC staff evaluated the information provided in the submittals and determined that the proposed alternative as requested by letter dated January 24, 2005, as supplemented by letters dated January 31 and February 1, 2005, would provide an acceptable level of quality and safety for one additional operating cycle. Therefore, EOI's proposed alternative is authorized, pursuant to 10 CFR 50.55a(a)(3)(i). This authorization is valid until the fall of 2006 refueling outage (2R18) when the ANO-2 pressurizer will be replaced. The NRC staff finds that the additional stress and fatigue levels for the presently installed MNSA-2s is within the criteria previously approved by the NRC staff, and that the existing MNSA-2 design is adequate for one additional operating cycle.

The NRC staff's safety evaluation is enclosed.

Sincerely,
/RA/

David Terao, Chief, Section 1
Project Directorate IV
Division of Licensing Project Management
Office of Nuclear Reactor Regulation

Docket No. 50-368

Enclosure: Safety Evaluation

cc w/encl: See next page

cc w/encl: See next page
DISTRIBUTION:
PUBLIC
PDIV-1 Reading
RidsNrrDlpmLpdiv (HBerkow)
RidsNrrDlpmLpdiv1 (DTerao)
MHartzman/KManoly
SMorris
RidsRgn4MailCenter (DGraves)
RidsOgcRp
RidsAcrsAcnwMailCenter
BElliot
MMitchell
RidsNrrPMDHolland
RidsNrrLADJohnson
DBujol
Accession No.: ML051670465

OFFICE	PDIV-1/PM	PDIV-1/LA	DE/EMEB	DE/EMCB	OGC	PDIV-1/SC
NAME	DHolland*	DJohnson*	KManoly*	MMitchell*	JZorn*	DTerao
DATE	9/19/05	9/19/05	9/29/05	9/22/05	9/29/05	9/29/05

OFFICIAL RECORD COPY

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

AUTHORIZATION FOR TEMPORARY INSTALLATION OF

THE NEW DESIGN OF MECHANICAL NOZZLE SEAL ASSEMBLIES

REQUEST FOR RELIEF

ENTERGY OPERATIONS, INC.

ARKANSAS NUCLEAR ONE, UNIT 2

DOCKET NO. 50-368

1.0 INTRODUCTION

By letter to the Nuclear Regulatory Commission (NRC) dated March 11, 2004 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML040780340), as supplemented by letters dated November 19, 2004 (ADAMS Accession No. ML043280623), December 20, 2004 (ADAMS Accession No. ML043630343), January 24, 2005 (ADAMS Accession No. ML050400108), January 31, 2005 (ADAMS Accession No. ML050390309), and February 1, 2005 (ADAMS Accession No. ML050390322), Entergy Operations, Inc. (EOI or the licensee) submitted a request to install a new design of mechanical nozzle seal assembly (MNSA), designated as MNSA-2, on leaking pressurizer nozzles and heater sleeves at Arkansas Nuclear One, Unit 2 (ANO-2). This new design is an improvement to the original MNSA that had been previously installed on a temporary basis at certain other plants. However, this application was withdrawn by letter dated December 20, 2004, and superseded by letter dated January 24, 2005. Specifically, EOI requested authorization to extend existing installations of MNSA-2 at ANO-2 for a period of one additional operating cycle, in the event that small bore pressurizer nozzles and heater sleeves on the pressurizer were found to be leaking during the 16th refueling outage (2R16), MNSA-2s would be used as temporary repairs until the 17th refueling outage (2R17). These leaks are typically attributed to primary water stress corrosion cracking (PWSCC) of the "J"-groove weld on the interior of the pressurizer shell.

2.0 REGULATORY EVALUATION

2.1 Background

Pursuant to 50.55a(a)(3) of Title 10 of the *Code of Federal Regulations* (10 CFR), licensees may use alternatives to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) when authorized by the Director of the Office of Nuclear Reactor Regulation. The licensee must demonstrate that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(i), the alternatives will provide an acceptable level of

quality and safety in lieu of meeting the requirements in Section XI of the Code, or that, pursuant to the requirements of 10 CFR 50.55a(a)(3)(ii), complying with the requirements of 10 CFR 50.55a would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety.

During ANO-2's 15th refueling outage in April 2002, EOI planned to inspect 2 lower level instrument nozzles, 1 shell side instrument nozzle, 1 vent nozzle, 4 upper steam space nozzles, and 96 heater sleeves on the pressurizer, for a total of 104 nozzles. The potential existed for leaks to occur in Alloy 600 pressurizer nozzles and heater sleeves due to PWSCC. EOI proposed to install, under the provisions of 10 CFR 50.55a(a)(3)(i), a MNSA-2 on each nozzle and/or heater sleeve found to be leaking, as a repair method to restore the integrity of the pressure boundary and prevent leakage of the identified cracked nozzle or heater sleeve. The use of a MNSA-2 had been proposed as a temporary alternative repair method to the Code requirements to restore the integrity and prevent leakage of pressurizer nozzles and heater sleeves for up to two cycles of operation. This relief request was approved in a letter dated July 3, 2002. As part of ANO-2 R&R-008, which was submitted by letter dated January 24, 2005, EOI has requested use of the existing MNSA-2s to 2R17. In the event that new leaks may be found during 2R16, EOI has requested that MNSA-2s be used in those situations, if applicable, as well.

The nozzles and heater sleeves are welded to the pressurizer bottom head with internal "J"-groove welds. These welds have been found to be susceptible to PWSCC. In addition, the two pressurizer instrument nozzles were modified with new SA-182, F-316 stainless steel nozzle additions. The original nozzles were cut off approximately 2 inches from the pressurizer shell's external surface and flush with the internal pressurizer surface. The stainless steel nozzles were inserted inside the existing pieces. The stainless steel additions extend 5 inches into the pressurizer and are socket welded to the 2 inch tails of the original pieces. The typical permanent repair of these nozzles and heater sleeves consists of either installing a heater sleeve plug welded to a temper-bead pad or a half sleeve replacement, in accordance with ASME Code Section XI requirements.

The licensee stated that an ASME Code Section XI repair method would extend reactor coolant system (RCS) drain-down activities or require de-fueled conditions. It could also cause a significant increase in worker radiation exposure while performing extensive field-machining and temper bead welding activities. MNSA-2s can be effectively installed under various plant conditions and thus provide outage schedule flexibility, as well as reduced worker radiation exposure, while restoring structural integrity and leak tightness to the RCS.

The NRC staff has approved similar requests for temporary repair of pressurizer nozzles and heater sleeves by MNSA (the original design) at San Onofre Nuclear Generating Station; Waterford Steam Electric Station, Unit 3 (Waterford 3); Palo Verde Nuclear Generating Station; and most recently at Millstone Nuclear Power Station.

The MNSA-2 utilizes the same materials of construction and the same seal material as the original MNSA. They are attached in a similar fashion. The primary seal is loaded by tensioning bolts or studs. The MNSA-2 design differs from the original MNSA design in three ways: (1) a counterbore provision contains the primary seal, (2) the method of live-loading the primary seal, and (3) a means to divert leakage, should it occur.

2.2 Licensing Basis

Paragraph (g) to 10 CFR 50.55a requires, in part, that all inservice examinations and system pressure tests conducted during the first 10-year in-service inspection (ISI) interval and subsequent intervals on ASME Code Class 1, 2, and 3 components comply with the requirements in the latest edition and addenda of the ASME Code Section XI incorporated by reference in 10 CFR 50.55a(b), on the date 12 months prior to the start of the 10-year ISI interval.

By reference to, and implementation of, ASME Code Section XI, Paragraphs IWB-3132 or IWB-3142, 10 CFR 50.55a also requires that existing flaws in ASME Code Class components be removed by mechanical means, or the components be repaired or replaced to the extent necessary to meet the acceptance standards in ASME Code Section XI, Article IWB-3000. Detection of leaks in the structural portion of an ASME Code Class 1, 2, or 3 component is direct evidence of a flaw in the component.

Paragraph IWA-4170 of Section XI of the ASME Code requires that repairs and the installation of RCS pressure boundary be performed and reconciled in accordance with the Owner's Design Specifications and Original Code of Construction for the component or system. The ANO-2 RCS pressurizer was designed and constructed to the rules of ASME Section III, Subsection NB, 1968 Edition, through and including the summer 1970 Addenda.

Paragraph NB-3671.7 to Section III of the ASME Code, "Sleeve Coupled and Other Patented Joints," applies to MNSA-2, and requires that ASME Code Class 1 joints be designed to meet the following criteria:

> provisions must be made to prevent separation of the joint under all service loading conditions, the joint must be designed to be accessible for maintenance, removal, and replacement activities, and the joint must either be designed in accordance with the rules of ASME Code, Section III, Subarticle NB-3200, or be evaluated using a prototype of the joint that will be subjected to additional performance tests in order to determine the safety of the joint under simulated service conditions. These conditions also apply to the design, installation, inspection, and maintenance of MNSAs.

3.0 TECHNICAL EVALUATION OF RELIEF REQUEST

Licensee's Proposed Alternative (As Stated):

In support of the spring 2002 refueling outage at ANO-2 (2R15), EOI requested, via Request for Alternative ANO2-R&R-002 (Reference 4 [to the January 24, 2005, supplement]), NRC authorization to use the improved design of the mechanical nozzle seal assembly, designated MNSA-2, for two (2) operating cycles. EOI made this request to repair leaks attributed to primary water stress corrosion cracking (PWSCC) that are detected while performing inspections during refueling outages. The NRC approved ANO2-R&R-002, as documented in Reference 5 [to letter dated January 24, 2005]. EOI installed six (6) MSNA-2 devices on leaking pressurizer heater sleeves (C2, E1, E2, F4, G1, and N2) at ANO-2 during 2R15 in accordance with Request for Alternative ANO2-R&R-002 (Reference 4 [to letter dated January 24, 2005]).

Pursuant to 10 CFR 50.55a(a)(3)(i), EOI requests that the NRC staff extend the temporary installation time period from the current two (2) operating cycles to three (3) operating cycles for the six MNSA-2 devices installed on the ANO-2 pressurizer during 2R15. EOI will replace the ANO-2 pressurizer in the fall 2006 refueling outage (2R18), at which time the MNSA-2 devices will no longer be needed.

EOI will perform the following activities to support the one-cycle extension:

A. Pre-Service Inspection for MNSAs Installed During Spring 2005 Refueling Outage (2R17)

In the event of a leaking pressurizer heater sleeve is discovered during 2R17, EOI may elect to install a MNSA-2 at that location. Such an installation would be performed in accordance with approved Request for Alternative ANO2-R&R-002 (Reference 4 [to letter dated January 24, 2005]). In addition to the requirements of ANO2-R&R-002, EOI will perform the following activities to support the MNSA-2 installation:

1. EOI will perform a VT-3 visual examination of the pressurizer in the area of installation in accordance with IWB-3520.2[1].

2. EOI will perform a VT-1 visual examination of pressure-retaining MNSA bolting prior to assembly. The acceptance standards of IWB-3517 shall apply.

3. EOI will perform a VT-2 examination of the MNSA connection in accordance with Table IWB-2500-1 Category B-P with the insulation installed on the pressurizer.

B. Inservice Inspections for MNSAs Installed During 2R15

Since EOI is replacing the ANO-2 pressurizer during 2R18 (2R18 is the same interval and period as 2R17), those ASME inspections performed on a per-period or per-interval schedule are excluded from the inspections to be performed during 2R17. EOI will perform inservice inspections on the six installed MNSAs during 2R17 as follows:

1. EOI will inspect the leakage detection/diversion fitting for evidence of leakage before the other inspections are performed.

---

[1]Although IWB-3520.2 is written specifically for the reactor vessel and its internal structures, application to the pressurizer is believed accurate to determine if conditions are acceptable for the installation of a MNSA-2.

2. If a MNSA-2 is required to be disassembled[2], EOI will perform a VT-1 examination using the acceptance criteria of Table IWB-2500-1 Examination Category B-G-2. Additionally, the VT-1 inspection will be expanded to include the counterbore, female threads in the pressurizer (to the extent that they are accessible), and the structural portions of the MNSA clamp, allowing no cracks.

3. With the plant at cold conditions, EOI will perform a VT-2 and a VT-3 examination with the insulation removed from the MNSA-2 and surrounding areas of the pressurizer.

4. EOI will perform a VT-2 of the MNSA-2s with insulation installed during system leakage testing required by Table IWB-2500-1 Examination Category B-P during each refueling outage.

5. The results of the VT-2 exams discussed in Sections III.B.3 and III.B.4 of Request for Alternative ANO2-R&R-008 will be evaluated by comparing them with acceptance standard IWB-3522.

6. The results of the VT-3 exam discussed in Section III.B. 3 of Request for Alternative ANO2-R&R-008 will be evaluated by comparing them with acceptance standard IWB-3520.2.

Upon NRC approval of this request, EOI will revise the ANO-2 Inservice Inspection Program to include the above activities.

C. Other Actions

If leakage from a MNSA-2 is detected during Cycle 18 operation, EOI may elect to retorque the MNSA bolting to stop the leakage. However, if retorquing above the design limit becomes necessary, EOI will perform an engineering analysis to revise the torque limit. If retorquing fails to stop the leak, EOI will disassemble the MNSA-2 and examine it in accordance with Section III.B.2 [of Request for Alternative ANO2-R&R-008], above and also perform a VT-3 examination with insulation removed. There shall be no evidence of leakage during plant startup.

Licensee's Basis for Relief (As Stated):

The specific details of the MNSA-2 description, design, and application were provided in Request for Alternative ANO2-R&R-002 (Reference 4 [to the January 24, 2005, letter]) which was approved by the NRC staff (Reference 5 [to the January 24, 2005, letter]). As stated in ANO2-R&R-002, the MNSA-2 device was designed for a 40-year life. The design of the MNSA-2 in combination with the proposed actions discussed [above] provides reasonable assurance that:

---

[2]In EOI letter CNRO-2002-00018, EOI committed to disassemble any MNSA-2 that was discovered leaking during the operating cycle and inspect it and the surrounding pressurizer surface for corrosion.

1. The MNSA-2 will adequately perform its design function for one additional operating cycle; and

2. Any degradation of a MNSA-2 device will be discovered and corrected prior to any gross failure of the reactor coolant pressure boundary.

Use of Mechanical Nozzle Seal Assemblies for which Relief is Requested:

2 Pressurizer lower level instrument nozzles
2 Pressurizer upper level instrument nozzles
2 Pressurizer upper pressure instrument nozzles
1 Pressurizer upper vent nozzle
1 Pressurizer side shell temperature nozzle
96 Pressurizer Heater Sleeves

Code Requirement:

ASME Code Section XI, IWA-4170 requires repairs and installation of replacements to be performed in accordance with the Owner's Design Specification and the original Construction Code of the component or system. The affected pressurizer instrument nozzles and heater sleeves were designed and constructed to the rules of ASME Code Section III, Subsection NB, 1968 Edition, through and including the summer 1970 Addenda. Rules for replacing ASME Code Section III, Class 1 welded nozzle or heater sleeve integrity with mechanical clamping devices are not clearly defined by ASME Code, Section III.

Upon NRC approval of this request, EOI will revise the ANO-2 ISI Program to include the above activities.

Evaluation:

The licensee requests the use of MNSA-2 pursuant to 10 CFR 50.55a(a)(3)(i), stating that this alternative provides an acceptable level of quality and safety. To determine if MNSA-2 provides an acceptable level of quality and safety, the staff compared the MNSA-2 design and operational characteristics with the applicable ASME Code requirements, reviewed the MNSA-2 resistance to corrosion for the intended service period, and evaluated the licensee's commitments associated with the use of MNSA-2. The staff's review is described below.

The MNSA-2 is a mechanical device designed to replace the function of partial penetration "J"-groove welds that attach Alloy 600 nozzles or heater sleeves to the pressurizer, moving the pressure boundary to the sub-surface of the pressurizer exterior wall. The MNSA-2 stainless steel components performing a RCS pressure boundary function are designed, fabricated, and constructed using approved ASME Code materials (except the Grafoil gasket, which is a non-Code material), in accordance with the applicable rules of ASME Code Section III, Subsection NB and Appendix I.

A MNSA-2 consists of two split-seal/flange assemblies placed around a leaking nozzle or heater sleeve. The seals are made of Grafoil, a graphite compound that is compressively loaded within the assembly to prevent RCS leakage past the nozzle. The seal assembly is placed in a counterbore below the pressurizer surface and bolted with threaded rods into holes drilled and threaded on the outer surface of the RCS component wall. The primary seal is held under

compression by a compression collar made of stainless steel. The compression collar with a collection area is utilized if there is leakage, to funnel the leakage along the annulus region between the nozzle and the compression collar. A second seal at the top of the compression collar blocks leakage from passing beyond the compression collar. A leakoff nozzle that penetrates through the collar allows for leakage to pass out to where it can be detected. This assembly acts as a complete replacement of the "J"-groove weld between the Alloy 600 sleeve and the pressurizer.

The MNSA-2 is designed to prevent separation of the joint under all service loadings. An anti-ejection clamp, which is installed and secured in place via the tie rods, Belleville spring washers, and hexagon nuts, serves as a structural restraint of the nozzle or heater sleeve in case of total "J"-groove weld failure and potential ejection of the nozzle or heater sleeve. This design is supported by technical analysis and tests that meet the design criteria specified in ASME Code Section III, Subsection NB, 1989 Edition, no Addenda. Enclosure 2 to the licensee's letter of March 6, 2002, for Waterford 3, "Westinghouse Electric Corporation Design Report No. DAR-CI-02-1, "Addendum to CENC-1244 Analytical Report for Waterford Unit 3 Pressurizer," documents the required ASME Code Section XI, IWA-4170(b), reconciliation of the construction codes for a component built to a later edition of the Code, which the staff finds acceptable. Additionally, MNSA-2 installations are accessible for maintenance, removal, and replacement. The provisions of NB-3671.7 are therefore nominally satisfied. It is also recognized that the MNSA-2 is designed to prevent separation of the device from the wall under all service loadings, and thus acts as a complete replacement of the "J"-groove weld between the Alloy 600 sleeve and the pressurizer. It therefore replaces both the sealing and the structural integrity of the "J"-groove welds, and thus becomes part of the reactor pressure boundary.

In its letter dated March 15, 2002, by reference to letter dated March 1, 2002, from EOI to NRC, "Use of Mechanical Nozzle Seal Assemblies" for use at Waterford 3, and the subsequent letter dated April 4, 2002, EOI also provided an evaluation to address potential corrosion of the nozzle bore holes, galvanic corrosion (Grafoil Seal to Low Alloy Steel), and stress corrosion cracking (SCC) of the MNSA components. The results of this evaluation are summarized as follows:

1. A through-wall crack in the nozzle could be a source of corrosion. However, the borated water will stagnate and will not replenish, except perhaps during shutdown when the RCS is drained. The level of the boric acid will not exceed that of the primary coolant at the beginning of a fuel cycle. In addition, low primary side oxygen levels in pressurized water reactors (PWRs) will result in corrosion potentials below the critical cracking potentials for these materials in high temperature water.

2. Boric acid corrosion of the materials of construction for the MNSA-2 has been addressed by use of corrosion resistant materials, testing, and analysis.

3. Corrosion of the bolts (SA 453 (A-286)), while susceptible to corrosion, is mitigated by use of the collection area and two seals, which diverts any leakage away from the bolts, and inspection of the bolts (addressed below).

4. If leakage occurs beyond the primary seal into the area formed by the MNSA-2 and the pressurizer, it may wet the compression collar and low alloy steel. The leakoff nozzle may permit oxygen to ingress into the crevice area resulting in an aerated environment.

Release of steam through the leakoff nozzle will potentially limit the oxygen in the crevice region. Remaining oxygen will be consumed in the corrosion of the low alloy steel. Therefore, the environment will be similar to that resulting from primary coolant leakage into control element drive mechanism crevices. Minor amounts of corrosion (several thousandths of an inch maximum) of low alloy steel corrosion, and no stainless steel corrosion will occur. Leakage will be observed via the leakoff nozzle and inspection of the counterbore hole during the next outage walkdown, and repaired or replaced.

5. Machining of the OD of the nozzle during the counterbore machining will not lead to SCC for several reasons: The OD of the nozzle was machined during original fabrication and the additional machining should not significantly alter the residual stresses present; The nozzle will not be welded, eliminating the residual stresses associated with the partial penetration weld at the pressurizer ID; The temperature at the OD is lower than the ID. Since PWSCC is a thermally activated process, time to initiate and propagate cracks at the OD will be longer.

6. A history of galvanic corrosion problems, in applications where low alloy steel is in contact with a Grafoil seal in an environment of an electrically conductive fluid (water), exists. This particular combination is used in other applications where the low alloy (or carbon steel) is frequently inspected (for example, steam generator secondary side manway and hand hole applications). The Grafoil seal, grade GTJ, is chemically resistant to attack from nearly all organic and inorganic fluids, and is very resistant to borated water. The MNSA-2 application is similar (i.e., Grafoil material is in contact with low alloy steel and visual inspections will be conducted at each refueling outage to identify signs of leakage), and for these reasons, significant galvanic corrosion is not expected. The licensee also noted that, in the absence of leakage past the Grafoil seal, the boric acid solution in the annulus region, below the seal, will become stagnant and will not allow replenishment of oxygen, thereby limiting the corrosion potential.

7. ASME Code Section XI preservice requirements, applicable to the MNSA-2 during each 10-year ISI interval, include a system leak test at the end of each refueling outage and bolting examination, based on the schedule of percentages required. For the MNSA-2 installed on the pressurizer nozzles and heater sleeves, the Bolting B-G-2 examination requirements would allow the VT-1 examination to be performed as follows: (a) in place under tension, and (b) when the connection is disassembled or when the bolting is removed. This examination is required once each 10-year interval.

8. The requirements of ASME Code Section XI pressure tests and alternatives of Code Case 416, on the pressure testing of mechanical joints made in the installation of pressure retaining replacements, are applicable to the MNSA-2. The tests and a VT-2 inspection, at temperatures and pressures appropriate to ANO-2 Pressure-Temperature (P-T) limits, will be performed as a part of plant restart.

Stress Evaluation:

The MNSA-2 design is supported by the manufacturer's technical analysis and tests that meet the design criteria specified in ASME Code Section III, Subsection NB, 1989 Edition, no Addenda. The technical analysis includes the required ASME Code Section XI, IWA-4170(b),

reconciliation of the construction codes for the use of a component built to a later edition of the Code, which the staff finds acceptable. Additionally, MNSA-2 installations are accessible for maintenance, removal, and replacement. The provisions of NB-3671.7 are therefore satisfied.

The acceptance of the original MNSAs was based on industry experience, which demonstrated that the structural integrity and leak tightness of the MNSAs, and the structural integrity of the components to which the MNSAs are attached, was maintained at least through one or two cycles. The staff has also reviewed qualifying seismic and other structural tests performed by the manufacturer that demonstrate the structural integrity of the MNSA-2s. EOI has also provided revised ASME Code Section III Class 1 fatigue analysis of the pressurizer, modified to account for the presence of the MNSA-2 counterbore and bolt holes, and demonstrated that the fatigue requirement of NB-3222.4(e), namely, the cumulative usage factor (CUF) not exceed 1.0 under the licensing design conditions, is met for the life of the plant. Based on experience at other plants, the staff considers the probability of exceeding the ASME Code Section III, Class 1 fatigue cumulative usage of 1.0 in the short-term operation of the three cycles requested by the licensee as low. However, for operation beyond the requested three cycles, the staff would need to complete the assessment of the stress and fatigue and other related information that may pertain to long-term usage, before approval can be granted for extended operation of the installed MNSA-2s.

Summary:

Based on the above evaluation of potential corrosion effects, the staff concludes that there are no significant corrosion issues associated with the application of MNSA-2 repairs to pressurizer nozzles and heater sleeves, with the exception of the two modified instrument nozzles. The data indicates that corrosion of the nozzle hole will also be acceptable over the requested three-cycle period of use.

With respect to the two modified instrument nozzles, further clarification of the scope of the relief is required. The socket weld between the inserted new nozzle and the old nozzle is the new pressure boundary. Cracks in the "J"-groove welds have the potential to show leakage at the surface of the pressurizer in the annulus region between the old nozzle and the base material, and if the socket weld were to crack, the leakage is observed at the socket weld. Since "...the MNSA-2 is a mechanical device designed to replace the function of partial penetration J-groove welds that attach Alloy 600 nozzles or heater sleeves to the pressurizer..." (as stated in the application dated March 15, 2002), for evidence of leakage at the surface of the pressurizer, the proposed MNSA-2 repair would be appropriate. On the other hand, if the evidence of leakage is at the socket weld, the proposed MNSA-2 repair would not be appropriate. Normal weld repair techniques would then be required.

In addition, if leakage is identified on the surface of the pressurizer and the MNSA-2 repair is utilized, Code weld inspections are still required to identify any subsequent leakage at the socket weld. If Code inspections of the socket welds are hampered by installation of MNSA-2, then removal of the MNSA-2 may be required to perform the appropriate inspections.

The NRC staff has reviewed the proposed licensee actions and limitations noted above, and concludes that they are sufficient to assure proper installation and operation of the MNSA-2 for its intended use and duration.

4.0 CONCLUSION

The NRC staff concludes that, pursuant to 10 CFR 50.55a(a)(3)(i), the use of MNSA-2s as an alternative to an ASME Code Section XI repair on any leaking nozzles or heater sleeves of the type described above, may be authorized for a period not to exceed three operating cycles, since it is found to provide an acceptable level of quality and safety. This authorization is valid for the next operating cycle of the current ISI interval for ANO-2, which ends on March 25, 2010. MNSA-2s presently installed on the ANO-2 pressurizer may remain in operation for one additional operating cycle (until 2R18) at which time the ANO-2 pressurizer will be replaced.

Principal Contributors: B. Elliot
M. Hartzman

Date: September 29, 2005

cc:

Senior Vice President
& Chief Operating Officer
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Director, Division of Radiation
Control and Emergency Management
Arkansas Department of Health
4815 West Markham Street, Slot 30
Little Rock, AR 72205-3867

Winston & Strawn
1700 K Street, N.W.
Washington, DC 20006-3817

Mr. Mike Schoppman
Framatome ANP
3815 Old Forest Road
Lynchburg, VA 24501

Senior Resident Inspector
U.S. Nuclear Regulatory Commission
P. O. Box 310
London, AR 72847

Regional Administrator, Region IV
U.S. Nuclear Regulatory Commission
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011-8064

County Judge of Pope County
Pope County Courthouse
Russellville, AR 72801

Vice President, Operations Support
Entergy Operations, Inc.
P. O. Box 31995
Jackson, MS 39286-1995

Wise, Carter, Child & Caraway
P. O. Box 651
Jackson, MS 39205