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F. G. Burford
Acting Director
Nuclear Safety & Licensing

CNRO-2006-00041

September 8, 2006

U. S. Nuclear Regulatory Commission
Attn.: Document Control Desk
Washington, DC 20555-0001

SUBJECT: Request for Alternative ANO1-ISI-006
Proposed Alternative to Extend the Third Inservice Inspection Interval for Reactor Vessel Examination Category B-F Weld Examinations

Arkansas Nuclear One - Unit 1
Docket No. 50-313
License No. DPR-51

REFERENCE: Entergy Operations, Inc. letter CNRO-2006-00025 dated April 24, 2006

Dear Sir or Madam:

In the referenced letter, Entergy Operations, Inc. (Entergy) submitted Request for Alternative ANO1-ISI-006, which requested authorization to extend the third 10-year inservice inspection (ISI) interval for the Examination Category B-F weld examinations associated with the Arkansas Nuclear One, Unit 1 (ANO-1) reactor core flood line. During review of ANO1-ISI-006, the NRC staff informed Entergy that the subject alternative is a stand-alone document and, as such, information contained in referenced documents that support it should be incorporated into the request.

Entergy has revised ANO1-ISI-006 to reflect the supporting information. In addition, Entergy has added a discussion of our intent to evaluate core flood line dissimilar metal weld mitigation during the subsequent fall 2008 refueling outage (1R21) at ANO-1. The revised Request for Alternative ANO1-ISI-006 is provided in Enclosure 1 and replaces in its entirety the previous version submitted via the referenced letter. Changes are denoted by revision bars in the margins of the affected pages.

Also in the referenced letter, Entergy committed to perform the Code-required third interval examinations of the reactor vessel Examination Category B-F welds during 1R21 consistent with the approved ANO1-ISI-006. This commitment remains in effect for this revised request and is denoted in Enclosure 2.

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Entergy requests NRC approve ANO1-ISI-006 by October 1, 2006 in order to support planning activities for ANO-1's upcoming spring 2007 refueling outage (1R20). Should you have any questions regarding this submittal, please contact Guy Davant at (601) 368-5756.

Very truly yours,

FGB/GHD/ghd

Enclosures: 1. Request for Alternative ANO-ISI-006
2. Licensee-Identified Commitments

cc: Mr. W. A. Eaton (ECH)
Mr. J. S. Forbes (ANO)

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ENCLOSURE 1

CNRO-2006-00041

REQUEST FOR ALTERNATIVE
ANO-ISI-006

ENTERGY OPERATIONS, INC.
ARKANSAS NUCLEAR ONE, UNIT 1
REQUEST FOR ALTERNATIVE
ANO-ISI-006

I. COMPONENTS

The affected component is the Arkansas Nuclear One, Unit 1 (ANO-1) dissimilar metal (DM) weld associated with the reactor core flood line nozzle-to-safe end welds. The specific examination category and item number are from Table IWB-2500-1 of the 1992 Edition of ASME Section XI.

Component	Number	Weld Numbers	Description
B-F	B5.10	01-025	Volumetric and Surface Examination of NPS 4 and Larger Nozzle-to-Safe End Butt Weld
B-F	B5.10	01-026	Volumetric and Surface Examination of NPS 4 and Larger Nozzle-to-Safe End Butt Weld

Code Class: 1

References:

1. EPRI MRP-112, Alloy 82/182 *Pipe Butt Weld Safety Assessment for US PWR Plant Designs: Babcock & Wilcox Design Plants* (October 2004)
2. EPRI MRP-113, *Alloy 82/182 Pipe Butt Weld Safety Assessment for US PWR Plant Designs* (July 2004)
3. Entergy Operations, Inc. letter CNRO-2006-00024, *Request for Alternative ANO-ISI-005 - Proposed Alternative to Extend the Third Inservice Inspection Interval for Reactor Vessel Inservice Examinations*, dated April 24, 2006
4. EPRI MRP-116, *Probabilistic Risk Assessment of Alloy 82/182 Piping Butt Welds* (August 2004)
5. NRC letter dated February 23, 1999, *Evaluation of the Second/Third 10-Year Inservice Inspection Interval, Request for Alternative 96-003 for Arkansas Nuclear One, Unit 1* (1CNA029906)
6. NRC Regulatory Guide 1.174, Revision 1, *An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant Specific Changes to the Licensing Basis,* November 2002

Unit / Inspection Interval:	ANO-1 / Third (3rd) 10-Year Interval

II. CODE REQUIREMENTS

ASME Section XI IWB-2412, *Inspection Program B*, requires volumetric examination of essentially 100% of reactor vessel and piping pressure-retaining welds identified in Table IWB-2500-1 once each 10-year interval. IWA-2430(d) allows inspection intervals to be extended by as much as one year if this adjustment does not cause successive intervals to be altered by more than one year.

Item B5.70 of Table IWB-2500-1 requires that the nozzle-to-safe end butt welds have both volumetric and surface examinations every inspection interval. Note 1 of Table IWB-2500 for Examination Category B-F welds states, "For the reactor vessel nozzle safe ends, the examinations may be performed coincident with the vessel nozzle examinations required by Examination Category B-D."

III. PROPOSED ALTERNATIVE

Pursuant to 10 CFR 50.55a(a)(3)(ii), Entergy Operations, Inc. (Entergy) proposes an alternative to the requirement of IWA-2412 that volumetric and surface examination of essentially 100% of reactor vessel pressure-retaining welds (Examination Category B-F) be performed once each 10-year inservice inspection (ISI) interval. Specifically, Entergy proposes to extend the ISI interval for the identified Examination Category B-F welds to the end of the fall 2008 refueling outage (1R21), which is approximately 180 days beyond the currently scheduled interval and the Code-allowed one-year extension.

The purpose of the requested extension is to defer the subject examinations to 1R21. This request is consistent with Entergy's Request for Alternative ANO1-ISI-005 (Reference 3), which proposes to defer the reactor vessel ISI interval to 1R21.

The NRC staff has previously approved relief for ANO-1 pertaining to the inability to perform surface examinations of the identified welds in accordance with IWB-2500 (Reference 5).

IV. BASIS FOR PROPOSED ALTERNATIVE

A. Background

ANO-1 is currently in its third inservice inspection (ISI) interval, which began June 1, 1997, and ends May 31, 2007. ASME Section XI IWA-2430(d) allows a one-year extension of an interval, which would extend the interval to May 31, 2008. (Use of this one-year extension does not require approval from the NRC.) In order to comply with Code requirements, third interval examination of the identified Examination Category B-F welds must be performed during ANO-1's spring 2007 refueling outage (1R20). Entergy proposes to perform these examinations during 1R21.

B. Basis for Proposed Alternative

Given approval to extend the ANO-1 10-year reactor vessel ISI interval to the end of 1R21 as contained in Entergy's Request for Alternative ANO1-ISI-005 (Reference 3), Entergy also seeks to extend the Code-required core flood line weld inspections until 1R21. In order to perform the core flood line Examination Category B-F weld inspections, access to the weld from the inside of the reactor vessel as described below is required. Therefore, performing this examination during the upcoming 1R20 refueling outage will result in a hardship without a compensatory increase in the level of quality and safety. Justification supporting this request is provided below.

1. Need to Perform Reactor Core Flood Line DM Weld Examinations during Reactor Vessel ISI

The ANO-1 reactor vessel has two (2) ASME Class 1 (14-inch) carbon steel core flood nozzles with stainless steel safe ends. The carbon steel nozzles are lined with stainless steel cladding and have Alloy-82 butter with an Alloy-182 butt-weld to the stainless steel safe ends. The core flood lines connect directly into the reactor vessel and experience temperatures near that of the cold leg temperatures (approximately 577°F) during power operation.

As shown in Figure 1, the nozzle butt welds are located between the reactor vessel and the concrete shield wall. Above these butt welds is the permanent reactor cavity seal plate used for refueling. This plate is located at the reactor vessel flange which is located at plant elevation 376 feet, 6 inches. The centerline of the core flood lines is at plant elevation 371 feet, 6 inches, which is 5 feet below the seal plate. Just below the seal plate is a series of four (4) concrete shield plugs. The core flood nozzles are located approximately one (1) foot below the shield plugs. Below the shield plugs is metal reflective insulation that surrounds the core flood lines.

Access to the core flood nozzles from above would require a modification to the reactor cavity seal plate to allow removing the reactor cavity shield plugs. The existing man-ways in the reactor cavity seal plate do not allow for removing the shield plugs. Access to the core flood nozzle outside diameter (OD) from below is not feasible due to the reactor vessel skirt configuration, which does not provide a man-way into the reactor vessel cavity. Access to the core flood nozzle OD from the shield wall penetration is also not feasible since that portion inside the reactor cavity is covered by removable reactor vessel insulation panels that cover the subject welds. Removing the insulation panels to allow inspections is not feasible due to the distance through the penetration (approximately 6 feet), and the limited clearance between the piping and penetration walls (approximately 4 inches).

Therefore, the core flood nozzle examinations per ASME Section XI IWB 2500 are performed from the inside of the reactor vessel as part of the reactor vessel ISI at the normal interval frequency. As noted above, Entergy has submitted Request for Alternative ANO1-ISI-005 to defer the reactor vessel ISI (Reference 3).

2. Plant-Specific Reactor Vessel ISI History

ANO-1 is in its third inservice inspection interval for the reactor vessel; therefore, the preservice and two inservice inspections have been performed on the Examination Category B-F welds. These inspections achieved acceptable coverage; no reportable indications were found. Based on the examination method and coverage obtained, it is reasonable to conclude that the examinations were of sufficient quality to detect any significant flaws that could challenge reactor vessel integrity. The last examination findings are provided in the following table.

ANO-1 ISI Results

Weld ID	ASME Weld Category	Date Last Inspected	% Coverage Obtained	# of Reportable Indications	# of Indications Currently being Monitored	Growth of Indications Currently being Monitored (in)
01-025	B-F	1995	100	0	0	N/A
01-026	B-F	1995	100	0	0	N/A

3. Safety Significance of Core Flood Line Deferral for One Outage

General experience has shown that the incidence of primary water stress corrosion cracking (PWSCC) in PWR primary coolant systems is due to tensile stresses and the operating temperature. The primary sources of tensile stresses are weld residual stresses and applied operating stresses (such as pressure and temperature). Higher mechanical stresses are typically due to fabrication activities where welding residual stresses cause shrinkage of the material around the weld.

For materials of equal PWSCC susceptibility with equal applied stresses, the time to crack initiation is a function of operating temperature. Locations that operate at higher temperatures, such as pressurizers, typically exhibit cracking much sooner than locations that operate at lower temperatures, such as cold legs. Therefore, Alloy 600 butt welds that operate closer to cold leg temperatures are generally much less susceptible to PWSCC than those that are close to Reactor Coolant System (RCS) operating temperatures.

EPRI document MRP-112 (Reference 1) documents the susceptibility of various locations of butt welds on Babcock & Wilcox (B&W) designed reactors. The assessment included a review of crack orientations and sizes, welding stresses, crack growth rates, limiting flaw sizes and the probability to determine the susceptibility of various butt welds. The B&W core flood line butt welds were specifically evaluated in this report. The core flood lines operate at temperatures that are only slightly above the cold leg temperature (577°F). Critical flaw sizes for a through-wall flaw were determined using the methodology of ASME Section XI and Code Case N-513. The critical flaw sizes were determined for Axial and Circumferential through-wall flaw lengths and for a 75% through-wall circumferential flaw depth. The core flood nozzle critical flaw sizes are as follows:

Axial Flaw Length	Circ Flaw Length	Circ Flaw Depth
22.3 inches	20.7 inches	0.75%

Using the critical flaw data, crack growth analyses were performed under both PWSCC conditions and fatigue.

The results of this report for the B&W core flood lines show that the time for propagation of a flaw from an initial flaw size that produces an applied stress intensity factor equal to the PWSCC threshold stress intensity factor until 75% through-wall would take greater than 40 years. The time from identification of a 1-gpm leak until it reached a critical flaw size would be in excess of 70 years. The results of this analysis were also reflected in MRP-113 (Reference 2). The core flood lines were inspected in 1995 during the last 10-year inspection interval and no flaws were identified in these welds. Therefore, the potential of the core flood line butt welds to represent a safety concern by deferral until 1R21 is very small.

In addition, the EPRI MRP performed a risk assessment for failures of Alloy 82/182 butt welds in MRP-116 (Reference 4). In this report, probabilistic fracture mechanics (PFM) evaluations were performed for a variety of locations of butt welds in B&W, Combustion Engineering (CE), and Westinghouse reactors. The PFM models are acceptable to the NRC in showing appropriate results. Specifically for B&W designs, the decay heat line and the surge line were modeled. The decay heat line would be more comparable to the core flood line based on RCS temperatures. The results of the analysis when conducting normal 10-year ISI exams over a 40-year life results in only a 3.75E-09 increase in core damage frequency (CDF). In addition, a sensitivity analysis was also performed that shows that if no ISI is performed over the 40 years, the change in relative risk only increases by 2%. Therefore, the relative risk increase from the decay heat line (comparable to core flood line) butt welds is fully acceptable within the guidance of Regulatory Guide 1.174 (Reference 6).

4. <u>Dose Reduction</u>

As discussed above, Entergy has submitted to the NRC staff a request to defer performing the complete reactor vessel ISI via Request for Alternative ANO1-ISI-005 (Reference 3). The complete reactor vessel ISI requires removing the core barrel. Deferring the examination of the core flood line DM welds until the performance of the complete reactor vessel ISI will consolidate activities and reduce personnel radiological exposure. Specifically, removing and replacing the core barrel in order to perform the weld examination involves approximately 600 mrem dose. The additional dose involved in performing the weld inspection separate from the remainder of the inspection is expected to be approximately 200 to 400 mrem. Therefore, performing this examination during the same planned evolution will result in a dose savings of up to 1 Rem since activities to support this examination (i.e., removing and replacing the core barrel and setup and performing the core flood line DM weld examination) will be performed only once rather than twice.

5. **Evaluation of Core Flood Alloy 600 Mitigation**

Entergy is evaluating mitigation of the Alloy 600 core flood nozzle DM weld during 1R21. As discussed above, these welds are only readily accessible from the inside diameter (ID) of the reactor vessel after the core barrel has been removed. Due to the relatively new technology to perform ID weld inlay mitigation and given the specific ANO-1 core flood line configuration, Entergy will utilize the additional time to 1R21 to investigate inlay mitigation design, analysis, and tooling.

V. CONCLUSION

10CFR50.55a(a)(3) states:

"Proposed alternatives to the requirements of (c), (d), (e), (f), (g), and (h) of this section or portions thereof may be used when authorized by the Director of the Office of Nuclear Reactor Regulation. The applicant shall demonstrate that:

(i) The proposed alternatives would provide an acceptable level of quality and safety, or

(ii) Compliance with the specified requirements of this section would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety."

As discussed in Section IV, above, Entergy believes that compliance with the requirements of ASME Section XI IWB-2412 would result in hardship or unusual difficulty without a compensating increase in the level of quality and safety. Entergy believes that the proposed alternative to extend the inspection interval for examining the core flood line Examination Category B-F welds to the end of 1R21, the ANO-1 fall 2008 refueling outage, provides an acceptable level of quality and safety. Therefore, Entergy requests the NRC staff approve this proposed alternative in accordance with 10 CFR 50.55a(a)(3)(ii).

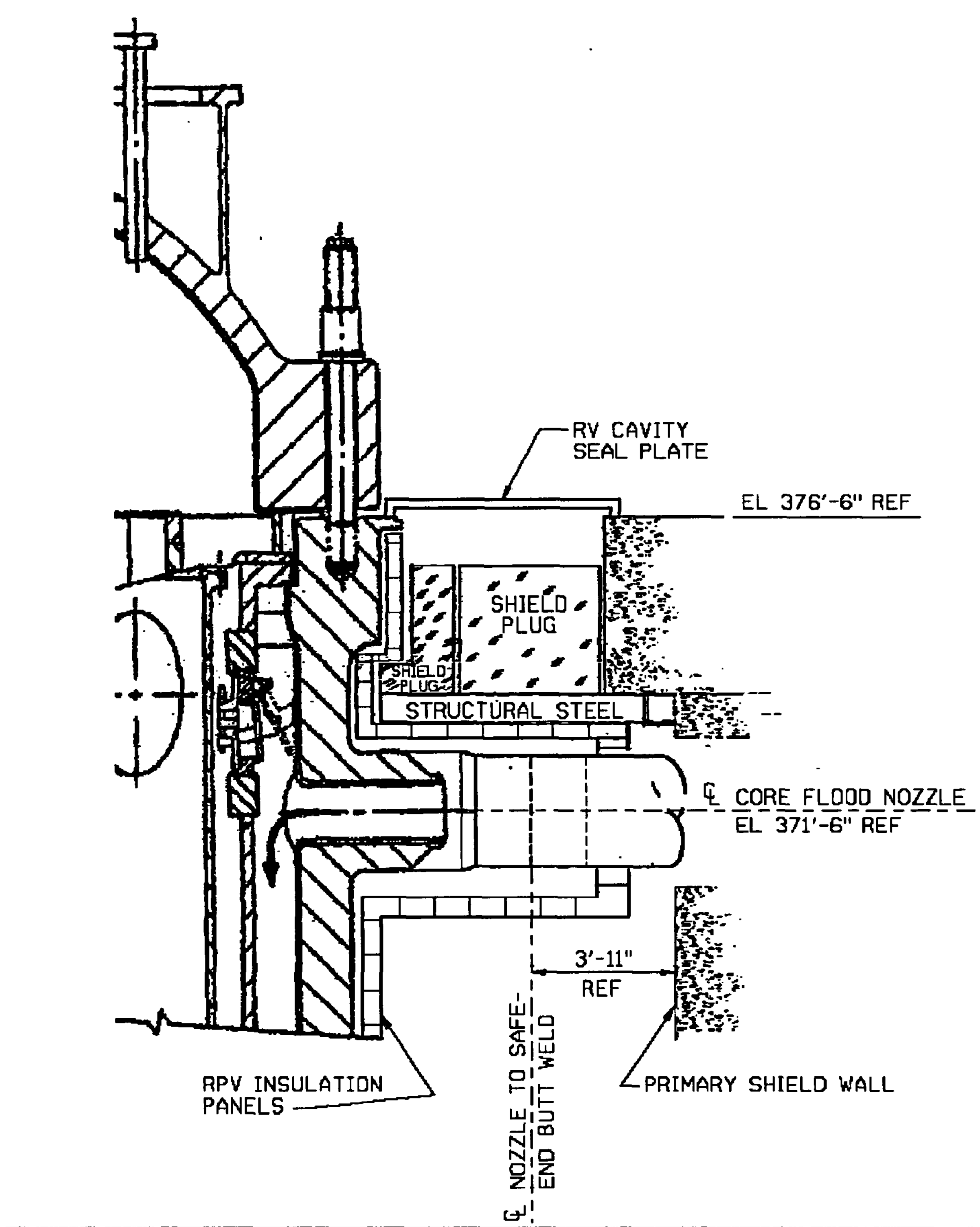

FIGURE 1

CORE FLOOD LINE B-F WELD ACCESSIBILITY

ENCLOSURE 2

CNRO-2006-00041

LICENSEE-IDENTIFIED COMMITMENTS

LICENSEE-IDENTIFIED COMMITMENTS

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE
	ONE-TIME ACTION	CONTINUING COMPLIANCE	
Entergy will perform volumetric examination of the ANO-1 core flood line Examination Category B-F welds during 1R21, the fall 2008 refueling outage, consistent with the approved ANO1-ISI-006.	✓		Fall 2008 refueling outage