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1CAN031103

March 29, 2011

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

SUBJECT: Request for Use of Non-ASME Code Repair to Service Water Piping in Accordance with Generic Letter 90-05
Relief Request ANO1-R&R-015
Arkansas Nuclear One, Unit 1
Docket No. 50-313
License No. DPR-51

References:
1. Generic Letter 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping", dated June 15, 1990.
2. NRC Safety Evaluation Report dated February 22, 2008, "Indian Point Nuclear Generating Unit No. 3 – Relief Request (RR) No. RR-3-43 for Temporary Non-code Repair of Service Water Pipe" (TAC No. MD6831)

Dear Sir or Madam:

Pursuant to the guidance of NRC Generic Letter (GL) 90-05, "Guidance for Performing Temporary Non-Code Repair of ASME Code Class 1, 2, and 3 Piping," (Reference 1) Entergy Operations, Inc. (Entergy) is requesting relief in accordance with 10 CFR 50.55a(a)(3)(i) for a temporary non-code repair to the Arkansas Nuclear One, Unit 1 (ANO-1) Service Water (SW) system. The circumstances regarding this request were discussed with NRC staff in a conference call on March 28, 2011. Justification for a temporary repair of this piping in accordance with GL 90-05 is provided in Attachment 1.

On June 23, 2010, with ANO-1 in operation at 100% power, a through-wall leak was identified in a section of SW system piping with leakage of approximately 2 - 4 drops per minute. Entergy performed ultrasonic testing non-destructive examinations to characterize the affected area and prepared evaluations in accordance with Reference 1. The examinations and evaluations conclude that the leakage is a result of wall-thinning due to localized corrosion on the inside of the pipe.

During the third 90-day re-inspection (CR-ANO-1-2010-2622, CA-23), a smaller grid and a 0.2" diameter transducer were used and a noted change in the data pertaining to the thickness of the flawed area was observed. SW system operability was established with compensatory measures consisting of enhanced monitoring of the affected area. The remaining wall thickness

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currently provides sufficient structural integrity to maintain operability of the SW system. The operability evaluation also concluded that, assuming ongoing corrosion at a rate consistent with the most recent data, operability cannot be assured for the remainder of the operating cycle, which ends in the fall of this year, and a near-term repair is necessary.

Implementing an American Society of Mechanical Engineer (ASME) code repair would require removing this section of piping from service, which is not desired because it does not result in a compensating increase in the level of quality or safety. The affected piping section would require the entire SW loop to be secured and drained. While the ANO-1 Technical Specification provides 72 hours to effect repairs to the system, doing so would result in the loss of an entire train of emergency core cooling components during the repair window. In addition, isolation and draining of a SW loop during power operation is complex and would expend a significant portion of the 72-hour allowed outage period.

Entergy has designed a temporary engineered repair which meets the applicable stress criteria for normal and seismic loading conditions. ASME Code Section IWA-4422.1 requires that a defect be removed as part of repair installation. Since defect removal is not possible with the system in service, Entergy is requesting relief from this code requirement.

Implementation of the repair will include periodic monitoring at inspection frequencies identified in GL 90-05. As required by GL 90-05, a code repair of the subject piping flaw will be performed at the next scheduled outage exceeding 30 days, but no later than the next scheduled refueling outage. The next ANO-1 refueling outage is currently scheduled to begin September 25, 2011.

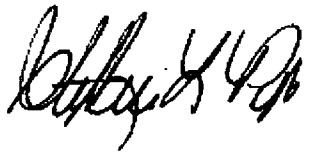
This request is similar to relief granted for Indian Point Nuclear Generating Unit No. 3 dated September 22, 2008 (Reference 2).

Entergy requests an expedited review of this relief request to support efforts for a prompt installation of the repair because an increase in leak rate could preclude the proposed repair approach. To avoid an unnecessary challenge to the SW system should degradation continue and the loop subsequently be declared inoperable, Entergy believes it is prudent to be prepared to install the temporary non-code repair within the next several days.

There are no new commitments being made in this submittal.

If you have any questions or require additional information, please contact me.

Sincerely,



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Attachments:
1. Relief Request ANO1-R&R-015
2. Minimum Weld Pad Thickness Calculation
3. HBD-45 Reinforcing Plate Sketch
4. NDE Report

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ATTACHMENT 1 TO

1CAN031103

RELIEF REQUEST ANO1-R&R-015

RELIEF REQUEST

ANO1-R&R-015

Component / Number:	HBD-45-10" Piping
Code Class:	ANSI B31.1 Treated as Class 3 for the purpose of ASME Section XI Inservice Inspection, Repair/Replacement and Pressure Testing
References:	ASME Code, Section XI, 2001 Edition with the 2003 Addenda (ISI Code of Record) Piping Construction Code USAS B31.1, 1967 and Summer Addenda of B31.1.b 1973 (Original Construction Code) ASME Code, B31.1, 1989 Edition (Installation Code of Record) ASME Code Section III, 1992 Edition / No Addenda (NDE) ASME Code Case N-661-1, "Alternative Requirements for Wall Thickness Restoration of Class 2 and 3 Carbon Steel Piping for Raw Water Service," Section XI, Division 1
Description:	Service Water (SW) supply line to the Reactor Building Cooling Coils VCC-2C/D
Unit / Inspection Interval Applicability:	Arkansas Nuclear One, Unit 1 (ANO-1) / Fourth (4th) 10-year Interval

I. CODE REQUIREMENTS

The following American Society of Mechanical Engineering (ASME) Code Section XI requirements are applicable to this relief request.

IWA-4411 states:

> *Welding, brazing, and installation shall be performed in accordance with the Owner's Requirements and...in accordance with Construction Code of the item.*

IWA-4412 states:

> *Defect removal shall be accomplished in accordance with IWA-4420.*

IWA-4422.1 states, in part:

> *A defect is considered removed when it has been reduced to an acceptable size.*

II. PROPOSED ALTERNATIVE

Background

On June 23, 2010, with ANO-1 in operation at 100% power, a through-wall leak was identified in a section of SW system piping with leakage of approximately 2 - 4 drops per minute. The leak rate has not changed appreciably since that time.

The leak was identified along a horizontal section of a 10" SW pipe, HBD-45-10". The leak, when first identified in June 2010, was addressed under Generic Letter (GL) 90-05. ANO obtained a generic relief request (0CNA039919) on April 6, 1999, that allows application of GL 90-05 without a specific relief request on certain SW lines, including ANO-1 HBD-45-10". The original leakage was approximately 2 drops per minute (dpm). As a result of this leak, an ultrasonic examination (UT) for thickness examination of the surrounding area was performed and the results were evaluated (reference Condition Report (CR) CR-ANO-1-2010-2622, CA-01) with reference to the requirements of the "Through Wall Flaw" approach of GL 90-05 as part of the operability evaluation. An expanded scope inspection of 5 additional locations was performed in accordance with GL 90-05 with no unacceptable degradation at those locations identified. Ninety-day re-inspections were implemented (CR-ANO-1-2010-2622, CA-07) as required by GL 90-05. During the third 90-day re-inspection (CR-ANO-1-2010-2622, CA-23), a smaller grid and a 0.2" diameter transducer were used and a noted change in the data pertaining to the thickness of the flawed area was observed. ANO CR-ANO-1-2011-0368 demonstrated continued system operability and established compensatory measures consisting of enhanced monitoring of the affected area. Refer to Attachment 4 for the results of the March 2011 UT measurements.

The SW system for ANO-1 consists of two independent full capacity 100 percent redundant loops. Each SW loop is capable of supplying cooling water to the required components during normal and emergency conditions. This redundancy allows continued plant operation when a single component failure occurs. ANO-1 Technical Specification (TS) 3.7.7 requires that two SW loops be operable and powered from independent essential buses to provide redundant and independent flow paths.

Implementing an ASME code repair would require removing this section of piping from service, which is not desired because it does not result in a compensating increase in the level of quality or safety. The affected piping section would require the entire SW loop to be secured and drained. While the ANO-1 TS provides 72 hours to effect repairs to the system, doing so would result in the loss of an entire train of emergency core cooling components during the repair window. In addition, isolation and draining of a SW loop during power operation is complex and would expend a significant portion of the 72-hour allowed outage period.

Proposed Alternative

Entergy Operations, Inc. (Entergy) considered several options for correcting this condition including replacement of the affected piping segment in accordance with IWA-4411, defect removal in accordance with IWA-4420, and installation of a weld overlay repair in accordance with ASME Section XI Code Case N-661-1. However, none of these repair/replacement options were desired for various reasons such as limited TS repair time, the risk of "burn-through" in small areas where the remaining pipe thickness is insufficient to deposit weld metal, and water leakage through the isolation valves which limits welding options.

Pursuant to 10CFR50.55a(g)(6)(i), Entergy proposes to install a welded reinforcing plate over the degraded area with an attachment weld or weld overlay located in an area where the minimum wall thickness is 0.280" or greater (refer to Attachment 3). The attachment weld will be installed using the methodology of Code Case N-661-1 as described herein. Minor surface conditioning will be required on an original construction code weld in order to obtain as near as practical metal to metal contact between the reinforcing plate and existing base material. To keep the weld area dry and moisture from encroaching near the reinforcing plate weld, sealant will be utilized around and/or over the leakage location to form a leakage barrier.

III. BASIS FOR ALTERNATIVE

As discussed above, IWA-4422.1 requires that a defect be removed prior to implementing an IWA-4000 repair. However, this is not desired for the reason described regarding securing the entire SW loop resulting in the loss of an entire train of emergency core cooling components. The alternative proposed under this relief request would install a plate over the degraded area to allow the attachment welding to be located in an area with minimal degradation, ensuring a structurally sound load path while minimizing the risk of "burn-through" and increased leakage. The design will also ensure that the configuration of the repair will allow continued wall thickness monitoring of the region by volumetric examination (UT) to ensure that future degradation will not adversely impact the structural capability of the repaired section.

ANO historical data collected for Microbiologically Induced Corrosion (MIC) rates, in SW, indicates that the maximum corrosion pit rate is 0.012"/yr. For conservatism, this corrosion rate has been applied globally (depth) to determine the extent of degradation, and in predicting the area which is less than the minimum wall thickness required by Code Case N-661-1 (refer to Attachment 3 for a detailed mapping of this area). Therefore, the postulated extent of degradation will be bounded by Entergy's proposed repair option.

Materials and Installation

The degraded pipe is 10", Schedule 40 (0.365" Wall), Seamless, A-53 Grade B. The repair plate will be constructed from a section of seamless pipe; either A-106 Grade B, or A-53 Grade B. These materials are P-No. 1 carbon steels and have an allowable stress of 15,000 psi up to 650 °F. The pipe material may be either A or SA designation, as long as the material is safety related traceable material.

The installation of the attachment weld shall comply with Code Case N-661-1. In addition, welding and inspection requirements specified for fabrication, installation, and repair of ANO-1 USAS B31.1 piping system identified as inservice inspection (ISI) Class 3 shall be in accordance with ASME B31.1 1989 Edition with the exception of Nondestructive Examination (NDE). NDE methods and acceptance criteria will comply with ASME Section III, Division 1, 1992 Edition, Subsection ND (Class 3), and, therefore, comply with 10CFR50.55a(b)(2)(xx)(B).

All welders and welding procedure specifications shall be qualified for groove welding in accordance with ASME Section XI Code. The new pressure boundary will now be located at the reinforcing plate attaching weld. The welding process to be used for attaching the reinforcing plate will be the shielded metal arc welding (SMAW) process utilizing low hydrogen E7018 covered electrodes. If rejectable indications are identified during performance of NDE, the indications will be removed and the attachment weld repaired in accordance with applicable provisions of N-661-1, ASME Section XI, and ASME B31.1.

Design Parameters

The welded plate repair option will be designed consistent with the original USAS B31.1.0, 1967 Edition of the Power Piping Code with the entire Summer Addenda to ANSI B31.1, 1973. The attachment weld will be designed using the methodology of Code Case N-661-1.

Attachment 2, "Minimum Weld Pad Thickness Calculation," has been prepared to determine the minimum allowed wall thickness, size and thickness of the repair plate, and determine required attachment weld thickness and width. The piping stress inputs were obtained from Pipe Stress Qualification CALC-91-E-0016-70, Revision 2. The pressure and temperature inputs were obtained from SW PT CALC-88-E-0100-23, Revision 2. The calculation included the effects on piping stresses due to a globally applied minimum pipe wall thickness. ANO historical data collected for MIC rates, in SW, indicates that the maximum corrosion pit rate is 0.012"/yr. Thus, the minimum required wall thickness conservatively included a corrosion allowance of 0.012" prior to replacement activities. Further, an additional stress intensification factor of 2.1 was applied to ratio up the stresses because the overlay is applied to straight pipe and adjacent welds as directed by Code Case N-661-1, Section 3.2(c). The required thickness was determined by iteratively selecting a required minimum wall thickness (0.280"), which satisfied ANSI B31.1-73 code of record equations 11, 12 and 13. Once the minimum wall thickness was determined, the plate was sized to cover the entire thinned area, which would be thinner than the required wall thickness. The plate size was then conservatively increased by 1/2" in length and width to provide a +1/4" tolerance in covering the affected area. Attachment 3 includes a depiction of the area which is less than 0.280" thick and shows the placement of the repair plate in relation to the thinned area.

The projected growth of the degradation is bounded by the welded plate and attachment weld as noted above.

Non-Destructive Examination

The area to be repaired has been characterized by performing straight beam UT mapping (Attachment 4) of the region to bound the degraded area and to ensure that the welds for reinforcing plate are located in areas of sound base metal. The weld for attaching the reinforcing plate to the pipe will be performed in an area where wall thickness is 0.280" or greater to ensure a structurally sound load path around the perimeter of the repair area.

The attachment weld surrounding the reinforcing plate will be nondestructively examined by the magnetic particle (MT) or liquid penetrant (PT) method in accordance with Code Case N-661-1 as summarized below:

- Prior to welding, the entire surface upon which the attachment weld will be deposited will be examined by the MT or PT method.

- The first weld layer and final surface of the completed attachment weld shall be examined by the MT or PT method.

- NDE acceptance criteria shall comply with ND-2500 for base material and ND-5300 for welds of ASME Section III. The MT or PT examination shall be performed no sooner than 48 hours after completion of welding.

- According to IWA-4520(a)(1) of ASME Section XI, "base metal repairs on Class 3 items are not required to be volumetrically examined when the Construction Code does not require that full penetration butt welds in the same location be volumetrically examined." Since butt welds in the subject piping, HBD-45-10", do not have to be volumetrically examined according to ND-5000 of the 1992 Edition of ASME Section III, then the attachment weld does not have to be volumetrically examined.

A system leakage test shall be performed in accordance with IWA-5000.

Post-Repair Monitoring Plan

In-service monitoring of the repair will be accomplished by applying a maximum 2" by 2" grid over the area, which will cover the reinforcing plate and the flat portion of the attaching weld (refer to Attachment 3). The intersection points in the grid will be inspected using straight beam UT. An initial baseline UT will be performed after installing the repair. Subsequent UTs will then be performed to verify that the structural requirements of the original construction code are maintained through the remainder of the current operating cycle. The UTs will be performed monthly the first 3 months and, if no unexpected degradation is identified, UTs will then be performed at least once every 3 months for the balance of the duration of this relief request. This UT monitoring plan complies with the Inservice Examination requirement of Code Case N-661-1 and the monitoring requirements of GL 90-05. To determine unexpected degradation, UT of the repair plate, attaching weld, and surrounding base material will be performed and an average corrosion rate will be calculated based on the point-to-point comparison between the current and the previous inspections. If this average corrosion rate exceeds the predicted corrosion rate (i.e., 0.012"/yr), it will be considered unexpected.

The March 2011 UT data obtained for CR-ANO-1-2011-0368 was collected with improved techniques and higher resolution equipment which resulted in a conservative material loss rate when compared to the previous data. However, ANO used this conservative material loss rate in all evaluations regarding the present condition. The evaluation for the repair uses a predicted corrosion rate, mentioned above, that is more realistic and consistent with historic trends and the best available information.

The inspection results discussed above will be evaluated to ensure that the structural margins required by the Code Case N-661-1are maintained through the remainder of the current operating cycle. If the results of the monitoring program indicate that the structural margins required by Code Case N-661-1 will be exceeded prior to the end of the current fuel cycle or in the event of an unacceptable weld anomaly during reinforcing plate installation, Entergy will implement additional repair and/or replacement activities prior to reaching the limits of the Code Case. These repair and/or replacement activities will be consistent either with (1) the requirements of this relief request, or (2) the requirements of the ASME Section XI, Sub-Section IWA- 4000. NRC approval will be requested prior to the performance of any additional non-code repair.

Also, routine walk downs are performed by Nuclear Plant Operators at least daily. This piping is not insulated and is accessible for visual inspection.

Degradation Mechanism

Based on the location of the defect and based on the UT inspections of the degraded area, Entergy has concluded that the flaw is likely caused by MIC. MIC is not a form of corrosion per se, but rather is a process that can influence the type and rate of corrosion present in a local area and even initiate consumption of the metal. MIC can accelerate most forms of corrosion; including uniform corrosion, pitting corrosion, crevice corrosion, galvanic corrosion, inter-granular corrosion, de-alloying, and stress corrosion cracking. Based on the localized conditions and the accelerated growth compared to the general corrosion, it is reasonable to assume that the degradation is MIC.

The application of maximum corrosion rates used for ANO MIC locations (0.012"/yr) ensures that the growth of the flawed area will not encroach on the edges of the repair pad. Additionally, MIC is typically a pitting corrosion mechanism that grows outward (vertically) and not in the circumferential direction. UT thickness of the plate will also ensure no advanced degradation adversely affects the plate during the six months the repair will be in-service. If any degradation is found that is predicted to affect the structural integrity of the repaired area, associated monitoring requirements will be increased.

Applicable Loads

The repair will be designed to accommodate all appropriate deadweight, pressure, thermal and seismic loads in accordance with the piping code of record. Because the system is a moderate energy system which operates at a low temperature, differential thermal expansion between the repair plate and the repaired component is not a concern.

Duration of Proposed Alternative

The duration of the temporary repair is limited in accordance with GL 90-05 until the next scheduled outage exceeding 30 days, but no later than the next refueling outage, which is currently scheduled for the fall of 2011.

References

This request is similar to relief granted for Indian Point Nuclear Generating Unit No. 3:

> NRC Safety Evaluation Report dated February 22, 2008, "Indian Point Nuclear Generating Unit No. 3 – Relief Request (RR) No. RR-3-43 for Temporary Non-code Repair of Service Water Pipe" (TAC No. MD6831)

IV. CONCLUSION

Pursuant to 10CFR50.55a(g)(6)(i), Entergy is requesting the NRC staff's evaluation of this relief request. Entergy believes that to comply with the requirements of ASME Section XI for performing an online code repair of the subject piping is impractical as demonstrated by this request for relief.

GL 90-05 states:

> *For the purpose of this generic letter, impracticality is defined to exist if the flaw detected during plant operation is in a section of Class 3 piping that cannot be isolated for completing a code repair within the time period permitted by the limiting condition for operation (LCO) of the affected system as specified in the plant Technical Specifications, and performance of code repair necessitates a plant shutdown. Pursuant to 10 CFR 50.55a(g)(6)(i), the Commission may grant relief for temporary non-code repair of code Class 3 piping, where impracticality exists in performing an ASME Code repair while the facility is operating, based on a staff evaluation considering the guidance in this generic letter.*

As discussed previously, isolation of an entire SW loop during power operations is quite complex and requires a significant portion of the TS allowable outage time to be expended. Given this complexity, the time to install the non-code repair following dry-out of the applicable section of SW pipe, and recovery of the SW loop thereafter, it is unlikely that the evolution can be completed within the 72-hour time frame provided by the TSs. In addition, the nuclear safety benefit of establishing the proposed non-code repair in lieu of challenging nearly an entire train of safety related equipment and/or continued plant operation outweighs the benefit of establishing a code repair at this time. Finally, the flaw will be repaired in accordance with code requirements no later than the next refueling outage in the fall of 2011. Therefore, Entergy believes that code repair of the flaw area is impractical from a nuclear safety perspective.

ATTACHMENT 2 TO

1CAN031103

MINIMUM WELD PAD THICKNESS CALCULATION

This spreadsheet determines the minimum weld overlay thickness required for HBD-45-10" pipe, and the required weld overlap distance "s". Code Case N-661-1 is used for the basis in determining thickness and overlap requirements. A stress intensification factor of 2.1 has been used to ratio up the stresses because the overlay is applied to straight pipe and adjacent welds (N-661-1, Section 3.2(c)). The piping stress inputs for this spreadsheet are taken from Pipe Stress Qualification CALC-91-E-0016-70, Revision 2. The pressure and temperature inputs are taken from Service Water PT CALC-88-E-0100-23, Revision 2. The Code of record used was USAS-B31.1.0-1967 & Summer Addenda to ANSI B31.1b-1973.

Input Section	
$P := 120psi$	Internal design pressure (Ref CALC-88-E-0100-23)
$Temp := 130deg$	Design Temperature (Ref. CALC-88-E-0100-23)
$D_o := 10.75in$	Outside Diameter of pipe (Reference Crane Technical Paper 410, 1991)
$t_n := 0.365in$	Nominal Thickness of Sch. 40 pipe (Reference Crane Technical Paper 410, 1991)
$S_h := 15000psi$ $S_c := 15000psi$	Maximum allowable stress (Ref. B31.1, Table A-2, for seamless A-53, Grade B, for temperature 650F and below. Design Temp = 130F Ref. CALC-88-E-0100-23)
$S_A := 1.25 \cdot S_c + 0.25 \cdot S_h = 22500 \cdot psi$	Reference B31.1, Section 102.3.2
$E := 1$	Longitudinal Welded Joint Efficiency Factor seamless Pipe (B31.1, Table 104.1.2(a)1)
$y := 0.4$	Coefficient for Ferritic and Austinitic Steel below 900 deg F, B31.1, Table 104.1.2(a)
$A := 0.012in$	Additional Thickness required (Ref. B31.1, 104.1.2(a)1). MIC Loss Per Cycle Value provided by Engineering Programs (0.012"/yr @ 95th Percentile, or 0.018"/Cycle). This calculation conservatively uses 0.012". The plate will be installed within a few months instead of a year. Also, the pipe will be replaced during the next refueling outage in approx. 6 months.
$t_m := \frac{P \cdot D_o}{2 \cdot (S_h \cdot E + P \cdot y)} + A = 0.055 \cdot in$	Equation 3, B31.1

The required thickness is determined by iteratively selecting t_{req} which satisfies code equations 11, 12 and 13 of B31.1b-1973, Section 104.8. The required overlap region is based upon the outer radius of the component and the nominal wall thickness as described in Code Case N-661-1, Section 3.1.

$t_{req} := 0.28in$ This is the required minimum wall thickness to meet the B31.1 Equations 11, 12 & 13 equations below - it is derived as an iterative solution.

$t_{actual} := t_{req} - A = 0.268 \cdot in$ Actual Wall thickness of pipe projected by end of cycle

$\sigma_{press} := \frac{P \cdot D_o}{4 \cdot t_{actual}} = 1203 \cdot psi$ Pressure term based on Equation 11, ANSI B31.1-1973, 104.8.1

Section Modulus Effect Determination Reference ANSI B31.1b-1973, Section 104.8.4

$Z_{orig} := \pi \cdot \left(\frac{D_o - t_n}{2}\right)^2 \cdot t_n = 30.917 \cdot in^3$ $Z_{new} := \pi \cdot \left(\frac{D_o - t_{actual}}{2}\right)^2 \cdot t_{actual} = 23.127 \cdot in^3$ $Z_{ratio} := \frac{Z_{orig}}{Z_{new}} = 1.337$

NOTE: This is a generic spreadsheet which may be used for Pipe, Tee, Weld or Elbow. For the case of Pipe, Weld, or Tee, Code Case N-661-1 requires an SIF of 2.1 be applied. For the case of an Elbow, a Stress multiplier of 1.7 x Elbow SIF is applied. Thus, by setting the variable TYPE=1, an elbow shape is selected and the 1.7 x Elbow SIF is used. Otherwise, an SIF of 2.1 is used.

Code Case N-661-1, Required SIF
Required SIF = 2.1 for **Pipe and Adjacent Welds**, Section 3.2(c)
Use Stress Multiplier of 1.7 x SIF on **Elbows**
Required SIF = 2.1 for **Tees** and **Branch Connections** overlay toe > $2.5(Rt_{nom})^{1/2}$

$Type := 0$ **(Enter 1 for Type if Elbow)**

Elbow SIF Effect Determination - Reference Appendix D, ANSI B31.1 - 1973 (This Section Active only for Elbows)

$R_1 := 1.5 \times 10in = 15 \cdot in$ $r_{2\_orig} := \frac{D_o - t_n}{2} = 5.193 \cdot in$ $r_{2\_actual} := \frac{D_o - t_{actual}}{2} = 5.241 \cdot in$

$h_{orig} := \frac{t_n \cdot R_1}{r_{2\_orig}^2} = 0.203$ $h_{actual} := \frac{t_{actual} \cdot R_1}{r_{2\_actual}^2} = 0.146$

$SIF_{orig} := \frac{0.9}{h_{orig}^{\frac{2}{3}}} = 2.605$ $SIF_{actual} := \frac{0.9}{h_{actual}^{\frac{2}{3}}} = 3.241$ $SIF_{ratio} := \frac{SIF_{actual}}{SIF_{orig}} = 1.244$

$Code_{multiplier} := \begin{cases} (1.7 \cdot SIF_{ratio}) & \text{if } Type = 1 \\ 2.1 & \text{otherwise} \end{cases} = 2.1$

********** This is the End of the Elbow SIF Determination Section. This Section only used for Elbows **********

$Stress\_Multiplier := Code_{multiplier}(Z_{ratio}) = 2.8074$ $\sigma_{press} = 1203.4 \cdot psi$

Stress inputs taken from CALC-91-E-0016-70, Att A. Pages 1382, 1399 Enveloped nodes 935, 945

$\sigma_{dwt} := 558psi$ $\sigma_{obe} := 5964psi$ $\sigma_{dbe} := 8895psi$ $\sigma_{thrm} := 2950psi$

$S_h = 15000 \cdot psi$ $1.2 \cdot S_h = 18000 \cdot psi$ $S_A = 22500 \cdot psi$ $2.4 \cdot S_h = 36000 \cdot psi$

Based upon Equation 11, B31.1-1973

$DWT_{stress} := \sigma_{press} + \sigma_{dwt} \cdot Stress\_Multiplier = 2770 \cdot psi$

$IR_{DWT} := \frac{DWT_{stress}}{S_h} = 0.1847$

Based upon Equation 12, B31.1-1973

$OBE_{stress} := \sigma_{press} + \sigma_{obe} \cdot Stress\_Multiplier = 17947 \cdot psi$

$IR_{OBE} := \frac{OBE_{stress}}{1.2 \cdot S_h} = 0.997$

Based upon Equation 12, B31.1-1973

$DBE_{stress} := \sigma_{press} + \sigma_{dbe} \cdot Stress\_Multiplier = 26175 \cdot psi$

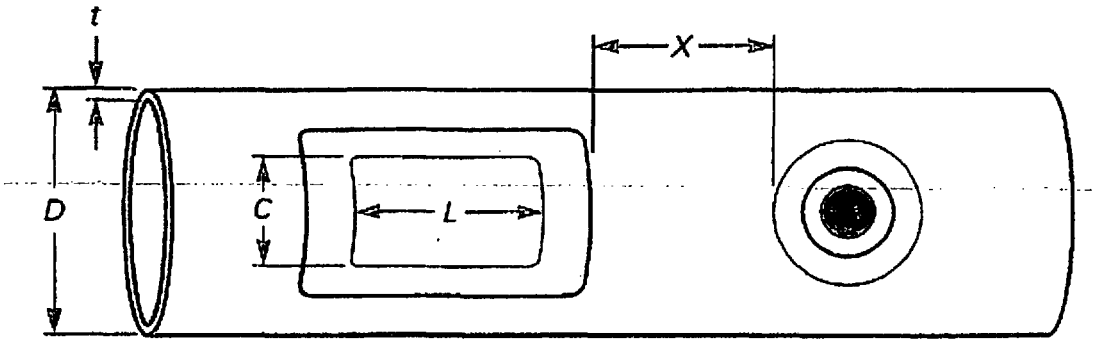
$IR_{DBE} := \frac{DBE_{stress}}{2.4 \cdot S_h} = 0.727$

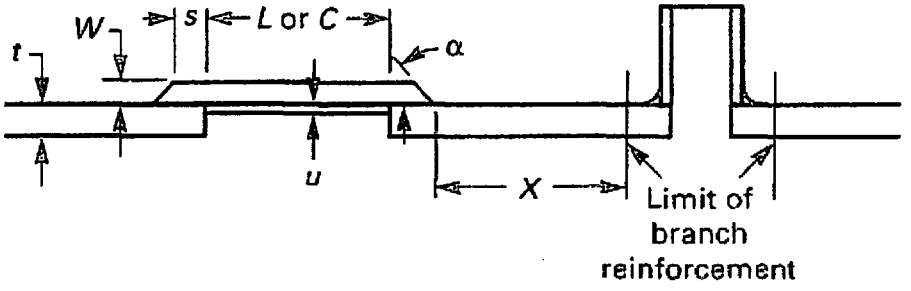
Based upon Equation 13, B31.1-1973

$Thrm_{stress} := \sigma_{thrm} \cdot Stress\_Multiplier = 8282 \cdot psi$

$IR_{Thrm} := \frac{Thrm_{stress}}{S_A} = 0.3681$

$Result := \begin{cases} \text{"PASSED"} & \text{if } IR_{DWT} < 1.0 \wedge IR_{OBE} < 1.0 \wedge IR_{Thrm} < 1.0 \wedge IR_{DBE} < 1.0 = \text{"PASSED"} \\ \text{"FAILED"} & \text{otherwise} \end{cases}$





$$X \geq 2\,1/2\sqrt{Rt_{nom}}$$

FIG. 1 BRANCH REINFORCEMENT

$$s_w := \frac{3}{4}\cdot\sqrt{\frac{D_o}{2}\cdot t_n} = 1.05\cdot in$$

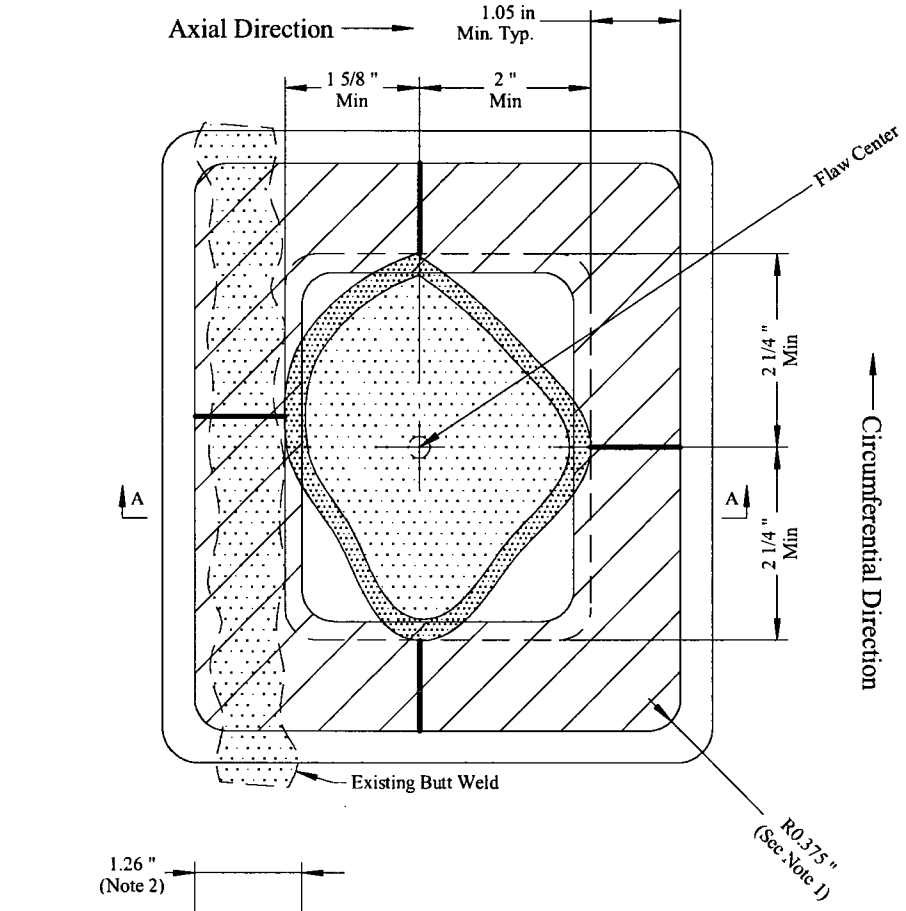
s - Minimum overlap of weld beyond predicted degraded area.
(Reference Code Case N-661-1, Section 3.1)

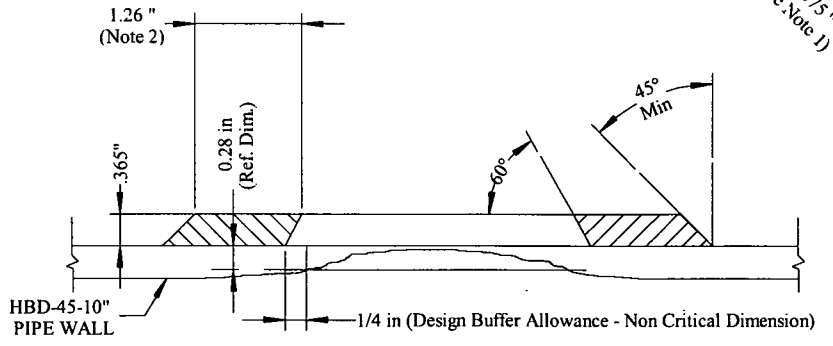
ATTACHMENT 3 TO

1CAN031103

HBD-45 REINFORCING PLATE SKETCH

HBD-45-10" Reinforcing Plate Sketch
EC-28569 13-SW-119, Item 48





SECTION A-A

Notes:

1) Minimum radius must be greater than or equal to actual pad thickness.
2) Critical Minimum Dimension for Weld Overlay (Provided for ease of measurement)

LEGEND

- 10" Sch. 40 (0.365" Wall) Pipe
- Weld Overlay (0.365", Min 0.280")
- 1/4" Wide Buffer Zone
- Flawed Area: < 0.280" Thick
- Existing Butt Weld
- Weld Taper Region

Sketch By: David E. Torgerson / 3-28-2011

Checked By: Keith Butler / 3-28-2011

ATTACHMENT 4 TO

1CAN031103

NDE REPORT

Entergy

UT Thickness Examination

Site/Unit:	ANO-1 / 1	Procedure:	CEP-NDE-0505	Outage No.:	N/A
Summary No.:	HBD-45 10" Leak	Procedure Rev.:	004	Report No.:	1-BOP-UT-11-008
Workscope:	BOP\Non-Outage	Work Order No.:	242416	Page:	1 of 5

Code: INFO ONLY Cat./Item: N/A Location: UNIT 1 AUX LNPPR

Drawing No.: 13-SW-119 Description: SERVICE WATER

System ID: SERVICE WATER

Component ID: HBD-45 10" LEAK Size/Length: 10.75" OD Thickness/Diameter: .365" NOM.

Limitations: Examined area around leak. Pipe is painted which impedes 100% scanning.

Temp. Tool Mfg.: PTC Serial No.: 89057 Surface Temp.: 65 °F

Couplant: ULTRAGEL II Batch No.: 11125 Cal. Report No.: N/A

Examination Surface: Inside ☐ Outside ☑ Surface Condition: Painted

Lo Location: TDC Wo Location: Upstream Toe of Weld

Area	around	hole		0.041"		0.064"		0.044"						
inside	white	circle			0.038"	0.048"	0.067"							
every	45°,	center		0.046"	0.064"	0.033"	0.031"	0.064"						
reading	is	closest			0.057"	0.058"	0.048"							
to	hole.			0.088"		0.072"		0.054"						
0°	0.155"	0.192"	0.226"	0.245"	0.258"	0.284"	last	reading	2"	from	hole	C/L		
45°	0.202"	0.242"	0.292"	1.5"	from	hole	C/L							
90°	0.193"	0.237"	0.257"	0.286"	1.75"	from	hole	C/L						
135°	0.146"	0.196"	0.214"	0.257"	0.299"	1.5"	from	hole	C/L					
180°	0.157"	0.167"	0.164"	0.180"	0.241"	0.247"	0.265"	0.269"	0.281"	2"	from	hole	C/L	
225°	0.187"	0.193"	0.199"	0.218"	0.296"	1.2"	from	hole	C/L					
270°	0.150"	0.294"	0.273"	315"	1.3"	from	hole	C/L						
315°	0.109"	0.180"	0.217"	0.233"	0.262"	0.315"	1.6"	from	hole	C/L				

Comments:

Readings above utilized the star pattern, with every row taken at 45° increments around hole. The top readings were all taken inside the drawn white hole nearest to the actual hole. The row of readings starting at 0° were all taken starting just outside the white circle. The white circle represents the start of readings greater than .100". UT Inst. S/N 51324510Panametrics37DL plus, Transducer S/N 100101, C/S Step Wedge .100-.500" S/N 17571, CAL IN/OUT acceptable

Results: Accept ☐ Reject ☐ Info ☑ Ref. Cr-ANO-1-2010-2622

Percent Of Coverage Obtained > 90%: N/A Reviewed Previous Data: N/A

Examiner	Level	Signature	Date	Reviewer	Signature	Date
Taylor, Michael W.	II		3/15/2011	N/A		
Examiner	Level	Signature	Date	Site Review	Signature	Date
Foster, Jimmy R.	II-K	Jimmy R Foster	3/15/2011	McGaha, Randal		3/15/2011
Other	Level	Signature	Date	ANII Review	Signature	Date
N/A	N/A			N/A		

Entergy

Supplemental Report

Report No.: 1-BOP-UT-11-008

Summary No.:	HBD-45 10" Leak						
Examiner:	Taylor, Michael W.		Level:	II	Reviewer:	N/A	Date:
Examiner:	Foster, Jimmy R.		Level:	II-L	Site Review:	McGaha, Randal	Date: 3/15/2011
Other:	N/A		Level:	N/A	ANII Review:	N/A	Date:

Comments: **Pictures of pit and white circle, which represents readings less than .100" within the circle.**

Sketch or Photo: \\jdcnsetsp001\IDDEAL\Iddeal Ver 8\Iddeal_Server\Iddeal_ANO\Documents\ANO BOP 2011\PHOTOS\U1HBD-45\U1hbd-45f1.jpg

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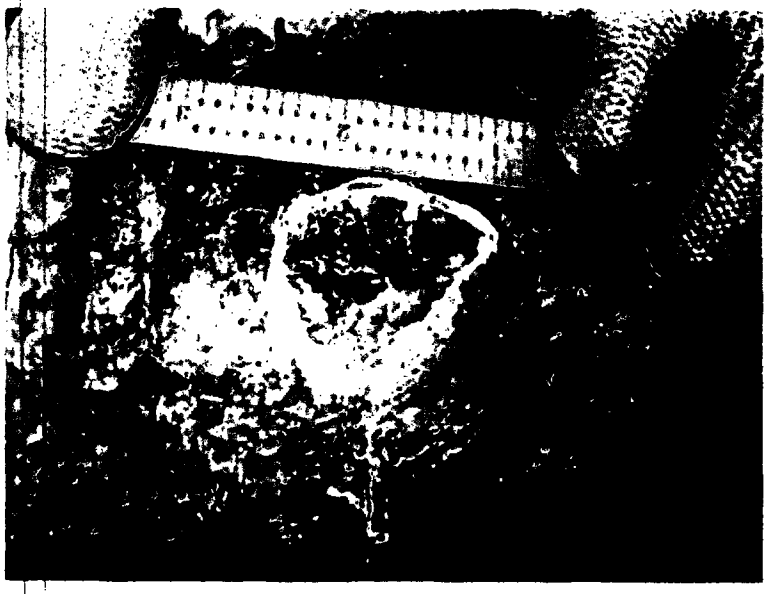
Supplemental Report

Report No.: **1-BOP-UT-11-008**

Summary No.:	**HBD-45 10" Leak**						
Examiner:	**Taylor, Michael W.**	Level:	**II**	Reviewer:	**N/A**	Date:	
Examiner:	**Foster, Jimmy R.**	Level:	**II-L**	Site Review:	**McGaha, Randal**	Date:	**3/15/2011**
Other:	**N/A**	Level:	**N/A**	ANII Review:	**N/A**	Date:	

Comments: **More pictures**

Sketch or Photo: \\jdcnsetsp001\IDDEAL\Iddeal Ver 8\Iddeal_Server\Iddeal_ANO\Documents\ANO BOP 2011\PHOTOS\U1HBD-45\U1hbd-45j1.jpg



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Supplemental Report

Report No.: 1-BOP-UT-11-008

Summary No.: HBD-45 10" Leak

Examiner:	Taylor, Michael W.		Level:	II	Reviewer:	N/A	Date:
Examiner:	Foster, Jimmy R.		Level:	II-L	Site Review:	McGaha, Randal	Date: 3/15/2011
Other:	N/A		Level:	N/A	ANII Review:	N/A	Date:

Comments: **Readings taken within the circle.**

Sketch or Photo: \\jdcnsetsp001\IDDEAL\Iddeal Ver 8\Iddeal_Server\Iddeal_ANO\Documents\ANO BOP 2011\PHOTOS\U1HBD-45\U1hbd-45 hole readings.jpg

Entergy

Supplemental Report

Report No.: **1-BOP-UT-11-008**

Summary No.: **HBD-45 10" Leak**

Examiner:	**Taylor, Michael W.**	Level:	**II**	Reviewer:	**N/A**	Date:	
Examiner:	**Foster, Jimmy R.**	Level:	**II-L**	Site Review:	**McGaha, Randal**	Date:	**3/15/2011**
Other:	**N/A**	Level:	**N/A**	ANII Review:	**N/A**	Date:	

Comments: **Readings taken outside the circle.**

Sketch or Photo: \\jdcnsetsp001\IDDEAL\Iddeal Ver 8\Iddeal_Server\Iddeal_ANO\Documents\ANO BOP 2011\PHOTOS\U1HBD-45\U1hbd-45 outsi readings.jpg