Attachment 2

ANO Calculation 96-E-0057-03 / FTI Calculation 32-1257716-00

FORM TITLE: CALCULATION COVER SHEET	FORM NO. 5010.015-ATT-2	REV. 1

This Document contains 1 Page.

Calc. No.: 96-E-0057-03 Rev. No.: 0

Calc. Title:
Alternative Calculation for the ART Values

Unit: 1 Category: Q
System(s): RCS
Calc.Type: NS

Component No(s):
R1

Topic(s): PTSI
Plt Area: Bldg. NA Elev.
Room: Wall
Coordinates:

Config. Checklist (per 5010.004) completed? (Y or N) Y
Document Comment/Resolution Form completed? (Y or N) Y

Abstract (Included Purpose/Results):
This document provides alternative calculations for adjusted reference temperatures (ART) for ANO-1 at 21 and 32 EFPY. This was to provide values for WF-112 weld metal using a more conservative initial reference temperature. The limiting 1/4T and 3/4T ART values at 21 EFPY are 194F and 149F, respectively. For 32 EFPY, the values are 212 F and 164 F respectively.

Pages Revised and/or Added:
Added pages 1 through 5 and Attachment A, pages A-1 and A-2.

Purpose of Revision:
Initial issue

Initiating Documents	Resulting Documents	Key Design Input Documents
ANO-1 Tech Spec 3.1.2.7	Revised ANO-1 Tech Spec 3.1.2.7; 96-E-0057-01	96-E-0057-02, Rev. 0; BAW-2245; BAW-1803, Rev 1

Verification Method: Design Review ☒ Alternate Calculation ☐ Qualification Testing ☐

Amends Calc(s): NA

Supersedes Calc(s): NA

Computer Software Used: NA

By: FTI / / 7/16/96 Rvw'd: Robert W. Clark / RWC / 11/26/96

Chk'd: FTI / / 7/16/96 Apv'd: Karen M. Head / KMHead / 12/3/96

(Print Name) (Initials) (Date) (Print Name) (Initials) (Date)

FRAMATOME TECHNOLOGIES

CALCULATION SUMMARY SHEET (CSS)

DOCUMENT IDENTIFIER: 32-1257716-00

TITLE: Alternative Calculations for 32-1245917-00

PREPARED BY:		REVIEWED BY:	
NAME	L. B. Gross	NAME	S. Fyfitch
SIGNATURE	L B Gross	SIGNATURE	S Fyfitch
TITLE	Advisory Engineer	TITLE	Supervisor, Materials
DATE	7/16/96	DATE	7/16/96
COST CENTER	41020	REF. PAGE(S)	
		TM STATEMENT: REVIEWER INDEPENDENCE	

PURPOSE AND SUMMARY OF RESULTS:

This is to provide alternative calculations for adjusted reference temperatures for ANO-1 at 21 and 32 EFPY. This was to provide values for WF-112 weld metal using a more conservative initial reference temperature. The limiting 1/4T and 3/4T adjusted reference temperature values at 21 EFPY are 194F and 149F, respectively. The limiting 1/4T and 3/4T adjusted reference temperature values at 32 EFPY are 212F and 164F, respectively. In addition, a determination was made that the 179F adjusted reference temperature at 1/4T would be reached at 16.3 EFPY.

DOCUMENT NUMBER	96-E-0057-03, Rev. 0
	PAGE 1 OF 5

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV

THIS DOCUMENT CONTAINS ASSUMPTIONS THAT MUST BE VERIFIED PRIOR TO USE ON SAFETY-RELATED WORK

○ YES ✓ NO

RECORD OF REVISIONS

REVISION	DESCRIPTION
00	Original Release

PREPARER: L. B. Gross DATE: 7/16/96
REVIEWER: S. Fyfitch DATE: 7/16/96

This is to provide an alternative calculation to 32-1245917-00.[1] The following discussion and calculations are for weld material WF-112.

For initial RT_{NDT}, instead of -27F, which is a proposed value in accordance with BAW-2245,[2] a generic value of -5F[3] will be used.

For σ_I, select 19.7.[3]

For σ_Δ, select 27, calculated as follows:

ΔRT_{NDT} Deviation from Mean (32-1245917-00, Page 35)	Deviation Squared
45.1	2034.0
-27.2	739.8
-9.2	84.6
-17.0	289.0
7.4	54.8
-3.3	10.9
-39.3	1544.5
-12.1	146.4
-37.6	1413.8
24.5	600.2
22.9	524.4
-8.7	75.7
39.5	1560.2
19.2	368.6

[1] M. J. DeVan, "Adjusted Reference Temperature for 21 and 32 EFPY for ANO-1," FTI Document 32-1245917-00, July 8, 1996.

[2] K. K. Yoon, "Initial RT_{NDT} of Linde 80 Welds Based on Fracture Toughness in the Transition Range," BAW-2245, B&W Nuclear Technologies, Lynchburg, VA, August 1995.

[3] Generic value for Linde 80 welds in accordance with BAW-1803, Revision 1. [A. L. Lowe and J. W. Pegram, "Correlations for Predicting the Effects of Neutron Irradiation on Linde 80 Submerged -Arc Welds," BAW-1803, Revision 1, B&W Nuclear Technologies, Lynchburg, VA, May 1991.]

Sum of the squares	9447.0
Sum/(n-1) where (n-1) = 13	726.7
σ_Δ = [Sum/(n-1)]$^{0.5}$	27

For calculation of margin, $M = 2*(\sigma_I^2 + \sigma_\Delta^2)^{0.5}$

$M = 2*(19.7^2 + 27^2)^{0.5}$

$M = 67$

To determine the EFPY for maintaining an ART_{NDT} of 179, subtract the new IRT_{NDT} and margin from 179; this will yield the new ΔRT_{NDT}. Dividing this value by the chemistry factor yields the new fluence factor. The fluence can be obtained from the fluence factor which can then be ratioed with the 32 EFPY value to obtain the new EFPY. This calculation is as follows:

$[\Delta RT_{NDT}]_{NEW} = 179-(-5)-67 = 117$

$[ff]_{NEW} = 117/185.6 = 0.6304$

Using $ff = f^{0.28-0.10\log f}$, $f = 0.256$

That is, Fluence is 2.56E18

$[EFPY]_{NEW} = 32*2.56E18/5.03E18$

$= 16.3$ years

To determine the limiting ART_{NDT} for 21 EFPY and 32 EFPY at ¼T and ¾T, add the IRT_{NDT} and margin, as determined above, to the appropriate ΔRT_{NDT} value from 32-1245917-00. This calculation is as follows:

21 EFPY		
	¼T	¾T
IRT_{NDT}	-5	-5
Margin	67	67
ΔRT_{NDT}	132	87
ART_{NDT}	194	149
32 EFPY		
	¼T	¾T
IRT_{NDT}	-5	-5
Margin	67	67
ΔRT_{NDT}	150	102
ART_{NDT}	212	164

ATTACHMENT A

FTI DISCLOSURE

FRAMATOME TECHNOLOGIES

November 20, 1996
INS-96-7661

integrated Nuclear Services

Mr. Bob Clark GSB/3W
Entergy Operations, Inc.
Arkansas Nuclear One
Route 3, Box 137G
Russellville, AR 72801

Subject: Arkansas Nuclear One Unit 1
Adjusted Reference Temperature Calculations

Reference: FTI Job No. 4100692
Entergy Contract NAC00123 - NAAM1003

Dear Mr. Clark:

Two FTI proprietary calculation package documents for the determination of the adjusted reference temperature (FTI Document No. 32-1245917-00 and FTI Document No. 32-1257716-00) were submitted to Entergy as part of the referenced contract. FTI has reviewed the content of these two documents and has determined that no information contained in these documents is proprietary. Therefore, no restrictions are placed on these documents, and Entergy is free to distribute these documents to applicable parties.

If you have any questions, please call me at (804) 832-3160.

Sincerely,

M. J. DeVan

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