TENNESSEE VALLEY AUTHORITY
CHATTANOOGA, TENNESSEE 37401

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MAY 05 1989

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

Gentlemen:

In the Matter of the Application of)
Tennessee Valley Authority)

Docket Nos. 50-390

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - 10 CFR 50.55a(a)(3) - PROPOSED ALTERNATIVE ACCEPTANCE TO AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION III

This letter supplements the letter to NRC from TVA dated August 19, 1988, requesting approval in accordance with 10 CFR 50.55a(a)(3) of an alternative acceptance to ASME Section III requirements.

TVA identified two welds in the containment sleeves around the residual heat removal (RHR) sump suction lines with radiographic indications. These indications have been interpreted to exceed the acceptance criteria of ASME Section III.

As previously identified, these sleeves are part of the containment pressure boundary and not the RHR system pressure boundary. As such, they will experience no more than approximately 15 psi peak containment pressure during a design basis accident. Because these two welds are embedded in reinforced concrete behind the stainless steel containment sump liner wall, they would be extremely difficult to repair (see enclosure 1 for location of welds).

TVA originally evaluated the flaws (Nuclear Engineering [NE] calculation CEB-CQS-415) using the rules of the method described in a proposed revision to ASME Section XI, paragraph IWB-3650, which provides flaw evaluation criteria for ferritic steel welds. This criteria had been approved by ASME as Code Case N-436. TVA believed that the use of the more conservative criteria in IWB-3650 would provide additional confidence that, if the flaws were located in the carbon steel base metal, they would still be suitable for service.

To supplement the original submittal, since NRC has not evaluated Code Case N-436 for approval, TVA completed a calculation using the approved ASME Section XI IWB-3610 procedures. The results of this calculation, WBN-MTB-025 (enclosure 2), agree with CEB-CQS-415; the flaws will not propagate and cause failure throughout the design life of the plant.

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MAY 05 1989

TVA has documented, through these calculations, that the integrity of the containment at the RHR system containment penetration will be maintained throughout the design life of the plant. This conclusion combined with the original inspections provide confidence that the level of quality and safety is comparable to that provided by radiographs with acceptable indications. Full compliance with the code requirements for radiographic acceptance of these two welds would, as stated in 10 CFR 50.55a(a)(3), "result in hardship and unusual difficulties without a compensating increase in the level of quality and safety." Therefore, TVA requests NRC approval in accordance with 10 CFR 50.55a(a)(3) of an alternative to ASME Section III requirements. After receiving approval for this proposed alternative, TVA will add a paragraph in the WBN Final Safety Analysis Report (FSAR) section 3.8 which lists two welds (1-074B-D045-01A and 1-074B-D045-08A) in the containment sleeves at the RHR sump that have radiographic indications which have been interpreted as exceeding the radiographic acceptance criteria of ASME Section III. Also, calculations WBN-MTB-025 and CEB-CQS-415 will be listed to document the basis for the acceptability of these welds.

Enclosure 3 lists the new commitment made in this report.

If there are any questions, please telephone G. R. Ashley at (615) 365-8527.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

M J Ray for

C. H. Fox, Jr., Vice President and
Nuclear Technical Director

Enclosures
cc: See page 3

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MAY 05 1989

cc (Enclosures):

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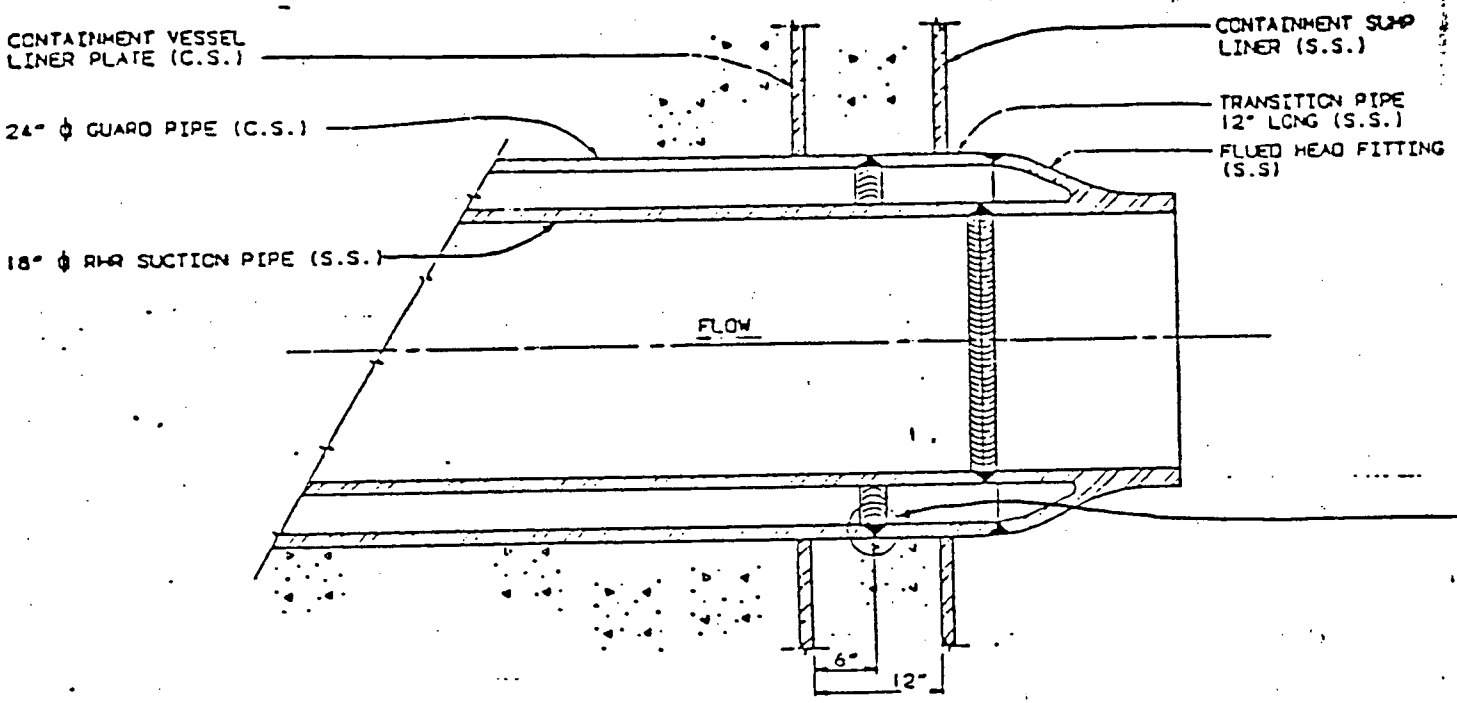
ATTACHMENT 2

LOCATION OF RHR SUMP CONTAINMENT BOUNDRY WELDS



DETAIL B2

REFERENCE DRAWINGS

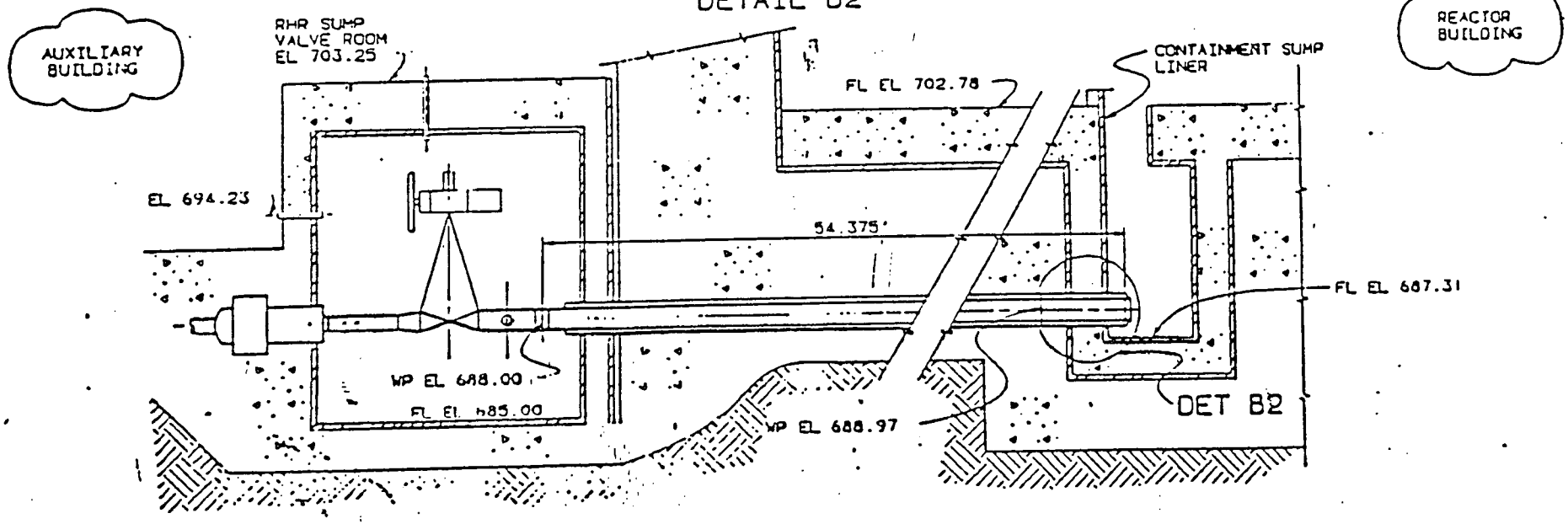
47W432-2 MECHANICAL PIPING
E2879-IC-45 WELD MAP
48-N-401 STRUCTURAL STEEL
48-N-402 STRUCTURAL STEEL
48-N-919 STRUCTURAL STEEL

NOTE:

THIS SKETCH IS FOR REFERENCE ONLY.

FIELD WELDS

1-0748-0045-1A & 8A (TYPICAL)



ENCLOSURE 1

TVA 10697 (DNE-6-86)

DNE CALCULATIONS

TITLE WBN Weld Flaw Evaluation Using ASME Section XI IWB 3610 Procedures	PLANT/UNIT WBN Unit 1
PREPARING ORGANIZATION MT	KEY NOUNS (Consult RIMS DESCRIPTORS LIST) Fracture Mechanics, Flaw Evaluation
BRANCH/PROJECT IDENTIFIERS WBN-MTB-025	Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.
APPLICABLE DESIGN DOCUMENT(S) ASME Section XI, WRC Bulletin 175	
SAR SECTION(S) / UNID SYSTEM(S) 74	

Rev	(for RIMS' use)	RIMS accession number
R0		B46 89 0412 521
R _		
R _		
R _		

Revision 0	R1	R2	R3
ECN No. (or indicate Not Applicable) N/A			
Prepared Wayne A. Pavynich			
Checked W.P. Joest			
Reviewed Patrick A. Walker			
Approved C.E. Robertson for J.F. Murdock			
Date APR 12 1989			
List all pages added by this revision.			
List all pages deleted by this revision.			
List all pages changed by this revision.			

Use form TVA 10534 if more space required.

Safety-related? Yes ☒ No ☐

Statement of Problem

Weld numbers 1-074B-D045-08A and 1-074B-D045-01A are embedded in concrete and can not be easily repaired.

Abstract

These calculations contain an unverified assumption(s) that must be verified later. Yes ☐ No ☒

This calculation documents the flaw evaluation for the subject welds to verify the ~~the~~ map results of CEB-CQS-415 using IWB 3610 of ASME section XI, since CEB-CQS-415 uses procedures in ASME Section XI IWB 3650 which have not yet been approved by the NRC. This calculation was prepared at the request of the NRC.
This Calculation Contains 11 total pages.

☐ Microfilm and store calculations in RIMS Service Center.

☒ Microfilm and return calculations to: Mare Dunaway

Microfilm and destroy. ☐

Address: WT 10D 226 HK

cc: RIMS, SL 26 C-K T. Woods, IOB-B102 WBN

TVA

Title: WBN Weld Flaw Evaluation Using ASME Section XI IWB 3610 Procedures

REVISION LOG
WBN-MTB-025

Revision No.	DESCRIPTION OF REVISION	Date Approved
Ro	Original Issue	

Total pages 5

TVA 10534 (EN DES-4-78)

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN-MTB-025 — Calculation No.

R0 — Revision

Method of design verification (independent review) used (check method used):

1. Design Review ✓
2. Alternate Calculation
3. Qualification Test

Justification (explain below):

Method 1: In the design review method, justify the technical adequacy of the calculation and explain how the adequacy was verified (calculation is similar to another, based on accepted handbook methods, appropriate sensitivity studies included for confidence, etc.).

Method 2: In the alternate calculation method, identify the pages where the alternate calculation has been included in the calculation package and explain why this method is adequate.

Method 3: In the qualification test method, identify the QA documented source(s) where testing adequately demonstrates the adequacy of this calculation and explain.

The analysis performed follows the methods detailed in ASME Section XI, IWB 3610 for evaluating the structural adequacy of welds containing flaws. As a result of the use of this industry method and ASME code, the calculation is considered technically adequate.

Patrick U. Walker
Design Verifier
(Independent Reviewer)

4/11/89
Date

LOG PREP NAME: ____ /
LOG CHECKER NAME: ____ /
LOG VERIF NAME: ____ /

CALCULATION CROSS REFERENCE SYSTEM INPUT FORM

LOG PREPARER ID: ___ - ___ - ____ DATE: __/__/__ UPDATE CODE: A

LOG VERIFIER ID: ___ - ___ - ____ DATE: __/__/__

A = ADD
C = CHANGE
D = DELETE
R = RENAME CALC
V = VERIFY CALC

	TYPE	PLANT	BRANCH	NUMBER	REV.
CALC ID:	CW	MBN	MTB	WBNMTB0257	R0C

TITLE: WBN WELD FLAW EVALUATION USING ASME SECTION XI IWB 3610 PROCEDURES

UNIT ..... ____
BUILDING .. ____
SYSTEM ... 074
ROOM .... ____
ELEVATION. ____
CORD/AZMTH .... ____
PRE RESTART .. ____

FIRM .... ____
RESP SUPV .... JFM
PREPARER. WAP
REVIEWER. ____
UVERFY AS ..... N
CATEGORY. ____

CLASS .. E
RIMS NUMBER . ____
STATUS . I
STATUS DATE ... __/__/__
EST FIN DATE ... __/__/__

RENAMED CALC

	TYPE	PLANT	BRANCH	NUMBER	REV.
CALC ID:					

KEYNOUNS

A/D		A/D	
A	FRACTURE MECHANICS		
A	FLAW EVALUATION		

CROSS REFERENCE INPUT

A/D	P/S/SS/SB	TYPE	PLANT	BRANCH	NUMBER	REV.

WBN Weld Fla[illegible] Evaluation Using ASME Section XI IWB 3610 Procedures
WBN-MTB-025

[illegible] 4/3/89
[illegible] 4/12/89

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WBN Weld Flaw Evaluation Using IWB 3610 Procedures

WBN-MTB-025

JVAP 4/10/89
WAJ 4-12-89

1.0 Purpose

The purpose of this calculation is to evaluate the structural integrity of weld numbers 1-074B-D045-08A and 1-074B-D045-01A in the presence of flaws using the procedures of ASME Section XI IWB-3610 to verify the results obtained using ASME Section XI IWB 365

2.0 Assumptions

It is assumed that:

1. The flaws will only grow in the ASME SA-516 Grade 70 carbon steel adjacent to the dissimilar welds.
2. The flaws in these welds will not grow, due to fatigue, during the life of the plant. (This has been shown in Reference 3.1)
3. The K_{IR} curve is a conservative lower bound of K_{Ia} toughness for SA-516 materials. This is appropriate as described in Reference 3.2 page 4.
4. $RT_{NDT} = T_{35mils} - 60°F$ since NDT values are not available for the SA 516 steel.
5. The flaw depth used throughout this Calculation is assumed to be equal to 1/8 inch as in Reference 3.1 Appendix C.

WBN Weld Flaw Evaluation Using ASME Section XI IWB 3610 Procedures.

WBN-MTB-025 NAP 4/10/89 WPS 4/12/89

3.0 Source of Design Input Information

3.1 WBN Weld Flaw Evaluation for Weld Numbers 1-074B-D045-08A and 1-074B-D045-01A. CEB-CQS-415 Rev 1, RIMS B46 88 0810 574.

3.2 PVRC Recommendations on Toughness Requirements for Ferritic Materials. WRC Bulletin No. 175, August 1972.

3.3 ASME Boiler and Pressure Vessel Code Section XI, 1986 Edition, Figure A-4200.

3.4 ASME Boiler and Pressure Vessel Code Section XI, 1986 Edition, Paragraph IWB 3610.

3.5 ASME Boiler and Pressure Vessel Code Section III, 1986 Edition, Appendix

4.0 Design Input Data (Reference 3.1)

For Weld 1-074B-D045-08A

Normal/upset, $K_I = 706.4$ psi $\sqrt{in}$, Emergency/Faulted, $K_I = 723.6$ psi $\sqrt{in}$

For Weld 1-074B-D045-01A

Normal/upset, $K_I = 617$ psi $\sqrt{in}$, Emergency/Faulted, $K_I = 626$ psi $\sqrt{in}$

5.0 Computations/Analysis

Following ASME Section XI IWB 3610 a flaw is acceptable if subparagraphs a) and b) are met.

Subparagraph a) is met if the criteria of IWB 3612 are satisfied.

$K_I < K_{Ic}/\sqrt{2}$ for emergency/faulted conditions.

$K_I < K_{Ia}/\sqrt{10}$ for normal/upset conditions.

WBN Weld Flaw Evaluation Using ASME Section XI IWB 3610 Procedures

WBN-MTB-025

NAP 4/3/89
NAP 4/12/89

Since K_I is known for all conditions, only the fracture toughnesses, K_{Ic} and K_{Ia} need to be determined. Reference 3.2 provides a conservative lower bound for K_{Ia} for ferritic steels with minimum yield strengths up to and including 50 Ksi. SA-~~106~~ 516 Grade ~~B~~ 70 piping material is in this category.

$$K_{IR} = 1.223 \exp\left\{0.0145\left[T-(R_{TNDT}-160)\right]\right\} + 26.777$$

Page 4 Reference 3.2 equation 4-1.

Reference 3.3 provides a conservative lower bound for K_{Ic} for SA-106 Grade B piping Material.

Both lower bounds are indexed to the RT_{NDT} of the material. Therefore, a conservative value of RT_{NDT} must be established. Since this is not known for the material in question, RT_{NDT} is defined as follows.

RT_{NDT} is defined in Reference 3.2 page 4 as the higher of T_{NDT} as measured by drop weight tests and T_{NDT} determined as follows:

$$T_{NDT} = T_{35\,mils} - 60°F$$

where $T_{35\,mils}$ is the temperature at which the Charpy transition curve achieves 35 mils of lateral expansion, provided that the corresponding absorbed energy is not less than 50 ft-lbs

WBN Weld Flaw Evaluation Using ASME Section XI IWB 3610 Procedures

WBN-MTB-025

2WAP 4/10/86
WAJ 4/12/89

Drop weight test values are not available for this material, so RT_{NDT} is estimated using the Charpy curves of Reference 3.2 page 12, Figures 6.3 and 6.4.

Since the orientation of the flaws is circumferential, Curve D of figure 6.3 is used to determine T_{35mils}. This value is 0°F. Since Curve D is so steep, this temperature corresponds to the 35 mil lateral expansion temperature. Therefore, RT_{NDT} for SA 516 in the circumferential flaw orientation is: 0°F − 60°F = −60°F

From Reference 3.1, the temperature of the material is 190°F, therefore

$$K_{IR} = K_{Ia} = 1.223 \exp\{0.0145[190-(-60-160)]\} + 26.777$$

$$= 493.8 \text{ Ksi}\sqrt{in}.$$ This value is unrealistically large. If RT_{NDT} is conservatively assumed to be 40°F then $K_{Ia} = 136.3$ Ksi $\sqrt{in}$.

From Reference 3.4: 2WAP 4/10/86

$K_{IC} > 200$ Ksi $\sqrt{in}$, ~~if~~ since RT_{NDT} is −60°F.

If RT_{NDT} is conservatively assumed to be 40°F then K_{IC} is still greater than 200 Ksi $\sqrt{in}$. Therefore, it is conservative to use $K_{IC} = 200$ Ksi $\sqrt{in}$.

For Weld 1-074B-D045-08A

Normal/upset conditions:

$$K_I = 0.7064 \text{ Ksi}\sqrt{in} < K_{Ia}/\sqrt{10} = 136.3/\sqrt{10} = 43.1$$

WBN Weld Flaw Evaluation Using ASME Section XI IWB-3610 Procedures

WBN-MTB-025 MAP 4/10/89 LPJ 4/12/89

Emergency/Faulted Conditions:

$K_I = 0.7236 \text{ Ksi}\sqrt{in} < K_{IC}/\sqrt{2} = 200/\sqrt{2} = 141.4$

For Weld 1-074B-D045-01A

Normal/upset conditions:

$K_I = 0.617 \text{ Ksi}\sqrt{in} < K_{Ia}/\sqrt{10} = 43.1$

Emergency/Faulted Conditions:

$K_I = 0.626 \text{ Ksi}\sqrt{in} < K_{IC}/\sqrt{2} = 141.4$

These results indicate that the flaws in the welds meet the acceptance criteria of IWB-3612.

Subparagraph b) of IWB 3610 is applied to the flawed welds as follows:

Primary Stress Limits

$1.2\ S_h = 21.0 \text{ Ksi}$ Normal/Upset

$2.4\ S_h = 42.0 \text{ Ksi}$ Emergency/Faulted

$S_h = 17.5 \text{ Ksi}$ Ref. 3.5

From Ref. 3.1 the primary stresses of the unflawed welds are:

1-74B-D045-08A	1-74B-D045-01A
$P_m + P_b = 0.683$ Ksi N/U	$P_m + P_b = 0.584$ Ksi N/U
$P_m + P_b = 0.708$ Ksi E/F	$P_m + P_b = 0.596$ Ksi E/F

Assuming the wall thickness decreases by the flaw depth, the primary stresses

will increase by the following factor:

$$t/(t-d) = 1.5$$

where: t = thickness
d = flaw depth

Applying this factor to the unflawed primary stresses yields:

1-74B-D045-08A	1-74B-D045-01A
$P_m+P_b = 1.025$ Ksi N/U	$P_m+P_b = 0.876$ Ksi N/U
$P_m+P_b = 1.062$ Ksi E/F	$P_m+P_b = 0.894$ Ksi E/F

These values are considerably less than the stress limits. Therefore, the conditions of IWB-3610 paragraph b) are met.

6.0 Summary of Results

This calculation (1) demonstrates that these flaws will be stable for the life of the plant since Reference 3.1 shows that no fatigue crack growth will occur (2) demonstrates that augmented ISI will not be required and (3) supports and verifies the results of Reference 3.1.

ENCLOSURE 3

LIST OF COMMITMENTS

TVA will add a paragraph in the Watts Bar Final Safety Analysis Report (FSAR) section 3.8 which lists, two welds (1-074B-D045-01A and 1-074-D045-08A) in the containment sleeves at the residual heat removal (RHR) sump that have radiographic indications which have been interpreted as exceeding the radiographic acceptance criteria of ASME Section III. Also, calculations CEB-CQS-415 and WBN-MTB-025 will be listed to document the basis for the acceptability of these welds.