

TITLE <b>Moderate Energy Line Break Flooding Study</b>				PLANT/UNIT <b>Watts Bar - Units 1 &amp; 2</b>	
PREPARING ORGANIZATION <b>Sargent &amp; Lundy</b>		KEY NOUNS (Consult RIMS DESCRIPTORS LIST) <b>Pipe Rupture, Flooding, SHUTDOWN, NUC SAFETY SYSTEMS</b>			
BRANCH/PROJECT IDENTIFIERS <b>-WBN-OSG4-099</b>		Each time these calculations are issued, preparers must enter the original (RO) RIMS accession number in this field. Rev (for RIMS' use) <b>780</b> RIMS accession number			
APPLICABLE DESIGN DOCUMENT(S) <b>WB-DC-40-31.51</b>		RO	<b>890710F0005 B26 '88 0504 02</b>		
SAR SECTION(S) <b>N/A</b>		UNID SYSTEM(S) <b>N/A</b>	RIMS accession number		
Revision 0		R1	R2	R3	Safety-related? Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>
ECN No. (or indicate Not Applicable) <b>N/A</b>					Statement of Problem
Prepared <i>[Signature]</i>					The purpose of this calculation is to compute flood levels throughout various areas of the plant for design-basis MELB flooding events.
Checked <i>Thomas J. Kane</i>					
Reviewed <i>Kern W. Schram</i>					
Approved <i>[Signature]</i>					
Date <b>5/2/88</b>					
Use form TVA 10534 if more space required	List all pages added by this revision.				
	List all pages deleted by this revision.				
	List all pages changed by this revision.				

**Abstract**

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

Analyses were performed to calculate flood levels for various areas of the plant arising from postulated failures of moderate energy fluid systems. These flood levels are to be used as input to i) structural load assessments, and ii) safe-shutdown assessments for MELB flooding events.

The calculated flood levels were found to be less than two inches for many areas of the plant. Calculated flood levels were less than six inches for the essential pump rooms on elevation 676'-0" due to design features (dropout panels) in these rooms. Most zones are protected from cross compartment flooding by design features in the plant such as the use of subcompartments for separation and the use of curbs to control leakage flow.

Note: The attached calculation is Sargent & Lundy Calculation No. 3C38-1086-001, Revision 2, entitled "MELB Flood Level Calculations."

9207070070 920630  
PDR ADOCK 05000390  
A PDR

Microfilm and store calculations in RIMS Service Center.  
 Microfilm and return calculations to **LINDA PATTON**

Microfilm and destroy.   
Address: **C197 IOB WBNP**

Calc. No. 3C38-1086-001  
Revision: 1  
Page: 3  
Project No. 7797-00

### SUMMARY

Analyses were performed to calculate flood levels for various areas of the plant arising from postulated failures of moderate energy fluid systems. These flood levels are to be used as input to i) structural load assessments, and ii) safe-shutdown assessments for MELB flooding events.

Overall, the auxiliary building is protected from MELB (Moderate Energy Line Break) flooding by the passive sump located at elevation 666'-0". This sump has a capacity of approximately 200,000 gallons and increases the time for plant operators to respond to various flooding events provided the flood waters have a flow path to the sump. This is true for a large majority of postulated MELB flooding events.

The calculated flood levels were found to be less than two inches for many areas of the plant. Calculated flood levels were less than six inches for the essential pump rooms on elevation 676'-0" due to design features (dropout panels) in these rooms. Most zones are protected from cross compartment flooding by design features in the plant such as the use of subcompartments for separation and the use of curbs to control leakage flow.

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Revision: 1  
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## 1.0 INTRODUCTION

Analyses were performed to determine the flood level response of various areas of the station to postulated failures of moderate energy fluid systems. To accomplish this, the station was divided into 247 flooding zones generally using the zones depicted on the architectural drawings (TVA Drawing Series 46W401 and 46W402).<sup>\*</sup> Many of these zones, termed "general areas", are areas that exhibit large open spaces within the plant and often contain stairwells and hatches which are open to lower levels. Other areas, termed "subcompartments", are smaller areas, generally enclosed by Seismic Category 1 walls, which open to the general areas only through doorways or hatches.

Maximum flood levels for any particular flood zone were calculated assuming a single piping failure as the initiating event per BTP APCSP3-1 [1] and PI-WB-005 [2]. For each zone, moderate energy piping was surveyed to determine which single postulated line failure would produce the limiting flood levels. Fluid release rates were calculated based on through-wall crack sizes determined from the Standard Review Plan 3.6.2 [3] and the duration of the release was generally taken to be 60 minutes.

Fluid removal from general areas was by means of centrally located stairwells or open hatches. Fluid removal from subcompartments was by means of dropout panels, louvers, hatches, open grating, and flow under doors leading to general areas. Where no such removal paths were present, the fluid was assumed to accumulate within the area.

<sup>\*</sup>Additional zones were designated in the intake pumping structure and reactor building and are described in Tables 1d and 1e.

TABLE 1a (Cont'd)

Calc. No. 3C38-1086-00  
 Revision: 1  
 PN 7797-00 Page 33

AUXILIARY BUILDING MELB FLOOD LEVEL INPUT PARAMETERS

ELEVATION 737'-0"

<u>ZONE</u>	<u>AREA DESCRIPTION</u>	<u>LIMITING FAILURE</u>	<u>INFLOW RATE (ft<sup>3</sup>/sec)</u>	<u>NET FLOOR AREA (ft<sup>2</sup>)</u>	<u>OUTFLOW DESCRIPTION</u>
757.0-A1	Auxiliary Control Room	--	--	*	*
<del>757.0-A2</del>	<del>6.9KV &amp; 480V Shutdown Board Room A</del>	<del>HPFP-3</del>	<del>0.140</del>	<del>*</del>	<del>Multiple Doors</del>
757.0-A3	125V Vital Battery Board Room II	--	--	*	*
757.0-A4	125V Vital Battery Board Room I	RWS-1 1/2	0.043	*	Doors
757.0-A5	480V Shutdown Board Room 1B	HPFP-3	0.140	*	Doors
757.0-A9	Personnel & Equipment Access - Unit 1	HVAC-4	0.138	*	Doors
757.0-A10	Spare	HPFP-4	0.202	1823	*
757.0-A11	Reactor Building Equipment Hatch - Unit 1	HPFP-3	0.140	560	*
757.0-A12	Reactor Building Access Room - Unit 1	HPFP-3	0.140	786	*
757.0-A13	Refueling Room	RWS-8	0.544	12400	*
757.0-A14	Reactor Building Access Room - Unit 2	HPFP-3	0.140	786	*
757.0-A15	Reactor Building Equipment Hatch - Unit 2	HPFP-3	0.140	560	*
757.0-A16	Emergency Gas Treatment Filter Room	WDS-4	0.273	1331	*
757.0-A17	Personnel & Equipment Access - Unit 2	HVAC-4	0.138	*	Doors

ATTACHMENT 4

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Calcs. For MELB FLOOD LEVEL	
CALCULATIONS	
<input checked="" type="checkbox"/> Safety-Related	<input type="checkbox"/> Non-Safety-Related

Calc. No. 38-1026 201	
Rev. 0	Date
Page 85-2 of	

Client TENNESSEE VALLEY AUTHORITY	Prepared by	Date
Project WATTS BAR NUCLEAR PLANT	Reviewed by	Date
Proj. No. 7797-00 Equip. No.	Approved by	Date

### Appendix B5

The appendix calculates flood levels for elevation 757'-0" and 763'-6" of the Auxiliary Building.

The door gap and width, free floor area and outflow parameters are based on the information transmitted by DIT-WBO-MNO-0006, 1/9/87.

Derivation of applicable equations is documented in Appendix A and modified on the following pages.



Calcs. For MELB FLOOD LEVEL	
CALCULATIONS	
<input checked="" type="checkbox"/> Safety-Related	<input type="checkbox"/> Non-Safety-Related

Calc. No. 3c 3E-1085-001	
Rev. 0	Date
Page 85-3 of	

Client	TENNESSEE VALLEY AUTHORITY	Prepared by	Date
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Equip. No.			

## Flow Under Pools

Based on p A7

$$h_0 - h_b = h + \frac{264}{g_c} \left[ \frac{Q}{C_e b h} \right]^2$$

Where:

$h_0$  = flood height (in)

$h_b$  = back pressure height (in)

$h$  = gate height (in)

$b$  = gate width (ft)

$C_e$  = contraction coefficient = 0.57

$g_c$  = 32.174 lbm-ft / lbf-sec<sup>2</sup>

$Q$  = Volumetric flow rate (ft<sup>3</sup>/sec)

Substituting:

$$h_0 - h_b = h + \frac{264}{32174} \left[ \frac{Q}{0.57 b h} \right]^2$$

$$\therefore h_0 - (h_b + h) = 82.6531 \left[ \frac{Q}{b h} \right]^2$$

**SARGENT & LUNDY**  
ENGINEERS

Calcs. For MELB FLOOD LEVEL

CALCULATIONS

Safety-Related

Non-Safety-Related

Calc. No. 3233-1036-01

Rev. 0 Date

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Project WATTS BAR NUCLEAR PLANT

Proj. No. 7797-00

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Prepared by

Date

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Date

Flow Over Weir

$$h_o' = \frac{3}{2} \left( \frac{Q}{b \sqrt{g}} \right)^{2/3}$$

where:

 $h_o' = \text{Flood height (ft)}$ 
 $b = \text{Weir width (ft)}$ 
 $Q = \text{Volumetric flow rate (ft}^3/\text{sec)}$ 
 $g = 32.174 \text{ ft/sec}^2$ 

Substituting

$$h_o' = \frac{3}{2} \left[ \frac{Q}{6(32.174)^{1/2}} \right]^{2/3}$$

or  $h_o = 12 \quad h_o'$

where:  $h_o = \text{Flood height (in)}$

$$\therefore h_o = 5.6594 \left[ \frac{Q}{b} \right]^{2/3}$$



Calc. For MELB Flood Level	
Calculations	
<input checked="" type="checkbox"/> Safety-Related	<input type="checkbox"/> Non-Safety-Related

Calc. No. 3C38-1086-001	
Rev. 0	Date
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Client Tennessee Valley Authority	
Project Watts Bar Nuclear Plant	
Proj. No. 7797-00	Equip. No.

Prepared by	Date
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Approved by	Date

Worksheet 1	Building: <i>AUX</i>
<i>6.9 KV and 480V Shutdown Ed Rm A</i>	Flood Zone: <i>757 AZ</i>

Sleeve MK No.	Sys. No.	Dia. (in)	Wall thickness (in)	Pressure (psig)	Temp. (°F)	Break Flow (ft³/sec)	
* 1202	HPPF 6	6					DCY + FHR \$ can not locate on piping composites
1668	HPPF 3	3	sch 40	150	130	0.1403	
\$ 932	RW 1 1/2	1 1/2					
1297	DW 1	1					
1461	Service System	1					per * and \$ same as DW, and CA can not be located on pipe composites
1461	HPPF 1	1					

- \* 47W471-15, R32
- \$ 47W491-4, R26
- \$ 47W491-82, R2
- # 47W850-2, R32
- \$ 47W850-5, R22
- # 47W491-1, R24

2) Free Floor Area

A = Not Required

3) Outflow Parameters

Door A121, width = 47", gap = 1/2" for 24" and 1/4" for 23"  
 Door A151, width = 94 1/2", gap = 1/2" for 16" and 3/4" for 31"  
 Door A140, 4" curb  
 Door A141, width = 58 1/2", gap = 1/4"  
 Door A142, width = 59 1/2", gap = 1/4" for 43 1/2"  
 Door A143, width = 94 1/2", gap = 3/8" for 6'6" and 1/2" for 26 1/2"  
 Door A145, width = 34 1/2", gap = 1/2" for 30 1/2" and 3/4" for 41"

Form GO-3.08.1 Rev. 2 8L-F647 10-85 MPB



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Calcs. For MELB Flood Level

Calc. No. 3C38-1086-001

Calculations

Rev. 0 Date

Safety-Related

Non-Safety-Related

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Client Tennessee Valley Authority

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Date

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Approved by

Date

Worksheet 2

Building: *AUX*

Flood Zone: *757.0-A2*

4) Detection and Isolation

*1 hr*

5) Flood Level -  $h_1$

*1/2" gap width = 24 + 16 + 28 1/2 + 30 1/2 = 99"*

*1/4" gap width = 23 + 58 1/2 + 43 1/2 = 125"*

*3/8" gap width = 66 + 4 = 70"*

*3/4" gap width = 31"*

*using only 1/4" gap width*

$h_0 = 0.65 + 82.6531 \left( \frac{.1403}{12(1.25)} \right)^2 < 2"$

*with 0.65" back-pressure*

*(see 7) For back-pressure calculation*

$h_1 = 2"$

6) Flood Level -  $h_2$

$h_2 = h_1 (757.0-A4) = 2"$

$h_2 = 2"$

7) Comments

*46W401-7, R11*

*Backpressure*

*Area (757.0-A2, 757.0-A3, 757.0-A4, 757.0-A5, 757.0-A24)*  
 $A_2 (26 + 18.5) (26 + 23 + 19 + 21 + 21 + 19 + 23 + 26.5 + 27 + 18.5)$   
 $+ 19.5 (18.5 + 27 + 26.5 + 23) = 44.5 (224) + 19.5 (95)$

$A \geq 11820.5 \text{ ft}^2 \text{ Area} > (.8) (11820.5) > 9450 \text{ ft}^2$

$h_B = \frac{3600(.1403)}{9450} 12 < 0.65"$

Calc. No. 3C38-1086-001  
 Revision 1  
 Page: J9  
 Project No. 7797-00

4. Elevation 757'-0"

<u>Zone</u>	<u>Remarks</u>
757.0-A11	No floor drains in these zones (47W479-11, R15) (DIT-WBO-MNO-0006, 1/9/87).
757.0-A12	
757.0-A14	
757.0-A15	
757.0-A25	
757.0-A26	
757.0-A27	
757.0-A28	
757.0-A1	These zones are interconnected by a floor drain network (47W479-11, R15). All zones except Zone 757.0- A1 have $h_2=2"$ which bounds level due to potential backflow.  **Revise $h_2$ (757.0-A1).
<del>757.0-A2</del>	
757.0-A3	
757.0-A4	
757.0-A5	
757.0-A16	
757.0-A21	
757.0-A22	
757.0-A23	Floor drains in this zone are capped per Detail C11 (47W479-11, R15).
757.0-A24	
757.0-A10	These zones are interconnected by floor drains. However, since $h_1=h_2=2"$ , flood levels due to potential backflow are already bounded (47W479-11, R15).
757.0-A13	
757.0-A17	

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**DESIGN INFORMATION TRANSMITTAL**

SAFETY-RELATED

NON-SAFETY-RELATED

DIT No. - WBO-MNO-0017

CLIENT Tennessee Valley Authority

Page 1 of 1

STATION Watts Bar UNIT(S) 1 & 2

To M. P. Murskyj (2/2) - 24  
W. R. Peebles (1/1) - 31

PROJECT NO(S). 7797-00

R. M. Field

NSLD

*R. M. Field*

1/12/87

Preparer (Please print name)

Division Preparer's signature

Issue date

**STATUS OF INFORMATION** (This information is approved for use. Design information, approved for use, that contains assumptions or is preliminary or requires further verification (review) shall be so identified)

The attached field walkdown information is approved for use. No further verification is required.

**IDENTIFICATION OF THE SPECIFIC DESIGN INFORMATION TRANSMITTED AND PURPOSE OF ISSUE**

(List any supporting documents attached to DIT by its title, revision and/or issue date, and total number of pages for each supporting document)

Attached are Submergence Data sheets for the following flood zones:

- |         |                     |           |
|---------|---------------------|-----------|
|         | 757.0-A1            | 757.0-A16 |
| 757.0   | <del>757.0-A2</del> | 757.0-A17 |
| M17     | 757.0-A3            | 757.0-A21 |
| 6-18-92 | 757.0-A4            | 757.0-A22 |
|         | 757.0-A5            | 757.0-A23 |
|         | 757.0-A9            | 757.0-A24 |
|         | 757.0-A10           | 757.0-A25 |
|         | 757.0-A11           | 757.0-A26 |
|         | 757.0-A12           | 757.0-A27 |
|         | 757.0-A13           | 757.0-A28 |
|         | 757.0-A14           | 763.5-A1  |
|         | 757.0-A15           | 763.5-A2  |

**SOURCE OF INFORMATION**

Calc. no. N/A N/A Report no. N/A N/A  
Rev. and/or date Rev. and/or date

Other Field Walkdown and Verification per PI-WB-06

**DISTRIBUTION**

J. S. Loomis (1/0) - 31	A. Goier (1/0) - 29	R. M. Schiavoni (1/0) - 21
T. A. McKenna (1/0) - 29	R. J. Hammersley (1/0) - 31	R. J. Suslick (originals)
N. Weber (1/0) - 31	R. Marshalla (1/0) - 28	- 22
		NSLD File: 3C38-A1 (1/0)

PI-WB-06 Attachment 2  
 SUBMERGENCE DATA SHEET  
 REVISION: 0

Tennessee Valley Authority  
 Watts Bar Nuclear Plant  
 Project No. 7797-00 PAGE 1 OF 2

ZONE: 757.0-A2 BUILDING:  
 NAME: 6.9KV + 480V SHUTDOWN BOARD ROOM A  
 h<sub>1</sub> = -- h<sub>2</sub> = --

- Auxilliary
- Control
- Diesel Generator
- Intake Structure
- Reactor

Component Number	Class 1-E (yes/no)											Comments
	Initial Submergence	Pump Motor	Valve Motor	Local Motor	Inst. Inst.	Power Panel	Junction Box	Switch	Conduit	Cable	Other	
2-BD-211-A-A	0"				✓							①
1-PNL-211-A-A	0"				✓							②
PNL	0"				✓							UNDEK CONST. NO TAG, YET, ③
2-PNL-211-A-A	0"				✓							④
L-1145	4"							✓				⑤
115V LINE (LIGHT)	4"							✓				⑤
2-BD-211-1A-A	0"				✓							⑥
1-MCC-214-A1-A	0"				✓							⑦
1-MCC-214-A2-A	0"				✓							⑧
1-BD-212-A2-A	0"				✓							⑨
1-BD-212-A1-A	0"				✓							⑩
1-PNL-202-1/1A	0"				✓							⑪
1-PNL-202-1/2A	0"				✓							⑪

Prepared by: *J. M. ...*

Date: 10.16-86

Reviewed by: *RDH ...*

Date: 10/16/86

ATTACHMENT 5

PAGE 2 OF 5

PI- WB-06 Attachment 3  
ADDENDUM TO: CONFIRMATION WALKDOWN DATA SHEET  
 SUBMERGENCE DATA SHEET

Tennessee Valley Authority  
Watts Bar Nuclear Plant

Project No. 7797-00

PAGE 2 OF 2

REVISION: 0

ZONE: ~~757 P-A2~~

BUILDING:

Auxilliary

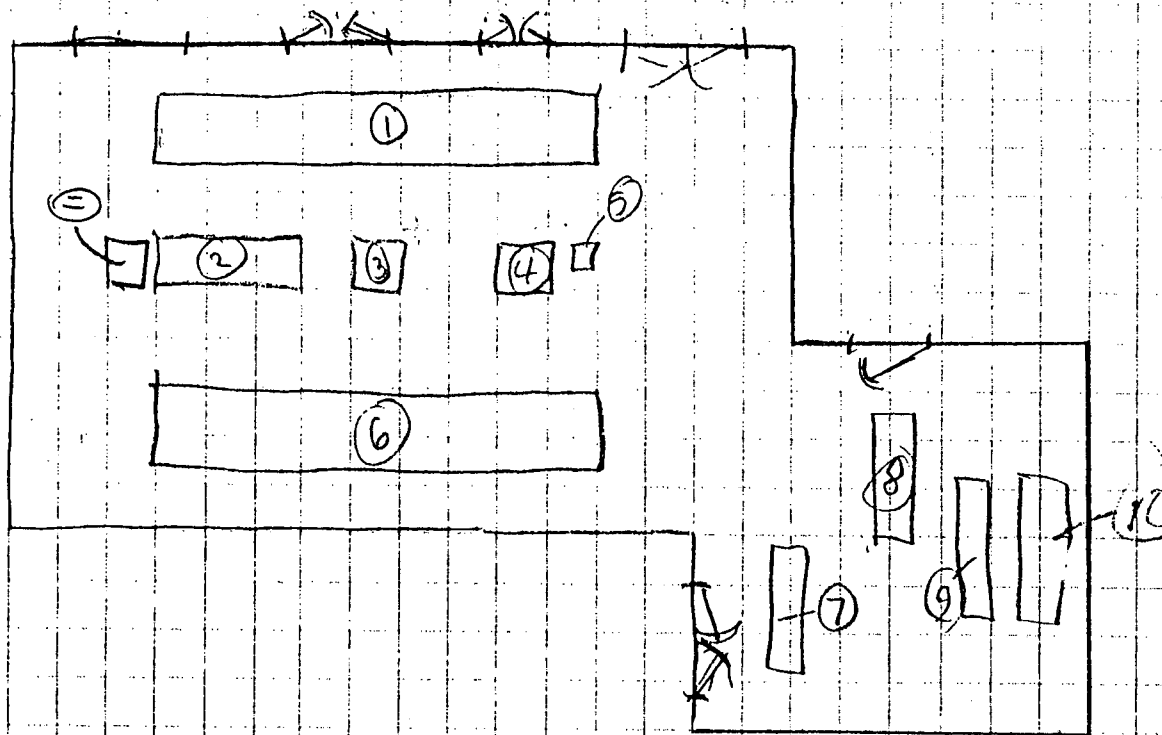
Intake Structure

NAME: 6.9KV + 480V SHUTDOWN BOARD RM A

Control

Reactor

Diesel Generator



Prepared by: *R. M. ...*

Date: 10-16-8

Reviewed by: *RAA...*

Date: 10/16/86

ATTACHMENT 5

PAGE 3 OF 5

**SARGENT & LUNDY**  
ENGINEERS

DESIGN INFORMATION TRANSMITTAL

SAFETY-RELATED

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DIT No. - WBO-MNO-0017-1

CLIENT Tennessee Valley Authority

Page 1 of 1

STATION Watts Bar UNIT(S) 1&2

To M. P. Mursky (2/2)-24  
R. M. Field (1/1)-31

PROJECT NO(S) 7797-00

W. R. Peebles  
Preparer (Please print name)

NSLD *[Signature]*  
Division Preparer's signature

4/6/87  
Issue date

**STATUS OF INFORMATION** (This information is approved for use. Design information, approved for use, that contains assumptions or is preliminary or requires further verification (review) shall be so identified)

The attached field walkdown information is approved for use.  
No further verification is required.

**IDENTIFICATION OF THE SPECIFIC DESIGN INFORMATION TRANSMITTED AND PURPOSE OF ISSUE**

(List any supporting documents attached to DIT by its title, revision and/or issue date, and total number of pages for each supporting document)

Attached are Supplemental Submergence Data sheets for the following flood zones:

757.0-A14*	757.0-A4	757.0-A22
<del>757.0-A2</del>	757.0-A5	757.0-A23
757.0-A3	757.0-A21	757.0-A24

\* Walkdown date of 3/27/87--all others are dated week of 3/2/87.

**SOURCE OF INFORMATION**

Calc. no. <u>N/A</u>	<u>N/A</u>	Report no. <u>N/A</u>	<u>N/A</u>
	Rev. and/or date		Rev. and/or date

Other Field walkdown and verification per PI-WB-06

**DISTRIBUTION**

J. S. Loomis (1/0) - 31	A. Goier (1/0) - 29	<i>R.J. Suslick</i> - 22
T. A. McKenna (1/0) - 29	R. Marshalla (1/0) - 28	(Originals)
N. Weber (1/0) - 31	R. M. Schiavoni (1/0) - 21	NSLD File:3C38-A1

Form GQ-3.17.1 Rev.1 (07-31-85)

PI-WB-00, Attachment 2  
 SUBMERGENCE DATA SHEET  
 REVISION: 0

Supplemental Walkdown  
 Week of 3/2/87

Tennessee Valley Authority  
 Watts Bar Nuclear Plant  
 Project No. 7797-00

ZONE: 757.0-A2  
 NAME: 6.9KV + 480V Shutdown Board Room A  
 Target Flood Levels:  $h_1 = 2$   $h_2 = 2$

BUILDING:

- Auxilliary  
 Control  
 Diesel Generator  
 Intake Structure  
 Reactor

Pg 1 of 2

Only components listed  
 were walked down

ATTACHMENT A  
 DIT# WBD-EPD-001  
 7797-00  
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Component Number	Class I-E (yes/no)	Initial Submergence	Valve Motor	Local Motor	Inst. Inst.	Power Panel	Junction Box	Switch	Conduit	Cable	Other	Comments
2-PNL-211-A-A	YES	0"										Grounding Bar at 2 1/2"; Conduit Penetrations at 3 1/2"; Terminal Blocks at 12"
1-PNL-211-A-A	YES	0"										See comments above for 2-PNL-211-A-A
2-BD-211-A-A	YES	0"										Cable Penetrations at 2"; Terminal Blocks at 4 1/2"; Rollout Pot. Transformers: TB's at 5" and Unexposed Cable at 2". Cables will be submerged at 1 1/2" (unexposed). (1)
<del>2-BD-211-1A-A</del>												
<del>2-BD-211-A-A</del>	YES	0"										Same comments as above with 2-BD-211-A-A
2-PNL-202-1/2A	RED	0"										Conduit Penetrations are submerged at 1/2"; Junction Boxes at 9 1/2" and Unexposed wires at 7"
1-PNL-202-1/1A	RED	0"										Same as above with 1-PNL-202-1/2A
1-BD-212-A2-A	-	0"										Bus Bars will be submerged at 6"; Cables at 7"; Terminal Blocks at 6" & 11 1/2"; Breaker at 4"; Floor Penetrations at 2"; Gnd Bar at 7 1/2" and RTM at 10 1/2".
1-BD-212-A1-A	-	0"										Same comments as 1-BD-212-A2-A

Prepared by: *Scalfebel*

Date: 3-5-87 Reviewed by: *J.P. High*

Date: 3/5/87

(1) ALT Supply XFMR C 2-FU-211-A2/2-A and 1-A are submerged. However 2" stand will have no

ATTACHMENT 5

PAGE 5 OF 6  
 ATTACHMENT A  
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