Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381

JUN 30 1992

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

Gentlemen:

In the Matter of the Application of) Docket No. 50-390
Tennessee Valley Authority)

WATTS BAR NUCLEAR PLANT (WBN) - UNIT 1 - MODERATE ENERGY LINE BREAK (MELB) FLOODING SPECIAL PROGRAM (TAC-M63595) - PROPOSED FSAR CHANGES

Reference 1: TVA letter to NRC, Watts Bar Nuclear Performance Plan (NPP) Volume 4 (Revision 0), May 22, 1989

Reference 2: NRC letter to TVA, Safety Evaluation on WBN NPP Volume 4 (NUREG-1232), December 28, 1989

TVA provided a description of the subject Special Program in Reference 1. NRC provided a preliminary evaluation of this program in Reference 2 and requested that TVA submit an MELB analysis addressing the criteria contained in Standard Review Plan 3.6.1 (NUREG-0800). During a February 26, 1992 teleconference between NRC and TVA staff, the request was clarified and TVA committed to submit the proposed FSAR changes for MELB with an example of program implementation for one area/room in the plant.

Enclosure 1 provides the proposed change and also addresses a change for high energy line break flooding for the staff's information. TVA will submit these changes in a future amendment to WBN's FSAR pending review and comment by the staff. Enclosure 2 provides an example of implementation of the MELB Flooding program for the 6.9KV and 480V Shutdown Board Room A. Please note the calculations provided in Enclosure 2 are subject to change through program implementation.

If you have any questions, please telephone Paul L. Pace at (615) 365-1824.

Sincerely,

W. J. Museler

William J. Museler
Site Vice President

Enclosures
cc: See page 2

A001

JUN 30 1992

cc (Enclosures):
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Watts Bar Nuclear Plant
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50-390 WATTS BAR 1 TVA

Moderate Energy Line Break Flooding Special Program-Proposed FSAR Changes

Rec'd w/ltr dtd 6/30/92...9207070059

Enclosure 1

Proposed FSAR Changes

WBNP-64

1. High Energy Piping

Circumferential ruptures and longitudinal splits

a. Pipe whip.
b. Jet impingement.
c. Environmental effects.

Through-wall leakage cracks

a. Jet impingement
b. Environmental effects

2. Moderate Energy Piping

Through-wall leakage cracks

a. Environmental effects.

In particularly susceptible areas, the jet impingement load associated with a through-wall leakage crack in moderate energy piping with the pressure exceeding 275 psig shall also be considered.

3.6A.2.2 Analytical Methods to Define Forcing Functions and Response Models

Insert "Flooding" (Attached)

3.6A.2.1.4 Flooding

Flooding consequences are also considered in addition to the local effects listed above in 3.6A.2.1.3 from piping failures. Additional environmental concerns are addressed in section 3.11.2.

High Energy Line Breaks (HELBs)
For the purposes of flooding evaluations, fluid systems that, during normal plant conditions are either in operation or maintained pressurized under conditions where maximum operating temperature exceeds 200°F are conservatively classified as high energy. This is bounding since for a given line, the flow from a high energy break emanates from a larger break area than flow from a moderate energy crack. The circumferential rupture is the bounding break for HELB flooding analyses.

Systems classified as high energy are re-classified as moderate energy if the total time that the above conditions are exceeded is less than either of the following:

1) One percent of the normal operating life span of the plant, or
2) Two percent of the time required for the system to accomplish its system design function.

The systems evaluated for high energy break flooding include the reactor coolant, main steam, feedwater, auxiliary boiler, auxiliary feedwater steam supply, and chemical volume and control system.

Moderate Energy Line Breaks
For the purposes of flooding evaluations, fluid systems are classified as moderate energy that, during normal plant conditions, are either in operation or maintained pressurized (above atmospheric pressure) under conditions where: (1) The maximum operating temperature is 200°F or less or (2) the one or two percent exclusion rules described above are applicable. The through-wall leakage crack is the postulated break for the MELB flooding analysis. Flood levels are calculated for the plant on an area basis. Both submergence and structural loading are addressed in the flooding studies.

HELB and MELB flooding effects are evaluated on all essential equipment on a case by case basis. If it is determined that an essential component is not qualified or cannot be demonstrated to operate under the adverse flood conditions, then the essential component is protected. Protection is accomplished by relocating the component or by installing a barrier or curb. Safe shutdown is ensured for design basis HELB/MELB flooding events through these actions.

Enclosure 2

(MELB vertical slice for a sample room)

Room 757.0-A2 (6.9KV and 480V Shutdown Board Room A) is included as a sample MELB area analysis. Pertinent information is provided from MELB calculations related to flooding in this room. This attachment is divided into several portions to represent the different flooding calculations.

Attachment 1
A portion of the Sargent & Lundy summary report (SL-4452) is included in this section to provide the reviewer with an understanding of TVA's MELB methodology and to provide guidance in the usage of the excerpts taken from the flooding calculations for the sample room.

Attachment 2
WBO-MNO-0006, Confirmatory Walkdown sheets to verify the plant geometry (e.g., curb heights, door gaps, etc.)

Attachment 3
Calculation excerpts and background information for "System Isolation for MELB Flooding"

Attachment 4
Moderate Energy Line Break Flooding Study - Provides flood levels for postulated MELBS in 757.0-A2.

Attachment 5
WBO-MNO-0017, Submergence walkdown data (and supplemental data) which lists equipment which could be flooded from flood levels listed in Attachment 4.

Attachment 6
MELB Safe Shutdown Logic Diagram and Equipment List provides a list of safe shutdown equipment in 757.0-A2.

Attachment 7
MELB Safe Shutdown Analysis examines the equipment list in Attachment 6 for electrical equipment found to be submerged based on field walkdown data in Attachment 5. The results (Table 1.0) show that no essential equipment will be submerged for the postulated MELB breaks in 757.0-A2.

Attachment 8
Structural Flood Load Assessments verify the structural adequacy by comparing design basis MELB flood loads to allowable floor live loads.

Section 1

INTRODUCTION

This report summarizes work performed by Sargent & Lundy to evaluate MELB flooding events for the Watts Bar Nuclear Plant (WBN). This report also serves as a guide that shows the relationships among the various design documents produced as a result of this evaluation. The process and controls used to perform this evaluation are also discussed.

Code of Federal Regulations 10 CFR 50, Appendix A, General Design Criteria 4, requires that the structures, systems, and components important to safety shall be designed to accommodate the effects of and be compatible with the environmental conditions associated with postulated piping failures. The effects of postulated piping failures include fluid jets, sprays, and pipe whips, while the environmental conditions include pressure, temperature, humidity, radiation, and submergence. The effects of fluid jets, sprays, and pipe whips are addressed in the TVA CEB Pipe Break Reports.[1,2] The impact of environmental conditions associated with high energy piping failures including pressure, temperature, humidity, radiation, and certain aspects of submergence (e.g., high energy line break (HELB) flooding[3] and submergence inside the reactor building) is covered by the TVA Equipment Qualification Project for Watts Bar. MELB flooding issues, including structural loading and submergence, are addressed in this report.

Historically, flood protection at WBN has been provided by plant design features and supported by engineering evaluations. One design feature is the large passive sump in the auxiliary building. In general, this sump greatly increases the margin for operator response in detecting and isolating flooding sources. Additional design features include the use of compartmentalization, dropout panels, hatches, open grating, and curbs. TVA engineering evaluations were not comprehensively documented in all cases. Therefore, this MELB flooding evaluation serves to verify previous design work performed by TVA and also provides comprehensive documentation that demonstrates adequate plant design for MELB flooding events.

SARGENT & LUNDY

Sargent & Lundy has based their evaluations on TVA documents provided by TVA. Sargent & Lundy did not independently verify the contents or accuracy of these documents. Field verification of certain information was carried out by Sargent & Lundy, including confirmation of drainage path parameters and submergence levels of electrical equipment. Various verbal and written directions were provided by cognizant technical personnel at TVA, and this direction is documented in Sargent & Lundy calculations and TVA Quality Information Requests, all of which are listed in Section 8 of this report.

Section 3

METHODOLOGY

GENERAL

The goal of this study is to demonstrate that safe plant shutdown can be achieved and maintained for design basis MELB flooding events. This requires both a structural load assessment and an electrical equipment safe shutdown evaluation. These in turn require input on flood levels arising from postulated MELB flooding events. The major elements of this study were:

- Flood level calculations (including field verification of input parameters)
- Structural load assessment
- Preparation of a safe shutdown logic diagram and equipment list
- Safe shutdown evaluation (including field identification of all submerged electrical equipment)
- Crack exclusion analysis
- Safe shutdown power supply analysis

Exhibit 3-1 shows the relationships among the tasks required to perform this overall evaluation. These tasks are further described in a series of Sargent & Lundy Project Instructions, PI-WB-004, -005, and -006. [12,13,14]

"MELB Flood Level Calculations"[15] provides flood levels for postulated MELB flooding events for input to structural flood load and safe shutdown assessments. "Piping Crack Exclusion Evaluation"[16] provides the justification for excluding piping cracks from consideration in many areas of the plant. These calculations are summarized in Section 4.

"Structural Flood Load Assessment" [17] verifies structural adequacy by comparing design basis MELB flood loads to allowable floor live loads provided by TVA and to concrete and

masonry wall capacities calculated by Sargent & Lundy. This assessment is further described in Section 5.

"Refined Structural Flood Load Assessment"[18] verifies the structural adequacy, for flood zones not qualified in Reference 17, using a refined structural analysis based on a more detailed review of loadings and capacities. This assessment is discussed further in Section 5.

The safe shutdown evaluation was divided into two parts. "MELB Safe Shutdown Logic Diagram and Equipment List"[19] provides the list of safe shutdown equipment, which is constructed by modifying the Appendix R equipment list[4] to include consideration of Class 1E equipment only and single active failure. This modification required the inclusion of several additional key diagrams to address functions such as ECCS charging, reactor coolant pump thermal barrier cooling, safety injection, long-term boration and spent fuel pool cooling. "MELB Safe Shutdown Analysis"[20] examines safe shutdown for MELB flooding events in which electrical equipment was found to be submerged based on field walkdowns.[21] This analysis assumes that safe shutdown power supplies and cables that are submerged directly or are within submerged conduits that are required will be operable during the MELB flooding event. This is ensured by the analyses presented in Section 6.

The design criteria used to perform the various evaluations of this study are contained in the Sargent & Lundy Project Instruction PI-WB-005, "Evaluation of the Effects of MELB Flooding Inside and Outside Containment."[12] This document is included as Appendix A to this report. Specific modeling assumptions used to perform various analyses are documented in individual calculations.[15,16,17,18,19,20,22,23]

TVA INPUT DOCUMENTS

A number of TVA documents, including drawings, diagrams, calculations, design criteria, letters, memoranda, surveillance instructions, general operating instructions, system operating instructions, and reports, were used as input to the various MELB flooding analyses. Use of these documents is controlled by Sargent & Lundy Project Instruction

PI-WB-017, "Use and Control of TVA Drawings and Documents."[8] The TVA documents used by Sargent & Lundy are recorded on three separate document control logs, one each for EPED, NSLD, and SED.[9,10,11] In addition, cognizant technical personnel at TVA provided verbal direction and interpretations, which in turn were documented by Sargent & Lundy. Any such verbal instructions not subsequently documented by TVA by a QIR, but used for this study, are identified as an unverified assumption in this report.

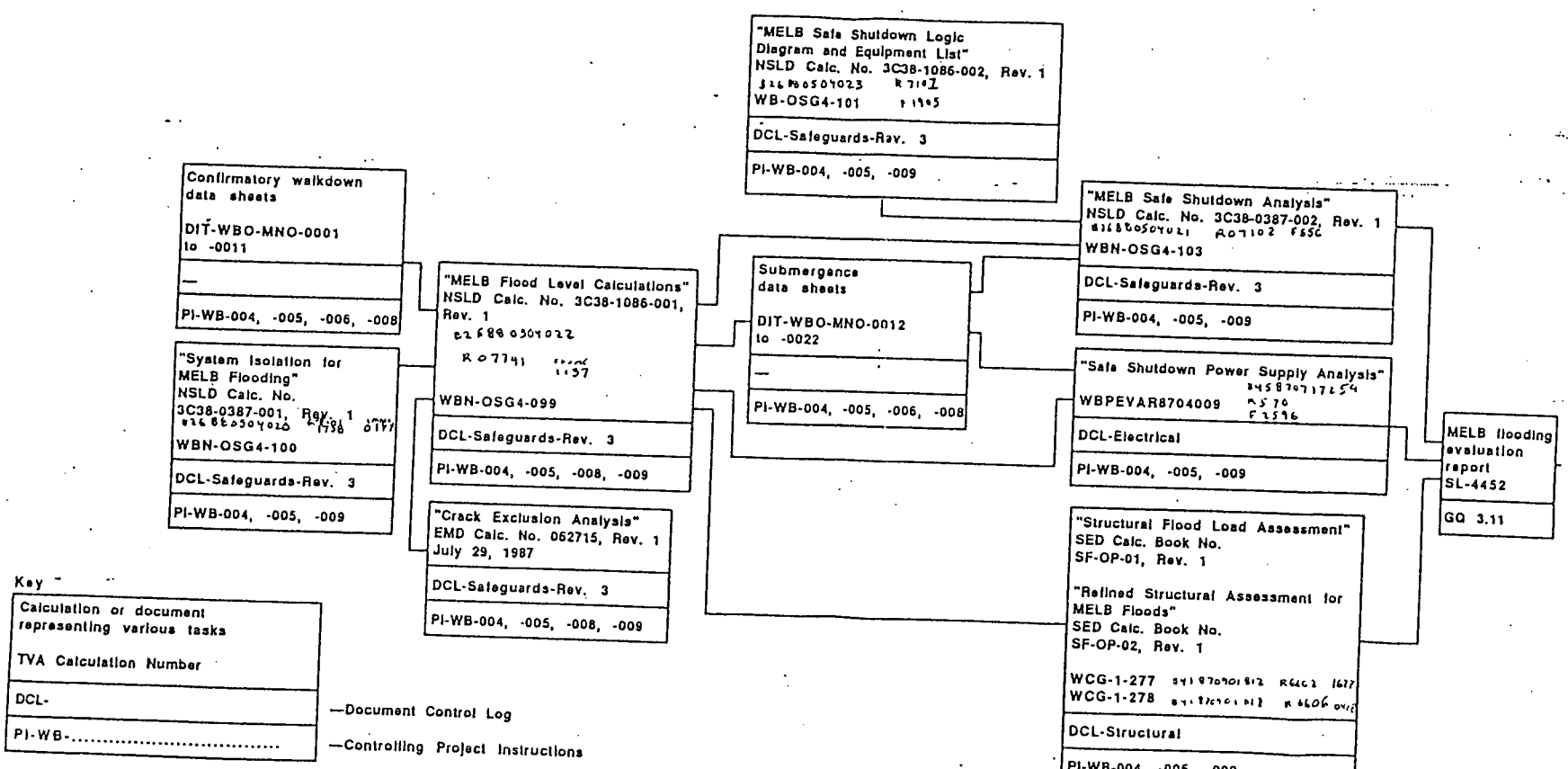
FIELD VERIFICATION

Field verification of various input parameters used to calculate flood levels was performed by the Sargent & Lundy walkdown team under Sargent & Lundy Project Instruction PI-WB-006.[14] This team also performed submergence walkdowns for electrical equipment, based on MELB flood levels, under the same project instruction.

SARGENT & LUNDY

Workflow and Documentation
Used to Support the
MELB Flooding Evaluation

Exhibit 3-1
SL-4452
08-12-87



M1369.001 08-87

ATTACHMENT 1
MELB FLOODING
PAGE 6 OF 11

Section 8

REFERENCES

TVA DOCUMENTS

1. "Evaluation of the Effects of Postulated Pipe Failures Outside Containment," TVA Report CEB 77-55.

2. "Report on Protection Against Dynamic Effects of Pipe Failure Inside Containment," TVA Report CEB 77-39.

3. K. W. Schram, "Flooding in Auxiliary Building due to Postulated Pipe Breaks," TVA Calculation, Branch Identifier WBN-OSG4-44, Revision 1, RIMS B45 860908218.

4. J. J. McComas et al., "Equipment Required for Safe Shutdown per 10 CFR 50 Appendix R," Revision 9, December 31, 1985 (B45851231218).

5. Final Safety Analysis Report - Watts Bar Nuclear Plant - Section 8.3.

6. TVA Calculation, "Short Circuit Currents During Flooding," SQN-EPS-001-2, Revision 0.

7. TVA Technical Report, "Electrical Conductivity of Borated Solutions for Sequoyah Nuclear Plant," 86-E-03-7001, January 28, 1986.

SARGENT & LUNDY DOCUMENTS

8. "Use and Control of TVA Drawings and Documents," Sargent & Lundy Project Instruction PI-WB-017, Revision 0, October 8, 1986.

9. M. P. Murskyj (EPED), to R. J. Suslick (PMED), "Electrical Department Document Control Log," Sargent & Lundy Interoffice Memorandum, June 1, 1987.

10. W. R. Peebles (NSLD) to R. J. Suslick (PMED), "Document/Drawing Control Log - Revision 3," Sargent & Lundy Interoffice Memorandum, June 19, 1987.

11. R. J. Marshalla (SED) to R. J. Suslick (PMED), "Structural Department Document Control Log," Sargent & Lundy Interoffice Memorandum, May 11, 1987.

12. "Evaluation of the Effects of MELB Flooding Inside and Outside Containment," Sargent & Lundy Project Instruction PI-WB-005, Revision 1, April 13, 1987.

13. "Work Flow for MELB Flooding Study," Sargent & Lundy Project Instruction PI-WB-004, Revision 0, October 8, 1986.

14. "Walkdown Procedure," Sargent & Lundy Project Instruction PI-WB-006, Revision 1, February 5, 1987.

15. R. M. Field, et al., "MELB Flood Level Calculations," NSLD Calc. No. 3C38-1086-001, Revision 1, August 7, 1987.

16. "Piping Critical Crack Exclusion Evaluation," EMD Calculation 062715, Revision 1, July 29, 1987.

17. J. J. Gustin, et al., "Structural Flood Load Assessment," SED Calc. Book No. SF-OP-01, Revision 1, TVA Branch Identifier WCG-1-277.

18. R. J. Marshalla, et al., "Refined Structural Assessment for Moderate Energy Line Break Flooding," SED Calculation Book SF-OP-02, Revision 1, TVA Branch Identifier WCG-1-278.

19. W. R. Peebles, "MELB Safe Shutdown Logic Diagram and Equipment List," NSLD Calculation 3C38-1086-002, Revision 1, August 7, 1987.

20. R. M. Field, et al., "MELB Safe Shutdown Analysis," NSLD Calc. No. 3C38-0387-002, Revision 1, August 7, 1987.

21. Sargent & Lundy Design Information Transmittals

DIT-WBO-MNO-0001, January 9, 1987
DIT-WBO-MNO-0002, January 9, 1987
DIT-WBO-MNO-0003, January 9, 1987
DIT-WBO-MNO-0004, January 9, 1987
DIT-WBO-MNO-0005, January 9, 1987
DIT-WBO-MNO-0006, January 9, 1987
DIT-WBO-MNO-0007, January 9, 1987
DIT-WBO-MNO-0008, January 9, 1987
DIT-WBO-MNO-0009, January 9, 1987
DIT-WBO-MNO-0010, January 9, 1987
DIT-WBO-MNO-0011, January 9, 1987

The above DITs transmitted the "Confirmatory Walkdown Data Sheets" from R. M. Field (NSLD) to W. R. Peebles (NSLD).

DIT-WBO-MNO-0012, January 12, 1987
DIT-WBO-MNO-0013, January 12, 1987
DIT-WBO-MNO-0014, January 12, 1987
DIT-WBO-MNO-0015, January 12, 1987
DIT-WBO-MNO-0016, January 12, 1987
DIT-WBO-MNO-0017, January 12, 1987
DIT-WBO-MNO-0018, January 12, 1987
DIT-WBO-MNO-0019, January 12, 1987
DIT-WBO-MNO-0020, January 12, 1987
DIT-WBO-MNO-0021, January 12, 1987
DIT-WBO-MNO-0022, January 12, 1987

The above DITs transmitted the "Submergence Data Sheets" from R. M. Field (NSLD) to M. P. Murskyj (EPED).

DIT-WBO-MNO-0012-1 April 6, 1987
DIT-WBO-MNO-0013-1 April 6, 1987
DIT-WBO-MNO-0014-1 April 6, 1987
DIT-WBO-MNO-0015-1 April 6, 1987
DIT-WBO-MNO-0016-1 April 6, 1987
DIT-WBO-MNO-0017-1 April 6, 1987
DIT-WBO-MNO-0018-1 April 6, 1987
DIT-WBO-MNO-0019-1 April 6, 1987
DIT-WBO-MNO-0020-1 April 6, 1987
DIT-WBO-MNO-0021-1 April 6, 1987
DIT-WBO-MNO-0022-1 April 6, 1987

The above DITs transmitted supplemental "Submergence Data Sheets" for selected zones from W. R. Peebles (NSLD) to M. P. Murskyj (EPED).

DIT-WBO-EPO-0001-1 March 30, 1987

The above DIT transmitted updated "Supplemental Walkdown Data Sheets" from J. P. Kish (EPED) to R. M. Field (NSLD) and W. R. Peebles (NSLD).

22. "Safe Shutdown Power Supply Analysis," Sargent & Lundy Calculation, TVA Branch Identifier WBREVAR 870009, Revision 1, August 10, 1987.

23. R. D. Astleford, "System Isolation for MELB Flooding," NSLD Calc. No. 3C38-0387-001, Revision 1, August 7, 1987.

24. S&L letter, R. J. Suslick to R. C. Weir, Subject: "MELB Flooding Study - Partial Corrective Action," dated February 6, 1987.

25. Memorandum of telephone conversation between R. D. Astleford and F. Carr regarding the "Essential Raw Water Cooling System," dated April 9, 1987.

26. Memorandum of telephone conversation between R. D. Astleford and D. Davis regarding "MELB Isolation Times for Various Systems," dated April 9, 1987.

27. S&L letter, R. J. Suslick to R. C. Weir, Subject: "MELB Flooding Study - Partial Recommended Corrective Action," dated March 30, 1987.

28. S&L letter, R. J. Suslick to R. C. Weir, Subject: "MELB Flooding Study - Final Recommended Corrective Action," dated June 10, 1987.

OTHER DOCUMENTS

29. "Determination of Break Locations and Dynamic Effects Associated with the Postulated Rupture of Piping," U.S. Nuclear Regulatory Commission Standard Review Plan Section 3.6.2, Revision 1, July 1981.

30. Gould Industrial Controlfax Catalog 1982, pp. 142-148.

31. "Multiples of Overload Relay Current Element Rating," Gould Drawing PC Number 409402-1.

SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRANSMITTAL

☒ SAFETY-RELATED ☐ NON-SAFETY-RELATED

DIT No. - WBO-MNO-0006

CLIENT Tennessee Valley Authority

Page 1 of 1

STATION Watts Bar UNIT(S) 1 & 2

To W. R. Peebles - 31

PROJECT NO(S). 7797-00

R. M. Field — Preparer (Please print name)

NSLD — Division

Robert M Field — Preparer's signature

1/9/87 — 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 Confirmatory Walkdown sheets for the following flood zones:

757.0-A1
757.0-A2
757.0-A3
757.0-A4
757.0-A5
757.0-A9
757.0-A10
757.0-A11
757.0-A12
757.0-A13
757.0-A14
757.0-A15
757.0-A16
757.0-A17
757.0-A21
757.0-A22
757.0-A23
757.0-A24
757.0-A25
757.0-A26
757.0-A27
757.0-A28
763.5-A1
763.5-A2

SOURCE OF INFORMATION

Calc. no. N/A — N/A (Rev. and/or date) Report no. N/A — N/A (Rev. and/or date)

Other : Field Walkdown and Verification per PI-WB-06

DISTRIBUTION

J. S. Loomis (1/0) - 31
T. A. McKenna (1/0) - 29
N. Weber (1/0) - 31
A. Goier (1/0) - 29
R. J. Hammersley (1/0) - 31
R. Marshalla (1/0) - 28
M. Murskyj (1/0) - 24
R. M. Schiavoni (1/0) - 21
R. J. Suslick (originals) - 22
NSLD File: 3C38-A1 (1/0)

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

PI-WB-06 Attachment 1
CONFIRMATION WALKDOWN DATA SHEET
REVISION: 0

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

ZONE: 757.0-A2 NAME: 6.9 KV + 480V SHUTDOWN BOARD ROOM A

BUILDING:
- [x] Auxilliary
- [ ] Control
- [ ] Diesel Generator
- [ ] Intake Structure
- [ ] Reactor

1) NSLB Input Comments

2) Doors - 7 SEE NEXT PAGE

	Gap	Curb
[ ] Door to Zone		
[ ] Door to Zone	)	)
[ ] Other	)	)

3) Floor Drains - NONE
- [ ] 3" - Drain
- [ ] Other (Describe - e.g. Gutter)

4) Floors and Walls
- [ ] Solid Floor
- [x] Solid Walls to 6" [x] S [x] N [x] E [x] W
- [x] Sealed Floor
- [ ] Other (see below)

5) Stairwells, Hatches and Gratings - NONE
- [ ] Stairwell down to Zone _____ Width _____
- [ ] Open Hatch, ____" x ____", Kick Plate ____"
- [ ] Open Grating, ____" x ____"

6) Piping (General Description of Piping, Types & Sizes)

7) Comments (Note unusual items related to flooding)

Prepared by: E O Stafford Date: 10/15/86 Reviewed by: R Miranda Date: 10-16-85

ATTACHMENT 2

PI- WB-06 Attachment 3
ADDENDUM TO: ✓ CONFIRMATION WALKDOWN DATA SHEET
____ SUBMERGENCE DATA SHEET
REVISION: 0

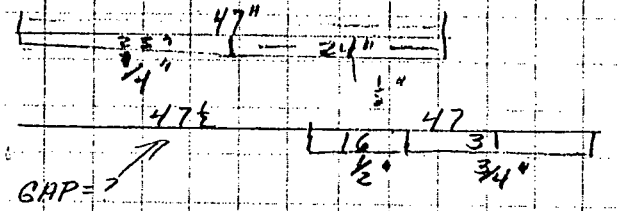
Tennessee Valley Authority
Watts Bar Nuclear Plant
Project No. 7797-00

ZONE: 757.0-A2
NAME: 6.9 KV + 480V INSTRUMENT BOARD RM A

BUILDING:
- [X] Auxilliary
- [ ] Intake Structure
- [ ] Control
- [ ] Reactor
- [ ] Diesel Generator

DOOR A171 to ZONE 757.0-A24 — WIDTH = 47"

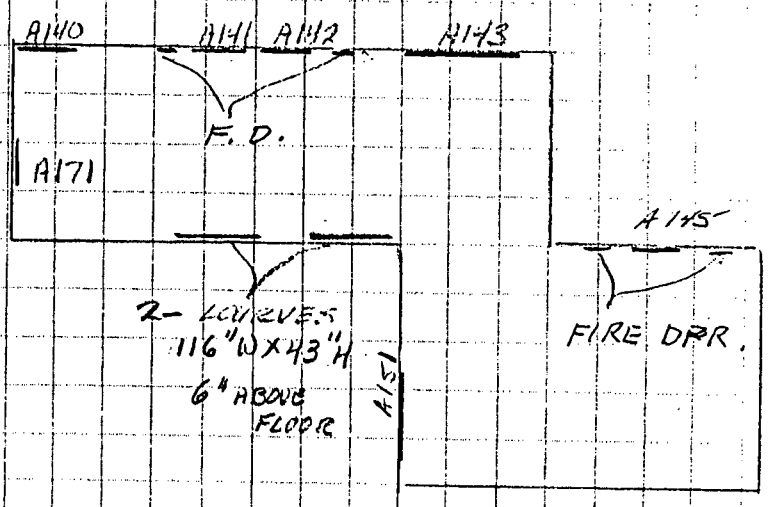
DOOR A151 to ZONE 757.0-A9 — WIDTH = 44½"



COULDN'T CLOSE V2 DOOR DUE TO RUBBER HOSE

FOR INFORMATION ON DOORS A140, A141, A142, A143 + A145 SEE CONFIRMATION WALKDOWN DATA SHEETS FOR ZONES 757.0-A1, 757.0-A3, 757.0-A4, 757.0-A5 + 757.0-A5 respectively

FOR INFORMATION ON FIRE DRR. SEE CONFIRMATION WALKDOWN DATA SHEET FOR ZONES 757.0-A5, 757.0-A4, AND 757.0-A3.



Prepared by: R D Stafford Date: 10/16/86 Reviewed by: K. Mann Jr. Date: 10-16-86