ATTACHMENT 6

CALCULATION EPM-PJA-080592

9608020119 960726
PDR ADOCK 05000390
P PDR

TVA 10697 (DNE-6-86)

DNE CALCULATIONS **QA Record**

TITLE: DOCUMENTATION OF DESIGN BASIS REVIEW, REQUIRED THRUST/TORQUE CALCULATIONS, AND VALVE AND ACTUATOR CAPABILITY ASSESSMENT FOR VALVE 1-FCV-68-333				PLANT/UNIT WATTS BAR NUCLEAR PLANT/#1
PREPARING ORGANIZATION DNE, ABB IMPELL, EBASCO, MECHANICAL		KEY NOUNS (Consult RIMS DESCRIPTORS LIST) MOV, VALVE OPER, VALVE ACTUATORS		
BRANCH/PROJECT IDENTIFIERS MEB-WBN-68 WBN-68-D053 EPM-PJA-080592		Each time these calculations are issued, preparer must ensure that the original (RO) RIMS accession number is filled in. Rev. (for RIMS' use)		RIMS accession number
		RO	B18 921113 283	
APPLICABLE DESIGN DOCUMENT(S) N/A		R 4	Oct 4, 1995 64B26	950831 347
		R		
SAR SECTION(S) 3.9.3.2	UNID SYSTEM(S) 68	R		
REVISION 0		R4	R	R
ECN No. (or Indicate Not Applicable) N/A		S-37937-A		
Prepared: P. J. Antonvich		D.C. Buecne		
Checked/Verified: T. S. Snead		TVLEASE		
Reviewed: T. J. Miller				
Approved: T. J. Miller				
Date: 11/12/92		8-31-95		
USE FORM TVA 10534 IF MORE SPACE REQUIRED	List all pages added by this revision	SEE REV. LOG		
	List all pages deleted by this revision	SEE REV. LOG		
	List all pages changed by this revision	SEE REV. LOG		

Safety-related? YES [X] NO [ ]

Statement of Problem:

NRC Generic Letter 89-10 requires that each licensee develop, implement, and document a program which ensures that specified safety-related motor-operated valves (MOVs) will perform their safety function for the life of the plant.

Part of this program involves the documentation of MOV design basis review, determination of required thrust/torque, and assessment of valve and actuator capability.

ORIGINAL

Abstract: These calculations contain an unverified assumption(s) that must be verified later. Yes [ ] No [X]

This calculation documents the design basis review and required thrust/torque for MOV 1-LCV-62-133. The design basis review has been performed and the required thrust/torque has been determined per the methodology specified in Mechanical Design Standards DS-M18.2.21 and DS-M18.2.22. This methodology addressed the new requirements specified in NRC Generic Letter 89-10. As summarized in Section 8.0 this calculation shows that the valve and valve actuator are capable of meeting the new thrust/torque requirements. Therefore, based on the results of this calculation MOV 1-FCV-68-333 is able to perform its design basis function.

This calculation contains special requirements: Yes [ ] No [X]

[ ] Microfilm and store calculations in RIMS Service Center
[X] Microfilm and return calculations to: Calculation Library

Microfilm and destroy. [ ]
Address: IOB-1E

cc: MEB

THIS PAGE ADDED BY REVISION 4 DCB 6/29/95

TITLE: DOCUMENTATION OF MOV DESIGN BASIS REVIEW FOR 1-FCV-68-333

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
0	ORIGINAL ISSUE Prepared by: P. J. Antonvich PJA 11/11/92 Checked by: T. Snead TS 11/12/92	11/12/92
1	This revision incorporates Design Change Notice W-12962-A for the spring pack replacement (0301-112) for 1-FCV-68-333 Pages Added: 3A Pages Revised: 9, 20, 21, 37, 4, 1, 2 Pages Deleted: 0 Total Pages: 41 Prepared: M. R. Johnson mrj 4/6/93 Checked: DLBell	5/25/93
2	This revision incorporates Design Change Notice F-22416-A for increased Actuator (SB-00) thrust rating of 140% above the nominal thrust rating of 14,000 lbs. . Pages Added: 3B, 3C, 3D Pages Revised: 1, 2, 4, 12, 35, 37, 38 Pages Deleted: 0 Total Pages: 44 Prepared by: M. R. Johnson mrj 1/4/94 ~~Checked by:~~	RGW for FAK 1/6/94

TITLE: DOCUMENTATION OF MOV DESIGN BASIS REVIEW FOR 1-FCV-68-333

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
3	This revision incorporates the following MOV issues: elevated temperature effects, seismic evaluation, EOI evaluation, reconciled DP test data Pages Revised: 1, 4, 5, 7, 9-18, 22-28, 30, 32-34, 37, 38, 3C, 21 Pages Added: 2A, 3E, ~~3F 3G~~ 24A, Att. 2 (4 pgs), Att. 3 (11 pgs) mj 12/14/94 Pages Deleted: None ~~Total Pages: 64~~ mj 12/14/94 DCCM and CCRIS search was performed on ~~11/10/94~~ 12/14/94 and no changes were found which affect this calculation. mj 12/14/94 Prepared: [signature] 11/14/94, [signature] 12/14/94 Checked: [signature] 12/15/94	12/21/94
4	This revision incorporates the following MOV issues: revised reconciled DP test data and mispositioning evaluation. Pages Revised: ~~1~~ TVA 7/12/95, 2A, 5, 7, 9-11, 17, 21, 24, 27, 4, 3C, 12, 14, 20, 22 Pages Added: 1A, 3F, ATT. 2 (4 PGS) Pages Deleted: ATT. 2 (4 PGS) DCCM and CCRIS search was performed on 6/29/95 and no changes were found which affect this calculation. Prepared: D.C. Bueche 6/29/95 Checked: Thomas V. [signature] 7/12/95	8-31-95

CLIENT: TENNESSEE VALLEY AUTHORITY PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW FOR 1-FCV-68-333

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-68, WBN-68-D053, EPM-PJA-080592 — 0
Calculation No. — Revision

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

1. Design Review X
2. Alternate Calculation NR
3. Qualification Test NR

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.

This design review was conducted in accordance with TVA Design Standards DS-M18.2.21 and DS-M18.2.22. Calculation methodology and results were compared to these standards and were found to meet the technical requirements contained therein. The design input and assumptions were verified and found to be reasonable. The calculation results are adequately conservative. The computations were checked, and the evaluation of the differential and line pressure scenarios was confirmed using the references in Section 5.0.

[signature] — 11/12/82
Design Verifier (Independent Reviewer) — Date

EBASCO SERVICES INCORPORATED

CLIENT: TENNESSEE VALLEY AUTHORITY PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW FOR 1-FCV-68-333

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-68, WBN-68-D053, EPM-PJA-080592 — Calculation No.

1 — Revision

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

1. Design Review X
2. Alternate Calculation NR
3. Qualification Test NR

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.

This design review was conducted in accordance with TVA Design Standards DS-M18.2.21 and DS-M18.2.22. Calculation methodology and results were compared to these standards and were found to meet the technical requirements contained therein. The design input and assumptions were verified and found to be reasonable. The calculation results are adequately conservative. The computations were checked, and the evaluation of the differential and line pressure scenarios was confirmed using the references in Section 5.0.

Design Verifier (Independent Reviewer) — Date: 5/25/93

CLIENT: TENNESSEE VALLEY AUTHORITY PROJECT: WATTS BAR NUCLEAR PLANT UNIT - 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-68-333

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-68, WBN-68-D053, EPM-PLA-080592 — Calculation No.

2 — Revision

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

1. Design Review X
2. Alternate Calculation NR
3. Qualification Test NR

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.

This design review was conducted in accordance with TVA Design Standards DS-M18.2.21 and DS-M18.2.22. Calculation Methodology and results were compared to these standards and were found to meet the technical requirements contained therein. The design input and assumptions were verified and found to be reasonable. The calculation results are adequately conservative. The computations were checked, and the evaluation of the differential and line pressure scenarios was confirmed using the references in Section 5.0

John F. Lind — Design Verifier (Independent Reviewer)

06JAN94 — Date

THIS PAGE ADDED BY REVISION 2

EBASCO SERVICES INCORPORATED

CLASSIFICATION, CATEGORIZATION AND MAINTENANCE OF DESIGN CALCULATIONS

CALCULATION CLASSIFICATION & CATEGORIZATION

CALCULATION INFORMATION: MEB-WBN-68
WBN-68-D053

PLANT/UNIT WBN IDENTIFIER EPM-PJA-080592 REV. ~~2~~ ~~3~~ 4 R3 12/14/94 R4 7/12/95

RIMS NO. NR ISSUE DATE NR

TITLE DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE REQUIREMENTS AND VALVE AND ACTUATOR CAPABILITY ASSESSMENT FOR 1-FCV-68-333

SYSTEM(S), COMPONENT, FEATURE OR SUBJECT OF CALCULATION

	SYSTEM/DESCRIPTION
(X) SAFETY SYSTEM	SYSTEM NO. 68
(X) SAFETY RELATED FEATURE	RCS Relief Flow Control Valve
( ) NON-SAFETY SYSTEM	SYSTEM NO.
( ) NON-SAFETY RELATED FEATURE	
( ) PLANT ENVIRONMENT (EQ, ETC.)	
( ) APPENDIX R	
( ) CIVIL STRUCTURES	
( ) INSTRUMENTATION (PAM, ETC.)	
( ) LICENSING	
( ) OTHER	

R3 12/14/94

CALCULATION CATEGORY E06

FINAL CLASSIFICATION

(X) ESSENTIAL ( ) FILE ONLY

( ) DESIRABLE ( ) SUPERSEDED

SUBMITTED [signature] DATE 1/4/94

REVIEWED [signature] DATE 06JAN94

APPROVED [signature] for FAK DATE 1/6/94

Rev. 3 12/14/94 R3

12/17/94

12/21/94

12/14/94 R4

THIS PAGE ADDED BY REVISION 2

REV. 4 7/12/95 7/12/95 8/31/95 7/12/95

Attachment 1
CALCULATION CLASSIFICATION & CATEGORIZATION

IDENTIFIER: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PRELIMINARY CLASSIFICATION

(X) ESSENTIAL ( ) FILE ONLY

( ) DESIRABLE ( ) SUPERSEDED

CALCULATION CLASSIFICATION JUSTIFICATION:

SUBMITTER This calculation documents the design basis review and required thrust/torque for MOV 1-FCV-68-333. The calculation addresses the requirements specified in NRC Generic Letter 89-10.

REVIEWER (✓) AGREE WITH CLASSIFICATION ( ) DISAGREE - COMMENTS REQUIRED

APPROVER (✓) AGREE WITH CLASSIFICATION ( ) DISAGREE - COMMENTS REQUIRED

THIS PAGE ADDED BY REVISION 2

WATTS BAR NUCLEAR PLANT UNIT 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW FOR 1-FCV-68-333

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-68, WBN-68-D053, EPM-PJA-080592 — 3
Calculation No. — Revision

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

1. Design Review X
2. Alternate Calculation NR
3. Qualification Test NR

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.

This design review was conducted in accordance with TVA Design Standards DS-M18.2.21 and DS-M18.2.22. Calculation methodology and results were compared to these standards and were found to meet the technical requirements contained therein. The design input and assumptions were verified and found to be reasonable. The calculation results are adequately conservative. The computations were checked, and the evaluation of the differential and line pressure scenarios was confirmed using the references in Section 5.0. This revision incorporates elevated temperature effects, EOI evaluation, seismic evaluation, and reconciliation of DP test data.

Design Verifier (Independent Reviewer) — 12/17/94 Date

THIS PAGE ADDED BY REV 3

CLIENT: TENNESSEE VALLEY AUTHORITY PROJECT: WATTS BAR NUCLEAR PLANT UNIT - 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-68-333

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-68, WBN-68-D053, EPM-PJA-080592 — Calculation No.

4 — Revision

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

1. Design Review X
2. Alternate Calculation NR
3. Qualification Test NR

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.

This design review was conducted in accordance with TVA Design Standards DS-M18.2.21 and DS-M18.2.22. Calculation Methodology and results were compared to these standards and were found to meet the technical requirements contained therein. The design input and assumptions were verified and found to be reasonable. The calculation results are adequately conservative. The computations were checked, and the evaluation of the differential and line pressure scenarios was confirmed using the references in Section 5.0, This revision incorporates revised test data reconciliation and mispositioning evaluation.

Thomas V. [illegible] — Design Verifier (Independent Reviewer)

7/12/95 — Date

THIS PAGE ADDED BY REVISION 4

DEB 6/29/95

EBASCO SERVICES INCORPORATED

CLIENT: TENNESSEE VALLEY AUTHORITY
PROJECT: WATTS BAR NUCLEAR PLANT UNIT - 1
SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE REQUIREMENTS FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92
CHECKER: T. Snead DATE: 11/12/92

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Revision Log 2
Calculation Design Verification (Independent Review) Form 3
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4.0 Assumptions 8
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6.0 Design Input Data 12
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9.0 Conclusions 39

ATTACHMENTS

1. Simplified Sketch - - - - - - - - - - - - - - - (page 1 of 1)

THIS CALCULATION PACKAGE CONTAINS ~~40~~ ~~41~~ ~~44~~ ~~64~~ ~~62~~ 64 TOTAL SHEETS

Attachment 2: Reconciliation Process (4 pgs)
Attachment 3: Test Data (11 pgs)

R4 R3 R2 R1 R2 11/14/94 5/25/93 4/6/93 4/4/94

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92
CHECKER : T. Snead DATE: 11/12/92

1.0 PURPOSE AND SCOPE

1.1 Purpose

This calculation documents the design basis review, performs the required thrust/torque calculation, and assesses the valve and actuator capabilities . The results of this calculation are the total valve package which contains the comprehensive Generic Letter 89-10 engineering analysis for the Reactor Coolant System Relief Flow Control Valve (Train A), 1-FCV-68-333, including elevated temperature effects, seismic evaluation, ~~and~~ revised ~~reconciled~~ test data, mispositioning evaluation and evaluation of Emergency Operating Instructions (EOIs).

R3 R4 11/14/94 DJ 6/29/95

1.2 Scope

The design basis review will be performed in accordance with TVA Mechanical Design Standard DS-M18.2.22 (Sect. 3.2). Its purpose is to identify the functional, seismic, and electrical considerations which will influence the valve's, 1-FCV-68-333, ability to perform its design function and also to document specific design information on both the valve and operator (Sections 7.1 through 7.5). The calculated maximum thrust/torque capability will be compared to the thrust/torque requirements, also calculated herein using TVA Mechanical Design Standard DS-M18.2.21 (Sect 3.1), in order to ensure sufficient thrust/torque is available to operate the valve.

The valve and operator thrust/torque capabilities and requirements are based on the worst case line/differential pressures and electrical conditions, as identified in the design basis review.

1.3 CORRELATION

This calculation is presented in Ebasco Project Procedure E-30-TVA format. To identify the location of data required by TVA Design Standard DS-M18.2.22 the following correlation is provided.

DS-M18.2.22 DATA Section		E-30-TVA FORMAT
Purpose	1.0	1.0
Assumptions	2.0	4.0
References	3.0	5.0
Design Basis Review	4.0 - 4.4	7.0 - 7.44
Calculations	4.5	7.5
Walkdown	5.0	7.6
Conclusion	6.0	8.0 & 9.0

2.0 CRITERIA

The motor-operated valve, 1-FCV-68-333, shall be evaluated using TVA Nuclear Design Standards DS-M18.2.21 and DS-M18.2.22.

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92
CHECKER : T. Snead TS DATE: 11/12/92

3.0 **APPLICABLE CODES AND STANDARDS**

3.1 TVA Nuclear Power Mechanical Design Standard DS-M18.2.21, "Motor-Operated Valve Thrust and Torque Calculations", Rev. 7 ~~2~~, ~~dated 07/07/92~~ R3 R4

3.2 TVA Nuclear Power Mechanical Design Standard DS-M18.2.22, "MOV Design Basis Review Methodology", Rev. 1~~, dated 07/29/91~~. AR 11/14/94

3.3 NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance", dated June 28, 1989, and Supplements.

3.4 Not Used. ~~Supplement 1 to NRC Generic Letter 89-10, "Results of Public Workshops", dated June 13, 1990.~~ DCB 6/29/95

3.5 "Application Guide for Motor-Operated Valves in Nuclear Power Plants", EPRI Report NP-6660-D, Final Report dated March 1990.

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68,WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92

CHECKER : T. Snead DATE: 11/12/92

4.0 **ASSUMPTIONS**

4.1 Valves are assumed to be in and remain in their normal position during normal operation or accident condition such that the effects of mispositioning can be determined. The technical justification for this assumption is to assure that the valves are evaluated at the maximum line and differential pressures.

4.2 The pressure drop for piping losses is neglected in the calculation. The technical justification for this assumption is that it allows for a conservative determination of line and differential pressure.

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA **DATE:** 11/11/92

CHECKER : T. Snead **DATE:** 11/12/92

5.0 **REFERENCES**

5.1 TVA WBN Calculation EPM-TSS-110791, Rev. ~~1~~ ~~4~~ 6, "Generic Letter 89-10 MOV Population at Watts Bar (Unit 1)"

5.2 TVA Design Basis Document, System Description N3-68-4001, Revision ~~2~~ 3 thru DCN ~~S-17564-A~~ S-36005-A, "Reactor Coolant System"

5.3 TVA Mechanical Piping Drawing 47W465-7, Rev. ~~F~~ G, "Reactor Coolant Auxiliary and Miscellaneous Piping"

5.4 TVA WBN WBPEVAR8909010, Rev. ~~28~~ ~~26~~ 35, "Cable Ampacity - NV4 & NV5 Cables in Class 1E Raceways"

5.5 TVA WBN DCN ~~M~~ W-12962-A, "MOV Uniqueness and Thrust Requirements" (RIMS # ~~B26 901004 827~~) T56 930323 840

5.6 TVA WBN Flow Diagram 1-47W813-1, Rev. ~~B~~ ~~15~~ ~~17~~ ~~35~~ 20, "Reactor Coolant System" R1 mf 4/6/93 5/25/93

5.7 TVA Mechanical Piping Drawing 47W465-2, Rev. ~~E~~ R, "Reactor Coolant Auxiliary & Miscellaneous Piping"

5.8 TVA Site Instruction ~~SI-4.0.5.68.A~~ 1-SI-68-901-A, Rev. ~~0~~ 1, "Valve Full Stroke Exercising During Plant Operation - Reactor Coolant A Train", Watts Bar Nuclear Plant

5.9 TVA WBN Schematic Diagram, 1-45W760-68-5, CCD, Rev. ~~13~~ ~~19~~ 15, "Reactor Coolant System Schematic Diagram"

5.10 Not Used. ~~TVA WBN Letter, dated June 26, 1992, "Evaluation of Cable Sizing for the Generic Letter 89-10 Motor Operated Valve (MOV) Program" (RIMS # T41 920626 868)~~ ~~T44 921111 033~~ Nov. 11

5.11 Westinghouse Electric Corporation Letter WAT-D-8939, dated July 30, 1992, "Seismic Qualification of Westinghouse Gate Valves for Watts Bar" (RIMS # T33 920730 983)

5.0 **REFERENCES** (Continued)

5.12 Westinghouse Letter WAT-D-6874, dated 02/24/86, to E. R. Ennis (TVA), "Data Base for Motor Operated Valves"

5.13 Westinghouse Drawing 115E010, Rev. 902, "Motor Op. Gate Valve - Mod. 03000GM88FNH008, 3-1500 ASME Class 1 GPO ASSY", Contract No. 71C62-54114-2

5.14 Marks Standard Handbook for Mechanical Engineers, Eighth Edition

5.15 Westinghouse Electric Corporation Letter WAT-D-8584, dated 6/25/91, Contract # 71C62-54114-1 "Maximum Allowable Thrusts" (RIMS #B26 91 0805 300)

5.16 ~~TVA QIR MNMWBN 92022, Rev. 0, Limitorque Actuator Torque Switch Setting Chart for New Replacement Spring Packs" (RIMS # T81 920804 937)~~ TVA WBN Vendor Technical Manual WBN-VTM-L200-0010, Rev. ~~12~~ 13, Section 0240, "Technical Details for Limitorque SMB motor operators."

5.17 TVA WBN Environmental Drawing 47~~W~~E235-42, Rev. ~~E~~ ~~6~~ E, 7 "Environment Data - Harsh Lower Compartment"

5.18 Limitorque Selection Guides:

5.18.1 Application Factors, SEL-4, Revised 07/01/77.

5.18.2 Gate & Globe Valve Efficiency Chart, SEL-7, 11/89.

5.18.3 Stem Factors, SEL-10, dated 05/21/79.

5.18.4 Rating Sheets, SEL-9, Rev. 2, Dated 6/2/75.

5.19 TVA WBN SOER 84-07, dated 6/7/91, "Identification of Gate Valves Subject to Thermal Binding and Bonnet Overpressurization"

5.20 Westinghouse Letter WAT-D-8830, "EMD Gate Valve Wedge Angle Information", dated 4/23/92 (Rims #T33 920423 954)

R3
R4
DCB 6/29/95
11/14/94

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92

CHECKER : T. Snead DATE: 11/12/92

5.0 **REFERENCES** (Continued)

5.21 TVA WBN Calculation WBN-EEB-MS-TI06-0010, Rev. ~~6~~ ~~29~~ 47, "Auxiliary Power System Analysis on 1E Buses Via CSST C and CSST D with Auto Load Tap Changers" R4 DCB 6/29/95

5.22 Westinghouse Equipment Specification G-678852, Rev. 2, "Motor Operated Gate Valves ASME Boiler and Pressure Vessel Code Section III Class 1, 2, & 3," Contract No. 71C62-54114-1.

5.23 TVA EQ Binder WBNEQ-MOV-001, Rev. ~~6~~ 12, "Environmental Qualification Documentation Package" R4

5.24 TVA WBN Calculation WBN-EEB-MS-TI08-0008, Rev. ~~28~~ ~~67~~ ~~68~~ 75 12/14/94, "480V 1E Coordination/Protection" DCB 6/29/95

5.25 Westinghouse Field Change Notice FCN No. WATM-10640 (RIMS # NEB 830223 358)

5.26 TVA WBN Valve Index by ID, WAT-ID, Rev. 10, dated 9/30/86 Contract No. 71C62-54114-1 (RIMS # B26 861230 900)

5.27 ~~TVA WBN Site Instruction 4.0.5.68.B, Rev. 1, "Valve Full Stroke Exercising During Cold Shutdown - Reactor Coolant"~~ R4

5.28 Not Used. ~~TVA WBN Letter, dated 11/11/92, "Watts Bar Nuclear Plant (WBN) - Evaluation of Cable Sizing for the Generic Letter 89-10 Motor Operated Valve (MOV) Program" (T44 921111 033)~~ DCB 6/29/95

5.29 TVA Electrical Design Standard DS-E12.6.3, Rev. ~~2~~ 4 ~~through EX-DS-12.6.3, "Cable Ampacity Tables for Auxiliary and Control Power Cables (0-15000 Volts)"~~ "Auxiliary and Control Power Cable Sizing Up to 15000 Volts (RIMS # B44 940215 001) R4

5.30 TVA WBN-OSG4-095, Rev. ~~7~~ 13, "Selection Criteria for MOVs Requiring Thermal Overload Bypass" DCB 7/12/95

5.31 ~~TVA Procedure Method PM87-26 (EEB), Rev. 2, "Cable Length/Impedance to be Used in Electrical Calculations" (RIMS # B43 890822 908)~~ Westinghouse Letter WAT-D-9838, 11/10/94, "MOV Seismic Analyses" (RIMS # T33 941110 803)

11/14/94

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92
CHECKER : T. Snead TS DATE: 11/12/92

5.0 **REFERENCES** (Continued)

5.32 Operability Test Report of Westinghouse Nuclear Gate Valves, Dated 1/28/77, Engineering Memorandum No. 4995 R7

5.33 ~~TVA QIR MNN WBN 89006, Rev. 0, "Motor Operator Valves Stroke Times"~~ TVA WBN Vendor Technical Manual WBN-VTM-L200-0010, Rev. 13 Section 0380, "Limitorque Technical Update 93-03, Elevated Temperature Effects" R4 7/12/95

A review of DCCM was performed and no outstanding changes affect this calculation. 12/14/94

6.0 **DESIGN INPUT DATA**

6.1 The design input for determining the Motor Operated Valve Design Basis and the motor operated valve thrust/ torque requirements, operation and capability was obtained from References listed in Section 5.0.

5.34 TVA WBN Letter from Limitorque (Pat McQuillian) to WBN Engineering Manager (R. M. Johnson), dated ~~1/4/94~~ 8/31/94, ~~T28940104 800~~ T24 940922 453, Subject: Increased Actuator Thrust Rating. R3 12/14/94

5.35 TVA WBN Vendor Technical manual WBN-VTM-W120-0800 Rev. 5 (6) Section 2958, "Westinghouse EMD Valves" R4 7/12/95 R7 R2 1/4/94 04JAN94 11/14/94

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7.0 **CALCULATIONS**

7.1 SYSTEM DESIGN BASIS DATA — DATA SOURCE

1. VALVE NO: 1-FCV-68-333 — Ref. 5.1

2. MARK NO : 8000A — Ref. 5.25, p. 2; Ref. 5.12, ~~p 2~~; Ref. 5.23, ~~p F126~~

3. DESCRIPTION: RCS Pressure Relief Flow Control Valve (Train A) — Ref. 5.9

4. SAFETY FUNCTION: Remains open and must be able to be opened to align the PORV's, providing a depressurization path. The valve is closed to isolate the PORV in the event it fails to close. — Ref. 5.2, ~~pp 54 & 55~~

5. SEISMIC CLASS: Category I (Active) — See Comment 7.1.5; Ref. 5.2, ~~pg 164~~

6. SYS DESIGN PRESS: 2510 psig — Ref. 5.2, ~~pg 166~~

   SYS DESIGN TEMP : 680° F — Ref. 5.2, ~~pg 166~~

7. NORMAL POSITION: Open — See Comment 7.1.7

   SAFETY POSITION: Close — See Comment 7.1.7

8. FLOW RATE: 210,000 lb/hr @ 2265 pisa — Ref. 5.2, ~~pg 166~~

9. MAX LINE/DIFFERENTIAL PRESS: — Comment 7.1.9

	Line P/Diff. P		Line P/Diff. P	
Normal Plant Operation:	OPEN	2235/2235	CLOSE	2235/0
Testing:	OPEN	2235/0	CLOSE	2235/0
Accident:	OPEN	NR	CLOSE	2335/2335
Misposition:	OPEN	~~2510~~/~~2510~~ 2734 2734	CLOSE	2335/2335

10. FLUID TYPE: Liquid & Saturated Steam - Reactor Coolant — Ref. 5.2, ~~pg 54 & 55~~

    FLUID TEMP: 680 ° F — Ref. 5.2, ~~pg 159~~

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7.0 **CALCULATIONS** (Continued)

7.1 SYSTEM DESIGN BASIS DATA (Continued) DATA SOURCE

11. REQUIRED STROKE TIME: ~~10.0 seconds~~ (design) Ref. ~~5.33, pg 5~~ 5.2 R4 R3 2/13/95
APPLICABLE SI: ~~SI-4.0.5.68.A~~ 1-SI-68-901-A

12. LEAK TIGHTNESS REQUIREMENT: 9 cc/hr See Comment 7.1.12 11/14/94

13. MOV CAN BE FULL FLOW TESTED? N (YES/NO) See Comment 7.1.13

14. BONNET OVERPRESSURIZATION/THERMAL BINDING/ PRESSURE LOCKING N (Y/N) See Comment 7.1.14

15. ORIENTATION OF VALVE: Ref. 5.3
Ref. 5.7
Ref. 5.23, ~~pg F117~~ R4 2/3 7/12/95

Line: Horiz X Vert ___ Degrees from vertical ___
Stem: Horiz ___ Vert X Degrees from vertical ___

16. BUTTERFLY VALVE CHARACTERISTICS: Not Required For a Gate Valve

Flow velocities: Not Required For a Gate Valve

Piping arrangements: Not Required For a Gate Valve

17. AMBIENT TEMPERATURE: 60° to 120°F (Normal) Ref. 5.17

327°F Maximum Accident

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7.0 **CALCULATIONS** (Continued)

7.1 SYSTEM DESIGN BASIS DATA (Continued)

Comments:

7.1.5 Seismic Class - ~~Reference 5.32 provides test data for seismic~~ qualification of Westinghouse Gate Valve of size 4" and 12". Reference 5.11 categorizes various sizes of Westinghouse gate valves into two different groups using the 4" valve as the representative for one group and the 12" valve as the representative for the other group. 1-FCV-68-333 (a 3" gate valve) is represented by the 4" valve.

Based on Ref. 5.11 and the test results of the 4" gate valves in Ref. 5.32, pg 22, an operating thrust range of 5,500 lbs to 7,500 lbs in the opening direction, and a thrust range of 11,500 lbs to 13,600 lbs in the closing direction were noted during stroking at 2500 psid.

Although Section 7.5.1 of this design basis review calculates a required opening thrust of 11,898 lbs (which is greater then the Ref. 5.32 value). Since Reference 5.32 demonstrated operability of the valve under differential pressure conditions similar to Section 7.5.1 it may be concluded that this valve is seismically qualified for its application.

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7.1.7 Valve Position - The PORV Block valve is required to be open (and is normally open) to allow venting of the pressurizer for plant depressurization following an accident or abnormal event, in the event the PORV does not close the PORV Block valve may be required to close to stop RCS depressurizaiton (Ref. 5.2~~, pp. 54 & 55~~).

Reference 5.31 provides seismic qualification for this valve for accelerations of 3.0 g's horizontal and 2.1 g's vertical and an operating thrust/torque of 20,000 lbf/250 ft-lb.

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7.0 **CALCULATIONS** (Continued)

7.1 SYSTEM DESIGN BASIS DATA (Continued)

7.1.9 Analysis of flow rate and maximum line/differential pressure for normal, testing, accident, and mispositioning scenarios:

Computation of maximum expected line pressures, differential pressures and flow velocity for RCS Pressure Relief Flow Control Valve (Train A), 1-FCV-68-333. Refer to Attachment 1, Simplified Sketch.

Opening (Accident/Abnormal Conditions) - The PORV Block valve is required to be open (and is normally open) to allow venting of the pressurizer for plant depressurization following an accident or abnormal event (Ref. 5.2~~, p. 54~~). Therefore, it is not required to open under accident conditions. R3

Closing (Accident/Abnormal Conditions) - The PORV Block valve may be required to close to stop RCS depressurization in the event the PORV does not close. (Ref. 5.2~~, pp. 4, 55, 164~~). In this scenario, the PORV would be isolated when it was determined it would not close. This would be at some pressure below the PORV setpoint. The maximum differential pressure for this operation occurs at an upstream pressure of 2335 psig based on the PORV setpoint (Ref. 5.2~~, pg. 179~~) and downstream pressure of 0 psig which results in a differential pressure of 2335 psid at a line pressure of 2335 psig. The downstream pressure in the pressurizer relief tank (PRT) is normally 3 psig (Ref. 5.2~~, pg. 163~~) but is taken as zero for conservatism and simplicity.
Accumulation and setpoint drift are not applicable as the valve would not be shut until pressure dropped below the PORV setpoint regardless of lift pressure.

Opening and Closing (Normal/Test Operations) - The valve may be required to be closed for maintenance or PORV testing and would subsequently be opened to restore the PORV flow path. During normal power operation, the differential pressure is 2235 psid at a line pressure of 2235 psig for opening operations. This is based on an upstream pressure at maximum normal system pressure (Ref. 5.2~~, pg. 130~~) and negligible pressure in the PRT (see: Closing Accident/Abnormal conditions). The valve is stroked for surveillance testing (Ref~~s~~. 5.8 ~~& 5.27~~). The opening and closing operation would occur at 0 psid differential pressure, as the PORV is closed, at a line pressure of 2235 psig. Conditions at cold shutdown are bounded by the power operations scenario.

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7.0 CALCULATIONS (Continued)

7.1 SYSTEM DESIGN BASIS DATA (Continued)

Inadvertent Mispositioning - The valve may be mispositioned, including both closing following inadvertent opening and inadvertent closure, during normal or accident/abnormal conditions. The closing scenario is bounded by the closing operation at accident/abnormal conditions (2335 psig/ 2335 psid). The opening scenario would require opening of the valve following inadvertent closure to restore the depressurization path following an accident or abnormal event. Worst case upstream pressure is based on the ASME Pressurizer Code ~~Safety Valve setpoint (RCS design pressure) of 2510 (2485 psig plus 1% setpoint error, Ref. 5.2, pp. 55) and a~~ negligible downstream pressure (see Closing (Accident/Abnormal Conditions)) is also used. The consideration of safety valve accumulation pressure for reopening the valve in not credible as the safety valves, once open, provide complete overpressure protection. This results in valve operation at a differential pressure of ~~2510~~ 2734 psid and a line pressure of ~~2510~~ 2734 psig.

requirement that safety valves be designed to limit system pressure to 110% of design or 2734 psig.

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COMMENTS

7.1.12 Leak Rate - Leak rate = 3 cc/hr * nominal valve size = 3 * 3 = 9 cc/hr max design leak rate. (Ref. 5.22, p. 25 & Ref. 5.13)

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7.1.13 Full flow testing - The valve cannot be full flow tested in the open or closed directions since it would require an RCS pressure of 2510 psig which is above the PORV setpoint of 2335 psig (Ref 5.8, Ref. 5.27, and Comment 7.1.9 above).

7.1.14 Bonnet overpressurization - All safety related active gate valves that may be susceptible to thermal binding or bonnet pressurization are evaluated in SOER 84-07 (Ref. 5.19, attachment 1, p. 12) and valve 1-FCV-68-333 is not susceptible to thermal binding or bonnet pressurization.

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7.1.9 For EOI evaluation, the max ΔP reflected in this section is based on system design pressure and documented in engineering design output documents such as the system description and flow diagrams.

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7.0 **CALCULATIONS** (Continued)

7.2 Valve Design Data

VALVE DESIGN DATA		DATA SOURCE
Valve Tag No.	1-FCV-68-333	
Valve Contract No.	71C62-54114-1	Ref 5.13
Valve Drawing.	115E010	Ref 5.26, ~~p. 13~~
1. Valve Serial No.	03000GM88FNH00B-00S710001	Ref. 5.25, ~~p. 2~~ Ref. 5.23, ~~p F126~~
2. Valve Model No.	03000GM88FNH00B	Ref 5.13
3. Valve Mfg.	Westinghouse	Ref 5.13
4. Valve Pressure Class.	1500	Ref 5.13
5. Valve Size/Type	3" Gate	Ref 5.13
6. Seat Diameter Mid point of seat)	2.87"	Comment 7.2.6 Ref 5.13
7. Seat Angle	7°	Ref 5.20
8. Stem Diameter	1.25"	Ref 5.13
9. Stem Pitch	0.333"	Ref 5.13
10. Stem Lead	0.333"	Ref 5.13
11. Stem Travel	4.31"	Ref 5.13
12. Disc type	Flexible Wedge Gate Valve	Ref 5.13

R3

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7.0 **CALCULATIONS** (Continued)

7.2 Valve Design Data (Continued)

Comments:

7.2.6 Seat Diameter - The seat diameter (2.87) was determined by the measurement shown of the valve drawing plus 0.25" (0.25" + 2.62") (Ref. 5.13). 0.25" was derived using 4 times (for conservatism) the .0625" seat width used in DS-M18.2.21, pg 4.

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7.0 **CALCULATIONS** (Continued)

7.3 OPERATOR DESIGN DATA

			DATA SOURCE
	Valve Tag Number	1-FCV-68-333	
1.	Operator Mfg.	Limitorque	Ref 5.23, ~~pg F126~~ R4
2.	Operator Type/Size	SB/00	Ref 5.23, ~~pg F126~~
3.	Order No.	378447B	Ref 5.23, ~~pg F126~~
4.	Serial No.	205838	Ref 5.23, ~~pg F126~~
5.	Spring Pack No.	0301-112 ~~0301-113~~	See Comment 7.3.5 PCB 7/12/95
6.	Overall Gear Ratio (OAR)	36.2	Ref 5.25, p. 2 R1 Ref 5.5, p. 4 4/6/93 5/25/95
7.	Pullout/Run Efficiency	0.45 / 0.60	Ref 5.18.2
8.	Stem Factor (FS 0.15)	0.0116	Ref 5.18.3, p. 6
9.	HBC Size	Not Applicable	NO HBC UNIT INSTALLED
10.	HBC Serial No.	Not Applicable	NO HBC UNIT INSTALLED
11.	HBC Order No.	Not Applicable	NO HBC UNIT INSTALLED
12.	HBC Gear Ratio	Not Applicable	NO HBC UNIT INSTALLED
13.	HBC Gear Eff.	Not Applicable	NO HBC UNIT INSTALLED

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7.0 **CALCULATIONS** (Continued)

7.3 OPERATOR DESIGN DATA (Continued)

Comments:

7.3.5 Determination of Spring Pack Capability -

TVA DCN ~~M~~ W-12962-A (Ref. 5.5, ~~p. 4~~) lists the installed spring pack as ~~301-113~~ 0301-112. The torque switch setting chart 3 shows torque switch setting 1 as ~~170~~ 115 ft-lbs and ~~2~~ 3 as ~~240~~ 185 ft-lbs (Ref. 5.16, p. 5). The minimum ~~thrust~~ torque required to close the valve (Section 7.5.1) ~~is 11,798 lbf (equivalent torque is 137 ft-lbs), to open the valve is 11,898 lbf (equivalent torque is 138 ft-lbs).~~ 143 12,291

The spring pack is satisfactory for this application.

and to open the valve is in

R1 6/6/95 6/29/95 12/14/94 DB 6/29/95

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7.0 **CALCULATIONS** (Continued)

7.4 ELECTRICAL DATA

			DATA SOURCE
Valve Tag Number		1-FCV-68-333	
1.	Motor Mfg.	Reliance	Ref 5.23, ~~pg F129D~~ R4
2.	ID No.	716275-XE-2	Ref 5.23, ~~pg F129D~~ R3
3.	Start Torque	15 ft-lbs (Nameplate Data)	Ref 5.23, ~~pg F129D~~
4.	Running Torque	Not Listed	Ref 5.23, ~~pg F129D~~ 11/14/94
5.	RPM	3400	Ref 5.23, ~~pg F129D~~
6.	Horsepower	1.9 HP	Ref 5.23, ~~pg F129D~~
7.	Volts	460 V	Ref 5.23, ~~pg F129D~~
8.	Running Current	3.5 A	Ref 5.23, ~~pg F129D~~ R3
9.	L. R. Current	26.0 A	Ref 5.21, ~~pg 180~~ DCB 7/12/95
10.	Duty Cycle	15 Min	Ref 5.23, ~~pg F129D~~ R4 11/14/94
11.	Motor Code	Not Listed	Not Listed DCB 7/12/95
12.	Insulation Class	RH	Ref 5.23, ~~pg F129D~~ R4
13.	Frame Designation	P56	Ref 5.23, ~~pg F129D~~
14.	Electrical Cable Sizing	Satisfactory	Comment 7.4.14 Ref 5.10, pgs 7 & 30 DCB 7/12/95
15.	Control Circuit Logic	Satisfactory	Comment 7.4.15 Ref 5.9 R3
16.	Degraded Voltage Cond.	Satisfactory	Comment 7.4.16 Ref 5.21, ~~pg 180~~
17.	Overload Sizing	T29 Satisfactory	Comment 7.4.17 Ref 5.21, ~~pg 180~~

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7.0 **CALCULATIONS** (Continued)

7.4 ELECTRICAL DATA (Continued)

Comments:

7.4.14 Electrical cable sizing - ~~Reference 5.21, page 180 lists the locked rotor current for this valve motor as 26 amps, the full load current as 3.5 amps, the cable size and numbers as # 12 AWG for 1V2451A and 1V2452A.~~

~~Reference 5.4, p. 528 (use of this calculation approved by Ref. 5.10) shows the derated 200% full load ampacity as 7.7 amperes and the allowed cable ampacity as 26.6 amperes for cable 1V2452A~~

~~Reference 5.4, Appendix I, p. 3 (use of this reference is allowed by Ref. 5.10) determined that this cable (1V2451A) is acceptable because it is similar to 1-FCV-68-332-B. 1-FCV-68-332 was found acceptable when analyzed in Appendix H, p.30 the derating factor used for 1-FCV-68-332 was 71% (acceptable per Ref. 5.28), the full load ampacity was found to be 5.9 amps and the allowable cable ampacity for the 1-FCV-68-332 power cable to be 9.4 amps.~~

The cable sizing for this application including its ability to withstand locked rotor condition (Ref. 5.4) was evaluated for both cables. The cable sizing for this application including its ability to withstand locked rotor condition (Ref. 5.29) was evaluated using the full load and locked rotor current and found satisfactory for cable 1V2452A. The cable sizing for 1V2451A is based on a similar valve cable (1-FCV-68-332) and its full load and locked rotor current were found satisfactory (Ref 5.4). ~~based on the following:~~

~~o The 71% full load current was evaluated in Ref. 5.28, and found acceptable for this application.~~

R3

AA 11/4/97

7.0 **CALCULATIONS** (Continued)

7.4 ELECTRICAL DATA Comments (Continued)

7.4.15 Control circuit logic - The valve is required to operate to isolate the RCPA anytime that a PORV may fail open; Ref. 5.30~~, Attach. 1, p. 14a~~ requires the Thermal Overload (TO) Protection Device to be bypassed and the Torque Switch (TS) to be bypassed in the closing direction during a DBE. R4 DED 6/29/95

The electrical schematic (Ref. 5.9) shows that the TO is bypassed by a safety signal; the valve travel is limited by a limit switch in the opening direction.~~and by torque switch with limit switch bypass in the closing direction.~~ Valve travel is limited by the limit switch in the closing direction (Ref 5.35). R4 R3 DED 6/29/95

The control circuit for this valve meets its design application. AA 11/14/94

7.4.16 Degraded voltage condition - Reference 5.17 shows that the valve is located in a harsh environment and a reduced voltage evaluation caused by elevated cable and motor temperature is applicable. The maximum accident environmental temperature is 327° F (Ref. 5.17) which equates to 164° C [C=(T-32)/1.8]. The minimum voltage indicated on page 180 of reference 5.21 is corrected to 90° C for cable and 40° C for motor. ~~Minimum motor terminal voltage (V_{min}) is determined using the following provided data and formulae:~~ See pg 24A for an evaluation of elevated temperature effects. R3 AA 11/14/94

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ELEVATED TEMPERATURE EVALUATION FOR: 1-FCV-68-333-A per (Ref. 5.33)

15.0 START TORQUE, Nameplate

MAX ENVIRONMENTAL TEMPERATURE
327 temperature (deg 164.0 degrees C

MOTOR INFORMATION
3400 rpm

VALVE INFORMATION
0.333 lead
4.31 travel

ACTUATOR INFORMATION
36.2 DAR
31.28 high speed stem
8.27 stroke time secs
0.14 stroke time mins

MOTOR TOTAL TEMPERATURE
168.3 total motor temperature

EVALUATION OF LRA AND LRT
19.2% max % LRA loss (Limitorque 93-03)
15.89% actual % LRA loss based on temp
21.9 adjusted LRA

21.4% max % TQ loss (Limitorque 93-03)
17.72% actual % TQ loss based on temp
12.34 adjusted TQ

EVALUATION OF MISPOSITIONING
4.32 temp rise due to misposition (3 strokes)

EVALUATION OF VT (BLOCK vs. INDIVIDUAL) PER STROKE
block start (y/n): n
block start (open/close): N/A
individual start (open/close: both

TERMINAL VOLTAGE EVALUATION

		load	FLI	LRA	LRPF	Zm	Rm	jXm	Rtot	Rc	jXc	Individual Motor Start	Block Motor Start
AS FOUND	1-FCV-68-333-A	1.90	3.50	26.0	0.90	10.2147	9.1932	4.4525	0.23700	1.0234	0.0364	415.2	
										0.2150	0.0077		
REVISED	1-FCV-68-333-A	1.90	3.50	21.9	0.90	12.1270	10.9143	5.2860	0.23700	1.0234	0.0364	418.9	
										0.2150	0.0077		

CORRECTION OF Rc, Rm, AND Xm FOR TEMPERATURE > 90 DEGREES CELSIUS FOR: 1-FCV-68-333-A per (Ref. 5.29)

Voltage Divider (VMin) = = Vmcc x Zmc / Ztotal
VMin = 403.92
formulae:

		REVISED	ORIGINAL
0.003082	= Temperature Coefficient of Resiste		
	= Temperature corrected MTR Impedanc	15.9843	13.4637
	= Temperature corrected MTR Resistar	15.0849	12.7062
1.2568	= Temperature corrected Cable Resistance (Rcc)		
	= Total corrected Impedance (Ztc) =	17.4121	14.8926

where

a1 = 1 / (234.5 + T1)
Zmc = [(Rmc)^2 + (Xm)^2]^0.5
Rmc = Rm (1+ (a1) (Tc - Tm))
Rcc = Rc (1+ (a1) (Tc - T1))
Ztc = [(Rmc + R12cc + Roh)^2 + (Xm + X12cc)^2]^0.5

Provided Data:

		REVISED	ORIGINAL
440	= Motor Control Center Volt		
	= Motor Resistance (RM) :	10.9143	9.1932
	= Motor Reactance (XM) =	5.2860	4.4525
1.0234	= Cable Resistance		
0.0364	= Cable reactance		
0.23700	= Overload Heater Resistance		
164	= Accident Environment Temperature (degree celsius)		
90	= Initial Temperature (degree celsius)		
40	= Initial Motor Temperature (degree celsius)		

DETERMINATION OF MOTOR CAPABILITY FOR : 1-FCV-68-333-A

36.2 DAR
0.6 run efficiency
0.45 pull out efficiency

415.2 individual motor start as found in WBN-EEB-MS-T106-0010 (Ref. 5.21)

418.9 new individual motor start based on reduced LRA
403.9 new individual motor start voltage corrected for > 90 degree celsius (*)

Open direction	Close direction *	
0.8781	0.8781	terminal voltage ratio
determination of voltage factor (VF)		
0.7711	0.7711	VF = 1, if voltage ratio >.9 otherwise = (voltage ratio)^2
determination of application factor (AF)		
1	1	AF=1, if terminal voltage ratio <.9 otherwise = .9 (Ref. 5.33)

OPENING MOTOR CAPABILITY CLOSING MOTOR CAPABILITY * 1-FCV-68-333-A

155 ft-lbs. 207 ft-lbs. (see section 7.5.2 for formulae)

0.0116 stem factor based on stem pitch, lead, diameter

13362 lbs. 17845 lbs.

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7.0 **CALCULATIONS** (Continued)

7.4 ELECTRICAL DATA Comments (Continued)

7.4.16 Degraded Voltage Condition (Continued)

Provided data

R3

V_{mcc} = 440 volts = Motor control center voltage (Ref. 5.21, pg 180)

R_m = 6.1288 ohms = Motor resistance (Ref. 5.21, pg 180)

X_m = 8.1717 Ohms = Motor reactance (Ref. 5.21, pg 180)

R_{0c} = 1.0234 ohms = Cable resistance outside containment wire (Ref. 5.21, pg 180)

X_{0c} = 0.0364 ohms = Cable reactance outside containment wire (Ref. 5.21, pg 180)

R_{Ic} = 0.2150 ohms = Cable resistance inside containment wire (Ref. 5.21, pg 180)

X_{Ic} = 0.0077 ohms = Cable reactance inside containment wire (Ref. 5.21, pg 180)

R_{oh} = 0.237 ohms = Overload heater resistance (Ref. 5.21, pg 180)

T_c = 164°C = Accident environment temperature inside containment (Ref. 5.17)

T_{1c} = 90°C = Initial cable temperature (Ref. 5.31, pg 2)

T_{1m} = 40°C = Initial motor temperature (Ref. 5.2, pg 180)

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7.0 **CALCULATIONS** (Continued)

7.4 ELECTRICAL DATA Comments (Continued)

7.4.16 Degraded Voltage Condition (Continued) R3

Formulae

$V_{min} = \frac{(V_{mcc}) * (Z_{mc})}{(Z_{total\text{-}corrected})}$ (Voltage Divider)

$a_1 = 1/(234.5 + T_1) =$ Temperature coefficient of resistance (Ref. 5.14, pg 15-5)

$Z_{mc} = [(R_{mc}^2) + (X_m^2)]^{1/2} =$ Temperature corrected motor impedance

$R_{mc} = R_m*(1 + (a_1)*(T_c - T_{1c})) =$ Temperature corrected motor resistance

$R_{cc} = R_c*(1 + (a_1)*(T_c - T_{1m})) =$ Temperature corrected cable resistance

$Z_{total\text{-}corrected} = [(R_{mc} + R_{Icc} + R_{Occ} + R_{ohc})^2 + (X_m + X_{Ic} + X_{Oc})^2]^{1/2}$

Calculations

$a_1 = 1/(234.5 + 90°C) = 0.003082/°C$

$R_{mc} = 6.1288$ ohms $(1 + (0.003082/°C)*(164°C - 40°C)) = 8.471$ ohms

$Z_{mc} = (8.471^2 \text{ ohms} + 8.1717^2 \text{ ohms})^{1/2} = 11.77$ ohms

$R_{Icc} = 0.2150$ ohms $(1 + (0.003082/°C)*(164°C - 90°C)) = 0.2640$ ohms

$R_{Oc} = 1.0234$ ohms

$R_{oh} = 0.237$ ohms

$(Z_{total\text{-}corrected}) = [(8.471 \text{ ohms} + 0.2640 \text{ ohms} + 1.0234 \text{ ohms} + 0.237 \text{ ohms})^2 + (8.1717 \text{ ohms} + 0.0364 \text{ ohms} + 0.0077 \text{ ohms})^2]^{1/2}$

$= 12.939$ ohms

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7.0 **CALCULATIONS** (Continued)

7.4 ~~ELECTRICAL DATA Comments~~ (Continued) R3

7.4.16 ~~Degraded Voltage Condition~~ (Continued)

$$V_{min} = \frac{(440 \text{ volts})\ (11.77 \text{ ohms})}{12.939 \text{ ohms}} = \mathbf{400.0 \text{ volts}}$$

~~The valve operator will deliver sufficient thrust and torque to the valve during degraded voltage conditions to perform its safety function (see Section 7.5).~~

7.4.17 Overload sizing - References 5.22~~, p. 180~~ and 5.24 ~~Attachment M12212A, p. 44~~ determined that an overload size of T29 is required and is installed. The correct heater is installed for this application. R4 11/14/94 6/29/95

7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations

7.5.1 Valve Requirements

Calculation of Piston Effect Load - F_p

$F_p = P * \pi/4 * d^2$ (Sect. 3.1, pg 2)

Where:

P = 2335 psig = Closing maximum line pressure (Sect. 7.1.9)

P = ~~2510~~ 2734 psig = Opening maximum line pressure (Sect. 7.1.9) R3

d = 1.25" = stem diameter at packing (Ref. 5.13)

$\pi/4 = 0.7854$

F_p Closing = 2335 * 0.7854 * 1.25^2 = 2865 lbf

F_p Opening = ~~2510~~ 2734 * 0.7854 * 1.25^2 = ~~3080~~ 3355 lbf

Calculation of Packing Friction Load - F_{pack}

F_{pack} = 1000 lbf * d (Sect. 3.1, pg 4)

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Where:

d = 1.25" = stem diameter at packing (Ref. 5.13)

F_{pack} = 1000 * 1.25 = 1250 lbf

7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.1 Valve Requirements (Continued)

Calculation Closing Differential Pressure Load - F_{dp}

$$F_{dp} = dp * \pi/4 * D^2 * FV * \frac{\mu}{[\cos\phi - (\mu * \sin\phi)]}$$

(Sect. 3.1, pg 3)

Where:

$\pi/4 = 0.7854$

dp = 2335 psid = Closing differential pressure (Sect. 7.1.9)

D = 2.87" = Seat diameter at midpoint. (Sect 7.2.6)

FV = 1.2 = Valve safety factor (Sect. 3.1, pg 3)

$\mu = 0.4$ = Valve friction factor (Sect. 3.1, pg 3)

$\phi = 7°$ = Wedge angle (Ref. 5.20)

$$F_{dp} = 2335 * 0.7854 * (2.87)^2 * 1.2 * \frac{.4}{[\cos 7 - (.4 \sin 7)]}$$

F_{dp} = 7,683 lbf

7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.1 Valve Requirements (Continued)

Calculation of Opening Differential Pressure Load - F_{dp} (Sect. 3.1, pg 3)

$$F_{dp} = dp * \pi/4 * D^2 * FV * \frac{\mu}{[\cos \phi + (\mu * \sin \phi)]}$$

Where:

$\pi/4 = 0.7854$

dp = ~~2510~~ 2734 psid = Opening differential pressure (Sect. 7.1.9)

D = 2.87" = Contact seat diameter (Sect. 7.2.6)

FV = 1.2 = Valve safety factor (Sect. 3.1, pg 3)

μ = 0.4 = Valve friction factor (Sect. 3.1, pg 3)

ϕ = 7° = Wedge angle (Ref. 5.20)

$$F_{dp} = \cancel{2510}\ 2734 * 0.7854 * 2.87^2 * 1.2 * \frac{.4}{[\cos 7 + (.4 \sin 7)]}$$

F_{dp} = ~~7,485~~ 8153 lbf

Calculation of Required Closing Thrust - F_r

$F_r = F_p + F_{pack} + F_{dp}$ (Sect. 3.1, pg 2)

Where:

F_{dp} = 7,683 lbf = Differential Pressure Load

F_p = 2,865 lbf = Piston Effect Load

F_{pack} = 1,250 lbf= Packing Friction Load

F_r = 7,683 + 2,865 + 1,250 = 11,798 lbf

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7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.1 Valve Requirements (Continued)

Calculation of Wedging Load - F_w (Sect. 3.1, pg 5)

$$F_w = F_k * f_w * F_v * \frac{(1 - (\mu * \tan \phi))}{[\sin \phi + (\mu * \cos \phi)]} * \frac{\mu}{[\cos \phi + (\mu * \sin \phi)]}$$

Where:

f_w = 0.6 = Wedge factor (Sect. 3.1, pg 5 & Ref. 5.13)

F_v = 1.2 = Valve safety factor (Sect. 3.1, pg 3)

μ = 0.4 = Valve friction factor (Sect. 3.1, pg 3)

ϕ = 7° = Wedge angle (Ref. 5.20)

F_{pack} = 1250 lbf = Packing friction load

F_p = 0 lbf = Piston effect load (In order to account for a "hard-seated" valve closed with no line pressure a zero value is used.)

F_{dp} = 0 lbf = Differential pressure force (In order to account for a "hard-seated" valve closed with no differential pressure a zero value is used.)

F_{rmax} = 1.15 * F_r = 13,568 lbf = Maximum closing stem thrust
= 11,798 lbf * 1.15 (Sect. 3.1, pg 5)

F_k = Effective unseating force = $F_{rmax} - F_{pack} - F_p - F_{dp}$ (only closing values) [Sect 3.1, pg 5] = 13,568 - 1250 - 0 - 0 = 12,318 lbf

$$F_w = 12{,}318 * 0.6 * 1.2 * \frac{(1 - (0.4 * \tan 7))}{[\sin 7 + (0.4 * \cos 7)]} * \frac{0.4}{[\cos 7 + (0.4 * \sin 7)]} = \underline{6{,}243} \text{ lbf}$$

7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.1 Valve Requirements (Continued)

Calculation of Required Opening Thrust - F_r

$F_r = F_{dp} + F_{pack} + F_w - F_p$ (Sect. 3.1, pg 1)

R3

Where:

F_{dp} = ~~7,485~~ 8153 lbf = Differential Pressure Load (see page 30)

F_{pack} = 1,250 lbf = Packing Friction Load (see page 28)

F_w = 6,243 lbf = Wedging load (see page 31)

F_p = ~~3,080~~ 3355 lbf = Piston Effect Load (see page 28)

F_r = ~~7,485~~ 8153 + 1,250 + 6,243 - ~~3,080~~ 3355 = ~~11,898~~ 12291 lbf

Calculation of Required Operator Torque - A_{tor}

$A_{tor} = F_r * SF$ (Sect. 3.1, pg 5)

Where:

F_r = 11,798 lbf = Closing Required Thrust

F_r = ~~11,898~~ 12291 lbf = Opening Required Thrust

SF = 0.0116 = Stem Factor (Ref. 5.18.3). Where: Coef. of friction = 0.15 (Sect. 3.1, pg 5); Stem Pitch = 1/3 and Stem Lead = 1/3 (Ref. 5.13)

A_{tor} (Closing) = 11,798 * 0.0116 = 137 ft-lbs

A_{tor} (Opening) = ~~11,898~~ 12291 * 0.0116 = ~~138~~ 143 ft-lbs

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7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.2 Operator Capabilities

Closing Operator Torque Capability - A_{tor} & A_{thr}

Closing A_{tor} = MT * OAR * AF * RE * VF (Sect. 3.1, pg 6)

Closing A_{thr} = A_{tor} / SF (Sect. 3.1, pg 6)

Where;

R3

MT = 15 ft-lbs = Motor Starting Torque (Ref. 5.23, pg F129D)

OAR = 36.2 = Overall Gear Ratio (Ref. 5.25, p. 2)

AF = 0.9 = Application Factor (Ref. 5.18.1)

RE = 0.60 = Running Efficiency (Ref. 5.18.2)

VF = 0.7561 = Voltage Factor (87.0% {400.0/460} available voltage squared, see Comment 7.4.16)

SF = 0.0116 = Stem Factor (Sect. 7.5.1)

Closing A_{tor} = 15 * 36.2 * 0.9 * 0.60 * 0.7561 = 222 ft-lbs

Closing A_{thr} = 222 / 0.0116 = 19,138 lbf

(see pg 24A)

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7.0 **CALCULATIONS** (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.2 Operator Capabilities (Continued)

Opening Operator Torque Capability - A_{tor} & A_{thr}

Opening A_{tor} = MT * OAR * AF * PE * VF (Sect. 3.1, pg 6)

Opening A_{thr} = A_{tor} / SF (Sect. 3.1, pg 6)

Where;

MT = 15 ft-lbs = Motor Starting Torque (Ref. 5.23, page F129D)

OAR = 36.2 = Overall Gear Ratio (Ref. 5.25, p. 2)

AF = 0.9 = Application Factor (Ref. 5.18.1)

PE = 0.45 = Pullout Efficiency (Ref. 5.18.2)

VF = 0.7561 = Voltage Factor (87.0% (400.0/460) available voltage squared, see Comment 7.4.16)

SF = 0.0116 = Stem Factor (Sect. 7.5.1)

Opening A_{tor} = 15 * 36.2 * 0.9 * 0.45 * 0.7561 = 166 ft-lbs

Opening A_{thr} = 166 / 0.0116 = 14,310 lbf

(see pg 24A)

R3

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SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68,WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92
CHECKER : T. Snead TS DATE: 11/12/92

7.0 CALCULATIONS (Continued)

7.5 Thrust/Torque Calculations (Continued)

7.5.3 Weak Link Calculations

Valve Weak-Link

The valve manufacturer (Westinghouse) analyzed the weak link component in both the open and close directions, and calculated their maximum allowable thrusts (Ref 5.15). Although no detailed sub-component evaluation was provided, the conclusion is that the most limiting components are:

	WEAK LINK COMPONENT	MAXIMUM ALLOWABLE LOAD
OPEN DIRECTION	Disc	23995 lbf
CLOSE DIRECTION	Disc	36733 lbf

Operator Weak-Link (see Ref 5.18.4, p. 3)

Maximum Allowable Operator Output Torque (ft-lbs) - - - - - 250

Maximum Allowable Operator Output Thrust (lbf) - - - - - - ~~14000~~ 19,600
(Ref 5.34)

R2
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7.6 WALKDOWN DATA

Walkdown data has been previously performed and is documented in TVA EQ Binder WBNEQ-MOV-001 (Ref. 5.23), "Environmental Qualification Documentation Package."

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA DATE: 11/11/92

CHECKER : T. Snead DATE: 11/12/92

8.0 SUMMARY OF CALCULATION RESULTS

MOV Tag Number 1-FCV-68-333

Required Thrust/torque (Section 7.5.1 and DS-M18.2.21 Section 2.1)

Open: ~~11,098~~ 12,291 lbf/~~138~~ 143 ft-lbs Close: 11,798 lbf/137 ft-lbs

Seismic ~~document which addresses~~ maximum thrust/torque: open & shut = 20,000 lbf/250 ft-lbs (Ref. 5.31)

~~WAT-D-8939 Seismic Qualification of Westinghouse Gate Valves for Watts Bar (RIMS # T33 920730 983)~~

Motor Actuator Capability (Section 7.5.2 and DS-M18.2.21 Section 2.2)

Open Thrust/torque ~~14,310~~ ~~14,224~~ 13362 lbf/~~166~~ ~~165~~ 155 ft-lbs

Close Thrust/torque ~~19,138~~ lbf/~~222~~ ft-lbs

17,845 ~~18,966~~ ~~220~~ 207

Valve Allowable (Section 7.5.3 and DS-M18.2.21 Section 2.3)

Limiting Component Open Disc
Thrust/Torque 23,995 lbf/278 ft-lbs

Limiting Component Close Disc
Thrust/Torque 36,733 lbf/426 ft-lbs

Actuator Allowable (Sect. 7.5.3)

Thrust/torque ~~14,000~~ 19,600 lbf/250 ft-lbs

Spring Pack Torque Band Capability -
Close Direction Only (Section 7.3.5)

Min. ~~170~~ 115
Max. ~~240~~ 185

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R1 4/6/93 5/25/93

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68, WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich DATE: 11/11/92
CHECKER : T. Snead DATE: 11/12/92

8.0 SUMMARY OF CALCULATION RESULTS (CONTINUED)

Thrust/torque Band Open Min. ~~11,098~~ 12,291 lbf/~~138~~ 143 ft-lbs*
Max. ~~14,000~~ lbf/~~166~~ ft-lbs
~~14,234~~ ~~14,310~~ 13362 ~~165~~ 155

Thrust/torque Band Close Min. 11,798 lbf/137 ft-lbs*
Max. ~~14,000~~ lbf/~~222~~ ft-lbs
17,845 ~~19,966~~ ~~19,138~~

IS MOV ACCEPTABLE FOR THE APPLICATION? Y (Y/N)

If "no", enter reference to design change document: NR

Comments:

The torque values were obtained by multiplying the thrust and stem factor i.e. 23,995 * 0.0116 = 278 ft-lbs.

The minimum torques and thrusts in the open and close bands are based upon the calculated valve minimums.

The maximum thrusts in the open and close bands are based upon ~~actuator weak link thrust.~~ the calculated actuator capabilities.

The maximum torques in the open and close bands are based upon the calculated operator capabilities.

The torque switch band envelopes the minimum required operating torque in the close direction, and is, therefore, satisfactory with the installed spring pack.

The minimum required torques are for information only and actual operating torques may be less, depending upon lubrication and other factors.

9.0 CONCLUSIONS

A design basis review has been performed and the required thrust/torque has been determined per the methodology specified in Mechanical Design Standards DS-M18.2.21 & DS-M18.2.22. This methodology determined that the motor operated valve 1-FCV-68-333 is acceptable from a design standpoint for its application as the Reactor Coolant System Pressure Relief Flow control Valve (Train A).

EBASCO SERVICES INCORPORATED

SHEET 1 OF 1
REVISION 0

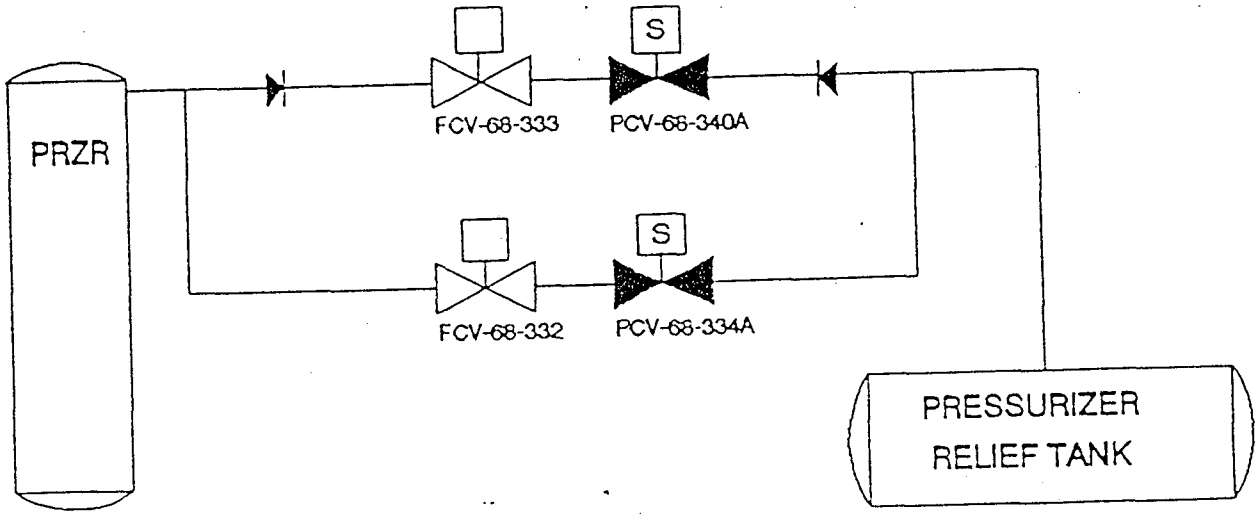
SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-68-333

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-68-WBN-68-D053, EPM-PJA-080592

PREPARER: P. J. Antonvich PJA Date: 11/11/92

CHECKER: T. Snead Date:

Attachment 1



MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

non-shaded is calc input - other is tracking data				30-Jun-95		Page 1
				Valve UNID:	Closing control circuit:	
1.0 INPUT: General Information				1-FCV-68-333-A	Limit	
Valve Information			Closing T.S. wired in parallel to closing L.S. TSS = 1.0			
Manufacturer	WESTINGHOUSE			Stem Diameter	1.2500	inches
Size	3.00	inches		Mean Seat Diameter	2.87	inches
Pressure Class	1500	psi		Seat Angle (theta)	7.0	degrees
Disc Style	FWG			cos(theta)	0.9925	
Stem Orientation	VERT			sin(theta)	0.1219	
Valve Stem Lead	0.3333	lead		Valve Stem Pitch	0.3333	pitch, ins
Actuator Information				Reforences (DP Test Data) (Rims Numbers)		
Manufacturer	Limitorque			T76 940614 847		
Type	SB	Size:	00	T76 940623 851		
MOV Design Basis Review Calculation						
Calculation Number	EPM-PJA-080592			REVISION 4		
Seat/Wdg Friction Factor (VF)	0.4000			Stem/Stem Nut Friction Factor (mu) (SF)	0.0116	
Closing Direction				Opening Direction		
Motor Capability	17845	lbs		Motor Capability	13362	lbs
Motor Capability	207.00	ft-lbs		Motor Capability	155.00	ft-lbs
Actuator Limit	19600	lbs		Actuator Capability	19600	lbs
Actuator Limit	250.00	ft-lbs		Actuator Capability	250.00	ft-lbs
Valve Weak Link	36733	lbs		Valve Capability	23995	lbs
Valve Weak Link	426.00	ft-lbs		Valve Capability	278.00	ft-lbs
Seismic Limit	20000	lbs		Seismic Limit	20000	lbs
Seismic Limit	250.00	ft-lbs		Seismic Limit	250.00	ft-lbs
Differential Pressure (DP)	2335	psid		Differential Pressure (DP)	2734	psid
Required Thurst	11798	lbs		Required Thrust	12291	lbs
Required Torque	137.00	ft-lbs		Required Torque	143.00	ft-lbs
Piston Effect	2865	lbs		Piston Effect	3335	lbs
Packing Load	1250	lbs		Packing Load	1250	lbs
DP Load	7683	lbs		Unseating Load	6243	lbs
				DP Load	8153	lbs
Static Test Information						
Static Test. Line Pressure	0	psig	(ASSUMED)	Stem Factor @ CST	0.0080	
Closing Direction				Opening Direction		
Ave Running Load. [D]	1506	lbs		Ave Running Load. [L]	1331	lbs
Thrust @ CST [G]	15514	lbs		Unseating Load. [J]	6268	lbs
Torque @ CST [G]	123.64	ft-lbs		Unseating Load. [J]	46.54	ft-lbs
Closing Direction				Closing Direction		
Total Peak. [H]	16669	lbs		Total Peak. [H]	131.4	ft-lbs
Total Final. [I]	16494	lbs		Total Final. [I]	126.38	ft-lbs
DP Test Information				Flow. Full Open	N/A	gpm
Maximum DP test condition	2211	psid		Line Pres. Full Open	2244	psig
Closing Direction				Opening Direction		
Req'd Closing Thrust [F]	13833	lbs		Measured DP Thrust. Opening [K]	4763	lbs
Req'd Closing Torque [F]	118.62	ft-lbs		Measured Unseating Thrust. Opening [J]	9140	lbs
Thrust @ CST Closing [G]	14183	lbs		Measured DP Torque. Opening [K]	49.73	ft-lbs
Torque @ CST Closing [G]	121.36	ft-lbs		Measured Unseating Torque. Opening [J]	62.51	ft-lbs
Closing Direction				Closing Direction		
Total Peak. [H]	15409	lbs		Total Peak. [H]	135.05	ft-lbs
Total Final. [I]	15234	lbs		Total Final. [I]	128.21	ft-lbs
Diagnostic Equipment Error Determination						
TTC	N			MOVATS Dia Sys / Equip Error	3000	
QSS	Y			If SMART STEM. Capacity =	N/A	lbs.
SMART STEM	N			If SMART STEM. Capacity =	N/A	ft-lbs.
If T. S. Repeatability applies. As Left TSS =	N/A			If SMART STEM. Cap Ref DWG =	N/A	

PREPARED BY: D.C. Bueche 7/12/95

CHECK BY: TVLEASE 7/12/95

THIS PAGE ADDED BY REVISION 4

ATTACHMENT 2

MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

30-Aug-95 | Page 2

Valve UNID: 1-FCV-68-333-A

2.0 Closing Stroke Reconciliation

DBR Parameters	DBR Calculation		Reconciled Parameters	Reconciled Test Data	
Minimum Required Thrust :	11798	lbs	Reconciled Thrust :	14529	lbs
Minimum Required Torque :	137.00	ft-lbs	Reconciled Torque :	124.59	ft-lbs
Piston Effect :	2865	lbs	Piston Effect (from DBR Calculation) :	2865	lbs
Packing Load :	1250	lbs	Average Packing Load (Section 8.0, step 3A) :	1419	lbs
DP Load :	7683	lbs	DP Load :	10246	lbs
Seat Wedge Friction Factor (VF) :	0.4000		Seat Contact, Seat Wedge Friction Factor (VF) :	0.6218	
	Calculated Parameter:				
	Comparison of Stem Factors		Load Sensitive Behavior (ROL) :	N/A	
Stem Factor (SF) DBR Calculation :	0.0116				
			SF @ Static CST [G] :	0.0080	
			SF @ DP CST [G] :	0.0086	
			SF @ Required Closing Th, DP Test [F] :	0.0086	

MARGIN EVALUATIONS OF DP TEST DATA AND DBR CALCULATION DATA

CST Thrust Margin :	-346	lbs	CST Torque Margin :	-3	ft-lbs
CST Thrust Margin :	-2.4	%	CST Torque Margin :	-2.6	%
Methodology Margin :	-4184	lbs	Thrust Capability Margin :	1863	lbs
Methodology Margin :	-26.2	%	Thrust Capability Margin :	11.7	%
			Torque Capability Margin :	70	ft-lbs
			Torque Capability Margin :	51.0	%

3.0 Opening Stroke Reconciliation

* BASED ON POINT : DP [J]

DBR Parameters	DBR Calculation		Reconciled Parameters	Reconciled Test Data	
Minimum Required Thrust :	12291	lbs	Reconciled Thrust :	10966	lbs
Minimum Required Torque :	143.00	ft-lbs	Reconciled Torque :	75.00	ft-lbs
Piston Effect Load :	3335	lbs	Piston Effect (from DBR Calculation) :	3335	lbs
Packing Load :	1250	lbs	Average Packing Load (Section 8.0, step 3A) :	1419	lbs
Unseating Load :	6243	lbs	Unseating (based on DP [J]) :	9140	lbs
DP Load :	8153	lbs	DP Load (based on DP [K]-Ave Pk Load + PE) :	7471	lbs
Seat Wedge Friction Factor (VF) :	0.4000		Seat Wedge Friction Factor (VF) :	0.4420	
	Comparison of Stem Factors				
Stem Factor (SF) :	0.0116		SF @ Max Req'd Opening Th :	0.0068	

MARGIN EVALUATIONS OF DP TEST DATA AND DBR CALCULATION DATA

Methodology Margin :	228	lbs	Thrust Capabiltiy Margin :	1299	lbs
Methodology Margin :	1.9	%	Thrust Capabiltiy Margin :	10.8	%
			Torque Capability Margin :	72	ft-lbs
			Torque Capability Margin :	87.9	%

4.0 FLAG INDICATION OF UNSATISFACTORY MARGINS ("PROBLEM" or "OK")

Closing Stroke			
Methodology Margin :	PROBLEM	CST Thrust Margin :	PROBLEM
Thrust Capability Margin :	OK	CST Torque Margin :	PROBLEM
Opening Stroke		Torque Capability Margin :	OK
Methodology Margin :	PROBLEM		
Thrust Capability Margin :	OK		
		Torque Capability Margin :	OK

PREPARED BY: [illegible] 8/31/95
CHECK BY: TVQ 8/31/95

THIS PAGE ADDED BY REVISION 4

OPENING RECONCILED THRUST METHODS:

1. For DP test pressure < DBR pressure; Reconciled Thrust = MAX of
   {STATIC [J] – Ave Static Run Load } * (Design DP/Actual DP) + Ave Static Run Load
   { DP [J] – Ave Static Run Load } * (Design DP/Actual DP) + Ave Static Run Load
   { DP [K] – Ave Static Run Load } * (Design DP/Actual DP) + Ave Static Run Load

* – indicates METHOD used to determine the opening reconciled thrust.

MOV RECONCILIATION WATTS BAR NUCLEAR PLANT UNIT 1		
	~~05-Sep-95~~ mf 8/31/95	Page 3
	Valve UNID:	
	1-FCV-68-333-A	

5.0 Remarks:

A. Differential Pressure (DP) testing was performed at 95% of the closing DP and at 82% of the opening DP used in the WBN Design Basis Review (DBR) Calculation.

B. The closing Load Sensitive Behavior (ROL) term of "N/A" indicates that the valve is "limit" switch controlled and ROL does not apply.

C. The stem factors are shown to be conservative when test results are compared to the calculated values.

D. The packing loads are higher due to high static running load and are based on average static running loads.

E. The unseating force during the DP test is higher than the DBR unseating load, but adequate margin exists to the open motor capability.

F. The calculated seat wedge friction factor (VF) for opening is higher than that used in the DBR calculation, but adequate margin exist between reconciled torque and the opening motor capability, and this VF reflects the actual DP tested conditions experienced at this high pressure.

G. The calculated seat wedge friction factor (VF) for closing is higher than that used in the DBR calculation, but adequate margins exist between reconciled thrust/torque and the closing motor capability.

H. The PROBLEM flags in the closing direction between the reconciled thrust to the CST trip thrust and the reconciled torque to the CST trip torque indicate there is no margin, but this valve is position seated with the position of the valve stem monitored to ensure the valve is hard seated each time the valve is stroked closed when the "limit" switch trips the valve. Adequate margins exist above the CST to the motor capability and to the maximum limits.

I. The PROBLEM flag in the closing direction for Methodology Margin indicates that the reconciled thrust is greater than the calculated minimum required thrust in the DBR calculation. This is influenced by the high DP effect force experienced during the DP test, which results in a high closing VF and reconciled DP Load component. The reconciled DP Load component is much larger than the value calculated in the DBR. However, adequate margin exists between the reconciled thrust and the closing motor capability.

J. To take into account the "Aging Issue", adequate margins exists to allow for degradation of packing coefficients, partial loss of lubrication, wear of valve/actuator's internal parts, and an increase in valve's surface friction coefficients.

6.0 Conclusions:

A. The valve's final setup is acceptable. DBR Calculation friction factor (with exception to the closing VF) and methodology are proven to be conservative with adequate margins.

B. By successful stroking of the valve (including indication of flow isolation) during the DP test, and by adequate margins in the reconciled test data, the valve's operability has been demonstrated.

7.0 Recommended follow up actions:

None.

PREPARED BY: mf 8/31/95

CHECKED BY: TW 8/31/95

THIS PAGE ADDED BY REVISION 4

ATTACHMENT 2

MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

30-Jun-95 | Page 4

Valve UNID: 1-FCV-68-333-A

8.0 Determination of Packing Load

1	Packing Load, Static Test Open & Close, lbs (Line Press = 0)		
	1506	= ARLSC = Ave Running Load Static Close, lbs. "D"	
	1331	= ARLSO = Ave Running Load Static Open, lbs. "L"	
2A	Piston Load Static Test (PNLST), lbs (Line Pressure, STLP is known and not = 0) (Used in Packing Load)		
	PNLST = 0	= Piston Load Static Test = STLP x PI x SD x SD / 4	
2B	Packing Load Static Test, lbs (Line Pressure, STLP, known & not = 0)		
	1506	= Pack Load Static Test Close = ARLSC - PNLST	
	1331	= Pack Load Static Test Open = ARLSO - PNLST	
3A	Estimated Packing Load Static Test, lbs (Line Pressure, STLP is not known)		
	1419	= (ARLSC + ARLSO) / 2 = ("D" + "L") / 2	
3B	Estimated Piston Effect Load Static Test, lbs (Line Pressure is not known)		
	PNLST = 88	= (ARLSC - ARLSO) / 2 = ("D" - "L") / 2	
3C	Estimated Static Line Pressure from Piston Effect Load, lbs (STLP')		
	STLP' = 71	= (4 x PNLST') / (PI x E2 x E2)	

9.0 Miscellaneous Intermediate Calculations

Unseating load during opening direction DP test

4377 lbs = [J] - [K] = Measured Unseating Th - Measured DP TH

If Unseating Load < 0, then assign a value of "0" to Reconciled Unseating Load on Page 2

9.0 A OPENING RECONCILED EVALUATION

STATIC [J]	7415	lbs.
DP [J]	10966	lbs.
DP [K]	5554	lbs.

	Point J DP:	Point K DP:	Point J STATIC:	
Max Req'd Opening Thrust to overcome DP, POINTS [J & K]:	9140	4763	6268	lbs
Max Req'd Opening Torque to overcome DP, POINTS [J & K]:	62.51	49.73	46.54	ft-lbs
Maximum Stem Factor (SF), POINTS [J] or [K]:	0.0068	0.0104	0.0074	= SF
Max Req'd Opening Thrust to overcome DP, GREATER OF POINTS [J & K]:	9140	lbs		
Piston Effect based on DP Test Line Pressure (Full Open):	2754	lbs		

10.0 Equipment Error determination

QSS - Thrust Sensor / Equip Error	YES	9.8	% Reading
TTC - Thrust Sensor / Equip Error		0.0	% Reading
TTC - Torque Sensor / Equip Error		0.0	% Reading
TTC - Thrust Sensor / Equip Error		0	lbs. ---->
TTC - Torque Sensor / Equip Error		0.0	ft-lbs. -->
SS - Thrust Sensor / Equip Error		0.0	% Capacity
SS - Thrust Sensor / Equip Error		0	lbs.
SS - Thrust Sensor / Equip Error		0.0	ft-lbs.
MOVATS Dia Sys / Equip Error	3000	2.0	% Reading
T. S. Repeatability Applied	NO	0	% Reading (Table below)

TTC 0.5% of full scale evaluation

SMB SIZE =	0	
000	67	lbs.
00	117	lbs.
0	200	lbs.
1	375	lbs.
2	500	lbs.
3	1000	lbs.
000	1.0	ft-lbs
00	2.2	ft-lbs
0	5.9	ft-lbs
1	9.2	ft-lbs
2	12.5	ft-lbs
3	30.0	ft-lbs

Summation of Equipment Error (EE)

Equipment Error = 10.0 Percent

T. S. Repeatability evaluation

As Left TSS =	DP TST TOR =
N/A	N/A

CASE EVALUATION, As Left

> 1.00	CASE 1	>50 '#	%
> 1.00	CASE 2	<50 '#	5
1.00	CASE 3	>50 '#	10
1.00	CASE 4	<50 '#	10
			20

REFERENCES:

T07930114889, MOVATS ER 5.0

T07930114890, TELEDYNE TR-A716-A-1

WBN-VTM-L200-0010, section 0350

PREPARED BY: D.C. Bouche 7/12/95

CHECK BY: T.V. LEASE 7/12/95

THIS PAGE ADDED BY REVISION 4

WBN 1	DYNAMIC TEST OF MOTOR OPERATED VALVES PROVIDING PORV AND RCP SEAL RETURN ISOLATION	TI-85.012 Revision 0 Page 39a of 66

Data Package: Page _____ of _____ Date 5/15/94

6.1 Test of 1-FCV-68-332, 1-FCV-68-333 (Continued)

[74] CALCULATE maximum differential pressure (DP) across 1-FCV-68-333 using information from traces on multichannel recorder as follows:

Col 1		Col 2	Col 3	Col 4	Col 5	Col 6	Col 7
1-FCV-68-333 STROKE		UPSTRM PRESS (PT1, psig)	DOWNSTRM PRESS (PT2, psig)	DP (psid) (Col 2 - Col 3)	90% DESIGN DP (psid)	75% DESIGN DP (psid)	INITIALS / VERIF BY
A	OPENING	2244	0	2244	2260	1880	JRB / RFM
B	CLOSING	2211	0	2211	2100	1750	JRB / RFM

[75] IF Col 4A or 4B < 75% DESIGN DP, THEN

INDICATE in Chronological Test Log that data for this valve may be outside of range for extrapolation to 100% DP condition. N/A

[76] RESTORE automatic initiation of Safety Injection, as required:

A. 1-HS-74-10A in A-AUTO. ☑

B. 1-HS-74-20A in A-AUTO. ☐

C. 1-HS-63-10A in A-AUTO. ☐ DN-5

D. 1-HS-63-15A in A-AUTO. ☐

E. 1-FCV-63-25 CLOSED with power restored. ☑

F. 1-FCV-63-26 CLOSED with power restored. ☑

JRB
Operations

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TEST DATA SHEET

Valve ID 1 MVOP 68 535 A WID No 91-01135-02

SECTION I: SYSTEM INFORMATION

NOTE 1 For Static Test, use sections 2, 3, 4, & 5.

NOTE 2 For Differential Pressure Test, use sections 2, 3, 6, 7, & 8.

NOTE 3 Circle Test Performed below:

(A) Static . . . . . GO TO Section II if Static is circled.

B. Differential Pressure Test . . COMPLETE Section I DP data below.

N R lfc 1/30/94

Flow Rate:_____GPM or LB/HR
Pressure Upstream Open: _____PSIG Pressure Downstream Open: _____PSIG
Pressure Upstream Closed:_____PSIG Pressure Downstream Closed:_____PSIG
Average Fluid Temperature:_____ Deg F
Flow Instrument Accuracies: _____ % FI Number_____ PI Number_____
Elevation:_____Ft above sea level.

SECTION II: PERFORMANCE SECTIONS

Motor Current Signature Acquisition. ☑
Switch Monitor Signature Acquisition. ☑
Spring Pack Monitor Signature Acquisition. ☑
Spring Pack Calibration. ☐
Torque-Thrust Setpoints Adjustments. ☑
Torque Thrust Cell Signature Acquisition. ☐
Quick Stem Sensor Signature Acquisition. ☑
other: ☐
☐

RECORD the vendor Calculations used in section 6.1.

MOVATS ER 5.0 REV 6
TELEDYNE TR A7116-A-1
DEN S21396-B, 28848-A, 22416-A

K Crawford 1/30/94
ENGINEER Date

Test Rept Acceptance Rev 3

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TEST DATA SHEET

910113502

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SECTION III: TARGET THRUST

Target Thrust Determination	Opening stroke	Closing stroke	
Required Minimum Thrust at Torque Switch Trip:	11898	11798	LBS
Test Equipment Accuracy # 1:	10	10	%
Adjusted Minimum Thrust at Torque Switch Trip:	13088	12978	LBS
Guaranteed Maximum Thrust at T.S.Trip:	14310.	19138	LBS
Test Equipment Accuracy # 2:	10	10	%
Adjusted Guaranteed Max. Thrust at T.S.Trip:	12879	17224	LBS
Maximum Total Thrust:	19600	19600	LBS
Test Equipment Accuracy # 3:	10	10	%
Maximum Adjusted Total Thrust:	17640	17640	LBS

Target Thrust Window			
Minimum Target Thrust at Torque Switch Trip:	13088	12978	LBS
Maximum Target Thrust at Torque Switch Trip:	12879	17224	LBS
Maximum Allowable Total Thrust:	17640	17640	LBS

Rapid Impact Overload Criteria: N/R dg 1/30/94

UNseating .5603

SECTION IV: STATIC TEST

Static Test As-Left Thrust Verification	Opening stroke	Closing Stroke	
Average Running Load:	N/R	1500	LBS
Thrust at Torque Switch Trip:		15515	LBS
Total Delivered Thrust:		16669	LBS

Static Test As-Left Torque Verification			
Torque at Torque Switch Trip:	N/R	123	FT-LBS
Total Output Torque:		131	FT-LBS

Static Test As-Left Spring Pack Displacement			
Available Displacement:			in.
Displacement at Torque Switch Trip:	N/R	N/R	in.
Total Displacement:			in.

DMT on Disk 1/30/94

Stem Factor:	N/A	.008	
Torque Switch Setting AS LEFT	1	1	
Rapid Impact Overloading Test	SAT N/R	UNSAT N/R	

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ENGINEER 1/30/94 Date

0501j

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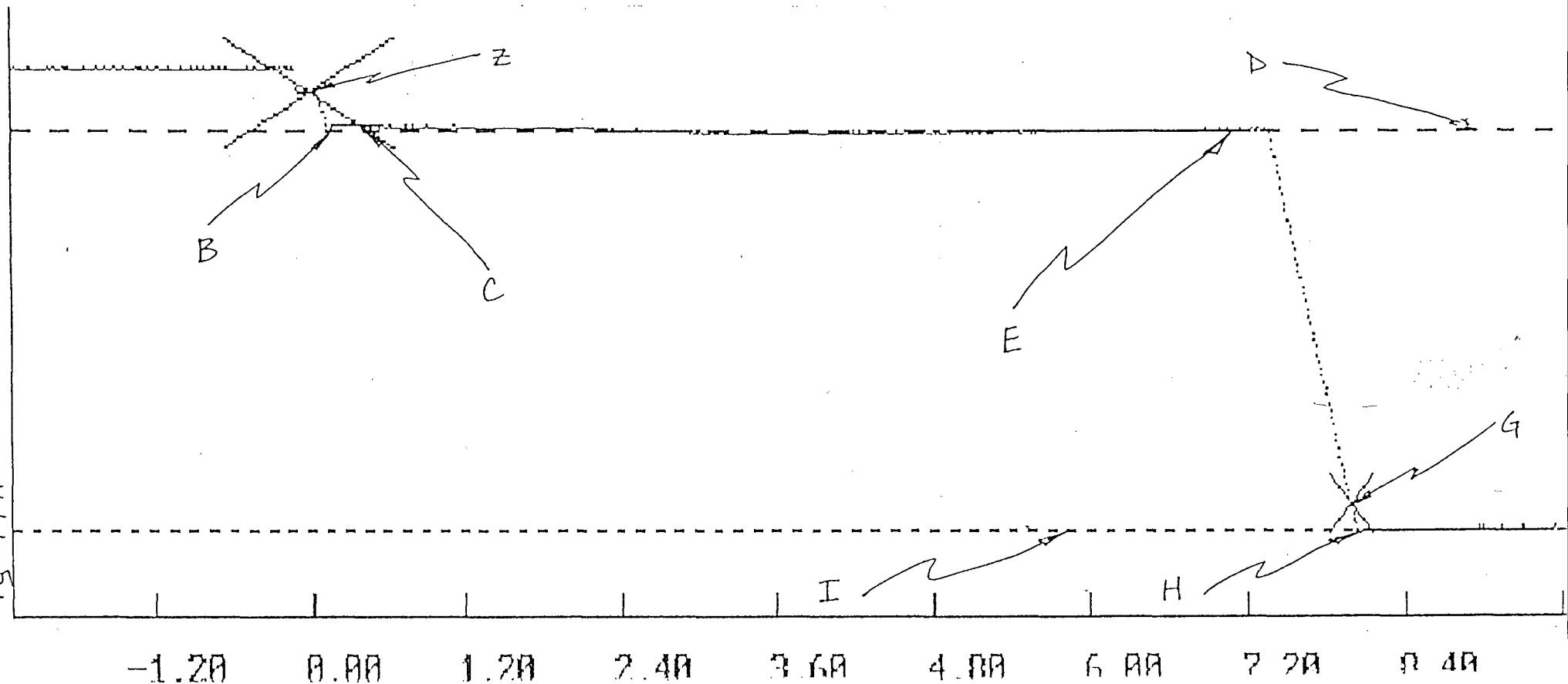
CLOSED STATIC THRUST lb OPEN

B	STAT FRIC BK PT	1611	J	UNSEATING	
C	BEGINING RL	1296	K	DP EFFECT	N/A
D	AVERAGE RL	1506	L	POST DP / AVE RL	
E	ENDING RL	1471	M	ENDING RL	
F	DP EFFECT	N/A			
G	CST	15514			
H	TOTAL PEAK	16669			
I	TOTAL FINAL	16494	Z	ZERO LOAD	0

<< 1-FCV-68-333>
Switch: V235\T5
THC : V235\T3
HX: 1 + VX: 1
Direction: ↓

0.000 V
0 Lb
0.000 Sec.



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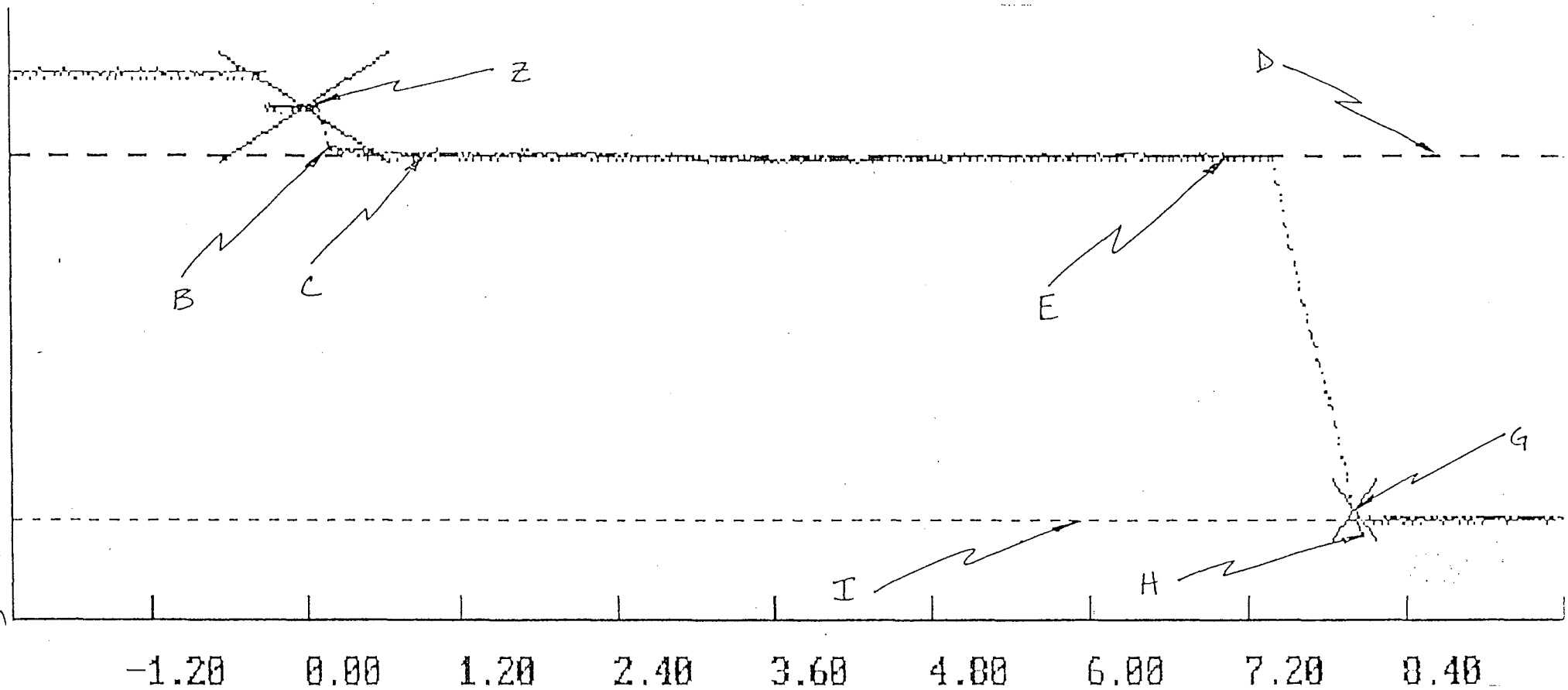
CLOSED STATIC TORQUE Ft lb OPEN

B	STAT FRIC BK PT	12.78	J	UNSEATING	
C	BEGINING RL	14.60	K	DP EFFECT	N
D	AVERAGE RL	14.60	L	POST DP / AVE RL	A
E	ENDING RL	14.71	M	ENDING RL	
F	DP EFFECT	N/A			
G	CST	123.64			
H	TOTAL PEAK	131.40			
I	TOTAL FINAL	126.38	Z	ZERO LOAD	O

<< 1-FCV-68-333
Switch: V235\T5
TQC : V235\T4
HX: 1 ✦ VX: 1
Direction: ↓

0.000 V
0 Ft-lb
0.000 Sec.



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T7% 940614 947

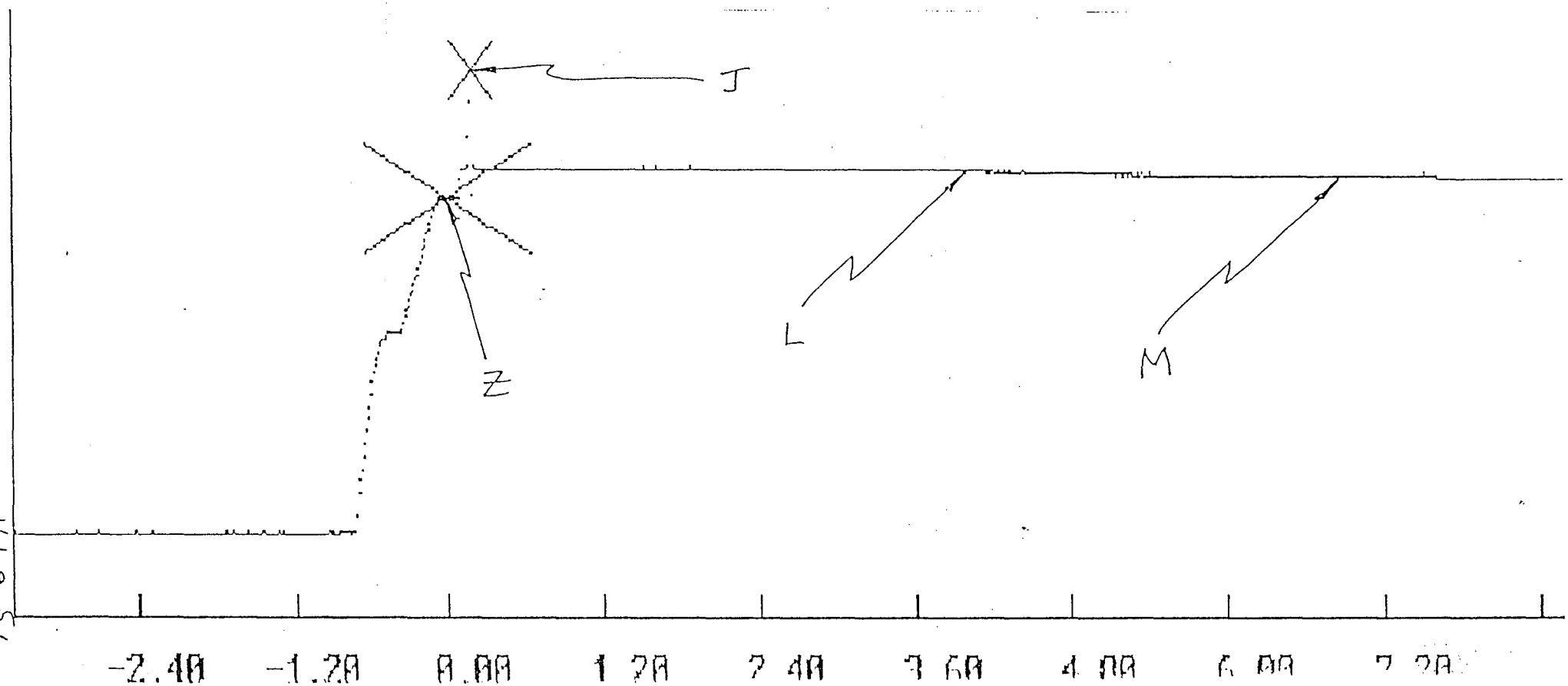
Title Page Added By Rev. 3

CLOSED OPEN STATIC THRUST lb

B	STAT FRIC BK PT		J	UNSEATING	6268
C	BEGINING RL		K	DP EFFECT	N/A
D	AVERAGE RL		L	POST DP / AVE RL	1331
E	ENDING RL	N	M	ENDING RL	1121
F	DP EFFECT	A			
G	CST				
H	TOTAL PEAK				
I	TOTAL FINAL		Z	ZERO LOAD	0

<<1-FCV-68-333>>
Switch: V235\T1
THC : V235\T8
HX: 1 ✦ VX: 1
Direction: ↑

0.000 V
0 Lb
-0.000 Sec.



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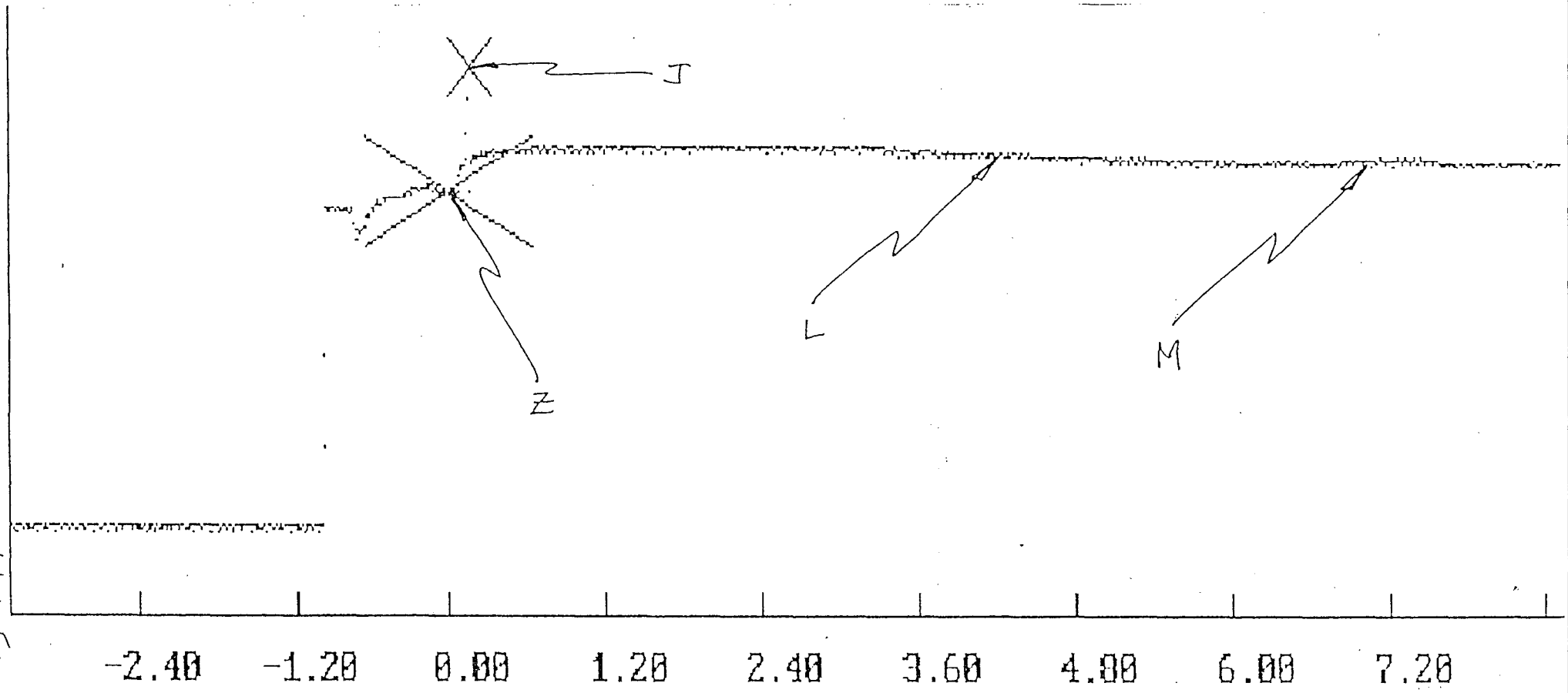
CLOSED OPEN STATIC TORQUE Ftlb

B	STAT FRIC BK PT		J	UNSEATING	46.54
C	BEGINING RL		K	DP EFFECT	N/A
D	AVERAGE RL		L	POST DP / AVE RL	13.23
E	ENDING RL	N	M	ENDING RL	12.32
F	DP EFFECT	A			
G	CST				
H	TOTAL PEAK				
I	TOTAL FINAL		Z	ZERO LOAD	0

<<1-FCV-68-333>>
Switch: V235\T1
TQC : V235\T9
HX: 1 + VX: 1
Direction: ↑

0.000 V
0 Ft-lb
-0.000 Sec.



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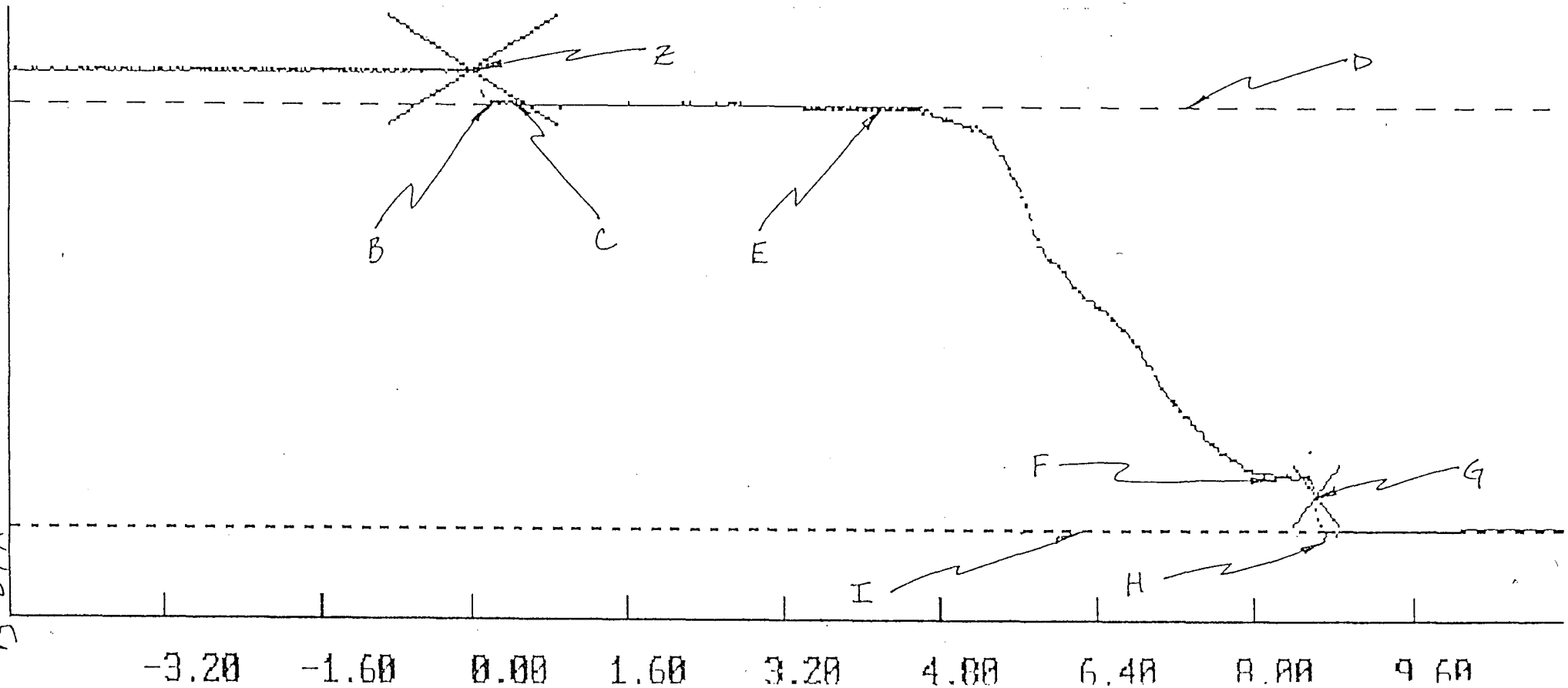
CLOSED DP THRUST lb OPEN

B	STAT FRIC BK PT	2977	J	UNSEATING	
C	BEGINING RL	2941	K	DP EFFECT	N
D	AVERAGE RL	3012	L	POST DP / AVE RL	A
E	ENDING RL	3082	M	ENDING RL	
F	DP EFFECT	13833			
G	CST	14183			
H	TOTAL PEAK	15409			
I	TOTAL FINAL	15234	Z	ZERO LOAD (OFFSET)	2031

<< 1-FCV-68-333>
Switch: V235\T1
THC : V235\T1
HX: 1 + VX: 1
Direction: ↓

0.000 V
0 LB
0.000 Sec.



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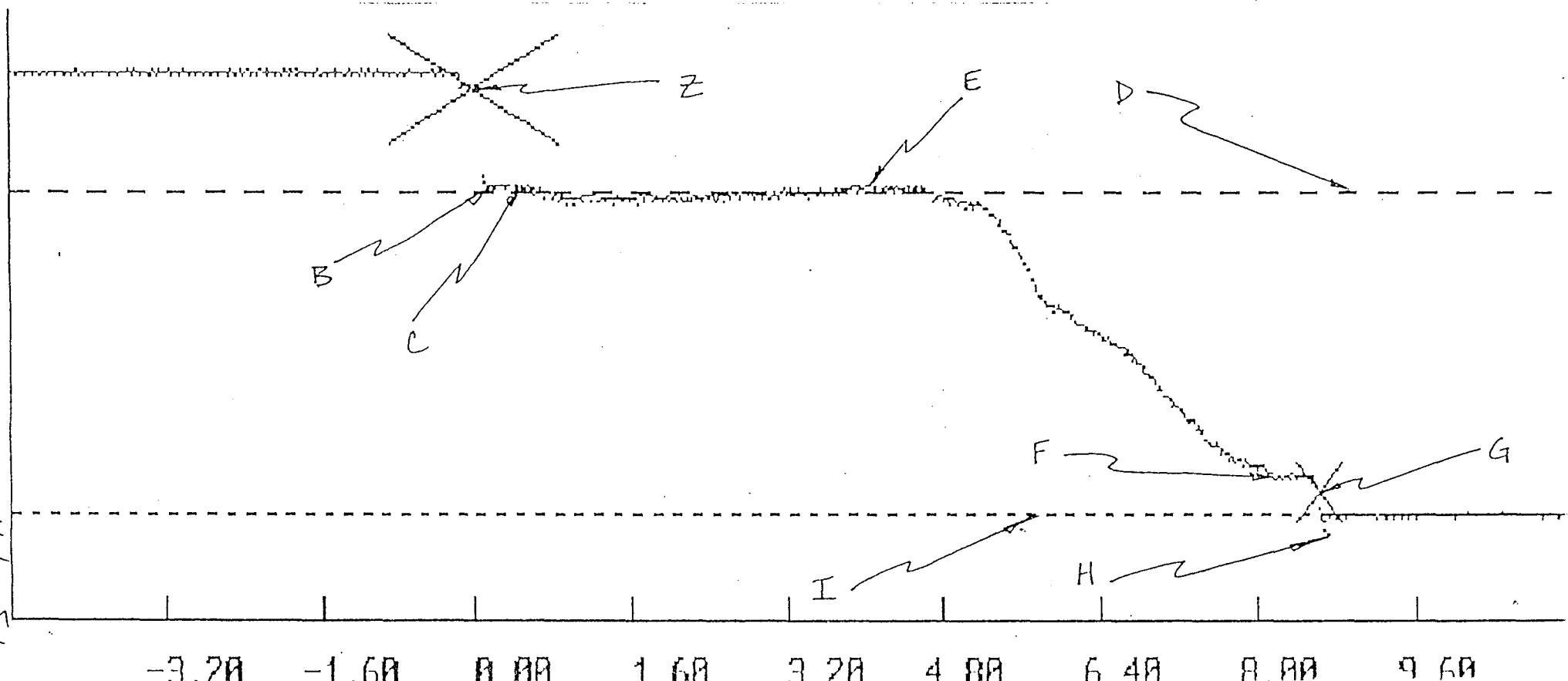
CLOSED DP TORQUE Ftlb OPEN

B	STAT FRIC BK PT	30.57	J	UNSEATING	
C	BEGINING RL	30.57	K	DP EFFECT	N
D	AVERAGE RL	32.85	L	POST DP / AVE RL	A
E	ENDING RL	31.02	M	ENDING RL	
F	DP EFFECT	118.62			
G	CST	121.36			
H	TOTAL PEAK	135.05			
I	TOTAL FINAL	128.21	Z	ZERO LOAD	O

<< 1-FCV-68-333>
Switch: V235\T1
TQC : V235\T1
HX: 1 + VX: 1
Direction: ↓

0.000 V
0 FT-LB
0.000 Sec.



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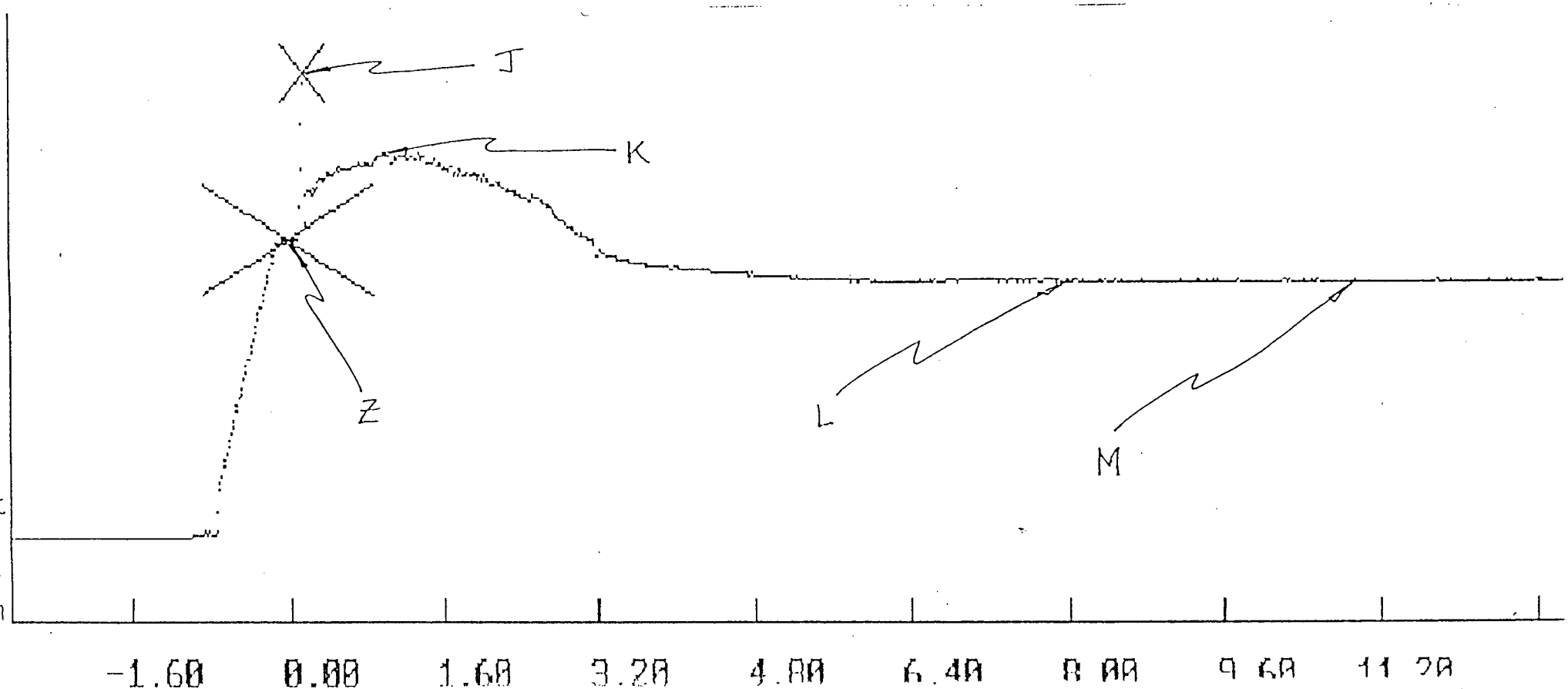
CLOSED OPEN DP THRUST lb

B	STAT FRIC BK PT		J	UNSEATING	9140
C	BEGINING RL		K	DP EFFECT	4763
D	AVERAGE RL		L	POST DP / AVE RL	-2136
E	ENDING RL	N	M	ENDING RL	-2136
F	DP EFFECT	A			
G	CST				
H	TOTAL PEAK				
I	TOTAL FINAL		Z	ZERO LOAD	0

<<1-FCV-68-333>>
Switch: V235\T2
THC : V235\T1
HX: 1 * VX: 1
Direction: ↑

0.000 V
0 LB
0.000 Sec.



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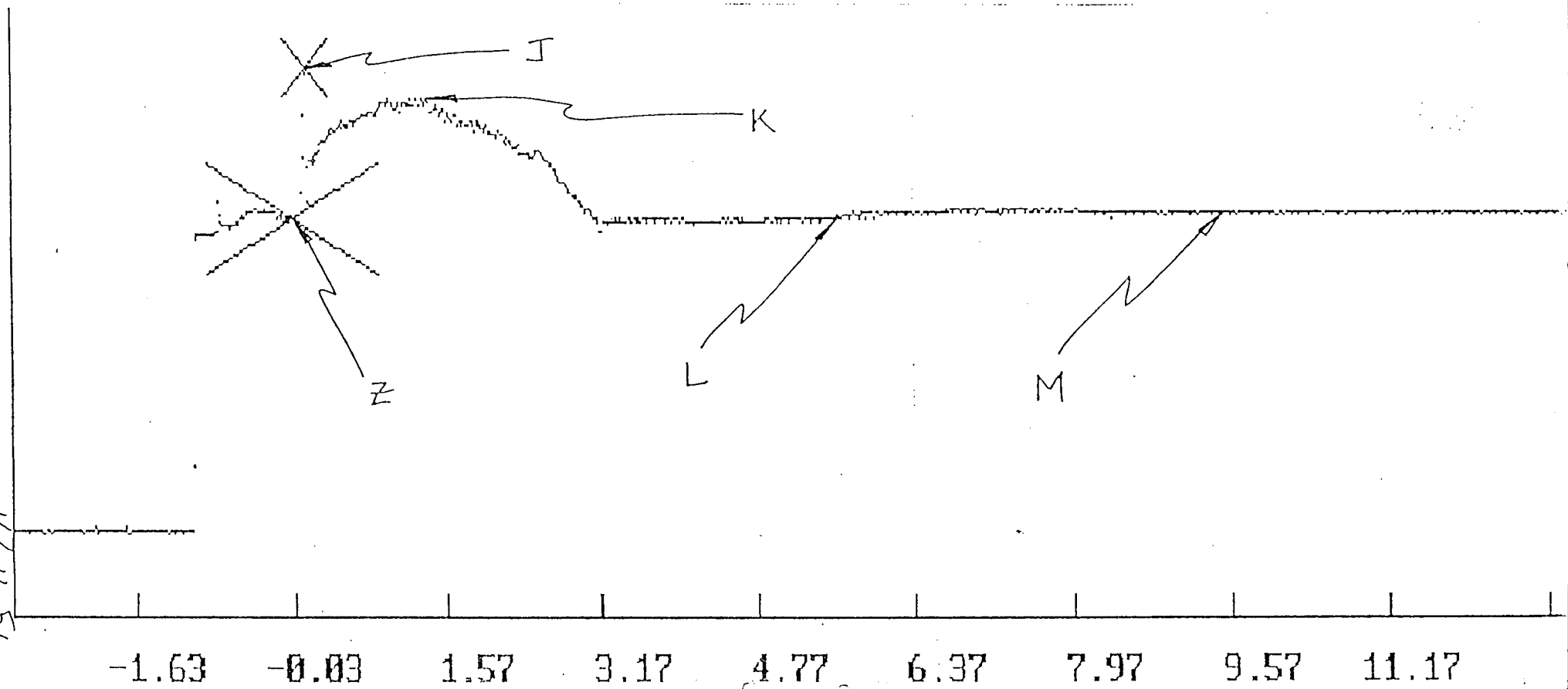
CLOSED OPEN DP TORQUE Ftlb

B	STAT FRIC BK PT		J	UNSEATING	62.51
C	BEGINING RL		K	DP EFFECT	49.73
D	AVERAGE RL		L	POST DP / AVE RL	1.37
E	ENDING RL	N	M	ENDING RL	3.19
F	DP EFFECT	A			
G	CST				
H	TOTAL PEAK				
I	TOTAL FINAL		Z	ZERO LOAD	0

<< 1-FCV-68-333
Switch: V235\T2
TQC : V235\T1
HX: 1 ✦ VX: 1
Direction: ↑

0.000 V
✦ 0 FT-LB
-0.000 Sec.



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