ATTACHMENT 2

CALCULATION EPM-DTN-070692

9608020066 960726
PDR ADOCK 05000390
P PDR

9

TITLE: DOCUMENTATION OF DESIGN BASIS REVIEW, REQUIRED THRUST/TORQUE CALCULATIONS, AND VALVE AND ACTUATOR CAPABILITY ASSESSMENT FOR VALVE 1-FCV-63-25	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-63 WBN-63-D053 EPM-DTN-070692	Each time these calculations are issued, preparer must ensure that the original (R0) RIMS accession number is filled in.

Rev.	(for RIMS' use)		RIMS accession number
R0	OCT 01 1992 (35)	B18	'92 0911 28
R1	NOV 22 1994 (39)	B26	'941112 388
R2	MAY 15, 1995	B26	'950424 379
R3	Oct 1, 1995 (63)	B26	'950830 335

APPLICABLE DESIGN DOCUMENT(S) N/A DTN 9/10/92

SAR SECTION(S)	UNID SYSTEM(S)
3.9.3.2	63

REVISION 0		R1	R2	R3
ECN No. (or Indicate Not Applicable) N/A DTN 9/10/92		S-33166-A	S-35993-A	S-37937-A
Prepared: D. T. Nakahata DTNakahata		MRJohnson	MRJohnson	MRJohnson
Checked/Verified: T. S. Snead TSnead		RMColl	RMColl	RMColl
Reviewed: T. J. Miller		RMColl	RMColl	RMColl
Approved: T. J. Miller		[illegible]	BCranlin	BCranlin
Date: 9/10/92		11-11-94	4/21/95	8/29/95
USE FORM TVA 10534 IF MORE SPACE REQUIRED	List all pages added by this revision	See Rev. Log	see rev. log	see rev. log
	List all pages deleted by this revision	See Rev. Log	see rev. log	see rev. log
	List all pages changed by this revision	See Rev. Log	see rev. log	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-FCV-63-25. 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-63-25 is able to perform its design basis function.

This calculation contains no special requirements.

R1

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

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

cc: ~~RIMS, GL-26-C-K; P Grossman, Trailer E-4, WBNP~~ ~~D Kilgore, Trailer E-7, WBNP~~ MEB

ABB 11/4/94

TITLE: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
0	Prepared By: D. Nakahata DTN 8/13/92 ORIGINAL ISSUE Checked By: T. Snead TS 8/13/92	9/10/92
1	This revision incorporates an elevated temperature effects evaluation and seismic evaluation. Pages Revised: 1,2,4,5,7,8,9,11,14,22,24,30,31,32,33,13 Pages Deleted: 0 Pages Added: 3A, 4A, 4B, 24A Total Pages: 39 DCCM and CCRIS search was performed on 11/4/94 and no changes were found which affect this calculation revision. Prepared By: Mark R Johnson 11/4/94 Checked By: RDMc 11/8/94	11-11-94
2	This revision incorporates: reconciled DP test data, mispositioning scenario evaluation, EOI evaluation, References updated Pages Revised: 1,2,4,4A,5,8-13,15-17,18,21,23,25-29,32,33 mj 4/11/95, 7,24,30,31 Pages Added: 3B, 34, Att. 2 (4 pgs), Att. 3 (10 pgs) Pages Deleted: 34,33,14 Dccm and CCRIS search was performed on ~~2/14/95~~ 4/11/95 mj 4/11/95 and no changes were found which affect this calculation Prepared: Mark R Johnson ~~2/22/95~~ 4/11/95 mj 4/11/95 Checked: RDMc 4/12/95	5/21/95

TITLE: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
3	This revision incorporates the following MOV issues: revise Reconciliation, update References Pages Revised: 1, 4, 4A, 7, 8-11, 22, 20, 15, 16, 17 Pages Deleted: Att. 2 (4pgs), Att. 3 (10pgs), 33, 34 Pages Added: 2A, 3C, Att. 2 (4pgs), Att. 3 (17pgs), 33, 34 DCCM and CCRIS search was performed on 7/20/92 and no changes were found which affect this calculation revision. Prepared: Mark R Johnson 7/20/95 Checked: [illegible] 7/28/95	8-29-95

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-63-25

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-63, WBN-63-D053, EPM-DTN-070692 — Calculation No.

0 — 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: 9/10/92

WATTS BAR NUCLEAR PLANT UNIT 1

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-63-25

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-63, WBN-63-D053, EPM-DTN-070692 — 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.

RJ McCall — Design Verifier (Independent Reviewer)

4/8/04 — Date

THIS PAGE ADDED BY REV 1

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

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-63-25

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-63, WBN-63-D053, EPM-DTN-070692 — 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. This revision incorporates reconciled test data and mispositioning scenario evaluation

R D McColl — Design Verifier (Independent Reviewer)

~~4/12/95~~ 4/18/95 — Date

THIS PAGE ADDED BY REVISION 2

CLIENT: TENNESSEE VALLEY AUTHORITY
PROJECT: WATTS BAR NUCLEAR PLANT UNIT 1
SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATION FOR 1-FCV-63-25

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

MEB-WBN-63, WBN-63-D053, EPM-DTN-070692 — Calculation No.
3 — 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 reconciled test data.

Design Verifier (Independent Reviewer) — Date 2/28/95

THIS PAGE ADDED BY REVISION 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-63-25

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

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ATTACHMENT 1: Simplified Sketch (Sheet 1 of 1)

2: Reconciled DP Test DATA (4 pgs)

THIS CALCULATION PACKAGE CONTAINS ~~35~~ ~~39~~ ~~54~~ ~~56~~ 63 TOTAL SHEETS

3: DP Test DATA (~~10~~ 17 pgs)

R3 mf 7/20/95 R2 mf 2/14/95 R1 mf 1/14/94

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 8/13/92

CHECKER: T. Snead DATE: 8/13/92

1.0 PURPOSE AND SCOPE

1.1 PURPOSE

This calculation documents the design basis review, performs the required thrust and torque calculations, and assesses valve and actuator capability for 1-FCV-63-25, the Boron Injection Tank Outlet Isolation Valve (Train B). This calculation contains the comprehensive Generic Letter 89-10 engineering analysis for 1-FCV-63-25, including elevated temperature effects, seismic evaluation, reconciled DP test data, mispositioning scenario evaluation, EQ I evaluation

R1 R2

1.2 SCOPE

The design basis review is performed in accordance with TVA Mechanical Design Standard DS-M18.2.22. It identifies the functional, seismic, and electrical considerations which influence the ability of valve 1-FCV-63-25 to perform its design function.

Sections 7.1 through 7.4 of this calculation document specific design information for both the valve and its operator. Section 7.5 calculates the maximum thrust/torque capabilities of the operator and the thrust/torque required to operate the valve, using the methodology in TVA Mechanical Design Standard DS-M18.2.21. Section 7.5 also summarizes the manufacturer's weak-link analysis of the valve. The calculated maximum thrust/torque capability and weak-link analysis are compared to the required thrust/torque to ensure the operability of the valve.

The capabilities and requirements of the valve and operator are based on the worst case line and 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 ANALYSIS 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 - 7.4
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-63-25, shall be evaluated using TVA Nuclear Design Standards DS-M18.2.21 and DS-M18.2.22.

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DTN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

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", Revision ~~2~~ 6 ~~dated 7/7/92.~~ 7

3.2 TVA Nuclear Power Mechanical Design Standard DS-M18.2.22, "MOV Design Basis Review Methodology", Revision 1~~, dated 7/29/91~~.

3.3 NRC Generic Letter 89-10, "Safety-Related Motor-Operated Valve Testing and Surveillance", dated 6/28/89, and Supplements.

3.4 Not Used ~~Supplement 1 to NRC Generic Letter 89-10, "Results of Public Workshops", dated 6/13/90.~~

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

4.0 ASSUMPTIONS

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

4.2 The pressure drop for piping losses is neglected. The technical justification is that it allows for a conservative determination of line/differential pressures and flow velocity.

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

5.0 REFERENCES

5.1 TVA WBN Calculation EPM-TSS-110791, Rev. ~~1~~ 4 (7), "Generic Letter 89-10 MOV Population at Watts Bar (Unit 1)" R1 R2 R3 mj 11/4/94

5.2 TVA WBN System Description, N3-63-4001, Rev. ~~4~~ 5 through ~~DIM-N3-63-4001-5~~ DCN ~~S-34554-A S-34864-A S-35532-A~~ S-37264-A, "Safety Injection System"

5.3 TVA WBN Flow Diagram CCD, 1-47W811-1, Rev ~~18~~ 19 (20), "Safety Injection System" mj 4/10/95 mj 4/11/95

5.4 TVA WBN System Description, N3-62-4001, Rev. ~~2~~ 3 through ~~DIM-N3-62-4001-6~~ DCN, "Chemical and Volume Control System" ~~S-33386-A~~ ~~S-33222-A~~ S-36887-A mj 4/4/95

5.5 TVA WBN Mechanical Piping Drawing 47W435-1, Rev. ~~N~~ P, "Auxiliary Building; Safety Injection System Piping" mj 2/14/95

5.6 TVA WBN Environmental Data Drawing, 47E235-61, Rev. ~~2~~ 4, "Auxiliary Building, El. 713, Environment - Harsh" mj 4/4/95 R1 mj 1/19/94

5.7 Westinghouse letter WAT-D-8939, dated 7/30/92, "Seismic Qualification of Westinghouse Gate Valves for Watts Bar (RIMS# T33 920730 983)

5.8 Westinghouse Engineering Memorandum EM-4995, dated 1/28/77, "Operability Test Report of Westinghouse Nuclear Gate Valves"

5.9 TVA WBN Mechanical Piping Drawing 47W435-2, Rev. ~~H~~ J, "Auxiliary Building; Safety Injection System Piping" R2 mj 2/14/95

5.10 TVA WBN Mechanical Piping Drawing 47W435-4, Rev. P, "Auxiliary Building; Safety Injection System Piping"

5.11 TVA WBN Mechanical Piping Drawing 47W309-3, Rev. B, "Yard & Auxiliary Building; Large Reservoirs"

5.12 TVA WBN Mechanical Piping Drawing 47W406-3, Rev. ~~K~~ L, "Chemical and Volume Control System" R2 mj 2/14/95

5.13 TVA WBN Mechanical/Nuclear Design Study dated 5/16/91, "Identification of Gate Valves Subject to Thermal Binding and Bonnet Overpressurization" (RIMS# B26 910618 302)

Rev.3 mj 7/20/95 TVL 7/24/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

5.0 REFERENCES (Continued)

5.14 TVA WBN Calculation EPM-MA-030292, Rev. ~~0~~ 3 ~~2~~ X, "Evaluation of Gate Valves Subject to Thermal Binding and Bonnet Pressurization per SOER 84-7" ~~(RIMS# B18 920326 269)~~

5.15 TVA WBN Surveillance Instruction ~~SI-4.0.5.63.V.2.B.0~~ 1-SI-63-903-A, Rev. ~~0~~ 2 X, "Valve Full Stroke Exercising During ~~Plant Operation~~ Cold Shutdown - Safety Injection System (Train ~~B~~ A)"

5.16 TVA WBN EQ Binder WBNEQ-MOV-003, Rev. ~~6~~ 15, "Environmental Qualification Documentation Package" (RIMS# B71 860627 789)

5.17 Westinghouse Drawing, 115E011, TVA Rev. 901, "Motor Op Gate Valve Model 04000GM88FNB00B"

5.18 Westinghouse Process Flow Diagram 1190E37, Sh. 1, Rev. 5, "Safety Injection System"

5.19 TVA WBN Calculation WBN-EEB-MS-TI06-0010, Rev. ~~3~~, "Auxiliary Power Systems Analysis on 1E Buses Via CSST C and CSST D with Auto Load Tap Changers," Attachment 10.6, "Motor Control Center Motor Starting Voltages"

5.20 TVA WBN DCN ~~M~~ W-11466-A

5.21 TVA WBN Schematic Diagram, CCD, 1-45W760-63-3, Rev. ~~2~~ 9 (10), "Safety Injection System"

5.22 Limitorque Bills of Material provided by letter dated 7/17/86, under Contract No. 86PNQ-961556 (Microfilm reel #684426)

5.23 TVA WBN System Description, N3-72-4001, Rev. 5 through DCN ~~S-18550-A~~ ~~30967~~ ~~S-34743-A~~ S-36005-A, "Containment Heat Removal Spray Systems"

5.24 TVA WBN Calculation WBN-EEB-MS-TI08-0008, Rev. ~~22~~ 70 ~~73~~ (76), "480V 1E Coordination/Protection"

5.25 Crane Technical Paper No. 410, "Flow of Fluids through Valves, Fittings, and Pipe," 1988

Rev3 7/20/95
7/24/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DTN DATE: 09/10/92

CHECKER: T. Snead TS DATE: 9/10/92

5.0 REFERENCES (Continued)

5.26 TVA WBN Unit 1 Valve Index by Location, WAT-LOC, Rev. 10, (RIMS# B26 861230 901)

5.27 Westinghouse letter WAT-D-6874, dated 2/24/86, "Data Base for Motor Operated Valves" (RIMS# B45 860228 601)

5.28 Westinghouse letter WAT-D-8584, dated 6/25/91, "Maximum Allowable Thrusts for MOVs" (RIMS# B26 910805 300)

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

5.30 TVA WBN Calculation WBPEVAR8909010, Rev. ~~25~~ 30 ~~28~~ mj 4/11/95, "Cable Ampacity - NV4 and NV5 Cables in Class 1E Raceways" ~~(Calculation WBPEVAR8909010 contains unverified assumptions that are qualified by Reference 5.31.)~~ R2 R3 mj 6/19/95

5.31 ~~TVA WBN Memorandum, dated June 26, 1992, "Evaluation of Cable Sizing for the Generic Letter 89-10 Motor Operated Valve (MOV) Program" (RIMS# T41 920626 868)~~ Not Used R3 mj 6/20/95

5.32 ANSI/IEEE Standard 242-1986, "IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems"

5.33 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.

5.34 ~~TVA WBN Emergency Instruction ES-0.2, Rev. 2, "SI Termination"~~ Not Used R2 mj 6/14/95

5.35 Limitorque Selection Guides:

5.35.1 Application Factors, SEL-4, 7/1/77

5.35.2 Gate & Globe Valve Efficiency, SEL-7, 11/89

5.35.3 Rating Sheets, SEL-9, Rev. 2

5.35.4 Stem Factors, SEL-10, 5/21/79

Rev.3 mj 7/20/95
TRL 7/24/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DTN DATE: 9/10/92

CHECKER: T. Snead TS DATE: 9/10/92

5.0 REFERENCES (Continued)

5.36 TVA WBN ~~Final Safety Analysis Report (FSAR) Transmittal Package No. 481, dated 1/14/88~~ Westinghouse letter WAT-D-7363 (B26 870428 953), dated 4/24/87, "Chapter 15, ~~NRC Question Responses and Other~~ FSAR Revisions ~~Due to Upper Head Injection Removal and Upflow/Downflow Conversion~~" R2 mj 4/14/95

5.37 TVA WBN QIR MNMWBN92022, Rev. 0, dated 7/28/92, "Limitorque Actuator Torque Switch Setting Chart for New Replacement Spring Packs" (RIMS# T31 920804 937)

5.38 TVA WBN Design Criteria WB-DC-30-15, Rev. ~~2~~ 3, "Motor Operated Valve Thermal Overload and Torque Switch Bypass" R3 R2 mj 7/20/95

5.39 TVA WBN ~~Procedure Method PM 87-26 (EEB), Rev. 2, "Cable Length/Impedance to be used in Electrical Calculations"~~ electrical design standard DS-E12.6.3, Rev. 4, "Auxiliary and control power cable sizing up to 15000 volts" (B44 940215 001)

5.40 TVA WBN Calculation WBN-OSG4-091, Rev. ~~2~~ 5, "Maximum Containment Water Level" mj 2/14/95

A review of DCCM was performed and no outstanding changes affect this calculation.

6.0 DESIGN INPUT DATA

The design input for determining the Motor-Operated valve design basis, minimum thrust/torque requirements and operator capability were obtained from the references in Section 5.0 with the exception of references 5.15, 5.31 and 5.32.

5.41 TVA WBN Vendor Technical Manual WBN-VTM-L200-0010, Rev. ~~12~~ 13, Section 0380, "Limitorque Technical Update 93-03, Elevated Temperature Effects." R1 R3 mj 7/27/95

5.42 TVA WBN Environmental Data Drawing, 47E235-59, Rev. ~~4~~ 5, "Environmental Data Environment - Harsh HELB Profiles" R2 mj 4/11/95

5.43 Westinghouse letter WAT-D-9838, dated 11/10/94, "MOV Seismic Analysis", T33 941110803 mj 11/14/94

5.44 TVA Corporate letter, B45 941018 252, dated 10/15/94, Topic: Increased Actuator Thrust Ratings. R2 mj 2/21/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DTN DATE: 9/10/92

CHECKER: T. Snead TS DATE: 9/10/92

7.0 CALCULATIONS

7.1 SYSTEM DESIGN BASIS DATA

		DATA SOURCE
1.	VALVE NO: 1-FCV-63-25	Ref. 5.1~~, Att. 4, p. 5~~ R2
2.	MARK NO: 8801B	Ref. 5.2~~, p. 105~~
3.	DESCRIPTION: Boron Injection Tank Outlet Isolation Valve (Train B)	Refs. 5.2~~, p.105~~; 5.21
4.	FUNCTION: To open upon receipt of a Safety Injection Signal to allow CCP flow to the RCS through the Boron Injection Tank.	Refs. 5.2~~, p.23~~; 5.21 mdj 2/14/95
5.	SEISMIC CLASS: Category I (Active)	See Comment 7.1.5
6.	SYS DESIGN PRESSURE: 2800 psig	Ref. 5.3
	SYS DESIGN TEMPERATURE: 200°F	Ref. 5.3
7.	NORMAL POSITION: Closed	See Comment 7.1.7
	SAFETY POSITION: Open	See Comment 7.1.7
8.	FLOW RATE: 354.5 gpm (9.1 fps)	See Comment 7.1.8
9.	MAXIMUM LINE/DIFFERENTIAL PRESSURE:	See Comment 7.1.9

	Line P/Diff. P	Line P/Diff. P
Normal Plant Operation:	OPEN --/--	CLOSE --/--
Testing:	OPEN 2235/2176	CLOSE 59 ~~62~~/0 R2
Accident:	OPEN ~~2547/2297~~ 2532 2319	CLOSE 2350/115
Misposition:	OPEN ~~2738/2723~~ 2761 2746	CLOSE ~~2573/338~~ 2761 2746

10. FLUID TYPE: Liquid (borated water) Ref. 5.2~~, p. 23~~ mdj 2/14/95

FLUID TEMP: 150°F, max. operating Ref. 5.18

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PREPARER: D. Nakahata DN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.1 SYSTEM DESIGN BASIS DATA (Continued) — DATA SOURCE

R2

11. REQUIRED STROKE TIME: 10 seconds — Ref. 5.2, ~~p. 108~~

APPLICABLE SI: ~~SI-4.0.5.63.V.2.B.0~~ 1-SI-63-903-A

12. LEAK TIGHTNESS REQUIREMENT: 12 cc/hr — Ref. 5.2, ~~p. 108~~ See Comment 7.1.12 mf 4/14/95

13. MOV CAN BE FULL FLOW TESTED?: Y (Y/N) — See Comment 7.1.13

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

15. ORIENTATION OF VALVE: — Refs. 5.10, 5.11

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

16. BUTTERFLY VALVE CHARACTERISTICS:

Flow velocities: Not Required for Gate Valves

Piping arrangement: Not Required for Gate Valves

R1

17. AMBIENT TEMPERATURE: 60°F to 104°F (normal); ~~210~~ 215°F (max. accident) — Ref. 5.6

mf 11/4/94

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
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PREPARER: M. R. Johnson DATE: 4/11/95
CHECKER : R. G. McColl DATE: 4/18/95

7.0 CALCULATIONS

7.1 SYSTEM DESIGN BASIS DATA (Continued)

Comments:

7.1.5 Seismic Class - Reference 5.43 provides data for seismic qualification of Westinghouse Gate Valve 1-FCV-63-25.

Reference 5.43 qualifies this valve up to a loading of 20000 lbs or 250 ft-lbs for opening and closing.

This valve is seismically qualified for its application.

7.1.7 Valve Position - This normally closed valve automatically opens upon a Safety Injection Signal to provide a flow path from the CCPs to the RCS through the Boron Injection Tank (BIT). (Ref. 5.2)

7.1.8 Flow rate - Reference 5.18 provided a maximum flow rate through the Boron Injection lines of 709 gpm during Cold Leg Recirculation conditions. Since there are two BIT Outlet isolation valves, the flow rate through each is 354.4 gpm. The flow velocity is 9.1 fps (354.4 gpm * [1 ft^3 / 7.48 gal] * [4/{π * (0.333 ft)^2}] * [1 min/60 sec]). This conversion is obtained from Ref. 5.25, p. 1-4. The full flow rate of 709 gpm would exist if, due to a single failure, only one of the BIT outlet isolation valves opened.

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PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.1 SYSTEM DESIGN BASIS DATA, COMMENTS (Continued)

7.1.9 Computation of maximum line and differential pressures - (Refer to Attachment 1, Simplified Sketch) The pressure sources applicable to this calculation are as follows:

- The Centrifugal Charging Pump (CCP) differential head is obtained from References 5.4 and 5.2 ~~, Figure 3.2-1~~. During an accident condition after isolation of the normal charging path, with a 60 gpm CCP recirculation flow rate (Ref. 5.4~~, p. 140~~), plus 32 gpm to the RCP seals (Ref. 5.4~~, p. 20~~), the maximum CCP head (shutoff) is ~~5850~~ 5980 ft * 0.433 psi/ft = ~~2533~~ 2555 psig. (The 0.433 psi/ft conversion factor is taken from Reference 5.25, p. B-11.) Ref. 5.2

  During normal operation at a minimum charging flow rate of 107 gpm [the regenerative heat exchanger requires 15 gpm (Ref. 5.4~~, p. 80~~), the RCP seals require 32 gpm, and the CCP recirculation flow is 60 gpm], the ~~maximum~~ design CCP head is 5800 ft * 0.433 psi/ft = 2511 psig. (Ref. 5.2)

- The elevation head upstream of the valve due to the RWST is 763'~~8~~6"5" (maximum RWST level, Ref. 5.11) - 730'0" (valve elevation, Ref. 5.9) = 33'~~8~~6"5" * 0.433 psi/ft = 14 psi.

- During normal operations the maximum head upstream of the valve is 65 psig (maximum VCT pressure, Ref. 5.4, ~~table 3.4-1~~) minus the elevation difference between the valve (730'0", Ref. 5.9) and the maximum VCT level [~~the bottom level instrumentation tap is 717'9 1/8" (Ref. 5.12) plus a high level limit of 65" above the lower instrument tap (Ref. 5.4, table 3.4-1)~~ (Ref. 5.12) 723'~~7~~1 1/8"]. 65 psig - (730'0" - 723'~~7~~1 1/8") * 0.433 psi/ft = ~~62~~ 59 psi. *

- The RCS pressure during normal operation is 2235 psig (Ref. 5.4~~, p. 17~~). Following an accident the RCS pressure would be 250 psig; ~~Figure 15.4-83 of~~ Reference 5.36 shows that 20 seconds after a cold leg double-ended shear, the pressure would be 265 psia. (Stroking of 1-FCV-63-25 at 21 seconds based on Ref. 5.2)

* Re-evaluation indicted that the pressure is 62 psi. The technical justification for no change is that the resultant DP values are conservative since the 59 psi is the downstream pressure source in determining the DP.

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PREPARER: D. Nakahata DTN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.1 SYSTEM DESIGN BASIS DATA, COMMENTS (Continued)

7.1.9 Computation of maximum line and differential pressures (Continued)

Opening (Accident Conditions) - The valve opens upon the receipt of a Safety Injection signal which is indicative of a decreasing RCS pressure. Both 1-FCV-63-25 and 1-FCV-63-26 should open as the normal charging valves close (Ref. 5.2~~, pp. 63 and 64~~). For conservatism it is postulated that the normal charging valves close before either 1-FCV-63-25 or 1-FCV-63-26 opens, maximizing the CCP discharge pressure. The line pressure at 1-FCV-63-25 would be 2562 ~~2547~~ psig which is the ~~2533~~ 2555 psig CCP head plus 14 psi RWST head. The differential pressure will be 2312 ~~2297~~ psid which is the 2562 ~~2547~~ psig line pressure minus 250 psig RCS pressure. R2

Closing (Accident Conditions) - During restoration from Safety Injection, the valve is closed, ~~when the RCS pressure is above 1500 psig~~, SI has been reset and normal charging has been restored ~~(Ref. 5.54)~~. Reference 5.4~~, page 19~~ provides a normal charging line pressure of 2350 psig when the RCS pressure is 2235 psig. Under these conditions the differential pressure across 1-FCV-63-25 is (2350 psig - 2235 psig) = 115 psid. (For conservatism RCS pressure of 2235 psig is used, maximizing the line pressure.) R3

Opening and Closing (Normal/Test Operations) - The valve is not cycled during normal operations; it is stroked for surveillance testing per ~~SI-4.0.5.63.V.2.B.0~~ (Ref. 5.15), with the positive displacement pump aligned to supply normal charging and the CCPs stopped and isolated from the charging header. For opening the valve, the downstream pressure could be as high as 2235 psig (RCS pressure) if any back leakage exists through the check valves in the boron injection line. The pressure upstream of the valve is 59 ~~62~~ psig, since the VCT remains aligned to the CCP suction. The differential pressure across 1-FCV-63-25 is (2235 - 59 ~~62~~ psig) = 2176 psid. For closing, the line pressure would be 59 ~~62~~ psig (VCT head) and the differential pressure would be zero.

2/16/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
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PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.1 SYSTEM DESIGN BASIS DATA, COMMENTS (Continued)

7.1.9 Maximum line and differential pressures (Continued)

Inadvertent Mispositioning - The valve could be mispositioned open during normal operations; it could be mispositioned closed during accident conditions. During normal operations, the reclosing of 1-FCV-63-25 after mispositioning would result in a maximum line pressure of 2578 ~~2573~~ psig which is the 2511 psig CCP head plus 57 ~~62~~ psi due to the VCT pressure and elevation difference. The differential pressure would be (2570 - 2235 psig RCS pressure) = 335 psid. R2

During accident conditions (RHR recirculation, with 1-FCV-63-26 having failed to open), the reopening of 1-FCV-63-25 after mispositioning would result in a maximum line pressure of 2761 ~~2738~~ ~~2760~~ psig which is the 2555 ~~2533~~ psig CCP head plus 206 ~~206~~ psig for the maximum RHR pump discharge pressure. The latter value is the sum of the RHR pump shutoff head of 195 psig (Ref. 5.2, ~~p. 102~~), the containment maximum pressure of 15 psig (Ref. 5.23, ~~p. 15~~), and -54 psi elevation difference between the maximum containment sump level (Ref. 5.40, ~~p. 2~~) and the valve (Ref. 5.9). (726 ~~719.3'~~ - 730')* 0.433 psi/ft = -54 psi. Postulating the RCS pressure to be equal to the containment pressure of 15 psig, the differential pressure is 2761 ~~2738~~ - 15 = 2746 ~~2723~~ psid. R3

7.1.12 Leak tightness - This leak rate is based on an allowed value for gate valves of 3 cc/hr per inch of nominal valve size * 4 inches = 12 cc/hr (Ref. 5.2, ~~p. 108~~).

7.1.13 Full flow testing - The valve can be full flow tested, although not during normal operation.

7.1.14 Bonnet overpressurization - Reference 5.13 (Section 5.0) states that this valve is susceptible to pressure locking and bonnet overpressurization. However, Reference 5.14 ~~(page 36)~~ further analyzed the valve and its operating conditions, and concluded that pressure locking and bonnet overpressurization do not exist for 1-FCV-63-25. MN 2/16/95

7.1.9 (Continued)

EOI evaluation: The maximum DP reflected in this section is based upon conservative accident values (i.e. pump shutoff) as documented in engineering design output documents such as system descriptions and flow diagrams.

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CHECKER: T. Snead DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.2 VALVE DESIGN DATA

		DATA SOURCE
Valve Tag No.	1-FCV-63-25	
Valve Contract No.	71C62-54114-2	Ref. 5.17
Valve Drawing	115E011	Ref. 5.26, p. 11

VALVE DESIGN DATA

1.	Valve Serial No.	00S710001	Ref. 5.27, p.2 of Att.
2.	Valve Model No.	4 GM78FN	Ref. 5.26, p. 11
3.	Valve Manufacturer	Westinghouse	Ref. 5.2~~, p. 105~~
4.	Valve Pressure Class	1500 psig	Ref. 5.33, p. 176
5.	Valve Size/Type	4" Gate	Ref. 5.33, p. 176
6.	Seat Diameter (Mid point of seat)	3.87"	Comment 7.2.6
7.	Seat Angle	7°	Ref. 5.29
8.	Stem Diameter	1.250"	Ref. 5.17
9.	Stem Pitch	0.333"	Ref. 5.17
10.	Stem Lead	0.333"	Ref. 5.17
11.	Stem Travel	4.3"	Ref. 5.17
12.	Disc Type - gate valves (solid wedge, flex wedge, double disc, etc.)	Flex wedge gate valve	Ref. 5.17

R2 mg 2/16/95

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7.0 CALCULATIONS (Continued)

7.2 VALVE DESIGN DATA (Continued)

COMMENT

7.2.6 The valve seat diameter at midpoint (Ref. 5.17) was determined by taking the valve throat diameter (3.44") plus 1/2 of the distance between the throat diameter and valve lift (4.3"). [3.44" + (4.3" - 3.44")/2] = 3.87"

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7.0 CALCULATIONS (Continued)

7.3 OPERATOR DESIGN DATA

			DATA SOURCE
	Valve Tag Number	1-FCV-63-25	
1.	Operator Mfg.	Limitorque	Ref. 5.16, ~~p. F-181~~
2.	Operator Type/Size	SBD-00	Ref. 5.16, ~~p. F-181~~
3.	Order Number	378446E	Ref. 5.16, ~~p. F-181~~
4.	Serial Number	197082	Ref. 5.16, ~~p. F-181~~
5.	Spring Pack No.	0301-112	Ref. 5.20, p. 5
6.	Overall Gear Ratio (OAR)	38.6	Ref. 5.22, p. 378446E
7.	Pullout/Run Efficiency	0.45 / 0.6	Ref. 5.35.2
8.	Stem Factor (FS 0.15)	0.0116	See Comment 7.3.8
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 Efficiency	Not Applicable	No HBC Unit Installed

R3

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
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7.0 CALCULATIONS (Continued)

7.3 OPERATOR DESIGN DATA (Continued)

COMMENT

7.3.5 Spring Pack Capability - Reference 5.20, p. 5 lists the valve's spring pack as 0301-112. For this spring pack Reference 5.37, p. 5 shows that torque switch settings from a minimum of 1 to a maximum of 3 correspond to output torque values ranging from 115 ft-lbs to 185 ft-lbs, respectively. ~~The minimum torque required to open the valve is 152 ft-lbs and a torque of 75 ft-lbs is needed to close it (Section 7.5.1). (see section 90 for justification)~~ R2 mg 4/15/95

The installed spring pack provides a satisfactory ~~closing~~ margin for this application. ~~The opening torque switch is jumpered in the MOV's control circuit (Ref. 5.21). The installed spring pack will provide shock absorption throughout the opening stroke and control throughout the closing stroke.~~

7.3.8 Stem Factor - Reference 5.35.4 (page 6) shows that, using a valve stem diameter, pitch and lead of 1.250, 0.333 and 0.333 inches, respectively, and coefficient of friction of 0.15, the stem factor is 0.0116.

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7.0 CALCULATIONS (Continued)

7.4 ELECTRICAL DATA

			DATA SOURCE
	Valve Tag Number	1-FCV-63-25	
1.	Motor Mfg.	Reliance	Ref. 5.16, ~~p. F-181~~ R3
2.	ID No.	710741-FZ	Ref. 5.16, ~~p. F-181~~
3.	Start Torque	15.0 ft-lbs (Nameplate)	Ref. 5.16, ~~p. F-181~~ R1
4.	Running Torque	3.0 ft-lbs	Ref. 5.16, ~~p. F-181~~ 11/4/94
5.	RPM	3400 rpm	Ref. 5.16, ~~p. F-181~~
6.	Horsepower	1.9 hp	Ref. 5.16, ~~p. F-181~~
7.	Volts	460 V	Ref. 5.19, ~~p. 183~~ R3 7/21/95
8.	Running Current	3.5 A	Ref. 5.19, ~~p. 183~~
9.	L. R. Current	26.0 A	Ref. 5.19, ~~p. 183~~
10.	Duty Cycle	15 min.	Ref. 5.16, ~~p. F-181~~ 7/21/95
11.	Motor Code	code not listed	Ref. 5.16, ~~p. F-181~~
12.	Insulation Class	B	Ref. 5.16, ~~p. F-181~~
13.	Frame Designation	P56	Ref. 5.16, ~~p. F-181~~
14.	Electrical Cable Sizing	Satisfactory	See Comment 7.4.14
15.	Control Circuit Logic	Satisfactory	See Comment 7.4.15
16.	Degraded Voltage Cond.	Satisfactory	See Comment 7.4.16
17.	Overload Sizing	T29 - Satisfactory	See Comment 7.4.17

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7.0 CALCULATIONS (Continued)

7.4 ELECTRICAL DATA (Continued)

COMMENTS

7.4.14 Electrical cable sizing - ~~For MOV 1 FCV-63-25, reference~~ 5.19, p. 183 shows the cable number as 1V2687B, the cable size as #10 wire, the full load (run) current as 3.50 amperes and the locked rotor current as 26.0 amperes. The cable ampacity calculation shows the derated 141% full load ampacity as 11.2 amperes and the allowed cable ampacity as 14.6 amperes (Ref. 5.30, App. G, p. 13; use ~~of this reference is approved by Ref. 5.31).~~ R2

The cable sizing for this application is considered satisfactory. (Ref. 5.30)

7.4.15 Control circuit logic - The valve has an active safety function to open upon receipt of a Safety Injection Signal to allow CCP flow to the RCS through the Boron Injection Tank (Ref. 5.2~~, p. 23~~), which requires the Thermal Overload (TO) Protection Device to be bypassed and the Torque Switch to be bypassed in the opening direction (Ref. 5.38, pp. 4-5). R2 md 2/16/95

The electrical schematic (Ref. 5.21) shows that the TO is bypassed by a safety signal; the valve travel is limit switch-controlled in the opening and ~~direction; torque switch controlled with limit switch bypass in the c~~losing direction; and the valve will open automatically upon receipt of a SI signal. Therefore the control circuit for this valve meets its design application. md 2/21/95

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PREPARER: D. Nakahata DTN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.4 ELECTRICAL DATA, COMMENTS (Continued)

7.4.16 Degraded voltage condition - During a load block start 392.7 ~~387.3~~ of 460 volts, or 85.4% ~~84.2%~~ are available to the valve (Ref 5.19~~, p. 183~~). During a LOCA/HELB inside containment (which results in the block start), the highest ambient temperature for this location is 116 ~~117~~°F or 46.7 ~~47.2~~°C (Ref. 5.6). Since the terminal voltage calculations are corrected to 90°C (Ref. 5.39), for this accident an evaluation for reduced voltage, due to elevated cable ~~or motor~~ temperatures, is not required. R2 mj 4/11/95

Following a HELB outside containment, the maximum ambient temperature at the valve is 215 ~~210~~°F or 101.7 ~~99~~°C (Ref. 5.6), and the temperature at the valve exceeds 90°C only during the period of 3 to 32 ~~13~~ minutes after a HELB in the RHR system (Ref. 5.42). Since the cable resistances are normalized to 90°C, ambient temperature exceeds 90°C for a 29 ~~10~~ minute period, and it takes 1 to 6 hours for cable temperatures to rise (Ref. 5.32, Chap. 8), an evaluation for reduced voltage, due to elevated cable ~~or motor~~ temperatures, is not required. See pg 24A for an evaluation of elevated temperature effects on the motor.

The thrust and torque capability of the operator during degraded voltage conditions is calculated in Section 7.5, and is shown to be greater than the thrust and torque required to operate the valve. Therefore, the valve and its operator are able to perform their safety function. mj 4/11/95

7.4.17 Overload sizing - References 5.19 ~~(page 183)~~ and 5.24 ~~(page 122)~~ determined that an overload size of T29 is required and is installed. The correct heater is installed for this application. R2 mj 4/11/95

Elevated Temperature Evaluation for 1-FCV-63-25-B (Ref. 5.41)

150 START TORQUE, Nameplate (Ref. 5.16)

MAX ENVIRONMENTAL TEMPERATURE
215 temperature (deg F) = 102.0 degrees C

MOTOR INFORMATION
3400 rpm

VALVE INFORMATION
0.333 lead

ACTUATOR INFORMATION
38.6 OAR

MOTOR TOTAL TEMPERATURE
106.4 total motor temperature

4.3 travel

29.33 high speed stem
8.80 stroke time secs
0.15 stroke time mins

EVALUATION OF LRA AND LRT
19.2% max % LRA loss (Limitorque 93-03)
8.23% actual % LRA loss based on temp
23.9 adjusted LRA

21.4% max % TQ loss (Limitorque 93-03)
9.17% actual % TQ loss based on temp
13.62 adjusted TQ

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

EVALUATION OF VT (BLOCK vs. INDIVIDUAL) PER STROKE
block start (y/n): y (must be y or n)
block start (open/close): OPEN
individual start (open/close): CLOSE

TERMINAL VOLTAGE EVALUATION

		lead	FLI	LRA	LRPF	Zm	Rm	jXm	Rret	Rc	jXc	Individual Motor Start	Block Motor Start
AS FOUND	1-FCV-63-25-B	1.90	3.50	26.0	0.90	10.2147	9.1932	4.4525	0.23700	0.8667	0.0453	400.0	392.7
REVISED	1-FCV-63-25-B	1.90	3.50	23.9	0.90	11.1122	10.0010	4.8437	0.23700	0.8667	0.0453	403.0	395.6

DETERMINATION OF MOTOR CAPABILITY
38.6 OAR
0.6 run efficiency
0.45 pull out efficiency
392.7 block motor start as found in WBN-EEB-MS-T106-0010 (Ref. 5.19)
400.0 individual motor start as found in WBN-EEB-MS-T106-0010 (Ref. 5.19)
395.6 new block motor start voltage base on reduced LRA
403.0 new individual motor start based on reduced LRA

Open direction	Close direction	
0.8601	0.8760	terminal voltage ratio
determination of voltage factor (VF)		
0.7398	0.7674	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. 5.41)

OPENING MOTOR CAPABILITY	CLOSING MOTOR CAPABILITY	
175 ft-lbs.	242 ft-lbs.	(see section 7.5.2 for formulas)
0.0116 stem factor		based on stem pitch, lead, diameter
15086 lbs.	20862 lbs.	

THIS PAGE ADDED BY REVISION 1 11/4/94

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PREPARER: D. Nakahata DN DATE: 9/10/92

CHECKER: T. Snead TS DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS

7.5.1 Valve Thrust and Torque Requirements

Calculation of Piston Effect Load - F_p (DS-M18.2.21~~, p. 2~~) R2 MB 4/11/95

$$F_p = P * \frac{\pi d^2}{4}$$

Where:

P = Closing maximum line pressure = ~~2573~~ 2761 psig (Sect. 7.1.9) R2

P = Opening maximum line pressure = ~~2738~~ 2761 psig (Sect. 7.1.9)

d = Stem diameter at packing = 1.25 inches (Ref. 5.17)

$$F_p, \text{Closing} = \cancel{2573}\ 2761 * \frac{\pi(1.25)^2}{4} = \cancel{3156}\ 3388 \text{ lbf}$$

$$F_p, \text{Opening} = \cancel{2738}\ 2761 * \frac{\pi(1.25)^2}{4} = \cancel{3358}\ 3388 \text{ lbf}$$

Calculation of Packing Friction Load - F_{pack} (DS-M18.2.21~~, p. 4~~) MB 2/21/95

$$F_{pack} = 1000 \text{ lbf} * d$$

where:

d = Stem diameter at packing = 1.25 inches (Ref. 5.17)

$$F_{pack} = 1000 * 1.25 = \underline{1250 \text{ lbf}}$$

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.1 Valve Thrust and Torque Requirements (Continued)

Differential Pressure Load - F_{dp} (DS-M18.2.21~~, p. 3~~) R2 MJ 4/11/95

$$F_{dp},\text{Opening} = dp * \frac{\pi D^2}{4} * FV * \frac{\mu}{\cos\phi + \mu\sin\phi}$$

$$F_{dp},\text{Closing} = dp * \frac{\pi D^2}{4} * FV * \frac{\mu}{\cos\phi - \mu\sin\phi}$$

where:

R2

dp = Opening differential pressure = ~~2723~~ 2746 psid (Sect. 7.1.9)

dp = Closing differential pressure = ~~338~~ 2746 psid (Sect. 7.1.9)

D = Seat diameter at midpoint = 3.87 inches (Sect. 7.2.6) MJ 2/21/95

FV = Valve safety factor = 1.2 (DS-M18.2.21~~, p. 3~~)

μ = Valve friction factor = 0.4 (DS-M18.2.21~~, p. 3~~)

ϕ = Wedge angle = 7° (Ref. 5.29)

R2

$$F_{dp},\text{Opening} = \cancel{2723}\,2746\left(\frac{\pi(3.87)^2}{4}\right)1.2\left(\frac{0.4}{\cos 7 + (0.4 * \sin 7)}\right) = \cancel{14757}\,14888\ \text{lbf}$$

$$F_{dp},\text{Closing} = \cancel{338}\,2746\left(\frac{\pi(3.87)^2}{4}\right)1.2\left(\frac{0.4}{\cos 7 - (0.4 * \sin 7)}\right) = \cancel{2021}\,16427\ \text{lbf}$$

MJ 2/21/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.1 Valve Thrust and Torque Requirements (Continued)

Required Closing Thrust - F_r (DS-M18.2.21~~, p. 1~~) R2

F_r,Closing = F_{dp} + F_{pack} + F_p

where:

F_{dp} = Differential Pressure load = ~~2021~~ 16427 lbf

F_{pack} = Packing Friction load = 1250 lbf

F_p = Piston Effect load = ~~3156~~ 3388 lbf

F_r,Closing = ~~2021~~ 16427 + 1250 + ~~3156~~ 3388 = ~~6427~~ 21065 lbf

MAJ 4/11/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.1 Valve Thrust and Torque Requirements (Continued)

R2

Calculation of Wedging Load - F_w (DS-M18.2.21~~, p. 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 = Wedge factor = 0.6 (DS-M18.2.21, p. 5 & Ref. 5.17)

F_v = Valve safety factor = 1.2 (DS-M18.2.21~~, p. 3~~)

μ = Valve friction factor = 0.4 (DS-M18.2.21~~, p. 3~~)

ϕ = Wedge angle = 7° (Ref. 5.29)

F_{rmax} = Maximum closing stem thrust (DS-M18.2.21~~, p. 5~~)
= 1.15 * F_r = 1.15 (~~6427~~ 21065) = ~~7391~~ 24225 lbf

F_{pack} = Packing friction load = 1250 lbf (Sect. 7.5.1)

F_p = Piston effect load = ~~3156~~ 3388 lbf

F_{dp} = Differential pressure load = ~~2021~~ 16427 lbf

F_k = Effective unseating force = F_{rmax} - F_{pack} - F_p^* - F_{dp}^*
(only closing values) (DS-M18.2.21~~, p. 5~~)
= ~~7391~~ 24225 - 1250 - ~~3156~~ 0 ~~3388~~ - ~~2021~~ 0 ~~16427~~ = ~~964~~ ~~3160~~ 22975 lbf

$$F_w = \text{~~964~~ (3160 / 22975)}(0.6)\,1.2\left(\frac{1 - (0.4\tan 7)}{\sin 7 + (0.4\cos 7)}\right)\left(\frac{0.4}{\cos 7 + (0.4\sin 7)}\right) = \text{~~489~~ ~~1601~~ (11643)} \text{ lbf}$$

* F_p & F_{dp} are assumed = 0. The valve is assumed to be closed with no line pressure, then re-opened.

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 9/10/92

CHECKER: T. Snead DATE: 9/10/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.1 Valve Thrust and Torque Requirements (Continued)

R2

Required Opening Thrust - F_r (DS-M18.2.21~~, p. 1~~)

F_r,Opening = F_{dp} + F_{pack} + F_w - F_p

where:

F_{dp} = Differential Pressure load = ~~14757~~ 14888 lbf

F_{pack} = Packing Friction load = 1250 lbf

F_w = Wedging load = ~~489~~ ~~4/4/95 1601~~ 11643 lbf

F_p = Piston Effect load = ~~3358~~ 3388 lbf

F_r,Opening = ~~14757~~ 14888 + 1250 + ~~489~~ ~~4/4/95 1601~~ 11643 - ~~3358~~ 3388 = ~~13138~~ ~~4/4/95 14351~~ 24393 lbf

Required Operator Torque - A_{tor},Opening and Closing (DS-M18.2.21~~, p. 5~~)

A_{tor} = F_r * SF, where:

F_r,Opening = ~~13138~~ ~~4/4/95 14351~~ 24393 lbf

F_r,Closing = ~~6427~~ 21065 lbf

SF = stem factor = 0.0116 (Sect. 7.3.8)

A_{tor},Opening = ~~13138~~ ~~4/4/95 14351~~ 24393 * 0.0116 = ~~152~~ ~~4/4/95 166~~ 283 ft-lbs

A_{tor},Closing = ~~6427~~ 21065 * 0.0116 = ~~75~~ 244 ft-lbs

mf 4/11/95

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.2 Actuator Capabilities

Opening Operator Torque and Thrust Capability - A_{tor} and A_{thr} (DS-M18.2.21~~, p. 6~~) R2 mj 4/11/95

A_{tor},Opening = MT * OAR * AF * PE * VF ;
A_{thr},Opening = A_{tor},Opening / SF

where:

R1

MT = Motor Starting Torque = 15 ft-lbs (Ref. 5.16, p. F-181)

OAR = Overall Gear Ratio = 38.6 (Ref. 5.22, p. 378446E)

AF = Application Factor = 0.9 (Ref. 5.35.1)

PE = Pullout Efficiency = 0.45 (Ref. 5.35.2)

VF = Voltage Factor = 0.709 = 84.2% available voltage squared or (387.3 volts available for block start / 460 volts)^2, (Ref. 5.19, p. 183)

SF = stem factor = 0.0116 (Sect. 7.3.8)

A_{tor},Opening = 15 * 38.6 * 0.9 * 0.45 * 0.709 = 166 ft-lbs

A_{thr},Opening = 166 / 0.0116 = 14310 lbf

(see pg 24A)

mj 11/4/94

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DTN DATE: 8/13/92

CHECKER: T. Snead TS DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.2 Actuator Capabilities (Continued)

Closing Operator Torque and Thrust Capability - A_{tor} and A_{thr} R2
(DS-M18.2.21~~, p. 6~~) 11/4/95

A_{tor},Closing = MT * OAR * AF * RE * VF ;
A_{thr},Closing = A_{tor},Closing / SF

where: R1

MT = Motor Starting Torque = 15 ft-lbs (Ref. 5.16, p. F-181)

OAR = Overall Gear Ratio = 38.6 (Ref. 5.22, p. 378446E)

AF = Application Factor = 0.9 (Ref. 5.35.1)

RE = Running Efficiency = 0.6 (Ref. 5.35.2)

VF = Voltage Factor = 0.797 = 89.3% available voltage squared or (410.6 volts available for motor start / 460 volts)^2, (Ref. 5.19, p. 183)

SF = stem factor = 0.0116 (Sect. 7.3.8)

A_{tor},Closing = 15 * 38.6 * 0.9 * 0.6 * 0.797 = 249 ft-lbs

A_{thr},Closing = 249 / 0.0116 = 21466 lbf

(see pg 24A)

11/4/94

SUBJ: DESIGN BASIS REVIEW; THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 8/13/92

CHECKER: T. Snead DATE: 8/13/92

7.0 CALCULATIONS (Continued)

7.5 THRUST/TORQUE CALCULATIONS (Continued)

7.5.3 Valve/Operator Weak-Link

Valve Weak-Link (Maximum Allowable Valve Thrust)

The valve manufacturer provided the results of an analysis which determined the maximum allowable opening and closing thrust which can be applied to the valve and identified the specific weak-link component. The results are summarized below:

Opening: 23995 lbf (valve disc)

Closing: 36733 lbf (valve disc)

Since $A_{tor} = A_{thr} * SF$, the corresponding Maximum SBD output torque values are: 23995 * 0.0116 = 278 ft-lbs (Opening), and 36733 * 0.0116 = 426 ft-lbs (Closing).

Operator Weak-Link

The maximum allowable output thrust/torque for an SBD-00 operator is 19600 ~~14000~~ lbf thrust or 250 ft-lbs torque (Ref. 5.35.3, p. 3) and Ref. 5.44. ~~For this valve the equivalent torque for 14000 lbf thrust is 162 ft-lbs. ($A_{tor} = A_{thr} * SF = 14000 * 0.0116$)~~ R2 [illegible] [illegible]

7.6 WALKDOWN DATA

A walkdown has been previously performed and is documented in Reference 5.16.

SUBJECT: DOCUMENTATION OF MOV DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: M. R. Johnson MRJ DATE: 7/25/95

CHECKER : ~~R. G. McColl~~ TVL 7/26/95 TVL DATE: 7/26/95
T. V. LEASE

8.0 SUMMARY OF CALCULATION RESULTS

MOV Tag Number 1-FCV-63-25
Required Thrust/Torque (Section 7.5.1)

Open: 24393 lbf/283 ft-lbs * Close: 21065 lbf/244 ft-lbs **

Seismic Max Thrust/Torque (Ref.5.43): 20,000 lbs/250 ft-lbs

Motor Actuator Capability (Section 7.5.2)
Open Thrust/Torque 15086 lbf/175 ft-lbs
Close Thrust/Torque 20862 lbf/242 ft-lbs

Valve/Actuator Allowables/Weak-Link Analysis (Section 7.5.3)
Limiting Component Open SBD Actuator
Thrust/Torque 19600 lbf/250 ft-lbs
Limiting Component Close SBD Actuator
Thrust/Torque 19600 lbf/250 ft-lbs

Thrust/torque Band Open Min. 24393 lbf/283 ft-lbs *
Max. 19600 lbf/175 ft-lbs

Thrust/torque Band Close Min. 21065 lbf/244 ft-lbs **
Max. 19600 lbf/242 ft-lbs

IS MOV ACCEPTABLE FOR THE APPLICATION? Y (Y/N)
If "no", enter reference to design change document: NR

Comments:
The thrust and torque bands for opening are information only, since the opening torque switch is bypassed in the MOV's control circuit (Sect. 7.4.15).

See Section 9.0 for design basis evaluation and justification, and see Att. 2, pg. 3 for reconciliation justification.
* Based on initial Accident event; the DP is bounded due to the recovery opening DP condition (after mispositioning closed) that occurs after the Accident event.
** Based on Mispositioning condition

THIS PAGE ADDED BY REVISION 2/3
TVL 7/26/95

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-63-25

BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: M. R. Johnson MRJ DATE: 7/25/95

CHECKER : ~~R. G. McColl~~ TVR 7/26/95 TVL DATE: 7/26/95
T. V. LEASE

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.

OPENING STROKE:
The minimum required opening thrust/torque reflects the accident DP conditions (DP is bounded by recovery opening stroke following mispositioning closed) during which the MOV must perform its safety function to open. During the calculated open stroke, the limits (motor and actuator) are exceeded primarily due to the calculated unseating force. However, the DP test was performed at 98% of the DBR accident conditions and the measured forces were much smaller than calculated. Based on testing close to DBR accident conditions, the valve ability to stroke open has been proven. Ample margin exists between the opening limits to the opening reconciled thrust for the valve to perform its safety function. See Attachment 2 for the actual test values.

CLOSING STROKE:
The minimum required closing thrust/torque reflects the mispositioning scenario DP conditions after the MOV has performed its safety function to open and has been inadvertently mispositioned closed. During the calculated closing stroke, the motor capability is exceeded. However, a design parallel flow path is available through 1-FCV-63-26 to provide adequate boration in the event this valve fails in midposition. Additionally, the DP test was performed at 98% of DBR conditions, which included closing under the misposition evaluated pressures and resulted in the measured forces being smaller than the calculated forces. Ample margin exists in the motor capability for the valve to perform its safety function. See Attachment 2 for the actual test values.

This methodology determined that the motor operated valve 1-FCV-63-25 is acceptable from a design standpoint for its application as the BIT Outlet Isolation Valve (Train B).

THIS PAGE ADDED BY REVISION ~~2~~ 3 TVL 7/26/95

EBASCO SERVICES INCORPORATED

SUBJECT: DESIGN BASIS REVIEW AND THRUST/TORQUE CALCULATIONS FOR 1-FCV-63-25

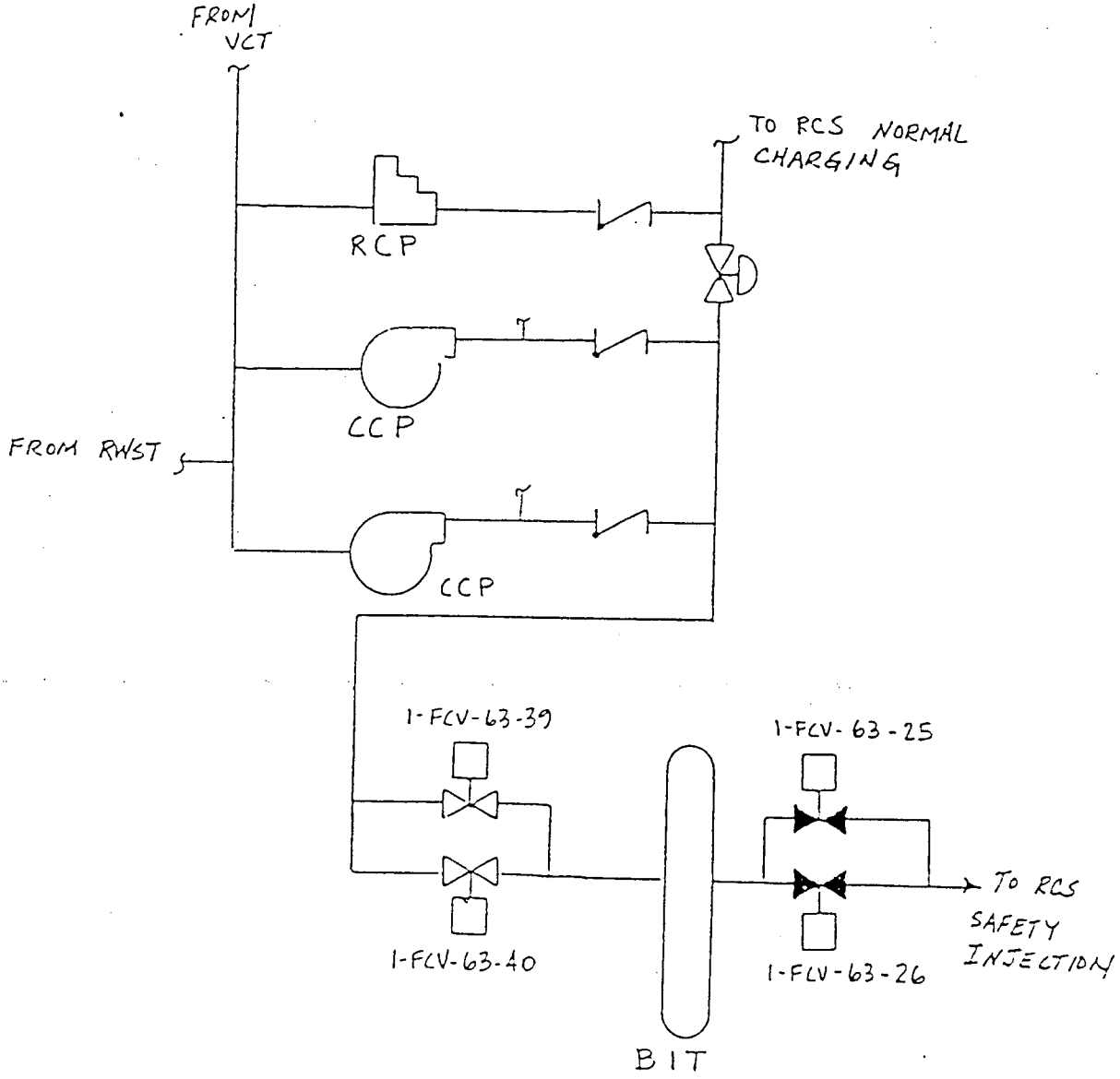
BRANCH/PROJECT IDENTIFIERS: MEB-WBN-63, WBN-63-D053, EPM-DTN-070692

PREPARER: D. Nakahata DATE: 8/13/92

CHECKER: T. Snead DATE: 8/13/92

ATTACHMENT 1

SIMPLIFIED SKETCH



MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

non-shaded is calc input – other is tracking data | 20-Jul-95 | Page 1

Valve UNID: 1-FCV-63-0025-B | Closing control circuit: Limit

1.0 INPUT: General Information

Closing T.S. wired in parallel to closing T.S. Bypass = 90+%

Valve Information					
Manufacturer	WESTINGHOUSE		Stem Diameter	1.2500	inches
Size	4.00	inches	Mean Seat Diameter	3.8700	inches
Pressure Class	1500	psi	Seat Angle (theta)	7.0	degrees
Disc Style	FWG		cos(theta)	0.9925	
Stem Orientation	VERTZ		sin(theta)	0.1219	
Valve Stem Lead	0.3333	lead	Valve Stem Pitch	0.3333	pitch, ins

Actuator Information		References (DP Test Data) (Rims Numbers)
Manufacturer	Limitorque	T53 950106 933
Type	SMB Size: 00	

MOV Design Basis Review Calculation

Calculation Number	EPM-DTN-070692		REVISION 3		
Seat/Wdg Friction Factor (VF)	0.4000		Stem/Stem Nut Friction Factor (SF)	0.0116	
Closing Direction			Opening Direction		
Motor Capability	20862	lbs	Motor Capability	15086	lbs
Motor Capability	242.00	ft-lbs	Motor Capability	175.00	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)	2746	psid	Differential Pressure (DP)	2746	psid
Required Thurst	21065	lbs	Required Thrust	24393	lbs
Required Torque	244.00	ft-lbs	Required Torque	283.00	ft-lbs
Piston Effect	3388	lbs	Piston Effect	3388	lbs
Packing Load	1250	lbs	Packing Load	1250	lbs
DP Load	16427	lbs	Unseating Load	11643	lbs
			DP Load	14888	lbs

Static Test Information

Static Test, Line Pressure	0	psig (ASSUMED)	Stem Factor @ CST	0.0090	
Closing Direction			Opening Direction		
Ave Running Load, [D]	864	lbs	Ave Running Load, [L]	784	lbs
Thrust @ CST [G]	15934	lbs	Unseating Load, [J]	4903	lbs
Torque @ CST [G]	140.99	ft-lbs	Unseating Load, [J]	43.80	ft-lbs
Closing Direction			Closing Direction		
Total Peak, [H]	17229	lbs	Total Peak, [H]	162.42	ft-lbs
Total Final, [I]	16984	lbs	Total Final, [I]	146.91	ft-lbs

DP Test Information

Maximum DP test condition	2700	psid CVCS Pump	Flow, Full Open	430	gpm
			Line Pres., Full Open	1055	psig
Closing Direction			Opening Direction		
Req'd Closing Thrust [F]	10716	lbs	Measured DP Thrust, Opening [K]	5113	lbs
Req'd Closing Torque [F]	90.79	ft-lbs	Measured Unseating Thrust, Opening [J]	7949	lbs
Thrust @ CST Closing [G]	15969	lbs	Measured DP Torque, Opening [K]	49.73	ft-lbs
Torque @ CST Closing [G]	131.85	ft-lbs	Measured Unseating Torque, Opening [J]	72.09	ft-lbs
Closing Direction			Closing Direction		
Total Peak, [H]	17159	lbs	Total Peak, [H]	150.11	ft-lbs
Total Final, [I]	16949	lbs	Total Final, [I]	132.77	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: MJ 7/20/95

CHECK BY: TVD 7/26/95

THIS PAGE ADDED BY REVISION 3

MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

29-Aug-95 | Page 2

Valve UNID: 1-FCV-63-0025-B

2.0 Closing Stroke Reconciliation

DBR Parameters	DBR Calculation		Reconciled Parameters	Reconciled Test Data	
Minimum Required Thrust :	21065	lbs	Reconciled Thrust :	10885	lbs
Minimum Required Torque :	244.00	ft-lbs	Reconciled Torque :	92.22	ft-lbs
Piston Effect :	3388	lbs	Piston Effect (from DBR Calculation) :	3388	lbs
Packing Load :	1250	lbs	Average Packing Load (Section 8.0, step 3A) :	824	lbs
DP Load :	16427	lbs	DP Load :	6673	lbs
Seat Wedge Friction Factor (VF) :	0.4000		Seat Contact, Seat Wedge Friction Factor (VF) :	0.2000	
	Calculated Parameter:		Load Sensitive Behavior (ROL) :	N/A	
Comparison of Stem Factors					
Stem Factor (SF) DBR Calculation :	0.0116		SF @ Static CST [G] :	0.0088	
			SF @ DP CST [G] :	0.0083	
			SF @ Required Closing Th. DP Test [F] :	0.0085	

MARGIN EVALUATIONS OF DP TEST DATA AND DBR CALCULATION DATA

CST Thrust Margin :	5084	lbs	CST Torque Margin :	40	ft-lbs
CST Thrust Margin :	46.7	%	CST Torque Margin :	43.0	%
Methodology Margin :	9092	lbs	Thrust Capability Margin :	7627	lbs
Methodology Margin :	75.9	%	Thrust Capability Margin :	63.7	%
			Torque Capability Margin :	141	ft-lbs
			Torque Capability Margin :	138.6	%

3.0 Opening Stroke Reconciliation

* BASED ON POINT : DP [J]

DBR Parameters	DBR Calculation		Reconciled Parameters	Reconciled Test Data	
Minimum Required Thrust :	24393	lbs	Reconciled Thrust :	8070	lbs
Minimum Required Torque :	283.00	ft-lbs	Reconciled Torque :	73.19	ft-lbs
Piston Effect Load :	3388	lbs	Piston Effect (from DBR Calculation) :	3388	lbs
Packing Load :	1250	lbs	Average Packing Load (Section 8.0, step 3A) :	824	lbs
Unseating Load :	11643	lbs	Unseating (based on DP [J]) :	7949	lbs
DP Load :	14888	lbs	DP Load (based on DP [K]-Ave Pk Load + PE) :	7750	lbs
Seat Wedge Friction Factor (VF) :	0.4000		Seat Wedge Friction Factor (VF) :	0.2453	
Comparison of Stem Factors					
Stem Factor (SF) :	0.0116		SF @ Max Req'd Opening Th :	0.0091	

MARGIN EVALUATIONS OF DP TEST DATA AND DBR CALCULATION DATA

Methodology Margin :	15515	lbs	Thrust Capability Margin :	6208	lbs
Methodology Margin :	174.8	%	Thrust Capability Margin :	69.9	%
			Torque Capability Margin :	94	ft-lbs
			Torque Capability Margin :	117.4	%

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

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

PREPARED BY: MJ 8/29/95
CHECK BY: TVK 8/29/95

THIS PAGE ADDED BY REVISION 3

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		
26-Jul-95		Page 3
	Valve UNID:	
	1-FCV-63-0025-B	

5.0 Remarks:

A. Differential Pressure (DP) testing was performed with Charging Pump (CVCS) as pressure source, with supply from RWST, and system line up for Boron Injection through 1-FCV-63-25 and -26 to an open vessel.

B. Differential Pressure (DP) testing was performed in both directions at 98% of the DP reflected in WBN Design Basis Review (DBR) Calculation.

C. The seat wedge friction factors (VF) for both opening and closing are low, based on low DP effect forces experienced during the DP test. This results in low calculated reconciled thrust. The DP Load components are much smaller than the values calculated in the DBR, and as used to calculate the VFs.
These low measured DP Loads denote conservative values when compared to the DBR calculation methodology.
The VFs do not represents typical design values, but are the results from actual DP testing.

D. The stem friction factors (SF) for both closing and opening are conservative.

E. The "N/A" for the load sensitive behavior (ROL) term indicates that this issue does not apply to this limit closed valve.

F. The opening reconciled thrust was calculated to result in the most conservative value (DP unseating force [J]).

G. For Mispositioning (Closing) Scenario Evaluation:
The DP test was performed at 98% of design DP and represents the actual conditions the valve will experience.
The closing reconciled thrust is 10885 lbf which is less than the closing limits, especially the closing motor capability, and actuator rating. Based on the DP test results (98% of DBR conditions and flow isolation) ample margin exists from the test results between the closing reconciled thrust to the upper limits (actuator thrust, motor torque).

H. For Accident (Opening) Evaluation: (DP based on recovery stroke which bounds the opening accident DP)
The DP test was performed at 98% of design DP and represents the actual conditions the valve will experience.
The opening reconciled thrust is 8070 lbf which is less than the opening limits, especially motor capability, and actuator rating. Based on the DP test results (98% of DBR conditions and flow isolation) ample margin exists in the motor capability to open the valve during accident conditions.

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

6.0 Conclusions:

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

B. This valve has been operated against 98% of the worst case DP conditions reflected in the DBR calculation. By successful stroking of the valve 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: 7/24/95
CHECKED BY: 7/27/95

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MOV RECONCILIATION
WATTS BAR NUCLEAR PLANT UNIT 1

20-Jul-95 Page 4

Valve UNID: 1-FCV-63-0025-B

8.0 Determination of Packing Load

1	Packing Load, Static Test Open & Close, lbs (Line Press = 0)		
	864	= ARLSC = Ave Running Load Static Close, lbs. "D"	
	784	= 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)		
	864	= Pack Load Static Test Close = ARLSC - PNLST	
	784	= Pack Load Static Test Open = ARLSO - PNLST	
3A	Estimated Packing Load Static Test, lbs (Line Pressure, STLP is not known)		
	824	= (ARLSC + ARLSO) / 2 = ("D" + "L") / 2	
3B	Estimated Piston Effect Load Static Test, lbs (Line Pressure is not known)		9.0 B PERCENTAGE DB DP
	PNLST' = 40	= (ARLSC - ARLSO) / 2 = ("D" - "L") / 2	98.32%
3C	Estimated Static Line Pressure from Piston Effect Load, lbs (STLP')		
	STLP' = 33	= (4 x PNLST') / (PI x E2 x E2)	9.0 A OPENING RECONCILED EVALUATION

STATIC [J]	4972	lbs.
DP [J]	8070	lbs.
DP [K]	5186	lbs.

9.0 Miscellaneous Intermediate Calculations

	Point J DP:	Point K DP:	Point J STATIC:	
Max Req'd Opening Thrust to overcome DP, POINTS [J & K]:	7949	5113	4903	lbs
Max Req'd Opening Torque to overcome DP, POINTS [J & K]:	72.09	49.73	43.80	ft-lbs
Maximum Stem Factor (SF), POINTS [J] or [K]:	0.0091	0.0097	0.0089	= SF
Max Req'd Opening Thrust to overcome DP, GREATER OF POINTS [J & K]:	7949	lbs		
Piston Effect based on DP Test Line Pressure (Full Open):	1295	lbs		

10.0 Equipment Error determination

OSS - Thrust Sensor / Equip Error	YES	9.8	% Reading		TTC 1.8%TH, 0.9%TOR of full scale (including Reposition Eff)			
TTC - Thrust Sensor / Equip Error		0.0	% Reading		SMB SIZE =	0		
TTC - Torque Sensor / Equip Error		0.0	% Reading		000	250	lbs.	
TTC - Thrust Sensor / Equip Error		0	lbs. ---->		00	437	lbs.	
TTC - Torque Sensor / Equip Error		0.00	ft-lbs. -->		0	748	lbs.	
SS - Thrust Sensor / Equip Error		0	% Capacity		1	1403	lbs.	
SS - Thrust Sensor / Equip Error		0	lbs.		2	1870	lbs.	
SS - Thrust Sensor / Equip Error		0.0	ft-lbs.		3	3740	lbs.	
MOVATS Dia Sys / Equip Error	3000	2.0	% Reading		000	2.06	ft-lbs	
T. S. Repeatability Applied	NO	0	% Reading	(Table below)	00	4.47	ft-lbs	
TTC - Repositioning Effect		0.0	% Reading		0	12.05	ft-lbs	
					1	18.92	ft-lbs	
Total EE (3000, TTC, TS Repeat)		0.00	% R TH / TOR		2	25.75	ft-lbs	
		0.00	lbs. / ft-lbs		3	61.80	ft-lbs	

Summation of Equipment Error (EE) without T. S Repeatability				T. S. Repeatability evaluation			
Equipment Error =	10.0	Percent		As Left TSS =	DP TST TOR =		
				N/A	N/A		
				CASE EVALUATION, As Left			%
				> 1.00	CASE 1	>50 '#	5
				> 1.00	CASE 2	<50 '#	10
				1.00	CASE 3	>50 '#	10
				1.00	CASE 4	<50 '#	20

REFERENCES:
T07930114889, MOVATS ER 5.0
T07930114890, TELEDYNE TR-A716-A-1
WBN-VTM-L200-0010, section 0350

PREPARED BY: 7/24/95

CHECK BY: 7/26/95

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Data Package: Page ____ of ____ PAGE 064 OF 118 6/26/95

6.1.1 BIT Outlet Isolation Valves 1-FCV-63-25 and 1-FCV-63-26 (Continued)

[30] PERFORM MOVATS open stroke testing for 1-FCV-63-25 as follows: (Continued)

[d] WHEN 1-FCV-63-25 stops in the open direction, THEN

SAVE MOVATS data in accordance with MI-0.006, and CN-2

RECORD the following system data:

* B: Backup Gauge

PARAMETER	INSTRUMENT	LOCATION	DATA	UNITS
OPERATIONAL CCP SUCTION PRESSURE	(4.4.[2]) 1-PI-62-109 [] 1-PI-62-105 ~~[]~~	A4U/692 1-L-108A or 1-L-112B	20	PSIG
CHARG HDR FLOW CONT	1-FI-62-93A	Main Control Room 1-M-5	0	GPM
CHARG HDR PRESS IND	1-PI-62-92A	Main Control Room 1-M-5	550	PSIG
CVCS CHG PMP TO BIT FLOW	1-FI-63-170	Main Control Room 1-M-6	430	GPM
SIS B INJ TK OUTLET PRESSURE	1-PI-62-106 ~~1-PI-63-35~~ MH 6/26/95	Main Control Room 1-M-6	1050	PSIG
1-FCV-63-25 & 1-FCV-63-26 DOWNSTREAM PRESSURE	PI-1	1-TV-63-677-S IC/734 AZ 295 No. 4 Acc Rm	1055	PSIG
SEAL WATER FILTER OUTLET PRESS	1-PI-62-65	PANEL 1-L-46 A6T/713	12	PSIG
CCP MINIFLOW RECIRCULATION FLOW DP	DP-1 (1-FE-62-257)	A4U/692 Pipe Chase	130	In. WG
Miniflow Line Contact/Surface Temperature	TI-1	1-FE-62-257 A4U/692 Pipe Chase	82	°F

DN-12

B = 1055

RDM

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Data Package: Page _____ of _____ PAGE 066 OF 143 Date 6/26/95

6.1.1 BIT Outlet Isolation Valves 1-FCV-63-25 and 1-FCV-63-26 (Continued)

[33] PERFORM MOVATS close stroke testing for 1-FCV-63-25 as follows: (Continued)

[d] WHEN 1-FCV-63-25 stops in the close direction, THEN

SAVE MOVATS data in accordance with MI-0.006, and CN-2

RECORD the following system data:

* B = Backup Gauge

PARAMETER	INSTRUMENT	LOCATION	DATA	UNITS
OPERATIONAL CCP SUCTION PRESSURE	(4.4.[2]) 1-PI-62-109 [] 1-PI-62-105 [X]	A4U/692 1-L-108A or 1-L-112B	20	PSIG
CHARG HDR FLOW CONT	1-FI-62-93A	Main Control Room 1-M-5	45	GPM
CHARG HDR PRESS IND	1-PI-62-92A	Main Control Room 1-M-5	1150	PSIG
CVCS CHG PMP TO BIT FLOW	1-FI-63-170	Main Control Room 1-M-6	0	GPM
SIS B INJ TK OUTLET PRESSURE	1-PI-62-106 ~~1-PI-63-35~~	Main Control Room 1-M-6	2700	PSIG
1-FCV-63-25 & 1-FCV-63-26 DOWNSTREAM PRESSURE	PI-1	1-TV-63-677-S IC/734 AZ 295 No. 4 Acc Rm	0	PSIG
SEAL WATER FILTER OUTLET PRESS	1-PI-62-65	PANEL 1-L-46 A6T/713	12.5	PSIG
CCP MINIFLOW RECIRCULATION FLOW DP	DP-1 (1-FE-62-257)	A4U/692 Pipe Chase	320	In. WG
Miniflow Line Contact/Surface Temperature	TI-1	1-FE-62-257 A4U/692 Pipe Chase	82	°F

DN-12

B = 0

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WBN 0, 1, 2	MOVATS TESTING OF MOTOR OPERATED VALVES	MI-0.006 Revision 7 Page 31 of 43

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APPENDIX B
Page 1 of 7

MOV TEST DATA SHEET

VALVE ID	1-MVOP-063-0025 B	TYPE OF TEST: STATIC ☑ DYNAMIC ☐

TABLE B-1: ADMINISTRATIVE INFORMATION

PERFORMANCE SECTIONS		RELATED TESTS AND DATA		
Motor Current Signature Acquisition	☒	Pre Maint LLRT Required?	YES ☐	NO ☑
Switch Monitor Signature Acquisition	☒	Post Maint LLRT Required?	YES ☐	NO ☑
Spring Pack Signature Acquisition	☒	Post Maint Stroke Required?	YES ☑	NO ☐
Spring Pack Calibration	N/A ☐	Stroke Time Test Required?	YES ☑	NO ☐
Torque-Thrust Setpoint Adjustments	N/A ☐	Preventive Maint Required?	YES ☐	NO ☑
Torque-Thrust Cell Signature Acquisition	N/A ☐	Rapid Impact Overload Test Required?	YES ☐	NO ☑
Quick Stem Sensor Signature Acquisition	☒			
Smart Stem Signature Acquisition	N/A ☐	Actuator Mounting Torque: *		ft-lbs
Other (specify):		Actuator Mount Torque Source Document: * Actuator Not being removed		
Vendor Calculation Used in Section 4.3: MOVATS ER 50 Rev 8 TELEDYNE TRAILO-A1 DCA 35993-04		Planner Donnie Wayman		
Engineer				

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WBN 0, 1, 2	MOVATS TESTING OF MOTOR OPERATED VALVES	MI-0.006 Revision 7 Page 34 of 43

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APPENDIX B
Page 4 of 7

VALVE ID	1-MVOP-063-0025 B

TABLE B-6: MOVATS SIGNATURE DATA

T 86 through T 90		T 81 through T 85	
CLOSING STROKE THRUST (lbs)		OPENING STROKE THRUST (lbs)	
A. Zero (offset)	Ø	J. Unseating	4903
B. Static Friction Brk Point	1261	K. DP Effect	N/A
C. Initial Running Load	911	L. Post DP/Avg Running Load	784
D. Average Running Load	864	M. Final Running Load	875
E. Final Running Load	840	N. Contr Sw Trip (Static Only)	N/A
F. DP Effect	N/A	O. Total Peak (Static Only)	
G. Control Switch Trip	15934	P. Total Final (Static Only)	
H. Total Peak	17229		
I. Total Final	16984		
CLOSING STROKE TORQUE (ft-lbs)		OPENING STROKE TORQUE (ft-lbs)	
A. Zero (offset)	Ø	J. Unseating	43.80
B. Static Friction Brk Point	11.41	K. DP Effect	N/A
C. Initial Running Load	8.21	L. Post DP/Avg Running Load	10.82
D. Average Running Load	8.25	M. Final Running Load	11.41
E. Final Running Load	8.66	N. Contr Sw Trip (Static Only)	N/A
F. DP Effect	N/A	O. Total Peak (Static Only)	
G. Control Switch Trip	140.99	P. Total Final (Static Only)	
H. Total Peak	162.42		
I. Total Final	146.91		

Engineer [signature] Verifier ____

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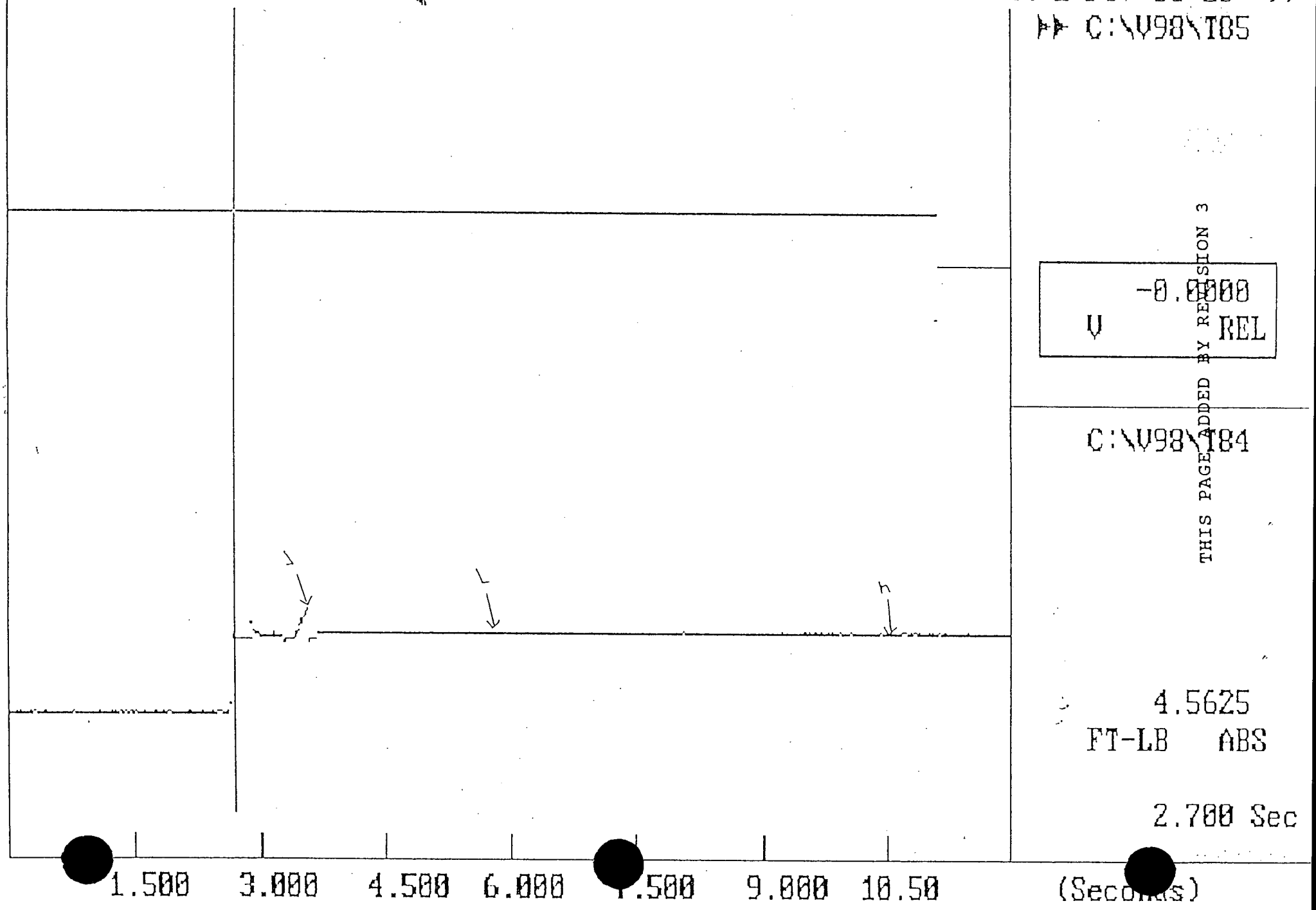
Static C-O

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>



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Static C-U

ITI MOVATS MATH PROGRAM

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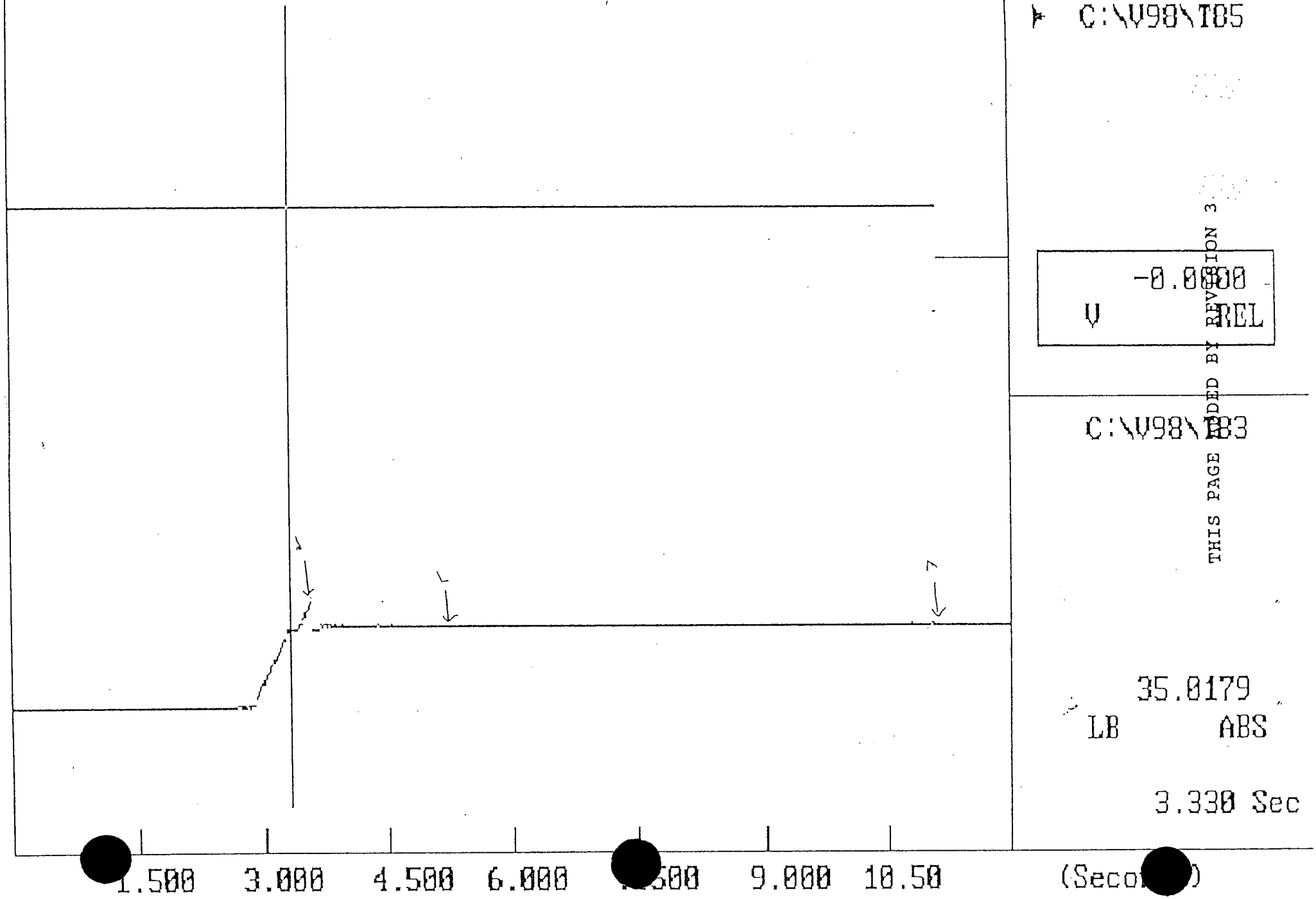

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ATTACHMENT 3

PAGE 100 OF 17

EPM-DTN-070692
T53 950106 933

Static U-C

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>

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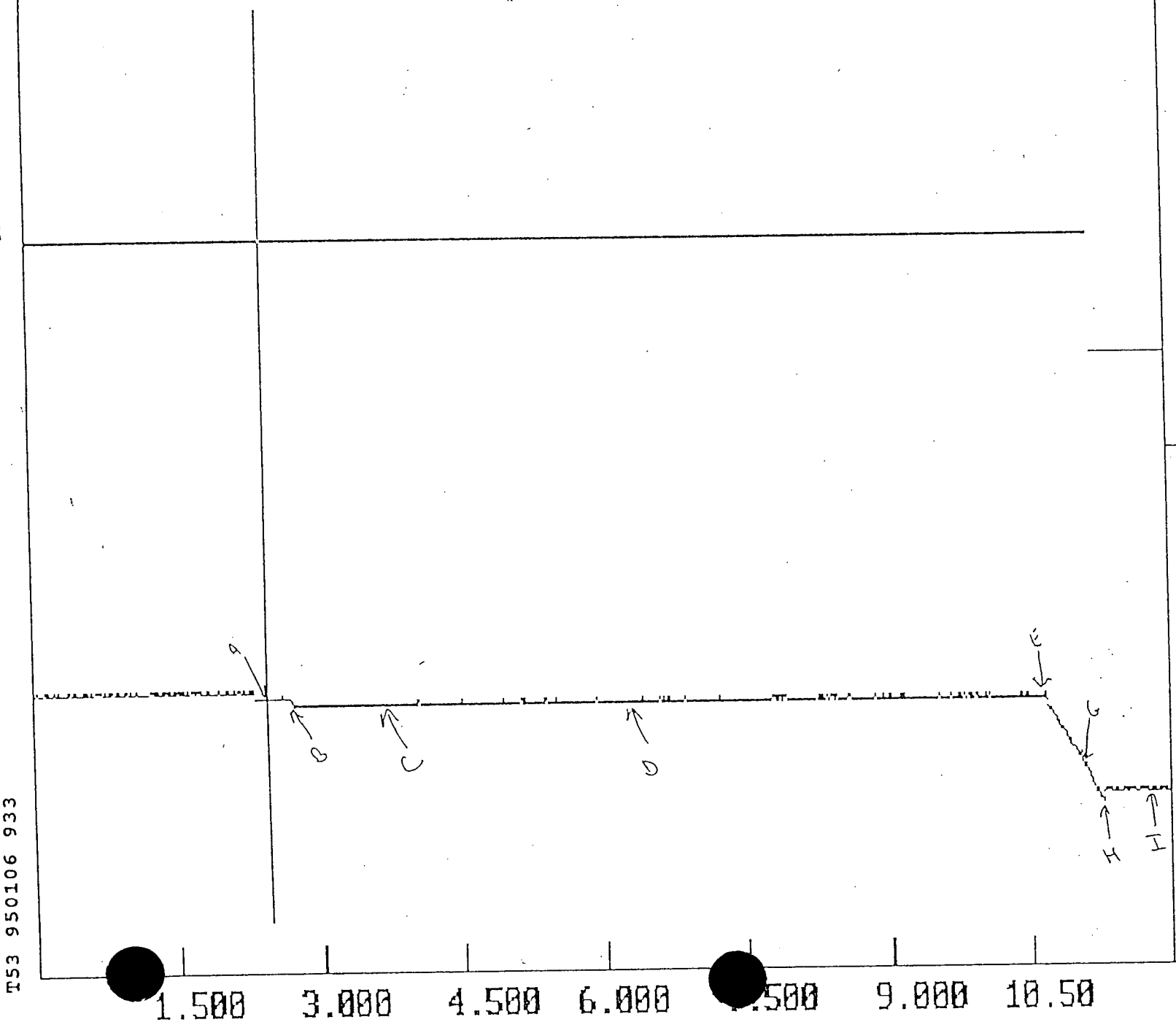

-0.0000
V REL

C:\V98\T89

-0.4563
FT-LB ABS

2.460 Sec

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Static 0-C

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>

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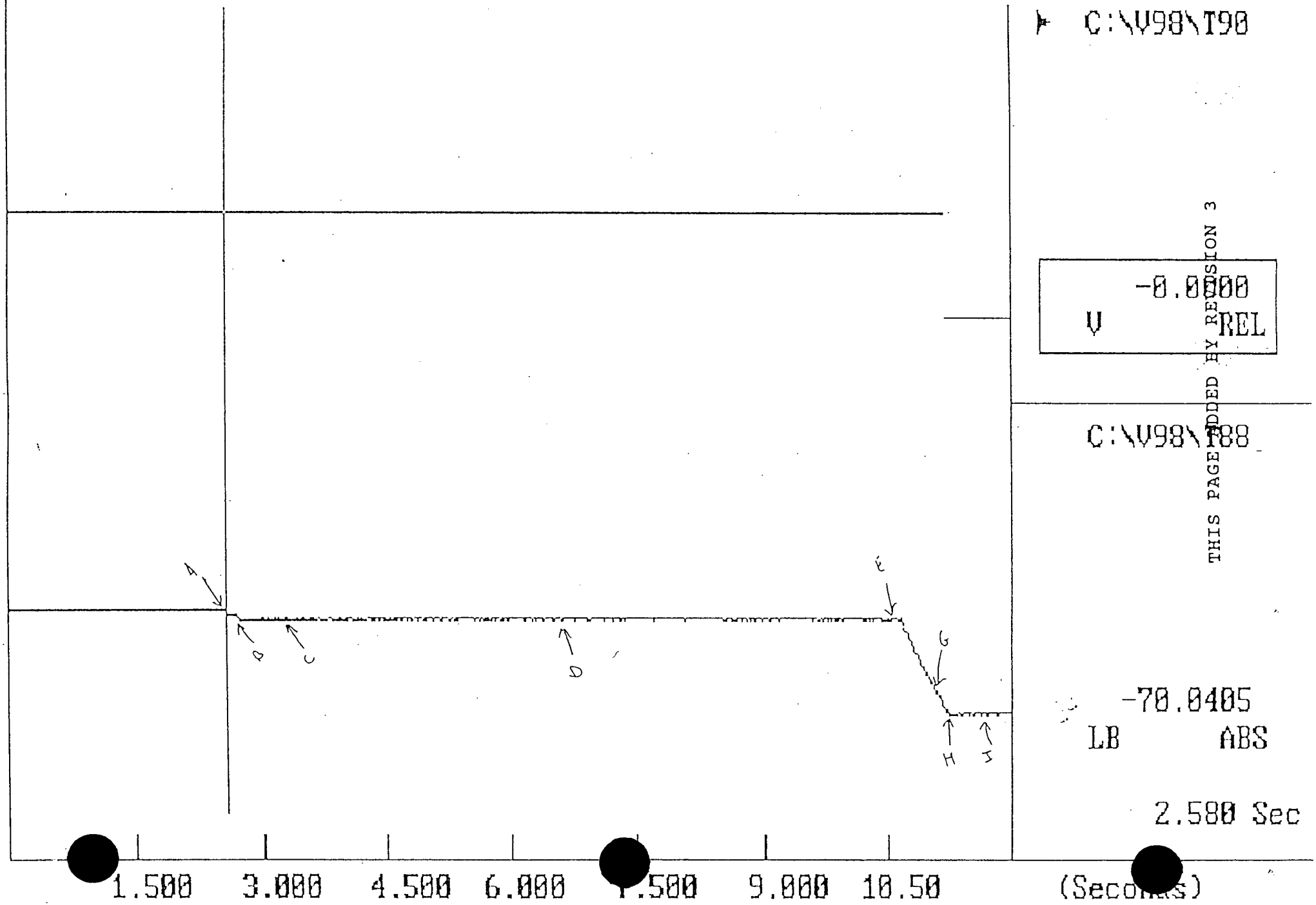

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WBN 0, 1, 2	MOVATS TESTING OF MOTOR OPERATED VALVES	MI-0.006 Revision 7 Page 34 of 43

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APPENDIX B
Page 4 of 7

VALVE ID	1-MVOP-063-0025-B

TABLE B-6: MOVATS SIGNATURE DATA

T 96 through T 100		T 91 through T 95	
CLOSING STROKE THRUST (lbs)		OPENING STROKE THRUST (lbs)	
A. Zero (offset)	Ø	J. Unseating	7949
B. Static Friction Brk Point	2206	K. DP Effect	5113
C. Initial Running Load	2031	L. Post DP/Avg Running Load	649
D. Average Running Load	1961	M. Final Running Load	649
E. Final Running Load	1996	N. Contr Sw Trip (Static Only)	N/A
F. DP Effect	10716	O. Total Peak (Static Only)	
G. Control Switch Trip	15969	P. Total Final (Static Only)	
H. Total Peak	17159		
I. Total Final	16949		

CLOSING STROKE TORQUE (ft-lbs)		OPENING STROKE TORQUE (ft-lbs)	
A. Zero (offset)	Ø	J. Unseating	72.09
B. Static Friction Brk Point	25.09	K. DP Effect	49.73
C. Initial Running Load	21.44	L. Post DP/Avg Running Load	3.94
D. Average Running Load	21.56	M. Final Running Load	3.94
E. Final Running Load	21.44	N. Contr Sw Trip (Static Only)	N/A
F. DP Effect	90.79	O. Total Peak (Static Only)	
G. Control Switch Trip	131.85	P. Total Final (Static Only)	
H. Total Peak	150.11		
I. Total Final	132.77		

Engineer [signature] Verifier ____

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DP 0-C

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>-

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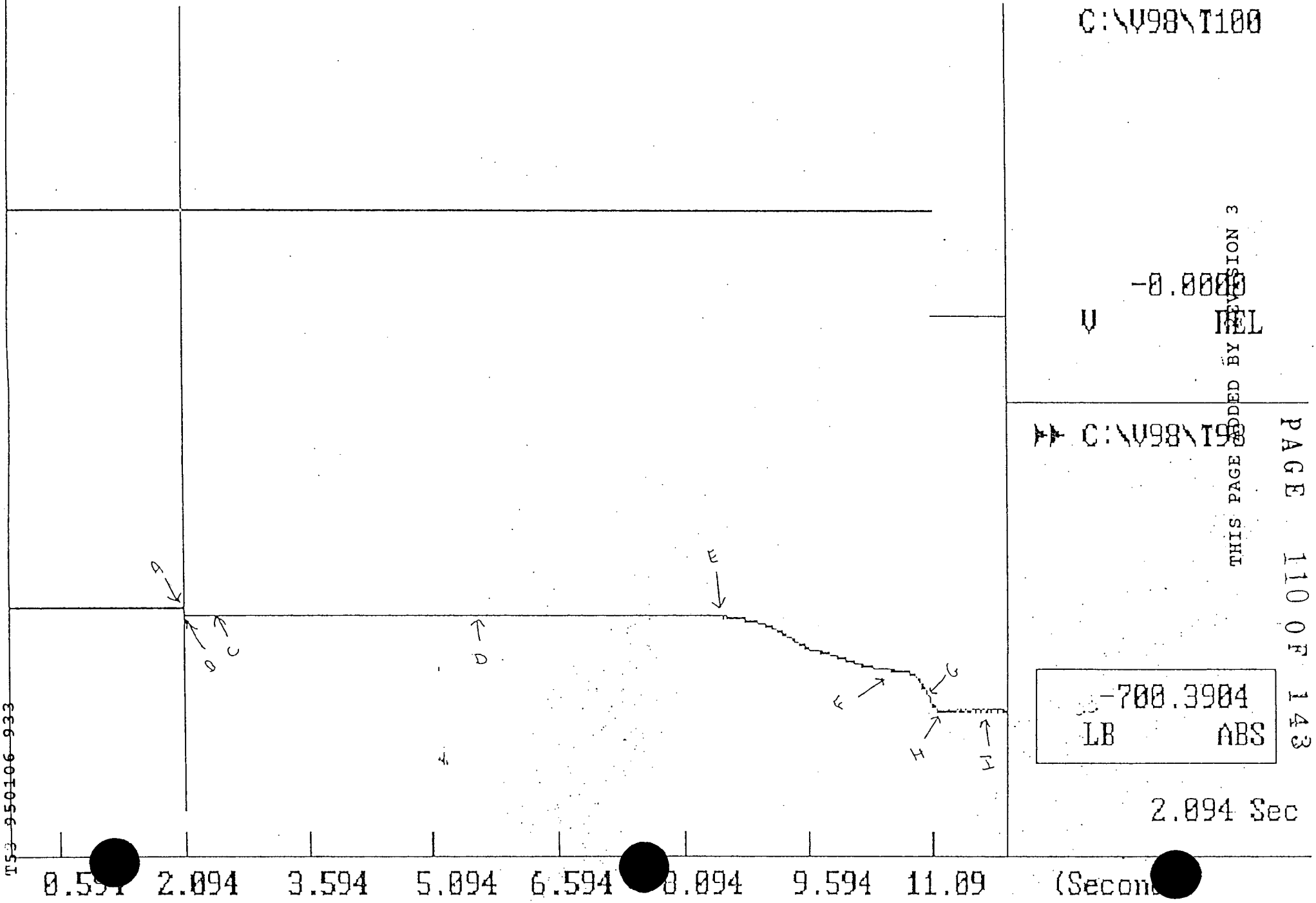

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DP 0-C

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>-

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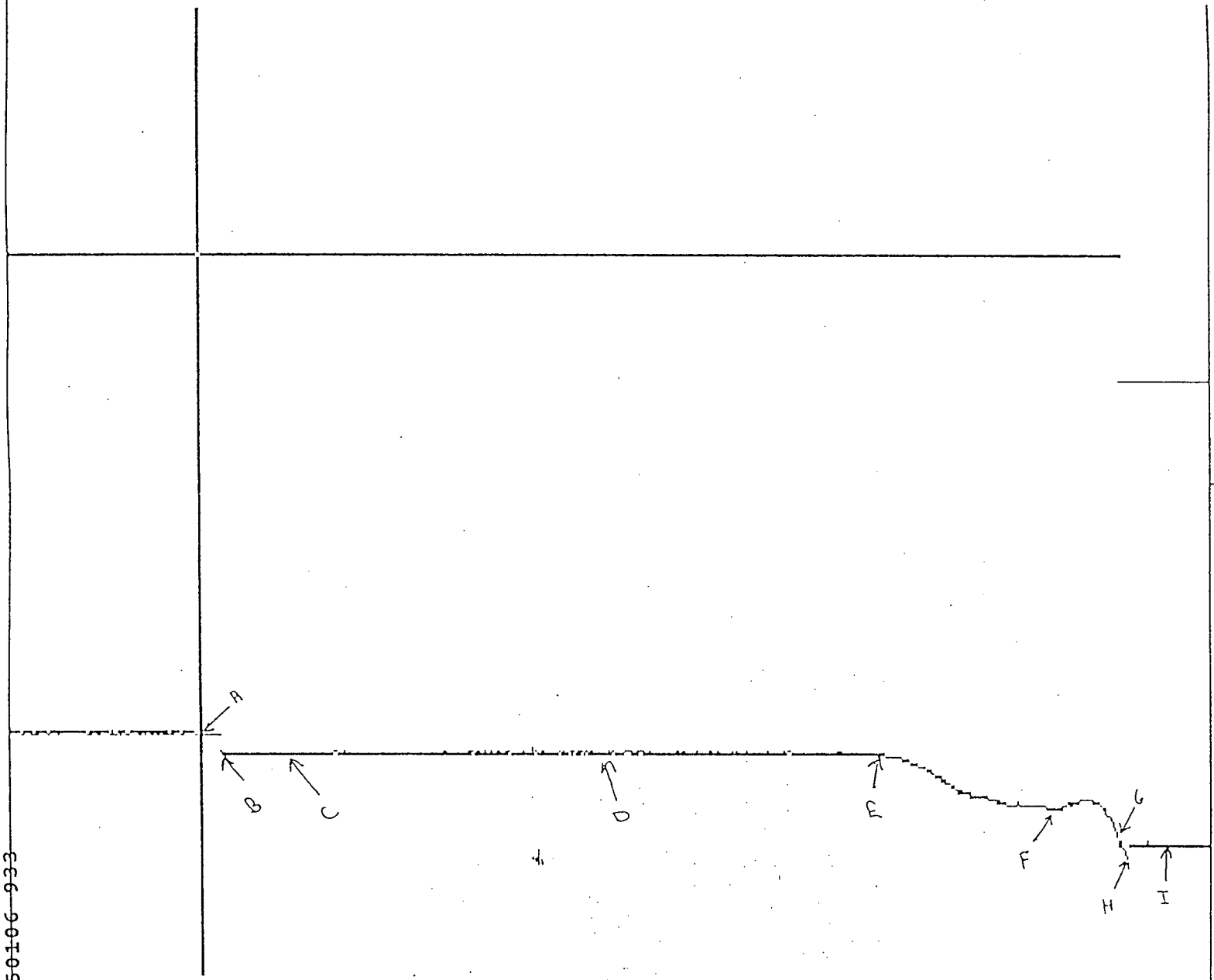

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V REL

C:\V98\T99

1.3687
FT-LB ABS

1.920 Sec

1.500 3.000 4.500 6.000 7.500 9.000 10.50 (Second

ATTACHMENT 3

EPM-DTN-070692
~~TS3-950106-933~~

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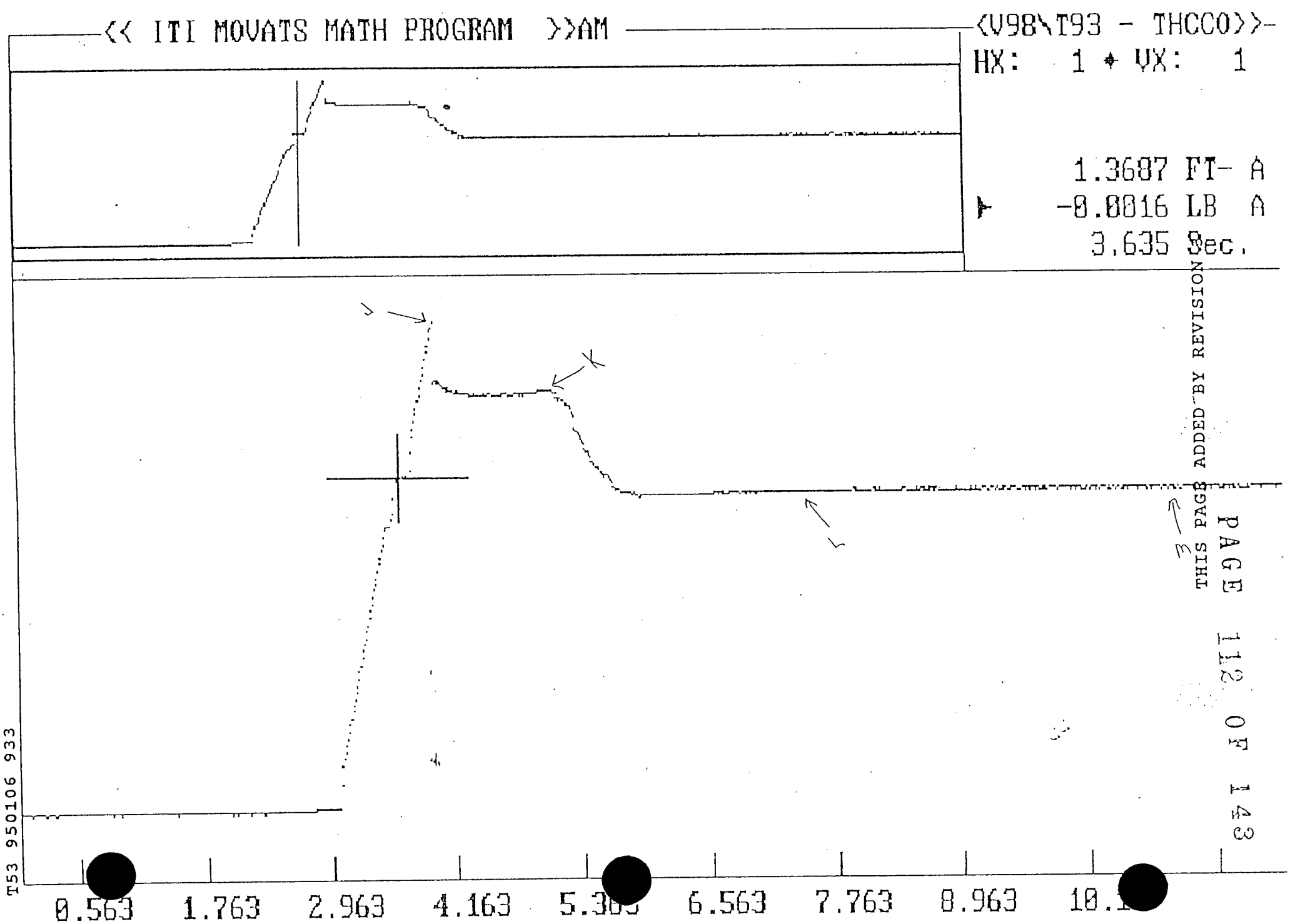
Unseating thrust - 1.1



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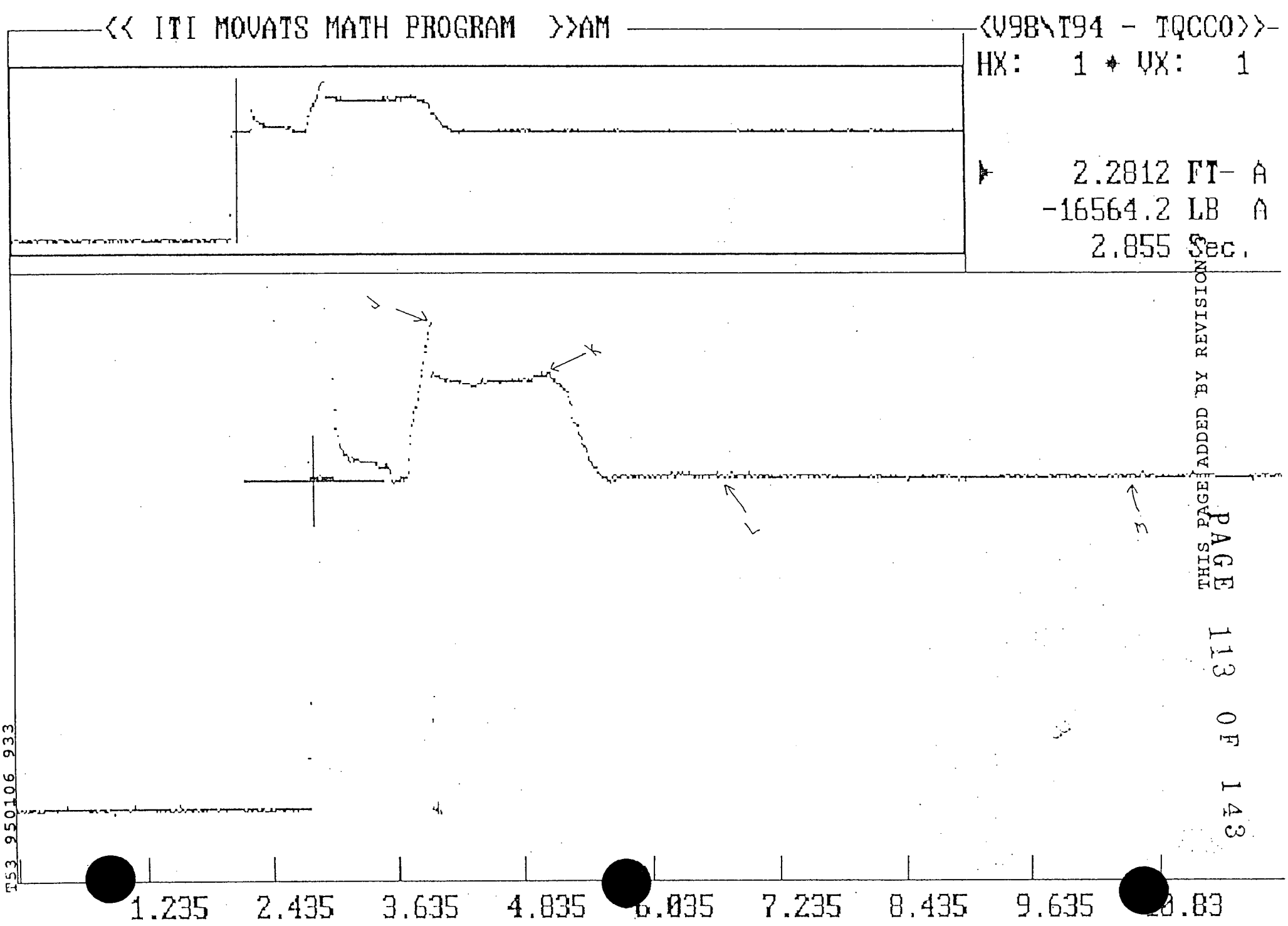
unseating torque - PP



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ITI MOVATS MATH PROGRAM

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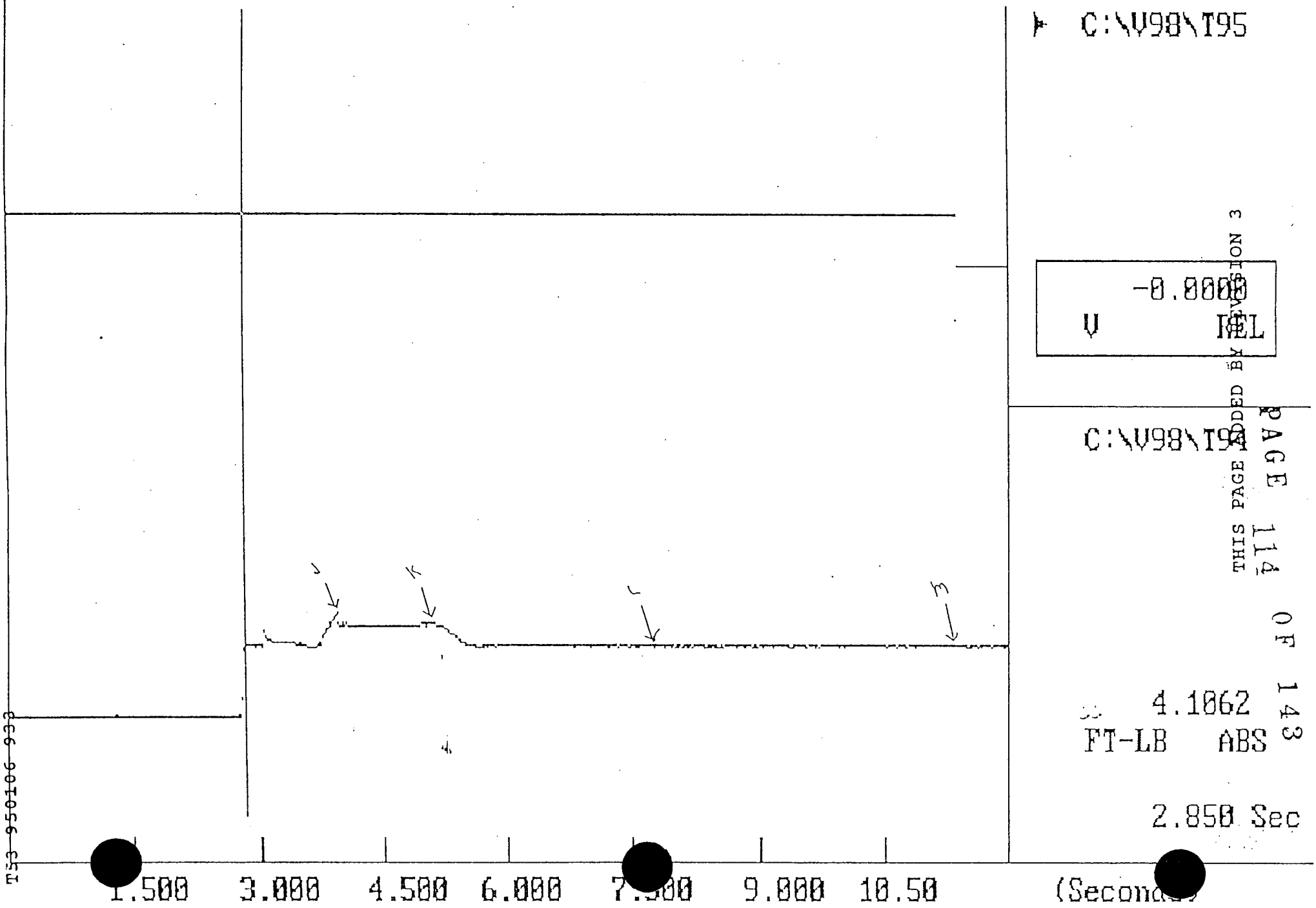

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DP O-C
C-O

ITI MOVATS MATH PROGRAM

<< 1-FCV-63-25- >>-

C:\V98\T95

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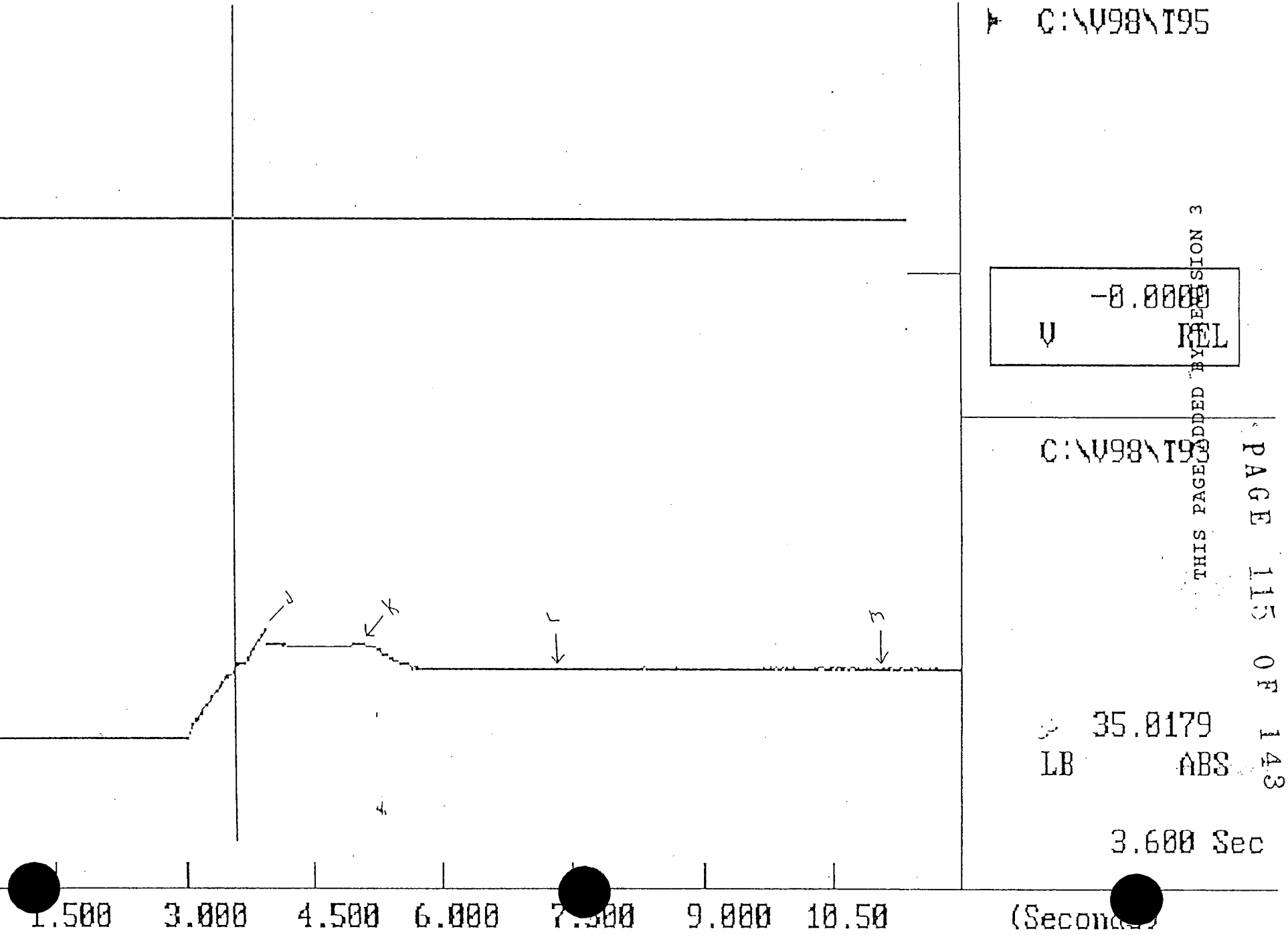
V REL

C:\V98\T95

35.0179
LB ABS

3.600 Sec



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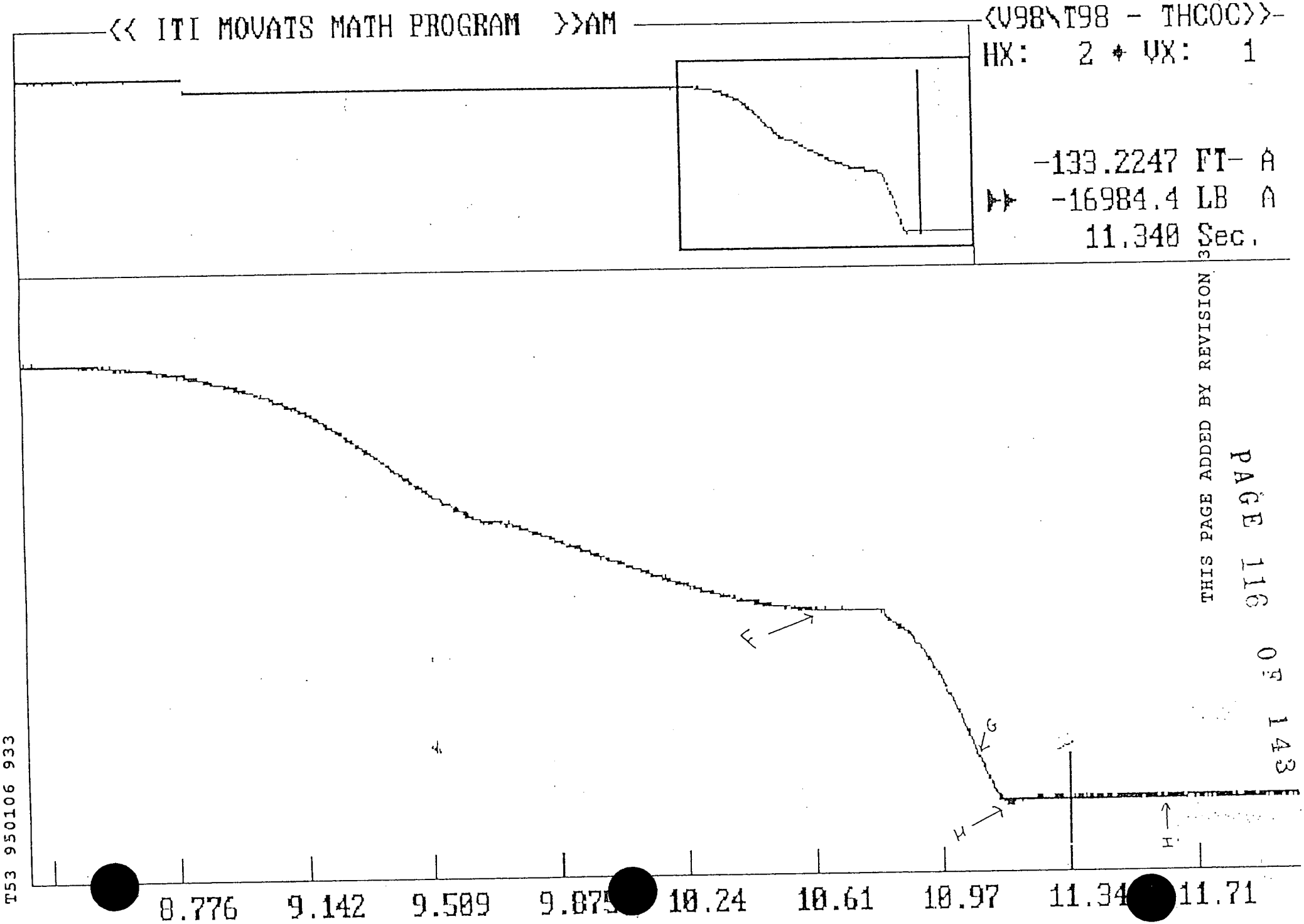

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DP O-C
Seat's area

<< ITI MOVATS MATH PROGRAM >>AM <V98\T99 - TQCOC>>-

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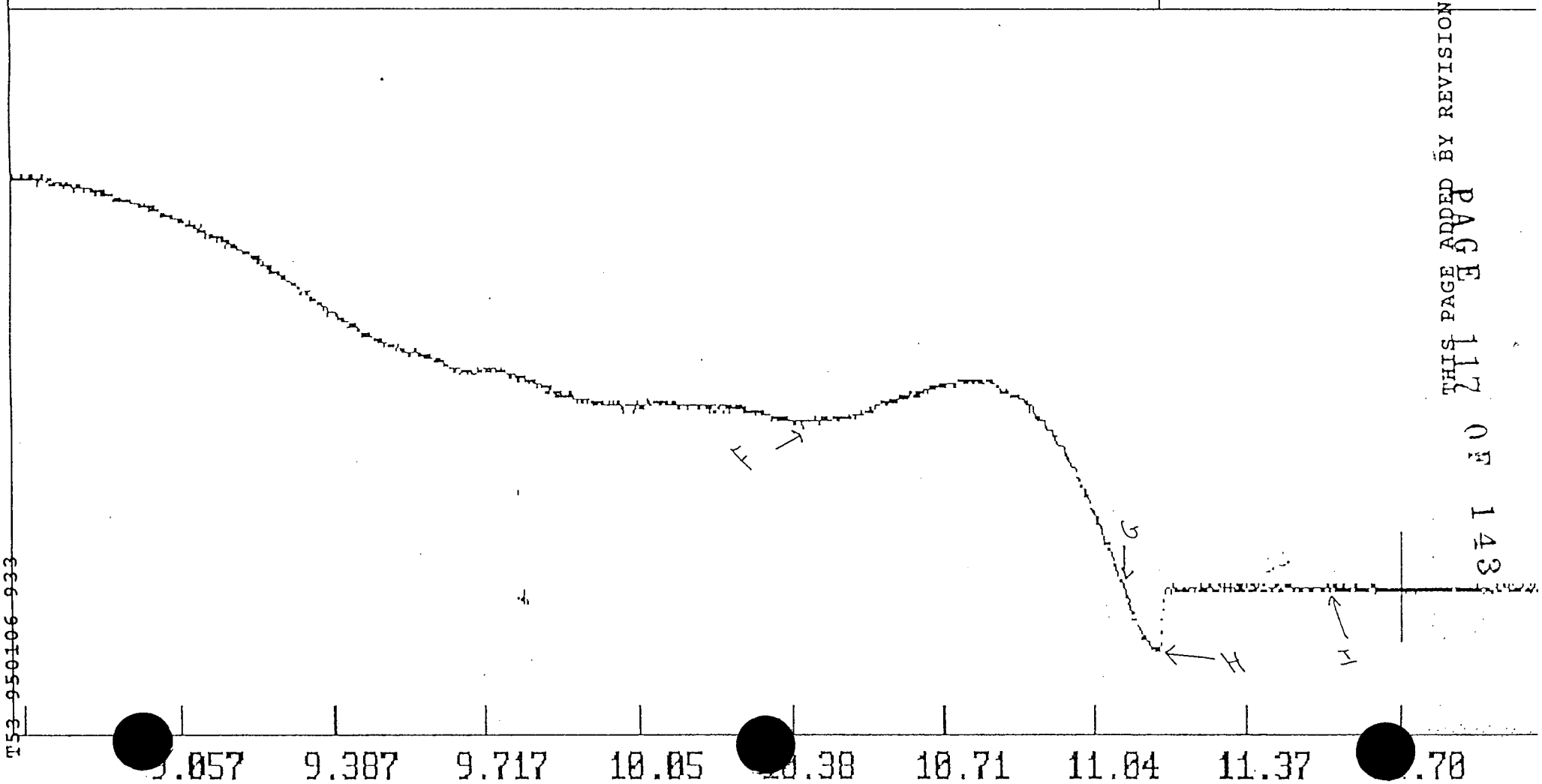
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