ENCLOSURE 1
WATTS BAR NUCLEAR PLANT (WBN)
CALCULATION WBN-EEB-MS-TI07-0005
125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATION

9206260087 920615
PDR ADOCK 05000390
A PDR

QA Record

EBASCO SERVICES INCORPORATED
DNE CALCULATIONS

TITLE: 125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATIONS	Plant/Unit WBNP/Units 1 & 2
[redacted]RING ORGANIZATION NE, Ebasco Services Inc.	KEY NOUNS (Consult RIMS DESCRIPTORS LIST) Short-Circuit Currents, Appendix R
BRANCH/PROJECT IDENTIFIERS WBN-EEB-MS-TI07-0005	Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.

Rev	(for RIMS' use)	RIMS accession number
R0	900329D0004	B2690 0202 409
R4	920316A0002	B18 920214 271
R5	MAR 3 1 1992	B18 '92 0319 263
R6	APR 2 7 1992 (402)	B18 '92 0422 255

APPLICABLE DESIGN DOCUMENT(S)
WB-DC-30-27 R0
DIM-WB-DC-30-27-1

SAR SECTION(S) 8.3.2 | UNID SYSTEM(S) 236

Revision 0	R4	R5	R6
ECN NO.(or indicate Not Applicable) N/A J.I.H. 02-13-92	See Rev Log	SEE REV LOG	SEE REV LOG
Prepared See Revision 0	02-13-92	Philip Barlow 3/18/92	Philip Barlow 4/21/92
Checked See Revision 0	2-13-92	3-18-92	4-21-92
Reviewed See Revision 0	D R Hundley 2-13-92	D R Hundley 3-18-92	D R Hundley 4-21-92
Approved See Revision 0	C.C. Lyke	C.C. Lyke	C.C. Lyke
Date See Revision 0	C.C. Lyke for MCB 2/14/92	for MCB 3/18/92	for MCB 4/22/92
[redacted]ORM 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

Calculate system fault currents and verify adequacy of equipment ratings.

Verify coordination of the protective devices.

Verify short-curcuit and auto-ignition protection for load cables.
Verify adequate electrical protection for 10CFR50 Appendix R.

Identify cascaded fuses and review for selective coordination.

ORIGINAL

Abstract:
These calculations contain an unverified assumption(s) that must be verified later. Yes [X] No [ ] R5
PB 3/18/92
In this calculation, maximum short-circuit currents are calculated and compard to equipment ratings. Time-current curves are prepared to show the coordination of protective devices and cable protection. ~~This calculation identifies that the load group fuses (Bussman FRN & FRS) are being used in an application that exceeds their interrupting rating.~~ Refer to Section 8.0 and 9.0 ~~fro~~ FOR results and conclusions. R5
Gp 2/13/92 PB 3/18/92 J.I.H. 02-15-92 LE

LEGIBILITY EVALUATED and ACCEPTED for issue.

Signature 3/13/92 Date

[ ] Microfilm and store calculations in RIMS Service Center
[X] Microfilm and return calculations to: Calculation Control Center
Microfilm and destroy. [ ]
Address: ~~DCRM, TSOB~~, WBNP CCC A-IOB

cc: RIMS, SL 26 C-K
[redacted] Ackley A120 IOB, WBNP
D. Kilgore, TR-E8 WBNP
A. Schildkraut, TR-E17 WBNP

0190x

THIS SHEET ADDED BY REV 4

TVA 10097 (DNE-6-86) **QA Record** DNE CALCULATIONS PAGE 1A

TITLE: 125-Vdc Vital Control Power System Fault Calculations	PLANT/UNIT: WBNP/Units 1 & 2
PREPARING ORGANIZATION: NE-EE-WBEP	KEY NOUNS (Consult RIMS DESCRIPTORS LIST): Short-Circuit Currents, Appendix R
BRANCH/PROJECT IDENTIFIERS: WBN-EEB-MS-TI07-0005	Each time these calculations are issued, preparers must ensure that the original (R0) RIMS accession number is filled in.
APPLICABLE DESIGN DOCUMENT(S): WB-DC-30-27R0, DIM-WB-DC-30-27-1	SAR SECTION(S): 8.3.2 / UNID SYSTEM(S): 236

Rev	(for RIMS' use)	RIMS accession number
R0	900329D0004	B26 '90 0202 409
R3	920204B0025 (333)	B26 '92 0124 400
R _		
R _		

Revision 0	R1	R2	R3
ECN No. (or indicate Not Applicable): N/A			DCN M-12564-A
Prepared: SEE REVISION 0			[signature]
Checked: SEE REVISION 0			[signature]
Reviewed: SEE REVISION 0			1/22/92 [signature]
Approved: SEE REVISION 0			1/22/92 C.C. Lyke for MCB
Date: SEE REVISION 0			1/23/92
List all pages added by this revision.			
List all pages deleted by this revision.			
List all pages changed by this revision.			

Use form TVA 10534 if more space required.

Safety-related? Yes [X] No [ ]

Statement of Problem

Calculate system fault currents and verify adequacy of equipment ratings.

Verify coordination of the protective devices.

Verify short-circuit and auto-ignition protection for load cables.

Verify adequate electrical protection for 10CFR50 Appendix R.

Identify cascaded fuses and review for selective coordination.

Abstract SEE REVISION 0 FOR ORIGINAL SIGNATURES

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

ORIGINAL

In this calculation, maximum short-circuit currents are calculated and compared to equipment ratings. Time-current curves are prepared to show the coordination of protective devices and calbe protection. This calculation identifies that the load group fuses (Bussman FRN & FRS) are being used in an application that exceeds their interrupting rating. Refer to Sections 8.0 and 9.0 for results and conclusions.

FSAR Compliance Review C.C. Lyke for MCB 1/23/92

R3 Total No. of Pages 333

LEGIBILITY EVALUATED and ACCEPTED for issue.

C.C. Lyke for MCB 2/3/92
Signature Date

QA Record

TVA 10697 (DNE-6-86) DNE CALCULATIONS

Page 1

TITLE	PLANT/UNIT
125V DC Vital Control Power System Fault Calculations	WBNP/Units 1 & 2

PREPARING ORGANIZATION	KEY NOUNS (Consult RIMS DESCRIPTORS LIST)
NE-EE-WBEP	Short Circuit Currents Appendix R

BRANCH/PROJECT IDENTIFIERS: WBN-EEB-MS-TI01-0005

Each time these calculations are issued, preparers must ensure that the original (RO) RIMS accession number is filled in.

Rev	(for RIMS' use)	RIMS accession number
R0	900329D0004	B26 '90 0202 409
R1	910416A0001 (253)	B26 '91 0201 416
R2	910729E0006 (321)	B26 '91 0708 401
R3		

R1

APPLICABLE DESIGN DOCUMENT(S): WB-DC-30-27 R0, DIM-WB-DC-30-27-1

SAR SECTION(S): 8.3.2 UNID SYSTEM(S): 236

	Revision 0	R1	R2	R3
ECN No. (or indicate Not Applicable)	N/A	DCN M-12070-A	See rev. log	
Prepared	W.J. Hollerith 1/29/90	1-23-91 S.J. Hunter	6/25/91 C. Johnson	
Checked	G.C. Patel	1-23-91 R.H. Sudduth	6/28/91 W.J. Hollerith	
Reviewed	G.W. Kerr	1/24/91	6/28/91 J.W. Dailey	
Approved	M.C. Burke	M.C. Burke	J.F. Torrora/MCB	
Date	2-2-90	2-1-91	7-5-91	
List all pages added by this revision.		SEE REV. LOG	See rev. log	
List all pages deleted by this revision.		SEE REV. LOG	See rev. log	
List all pages changed by this revision.		SEE REV. LOG	See rev. log	

Use form TVA 10534 if more space required.

Safety-related? Yes ☒ No ☐

Statement of Problem

Calculate system fault currents & verify adequacy of equipment ratings.
Verify coordination of the protective devices.
Verify short circuit & auto-ignition protection for load cables.
Verify adequate electrical protection for 10CFR50 Appendix R
Identify cascaded fuses & review for selective coordination.

Abstract

These calculations contain an unverified assumption(s) that must be verified later. Yes ~~Yes ☒~~ ~~No ☒~~ WH 1/29/90 6/25/91

ORIGINAL

In this calculation, maximum short circuit currents are calculated and compared to equipment ratings. Time-current curves are prepared to show the coordination of protective devices and cable protection. This calculation identifies that the load group fuses (Bussmann FRN & FRS) are being used in an application that exceeds their interrupting rating. Refer to sections 8.0 and 9.0 for results and conclusions.

R2 6/25/91

FSAR Compliance Review 321 6/25/91 ~~237~~ WSH — LE — 2-2-90

~~RO~~ R2 Total No of Pages ~~235~~

4384

~~76B3~~

☐ Microfilm and store calculations in RIMS Service Center. Microfilm and destroy. ☐

☒ Microfilm and return calculations to: Calculation Control Center Address: QAC-IC-WBN

cc: RIMS, SL 26 C-K

TVA

WBN-EEB-MS-TI07-0005

Title: 125V DC Vital Control Power System's Fault Calculations

REVISION LOG

Revision No.	DESCRIPTION OF REVISION	Date Approved
0	Initial Issue	2-2-90
1	ADDED: ATTACHMENT M12070A (15 PAGES) PAGE 3A REVISED: PAGES 1, 2, 4, 6, 16, 17, 23, 60, 48 TOTAL PAGES OF R~~0~~1: ~~20~~ 253 WTH 1/26/91 1-28-91 ~~TOTAL COMPLETE CALCULATION COMBINED R0 → R1~~ Pages 16, 17, 23, 48, and 60 were revised to incorporate audit comments from TVA's self-assessment and to remove the UVA in paragraph 5.10 FSAR Compliance Review [signature] Date 5-1-91	WTH 1/26/91 GP 1/31/91
2	Revised pages 7, 84, 85, 86 and 88 to eliminate requirements for dual protection for cable auto-ignition in accordance with DIM-WPS-DC-30-27-2. Revised pages 17, 40 and 42 for requirements for selective coordination for Appendix R. Removed UVA 5.11. Revised pages 41, 77, 82, 84, 93, 95 and 113 to incorporate corrective action for WBFIR910179112. Revised pages 1, 2, 4, 6 and 12. Added page 38. Added Attachments ECN 3614, DCN P-01012-A, DCN P-01013-A, DCN P-01014-A, DCN P-01015-A. Revised page 34 to correct curve identification. Reviewed R1 to verify design margins were unaffected by any UVA's in accordance with WBFIR910184112. Total pages R2 = 321. This is a complete calc revision. Section 8.3.2 of the FSAR was reviewed and no discrepancies identified. R2 FSAR Compliance Review J.F. TORTORA/MCB / 7-5-91 ADC/LE Date Attachments DCN P-01012-A, DCN P-01013-A, DCN P-01014-A and P-01015-A each contain an unverified assumption. This unverified assumption does not affect the results and conclusions in the baseline portion of the calc. Existing design margins are not adversely affected by this revision and therefore, existing design inputs and previously made engineering judgements and assumptions are not invalidated.	Refer to cover sheet for approval and date. GP 6/25/91

TITLE	WBP-EEB-MS-TI07-0005 125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATION	REVISION LOG
REV NO.	DESCRIPTION OF REVISION	DATE APPROVED
3	REVISED PAGES: 4, 38, 39, 41, 42 ADDED PAGES: 1A, 2A, 3C, ATT. H. pg 185A ADDED ATTACHMENT: DCN M-12564-A (8 pages) FSAR Sect 8.3.2 requires revision (by DCN M12564A). R3 FSAR COMPLIANCE REVIEW C.C. Lyke for MCB 1/23/92 ABC/LE DATE Existing design margins are not adversely affected by this revision and therefore existing design inputs and previously made engineering judgements and assumptions are not invalidated.	See cover sheet for approval & date 1/21/92
4	Added attachment M12187A/M14241A to document rerouting of cables listed in DCNs M-12187-A and M-14241-A. Also added Attachment S12854A. Added pages: 1B, 3D, Att. M12187A/M14241A (10 pages) and Att. S12854A (25 pages) Deleted pages: none Changed pages: 2A, 4 Total pages in entire calculation: ~~370~~ ~~369~~ 370 (ONE PAGE MISNUMBERED ATTAC. NO. P-010JFA) J.I.H. 02-15-92 LE J.I.H. 03-13-92 LE Section 8.3.2 of the FSAR was reviewed and no discrepancies identified. R4 FSAR Compliance Review C.C. Lyke for MCB 2/14/92 ABC/LE DATE Attachments M12187A/M14241A and S12854A do not have any unverified assumptions. Existing design margins are not adversely affected by this revision and therefore, existing design inputs and previously made engineering judgements and assumptions are not invalidated	2/14/92 J.I.H. 02-13-92

CALCULATION REVISION LOG

TITLE: 125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATIONS	REVISION LOG WBN EEB-MS-TI07-0005

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
5	ADDED ATTACHMENT M-17941-A (PAGES 1 THRU 17) 1. TO RESOLVE PROBLEMS IDENTIFIED IN REVISION 2 OF THIS CALCULATION (WBN-EEB-MS-TI07-0005) WHICH ARE ASSOCIATED WITH SYSTEM 211 (6.9kV REACTOR SHUTDOWN POWER SYSTEM) AS PART OF DCN M-17941-A. 2. REMOVED UNVERIFIED ASSUMPTION IN BASELINE CALCULATION SECTION 5 ASSOCIATED WITH CONTRACT NO. 75835A (DCN M-12564-A) WHICH IS REPEATED IN ATTACHMENTS P-01012-A, P-01013-A, P-01014-A AND P-01015-A. 3. DOCUMENTED REPLACEMENT FUSE FOR "MIS 5" AS PART OF DCN S-15660-A. ADDED PAGES: 2B, 3E, 1 THRU 17 - (Attachment M-17941-A) DELETED PAGES: NONE REVISED PAGES: 1B, 4, 17, 6 (P-01012-A), 6 (P-01013-A), 4 (P-01014-A), 3 (P0105-A) TOTAL PAGES IN ENTIRE CALCULATION: 389 SECTION 8.3.2 OF THE FSAR WAS REVIEWED AND NO DISCREPANCIES IDENTIFIED. PB 3/18/92 R5 FSAR COMPLIANCE REVIEW C.C.Cyke for MCB (ABC/LE) 3/18/92 (DATE)	3/18/92 PB 3/18/92 3-18-92 CP 3/18/92

THIS SHEET ADDED BY REV 5

TITLE: 125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATIONS	REVISION LOG WBN EEB-MS-TI07-0005

REVISION NUMBER	DESCRIPTION OF REVISION	DATE APPROVED
6	ADDED ATTACHMENT M-18173-A (PAGES 1 THRU 11) TO RESOLVE PROBLEMS IDENTIFIED IN REVISION 2 OF THIS CALCULATION (WBN-EEB-MS-TI07-0005) WHICH ARE ASSOCIATED WITH SYSTEM 212 & 236 AS PART OF DCN M-18173-A. FOR SUMMARY OF RESULTS SEE SECTION 8.0. FOR CONCLUSIONS SEE SECTION 9.0 ADDED PAGES: 2C, 3F, ATTACHMENT M18173A 1 THRU 11 DELETED PAGES: NONE REVISED PAGES: 1B, 4, 39, 40, 41, 42 TOTAL PAGES IN ENTIRE CALCULATION: 402 SECTION 8.3.2 OF THE FSAR WAS REVIEWED AND NO DISCREPANCIES IDENTIFIED. R6 FSAR COMPLIANCE REVIEW C.C. Lybe for MCB 4/22/92 ABC/LE DATE PREPARED BY: Philip Bar DATE 4/21/92 CHECKED BY: [illegible] DATE 4-21-92	4/22/92 PB 4/21/92 [illegible] 4-21-92

THIS SHEET ADDED BY REV 6

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN-EEB-MS-TI07-0005 — Calculation No.

0 — Revision

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

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

Justification (explain below):

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

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

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

PERFORMED DESIGN REVIEW IN ACCORDANCE WITH MEMO FROM W.S. RAUGHLEY TO A P CAPOZZI DATED DEC 22, 1987 (B43871222905). VERIFIED THAT THE INPUTS AND OUTPUTS ARE REASONABLE AND CONSISTENT BASED UPON EXPERIENCE, ENGINEERING JUDGEMENT, OR DETAILED CHECK OF SELECTED DATA. REVIEWED THE PURPOSE, ASSUMPTIONS, METHOD AND CONCLUSIONS TO VERIFY THE TECHNICAL ADEQUACY OF EACH.

[signature] — Design Verifier (Independent Reviewer)

2/1/90 — Date

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN-EEB-MS-TI07-0005 — Calculation No.

1 — Revision

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

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

Justification (explain below):

Method 1: In the design review method, justify the technical adequacy of the calculation and explain how the adequacy was verified (calculation is similiar 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.

* Design verification has been performed by the design review method in accordance with the guidelines set forth by project procedure E-76-TVA.

C. H. Sudduth — Design Verifier (Independent Reviewer)

1-23-91 — Date

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN EEB-MS-TI07-0005 — Calculation No.
2 — Revision

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

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

Justification (explain below):

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

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

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

Reviewed R2 for technical adequacy as addressed in NEP 3.1 Attachment 10. The design input data and assumptions were reviewed and found appropriate and reasonable. The calculation methods were based on Rev 0 and Branch Technical Instructions EEB-TI-7 & EEB-TI-8. The results and conclusions are adequate.

William L. Hollert — Design Verifier (Independent Reviewer)
6/28/91 — Date

WJ 7-5-91

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN-EEB-MS-TI07-0005 — Calculation No.

3 — Revision

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

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

Justification (explain below):

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

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

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

INDEPENDENTLY REVIEWED CALCULATION WBN-EEB-MS-TI07-0005 R/3 FOR TECHNICAL ADEQUACY AS ADDRESSED IN 10CFR50. APPENDIX B (NEP 3.1 ATTACHMENT 10) THE DESIGN INPUT DATA AND ASSUMPTIONS WERE REVIEWED AND WERE FOUND APPROPRIATE AND REASONABLE

TB Thrasher — Design Verifier (Independent Reviewer)

12-17-91 — Date

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN EEB-MS-TI07-0005	4 J.I.H. 02-12-92 ~~3~~
Calculation No.	Revision

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

1.	Design Review	*
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.

Reviewed R3 for technical adequacy as addressed in NEP 3.1 Attachment 10. The design input data and assumptions were reviewed and found appropriate and reasonable. The calculation methods were based on Rev. 0 and Branch Technical Instructions EEB-TI-7 & EEB-TI-8. The results and conclusions are adequate.

[signature]	13 WJH 2-13-92 ~~2-12-92~~
Design Verifier (Independent Reviewer)	Date

THIS SHEET ADDED BY REV 4

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN EEB-MS-TI07-0005	5
Calculation No.	Revision

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

1.	Design Review	*
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.

Reviewed R5 for technical adequacy as addressed in NEP 3.1 Attachment 10. The design input data and assumptions were reviewed and found appropriate and reasonable. The calculation methods were based on Rev. 0 and Branch Technical Instructions EEB-TI-7 & EEB-TI-8. The results and conclusions are adequate.

Design Verifier (Independent Reviewer)	3-17-92 Date

THIS SHEET ADDED BY REV 5

CALCULATION DESIGN VERIFICATION (INDEPENDENT REVIEW) FORM

WBN EEB-MS-TI07-0005	6
Calculation No.	Revision

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

1.	Design Review	*
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.

Reviewed R6 for technical adequacy as addressed in NEP 3.1 Attachment 10. The design input data and assumptions were reviewed and found appropriate and reasonable. The calculation methods were based on Rev. 0 and Branch Technical Instructions EEB-TI-7 & EEB-TI-8. The results and conclusions are adequate.

Design Verifier (Independent Reviewer)	4-21-92 Date

THIS SHEET ADDED BY REV 6

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Attachment ECN 3614 - Evaluation of DCN Modification
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Attachment DCN P-01014-A - Evaluation of DCN Modification
Attachment DCN P-01015-A - Evaluation of DCN Modification
| R1 JWH 1-23-91 CAS 1/23/91 R2 GP 6/25/91 CTH 6/27/91

ATTACHMENT DCN M-12564-A EVALUATION OF DCN MODIFICATION
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| R3 R4 J.H.H. 02-13-92 WJH 2-13-92

ATTACHMENT DCN M-17941-A - EVALUATION OF DCN MODIFICATION
| R5 PB 3/18/92 3-18-92

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LIST OF CURVES AND TABLES

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20	LVSG FUSES	209

FSAR COMPLIANCE REVIEW

SECTION 8.3.2 OF THE FSAR WAS REVIEWED AND NO DISCREPANCIES WERE IDENTIFIED BETWEEN THIS CALCULATION AND SECTION 8.3.2.

PREPARED William T. Hollert

CHECKED G C Patel

PREPARED Scott J. Hunter

CHECKED C. H. Sudduth 1/23/91

R1 SJH 1-23-91

1.0 PURPOSE

THE 125V DC VITAL POWER SYSTEM IS A SYSTEM THAT IS COMMON TO BOTH UNITS. THE SYSTEM CONSISTS OF FOUR CHANNELS (I,II,III, & IV) WITH EACH CHANNEL HAVING A BATTERY, BATTERY BOARD, AND BATTERY CHARGER. ALSO, THERE IS A FIFTH BATTERY (V) THAT CAN MANUALLY BE ALIGNED TO REPLACE ANYONE OF THE FOUR BATTERIES VIA BATTERY BOARD V AND DISTRIBUTION PANELS. THE 125V DC VITAL POWER SYSTEM AND ITS COMPONENTS ARE DESCRIBED IN DETAIL IN BOTH THE DESIGN CRITERIA WB-DC-30-27 AND SECTION 8.3.2 OF THE FSAR.THE PURPOSE OF THIS CALCULATION IS:

1.1 TO VERIFY THE ADEQUACY OF THE 125V DC VITAL POWER SYSTEM TO MEET THE FOLLOWING CRITERIA IN WB-DC-30-27:

1.1.1 PROTECTIVE DEVICES SHALL BE SELECTED TO OPERATE CONTINUOUSLY WITHIN THEIR CURRENT RATINGS.

1.1.2 PROTECTIVE DEVICES ARE RATED PROPERLY TO INTERRUPT MAXIMUM AVAILABLE FAULT CURRENTS

1.1.3 EACH SUBDISTRIBUTION CIRCUIT BREAKER SHALL BE COORDINATED WITH ITS LOAD GROUP FUSE.

1.1.4 EACH LOAD GROUP FUSE SHALL BE COORDINATED WITH THE BATTERY SUPPLY BREAKER.

1.1.5 THE BATTERY SUPPLY BREAKER SHALL BE COORDINATED WITH THE BATTERY SUPPLY FUSE.

1.1.6 BATTERY CHARGER'S INPUT BREAKER AND FUSE SHALL BE CONSIDERED A LOAD GROUP AND WILL BE COORDINATED WITH THE BATTERY SUPPLY PROTECTIVE DEVICES.

1.1.7 EACH DISTRIBUTION FEEDER PROTECTIVE DEVICE (BREAKER OR FUSE) SHALL BE COORDINATED SUCH THAT THE DEVICE NEAREST AN OVERLOAD SHALL BE THE ONLY ONE TO OPERATE.

1.1.8 Deleted. ~~DUAL PROTECTIVE MEANS SHALL BE PROVIDED FOR EACH LOAD FEEDER TO PRECLUDE LOSS OF THE EMERGENCY POWER SUPPLY OR THE ENTIRE DISTRIBUTION BOARD AND PREVENT A CABLE TRAY FIRE DUE TO THE FAILURE OF A SINGLE BREAKER TO OPERATE.~~ R2 6/6/25/91

1.1.9 SUBSTITUTION OF VITAL BATTERY V FOR A PRIMARY VITAL BATTERY SHALL NOT DEGRADE THE CAPACITY OF THE 125V DC VITAL POWER SYSTEM.

1.2 TO ANALYZE ALL CIRCUITS IN ACCORDANCE WITH DESIGN CRITERIA WB-DC-30-13 "10CFR50, APPENDIX R, TYPE I, II, & III CIRCUITS" THAT:

1.2.1 SHARE A POWER SUPPLY WITH CIRCUITS REQUIRED FOR SAFE SHUTDOWN FOR A POSTULATED FIRE.

1.2.2 SHARE A COMMON ENCLOSURE (CABLE TRAY, JUNCTION BOX, ETC.) WITH REQUIRED CIRCUITS.

1.2.3 ARE NOT ELECTRICALLY PROTECTED SO THAT AN ELECTRICAL FAULT WILL RAISE THE CONDUCTOR TEMPERATURE TO THE INSULATION AUTO-IGNITION POINT, OR DEGRADE THE REQUIRED POWER SYSTEM.

1.3 TO IDENTIFY CASCADED FUSES AND DETERMINE WHICH CASES ARE PROPERLY COORDINATED AND WHICH ARE NOT.

2.0 ASSUMPTIONS

REFER TO SECTION 5.0 FOR DOCUMENTATION AND JUSTIFICATION OF ASSUMPTIONS.

3.0 SOURCES OF DESIGN INPUT INFORMATION

3.1 DRAWINGS

TVA-WBN	CONTRACT	
45N700-1 R5	85-836724	
45W1418-1 R19		K482-W1 R3
45W1418-2 R21		K482-W2 R3
45W1419-1 R16		
45W217-1 R3	74-84376	
45W218 R10		0126D4084 R908
45W2418-1 R22		0126D4097 R906
45W2419-1 R11		0126D4442 R906
45W703-1 R19		0126D4454 SH6 R907
45W703-2 R21		0126D4457 R907
45W703-3 R20		0126D4462 SH6 R909
45W703-4 R17		0126D4462 SH6 R911
45W703-5 R25		0126D4499 SH1 R908
45W703-6 R21		0126D4499 SH6 R911
45W703-7 R19		0126D4501 R906
45W703-8 R20		0126D4516 R907
45W703-9 R1		0126D4525 R907
45W709-2 R5		0126D4540 R906
45W709-4 R3		0126D4542 SH2 R911
45W709-6 R2		0126D4593 SH2 R911
45W709-9 R0		0126D4593 SH6 R907
45W709-9 R0	74-84647	
45W724-1 R15		6947D10 R910
45W724-2 R15		6947D18 R914
45W724-3 R16		6947D19 R914
45W724-4 R15		6947D27 R911
45W749-1 R23		6947D36 R915
45W749-2 R22		6947D37 R915
45W749-3 R22		6947D45 R2
45W749-4 R23		6947D58 R910
45W793-5 R3		6947D66 R914
45W760-3-1 R7		6947D75 R910
45W760-26-1 R12		6947D84 R913
45W760-3-8 R11		6947D85 R915
45W760-3-9 R7		
45W760-30-8 R11	75-85281	
45W760-30-9 R7		CD-33697-MKE-BM-1
45W760-30-10 R6		CD-33697-MKE-BM-2
45W760-30-11 R8		CD-33697-MKE-BM-3
45W760-30-12 R8		CD-33697-MKE-BM-4
45W760-30-13 R4		CD-33697-MKE-BM-5
45W760-30-14 R6		CD-33697-MKE-BM-6
45W760-30-26 R4		CD-33697-MKE-BM-7
45W760-31-11 R11		CD-33697-MKE-BM-8
45W760-31-12 R11		

3.0 SOURCES OF DESIGN INPUT INFORMATION

45W760-31-13 R10	75-87048-1	
45W760-31-14 R12		FS-239-800
45W760-31-17 R7		FS-259-204
45W760-31-18 R14		
45W760-31-19 R12	75-87048-2	
45W760-32-1 R4		SO-20634-B
45W760-62-1 R13		
45W760-62-2 R11	84-832101	
45W760-63-1 R7		410335C
45W760-67-1 R8		410337C
45W760-68-3 R11		400199C
45W760-68-4 R8		
45W760-70-1 R9		
45W760-70-2 R9		
45W760-72-1 R9		
45W760-74-1 R9		
45W760-78-1 R6		
45W760-82-6 R13		
45W760-82-16 R5		
45W760-211-1 R13		
45W760-211-2 R15		
45W760-211-3 R15		
45W760-211-4 R15		
45W760-211-5 R8		
45W760-211-6 R14		
45W760-211-7 R16		
45W760-211-8 R12		
45W760-211-9 R12		
45W760-211-10 R13		
45W760-211-11 R10		
45W760-211-12 R11		
45W760-211-13 R10		
45W760-211-14 R10		
45W760-211-15 R10		
45W760-211-16 R7		
45W760-211-17 R9		
45W760-211-18 R9		
45W760-211-19 R7		
45W760-211-20 R8		
45W760-211-21 R9		
45W760-211-22 R2		
45W760-211-23 R0		
45W760-212-1 R9		
45W760-212-2 R10		
45W760-212-3 R7		
45W828-1 R34		
45W828-2 R24		
45W828-8 R36		
45W828-11 R27		

3.0 SOURCES OF DESIGN INPUT INFORMATION

45W828-19 R26
45W828-22 R35
45W828-30 R4
45W830-1 R20
45W830-2 R19
45W830-3 R35
45W830-4 R34
45W1635-20 R5
45W1635-44 R1
45W1635-46 R3
45W1635-47 R3
45W1635-48 R30
45W1747-1 R3
45N2635-20 R4
45W2747-1 R4
47W605-2 R18

3.2 TVA CONTRACTS

3.2.1 75C2-85281 125V VITAL BATTERY BOARDS
3.2.2 74C8-85251 125V VITAL BATTERY CHARGER
3.2.3 76K3-85763 125V VITAL BATTERIES
3.2.4 85K8-836724 125V VITAL BATTERY BD V & DISTR PANELS
3.2.5 74C8-85264 120V VITAL INVERTERS
3.2.6 80K6-826364 120V VITAL INVERTERS
3.2.7 75K5-87048-1 125V DC LIGHTING CONTACTOR
3.2.8 75K5-87048-2 SPARE BATTERY CHARGER TRANSFER SWITCH
3.2.9 84X8-832101 FIFTH VITAL BATTERY
3.2.10 833485 FIFTH VITAL BATTERY CHARGER
3.2.11 74C2-84376 MVSG
3.2.12 74C2-84647 LVSG
3.2.13 90NLC-75508A FLAS-5A FUSES

3.3 TVA DOCUMENTS

3.3.1 DESIGN CRITERIA WB-DC-30-27 "AC & DC CONTROL POWER SYSTEM"
3.3.2 FSAR SECTION 8.3.2
3.3.3 ELECTRICAL DESIGN STANDARD DS-E8.1.1 "FUSES"
3.3.4 ELECTRICAL DESIGN GUIDE DG-E2.4.6 "EQUIPMENT TYPICAL DATA"
3.3.5 CALCULATION WBN-EEB-MS-TI11-0003
3.3.6 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24881116613)
3.3.7 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24881116615)
3.3.8 CALC WBPEVAR8907005 VERIFICATION OF FLAS-5
3.3.9 PM 87-26(EEB) CABLE LENGTH VALUES TO BE USED IN ELECTRICAL CALCULATIONS
3.3.10 ELECTRICAL DESIGN GUIDE DG-E12.6.2 SELECTION OF CONDUCTOR SIZES BASED ON FAULT CURRENT
3.3.11 QIR WBNEEB84001R3 CRITERIA FOR THE IDENTIFICATION AND EVALUATION OF ASSOCIATED CIRCUITS OF CONCERN AS DEFINED BY 10CFR50, APPENDIX R (EEB850204943)
3.3.12 EEB-TI-7 AC/DC SHORT CIRCUIT ANALYSIS
3.3.13 EEB-TI-8 AC/DC CIRCUIT PROTECTION
3.3.14 WBNP CABLE SCHEDULE PRINTOUT DATED 10/17/89
3.3.15 DESIGN CRITERIA WB-DC-30-13 "10CFR50,APPENDIX R, TYPE I,II, AND III CIRCUITS R2 ~~(Unissued) 1/30/90 WJH~~ (B26900213076) R2 6/6/90 WJH 6/28/
3.3.16 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24880822616)
3.3.17 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24880616003)
3.3.18 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24880825622)
3.3.19 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24880909602)
3.3.20 DCN P-03388-A (RIMS B26890912811)
3.3.21 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24881121619)
3.3.22 WBN WALKDOWN PROCEDURE WP-37 (RIMS C24881121620)
3.3.23 CALCULATION WBN-0564-031 R10 (B26891221203) R1 GP 1/31/91 WJH 6/28/91

3.4 OTHER

3.4.1 NATIONAL ELECTRICAL CODE
3.4.2 THE FOLLOWING MANUFACTURER'S TIME-CURRENT CURVES

3.4.2.1 BUSSMANN FORM 235 DATED 10-17-70
3.4.2.2 BUSSMANN FORM 233 DATED 11-7-70
3.4.2.3 BUSSMANN FORM 50549 DATED 8-22-74

3.4.2.4 WESTINGHOUSE CURVE NO. SC-340-70 JAN 71
3.4.2.5 WESTINGHOUSE CURVE NO. SC-341-70 JAN 71
3.4.2.6 WESTINGHOUSE CURVE NO. SC-3208-72 JUNE 72
3.4.2.6A WESTINGHOUSE CURVE NO. SC-342-70 JAN 71 GWH 1-29-90
3.4.2.7 GENERAL ELECTRIC GES-6000A

3.4.2.8 CHASE-SHAWMUT FORM 480 AMP-TRAP
3.4.2.9 CHASE-SHAWMUT 95718-B

3.4.2.10 LITTELFUSE FLAS 5

3.4.2.10 GOULD-ITE TD-4950R1 DATED 11-23-76

3.4.3 IEEE STD 946-1985 IEEE RECOMMENDED PRACTICE FOR THE DESIGN OF SAFETY-RELATED DC AUXILIARY POWER SYSTEMS FOR NUCLEAR POWER GENERATING STATIONS

4.0 DESIGN INPUT DATA

4.1 BATTERIES I,II,III, & IV (REF 3.2.3)
GOULD NCX-2250
SHORT CIRCUIT CURRENT 18,360 AMPS

4.2 BATTERY V (REF 3.2.9)
GOULD NCX-2550
SHORT CIRCUIT CURRENT 20,808 AMPS

4.3 BATTERY BOARDS I,II,III, & IV (REF 3.2.1 & WALKDOWNS)
MAIN FUSE CHASE-SHAWMUT 1600A AMP-TRAP A4BY1600
MAIN BREAKER GE AK-2-50 1600A FRAME WITH 1000A
TRIP TYPE EC-1 LONG TIME CURVE 1A & SHORT TIME
CURVE 2C (2X-7X) 50,000 AIC AT 125V DC
HFB MOLDED-CASE BKRS WESTINGHOUSE 20,000AIC 125V DC
HLB MOLDED-CASE BKRS WESTINGHOUSE 20,000AIC 125V DC
BUS RATINGS SAME AS BREAKER RATINGS

4.4 BATTERY BOARD V (REF 3.2.4 & 3.3.6)
MAIN FUSE CHASE-SHAWMUT 1600A AMP-TRAP A4BY1600
MAIN BREAKER GE AKR-2D-30 800A FRAME WITH 800A
TRIP TYPE EC-1 LONG TIME CURVE 1A & SHORT TIME
CURVE 2C (4X-10X) 50,000 AIC AT 125V DC
JL CB ITE 400A FRAME 300 TRIP 20,000AIC 250V DC

4.5 BATTERY CHARGERS I,II,III, & IV (REF 3.2.2)
OUTPUT RATING 200A & LIMITED AT 130% OF RATING

4.6 BATTERY CHARGER V (REF 3.2.10)
OUTPUT RATING 300A

4.7 125V DC DISTRIBUTION PANELS A & B (REF 3.2.4 & 3.3.6)
CB NON-AUTOMATIC ITE TYPE KM 800A FRAME
WITHSTAND CAPABILITY 20,000A RMS FOR 3 CYCLES

4.8 125V DC DISTRIBUTION PANELS O (REF 3.2.4 & 3.3.6)
MOLDED-CASE CB 800A FRAME 800A TRIP ITE TYPE KM
20,000AIC AT 250V DC

4.9 CABLES-VARIOUS (REF 3.3.14)
TYPE, SIZE, MARK NUMBER, LENGTH

4.10 BATTERY BOARD III'S LOAD CURRENTS (REF 3.3.5)

5.0 Documentation of Assumptions & Justification
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

5.1 It is assumed for short circuits the battery terminal voltage equals 120 volts i.e. (2.0 volts/cell)(60 cells) = 120 volts

This assumption is conservative. In calculation WBN-EEB-MS-TI11-0003, the battery's voltage profile shows that the battery's terminal voltage is less than 114 volts at a load current of approximately 1300 amperes.

5.2 It is assumed that the resistance of the components on the vital battery boards and distribution panels (subdistribution circuit breaker, load group fuse, battery supply breaker, battery supply fuse, bus, connections, etc) is zero except where noted.

This assumption is conservative since it maximizes the calculated fault currents.

5.3 It is assumed that large loads such as the inverters and lighting cabinets can be treated as a load group and coordination between the subdistribution circuit breaker and load group fuse is not required.

This assumption applies the same requirements to all large loads having the same protective configuration as the battery chargers (load group fuse with a single subdistribution circuit breaker).

5.4 In calculating the cables' resistance, it is assumed that the cables' temperature is 25°C.

This assumption is conservative since it maximizes the fault currents.

5.0 Documentation of Assumptions & Justification
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

5.5 It is assumed that the 5th Vital Battery Charger's current limit is less than or equal to 1.6 times the battery charger's rated output.

This is conservative since typical values of battery chargers' current limit is less than 1.5 times the rated output per IEEE Standard 946 - 1985.

5.6 It is assumed that the 5th Vital Battery Charger is not connected to the 5th Vital Battery Board when the 5th Vital Battery is substituted for anyone of the primary batteries.

This assumption is valid since the procedure stated in the FSAR and design criteria requires the 5th battery charger to be initially disconnected whenever the 5th vital battery is substituted.

5.7 It is assumed that the contribution of any dc motors that is operating to the total fault current is insignificant.

This assumption is valid since the number of dc motors is minimal, and the motor sizes are small (< 1hp).

5.8. It is assumed that the actual length of the cables from the subdistribution circuit breakers to the loads is ~~≤ 100%~~ 80% of the values in the cable schedule. R1 WJH 1/26/91 GCP 1/31/91

This assumption is only used to obtain an estimate of the number of loads that fail coordination. Any finalized list will be determined by pull lengths and/or verification by scaling drawings or a walkdown if the scaled measurements are inadequate.

5.0 Documentation of Assumptions & Justification
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

5.9 It is assumed that the walkdown data is connect whenever "As Constructed" drawings and the walkdown data disagrees.

Some fuse changes may have occurred since the walkdowns are one to one and a half years old. However, this assumption is reasonable since the walkdown data is from actual equipment inspections and any changes are addressed by DCN/NEP requirements.

5.10 It is assumed that the non-Appendix R circuits on the MVSG are the non-safety related pressurizer heaters, containment spray pumps, and safety injection pumps.

~~This is an unverified assumption and will require later verification whenever the Appendix R analysis is performed and issued.~~ Review of Calculation WBN-OSG4-031 Rev 10 confirms that the above listed components do not have to operate for an Appendix R event. WJH 1/26/91 R1

5.11 ~~It is assumed that the alternate control power feeds to the MVSG & LVSG are required Appendix R circuits. Also, it is assumed that all of the required Appendix R circuits are grouped on separate load group fuses from the non-required Appendix R circuits.~~ Deleted. R2 GP 6/25

~~This is an unverified assumption that will require verification when the Appendix R analysis is complete.~~

~~NOTE: THERE IS A UVA ASSOCIATED WITH CONTRACT NO. 75835A (DCN # M-12564A) WHICH IS REPEATED IN ATTACHMENTS P-01012-A, P-01013-A, P-01014-A, P-01015-A.~~ R2 RLS 7/5 DWG 7/5

3-18-92 R5 PB 3/18

6.0 Computations & Analyses
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

6.1 Subdistribution Circuit Breakers & Load Group Fuses/ Board Loading

Load currents for the most heavily loaded battery (Vital Battery III) were taken from calculation WBN-EEB-MS-TI11-0003 to calculate the subdistribution circuit breaker/load group fuse/board loading. Specific load data for each subdistribution circuit breaker/load group fuse is presented in detail in Appendix A Table 1.

6.2 Vital Battery Boards & Major Loads' Short Circuit Currents

Vital battery V is larger than vital batteries I, II, III, & IV and maybe substituted for anyone of the four vital batteries. Calculations were performed to determine if the maximum fault current at the vital battery boards (I - IV) occurs when the board is supplied by its dedicated battery or when battery V is substituted (Appendices B & C). Maximum fault currents were calculated for the larger loads and then compared to the equipment's rating (Appendices B, C, & D).

6.0 Computations and Analyses
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

6.3 Coordination

Coordination curves are plotted for the subdistribution circuit breakers and their corresponding load group fuse (Curves 1-6). Coordination curves are also plotted for the battery supply breaker, battery supply fuse, and battery charger's input breaker and fuse (Curves 7 and 8 for vital battery boards I-IV and V respectively). The available fault currents at the output terminals of the subdistribution circuit breakers are such a value that both the subdistribution circuit breakers and load group fuses see the fault. Therefore, the cable lengths required to the loads for coordination between the subdistribution circuit breakers and its corresponding load group fuse are calculated for a fault at the load (Appendix E). These calculated cable lengths are than compared to the cable lengths in the cable schedules. The load's protective devices are considered to fail coordination if the cable length from the cable schedule is less than 125% of the length of cable required

6.0 Computations and Analyses
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

6.3 Coordination (Cont)

to limit the short circuit amperes.

DCN P-03388-A replaces the KAZ devices with FLAS 5 fuses (Panel 4 fuses A1-A50, B1-B50, C1-C50, D1-D50, & E1-E50). Calculation WBPEVAR8907005 verifies and documents that the FLAS 5 fuse coordinates with the subdistribution circuit breaker/load group fuse and provides necessary protection for penetration conductors. Curve 9 shows the coordination of the FLAS 5 fuse with the subdistribution circuit breaker and its load group fuse. Curve 10 shows the coordination of the control power fuses on the MVSG and LVSG with the subdistribution circuit breaker feeder and the load group fuse using the fuse types specified on the MVSG and LVSG s/L's. Curves 11 & 12 show coordination with the control power fuses on the MVSG & LVSG from the walkdown data. Curve 13 shows the coordination of the relay racks.

6.0 Computations and Analyses
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

6.4 Cable Protection

Appendix F evaluates cable protection for cable damage and auto-ignition for the various conductor sizes using the standard IPCEA equation and time-current plots of protective devices.

6.5 10CFR50 Appendix R

Appendix H addresses the requirements in design criteria WB-DC-30-13 for non-required Appendix R circuits. Board loading with a high impedance fault on a non-Appendix R circuit is calculated. The coordination of non-require Appendix R protective devices and cable protection are reviewed to ensure that the electrical protection is adequate. Adequate electrical protection ensures that potential Type I or Type III circuits are not Associated Circuits of Concern.

6.6 Cascaded Fuses

Appendix I identifies cascaded fuses and analyzes

6.0 Computations and Analyses
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE
CHECKED GCP DATE 1-31-90

6.6 Cascaded Fuses (Cont)

whether or not selective coordination exists by reviewing the time current plots and manufacturer's selectivity guides.

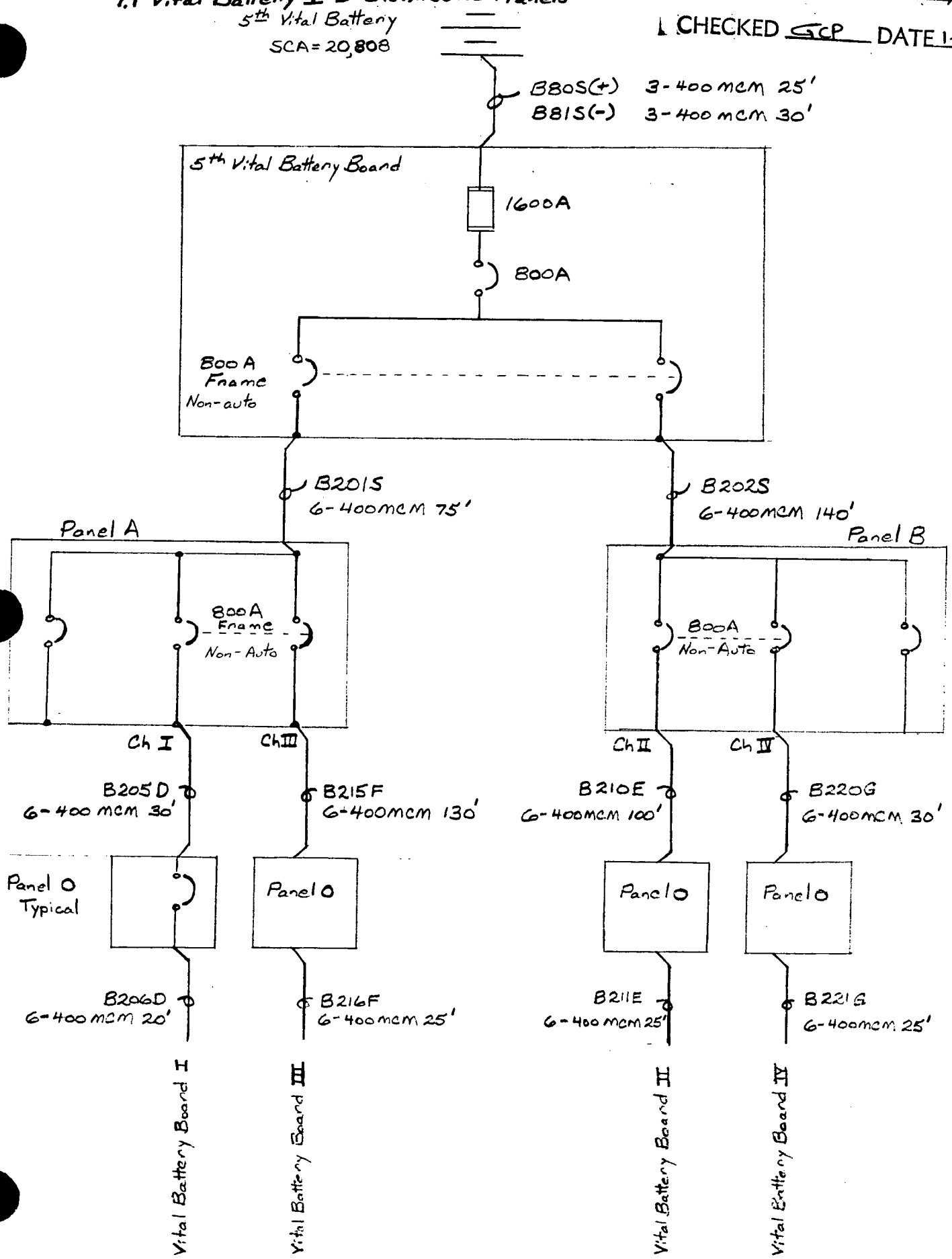
COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

7.0 Supporting Graphics

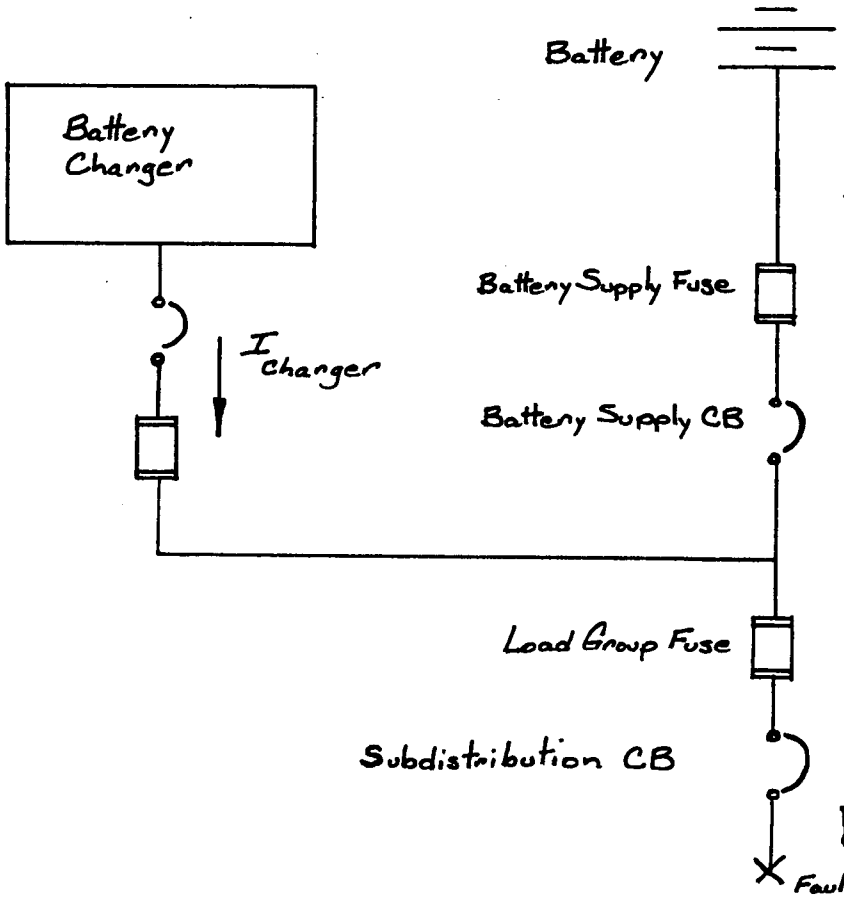
Calculation WBN-EEB-MS-TI07-0005

7.1 Vital Battery V & Distribution Panels



7.0 Supporting Graphics
Calculation WBN-EEB-MS-TI07-0005

7.2 Vital Battery Boards I-IV Basic Circuit & Equations

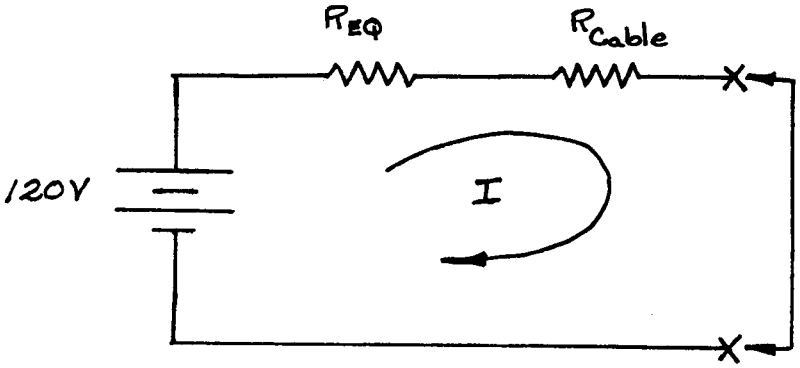


$$I_B = \frac{120}{R_B + R_{Supply\ Cables}}$$

where $R_B = \frac{120}{\text{Battery SCA}}$

$R_{Supply\ Cables}$ is the dc resistance of the battery supply cables

$$I_{Fault} = I_B + I_{Charger} \text{ amps}$$ R1 WJH 1/28/91 GCP 1/31/91



$$R_{EQ} = \frac{120}{I_{Fault}}$$

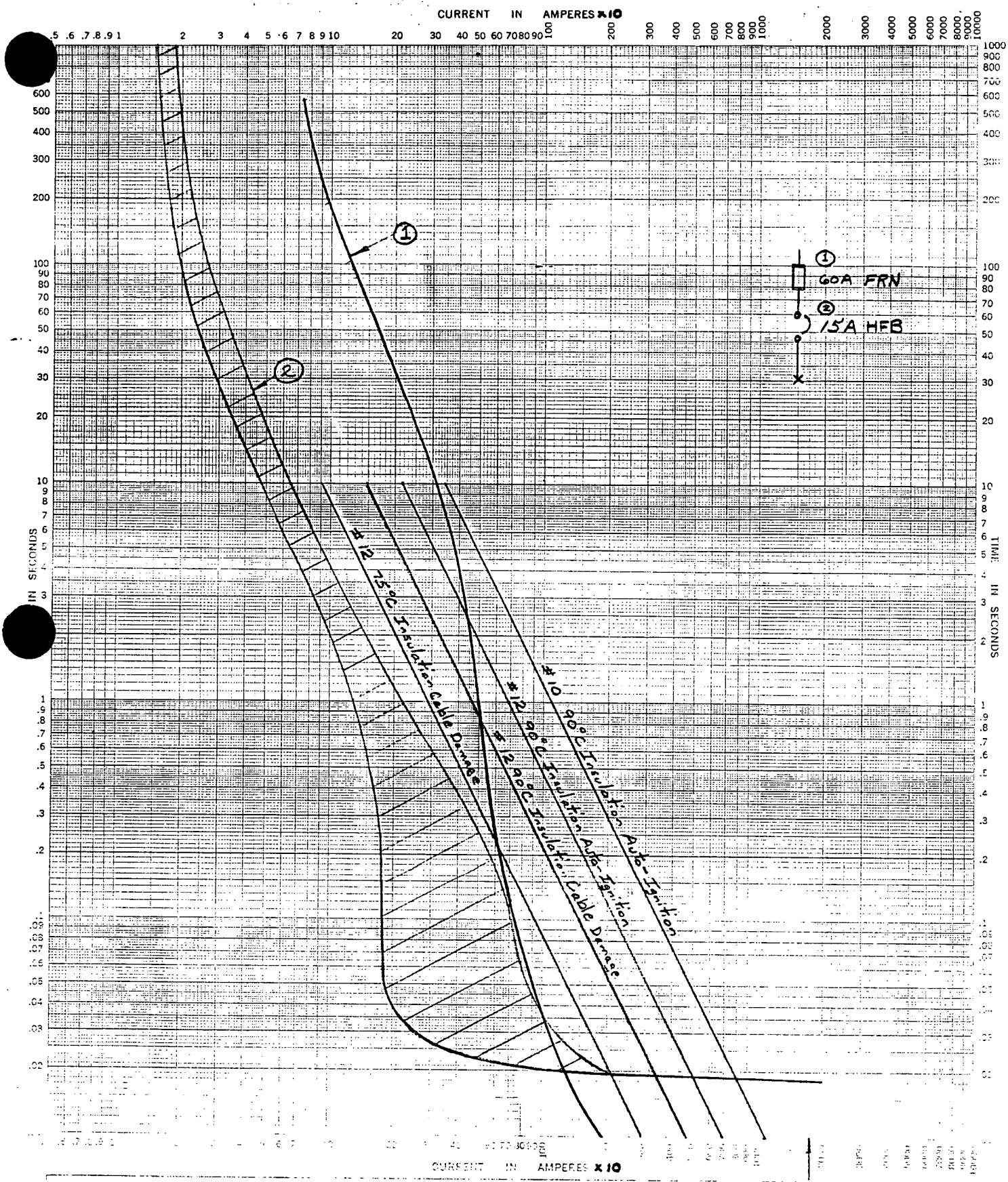
$$R_{Cable} = (2)(\text{Cable } \Omega/\text{ft})(\text{Cable length})$$

$$I = \frac{120}{R_{EQ} + R_{Cable}} \text{ amps}$$ R1 WJH 1/28/91 GCP 1/31/91

Calc WBN-EEB-MS-TI07-0006
7.0 Supporting Graphics

PAGE 24
PREPARED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No 1



Isc at breaker output terminals 17,575 amps

For 60 A Fuse & 15A CB (Typical) TIME-CURRENT CHARACTERISTIC CURVES
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at
2. Curves are plotted to Test points so variations should be

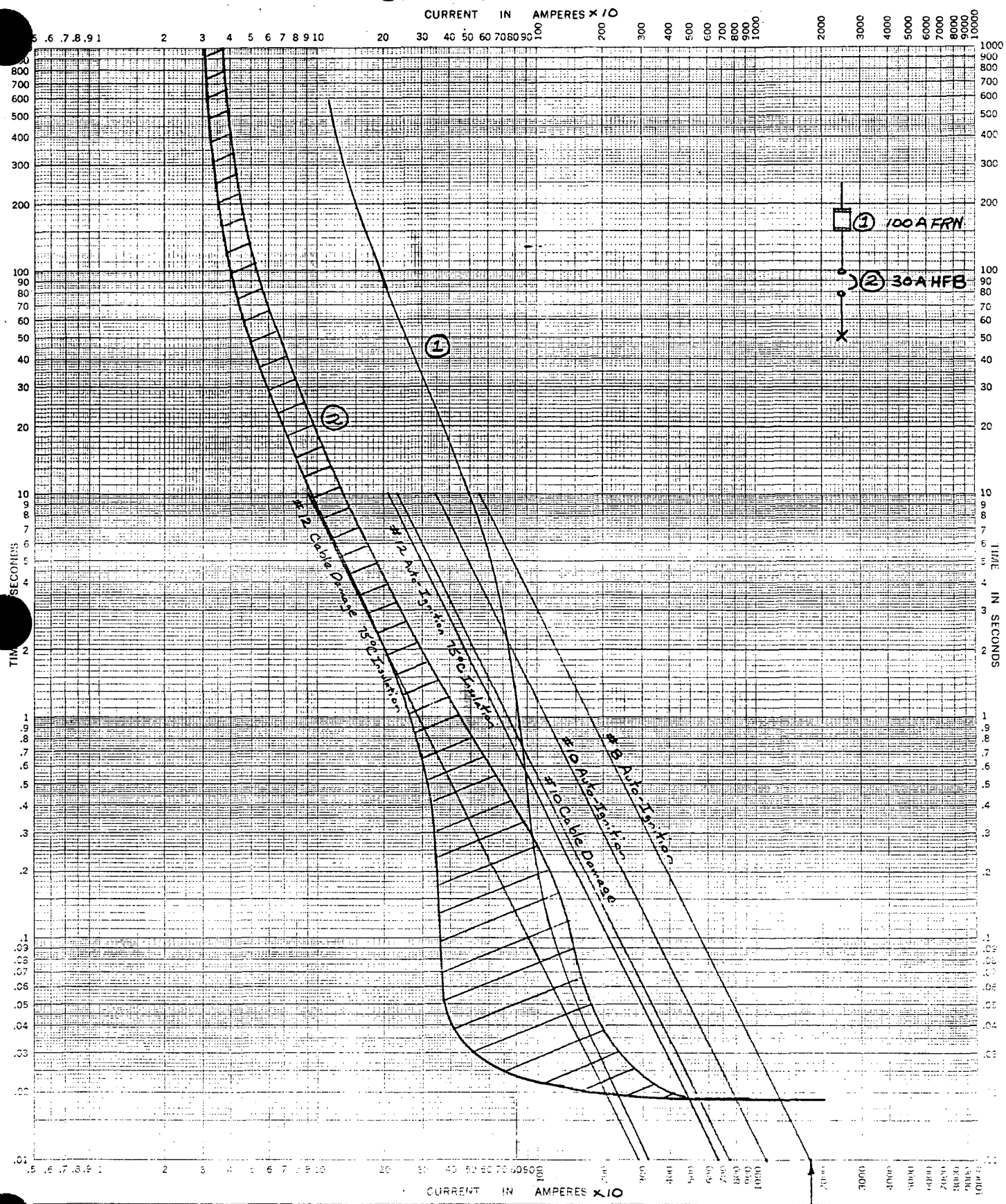
Date

Minimum Melting Time 60 Amp fuse

PREPARED WJH DATE 1/29/90
CHECKED SCP DATE 1-31-90

Calc WBN-EEB-MS-TI07-0005
7.0 Supporting Graphics

Curve No. 2



Isc at breaker's output terminals 17,575 amps

For 100A Fuse & 30A CB (Typical) TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links. In
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at phase starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be

No.
Date

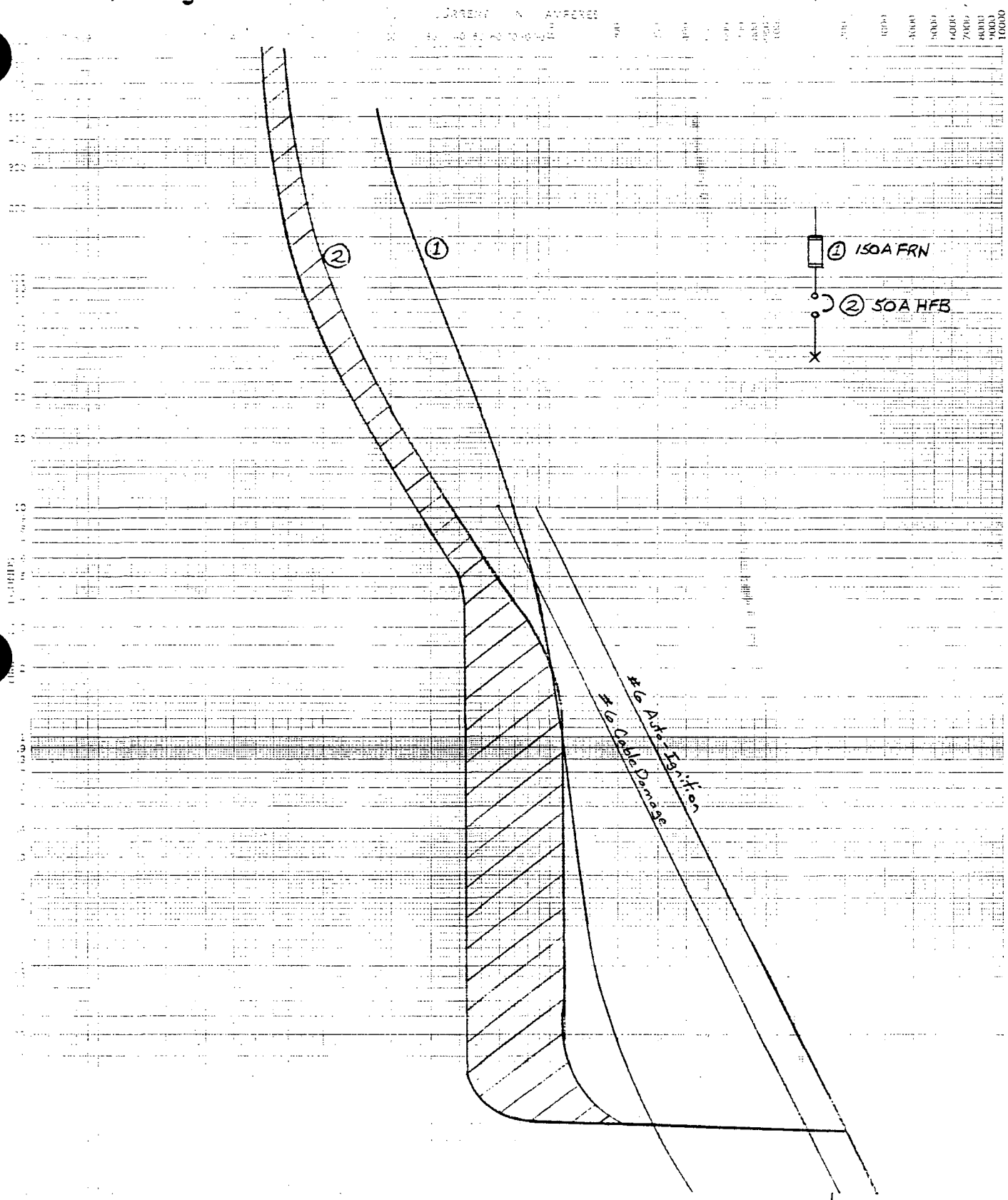
Minimum Melting Time 100 Amp Fuse

TIME-CURRENT CHARACTERISTIC

PREPARED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Calc WBN-EEB-MS-TI07-0005
7.0 Supporting Graphics

Curve No 3



Isc at Breaker's output Terminals (17,575 amps)

For 150A Fuse & 50ACB

TIME-CURRENT CHARACTERISTIC CURVE

Fuse Links. In

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at p-f., starting at 25C with no initial load

2. Curves are plotted to Test points so variations should be

No

Date

Minimum Melting Time

TIME-CURRENT CHARACTERISTIC 46 5275
KEUFFEL & ESSER CO. MADE IN U.S.A.

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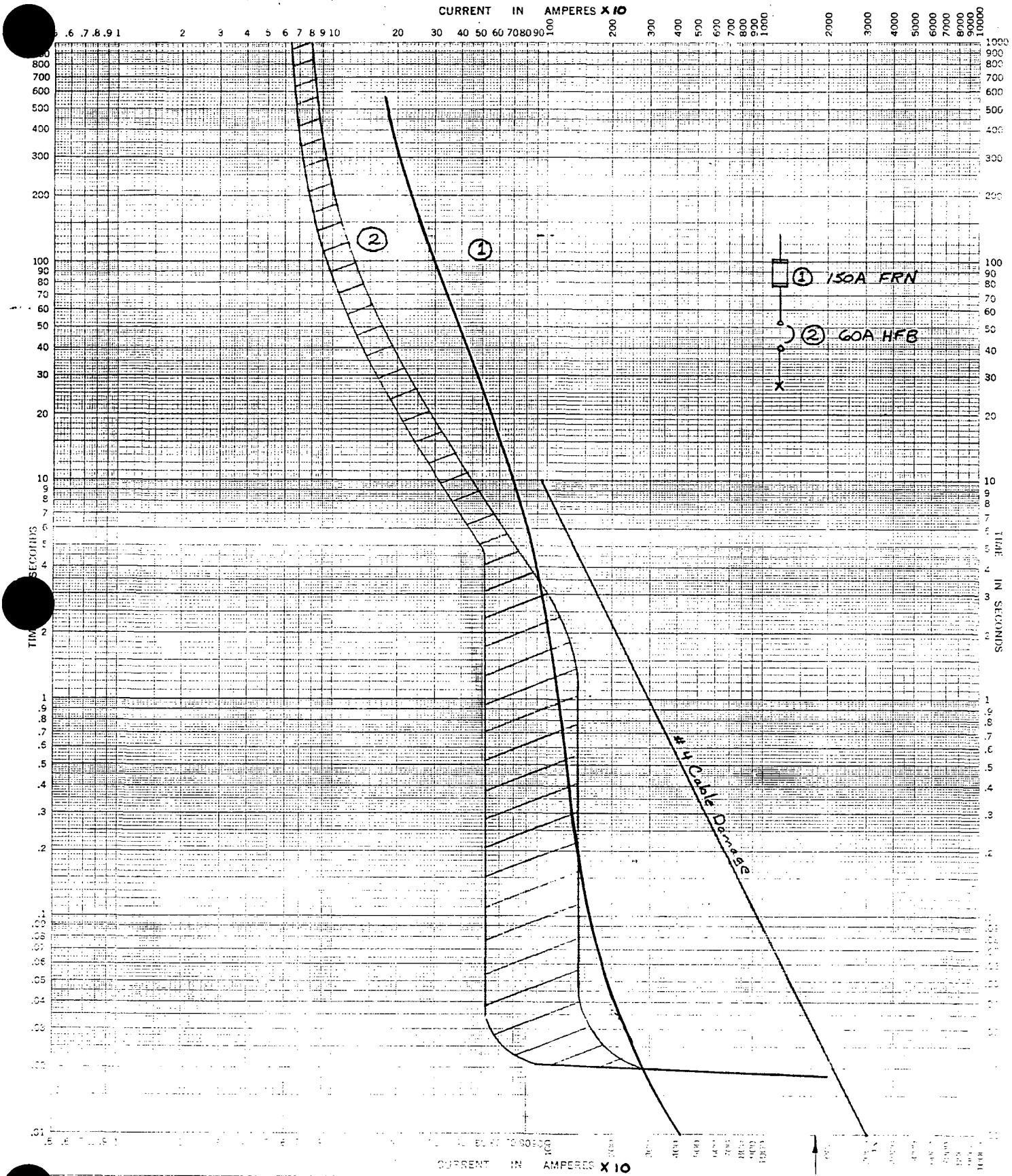
PREPARED [illegible] DATE 1/29/90

CHECKED GCP DATE 1-31-90 Curve No 4 Calc WBN-EEB-MS-TI07-0005



I_{sc} at breaker's output terminals 17,575 amps

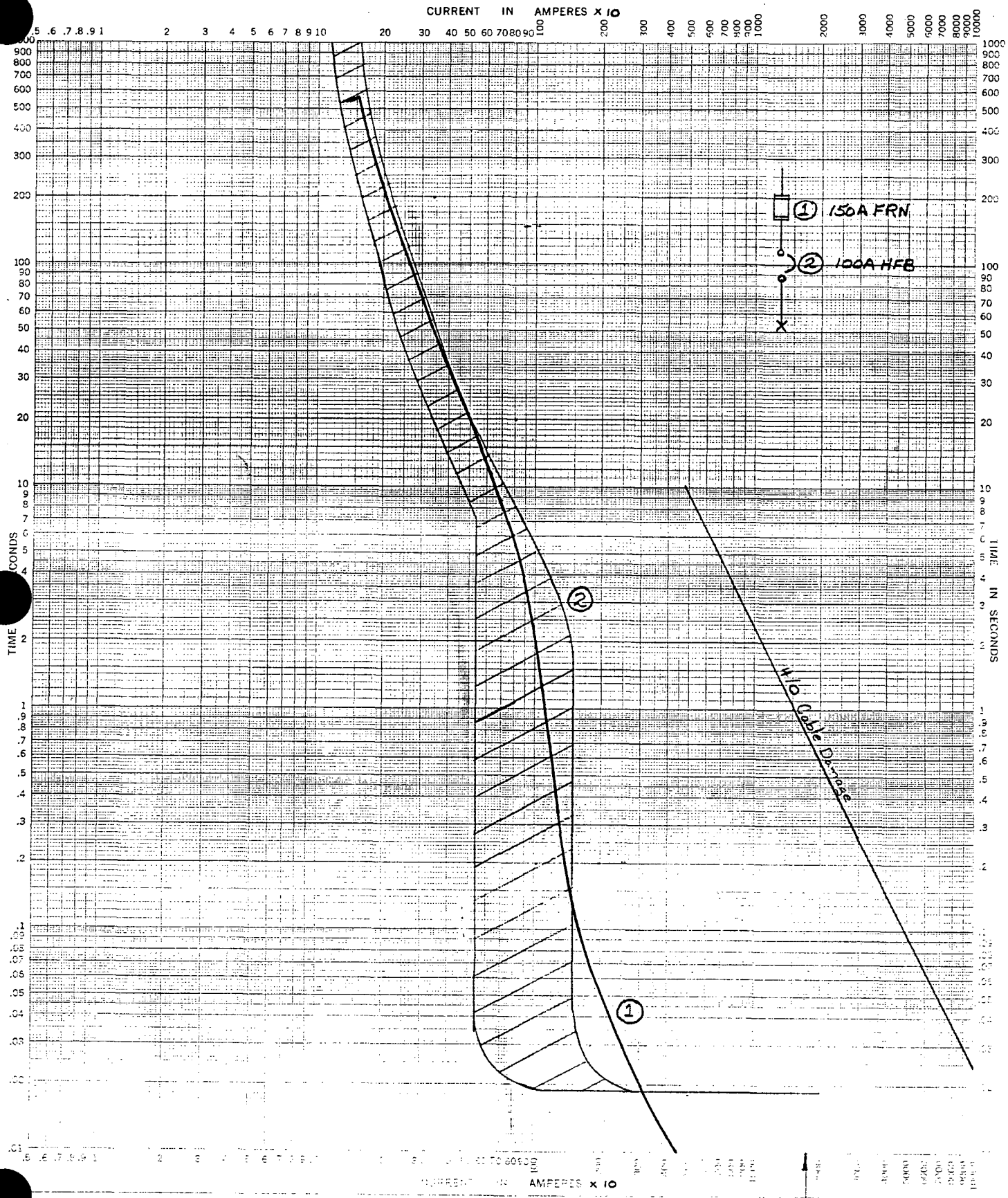
For 150A Fuse and 60A CB (Typical) TIME-CURRENT CHARACTERISTIC CURVES

BASIS FOR DATA Standards Dated

1. Tests made at Volts and at % for starting at LRC with initial load No.
2. Curves are plotted to Tolerances should be Date

Minimum Melting Time 150A Fuse

Curve No. 5 Calc WBN-EEB-MS-TI07-0005



For 150 A Fuse & 100 A CB TIME-CURRENT CHARACTERISTIC CURVES

I_{sc} at breaker's output terminals 17,575 amps

BASIS FOR DATA Standards Dated

1. Tests made at Volts and at Amps starting at 25C with no initial load
2. Curves are plotted to Test data variations should be

Minimum Melting Time 150A Fuse

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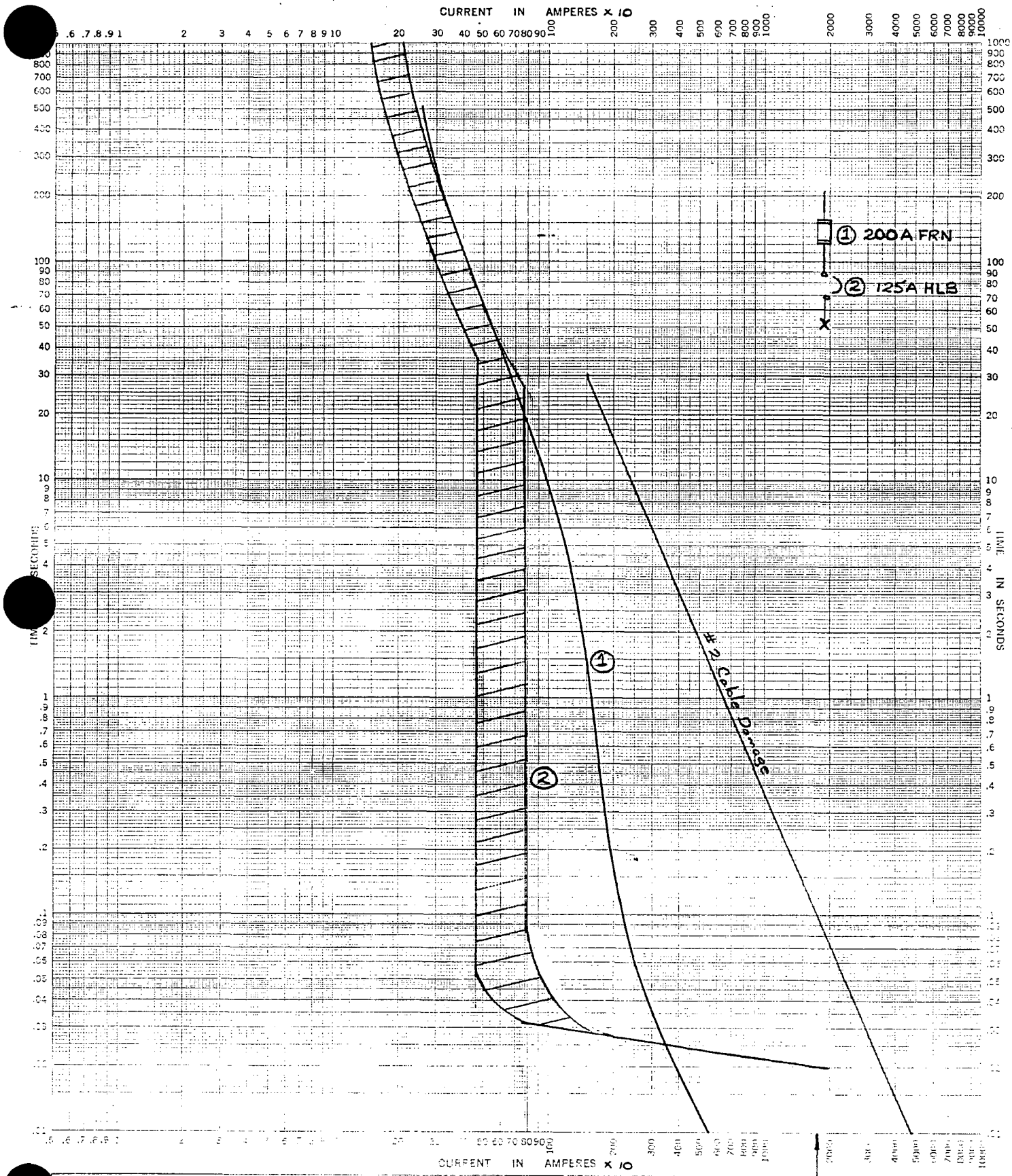
PREPARED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No. 6 Calc WBN-EEB-MS-TI07-0005



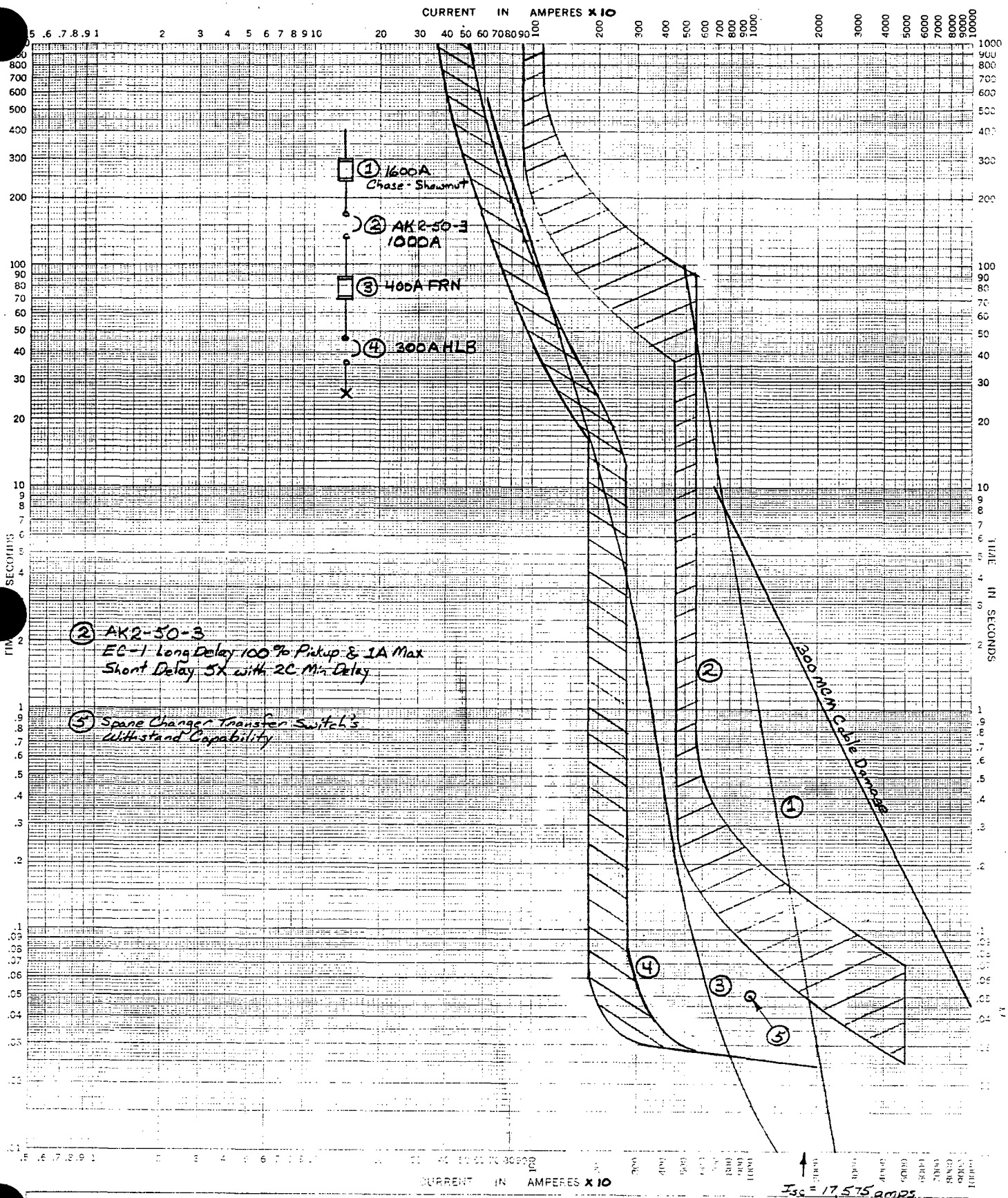
I_{sc} = 17,575 amps

Typical
For 200A Fuse & 125 Amp CB (low setting) TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links In
BASIS FOR DATA Standards Dated
1. Tests made at Volts p-p at p.f., starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be
No.
Date

Minimum Melting Time 200A Fuse

PREPARED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No. 7 Calc WBN-EEB-MS-TI07-0005

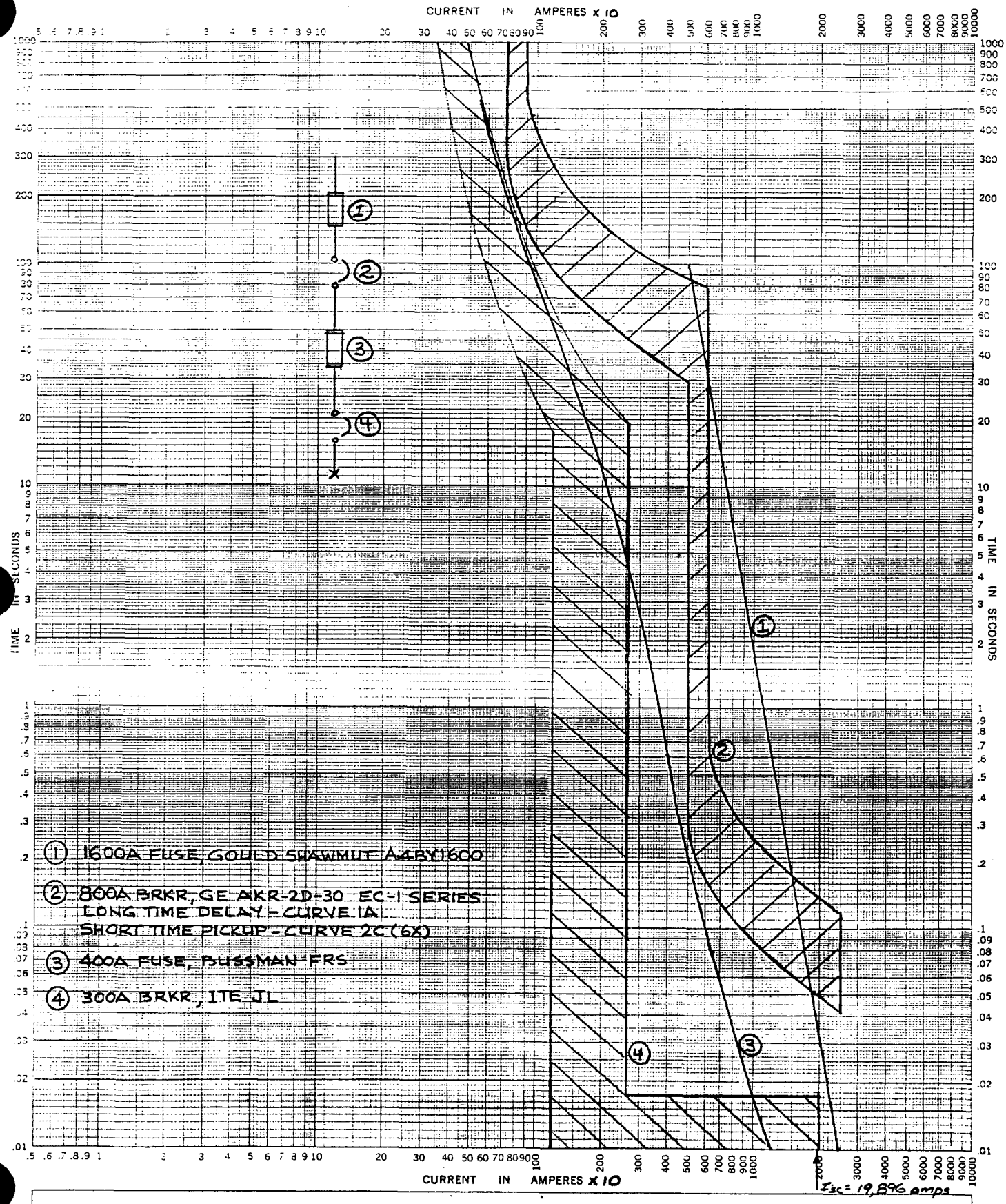


Vital Battery Bds I-IV
For Main Fuse & Bkr & 400A Fuse, 300A CB
TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links. In
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at Pf. starting at 250 with no initial load
2. Curves are plotted to Test points so variations should be
No.
Date

PREPARED GJH DATE 1/29/90

CHECKED SCP DATE 1-31-90

Curve No 8 Calc WBN-EEB-MS-TI07-0005



For Battery Bd I Main Bkr, Fuse & Chgr's TIME-CURRENT CHARACTERISTIC CURVES

Fuse Links. In

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at p-f., starting at 25C with no initial load

2. Curves are plotted to Test points so variations should be

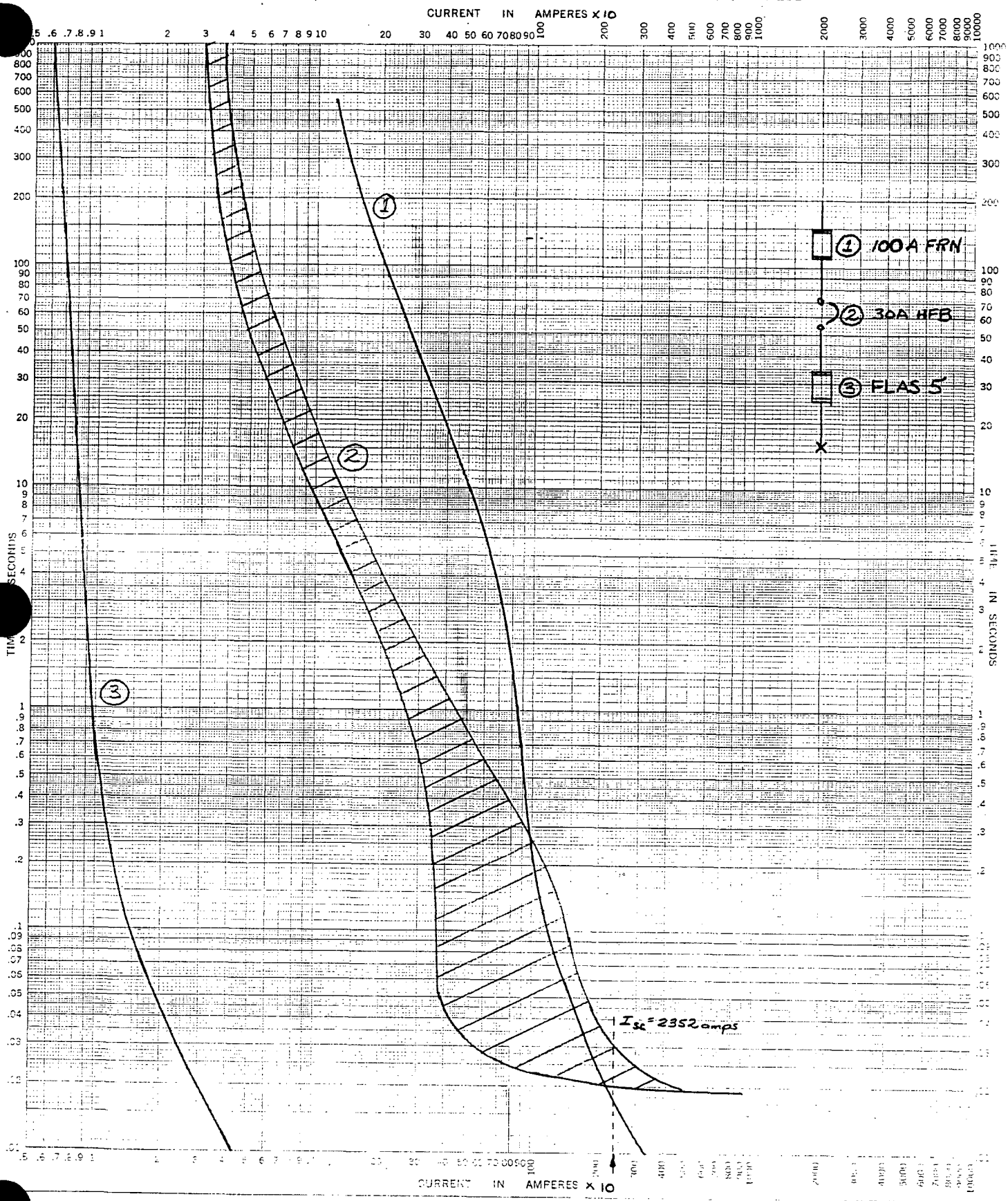
No.

Date

PREPARED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

Curve No. 9 Calc WBN-EEB-MS-TI07-0005



For Fuse Assemblies (Typical) TIME-CURRENT CHARACTERISTIC CURVES

Fuse Links, In

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at p.f. starting at 25C with no initial load

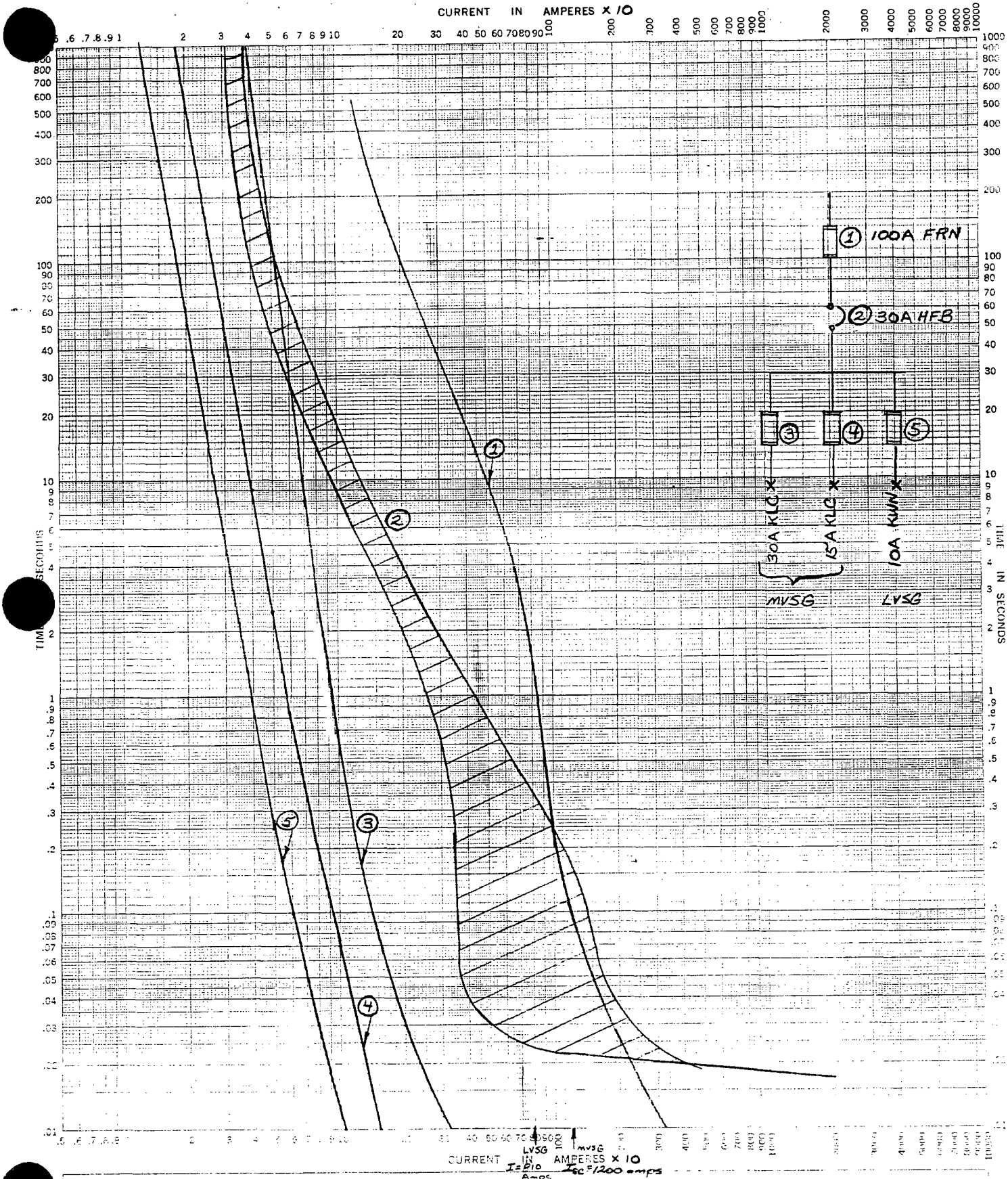
2. Curves are plotted to Test points so variations should be

No.

Date

PREPARED CWSH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No 10 Calc WBN-EEB-MS-TI07-0005



For LVSG & MVSG Coordination (Typical) TIME-CURRENT CHARACTERISTIC CURVES

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at p-f. starting at 25C with no initial load No.
2. Curves are plotted to Test points so variations should be Date

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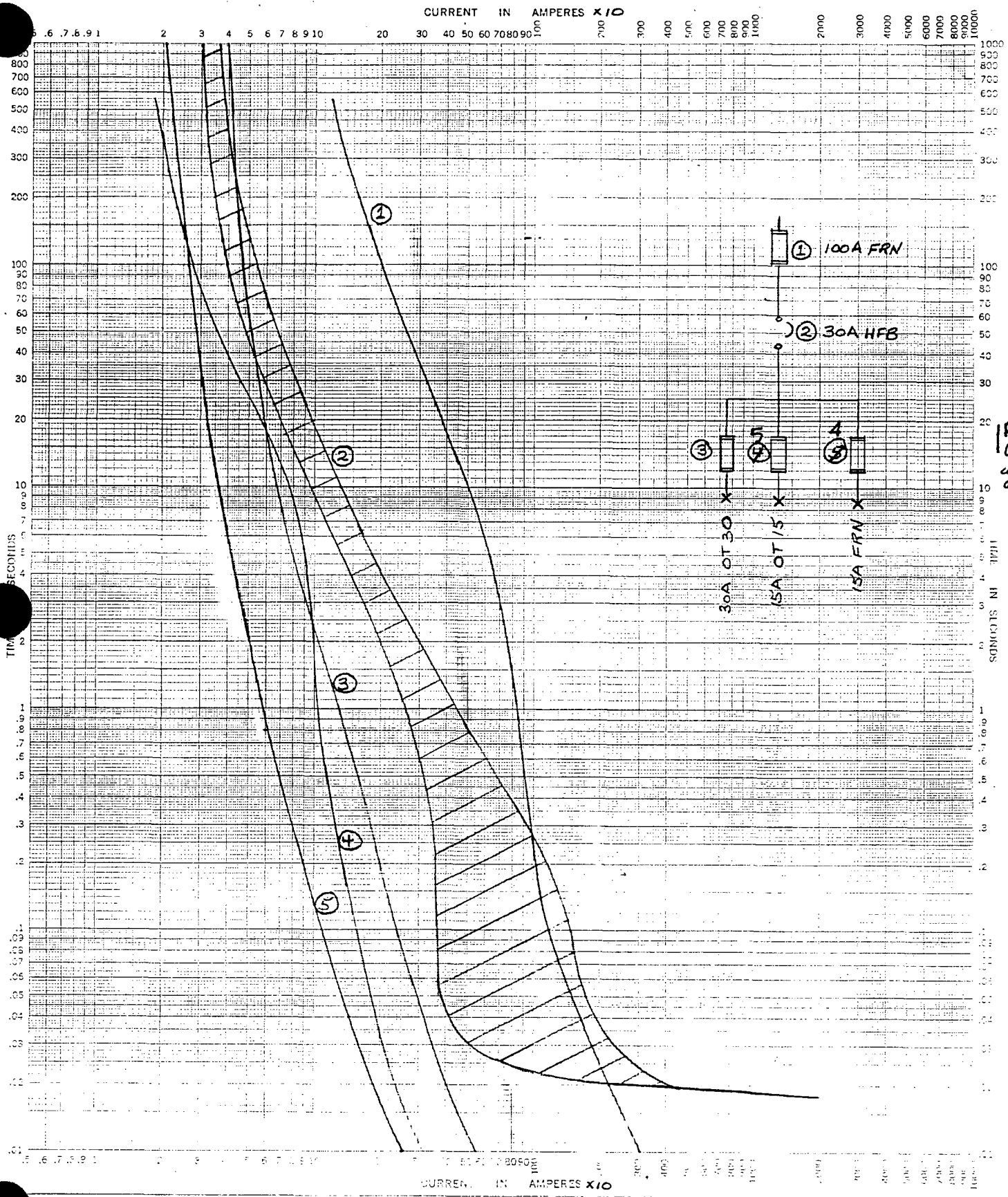
PREPARED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No 11 Calc WBN-EEB-MS-TI07-0005



For MVSG Coordination Installed Fuses TIME-CURRENT CHARACTERISTIC CURVES

BASIS FOR DATA Standards Dated

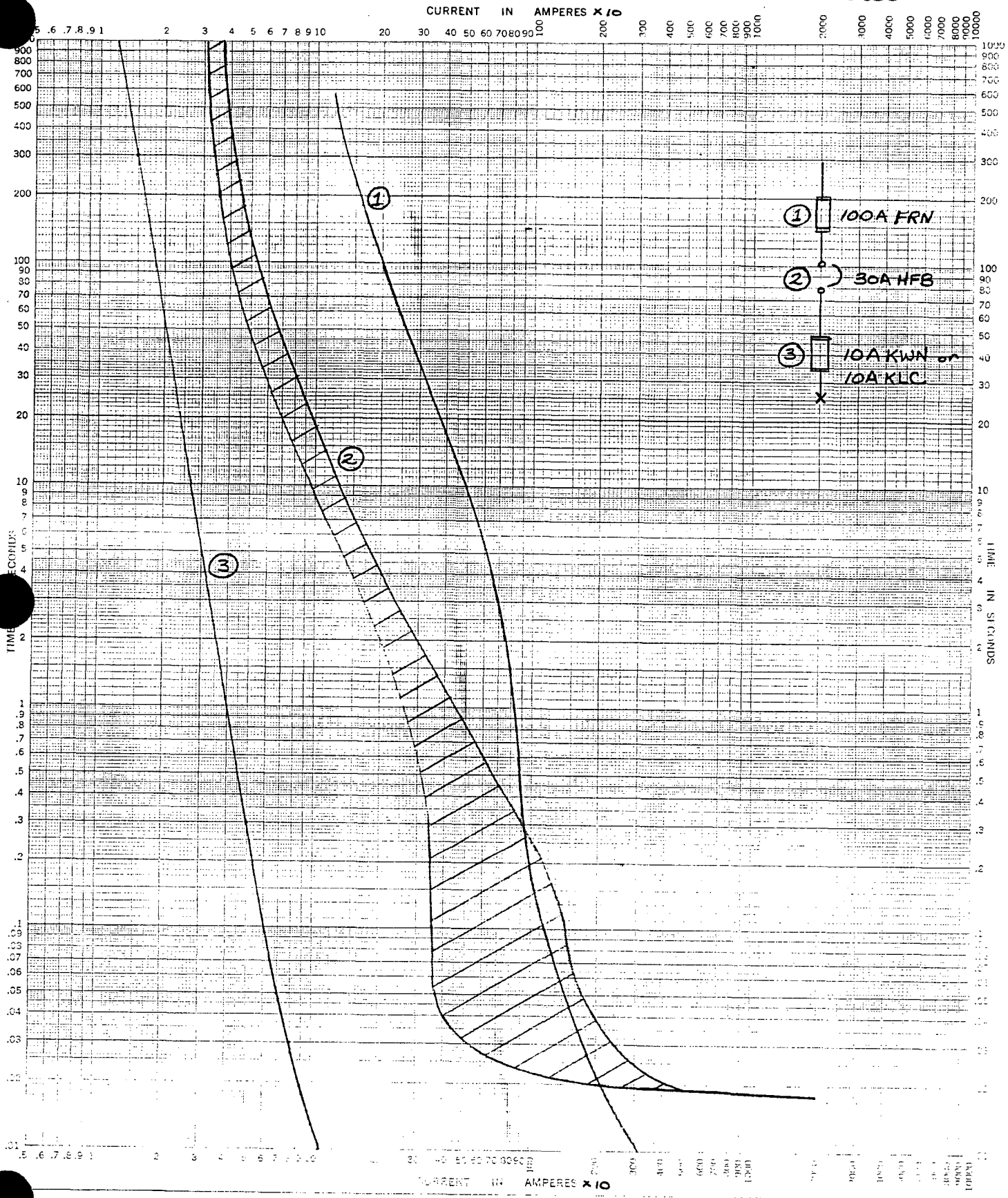
1. Tests made at Volts and at
2. Curves are plotted to Test points and variations shown

No.
Date

PREPARED WSH DATE 1/29/90

CHECKED GCP DATE 1-31-90

Curve No 12 Calc WBN-EEB-MS-TI07-0005



For LVSG Coordination with Installed Fuses TIME-CURRENT CHARACTERISTIC CURVES

BASIS FOR DATA Standards Date

1. Tests made at Volts a-c at Prior loading starting at 25C with no prior load
2. Curves are plotted to Test points or variations should be

No.

Date

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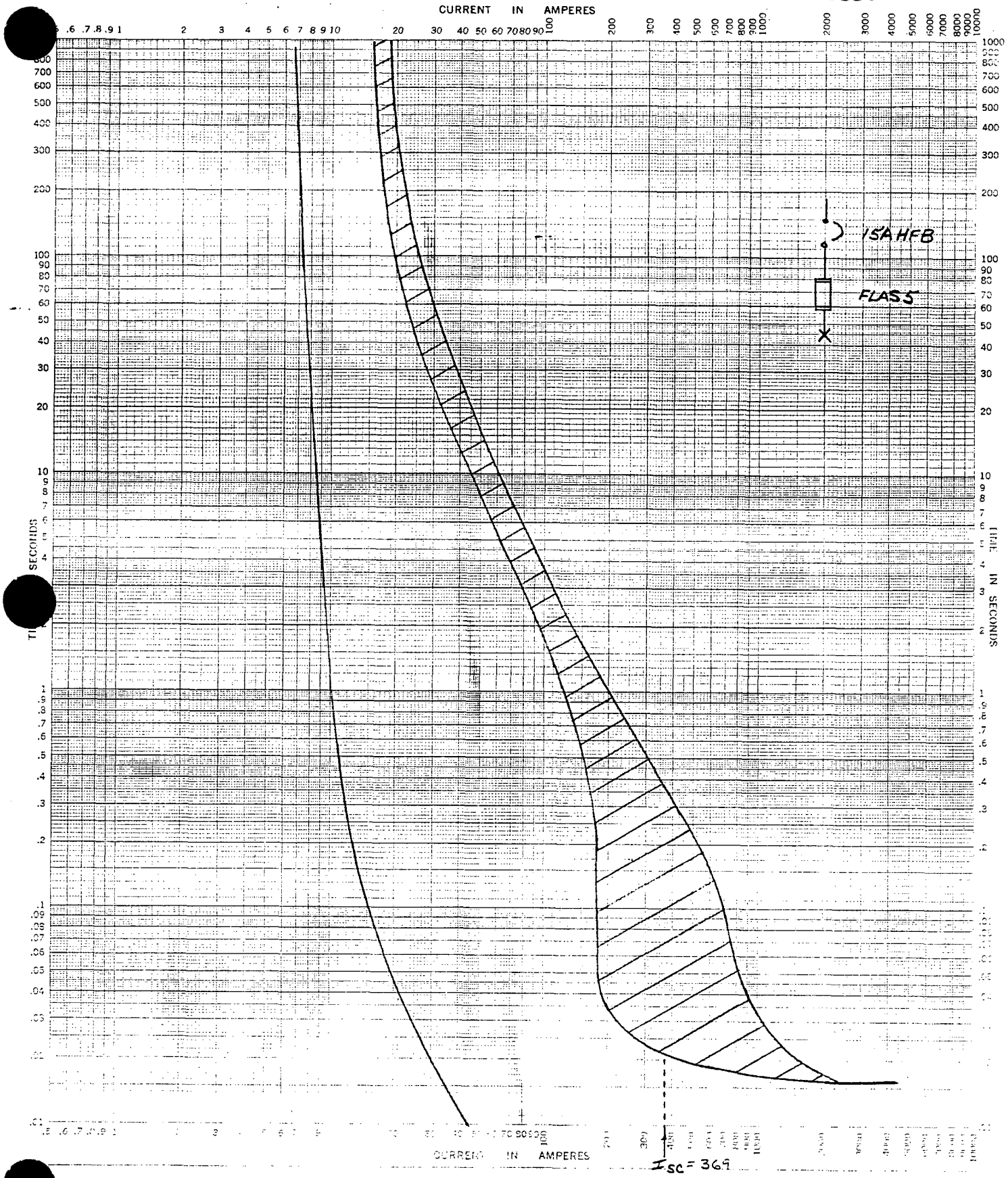
PREPARED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Curve No 13 Calc WBN-EEB-MS-TI07-0005

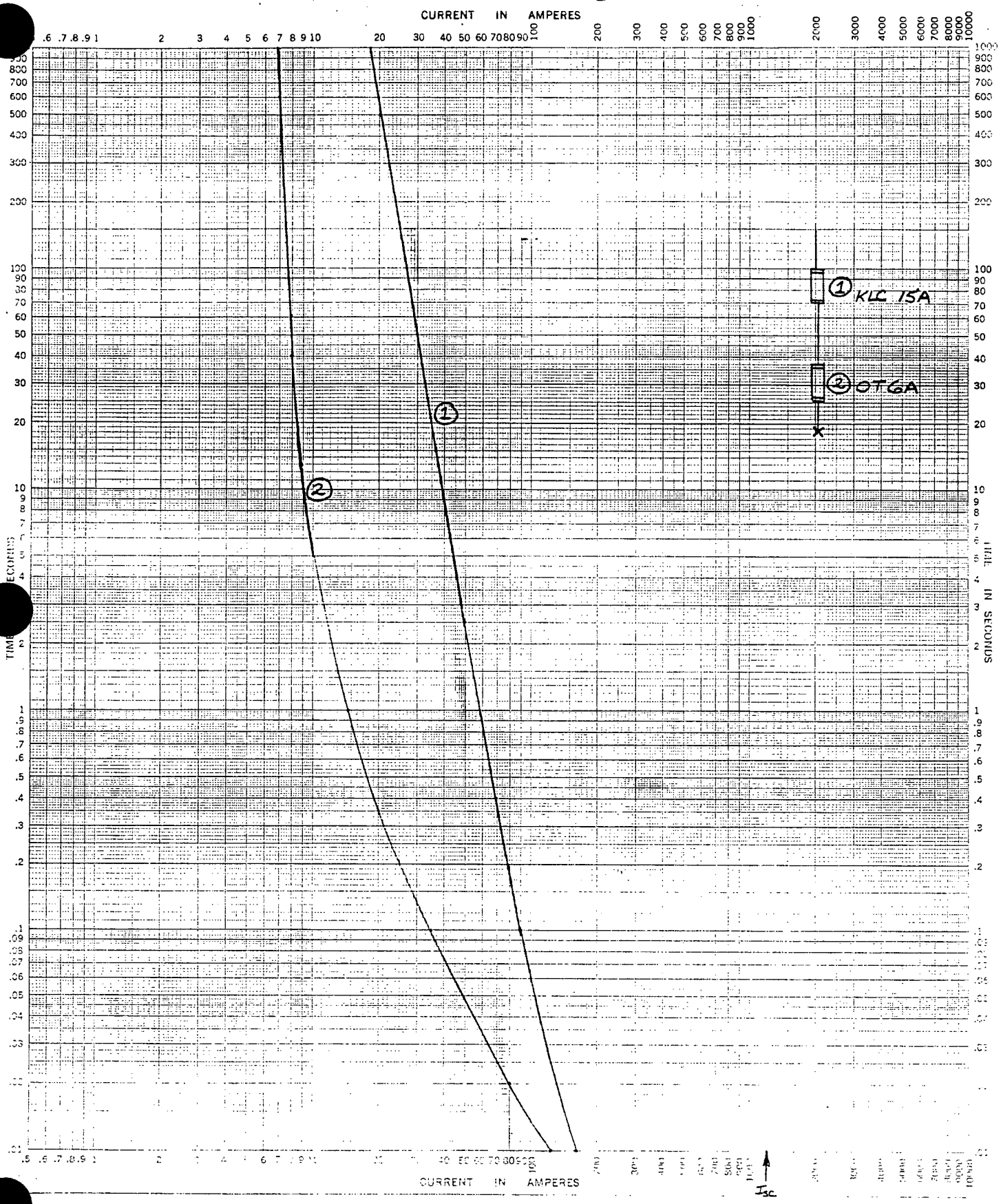


For Relay Racks TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links in
BASIS FOR DATA Standards Date
1. Tests made at Volts a-c at pf. starting at 25C with no initial load No
2. Curves are plotted to Test points so variations should be Date

PREPARED [illegible] DATE 1/29/90

CHECKED GCP DATE 1-31-90

Curve No 14 Calc WBN-EEB-MS-TI07-0005



For MVSG Cascaded Fuses TIME-CURRENT CHARACTERISTIC CURVES

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at starting at 25C with no initial load No.
2. Curves are plotted to Test points so variations should be Date

8.0 Summary of Results
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WBH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Note: Item 8.1.1 corresponds to 1.1.1, 8.1.2 to 1.1.2, etc)

8.1.1 Appendix A verifies that the protective devices are selected to operate continuously within their continuous current ratings.

8.1.2 Appendices B & C identify that the available fault currents are ~~greater~~ LESS than the FRS & FRN fuses dc interrupting ratings. IR3

8.1.3 Coordination between the subdistribution circuit breakers and load group fuse cannot be achieved for a short circuit at the output terminals of the circuit breakers. Coordination curves were reviewed and the maximum short circuit current was determined that would allow coordination between the circuit breaker and load group fuse. Using the value of short circuit current that would allow coordination, a minimum cable length was calculated for various conductor sizes (Table 6 Appendix E). The calculated cable lengths were compared with the cable lengths in the cable schedule and fifteen (15) loads failed to have sufficient cable lengths to have coordination between the subdistribution circuit breaker and the load group fuse for a fault at the load's terminals (Table 11 Appendix E). LOAD GROUP FUSES HAVE BEEN DELETED BY DCN M-12564-A TO ACHIEVE SELECTIVE COORDINATION (REFER TO ATTACHMENT M12564A) IR

8.1.4 Curves 7 and 8 show that the load group fuses will coordinate with the battery supply breaker.

8.1.5 Curves 7 and 8 show that the battery supply breaker and battery supply fuse do not completely coordinate.

8.1.6 Curves 7 and 8 show that the battery charger's input breaker and group fuse coordinate with the battery supply breaker and fuse.

8.0 Summary of Results
Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

8.17 Curves 1 thru 6 and 9 show the coordination of subdistribution circuit breakers/fuses. Only curve 5 which represents a load group fuse and subdistribution circuit breaker that exists only on vital battery board III, shows the protective device nearest the fault may not be the first to operate for an overload. LOAD GROUP FUSES HAVE BEEN DELETED BY DCN M-12564-A TO ACHIEVE SELECTIVE COORDINATION (REFER TO ATTACHMENT M-12564-A) R6 PB 4/21/9 4/21

8.18 Curves 1 thru 7 show cable damage and cable auto-ignition plots. One cable (Cable No. 2G920) which is a 1-2c #12 75°C Insulation is not protected for cable damage (Curve No 2 primary protection 30 amp CB). 14 other cables that are routed on trays are not completely protected for auto-ignition in the event the breaker fails to operate (Table 16 Appendix F). (REFER TO AS-BUILT DWG 45W703-4, REV. 1 AND DCN M-12564-A) R3

8.19 The fifth vital battery board's main supply breaker is 800 amps versus 1000 amps for vital battery boards I thru IV. Using vital battery III's load profile from calculation WBN-EEB-MS-TI11-0003, the 800 amp setting for vital battery V will not degrade the capacity of channel III.

8.20 An analysis of the feeder breaker loading for a high impedance fault (Appendix H.1) revealed that all protective devices providing Appendix R loads should be capable of supplying the Appendix R loads, the normal loads that would be operating and a non-required Appendix R load with a high impedance fault.

8.0 Summary of Results
Calc WBN-EEB-MS-TI07-0005

COMPUTED WSH DATE 1/29/90
CHECKED GCP DATE 1-31-90

8.21 Selective coordination ~~exists~~ does not exist for the non-required Appendix R circuits fed from the LVSG, MVSG, and relay racks as well as the non-required Appendix R circuits feed directly from the vital battery boards. REFER TO DCN'S M-18173A & M-17941-A FOR RESOLUTION (ATTACHMENTS M-18173-A & M-17941-A) R2 [illegible] WSH 6/28/91 R6 PB 4/21/92 [illegible] 4-21-92

8.22 All cables of non-required Appendix R circuits terminating in the vital battery boards are protected for auto-ignition.

8.23 Some of the fuse types being used in the LVSG and MVSG are not the type specified on the boards s/L's (Attachment I) Various cases of cascaded fuses have been identified that do not coordinate. REFER TO DCN'S M-18173-A & M-17941-A FOR RESOLUTION (ATTACHMENTS M-18173-A & M-17941-A) R6 PB 4/21/92 [illegible] 4-21-92

Curve 10 is a time current plot of the MVSG and LVSG control power protective feeders and the control power fuses on the MVSG & LVSG. For overloads, the 30 amp fuses in the MVSG do not coordinate with the 30 amp subdistribution circuit breakers. REFER TO DCN'S M-18173-A & M-17941-A FOR RESOLUTION (ATTACHMENTS M-18173-A & M-17941-A) R6 PB 4/21/92 [illegible] 4-21-92

The lighting contactors (Mark No. MVR) are not tested for any short circuit withstand capability and do not have any short circuit withstand rating. REFER TO DCN M-12564-A FOR RESOLUTION (ATTACHMENT M-12564-A) R6 PB 4/21/92 [illegible] 4-21-92

9.0 Conclusions

Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

9.1 Protective devices have been selected to operate within their continuous current ratings.

9.2 ~~The FRN & FRS fuses should be replaced with fuses having a minimum interrupting rating of 20,000 amps at 125 V DC.~~ (REFER TO ATTACHMENT H PG. 185A) | R3

9.3 In all likihood, any replacement fuses' time-current characterics will vary slightly from the existing FRN & FRS fuse characterics. This variation will probably result in changes to Tables 11 (coordination failures) and 16 (auto-ignition failures). Therefore, coordination curves with the FRN & FRS fuse replacements should be replotted prior to making any connective actions. Tables 11 and 16 are located in Appendices E and F respectively. | R2 (4pt/ts, WJH 6/28/9)

9.4 Complete selectivity or coordination (no overlapping of the characteristic curves ~~Figures~~ WJH 1/29/90 7 & 8) between the main battery fuse and the battery supply breaker is the ideal condition. However, partial overlapping of the main battery fuse and the battery supply breaker's characteristic curves should not be objectionable when it is realized that there would be concurrent operation of the fuse and breaker only for bus faults. Bus faults are extremely rare.

9.5 Cable 2G920 is not protected for cable damage. 2G920 is a 1-2C #12 75°C insulation (Mark No. WGB), and its primary protection is a 30 amp C.B. Reference Curve No. 2 and Appendix F, Table 16. REFER TO AS-BUILT DWG. 45W703-4 REV. 1 | R3 | R2 (4pt/ts, WJH 6/28/9)

9.6 The capacity of the vital battery system is not degraded when vital battery V replaces either on of the four vital batteries.

9.7 The 30 amp fuses in the MVSG boards should be replaced with a fuse that will coordinate with the 30 amp CB and supply the current requirements REFER TO DCN M-17941-A FOR RESOLUTION (ATTACHMENT M-17941-A) | R6 PB 4/24/92 BAT 4-21-92

9.0 Conclusions

Calc WBN-EEB-MS-TI07-0005

COMPUTED WBH DATE 1/29/90

CHECKED GCP DATE 1-31-90

of the load.

9.8 Cascaded fuses which do not selectively coordinate should be replaced with fuses that do. REFER TO DCN M-17941-A & M-18173-A FOR RESOLUTION (ATTACHMENTS M-17941-A & M-18173-A) R6 PB 4/21/92 JAH 4-21-92

9.9 Several of the fuses installed in the Class 1E MVSG and LVSG are a different type than the type specified on the boards' s/L. The installed fuses ~~should~~ be verified ~~to be Class 1E~~ or replaced, ~~AS NECESSARY TO AGREE WITH THE MASTER FUSE LIST~~ (REFER TO M-12564-A) R3

9.10 The non-required Appendix R circuits have adequate electrical protection.

9.11 The lighting contactors have only an interrupting capability of 150% rated current. REFER TO DCN M-12564-A FOR RESOLUTION (ATTACHMENT M-12564-A) R6 PB 4/21/92 JAH 4-21-92

9.12 The load group fuses require replacement or elimination for all safety-related branch circuits except the vital battery chargers, vital inverters and emergency dc lighting feeders to provide independent selective coordination for an Appendix R event. Since the branch circuit breakers have an interrupting capacity of 20,000A, current-limiting by load group fuses is not required. R2 [illegible] WITH [illegible]

10.0 APPENDICES

A CIRCUIT BREAKERS & SUB-DISTRIBUTION FUSES/BOARD LOADING

B FIFTH VITAL BATTERY SHORT CIRCUIT CURRENT

C VITAL BATTERY BOARDS I THRU IV SHORT CIRCUIT CURRENT

D FAULT CURRENTS AT LARGE LOADS (BATTERY CHGRS, INVERTERS, ETC)

E PROTECTIVE DEVICES' COORDINATION

F CABLE DAMAGE & AUTO-IGNITION

G DC RESISTANCE OF LARGE CONDUCTORS

H 10CFR50 APPENDIX R

I CASCADED FUSES

10.0 APPENDIX A

CIRCUIT BREAKERS & SUB-DISTRIBUTION FUSES/BOARD LOADING

FROM CALCULATION WBN-EEB-MS-TI11-0003, BATTERY III IS THE MOST HEAVILY LOADED, AND TABLE 1 PRESENTS THE MAXIMUM LOAD FROM THE THREE CONDITIONS (LOSS OF ALL AC POWER, AN ACCIDENT, AND NORMAL OPERATION) ANALYZED IN WBN-EEB-MS-TI11-0003. ONLY CIRCUIT BREAKER 312'S LOAD EXCEEDS 80% OF THE PROTECTIVE DEVICES' RATINGS (25.01 AMPS VS 24.0 AMPS). THE LOAD ON CIRCUIT BREAKER 312 REPRESENTS A CONSERVATIVE WORST CASE CONDITION WITH ALL RELAYS AND SOLENOID VALVES BEING SIMULTANEOUSLY ENERGIZED. SINCE THE DIFFERENCE BETWEEN 80% AND WORST CASE IS ONLY 1 AMP, THE WORST CASE LOADING ON BREAKER 312 IS CONSIDERED ACCEPTABLE.

125V DC VITAL POWER SYSTEM BOARD III COMPONENT LOADING

BOARD	BKR NO	BKR SIZE	MAX LOAD (AMP)	% OF RATING	FUSE NO	FUSE SIZE	% OF RATING
3	109	1000	558.5	55.85	101	1600	34.91
3	201	30	3.26	10.87	201	100	16.07
3	202	30	2.12	7.07			
3	203	30	3.78	12.60			
3	204	30	3.25	10.83			
3	205	30	0.58	1.93			
3	206	30	3.08	10.27			
		TOTAL	16.07				
3	208	100	56.2	56.20	203	150	37.48
3	210	40	0.02	0.05			
		TOTAL	56.22				
3	213	30	2.064	6.88	205	100	10.93
3	214	30	4.257	14.19			
3	215	30	0.05	0.17			
3	217	30	2.31	7.70			
3	218	30	2.25	7.50			
		TOTAL	10.931				
3	220	15	0	0.00	207	60	6.03
3	221	15	3.4	22.67			
3	223	15	0.22	1.47			
		TOTAL	3.62				
3	225	300	200	66.67	209	400	50.00
3	226	300	200	66.67	210	400	50.00
3	301	30	2.68	8.93	301	100	13.47
3	302	30	1.97	6.57			
3	303	30	4.17	13.90			
3	304	30	3.49	11.63			
3	305	30	0.58	1.93			
3	306	30	0.58	1.93			
		TOTAL	13.47				
3	310	30	7.83	26.10	303	150	25.44
3	311	30	5.32	17.73			
3	312	30	25.01	83.37			
		TOTAL	38.16				
3	313	15	3.36	22.40	305	60	16.62
3	319	15	0.05	0.33			
3	321	15	6.56	43.73			
		TOTAL	9.97				
3	325	125	67.1	53.68	311	200	33.55

TABLE 1 APPENDIX A CALCULATION WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD III COMPONENT LOADING

BOARD	BKR NO	BKR SIZE	MAX LOAD (AMP)	% OF RATING	FUSE NO	FUSE SIZE	% OF RATING
3	326	300	186.2	62.07	310	400	46.55
3	327	300	186.2	62.07	309	400	46.55

Appendix B Fifth Vital Battery Short Circuit Current Calc WBN-EEB-MS-TI07-0005

COMPUTED CWH DATE 1/29/90

CHECKED GCP DATE 1-31-90

10.0 Appendix B

In Appendix B, the maximum fault currents at the fifth vital battery board, Panel A, Panel O, and the fault current at vital battery board I when supplied by the fifth vital battery are calculated. Vital battery board I was used due to the supply cables being the shortest length of the four boards, and the calculated fault currents will be the maximum obtainable for any of the boards/panels. Cable lengths were obtained using the identified drawings. Tables 2 and 3 presents the results of Appendix B listing the component, components interrupting/withstand rating and the calculated fault currents.

Appendix B Fifth Vital Battery Short Circuit Current Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

5th Vital Battery Gould NCX-2550

Battery short circuit capacity 20,808 amps (Ref Attachment E)

From cable schedule Positive Cable B80S 3-400mcm 25'
Negative Cable B81S 3-400 mcm 30'

From drawing 45W217-1 R3 B80S length > 21'
B81S length > 26'

Cell intercables are 6-350mcm supplied by Gould
Length of intercell from +Cell 25 to -Cell 24 > 5'
-Cell 52 to +Cell 53 > 5'
+Cell 17 to -Cell 16 > 5'

$R_{350\,mcm} = 0.028796 \times 10^{-3}\ \Omega$ per foot

$R_{400\,mcm} = 0.024818 \times 10^{-3}\ \Omega$ per foot

R1 WJH 1/26/91 GCP 1/27/91

The resistance of 1 foot of 6-350mcm in parallel is equal to 0.58 feet of 3-400mcm in parallel.

$$\frac{0.028796 \times 10^{-3}}{6} = (x)\left(\frac{0.024818 \times 10^{-3}}{3}\right)$$

$$x = \left(\frac{0.028796}{6}\right)\left(\frac{3}{0.024818}\right) = 0.58 \text{ feet}$$

Equivalent cable length = (0.58)(15) + 21 + 26 = 55.7 ft

The equivalent cable from the battery to the battery board is greater than 50! 50 feet will be used to calculate the fault current at the battery board from the battery.

$$R_B = \frac{120}{20{,}808} = 0.005767\ \Omega$$

Appendix B Fifth Vital Battery Short Circuit Current
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

$$R_{Cable} = \frac{(2)(25)(0.0248 \times 10^{-3})}{3} = 0.0004133\ \Omega$$

$$I = \frac{120}{R_{Battery} + R_{Cable}}$$

$$I = \frac{120}{0.005767 + 0.0004133} = 19{,}416 \text{ amps}$$ short circuit current at 5th Vital Battery Bd from battery.

From cable schedule
Panel A feeder cable is B201S 6-400 mcm 75'
Panel B feeder cable is B202S 6-400 mcm 140'
Panel A is closer than Panel B
Reference drawing 45W828-19
From drawing 45W204 R7 B201S > 50'

50 ft will be used for the cable length from the 5th Vital Battery Bd to Panel A. Short circuit contribution of the battery charger to the fault current at Panel A is zero since the first thing done in replacing a battery with battery V is to disconnect the 5th battery charger.

$$R_{Cable} = \frac{(2)(25+50)(0.0248 \times 10^{-3})}{3} = 0.00124\ \Omega$$

$$I = \frac{120}{R_{Battery} + R_{Cable}}$$

$$I = \frac{120}{0.005767 + 0.00124} = 17{,}125 \text{ amps}$$ fault current at Panel A

Appendix B Fifth Vital Battery Short Circuit Current Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

Fault Current at 125V Vital Battery Bd I's Panel O

From cable schedule the cable from Panel A to Panel O is B205D 6-400MCM 30'

To be conservative, 10' will be used for B205D's length

Ref drawing 45W828-19

$$R_{Cable} = \frac{(2)(25+50+10)(0.0248\times10^{-3})}{3} = 0.001405\ \Omega$$

$$I = \frac{120}{R_{Battery} + R_{Cable}}$$

$$I = \frac{120}{0.005767 + 0.001405} = 16,731 \text{ amps}$$ fault current at panel O Battery Bd I

Cable from Panel O to Battery Bd I is B206D 6-400MCM 20'

To be conservative, 5' will be used for B206D's length

Ref drawing 45W828-6 & 45N218

$$R_{Cable} = \frac{(2)(25+50+10+5)(0.0248\times10^{-3})}{3} = 0.001488\ \Omega$$

$$I = \frac{120}{0.005767 + 0.001488} = 16,540 \text{ amps}$$ fault current at Vital Bd I when supplied by the 5th Vital Battery without charger

Appendix B Fifth Vital Battery Short Circuit Current Calculation WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

Total Fault Current at the 5th Vital Battery Board

I_T = Battery's SCA + Battery Charger's

$I_{Battery\ SCA}$ = 19,416 amps

$I_{Battery\ Chgr} \leq (1.6)(FLI) = (1.6)(300) = 480$ amps

$I_T = 19,416 + 480 = 19,896$ amps

APPENDIX B TABLE 2 CALCULATION WBN-EBB-MS-TI07-0005

FIFTH BATTERY BOARD COMPONENTS

COMPONENT	TYPE	SETTING	FAULT CURRENT	RATING
MAIN FUSE	CHASE-SHAWMUT A4BY1600	1600A	19416	20000 AIC 300VDC
CHGR FUSE	BUSSMAN FRS	400A	19416	10000 AIC AT 150V DC
BKR 102	ITE JL 400A FRAME	300A	19416	20000 AIC 250VDC
BKR 109	GE AKR-2D-30 EC-1 long curve 1A short curve 2C 4X-10X	800A	19416	50000 AIC 125VDC
BKR 201	ITE CB KM FRAME 2 POLE 800A	N/A	19896	20000-A RMS for 3 cycles
BKR 202	ITE CB KM FRAME 2 POLE 800A	N/A	19896	20000-A RMS for 3 cycles

APPENDIX B TABLE 3 CALCULATION WBN-EEB-MS-TI07-0005

125V DC PANELS A, B, & O

COMPONENT	TYPE	SETTING	FAULT RATING CURRENT
PANEL A BKR 301	ITE CB KM FRAME 2 POLE 800A	N/A	17125 20000-A RMS for 3 cycles
PANEL A BKR 302	ITE CB KM FRAME 2 POLE 800A	N/A	17125 20000-A RMS for 3 cycles
PANEL B BKR 401	ITE CB KM FRAME 2 POLE 800A	N/A	17125 20000-A RMS for 3 cycles
PANEL B BKR 402	ITE CB KM FRAME 2 POLE 800A	N/A	17125 20000-A RMS for 3 cycles
PANEL O CB 001	ITE CB KM FRAME 2 POLE 800A	800A	16731 20000 AIC at 250VDC

Appendix C Vital Battery Boards I-IV Short Circuit Current Calc WBN-EEB-MS-TI07-0003

COMPUTED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

10.0 Appendix C

In Appendix C the maximum fault current at the vital battery boards is calculated when the board is supplied power by its dedicated battery. Battery Board II is used since its supply cables have the shortest length. Table 4 presents the results of Appendix C listing the component, component's interrupting rating and the calculated fault current.

Appendix C Vital Battery Boards I-IV Short Circuit Current Calc WBN-EEB-MS-TI07-0003

COMPUTED CWH DATE 1/29/90

CHECKED GCP DATE 1-31-90

125V Vital Battery Boards I, II, III, & IV

The maximum short circuit current at anyone of the four vital battery boards when the board is supplied by its dedicated battery will be the sum of the battery's short circuit current and the battery charger's capacity.

Battery's short circuit current = 18,360 amps (Ref Attachment C)

Battery Charger's current limit = (130%)(Rated Value)
(Ref Attachment B) = (1.3)(200) = 260 amps

I = 18,360 + 260 = 18,620 amps maximum fault current at anyone of the four vital battery boards (neglects cable resistance)

Appendix C Vital Battery Boards I - IV Short Circuit Current Calc WBN-EEB-MS-TI07-0003

COMPUTED [illegible] DATE 1/29/90

CHECKED GCP DATE 1-31-90

Battery Cables to Vital Battery Boards

Board	Positive Cable	Negative Cable	Intertie
I	B55D-25'	B56D-35'	B57D-10'
II	B60E-25'	B61E-25'	B62E-10'
III	B65F-35'	B66F-35'	B67F-10'
IV	B70G-40'	B71G-40'	B72G-10'

Battery Board II has the shortest cables (B60E, B61E, & B62E) which total 60' in length. To calculate the maximum short circuit current at anyone of the four vital battery boards, 35 feet will be used for the total length of the positive, negative and intertie cables (Drawing 45N218 R10).

$$R_{Battery} = \frac{120}{18,360} = 0.0065359\ \Omega$$

All of the battery cables are 3-300MCM in parallel

$$R_{Cable} = \frac{(35)(0.0338 \times 10^{-3})}{3} = 0.0003943\ \Omega$$

Appendix C Vital Battery Boards I-IV Short Circuit Current Calc WBN-EEB-MS-TI07-0003

COMPUTED CWH DATE 1/29/90

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$$I = \frac{120}{R_{Battery} + R_{Cable}}$$

$$I = \frac{120}{0.0065359 + 0.0003943} = 17,315 \text{ amps}$$ short circuit current from battery

Short circuit contribution of the battery charger is:

$I = (200)(1.3) = 260$ amps

Total short circuit current at the four vital battery boards is

$I = 17,315 + 260 = 17,575$ amps

$$R_{Equivalent} = \frac{120}{17575} = 0.0068279\ \Omega$$

APPENDIX C TABLE 4 CALCULATION WBN-EEB-MS-TI07-0003

VITAL BATTERY BOARD II COMPONENTS

COMPONENT	TYPE	SETTING	FAULT CURRENT	RATING
FUSE 101	CHASE-SHAWMUT 1600A A4BY1600	1600A	17315	20000 at 300VDC
BKR 108 BKR 109	GE AK-2-50 EC-1 long curve 1A short curve 2C 5X	1000A	17575 with 1/29/90 ~~17315~~	50000 AIC 125VDC
LOAD BKRS	HFB	VARIOUS (15A-100A)	17575	20000 at 125VDC
LOAD BKRS	HLB	VARIOUS (125A-300A)	17575	20000 at 125VDC
FUSE	FRN	VARIOUS (60A-400A)	17575	10000AIC AT 125V DC
CHGR BKR	HLB	300A	17575	20000 at 125VDC
BOARD BUS	1600A	N/A	17575	50000 at 125VDC
	600A	N/A	17575	25000 at 125VDC
	400A	N/A	17575	20000 at 125VDC

Appendix D Fault Currents at Large Loads
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

10.0 Appendix D

In Appendix D, fault currents for the battery chargers, inverters, spare charger transfer switch and lighting contactor are calculated. Table 5 lists the components, components interrupting/withstand rating and the calculated fault current.

Appendix D Fault Currents at Large Loads
Calc WBN-EEB-MS-TI07-0005

COMPUTED WHH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Fault current at battery chargers
Shortest cable is B10D 40' (cable schedule) Cable is 300 mcm.
To calculate the fault current at the battery charger, a cable length of 20' will be used

$R_{Battery} = 0.0065359\,\Omega$ (Appendix C page ~~57~~ 56 WHH 1/29/90)

$R_{Cable} = (2)(20)(0.0338 \times 10^{-3}) = 0.001352\,\Omega$

$I = \dfrac{120}{0.0065359 + 0.001352} = 15{,}213$ amps fault current at battery chargers

Fault current at inverters
Shortest cable is B30B 45' (cable schedule) Cable is 300 mcm
To calculate the fault current at the inverters, a cable length of 30' will be used

$R_{Equivalent} = 0.0068279\,\Omega$ (Appendix C page 57)

$R_{Cable} = (2)(30)(0.0338 \times 10^{-3}) = 0.002028\,\Omega$

$I = \dfrac{120}{0.0068279 + 0.002028}$

$I = 13{,}550$ amps fault current at the inverters

Appendix D Fault Currents at Large Loads
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Fault current at the Spare Changer Transfer Switch
From cable schedule the shortest cable is B17F (55 ft)
From drawings 45N218, 45W830-1 & 45W830-2, 2-300mcm
the minimum distance is 35'.

$R_{Cable} = (2)(35)(0.0338 \times 10^{-3}) = 0.002366\ \Omega$

$I = \dfrac{120}{0.0068279 + 0.002366} = 13{,}052$ amps

Fault current at lighting contactor
From cable schedule the shortest cable is 55' (B5A), 2-1/c #2
From drawings 45N218 and 45W828-19, the cable length
is greater than 50 feet.

$R_{Cable} = (2)(50)(0.1604 \times 10^{-3}) = 0.01604\ \Omega$ | R1 WJH 1/26/91 GCP 1/31/91

$I = \dfrac{120}{0.0068279 + 0.01604}$

$I = 5{,}247$ amps

The lighting cabinet is adjacent to the contactor. Minimum cable length between the two components is greater than 4 ft.

$R_{Cable} = 0.01604 + (2)(4)(0.0001604) = 0.0173232\ \Omega$

$I = \dfrac{120}{0.0068279 + 0.0173232} = 4968.7$ amps

APPENDIX D TABLE 5 CALCULATION WBN-EEB-MS-TI07-0005

COMPONENT	UNID	CABLE	LENGTH	SIZE	FAULT CURRENT	RATED
INVERTER						
	1-I	B30D	45	2-300MCM	13550	20000 AIC 125VDC
	2-I	B31D	45	2-300MCM	13550	20000 AIC 125VDC
	1-II	B34E	50	2-300MCM	13550	20000 AIC 125VDC
	2-II	B35E	50	2-300MCM	13550	20000 AIC 125VDC
	1-III	B38F	50	2-300MCM	13550	20000 AIC 125VDC
	2-III	B39F	50	2-300MCM	13550	20000 AIC 125VDC
	1-IV	B42G	65	2-300MCM	13550	20000 AIC 125VDC
	2-IV	B43G	65	2-300MCM	13550	20000 AIC 125VDC
BATT CHGR						
	I	B10D	40	2-300MCM	15213	20000 AIC 125VDC
	II	B11E	50	2-300MCM	15213	20000 AIC 125VDC
	III	B12F	50	2-300MCM	15213	20000 AIC 125VDC
	IV	B13G	45	2-300MCM	15213	20000 AIC 125VDC
SPARE CHGR	I	B15D	90	2-300MCM	13052	10000A for 3 cycles
XFER SW	II	B16E	55	2-300MCM	13052	10000A for 3 cycles
	III	B17F	55	2-300MCM	13052	10000A for 3 cycles
	IV	B18G	85	2-300MCM	13052	10000A for 3 cycles
LTGN CONT	I	B5A	55	2-1/C #2	5247	
	II	B6B	55	2-1/C #2	5247	
	III	B7A	55	2-1/C #2	5247	
	IV	B8B	60	2-1/C #2	5247	
LTGN CAB	I	L454A	20	2-1/C #2	4969	5000 AIC 125/250VDC
	II	L459B	20	2-1/C #2	4969	5000 AIC 125/250VDC
	III	L456A	35	2-1/C #2	4969	5000 AIC 125/250VDC
	IV	L461B	35	2-1/C #2	4969	5000 AIC 125/250VDC

Appendix E Coordination
Calc. WBN-EEB-MS-TI07-0005

COMPUTED WSH DATE 1/29/90
CHECKED GCP DATE 1-31-90

10.0 Appendix E

In Section E.1, minimum cable lengths are calculated that will allow coordination between the load group fuse and the distribution circuit breakers. The fault currents used to calculate the minimum cable lengths were obtained from curves 1 thru 4. Table 6 lists the fault current, load cable's resistance, cable size, and minimum cable length. Tables 7 thru 10 list the load's cable length with the minimum required length for vital boards I, II, III and IV respectively. Table 11 is a listing of all of the load breakers on the four boards that will not coordinate with their ~~subdistribution~~ load group fuse WSH 2/19/90 due to inadequate cable lengths.

Section E.2 includes the coordination of the protective devices on the MVSG and LVSG with the load group fuse and the subdistribution circuit breaker. Tables 12 and 13 list the subdistribution load breakers for the MVSG and LVSG with the corresponding minimum

Appendix E Coordination
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
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conduit lengths that were obtained from C&G drawings. Minimum cable lengths needed to limit the short circuit current to 552 amps and 1200 amps at the MVSG boards are calculated. By limiting the short circuit currents to the above values, tests performed by Bussmann show that the peak let thru currents will allow the MVSG close/trip fuses to coordinate with the 30 amp subdistribution circuit breaker and 100 amp load group fuse. Similarly, LVSG control power fuses, cable lengths, etc were also reviewed for coordination with the load group fuse and subdistribution circuit breakers.

In section E.3, non-required Appendix R circuits are reviewed to ensure that the cable lengths are sufficient for coordination between protective devices.

Appendix E Co-ordination
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
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E.1 Load Group Fuse & Subdistribution Circuit Breaker

From the time current curves, the following values of fault currents at the load's terminals which would allow co-ordination between the load group fuse and the distribution circuit breakers were determined:

Curve Number	Protective Devices	Load's Fault Current
1	60A fuse & 15A CB	600 amps
2	100A fuse & 30A CB	900 amps
3	~~100~~ 150A fuse & 50A CB WJH 1/29/90	~~600~~ 900 amps WJH 1/29/90
4	150A fuse & 60A CB	850 amps
5	150A fuse & 100A CB	*
6	200A fuse & 125A CB	**
7	400A fuse & 300A CB	**

* A value does not exist

** Co-ordination not required between fuse and breaker

Appendix E Co-ordination
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
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E.1 Load Group Fuse & Subdistribution Circuit Breaker

Neglecting any resistance on the battery board due to the various components (fuses, circuit breakers, buses, etc), the fault current at any load's terminal will be:

$$I_F = \frac{120}{R_{Eq} + R_{Cable}}$$

where R_{Eq} is the equivalent source resistance
R_C is the cable resistance to the load
I_F is the fault current at the load's terminals

$$I_F (R_{Eq} + R_{Cable}) = 120$$

$$I_F R_{Cable} = 120 - I_F R_{Eq}$$

$R_{Eq} = 0.0068279\,\Omega$ Appendix C

$$R_C = \frac{120 - I_F R_{Eq}}{I_F} = \frac{120 - (I_F)(0.0068279)}{I_F}$$

Acceptable Cable length $\geq \dfrac{R_C}{(2)(\text{Cable resistance/ft})}$

APPENDIX E TABLE 6 CALCULATION WBN-EEB-MS-TI07-0005

CABLE LENGTHS FOR VARIOUS FAULT CURRENTS

CONFIGURATION	FAULT CURRENT (AMPS)	LOAD CABLE'S RESISTANCE (OHMS)	SIZE	DC RESIS OHMS PER 1000 FT	MIN CABLE LENGTH
60A FUSE, 15A CB	600	0.193172	#12	1.6500	58.54
			#10	1.0400	92.87
			#8	0.6540	147.69
			#6	0.4100	235.58
			#4	0.2590	372.92
150A FUSE, 60A CB	850	0.134349	#4	0.2590	259.36
			#2	0.1604	418.80
			4/0	0.0483	1391.18
100A FUSE, 30A CB 150A FUSE, 50A CB	900	0.126505	#12	1.6500	38.33
			#10	1.0400	60.82
			#8	0.6540	96.72
			#6	0.4100	154.27
			#4	0.2590	244.22
			#2	0.1604	394.35
			4/0	0.0483	1309.97

APPENDIX E TABLE 7 CALC WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD I

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
1	109	1000	101	1600	B56D	WDN	3-300MCM	35	7		P
1	109	1000	101	1600	B57D	WDN	3-300MCM	10	7		P
1	109	1000	101	1600	B55D	WDN	3-300MCM	25	7		P
1	201	30	201	100	1B1D	WDD	2-1/C #8	70	2	97	F
1	202	30	201	100	1B11D	WDD-1	2-1/C #8	175	2	97	P
1	203	30	201	100	1B16D	WDD-1	2-1/C #8	175	2	97	P
1	204	30	201	100	1B4D	WDD	2-1/C #8	90	2	97	F
1	205	30	201	100	1B14D	WDD-1	2-1/C #8	175	2	97	P
1	206	30	201	100	1B19D	WDD-1	2-1/C #8	175	2	97	P
1	213	30	205	100	B23	WDD-1	2-1/C #8	154	2	97	P
1	214	30	205	100	B20	WDD-1	2-1/C #8	462	2	97	P
1	215	30	205	100	1B44	WDD-1	2-1/C #8	264	2	97	P
1	216	30	205	100	B45	WDD-1	2-1/C #8	900	2	97	P
1	220	15	207	60	1M2468	WGB-1	1-2C #12	504	1	59	P
1	221	15	207	60	1B47	WGB	1-2C #12	382	1	59	P
1	222	15	207	60	B1	WLN	1-2C #10	603	1	93	P
1	223	15	207	60	B501R	WDF-1	2-1/C #4	1414	1	373	P
1	225	300	209	400	B15D	WDN	2-300MCM	90	7		P
1	226	300	210	400	B10D	WDN	2-300MCM	40	7		P
1	301	30	301	100	2B2D	WDD	2-1/C #8	50	2	97	F
1	302	30	301	100	2B12D	WDD-1	2-1/C #8	300	2	97	P
1	303	30	301	100	2B17D	WDD-1	2-1/C #8	300	2	97	P
1	304	30	301	100	2B3D	WDD	2-1/C #8	90	2	97	F
1	305	30	301	100	2B13D	WDD-1	2-1/C #8	300	2	97	P
1	306	30	301	100	2B18D	WDD-1	2-1/C #8	300	2	97	P
1	313	15	305	60	1B40A	WLB	1-2C #12	296	1	59	P
1	319	15	305	60	1B36A	WGB-2	1-2C #12	370	1	59	P
1	321	15	305	60	2SG220A	WLB	1-2C #12	557	1	59	P
1	325	125	311	200	B5A	WDG	2-1C #2	55	6		P
1	326	300	310	400	B30D	WDN	2-300MCM	45	7		P
1	327	300	309	400	B31D	WDN	2-300MCM	45	7		P

APPENDIX E TABLE 8 CALCULATION WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD II

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
2	109	1000	101	1600	B60E	WDN	3-300MCM	25	7		P
2	109	1000	101	1600	B61E	WDN	3-300MCM	25	7		P
2	109	1000	101	1600	B62E	WDN	3-300MCM	10	7		P
2	201	30	201	100	1B6E	WDD	2-1/C #8	115	2	97	F
2	202	30	201	100	1B25E	WDD	2-1/C #8	185	2	97	P
2	203	30	201	100	1B30E	WDD	2-1/C #8	185	2	97	P
2	204	30	201	100	1B9E	WDD	2-1/C #8	75	2	97	F
2	205	30	201	100	1B28E	WDD	2-1/C #8	185	2	97	P
2	206	30	201	100	1B33E	WDD	2-1/C #8	185	2	97	P
2	207	50	203	150	B90	WDE-1	2-1/C #6	993	3	155	P
2	214	30	205	100	B46	WDD-1	2-1/C #8	822	2	97	P
2	215	30	205	100	1B45	WDD-1	2-1/C #8	261	2	97	P
2	219	15	207	60	1G920	WGB-1	1-2C #12	465	1	59	P
2	221	15	207	60	B53	WLN	1-2C #10	551	1	93	P
2	223	15	207	60	B503P	WDF-1	2-1/C #4	1402	1	373	P
2	225	300	209	400	B16E	WDN	2-300MCM	55	7		P
2	226	300	210	400	B11E	WDN	2-300MCM	50	7		P
2	301	30	301	100	2B7E	WDD	2-1/C #8	140	2	97	P
2	302	30	301	100	2B26E	WDD	2-1/C #8	275	2	97	P
2	303	30	301	100	2B31E	WDD	2-1/C #8	275	2	97	P
2	304	30	301	100	2B8E	WDD	2-1/C #8	100	2	97	F
2	305	30	301	100	2B27E	WDD	2-1/C #8	275	2	97	P
2	306	30	301	100	2B32E	WDD	2-1/C #8	275	2	97	P
2	313	15	305	60	1B41B	WLB	1-2C #12	509	1	59	P
2	319	15	305	60	1B37B	WFB-1	1-2C #10	492	1	93	P
2	321	15	305	60	2S6221B	WLB	1-2C #12	503	1	59	P
2	325	125	311	200	B6B	WDG	2-1/C #2	55	6		P
2	326	300	310	400	B34E	WDN	2-300MCM	50	7		P
2	327	300	309	400	B35E	WDN	2-300MCM	50	7		P

125V DC VITAL POWER SYSTEM BOARD III

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
3	109	1000	101	1600	B65F	WDN	3-300MCM	35	7		P
3	109	1000	101	1600	B66F	WDN	3-300MCM	35	7		P
3	109	1000	101	1600	B67F	WDN	3-300MCM	10	7		P
3	201	30	201	100	1B2F	WDE	2-1/C #6	130	2	155	P
3	202	30	201	100	1B12F	WDD-1	2-1/C #8	250	2	97	P
3	203	30	201	100	1B17F	WDD-1	2-1/C #8	245	2	97	P
3	204	30	201	100	1B3F	WDD	2-1/C #8	95	2	97	F
3	205	30	201	100	1B13F	WDD-1	2-1/C #8	225	2	97	P
3	206	30	201	100	1B18F	WDD-1	2-1/C #8	300	2	97	P
3	208	100	203	150	1B22	WDK	2-1/C #4/0	357	5		F
3	213	30	205	100	B24	WDD-1	2-1/C #8	411	2	97	P
3	214	30	205	100	B47	WDD-1	2-1/C #8	458	2	97	P
3	215	30	205	100	2B44	WDD-1	2-1/C #8	568	2	97	P
3	220	15	207	60	2M246B	WGB-1	1-2C #12	462	1	59	P
3	221	15	207	60	2B47	WGB-1	1-2C #12	408	1	59	P
3	223	15	207	60	B500	WDF-2	2-1/C #4	1072	1	373	P
3	225	300	209	400	B17F	WDN	2-300MCM	55	7		P
3	226	300	210	400	B12F	WDN	2-300MCM	50	7		P
3	301	30	301	100	2B1F	WDE-1	2-1/C #6	55	2	155	F
3	302	30	301	100	2B11F	WDD-1	2-1/C #8	225	2	97	P
3	303	30	301	100	2B16F	WDD-1	2-1/C #8	225	2	97	P
3	304	30	301	100	2B4F	WDD	2-1/C #8	75	2	97	F
3	305	30	301	100	2B14F	WDD-1	2-1/C #8	225	2	97	P
3	306	30	301	100	2B19F	WDD-1	2-1/C #8	225	2	97	P
3	313	15	305	60	2B40A	WLB	1-2C #12	128	1	59	P
3	319	15	305	60	2B36A	WLB	1-2C #12	504	1	59	P
3	321	15	305	60	1SG220A	WDF-2	2-1/C #4	517	1	373	P
3	325	125	311	200	B7A	WDG-1	2-1/C #2	55	6		P
3	326	300	310	400	B38F	WDN	2-300MCM	50	7		P
3	327	300	309	400	B39F	WDN	2-300MCM	50	7		P

APPENDIX E TABLE 10 CALC WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD IV

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
4	109	1000	101	1600	B70G	WDN	3-300MCM	40	7		P
4	109	1000	101	1600	B71G	WDN	3-300MCM	40	7		P
4	109	1000	101	1600	B72G	WDN	3-300MCM	10	7		P
4	201	30	201	100	1B7G	WDD	2-1/C #8	45	2	97	F
4	202	30	201	100	1B26G	WDD	2-1/C #8	300	2	97	P
4	203	30	201	100	1B31G	WDD	2-1/C #8	300	2	97	P
4	204	30	201	100	1B8G	WDD	2-1/C #8	100	2	97	F
4	205	30	201	100	1B27G	WDD	2-1/C #8	200	2	97	P
4	206	30	201	100	1B32G	WDD	2-1/C #8	300	2	97	P
4	208	60	203	150	2B22	WDF	2-1/C #4	375	4	260	P
4	214	30	205	100	B51	WFB	1-2C #10	880	2	97	P
4	215	30	205	100	2B45	WDD-1	2-1/C #8	603	2	97	P
4	219	30	205	100	2G920	WGB	1-2C #12	258	2	97	P
4	221	15	207	60	B54	WLN	1-2C #10	463	1	93	P
4	222	15	207	60	B2	WLN	1-2C #10	393	1	93	P
4	223	15	207	60	B502	WDF-2	2-1/C #4	1102	1	373	P
4	225	300	209	400	B18G	WDN	2-300MCM	85	7		P
4	226	300	210	400	B13G	WDN	2-300MCM	45	7		P
4	301	30	301	100	2B6G	WDD	1-2C #8	80	2	97	F
4	302	30	301	100	2B25G	WDD	1-2C #8	175	2	97	P
4	303	30	301	100	2B30G	WDD	1-2C #8	175	2	97	P
4	304	30	301	100	2B9G	WDD	1-2C #8	100	2	97	F
4	305	30	301	100	2B28G	WDD	1-2C #8	175	2	97	P
4	306	30	301	100	2B33G	WDD	1-2C #8	175	2	97	P
4	313	15	305	60	2B41B	WLB	1-2C #12	473	1	59	P
4	319	15	305	60	2B37B	WFB-1	1-2C #10	389	1	93	P
4	321	15	305	60	1SG221B	WGB-1	1-2C #12	576	1	59	P
4	325	125	311	200	B8B	WDG	2-1/C #2	60	6		P
4	326	300	310	400	B42G	WDN	2-300MCM	65	7		P
4	327	300	309	400	B43G	WDN	2-300MCM	65	7		P

APPENDIX E TABLE 11 CALC WBN-EEB-MS-TI07-0005

CABLES WITH INADEQUATE LENGTH FOR COORDINATION AT THE
LOAD'S TERMINALS USING CABLE LENGTHS FROM THE CABLE SCHEDULE

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
1	201	30	201	100	1B1D	WDD	2-1/C #8	70	2	97	F
1	204	30	201	100	1B4D	WDD	2-1/C #8	90	2	97	F
1	301	30	301	100	2B2D	WDD	2-1/C #8	50	2	97	F
1	304	30	301	100	2B3D	WDD	2-1/C #8	90	2	97	F
2	201	30	201	100	1B6E	WDD	2-1/C #8	115	2	97	F
2	204	30	201	100	1B9E	WDD	2-1/C #8	75	2	97	F
2	304	30	301	100	2B8E	WDD	2-1/C #8	100	2	97	F
3	204	30	201	100	1B3F	WDD	2-1/C #8	95	2	97	F
3	208	100	203	150	1B22	WDK	2-1/C #4/0	357	5		F
3	301	30	301	100	2B1F	WDE-1	2-1/C #6	55	2	155	F
3	304	30	301	100	2B4F	WDD	2-1/C #8	75	2	97	F
4	201	30	201	100	1B76	WDD	2-1/C #8	45	2	97	F
4	204	30	201	100	1B86	WDD	2-1/C #8	100	2	97	F
4	301	30	301	100	2B66	WDD	1-2C #8	80	2	97	F
4	304	30	301	100	2B96	WDD	1-2C #8	100	2	97	F

Appendix E Coordination
Cal WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
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E.2 Fuse Assemblies

From Littelfuse test report the minimum resistance of a FLAS 5 fuse is 0.0221. The short circuit current at the terminals of the fuses is:

$$I_{sc} = \frac{120}{R_{eq} + (2)\,R_{Fuse}}$$

where $R_{eq} = 0.0068279\,\Omega$
$R_{Fuse} = 0.0221\,\Omega$
Attachment G

$$= \frac{120}{0.0068279 + (2)(0.0221)}$$

$= 2351.6$ amps at terminals of fuse

Per CLSB test report (51387083182G) in Attachment G, the let-thru current for a fault current of 3400 amps is less than 350 amps for a FLAS 5 fuse. Therefore the fuses in the fuse assemblies will coordinate with the subdistribution circuit breaker and load group fuse.

Appendix E Coordination
Cal WBN-EEB-MS-TI07-0005

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E.2 Relay Racks

Subdistribution BKr 15 amp Load Group Fuse 60 amp

Cable Nos		Tray Length from Cable Schedule
1B40A	2/c #12	296-40 = 256
1B41B	2/c #12	509-30 = 479
2B40A	2/c #12	128-45 = 83
2B41B	2/c #12	473-45 = 428

Fuses in the relay racks are FLAS 5. Minimum cable length is cable 2B40A 65 feet. Reference dwgs 47W605-2, 45N218
Fault current at relay's racks is:

$$I = \frac{120}{R_{eq} + R_{Cable}} \qquad R_{Cable} = (2)(65)(1.65 \times 10^{-3})$$

$$I = \frac{120}{0.0068279 + (2)(65)(0.00165)} = 542 \text{ amps}$$

Cable length required if the current limiting feature of the FLAS 5 fuse was neglected (Reference Curve 13).

$$I = \frac{120}{0.0068279 + (2)(L)(0.00165)} = 170 \text{ amps}$$

$$120 = 170\,(0.0068279 + 0.0033L)$$

$$118.83 = 0.561L$$

$$L = 211.8 \text{ ft}$$

Including the resistance of the fuse

$$120 = 170\,(0.0068279 + (2)(0.0221) + 0.0033L)$$

$$111.325 = 0.561L$$

$$L = 198.44 \text{ ft}$$

Appendix E Coordination
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E.2 Relay Racks

Maximum fault current using resistance of fuse and cable's tray length (83 feet)

$$I = \frac{120}{0.0068279 + (2)(0.0221) + (2)(L)(0.00165)}$$

$$I = \frac{120}{0.0510279 + (0.0033)(83)} = \frac{120}{0.32493}$$

$I = 369.31$ amps

If the cable length is greater than 198.5 feet, the current limiting capability of the FLAS 5 fuse can be ignored for coordination purposes. Three of the four cables have tray lengths that exceed this length (1B40A, 1B41B, & 2B41B). Cable 2B40A's tray length is 83 feet, and the maximum fault current would be 369.3 amps. The FLAS 5 fuse is a current limiting fuse that reduced the let-thru by approximately a factor of ten at 3400 amps in tests performed by CLSB. It is reasonable to conclude that the let-thru will be reduced to less than 170 amps at 370 amps since the 370 amps represents a worst case value (minimum cable lengths and resistances, constant supply voltage and conductor temperatures, etc).

Appendix E Co-ordination
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
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E.2 MVSG Control Power Co-ordination

Maximum control power fuse size in the MVSG is 30 amps (Dwg 45W760-21-8). The control fuses for breaker "close" and "trip" functions are 15 amp. Per note 3 on the 6900 volt S/L's, all fuses in dc circuits are KLC or equivalent. Table 12 lists all of the MVSG feeders with the conduit lengths taken from drawings 45W828-1 and 45W828-2.
In tests performed by Bussmann on the KLC 15 (RIMS EEB 840906009), the mean peak let-through was 370.4 amps for a short circuit current of 1200 amperes. To limit the short circuit current at the load side of the KLC fuses to 1200 amperes, a #8 cable's length should be greater than

$$I = \frac{120}{R_{eq} + (2)(L)(0.000654)} = 1200 \text{ amps}$$

$$1200\left[R_{eq} + 0.001308\,L\right] = 120$$

$$1.5696\,L = 120 - (1200)(0.0068279)$$

$$L = \frac{111.806}{1.5696} = 71.23 \text{ ft}$$

For a #6 cable the length should be greater than

$$(1200)(2)(L)(0.00041) = 111.806 \text{ ft}$$

$$L = \frac{111.806}{0.984}$$

$$L = 113.62 \text{ ft}$$

Appendix E Coordination
Calc WBN-EEB-MS-TI07-0005

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E.2 MVSG Control Power Coordination

For the 15 amp FRN fuse, the tests (EEB840906009) measured the mean peak let-thru to be 343.2 amps for a short circuit current of 552 amps. The cable length required to limit the current to 552 amps is:

#8 Conductors

$$I = \frac{120}{R_{eq} + (2)(L)(0.000654)} = 552$$

$$552\,(R_{eq} + 0.001308L) = 120$$

$$0.72202\,L = 120 - (552)(0.0068279)$$

$$L = 161 \text{ ft}$$

#6 Conductors

$$I = \frac{120}{R_{eq} + (2)(L)(0.00041)} = 552$$

$$(552)(2)(L)(0.00041) = 120 - (552)(0.0068279)$$

$$L = \frac{116.23}{0.45264}$$

$$L = 256.8 \text{ ft}$$

MVSG FEEDERS

SWGR	FUNCTION	BAT BD	BKR NO	CABLE NUMBER	CABLE SIZE	CONDUIT NUMBER	MIN CONDUIT LENGTH	RES/FT #8 or #6	MIN FDR CABLE RES	#10 CABLE LENGTH I=1200	#10 CABLE LENGTH I=552
1A-A	NOR BUS NOR FDR	I	204	1B4D	#8	1B1061D	72	0.000654	0.09418	0.00	55.96
	NOR BUS ALT FDR	III	204	1B3F	#8	1B1070F	64	0.000654	0.08371	4.55	60.99
	B/U BUS NOR FDR	III	201	1B2F	#6	1B1071F	107	0.00041	0.08774	2.61	59.06
	B/U BUS ALT FDR	I	201	1B1D	#8	1B1060D	48	0.000654	0.06278	14.61	71.06
2A-A	NOR BUS NOR FDR	III	304	2B4F	#8	2B1067F	45	0.000654	0.05886	16.50	72.94
	NOR BUS ALT FDR	I	304	2B3D	#8	2B1070D	64	0.000654	0.08371	4.55	60.99
	B/U BUS NOR FDR	I	301	2B2D	#8	2B1071D	24	0.000654	0.03139	29.70	86.15
	B/U BUS ALT FDR	III	301	2B1F	#6	2B1068F	96	0.00041	0.07872	6.95	63.39
1B-B	NOR BUS NOR FDR	II	204	1B9E	#8	1B1066E	53	0.000654	0.06932	11.47	67.91
	NOR BUS ALT FDR	IV	204	1B8G	#8	1B1076G	59	0.000654	0.07717	7.69	64.14
	B/U BUS NOR FDR	IV	201	1B7G	#8	1B1075G	24	0.000654	0.03139	29.70	86.15
	B/U BUS ALT FDR	II	201	1B6E	#8	1B1065E	101	0.000654	0.13211	0.00	37.72
2B-B	NOR BUS NOR FDR	IV	304	2B9G	#8	2B1063G	72	0.000654	0.09418	0.00	55.96
	NOR BUS ALT FDR	II	304	2B8E	#8	2B1076E	67	0.000654	0.08764	2.66	59.11
	B/U BUS NOR FDR	II	301	2B7E	#8	2B1075E	107	0.000654	0.13996	0.00	33.95
	B/U BUS ALT FDR	IV	301	2B6G	#8	2B1062G	48	0.000654	0.06278	14.61	71.06

Control Cables for close/trip commands are #10 $R/_{ft}$ #10 = 0.00104 Ω

$$I = \frac{120}{R_{eq} + R_{Fdr} + (2)(L)(0.00104)} \quad \text{where } R_{eq} = 0.0068279$$

$$I = \frac{120}{0.0068279 + R_{Fdr} + 0.00208L}$$

Lotus 1-2-3 was used to generate values for the above table; a hand calculated example is provided to verify its correct application:

1A-A Nor Bus Alt Fdr III

$$L = \frac{\frac{120}{I} - (0.0068279 + R_{Fdr})}{0.00208} = \frac{\frac{120}{552} - (0.0068279 + 0.08371)}{0.00208}$$

$$L = \frac{0.21739 - (0.09054)}{0.00208} = \frac{0.12685}{0.00208} = 60.99 \text{ ft}$$

R2 GP 6/25/91 WTH 6/28/91

Appendix E Coordination
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E.3 Append R Common Power Supply
MVSG Non-Appendix R Circuits

In all four MVSG, the normal dc control power bus feeders terminate in panel number 2 at a manual transfer switch. Non-Appendix R loads in the MVSG are the non-safety pressurizer heaters, containment spray pumps, and safety injection pumps. For all four MVSG, the non-safety pressurizer heaters, containment spray pumps and safety injection pumps are in panels 21, 13, and 15 respectively. Per the MVSG connection diagrams (0126D4525, 0126D4540, 0126D4084, 0126D4097, etc) the internal board wiring for the control power bus is #8 AWG. The width of each MVSG panel is 3 feet. Therefore, the minimum distance between the panel that the normal control power transfer switch is located in (panel 2) and the closest non-Appendix R circuit breaker (panel 13) is 30 feet. When 30 feet is added to the normal feeder's minimum conduit length in Table 12 all normal feeders are sufficient in length to limit the fault current to less than 1200 amps for any of the non-Appendix R circuits.

LVSG Non-Appendix R Circuits

The length of the control power feeders from the battery boards to the LVSG is sufficient that the 10 amp KWN fuse will coordinate with the subdistribution circuit breaker and load group fuse. Therefore, there is no minimum length for the non-Appendix R circuits.

Appendix E Coordination
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E.2 LVSG Control Power Coordination

Maximum dc control power fuse size in the LVSG is 10 amps. Per note 4 or 5 on the 480V S/D Board S/L's, all fuses in dc circuits are KWN or equivalent. Table 13 lists all of the LVSG control power feeders with the corresponding straight line scaled length from drawing series 45W828. The given lengths do not take into account the vertical distance from the board to the ceiling and the distance from the ceiling to the floor (approximately 20 ft) or the internal lengths within the boards. The maximum fault current at any LVSG on the line side of the control power fuses will be less than

$$I \leq \frac{120}{0.0068279 + (2)(88+20)(0.000654)}$$

$$\leq \frac{120}{0.1480919} = 810 \text{ amps}$$

LVSG FEEDERS

SWGR	FUNCTION	BAT BD	BKR NO	CABLE NUMBER	CABLE SIZE	CONDUIT NUMBER	LENGTH
1A1-A	NOR BUS NOR FDR	I	202	1B11D	#8	1B1040D,1044D	99
	NOR BUS ALT FDR	III	202	1B12F	#8	1B1045F,1049F	181
	B/U BUS NOR FDR	III	205	1B13F	#8	1B1046F,1049F	181
	B/U BUS ALT FDR	I	205	1B14D	#8	1B1041D,1044D	99
1A2-A	NOR BUS NOR FDR	I	203	1B16D	#8	1B1042D,1044D	109
	NOR BUS ALT FDR	III	203	1B17F	#8	1B1047F,1049F	176
	B/U BUS NOR FDR	III	206	1B18F	#8	1B1048F,1049F	176
	B/U BUS ALT FDR	I	206	1B19D	#8	1B1043D,1044D	109
1B1-B	NOR BUS NOR FDR	II	202	1B25E	#8	1B1055E,1059E	101
	NOR BUS ALT FDR	IV	202	1B26G	#8	1B1050G,1054G	192
	B/U BUS NOR FDR	IV	205	1B27G	#8	1B1051G,1054G	192
	B/U BUS ALT FDR	II	205	1B28E	#8	1B1056E,1059E	101
1B2-B	NOR BUS NOR FDR	II	203	1B30E	#8	1B1057E,1059E	96
	NOR BUS ALT FDR	IV	203	1B31G	#8	1B1052G,1054G	192
	B/U BUS NOR FDR	IV	206	1B32G	#8	1B1053G,1054G	192
	B/U BUS ALT FDR	II	206	1B33E	#8	1B1058E,1059E	96
2A1-A	NOR BUS NOR FDR	III	302	2B11F	#8	2B1045F,1049F	101
	NOR BUS ALT FDR	I	302	2B12D	#8	2B1040D,1044D	192
	B/U BUS NOR FDR	I	305	2B13D	#8	2B1041D,1044D	192
	B/U BUS ALT FDR	III	305	2B14F	#8	2B1046F,1049F	101
2A2-A	NOR BUS NOR FDR	III	303	2B16F	#8	2B1047F,1049F	101
	NOR BUS ALT FDR	I	303	2B17D	#8	2B1042D,1044D	192
	B/U BUS NOR FDR	I	306	2B18D	#8	2B1043D,1044D	192
	B/U BUS ALT FDR	III	306	2B19F	#8	2B1048F,1049F	101
2B1-B	NOR BUS NOR FDR	IV	302	2B25G	#8	2B1050G,1054G	93
	NOR BUS ALT FDR	II	302	2B26E	#8	2B1055E,1059E	192
	B/U BUS NOR FDR	II	305	2B27E	#8	2B1056E,1059E	192
	B/U BUS ALT FDR	IV	305	2B28G	#8	2B1051G,1054G	96
2B2-B	NOR BUS NOR FDR	IV	303	2B30G	#8	2B1052G,1054G	88
	NOR BUS ALT FDR	II	303	2B31E	#8	2B1057E,1059E	203
	B/U BUS NOR FDR	II	306	2B32E	#8	2B1058E,1059E	203
	B/U BUS ALT FDR	IV	306	2B33G	#8	2B1053G,1054G	91

Appendix F Cable Damage & Auto-Ignition
Calc WBN-EEB-MS-TI07-0005

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10.0 Appendix F

F.1 In Appendix F, cable damage and auto-ignition currents are calculated for various cable sizes for cable with 75°C and 90°C insulation. The calculated insulation damage and auto-ignition currents are based on the IPCEA formula:

$$\left(\frac{I}{A}\right)^2 t = 0.0297 \log_{10}\left(\frac{T_F + 234}{T_o + 234}\right)$$

where I = Short Circuit Current - Amperes
A = Conductor Area - Circular Mils
t = Time of Short Circuit - Seconds
T_o = Maximum operating temperature - °C
T_F = Maximum short circuit/auto-ignition temperature - °C

For 75°C insulation, T_F is equal to 125°C and 455°C for cable damage and auto-ignition respectively; for 90°C insulation, T_F is equal to 250°C and 530°C. Table 14 provides the cable damage and auto-ignition currents for various cable sizes and times.

Appendix F Cable Damage & Auto-Ignition
Calc WBN-EEB-MS-TI07-0005

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IPCEA Equation

$$\left(\frac{I}{A}\right)^2 t = 0.0297 \log_{10}\left(\frac{T_F+234}{T_o+234}\right)$$

$$I^2 = \left(\frac{A^2}{t}\right)\left(0.0297 \log\left(\frac{T_F+234}{T_o+234}\right)\right)$$

$$I = \sqrt{\frac{A^2}{t}\left(0.0297 \log\left(\frac{T_F+234}{T_o+234}\right)\right)}$$

Temperature	Cable Type PJJ	CPJ, PXMJ
Operating T_o	75°C	90°C
Insulation Damage T_F	125°C	250°C
Auto-Ignition T_F	455°C	530°C

Lotus 1-2-3 was used to generate values for Table 14, page 83. The following hand calculated example is provided to verify its correct application:
#12 AWG cable, 6530 cm, 90°C insulation, T_F = 250°C insul. damage, t=0.01 sec

$$I=\sqrt{\frac{A^2}{t}\left(0.0297\log\left(\frac{T_F+234}{T_o+234}\right)\right)} = \sqrt{\frac{(6530)^2}{0.01}\left(0.0297\log\left(\frac{250+234}{90+234}\right)\right)} = \sqrt{\frac{42640900}{0.01}(0.0297\log 1.4938)}$$

$$I=\sqrt{\frac{42640900}{0.01}(0.0297)(0.1743)} = \sqrt{\frac{42640900}{0.01}(0.005177)}$$

I = 4698 amps

6/26 WTH

CABLE DAMAGE & AUTO-IGNITION CURRENTS

INSULATION DAMAGE

90C INSULATION T=250C

CABLE SIZE	CIRCULAR MILS	t=0.01	t=0.016	t=.10	t=1.0	t=10.0
#12	6530	4698	3714	1486	470	149
#10	10380	7468	5904	2362	747	236
#8	16510	11879	9391	3756	1188	376
#6	26240	18880	14926	5970	1888	597
#4	41740	30032	23742	9497	3003	950
#2	66360	47746	37746	15098	4775	1510
1/0	105600	75979	60066	24027	7598	2403
2/0	133100	95765	75709	30283	9576	3028
4/0	211600	152245	120360	48144	15224	4814
300MCM	300000	215848	170643	68257	21585	6826
400MCM	400000	287798	227524	91010	28780	9101

75C INSULATION T=125C

CABLE SIZE	CIRCULAR MILS	t=0.01	t=0.016	t=.10	t=1.0	t=10.0
#12	6530	2872	2271	908	287	91
#10	10380	4565	3609	1444	457	144
#8	16510	7262	5741	2296	726	230

AUTO-IGNITION

90C INSULATION T=530C

CABLE SIZE	CIRCULAR MILS	t=0.01	t=0.016	t=.10	t=1.0	t=10.0
#12	6530	6869	5430	2172	687	217
#10	10380	10919	8632	3453	1092	345
#8	16510	17367	13730	5492	1737	549
#6	26240	27602	21821	8728	2760	873
#4	41740	43906	34711	13884	4391	1388
#2	66360	69803	55184	22074	6980	2207
1/0	105600	111079	87816	35126	11108	3513
2/0	133100	140006	110685	44274	14001	4427
4/0	211600	222580	175965	70386	22258	7039
300MCM	300000	315566	249477	99791	31557	9979
400MCM	400000	420755	332636	133054	42076	13305

75C INSULATION T=455C

CABLE SIZE	CIRCULAR MILS	t=0.01	t=0.016	t=.10	t=1.0	t=10.0
#12	6530	6641	5250	2100	664	210
#10	10380	10557	8346	3338	1056	334
#8	16510	16791	13274	5310	1679	531

SHEET 83 OF ___ COMPUTED [illegible] DATE 1/29/90 CHECKED SCP DATE 1-31-90

Appendix F Cable Damage & Auto-Ignition
Calc WBN-EEB-MS-TI07-0005

COMPUTED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

F.2 ~~Design Criteria WB-DC-30-27~~ Cable Protection

Cable ~~thermal damage protection is required for~~ ~~Design criteria WB-DC-30-27 requires dual protective~~ each branch circuit. ~~devices to prevent a cable tray fire due to the failure of a single breaker to operate.~~ Table 15 is a composite listing of the loads in panels 2 and 3 for all four battery boards. Table 15 lists the load, breaker size, breaker number, identifies the appropriate curve number and raceway configuration ("T" if the cable routes in a tray and "C" if the cable is completely in conduit). ~~Table 16 lists the cables routed in trays that are not protected for auto-ignition by two protective devices.~~ Curves 1 through 6 provide the basis for "pass/fail".

R2 GP 6/25/91 CWH 6/28/91

R2 GP 6/25/91 CWH 6/28/91

APPENDIX F TABLE 15 CALCULATION WBN-EEB-MS-TI07-0005

125V CONTROL POWER SYSTEM BOARDS

BD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH (CABLE SCH)	CABLE LEN COORD	RESIST OHMS/1000	CABLE RESISTANCE	CURVE NO	RACE-WAY	AUTO-IGN
1	223	15	207	60	B501R	WDF-1	2-1/C #4	1414	373	0.259	0.732452	1	T	P
1	220	15	207	60	1M2468	WGB-1	1-2C #12	504	59	1.65	1.663200	1	T	~~P~~
1	222	15	207	60	B1	WLN	1-2C #10	603	93	1.04	1.254240	1	T	P
1	319	15	305	60	1B36A	WGB-2	1-2C #12	370	59	1.65	1.221000	1	T	~~P~~
1	321	15	305	60	2SG220A	WLB	1-2C #12	557	59	1.65	1.838100	1	T	~~P~~
1	313	15	305	60	1B40A	WLB	1-2C #12	296	59	1.65	0.976800	1	T	~~P~~
1	221	15	207	60	1B47	WGB	1-2C #12	382	59	1.65	1.260600	1	T	~~P~~
2	223	15	207	60	B503P	WDF-1	2-1/C #4	1402	373	0.259	0.726236	1	T	P
2	313	15	305	60	1B41B	WLB	1-2C #12	509	59	1.65	1.679700	1	T	~~P~~
2	321	15	305	60	2SG221B	WLB	1-2C #12	503	59	1.65	1.659900	1	T	~~P~~
2	219	15	207	60	16920	WGB-1	1-2C #12	465	59	1.65	1.534500	1	T	~~P~~
2	221	15	207	60	B53	WLN	1-2C #10	551	93	1.04	1.146080	1	T	P
2	319	15	305	60	1B37B	WFB-1	1-2C #10	492	93	1.04	1.023360	1	T	P
3	313	15	305	60	2B40A	WLB	1-2C #12	128	59	1.65	0.422400	1	T	~~P~~
3	319	15	305	60	2B36A	WLB	1-2C #12	504	59	1.65	1.663200	1	T	~~P~~
3	220	15	207	60	2M2468	WGB-1	1-2C #12	462	59	1.65	1.524600	1	T	~~P~~
3	221	15	207	60	2B47	WGB-1	1-2C #12	408	59	1.65	1.346400	1	T	~~P~~
3	223	15	207	60	B500	WDF-2	2-1/C #4	1072	373	0.259	0.555296	1	T	P
3	321	15	305	60	1SG220A	WDF-2	2-1/C #4	517	373	0.259	0.267806	1	T	P
4	319	15	305	60	2B37B	WFB-1	1-2C #10	389	93	1.04	0.809120	1	T	P
4	313	15	305	60	2B41B	WLB	1-2C #12	473	59	1.65	1.560900	1	T	~~P~~
4	223	15	207	60	B502	WDF-2	2-1/C #4	1102	373	0.259	0.570836	1	T	P
4	221	15	207	60	B54	WLN	1-2C #10	463	93	1.04	0.963040	1	T	P
4	222	15	207	60	B2	WLN	1-2C #10	393	93	1.04	0.817440	1	T	P
4	321	15	305	60	1SG221B	WGB-1	1-2C #12	576	59	1.65	1.900800	1	T	~~P~~
1	201	30	201	100	1B1D	WDD	2-1/C #8	70	97	0.654	0.091560	2	C	P
1	204	30	201	100	1B4D	WDD	2-1/C #8	90	97	0.654	0.117720	2	C	P
1	306	30	301	100	2B18D	WDD-1	2-1/C #8	300	97	0.654	0.392400	2	C	P
1	205	30	201	100	1B14D	WDD-1	2-1/C #8	175	97	0.654	0.228900	2	C	P
1	304	30	301	100	2B3D	WDD	2-1/C #8	90	97	0.654	0.117720	2	C	P
1	216	30	205	100	B45	WDD-1	2-1/C #8	900	97	0.654	1.177200	2	T	P
1	302	30	301	100	2B12D	WDD-1	2-1/C #8	300	97	0.654	0.392400	2	C	P
1	215	30	205	100	1B44	WDD-1	2-1/C #8	264	97	0.654	0.345312	2	T	P
1	202	30	201	100	1B11D	WDD-1	2-1/C #8	175	97	0.654	0.228900	2	C	P
1	206	30	201	100	1B19D	WDD-1	2-1/C #8	175	97	0.654	0.228900	2	C	P
1	305	30	301	100	2B13D	WDD-1	2-1/C #8	300	97	0.654	0.392400	2	C	P
1	214	30	205	100	B20	WDD-1	2-1/C #8	462	97	0.654	0.604296	2	T	P
1	301	30	301	100	2B2D	WDD	2-1/C #8	50	97	0.654	0.065400	2	C	P
1	303	30	301	100	2B17D	WDD-1	2-1/C #8	300	97	0.654	0.392400	2	C	P
1	203	30	201	100	1B16D	WDD-1	2-1/C #8	175	97	0.654	0.228900	2	C	P
1	213	30	205	100	B23	WDD-1	2-1/C #8	154	97	0.654	0.201432	2	T	P
2	302	30	301	100	2B26E	WDD	2-1/C #8	275	97	0.654	0.359700	2	C	P
2	205	30	201	100	1B28E	WDD	2-1/C #8	185	97	0.654	0.241980	2	C	P

R2
GP 6/25/91
WJH 6/20/91

APPENDIX F TABLE 15 CALCULATION WBN-EEB-MS-TI07-0005

125V CONTROL POWER SYSTEM BOARDS

BD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH (CABLE SCH)	CABLE LEN COORD	RESIST OHMS/1000	CABLE RESISTANCE	CURVE NO	RACE-WAY	AUTO-IGN
2	203	30	201	100	1B30E	WDD	2-1/C #8	185	97	0.654	0.241980	2	C	P
2	303	30	301	100	2B31E	WDD	2-1/C #8	275	97	0.654	0.359700	2	C	P
2	215	30	205	100	1B45	WDD-1	2-1/C #8	261	97	0.654	0.341388	2	T	P
2	304	30	301	100	2B8E	WDD	2-1/C #8	100	97	0.654	0.130800	2	C	P
2	201	30	201	100	1B6E	WDD	2-1/C #8	115	97	0.654	0.150420	2	C	P
2	305	30	301	100	2B27E	WDD	2-1/C #8	275	97	0.654	0.359700	2	C	P
2	301	30	301	100	2B7E	WDD	2-1/C #8	140	97	0.654	0.183120	2	C	P
2	306	30	301	100	2B32E	WDD	2-1/C #8	275	97	0.654	0.359700	2	C	P
2	206	30	201	100	1B33E	WDD	2-1/C #8	185	97	0.654	0.241980	2	C	P
2	214	30	205	100	B46	WDD-1	2-1/C #8	822	97	0.654	1.075176	2	T	P
2	202	30	201	100	1B25E	WDD	2-1/C #8	185	97	0.654	0.241980	2	C	P
2	204	30	201	100	1B9E	WDD	2-1/C #8	75	97	0.654	0.098100	2	C	P
3	204	30	201	100	1B3F	WDD	2-1/C #8	95	97	0.654	0.124260	2	C	P
3	201	30	201	100	1B2F	WDE	2-1/C #6	130	154	0.41	0.106600	2	C	P
3	202	30	201	100	1B12F	WDD-1	2-1/C #8	250	97	0.654	0.327000	2	C	P
3	306	30	301	100	2B19F	WDD-1	2-1/C #8	225	97	0.654	0.294300	2	C	P
3	203	30	201	100	1B17F	WDD-1	2-1/C #8	245	97	0.654	0.320460	2	C	P
3	304	30	301	100	2B4F	WDD	2-1/C #8	75	97	0.654	0.098100	2	C	P
3	215	30	205	100	2B44	WDD-1	2-1/C #8	568	97	0.654	0.742944	2	T	P
3	302	30	301	100	2B11F	WDD-1	2-1/C #8	225	97	0.654	0.294300	2	C	P
3	205	30	201	100	1B13F	WDD-1	2-1/C #8	225	97	0.654	0.294300	2	C	P
3	213	30	205	100	B24	WDD-1	2-1/C #8	411	97	0.654	0.537588	2	T	P
3	206	30	201	100	1B18F	WDD-1	2-1/C #8	300	97	0.654	0.392400	2	C	P
3	303	30	301	100	2B16F	WDD-1	2-1/C #8	225	97	0.654	0.294300	2	C	P
3	305	30	301	100	2B14F	WDD-1	2-1/C #8	225	97	0.654	0.294300	2	C	P
3	301	30	301	100	2B1F	WDE-1	2-1/C #6	55	154	0.41	0.045100	2	C	P
3	214	30	205	100	B47	WDD-1	2-1/C #8	458	97	0.654	0.599064	2	T	P
4	301	30	301	100	2B6G	WDD	1-2C #8	80	97	0.654	0.104640	2	C	P
4	206	30	201	100	1B32G	WDD	2-1/C #8	300	97	0.654	0.392400	2	C	P
4	205	30	201	100	1B27G	WDD	2-1/C #8	200	97	0.654	0.261600	2	C	P
4	201	30	201	100	1B7G	WDD	2-1/C #8	45	97	0.654	0.058860	2	C	P
4	215	30	205	100	2B45	WDD-1	2-1/C #8	603	97	0.654	0.788724	2	T	P
4	302	30	301	100	2B25G	WDD	1-2C #8	175	97	0.654	0.228900	2	C	P
4	304	30	301	100	2B9G	WDD	1-2C #8	100	97	0.654	0.130800	2	C	P
4	203	30	201	100	1B31G	WDD	2-1/C #8	300	97	0.654	0.392400	2	C	P
4	214	30	205	100	B51	WFB	1-2C #10	880	61	1.04	1.830400	2	T	~~P~~
4	204	30	201	100	1B8G	WDD	2-1/C #8	100	97	0.654	0.130800	2	C	P
4	219	30	205	100	2G920	WGB	1-2C #12	258	39	1.65	0.851400	2	T	~~P~~
4	305	30	301	100	2B28G	WDD	1-2C #8	175	97	0.654	0.228900	2	C	P
4	303	30	301	100	2B30G	WDD	1-2C #8	175	97	0.654	0.228900	2	C	P
4	202	30	201	100	1B26G	WDD	2-1/C #8	300	97	0.654	0.392400	2	C	P
4	306	30	301	100	2B33G	WDD	1-2C #8	175	97	0.654	0.228900	2	C	P
2	207	50	203	150	B90	WDE-1	2-1/C #6	993	236	0.41	0.814260	4	C	P

R2 GP 6/25/9 WTH 6/28/91

APPENDIX F TABLE 15 CALCULATION WBN-EEB-MS-TI07-0005

125V CONTROL POWER SYSTEM BOARDS

BD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH (CABLE SCH)	CABLE LEN COORD	RESIST OHMS/1000	CABLE RESISTANCE	CURVE NO	RACE-WAY	AUTO-IGN
4	208	60	203	150	2B22	WDF	2-1/C #4	375	260	0.259	0.194250	4	T	P
3	208	100	203	150	1B22	WDK	2-1/C #4/0	357		0.0507	0.036200	5	T	P
1	325	125	311	200	B5A	WDG	2-1C #2	55		0.162	0.017820	6	C	P
2	325	125	311	200	B6B	WDG	2-1/C #2	55		0.162	0.017820	6	C	P
3	325	125	311	200	B7A	WDG-1	2-1/C #2	55		0.162	0.017820	6	C	P
4	325	125	311	200	B8B	WDG	2-1/C #2	60		0.162	0.019440	6	C	P
1	326	300	310	400	B30D	WDN	2-300MCM	45		0.0362	0.003258	7	C	P
1	226	300	210	400	B10D	WDN	2-300MCM	40		0.0362	0.002896	7	C	P
1	225	300	209	400	B15D	WDN	2-300MCM	90		0.0362	0.006516	7	C	P
1	327	300	309	400	B31D	WDN	2-300MCM	45		0.0362	0.003258	7	C	P
2	225	300	209	400	B16E	WDN	2-300MCM	55		0.0362	0.003982	7	C	P
2	226	300	210	400	B11E	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
2	326	300	310	400	B34E	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
2	327	300	309	400	B35E	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
3	225	300	209	400	B17E	WDN	2-300MCM	55		0.0362	0.003982	7	C	P
3	327	300	309	400	B39F	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
3	326	300	310	400	B38F	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
3	226	300	210	400	B12E	WDN	2-300MCM	50		0.0362	0.003620	7	C	P
4	225	300	209	400	B18G	WDN	2-300MCM	85		0.0362	0.006154	7	C	P
4	326	300	310	400	B42G	WDN	2-300MCM	65		0.0362	0.004706	7	C	P
4	327	300	309	400	B43G	WDN	2-300MCM	65		0.0362	0.004706	7	C	P
4	226	300	210	400	B13G	WDN	2-300MCM	45		0.0362	0.003258	7	C	P
1	109	1000	101	1600	B55D	WDN	3-300MCM	25		0.0362	0.000603	7	C	P
1	109	1000	101	1600	B56D	WDN	3-300MCM	35		0.0362	0.000845	7	C	P
1	109	1000	101	1600	B57D	WDN	3-300MCM	10		0.0362	0.000241	7	C	P
2	109	1000	101	1600	B60E	WDN	3-300MCM	25		0.0362	0.000603	7	C	P
2	109	1000	101	1600	B62E	WDN	3-300MCM	10		0.0362	0.000241	7	C	P
2	109	1000	101	1600	B61E	WDN	3-300MCM	25		0.0362	0.000603	7	C	P
3	109	1000	101	1600	B66F	WDN	3-300MCM	35		0.0362	0.000845	7	C	P
3	109	1000	101	1600	B67F	WDN	3-300MCM	10		0.0362	0.000241	7	C	P
3	109	1000	101	1600	B65F	WDN	3-300MCM	35		0.0362	0.000845	7	C	P
4	109	1000	101	1600	B72G	WDN	3-300MCM	10		0.0362	0.000241	7	C	P
4	109	1000	101	1600	B70G	WDN	3-300MCM	40		0.0362	0.000965	7	C	P
4	109	1000	101	1600	B71G	WDN	3-300MCM	40		0.0362	0.000965	7	C	P

APPENDIX F TABLE 16 CALC WBN-EEB-MS-TI07-0005

Deleted

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH	RESIST OHMS/1000	CABLE RESIST	CURVE NO	RACE-WAY	PASS/FAIL
1	319	15	305	60	1B36A	WGB-2	1-2C #12	370	1.65	1.221000	1	T	F
1	221	15	207	60	1B47	WGB	1-2C #12	382	1.65	1.260600	1	T	F
1	220	15	207	60	1M2468	WGB-1	1-2C #12	504	1.65	1.663200	1	T	F
1	321	15	305	60	2SG220A	WLB	1-2C #12	557	1.65	1.838100	1	T	F
1	313	15	305	60	1B40A	WLB	1-2C #12	296	1.65	0.976800	1	T	F
2	313	15	305	60	1B41B	WLB	1-2C #12	509	1.65	1.679700	1	T	F
2	219	15	207	60	1G920	WGB-1	1-2C #12	465	1.65	1.534500	1	T	F
2	321	15	305	60	2SG221B	WLB	1-2C #12	503	1.65	1.659900	1	T	F
3	220	15	207	60	2M2468	WGB-1	1-2C #12	462	1.65	1.524600	1	T	F
3	319	15	305	60	2B36A	WLB	1-2C #12	504	1.65	1.663200	1	T	F
3	313	15	305	60	2B40A	WLB	1-2C #12	128	1.65	0.422400	1	T	F
3	221	15	207	60	2B47	WGB-1	1-2C #12	408	1.65	1.346400	1	T	F
4	219	30	205	100	2G920	WGB	1-2C #12	258	1.65	0.851400	2	T	F
4	214	30	205	100	B51	WFB	1-2C #10	880	1.04	1.830400	2	T	F
4	313	15	305	60	2B41B	WLB	1-2C #12	473	1.65	1.560900	1	T	F
4	321	15	305	60	1SG221B	WGB-1	1-2C #12	576	1.65	1.900800	1	T	F

R2
GP 6/25/91
WJH
6/28/91

Appendix G DC Resistance of Large Conductors
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Table 17 lists the dc resistance for various conductor sizes (#2 and larger). The ac resistance values in Table 17 were taken from Table 1-1 in Electrical Design Guide DG-E2.4.6 (Minimum Impedance @ 25°C). The conductor's dc resistance was calculated by dividing the ac resistance by the conversion factor in the National Electrical Code. For conductor sizes smaller than #2, the dc resistance is equal to the ac resistance.

DC RESISTANCE OF LARGE CONDUCTORS

CABLE SIZE	AC RESISTANCE (ELEC DG-E2.4.6)	FACTOR (NEC)	DC RESISTANCE (PER FOOT)
#2	0.0001620	1.01	0.0001604
1/0	0.0001021	1.02	0.0001001
2/0	0.0000812	1.03	0.0000788
4/0	0.0000507	1.05	0.0000483
300MCM	0.0000362	1.07	0.0000338
350MCM	0.0000311	1.08	0.0000288
400MCM	0.0000273	1.10	0.0000248
500MCM	0.0000220	1.13	0.0000195

Appendix H 10CFR50 Appendix R
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

H.1. Board Loading for Appendix R

Design Criteria WB-DC-30-13 (Reference 3.3.15) requires an evaluation to ensure that the upstream feeder breakers that supply a board or panel will not trip as a result of a high impedance fault. The condition to be evaluated is the largest non-required Appendix R load being subjected to a high impedance fault such that the current is just below the trip setpoint plus all of the normal loads that could be operating plus all of the Appendix R loads.

1.1 Battery Boards

From Appendix A the worst case load on anyone of the four battery boards is 558.5 amps. The largest non-Appendix R load is the Emergency DC Lighting Cabinet with a 125 amp circuit breaker (BKr 325). The Emergency DC Lighting load part of the 558.5 amps is 67.1 amps.

Maximum Appendix R Loading = 558.5 − 67.1 + 125.0
= 616.4 amps

The main breakers in the vital battery boards I, II, III, & IV are set at 1000 amps and the 5th vital battery board's main breaker is set at 800 amps.

1.2 LVSG

From calculation WBN-EEB-MS-TI11-0003 pages 194-197, the maximum dc load for anyone of the LVSG control power feeders is 4.12 amps (480V S/D Board 2A2-A page 196 and 2B2-B page 197). All breaker close and trip fuses are Bussmann 10Amp KWN.

Maximum Appendix R LVSG Loading = 4.12 + 10.0 = 14.12 amps

All LVSG dc control power feeder breakers on the vital battery boards are 30 amp.

Appendix H 10CFR50 Appendix R
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

1.3 MVSG

From calculation WBN-EEB-MS-TI11-0003 pages 194-197, the maximum dc load for anyone of the MVSG control power feeders is 3.58 amps (6.9 KV S/D Board 2A-A page 196 and 2B-B page 197). The close and trip fuses are Bussmann 15 Amp

Maximum Appendix R MVSG Loading = 3.58 + 15.0 = 18.58 Amps

All MVSG dc control power feeder breakers on the vital battery boards are 30 amps.

1.4 Fuse Assemblies

From calculation WBN-EEB-MS-TI11-0003 pages 194-197, the maximum dc load on anyone of the fuse assemblies is 25.006 amps (Fuse Assembly C).

Maximum Appendix R Fuse Assy Loading = 25.006 + 5.0 = 30.006

All fuse assemblies feeder breakers are 30 amps. This is acceptable since the 30.006 represents a worst case condition with all loads being on and circuit breakers are required to carry their continuous rating in an ambient temperature of 40°C.

Appendix H 10CFR50 Appendix R
Calc WBN-EEB-MS-TI07-0005

COMPUTED WTH DATE 1/29/90
CHECKED GCP DATE 1-31-90

H.2. Common Power Supply

Design Criteria WB-DC-30-13 requires selective trip coordination among protective devices of non-required Appendix R circuits. For non-required circuits on LVSG & MVSG, selective coordination is shown to exist in Appendix E.2. For the following non-required Appendix R circuits, Curve 8 shows that the load group fuses coordinate with the main supply breaker:

Non-required Appendix R Circuits

Battery Bd

	I	II	III	IV
Breaker Numbers	213	207	208	208
	214	214	213	214
	215	215	214	215
	216	217	215	217
	217	218	217	218
	218	219	218	219
	220	221	220	221
	221	223	221	222
	222	325	223	223
	223		325	325
	325			

R2 GCP 10/25/91 WTH 6/28/91

Load fuse groups are breakers 207-212, 213-218, 219-224 and 325 for non-required circuits. Since the non-required Appendix R circuits that are being feed directly from the battery boards have been grouped on specific load group fuses, selective coordination exists for the above circuits.

Appendix H 10CFR50 Appendix R
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

H. 2. Common Power Supply

The auxiliary relay racks have FLAS 5 fuses and some of the circuits maybe non-required Appendix R circuits. Coordination of the auxiliary relay racks is also addressed in Appendix E. 2.

Appendix H 10CFR50 Appendix R
Calc WBN-EEB-MS-TI07-0005

COMPUTED WJH DATE 1/29/90
CHECKED GCP DATE 1-31-90

H.3 Common Enclosures

10CFR50 Appendix R requires that all circuits that share a common enclosure (eg cable tray, conduit, etc) with an Appendix R required circuit be designed such that a fault due to a postulated fire in an alien fire zone to the common enclosure will not be propagated and cause damage to the required circuit in the common enclosure. This can be accomplished by protecting all of the circuits with a fuse or breaker that will actuate prior to the jacket of the faulted cable reaching its auto-ignition temperature. Curves 1 thru 7 (pages 24 thru 30) show that the cables terminated in panels 2 and 3 of the battery boards are protected for auto-ignition. The protective devices in panel 4 in the battery boards are 5 amp FLAS 5 fuses which protect the cables terminating in panel 4 for cable damage.

RC 6/4/25/19 WJH 6/28/91

Appendix I Cascaded Fuses
Calc WBN-EEB-MS-TI07-0005

COMPUTED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Cascaded fuses should selectively coordinate, and schematic drawings (eg 45N600 series, 45W760-211 & 212 series, etc) were reviewed to identify the various dc circuits where fuses have been cascaded. Table 18 lists the fuses on panel 4 in the four battery boards and the drawings on which the circuits are shown. Table 19 identifies the equipment and circuits having cascaded fuses, and table 20 lists the relay panels reviewed.

Circuits with Cascaded Fuses

I.1 Dsl Gen Circuits - The diesel generator circuits have a FLAS 5 amp fuse supplying power to several other FLAS 5 fuses and a 6 amp KWN fuse. Obviously, this combination of fuses will not coordinate

I.2 MVSG Circuits - The 30 amp fuse in the MVSG supply power to a 5 amp MIS 5 fuse. The 30 amp fuse receives power from a 30 amp circuit breaker and needs to be replaced.

Appendix I Cascaded Fuses
Calc. WBN-EEB-MS-TI07-0005

COMPUTED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

I.2 MVSG Circuits - 15 amp OT15 and FRN 15 fuses on the MVSG provide power to a 1 amp FRN-R-1 fuse. At the fault currents available, coordination may not exist between the 15 amp fuses and the 1 amp.

The FRN 15 amp fuse in the MVSG also provides power to a 6 amp OT fuse. Coordination is a problem between these two fuses.

I.3 LVSG Circuits A 10 amp KWN fuse provides power to a 6 amp KWN or KTN and a 1 amp FRN-R-1. Coordination is a problem between the 10 amp and 6 amp and may not exist between the 10 amp and 1 amp.

CIRCUITS REVIEWED FOR CASCADED FUSES

	BOARD I	BOARD II	BOARD III	BOARD IV
A 1	45N600-62-1 R7		45N600-62-1 R7	
A 2	45N600-62-1 R7	45N600-62-1 R7	45N600-62-1 R7	45N600-62-1 R7
A 3	45N600-62-5 R5	45N600-62-1 R7	45N600-62-5 R5	45N600-62-1 R7
A 4	45N600-62-1 R7	45N600-68-1 R8	45N600-62-1 R7	45N600-68-1 R8
A 5	45N600-62-2 R9	45N600-68-1 R8	45N600-62-2 R9	45N600-68-1 R8
A 6	45N600-62-2 R9	45N600-63-1 R3	45N600-62-2 R9	45N600-63-1 R3
A 7	45N600-62-2 R9	45N600-63-1 R3	45N600-62-2 R9	45N600-63-1 R3
A 8	45N600-62-2 R9	45N600-62-1 R7	45N600-62-2 R9	45N600-62-1 R7
A 9	45N600-62-1 R7	45N600-67-1 R8	45N600-62-1 R7	45N600-67-1 R8
A10	45N600-68-1 R8	45N600-67-1 R8	45N600-68-1 R8	45N600-67-1 R8
A11	45N600-68-1 R8	45N600-67-1 R8	45N600-68-1 R8	45N600-67-1 R8
A12	45N600-63-1 R3	45N600-67-1 R8	45N600-63-1 R3	45N600-67-1 R8
A13	45N600-63-1 R3	45N600-30-2 R3	45N600-63-1 R3	45N600-30-2 R3
A14	45N600-61-1 R1	45N600-30-1 R2	45N600-61-1 R1	45N600-30-1 R2
A15	45N600-61-1 R1	45N600-30-2 R3	45N600-61-1 R1	45N600-30-2 R3
A16	45N600-3-2 R8	45N600-30-1 R2	45N600-3-2 R8	45N600-30-1 R2
A17	45N600-62-2 R9	45N600-61-1 R1	45N600-62-2 R9	45N600-61-1 R1
A18	45N600-68-2 R8	45N600-61-1 R1	45N600-68-2 R8	45N600-61-1 R1
A19		45N600-3-2 R8		45N600-3-2 R8
A20	45N600-81 R1	45N600-43-2 R10	45N600-81 R1	45N600-43-2 R10
A21	45N600-67-1 R8	45N600-43-2 R10	45N600-67-1 R8	45N600-43-2 R10
A22	45N600-67-1 R8	45N600-43-2 R10	45N600-67-1 R8	45N600-43-2 R10
A23	45N600-67-1 R8	45N600-43-2 R10	45N600-67-1 R8	45N600-43-2 R10
A24	45N600-67-1 R8	45N600-77-2 R4	45N600-67-1 R8	45N600-77-2 R4
A25	45N600-43-2 R10	45N600-3-2 R8	45N600-43-2 R10	45N600-3-2 R8
A26	45N600-62-2 R9	45N600-3-4 R5	45N600-62-2 R9	45N600-3-4 R5
A27	45N600-43-2 R10	45N600-65-1 R4	45N600-43-2 R10	45N600-65-1 R4
A28	45N600-62-2 R9	45N600-3-4 R5	45N600-62-2 R9	45N600-3-4 R5
A29	45N600-62-2 R9	45N600-63-1 R3	45N600-62-2 R9	45N600-63-1 R3
A30	45N600-43-2 R10		45N600-43-2 R10	
A31	45N600-63-1 R3	45N600-65-3 R2	45N600-63-1 R3	45N600-65-1 R4
A32	45N600-3-2 R8	45N600-65-1 R4	45N600-3-2 R8	45N600-65-3 R2
A33	45N600-65-1 R4	45N600-65-1 R4	45N600-65-1 R4	45N600-65-1 R4
A34	45N600-65-2 R4	45N600-65-2 R4	45N600-65-2 R4	45N600-65-2 R4
A35	45N600-65-1 R4		45N600-65-1 R4	45N600-30-8 R2
A36	45N600-65-3 R2		45N600-65-3 R2	
A37	45N600-3-3 R5		45N600-3-3 R5	
A38	45N600-65-1 R4		45N600-65-1 R4	
A39	45N600-65-1 R4	45N600-65-1 R4	45N600-65-1 R4	45N600-65-1 R4
A40	45N600-67-1 R8		45N600-67-1 R8	45N600-30-8 R2
A41	45N600-67-1 R8	45N600-67-1 R8	45N600-67-1 R8	45N600-67-1 R8
A42	45N600-30-2 R3	45N600-67-1 R8	45N600-30-2 R3	45N600-67-1 R8
A43	45N600-30-1 R2	45N600-77-6 R9	45N600-30-1 R2	45N600-77-6 R9
A44	45N600-30-2 R3	45N600-77-1 R7	45N600-30-2 R3	45N600-77-1 R7
A45	45N600-30-1 R2	45N600-77-2 R4	45N600-30-1 R2	45N600-77-2 R4
A46	45N600-1-5 R4	45N600-1-6 R2	45N600-1-5 R4	45N600-1-6 R2
A47	45N600-1-5 R4	45N600-1-6 R2	45N600-1-5 R4	45N600-1-6 R2
A48	45N600-1-5 R4	45N600-1-6 R2	45N600-1-5 R4	45N600-1-6 R2
A49	45N600-1-5 R4	45N600-1-6 R2	45N600-1-5 R4	45N600-1-6 R2
A50	45N600-43-2 R10	45N600-30-10 R8	45N600-43-2 R10	
B 1	45N600-62-1 R7		45N600-62-1 R7	

Appendix I

TABLE 18 CALCULATION WBN-EEB-MS-TI07-0005

CIRCUITS REVIEWED FOR CASCADED FUSES

	BOARD I	BOARD II	BOARD III	BOARD IV
B 2	45N600-62-1 R7	45N600-62-1 R7	45N600-62-1 R7	45N600-62-1 R7
B 3	45N600-62-5 R5	45N600-62-1 R7	45N600-62-5 R5	45N600-62-1 R7
B 4	45N600-62-1 R7	45N600-68-1 R8	45N600-62-1 R7	45N600-68-1 R8
B 5	45N600-62-2 R9	45N600-68-1 R8	45N600-62-2 R9	45N600-68-1 R8
B 6	45N600-62-2 R9	45N600-63-1 R3	45N600-62-2 R9	45N600-63-1 R3
B 7	45N600-62-2 R9	45N600-63-1 R3	45N600-62-2 R9	45N600-63-1 R3
B 8	45N600-62-2 R9	45N600-62-1 R7	45N600-62-2 R9	45N600-62-1 R7
B 9	45N600-62-1 R7	45N600-67-1 R8	45N600-62-1 R7	45N600-67-1 R8
B10	45N600-68-1 R8	45N600-67-1 R8	45N600-68-1 R8	45N600-67-1 R8
B11	45N600-68-1 R8	45N600-67-1 R8	45N600-68-1 R8	45N600-67-1 R8
B12	45N600-63-1 R3	45N600-67-1 R8	45N600-63-1 R3	45N600-67-1 R8
B13	45N600-63-1 R3	45N600-30-2 R2	45N600-63-1 R3	45N600-30-2 R2
B14	45N600-31-2 R15	45N600-30-1 R2	45N600-77-4 R3	45N600-30-1 R2
B15	45N600-3-2 R8	45N600-30-2 R3	45N600-3-2 R8	45N600-30-2 R3
B16	45N600-30-13 R7	45N600-30-1 R2		45N600-30-1 R2
B17		45N600-68-2 R8		45N600-68-2 R8
B18				
B19	45N600-63-1 R3	45N600-3-2 R8	45N600-63-1 R3	45N600-3-2 R8
B20	45N600-81 R1		45N600-81 R1	
B21	45N600-67-1 R8	45N600-77-6 R9	45N600-67-1 R8	45N600-77-6 R9
B22	45N600-67-1 R8	45N600-77-1 R7	45N600-67-1 R8	45N600-77-1 R7
B23	45N600-67-1 R8	45N600-77-2 R4	45N600-67-1 R8	45N600-77-2 R4
B24	45N600-67-1 R8	45N600-77-2 R4	45N600-67-1 R8	45N600-77-2 R4
B25	45N600-43-2 R10	45N600-3-2 R8	45N600-43-2 R10	45N600-3-2 R8
B26	45N600-30-9 R2	45N760-82-6 R13*	45N600-30-9 R2	45N600-30-11 R7
B27	45N600-30-9 R2	45N600-90-1 R6	45N600-30-9 R2	45N600-90-1 R6
B28	45N600-30-9 R2	45N600-90-1 R6	45N600-30-9 R2	45N600-90-1 R6
B29	45N600-30-11 R7		45N600-30-11 R7	
B30	45N600-30-11 R7	45N600-1-4 R5	45N600-30-11 R7	45N600-30-11 R7
B31	45N600-30-13 R7	45N600-3-4 R5		45N600-3-4 R5
B32	45N600-30-12 R5	45N600-1-4 R5	45N600-30-12 R5	45N600-30-11 R7
B33	45N600-3-2 R8	45N600-90-1 R6	45N600-3-2 R8	45N600-90-1 R6
B34	45N600-3-3 R5		45N600-3-3 R5	45N600-30-12 R5
B35	45N600-3-3 R5		45N600-3-3 R5	45N600-77-4 R3
B36	45N600-30-8 R2	45N600-90-1 R6	45N600-30-8 R2	45N600-90-1 R6
B37	45N600-68-1 R8		45N600-68-1 R8	
B38	45N600-62-2 R9	45N600-3-4 R5	45N600-62-2 R9	45N600-3-4 R5
B39	45N600-30-12 R5	45N600-30-13 R7	45N600-30-12 R5	
B40	45N600-30-9 R2	45N600-30-13 R7	45N600-30-9 R2	
B41	45N600-30-9 R2	45N600-30-13 R7	45N600-31-1 R2	
B42	45N600-30-2 R3		45N600-30-2 R3	
B43	45N600-30-1 R2		45N600-30-1 R2	
B44	45N600-30-2 R3	45N600-63-1 R3	45N600-30-2 R3	45N600-63-1 R3
B45	45N600-30-1 R2		45N600-30-1 R2	
B46	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2
B47	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2
B48	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2
B49	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2	45N600-1-7 R2
B50	45N600-30-10 R8			
C 1	45N600-30-8 R2	45N600-30-8 R2	45N600-30-9 R2	45N600-30-9 R2
C 2	45N600-30-8 R2	45N600-30-8 R2	45N600-30-9 R2	45N600-30-9 R2

CIRCUITS REVIEWED FOR CASCADED FUSES

	BOARD I	BOARD II	BOARD III	BOARD IV
C 3	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2
C 4	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2
C 5	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2
C 6	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2	45N600-31-1 R2
C 7		45N600-30-10 R8	45N600-68-1 R8	45N600-30-8 R2
C 8	45N600-30-9 R2		45N600-30-9 R2	45N600-31-1 R2
C 9	45N600-1-3 R7	45N600-30-8 R2	45N600-1-3 R7	
C10	45N600-68-1 R8	45N600-43-2 R10	45N600-30-2 R3	45N600-43-2 R10
C11	45N600-1-3 R7	45N600-43-2 R10	45N600-1-3 R7	45N600-43-2 R10
C12	45N600-30-3 R1	45N600-30-3 R1	45N600-30-3 R1	
C13	45N600-1-4 R5	45N600-30-3 R1	45N600-1-4 R5	45N600-30-3 R1
C14	45N600-61-1 R1	45N600-30-3 R1	45N600-61-1 R1	45N600-30-3 R1
C15	45N600-1-4 R5	45N600-31-2 R15	45N600-1-4 R5	45N600-30-3 R1
C16	45N600-61-1 R1	45N600-46-7 R3	45N600-61-1 R1	45N600-46-7 R3
C17	45N600-30-8 R2	45N600-1-3 R7	45N600-30-8 R2	45N600-1-3 R7
C18	45N600-30-3 R1	45N600-30-11 R7	45N600-30-3 R1	45W760-82 6 R13 *
C19	45N760-82-6 R13*	45N600-30-9 R2	45N760-82-6 R13*	
C20	45N600-43-1 R7		45N600-43-1 R7	
C21		45N600-43-2 R10	45N600-77-2 R4	45N600-43-2 R10
C22	45N600-1-3 R7		45N600-1-3 R7	
C23	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3
C24	45N600-77-2 R4	45N600-61-1 R1	45N600-77-2 R4	45N600-61-1 R1
C25	45N600-3-3 R5	45N600-3-11 R3	45N600-3-3 R5	45N600-3-11 R3
C26	45N600-77-2 R4	45N600-61-1 R1	45N600-77-2 R4	45N600-61-1 R1
C27	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3
C28	45N600-77-2 R4		45N600-77-2 R4	
C29	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3	45N600-3-11 R3
C30	45N600-77-2 R4		45N600-77-2 R4	
C31	45N600-46-7 R3	45N600-46-7 R3	45N600-46-7 R3	45N600-46-7 R3
C32	45N600-30-3 R1		45N600-3-11 R3	
C33	45N600-46-7 R3		45N600-46-7 R3	
C34	45N600-77-2 R4	45N600-90-1 R6		45N600-90-1 R6
C35	45N600-3-11 R3	45N600-90-1 R6		45N600-90-1 R6
C36	45N600-30-13 R7	45N600-30-8 R2		
C37		45N600-30-12 R5		
C38	45N600-1-3 R7	45N600-30-11 R7	45N600-1-3 R7	45N600-1-4 R5
C39	45N600-90-1 R6	45N600-30-8 R2	45N600-90-1 R6	
C40	45N600-90-1 R6	45N600-30-11 R7	45N600-90-1 R6	45N600-1-4 R5
C41		45N600-43-1 R7		45N600-43-1 R7
C42	45N600-90-1 R6	45N600-43-1 R7	45N600-90-1 R6	45N600-43-1 R7
C43	45N600-1-2 R7	45N600-43-1 R7	45N600-1-2 R7	45N600-43-1 R7
C44	45N600-1-2 R7	45N600-43-1 R7	45N600-1-2 R7	45N600-43-1 R7
C45	45N600-90-1 R6	45N600-1-3 R7	45N600-90-1 R6	45N600-1-3 R7
C46	45N600-30-8 R2	45N600-1-3 R7	45N600-30-8 R2	45N600-1-3 R7
C47	45N600-30-9 R2	45N600-1-3 R7	45N600-30-9 R2	45N600-1-3 R7
C48	45N600-30-10 R8	45N600-1-2 R7		45N600-1-2 R7
C49	45N600-43-2 R10	45N600-1-2 R7	45N600-43-2 R10	45N600-1-2 R7
C50	45N600-43-2 R10		45N600-43-2 R10	
D 1				
D 2	45N600-62-1 R7		45N600-62-1 R7	
D 3				

CIRCUITS REVIEWED FOR CASCADED FUSES

	BOARD I	BOARD II	BOARD III	BOARD IV
D 4				
D 5		45N600-62-1 R7		45N600-62-1 R7
D 6		45N600-68-1 R8		45N600-68-1 R8
D 7	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	
D 8		45N600-63-2 R1		45N600-63-2 R1
D 9		45N600-63-2 R1		45N600-63-2 R1
D10	45N600-30-11 R7	45N600-63-2 R1	45N600-30-11 R7	45N600-63-2 R1
D11	45N600-65-3 R2	45N600-63-2 R1	45N600-65-3 R2	45N600-63-2 R1
D12	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
D13				
D14	45N600-62-1 R7	45N600-63-2 R1	45N600-62-1 R7	45N600-63-2 R1
D15		45N600-30-12 R5	45N600-30-1 R2	
D16		45N600-30-11 R7	45N600-30-2 R3	45N600-30-11 R7
D17	45N600-62-1 R7	45N600-65-3 R2	45N600-62-1 R7	45N600-65-3 R2
D18		45N600-62-1 R7		45N600-62-1 R7
D19		45N600-62-1 R7		45N600-62-1 R7
D20	45N600-68-1 R8		45N600-68-1 R8	
D21	45N600-68-1 R8	45N600-62-5 R5	45N600-68-1 R8	45N600-62-5 R5
D22	45N600-61-1 R1	45N600-43-1 R7	45N600-61-1 R1	45N600-43-1 R7
D23	45N600-63-2 R1		45N600-63-2 R1	
D24	45N600-63-2 R1	45N600-43-1 R7	45N600-63-2 R1	45N600-43-1 R7
D25				
D26	45N600-62-2 R9	45N600-43-1 R7	45N600-62-2 R9	45N600-43-1 R7
D27	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
D28	45N600-63-2 R1	45N600-43-1 R7	45N600-63-2 R1	45N600-43-1 R7
D29	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
D30	45N600-63-2 R1		45N600-63-2 R1	
D31	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
D32	45N600-63-2 R1		45N600-63-2 R1	
D33	45N600-81 R1	45N600-63-2 R1	45N600-81 R1	45N600-63-2 R1
D34		45N600-81 R1		45N600-81 R1
D35		45N600-81 R1		45N600-81 R1
D36		45N600-63-2 R1		45N600-63-2 R1
D37	45N600-63-2 R1	45N600-77-5 R5	45N600-63-2 R1	
D38	45N600-63-2 R1	45N600-77-4 R3	45N600-63-2 R1	
D39	45N600-3-1 R5	45N600-77-4 R3	45N600-3-1 R5	
D40	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
D41	45N600-61-1 R1	45N600-43-1 R7	45N600-61-1 R1	45N600-43-1 R7
D42	45N600-63-2 R1	45N600-43-1 R7	45N600-63-2 R1	45N600-43-1 R7
D43		45N600-43-1 R7		45N600-43-1 R7
D44		45N600-43-1 R7		45N600-43-1 R7
D45	45N600-63-2 R1	45N600-43-1 R7	45N600-63-2 R1	45N600-43-1 R7
D46	45N600-61-1 R1		45N600-61-1 R1	
D47	45N600-61-1 R1		45N600-61-1 R1	
D48	45N600-3-5 R6	45N600-43-1 R7	45N600-3-5 R6	45N600-43-1 R7
D49		45N600-43-1 R7		45N600-43-1 R7
D50		45N600-43-1 R7		45N600-43-1 R7
E 1		45N600-3-8 R2		45N600-3-8 R2
E 2	45N600-62-1 R7	45N600-3-8 R2	45N600-62-1 R7	45N600-3-8 R2
E 3	45N600-77-6 R9	45N600-3-9 R2		45N600-3-9 R2
E 4		45N600-3-9 R2		45N600-3-9 R2

Appendix I

TABLE 18 CALCULATION WBN-EEB-MS-TI07-0005

CIRCUITS REVIEWED FOR CASCADED FUSES

	BOARD I	BOARD II	BOARD III	BOARD IV
E 5		45N600-62-1 R7		45N600-62-1 R7
E 6		45N600-68-1 R8		45N600-68-1 R8
E 7	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	
E 8		45N600-63-2 R1		45N600-63-2 R1
E 9	45N600-77-6 R9	45N600-63-2 R1		45N600-63-2 R1
E10		45N600-63-2 R1		45N600-63-2 R1
E11		45N600-63-2 R1		45N600-63-2 R1
E12		45N600-3-1 R5		45N600-3-1 R5
E13		45N600-63-2 R1		45N600-63-2 R1
E14	45N600-62-1 R7	45N600-63-2 R1	45N600-62-1 R7	45N600-63-2 R1
E15		45N600-63-2 R1		45N600-63-2 R1
E16		45N600-77-1 R7		
E17	45N600-62-1 R7		45N600-62-1 R7	
E18		45N600-62-1 R7		45N600-62-1 R7
E19		45N600-62-1 R7		45N600-62-1 R7
E20	45N600-68-1 R8	45N600-63-2 R1	45N600-68-1 R8	45N600-63-2 R1
E21	45N600-68-1 R8	45N600-62-5 R5	45N600-68-1 R8	45N600-62-5 R5
E22				
E23	45N600-63-2 R1		45N600-63-2 R1	
E24	45N600-63-2 R1		45N600-63-2 R1	
E25				
E26		45N600-63-2 R1		45N600-63-2 R1
E27				
E28				
E29				
E30	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
E31				
E32	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1	45N600-63-2 R1
E33		45N600-63-2 R1		45N600-63-2 R1
E34	45N600-81 R1		45N600-81 R1	
E35				
E36	45N600-63-2 R1		45N600-63-2 R1	
E37	45N600-77-4 R3	45N600-43-1 R7		45N600-43-1 R7
E38	45N600-77-4 R3	45N600-43-1 R7		45N600-43-1 R7
E39	45N600-77-4 R3	45N600-63-2 R1		45N600-63-2 R1
E40	45N600-3-6 R5		45N600-3-6 R5	
E41	45N600-3-6 R5		45N600-3-6 R5	
E42	45N600-3-7 R4		45N600-3-7 R4	
E43	45N600-3-7 R4	45N600-63-2 R1	45N600-3-7 R4	45N600-63-2 R1
E44		45N600-68-1 R8		45N600-68-1 R8
E45	45N600-77-6 R9	45N600-43-1 R7		45N600-43-1 R7
E46		45N600-43-1 R7		45N600-43-1 R7
E47		45N600-43-1 R7		45N600-43-1 R7
E48		45N600-43-1 R7		45N600-43-1 R7
E49		45N600-43-1 R7		45N600-43-1 R7
E50		45N600-43-1 R7		45N600-43-1 R7

Appendix I

Table 19 Dsl Gen Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
Dsl Gen 1B-B 0-FU-236-2/B26	5 FLAS5	45W760-82-6 R13	1-FU-211-B/C1 B/C2 B/B1 B/B2 B/A1 B/A2	5 FLAS5	45W760-82-6 R13
			1-FU-~~211~~ 82-CDP/B1 WJH 1/29/90	6 KWN6	
Dsl Gen 2B-B 0-FU-236-4/C18	5 FLAS5	45W760-82-6 R13	2-FU-211-B/C1 B/C2 B/B1 B/B2 B/A1 B/A2	5 FLAS5	45W760-82-6 R13
			2-FU-~~211~~ 82-CDP/B1 WJH 1/29/90	6 KWN6	

Appendix I

Table 19 Dsl Gen Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
Dsl Gen 1A-A 0-FU-236-1/C19	5 FLAS5	45W760-82-6 R13	1-FU-211-A/C1 A/C2 A/B1 A/B2 A/A1 A/A2 1-FU-82-CDP/A1	5 FLAS5 ↓ 6 KWN6	45W760-82-6 R13
Dsl Gen 2A-A 0-FU-236-3/C19	5 FLAS5	45W760-82-6 R13	2-FU-211-A/C1 A/C2 A/B1 A/B2 A/A1 A/A2 2-FU-82-CDP/A1	5 FLAS5 ↓ 6 KWN6	45W760-82-6 R13

Appendix I

Table 19 MVSG Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
1-FU-211-A12/11 A12/12	30amp One Time	45W760-211-8 R12	1-FU-211-A4/1A	5amp MIS 5	45W760-211-9 R12
1-FU-211-B12/11 B12/12	30 amp One Time	45W760-211-10 R13	1-FU-211-B4/1A	5amp MIS 5	45W760-211-11 R10
2-FU-211-A12/11 A12/12	30 amp One Time	45W760-211-12 R11	2-FU-211-A4/1A	5amp MIS 5	45W760-211-13 R10
2-FU-211-B12/11 B12/12	30 amp One Time	45W760-211-14 R10	2-FU-211-B4/1A	5amp MIS 5	45W760-211-15 R10

Appendix I

Table 19 MVSG Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
(Typical)		Board Feeders			
1-FU-211-A11/2N 2A	15amp OT15	45W760-211-2 R15	1-FU-211-A11/4	1 amp FRN-R-1	45W760-211-2 R15
1-FU-211-A11/1N 1A	15 amp FRN15	45W760-211-2 R15	1-FU-211-A11/5	1 amp FRN-R-1	45W760-211-2 R15
Boards 1A-A 1B-B 2A-A 2B-B		45W760-211-3 R15			
		45W760-211-4 R15			
		45W760-211-5 R8			
		45W760-211-18 R9			
		45W760-211-19 R7			
		45W760-211-20 R8			
		45W760-211-21 R9			
(Typical)		Transformer Feeders			
1-FU-211-B3/1	15amp FRN 15	45W760-211-5 R8	1-FU-211-B3/4	6amp OT6	45W760-211-5 R8
Boards 1A1-A 2A1-A 1A2-A 2A2-A 1B1-B 2B1-B 1B2-B 2B2-B					

Appendix I

Table 19 LVSG Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
Typical		Normal Feeder Alternate Feeder			
480V Shdn Bd 1A1-A					
1-FU-212-A11/13	10 Amp KWN	45W760-212-1 R9	1-FU-212-A11/15	6 Amp KWN	45W760-212-1 R9
			1-FU-212-A11/17	1 Amp FRN-R-1	45W760-212-1 R9
1-FU-212-A11/14	10 Amp KWN	45W760-212-1 R9	1-FU-212-A11/16	1 Amp FRN-R-1	45W760-212-1 R9
480V Shdn Bds 1A2-A 2A1-A 2A2-A		45W760-212-1 R9			

Appendix I
Table 19 LVSG Calc WBN-EEB-MS-TI07-0005

FEEDER CIRCUIT FUSE ID	SIZE (AMPS) TYPE	SUPPLY FUSE SCHEMATIC	BRANCH CIRCUIT FUSE ID	SIZE (AMPS) TYPE	BRANCH CIRCUIT SCHEMATIC
Typical		Normal Feeder Alternate Feeder			
480V Shdn Bd 1B1-B					
1-FU-212-B11/13	10 Amp KWN	45W760-212-2 R10	1-FU-212-B11/15	6 Amp KWN	45W760-212-2 R10
			1-FU-212-B11/17	1 Amp FRN-R-1	45W760-212-2 R10
1-FU-212-B11/14	10 Amp KWN	45W760-212-2 R10	1-FU-212-B11/16	1 Amp FRN-R-1	45W760-212-2 R10
480 V Shdn Bds 1B2-B 2B1-B 2B2-B		45W760-212-2 R10			

Table 20 PNL 1-R-54 Calc WBN-EEB-MS-TI07-0005

COMPUTED WMB DATE 1/17/90
CHECKED RRP DATE 1/17/90

DC SUP FDR - 15A BKR FROM 125VDC BAT BD I, BKR 313 (45N703-1 R19).

1-R-54 PNL FUSES - 5A (See DCN P-03388-A) FUSES (45N1680-2 R8) FOR THE FOLLOWING VALVES.

FCV-1-103A (45N600-1-2 R7)
104A
105A
106A
107A
108A
109A
110A
111A
112A
113A
114A

ONLY ONE SET OF FUSE IN EACH CIRCUIT

DC SUP FDR - 15A BKR FROM 125V DC BAT BD II BKR 313 (45N703-2 R21).

1-R-55 PNL FUSES - 5 A (SEE DCN P-03388-A) FUSES (45N1681-2 R8) FOR THE FOLLOWING VALUES.

FSY-1-103B & D (45N600-1-2 R7)
104B & D
105B & D
106B & D
107B & D
108B & D
109B & D
110B & D
111B & D
112B & D
113B & D
114B & D

ONLY ONE SET OF FUSES IN EACH CIRCUIT.

DC SUP PWR - 15A BKR FROM 125V DC BAT BD III
BKR 313 (45N703-3 R20).

2-R-54 PNL FUSES - 5A (SEE DCN later) FUSES
(45N2680-2 R7) FOR THE FOLLOWING VALVES.

FCV-1- 103-A (45N600-1-2 R7)
104-A
105-A
106-A
107-A
108-A
109-A
110-A
111-A
112-A
113-A
114-A

ONLY ONE SET OF FUSES IN
EACH CIRCUIT

DC SUP PWR – 15A BKR ON 125V DC BAT BD IV
BKR 313 (45N703-4 R17).

2-R-55 PNL FUSES – 5A (SEE DCN later) FUSES
(45N2681-2 R7) FOR THE FOLLOWING VALVES.

FSV-1-103B & D (45N600-1-2 R7)
104B & D
105B & D
106B & D
107B & D
108B & D
109B & D
110B & D
111B & D
112B & D
113B & D
114B & D

ONLY ONE SET OF FUSES IN
EACH CIRCUIT.

11.0 ATTACHMENTS

NO		Page
A	125V VITAL BATTERY BOARDS CONTRACT DATA	114
B	125V VITAL BATTERY CHARGER CONTRACT DATA	128
C	125V VITAL BATTERIES CONTRACT DATA	134
D	125V VITAL BATTERY BD V & DISTR PANELS CONTRACT DATA	140
E	125V VITAL BATTERY V CONTRACT DATA	153
F	LTG CONTACTOR & SPARE CHARGER TRANSFER SWITCH CONTRACT DATA	160
G	COMPONENT DATA	165
H	BREAKER/FUSE TIME-CURRENT CURVES	185
I	LVSG & MVSG WALKDOWN DATA SUMMARY ON CONTROL POWER FUSES	199

R2 GP 6/25/90 WJH 6/28/9

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ORIGINAL
Bidder No. 2

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone — Area Code 615/265-3551
TWX No. 810 573 5274

7 582

INVITATION, BID, AND ACCEPTANCE

This block to be completed by TVA

State or Country Code	21	TVA Reference No.	75C2-85281
Vendor Code		Contract Date	July 1, 1974
Buying Code	L. A.	Total Amount $	113,388.00
Commodity Code		Performance Date	April 1, 1975
Account Number	N3 39		

INVITATION

Date April 9, 1974

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until 10 a.m. EST, May 3, 1974,* and will be opened and read in public. Bids not physically received by the time stated will be returned unopened to the bidder.

TENNESSEE VALLEY AUTHORITY, By Tim E. Tilley
Purchasing Agent

Requisitioner: Ref. No. N3E-51 Project Watts Bar Nuclear Plant Units 1 and 2

BID — Date May 3, 1974 Bidder's Reference Number NKVU-3920

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees if this bid be accepted within ____ days (60 days unless otherwise stated) from the date of the opening, to furnish the services and/or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: Net
Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price; and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination, or from date of receipt of correct bill, whichever date is later.

Approved: J. H. McDowell, Jr. 6/28/74

The bidder represents:

That he is ___, is not X, a small business concern as defined in Code of Federal Regulations, Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if bidder is a nonmanufacturer, he also represents that the products to be furnished hereunder will ___, will not X, be produced by a small business concern. In construction and construction-related nonpersonal service contacts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more:)
That he is X a manufacturer of the articles, equipment, material or supplies quoted upon herein.
That he is ___ a regular dealer in, and maintains a stock for sale to the general public of articles, equipment, materials, or supplies of the general character of that or those upon which he bids herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $25,000 or more, or (b) the aggregate amount of bid on a negotiated purchase is more than $1,000:)
That (a) he has ___, has not X, employed or retained any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] to solicit or secure this contract; and (b) he has ___, has not X, paid or agreed to pay any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Bidder: WESTINGHOUSE ELECTRIC CORPORATION
Street: Suite 600, American National Bank Building
City, State, and Zip Code: Chattanooga, Tennessee 37402
Person authorized to sign bid — Name and title (print or type) and signature: E. E. Rolston, Sales Engineer.

P. O. Box
Telephone No. 267-9261974
TWX No.

ARTICLES OR SERVICES AND ATTACHMENTS WHICH FORM PART OF CONTRACT

ps

*local time at Chattanooga, Tennessee

125-Volt Vital Battery Boards

Schedule of Prices (including Shipping Data)
Quality Assurance Program of Manufacturers and Suppliers of Class IE Materials and Equipment (Appendix A)
Design Data (Appendix B)
Guaranteed Performance Data (Appendix C)
Experience Data (Appendix D)
Seismic Laboratory Data (Appendix E)
Special Conditions
General Conditions (form 5052)
Walsh-Healey Act
Equal Opportunity (forms 9923 and 9925)
Contractor and Subcontractor Listing Requirements (form 9934)
TVA Specification 2091
TVA Drawings 45N701-1R1, 45N703-1R1, -2R1, -3R1, and -4R1

Killian 4	Sisk
CAB TB PAB	Specs. 6
Sherrod	Contractor 3

TVA USE ONLY — DO NOT USE THIS SPACE.

21

ACCEPTANCE — Accepted only as to: Items 1, 2, 3, and 4.
Shipment is to be made by prepaid motor freight unless TVA's Traffic Branch later specifies the use of Government bill of lading.
CONFIRMING TELEPHONE AWARD TO MR. H. M. HUIE, JR., JULY 1, 1974 - DO NOT DUPLICATE.

Drawings to be submitted by August 15, 1974.

TENNESSEE VALLEY AUTHORITY, By Tim E. Tilley
Tim E. Tilley, Purchasing Agent

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Watts Bar Nuclear Plant, near Spring City, Tennessee (Accessible from U.S. Highway 27)
MARK: Contract 75C2-85281
For: Watts Bar Nuclear Plant Units 1 & 2
Attn: Chief Storekeeper

MAIL INVOICE in DUPLICATE to — TENNESSEE VALLEY AUTHORITY
Construction Accounting Branch
400 Northshore Building
Knoxville, Tennessee 37902

Invoices must show contract number, discount or terms of payment applicable, item number, description of article or service, quantity, unit price, and total amount.

TVA USE ONLY	Person receiving material	Date Material Received	G.B.L. No.	Carrier's Charges: Paid $	Collect $
I certify that the articles or services listed above have been received in quantity and quality specified except as noted.	Approved as reported above	Truck: Vendor / TVA	Common Carrier: Express (Air, REA, UPS); Freight (Air, Brg., Mtr., Rail); Par. Post	Purchase Cost / Cash Discount-cr / Carrier's Charges / Total Cost	

TVA 5050 (DP-7-70)

Contract File — Purchasing A File — Accounting Office — Consignee —

Sub-Contractor - Iron Mountain Mich
906-774-0440
FTS 8-226-1000

DEP MASTER FILE

Calculation WBN-EEB-MS-TI07-0005
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TENNESSEE VALLEY AUTHORITY
OPENED 10:00 AM
MAY 3 1974
DIVISION OF PURCHASING
CHATTANOOGA, TENNESSEE

Schedule of Prices

~~Reissue~~ No. 2-85281
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	F.O.B.				
	Watts Bar Nuclear Plant, near Spring City, Tennessee (Accessible from U. S. Highway 27) if by motor freight, vendor's delivery, or UPS 37381 Spring City, Tennessee, (Southern Railway System) if by rail freight P. O. Box 2000, Spring City, Tennessee 37381, if by parcel post				
	The following equipment shall be furnished in accordance with TVA specification 2091 and drawings 45N701-1R1, 45N703-1R1, -2R1, -3R1, and -4R1.				
1	125-Volt DC vital battery board I, cubicle type, 4 sections.	1	only	for	28,347
	Manufacturer Westinghouse				
	Point of Manufacture Iron Mountain, Michigan				
2	125-Volt DC vital battery board II, cubicle type, 4 sections.	1	only	for	28,347
	Manufacturer Westinghouse				
	Point of Manufacture Iron Mountain, Michigan				
3	125-Volt DC vital battery board III, cubicle type, 4 sections.	1	only	for	28,347
	Manufacturer Westinghouse				
	Point of Manufacture Iron Mountain, Michigan				
4	125-Volt DC vital battery board IV, cubicle type, 4 sections.	1	only	for	28,347
	Manufacturer Westinghouse				
	Point of Manufacture Iron Mountain, Michigan				
	Total Items 1 through 4				113,388

TVA 5051 (DP-9-73)

BIDDER WESTINGHOUSE ELECTRIC CORPORATION

Calculation WBN-EEB-MS-TI07-0005
Attachment A
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TENNESSEE VALLEY AUTHORITY

APPENDIX B

DESIGN DATA

The following design data shall be submitted with each copy of the bid:

1. Exceptions to TVA specifications. (See section B.2.) None Intended

2. Dimensional sketches for each panel, including (a) length, (b) height, (c) depth, (d) available space for power cable and conduit termination, (e) net inside dimensions of wiring gutters, and (f) approximate total net weight. Per TVA Drawings and Specs.

3. Manufacturer and type designation of each of the following:

a. Drawout breakers	
(1) 600-Ampere frame	G.E. AK-2-25
(2) 1600-Ampere frame	G.E. AK-2-50
b. Molded-case breakers	
(1) 150-Ampere frame	(W) HFB
(2) 400-Ampere frame	(W) HLB
c. Relays	
(1) Auxiliary	Potter-Brumfield MDR
(2) Undervoltage	G.E. NGV-17A
d. Instruments	
(1) Voltmeter	(W) KX-241
(2) Ammeter	(W) KX-241
(3) Ground indicator	Weston 1073-9820 and 1074

APPENDIX B (Continued)

DESIGN DATA (Continued)

e. Fuses	
(1) Main power	
(a) 1600 Amperes	Chase-Shawmut Amp-Trap
(b) 350 Amperes	Buss-Limitron JKS
(c) 200 Amperes	" -Fusetron - FRN
(d) 150 Amperes	" " "
(e) 100 Amperes	" " "
(f) 60 Amperes	" " "
(2) Instrument	Buss-Fusetron 10 Amperes
(3) Signal	Bussman type KAZ 10 Amperes
f. Bus filter network	
(1) 1300-Microfarad capacitor	Mallory-Computer Grade
(2) 1.0-Microfarad capacitor	Aerovox Metalize Bathtub
(3) Resistor	Ohmite 50 Watt
g. Miscellaneous	
(1) Terminal blocks	G.E. EB5
(2) Shunt	Westinghouse
(3) Cable lugs	Burndy

WESTINGHOUSE ELECTRIC CORPORATION
Bidder

Calculation WBN-EEB-MS-TI07-0005
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No. 2-85281

TENNESSEE VALLEY AUTHORITY

APPENDIX C

GUARANTEED PERFORMANCE DATA

(To be Made a Part of the Contract)

The bidder hereby guarantees that the performance and characteristics of the equipment bid upon will be as stated in the following tabulation. In the case of conflicts between data furnished below and any other data furnished with the bid, that furnished below shall govern.

TVA considers this information so material to its decision on whether or not a bid meets the specifications that the omission of any one or more of them could make impossible such decision and cause the bid to be nonresponsive. If the omission of items of information renders a bid nonresponsive, such bid will be rejected.

1. Circuit breaker

   a. Short circuit interrupting rating at 125 volts DC

      (1) 150-Ampere frame, amperes ____ 20,000

      (2) 400-Ampere frame, amperes ____ 20,000

      (3) 600-Ampere frame, amperes ____ 25,000

      (4) 1600-Ampere frame, amperes ____ 50,000

2. Board ratings*

   a. Rated nominal voltage ____ 250 Volt DC

   b. Rated maximum voltage ____ 300 Volt DC

   c. Rated insulation level ____ 1.5 kV 60 Hz 2.1 kV DC

   d. Rated continuous current ____ 1600 Amps-600 Amps-400 Amps-150 Amps

   e. Continuous current rating ____ See Circuit Breaker Trip Rating

   f. Rated momentary current ____ Same as short circuit interrupting ratings given above.

*Defined in ANSI C37.20-1969 (see environmental conditions stated in paragraph E.4 of specification 2091)

WESTINGHOUSE ELECTRIC CORPORATION
Bidder

Calculation WBN-EEB-MS-TI07-0005 Page 119
Attachment A

Address all communications and invoices to
TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone 615 265-3551
TWX 810 573-5274

This block to be completed by

State or Country Code 21	Contract No. 7C02-85281 Change No. 1
Vendor Code	Change Date October 29, 1974
Buying Code L A	Change Amount $ + $16,116.00
Commodity Code	Performance Date April 1, 1975
Account Number N3 39	

CHANGE OF CONTRACT

Project Watts Bar Nuclear Plant Units 1 and 2

11 847

Vendor Reference No. NEVU-3920

To

Westinghouse Electric Corporation
Suite 600
American National Bank Building
Chattanooga, TN 37402

125-VOLT VITAL BATTERY BOARDS

ELECT ENGR BRANCH
NOV 11 1974

We hereby make the following changes to the subitem descriptions in section D, Itemized Equipment Requirements, of specification 2001:

Item	Change	
1b, 2b, 3b, 4b	Change scale from 300-0-600 ampere to 400-0-800 ampere. Change shunt from 100 mV, 600 ampere to 100 mV, 800 ampere. 1 Job for	$ 32.00
1d, 2d, 3d, 4d	Change the manufacture and type number from Weston models 1073, 9020, and 1074 to LFE Corporation type 503L and 903, or General Electric type 195, or equal.	No Charge
1f, 2f, 3f, 4f	Change frame size from 600 ampere to 1600 ampere, change trip rating from 600 ampere to 800 ampere, change short time delay characteristic from 2C with 7X setting to 2C adjustable 4-10X set for 6X, General Electric type AK-2-50. 1 Job for	$15,276.00
1g, 2g, 3g, 4g	Change the quantities of the following Westinghouse type HFB circuit breakers:	

Items	Trip	Old Quantity	New Quantity
1g3,2g3,3g3,4g3	30A	6	24
1g5,4g5	50A	22	4
2g5,3g5	50A	23	5

No Charge

(Continued on page 2)

All other terms and conditions of the original contract and previous changes of contract (if any), shall apply.

Previous Total $113,388.00
Correct Total $131,504.00

Hillian-3 Contr. 3
Sherrod
Specs. 6
~~XXXX~~ Lavinder
TB

TENNESSEE VALLEY AUTHORITY
Division of Purchasing
By Walter F. Rowan Jr.
for Tim E. Tilley
Purchasing Agent

TVA 394 (DP-12-71)

CONTRACT NUMBER must be shown on all invoices, packages, shipping papers and correspondence.

4 1. Contractor 2. Auditor 3. Contract File 4. Purchasing File 5. Accounting Office 6. Consignee 7. Requisitioner 8. Requisitioner 9. Plant Accounting 10. & 11. Extra

No. 7502-85281
Page No. 2

		QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT

Item — **Change**

1h, 2h, 3h, 4h — Change the trip ratings of the following Westinghouse type HLB circuit breakers:

Items	Quantity	Old Trip	New Trip
1h1,2h1,3h,4h1	1	100A	125A
1h2,2h2,3h2,4h2	5	250A	300A

No Charge

1i4,2i4,3i4,4i4 — Change fuse ratings from 350 amperes to 300 amperes, change type from Bussmann type JNS350 to Bussmann type KWN300, complete with single-pole fuse holder

No charge

1i5,2i5,3i5,4i5 — Change the quantity of the following Bussmann type FRN fuses:

Amperes	Old Quantity	New Quantity
150	8	2
100	2	8

No Charge

1j1,2j1,3j1,4j1 — Add model No. MDR-5058 to description of the Potter and Brumfield type MDR relay

No Charge

1k, 2k, 3k, 4k — Add this item to all battery boards:

Battery State-of-Charge Indicator, to be used with 800-ampere, 100-mV shunt supplied separately will be used to monitor a 60-cell lead-calcium battery of 125-volt nominal and rated for 800 amperes continuous discharge for 2 hours, indicator complete with high level and low level alarm contacts, operating voltage of 105-140V dc, Curtis Instruments, Incorporated, model 926A, or equal. Low level alarm set for 75 percent capacity.

1 Job for $2,803.00

In accordance with Westinghouse Electric Corporation's letter to Tim E. Tilley dated August 22, 1974.

Refer to memorandums from F. W. Chandler to Tim E. Tilley dated September 4 and October 21, 1974, and letter from F. W. Chandler to Westinghouse Electric Corp. dated July 25, 1974.

C. GENERAL REQUIREMENTS, continued

4. Materials and Workmanship

a. All equipment shall be new and of current model and latest design, shall be of standard commercial, first-grade quality as to materials and workmanship, in accordance with the best engineering practice, and shall be such as has been proved to be suitable for the intended purpose. Approval must be obtained from TVA for any device used which contains mercury.

b. All breakers shall be legibly stamped "Class IE."

c. Where an item in the subsequent lists of material is listed of a particular manufacturer and is not followed by "or equal" then the item of that manufacturer, and no other, is required.

5. Class IE Equipment for Nuclear Reactor Service

a. These boards are designated Class IE equipment (IEEE Publication No. 308) and shall be subject to requirements specified herein which pertain to special quality assurance procedures and to seismic design, in addition to all other requirements specified herein.

b. The Contractor shall maintain a Quality Assurance Program during the design, manufacture, and test of these boards in accordance with appendix A of this specification. This program shall be available for review and approval by the Engineer or his authorized representative prior to the award of the contract and throughout the life of the contract, and the Contractor shall notify the Engineer in writing of any change in his Quality Assurance Program.

D. ITEMIZED EQUIPMENT REQUIREMENTS

1. Item 1 - Battery Board I

a. The Contractor shall furnish a 4-section cubicle-type switchboard with hinged rear doors, top covers, and 2-inch trim sections on each end. The board shall be provided in accordance with the detailed requirements of section E. of this specification and as shown on TVA drawings 45N701-1 and 45N703-1.

b. The Contractor shall furnish the battery board complete with air circuit breakers, instruments, and other equipment mounted as shown on drawing 45N701-1. The breakers shall be furnished with trip elements per circuit schedule on drawing 45N703-1. Each breaker shall be equipped with "make" alarm contacts, wired to terminal blocks on each panel. The chargers, inverters, and other miscellaneous equipment shown (except bus filter circuit) shall not be furnished on this contract.

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 1, continued

c. The Contractor shall supply the battery boards with all required buswork and completely wired prior to shipment. In addition, each cubicle shall be equipped with a 40-watt fluorescent lamp fixture and guard, a 3-pole polarized convenience receptacle (Hubbell No. 5362, or equal), a single-pole toggle switch for the lamp (mounted inside the cubicle), and one 12-point terminal block. The equipment to be supplied shall include the following:

Item	Description	Quantity
1a	DC voltmeter, self-contained, 0-150-volt scale with suppressed zero (expanded portion of scale approximately 100-150 volts), General Electric type DB-40, or equal.	3
1b	DC ampere meter relay, 300-0-600-ampere scale, double set points adjustable from front of case, 4-1/2-inch case with load relay, General Electric type 195, or equal, complete with 100-mv, 600-ampere shunt.	1
1c	DC ammeter, 0-600-ampere scale, complete with 100-mv, 600-ampere shunt, General Electric type DB-40 complete with type 140 shunt, or equal.	1
1d	Ground indicating and alarm equipment consisting of continuous reading meter-relay and accessories according to the following requirements:	1 lot

Meter movement, full scale - 15-0-15 ma

Scale marking, full scale - 150-0-150 volts

Indicator accuracy - ±2% full scale

Set point accuracy - ±2%

Meter case - 4-1/4 inches square (approximately) for semiflush mounting

Alarm contacts - Two; adjustable from front of case; automatic reset

Locking coils - Two; independent of signal coil (not applicable to optical types); manual reset with pushbutton on front of meter case

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 1 c 1d, continued

Item	Description	Quantity
	Load relay - SPDT contact rated at 5 amperes, 115 volts AC; operated at set point or above, released when pointer drops below set point; in case or module for back-of-board mounting	
	Power supply - As required, to operate from 115 volts AC; in case or module for back-of-board mounting	
	Potential dividing resistors - Two; 10,000 ohms, 5 watts, 2% accuracy	
	Weston Instruments Division (of Daystrom Corporation), meter relay model 1073, power supply model 9820, and load relay model 1074, or equal.	
1e	Air circuit breaker, 2 pole, 1600-ampere frame (with 50,000-ampere interrupting capacity at 250 volts DC), 800-ampere trip, with series trip device (EC-2A) having an adjustable long time-delay (curve 1A adjusted for 110%) and instantaneous (4X to 9X adjusted to 4X) characteristics, an independent manual (spring closing) mechanism, and a normally open trip alarm switch, drawout mounting, General Electric type AK-2-50.	1
1f	Air circuit breaker, 2 pole, 600-ampere frame (with 25,000-ampere interrupting capacity at 250 volts DC), 600-ampere trip, with series selective overcurrent tripping device (type EC-1) having an adjustable long (curve 1A) and short (curve 2C with 7X setting) time-delay characteristic, an independent manual (spring closing) mechanism, and a normally open trip alarm switch, drawout mounting, General Electric type AK-2-25.	1
1g	Air circuit breaker, 2 pole, 150-ampere frame with thermal and magnetic trip (with 20,000-ampere interrupting capacity at 250 volts DC per NEMA test procedure), Westinghouse type HFB, with trip ratings and in quantities as follows:	1 lot

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 1 c 1g, continued

Item	Trip Rating, Amperes	Quantity
1g1	15	16
1g2	20	2
1g3	30	6
1g4	40	1
1g5	50	22
1g6	100	1

Item	Description	Quantity
1h	Air circuit breaker, 2 pole, 400-ampere frame with thermal and magnetic trip (with 20,000-ampere interrupting capacity at 250 volts DC per NEMA test procedure), Westinghouse type HLB, or equal, with trip ratings and in quantities as follows:	1 lot

Item	Trip Rating, Amperes	Quantity
1h1	100	1
1h2	250	5

Item	Description	Quantity
1i	Back-of-board equipment for panels 1 through 3, including all necessary copper feeder buses and continuous ground bus (panels 1 through 4), cable terminal lugs, circuitry for remote instrumentation, fuses of the type and ratings indicated on drawing 45N703-1 (instrument fuses to be non-deteriorating type), and a bus filter circuit as shown in detail A of drawing 45N703-1. The selection of components used shall be subject to TVA approval. The following items shall be included:	1 lot

Item	Description	Quantity
1i1	Undervoltage relay, 125 volts DC, calibration dropout range 100-140 volts, one normally open and one normally closed contacts, molded case, General Electric model 12NGV17A2, or equal	1

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 1 c li, continued

Item	Description	Quantity
li2	Time-delay relay, 120 volts AC, range 5-50 seconds, delay on dropout, DPDT contacts, complete with total enclosure, Agastat model 7022ADGZ, or equal, to be mounted in rear of panel 1.	1
li3	Fuse, 1600 amperes, rated 600 volts, Chase-Shawmut Amp-Trap A4BY1600, type 55, or equal, complete with mounting hardware.	2
li4	Fuse, 350 amperes, 600 volts, Bussmann Limitron type JKS350, or equal, complete with class J single-pole fuseholder.	10
li5	Fuse, rated 250 volts, Bussmann Fusetron type FRN, or equal, with current ratings and in quantities as follows, each fuse complete with single-pole fuseholder:	1 lot

Amperes	Quantity
200	2
150	8
100	2
60	6

li6	Signal actuator device, with indicator fuse rated 10 amperes, 250 volts DC, 30,000-ampere interrupting capacity at 125 volts DC, complete with single-pole fuseholder and microswitch, Bussmann type KAZ fuse and type 2778 fuseholder, or equal, to be used with items li3, li4, and li5.	30

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 1 c 1i, continued

Item	Description	Quantity
1i7	Illuminated pushbutton switch, white lens, with one normally open and one normally closed contacts for 120-volt operation, with legend plate engraved ALARM RESET, Cutler-Hammer catalog No. 10250T471-1C26M36, or equal.	1

Item	Description	Quantity
1j	Back-of-board equipment for panel 4, including the vertical copper supply bus and signal bus for each column (group) of circuits, vertical cable gutters, continuous ground bus (panels 1 through 4), and the following items shown on drawing 45N701-1 completely wired.	1 lot

Item	Description	Quantity
1j1	Blown fuse alarm relay, 125-volt DC operation, with two normally open and two normally closed contacts, molded case, Potter and Brumfield type MDR, or equal.	10
1j2	Signal fuse block, 4 pole, for 250-volt DC signal indicating fuses, Bussmann Manufacturing Division catalog No. 2828, or equal.	125
1j3	Fuse, signal indicating type, 250 volts DC, rated 10 amperes, to be used with item 1j2, Bussmann Manufacturing Division type KAZ, or equal.	500

2. Item 2 - Battery Board II

a. The Contractor shall furnish a 4-section cubicle-type switchboard with hinged rear doors, top covers, and 2-inch trim sections on each end. The board shall be provided in accordance with the detailed requirements of section E. of this specification and as shown on TVA drawings 45N701-1 and 45N703-2.

D. ITEMIZED EQUIPMENT REQUIREMENTS, continued
D 2, continued

b. The Contractor shall furnish the battery board complete with air circuit breakers, instruments, and other equipment mounted as shown on drawing 45N701-1. The breakers shall be furnished with trip elements per circuit schedule on drawing 45N703-2. Each breaker shall be equipped with "make" alarm contacts, wired to terminal blocks on each panel. The chargers, inverters, and other miscellaneous equipment shown (except bus filter circuit) shall not be furnished on this contract.

c. The Contractor shall supply the battery boards with all required buswork and completely wired prior to shipment. In addition, each cubicle shall be equipped with a 40-watt fluorescent lamp fixture and guard, a 3-pole polarized convenience receptacle (Hubbell No. 5362, or equal), a single-pole toggle switch for the lamp (mounted inside the cubicle), and one 12-point terminal block. The equipment to be supplied shall include the following:

Item	Description	Quantity
2a	DC voltmeter, self-contained, 0-150-volt scale with suppressed zero (expanded portion of scale approximately 100-150 volts), General Electric type DB-40, or equal.	3
2b	DC ampere meter relay, 300-0-600-ampere scale double set points adjustable from front of case, 4-1/2-inch case with load relay, General Electric type 195, or equal, complete with 100-mv, 600-ampere shunt.	1
2c	DC ammeter, 0-600-ampere scale, complete with 100-mv, 600-ampere shunt, General Electric type DB-40 complete with type 140 shunt, or equal.	1
2d	Ground indicating and alarm equipment consisting of continuous reading meter-relay and accessories according to the following requirements: Meter movement, full scale - 15-0-15 ma Scale marking, full scale - 150-0-150 volts Indicator accuracy - ±2% full scale Set point accuracy - ±2%	1 lot

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ORIGINAL

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone — Area Code 615, 265-3551
TWX No. 810 573 5274

INVITATION, BID, AND ACCEPTANCE

This block to be completed by TVA

Bidder No.

State or Country Code 12
Vendor Code
Buying Code S A
Commodity Code
Account Number N3 | | 391 |

TVA Reference No. 74C 8-85251
Contract Date January 28, 197
Total Amount $ 27,180
Performance Date April 1, 1975

INVITATION

Date November 20, 1973

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until *10 a.m. EST, December 20, 1973 and will be opened and read in public. Bids not physically received by the time stated will be returned unopened to the bidder.

TENNESSEE VALLEY AUTHORITY, By John P. Opp
Purchasing Agent

Requisitioner Ref. No. N3E-50 Project Watts Bar Nuclear Plan

ARTICLES OR SERVICES AND ATTACHMENTS WHICH FORM PART OF CONTRACT

bb

*Local time at Chattanooga, Tennessee

120-Volt Vital Battery Charger

Schedule of Prices
Shipping Data (form 5053)
Conditions Applicable to Foreign Equipment and Material (form 9699)
Origin of Materials (form 9699A)
Checklist for Review of Manufacturers or Suppliers Quality Assurance Program
Quality Assurance Program (Appendix A)
Design Data (Appendix B)
Guaranteed Performance Data (Appendix C)
Experience Data (Appendix D)
Seismic Laboratory Data (Appendix E)
Special Conditions
General Conditions (form 5052)
Walsh-Healey Act
Equal Opportunity)forms 9923 & ~~9925~~)
Contractor and Subcontractor Listing Requirements (form 9934)
TVA Specification 2090

Killian 4 Sherrod
CAB Specs. 6
TB Sisk
BAR Contr. 2

APPROVED 1-25-74

TVA USE ONLY — DO NOT USE THIS SPACE

BID

Date 1-7-74 Bidder's Reference Number

In compliance with the invitation for bids, and subject to all the conditions thereof, the unders offers, and agrees if this bid be accepted within 45 days (45 days unless otherwise s from the date of the opening, to furnish the services and/or sell and deliver the articles list any or all of the items at the price quoted opposite each. Bids may not be withdrawn afte opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: Net 30 days
Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the contract price; and (2) time in connection with discounts offered will be computed from dat delivery of the supplies at destination, or from date of receipt of correct bill, whichever dat later.

The bidder represents:

That he is X, is not ___, a small business concern as defined in Code of Federal Regulatio Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if bid is a nonmanufacturer, he also represents that the products to be furnished hereunder will X will not ___, be produced by a small business concern. In construction and construction-rela nonpersonal service contacts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more:)
That he is X a manufacturer of the articles, equipment, material or supplies quoted upon here
That he is ___ a regular dealer in, and maintains a stock for sale to the general public of artic equipment, materials, or supplies of the general character of that or those upon which he bi herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $25,000 more, or (b) the aggregate amount of bid on a negotiated purchase is more than $1,000:)
That (a) he has ___, has not X, employed or retained any company or person [other than bona fid employees or bona fide established commercial or selling agencies maintained by the bidder fo contractor) for purposes of securing business] to solicit or secure this contract; and (b) he has ___ has not X, paid or agreed to pay any company or person [other than bona fide employees o bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Bidder
Power Conversion Products Inc.
Street
42 East Street
City, State, and Zip Code
Crystal Lake, Illinois
P. O. Box Number 380 Zip Code 60014
Telephone No. (815) 459-9100
TWX No. 910-634-3256
Person authorized to sign bid — Name and title (print or type) and signature
Chris F. Seyer
Sales Manager

FEB 1974

ACCEPTANCE — Accepted only as to:

Items 1 and 2. Addendum No. I is made a part of this contract.

Performance Bond is not required.

Drawings shall be submitted by March 14, 1974.

Ship by prepaid motor freight.

TENNESSEE VALLEY AUTHORITY, By John P. Opp
Purchasing Agent

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Watts Bar Nuclear Plant, near Spring City, T
MARK: Contract 74C8-85251
For: Watts Bar Nuclear Plant
Attn: Chief Storekeeper

MAIL INVOICE in DUPLICATE to — TENNESSEE VALLEY AUTHORITY
Construction Accounting Branch
400 Northshore Building
Knoxville, TN 37902

Invoices must show contract number, discount or terms of payment applicable, item number, description of article or service, quantity, unit price, and total amount.

TVA USE ONLY
I certify that the articles or services listed above have been received in quantity and quality specified except as noted.
TVA 5050 (DP-7-70)

Person receiving material
Approved as reported above

Date Material Received
G.B.L. No
Carrier's Charges: Paid $ Collect $
Truck: Vendor | TVA
Common Carrier: Express: Air | REA | UPS; Freight: Air | Brg | M | Rail | Par. Post

Purchase Cost	
Cash Discount-cr	
Carrier's Charge	
Total Cost	

Contract File
Purchasing A File
Accounting Office
Consignee

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Schedule of Prices

No. 8- 85251
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	F.O.B. Watts Bar Nuclear Plant, near Spring City, Tennessee by Motor Freight				
1	Battery charger, 200 amperes, 125 volts, for automatic float charging of a lead-acid, 60-cell vital battery, in accordance with requirements which follow in specification 2090.	6	each	4,530.00	$27,180.
	Make and Model or Type 3SC-130-200				
	Point of Manufacture Crystal Lake, Illinois				
Alt 1a	Same as item 1 except 250-ampere size. 3SC-130-250	6	each	~~$5,110.00 $30,660.0~~	
2	Applicable drawings for one of the above.	1	lot	for	N/C

ZONE PRICES. Are prices quoted zone or national prices? NO (Yes or No). TVA considers a national price to be a zone price for the purpose of this clause. If zone prices are quoted, no adjustment will be made thereof when destination is changed from that originally specified unless the new destination is in a different zone from that first named. If shipment is on a government bill of lading, transportation charges by contractor's proposed method of shipment to actual destination on date of shipment will be deducted from invoices unless the charges on date of bid by the method of shipment stated in the bid are higher, in which event such higher charges shall be deducted. If bidder's answer is affirmative the General Condition CHANGES IN FREIGHT RATES becomes inapplicable to this purchase. NOTE: If prices quoted are zone prices, give zone number and geographical boundary of the zone in which each destination is located.

TVA 5051 (DP-8-70)

BIDDER Power Conversion Products Inc.

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Attachment B
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No. 8- 85251

TENNESSEE VALLEY AUTHORITY

ITEM 1 (3SC-130-200)

APPENDIX C

GUARANTEED PERFORMANCE DATA

(To be Made a Part of the Contract)

The bidder hereby guarantees that the performance and characteristics of the equipment bid upon will be as stated in the following tabulation. In the case of conflicts between data furnished below and any other data furnished with the bid, that furnished below shall govern. Include a separate tabulation for alternate proposal where applicable.

TVA considers this information so material to its decision on whether or not a bid meets the specifications that the omission of any one or more of them could make impossible such decision and cause the bid to be nonresponsive. If the omission of items of information renders a bid nonresponsive, such bid will be rejected.

Input requirement:	47.0 kva input at 26.0 kw output (rated) 30.5 kw input at 26.0 kw output (rated) 85 percent efficiency *
Regulation:	± 1 percent from no load to full load with a simultaneous ± 7-1/2 percent line voltage variation and ± 2 percent frequency variation
Output voltage ripple:	100mv. volts rms, or .5 percent without battery connected
Current limit:	125 percent rated at nominal input (480 volts, 60 Hz) 130 percent rated value at nominal +10 percent input 120 percent rated value at nominal -10 percent input
Ambient temperature:	45° C maximum

* At full load and nominal input voltage.

Power Conversion Products Inc.
Bidder

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No. 8-85251

TENNESSEE VALLEY AUTHORITY

APPENDIX B ITEM 1 (3SC-130-200)

DESIGN DATA

The following design data shall be submitted with each copy of the bid:

1. Exceptions to TVA specifications. NONE

2. Typical schematic diagrams and an outline drawing showing mounting and cable entrance details of the cabinet he proposes to furnish.
   See drawing IDF-505 (schematic) and H-55-4645-01A (outline)

3. The following specific data (where necessary show separate listing for both items 1 and 1a):

   a. AC circuit breaker: Manufacturer Westinghouse Type EHB3090
      Trip rating 90 amperes
      Instantaneous trip rating 14,000 amperes

   b. DC circuit breaker: Manufacturer Westinghouse Type MA2300
      Trip rating 300 amperes
      Instantaneous trip rating 20,000 amperes
      Interrupting rating

   c. Current limit: Adjustable x Yes ____ No
      Time rating at current limit X continuous
      or ____ hours

   d. Type of charger output failure alarm device Output current sensing
      sensitivity 0 to 2.0A speed of operation 3 minutes time delay

   e. Parallel operation: Units can be operated in parallel without hunting or oscillating. Should one unit fail, the other will automatically pick up the full l

   f. Method of regulation: SCR

   g. Float voltage adjustment: From 2.15 volts per cell
      to 2.25 volts per cell

   h. Equalizing voltage adjustment: From 2.15 volts per cell
      to 2.33 volts per cell

   i. Rectifiers: Kind Silicon Manufacturer's type No. IN4052R

   j. Surge suppressors: Type Selenium

   k. Cooling: Convection

   l. Instruments: DC ammeter 2 % accuracy, DC voltmeter 1 % accuracy
      DC voltmeter 75 to 150 scale
      Equalize timer 0 to 24 hours

Power Conversion Products Inc.
Bidder

III. DETAILED REQUIREMENTS

A. BATTERY CHARGER

1. Charger shall be of the constant-voltage current limited type to operate from a nominal 480-volt, 3-phase, 60-Hz supply and shall have the continuous rated charging capacity within the ambient temperature range specified in paragraph III.C.1. Battery charger shall be of the solid-state silicon rectifier type and shall include insulating transformers to isolate the supply from the load circuits. The battery voltage shall automatically be maintained within the limits of plus or minus 1 percent from no load to full load with a simultaneous variation of ±7-1/2 percent in the AC supply voltage and ±2 percent in the supply frequency. Silicon-controlled rectifier or magnetic amplifier-type regulation is acceptable.

2. The float voltage shall be adjustable between 2.15 and 2.25 volts per cell. A selector switch shall be provided for giving the battery a periodic equalizing charge without disturbing the normal voltage adjustment. The equalize voltage setting shall be adjustable up to 2.33 volts per cell. A zero to 24-hour equalize timer shall be provided. The equalizing selector switch shall be connected so that all equalizing periods are controlled by the timer with no manual bypass. The selector switch may be part of the timing mechanism. The timer shall be capable of being manually reset before a set period of time has elapsed.

3. Protective devices shall be included to prevent damage from short circuits and to limit sustained loading within safe operating temperatures. The charger shall be inherently current limiting to 125 percent of rated output at the nominal input voltage. The DC output circuit shall be protected with a 2-pole, thermal-magnetic-trip air circuit breaker which shall have an alarm auxiliary contact, which is closed when a fault or overload has tripped the breaker, for connection to an external alarm circuit. The output breaker shall have a minimum interrupting rating of 20,000 amperes DC at 125 volts. The AC input circuit shall be provided with a 3-pole thermal-magnetic-trip air circuit breaker which will serve as the charger power ON-OFF switch, and shall have a minimum interrupting rating of 14,000 symmetrical RMS amperes at 480 volts.

4. An AC power failure alarm relay with two contacts that close upon loss of input power shall be provided. During the absence of AC power, the DC regulating circuit shall be isolated from the output bus to prevent backfeed drainage from the battery or shall be of such design so as not to draw more than 25 milliamperes during this condition.

III. DETAILED REQUIREMENTS, continued
III A, continued

5. A charger output failure alarm relay with two contacts that close upon loss of charger output shall be provided. The relay may be a ripple sensing, current sensing, or similar device and it must function with the battery load connected to the charger.

6. Relay and circuit breaker alarm contacts shall be rated for a minimum of 5 ma at 140 volts DC.

7. The charger shall be equipped with a voltmeter with expanded scale of 75 to 150 volts, having a plus or minus 1 percent accuracy within the normal range of 105 to 140 volts, an ammeter, 2 percent accuracy, 0 to 25 percent above charger rated output, in the DC output circuit, and any other instruments required for adjusting the charger. All instruments and controls for normal operation shall be on the front of the cabinet. If the cabinet utilizes a front door for access to the charger interior, the instruments and controls shall be mounted on the door and connected with a flexible harness.

8. Filtering shall be sufficient to reduce ripple below 0.5 percent when the battery is disconnected and less than 100 mv measured with a battery across the output. The ampere-hour rating of the battery will be four times the current rating of the charger.

9. Two of the six chargers on this order will be used as spares. Any two of the chargers shall be capable of operating in parallel continuously. The paralleled chargers need not share the load equally, but Contractor shall provide any load sharing circuit if necessary to prevent one charger from exceeding its rating. If one charger should fail during parallel operation, then any common load sharing circuit shall be automatically disconnected. If required, selector switch shall be provided on the two spare chargers for switching the load sharing control circuit from one charger to another.

10. All internal wiring shall have an insulation (and jacket if applicable) material such as intrinsically self-extinguishing cross-linked polyethylene, chlorosulfonated polyethylene, or other similar material meeting TVA approval.

11. All control wiring shall be brought to suitable terminal blocks for connection to TVA's external wiring. All contactor auxiliary switches shall be wired to terminal blocks.

12. The charger shall be convection cooled. Forced-air cooling is not acceptable.

Calculation WBN-EEB-MS-TI07-0005
Attachment C
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TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone (615) 755-3011
TELEX 55-8417

INVITATION, BID, AND ACCEPTANCE

This block to be completed by P[illegible]der No. 2 ORIGINAL

State or Country Code 12	TVA Reference No. 76K3-85763
Vendor Code	Contract Date March 19, 1976
Buying Code L. A.	Total Amount $ 99,225.60
Commodity Code 6140	Performance Date July 27, 1976
Account Number N3 391	

INVITATION

Date January 15, 1976

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until 10 a.m., February 5, 1976 local time Chattanooga, Tennessee, and will be opened and read in public. Bids not physically received by the time stated will be returned unopened to the bidder.

TENNESSEE VALLEY AUTHORITY, By John J. Cain
Purchasing Agent

ARTICLES OR SERVICES AND ATTACHMENTS WHICH FORM PART OF CONTRACT

125-VOLT VITAL BATTERIES

Schedule of Prices
Shipping Data (form 5053)
Special Conditions
General Conditions (form 5052)
Walsh-Healey Act
Equal Opportunity (forms 9923 and 9925)
Contractor and Subcontractor Listing Requirements (form 9934)
TVA Specification 1980
Quality Assurance Program (Appendix A)
Repairs and Nonconforming Materials (Appendix B)
Design Data (Appendix C)
Guaranteed Performance Data (Appendix D)
*TVA Drawings 85E4-45N218R1 and 85E4-45B201-2R2

ONLY ONE AWARD WILL BE MADE ON EACH SCHEDULE

*Bidders should have drawings on hand from first issue. Additional copies may be obtained upon request.

TVA USE DO NOT USE THIS SPACE

Requisitioner Ref. No. N3E-97 Project Watts Bar Nuclear Plant

BID — Date 2-13-76 Bidder's Reference Number MAE-829-21376

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees if this bid be accepted within ____ days (60 days unless otherwise stated) from the date of the opening, to furnish the services and/or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: net 30 days
Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price; and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination, or from date of receipt of correct bill, whichever date is later.

Killian 4 TB Sherrod (19) 53
APS PAB Specs. 8

The bidder represents:
That he is ___, is not X, a small business concern as defined in Code of Federal Regulations, Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if bidder is a nonmanufacturer, he also represents that the products to be furnished hereunder will ___, will not ___, be produced by a small business concern. In construction and construction-related nonpersonal service contacts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more:)
That he is X a manufacturer of the articles, equipment, material or supplies quoted upon herein. That he is X a regular dealer in, and maintains a stock for sale to the general public of articles, equipment, materials, or supplies of the general character of that or those upon which he bids herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $25,000 or more, or (b) the aggregate amount of bid on a negotiated purchase is more than $1,000:)
That (a) he has ___, has not X, employed or retained any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] to solicit or secure this contract; and (b) he has ___, has not X, paid or agreed to pay any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Bidder Gould, Inc. % Robert W. Chapman & Co.	P. O. Box Number 15415 Zip Code 28210
Street 4732 Old Pineville Rd.	Telephone No. 704-525-2421
City, State, and Zip Code Charlotte, N. C. 28210	TWX No.
Person authorized to sign bid — Name and title (print or type) and signature Ed Adams Ed Adams Sales Engineer	

ACCEPTANCE — Accepted only as to: Items 1, 2, & 3.
Addenda I, II, & III are hereby made a part of this contract.
F.O.B. Watts Bar Nuclear Plant, near Spring City, Tennessee.
Shipment is to be made by prepaid motor freight unless TVA's Traffic Branch later specifies the use of Government bill of lading.
Drawings are to be submitted by May 3, 1976.
CONFIRMING telephone award of 3-19-76 to Miss Beeler. DO NOT DUPLICATE.

TENNESSEE VALLEY AUTHORITY, By John J. Cain
John J. Cain Purchasing Agent

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Watts Bar Nuclear Plant, near Spring City, TN

MARK: Contract 76K3-85763
For: Watts Bar Nuclear Plant
Attn: Chief Storekeeper

MAIL INVOICE in ~~DUPLICATE~~ TRIPLICATE to — TENNESSEE VALLEY AUTHORITY
Accounts Payable Section
305 Miller Building
Knoxville, TN 37902

Invoices must show contract number, discount of terms of payment applicable, item number, description of article or service, quantity, unit price, and total amount.

TVA USE ONLY	Person receiving material	Date Material Received	G.B.L. No.	Carrier's Charges: Paid $ Collect $
I certify that the articles or services listed above have been received in quantity and quality specified except as noted.	Approved as reported above	Truck: Vendor / TVA	Common Carrier: Express: Air, REA, UPS; Freight: Air, Brg., Rail, Par. Post	Purchase Cost / Cash Discount / Carrier Charges / Total Cost

TVA 5050 (DP-5-74)

Contract File — Purchasing A File — Accounting Office — Consignee —

DED MASTER FILE

Calculation WBN-EEB-MS-TI07-0005
Attachment C
Page 135

OPENED FEB 18 1976 10:00 AM
TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
CHATTANOOGA, TENNESSEE

Schedule of Prices

~~Reissue~~ No. 3-85763
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	F.O.B. Watts Bar Nuclear Plant, near Spring City, Tennessee (accessible from U. S. Highway 27) by motor freight of vendor's delivery.				
	Deviation from Price Adjustment Clause. Bids stating "Price in effect at time of shipment" or otherwise taking exception to the price adjustment clause contained in this invitation, or stating "Stock subject to prior sale" will be nonresponsive, and will not be considered for award.				
1	125-Volt vital battery, 60 cells, lead-acid type with plastic jars, for floating operation. Battery shall be capable of supplying the loads initially as shown on TVA drawing 85E4-45B201-2R2 to a minimum voltage of 105 volts at 60 F. The battery shall be furnished with other items in accordance with TVA specification 1980. Mark BLA Brand Name & Cat. No. Gould NCX-2250 Point of Manufacture Kankakee, Ill.	4	each	22,072	88,288.00
2	Earthquake-type battery rack, for item 1, steel frame, steel rail construction, with plastic cover over rails, 2 steps, 10 cells per step, 20 cells per rack, in accordance with TVA specification 1980. Mark BLB Brand Name & Cat. No. Gould S07-074526-666 Point of Manufacture Kankakee, Ill.	12	each	748.80	8,985.60
3	Flexible battery insulated cable assembly, with compression (crimp-type) 2-hole terminal with NEMA spacing and drilling, adapter plate, and hardware in accordance with sections F-F, F1-F1, G-G, and H-H, TVA drawing 85E4-45N218R1. Current rating of flexible cable assembly shall be no less than intercell connectors. Mark BLC Brand Name & Cat. No. Gould Point of Manufacture Kankakee, Ill.	16	each	122.00	1952.00
	Total Items 1 through 3		lump sum		99,225.60

5051 (DP-9-73)

BIDDER Gould, Inc. % Robert W. Chapman & Co.

Calculation WBN-EEB-MS-TI07-0005
Attachment C
Page 136

No. ~~Reissue~~ 3-85763

TENNESSEE VALLEY AUTHORITY

APPENDIX C

DESIGN DATA

The following design data shall be submitted with each copy of the bid:

Cell length, inches	14-9/16
Cell width, inches	14-1/2
Cell height, inches	22-1/2
Depth of sediment space, inches	1-1/16
Specific gravity full charged	1.205 to 1.225
Weight of electrolyte per cell, pounds	109
Weight of cell with electrolyte, pounds	462

Gould, Inc. % Robert W. Chapman & Co.
Bidder

Calculation WBN-EEB-MS-TI07-0005
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No. ~~Reissue~~ 3- 85763

TENNESSEE VALLEY AUTHORITY

APPENDIX D

GUARANTEED PERFORMANCE DATA

The bidder hereby guarantees that the performance and characteristics of the equipment bid upon will be as stated below. In the case of conflict between data furnished below and any other data furnished with the bid, that furnished below shall govern.

TVA considers this information so material to its decision on whether or not a bid meets the specifications that the omission of any one or more of them could make impossible such decision and cause the bid to be nonresponsive. If the omission of items of information renders a bid nonresponsive, such bid will be rejected.

		77 F	60 F
1.	Guaranteed discharge rated		
a.	1 Minute to 1.75 volts per cell, amperes	2400	2136
b.	30 Minutes to 1.75 volts per cell, amperes	1537	1389
c.	1 Hour to 1.75 volts per cell, amperes	1125	1019
d.	2 Hours to 1.75 volts per cell, amperes	765	696
e.	8 Hours to 1.75 volts per cell, amperes	281	257
*2.	Short circuit capacity at terminals of completely connected battery, amperes	17,911	
3.	Calculated "zero resistance" short circuit capacity, amperes	18,360	

Discharge rates shall be based on minimum of 1.75 volts per cell including the voltage drop in the intercell connectors that will be supplied with the batteries.

4. Bidder shall provide data showing the ~~present~~ Percent of the battery catalog rating for each year of its qualified life. A graph is acceptable.

5. Bidder shall list below or on a separate sheet, previous installations in nuclear power plants of Class IE equipment identical to or similar to that being purchased on this order. List shall include the purchaser, name of plant, location, year delivered, and catalog numbers of items furnished.

APPENDIX D (Continued)

*6. The bidder shall provide the following data for a cell with the same number of plates and jar size as those quoted under item 1.

TABLE 1

Average Initial Cell Temperature, F	Amperes, 2 Hours to 1.75 Volts Per Cell
60	696 (695.0 min)
65	715
70	735
71	740
72	745
73	750
74	754
75	759
76	763
77	765
78	768
79	772
80	777
81	782
82	787
83	792
84	797
85	802
90	810
95	826
100	841
105	849
110	856

TABLE 2

Final Volts Per Cell	2-Hour Capacity, Ampere-Hours at 77 F
1.0	1560
1.1	1560
1.2	1560
1.3	1560
1.4	1560
1.5	1560
1.6	1560
1.7	1560
1.75	1530
1.8	1380
1.85	1230
1.9	1005

*7. For fully charged battery at equalizing voltage of 2.33 volts per cell manufacturer shall furnish:

a. Amount of hydrogen generated per charging ampere per battery 0.000266 cu ft/min.

b. Charging current per battery 0.38 amperes.

c. Percent of charging current producing hydrogen 82 percent.

*8. Time to recharge battery after:

a. 30-Minute discharge at 515.8 amperes 576 minutes.

b. 2-Hour discharge at 515.8 amperes 2760 minutes.

APPENDIX D (Continued)

Battery manufacturer may assume that the battery charger has ample capacity to supply all the current the battery will accept at 2.33 volts per cell without exceeding 110 F electrolyte temperature and that electrolyte temperature is 77 F at start of charge. End of charge shall be arbitrarily assumed to be that point at which the rate of decay of charging current is 0.3 ampere per hour. A graph showing charging current plotted against time is preferred.

*9. Manufacturer's recommended percent deviation of individual cell capacity, based on the above data, that can be used as acceptance criteria for test performed in accordance with IEEE 450. ± 5% @ 2 Hr. Rate

*If exact data requested for items 2, 4b., and 6 through 9 are not available at time of bid, bidder shall provide best data available and shall state that the figures are approximate. The Contractor shall then furnish exact data prior to the first shipment of batteries.

Gould, Inc. % Robert W. Chapman & Co.
Bidder

MAMS

Calculation WBN-EEB-MS-TI07-0005
Attachment D
Page 140

TAS '85 0131 535 ORIGINAL

This block to be completed by TVA

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401

Telephone—615-751-0011 ESL 62203270
Telecopier—615-751-5742, 5744 ANSWERBACK-TVA PURCHASING

RETURN MAIL

~~INVITATION, BID, AND ACCEPTANCE~~

State or Country Code
Vendor Code
Buying Code
Commodity Code 6150
Foreign Trade Data

TVA Reference No. 85K 8-836724
Contract Date January 16, 1985
Total Amount $ 128,755.00
Performance Date On or before 6/17/85
Requisitioner Ref. No. N3E-1410

Account Number N030 39
Project WATTS BAR NUCLEAR PLANT

INVITATION

Date December 31, 1984

TITLE

125-V DC VITAL BATTERY BOARD V AND 125-V DC DISTRIBUTION PANELS

A bid in duplicate is requested on the items listed, subject to the conditions herein. Bids and modifications to bids will be received at this office until January 14, 1984

NOTICE TO BIDDER

USE ATTACHED ADDRESS LABEL FOR RETURNING BID.

TENNESSEE VALLEY AUTHORITY, By David L. Longmire
Purchasing Agent
es/

mh

ARTICLES OR SERVICES AND ATTACHMENTS SHOWN ON BACK OF FORM WHICH, IN ADDITION TO THIS FORM 5050, CONSTITUTE THE CONTRACT

BID

Date January 10, 1985
Bidder's Reference Number 1759

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers and agrees, if this bid is accepted within ----- days (30 days unless otherwise stated) from the date of the opening, to furnish the services and/or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

EXPIRATION:

Bids will expire at the close of TVA's workday on the bid expiration date as determined from the number of days quoted by the bidder or the number of days stipulated by TVA in the BID section of form TVA 5050, INVITATION, BID, AND ACCEPTANCE, or as extended by the bidder. Bids which would otherwise expire on a Saturday, Sunday, or TVA holiday shall expire at the close of TVA's last regular workday prior to such date.

DISCOUNTS:

Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price; and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination or from date of receipt of correct invoice, whichever date is later.

DISCOUNT TERMS:

N % 30 Days

Bids not offering discount terms will be considered to require net payment in 30 days. Bidders offering net payment in less than 30 days will be nonresponsive and will not be considered. Early payment discounts will not be used in evaluating bids which require payment to be made within 15 days or less to obtain the discounts.

Bidder KEMCO UNIT CONTROL, INC.
P.O. Box Number Zip Code
Street 130 Atlantic Drive
City, State and Zip Code Maitland, Florida 32751
Telephone No. 305/831-1900
TWX/TLX No.
ANSWERBACK
Person authorized to sign bid - Name and title (print or type) and signature
Robert C. Patrick/Quotations Mgr.

ACCEPTANCE – Accepted only as to: Items 1 through 6

Confirming telegraphic award to Robert C. Patrick on January 16, 1985.

F.O.B. Destination
SHIP BY: Prepaid Motor Freight

ENGR BRANCH
FEB 05 '85

	In	Out	Noted
PFVC			
RCW			
EC	12-5	12-5	
JW		DW	
G			
AFP			
MRB		MCB	
B E G R			
MJS			
GR		CS	GT
A G		HR	WR
WHD			
WAG			
GTH			
JBK			
GRO			
LTP			
RRR	PAB	(Plant)	
RBR	QA (C)		
JLS			
WEK	QA (R)		
C H	Contractor		

RSG 25

25
88

EN DES (13)
Expediting
CAB
TB

TENNESSEE VALLEY AUTHORITY, By David L. Longmire
David L. Longmire
Purchasing Agent

THIS BLOCK IS APPLICABLE ONLY AFTER CONTRACT AWARD

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Watts Bar Nuclear Plant
near Spring City, Tennessee 373

MARK: Contract 85K8-836724
For: Watts Bar Nuclear Plant
Attn: Chief Storekeeper

MAIL INVOICE in TRIPLICATE FOR EACH PAYMENT
To: TENNESSEE VALLEY AUTHORITY
Central Accounting Branch
400 Summit Hill Drive
Knoxville, Tennessee 37902

INVOICES MUST SHOW CONTRACT NUMBER, DISCOUNT OR TERMS OF PAYMENT AND F.O.B. POINT APPLICABLE TO THIS CONTRACT, ITEM NUMBER, DESCRIPTION OF ARTICLES, OR SERVICE, QUANTITY, UNIT PRICE, AND TOTAL AMOUNT. (SEE *TERMS OF PAYMENT* CLAUSE FOR MORE DETAILS.)

TVA USE ONLY
I certify that the articles or services listed above have been received in quantity and quality specified except as noted.
TVA 5050 (DP-8-84)

Date Material Received
G.B.L. No.
Carrier's Charges: Paid $ Collect $
Truck: Vendor, TVA
Common Carrier: Express (Air, UPS); Freight (Air, Brg., Mtr., Rail); Par. Post

Purchase Cost		
Cash Discount-cr		
Carrier's Charges		
Total Cost		

Person receiving material
Approved as reported above
JAN 16 1985

Contract File — JAN 23 '85
ADP Operation Services —
Accounting Office —
Consignee — JAN 2 1985

Calculation WBN-EEB-MS-TI01-0005 Attachment D Page 141

B49 85 06 0 581

CHANGE OF CONTRACT

(THIS BLOCK TO BE COMPLETED BY TVA)

VENDOR CODE	STATE OR COUNTRY CODE	TVA REFERENCE NO.	CHANGE NO
		85K8-836724	2
BUYING CODE	COMMODITY CODE	CHANGE AMOUNT $	
	6150	MINUS (-) $4,731.20	
VENDOR REFERENCE NO.		CHANGE DATE	PERFORMANCE DATE
1759		5/17/85	On or before 8/9/85
ACCOUNT NO.			
N030 39			
PROJECT			
WATTS BAR NUCLEAR PLANT			

Address all communication except invoices to
TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401

TELEPHONE—615-751-0011
TELECOPIER—615-751-5742, 5744

ESL 62203270
ANSWERBACK—TVA PURCHASING

CONTRACT NUMBER must be shown on all invoices, packages, shipping papers and correspondence.

M Swed

To:

KEMCO Unit Control, Inc.
130 Atlantic Drive
Maitland, Florida 32751

125-V DC VITAL BATTERY BOARD V AND
125-V DC DISTRIBUTION PANELS

Attn: George F. Scherpf

INFO
NAR
RSG

This confirms our telephone conversation of May 16, 1985.

We hereby revise this contract as follows:

Item	Existing Quantity	Revised Quantity
4A	1	0
4B	1	1
4C	1	0
4D	2	3
4E	1	1
4F	1	0
5	8	4

Total reduction $4,731.20

The following shall be added to the written description for item 4E:

To be supplied with calibrated shunt leads (TVA to note length information on first submittal of panel 0 parts list).

OK per our memo D

(Re: Memorandum from F. W. Chandler dated May 1, 1985.)

ELEC ENGR BRANCH
JUN 12 '85
ATTRD. DP Rtn Out Noted
FWC JRK JW G AFP MRB MCB FT B E G R S MJS WHD GTH GLO LTP FR WEK C H S W

All other terms and conditions of the original contract and previous changes of contract (if any), shall apply.

Previous Total	$128,755.00	EN DES (13)
Correct Total	$124,023.80	Expediting
		CAB
		PAB (Plant)
		QA (C)
		QA (K)
		Contractor (3)

TENNESSEE VALLEY AUTHORITY
Division of Purchasing

By David L. Longmire
(8) David L. Longmire Purchasing Agent /es

TVA 394 (DP-8-84)

Contractor
Auditor

Contract File
ADP Operation Services

Accounting Office
Consignee

Requisitioner (2)
Plant Accounting

Calculation WBN-EEB-MS-TI07-0005
Attachment D
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No. 8-836724
Page No. 1

Schedule of Prices

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	F.O.B. Watts Bar Nuclear Plant, near Spring City, Tennessee 37381, by motor freight				
	Watts Bar Nuclear Plant Class 1E Equipment				
1	125-V dc vital battery board V, two-section, cubicle-type switchboard, as shown on TVA drawings 45N217-2 and 45W703-9. Manufacturer KEMCO UNIT CONTROL, INC. Point of manufacture Maitland, Florida Item 1 listed above must conform to the following TVA specifications: TVA Specification 5886 - 125-V DC Vital Battery Board V TVA SS-E18.12.01 - Seismic Requirements for Category I Electrical and I&C Equipment TVA SS-E18.11.02 - Quality Assurance Requirements for Safety-Related Electrical Equipment	1	only	for	$26,992.00
2	125-V dc distribution panel A, as shown on TVA drawing 45W703-9, with NEMA 12 enclosure, painted ANSI 61, light gray, which will allow the operation of the circuit breakers without removing the cover (the depth of the enclosure shall not exceed 16"), with space at top and bottom of enclosure for conduit entry, complete with mounting hardware for wall mounting. The equipment to be supplied shall include the following:	1	only	for	$ 9,047.00

TVA 5051 (DP-9-82)

014279.01

BIDDER KEMCO UNIT CONTROL, INC

Calculation WBN-EEB-MS-TI07-0005
Attachment D
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Schedule of Prices

No. 8- 836724
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE	AMOUNT
				(Quote unit price and compute extension)	
2A	Molded-case circuit breaker, non-automatic, 2-pole with shorttime withstand rating = 20,000-A RMS for 3 cycles, I-T-E type KM, or equal, complete with 2 NO and 2 NC auxiliary contacts.	1			Incl. in Item 2
2B	Manually operated mechanically held, 2-pole, circuit breaker transfer switch, consisting of two 2-pole nonautomatic molded case circuit breakers, rated 250 V dc, 800-A frame, with short time withstand capability: 20,000-A RMS symmetrical for 3 cycles. Breakers shall be mechanically interlocked by walking beam to prevent simultaneous closure of both breakers providing a 2 pdt transfer switch. Break before make action shall prevent both breakers from being in the closed position at the same time but shall permit both breakers to be in the open position at the same time. Each breaker shall be equipped with a normally open and a normally closed auxiliary contact. In addition to the above, each breaker shall have an indicating light with amber lens, to operate on 125 V dc, Cutler-Hammer catalog No. E30BM, or equal. The assembly shall include 3 lugs per pole, each sized for No. 400 MCM cable on the output of each breaker, and shall have corresponding poles on the input side of both breakers connected by insulated bus bars with 3 lugs per pole each sized for No. 400 MCM incoming cable. Metal barriers to isolate each breaker and its associated wiring from the other breaker and to isolate both breakers from the common bus shall be provided. Manufacturer KEMCO UNIT CONTROL, INC. Point of manufacture Maitland, Florida	1			Incl. in Item 2

A 3051 (DP-9-82)

014279.01

BIDDER KEMCO UNIT CONTROL, INC.

Calculation WBN-EEB-MS-TI07-0005
Attachment D
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No. 8-836724
Page No. 3

Schedule of Prices

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
3	125-V dc distribution panel B, as shown on TVA drawing 45W703-9 with NEMA 12 enclosure (the depth of the enclosure shall not exceed 16"), same as item 2 except without item 2A (molded case circuit breaker). Manufacturer KEMCO UNIT CONTROL, INC. Point of manufacture Maitland, Florida	1	only	for	$7,823.00
	Items 2 and 3 listed above must conform to the following TVA specifications: All sections except subsections 7.2, 7.3, 7.6, 9.1, 9.2, and 9.4 of TVA specification 5886. TVA specification SS-E18.12.01. TVA specification SS-E18.11.02.				
4	125-V dc distribution panel 0 with NEMA 12 enclosure, complete with mounting hardware for wall mounting. Each panel to be supplied shall include the following: Manufacturer KEMCO UNIT CONTROL, INC. Point of Manufacture Maitland, Florida	4	EA	$7,608.00	$30,432.00
4A	Molded case circuit breaker, 2-pole, 400-A frame 300-A trip, rated 20,000 AIC at 250-V dc, Westinghouse type HLB, or equal, complete with terminals for TVA incoming and outgoing power cables (one 500 MCM per pole).	1			Incl. in Item #4
4B	Molded case circuit breaker, 2-pole, 800-A frame, 800-A trip, rated 20,000 AIC at 250-volt dc, I-T-E type KM, or equal, complete with terminals for TVA incoming and outgoing power cables (two 750 MCM per pole).	1			Incl. in Item #4
4C	Fuse, 400A, 600-volt dc, 200,000 AIC, Bussmann type FRS, or equal, complete with fuseblock and terminals for TVA incoming and outgoing power cables (one 500 MCM per pole).	1			Incl. in Item #4

TVA 5051 (DP-9-82)

014279.01

BIDDER KEMCO UNIT CONTROL, INC.

Calculation WBN-EEB-MS-TI07-0005
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Schedule of Prices

No. 8-836724
Page No. 4

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
4D	Fuse, 10A, 250-volt dc, 10,000 AIC, Bussman type NON, or equal, complete with fuseblock.	2			Incl. in Item #4
4E	Shunt, 800A, 100 MV, Westinghouse type SS-851, or equal, complete with terminals for TVA incoming and outgoing cables (three 400 MCM per pole).	1			Incl. in Item #4
4F	Shunt, 250A, 100 MV, Westinghouse type SS-851, or equal, complete with terminals for TVA incoming and outgoing cables (one 500 MCM per pole).	1			Incl. in Item #4
	The enclosure shall allow the operation of the breakers without removing the cover. Space for top and bottom conduit entry shall be provided. The enclosure shall be painted ANSI 61, light gray.				
	Item 4 listed above must conform to the following TVA specifications:				
	All sections except subsections 7.2, 7.3, 7.6, 9.1, 9.2, and 9.4 of TVA Specification 5886.				
	TVA specification SS-E18.12.01 TVA specification SS-E18.11.02				
5	Transfer switch, manually operated, three stage, six contacts, two position, pistol grip, stayput handle. Switch must conform to and satisfy TVA sketch JAR113084 (switch development and faceplate engraving). General Electric type SBM, model 10AA052. DO NOT SUBSTITUTE.	8	EA	$148.00	1,184.00
	Point of manufacture Maitland, Florida				
	Item 5 listed above must conform to the following TVA specifications:				
	TVA specification SS-E18.12.01 TVA specification SS-E18.11.02				
	Special Requirements for Items 1 Through 4 (except where noted)				
	1. All equipment furnished shall be designed to operate continuously over a range of 105-V dc to 140-V dc.				

TVA 5051 (DP-9-82)

014279.01

BIDDER KEMCO UNIT CONTROL, INC

Calculation WBN-EEB-MS-TI07-0005
Attachment D
Page 146

No. 8-836724
Page No. 5

Schedule of Prices

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	2. The Contractor shall submit data in accordance with Attachment 2, Contract Document Requirements List.				
	3. The number and size of the TVA incoming and outgoing power cables are to be three No. 400 MCM per pole (items 1-3 only).				
6.	Testing & Qualification	Lot			$53,277.00
	Total Bid				$128,755.00

TVA 5051 (DR-9-82)

014279.01

BIDDER KEMCO UNIT CONTROL, INC.

1 P. Barnes G. Scherff 5/15/85 Calc WBN-EEB-MS-TI07-0005
2 P. Barnes G. Scherff 6/19/85 Attachment D Page 147

125 VDC VITAL BATTERY BOARD V

BILL/MATERIAL CUSTOMER TENNESSEE VALLEY AUTHORITY JOB NO. K482N

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref. No. 85K8-836724
				125 VDC Vital Battery Board V and 125 VDC Distribution Panels
1	1	Similar to 50-103-011PZPZ	G.E.	Voltmeter, Type DB-40, Scale 0-150V Expanded in the 100-150V Range
2	1	Similar to 195437GBSN	G.E.	Ammeter, Type 195, Double Set Point, 100MV Shunt-rated, Scale 400-0-800A
3	1		G.E.	Ammeter, Type 195, Double Set Point, 15-0-15MA, Scale 150-0-150V
3A	2			Resistors, 10,000 OHMS, 5 Watts Wire wound, 2% Accuracy with Thru Bolt Mounting and Mica Washers for 300 VDC Service
	1		Cutler-Hammer	Indicating Lamp Assembly Consisting of the Following for 125 VDC Operation: 1 - E30 BM Indication Light Unit 1 - E30 KF30 Amber Lens
1 5	1		Cutler-Hammer	Reset Switch Assembly Consisting of the Following: 1 - 10250T3071 Operator with Black Lever 1 - 10250T1 Contact Block 1 - 10250TM29 Legend Plate "RESET"
6	1	Similar to AKR-2D-30	G.E.	Circuit Breaker, Type AKR-2D-30, 2 Pole, 800 A Frame with 800 A Trip Type EC-1, Curve 1A for Long Time and Curve 2C for Short Time (4X-10X). Normally Open Trip Alarm Contact. Drawout Mounting, Manually Operated.
6A	1		G.E.	Substructure for Item 6 with Secondary Contact Block for Alarm Contact
2 7	1	Similar to JL2-B300	I.T.E.	Circuit Breaker, Type JL , 400 A Frame, 300 A Trip, 2 Pole, with Lugs TAI-500 and 1 NO, 1 NC Auxiliary Switch

APPROVED
JUL 17 1985
TENNESSEE VALLEY AUTHORITY
F.W. CHANDLER

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE 5/15/85

PAGE 1 OF 4

Drawn By Patricia L. Barnes Approved By George F. Scherff 2-19-85

1 P. Barnes 6/19/85 Calc WBN-EEB-MS-TI07-0005 Attachment D Page 148.

125 VDC VITAL BATTERY BOARD V

BILL/MATERIAL CUSTOMER TENNESSEE VALLEY AUTHORITY JOB NO. K482N

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref. No. 85K8-836724
				125 VDC Vital Battery Board ~~V and 125 VDC Distribution~~
1 7A	4	RS-5771	I.T.E.	Breaker Stud, 400 A
1 7B	N/U	—	—	~~Breaker Stud Tube~~
1 8	2	Similar to KM2-S800	I.T.E.	Circuit Breaker, Type KM 800 A Frame, Nonautomatic, 2 Pole, 1 NO & 1 NC Auxiliary contact and Terminal Lugs TA3-K400 Drilled for Item 8A
1 8A	1	MI-5460	I.T.E.	Walking Beam Interlock for Item 8 on 9" centers
1 8B	8	RS-9603		Breaker Stud, 800 A
8C	2		Cutler-Hammer	Indicating Lamp Assembly consisting of the following for 125 VDC Operation: 1 - E30 CM Indicating Light Unit 2 - E30KG10 Red Lenses
	1	E7022ADGZ	Agastat	Time-Delay Relay, 120 VAC, Timing Range 2.5 to 50 Seconds
9B	2	A4BY1600	Gould-Shawmut	Main Fuse, Type A4BY, 1600 A, 250 VDC
9C	2	FRS400	Buss	Fuse, Type FRS, 400 A, 600 VDC
9D	4	A-31	Ellmor	Fuse holder for 400 A Fuse with 1/4" thick Blade, Front Connected
9E	4	KAZ	Buss	Actuator Fuse, Type KAZ, 600 V
9F	2	2837	Buss	Fuseblock, Signaling type for KAZ Actuators, 2 Pole
10	1	50-140014SNAA	G.E.	Shunt, 800 A, 100 MV, Without Base

APPROVED
This approval does not relieve the Contractor from the part of his responsibility for the correctness of design, details and dimensions.
Date JUL 17 1985
TENNESSEE VALLEY AUTHORITY
F. W. CHANDLER

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE 5/15/85

PAGE 2 OF 4

Drawn By Patricia L Barnes Approved By George F. Schupf 2/19/85

125 VITAL BATTERY BOARD V

BILL/MATERIAL CUSTOMER TENNESSEE VALLEY AUTHORITY JOB NO. K482N

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref. No. 85K8-836724
				125 VDC Vital Battery Board V and 125 VDC Distribution
				Panels
11	1	7605K12722	G.E.	Shunt Leads, 10 Feet Long
12	6	616508-4	Buchanan	Terminal Block, 12 Pole, 30A, 600V with cover
13	2	1201	Hubbell	Toggle Switch, SPST
14	2	5362	Hubbell	Polarized Receptacle
[illegible]	2			Fluorescent Lamp Fixture with Guard and 2-20 W Tubes
16	12'			Copper Bus Bar 1/4" x 3" Round Edge
17	12'	322	Power-con	Moulded Bus Insulation 1/4" x 3"
18	35'	321	Power-con	Moulded Bus Insulation 3/8" x 2"
19	35'			Copper Bus Bar 3/8" x 2" Round Edge

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE

PAGE 3 OF 4

Drawn By Patricia L. Barnes Approved By George F. [illegible] 2-19-85

BILL/MATERIAL CUSTOMER 125 VDC Vital Battery Board V TENNESSEE VALLEY AUTHORITY JOB NO. K48

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref. No. 85K8-836724 125 VDC Vital Battery Board ; and 125VDC Distribution Panels
20	2	31011	T & B	Cable Connector for #2/0 Cable
21	2	487S	ALBI	Gallon Primer
22	2	107A	ALBI	Gallon Intermediate Coat
23	2	144	ALBI	Gallon Finish Coat, Semi-Gloss White
24	2		Randolph	Gallon Flat, Light Green, Alkyd Enamel per F.S. TT-E-508, Color No. 34432 per F.S. 595
25	2	NON10	Buss	Fuse, One Time, 10A, 250V
26	1	1B0002	Buss	Fuse Block, 2 Pole, 30A, 250V

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE

PAGE 4 OF 4

Drawn By Patricia L. Barnes Approved By George F. Acherpf 2-19-85

BILL/MATERIAL CUSTOMER 125 VDC Distribution Panel A TENNESSEE VALLEY AUTHORITY JOB NO. K48

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref No 85K8-836724 125 VDC Vital Battery Board V and 125VDC Distribution Panels
2 101	1	Similar to KM2-S800	I.T.E.	Circuit Breaker, Type KM , 800A Frame, Nonautomatic, 2 Pole, 2 NO and 2 NC Auxiliary Contact and Terminal Lugs TA3-K400
1 2 102	2	Similar to KM2-S800	I.T.E.	Circuit Breaker, Type KM , 800 A Frame, Nonautomatic, 2 Pole, 1 NO and 1 NC Auxiliary contact and Terminal Lugs TA3-K400 , drilled for Item 102A
1 2 102A	1	MI-5460	I.T.E.	Walking Beam Interlock for Item 102 on 9" Centers
2 102B	12	RS-9603		Breaker Stud, 800A
103	2		Cutler Hammer	Indicating Lamp Assembly Consisting of the following for 125 VDC Operation: 1 - E30 BM Indication Light Units 1 - E30 KF30 Amber Lens
104	12			Copper Bus Bar 3/8"x 2" Round Edge
105	1	616508-4	Buchanan	Terminal Block, 12 Pole, 30A, 600V with cover
106	1			Gallon ANSI 61 Gray Lacquer
107	12	321	Power-	Moulded Bus Insulation 3/8" X 2"

APPROVED
This approval does not relieve the Contractor from any part of his responsibility for the correctness of design details and dimensions.
Date JUL 17 1985
TENNESSEE VALLEY AUTHORITY
F. W. CHANDLER

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE 5/15/85
PAGE 1 OF 1

Drawn By Patricia L Barnes Approved By George F. Scherff 2-19-85

REV	DRAWN	APPR'D	DATE
1	P. Barnes	GScherpf	5/15/85
2	P. Barnes	GScherpf	6/19/85

Calc WBN-EEB-MS-TI07-0005
Attachment D

125VDC Distribution Panel B

BILL/MATERIAL CUSTOMER TENNESSEE VALLEY AUTHORITY JOB NO. K482N

ITEM	QTY	CAT. NO.	MFR.	DESCRIPTION
				Watts Bar Nuclear Plant TVA Ref. No. 85K8-836724 125 VDC Vital Battery Board V and 125 VDC Distribution Panels
1 2 201	2	Similar to KM2-S800	I.T.E.	Circuit Breaker, Type KM , 800A Frame, Nonautomatic, 2 Pole, 1 NO & 1 NC Auxiliary contact and Terminal Lugs TA3-K400 , Drilled for Item 201A
1 2 201A	1	MI-5460	I.T.E.	Walking Beam Interlock for Item 201 on 9" Centers
2 201B	8	RS-9603	I.T.E.	Breaker Stud, 800A
202	2		Cutler Hammer	Indicating Lamp Assembly Consisting of the following for 125 VDC Operation: 1 - E30 BM Indication Light Unit 1 - E30 KE30 Amber Lens
203	12'			Copper Bus Bar 3/8" x 2" Round Edge
204	1	616508-4	Buchanan	Terminal Block, 12 Pole, 30A, 600V with cover
205	1			Gallon ANSI 61 Gray Lacquer
206	12'	321	Power-con	Moulded Bus Insulation 3/8" X 2"

APPROVED
This approval does not relieve the Supplier of his responsibility for the correctness of design, details and dimensions.
Date JUL 17 1985
TENNESSEE VALLEY AUTHORITY
F. W. CHANDLER

KEMCO Unit Control, Inc.
130 ATLANTIC DR. • MAITLAND, FL 32751 • PHONE (305) 831-1900

ISSUE DATE 5/15/85
PAGE 1 OF 1

Drawn By Patricia L. Barnes Approved By George F. Scherpf 2-19-85

Calculation WBN-EEB-MS-TI07-0005
Attachment E
Page 153

MED '84 0125 504

This block to be completed by TVA — REQUISITION No.

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401

Telephone—615 755-3011 Telex 55-8417
Telecopier—615 755-3214 ANSWERBACK-TVAPURTRFCTA

State or Country Code 05
Vendor Code
Buying Code L A 5 D V
Commodity Code 6140
Foreign Trade Data 0-00
Account Number See reverse*

TVA Reference No. 84X 8-832101
Contract Date December 21, 1983
Total Amount $ 115,432.00
Performance Date See Below**
Requisitioner Ref. No. N2E-2080 & N3E-878

Project SEQUOYAH - PA 2548 AND WATTS BAR - PA 2781

INVITATION, BID, AND ACCEPTANCE

INVITATION

Date October 4, 1983

TITLE

125-V STATION BATTERIES - CLASS 1E

A bid in duplicate is requested on the items listed, subject to the conditions herein. Bids and modifications to bids will be received at this office until 10 a.m., October 20, 1983, local time Chattanooga, Tennessee, and will be opened and read in public. Bids and modifications to bids, not physically received by Bid Clerk, Division of Purchasing, by the time stated will be returned unopened to the bidder.

NOTICE TO BIDDER

USE ATTACHED ADDRESS LABEL FOR RETURNING BID.

TENNESSEE VALLEY AUTHORITY, By David L. Longmire
s/ Purchasing Agent

mh

ARTICLES OR SERVICES AND ATTACHMENTS SHOWN ON BACK OF FORM WHICH, IN ADDITION TO THIS FORM 5050, CONSTITUTE THE CONTRACT

ACCEPTANCE - Accepted only as to: Schedule I (Item 1) and Schedule II (Item 2)

Addendum I, your letters dated October 19, December 19, and December 21, 1983, are made a part of this contract.

Confirming award to Mr. C. E. Wood on December 21, 1983. DO NOT DUPLICATE

Award contingent upon TVA approval of Quality Assurance Program at Ft. Smith, Arkansas.

*Performance Date: Sch I - Battery Racks - 2/1/84
Battery - 3/1/84
Sch II - Battery Racks - 7/1/84
Battery - 3/1/85

31 137
EN DES 22
PAB PAB (Plant)
CAB McWherter QA (1)
FB
Expediting
F.O.B.: Destination
SHIP BY: Prepaid motor freight

Approved Robert Rogers 12/21/83

TENNESSEE VALLEY AUTHORITY, By David L. Longmire
David L. Longmire Purchasing Agent

BID

Date October 19, 1983

Bidder's Reference Number 5211-08750

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers and agrees, if this bid is accepted within ___ days (30 days unless otherwise stated) from the date of the opening, to furnish the services and/or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

EXPIRATION:

Bids will expire at the close of TVA's workday on the bid expiration date as determined from the number of days quoted by the bidder or the number of days stipulated by TVA in the BID section of form TVA 5050, INVITATION, BID, AND ACCEPTANCE, or as extended by the bidder. Bids which would otherwise expire on a Saturday, Sunday, or TVA holiday shall expire at the close of TVA's last regular workday prior to such date.

DISCOUNTS:

Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price, and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination or from date of receipt of correct invoice, whichever date is later.

DISCOUNT TERMS

___ % ___ Days

Bids not offering discount terms will be considered to require net payment in 30 days. Bidders offering net payment in less than 30 days will be nonresponsive and will not be considered. Early payment discounts will not be used in evaluating bids which require payment to be made within 15 days or less to obtain the discounts.

Bidder GNB BATTERIES, INC.
Brown Boveri Electric, Inc. Agent

P.O. Box Number 90327 Zip Code 37990

Street 9041 Executive Park Drive

City, State and Zip Code Knoxville, Tenn. 37990

Telephone No. 615-690-1711 TWX/TLX No.

Answer Back

Person authorized to sign bid - Name and title (print or type) and signature
William R. Nash, District Manager
William R. Nash Dist Mgr.

THIS BLOCK IS APPLICABLE ONLY AFTER CONTRACT AWARD.

CONSIGN TO — TENNESSEE VALLEY AUTHORITY

See Schedule of Prices page

MARK: Contract 84X8-832101
For: See Schedule of Prices page

Attn:

MAIL INVOICE in TRIPLICATE to —
TENNESSEE VALLEY AUTHORITY

See Page 1A

Invoices must show contract number, discount or terms of payment applicable, item number, description of article or service, quality, unit price, and total amount.

TVA USE ONLY

Date Material Received | G.B.L. No. | Carrier's Charges: Paid $ Collect $

Truck: Vendor | TVA
Common Carrier: Express: Air | UPS; Freight: Air | Brg. | Mtr. | Rail; Par. Post

Purchase Cost
Cash Discount-cr
Carrier's Charges
Total Cost

Person receiving material
Approved as reported above

Contract File — Purchasing Agent — Accounting Office 2 — Consignee

JAN 2 '84

LINDA MORRISON

following errors to be corrected by DLL, No input required by U.S. 3) Completed Battery Design data not ... JBK 71283-1, -2 should be deleted 4) Special Requirement 1992 not ...

TENNESSEE VALLEY AUTHORITY

BATTERY GUARANTEED DATA AND PERFORMANCE CHARACTERISTICS

The bidder hereby guarantees that the performance and characteristics of the equipment bid upon will be as stated below. In the case of conflict between data furnished below and any other data furnished with the bid, that furnished below shall govern.

TVA considers part 1 of this information so material to its decision on whether or not a bid meets the specifications that the omission of part 1 could make impossible such decision and cause the bid to be nonresponsive. If the omission of information renders a bid nonresponsive, such bid will be rejected.

The following data shall be submitted with each copy of the bid for each battery listed under the schedule of prices:

	Item(s)				
1. Rating based on referenced load cycle diagram duration at specified temperature and minimum voltage requirements:	1			2	
a. Guaranteed discharge, amperes*	736			782	
b. Duration, hours	2			2	
c. Minimum battery voltage	108.5			108.5	
d. Minimum volts per cell	1.81*			1.81*	

*Average Value

*Discharge rates shall include intercell and interstep connectors that will be supplied with the batteries. Bidder shall provide detailed justification if guaranteed rating deviates from published data.

	Item(s)				
2. Short circuit capacity at terminals of completely connected battery at 77°F amperes:	19,584			20,808	

Certified short circuit test results and calculations shall be submitted for each item.

BATTERY GUARANTEED DATA AND PERFORMANCE CHARACTERISTICS (Continued)

	Item(s)				
3. Calculated "zero resistance" short circuit capacity, amperes:	1			2	
4. Type and amount of material for:					
Battery case (each)	STYRENE ACRYLONITRILE 15#				
Battery cover (each)	BUTADIENE STYRENE 1.8#				
Rack insulation (~~one~~ three racks)	POLYVINYL CHLORIDE 50# (3 RACKS)				
5. Combustibility*:					
Potential Btu release of material listed in item 4					
Battery case (each)	270,000 BTU			270,000 BTU	
Battery cover (each)	32,400 BTU			32,400 BTU	
Rack insulation (~~one~~ Three racks)	550,000 BTU			550,000 BTU	
*Test method used for determination of potential Btu release					
Battery case	ASTM D-703			ASTM D-703	
Battery cover	"			"	
Rack insulation	"			"	

GNB BATTERIES INC. (GOULD)
Bidder

TENNESSEE VALLEY AUTHORITY

BATTERY DESIGN DATA

The following design data shall be submitted with each copy of the bid for each battery listed under the schedule of prices:

	Item(s)				
1. Details and dimensions	1			2	
a. Specific gravity fully charged	1.205 to 1.225			1.205 to 1.225	
b. Weight of electrolyte per cell, pounds	103			97	
c. Weight of cell with electrolyte, pounds	479			496	
d. Cell length, inches	14-9/16			14-9/16	
e. Cell width, inches	14-1/2			14-1/2	
f. Cell height, inches	22-1/2			22-1/2	
g. Depth of sediment space, inches	1-1/16			1-1/16	

2. Bidder shall provide data showing the percent of the battery catalog rating for each year of its guaranteed life. A graph is acceptable.

GNB BATTERIES INC. (GOULD)
Bidder

CLASS 1E BATTERY AND RACK

GUARANTEED PERFORMANCE AND CELL CHARACTERISTICS DATA

The bidder hereby guarantees that the performance and characteristics of the equipment bid upon will be as stated below. In the case of conflict between data furnished below and any other data furnished with the bid, that furnished below shall govern.

Guaranteed Performance

TVA considers this information so material to its decision on whether or not a bid meets the specifications that the omission of any one or more of them could make impossible such decision and cause the bid to be nonresponsive. If the omission of items of information renders a bid nonresponsive, such bid will be rejected.

The bidder shall provide the following data for a cell with the same number of plates and jar size as those quoted under the schedule of prices.

TABLE 1

Average Initial Cell Temperature, °F	Amperes (Based on Standard Catalog Rating) at 2 Hours to 1.81 V Per Cell	
60	712	(687 min)
65	731	
70	752	
71	756	
72	760	
73	764	
74	769	
75	773	
76	778	
77	782	
78	787	
79	792	
80	797	
81	800	
82	803	
83	807	
84	810	
85	813	
90	828	
95	844	
100	860	
105	869	
110	878	

Note: ( ) denotes TVA-supplied information.

GUARANTEED PERFORMANCE AND CELL CHARACTERISTICS DATA (Continued)

Cell Characteristics

The bidder shall provide the following data for a cell with the same number of plates and jar size as those quoted under the schedule of prices.

1. Volts per cell versus cell capacity when discharging at standard 2-hour discharge rate to 1.75 V per cell and 77°F initial electrolyte temperature.

TABLE 2

Volts Per Cell	Capacity, Ampere-Hours
* _____	_____
1.0	_____
1.1	_____
1.2	_____
1.3	_____
1.4	_____
1.5	_____
1.6	_____
1.7	_____
1.75	1734
1.8	1582
1.85	1410
1.9	1140

*Bidder shall provide the final volts per cell and the ampere-hour capacity where the cell polarity reverses.

2. For fully charged battery at equalizing voltage of 2.33 V per cell, manufacturer shall furnish:

   a. Amount of hydrogen generated per charging ampere per battery 0.0147 cfm.

   b. Charging current per battery 0.69 A.

   c. Percent of charging current producing hydrogen 66 %.

3. Time to recharge battery, with initial electrolyte temperature of 77°F, after:

   a. 30-Minute discharge at (NA) A _____ minutes.

   b. 2-Hour discharge at (762) A 960 minutes.

GUARANTEED PERFORMANCE AND CELL CHARACTERISTICS DATA (Continued)

Battery manufacturer may assume that the battery charger has a capacity equal to the ampere-hours removed, as listed in part 3.b above, divided by 9. Manufacturer shall define the conditions at which time the battery is nominally fully recharged, i.e., rate of decay of current, stabilized current at a specific value, or percent of ampere-hours returned. The time to the nominally fully charged state should not include the time required to equalize cells.

4. Manufacturer's recommended percent deviation of individual cell capacity, based on the above data, that can be used as replacement criteria for test performed in accordance with IEEE 450-1975 80 percent of individual cell ampere-hour capacity.

If exact data requested for above items is not available at time of bid, bidder shall provide best data available and shall state that the figures are approximate. The Contractor shall then furnish exact data prior to the first shipment of batteries.

GNB BATTERIES INC. (GOULD)
Bidder

Calculation WBN-EEB-MS-TI07-0005
Attachment F
Page 160

7 681 mwp

No. 1 ORIGINAL

TENNESSEE VALLEY AUTHORITY
DIVISION OF PURCHASING
Chattanooga, Tennessee 37401
Telephone (615) 755-3011
TELEX 55-8417

INVITATION, BID, AND ACCEPTANCE

This block to be completed by TVA

State or Country Code	29	TVA Reference No.	75K 5-87048-1
Vendor Code		Contract Date	June 20, 1975
Buying Code	S. A.	Total Amount $	2,100.00
Commodity Code	6110	Performance Date	September 12, 1975
Account Number	N3 139		

INVITATION

Date May 1, 1975

A quotation IN DUPLICATE is requested on the items listed, subject to the conditions herein. Quotations will be received at this office until 10 a.m., May 22, 1975 local time Chattanooga, Tennessee, and will be opened and read in public. Bids not physically received by the time stated will be returned unopened to the bidder.

TENNESSEE VALLEY AUTHORITY, By Sam C. Wyatt
Purchasing Agent

ARTICLES OR SERVICES AND ATTACHMENTS WHICH FORM PART OF CONTRACT

ac

Electrical Control Equipment

Schedule of Prices (including Special Requirements for Schedules I and II and Shipping Data)
Additional Special Requirements
General Requirements
Quality Assurance Program of Manufacturers and Suppliers of Class I Materials and Equipment (Appendix A)
Special Conditions
General Conditions (form 5052)
~~Walsh-Healey Act~~
~~Equal Opportunity (forms 9923 & 9925)~~
~~Contractor Listing Requirements (form 9934)~~

AWARD WILL BE MADE BY SCHEDULES ONLY

Killian 4 Specs. 8
APS Knight
TB
PAB
Sherrod

TVA USE ONLY. DO NOT USE THIS SPACE.

Requisitioner Ref. No. N3E-162 Project Watts Bar Nuclear Plant

BID — Date 5/19/75 Bidder's Reference Number

In compliance with the invitation for bids, and subject to all the conditions thereof, the undersigned offers, and agrees if this bid be accepted within 30 days (30 days unless otherwise stated) from the date of the opening, to furnish the services and/or sell and deliver the articles listed in any or all of the items at the price quoted opposite each. Bids may not be withdrawn after bid opening without the consent of the Contracting Officer.

Discounts will be allowed for payments as follows: NET 30
Unless otherwise qualified by the bidder on this form: (1) discounts will be deducted from the gross contract price; and (2) time in connection with discounts offered will be computed from date of delivery of the supplies at destination, or from date of receipt of correct bill, whichever date is later.

The bidder represents:

That he is ✓, is not ___, a small business concern as defined in Code of Federal Regulations, Title 13, Chapter I, Part 121, Section 121.3-8. In connection with supply contracts, if bidder is a nonmanufacturer, he also represents that the products to be furnished hereunder will ___, will not ___, be produced by a small business concern. In construction and construction-related nonpersonal service contacts, the preceding sentence is not applicable.

(Complete only when the aggregate amount of bid is $10,000 or more:)
That he is ___ a manufacturer of the articles, equipment, material or supplies quoted upon herein. That he is ✓ a regular dealer in, and maintains a stock for sale to the general public of articles, equipment, materials, or supplies of the general character of that or those upon which he bids herein.

(Complete only when (a) the aggregate amount of bid in response to advertising is $25,000 or more, or (b) the aggregate amount of bid on a negotiated purchase is more than $1,000:)
That (a) he has ___, has not ✓ employed or retained any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] to solicit or secure this contract; and (b) he has ___, has not ✓, paid or agreed to pay any company or person [other than bona fide employees or bona fide established commercial or selling agencies maintained by the bidder (or contractor) for purposes of securing business] any fee, commission, percentage, or brokerage fee, contingent upon or resulting from the award of this contract, and agrees to furnish information relating thereto as requested by the Contracting Officer.

Bidder POWER INDUSTRIAL DIV. H. H. BENFIELD ELEC & CO INC.	P. O. Box Number	Zip Code
Street 25 LAFAYETTE AVE.	Telephone No. 914 948 0995	
City, State, and Zip Code WHITE PLAINS, N.Y. 10603	~~TWX~~ No. TELEX # 137487	
Person authorized to sign bid — Name and title (print or type) and signature. ROY C. KOHLI, VP Roy C. Kohli	8-883-7220	

ACCEPTANCE — Accepted only as to: Item 1 only, Schedule I. Addendum No. I is hereby made a part of this award. Confirming telephone award to Mr. Joe Mauriello, June 20, 1975. DO NOT DUPLICATE.

Drawings shall be submitted by July 14, 1975.

TENNESSEE VALLEY AUTHORITY, By Sam C. Wyatt
Purchasing Agent

CONSIGN TO — TENNESSEE VALLEY AUTHORITY
Watts Bar Nuclear Plant, near Spring City, TN (accessible from U.S. Hwy. 27)
MARK: Contract 75K5-87048-1
For: Watts Bar Nuclear Plant
Attn: Chief Storekeeper

MAIL INVOICE in DUPLICATE to — TENNESSEE VALLEY AUTHORITY
Accounts Payable Section
305 Miller's Bldg., Gay Street
Knoxville, TN 37902

JUL 14 1975

Invoices must show contract number, discount or terms of payment applicable, item number, description of article or service, quantity, unit price, and total amount.

TVA USE ONLY
I certify that the articles or services listed above have been received in quantity and quality specified except as noted.
TVA 5050 (DP-5-74)

Person receiving material
Approved as reported above

Date Material Received
G.B.L. No.
Carrier's Charges: Paid $ Collect $

Truck		Common Carrier							
Vendor	TVA	Express			Freight				Par. Post
		Air	REA	UPS	Air	Brg.	Mtr.	Rail	

Purchase Cost
Cash Discount
Carrier's Charges
Total Cost

Contract File — Purchasing A File — Accounting Office — Consignee —

DED MASTER FILE

Calculation WBN-EEB-MS-TI07-0005
Attachment F
Page 161

Schedule of Prices

No. 5-87048 1
Page No. 2

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
	F.O.B. Watts Bar Nuclear Plant near Spring City, Tennessee (Accessible from U. S. Highway 27) by motor freight.				
	BIDS STATING "PRICE IN EFFECT AT TIME OF SHIPMENT" OR OTHERWISE TAKING EXCEPTION TO THE PRICE ADJUSTMENT CLAUSE CONTAINED IN THIS INVITATION, OR STATING "STOCK SUBJECT TO PRIOR SALE" WILL BE NONRESPONSIVE, AND WILL NOT BE CONSIDERED FOR AWARD.				
	SCHEDULE I - Class 1E Equipment				
1	Magnetic contactor (relay), 2PST, 120-volt AC form 2 operating coil, with normally closed, 125-volt DC contacts rated at 100 amperes and 150 amperes interrupting. The contactor shall be furnished complete with surface-mounted NEMA I enclosure with space for three 1-1/2-inch conduits in both top and bottom. The contactor shall have provision for accepting input, output, and control cables from either top or bottom of the enclosure and shall have input/output terminations sized for No. 2/0 AWG cable, Automatic Switch Company catalog No. X4435-N-1, or equal. Mark MVP, Class I 4436-C Brand Name & Cat. No. As Above Point of Manufacture Florham Pk, N.J. 65LB ea 10-12 wks To Ship	4	each	525.00	2100.00
	shipped X4436-C S.O. #63638 Y				
2	Seismic tests for item 1. Only one contactor for item 1 requires testing and where identical components appear in an item, only one such component requires monitoring. One each of the above items shall be tested in accordance with composite Response Acceleration Spectrum for Electrical Control Equipment located in Class I Structures at Watts Bar Nuclear Plant.		lump	sum	~~5378.00~~
	Total Schedule I				~~7478.00~~
	SPECIAL REQUIREMENTS FOR SCHEDULE I				
	The Contractor shall furnish one reproducible and four prints of complete assembly drawings, outline, and wiring drawings for TVA approval in accordance with section A, items 1 through 11, of the Additional Requirements section.				

TENNESSEE VALLEY AUTHORITY
OPENED 10:00 AM
MAY 22 1975
DIVISION OF PURCHASING
CHATTANOOGA, TENNESSEE

TVA 5051 (DP-9-73)

BIDDER _____

Calculation WBN-EEB-MS-TI07-0005
Attachment F
Page 162

Schedule of Prices

No. 5-87048-1
Page No. 4

ITEM NO.	ARTICLES OR SERVICES (GIVE DESCRIPTION OR CATALOG NO.)	QUANTITY	UNIT	UNIT PRICE (Quote unit price and compute extension)	AMOUNT
4	Circuit breaker assembly (transfer switch), complete with enclosure, consisting of two 3-pole, nonautomatic molded-case circuit breakers mechanically interlocked such that contacts are break-before-make and such that when one breaker is closed, a plunger extends into the opposite breaker to prevent it from closing. The interlock shall not prevent both breakers from being in the open position at the same time. Circuit breakers shall be rated at 600 volts AC, 3 phase, 60 Hz, with ~~225~~ 400-ampere frames and at 480 volts AC have a withstand current rating of 10,000 amperes symmetrical for a duration time of 3 cycles at a 0.50 power factor and 8000 amperes symmetrical for a duration time of 3 cycles at a power factor of 0.20 and still be operational. Each breaker shall be equipped with two type A auxiliary contacts rated at 0.5 ampere, 120 volts DC. In addition to the above each breaker shall have an indicating light mounted on the front of the enclosure, wired to the breaker input poles, and complete with the following Cutler-Hammer type T components, or equal: 480-Volt indicating light - 10250T184 Red lens - 10250TC1 The assembly shall include lugs sized for No. 2/0 AWG cable on the input of each breaker and shall have corresponding poles on the output side of both breakers connected by insulated bus bars with four lugs sized for No. 6 through No. 4/0 AWG cables per bar. The enclosure shall be NEMA I, surface mounted with metal barriers, 1 gauge heavier than the enclosure, to isolate each breaker and its associated wiring from the other breaker and to isolate both breakers from the common bus. The enclosure shall allow operation of the breakers without removing the cover, provide for both top and bottom conduit entry, and shall include a safety wire seal to lock assembly in normal position. Mark MWA-1, Class I Brand Name & Cat. No. B-K Electrical Products Div. Point of Manufacture Parsippany, New Jersey	5	each	$1,100.	$5,500.

TVA 5051 (DP-9-73)

BIDDER B-K Electrical Products Div.

BULLETIN 1044

NORMALLY CLOSED A-C and D-C CONTACTORS

FOR LIGHTING AND MIXED LOADS TO 600 VOLTS A-C, 250 VOLTS D

This approval does not relieve the Contractor of any responsibility for his contract obligations.
TENNESSEE VALLEY AUTHORITY
OCT 16 1975
W. COMPTROLLER

Construction

As seen from the illustrations, these switches consist of a powerful electromagnet in which the moving armature is assembled to a rigid rocker-type structure. The armature utilizes a self-aligning mounting arrangement. The rocker-type structure is pivoted at its center. Normally closed contacts are mounted on the rocker arm.

The normally closed contacts open when the electromagnet is energized. When the electromagnet is de-energized, the normally closed contacts close under the action of gravity using a stainless steel extension spring to accelerate the motion and to maintain contact pressure.

Insulation is bakelite, and panels are ebony asbestos. All parts are attractively finished and protected.

All main contacts for direct current are equipped with current coil-type magnetic blowouts.

Ratings

The listed ratings are the full ratings for continuous duty, open or enclosed types. No de-rating is necessary for the applications listed. Liberal and deliberate designing for continuous duty and high current making ability insures dependable control with ASCO 1044 Contactors.

Connections

Bulletin 1044 Contactors are listed as standard with Form 2 Control only (refer to Page 80). Since separate control is provided on all contactors, the main line connections can be made to the top or bottom terminals. When the line connections are made to the top terminals, the poles will be dead when the control circuit is de-energized.

Operating Currents

The opening current is the current in-rush when the control circuit is energized. This is the current which the controlling device must adequately control. The holding current is the continuous current demand when the contactor is open. In normal operation, the controlling device must interrupt this current.

Bulletin 1044 Contactor Coils will operate the contacts at 85% of normal voltage or less and will withstand 10% overvoltage without damaging the coil windings.

OPERATING CURRENTS AT 115 VOLTS

Currents at Other Voltages are Approximately Proportional

CURRENT VALUES FOR	CLOSING CURRENT		HOLDING CURRENT	
	115-60 CYS.	115 D-C	115-60 CYS.	115 D-C
1-2-3 Pole, 30 Amperes	1.55	0.50	0.50	0.20
1 Pole, 60 & 100 Amperes	4.31	1.82	0.78	0.37
2-3 Pole, 60 & 100 Amperes	8.90	1.70	0.97	0.36

NOTE: The holding watts loss values are as follows:
1-2-3 pole, 30 amperes.....17 watts A-C - 23 watts D-C
1 pole, 60 and 100 amperes.....43 watts A-C - 42 watts D-C
2-3 pole, 60 and 100 amperes.....51 watts A-C - 42 watts D-C

Calculation WBN-EEB-MS-T101-0003 Attachment F

DIMENSIONS AND WEIGHTS

Amperes	Poles	Type	A-C CONTROL FORM 2								D-C CONTROL FORM 2							
			A-C Contacts				D-C Contacts				A-C Contacts				D-C Contacts			
			Width	Height	Depth	Weight	Width	Height	Depth	Weight	Width	Height	Depth	Weight	Width	Height	Depth	Weight
30	1	Open	6	9	4	17	7½	10½	4	19	6	9	4	18	7½	10½	4	19
		Enclosed	9	12	5	29	10½	13½	5	33	9	12	5	30	10½	13½	5	33
	2	Open	6	9	4	18	7½	10½	4	20	6	9	4	19	7½	10½	4	20
		Enclosed	9	12	5	30	10½	13½	5	34	9	12	5	31	10½	13½	5	24
	3	Open	7½	9	4	19	9	10½	4	21	7½	9	4	20	9	10½	4	21
		Enclosed	10½	13½	5	43	12	13½	5	39	10½	13½	5	44	12	13½	5	39
60	1	Open	6	13	7	23	6	15	7	25	6	13	7	24	6	15	7	25
		Enclosed	10	17	8	42	10	19	8	45	10	17	8	43	10	19	8	45
	2	Open	8	13	7	29	8	15	7	35	8	13	7	30	8	15	7	35
		Enclosed	12	17	8	50	12	19	8	56	12	17	8	51	12	19	8	56
	3	Open	8	13	7	39	10	15	7	46	8	13	7	40	10	15	7	46
		Enclosed	12	17	8	60	14	19	8	70	12	17	8	61	14	19	8	70
100	1	Open	6	13	7	25	6	15	7	27	6	13	7	26	6	15	7	27
		Enclosed	12	19	8	46	12	21	8	61	12	19	8	47	12	21	8	61
	2	Open	8	13	7	31	8	15	7	37	8	13	7	32	8	15	7	37
		Enclosed	14	21	8	56	14	23	8	64	14	21	8	57	14	23	8	64
	3	Open	8	13	7	41	10	15	7	48	8	13	7	43	10	15	7	48
		Enclosed	14	21	8	66	16	23	8	84	14	21	8	67	16	23	8	84

Mounting Holes: 30 ampere—4 holes, located ½" from each edge, ¼" diameter.
60 and 100 ampere—4 holes, located ⅝" from each edge, 9/16" diameter.

All weights are approximate shipping weights, and are in pounds. All dimensions are in inches.

75-8-C

Printed in U.S.A.

A-C and D-C CONTACTORS

R LIGHTING AND MIXED LOADS TO 600 VOLTS A-C, 250 VOLTS D-C

TENNESSEE VALLEY AUTHORITY
OCT 16 1975
F. W. CHANDLER

BULLETIN 1044

Page 164

ELECTRICAL SPECIFICATIONS

- AVAILABLE FOR ALL CLASSES OF LOAD TO 750 VOLTS.
- INTERRUPTING CAPACITY 150% OF RATING.
- SUITABLE FOR TUNGSTEN LAMP LOAD, FLUORESCENT AND ALL OTHER TYPES OF LIGHTING LOADS TO FULL LISTED CAPACITY, OPEN OR ENCLOSED.
- NO DERATING WHEN USED ON HIGH INRUSH LOADS SUCH AS COLD TUNGSTEN LAMPS.
- RATED IN AMPERES FOR NONINDUCTIVE LOADS.
- STANDARD LISTINGS 30 TO 100 AMPERES TO 600 VOLTS A-C AND 250 D-C, 1, 2, AND 3 POLE.

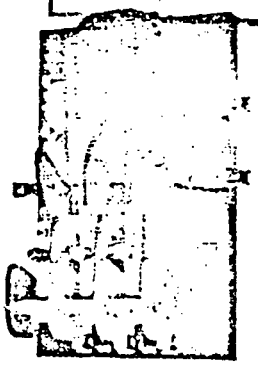


Figure 36.
3 Pole, 60 Ampere,
A-C Service,
A-C Control.
Catalog No. 4411.

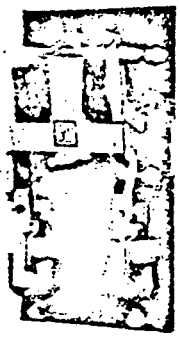


Figure 37.
2 Pole, 30 Ampere,
D-C Service,
A-C Control.
Catalog No. 4423.

Application

Bulletin 1044 Contactors are suitable for all types of noninductive loads including heater, tungsten lamp, fluorescent and other lighting loads. Like all ASCO noninductively rated contactors they can be used for inductive loads when their rating is evaluated as discussed on P. 80.

Normally closed contactors are frequently used to electrically interlock circuits of different voltages so that when the control circuit is de-energized, the contacts close the load circuits to an independent service. A common application of normally closed contactors is in street lighting. Bulletin 1038 Street Lighting Relays listed on Pages 93 and 94 are one pole normally closed relays used for this purpose. When used for emergency lighting, Bulletin 1044 Contactors will close the normally off emergency lighting circuits to an independent service upon loss of coil voltage. Thus they are fail-safe in operation: any interruption in current in the coil operating circuit will effect closing of the contacts. Bulletin 1044 Contactors are available equipped with one or more phase relays to effect operation upon loss of voltage on any phase. Refer to Section 1, Page 18, for a discussion of such relays.

Calculation WBN-EEB-MS-TI07-005
Attachment F

LIST PRICES AND AMPERE RATINGS, OPEN OR ENCLOSED — FOR 600 VOLTS A-C*, 250 VOLTS D-C
Control Circuits Furnished as Separate Control

Amperes	Poles	Type	A-C CONTROL FORM 2				D-C CONTROL FORM 2			
			A-C Contacts		D-C Contacts		A-C Contacts		D-C Contacts	
			Catalog No.	List Price	Catalog No.	List Price	Catalog No.	List Price	Catalog No.	List Price
30	1	Open	4401	$ 73.00	4421	$ 90.00	4441	$105.00	4461	$131.00
		Enclosed	4402C	96.00	4422C	113.00	4442C	128.00	4462C	154.00
	2	Open	4403	78.00	4423	116.00	4443	131.00	4463	167.00
		Enclosed	4404C	102.00	4424C	139.00	4444C	154.00	4464C	190.00
	3	Open	4405	89.00	4425	144.00	4445	158.00	4465	192.00
		Enclosed	4406C	112.00	4426C	170.00	4446C	181.00	4466C	218.00
60	1	Open	4407	93.00	4427	100.00	4447	118.00	4467	142.00
		Enclosed	4408C	121.00	4428C	129.00	4448C	145.00	4468C	171.00
	2	Open	4409	131.00	4429	154.00	4449	171.00	4469	192.00
		Enclosed	4410C	160.00	4430C	184.00	4450C	200.00	4470C	222.00
	3	Open	4411	147.00	4431	186.00	4451	203.00	4471	252.00
		Enclosed	4412C	176.00	4432C	218.00	4452C	232.00	4472C	284.00
100	1	Open	4413	102.00	4433	110.00	4453	129.00	4473	155.00
		Enclosed	4414C	132.00	4434C	144.00	4454C	160.00	4474C	189.00
	2	Open	4415	144.00	4435	170.00	4455	187.00	4475	210.00
		Enclosed	4416C	178.00	4436C	207.00	4456C	222.00	4476C	248.00
	3	Open	4417	161.00	4437	205.00	4457	223.00	4477	277.00
		Enclosed	4418C	196.00	4438C	254.00	4458C	258.00	4478C	326.00

* One pole limited to 250 volts on contacts. Use 2 pole contactors with poles connected in series for 600 volts A-C service.

STANDARD DATA

Standard Control Voltages: 110 to 120, 208 to 240, 440 or 600, 25, 50 or 60 cycles; 115 or 230 volts D-C.
Standard Panels: Ebony asbestos, front connected, flush dead back construction.
Standard Cabinets: NEMA 1, surface mounting.
Form 2 Separate Control Standard.
Solderless Lugs furnished as standard.
Enclosed ratings are continuous and the same as open type.
Evaluation of Inductive Load Rating, Page 80.

ADDITIONAL FEATURES

Special Control Voltages: To 600 volts A-C, 250 volts D-C—
30 ampere size.....Add $7.00 List
60 and 100 ampere size .....
Add $13.00 List
Back Connected Panels .....Add 10%
Special pole combinations available.
Control Stations: Standard duty with steel box for surface mounting —
Type C for Form 2.....$11.00 List
Type D for Form 3.....$11.00 List
Special Cabinets: Available to meet specifications.

Auxiliary Contacts: Maximum of two added to Form 2 Contactors . . .
Add $9.00 List Each
(Prices on request for more than two).
Form 3 Control.....Add $9.00 List

WHEN ORDERING

Specify catalog number, voltage and frequency of line and control circuits, and type of cabinet if other than NEMA 1.

Printed in U.S.A.
1959
Reissued 1962

75-87048

Calculation WBN-EEB-MS-TI07-0005

~~Appendix G~~ Attachment G
Page 165

Type AKR Breakers

70-4000 Amperes
600 Volts Ac, 50/60 Hertz

40-6000 Amperes
250 Volts Dc

DESCRIPTION

Type AKR low voltage power circuit breakers are intended for use in commercial, industrial and utility applications. Built to withstand intense service conditions, these power breakers may be used as feeders, mains, for capacitor switching, in motor circuits, for resistance welding machines and others.

FEATURES

- Five Frame Sizes: AKR-30,-50, AKRT-50, AKR-75,-100
- Solid State Trip Devices for Ac Ratings: Types ECS* and SST*
- Electromechanical Trip Devices for Dc Ratings: Types EC-1, EC-1B, EC-2A
- Overcurrent Trip Indication Targets with ECS and SST
- Easy Access to Major Components
- Multi-Contact Design
- Stored Energy Closing — Manual and Electrical
- Complete Line of Accessories
- Short-Circuit Ratings Through 200,000 Amperes
- Metal Frame Constuction Provides Rigidity and Endurance

DESCRIPTIVE MATERIAL

Order from General Electric Company, Distribution Unit, Hoerle Bldg., Plainville, CT. 06062

Bulletins

Breaker Selection and Application GEA-8733

Installation and Operation Instructions:

- AK-25, 50, AKT-50, AK-75, 100 ..... GEK-7302
- AKR-30, 50, AKRT-50 ..... GEI-86150
- AKR-75, 100 ..... GEI-86151
- AKJ-50, AKJT-50 ..... GEI-86152
- SST Conversion Kits:
  - AK-15, 25 ..... GEI-86153
  - AK-50, AKT-50 ..... GEI-86154
  - AK-75,100 ..... GEI-86155
- ECS, SST Trip Devices GEI-86156
- EC-1, 1B, 2A Trip Devices GEI-86157

Time Current Curves

Trip Device	Trip Elements ①	Trip Characteristic (EC Devices Only)	Curve
EC-1	LSI	(See Curves)	GES-6000A
EC-1B	LI	1BE-3	GES-6003
	LI	1CC-3	GES-6004
	LSI	(See Curves)	GES-6005
EC-2/2A	LI	1A-3	GES-6010
	LI	1B-3	GES-6011
	LI	1C-3	GES-6012
Power Sensor	LSI	—	GES-6021A
	G	—	GES-6031②
ECS	LSI	—	GES-6032
SST	LSI	—	GES-6033
	G	—	GES-6034, 6035

① L = Long Time I = Instantaneous
S = Short Time G = Ground Fault

② Use GES-6030 for PS-1 units manufactured prior to May, 1973.

Maintenance Manuals

AK-25 ..... GEI-50299

AK-50, AKT-50, AK-75, 100:
- Basic Manual GEK-7303
- ECS/SST Supplement (for AK-75. 100) GEI-86135

AKR-3/3A-50 ..... GEK-7310

AKR-30 thru AKRT-50, including AKJ/AKJT-50 ..... GEK-64459

AKR-75, 100 ..... GEK-64460

Testing Instructions

Power Sensor® Test Set GEK-7301
Power Sensor Hi-Current Testing GEK-7309
ECS/SST Test Set TAK-TS1 ..... GEK-64454
ECS/SST Test Set TAK-TS2 ..... GEK-73300
ECS/SST Hi-Current Testing GEK-64455

Renewal Parts

AKR-30, 50, AKRT-50 ..... GEF-4527
AKR-75, 100 ..... GEF-4552
AK 25 ..... GEF-4149
AK-50 ..... GEF-4150
AK-75 ..... GEF-4395
AK-100 ..... GEF-4396

AMPERE RATINGS AND OVERCURRENT TRIP DEVICES — QUICK SELECTOR

BREAKER TYPE	600 Volts Ac, 50/60 Hertz		250 Volts Dc	
	Frame Size (Amps)	Solid State Trip Device	Frame Size (Amps)	Electromechanical Trip Device
AKR-30	800	SST or ECS	800	EC-1 or EC-2A
AKR-50	1600		2000	
AKR-75	3000		4000	EC-1B
AKR-100	4000		6000	

Note—For a comprehensive listing of all available models and mounting types, refer to your local General Electric Sales Office or to General Electric Apparatus Handbook Section 7690.

*Trademark of General Electric Company.

Data subject to change without notice

Calc WBN-EED-MS-1201-0005
~~Appendix G~~
Page 166

Type AKR Breakers

Rating Data

100-4000 Amperes
600 Volts Ac, 50/60 Hertz

100-6000 Amperes
250 Volts Dc

Attachment G

NOTE: For complete details on breaker application such as motor applications, fused breakers, overcurrent trip details, etc., refer to Bulletin GEA-8733, Selection and Application of Low-voltage Power Circuit Breakers.

TABLE 1—50/60 Hertz Ac Current Ratings

Rated Voltage (Nominal) Ac	Breaker Type	Frame Size in Amperes	Short Circuit Ratings - RMS Symmetrical KA		
			Short Time	With Instantaneous Trip	Without Instantaneous Trip
600	AKR-30	800	30	30	30
	AKR-30H		42	42	42
	AKR-50	1600	42	42	42
	AKR-50H		65	65	65
	AKR-75	3200	65	65	65
	AKR-100	4000	85	85	85
480	AKR-30	800	30	30	30
	AKR-30H		42	42	42
	AKR-50	1600	50	50	50
	AKR-50H		65	65	65
	AKR-75	3200	65	65	65
	AKR-100	4000	85	85	85
240	AKR-30	800	30	42	30
	AKR-30H		42	50	42
	AKR-50	1600	50	65	50
	AKR-50H		65	65	65
	AKR-75	3200	65	85	65
	AKR-100	4000	85	130	85

TABLE 2—Overcurrent Trip Device Current Ratings in Amperes

BREAKER FRAME	50/60 Hertz Ac		Dc
	ECS*	SST*	EC ①
	Sensor Rating	Sensor Top Range	Device Rating
AKR-30	100, 150, 225, 300, 400, 600, 800	(100-150-225-300) or (300-400-600-800)	100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600, 800
AKR-50	300, 400, 600, 800, 1200, 1600	(300-400-600-800) or (600-800-1200-1600)	200, 225, 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600, 2000
AKR-75	1200, 1600, 2000, 3000, 3200	(1200-1600-2000-3200)	2000, 2500, 3000, 4000
AKR-100	1600, 2000, 3000, 4000	(1600-2000-3000-4000)	2000, 2500, 3000, 4000, 5000, 6000

TABLE 3—250 Volt Dc Current Ratings

With EC Trip Devices Only

Breaker Type	Frame Size Amperes	Short Circuit KA
AKR-30	800	25
AKR-50	2000	50
AKR-75	4000	75
AKR-100	6000	100

① Observe Table 4 minimum overcurrent trip ratings.
② Refer to time-current curves GES-6000 (for EC-1) and GES-6005 (for EC-1B).

TABLE 4—Minimum EC Trip Ratings

Amperes at 250 Volts Dc

Breaker Type	With Instantaneous Trip	With Short Time Trip Characteristic ②		
		2C	2B	2A
AKR-30	100	175	200	250
AKR-50	200	350	400	500

		2CC	2BB	2AA
AKR-75 AKR-100	2000	2000	2000	2000

* Trademark of General Electric Company.

Data subject to change without notice

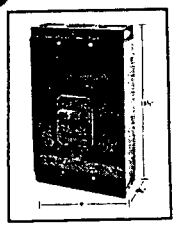
Calc WBN-EEB-MS-TI07-0005 Appendix G Page

I-T-E CIRCUIT BREAKERS GOULD

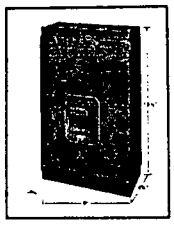
MOLDED CASE

Attachment G 167

HEAVY DUTY—ET



KM
2 or 3 pole



KP
3 pole

KM-KP
Designed to provide service entrance protection and as main distribution feeder circuit breakers in switchboards. Also used in transfer switches, motor control centers and all types of individual enclosures.

800, 1200 AMPERE

INTERCHANGEABLE TRIP

Ratings Ampere	Instantaneous Trip Range Min.	Max.	Complete Breaker, Unenclosed Cat. No.	List Price*	Trip Unit Only Cat. No.	List Price
KM FRAME—800 AMPERE						
2 POLE				600 VOLT AC/250 VOLT DC		
250 300	1050	2250	KM2-B250 KM2-B300		KM2-T250 KM2-T300	
350 400 450 500 600	1900	3500	KM2-B350 KM2-B400 KM2-B450 KM2-B500 KM2-B600	$1132.00	KM2-T350 KM2-T400 KM2-T450 KM2-T500 KM2-T600	$ 530.00
700 800	3200	5600	KM2-B700 KM2-B800	1150.00	KM2-T700 KM2-T800	530.00
‡800	—	—	KM2-S800	610.00	—	—
3 POLE					600 VOLT AC	
250 300	1050	2250	KM3-B250 KM3-B300		KM3-T250 KM3-T300	
350 400 450 500 600	1900	3500	KM3-B350 KM3-B400 KM3-B450 KM3-B500 KM3-B600	1448.00	KM3-T350 KM3-T400 KM3-T450 KM3-T500 KM3-T600	700.00
700 800	3200	5600	KM3-B700 KM3-B800	1475.00	KM3-T700 KM3-T800	700.00
‡800	—	—	KM3-S800	860.00	—	—
KP FRAME—1200 AMPERE						
3 POLE				600 VOLT AC/250 VOLT DC		
600	3200	5600	KP3-B600	1830.00	KP3-T600	710.00
700	3200	5600	KP3-B700	1830.00	KP3-T700	710.00
800	3200	5600	KP3-B800	1830.00	KP3-T800	710.00
900	4000	8000	KP3-B900	1890.00	KP3-T900	770.00
1000	4000	8000	KP3-B100	1890.00	KP3-T100	770.00
1200	4000	8000	KP3-B120	2550.00	KP3-T120	1430.00
‡1200	—	—	KP3-S120	1310.00	—	—

See pages 20–25 for features and application data.

COMPONENT DATA

BREAKER FRAME ONLY

Frame Size	2 Pole Cat. No.	List Price	3 Pole Cat. No.	List Price
KM	KM2-F800	$550.00	KM3-F800	$670.00

INSULATED GROUNDABLE NEUTRAL

Breaker Frame	Cable Range (Cu or Al)	Cat. No. Sheet Steel	Cat. No. Cast Aluminum	List Price
KM	3—#1/0 Awg-500 MCM	N-800	NC-800	$40.00
KP	4—#1/0 Awg-500 MCM	N-1200	—	76.00

PRESSURE WIRE CONNECTORS

Breaker Frame	Rating Amperes	Cable Range (Cu or Al)	Cat. No.	List Price
KM	250–600	2—#1 Awg-500 MCM	TA2-K500▪	$13.00
	700–800	3—300–350 MCM	TA3-K350▪	17.50
	700–800	3—400 MCM	TA3-K400	17.50
KP	600–1200	4—250–500 MCM	TA4-P500	43.00

INTERRUPTING RATINGS

(Based on NEMA Test Procedures)

Frame	Voltage		Amperes Asymmetrical	Amperes Symmetrical
KM, KP	AC	240	50,000	42,000
		480	35,000	30,000
		600	25,000	22,000
	DC	250	20,000	

KM ENCLOSURES§

NEMA Type	Cat. No.	List Price	Weight—Pounds
1 Indoor, Surface	KM1	$ 85.00	132
1A Semi-Dusttight	KM1A	245.00	136
3 Outdoor, Raintight	KM3	319.00	148
4, 5, 9 Watertight Combustible, Dust	KM9	1460.00	198
7 Flammable Gas	KM7	1510.00	198
12 Lint, Dust, Oils	KM12	245.00	136

KP ENCLOSURES§

NEMA Type	Cat. No.	List Price	Weight—Pounds
1	KP1	$ 85.00	132
1A	KP1A	245.00	136
3	KP3	319.00	136
12	KP12	245.00	136

UNENCLOSED BREAKER WEIGHTS

Breaker Frame	No. of Poles	Shipping Weight—Pounds Complete Breaker	Breaker Frame	Trip Unit
KM	2	27	24	3
	3	33	29	4
KP	3	46	—	—

§**TO ORDER**—Add Enclosure Suffix to complete breaker Cat. No. Example: **KM3-B800-KM1.**

*Includes pressure wire connectors, suitable for use with copper or aluminum conductors. See Component Data Table on this page. Specify connectors required.

‡Molded Case Switch.

▪Unless specified otherwise, these are the connectors supplied with these frames and ampere ratings.

For Breaker Frame Only—See Component Data Table on this page.

Insulated Groundable Neutral—Priced and shipped as separate assembly. See Component Data Table on this page.

For Optional Accessories—Refer to page 60.

For Enclosure Dimensions—Refer to Page 59.

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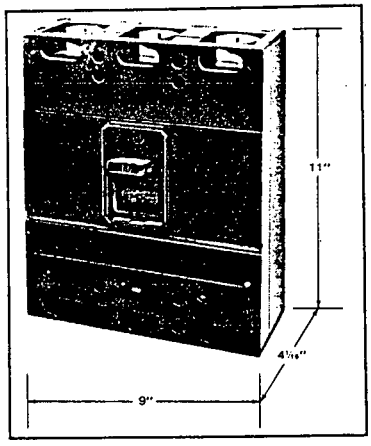
GOULD I-T-E CIRCUIT BREAKERS

Attachment G

MOLDED CASE
HEAVY DUTY—ET

JL & LL
JL(400A) and LL(600A) frame breakers are designed for use in motor control centers, bus plugs, power panelboards and switchboards, machine tool and resistance welder control panels and individual enclosures. Interchangeable trip feature allows easy changes when power requirements change.



JL and LL

400–600 AMPERE

INTERCHANGEABLE TRIP

400–600 Amperes

See pages 20–25 for features and application data.
(2 or 3 Pole)
Interchangeable Trip

Rating Amperes	Instantaneous Trip Range Min.	Instantaneous Trip Range Max.	Complete Breaker, Unenclosed Cat. No.	Complete Breaker, Unenclosed List Price*	Trip Unit Only Cat. No.	Trip Unit Only List Price
JL FRAME—400 AMPERE						
2 POLE				**600 VOLT AC/250 VOLT DC**		
70	750	1600	JL2-B070	$359.00	JL2-T070	$ 67.00
90	750	1600	JL2-B090		JL2-T090	
100	750	1600	JL2-B100		JL2-T100	
125	750	1600	JL2-B125		JL2-T125	
150	750	1600	JL2-B150		JL2-T150	
175	750	1600	JL2-B175		JL2-T175	
200	960	2000	JL2-B200		JL2-T200	
225	960	2000	JL2-B225		JL2-T225	
250	1050	2250	JL2-B250	565.00	JL2-T250	273.00
300	1050	2250	JL2-B300		JL2-T300	
350	1900	3500	JL2-B350		JL2-T350	
400	1900	3500	JL2-B400		JL2-T400	
3 POLE						**600 VOLT AC**
70	750	1600	JL3-B070	443.00	JL3-T070	84.00
90	750	1600	JL3-B090		JL3-T090	
100	750	1600	JL3-B100		JL3-T100	
125	750	1600	JL3-B125		JL3-T125	
150	750	1600	JL3-B150		JL3-T150	
175	750	1600	JL3-B175		JL3-T175	
200	960	2000	JL3-B200		JL3-T200	
225	960	2000	JL3-B225		JL3-T225	
250	1050	2250	JL3-B250	685.00	JL3-T250	326.00
300	1050	2250	JL3-B300		JL3-T300	
350	1900	3500	JL3-B350		JL3-T350	
400	1900	3500	JL3-B400		JL3-T400	

Rating Amperes	Instantaneous Trip Range Min.	Instantaneous Trip Range Max.	Complete Breaker, Unenclosed Cat. No.	Complete Breaker, Unenclosed List Price*	Trip Unit Only Cat. No.	Trip Unit Only List Price
LL FRAME—600 AMPERE						
2 POLE				**600 VOLT AC/250 VOLT DC**		
450	1900	3500	LL2-B450	$ 887.00	LL2-T450	$283.00
500	1900	3500	LL2-B500		LL2-T500	
600	1900	3500	LL2-B600		LL2-T600	
600†	—	—	LL2-S600	630.00	—	—
3 POLE						**600 VOLT AC**
450	1900	3500	LL3-B450	1124.00	LL3-T450	368.00
500	1900	3500	LL3-B500		LL3-T500	
600	1900	3500	LL3-B600		LL3-T600	
600†	—	—	LL3-S600	820.00	—	—

BREAKER FRAME ONLY

Breaker Frame	Number of Poles	Cat. No.	List Price
JL	2	JL2F400	$272.00
	3	JL3F400	329.00
LL	2	LL2F600	560.00
	3	LL3F600	690.00

SHIPPING WEIGHTS—Pounds

Breaker Frame	Number of Poles	Complete Breaker, Unenclosed	JL, LL Breaker Frame	JL, LL Trip Unit
FJ	2	7	—	—
	3	9		
JJ, JL, LL	2	18	16	2
	3	21	18	3

*Includes pressure wire connectors, suitable for use with copper or aluminum conductors. See Component Data Table on opposite page. Specify connectors required.

INTERRUPTING RATINGS
(Based on NEMA Test Procedures)

Frame	Voltage		Amperes Asymmetrical	Amperes Symmetrical
JL,★ LL	AC	240	50,000	42,000
		480	35,000	30,000
		600	25,000	22,000
	DC	250	20,000	

★70, 90 & 100 Ampere JL breakers have reduced interrupting ratings. See Selection Table on page 21 for ratings.

ENCLOSURES▪ JL FRAME

NEMA Type	Cat. No.	List Price	Weight—Pounds
1	JL1	$ 46.50	32
1A	JL1A	130.00	35
3	JL3	245.00	42
4, 5, 9	JL9	820.00	53
7	JL7	1230.00	94
12	JL12	130.00	38

ENCLOSURES▪ LL FRAME

1	LL1	$ 85.00	43
1A	LL1A	245.00	46
3	LL3	319.00	53
12	LL12	245.00	49

For Enclosure Dimensions—Refer to Page 59.

Insulated Groundable Neutral—Priced and shipped as separate assembly. See Component Data Table on opposite page.

For Prices of Enclosures Only—See page 58.

For Optional Accessories—Refer to page 60.

†Molded Case Switch.

ALPHANUMERIC LISTING OF FUSES FOR REFERENCE TO DC RATINGS (Continued)

Manufacturer Catalog Type	Rating		Source of Rating Data (Reference)
	Volts DC	KAIR	
Gould Shawmut			
TR-R (0-12)	250	20	4.11
(15-30)	200	20	4.11
(35-60)	250	20	4.11
(70-100)	200	20	4.11
(110-600)	250	20	4.11
TRS (0-12)	600	20	4.11
(15-30)	300	20	4.11
(70-600)	600	20	4.11
Bussmann			
FRN-R 15	150	10	4.14
30,60	125	--	4.16
40,100,50	125	10	4.14
125	250	10	4.14
150,200	250	10	4.14
400,600	125	--	4.16
FRS-R 15,400	150	10	4.14
FWA	150	10	4.14
FWX	300	--	4.3
JHC 100,200	300	--	4.16
400,600	300	--	4.16
JKS 10,300,350	300	10	4.14
100,200	300	--	4.16
400,600	300	--	4.16
KAZ	150	10	4.14
KLC(0-60)	500	150	4.9

Figure 1

TENNESSEE VALLEY AUTHORITY

CERTIFICATE OF CONFORMANCE
(TO BE COMPLETED BY VENDOR)

EQUIPMENT IDENTIFICATION

Catalog No.	Lot Code	Quantity
FLAS 5	019	1000

QUALITY ASSURANCE REQUIRMENTS

I hereby certify that these fuses are duplicates of those provided to TVA for seismic testing as supplied to TVA's Sequoyah Nuclear Plant under contract 87NLF-839335. The only difference is in the length of the actuator pin which will be flush with the cupped portion of the ferrule.

I also hereby certify that all items furnished comply with the requirements of this contract except as documented by any known supplier nonconformance report(s) listed below:

_____ (nonconformance report)

_____ (nonconformance report)

TVA Project Watts Bar Nuclear Plant

Date November 8, 1989 Contract No. 90NLC-75508A

Point of Manufacture Arcola, IL

Person in manufacturing company authorized to sign certificate (must be same person whose name appears on Procedure for Certificate of Conformance) Kenneth D. R. Aurland (Signature)

V.P. Reliability & Quality Assurance
(Title)

Manufacturing Company Littelfuse Tracor, Inc.

Calc WBN-EEB-MS-TI07-0005 Page 171

TVA 10526B (NP-6-89)

TVA QC CHECKLIST AND SHIPPING RELEASE
MATERIALS AND PROCUREMENT QUALITY DEPARTMENT

Attachment G

Sheet 1 of 1

Contractor: G.W. Supply Company

TVA Contract: 90NLC-75508A

Item(s): 1

Release Order/RD No.: — —

S.O.: — —

Release No.: 1-KN

Contractor	Equipment	TVA Project
Littlefuse, Inc	Fuses	Watts Bar Nuclear Plant

Inspection Documents (Drawings, Specifications, Standards, etc.) used
TVA Contract w/cc#1 Detailed Specifications
CSSP Rev. 0, dated 10/31/89

Released 2,000 100 =
Required 4000 50 % Complete
Inspection Report No. 1-KN

Items released by TVA Inspector (Complete identification - Mark No., Serial No., etc):

Item No. 1 - Fuse, Pin Indicating Type, 250 Volt AC, 150 Volt DC
5-AMP Part No. Littlefuse FLAS-5
Lot No. 019 - Qty 1000
Lot No. 009 - Qty 1000
Total quantity of 2,000 released

All boxes below must be marked by TVA Inspector. X = Inspection made. V = Verification of records. N = Not applicable on this release. C = Contingent item requiring contractor's QA representative clearance and signature prior to shipping.* (*To be verified by TVA Site Receipt Inspector).

Inspection Activities Required:

- [X] Witnessed Initial Resistance Test
- [X] Witnessed Drop Test 60"
- [X] Witnessed Current Carry @ 5.5 A
- [X] Witnessed Current Carry @ 5 A
- [X] Witnessed Final Resistance Test
- [X] Witnessed Current Interruption @ 7.5 A
- [X] Dimensional Verification 2" lgth 13/32" diameter
- [X] Markings
- [V] Certificate of Conformance
- [V] Test Reports
- [V] Time-Current Characteristic Curve
- [X] Packaging per ANSI N45.2.2 level B
- [X] Visual-Workmanship-Cleanliness

Remarks:
Per contract requirements 70 fuses tested for each lot of 1000 fuses ~~produced~~ shipped. GWG 11/8/89
Note: (1) Fuseholder, block, 2 pole, provided by WBN on Shipping Ticket No. 562-6522 will remain at Littlefuse, Inc. until after testing of remaining 2,000 fuses.

The undersigned hereby certifies that the equipment and/or material released meets all contractual requirements. All nonconformances, if any, are approved.

Contractor's QAR: James P. Stoffel Title: Mgr. Rel. Assurance Date: 11/8/89

The TVA inspector's approval for shipment of the above described equipment and/or material is subject to the provisions of the contract concerning inspection and, notwithstanding such approval, the contractor is in no way released from complying with all provisions of the contract. All nonconformances, if any, are approved.

Inspector: James W. Chanty
Phone No.: (615) 632-4498 Title: Auditor Date: 11/8/89

Distribution:
1 - Knoxville
2 - To Plant Site
3 - Regional Inspection Office file
4 - Chief Storekeeper
5 - Materials Unit Supervisor
6 - Other

TEST REPORT

PART NUMBER	PART NAME	REPORT NO.
FLA5005	5 AMP INDICATING FUSES FOR TVA	TL— 11808

REQUESTED BY:	NO. SAMPLES	AMBIENT	SPECIFICATION	DATE	TESTED BY
TVA	70	23°c	WBN 90NLC-75508A	11/6/89	ET O.F.

TYPE OF TEST: INSPECTION TESTS FOR LOT: 019 RESISTANCE LIMITS: .0221/.0270 Ω

NO.	RESISTANCE	DROP TEST	10 SEC. @ 5.5 AMPS	PIN EXTENSION	12 HRS. @ 5.0 AMPS	RESISTANCE	BLOW TIME @ 7.5 AMPS
1	.0244 Ω	60 IN.	DID NOT OPEN	< 0.1 IN.	DID NOT OPEN	.0237 Ω	1' 32"
2	.0239					.0240	2' 34"
3	.0234					.0224	2' 14"
4	.0247					.0247	1' 27"
5	.0223					.0240	1' 42"
6	.0238					.0244	1' 12"
7	.0238					.0234	1' 47"
8	.0238					.0238	1' 59"
9	.0239					.0240	2' 04"
10	.0250					.0252	1' 19"
11	.0243					.0243	1' 28"
12	.0242					.0242	1' 22"
13	.0242					.0242	1' 21"
14	.0246					.0247	1' 21"
15	.0239					.0241	1' 21"
16	.0237					.0239	1' 20"
17	.0242					.0233	1' 58"
18	.0235					.0237	2' 04"
19	.0238					.0238	2' —
20	.0241					.0241	2' 29"
21	.0235					.0234	1' 54"
22	.0243					.0244	1' 10"
23	.0254					.0255	1' 04"
24	.0242					.0238	1' 16"
25	.0231	↓	↓	↓	↓	.0233	1' 46"

EQUIPMENT USED: SEE PAGE 3.

Tests witnessed by: TVA Auditor, James W. Grantz 11/8/89 TVA JWG

APPROVALS: James P. Stoffel

SHEET NO. 1 OF 3 SHEETS

TEST REPORT

PART NUMBER	PART NAME	REPORT NO.
FLA5005	5 AMP INDICATING FUSES FOR TVA	TL- 11805

REQUESTED BY:	NO. SAMPLES	AMBIENT	SPECIFICATION	DATE	TESTED BY
TVA	70	23°C	WBN 90NLC-75508A	11/6/89	ED G.P.

TYPE OF TEST: INSPECTION TESTS FOR LOT: 019 RESISTANCE LIMITS: .0221/.0270 Ω

NO.	RESISTANCE	DROP TEST	10 SEC. @ 5.5 AMPS	PIN EXTENSION	12 HRS. @ 5.0 AMPS	RESISTANCE	BLOW TIME @ 7.5 AMPS
26	.0240Ω	60 IN.	DID NOT OPEN	< 0.1 IN.	DID NOT OPEN	.0240Ω	1' 47"
27	.0246	↓	↓	↓	↓	.0246	1' 07"
28	.0236					.0246	1' 22"
29	.0241					.0236	2' 12"
30	.0245					.0241	1' 11"
31	.0233					.0245	1' 34"
32	.0239					.0233	1' 22"
33	.0240					.0240	1' 31"
34	.0240					.0240	2' 02"
35	.0242					.0240	1' 15"
36	.0234					.0242	1' 44"
37	.0241					.0237	2' 26"
38	.0244					.0240	1' 02"
39	.0252					.0244	1' 01"
40	.0243					.0253	1' 13"
41	.0247					.0247	2' 26"
42	.0240					.0247	1' 18"
43	.0248					.0248	1' 22"
44	.0236					.0236	1' 17"
45	.0240					.0241	1' 30"
46	.0245					.0245	1' 21"
47	.0243					.0238	1' 44"
48	.0247					.0247	1' 55"
49	.0239					.0240	1' 10"
50	.0237	↓	↓	↓	↓	.0247	1' 28"

TVA

APPROVALS:

SHEET NO. 2 OF 3 SHEET

TEST REPORT

PART NUMBER	PART NAME	REPORT NO.
FLA5005	5 AMP INDICATING FUSES FOR TVA	TL— 11808

REQUESTED BY:	NO. SAMPLES	AMBIENT	SPECIFICATION	DATE	TESTED BY
TVA	70	23°c	WBN 90NLC-75508A	11/6/89	GD O.P

TYPE OF TEST: INSPECTION TESTS FOR LOT: 019 RESISTANCE LIMITS: .0221/.0270 Ω

NO.	RESISTANCE	DROP TEST	10 SEC. @ 5.5 AMPS	PIN EXTENSION	12 HRS. @ 5.0 AMPS	RESISTANCE	BLOW TIME @ 7.5 AMPS
51	.0242 Ω	60 IN.	DID NOT OPEN	< 0.1 IN.	DID NOT OPEN	.0242 Ω	1' 35"
52	.0244					.0249	1' 21"
53	.0239					.0238	1' 36"
54	.0231					.0236	1' 56"
55	.0232					.0233	1' 30"
56	.0240					.0240	2' 03"
57	.0242					.0242	1' 29"
58	.0237					.0237	1' 32"
59	.0228					.0234	2' —
60	.0231					.0237	2' —
61	.0244					.0244	1' 21"
62	.0250					.0251	1' 16"
63	.0244					.0243	2' 26"
64	.0241					.0241	1' 32"
65	.0232					.0244	1' 23"
66	.0246					.0245	1' 44"
67	.0250					.0251	1' 25"
68	.0242					.0245	1' 33"
69	.0234					.0233	2' 27"
70	.0242	↓	↓	↓	↓	.0241	1' 50"

MAX. UNBLOWN PIN EXTENSION WAS .019 IN.

EQUIPMENT USED:
RL-DM-001 DIGITAL OHMMETER
RL-DC-002 CALIPERS
RL-DP-023 0-30 VDC POWER SUPPLY
CVT-7 SOLA TRANSFORMER
RL-VR-003 VARIAC VOLTAGE TRANSFORMER
RL-IK-013 0-10 A DC POWER SUPPLY
RL-IK-014 0-10 A DC POWER SUPPLY
RL-TT-006 SOLID STATE TIMER
RL-TT-007 SOLID STATE TIMER
RL-PD-049 DIGITAL MULTIMETER
RL-AA-011 AC AMMETER
RL-UT-008 CLOCK
RL-PT-008 16 Ω, 7.90 A POT
RL-PT-032 5 Ω, 10 A POT

GWD
TVA

APPROVALS:

SHEET NO. 3 OF 3 SHEETS

Calc WBN-EEB-MS-TI07-0005 SHEET 175 OF

DC LIGHTING PANELS

Attachment G

COMPUTED WMB DATE 1/17/90

CHECKED RRP DATE 1/17/90

PANEL LD-2

MFRR - FEDERAL PACIFIC

MODEL NO - TYPE NDP, 225A, 1 ϕ, 2 WIRE

PANEL NO - BE321823

MAIN BKR - NONE

LOAD BKRS - 20A - STICK ON TYPE TAG IDENTIFYING BKR TYPE HAS BEEN REMOVED.

PANEL LD-4

MFRR - FEDERAL PACIFIC

MODEL NO - TYPE NDP, 225A, 1 ϕ, 2 WIRE

PANEL NO - BE321825

MAIN BKR - NONE

LOAD BKRS - 20A, TYPE NE, RMS RATING 18000 @ 240V

DATA LISTED ABOVE IS VISIBLE WHEN PANEL DOOR IS OPEN. ADDITIONAL DATA WILL REQUIRE REMOVAL OF THE INSIDE PANEL COVER.

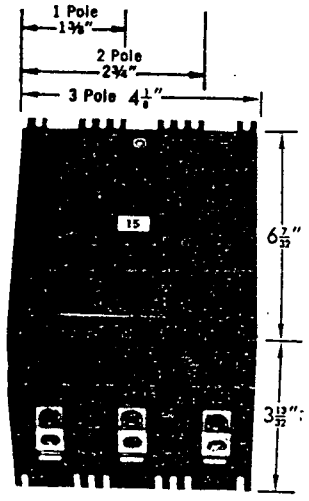
11030 (WM-7-75)

Molded Case Circuit Breakers Attachment G

THERMAL MAGNETIC

Types NE, NEF and NEG — 10 through 100 Amperes — 600 V. Max.

• Thermal Magnetic • Non-Interchangeable Trip • Quick Make, Quick Break • Common Trip • Trip Free • 40°C • U.L. Listed • Lugs included on load terminals only. Line lugs will be supplied at no cost when ordered with breakers.‡



3 Pole
Type NE/NEF/NEG

Ampt	TOGGLE HANDLE 1 POLE 120 V., A.C. 125 V., D.C. Cat. No.	List Price	2 POLE 240 V., A.C. 125/250 V., D.C. Cat. No.	List Price	3 POLE 240 Volts, A.C. Cat. No.	List Price	Wire Size
NE — 120 and 240 Volts, A.C.; 125 and 125/250 Volts, D.C. Meets Classes 11a, 12a and 12b, Federal Spec. W-C-375B.							
10*	NE113010	$22.50	NE223010	$57.00	NE233010	$83.00	#14 - #2
15	NE113015	22.50	NE223015	57.00	NE233015	83.00	#14 - #2
20	NE113020	22.50	NE223020	57.00	NE233020	83.00	#14 - #2
30	NE113030	22.50	NE223030	57.00	NE233030	83.00	#14 - #2
40	NE113040	22.50	NE223040	57.00	NE233040	83.00	#14 - #2
50	NE113050	22.50	NE223050	57.00	NE233050	83.00	#14 - #2
60	NE113060	22.50	NE223060	57.00	NE233060	83.00	#14 - #2
70	NE113070	45.50	NE223070	92.50	NE233070	121.00	#14 - 1/0
90	NE113090	45.50	NE223090	92.50	NE233090	121.00	#14 - 1/0
100	NE113100	45.50	NE223100	92.50	NE233100	121.00	#14 - 1/0
100A Molded Case Switch	NE113100NA	22.50	NE223100NA	57.00	NE233100NA	83.00	#14 - 1/0
NEF — 277 and 480 Volts, A.C.; 125 and 250 Volts, D.C. 1 Pole 277V meets Classes 12c, 13a 2 and 3 pole meet Class 13b, Federal Spec. W-C-375B.							
	277 V., A.C. 125V., D.C.		480 V., A.C., (250 V., D.C. 2 Pole)				
10*	NEF213010	$28.00	NEF423010	$103.00	NEF433010	$133.00	#14 - #2
15	NEF213015(•)	28.00	NEF423015	103.00	NEF433015	133.00	#14 - #2
20	NEF213020(•)	28.00	NEF423020	103.00	NEF433020	133.00	#14 - #2
30	NEF213030	28.00	NEF423030	103.00	NEF433030	133.00	#14 - #2
40	NEF213040	28.00	NEF423040	103.00	NEF433040	133.00	#14 - #2
50	NEF213050	28.00	NEF423050	103.00	NEF433050	133.00	#14 - #2
60	NEF213060	28.00	NEF423060	103.00	NEF433060	133.00	#14 - #2
70	NEF213070	53.50	NEF423070	133.00	NEF433070	157.00	#14 - 1/0
90	NEF213090	53.50	NEF423090	133.00	NEF433090	157.00	#14 - 1/0
100	NEF213100	53.50	NEF423100	133.00	NEF433100	157.00	#14 - 1/0
100A Molded Case Switch	NEF213100NA	28.00	NEF423100NA	103.00	NEF433100NA	133.00	#14 - 1/0
NEG — 600 Volts, A.C.; 250 Volts, D.C. Meets Class 18a Federal Spec. W-C-375B.							
			600 Volts, A.C. (250 V., D.C. 2 Pole)				
10*			NEG621010•	$121.00	NEG631010	$153.00	#14 - 1/0
15			NEG621015•	121.00	NEG631015	153.00	#14 - 1/0
20			NEG621020•	121.00	NEG631020	153.00	#14 - 1/0
30			NEG621030•	121.00	NEG631030	153.00	#14 - 1/0
40			NEG621040•	121.00	NEG631040	153.00	#14 - 1/0
50			NEG621050•	121.00	NEG631050	153.00	#14 - 1/0
60			NEG621060•	121.00	NEG631060	153.00	#14 - 1/0
70			NEG621070•	153.00	NEG631070	189.00	#14 - 1/0
90			NEG621090•	153.00	NEG631090	189.00	#14 - 1/0
100			NEG621100•	153.00	NEG631100	189.00	#14 - 1/0
Molded Case Switch			NEG621100NA•	121.00	NEG631100NA	153.00	#14 - 1/0
Shipping Weight			3 lbs.		4 lbs.		

* Not Underwriters' Laboratories, Inc. listed.
• In 3 pole case.
†25, 35, 45, 80 amperes also available on request.
(•) UL Listed: Suitable for Switching Duty.

ACCESSORIES: REFER TO PAGES 57, 58.

ENCLOSURES: REFER TO PAGES 54, 55.

For types HEF and HEG, High Interrupting Capacity Breakers, see page 50.

NE

UL—Interrupting Rating—RMS Amperes

Poles	Rated Voltage	Amperes ASY	Amperes SYM*
1	120V	15,000	14,000
2-3	240V	20,000	18,000
	120V only	30,000	25,000
1	125 DC	5,000	
2	125/250 DC		

NEF and NEG

UL – INTERRUPTING RATINGS – RMS AMPERES

Poles	Rated Voltage	Amperes ASY	Amperes SYM
1	120 only	30,000	25,000
	277	15,000	14,000
2, 3	120 only	30,000	25,000
	240	20,000	18,000
	480	15,000	14,000
	600 NEG	15,000	14,000
2	250 DC	10,000	

‡Lug Kits

Breaker	Cat. No.
NE, NEF (480V) 15-60A	E35
70-100A	E31
NEG (600V) 15-100A	G31

Memorandum

TENNESSEE VALLEY AUTHORITY

TO : W. S. Raughley, Chief, Electrical Engineering Branch, DNE, WB C126 C-K

FROM : Richard L. Morley, Chief, Central Laboratories Services Branch, LA PSC 1-C

DATE : October 27, 1987

SUBJECT: PEAK LET THROUGH CURRENT TEST

Attached is the final report containing the results of the tests that Central Laboratories Services Branch (CLSB) performed on Littelfuse type FLAS-5 and Limitron KLC-15 fuses for Sequoyah Nuclear Plant.

We hope that the report will assist you and look forward to continuing to support your future needs. Should you have any questions or additional needs, please feel free to contact CLSB.

RLM

RLM:OCS
Attachment
cc (Attachment):
WIMS, MR 4N 72A-C
Ken Greene, WB C144 C-K
02020

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INTRODUCTION

On August 18, 1987, Tim Arnett of the Division of Nuclear Engineering (DNE), requested that the Central Laboratories Services Branch (CLSB) perform a test on two types of fuses. The two types of fuses tested were Lot No. 010 Littelfuse FLAS-5, 5 amp fuses, and Limitron KLC-15, 15 amp fuses. This test was to provide DNE with data to assist them in a fuse/breaker coordination task for Sequoyah Nuclear Plant. A formal report was requested at that time and this document summarizes the data collected in Table I. Additionally, on October 1, 1987, in a telephone conversation between Tim Arnett and Glen Jones of CLSB, Tim requested the CLSB review IEEE article "The Magic of I^2t" on breaker tripping to provide DNE with our determination of fuse/breaker coordination.

TEST REQUIREMENTS

The test requirements for both types of fuses were similar. Tests were to be conducted on a minimum of 5 fuses of each type and to expose each fuse to a fault current with a rise time not to be less than 10 milliseconds. Peak let through current, interrupting time, rise time, and available current data was to be recorded.

The Littelfuse FLAS-5 Fuse test specifications were as follows:

Voltage: 120V dc
Fault Current Available: 3400 Amps
Fault Current Rise Time: 10 Milliseconds
Initial Rate of Rise : 340 amps/ms (based on above data)

The Limitron KLC 15 test specifications were as follows:

Voltage: 140V dc
Fault Current Available: 2000 Amps
Fault Current Rise Time: 10 Milliseconds
Initial Rate of Rise : 200 amps/ms (based on above data)

TEST EQUIPMENT

Digital Voltmeter, Fluke Model 8400A, US TVA 305628

Oscilloscope, Tektronix Model 2230, US TVA 548572

Precision Shunt, .00999Ω, US TVA 903318

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TEST SETUP

The test setup for creating the required conditions is detailed in Figure I. A dc voltage power supply was used to raise the voltage on a 54000 microfarad capacitor bank to the required voltage through a double pole double throw switch. A 200-watt resistor was placed across the output of the power supply to help protect it during the discharging of the capacitor bank after a fuse had been blown. The short circuit, or fault current loop, consisted of a series connection of the capacitor bank, a precision shunt, the fuse under test, a switch (actually another set of contacts on S1), and an appropriately sized inductor. A dual-trace, digital, storage oscilloscope was used to measure the voltage on the capacitor bank and the voltage drop across the precision shunt for determining fault current. The oscilloscope was also used to measure the elapsed time from the closing of the switch, S1B, to the fuse blowing. The DVM was used to verify the oscilloscope's voltage measurement on the capacitor bank prior to blowing the fuses. All fuses and photographs were labeled with the letter B and a sequential number for unique identification. Matching photographs and fuses bear the same I.D.

A detailed description of the step-by-step process of this test is contained in the measurement process section of this report.

MEASUREMENT PROCESS

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In order to better understand the data collected during this test, a step-by-step explanation of the testing process is provided below. This process was the same for both types of fuses tested. Refer to Figure I for the test setup.

The first step in this process was to turn on the oscilloscope and the DVM and allow both instruments to warmup. At this time Switch 1, or S1, was set such that contacts A were closed forcing contact B open. After equipment warmup, the dc power supply was turned on and the output voltage was elevated to 140V dc.

This charged the capacitor bank and the voltage was checked with the DVM. The oscilloscope trigger settings were checked at this time. Switch 1 was then operated, causing contacts A to open and leaving contact B open. This removed the power supply and overload protection resistor from the fault loop. Another check of the oscilloscope was made to ensure the trigger was set. Any other incorrect settings or falsely triggered readings were corrected at this time.

Switch 1 was then operated causing contact B to close and contacts A to remain open. This created a short circuit path for current to flow through the inductor, fuse, and shunt series loop causing the fuse to blow and the oscilloscope to trigger. The event was captured and stored by the oscilloscope. Switch 1 was then operated opening contact B and closing contact A, thus reconnecting the still charged capacitor bank with the dc power supply and the overload protection resistor. The power supply/resistor combination was then used to drain the remaining charge off the capacitor bank. Power was then removed from the test loop. A photograph of the oscilloscope traces was taken for each fuse tested. The picture included the voltage drop across the precision shunt and the voltage decrease on the capacitor bank. It also shows the duration of the event in milliseconds.

All of the data collected is tabulated in Table I. The only differences to note in the testing was in the oscilloscope settings. This was due to the amount of fault current measured and event duration. Slightly different settings were required to provide better resolution.

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CONCLUSION

Tim Arnett, DNR, witnessed all testing performed on these fuses and was given a copy of all photographs taken. All data collected during this test was compiled and placed in Table I. Determining the peak let through current was done using an oscilloscope to measure the voltage drop across the precision shunt. The oscilloscope was also used to time the duration of the entire event.

The peak let through current was measured to be less than the breaker's instantaneous trip current of 350 amps. This current limit was provided to the CLSB by Tim Arnett. Therefore, there should not be a problem in the FLAS-5 fuses and their associated breakers coordinating. For this test, the rise time was less than 10 milliseconds. However, a longer time constant always results in lower let through current. Therefore, the shorter time constant results in a more severe test.

The testing of the KLC-15 fuses was no more difficult than the FLAS-5 fuses, but a more involved analysis was required.

Though the peak let through current of the KLC-15 fuses is higher than the 450 amp instantaneous trip current of the upstream breaker, no coordination problem should exist. This conclusion is reached mainly because the fuses are faster. According to the breaker manufacturer, the instantaneous element responds to the product of the current squared times the time, or I^2t. Based on their test procedure, the absolute minimum current required for pickup is 450 amps RMS for 8 milliseconds (one-half cycle of the 60 Hz test current for the breaker). These quantities represent an I^2t of $(450)^2(.008)$ or 1620 amp^{2}seconds.

At those speeds, the fuses also respond t. I^2t. Since an exponential rise is being used, the I^2t of each fuse blown can be computed from the oscilloscope data and the circuit parameters. A simplified method was used; however, which required only information that can be obtained from the oscilloscope data, and was easier to document. The initial rate of rise, that was measured from the oscillogram, was assumed to continue until the fuse blew, giving a higher current triangular wave form which envelopes the exponential wave (see Figure II). The arc-tail after the fuse blows was also considered and the following formula was used:

$$I^2t = \frac{(RB)^2(B+T)}{3}$$

where R is the initial rate of rise, B is the time to blow, and T is the time of the arc-tail. For example, the worst case KLC-15 fuse had an initial rise of 177,000 amps/sec, a blowing time of .0045 second, and a tail of .0010 second; thus $I^2 = [(177,000)(.0045)]^2(.0045 + .0010)/3 = 1163$ amp^2 seconds. The projected peak current of the worst case was 797 amps and is well above, and thus on the conservative side of the 630 amps actually measured, yet the 1163 amp^2 seconds is only 72% of the minimum 1620 amp^2 seconds.

FUSE TYPE	FUSE IDENTIFICATION NO.	PEAK LET THROUGH CURRENT	CAPACITOR BANK VOLTAGE INITIAL	CAPACITOR BANK VOLTAGE FINAL	EVENT DURATION
FLAS-5	B1	256 Amp	120V dc	117.6V dc	.752 ms
FLAS-5	B2	264 Amp	120V dc	116.0V dc	.750 ms
FLAS-5	B3	272 Amp	145V dc	143.0V dc	.630 ms
FLAS-5	B4	280 Amp	145V dc	143.0V dc	.640 ms
FLAS-5	B5	280 Amp	145V dc	143.0V dc	.602 ms
FLAS-5	B6	296 Amp	145V dc	139.0V dc	.708 ms
FLAS-5	B7	288 Amp	145V dc	143.0V dc	.604 ms
KLC-15	B8	600 Amp	160V dc	136.0V dc	4.33 ms
KLC-15	B9	600 Amp	160V dc	134.0V dc	4.37 ms
KLC-15	B10	600 Amp	160V dc	132.0V dc	4.50 ms
KLC-15	B11	576 Amp*	160V dc	134.0V dc	4.16 ms
KLC-15	B12	600 Amp	160V dc	134.0V dc	4.53 ms
KLC-15	B13	624 Amp	160V dc	134.0V dc	4.56 ms
KLC-15	B14	856 Amp	140V dc	118.0V dc	2.06 ms

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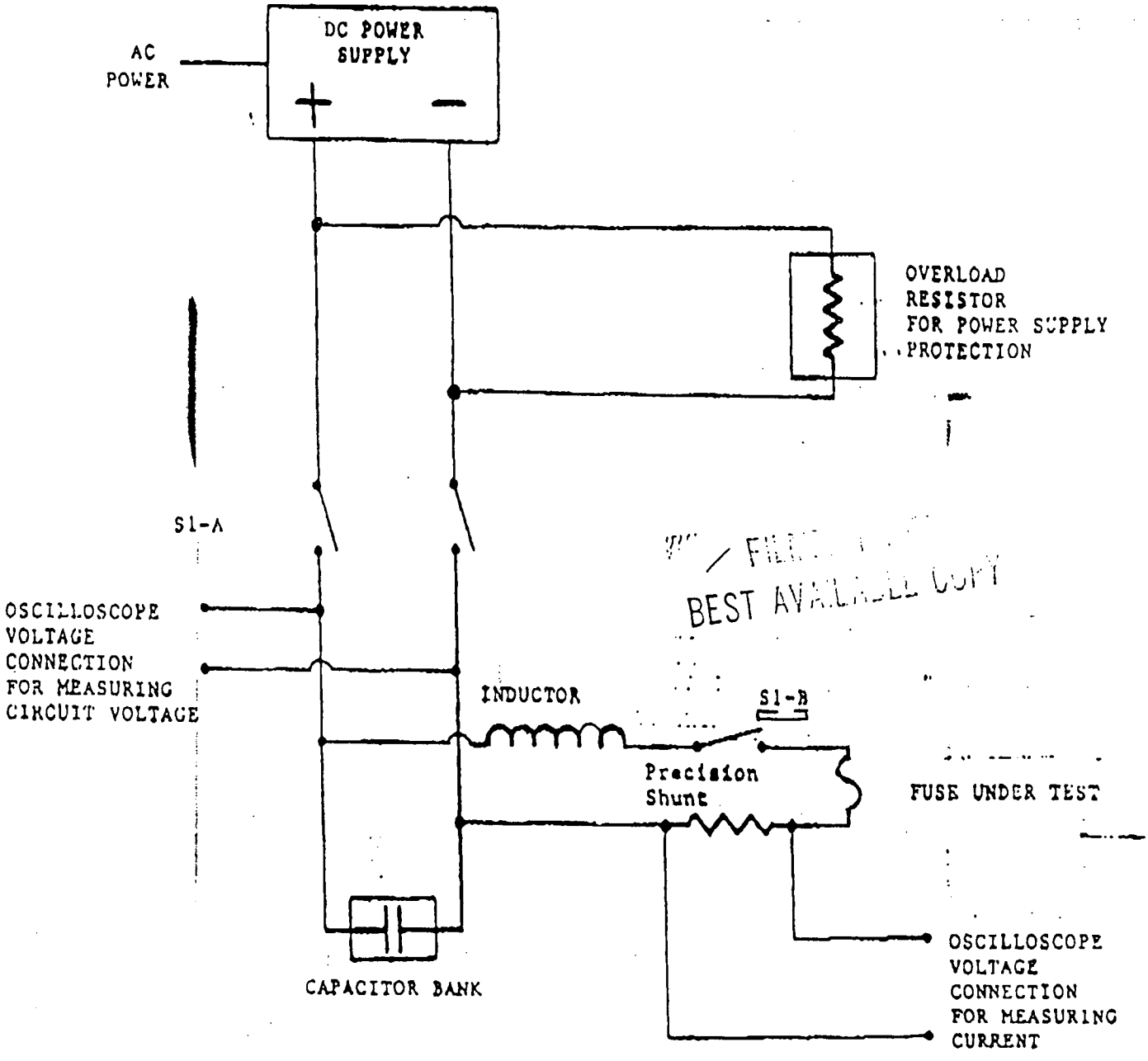
*Error in scope setting caused low current reading.

TABLE I



FILE COPY
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BLOCK DIAGRAM OF TEST SET-UP

FIGURE I

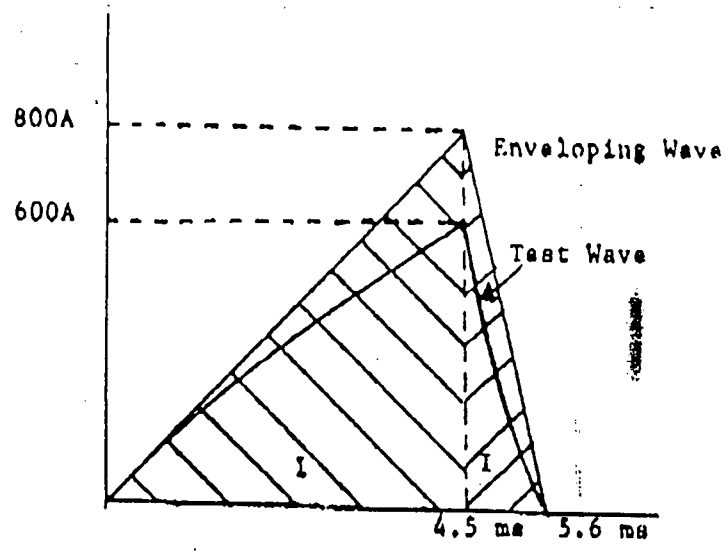

FIGURE II

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WBN-EEB-MS-TI07-0005
ATTACHMENT G

One fuse was blown in a circuit with a 7 millisecond time constant. The I^2t computed was 1112 $amps^2$ seconds. Six fuses were blown using a 19 millisecond time constant. The maximum I^2t was 1163 amp^2 seconds and the average was 1045 amp^2 seconds, all well below the minimum 1620 amp^2 seconds specified for the breaker.

An IEEE paper, "The Magic of I^2t," by R. H. Kaufmann (IGA-2 No. 5, Sept/Oct 1966) gives more detail on these concepts.

The CLSB will hold all the sample fuses and photographs for 90 days at which time the CLSB will contact DNE about final disposition of these items.

If you have any questions regarding this report, please telephone Glen Jones, extension 4219 at the CLSB. We would be glad to assist you in any way we can.

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WGJ:OCS
01710

ATTACHMENT H

BREAKER/FUSE TIME-CURRENT CURVES

Calculation WBN-EEB-MS-TI07-0005
ATTACHMENT H

RECEIVED
SEP 26 1990

Underwriters Laboratories Inc.

MCI Mail No. 254-3343
Cable ULINC NORTHBROOK
Telex No. 6502543343

p. 185 A

NOTICE OF AUTHORIZATION TO APPLY THE UL MARK

September 25, 1990

Bussmann
Cooper Industries
Attn: Mr. Walter Curtis
P.O. BOX 14460
St. Louis, MISSOURI 63178

Our Reference: File E4273, Project 90NK20729

Subject: 125V 20K FRN-R 0-600, LPN-RK 0-600
300V 20K FRS-R 0-600, LPS-RK 0-10 AND 31-600
DC RATING

Dear Mr. Curtis,

We have completed our engineering investigation under the above project number and find the product complies with the applicable requirements. Records covering the product are now being prepared and will be sent to you in the near future.

This letter temporarily supplements the Follow-Up Service Inspection Procedure for a period of 90 days from the date of this notice and will serve as authorization to apply the UL Listing mark to products constructed:

> Identical to CAT. NOS. ABOVE submitted to UL for this investigation. The UL records covering this product will be in the Follow-Up Services Inspection Procedure, File E4273, Vol. 2,3.

Products produced which bear the UL Mark shall be identical to those which were evaluated by UL and found to comply with UL's requirements. If changes in construction are discovered, authorization to use the UL Mark may be withdrawn and products that bear the UL Mark may have to be revised (in the field or at the manufacturer's facility) to bring them into compliance with UL's requirements.

Regards,

T. Skibbs (3534)
Engineering Assistant
Electrical Department

Reviewed by:

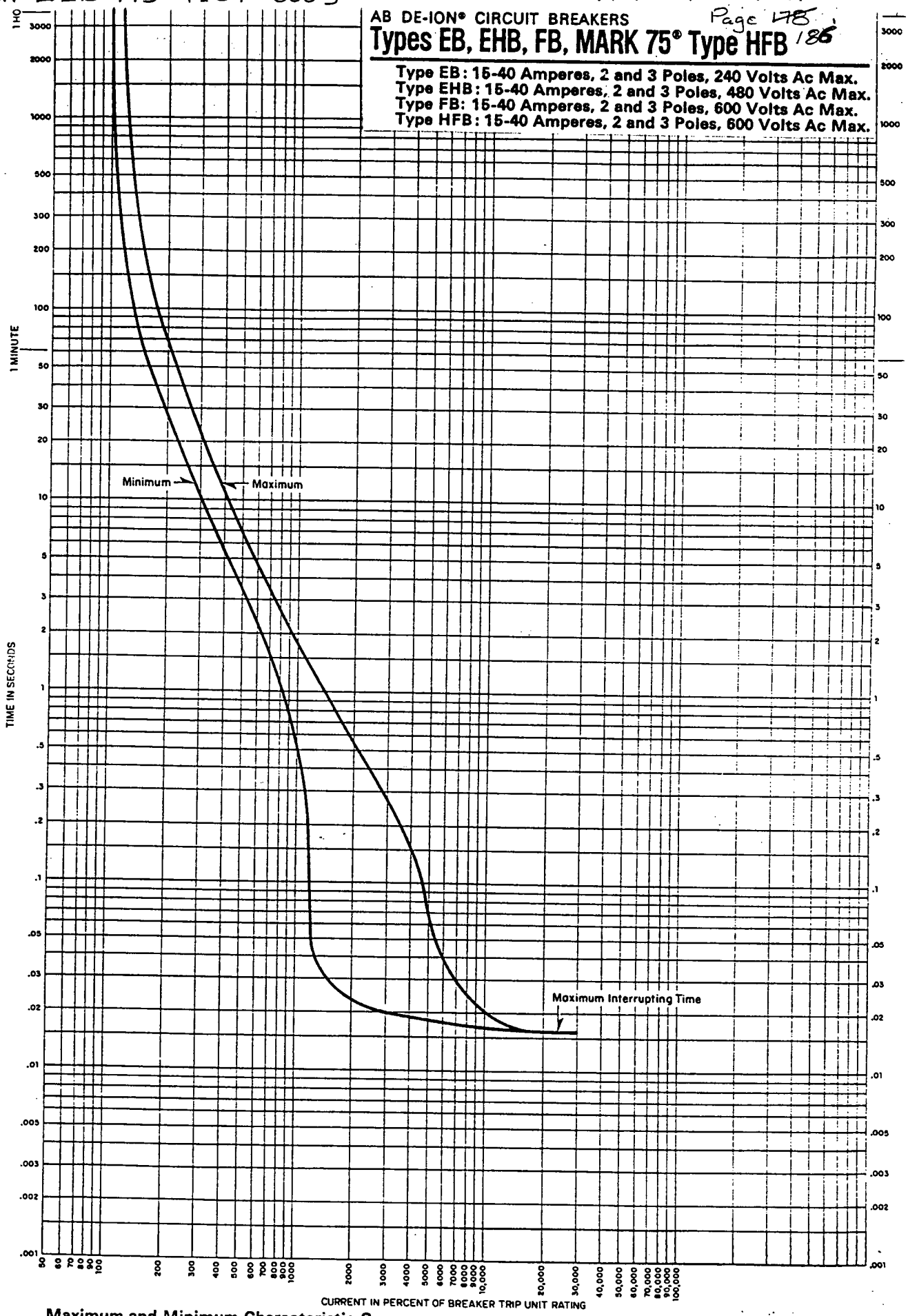
Dale A. Hallerberg (3224)
Senior Project Engineer
Electrical Department

An independent,
not-for-profit organization
testing for public safety

AB DE-ION® CIRCUIT BREAKERS

Types EB, EHB, FB, MARK 75® Type HFB

Type EB: 15-40 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Type EHB: 15-40 Amperes, 2 and 3 Poles, 480 Volts Ac Max.
Type FB: 15-40 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
Type HFB: 15-40 Amperes, 2 and 3 Poles, 600 Volts Ac Max.



Maximum and Minimum Characteristic Curves
40°C Ambient, Cold Start • Thermal Magnetic

Interrupting Capacity (Symmetrical Amperes)

Breaker	240 Volts	480 Volts	600 Volts
Type EB	10,000	.....	.....
Type EHB	18,000	14,000	.....
Type FB	18,000	14,000	14,000
Type HFB	65,000	25,000	18,000

Curve No. SC-340-70
January, 1971

Westinghouse Electric Corporation
Low Voltage Breaker Division, Beaver, Pa.

WBN-EEB-MS-TI07-0005

ATTACHMENT H

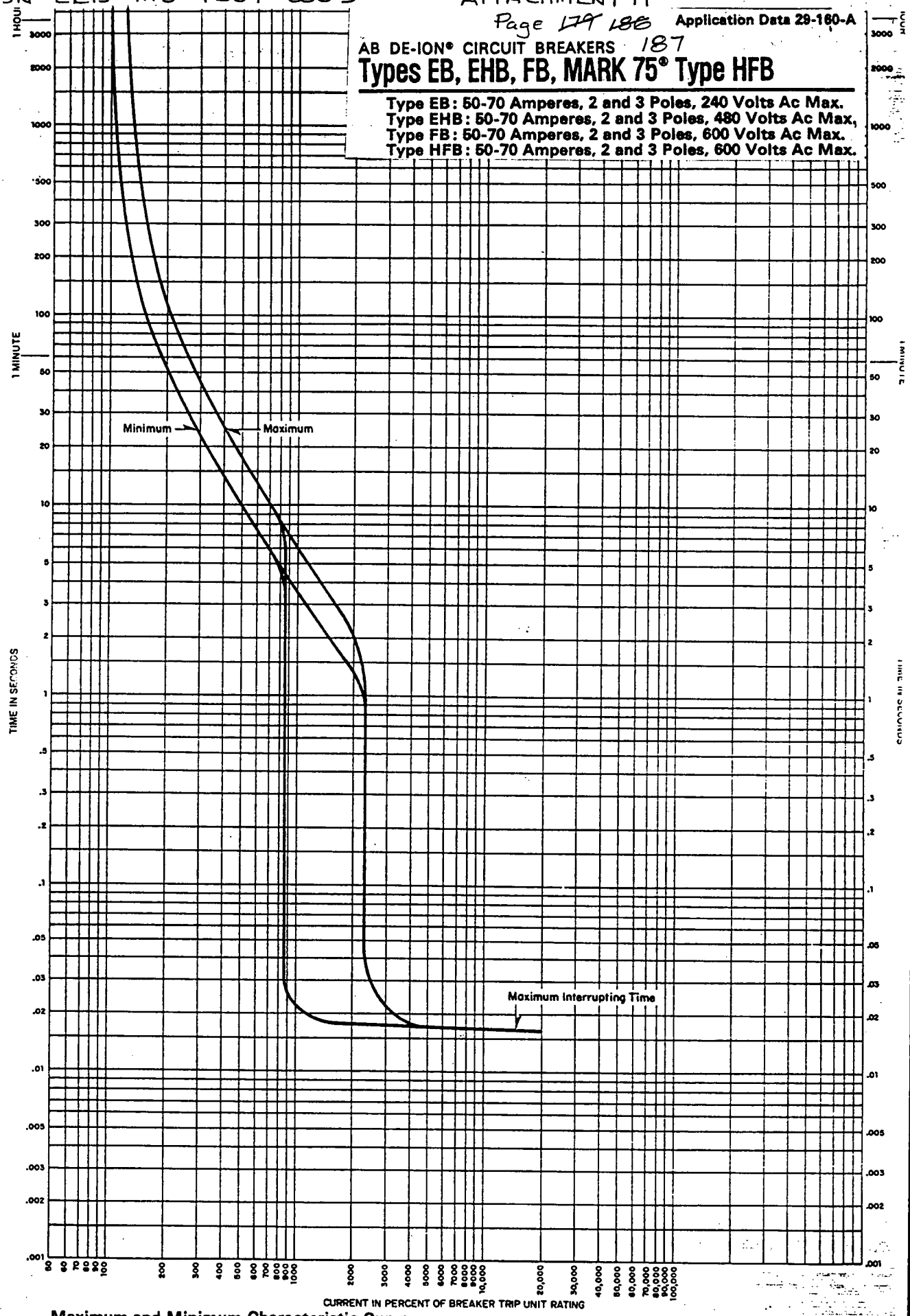
Page 179 186 187

Application Data 29-160-A

AB DE-ION® CIRCUIT BREAKERS

Types EB, EHB, FB, MARK 75® Type HFB

Type EB: 50-70 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Type EHB: 50-70 Amperes, 2 and 3 Poles, 480 Volts Ac Max.
Type FB: 50-70 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
Type HFB: 50-70 Amperes, 2 and 3 Poles, 600 Volts Ac Max.



Maximum and Minimum Characteristic Curves
40°C Ambient, Cold Start • Thermal Magnetic

Interrupting Capacity (Symmetrical Amperes)

Breaker	240 Volts	480 Volts	600 Volts
Type EB	10,000	.....	.....
Type EHB	18,000	14,000	.....
Type FB	18,000	14,000	14,000
Type HFB	65,000	25,000	18,000

Curve No. SC-341-70
January, 1971

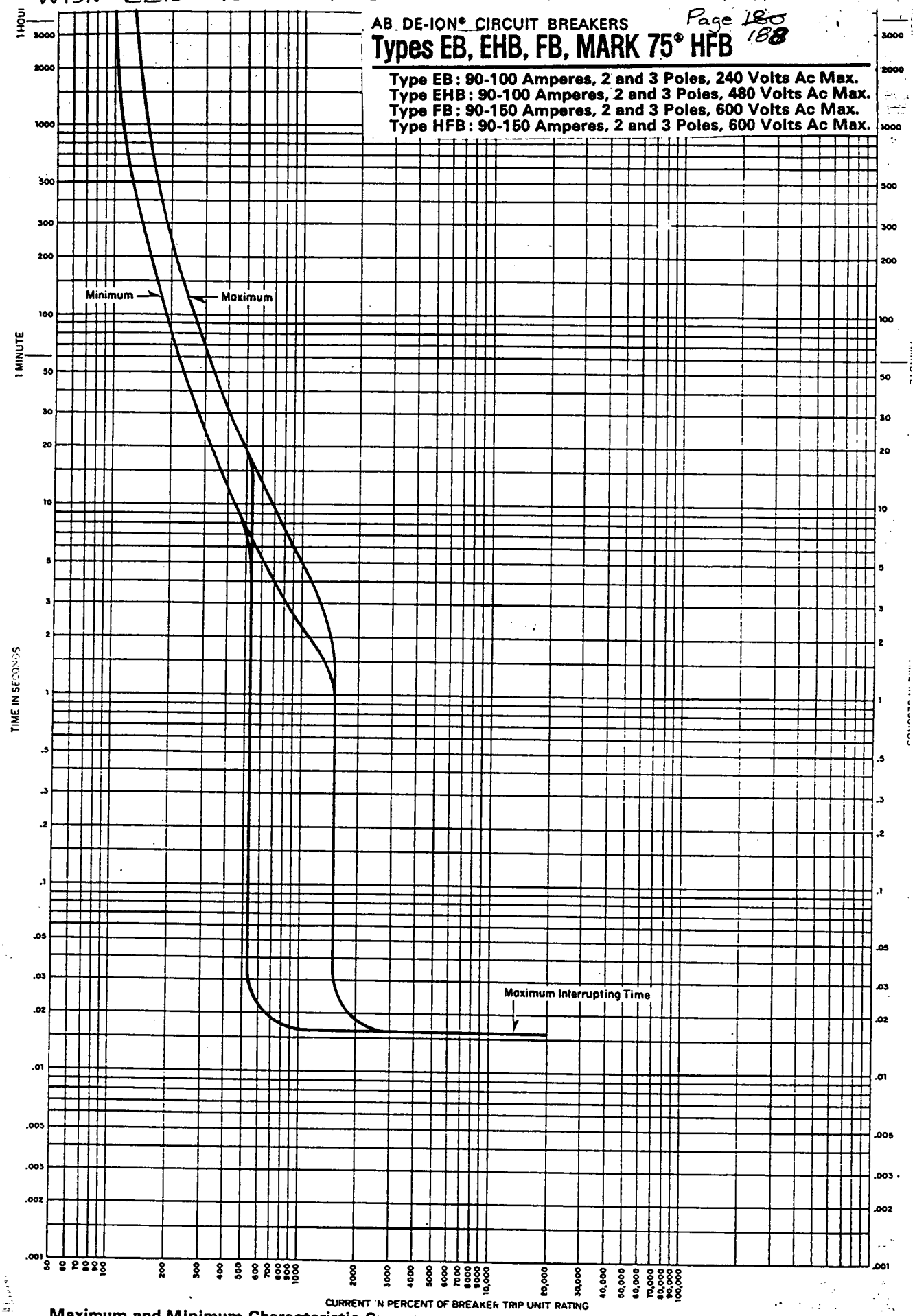
Westinghouse Electric Corporation
Low Voltage Breaker Division, Beaver, Pa.

WBN-EEB-MS-TI07-0005 ATTACHMENT H

AB DE-ION® CIRCUIT BREAKERS

Types EB, EHB, FB, MARK 75® HFB

Type EB: 90-100 Amperes, 2 and 3 Poles, 240 Volts Ac Max.
Type EHB: 90-100 Amperes, 2 and 3 Poles, 480 Volts Ac Max.
Type FB: 90-150 Amperes, 2 and 3 Poles, 600 Volts Ac Max.
Type HFB: 90-150 Amperes, 2 and 3 Poles, 600 Volts Ac Max.



Maximum and Minimum Characteristic Curves
40°C Ambient, Cold Start • Thermal Magnetic

Interrupting Capacity (Symmetrical Amperes)

Breaker	240 Volts	480 Volts	600 Volts
Type EB	10,000	.....	.....
Type EHB	18,000	14,000	.....
Type FB	18,000	14,000	14,000
Type HFB	65,000	25,000	18,000

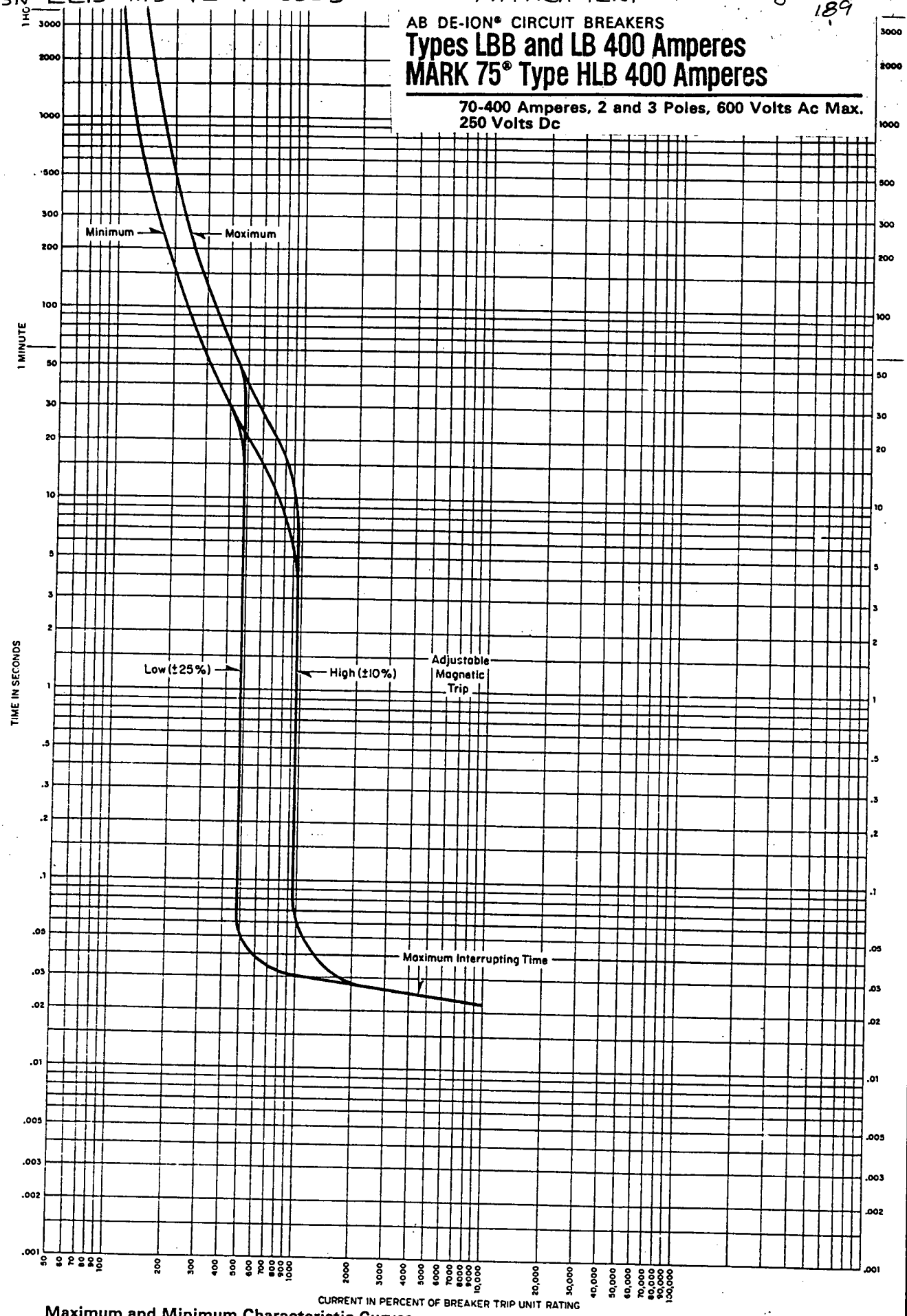
Curve No. SC-342-70
January, 1971

Westinghouse Electric Corporation
Low Voltage Breaker Division, Beaver, Pa.

AB DE-ION® CIRCUIT BREAKERS

Types LBB and LB 400 Amperes
MARK 75® Type HLB 400 Amperes

70-400 Amperes, 2 and 3 Poles, 600 Volts Ac Max. 250 Volts Dc



Maximum and Minimum Characteristic Curves

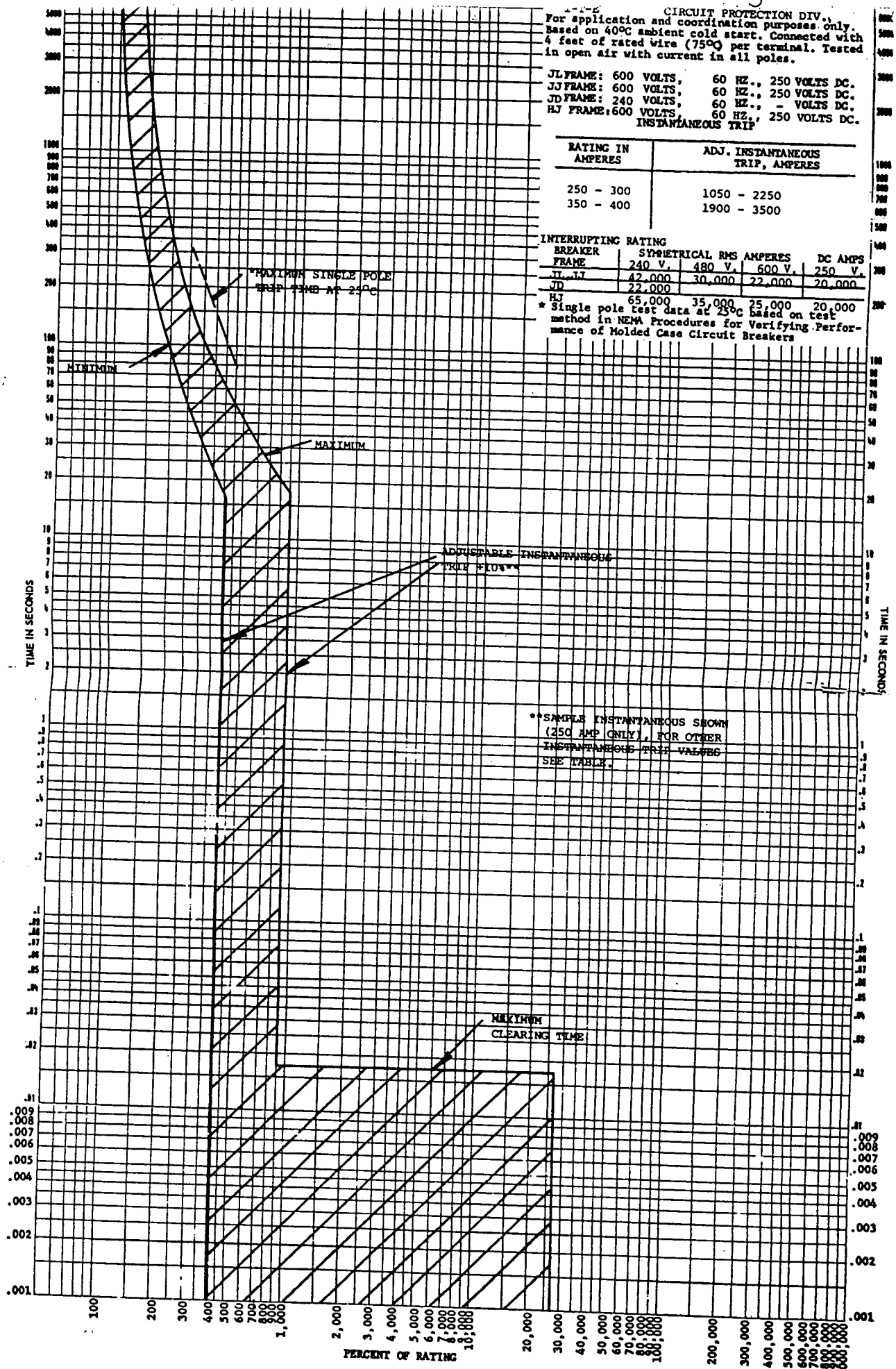
40°C Ambient, Cold Start • Thermal Magnetic

Interrupting Capacity (Symmetrical Amperes)

Breaker	240 Volts	480 Volts	600 Volts
LBB, LB	42,000	30,000	22,000
HLB	65,000	35,000	25,000

Curve No. SC-3208-72
June, 1972

Westinghouse Electric Corporation
Low Voltage Breaker Division, Beaver, Pa.



CIRCUIT PROTECTION DIV.

For application and coordination purposes only. Based on 40°C ambient cold start. Connected with 4 feet of rated wire (75°C) per terminal. Tested in open air with current in all poles.

JL FRAME: 600 VOLTS, 60 HZ., 250 VOLTS DC.
JJ FRAME: 600 VOLTS, 60 HZ., 250 VOLTS DC.
JD FRAME: 240 VOLTS, 60 HZ., - VOLTS DC.
HJ FRAME: 600 VOLTS, 60 HZ., 250 VOLTS DC.

INSTANTANEOUS TRIP

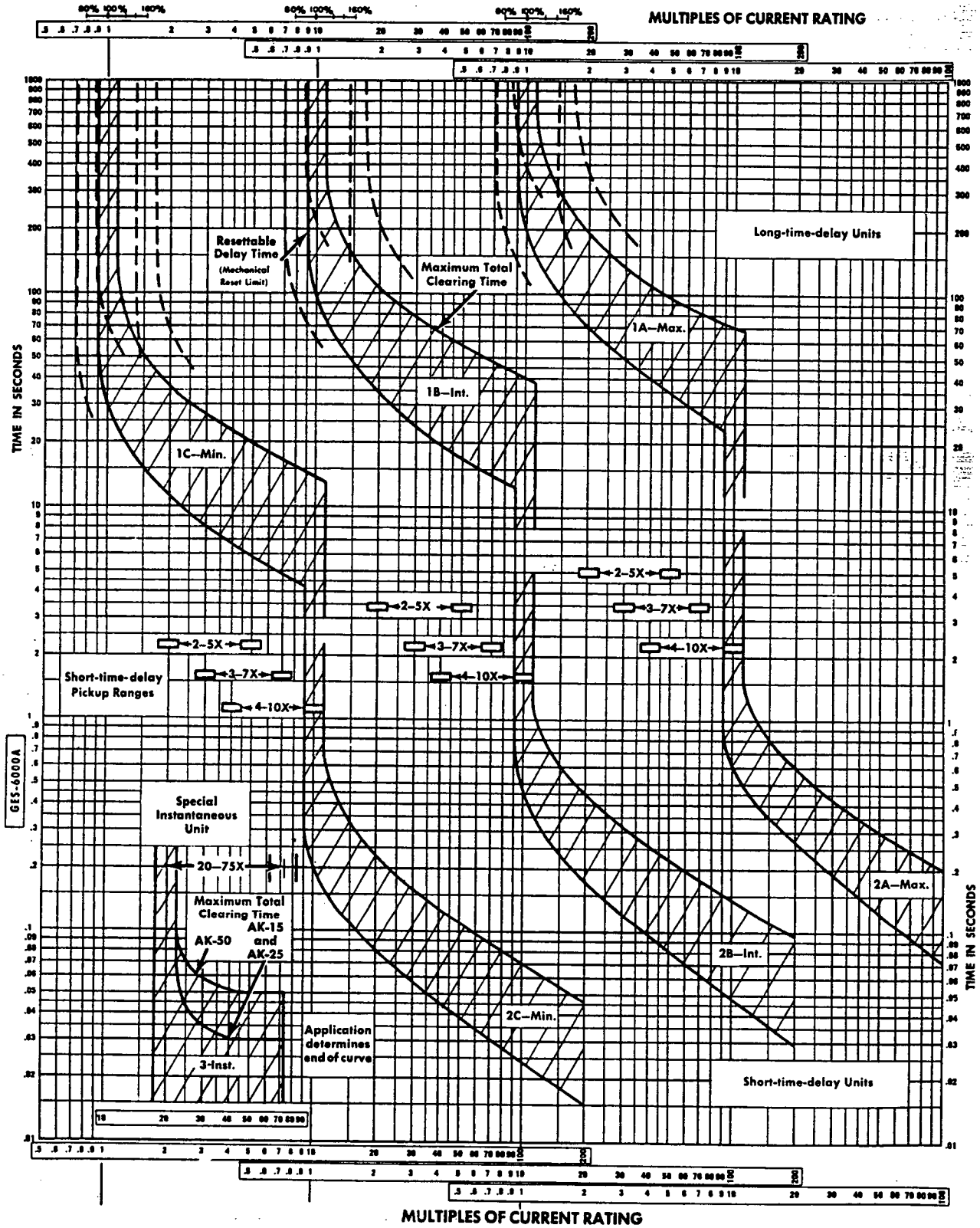
RATING IN AMPERES	ADJ. INSTANTANEOUS TRIP, AMPERES
250 - 300	1050 - 2250
350 - 400	1900 - 3500

INTERRUPTING RATING

BREAKER FRAME	SYMMETRICAL RMS AMPERES 240 V.	480 V.	600 V.	DC AMPS 250 V.
JL, JJ	42,000	30,000	22,000	20,000
JD	22,000			
HJ	65,000	35,000	25,000	20,000

* Single pole test data at 25°C based on test method in NEMA Procedures for Verifying Performance of Molded Case Circuit Breakers

TD-4950 REV. 1
SHEET 1 OF 3
NOV. 23, 1976



GENERAL ELECTRIC

Current Ratings (Amperes)

AK-15 15, 20, 30, 40, 50, 70, 90, 100, 125, 150, 175, 200, 225
AK-25 40, 50, 70, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 500, 600
AK-50 200, 225, 250, 300, 350, 400, 500, 600, 800, 1000, 1200, 1600
AKT-50 2000

TYPE AK LOW-VOLTAGE POWER CIRCUIT BREAKER

EC-1 SERIES TRIP DEVICE

Long-time-delay, Short-time-delay and Instantaneous Time-current Curves

(Curves apply at 60 Hertz for ambient temperature of 25 C)

GES-6000A

Adjustments

Long-time-delay Unit: Pickup current settings are 80 to 160% of rating. (Settings higher than 100% do not increase the continuous current ratings.)
Short-time-delay Unit: Pickup current settings are 2 to 5X, or 3 to 7X, or 4 to 10X of ratings.
Instantaneous Unit: Special pickup current settings are 20–75X of ratings.

8-78 (2M)

GENERAL ELECTRIC CO., CIRCUIT PROTECTIVE DEVICES DEPARTMENT, PLAINVILLE, CONN. 06062

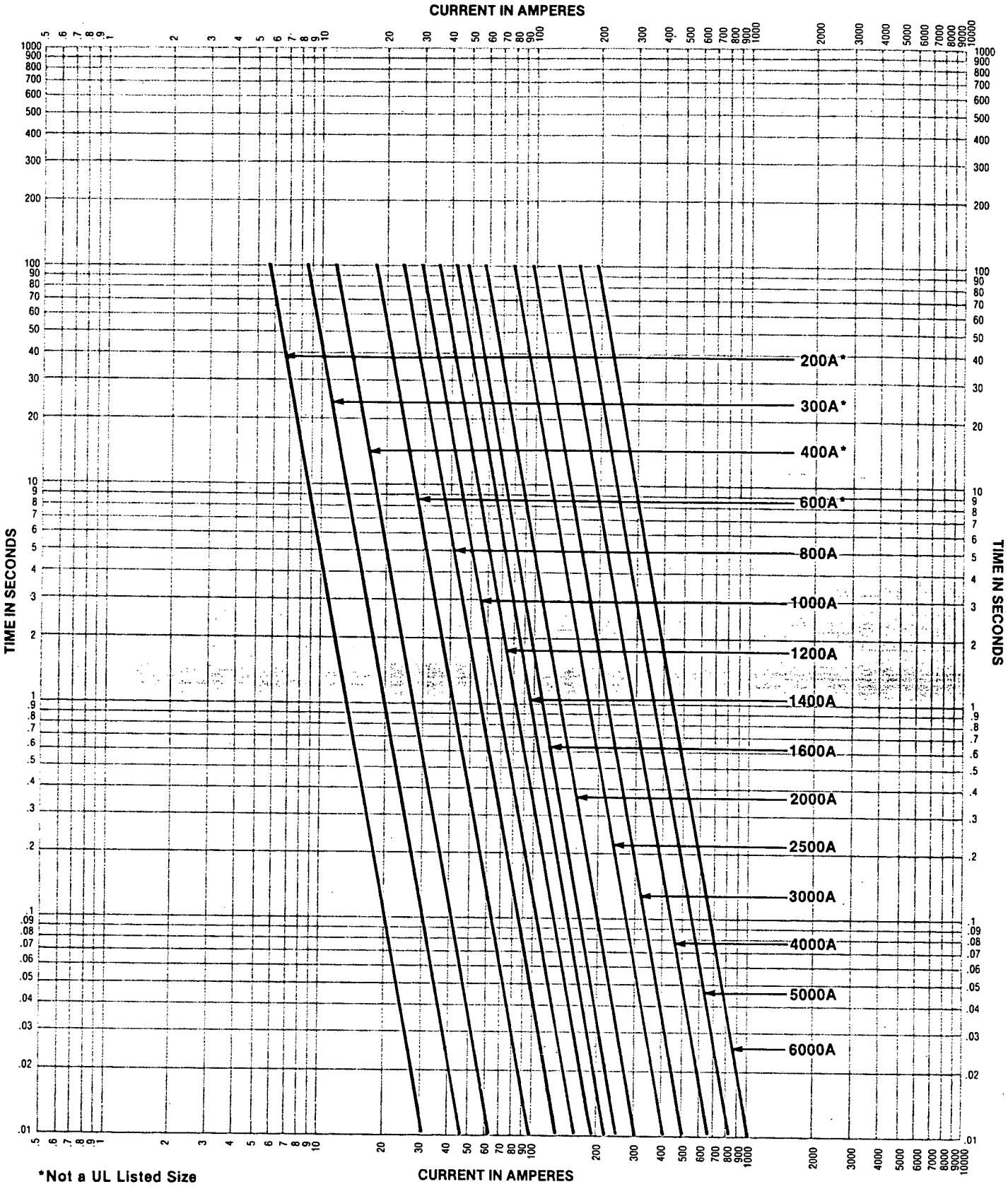
M-6388035

Form 480

WBN-EEB-MS-TI07-0005

ATTACHMENT H

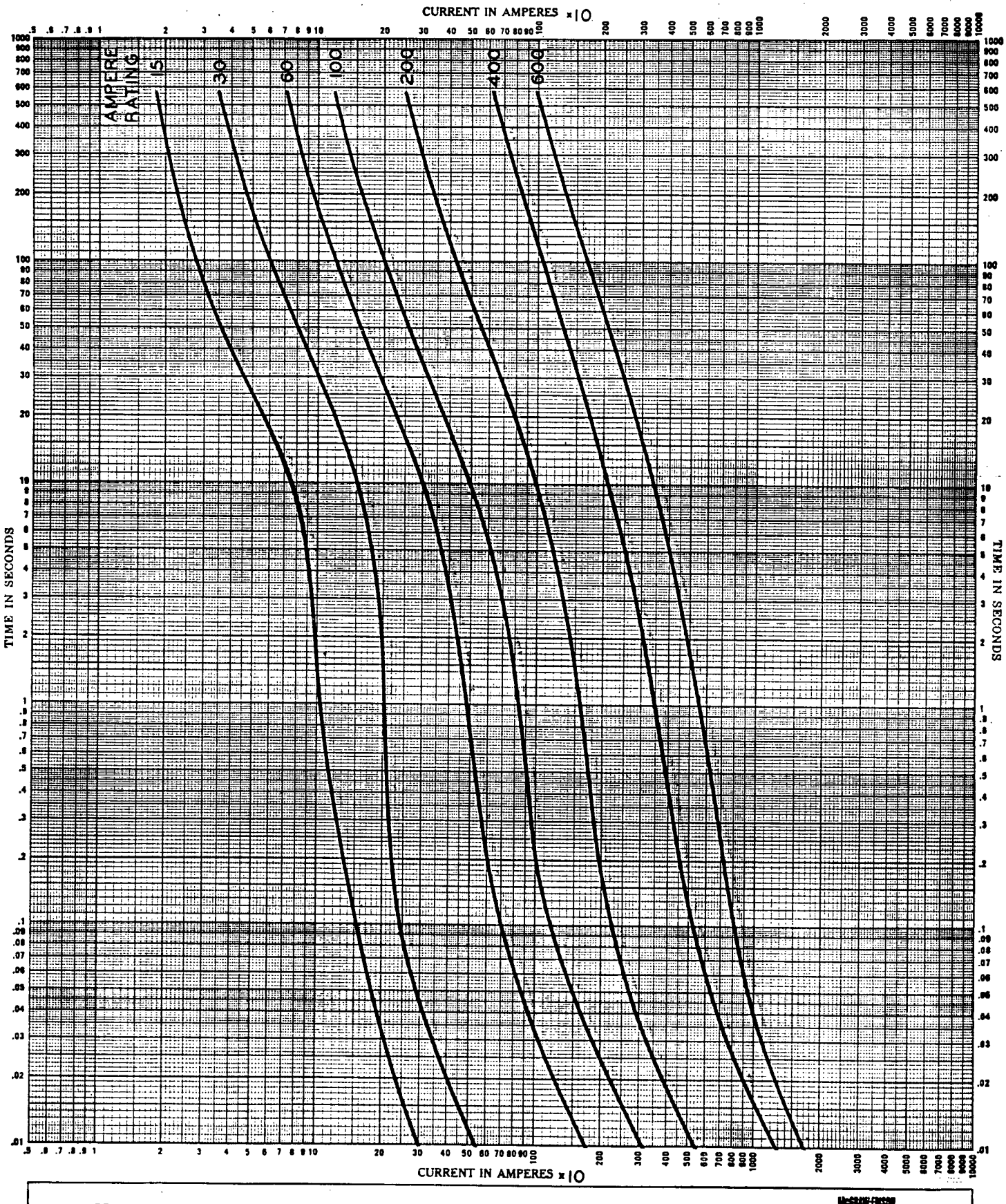
MELTING TIME-CURRENT DATA
200-6000 Amps 600 Volts AC
CAT. NO. A4BY (Amp. Rating)
86259J



*Not a UL Listed Size

WBN-EEB-MS-TI07-0005

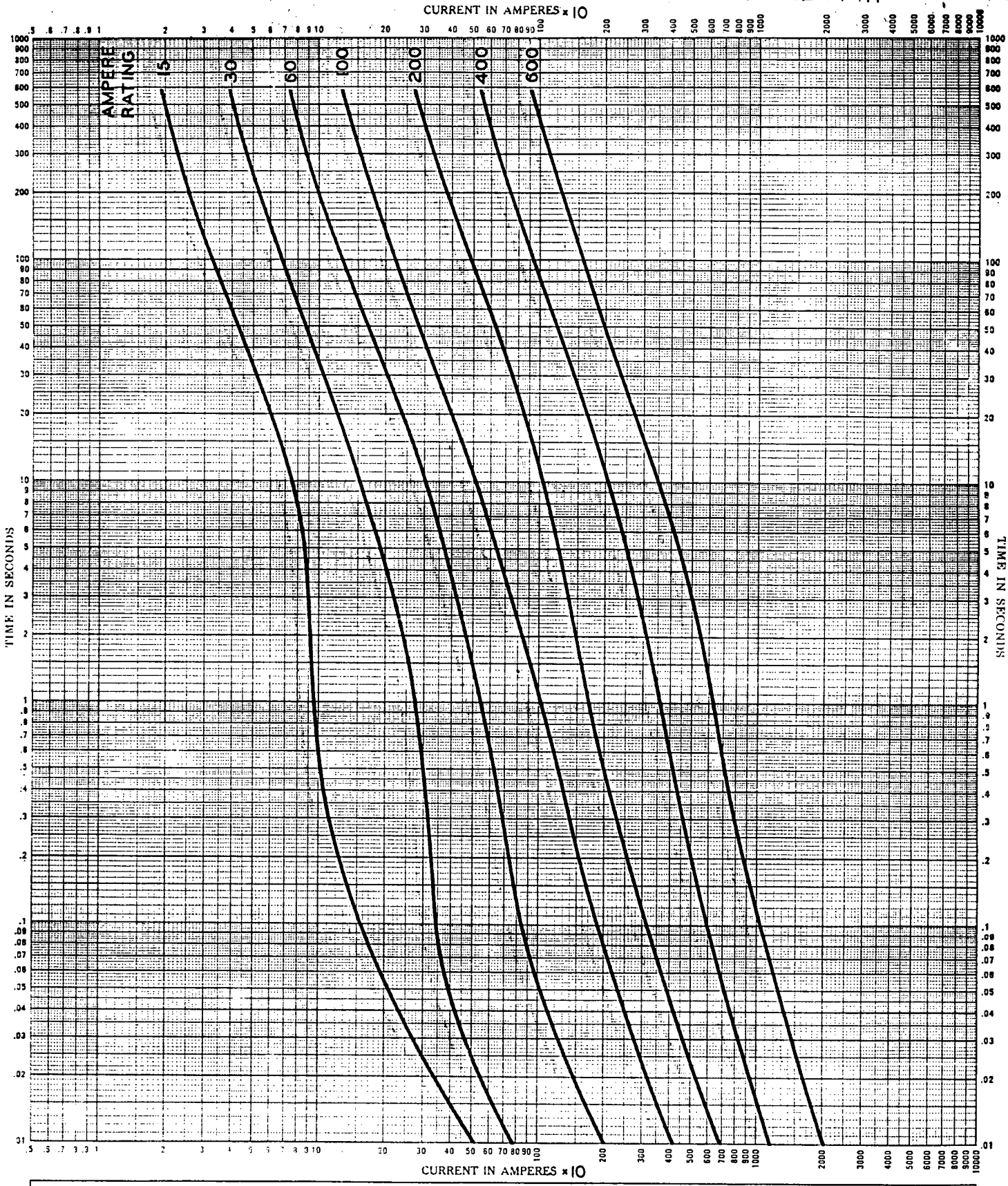
ATTACHMENT H



Minimum Melting Time-Current Characteristic Curves
For
FRN FUSETRON® (K5) (250V) Fuses

McGRAW-EDISON
Buss

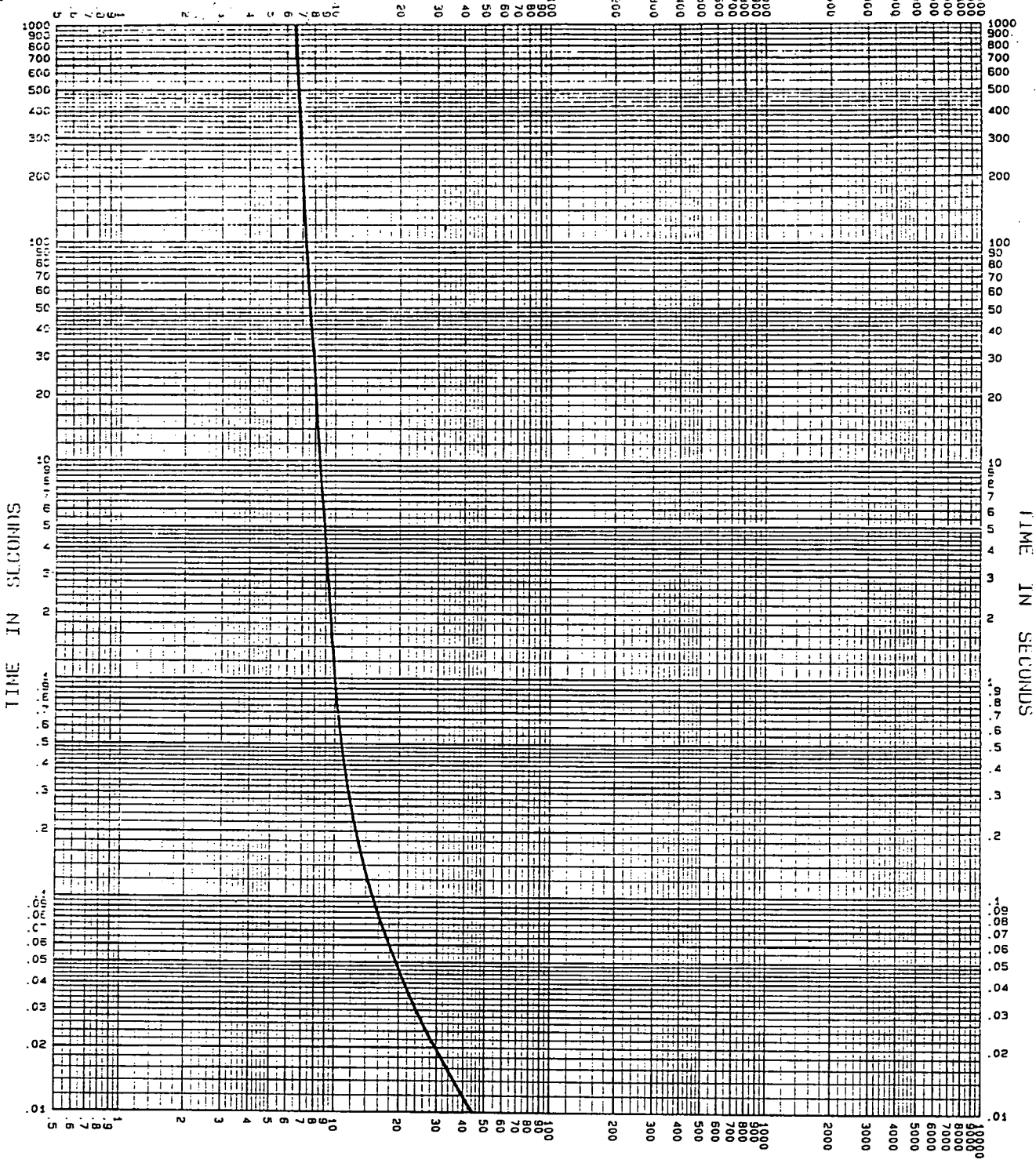
No. FORM 235
Date 10-17-70



Minimum Melting Time-Current Characteristic Curves
For
FRS FUSETRON® Fuses (K5) (600V)

McGRAW-EDISON
Buss

No. 233
Date 11-7-70

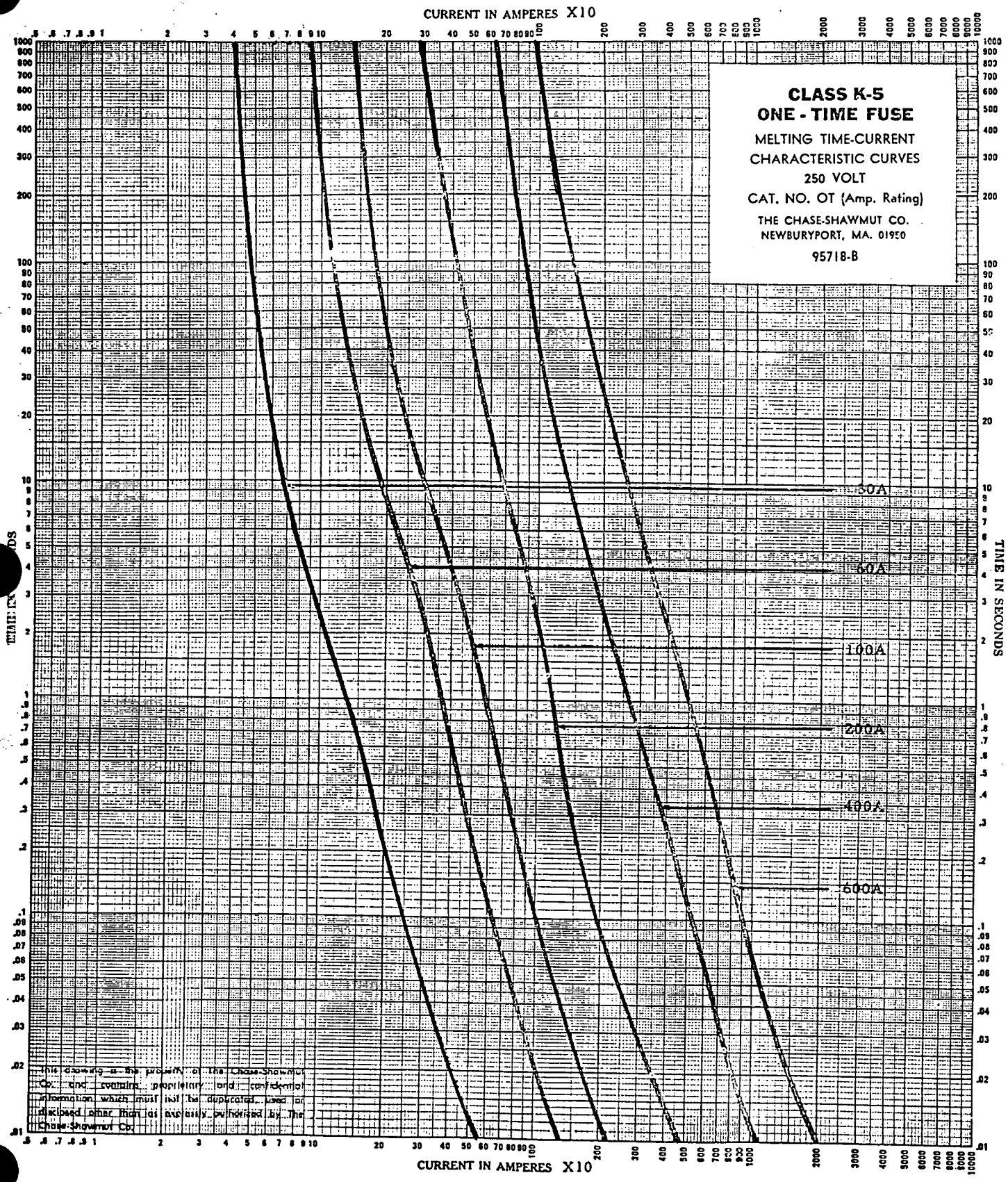


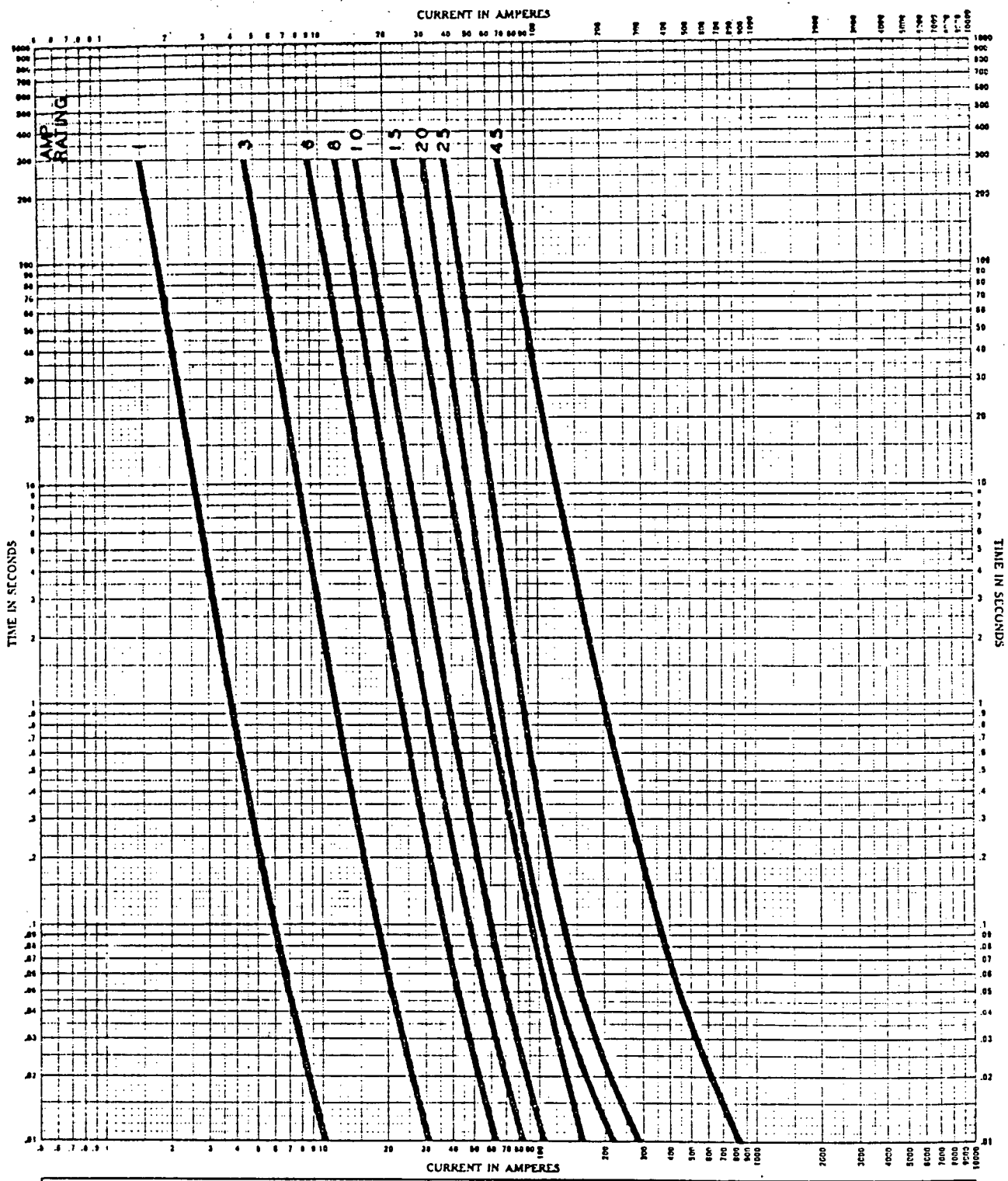
Performance certified as shown.
Heraclio R. Lopez, P.E.
Chief Engineer Power Fuses / 11-6-89

NOV 3 1989

TEST VOLTAGE 250 VAC TIME CONSTANT / POWER FACTOR 100%	FUSE CATALOG NUMBER WBN
BASIS FOR DATA AVERAGE TIME / CURRENT CURVE	FLAS 5A CONTRACT No. 90NLC-755069
Littelfuse® Tracor Des Plaines, IL, USA	DRAWN BY S. GRAFER DATE 1/14/87 CHECKED BY [illegible]
TIME CURRENT CHARACTERISTIC CURVES	DRAWING NO. B - FCC01-526-001

003014


CLASS K-5
ONE - TIME FUSE
MELTING TIME-CURRENT
CHARACTERISTIC CURVES
250 VOLT
CAT. NO. OT (Amp. Rating)
THE CHASE-SHAWMUT CO.
NEWBURYPORT, MA. 01950
95718-B
CURRENT IN AMPERES X10
TIME IN SECONDS
30A
60A
100A
200A
400A
600A
This drawing is the property of The Chase-Shawmut Co. and contains proprietary and confidential information which must not be duplicated, used or disclosed other than as expressly authorized by The Chase-Shawmut Co.



TOTAL CLEARING TIME-CURRENT CHARACTERISTIC CURVES

For KTN, KTS, KWN & KWS LIMITRON FAST-ACTING FUSES

Bussmann Division
Cooper Industries
St. Louis, MO 63178

BASIS FOR DATA Standards ..... Dated .....

1. Tests made at ..... Volts a-c at ..... p-f, Starting at 25C with no initial load .....
2. Curves are plotted to ..... Test points so variations should be .....

No. 50549
Date 8-22-74

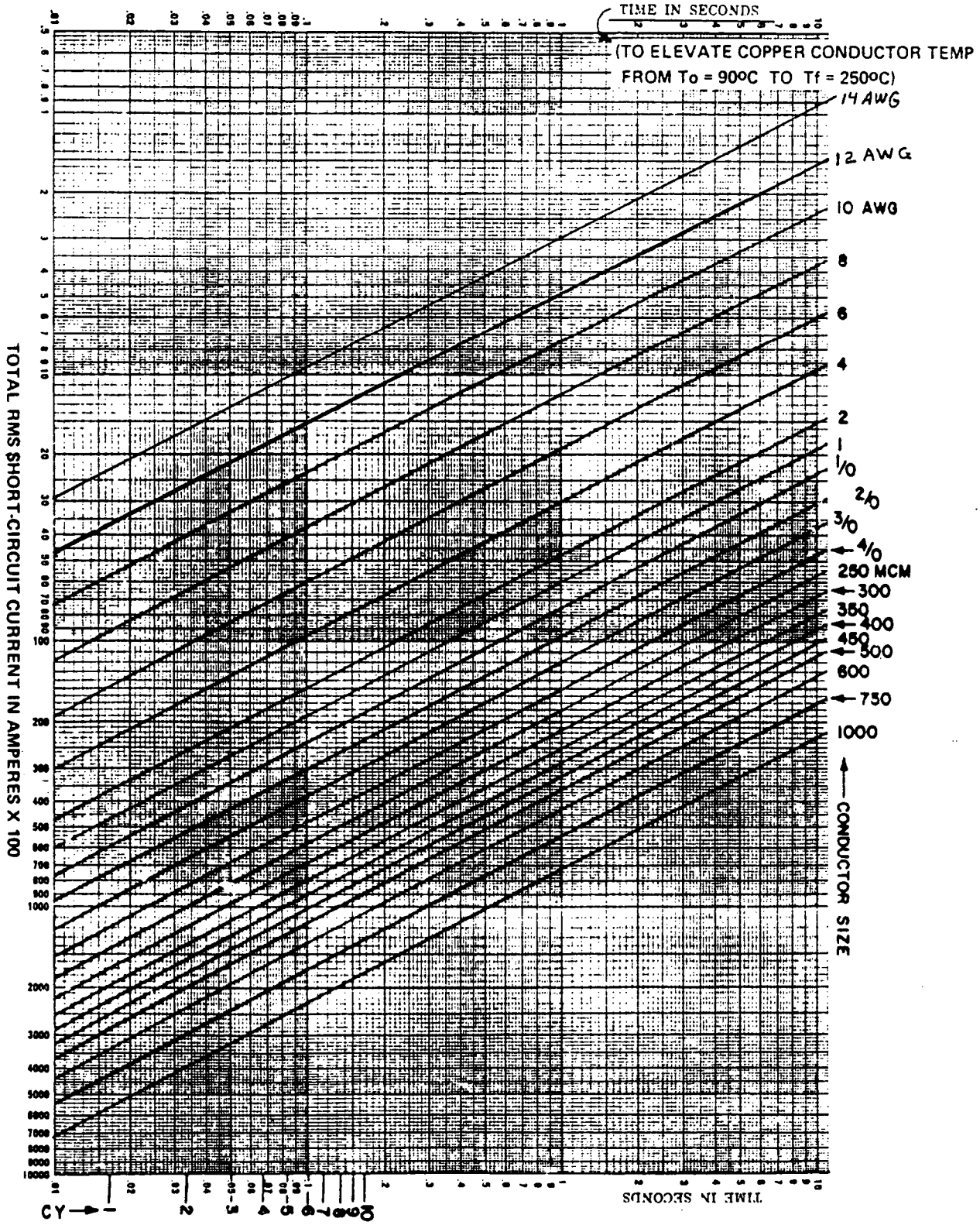


FIG. 1

SHORT-TIME HEATING LIMITS FOR CROSS-LINKED POLYETHYLENE AND ETHYLENE-PROPYLENE RUBBER INSULATED CABLES

TVA 488 (EN DES-3-77)

WBN-EEB-MS-TI07-0005 SHEET 199 OF

Attachment I LVSG & MVSG Walkdown Data
Summary on Control Power Fuses

COMPUTED WFH DATE 1/29/90

CHECKED GCP DATE 1-31-90

Attachment I contains summary listings from the walkdown data of the control power fuses in the LVSG & MVSG.

Sys 211 Fuse Verification

Information taken from documents listed below;

45W760-68-4	Rev. H	45W724-1	Rev 15
-3	Rev. K	-2	Rev 15
45W760-211-1	Rev S	-3	Rev 16
-2	Rev L	-4	Rev 15
-3	Rev M		
-4	Rev V		
-5	Rev H		
-6	Rev L		
-7	Rev L		
-8	Rev K		
-9	Rev J		
-10	Rev L		
-11	Rev G		
-12	Rev K		
-13	Rev H		
-14	Rev J		
-15	Rev K		
-16	Rev G		
-17	Rev F		
-18	Rev K		
-19	Rev F		
-20	Rev H		
-21	Rev J		
-22	Rev C		
-23	Rev B		

Prepared By WMB 1/24/90
Reviewed By AKP 1/25/90

Prepared By RR Pierce 1-25-90
Reviewed By Wm Barry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

MVSG
3D 1A-A

Compt	1N	1A	2N	2A	3N	3A	4	5	6
1	FRN15	FRN15	OT15	OT15	OT10	OT10	FRN-R1	FRN-R1	
2									
3							OT6	FRN-R1	FRN-R1
4							OT6	FRN-R1	FRN-R1
5							OT6	FRN-R1	FRN-R1
6	FRN15	FRN15	OT15	OT15	OT10	OT10	OT6	FRN-R1	FRN-R1
7									
8	FRN15	FRN15	OT15	KLC15	OT10	OT10			
9	FRN15	FRN15	OT15	KLC15	OT15	OT10			
10	FRN15	FRN15	OT15	OT15	OT10	OT10			
11	FRN15	FRN15	OT15	OT15	OT10	OT10	FRN-R1	FRN-R1	
12									
13	FRN15	FRN15	OT10	OT10	OT10	OT10			
14	FRN15	FRN15	OT15	OT15	OT10	OT10			
15	FRN15	FRN15	OT15	OT15	OT10	OT10			
16	OT15	FRN15	FRN15	OT15	OT10	OT15	FRN1	FRN1	
17									
18	FRN15	OT15 FRN15	OT15	OT15	OT10	OT10			
19	FRN15	FRN15	OT15	OT15	OT10	OT10			
20	FRN15	OT15	OT15	FRN15	OT10	OT10			
21	FRN15	FRN15	OT15	OT15	OT10	OT15			

WBN-EEB-MS-TI07-0005
Attachment I

Prepared By R R Pierce 1-25-90
Reviewed By W Berry 1-25-90

BD 1A-A

Compt	1	2	3	5	6	11	12	14
1								
2			OT6					
3	FRN15	OT15	OT10					
4	FRN15	OT15	OT10					
5	FRN15	OT15	OT10					
6								
7								
8								
9								
10								
11								
12						OT30	OT30	3A
13								
14								
15								
16								
17			OT6					
18								
19								
20								
21								

WBN-EEB-MS-TI07-0005
MUSG Attachment I
BD 1B-B

Prepared By RR Pierce 1-25-90
Reviewed By W. Berry 1-25-90

Compt	1N	1A	2N	2A	3N	3A	4	5	6
1	FRN15	FRN15	OT15	KLC15	10 AMP AMPTRAP	OT10	FRN-R1	FRN-R1	
2									
3							OT6	FRN-R1	FRN-R1
4							OT6	FRN-R1	FRN-R1
5							OT6	FRN-R1	FRN-R1
6	FRN15	FRN15	OT15	OT15	OT10	OT10	AMPTRAP II KLC6	FRN-R1	FRN-R1
7									
8	FRN15	FRN15	OT15	KLC15	OT10 OT15	OT10			
9	FRN15	FRN15	OT15	OT15	OT10	OT10			
10	FRN15	FRN15	OT15	OT15	OT10	OT10			
11	FRN15	FRN15 KLC15	OT15	OT15	OT10	OT10	FRN-R1	FRN-R1	
12									
13	FRN15	FRN15	OT15	OT15	Fuse Removed	OT10			
14	FRN15	FRN15	OT15	OT15	KLC10	OT15			
15	FRN15	OT15	OT15	FRN15	OT15	OT10			
16	OT15	FRN15	FRN15	FRN15 OT15	OT10	OT10	FRN-R1	FRN-R1	
17							OT6	OT6	OT6
18	FRN15	FRN15	OT10	OT10	OT10	KLC15			
19	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	OT10			
20	FRN15	FRN15	FRN15	FRN15	OT10	OT10			
21	OT15	OT15	OT10	OT10	OT10	OT10			

Prepared By RRPierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005 Attachment I Page 204

BD 1B-B

Compt	1	2	3	11	12	14			
1									
2			OT6						
3	FRN15	KLC15	OT10						
4	FRN15	OT15	OT10						
5	FRN15	KLC15	OT10						
6									
7									
8									
9									
10									
11									
12				OT30	OT30	A4J3			
13									
14									
15									
16									
17			OT6						
18									
19									
20									
21									

WBN-EEB-MS-TI07-0005

MVSG
BD 2A-A Attachment I

Prepared By RRPierce 1-25-90
Reviewed By W. Berry 1-25-90

Compt	1N	1A	2N	2A	3N	3A	4	5	6
1	FRN15	OT15	OT15	OT15	10A AMP TRAP	10A AMP TRAP	FRN-RI	FRN-RI	
2									
3							OT6		
4							OT6		
5							OT6		
6	FRN15	FRN15	OT15	OT15	OT10	OT 10	KLC ? OT6		
7									
8	FRN15	FRN15	OT15	OT10	OT10	OT10			
9	FRN15	FRN15	OT15	OT10	OT10	OT10			
10	NON 15A	FUSE REMOVED	5A KLC 15A KLC	OT15	NON 10A	OT10			
11	FRN15	FRN15	OT15	OT15	OT10	OT10	FRN-RI	FRN-RI	
12									
13	FRN15	FRN15	OT15	OT15	OT10	OT10			
14	FRN15	FRN15	OT15	OT15	OT10	OT10			
15	FRN15	FRN15	FUSE REMOVED	OT15	OT10	OT10			
16	FRN15	FRN15	OT15	OT15	FRN15	OT10			
17									
18	FRN15	FRN15	OT15	OT15	OT10	OT10			
19	FRN15	FRN15	FUSE REMOVED	FUSE REMOVED	OT10	OT10			
20	FUSE REMOVED	FRN15	OT15 NON15	FUSE REMOVED	OT10	OT10			
21	FRN15	FRN15	OT15	KLC15	OT10	OT10 OT15			

Prepared By RR Pierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005

BD 2A-A

Attachment I

Page 206

Compt	1	2	3	11	12	14			
1									
2			OT6						
3	FRN 15	OT15	OT10						
4	FRN 15	OT15	OT10						
5	FRN 15	OT15	OT10						
6									
7									
8									
9									
10									
11									
12			OT6	OT30	OT30	A4J3			
13									
14									
15									
16									
17			OT6						
18									
19									
20									
21									

Prepared By RRPierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005

MVSG BD 2B-B

Attachment I

Compt	1N	1A	2N	2A	3N	3A	4	5	6
1	FRN15	FRN15	FRN15	OT15	NON15	10A AMP TRAP	FRN-R1	FRN-R1	
2									
3							OT6		
4							OT6		
5							OT6		
6	OT15	KLC15	OT10	OT10	OT10	OT 15	AMP TRAP # OT6		
7									
8	FRN15	KLC15	OT15	OT15 KLC15	OT10	OT10			
9	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	Fuse REMOVED	Fuse Removed			
10	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED			
11	OT15	FRN15	FRN15	OT15	OT10	OT10	FRN-R1	FRN-R1	
12									
13	KLC15	KLC15	OT15	KLC15	OT10	OT15			
14	FRN15	FRN15	OT15	OT15	OT10	OT10			
15	FRN15	FRN15	OT10	Fuse Removed	FUSE REMOVED	KLC15			
16	KLC15	OT15	OT15	OT15	OT10	OT10	FRN-R1	FRN-R1	
17							OT6	OT6	OT6
18	FUSE REMOVED	OT15	OT15	FUSE REMOVED	OT10	OT10			
19	FRN15	FRN15	OT15	OT15	OT10	FUSE REMOVED			
20	FRN15	Fuse Removed	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED	FUSE REMOVED			
21	FRN15	FUSE REMOVED	OT15	KLC15	Fuse Removed	OT10			

Prepared By RK Pierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005

BD 2B-B Attachment I Page 208

Compt	1	2	3	11	12	14			
1									
2			OT6						
3	FRN15	OT15	OT10						
4	FRN15	KLC15	OT10						
5	FRN15	OT15	OT10						
6									
7									
8									
9									
10									
11									
12				OT30	OT30				
13									
14									
15									
16									
17			OT6						
18									
19									
20									
21									

UNID	DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES WITH S/L	LOCATION
WBN-1-FU -210-B8/41 -	COND BOOSTER PMP COOLER 1B	S156	TRM1.6			
WBN-2-FU -210-B8/41 -	COND BOOSTER PMP COOLER 2B	S156	TRM1.6			
WBN-1-FU -210-B9/1 -	SOUTH TB EL 755 SUP FAN 1	S156	TRM2.5			
WBN-2-FU -210-B9/1 -	SOUTH TB EL 755 SUP FN 2	S156	TRM2.5			
WBN-1-FU -210-B9/11 -	SOUTH TB EL 729 SUP FN 1	S156	TRM1.6			
WBN-2-FU -210-B9/11 -	SOUTH TB EL 729 SUP FN 2	S156	TRM1.6			
WBN-1-FU -210-B9/31 -	SOUTH TB EL 708 SUP FN 1	S156	TRM1.6			
WBN-2-FU -210-B9/31 -	SOUTH TB EL 708 SUP FN 2	S156	TRM1.6			
WBN-1-FU -210-B9/41 -	SPARE	S156	TRM1			
WBN-2-FU -210-B9/41 -	SPARE	S156	TRM1			
WBN-1-FU -211-A /A1 -A	DG 1A-A RC CKT FOR 1-FCV-67-68-A	T268	FLAS 5			
WBN-2-FU -211-A /A1 -A	DG 2A-A RC CKT FOR 2-FCV-67-68-A	T268	FLAS 5			
WBN-1-FU -211-A /A2 -A	DG 1A-A RC CKT FOR 1-FCV-67-66	T268	FLAS 5			
WBN-2-FU -211-A /A2 -A	DG 2A-A RC CKT FOR 2-FCV-67-66-A	T268	FLAS 5			
WBN-1-FU -211-A /B1 -A	DG 1A-A RC CKT FOR AUX CONT RM EMERG START CKT	T268	FLAS 5			FUSES WILL BE CHANGED PER DCN P-0338-A
WBN-2-FU -211-A /B1 -A	DG 2A-A RC CKT FOR AUX CONT RM EMERG START CKT	T268	FLAS 5			
WBN-1-FU -211-A /B2 -A	DG 1A-A REMOTE CONTROL CIRCUIT	T268	FLAS 5			
WBN-2-FU -211-A /B2 -A	DG 2A-A REMOTE CONTROL CIRCUIT	T268	FLAS 5			
WBN-1-FU -211-A /C1 -A	DG 1A-A RC CKT FOR AUX CONT RM EMERG STOP CKT	T268	FLAS 5			
WBN-2-FU -211-A /C1 -A	DG 2A-A RC CKT FOR AUX CONT RM EMERG STOP CKT	T268	FLAS 5			
WBN-1-FU -211-A /C2 -A	DG 1A-A RC CKT FOR EMERG STOP CKT	T268	FLAS 5			
WBN-2-FU -211-A /C2 -A	DG 2A-A RC CKT FOR EMERG START CKT	T268	FLAS 5			
WBN-2-FU -211-A 11/4 -A	6900V SD BD 2A-A NORM FDR BKR 1818 - GR LT	B569	FRN-R1	Y	N	
WBN-2-FU -211-A 11/5 -A	6900V SD BD 2A-A NORM FDR BKR 1818 - RED LT	B569	FRN-R1	Y	N	
WBN-1-FU -211-A1/1A -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1932-AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A1/1A -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-AUX TRIP	B569	FRN15	N	N	OT 15
WBN-1-FU -211-A1/1N -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1932-NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A1/1N -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-A1/2A -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1932-AUX CLS	S156	OT15	Y	N	
WBN-2-FU -211-A1/2A -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-AUX CLS	S156	OT15	Y	N	
WBN-1-FU -211-A1/2N -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1432-NOR CLS	S156	OT15	Y	N	
WBN-2-FU -211-A1/2N -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-NOR CLS	S156	OT15	Y	N	
WBN-1-FU -211-A1/3A -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1932-AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A1/3A -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-AUX ELEV	S156	OT10	N	N	AMP TRAP II-10A
WBN-1-FU -211-A1/3N -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1932-NOR ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A1/3N -A	6900V SD BD 2A-A ALT NO2 FDR BKR 1936-NOR ELEV	S156	OT10	N	N	AMP TRAP II-10A
* WBN-1-FU -211-A1/4 -A	6900V SD BD 1A-A ALT NO2 FDR BKR 1932-GR LT	B569	FRN-R1	Y	N	
* WBN-1-FU -211-A1/5 -A	125V DC AUX ELEV BKR 1932 ALT FDR NO.2	B569	FRN-R1	Y	N	
WBN-1-FU -211-A10/1A -A	MDAFW PUMP 1A-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A10/1A -A	MDAFW PUMP 2A-A	B569	FRN15	—	—	FUSE REMOVED
WBN-1-FU -211-A10/1N -A	MDAFW PUMP 1A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A10/1N -A	MDAFW PUMP 2A-A	B569	FRN15	N	N	NON 15A
WBN-1-FU -211-A10/2A -A	MDAFW PUMP 1A-A AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A10/2A -A	MDAFW PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU -211-A10/2N -A	MDAFW PUMP 1A-A NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A10/2N -A	MDAFW PUMP 2A-A	S156	OT15	—	N	ONE 5A RLC, ONE 15A RLC
WBN-1-FU -211-A10/25 -A	MDAFW PUMP 1A-A STATUS MONITOR RELAY A2 92	T268	312.062			NOT LISTED IN W/D DATA
WBN-2-FU -211-A10/25 -A	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN W/D DATA
WBN-1-FU -211-A10/3A -A	MDAFW PUMP 1A-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A10/3A -A	MDAFW PUMP 2A-A	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU -211-A10/3N -A	MDAFW PUMP 1A-A NOR ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A10/3N -A	MDAFW PUMP 2A-A	S156	OT10	N	N	NON 10A
WBN-1-FU -211-A11/1A -A	125V DC AUX TRIP BKR 1718 NORM FDR	B569	FRN15	Y	N	
WBN-2-FU -211-A11/1A -A	6900V SD BD 2A-A NOR FDR BKR 1818-AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-A11/1N -A	6900V SD BD 1A-A NOR FDR BKR 1718 NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A11/1N -A	6900V SD BD 2A-A NOR FDR BKR 1818-NOR TRIP	B569	FRN15	Y	N	

* U2 FUSES NOT LISTED IN PRINT OUT.

WBN-EEB-MS-TI08-0005
Attachment I

COMPUTED W. Berry DATE 1-25-90
CHECKED R. Rhiem DATE 1-25-90

UNID DESCRIPTION MFG REF # MFG MOD # LOCATION

PRINTED IN U.S.A.

UNIT			DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES WITH S/L	LOCAT
WBN-1-FU	-211-A11/2A	-A	125V DC AUX CLOSE BKR 1718 NORM FDR	S156	OT15	Y	N	
WBN-2-FU	-211-A11/2A	-A	6900V SD BD 2A-A NOR FDR BKR 1818-AUX CLS	S156	OT15	Y	N	
WBN-1-FU	-211-A11/2N	-A	125V DC NOR CLOSE BKR 1718 NORM FDR	S156	OT15	Y	N	
WBN-2-FU	-211-A11/2N	-A	6900V SD BD 2A-A NOR FDR BKR 1818-NOR CLS	S156	OT15	Y	N	
WBN-1-FU	-211-A11/3A	-A	125V DC AUX ELEV BKR 1718 NORM FDR	S156	OT10	Y	N	
WBN-2-FU	-211-A11/3A	-A	6900V SD BD 2A-A NOR FDR BKR 1818-AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A11/3N	-A	125V DC NOR ELEV BKR 1718 NORM FDR	S156	OT10	Y	N	
WBN-2-FU	-211-A11/3N	-A	6900V SD BD 2A-A NOR FDR BKR 1818-NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A11/4	-A	LOOP ISOL APPDX R-PNL O-L4 IND LT BKR 1718	B569	FRN-R1	Y	N	
WBN-1-FU	-211-A11/5	-A	LOOP ISOL-APPDX R-PNL O-L-4 IND LT BKR 1718	B569	FRN-R1	Y	N	
WBN-1-FU	-211-A12/1	-A	6.9KV SHUTDN BD 1A-A BUS-PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-A12/1	-A	6900V SD BD 2A-A MAIN BUS PTS PRI	G080	9F60BDE001			
AC WBN-1-FU	-211-A12/10	-A	6.9KV SHUTDN BD 1A-A BUS VOLTMETER	B569	KLC6			AC
WBN-2-FU	-211-A12/10	-A	6900V SD BD 2A-A MAIN BUS PTS SEC - VM	B569	KLC6			
WBN-1-FU	-211-A12/11	-A	125V DC EMERG CONT BUS	S156	OT30	Y	N	
WBN-2-FU	-211-A12/11	-A	125V DC EMERG CONTROL BUS-UV AUX RLY	S156	OT30	Y	N	
WBN-1-FU	-211-A12/12	-A	125V DC NOR CONT BUS	S156	OT30	Y	N	
WBN-2-FU	-211-A12/12	-A	125V DC NOR CONTROL BUS-DIFF & UV AUX RLY	S156	OT30	Y	N	
AC WBN-2-FU	-211-A12/13	-A	NOR SUP FROM 6900V UB 2B-BUS PTS SEC	S156	OT6			AC
WBN-1-FU	-211-A12/13A	-	VM SW-NORM SUPPLY	S156	OT6			
WBN-1-FU	-211-A12/14	-A	125V DC NOR FDR BKR 1718	S156	OT3	—	N	3A, CLASS J - NEED FUSE TY
WBN-2-FU	-211-A12/14	-A	125V DC DEGRADED VOLTAGE XFER/TRIP RLYS	S156	A4J3	Y	N	
WBN-1-FU	-211-A12/2	-A	6.9KV SHUTDN BD 1A-A BUS-PT'S B-C					
WBN-2-FU	-211-A12/2	-A	6900V SD BD 2A-A MAIN BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-A12/3	-A	NOR SUPPLY-6.9KV UNIT BD 1B PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-A12/3	-A	NOR SUP FROM 6900V UB 2B-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-A12/4	-A	NOR SUPPLY-6.9KV UNIT BD 1B PT'S B-C	G080	9F60BDE001			
WBN-2-FU	-211-A12/4	-A	NOR SUP FROM 6900V UB 2B-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-A12/5	-A	VM TRANS SW 1-XS-82-6C	B569	KLC6			
WBN-2-FU	-211-A12/5	-A	VM XFER SW 2-XS-82-6C	B569	KWN6			
WBN-1-FU	-211-A12/6	-A	VM TRANS SW 1-XS-57-39 & 1-XS-82-6A	S156	OT6			AC
AC WBN-2-FU	-211-A12/6	-A	VM XFER SW 2-XS-57-39 & 2-XS-82-6A	B569	KLC6			
WBN-1-FU	-211-A12/7	-A	BUS 1A-1 6.9 KV PUMP WATTHOUR METERS	S156	OT6			
WBN-2-FU	-211-A12/7	-A	6900V SD BD 2A-A MAIN BUS PTS SEC-WHM	S156	OT6			
WBN-1-FU	-211-A12/8	-A	VM TRANS SW 1-XS-82-6C	S156	OT6			
WBN-2-FU	-211-A12/8	-A	VM XFER SW 2-XS-82-6C	S156	OT6			
WBN-1-FU	-211-A12/9	-A	VM TRANS SW 1-XS-57-39 & 1-XS-82-6A	S156	OT6			
WBN-2-FU	-211-A12/9	-A	VM XFER SW 2-XS-57-39 & 2-XS-82-6A	S156	OT6			
WBN-1-FU	-211-A13/1A	-A	CS PUMP 1A-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A13/1A	-A	CS PUMP 2A-A AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A13/1N	-A	CS PUMP 1A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A13/1N	-A	CS PUMP 2A-A NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A13/2A	-A	CS PUMP 1A-A AUX CLOSE	S156	OT10	Y	N	
WBN-2-FU	-211-A13/2A	-A	CS PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU	-211-A13/2N	-A	CS PUMP 1A-A NOR CLOSE	S156	OT10	Y	N	
WBN-2-FU	-211-A13/2N	-A	CS PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU	-211-A13/25	-A	CS PUMP 1A-A STATUS MONITOR RELAY A2-94	T268	312.062			NOT LISTED IN W/D DATA
WBN-2-FU	-211-A13/25	-A	CONTAINMEMT SPRAY PMP 2A-A 2-MTR-72-27-A CONT		*			NOT LISTED IN W/D DATA
WBN-1-FU	-211-A13/3A	-A	CS PUMP 1A-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A13/3A	-A	CS PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU	-211-A13/3N	-A	CS PUMP 1A-A NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A13/3N	-A	CS PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU	-211-A14/1A	-A	RHR PUMP 1A-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A14/1A	-A	RHR PUMP 2A-A	B569	FRN15	Y	N	
WBN-1-FU	-211-A14/1N	-A	RHR PUMP 1A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A14/1N	-A	RHR PUMP 2A-A	B569	FRN15	Y	N	

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Attachment I
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Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

	DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES WITH S/L	LOCATION
WBN-1-FU -211-A14/2A -A	RHR PUMP 1A-A AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A14/2A -A	RHR PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU -211-A14/2N -A	RHR PUMP 1A-A NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A14/2N -A	RHR PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU -211-A14/25 -A	RHR PUMP 1A-A STATUS MONITOR RLY A2-96	T268	312.062			NOT LISTED IN W/D DAT
WBN-2-FU -211-A14/25 -A	RESIDUAL HEAT REMOVAL PHP 2A-A CONT FUSE		*			NOT LISTED IN W/D DAT
WBN-1-FU -211-A14/3A -A	RHR PUMP 1A-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A14/3A -A	RHR PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU -211-A14/3N -A	RHR PUMP 1A-A NOR ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A14/3N -A	RHR PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU -211-A15/1A -A	SI PUMP 1A-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A15/1A -A	SI PUMP 2A-A	B569	FRN15	Y	N	
WBN-1-FU -211-A15/1N -A	SI PUMP 1A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A15/1N -A	SI PUMP 2A-A	B569	FRN15	Y	N	
WBN-1-FU -211-A15/2A -A	SI PUMP 1A-A AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A15/2A -A	SI PUMP 2A-A	S156	OT15	Y	N	
WBN-1-FU -211-A15/2N -A	SI PUMP 1A-A NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A15/2N -A	SI PUMP 2A-A	S156	OT15			FUSE REMOVED
WBN-1-FU -211-A15/25 -A	SI PUMP 1A-A STATUS MONITOR RLY A2-98	T268	312.062			NOT LISTED IN W/D DAT
WBN-2-FU -211-A15/25 -A	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN W/D DAT
WBN-1-FU -211-A15/3A -A	SI PUMP 1A-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A15/3A -A	SI PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU -211-A15/3N -A	SI PUMP 1A-A NOR ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A15/3N -A	SI PUMP 2A-A	S156	OT10	Y	N	
WBN-1-FU -211-A16/1A -A	125VDC AUX TRIP BKR 1716 ALT FDR NO 1	B569	FRN15	N	N	OT 15 INSTALLED
WBN-2-FU -211-A16/1A -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-A16/1N -A	125VDC NOR TRIP BKR 1716 ALT FDR NO 1	B569	FRN15	Y	N	
WBN-2-FU -211-A16/1N -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-A16/2A -A	125VDC AUX CLOSE BKR 1716 ALT FDR NO 1	S156	OT15	Y	N	
WBN-2-FU -211-A16/2A -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-AUX CLS	S156	OT15	Y	N	
WBN-1-FU -211-A16/2N -A	125VDC NOR CLOSE BKR 1716 ALT FDR NO 1	B569	FRN15	Y	N	
WBN-2-FU -211-A16/2N -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-NOR CLS	S156	OT15	Y	N	
WBN-1-FU -211-A16/3A -A	125VDC AUX ELEV BKR 1716 ALT FDR NO 1	S156	OT10	Y	N	
WBN-2-FU -211-A16/3A -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-AUX ELEV	S156	OT10	N	N	OT15 INSTALLED
WBN-1-FU -211-A16/3N -A	125VDC NOR ELEV BKR 1716 ALT FDR NO 1	S156	OT10	Y	N	
WBN-2-FU -211-A16/3N -A	6900V SD BD 2A-A ALT NO1 FDR BKR 1816-NOR ELEV	S156	OT10	N	N	FRN 15 INSTALLED
* WBN-1-FU -211-A16/4 -A	LOOP ISOL APPDX R-PNL 0-L-4 IND LT BKR 1716	B569	FRN1	Y	N	
* WBN-1-FU -211-A16/5 -A	LOOP ISOL APPDX R-PNL 0-L-4 IND LT BKR 1716	B569	FRN1	Y	N	
WBN-1-FU -211-A17/1 -A	ALT SUPPLY NO 1 - CSS XFMR C PT'S A-B	G080	9F608DE001			
WBN-2-FU -211-A17/1 -A	ALT NO. 1 SUPPLY FROM CSST C BUS PTS PRI	G080	9F608DE001			AC
WBN-1-FU -211-A17/2 -A	ALT SUPPLY NO 1 - CSS XFMR C PT'S B-C	G080	9F608DE001			
WBN-2-FU -211-A17/2 -A	ALT NO. 1 SUPPLY FROM CSST C-BUS PTS PRI	G080	9F608DE001			
WBN-1-FU -211-A17/3 -A	125VDC EMERG CONTROL BUS	S156	OT6	Y	N	
WBN-2-FU -211-A17/3 -A	125V DC EMERG CONTROL BUS RED LIGHT	S156	OT6	Y	N	
WBN-1-FU -211-A17/4 -A	VM TRANS SW 1-XS-82-6C	S156	OT6			
WBN-2-FU -211-A17/4 -A	VM XFER SW 2-XS-82-6C	S156	OT6			
WBN-1-FU -211-A17/5 -A	VM TRANS SW 1-XS-57-39 & 1-XS-82-6A	S156	OT6			AC
WBN-2-FU -211-A17/5 -A	VM XFER SW 2-XS-57-39 & 2-XS-82-6A	S156	OT6			
WBN-1-FU -211-A17/6 -A	VM SW-ALT SUPPLY NO 1	S156	OT6			
WBN-2-FU -211-A17/6 -A	ALT NO. 1 SUPPLY FROM CSST C-BUS PTS SEC	S156	OT6			
WBN-1-FU -211-A18/1A -A	CVCS PUMP 1A-A AUX TRIP	B569	FRN15	—	—	ONE OT15, ONE FRN15
WBN-2-FU -211-A18/1A -A	CC PUMP 2A-A	B569	FRN15	Y	N	
WBN-1-FU -211-A18/1N -A	CVCS PUMP 1A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-A18/1N -A	CC PUMP 2A-A	B569	FRN15	Y	N	
WBN-1-FU -211-A18/2A -A	CVCS PUMP 1A A AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-A18/2A -A	CC PUMP 2A-A	S156	OT15	Y	N	

* U2 FUSES (2-FU-2N-A16/4-A, 5-A) NOT LISTED IN PRINTOUT.

Prepared By W. Berry 2-25-90
Reviewed By R. Pickle 1-25-90

PRINTED IN U.S.A.

	UNI			DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES WITH S/L	LCCA
	WBN-[illegible]U	-211-A18/2N	-A	CVCS PUMP 1A-A NOR CLOSE	S156	OT15	Y	N	
	WBN-2-FU	-211-A18/2N	-A	CC PUMP 2A-A	S156	OT15	Y	N	
	WBN-1-FU	-211-A18/25	-A	CVCS PUMP 1A-A STATUS MONITOR RLY 1A2-100	T268	312.062			NOT LISTED IN W/D DATA
	WBN-2-FU	-211-A18/25	-A	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN W/D DATA
	WBN-1-FU	-211-A18/3A	-A	CVCS PUMP 1A-A AUX ELEV	S156	OT10	Y	N	
	WBN-2-FU	-211-A18/3A	-A	CC PUMP 2A-A	S156	OT10	Y	N	
	WBN-1-FU	-211-A18/3N	-A	CVCS PUMP 1A-A NOR ELEV	S156	OT10	Y	N	
	WBN-2-FU	-211-A18/3N	-A	CC PUMP 2A-A	S156	OT10	Y	N	
	WBN-1-FU	211-A19/1A	-A	AUX TRIP - SPARE	B569	FRN15	Y	N	
	WBN-2-FU	-211-A19/1A	-A	AUX TRIP	B569	FRN15	Y	N	
	WBN-1-FU	-211-A19/1N	-A	NOR TRIP - SPARE	B569	FRN15	Y	N	
	WBN-2-FU	211-A19/1N	-A	NOR TRIP	B569	FRN15	Y	N	
	WBN-1-FU	-211-A19/2A	-A	AUX CLOSE - SPARE	S156	OT15	Y	N	
	WBN-2-FU	-211-A19/2A	-A	AUX CLOSE	S156	OT15	—	—	FUSE REMOVED
	WBN-1-FU	-211-A19/2N	-A	NOR CLOSE - SPARE	S156	OT15	Y	N	
	WBN-2-FU	211-A19/2N	-A	NOR CLOSE	S156	OT15	—	—	FUSE REMOVED
	WBN-1-FU	-211-A19/3A	-A	AUX ELEV - SPARE	S156	OT10	Y	N	
	WBN-2-FU	-211-A19/3A	-A	AUX ELEV	S156	OT10	Y	N	
	WBN-1-FU	211-A19/3N	-A	NOR ELEV - SPARE	S156	OT10	Y	N	
	WBN-2-FU	-211-A19/3N	-A	NOR ELEV	S156	OT10	Y	N	
AC	WBN-1-FU	-211-A2/1	-A	ALT SUPPLY NO 2 CSS XFMR D PT'S A-B	G080	9F60BDE001			AC
AC	WBN-2-FU	-211-A2/1	-A	ALT NO. 2 SUP FROM CSST D-BUS PTS PRI	G080	9F60BDE001			AC
AC	WBN-1-FU	-211-A2/2	-A	ALT SUPPLY NO 2 CSS XFMR D PT'S B-C	G080	9F60BDE001			AC
AC	WBN-2-FU	211-A2/2	-A	ALT NO. 2 SUP FROM CSST D BUS PTS PRI	G080	9F60BDE001			AC
	WBN-1-FU	-211-A2/3	-A	125V DC NOR CONTROL BUS - IND LT ISOL	S156	OT6	Y	N	
	WBN-2-FU	-211-A2/3	-A	125V DC NOR CONTROL BUS RED LIGHT	S156	OT6	Y	N	
AC	WBN-1-FU	-211-A2/4	-A	VM SW-ALT SUPPLY NO 2	S156	OT6			AC
AC	WBN-2-FU	-211-A2/4	-A	ALT NO. 2 SUP FROM CSST D-BUS PTS SEC	S156	OT6			AC
AC	WBN-1-FU	-211-A2/5	-A	VM TRANS SW 1-XS 82-6C	S156	OT6			AC
AC	WBN-2-FU	211-A2/5	-A	VM XFER SW 2-XS-82-6C	S156	OT6			AC
AC	WBN-1-FU	-211-A2/6	-A	VM TRANS SW 1-XS-57-39 & 1-XS-32-6A	S156	OT6			AC
AC	WBN-1-FU	-211-A2/6	-A	VM TRANS SW 1-XS-57-39 & 1-XS-82-6A	S156	OT6			AC
AC	WBN-2-FU	-211-A2/6	-A	VM XFER SW 2-XS-57-39 & 2-XS-82-6A	S156	OT6			AC
	WBN-1-FU	211-A20/1A	-A	PRESS HTR BACKUP AUX TRIP	B569	FRN15	N	N	OT 15
	WBN-2-FU	-211-A20/1A	-A	PRES HTR BACKUP AUX TRIP	B569	FRN15	Y	N	
	WBN-1-FU	-211-A20/1N	-A	PRESS HTR BACKKUP NOR TRIP	B569	FRN15	Y	N	
	WBN-2-FU	-211-A20/1N	-A	PRES HTR BACKUP NOR TRIP	B569	FRN15	—	—	FUSE REMOVED
AC	WBN-1-FU	211-A20/10		PRESS HTR BACKUP GROUP 1A-A	F055	XJL225			AC
AC	WBN-1-FU	-211-A20/11	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/12	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/13	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/14	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/15	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/16	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
AC	WBN-1-FU	-211-A20/17	-	PRESS HTR BACKUP GROUP 1A-A	B569	JJS225			AC
	WBN-1-FU	-211-A20/2A	-A	PRESS HTR BACKUP AUX CLOSE	B569	FRN15	Y	N	
	WBN-2-FU	-211-A20/2A	-A	PRES HTR BACKUP AUX CLOSE	S156	OT15	—	—	FUSE REMOVED
	WBN-1-FU	-211-A20/2N	-A	PRESS HTR BACKUP NOR CLOSE	S156	OT15	Y	N	
	WBN-2-FU	-211-A20/2N	-A	PRES HTR BACKUP NOR CLOSE	S156	OT15	—	N	ONE OT15, ONE NON15
	WBN-1-FU	-211-A20/3A	-A	PRESS HTR BACKUP AUX ELEV	S156	OT10	Y	N	
	WBN-2-FU	-211-A20/3A	-A	PRES HTR BACKUP NOR ELEV	S156	OT10	Y	N	
	WBN-1-FU	-211-A20/3N	-A	PRESS HTR BACKUP NOR ELEV	S156	OT10	Y	N	
	WBN-2-FU	-211-A20/3N	-A	PRES HTR BACKUP NOR ELEV	S156	OT10	Y	N	
AC	WBN-1-FU	-211-A20/4	-	PRESS HTR BACKUP GROUP 1A-A	F055	XJL225			AC
AC	WBN-1-FU	-211-A20/5	-	PRESS HTR BACKUP GROUP 1A-A	F055	XJL225			AC
AC	WBN-1-FU	-211-A20/6	-	PRESS HTR BACKUP GROUP 1A-A	F055	XJL225			AC
AC	WBN-1-FU	-211-A20/7		PRESS HTR BACKUP GROUP 1A-A	F055	XJL225			AC

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

			DESCRIPTION		MFG REF #	MFG MOD #	AGREES WITH W/D DATA	S/L	ION
AC	WBN-1-FU	-211-A20/8	PRESS HTR BACKUP GROUP 1A-A		F055	XJL225			
AC	WBN-1-FU	-211-A20/9 -	PRESS HTR BACKUP GROUP 1A-A		F055	XJL225			AC
	WBN-1-FU	-211-A21/1A -A	PRESS HTR CINTL GROUP 1D AUX TRIP		B569	FRN15	Y	N	
	WBN-2-FU	-211-A21/1A -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					FRN 15 INSTALLED
	WBN-1-FU	-211-A21/1N -A	PRESS HTR CNTL GROUP 1D NOR TRIP		B569	FRN15	Y	N	
	WBN-2-FU	-211-A21/1N -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					FRN 15 INSTALLED
AC	WBN-1-FU	-211-A21/10 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			
	WBN-1-FU	-211-A21/11 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			
	WBN-1-FU	-211-A21/12 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			
	WBN-1-FU	-211-A21/13 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			AC
	WBN-1-FU	-211-A21/14 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			
	WBN-1-FU	-211-A21/15 -	PRESS HTR CNTL GROUP 1D		B569	JJS225			
	WBN-1-FU	-211-A21/2A -A	PRESS HTR BACKUP 1D AUX CLOS		S156	OT15	Y	N	
	WBN-2-FU	-211-A21/2A -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					KLC 15 INSTALLED
	WBN-1-FU	-211-A21/2N -A	PRESS HTR BACKUP 1D AUX CLOS		S156	OT15	Y	N	
	WBN-2-FU	-211-A21/2N -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					OT15 INSTALLED
	WBN-1-FU	-211-A21/3A -A	PRESS HTR BACKUP 1D AUX ELEV		S156	OT15	Y	N	
	WBN-2-FU	-211-A21/3A -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					ONE OT10 & ONE OT15 INSTALLE
	WBN-1-FU	-211-A21/3N -A	PRESS HTR BACKUP 1D NOR ELEV		S156	OT10	Y	N	
	WBN-2-FU	-211-A21/3N -	PRESSURIZER HTR CONTROL GROUP 2D	CONT FU					OT10 INSTALLED
AC	WBN-1-FU	-211-A21/4 -	PRESS HTR CNTL GROUP 1D		F055	XJL225			
	WBN-1-FU	-211-A21/5 -	PRESS HTR CNTL GROUP 1D		F055	XJL225			
	WBN-1-FU	-211-A21/6 -	PRESS HTR CNTL GROUP 1D		F055	XJL225			AC
	WBN-1-FU	-211-A21/7 -	PRESS HTR CNTL GROUP 1D		F055	XJL225			
	WBN-1-FU	-211-A21/8	PRESS HTR CNTL GROUP 1D		F055	XJL225			
	WBN-1-FU	-211-A21/9 -	PRESS HTR CNTL GROUP 1D		F055	XJL225			
	WBN-1-FU	-211-A3/1 -A	480V SHTDN TRANS 1B1-B-TRIP		B569	FRN15	Y	N	
	WBN-2-FU	-211-A3/1 -A	125V DC SHUTDN TRANS 2A1-A		B569	FRN15	Y	N	
	WBN-1-FU	-211-A3/2 -A	480V SHTDN TRANS 1B1-B-CLOSE		S156	OT15	Y	N	
	WBN-2-FU	-211-A3/2 -A	125V DC SHUTDN TRANS 2A1-A CLOSE		S156	OT15	Y	N	
	WBN-1-FU	-211-A3/3 -A	480V SHTDN TRANS 1B1-B-ELEV		S156	OT10	Y	N	
	WBN-2-FU	-211-A3/3 -A	125V DC SHUTDN TRANS 2A1-A		S156	OT10	Y	N	
	WBN-1-FU	-211-A3/4 -A	480V SHTDN TRANS IND LTS PNL 1-M-1 & 0-M-26		S156	OT6	Y	N	
	WBN-2-FU	-211-A3/4 -A	125V DC SHUTDN TRANS 2A1-A		S156	OT6	Y	N	
*	WBN-1-FU	-211-A3/5 -A	LOOP ISOL APPDX R PNL 0-L-4 IND LT		B569	FRN-R1	Y	N	
*	WBN-1-FU	-211-A3/6 -A	LOOP ISOL APPDX R PNL 0-L-4 IND LT		B569	FRN-R1	Y	N	
	~~WBN-2-FU~~	~~-211-A30/3A -A~~	~~PRESS HTR BACK UP AUX ELEV~~		~~S156~~	~~OT10~~			
	WBN-1-FU	-211-A4/1 -A	480V SHTDN TRANS 1A2-A-TRIP		B569	FRN15	Y	N	
	WBN-2-FU	-211-A4/1 -A	125V DC SHUTDN TRANS 2A2-A		B569	FRN15	Y	N	
	WBN-1-FU	-211-A4/1A -A	ANN HI TEMP RELAY ISOLATION-APPENDIX R		B569	MISS			NOT LISTED IN W/D DATA
	WBN-2-FU	-211-A4/1A -A	HI TEMP RELAY ISOLATION		B569	MISS			NOT LISTED IN W/D DATA
	WBN-1-FU	-211-A4/2 -A	480V SHTDN TRANS 1A2-A-CLOSE		S156	OT15	Y	N	
	WBN-2-FU	-211-A4/2 -A	125V DC SHUTDN TRANS 2A2-A		S156	OT15	Y	N	
	WBN-1-FU	-211-A4/3 -A	480V SHTDN TRANS 1A2-A-ELEV		S156	OT10	Y	N	
	WBN-2-FU	-211-A4/3 -A	125V DC SHUTDN TRANS 2A2-A		S156	OT10	Y	N	
	WBN-1-FU	-211-A4/4 -A	480V SHTDN TRANS IND LTS PNL 1-M-1 & 0-M-26		S156	OT6	Y	N	
	WBN-2-FU	-211-A4/4 -A	125V DC SHUTDN TRANS 2A2-A		S156	OT6	Y	N	
**	WBN-1-FU	-211-A4/5 -A	INDICATING LT FUSE PNL 0-L-4		B569	FRN-R1	Y	N	
**	WBN-1-FU	-211-A4/6 -A	INDICATING LT FUSE PNL 0-L-4		B569	FRN-R1	Y	N	
	WBN-1-FU	-211-A5/1 -A	480V SHTDN TRANS 1A-A-TRIP		B569	FRN15	Y	N	
	WBN-2-FU	-211-A5/1 -A	125V DC SHUTDN TRANS 2A-A		B569	FRN15	Y	N	
	WBN-1-FU	-211-A5/2 -A	480V SHTDN TRANS 1A-A-CLOSE		S156	OT15	Y	N	
	WBN-2-FU	-211-A5/2 -A	125V DC SHUTDN TRANS 2A-A		S156	OT15	Y	N	
	WBN-1-FU	-211-A5/3 -A	480V SHTDN TRANS 1A-A-ELEV		S156	OT10	Y	N	
	WBN-2-FU	-211-A5/3 -A	125V DC SHUTDN TRANS 2A-A		S156	OT10	Y	N	
	WBN-1-FU	-211-A5/4 -A	480V SHTDN TRANS IND LTS PNL 1-M-1 & 0-M-26		S156	OT6	Y	N	

** U2 FUSES (2-FU-211-A4/5-A & /6-A) NOT LISTED IN PRINT OUT.

* U2 FUSES (2-FU-211-A3/5-A & /6-A) NOT LISTED IN PRINT OUT.

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

PRINTED IN U.S.A.

UNI			DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	TYPE AGREES LOCAT WITH S/L	
WBN-2-FU	-211-A5/4	-A	125V DC SHUTDN TRANS 2A-A	S156	OT6	Y	N	
WBN-1-FU	-211-A5/5	-A	INDICATING LT FUSE PNL O-L-4	B569	FRN-R1	Y	N	
** WBN-1-FU	-211-A5/6	-A	INDICATING LT FUSE PNL O-L-4	B569	FRN-R1	Y	N	
** WBN-1-FU	-211-A6/1A	-A	6.9KV D-G 1A-A-BKR 1912 AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A6/1A	-A	6900V SD BD 2A-A EMERG FDR BKR 1922-AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A6/1N	-A	6.9KV D-G 1A-A-BKR 1912 - NORM TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A6/1N	-A	6900V SD BD 2A-A EMERG FDR BKR 1922-NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A6/2A	-A	6.9KV D-G 1A-A-BKR 1912 - AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-A6/2A	-A	6900V SD BD 2A-A EMERG FDR BKR 1922 AUX CLS	S156	OT15	Y	N	
WBN-1-FU	-211-A6/2N	-A	6.9KV D-G 1A-A-BKR 1912-NORM CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-A6/2N	-A	6900V SD BD 2A-A EMERG FDR BKR 1922-NOR CLS	S156	OT15	Y	N	
WBN-1-FU	-211-A6/3A	-A	6.9KV D-G 1A-A-BKR 1912 - AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A6/3A	-A	6900V SD BD 2A-A EMERG FDR BKR 1922-AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A6/3N	-A	6.9KV D-G 1A-A-BKR 1912 - NORM ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A6/3N	-A	6900V SD BD 2A-A EMERG FDR BKR 1922 NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A6/4	-A	FEEDER AUTO TRANSFER LOCKOUT	S156	OT6	Y	N	
WBN-2-FU	-211-A6/4	-A	125V DC AUTO XFER LOCKOUT	S156	OT6	—	—	1-OT6, 1-KLC
* WBN-1-FU	-211-A6/5	-B	LOOP ISOL APPDX R-PNL O-L-4 IND LT BKR 1912	B569	FRN-R1	Y	N	
* WBN-1-FU	-211-A6/6	-B	LOOP ISOL APPDX R-PNL O-L-4 IND LT BKR 1912	B569	FRN-R1	Y	N	
WBN-1-FU	-211-A7/1	-A	DIESEL GEN 1A-A - PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-A7/1	-A	EMERG SUP FROM DG 2A-A-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-A7/2	-A	DIESEL GEN 1A-A - PT'S B-C	G080	9F60BDE001			
WBN-2-FU	-211-A7/2	-A	EMERG SUP FROM DG 2A-A-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-A7/3	-A	DIESEL GEN 1A-A-VM SW 1-XS-82-6A	B569	KLC6			
WBN-2-FU	-211-A7/3	-A	VM XFER SW 1-XS-82-6A	B569	KLC6			
WBN-1-FU	-211-A7/4	-A	DIESEL GEN 1A-A-VM SW 1-XS-82-6C	S156	OT6			AC
WBN-2-FU	-211-A7/4	-A	VM XFER SW 2-XS-82-6C	S156	OT6			
WBN-1-FU	-211-A7/5	-A	DIESEL GEN 1A-A VM, VARM, WM	S156	OT6			
WBN-2-FU	-211-A7/5	-A	EMERG SUP FROM DG 2A-A-BUS PTS SEC	S156	OT6			
WBN-1-FU	-211-A7/6	-A	6.9KV SHUTDN BD 1A-A VOLT RELAYS-PRI FUSE	S156	A2D10R			
WBN-2-FU	-211-A7/6	-A	6.9KV SHUTDOWN BD 2A-A					
WBN-1-FU	-211-A7/7	-A	6.9KV SHUTDN BD 1A-A VOLT RELAYS-SEC FUSE	B569	JKS1			
WBN-2-FU	-211-A7/7	-A	6900V SD BD 2A-A MN BUS PTS SEC-V RLYS	S156	A4J1			
WBN-1-FU	-211-A8/1A	-A	ERCW PUMP A-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A8/1A	-A	ERCW PUMP D-A AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A8/1N	-A	ERCW PUMP A-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A8/1N	-A	ERCW PUMP D-A NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A8/2A	-A	ERCW PUMP A-A AUX CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-A8/2A	-A	ERCW PUMP D-A AUX CLOSE	B569	KLC15	N	N	OT10
WBN-1-FU	-211-A8/2N	-A	ERCW PUMP A-A NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-A8/2N	-A	ERCW PUMP D-A NOR CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-A8/25	-A	ERCW PUMPS A-A STATUS MONITOR RELAY 1A288	T268	312.062			NOT LISTED IN W/D
WBN-2-FU	-211-A8/25	-A	ERCW PMP D-A STATUS MONITOR RELAY 2A2-106	T268	312.062			NOT LISTED IN W/D
WBN-1-FU	-211-A8/3A	-A	ERCW PUMP A-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A8/3A	-A	ERCW PUMP D-A AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A8/3N	-A	ERCW PUMP A-A NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-A8/3N	-A	ERCW PUMP D-A NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-A9/1A	-A	ERCW PUMP B-A AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A9/1A	-A	ERCW PUMP C-A AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A9/1N	-A	ERCW PUMP B-A NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-A9/1N	-A	ERCW PUMP C-A NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-A9/2A	-A	ERCW PUMP B-A AUX CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-A9/2A	-A	ERCW PUMP C-A AUX CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-A9/2N	-A	ERCW PUMP B-A NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-A9/2N	-A	ERCW PUMP C-A NOR CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-A9/25	-A	ERCW PUMP B-A STATUS MONITOR RELAY 1A2 90	T268	312.062			NOT LISTED IN W/D DATA

* U2 FUSES (2-FU-211-A6/5-A, 16-A) NOT LISTED IN PRINT OUT.

** U2 FUSES (2-FU-211-A5/5-A, 16-A) NOT LISTED IN PRINT OUT.

Prepared By W. Berry 2-25-90
Reviewed By R. Pierce 1-25-90

UN[illegible]	DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH WID DATA	AGREES WITH S/L	LCC[illegible]N
WBN-2-FU -211-A9/25 -A	ERCW PMP C-A STATUS MONITOR RELAY 2A2-104	T268	312.062			NOT LISTED IN WID DATA
WBN 1 FU -211-A9/3A -A	ERCW PUMP B-A AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-A9/3A -A	ERCW PUMP C-A AUX ELEV	S156	OT10	Y	N	
WBN-1-FU -211-A9/3N -A	ERCW PUMP B-A NOR ELEV	S156	OT10	N	N	OT15
WBN 2 FU -211-A9/3N -A	ERCW PUMP C-A NOR ELEV	S156	OT10	Y	N	
WBN-1-FU -211-B /A1 -B	DG 1B-B RC CKT FOR 1-FCV-67-65-B	T268	FLAS 5			
WBN-2-FU -211-B /A1 -B	DG 2B-B REMOTE CNTL CKT FOR 2-FCV-67-65-B	T268	FLAS 5			
WBN-1-FU -211-B /A2 -B	DG 1B-B RC CKT FOR 1-FCV-67-67-B	T268	FLAS 5			
WBN-2-FU -211-B /A2 -B	DG 2B-B REMOTE CNTL CKT FOR 2-FCV-67-67-B	T268	FLAS 5			
WBN 1 FU -211-B /B1 -B	DG 1B-B RC CKT FOR AUX CONT RM EMERG START CKT	T268	FLAS 5			FUSE WILL BE CHANGED FOR DCN P-03388-A
WBN-2-FU -211-B /B1 -B	DG 2B-B RC CKT FOR AUX RM EMERG START CKT	T268	FLAS 5			
WBN-1-FU -211-B /B2 -B	DG 1B-B REMOTE CONTROL CIRCUIT	T268	FLAS 5			
WBN-2-FU -211-B /B2 -B	DG 2B-B REMOTE CONTROL CIRCUIT	T268	FLAS 5			
WBN-1-FU -211-B /C1 -B	DG 1B-B RC CKT FOR AUX CONT RM EMERG STOP CKT	T268	FLAS 5			
WBN 2 FU -211-B /C1 -B	DG 2B-B RC CKT FOR AUX CONT RM EMERG STOP CKT	T268	FLAS 5			
WBN-1-FU -211-B /C2 -B	DG 1B-B RC CKT FOR EMERG START CKT	T268	FLAS 5			
WBN-2-FU -211-B /C2 -B	DG 2B-B RC CKT FOR EMERG START CKT	T268	FLAS 5			
WBN-2-FU -211-B 1/4 -B	6900V SD BD 2B-B ALT NO. 2 FOR BKR 1938-GR LT	B569	FRN-R1	Y	N	
WBN-2-FU -211-B 1/5 -B	6900V SD BD 2B-B ALT NO. 2 FOR BKR 1938-RED LT	B569	FRN-R1	Y	N	
WBN 2 FU -211-B 7/5 -B	EMER SUP FROM DG 2B-B - BUS PTS SEC	S156	OT6			
WBN-2-FU -211-B 11/4 -B	6900V SD BD 2B-B NORM FDR BKR 1826 - GR LT	B569	FRN-R1	Y	N	
WBN-2-FU -211-B 11/5 -B	6900V SD BD 2B-B NORM FOR BKR 1826 - RED LT	B569	FRN-R1	Y	N	
WBN-2-FU -211-B 16/4 -B	6900V SD BD 2B-B ALT NO. 1 FDR BKR 1828-GR LT	B569	FRN-R1	Y	N	
WBN-2-FU -211-B 16/5 -B	6900V SD BD 2B-B ALT NO. 1 FDR BKR 1828 RED LT	B569	FRN R1	Y	N	
WBN-1-FU -211-B1/1A -B	ALT FOR NO2-AUX TRIP BKR 1934	B569	FRN15	Y	N	
WBN 2 FU -211-B1/1A -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-B1/1N -B	ALT FDR NO2-NOR TRIP BKR 1934	B569	FRN15	Y	N	
WBN-2-FU -211-B1/1N -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU -211-B1/2A -B	ALT FDR NO2-AUX CLOSE BKR 1934	B569	KLC15	Y	Y	
WBN-2-FU -211-B1/2A -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-AUX CLS	S156	OT15	Y	N	
WBN 1 FU -211-B1/2N -B	ALT FDR NO2-NOR CLOSE BKR 1934	S156	OT15	Y	N	
WBN-2-FU -211-B1/2N -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-NOR CLS	B569	FRN15	Y	N	
WBN-1-FU -211-B1/3A -B	ALT FDR NO2-AUX ELEV BKR 1934	S156	OT10	Y	N	
WBN-2-FU -211-B1/3A -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-AUX ELEV	S156	OT10	N	N	AMP TRAP 10A
WBN-1-FU -211-B1/3N -B	ALT FDR NO2-NOR ELEV BKR 1934	S156	A2C10R	—	N	AMP TRAP II-10A
WBN 2 FU -211-B1/3N -B	6900V SD BD 2B-B ALT NO2 FDR BKR 1938-NOR ELEV	B569	NCN15	Y	N	
* WBN-1-FU -211-B1/4 -B	O-L-4 IND LIGHT - LOOP ISOLATION APP. R	B569	FRN-R1	Y	N	
* WBN-1-FU -211-B1/5 -B	O-L-4 IND LIGHT-LOOP ISOLATION APP. R	B569	FRN-R1	Y	N	
WBN-1-FU -211-B10/1A -B	MDAFW PUMP 1B-B AUX TRIP	B569	FRN15	Y	N	
WBN 2 FU -211-B10/1A -B	MDAFW PUMP 2B-B	B569	FRN15			FUSE REMOVED
WBN-1-FU -211-B10/1N -B	MDAFW PUMP 1B-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-B10/1N -B	MDAFW PUMP 2B-B	B569	FRN15			FUSE REMOVED
WBN-1-FU -211-B10/2A -B	MDAFW PUMP 1B-B AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU -211-B10/2A -B	MDAFW PUMP 2B-B	S156	OT15			FUSE REMOVED
WBN-1-FU -211-B10/2N -B	MDAFW PUMP 1B-B NOR CLOSE	S156	OT15	Y	N	
WBN 2 FU -211-B10/2N -B	MDAFW PUMP 2B-B	S156	OT15			FUSE REMOVED
WBN-1-FU -211-B10/25 -B	MDAFW PUMP 1B-B STATUS MONITOR RELAY B2-92	T268	312.062			NOT LISTED IN WID DATA
WBN 2 FU -211-B10/25 -B	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN WID DATA
WBN-1-FU -211-B10/3A -B	MDAFW PMP 1B-B AUX ELEV	S156	OT10	Y	N	
WBN-2-FU -211-B10/3A -B	MDAFW PUMP 2B-B	S156	OT10			FUSE REMOVED
WBN-1-FU -211-B10/3N -B	MDAFW PMP 1B-B NOR ELEV	S156	OT10	Y	N	
WBN-2-FU -211-B10/3N -B	MDAFW PUMP 2B-B	S156	OT10			FUSE REMOVED
WBN-1-FU -211-B11/1A -B	NORM FDR BKR 1726-AUX TRIP	B569	FRN15	—	N	
WBN 2 FU -211-B11/1A -B	6900V SD BD 2B-B NOR FDR BKR 1826-AUX TRIP	B569	FRN15	Y	N	DWF FRN15, ONE KLC15
WBN-1-FU -211-B11/1N -B	NORM FDR BKR 1726-NORM TRIP	B569	FRN15	Y	N	
WBN-2-FU -211-B11/1N -B	6900V SD BD 2B-B NOR FDR BKR 1826-NOR TRIP	B569	FRN15	N	N	OT15

~~* U2 FUSES (2-FU-211-B1/1A-B & 15-B) NOT USED IN PRINTOUT- LISTED~~

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

PRINTED IN U.S.A.

U			DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH WD DATA	SL	LOC
WBN-1-FU	211-B11/2A	-B	NORM FDR BKR 1726-AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B11/2A	-B	6900V SD BD 2B-B NOR FDR BKR 1826-AUX CLS	S156	OT15	Y	N	
WBN-1-FU	-211-B11/2N	-B	NORM FDR BKR 1726-NORM CLOSE	S156	OT15	Y	N	
WBN-2-FU	211-B11/2N	-B	6900V SD BD 2B-B NOR FDR BKR 1826-NOR CLS	B569	FRN15	Y	N	
WBN-1-FU	-211-B11/3A	-B	NORM FDR BLR 1726-AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B11/3A	-B	6900V SD BD 2B-B NOR FDR BKR 1826-AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B11/3N	-B	NORM FDR BKR 1726-NORM ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B11/3N	-B	6900V SD BD 2B-B NOR FDR BKR 1826-NOR ELEV	S156	OT10	Y	N	
* WBN-1-FU	211-B11/4	-B	0-L-4 IND LT-LOOP ISOLATION APP. R	B569	FRN-R1	Y	N	
* WBN-1-FU	-211-B11/5	-B	0-L-4 IND LT-LOOP ISOLATION APP. R	B569	FRN-R1	Y	N	
WBN-1-FU	-211-B12/1	-B	6.9KV SHUTDN BD 1B-B-BUS PT'S A-B	G080	9F608DE001			
WBN-2-FU	-211-B12/1	-B	6900V SD BD 2B-B MAIN BUS PTS PRI	G080	9F608DE001			AC
AC WBN-1-FU	-211-B12/10	-B	6.9KV SHUTDN BD 1B-B-VM & VOLT RELAYS	B569	KLC6			
WBN-2-FU	-211-B12/10	-B	6900V SD BD 2B-B MAIN BUS PTS SEC-VM	B569	KLC10			
WBN-1-FU	-211-B12/11	-B	6.9KV SHUTDN BD 1B-B-DC CONTROL BUS-EMERG	S156	OT30	Y	N	
WBN-2-FU	-211-B12/11	-B	125V DC EMERG CONTROL BUS-UV AUX RLY	S156	OT30	Y	N	
WBN-1-FU	-211-B12/12	-B	6.9KV SHUTDN BD 1B-B-DC CONTROL BUS-NORMAL	S156	OT30	Y	N	
WBN-2-FU	-211-B12/12	-B	125V DC NOR CONTROL BUS-DIFF & UV AUX RLY	S156	OT30	Y	N	
WBN-1-FU	-211-B12/13	-B	NORM SUPPLY 6.9KV BD 1C-WHM, WM & VM	S156	OT6			
AC WBN-2-FU	-211-B12/13	-B	NOR SUP FROM 6900V UB 2C-BUS PTS SEC	S156	OT6			AC
WBN-1-FU	211-B12/14	-B	125V DC 6.9KV SHUTDN BD 1B-B	S156	A4J3	Y	N	
WBN-2-FU	-211-B12/14	-B	125V DC DEGRADED VOLTAGE XFER/TRIP RLYS	S156	OT3			NOT LISTED IN WD DATA
WBN-1-FU	-211-B12/2	-B	6.9KV SHUTDN BD 1B-B BUS PT'S B-C	G080	9F608DE001			
WBN-2-FU	-211-B12/2	-B	6900V SD BD 2B-B MAIN BUS PTS PRI	G080	9F608DE001			
WBN-1-FU	-211-B12/3	-B	NOR SUPPLY 6.9KV BD 1C PT'S A-B	G080	9F608DE001			
WBN-2-FU	211-B12/3	-B	NOR SUP FROM 6900V UB 2C BUS PTS PRI	G080	9F608DE001			
WBN-1-FU	-211-B12/4	-B	NOR SUPPLY 6.9KV BD 1C PT'S B-C	G080	9F608DE001			
WBN-2-FU	-211-B12/4	-B	NOR SUP FROM 6900V UB 2C-BUS PTS PRI	G080	9F608DE001			
WBN-1-FU	-211-B12/5	-B	VM TRANS SW 1-XS-82-36C	B569	KLC6			
WBN-2-FU	-211-B12/5	-B	VM XFER SW 2-XS-82-36C	S156	OT6			
AC WBN-1-FU	-211-B12/6	-B	VM TRANS SW 1-XS-57-66 & 1-XS-82-36A	S156	OT6			AC
WBN-2-FU	-211-B12/6	-B	VM XFER SW 2-XS-57-66 & 2-XS-82-36A	S156	OT6			
WBN-1-FU	-211-B12/7	-B	BUS 1B-B 6.9KV PUMPS-WATTHOUR METERS	S156	OT6			
WBN-2-FU	-211-B12/7	-B	6900V SD BD 2B-B MAIN BUS PTS SEC-WHM	S156	OT6			
WBN-1-FU	-211-B12/8	-B	VM TRANS SW 1-XS-82-36C	S156	OT6			
WBN-2-FU	-211-B12/8	-B	VM XFER SW 2-XS-82-36C	S156	OT6			
WBN-1-FU	-211-B12/9	-B	VM TRANS SW 1-XS-57-66 & 1-XS-82-36A	S156	OT6			
WBN-2-FU	211-B12/9	-B	VM XFER SW 2-XS-57-66 & 2-XS-82-36A	B569	KWN6			
WBN-1-FU	-211-B13/1A	-B	CS PUMP 1B-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B13/1A	-B	CS PUMP 2B-B	B569	FRN15	N	Y	KLC 15
WBN-1-FU	-211-B13/1N	-B	CS PUMP 1B-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	211-B13/1N	-B	CS PUMP 2B-B	B569	FRN15	N	Y	KLC 15
WBN-1-FU	-211-B13/2A	-B	CS PUMP 1B-B AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	211-B13/2A	-B	CS PUMP 2B-B	S156	OT15	N	Y	KLC 15
WBN-1-FU	-211-B13/2N	-B	CS PUMP 1B-B NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B13/2N	-B	CS PUMP 2B-B	S156	OT15	Y	N	
WBN-1-FU	-211-B13/25	-B	CS PUMP 1B-B STATUS MONITOR RELAY 82 94	T268	312.062			NOT LISTED IN WD DATA
WBN-2-FU	-211-B13/25	-B	CONTAINMEMT SPRAY PMP 2B-B 2-MTR-72-10-B CONT	T268	312.062			NOT LISTED IN WD DATA
WBN-1-FU	-211-B13/3A	-B	CS PUMP 1B-B AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	211-B13/3A	-B	CS PUMP 2B-B	S156	OT10	N	N	OT15
WBN-1-FU	-211-B13/3N	-B	CS PUMP 1B-B NOR ELEV	S156	OT10	—	—	FUSE REMOVED
WBN-2-FU	-211-B13/3N	-B	CS PUMP 2B-B	S156	OT10	Y	N	
WBN-1-FU	-211-B14/1A	-B	RHR PUMP 1B-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B14/1A	-B	RHR PUMP 2B-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B14/1N	-B	RHR PUMP 1B-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B14/1N	-B	RHR PUMP 2B-B	B569	FRN15	Y	N	

~~* U2 FUSES (2-FU-211-B11/4-B & 1-B) NOT IN FUSE PRINTOUT~~

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

		DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	S/L	LOCATION
WBN-1-FU	-211-B14/2A -B	RHR PUMP 1B-B AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B14/2A -B	RHR PUMP 2B-B	S156	OT15	Y	N	
WBN-1-FU	-211-B14/2N -B	RHR PUMP 1B-B NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B14/2N -B	RHR PUMP 2B-B	S156	OT15	Y	N	
WBN-1-FU	-211-B14/25 -B	RHR PUMP 1B-B STATUS MONITOR RELAY B2 96	T268	312.062			NOT LISTED IN W/D DATA
WBN-2-FU	-211-B14/25 -B	RESIDUAL HEAT REMOVAL PHP 2B-B CONT FUSE	T268	312.062			NOT LISTED IN W/D DATA
WBN-1-FU	-211-B14/3A -B	RHR PUMP 1B-B AUX ELEV	S156	OT15	Y	N	
WBN-2-FU	-211-B14/3A -B	RHR PUMP 2B-B	S156	OT10	Y	N	
WBN-1-FU	-211-B14/3N -B	RHR PUMP 1B-B NOR ELEV	B569	KLC10	Y	Y	
WBN-2-FU	-211-B14/3N -B	RHR PUMP 2B-B	S156	OT10	Y	N	
WBN-1-FU	-211-B15/1A -B	SI PUMP 1B-B AUX TRIP	S156	OT15	Y	N	
WBN-2-FU	-211-B15/1A -B	SI PUMP 2B-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B15/1N -B	SI PUMP 1B-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B15/1N -B	SI PUMP 2B-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B15/2A -B	SI PUMP 1B-B AUX CLOSE	B569	FRN15	Y	N	
WBN-2-FU	-211-B15/2A -B	SI PUMP 2B-B	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B15/2N -B	SI PUMP 1B-B NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B15/2N -B	SI PUMP 2B-B	S156	OT15	N	N	OT 10
WBN-1-FU	-211-B15/25 -B	SI PUMP 1B-B STATUS MONITOR RELAY A2 98	T268	312.062			NOT LISTED IN W/D DATA
WBN-2-FU	-211-B15/25 -B	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN W/D DATA
WBN-1-FU	-211-B15/3A -B	SI PUMP 1B-B AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B15/3A -B	SI PUMP 2B-B	S156	OT10	N	N	KLC 15
WBN-1-FU	-211-B15/3N -B	SI PUMP 1B-B NOR ELEV	S156	OT15	Y	N	
WBN-2-FU	-211-B15/3N -B	SI PUMP 2B-B	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU	-211-B16/1A -B	125VDC AUX TRIP BKR 1728 ALT FDR NO1	B569	FRN15	Y	N	
WBN-2-FU	-211-B16/1A -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828-AUX TRIP	B569	FRN15	N	N	OT15
WBN-1-FU	-211-B16/1N -B	125VDC NOR TRIP BKR 1728 ALT FDR NO1	S156	OT15	Y	N	
WBN-2-FU	-211-B16/1N -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828-NOR TRIP	B569	FRN15	N	Y	KLC15
WBN-1-FU	-211-B16/2A -B	125VDC AUX CLOSE BKR 1728 ALT FDR NO1	S156	OT15	—	N	ONE FRN15, ONE OT15 Δ
WBN-2-FU	-211-B16/2A -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828-AUX CLS	S156	OT15	Y	N	
WBN-1-FU	-211-B16/2N -B	125VDC NOR CLOSE BKR 1728 ALT FDR NO1	B569	FRN15	Y	N	
WBN-2-FU	-211-B16/2N -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828-NOR CLS	S156	OT15	Y	N	
WBN-1-FU	-211-B16/3A -B	125VDC AUX ELEV BKR 1728 ALT FDR NO1	S156	OT10	Y	N	
WBN-2-FU	-211-B16/3A -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828 AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B16/3N -B	125VDC NOR ELEV BKR 1728 ALT FDR NO1	S156	OT10	Y	N	
WBN-2-FU	-211-B16/3N -B	6900V SD BD 2B-B ALT NO1 FDR BKR 1828 NOR ELEV	S156	OT10	Y	N	
* WBN-1-FU	-211-B16/4 -B	LOOP ISOL APPDX R-PNL O-L-4 IND LT BKR 1728	B569	FRN-R1	Y	N	
* WBN-1-FU	-211-B16/5 -B	LOOP ISOL APPDX R-PNL O-L-4 IND LT BKR 1728	B569	FRN-R1	Y	N	
WBN-1-FU	-211-B17/1 -B	ALT SUPPLY NO 1- CSS XFMR D-PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-B17/1 -B	ALT NO. 1 SUPPLY FROM CSST D-BUS PTS PRI	G080	9F60BDE001			AC
AC WBN-1-FU	-211-B17/2 -B	ALT SUPPLY NO 1-CSS XFMR D-PT'S B-C	G080	9F60BDE001			
WBN-2-FU	-211-B17/2 -B	ALT NO. 1 SUPPLY FROM CSST D-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-B17/3 -B	125VDC EMERG CONTROL BUS 6.9KV SHTDN BD 1B-B	S156	OT6	Y	N	
WBN-2-FU	-211-B17/3 -B	125V DC EMERG CONTROL BUS RED LIGHT	S156	OT6	Y	N	
WBN-1-FU	-211-B17/4 -B	VM TRANS SW 1-XS-82-36C	S156	OT6			
WBN-2-FU	-211-B17/4 -B	VM XFER SW 2-XS-82-36C	S156	OT6			
WBN-1-FU	-211-B17/5 -B	VM TRANS SW 1-XS-57-66 & 1-XS-82-36A	S156	OT6			AC
AC WBN-2-FU	-211-B17/5 -B	VM XFER SW 2-XS-57-66 & 2-XS-82-36A	S156	OT6			
WBN-1-FU	-211-B17/6 -B	ALT SUPPLY NO 1-VM, WM, WHM, RELAYS	S156	OT6			
WBN-2-FU	-211-B17/6 -B	ALT NO. 1 SUPPLY FROM CSST D-BUS PTS SEC	S156	OT6			
WBN-1-FU	-211-B18/1A -B	CC PUMP 1B-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B18/1A -B	CC PUMP 2B-B	B569	FRN15	N	N	OT 15
WBN-1-FU	-211-B18/1N -B	CC PUMP 1B-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B18/1N -B	CC PUMP 2B-B NOR TRIP	B569	FRN15	—	—	FUSED REMOVED
WBN-1-FU	-211-B18/2A -B	CC PUMP 1B-B AUX CLOSE	S156	OT10	Y	N	
WBN-2-FU	-211-B18/2A -B	CC PUMP 2B-B	S156	OT15	—	—	FUSE REMOVED

Δ - FUSE UNID NO. NOTE SHOWN IN W/D DATA.

~~* - FUSE NO. (2-FU-211-B16/4-B & /5-B) NOT IN FUSE PRINT OUT~~

Prepared By W. Berry 1-25-90

Reviewed By R. Price 1-25-90

PRINTED IN U.S.A.

UN		DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH WND DATA	AGREES WITH S/C	LOCA
WBN-1-FU	-211-B18/2N -B	CC PUMP 1B-B NOR CLOSE	S156	OT10	Y	N	
WBN-2-FU	-211-B18/2N -B	CC PUMP 2B-B	S156	OT15	Y	N	
WBN-1-FU	-211-B18/25 -B	CC PUMP 1B-B STATUS MONITOR RELAY 182 100	T268	312.062			NOT LISTED IN WND DATA
WBN-2-FU	-211-B18/25 -B	STATUS MONITOR RELAY	T268	312.062			NOT LISTED IN WND DATA
WBN-1-FU	-211-B18/3A -B	CC PUMP 1B-B AUX ELEV	B569	KLC15	Y	Y	
WBN-2-FU	-211-B18/3A -B	CC PUMP 2B-B					OT10 INSTALLED
WBN-1-FU	-211-B18/3N -B	CC PUMP 1B-B NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B18/3N -B	CC PUMP 2B-B	S156	OT10	Y	N	
WBN-1-FU	-211-B19/1A -B	AUX TRIP - SPARE	B569	FRN15	—	—	FUSE REMOVED
WBN-2-FU	-211-B19/1A -B	AUX TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-B19/1N -B	NOR TRIP - SPARE	B569	FRN15	—	—	FUSE REMOVED
WBN-2-FU	-211-B19/1N -B	NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-B19/2A -B	AUX CLOSE - SPARE	S156	OT15	—	—	FUSE REMOVED
WBN-2-FU	-211-B19/2A -B	AUX CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-B19/2N -B	NOR CLOSE - SPARE	S156	OT15	—	—	FUSE REMOVED
WBN-2-FU	-211-B19/2N -B	NOR CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-B19/3A -B	AUX ELEV - SPARE	S156	OT10	Y	N	
WBN-2-FU	-211-B19/3A -B	AUX ELEV	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU	-211-B19/3N -B	NOR ELEV - SPARE	S156	OT10	—	—	FUSE REMOVED
WBN-2-FU	-211-B19/3N -B	NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B2/1 -B	ALT SUPPLY NO2 CSS XFMR C PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-B2/1 -B	ALT NO. 2 SUP FROM CSST C BUS PTS PRI	G080	9F60BDE001			AC
WBN-1-FU	-211-B2/2 -B	ALT SUPPLY NO2 CSS XFMR C PT'S B-C	G080	9F60BDE001			
WBN-2-FU	-211-B2/2 -B	ALT NO. 2 SUP FROM CSST C BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-B2/3 -B	125V DC NOR CONTROL BUS - IND LT ISOL	S156	OT6	Y	N	
WBN-2-FU	-211-B2/3 -B	125V DC NOR CONTROL BUS RED LIGHT	S156	OT6	Y	N	
WBN-1-FU	-211-B2/4 -B	ALT SUPPLY NO2 - VM, WM, WHM, RELAYS	S156	OT6			
WBN-2-FU	-211-B2/4 -B	ALT NO. 2 SUP FROM CSST C-BUS PTS SEC	S156	OT6			
WBN-1-FU	-211-B2/5 -B	VM TRANS SW 1-XS-82-36C	S156	OT6			AC
WBN-2-FU	-211-B2/5 -B	VM XFER SW 2-XS-82-36C	S156	OT6			
WBN-1-FU	-211-B2/6 -B	VM TRANS SW 1-XS-57-66 & 1-XS-83-36A	S156	OT6			
WBN-2-FU	-211-B2/6 -B	VM XFER SW 2-XS-57-66 & 2-XS-82-36A	S156	OT6			
WBN-1-FU	-211-B20/1A -B	PRES HTR BACKUP 1B-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B20/1A -B	PRES HTR BACKUP AUX TRIP	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B20/1N -B	PRESS HTR BACKUP 1B-B NORM TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B20/1N -B	PRES HTR BACKUP	B569	FRN15	Y	N	
WBN-1-FU	-211-B20/10 -	PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			
WBN-1-FU	-211-B20/11 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/12 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/13 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			AC
WBN-1-FU	-211-B20/14 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/15 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/16 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/17 -	PRESS HTR BACKUP GROUP 1B-B	B569	JJS225			
WBN-1-FU	-211-B20/2A -B	PRES HTR BACKUP 1B-B AUX CLOSE	B569	FRN15	Y	N	
WBN-2-FU	-211-B20/2A -B	PRES HTR BACKUP	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B20/2N -B	PRES HTR BACKUP 1B-B NOR CLOSE	B569	FRN15	Y	N	
WBN-2-FU	-211-B20/2N -B	PRES HTR BACKUP NOR CLOSE	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B20/3A -B	PRES HTR BACKUP 1B-B AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B20/3A -B	PRES HTR BACKUP AUX ELEV	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU	-211-B20/3N -B	PRES HTR BACKUP 1B-B NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B20/3N -B	PRES HTR BACKUP NOR ELEV	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU	-211-B20/4 -	PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			
WBN-1-FU	-211-B20/5 -	PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			
WBN-1-FU	-211-B20/6 -	PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			AC
WBN-1-FU	-211-B20/7 -	PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

UNI[illegible]		DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES WITH SL	LOCA[illegible]N
WBN-1-FU	-211-B20/8	- PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			AC
WBN 1 FU	-211-B20/9	- PRESS HTR BACKUP GROUP 1B-B	F055	XJL225			
WBN-1-FU	-211-B21/1A	-B PRES HTR BACKUP 1C-AUX TRIP	S156	OT15	Y	N	
WBN-2-FU	-211-B21/1A	-B PRES HTR BACKUP 2C AUX TRIP	B569	FRN15	—	—	FUSE REMOVED
WBN-1-FU	-211-B21/1N	-B PRES HTR BACKUP 1C - NOR TRIP	S156	OT15	Y	N	
WBN-2-FU	-211-B21/1N	-B PRES HTR BACKUP 2C NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-B21/10	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			
WBN-1-FU	-211-B21/11	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			
WBN-1-FU	-211-B21/12	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			
WBN-1-FU	-211-B21/13	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			AC
WBN-1-FU	-211-B21/14	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			
WBN-1-FU	-211-B21/15	- PRESS HTR BACKUP GROUP 1C	B569	JJS225			
WBN-1-FU	-211-B21/2A	-B PRES HTR BACKUP 1C AUX CLOSE	S156	OT10	Y	N	
WBN 2 FU	-211-B21/2A	-B PRES HTR BACKUP 2C AUX CLOS	S156	OT15	N	Y	KLC 15A
WBN-1-FU	-211-B21/2N	-B PRES HTR BACKUP 1C NOR CLOSE	S156	OT10	Y	N	
WBN 2 FU	-211-B21/2N	-B PRES HTR BACKUP 2C NOR CLOS	S156	OT15	Y	N	
WBN-1-FU	-211-B21/3A	-B PRES HTR BACKUP 1C AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B21/3A	-B PRES HTR BACKUP 2C AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B21/3N	-B PRES HTR BACKUP 1C NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B21/3N	-B PRES HTR BACKUP 2C	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU	-211-B21/4	- PRESS HTR BACKUP GROUP 1C	F055	XJL225			
WBN-1-FU	-211-B21/5	- PRESS HTR BACKUP GROUP 1C	F055	XJL225			
WBN-1-FU	-211-B21/6	- PRESS HTR BACKUP GROUP 1C	F055	XJL225			
WBN-1-FU	-211-B21/7	- PRESS HTR BACKUP GROUP 1C (A)	F055	XJL225			AC
WBN-1-FU	-211-B21/8	- PRESS HTR BACKUP GROUP 1C	F055	XJL225			
WBN-1-FU	-211-B21/9	- PRESS HTR BACKUP GROUP 1C	F055	XJL225			
WBN 1 FU	-211-B3/1	-B 125V DC SHUTDN TRANS 1B1-B TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B3/1	-B 125V DC SHUTDN TRANS 2B1-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B3/2	-B 125V DC SHUTDN TRANS 1B1-1 CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-B3/2	-B 125V DC SHUTDN TRANS 2B1-B	S156	OT15	Y	N	
WBN-1-FU	-211-B3/3	-B 125V DC SHUTDN TRANS 1B1-B-ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B3/3	-B 125V DC SHUTDN TRANS 2B1-B	S156	OT10	Y	N	
WBN 1 FU	-211-B3/4	-B 125V DC SHUTDN TRANS 1B1-B-CONT	S156	OT6	Y	N	
WBN-2-FU	-211-B3/4	-B 125V DC SHUTDN TRANS 2B1-B	S156	OT6	Y	N	
* WBN-1-FU	-211-B3/5	-B LOOP ISOL APPDX R PNL O-L-4 IND LT	B569	FRN-R1	Y	N	
* WBN-1-FU	-211-B3/6	-B LOOP ISOL APPDX R-PNL O-L-4 IND LT	B569	FRN-R1	Y	N	
WBN-1-FU	-211-B4/1	-B 480V SHUTDN TRANS 1B2-B TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B4/1	-B 125V DC SHUTDN TRANS 2B2-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B4/1A	-B ANN HI TEMP RELAY ISOLATION APPENDIX R	B569	MIS5			NOT LISTED IN W/D DATA
WBN-2-FU	-211-B4/1A	-B HI TEMP RELAY ISOLATION	B569	MIS5			NOT LISTED IN W/D DATA
WBN-1-FU	-211-B4/2	-B 480V SHUTDN TRANS 1B2-B CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-B4/2	-B 125V DC SHUTDN TRANS 2B2-B	S156	OT15	Y	N	
WBN 1 FU	-211-B4/3	-B 480V SHUTDN TRANS 1B2-B ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B4/3	-B 125V DC SHUTDN TRANS 2B2-B	S156	OT10	Y	N	
WBN-1-FU	-211-B4/4	-B IND LT FUSES 1-M-1 & O-M-26	S156	OT6	Y	N	
WBN 2 FU	-211-B4/4	-B 125V DC SHUTDN TRANS 2B2-B	S156	OT6	Y	N	
** WBN-1-FU	-211-B4/5	-B LOOP ISOLATION APPDX R-IND LT O-L-4	B569	FRN-R1	Y	N	
** WBN-1-FU	-211-B4/6	-B LOOP ISOL APPDX R - IND LT O-L-4	B569	FRN-R1	Y	N	
** WBN-1-FU	-211-B5/1	-B 480V SHTDN TRANS 1B-B TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B5/1	-B 125V DC SHUTDN TRANS 2B-B	B569	FRN15	Y	N	
WBN-1-FU	-211-B5/2	-B 480V SHTDN TRANS 1B-B CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-B5/2	-B 125V DC SHUTDN TRANS 2B-B	S156	OT15	Y	N	
WBN-1-FU	-211-B5/3	-B 480V SHTDN TRANS 1B-B ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B5/3	-B 125V DC SHUTDN TRANS 2B-B	S156	OT10	Y	N	
WBN-1-FU	-211-B5/4	-B IND LT FUSES 1-M-1 & O-M-26	S156	OT6	Y	N	
WBN-2-FU	-211-B5/4	-B 125V DC SHUTDN TRANS 2B-B	S156	OT6	Y	N	

* U2 FUSES (2-FU-211-B3/5-B & /6-B) NOT LISTED IN PRINT OUT.

** U2 FUSES (2-FU-211-B4/5-B & /6-B) NOT LISTED IN PRINT OUT.

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

PRINTED IN U.S.A.

UNIT			DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/D DATA	AGREES LCCAT WITH S/C	
** WBN-1-FU	-211-B5/5	-B	LOOP ISOL APPDX R - IND LT O-L-4	B569	FRN-R1	Y	N	
** WBN-1-FU	-211-B5/6	-B	LOOP ISOL APPDX R - IND LT O-L-4	B569	FRN-R1	Y	N	
WBN-1-FU	-211-B6/1A	-B	6.9KV D-G 1B-B BKR 1914 - AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B6/1A	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-AUX TRIP	B569	FRN15	N	Y	KLC 15 INSTALL
WBN-1-FU	-211-B6/1N	-B	6.9KV D-G 1B-B BKR 1914 - NORM TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B6/1N	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-NOR TRIP	B569	FRN15	N	N	OT15 INSTALLED
WBN-1-FU	-211-B6/2A	-B	6.9KV D-G 1B-B BKR 1914 - AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B6/2A	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-AUX CLS	S156	OT10	Y	N	
WBN-1-FU	-211-B6/2N	-B	6.9 KV D-G BKR 1914 - NORM CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B6/2N	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-NOR CLS	S156	OT10	Y	N	
WBN-1-FU	-211-B6/3A	-B	6.9KV DG 1B-B BKR 1914 - AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B6/3A	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-AUX ELEV	S156	OT15	Y	N	
WBN-1-FU	-211-B6/3N	-B	6.9KV DG 1B-B BKR 1914 - NOR ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B6/3N	-B	6900V SD BD 2B-B EMERG FDR BKR 1924-NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B6/4	-B	FEEDER AUTO TRANSFER LOCKOUT	B569	KLC6	—	—	ONE KLC6, ONE AND TR
WBN-2-FU	-211-B6/4	-B	125V DC AUTO XFER LOCKOUT	S156	OT6	—	N	ONE OT6, ONE AND TRAP
* WBN-1-FU	-211-B6/5	-B	INDICATING LT FUSE PNL O-L-4	B569	FRN-R1	Y	N	
WBN-1-FU	-211-B6/6	-B	INDICATING LT FUSE PNL O-L-4	B569	FRN-R1	Y	N	
* WBN-1-FU	-211-B7/1	-B	USL GEN 1B-B PT'S A-B	G080	9F60BDE001			
WBN-2-FU	-211-B7/1	-B	EMERG SUP FROM DG 2B-B-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-B7/2	-B	DSL GEN 1B-B PT'S B-C	G080	9F60BDE001			
WBN-2-FU	-211-B7/2	-B	EMERG SUP FROM DG 2B-B-BUS PTS PRI	G080	9F60BDE001			
WBN-1-FU	-211-B7/3	-B	VM TRANS SW 1-XS-82-36C	S156	OT6			
AC WBN-2-FU	-211-B7/3	-B	VM XFER SW 2-XS-82-36A	S156	OT6			
WBN-1-FU	-211-B7/4	-B	VM TRANS SW 1-XS-82-36C	S156	OT6			AC
WBN-2-FU	-211-B7/4	-B	VM XFER SW 2-XS-82-36C	S156	OT6			
WBN-1-FU	-211-B7/5	-B	DIESEL GEN 1B-B VM, VARM, WM	S156	OT6			
WBN-1-FU	-211-B7/6	-B	6.9KV SHUTDN BD 1B-B VOLT RELAYS-PRIMARY	G080	9F60BDE001			
WBN-2-FU	-211-B7/6	-B	6.9KV SHUTDOWN BD 2B-B					
AC WBN-1-FU	-211-B7/7	-B	6.9KV SHUTDN BD 1B-B VOLT RELAYS-SECONDARY	S156	A4J1			
WBN-2-FU	-211-B7/7	-B	6.9KV SHUTDN BD 1B-B		*			
WBN-1-FU	-211-B8/1A	-B	ERCW PUMP F-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B8/1A	-B	ERCW PUMP H-B AUX TRIP	B569	FRN15	N	Y	KLC 15
WBN-1-FU	-211-B8/1N	-B	ERCW PUMP F-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B8/1N	-B	ERCW PUMP H-B NOR TRIP	B569	FRN15	Y	N	
WBN-1-FU	-211-B8/2A	-B	ERCW PMP F-B AUX CLOSE	B569	KLC15	Y	Y	
WBN-2-FU	-211-B8/2A	-B	ERCW PUMP H-B AUX CLOSE	S156	OT15	—	—	ONE OT15, ONE KLC
WBN-1-FU	-211-B8/2N	-B	ERCW PMP F-B NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B8/2N	-B	ERCW PUMP H-B NOR CLOSE	S156	OT15	Y	N	
WBN-1-FU	-211-B8/25	-B	ERCW PMP STATUS MONITOR RELAY 1B2-88	T268	312.062			NOT LISTED IN W/D DAT
WBN-2-FU	-211-B8/25	-B	STATUS MONITOR RELAY 2B2-106	T268	312.062			NOT LISTED IN W/D DA
WBN-1-FU	-211-B8/3A	-B	ERCW PMP F-B AUX ELEV	S156	OT10	Y	N	
WBN-2-FU	-211-B8/3A	-B	ERCW PUMP H-B AUX ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B8/3N	-B	ERCW PMP F-B NOR ELEV	S156	OT15	—	N	ONE OT10, ONE OT15
WBN-2-FU	-211-B8/3N	-B	ERCW PUMP H-B NOR ELEV	S156	OT10	Y	N	
WBN-1-FU	-211-B9/1A	-B	ERCW PMP E-B AUX TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B9/1A	-B	ERCW PUMP G-B AUX TRIP	B569	FRN15	—	—	FUSE REMOVED
WBN-1-FU	-211-B9/1N	-B	ERCW PMP E-B NOR TRIP	B569	FRN15	Y	N	
WBN-2-FU	-211-B9/1N	-B	ERCW PUMP G-B NOR TRIP	B569	FRN15	—	—	FUSE REMOVED
WBN-1-FU	-211-B9/2A	-B	ERCW PMP E-B AUX CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B9/2A	-B	ERCW PUMP G-B AUX CLOSE	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B9/2N	-B	ERCW PMP E-B NOR CLOSE	S156	OT15	Y	N	
WBN-2-FU	-211-B9/2N	-B	ERCW PUMP G-B NOR CLOSE	S156	OT15	—	—	FUSE REMOVED
WBN-1-FU	-211-B9/25	-B	ERCW PMP-STATUS MONITOR RELAY 1B2 90	T268	312.062			NOT LISTED IN W/D A
WBN-2-FU	-211-B9/25	-B	STATUS MONITOR RELAY 2B2-104	T268	312.062			NOT LISTED IN W/D D
WBN-1-FU	-211-B9/3A	-B	ERCW PMP E-B AUX ELEV	S156	OT10	Y	N	

* U2 FUSES (2-FU-211-A6/5-A & /6-A) NOT LISTED IN PRINTOUT.
** U2 FUSES (2-FU-211 B5/5-B & /6-B) NOT LISTED IN PRINTOUT.

Prepared By W. Berry 1-25-90
Reviewed By R. Pierce 1-25-90

UNIT	DESCRIPTION	MFG REF #	MFG MOD #	AGREES WITH W/P DATA	AGREES WITH S/L	LOCATION
WBN-2-FU -211-B9/3A -B	ERCW PUMP G-B AUX ELEV	S156	OT10	—	—	
WBN-1-FU -211-B9/3N -B	ERCW PMP E-B NOR ELEV	S156	OT10	Y	N	FUSE REMOVED...
WBN-2-FU -211-B9/3N -B	ERCW PUMP G-B NOR ELEV	S156	OT10	—	—	FUSE REMOVED
WBN-1-FU -212-A11/11 -A	480V SD BD 1A1-A NOR FDR BKR 52N PTS-PRI	B569	JKS6			
WBN-2-FU -212-A11/11 -A	480V SD BD 2A1-A NOR FDR BKR 52N PTS-PRI	B569	JKS6			
WBN-1-FU -212-A11/12 -A	480V SD BD 1A1-A NOR FDR BKR 52N PTS-PRI	B569	KLC6			
WBN-2-FU -212-A11/12 -A	480V SD BD 2A1-A NOR FDR BKR 52N PTS-SEC	B569	KTN6			
WBN-1-FU -212-A11/13 -A	480V SD BD 1A1-A NOR FDR BKR 52N TRIP	B569	KWN10			
WBN-2-FU -212-A11/13 -A	480V SD BD 2A1-A NOR FDR BKR 52N TRIP	B569	KWN10			
WBN-1-FU -212-A11/14 -A	480V SD BD 1A1-A NOR FDR BKR 52N CLOSE	B569	KWN10			
WBN-2-FU -212-A11/14 -A	480V SD BD 2A1-A NOR FDR BKR 52N CLOSE	B569	KWN10			
WBN-1-FU -212-A11/15 -A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6			
WBN-2-FU -212-A11/15 -A	480V SD BD 2A1-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6			
WBN-1-FU -212-A11/16 -A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-2-FU -212-A11/16 -A	480V SD BD 2A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-1-FU -212-A11/17 -A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-2-FU -212-A11/17 -A	480V SD BD 2A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-1-FU -212-A11/31 -A	BKR 10 FUTURE 1600A (EO) - TRIP	B569	KWN10			
WBN-2-FU -212-A11/31 -A	TRIP BKR 10	B569	KWN10			
WBN-1-FU -212-A11/32 -A	BKR 10 FUTURE 1600A (EO) - CLOSE	B569	KWN10			
WBN-2-FU -212-A11/32 -A	CLOSE BKR 10	B569	KWN10			
WBN-1-FU -212-A110/1 -A	NOR FDR 125V VITAL BATT CHG 1	S156	CP500C5			
WBN-1-FU -212-A110/11 -A	NOR FDR C&A VT BD 1A1-A	S156	CP500C5			
WBN-2-FU -212-A110/13 -A	COMPARTMENT 10B	S156	CP6A			
WBN-1-FU -212-A110/21 -A	BKR 10C CNTMT AIR RETURN FAN 1A-A TRIP	B569	KWN10			
WBN-1-FU -212-A110/22 -A	BKR. 10C, CNTMT AIR RETURN FAN 1A-A CLOSE	B569	KWN10			
WBN-1-FU -212-A110/23 -A	CNTMT AIR RETURN FAN 1A-A	S156	CP6A-85			
WBN-2-FU -212-A110/23 -A	CNTMT AIR RETURN FAN 2A-A	S156	CP6A			
WBN-1-FU -212-A110/24 -A	ANN.COMPT 10C CNTMT AIR RETURN FAN 1A-A	T268	FLAS 5			
WBN-2-FU -212-A110/24 -A	CNTMT AIR RETURN FAN 2A-A	B569	KAZ			
WBN-2-FU -212-A110/3 -A	125V VITAL BATT III NOR FDR	S156	CP6A			
WBN-1-FU -212-A110/30 -A	CNTMT AIR RETURN FAN 1A-A	T268	312.062			
WBN-2-FU -212-A110/30 -A	FILTERING MODULE	T268	312.062			
WBN-1-FU -212-A110/31 -A	SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A TRIP	B569	KWN10			
WBN-1-FU -212-A110/31A -A	ALT FEEDER C & A VT BD		*			
WBN-2-FU -212-A110/31A-A	AUX TRIP BKR 10D	B569	KWN10			
WBN-2-FU -212-A110/31N-A	NOR TRIP BKR 10C	B569	KWN10			
WBN-1-FU -212-A110/32 -A	SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A-CLOSE	B569	KWN10			
WBN-2-FU -212-A110/32 -A	AUX TRIP BKR 10C	B569	KWN10			
WBN-2-FU -212-A110/32N-A	NOR CLOSE BKR 10C	B569	KWN10			
WBN-1-FU -212-A110/33	480V SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A	S156	CP500C5			
WBN-2-FU -212-A110/33 -A	ALT FDR CONT & AUX BLDG	S156	CP6A			
WBN-1-FU -212-A111/1 -A	480V SD BD 1A1-A 1600A BUS PTS-PRI	B569	JKS6			
WBN-2-FU -212-A111/1 -A	480V SD BD 2A1-A 1600A BUS PTS-PRI	B569	JKS6			
WBN-1-FU -212-A111/2 -A	480V SD BD 1A1-A 1600A BUS PRS-SEC	B569	KTN6			
WBN-2-FU -212-A111/2 -A	480V SD BD A1-A VM CONT FU					
WBN-1-FU -212-A111/3 -A	480V SD BD 1A1-A 1600A BUS GRND IND PTS-PRI	B569	JKS6			
WBN-2-FU -212-A111/3 -A	480V SD BD 2A1-A 1600A BUS GRND IND PTS-PRI	B569	JKS6			
WBN-1-FU -212-A111/4 -A	480V SD BD 1A1-A 1600A BUS GRND IND PTS-SEC	B569	KTN5			
WBN-2-FU -212-A111/4 -A	480V SD BD 2A1-1 1600A BUS GRND IND PTS-SEC	B569	KTN6			
WBN-1-FU -212-A112/11 -A	480V SD BD 1A1-A SPARE BKR 52S PTS-PRI	B569	JKS6			
WBN-2-FU -212-A112/11 -A	480V SD BD 2A1-A SPARE BKR 52S PTS-PRI	B569	JKS6			
WBN-1-FU -212-A112/12 -A	480V SD BD 1A1-A SPARE BKR 52S PTS SEC	B569	KTN6			
WBN-2-FU -212-A112/12 -A	480V SD BD 2A1-A SPARE BKR 52S PTS-SEC	B569	KTN6			
WBN-1-FU -212-A112/13 -A	480V SD BD 1A1-A SPARE BKR 52S TRIP	B569	KWN10			
WBN-2-FU -212-A112/13 -A	480V SD BD 2A1-A SPARE BKR 52S-TRIP	B569	KWN10			

Prepared By [illegible] 1-25-
Reviewed By [illegible] 1-25-

WBN-EEB-MS-TI07-0005
Attachment I

WBN-EEB-MS-TI07-0005
Attachment I

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/ WID Pkg	agrees with S/L & schematic	LOCATION
~~WBN-2-FU -211-B9/3A -A~~	~~ERCW PUMP G-B AUX ELEV~~	~~S156~~	~~OT10~~			
~~WBN-1-FU 211 B9/3N -A~~	~~ERCW PMP E-B NOR ELEV~~	~~S156~~	~~OT10~~			
~~WBN-2-FU -211-B9/3N -A~~	~~ERCW PUMP G-B NOR ELEV~~	~~S156~~	~~OT10~~			
WBN-1-FU -212-A11/11 -A	480V SD BD 1A1-A NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	AC
WBN-2-FU -212-A11/11 -A	480V SD BD 2A1-A NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	
WBN 1 FU 212 A11/12 -A	480V SD BD 1A1-A NOR FDR BKR 52N PTS-PRI	B569	KLC6	—	—	
WBN-2-FU -212-A11/12 -A	480V SD BD 2A1-A NOR FDR BKR 52N PTS-SEC	B569	KTN6	—	—	
WBN 1 FU 212 A11/13 A	480V SD BD 1A1-A NOR FDR BKR 52N TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-A11/13 -A	480V SD BD 2A1-A NOR FDR BKR 52N TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A11/14 -A	480V SD BD 1A1-A NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-A11/14 -A	480V SD BD 2A1-A NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	
WBN 1 FU 212 A11/15 A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	X	✓	(KTN & KWN used)
WBN-2-FU -212-A11/15 -A	480V SD BD 2A1-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	X	✓	
WBN-1-FU -212-A11/16 -A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-A11/16 -A	480V SD BD 2A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU -212-A11/17 -A	480V SD BD 1A1-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN 2 FU 212 A11/17 A	480V SD BD 2A1 A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU -212-A11/31 -A	BKR 10 FUTURE 1600A (EO) - TRIP	B569	KWN10	✓	—	Future Compt
WBN-2-FU -212-A11/31 -A	TRIP BKR 10	B569	KWN10	✓	—	(NO Fuses)
WBN-1-FU -212-A11/32 -A	BKR 10 FUTURE 1600A (EO) - CLOSE	B569	KWN10	✓	—	Future Compt
WBN-2-FU -212-A11/32 -A	CLOSE BKR 10	B569	KWN10	✓	—	(NO Fuses)
WBN 1 FU 212 A110/1 A	NOR FDR 125V VITAL BATT CHG 1	S156	CP500C5	—	—	
WBN-1-FU -212-A110/11 -A	NOR FDR C&A VT BD 1A1-A	S156	CP500C5	—	—	AC
WBN 2 FU 212 A110/13 -A	COMPARTMENT 10B	S156	CP6A	—	—	
WBN-1-FU -212-A110/21 -A	BKR 10C CNTMT AIR RETURN FAN 1A-A TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A110/22 -A	BKR. 10C, CNTMT AIR RETURN FAN 1A-A CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-A110/23 -A	CNTMT AIR RETURN FAN 1A-A	S156	CP6A-85	—	—	
WBN 2 FU 212 A110/23 -A	CNTMT AIR RETURN FAN 2A-A	S156	CP6A	—	—	AC
WBN-1-FU -212-A110/24 A	ANN.COMPT 10C CNTMT AIR RETURN FAN 1A A	T268	FLAS 5	—	—	AC
WBN-2-FU -212-A110/24 -A	CNTMT AIR RETURN FAN 2A-A	B569	KAZ	—	—	
WBN-2-FU -212-A110/3 -A	125V VITAL BATT III NOR FDR	S156	CP6A	—	—	
WBN-1-FU -212-A110/30 -A	CNTMT AIR RETURN FAN 1A-A	T268	312.062	—	—	not listed in w/D Data
WBN-2-FU -212-A110/30 -A	FILTERING MODULE	T268	312.062	—	—	
WBN-1-FU -212-A110/31 -A	SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A TRIP	B569	KWN10	✓	✓	
WBN 1 FU 212 A110/31A A	ALT FEEDER C & A VT BD		*			(NOT LISTED IN WID DATA
WBN-2-FU -212-A110/31A-A	AUX TRIP BKR 10D	B569	KWN10	✓	✓	
WBN-2-FU -212-A110/31N-A	NOR TRIP BKR 10C	B569	KWN10	✓	✓	
WBN-1-FU -212-A110/32 -A	SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A-CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-A110/32 -A	AUX TRIP BKR 10C	B569	KWN10	✓	✓	
WBN-2-FU -212-A110/32N-A	NOR CLOSE BKR 10C	B569	KWN10	✓	✓	
WBN 1 FU 212 A110/33	480V SD BD 1A1-A ALT FDR TO C&A VT BD 1A2-A	S156	CP500C5	—	—	
WBN-2-FU -212-A110/33 -A	ALT FDR CONT & AUX BLDG	S156	CP6A	—	—	
WBN-1-FU -212-A111/1 -A	480V SD BD 1A1-A 1600A BUS PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-A111/1 -A	480V SD BD 2A1-A 1600A BUS PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-A111/2 -A	480V SD BD 1A1-A 1600A BUS PRS-SEC	B569	KTN6	—	—	AC
WBN-2-FU 212 A111/2 A	480V SD BD A1 A VM CONT FU			—	—	
WBN-1-FU -212-A111/3 -A	480V SD BD 1A1-A 1600A BUS GRND IND PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-A111/3 -A	480V SD BD 2A1-A 1600A BUS GRND IND PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-A111/4 -A	480V SD BD 1A1-A 1600A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-A111/4 -A	480V SD BD 2A1-1 1600A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-A112/11 -A	480V SD BD 1A1-A SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-A112/11 A	480V SD BD 2A1-A SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN 1 FU 212 A112/12 A	480V SD BD 1A1-A SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	omitted in
WBN-2-FU -212-A112/12 -A	480V SD BD 2A1-A SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	evaluation
WBN-1-FU -212-A112/13 -A	480V SD BD 1A1-A SPARE BKR 52S TRIP	B569	KWN10	—	—	
WBN-2-FU -212-A112/13 -A	480V SD BD 2A1-A SPARE BKR 52S-TRIP	B569	KWN10	—	—	

Prepared By RR Pierce 1-25-90
Reviewed By W. Berry 1-25-90

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 1990 85

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/P Pkg	agrees with S/L Schem.	LOCATION
WBN-1-FU -212-A112/14 -A	480V SD BD 1A1-1 SPARE BKR 52S CLOSE	B569	KWN10	—	—	
WBN 2 FU 212 A112/14 A	480V SD BD 2A1 A SPARE BKR 52S CLOSE	B569	KWN10	—	—	
WBN-1-FU -212-A112/15 -A	480V SD BD 1A1-A SPARE BKR 52S IND LGTS	B569	KTN6	—	—	omitted in
WBN-2-FU -212-A112/15 -A	480V SD BD 2A1-A SPARE BKR 52S IND LTS	B569	KTN6	—	—	evaluation
WBN-1-FU -212-A112/16 -A	480V SD BD 1A1 A SPARE BKR 52S INTL FUSE	W120	151D932G010	—	—	
WBN 2 FU 212-A112/16 -A	BUS PROTECTION BKR 12B	W120	151D932G010	—	—	
WBN-1-FU -212-A112/31 -A	480V SD BD 1A1-A BUS TIE BKR 52T PTS- PRI	B569	JKS6	—	—	
WBN-2-FU -212-A112/31 -A	480V SD BD 2A1-A BUS BKR 52T PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-A112/32 -A	480V SD BD 1A1-A BUS TIE BKR 52T PTS-SEC	B569	KTN6	—	—	AC
WBN-2-FU -212-A112/32 -A	480V SD BD 2A1-A BUS TIE BKR 52T PTS-SEC	B569	KTN6	—	—	
WBN 1 FU 212 A112/33 A	480V SD BD 1A1-A BUS TIE BKR 52T TRIP	B569	KWN10	—	✓	NOT LISTED IN W/P DATA
WBN 2 FU 212 A112/33 A	480V SD BD 2A1 A BUS TIE BKR 52T TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A112/34 -A	480V SD BD 1A1-A BUS TIE BKR 52T CLOSE	B569	KWN10	—	—	NOT LISTED IN W/P DATA
WBN-2-FU -212-A112/34 -A	480V SD BD 2A1-A BUS TIE BKR 52T CLS	B569	KWN10	✓	✓	
WBN-1-FU -212-A112/35 -A	480V SD BD 1A1-A BUS TIE BKR 52T IND LTS ISOL	B569	KWN10	—	—	NOT LISTED IN W/P DATA
WBN-2-FU -212-A112/35 -A	480V SD BD 2A1-A BUS TIE BKR 52T IND LTS ISOL	B569	KTN6	✓	X	
WBN 1 FU 212 A112/36 A	480V SD BD 1A1 A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-A112/36 -A	480V SD BD 2A1-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU -212-A112/37 -A	480V SD BD 1A1-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-A112/37 -A	480V SD BD 2A1-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN 1 FU 212 A112/38 A	480V SD BD 1A1 A SPARE BKR 52T INTL FUSE	W120	151D932G010	—	—	AC
WBN-2-FU -212-A112/38 -A	BUS PROTECTION BKR 12D	W120	151D932G010	—	—	
WBN-1-FU -212-A12/11 -A	BKR 2B FUTURE 1600A (EO) TRIP	B569	KWN10	✓	—	Future Compt
WBN-2-FU -212-A12/11 -A	TRIP BKR 2B	B569	KWN10	✓	—	
WBN-1-FU -212-A12/12 -A	BKR 2B FUTURE 1600A (EO) CLOSE	B569	KWN10	✓	—	
WBN-2-FU -212-A12/12 -A	CLOSE BKR 2B	B569	KWN10	✓	—	
WBN 1 FU 212 A12/21 A	AUX BLDG GEN SUPPLY FAN 1A BKR 2C TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-A12/21 -A	TRIP BKR 2C	B569	KWN10	✓	✓	
WBN-1-FU -212-A12/22 -A	AUX BLDG GEN SUPPLY FAN 1A BKR 2C CLOSE	B569	KWN10	✓	✓	
WBN 2 FU 212 A12/22 -A	CLOSE BKR 2C	B569	KWN10	✓	✓	
WBN-1-FU -212-A12/31 -A	BKR 2D FUTURE 1600A (EO) TRIP	B569	KWN10	✓	—	(Fuses not installed)
WBN-2-FU -212-A12/31 -A	TRIP BKR 2D	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A12/32 -A	BKR 2D FUTURE 1600A (EO) CLOSE	B569	KWN10	—	—	(Fuses not installed)
WBN 2 FU 212 A12/32 -A	CLOSE BKR 2D	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A13/11A -A	CCS PUMP 1A-A BKR 3B AUX TRIP	B569	KWN10	✓	✓	
WBN 2 FU 212 A13/11A A	AUX TRIP BKR 3B	B569	KWN10	✓	✓	
WBN-1-FU -212-A13/11N -A	CCS PUMP 1A-A BKR 3B NOR TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-A13/11N -A	NOR TRIP BKR 3B	B569	KWN10	✓	✓	
WBN-1-FU -212-A13/12A -A	CCS PUMP 1A-A BKR 3B AUX CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-A13/12A -A	AUX CLOSE BKR 3B	B569	KWN10	✓	✓	
WBN-1-FU -212-A13/12N -A	CCS PUMP 1A-A BKR 3B NOR CLOSE	B569	KWN10	✓	✓	
WBN 2 FU 212 A13/12N A	NOR CLOSE BKR 3B	B569	KWN10	✓	✓	
WBN-1-FU -212-A13/20 -A	CCS PMP 1A-A	T268	312.062	—	—	Not listed in W/P Data
WBN-2-FU -212-A13/20 -A	FILTERING MODULE	T268	312.062	—	—	
WBN-1-FU -212-A13/21A -A	AUX TRIP BKR 3C, SPARE	B569	KWN10	✓	—	SPARE COMPT
WBN-2-FU -212-A13/21A -A	AUX TRIP BKR 3C, SPARE	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A13/21N -A	NOR TRIP BKR 3C, SPARE	B569	KWN10	✓	—	Spare Compt
WBN-2-FU 212 A13/21N A	NOR TRIP BKR 3C	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A13/22A -A	AUX CLOSE BKR 3C, SPARE	B569	KWN10	✓	—	Spare Compt
WBN-2-FU 212 A13/22A A	AUX CLOSE BKR 3C	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A13/22N -A	NOR CLOSE BKR 3C, SPARE	B569	KWN10	✓	—	Spare Compt
WBN-2-FU -212-A13/22N -A	NOR CLOSE BKR 3C	B569	KWN10	—	—	(No Fuses)
WBN-1-FU -212-A13/31 -A	BKR 3D FUTURE 1600A (EO) TRIP	B569	KWN10	—	—	(not installed)
WBN 2 FU 212 A13/31 A	TRIP BKR 3D	B569	KWN10	—	—	(not installed)
WBN-1-FU -212-A13/32 -A	BKR 3D FUTURE 1600A (EO) CLOSE	B569	KWN10	—	—	(not installed)
WBN-2-FU -212-A13/32 -A	CLOSE BKR 3D	B569	KWN10	—	—	(not installed)

Prepared By RR Pierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

UNID		DESCRIPTION	MFG REF #	MFG MOD #	agrees with DB Pkg	agrees with S/L & schem	LOCATION
WBN 1-FU	212 A14/11 A	480V SD BD 1A1-A EMERG FDR BKR 52E PTS PRI	B569	JKS6	—	—	
WBN-2-FU	-212-A14/11 -A	480V SD BD 2A1-A EMERG FDR BKR 52E PTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-A14/12 -A	480V SD BD 1A1-A EMERG FDR BKR 52E PTS-PRI	B569	KWN6	—	—	AC
WBN-2-FU	-212 A14/12 A	480V SD BD 2A1-A EMERG FDR BKR 52E PTS PRI	B569	KTN6	—	—	
WBN-1-FU	-212-A14/13 -A	480V SD BD 1A1-A ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A14/13 -A	480V SD BD 2A1-A ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN-1-FU	-212-A14/14 -A	480V SD BD 1A1-A ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A14/14 -A	480V SD BD 2A1-A ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN 1 FU	212 A14/15 A	480V SD BD 1A1-A ALT FDR BKR 52E IND LTS ISOL	B569	KTN6	X	X	(has both KWN6 & KTN-6)
WBN 2 FU	212 A14/15 A	480V SD BD 2A1-A ALT FDR BKR 52E IND LTS ISOL	B569	KWN6	✓	✓	
WBN-1-FU	-212-A14/16 -A	480V SD BD 1A1-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-A14/16 -A	480V SD BD 2A1-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-A14/17 -A	480V SD BD 1A1-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN 2 FU	212 A14/17 A	480V SD BD 2A1-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-A15/1 -A	480V SD BD 1A1-A BUS PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-A15/1 -A	480V SD BD 2A1-A BUS PTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-A15/2 -A	480V SD BD 1A1-A BUS PTS-SEC	B569	KWN6	—	—	AC
WBN 2 FU	212 A15/2 A	480V SD BD 2A1-A BUS PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-A15/3 -A	480V SD BD 1A1-A GRND IND PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-A15/3 -A	480V SD BD 2A1-A BUS GRND IND PTS-PRI	B569	JKS6	—	—	
WBN 1 FU	212-A15/4 -A	480V SD BD 1A1-A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-A15/4 -A	480V SD BD 2A1-A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-A15/5 -A	480V SD BD 1A1-A NOR DC CNTL BUS UV RLY	B569	KWN6	✓	✓	
WBN-2-FU	-212-A15/5 -A	480V SD BD 2A1-A NOR DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU	-212-A15/6 -A	480V SD BD 1A1-A EMERG DC CNTL BUS UV RLY	B569	KWN-R6	X	X	(has both KWN-R6 & KWN6)
WBN 2 FU	212 A15/6 A	480V SD BD 2A1-A EMERG DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU	-212-A17/1 -A	SPENT FUEL PIT PUMP C-S TRAIN A BRK 7A TRIP	B569	KWN10	✓	—	(not installed)
WBN-2-FU	-212-A17/1 -A	TRIP BKR 7A	B569	KWN10	✓	—	
WBN-1-FU	-212-A17/11A -A	CRDM CLR FAN 1A-A MTR 1 BKR 7B AUX TRIP	B569	KWN10	✓	X	
WBN-2-FU	-212-A17/11A -A	AUX TRIP BKR 7B	B569	KWN10	✓	—	(no Fuse)
WBN-1-FU	-212-A17/11N -A	CRDM CLR FAN 1A-A MTR 1 BKR 7B NOR TRIP	B569	KWN10	✓	X	
WBN-2-FU	-212 A17/11N A	NOR TRIP BKR 7B	B569	KWN10	✓	—	(no Fuse)
WBN-1-FU	-212-A17/12A -A	CRDM CLR FAN 1A-A MTR 1 BKR 7B AUX CLOSE	B569	KWN10	✓	X	
WBN-2-FU	-212-A17/12A -A	AUX CLOSE BKR 7B	B569	KWN10	✓	—	(no Fuse)
WBN-1-FU	-212-A17/12N -A	CRDM CLR FAN 1A-A MTR 1 BKR 7B NOR CLOSE	B569	KWN10	✓	X	
WBN-2-FU	212 A17/12N A	NOR CLOSE BKR 7B	B569	KWN10	—	—	(no Fuse)
WBN-1-FU	-212-A17/13 -A	CRDM CLR FAN 1A-A MTR 1	S156	CP6A-150	—	—	AC
WBN 2 FU	212 A17/13 A	CRD MECH CLR FAN 2A A(MTR 1	B569	KWN10	—	—	
WBN-1-FU	-212-A17/2 -A	SPENT FUEL PIT PMP C-S TRAIN A BKR 7A CLOSE	B569	KWN10	—	—	(not installed)
WBN-2-FU	-212-A17/2 -A	CLOSE BKR 7A	B569	KWN10	✓	✓	
WBN-1-FU	-212-A17/21A -A	REACTOR LWR COMPT CLR FAN 1A-ABKR 7C AUX TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A17/21A -A	AUX TRIP BKR 7C	B569	KWN10	✓	X	
WBN-1-FU	-212-A17/21N -A	REACTOR LWR COMPT CLR FAN 1A-ABKR 7C NOR TRIP	B569	KWN10	✓	X	
WBN 2 FU	-212-A17/21N -A	NOR TRIP BKR 7C	B569	KWN10	✓	X	
WBN-1-FU	-212-A17/22A -A	REACTOR LWR COMPT CLR FAN1A-A BKR 7C AUX CLOSE	B569	KWN10	✓	X	
WBN-2-FU	-212-A17/22A -A	AUX CLOSE BKR 7C	B569	KWN10	✓	X	
WBN-1-FU	-212-A17/22N -A	REACTOR LWR COMPT CLR FAN1A-ABKR 7C NOR CLOSE	B569	KWN10	✓	X	
WBN-2-FU	-212-A17/22N -A	NOR CLOSE BKR 7C	B569	KWN10	✓	X	
WBN 1 FU	212 A17/23 A	REACTOR LWR CMPT COOLER FAN 1A-A	S156	CP6A-81	—	—	
WBN-2-FU	-212-A17/23 -A	REAC LOWER CMPT CLR FAN 2A-	S156	CP6A	—	—	AC
WBN-1-FU	-212-A17/3 -A	SPENT FUEL PIT PUMP C-S TRAIN A	S156	CP4/OCS	—	—	
WBN-1-FU	-212-A17/31 -A	CRDM CLR FAN 1A-A MTR2 BKR 7D TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A17/31 -A	TRIP BKR 7D	B569	KWN10	✓	✓	(no Fuse)
WBN-1-FU	-212-A17/32 -A	CRDM CLR FAN 1A-A MTR 2 BKR 7D CLOSE	B569	KWN10	✓	✓	
WBN 2 FU	212 A17/32 A	CLOSE BKR 7D	B569	KWN10	—	—	(no Fuse)
WBN-1-FU	-212-A17/33 -A	CRDM CLR FAN 1A-A MTR 2	S156	CP6A-150	—	—	AC

Prepared By RRPierce 1-25-90
Reviewed By W. Berry 1-25-90

PRINTED IN USA

WBN-EEB-MS-TI07-0005
Attachment I

UNID		DESCRIPTION	MFG REF #	MFG MOD #	agrees with w/o pkg	agrees with S/L & system	LOCATION
WBN-2-FU	-212-A17/33 -A	CRD MECH CLR FAN 2A-A MTR 2	S156	CP6A	—	—	
WBN-1-FU	212 A18/1 A	ALT FDR 250V BATT CHGR #1&2	S156	CP350C5	—	—	
WBN-1-FU	-212-A18/11 -A	NOR FDR REAC BD 1A1-A/ALT FDR REA MOV BD 1A2-A	S156	CP350C5	—	—	
WBN-2-FU	212 A18/13 A	REAC MOV BD 2A1 A NOR FDR	S156	CP6A	—	—	
WBN-1-FU	-212-A18/21 -A	SPARE	S156	CP470C5	—	—	AC
WBN-2-FU	-212-A18/23 -A	SPARE	S156	CP6A	—	—	
WBN-2-FU	-212-A18/3 -A	250V BATH CHGR II ALT FDR	S156	CP6A	—	—	
WBN-1-FU	212 A18/31 A	NOR FDR DSL AUX BD 1A1 A/ALT FDR BD 1A2-A	S156	CP500C5	—	—	
WBN-2-FU	-212-A18/33 -A	DSL AUX BD 2A2-A	S156	CP6A	—	—	
WBN-1-FU	-212-A19/11 -A	SD BD 1A1-A NOR FDR TO REAC VT BD 1A-A TRIP	B569	KTN6	—	—	one KTN6, one KWN10
WBN-2-FU	212 A19/11 A	TRIP BKR 9B	B569	KWN10	✓	✓	
WBN-1-FU	-212-A19/12 -A	SD BD 1A1-A NOR FDR TO REAC VT BD 1A-A CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A19/12 -A	CLOSE BKR 9B	B569	KWN10	✓	✓	
WBN-2-FU	-212-A19/13 -A	REAC VT BD 2A-A NOR FDR	S156	CP6A	—	—	AC
WBN-1-FU	-212-A19/21 -A	ELECT BD RM AHU A-A BKR 9C TRIP	B569	KWN10	X	X	KLC Fuse 10A
WBN-2-FU	-212 A19/21 A	ELECT BD RM AHU B-A BKR 9C TRIP	B569	KWN10	✓	✓	
WBN-1-FU	-212-A19/22 -A	ELECT BD RM AHU A-A BKR 9C CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A19/22 -A	ELECT BD RM AHU B-A BKR 9C CLOSE	B569	KWN10	✓	✓	
WBN-1-FU	-212-A19/23 -A	ELECT BD RM AIR HANDLING UNIT A-A	S156	CP470C5	—	—	AC
WBN-2-FU	-212-A19/23 -A	ELECT BD RM AIR HANDLING UNIT B-A	S156	CP470C5	—	—	
WBN-1-FU	-212-A19/31 -A	SPARE	S156	CP500C5	—	—	
WBN-1-FU	212 A19/31A A	AUX TRIP BKR 9D SPARE	B569	KWN10	—	—	(Fuses not installed)
WBN-2-FU	-212-A19/31A -A	AUX TRIP BKR 9D	B569	KWN10	—	—	
WBN-1-FU	-212-A19/31N -A	NOR TRIP BKR 9D SPARE	B569	KWN10	—	—	
WBN-2-FU	-212-A19/31N -A	NOR TRIP BKR 9D	B569	KWN10	—	—	
WBN-1-FU	-212-A19/32A -A	AUX CLOSE BKR 9D SPARE	B569	KWN10	—	—	
WBN-2-FU	-212-A19/32A -A	AUX CLOSE BKR 9D	B569	KWN10	—	—	
WBN-1-FU	-212-A19/32N -A	NOR CLOSE BKR 9D SPARE	B569	KWN10	—	—	
WBN-2-FU	212 A19/32N A	NOR CLOSE BKR 9D	B569	KWN10	—	—	
WBN-2-FU	-212-A19/33 -A	SPARE			—	—	
WBN-1-FU	-212-A21/11 -A	480V SD BD 1A2-A NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-A21/11 -A	480V SD BD 2A2-A NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	AC
WBN-1-FU	-212-A21/12 -A	480V SD BD 1A2-A NOR FDR BKR 52N PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-A21/12 -A	480V SD BD 2A2-A NOR FDR BKR 52N PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	212 A21/13 A	480V SD BD 1A2-A NOR FDR BKR 52N TRIP	B569	KWN10	✓	✓	
WBN-2-FU	212 A21/13 A	480V SD BD 2A2-A NOR FDR BKR 52N TRIP	B569	KWN10	—	—	(not listed in w/o PKG)
WBN-1-FU	-212-A21/14 -A	480V SD BD 1A2-A NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A21/14 -A	480V SD BD 2A2-A NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	
WBN-1-FU	-212-A21/15 -A	480V SD BD 1A2-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	✓	✓	
WBN-2-FU	-212-A21/15 -A	480V SD BD 2A2-A NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	✓	✓	
WBN-1-FU	-212-A21/16 -A	480V SD BD 1A2-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-A21/16 -A	480V SD BD 2A2-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-A21/17 -A	480V SD BD 1A2-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-A21/17 -A	480V SD BD 2A2-A NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	212 A210/1 A	SD BD 1A2-A ALT FDR TO REAC VT BD 1A-A TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A210/1 -A	TRIP BKR 10A	B569	KWN10	✓	✓	
WBN-1-FU	-212-A210/11 -A	TRIP BKR 10B SPARE	B569	KWN10	—	—	(NO Fuses INSTALLED)
WBN-2-FU	-212-A210/11 -A	SPARE	B569	KWN10	—	—	(NOT LISTED IN W/O DATA
WBN-1-FU	-212-A210/12 -A	CLOSE BKR 10B SPARE	B569	KWN10	—	—	(NO Fuses INSTALLED
WBN-2-FU	-212-A210/12 A	BLOS BKR 10B	B569	KWN10	—	—	(Fuse not installed)
WBN-1-FU	-212-A210/13 -	SPARE	S156	CP500C5	—	—	AC
WBN-1-FU	-212-A210/2 -A	SD BD 1A2-A ALT FDR TO REAC VT BD 1A-A CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A210/2 -A	CLOSE BKR 10A	B569	KWN10	✓	✓	
WBN-1-FU	-212-A210/21 A	SPARE	B569	KWN10	—	—	not listed in w/o DATA
WBN-1-FU	-212-A210/22 -A	SPARE	B569	KWN10	—	—	
WBN-1-FU	-212-A210/23 -		S156	CP500C5	—	—	AC

Prepared By R.A. Price 1-25-90
Reviewed By W. Barry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 25, 1990 88

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees with w/D PKG	agrees with SPEC	
WBN-1-FU -212-A210/23 -A	SPARE	S156	CP500C5	—	—	AC
WBN-1-FU 212-A210/3 -A	REACTOR VENT BD 1A-A ALT FOR	S156	CP500C5	—	—	
WBN-1-FU 212-A210/31 -A	SPARE	B569	KWN10	—	—	not listed in w/D
WBN-1-FU -212-A210/32 -A	SPARE	B569	KWN10	—	—	
WBN-1-FU -212-A211/1 -A	480V SD BD 1A2-A 1600A BUS PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-A211/1 -A	480V SD BD 2A2-A 1600A BUS PTS-PRI	B569	JKS6	—	—	
WBN-1-FU 212-A211/2 -A	480V SD BD 1A2-A 600A BUS PTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-A211/2 -A	480V SD BD 2A2-A 1600A BUS PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-A211/3 -A	480V SD BD 1A2-A 1600A BUS GRND IND PTS-PRI	B569	JKS6	—	—	AC
WBN-2-FU 212-A211/3 -A	480V SD BD 2A2-A 1600A BUS GRND IND PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-A211/4 -A	480V SD BD 1A2-A 1600A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-A211/4 -A	480V SD BD 2A2-A 1600A BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-A212/11 -A	480V SD BD 1A2-A SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-A212/11 -A	480V SD BD 2A2-A SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN-1-FU 212-A212/12 -A	480V SD BD 1A2-A SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	
WBN-2-FU 212-A212/12 -A	480V SD BD 2A2-A SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-A212/13 -A	480V SHTDN BD 1A2-A SPARE BKR 52S TRIP	B569	KWN10	—	—	
WBN-2-FU -212-A212/13 -A	480V SD BD 2A2-A SPARE BKR 52S-TRIP	B569	KWN10	—	—	
WBN-1-FU -212-A212/14 -A	480V SHTDN BD 1A2-A SPARE BKR 52S CLOSE	B569	KWN10	—	—	omitted in
WBN-2-FU -212-A212/14 -A	480V SD BD 2A2-A SPARE BKR 52S CLOSE	B569	KWN10	—	—	evaluation
WBN-1-FU 212-A212/15 -A	480V SHTDN BD 1A2-A SPARE BKR 52S IND LGTS	B569	KTN6	—	—	
WBN-2-FU -212-A212/15 -A	480V SD BD 2A2-A SPARE BKR 52S IND LTS	B569	KTN6	—	—	
WBN-1-FU -212-A212/16 -A	480V SD BD 1A2-A SPARE BKR 52S INTL FUSE	W120	1510932G010	—	—	
WBN-2-FU -212-A212/16 -A	BUS PROTECTION BKR 12B	W120	1510932G010	—	—	
WBN-1-FU -212-A212/31 -A	480V SD BD 1A2-A BUS TIE BKR 52T PTS-PRI	B569	JKS6	—	—	
WBN-2-FU 212-A212/31 -A	480V SD BD 2A2-A BUS TIE BKR 52T PTS-PRI	B569	JKS6	—	—	AC
WBN-1-FU -212-A212/32 -A	480V SD BD 1A2-A BUS TIE BKR 52T PTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-A212/32 -A	480V SD BD 2A2-A BUS TIE BKR 52T PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-A212/33 -A	480V SD BD 1A2-A BUS TIE BKR 52T TRIP	B569	KWN10	—	✓	(not listed in w/D Pkg)
WBN-2-FU -212-A212/33 -A	480V SD BD 2A2-A BUS TIE BKR 52T TRIP	B569	KWN10	✓	✓	
WBN-1-FU 212-A212/34 -A	480V SD BD 1A2-A BUS TIE BKR 52T CLOSE	B569	KWN10	—	—	(not listed in w/D Pkg)
WBN-2-FU 212-A212/34 -A	480V SD BD 2A2-A BUS TIE BKR 52T CLS	B569	KWN10	✓	✓	
WBN-1-FU -212-A212/35 -A	480V SD BD 1A2-A BUS TIE BKR 52T IND LTS ISOL	B569	KWN10	✓	—	(not listed in w/D Pkg)
WBN-2-FU -212-A212/35 -A	480V SD BD 2A2-A BUS TIE BKR 52T IND LTS ISOL	B569	KTN6	✓	X	
WBN-1-FU -212-A212/36 -A	480V SD BD 1A2-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-A212/36 -A	480V SD BD 2A2-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU 212-A212/37 -A	480V SD BD 1A2-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-A212/37 -A	480V SD BD 2A2-A BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU -212-A212/38 -A	480V SD BD 1A2-A BUS TIE BKR INTL FUSE	W120	1510932G010	—	—	AC
WBN-2-FU -212-A212/38 -A	BUS PROTECTION BKR 12D	W120	1510932G010	—	—	
WBN-1-FU -212-A22/11 -A	TRIP BKR 2B SPARE	B569	KWN10	✓	✓	
WBN-2-FU 212-A22/11 -A	TRIP BKR 2B	B569	KWN10	✓	✓	
WBN-1-FU -212-A22/12 -A	CLOSE BKR 2B SPARE	B569	KWN10	✓	✓	
WBN-2-FU -212-A22/12 -A	CLOSE BKR 2B	B569	KWN10	✓	✓	
WBN-1-FU -212-A22/21 -A	TRIP BKR 2C - CNTL RM A/C A-A CMPRSR	B569	KWN10	✓	✓	
WBN-2-FU -212-A22/21 -A	TRIP BKR 2C-ELEC BD RM CHILLER PKG A-A	B569	KWN10	✓	✓	
WBN-1-FU -212-A22/22 -A	CLOSE BKR 2C - CNTL RM A/C A-A CMPRSR	B569	KWN10	✓	✓	
WBN-2-FU 212-A22/22 -A	CLOSE BKR 2C-ELECT BD RM CHILLER PKG A-A	B569	KWN10	✓	✓	
WBN-1-FU 212-A23/11A -A	AUX TRIP BKR 3B - CCS PUMP C-S	B569	KWN10	—	—	*
WBN-2-FU -212-A23/11A -A	AUX TRIP BKR 3B	B569	KWN10	—	—	(NO FUSES INSTALLED)
WBN-1-FU -212-A23/11N -A	NOR TRIP BKR 3B - CCS PUMP C-S	B569	KWN10	—	—	(NO Fuses installed). *
WBN-2-FU -212-A23/11N -A	NOR TRIP BKR 3B	B569	KWN10	—	—	(NO FUSES, INSTALLED)
WBN-1-FU 212-A23/12A -A	AUX CLOSE BKR 3B CCS PUMP C-S	B569	KWN10	—	—	(NO Fuses installed)
WBN-2-FU -212-A23/12A -A	AUX CLOSE BKR 3B	B569	KWN10	—	—	(NO FUSES INSTALLED)
WBN-1-FU 212-A23/12N -A	NOR CLOSE BKR 3B - CCS PUMP C-S	B569	KWN10	—	—	(NO FUSES INSTALLED) *
WBN-2-FU -212-A23/12N -A	NOR CLOSE BKR 3B	B569	KWN10	—	—	(NO Fuses installed)

Prepared By RKPrince 1-25-90
Reviewed By W. Berry 1-25-90

* Fuses not installed. Hold order # 860850.

WBN-EEB-MS-TI07-0005
Attachment I

UNID			DESCRIPTION	MFG REF #	MFG MOD #	agree w/DBM	agrees with SLE Screen	LOCATION
WBN-1-FU	-212-A23/20	-A	CCS PUMP C-S	T268	312.062	—	—	
WBN-1-FU	-212-A23/21A	-A	TRIP BKR 3C SPARE	B569	KWN10	✓	—	not listed in w/p DATA
WBN-2-FU	212-A23/21A	A	AUX TRIP BKR 3C-SD BD RMS A&B CHLR PKG A-A	B569	KWN10	✓	✓	
WBN-2-FU	-212-A23/21N	-A	NOR TRIP BKR 3C-SD BD RMS A&B CHLR PKG A-A	B569	KWN10	✓	✓	
WBN-1-FU	-212-A23/22	-A	CLOSE BKR 3C	B569	KWN10	✓	✓	
WBN-2-FU	-212-A23/22A	-A	AUX CLOSE BKR 3C-SD BD RMS A&B CHLR PKG A-A	B569	KWN10	✓	✓	
WBN-2-FU	-212-A23/22N	-A	NOR CLOSE BKR 3C-SD BD RMS A&B CHLR PKG A-A	B569	KWN10	✓	✓	
WBN-1-FU	-212-A23/31	-A	TRIP BKR 3D CONTROL & SERVICE AIR CPRSR A	B569	KWN10	✓	✓	
WBN-2-FU	212-A23/31	A	TRIP BKR 3D	B569	KWN10	✓	✓	
WBN-1-FU	-212-A23/32	-A	CLOSE BKR 3D CONTROL & SERVICE AIR CPRSR A	B569	KWN10	✓	✓	Fuse not installed
WBN-2-FU	-212-A23/32	-A	CLOSE BKR 3D	B569	KWN10	✓	✓	Fuse not installed
WBN-1-FU	-212-A24/11	-A	480V SD BD 1A2-A EMERG FDR BKR 52E PTS-PRI	B569	JKS6	—	—	AC
WBN-2-FU	-212-A24/11	-A	480V SD BD 2A2-A EMER FDR BKR 52E PTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-A24/12	-A	480V SD BD 1A2-A EMERG FDR BKR 52E PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-A24/12	-A	480V SD BD 2A2-A EMER FDR BKR 52E PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-A24/13	-A	480V SD BD 1A2-A ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A24/13	-A	480V SD BD 2A2-A ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN-1-FU	-212-A24/14	-A	480V SD BD 1A2-A ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A24/14	-A	480V SD BD 2A2-A ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN-1-FU	-212-A24/15	-A	480V SD BD 1A2-A ALT FDR BKR 52E IND LTS ISOL	B569	KWN6	✓	✓	
WBN-2-FU	212-A24/15	A	480V SD BD 2A2-A ALT FDR BKR 52E IND LTS ISOL	B569	KWN6	✓	✓	
WBN-1-FU	-212-A24/16	-A	480V SD BD 1A2-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-A24/16	-A	480V SD BD 2A2-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-A24/17	-A	480V SD BD 1A2-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	212-A24/17	A	480V SD BD 2A2-A ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-A24/31A	-A	AUX TRIP BKR 4D STA FIRE PMP 1A-A	B569	KWN10	✓	✓	
WBN-2-FU	212-A24/31A	A	STA FIRE PMP 2A-A AUX TRIP BKR 4D	B569	KWN10	✓	✓	
WBN-1-FU	-212-A24/31N	-A	NOR TRIP BKR 4D STA FIRE PMP 1A-A	B569	KWN10	✓	✓	
WBN-2-FU	-212-A24/31N	-A	STA FIRE PMP 2A-A NOR TRIP BKR 4D	B569	KWN10	✓	✓	
WBN-1-FU	-212-A24/32A	-A	AUX CLOSE 4D STA FIRE PMP 1A-A	B569	KWN10	✓	✓	
WBN-2-FU	-212-A24/32A	-A	STA FIRE PMP 2A-A AUX CLOSE BKR 4D	B569	KWN10	✓	✓	
WBN-1-FU	212-A24/32N	A	NOR CLOSE 4D STA FIRE PMP 1A-A	B569	KWN10	✓	✓	
WBN-2-FU	-212-A24/32N	-A	STA FIRE PMP 2A-A NOR CLOSE BKR 4D	B569	KWN10	✓	✓	
WBN-1-FU	-212-A25/1	-A	480V SD BD 1A2-A BUS PTS-PRI	B569	JKS6	—	—	AC
WBN-2-FU	-212-A25/1	-A	480V SD BD 2A2-A BUS PTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-A25/2	-A	480V SD BD 1A2-A BUS PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	212-A25/2	A	480V SD BD 2A2-A BUS PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-A25/3	-A	480V SD BD 1A2-A BUS GRND IND LTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-A25/3	-A	480V SD BD 2A2-A BUS GRND IND LTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-A25/4	-A	480V SD BD 1A2-A BUS GRND IND LTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-A25/4	-A	480V SD BD 2A2-A BUS GRND IND LTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-A25/5	-A	480V SD BD 1A2-A NOR DC CNTL BUS UV RLY	B569	KWN6	✓	✓	
WBN-2-FU	212-A25/5	A	480V SD BD 2A2-A NOR DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU	-212-A25/6	-A	480V SD BD 1A2-A EMERG DC CNTL BUS UV RLY	B569	KWN6	✓	✓	
WBN-2-FU	-212-A25/6	-A	480V SD BD 2A2-A EMERG DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU	-212-A27/1A	-A	CRDM CLR FAN 1C-A BKR 7A AUX TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A27/1A	-A	AUX TRIP 7A	B569	KWN10	✓	✓	
WBN-1-FU	212-A27/1N	A	CRDM CLR FAN 1C-A BKR 7A NOR TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A27/1N	-A	NOR TRIP 7A	B569	KWN10	✓	✓	
WBN-1-FU	212-A27/11	A	AUX BLDG GEN EXH FAN 1A BKR 7B TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-A27/11	-A	AUX TRIP 7B	B569	KWN10	✓	✓	
WBN-1-FU	-212-A27/12	-A	AUX BLDG GEN EXH FAN 1A BKR 7B CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-A27/12	-A	AUX CLOSE 7B	B569	KWN10	✓	✓	
WBN-1-FU	212-A27/13	A	AUX BLDG GEN EXH FAN 1A	S156	CP4/0C5	—	—	AC
WBN-2-FU	212-A27/13	A	AUX BLDG GEN EXH FAN 2A	S156	CP6A	—	—	
WBN-1-FU	-212-A27/2A	-A	CRDM CLR FAN 1C-A BKR 7A AUX CLOSE	B569	KWN10	✓	✓	

Prepared By R.R. Pierce 1-25-90
Reviewed By W. M. Berry 1-25-90

PRINTED IN USA

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 90

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees with W/D Pkgs	agrees with S/L Lists	LOCATION
WBN-2-FU -212-A27/2A -A	CRD MECH CLR 2C-A MTR 1	B569	KWN10	✓	✓	
WBN-1-FU -212-A27/2N -A	CRDM CLR FAN 1C-A BKR 7A NOR CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-A27/2N -A	CRD MECH CLR 2C-A MTR 1	B569	KWN10	✓	✓	
WBN-1-FU -212-A27/21 -A	TRIP BKR 7C SPARE	B569	KWN10	—	—	(not Installed)
WBN-2-FU -212-A27/21 -A	FUEL HDLG EXH FAN A	B569	KWN10	✓	✓	
WBN-1-FU -212-A27/22 -A	CLOSE BKR 7C SPARE	B569	KWN10	—	—	(not Installed)
WBN-2-FU -212-A27/22 -A	FUEL HDLG EXH FAN A	B569	KWN10	✓	✓	
WBN-1-FU -212-A27/23 -A	REACTOR LOWER COMPT COOLER FAN 1A-A	S156	CP6A-81	—	—	
WBN-2-FU -212-A27/23 -A	FUEL HANDLING EXH FAN A	S156	CP6A	—	—	AC
WBN-1-FU -212-A27/3 -A	CRD MECH CLR 1C-A SUPPLY	S156	CP6A-150	—	—	
WBN-2-FU -212-A27/3 -A	CRD MECH CLR 2C-A (MTR 1)			✓	✓	
WBN-1-FU -212-A27/31A -A	REAC LO CMPT CLR FAN 1C-A AUX TRIP BKR 7D	B569	KWN-R6	✓	✓	
WBN-2-FU -212-A27/31A -A	REAC LO COMPT CLR FAN 2C-A	B569	KWN6	X	✓	KWN10 installed
WBN-1-FU -212-A27/31N -A	REAC LO CMPT CLR FAN 1C-A NOR TRIP BKR 7D	B569	KWN-R6	✓	✓	
WBN-2-FU -212-A27/31N -A	REAC LO COMPT CLR FAN 2C-A	B569	KWN6	X	✓	KWN10 installed
WBN-1-FU -212-A27/32A -A	REAC LO CMPT CLR FAN 1C-A AUX CLOSE BKR 7D	B569	KWN-R6	✓	✓	
WBN-2-FU -212-A27/32A -A	REAC LO COMPT CLR FAN 2C-A	B569	KWN6	X	✓	KWN10 installed
WBN-1-FU -212-A27/32N -A	REAC LO COMPT CLR FAN 1C-A NOR CLOSE BKR 7D	B569	KWN-R6	✓	✓	
WBN-2-FU -212-A27/32N -A	REAC LO COMPT CLR FAN 2C-A	B569	KWN6	X	✓	KWN10 installed
WBN-1-FU -212-A27/33 -A	REAC LO CMPT CLR FAN 1C-A	S156	CP6A-81	—	—	
WBN-2-FU -212-A27/33 -A	REAC LO CMPMT CLR FAN 2C-A	S156	CP6A	—	—	AC
WBN-1-FU -212-A28/1 -A	CRDM CLR FAN 1C-A MTR 2 BKR 8A TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A28/13 -A	NOR FDR MOV BD 1A2-A	S156	CP350C5	—	—	AC
WBN-1-FU -212-A28/2 -A	CRDM CLR FAN 1C-A MTR 2 BKR 8A CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-A28/23 -A	NOR FDR DSL BD 1A2-A/ALT FDR DSL BD 1A1-A	S156	CP500C5	—	—	
WBN-2-FU -212-A28/23 -A	DSL AUX BD 2A2-A NOR FDR	S156	CP6A	—	—	
WBN-1-FU -212-A28/3 -A	CRDM CLR 1C-A MTR 2	S156	CP6A-150	—	—	AC
WBN-2-FU -212-A28/3 -A	CRD MECH CLR FAN 2C-A(MTR 2	S156	CP6A	—	—	
WBN-2-FU -212-A28/31 -A	480V SHTDN BD RM A&B AHU B-A BKR 8D TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A28/31A	SPARE 480V SHT DN BD 1A2-A BKR 8D AUX TRIP	B569	KWN10	—	—	(spare) not installed
WBN-1-FU -212-A28/31N	SPARE 480V SHT DN BD 1A2-A BKR 8D NOR TRIP	B569	KWN10	—	—	(spare)
WBN-2-FU -212-A28/32 -A	480V SHTDN BD RM A&B AHU B-A BKR 8D CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-A28/32A -	SPARE 480V SHT DN BD 1A2-A BKR 8D AUX CLOSE	B569	KWN10	—	—	(spare) not installed
WBN-1-FU -212-A28/32N -	SPARE 480V SHT DN BD 1A2-A BKR 8D NOR CLOSE	B569	KWN10	—	—	
WBN-1-FU -212-A28/33 -A	SPARE 480V SHT DN BD 1A2-A	S156	CP4/0C5	—	—	
WBN-2-FU -212-A28/33 -A	480V SHTDN BD RM A&B AHU B-A SUPPLY	S156	CP4/0C5	—	—	AC
WBN-1-FU -212-A29/13 -A	C & A VENT BD 1A1-A ALT FDR	S156	CP500C5	—	—	
WBN-1-FU -212-A29/21 -A	SD BD 1A2-A NOR FDR TO C&A VT BD 1A2-A TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-A29/21 -A	TRIP BKR 9C	B569	KWN10	✓	✓	
WBN-1-FU -212-A29/22 -A	SD BD 1A2-A NOR FDR TO C&A VT BD 1A2-A CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-A29/22 -A	CLOSE BKR 9C	B569	KWN10	✓	✓	
WBN-1-FU -212-A29/23 -A	C&A VENT BD 1A2-A NOR FDR	S156	CP500C5	—	—	
WBN-1-FU -212-A29/3 -A	125V VITAL BATT CHGR 2 ALT FDR	S156	CP500C5	—	—	AC
WBN-1-FU -212-A29/31 -A	SHTDN BD RM A&B AHU A A BKR 9D TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-A29/31 -A	SPENT FUEL PIT PUMP A-A BKR 9D TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-A29/32 -A	SHTDN BD RM A&B AHU A-A BKR 9D CLOSE	B569	KLC10	✓	X	Fuse not installed
WBN-2-FU -212-A29/32 -A	SPENT FUELD PIT PUMP A-A BKR 9D CLOSE	B569	KWN10	—	—	
WBN-1-FU -212-A29/33 -A	SHTDN BD RM A & B AHU A-A MTR FDR	S156	CP4/0C5	—	—	Fuse not installed
WBN-2-FU -212-A29/33 -A	SPENT FUEL PIT PUMP A-A-SUPPLY	S156	CP4/0C5	—	—	AC
WBN-1-FU -212-B11/11 -B	480V SD BD 181-B NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-B11/11 -B	480V SD BD 281-B NOR FDR BKR 52N PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-B11/12 -B	480V SD BD 181-B NOR FDR BKR 52N PTS-SEC	B569	KTN6	—	—	AC
WBN-2-FU -212-B11/12 -B	480V SD BD 281-B NOR FDR BKR 52N PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-B11/13 -B	480V SD BD 181-B NOR FDR BKR 52N TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-B11/13 -B	480V SD BD 281-B NOR FDR BKR 52N TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-B11/14 -B	480V SD BD 181-B NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	

Prepared By M A Pierce 1-25-90
Reviewed By A. Berry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

UNID		DESCRIPTION	MFG REF #	MFG MOD #	agrees with W/D Pkg	agrees with SIL Scheduling	LOCATION
WBN-2-FU	-212-B11/14 -B	480V SD BD 281-B NOR FDR BKR 52N CLOSE	B569	KWN10	✓	✓	
WBN-1-FU	-212-B11/15 -B	480V SD BD 181-B NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	✓	✓	
WBN-2-FU	-212-B11/15 -B	480V SD BD 281-B NOR FDR BKR 52N IND LTS ISOL	B569	KWN6	✓	✓	
WBN-1-FU	212-B11/16 -B	480V SD BD 181-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-B11/16 -B	480V SD BD 281-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-B11/17 -B	480V SD BD 181-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-B11/17 -B	480V SD BD 281-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-B110/13 -B	C&A VENT BD 181-B NOR FDR	S156	CP500C5	—	—	
WBN-2-FU	212-B110/13 B	C&A VT BD 281-B NOR FDR	S156	CP6A	—	—	
WBN-1-FU	-212-B110/23 -B	SPARE COMPARTMENT 10C	S156	CP500C5	—	—	AC
WBN-2-FU	-212-B110/23 -B	SPARE	S156	CP6A	—	—	
WBN-1-FU	-212-B110/3 -B	125V DC VITAL BATT 1 SYS ALT SUPPLY	S156	CP500C5	—	—	
WBN-2-FU	-212-B110/3 -B	125V VITAL BATT III ALT FDR	S156	CP6A	—	—	
WBN-1-FU	-212-B110/31 -B	CRDM CLR FAN 1B-B MTR 2 BKR 10D TRIP	B569	KWN10	X	✓	(KWN-R6)
WBN-2-FU	212-B110/31 B	TRIP BKR 10D	B569	KWN10	—	—	(no fuse)
WBN-1-FU	-212-B110/32 -B	CRDM CLR FAN 1B-B MTR 2 BKR 10D CLOSE	B569	KWN10	X	X	FWN-R10 installed
WBN-2-FU	212-B110/32 B	CLOSE BKR 10D	B569	KWN10	—	—	(no fuse)
WBN-1-FU	-212-B110/33 -B	CNTL ROD DRIVE MECH. COOLER FAN 1B-B(MTR 2)	S156	CF6A-150	—	—	
WBN-2-FU	-212-B110/33 -B	CRD MECH CLR FAN 2B-B(MTR 2	S156	CP6A	—	—	
WBN-1-FU	-212-B111/1 -B	480V SD BD 181-B BUS PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	212-B111/1 B	480V SD BD 281-B BUS PTS-PRI	B569	JKS6	—	—	AC
WBN-1-FU	-212-B111/2 -B	480V SD BD 181-B BUS PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	212-B111/2 B	480V SD BD 281-B BUS PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-B111/3 -B	480V SD BD 181-B BUS GRND IND PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-B111/3 -B	480V SD BD 281-B BUS GRND IND PTS-PRI	B569	JKS6	—	—	AC
WBN-1-FU	-212-B111/4 -B	480V SD BD 181-B BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-B111/4 -B	480V SD BD 281-B BUS GRND IND PTS-SEC	B569	KTN6	—	—	
WBN-1-FU	-212-B112/11 -B	480V SD BD 181-B SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	212-B112/11 B	480V SD BD 281-B SPARE BKR 52S PTS-PRI	B569	JKS6	—	—	
WBN-1-FU	-212-B112/12 -B	480V SD BD 181-B SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-B112/12 -B	480V SD BD 281-B SPARE BKR 52S PTS-SEC	B569	KTN6	—	—	omitted in evaluation
WBN-1-FU	-212-B112/13 -B	480V SHTDN BD 181-B SPARE BKR 52S TRIP	B569	KWN10	—	—	
WBN-2-FU	-212-B112/13 -B	480V SD BD 281-B SPARE BKR 52S-TRIP	B569	KWN10	—	—	
WBN-1-FU	-212-B112/14 -B	480V SHTDN BD 181-B SPARE BKR 52S CLOSE	B569	KWN10	—	—	
WBN-2-FU	-212-B112/14 -B	480V SD BD 281-B SPARE BKR 52S-CLOSE	B569	KWN10	—	—	
WBN-1-FU	-212-B112/15 -B	480V SHTDN BD 181-B SPARE BKR 52S IND LTS	B569	KTN6	—	—	
WBN-2-FU	-212-B112/15 -B	480V SD BD 281-B SPARE BKR 52S IND LTS	B569	KTN6	—	—	
WBN-1-FU	-212-B112/16 -B	480V SD BD 181-B SPARE BKR 52S INTL FUSE	W120	151D932G010	—	—	
WBN-2-FU	212-B112/16 B	BUS PROTECTION BKR 12B	W120	151D932G010	—	—	
WBN-1-FU	-212-B112/31 -B	480V SD BD 181-B BUS TIE BKR 52T PTS-PRI	B569	JKS6	—	—	
WBN-2-FU	-212-B112/31 -B	480V SD BD 281-B BUS TIE BKR 52T PTS-PRI	B569	JKS6	—	—	AC
WBN-1-FU	-212-B112/32 -B	480V SD BD 181-B BUS TIE BKR 52T PTS-SEC	B569	KTN6	—	—	
WBN-2-FU	-212-B112/32 -B	480V SD BD 281-B BUS TIE BKR VM CONT FU			—	—	
WBN-1-FU	-212-B112/33 -B	480V SD BD 181-B BUS TIE BKR 52T TRIP	B569	KWN10	✓	✓	
WBN-2-FU	-212-B112/33 -B	480V SD BD 281-B BUS TIE BKR 52T TRIP	B569	KWN10	—	—	(not listed in W/D Pkg
WBN-1-FU	-212-B112/34 -B	480V SD BD 181-B BUS TIE BKR 52T CLOSE	B569	KWN10	✓	✓	
WBN-2-FU	-212-B112/34 -B	480V SD BD 281-B BUS TIE BKR 52T CLOSE	B569	KWN10	—	—	(not listed in W/D Pkg
WBN-1-FU	-212-B112/35 -B	480V SD BD 181-B BUS TIE BKR 52T IND LTS ISOL	B569	KTN6	✓	✓	
WBN-2-FU	-212-B112/35 -B	480V SD BD 281-B BUS TIE BKR 52T IND LTS ISOL	B569	KTN6	—	—	(not listed in W/D Pkg
WBN-1-FU	-212-B112/36 -B	480V SD BD 181-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-B112/36 -B	480V SD BD 281-B BUS TIE BKR 52T IND LTS ISOL	B569	KTN6	✓	X	
WBN-1-FU	-212-B112/37 -B	480V SD BD 181-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU	-212-B112/37 -B	480V SD BD 281-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU	-212-B112/38 -B	480V SD BD 181-B BUS TIE BKR 52T INTL FUSE	W120	151D932G010			AC
WBN-2-FU	-212-B112/38 -B	BUS PROTECTION BKR 12D	W120	151D932G010			
WBN-1-FU	-212-B12/11 -B	AUX BLDG GEN SUP FNA 1B BKR 2B TRIP	B569	KWN10	✓	✓	

Prepared By RRPierson 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

UNID			DESCRIPTION	MFG REF #	MFG MOD #	agrees w/ W/D Pkg	agrees w/ field schedule	LOCATION
WBN-2-FU	-212-812/11	-B	TRIP BKR 2B	B569	KWN10			
WBN-1-FU	-212-812/12	-B	AUX BLDG GEN SUP FAN 1B BKR 2B CLOSE	B569	KWN10			
WBN-2-FU	-212-812/12	-B	CLOSE BKR 2B	B569	KWN10			
WBN-1-FU	-212-813/11A	-B	REC CHG PMP BKR 3B AUX TRIP	B569	KWN10			
WBN-2-FU	-212-813/11A	-B	AUX TRIP BKR 3B	B569	KWN10			
WBN-1-FU	-212-813/11N	-B	REC CHG PMP BKR 3B NOR TRIP	B569	KWN10			Fuse not installed
WBN-2-FU	-212-813/11N	-B	NOR TRIP BKR 3B	B569	KWN10			
WBN-1-FU	-212-813/12A	-B	REC CHG PMP BKR 3B AUX CLOSE	B569	KWN10			Fuse not installed
WBN-2-FU	-212-813/12A	-B	AUX CLOSE BKR 3B	B569	KWN10			
WBN-1-FU	-212-813/12N	-B	REC CHG PMP BKR 3B NOR CLOSE	B569	KWN10			Fuse not installed
WBN-2-FU	-212-813/12N	-B	NOR CLOSE BKR 3B	B569	KWN10			
WBN-1-FU	-212-813/20	-B	REC CHG PMP BKR 3B	B569	KWN10			Fuse not installed
WBN-2-FU	-212-813/20	-B	FILTERING MODULE	T268	312.062			not listed in W/D DATA
WBN-1-FU	-212-813/21A	-B	CCS PMP 1B-B BKR 3C AUX TRIP	T268	312.062			
WBN-2-FU	-212-813/21A	-B	AUX TRIP BKR 3C	B569	KWN10			
WBN-1-FU	-212-813/21N	-B	CCS PMP 1B-B BKR 3C NOR TRIP	B569	KWN10			
WBN-2-FU	-212-813/21N	-B	NOR TRIP BKR 3C	B569	KWN10			
WBN-1-FU	-212-813/22A	-B	CCS PMP 1B-B BKR 3C AUX CLOSE	B569	KWN10			
WBN-2-FU	-212-813/22A	-B	AUX CLOSE BKR 3C	B569	KWN10			
WBN-1-FU	-212-813/22N	-B	CCS PMP 1B-B BKR 3C NOR CLOSE	B569	KWN10			
WBN-2-FU	-212-813/22N	-B	NOR CLOSE BKR 3C	B569	KWN10			
WBN-1-FU	-212-813/30	-B	CCS PMP 1B-B	T268	312.062			not listed in W/D DATA
WBN-2-FU	-212-813/30	-B	FILTERING MODULE	T268	312.062			
WBN-1-FU	-212-813/31	-B	CNTL & SEV AIR CMPRSR B BKR 3D TRIP	B569	KWN10			
WBN-2-FU	-212-813/31	-B	TRIP BKR 3D	B569	KWN10			
WBN-1-FU	-212-813/32	-B	CNTL & SEV AIR CMPRSR B BKR 3D CLOSE	B569	KWN10			
WBN-2-FU	-212-813/32	-B	CLOSE BKR 3D	B569	KWN10			
WBN-1-FU	-212-814/11	-B	480V SD BD 1B1-B EMERG FDR BKR 52E PTS-PRI	B569	JKS6			
WBN-2-FU	-212-814/11	-B	480V SD BD 2B1-B EMER FDR BKR 52E PTS-PRI	B569	JKS6			AC
WBN-1-FU	-212-814/12	-B	480V SD BD 1B1-B EMERG FDR BKR 52E PTS-SEC	B569	KWN6			
WBN-2-FU	-212-814/12	-B	480V SD BD 2B1-B EMERG FDR BKR 52E PTS-SEC	B569	KTN6			
WBN-1-FU	-212-814/13	-B	480V SD BD 1B1-B ALT FDR BKR 52E TRIP	B569	KWN10			
WBN-2-FU	-212-814/13	-B	480V SD BD 2B1-B ALT FDR BKR 52E TRIP	B569	KWN10			
WBN-1-FU	-212-814/14	-B	480V SD BD 1B1-B ALT FDR BKR 52E CLOSE	B569	KWN10			
WBN-2-FU	-212-814/14	-B	480V SD BD 2B1-B ALT FDR BKR 52E CLOSE	B569	KWN10			
WBN-1-FU	-212-814/15	-B	480V SD BD 1B1-B ALT FDR BKR 52E IND LTS ISOL	B569	KWN6			
WBN-2-FU	-212-814/15	-B	480V SD BD 2B1-B ALT FDR BKR 52E IND LTS ISOL	B569	KWN6			
WBN-1-FU	-212-814/16	-B	480V SD BD 1B1-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1			
WBN-2-FU	-212-814/16	-B	480V SD BD 2B1-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1			
WBN-1-FU	-212-814/17	-B	480V SD BD 1B1-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1			
WBN-2-FU	-212-814/17	-B	480V SD BD 2B1-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1			
WBN-1-FU	-212-814/31A	-B	AUX TRIP BKR 4D SPARE	B569	KWN10			
WBN-2-FU	-212-814/31A	-B	AUX TRIP BKR 4D	B569	KWN10			
WBN-1-FU	-212-814/31N	-B	NOR TRIP BKR 4D SPARE	B569	KWN10			
WBN-2-FU	-212-814/31N	-B	NOR TRIP BKR 4D	B569	KWN10			
WBN-1-FU	-212-814/32A	-B	AUX CLOSE BKR 4D SPARE	B569	KWN10			
WBN-2-FU	-212-814/32A	-B	AUX CLOSE BKR 4D	B569	KWN10			
WBN-1-FU	-212-814/32N	-B	NOR CLOSE BKR 4D SPARE	B569	KWN10			
WBN-2-FU	-212-814/32N	-B	NOR CLOSE BKR 4D	B569	KWN10			
WBN-1-FU	-212-815/1	-B	480V SD BD 1B1-B BUS PTS-PRI	B569	JKS6			
WBN-2-FU	-212-815/1	-B	480V SD BD 2B1-B BUS PTS-PRI	B569	JKS6			
WBN-1-FU	-212-815/2	-B	480V SD BD 1B1-B BUS PTS SEC	B569	KTN6			
WBN-2-FU	-212-815/2	-B	480V SD BD 2B1-B BUS PTS-SEC	B569	KTN6			AC
WBN-1-FU	-212-815/3	-B	480V SD BD 1B1-B BUS GRND IND LTS-PRI	B569	JKS6			
WBN-2-FU	-212-815/3	-B	480V SD BD 2B1-B BUS GRND IND LTS-PRI	B569	JKS6			
WBN-1-FU	-212-815/4	-B	480V SD BD 1B1-B BUS GRND IND LTS-SEC	B569	KTN6			

Prepared By R.R. Rivers 1-25-90
Reviewed By W. Berry 1-25-90

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UNID	DESCRIPTION	MFG REF #	MFG MOD #	Agrees with DWG	Agrees with P&ID	S/L & Ckt Bkr	LOCATION
WBN-2-FU -212-B15/4 -B	480V SD BD 2B1-B BUS GRND IND LTS-SEC	B569	KTN6	—	—		AC
WBN-1-FU -212-B15/5 -B	480V SD BD 1B1-B NOR DC CONT BUS UV RLY	B569	KWN6	✓	✓		(KWN6 & KTN6)
WBN-2-FU -212-B15/5 -B	480V SD BD 2B1-B NOR DC CONT BUS UV RLY	B569	KWN6	✓	✓		
WBN-1-FU 212-B15/6 -B	480V SD BD 1B1-B EMERG DC CONT BUS UV RLY	B569	KWN6	X	✓		(KWN-R6)
WBN-2-FU 212-B15/6 -B	480V SD BD 2B1-B EMERG DC CONT BUS UV RLY	B569	KWN6	✓	✓		
WBN-1-FU -212-B17/1 -B	ELECT BD RM AHU C-B BKR 7A TRIP	B569	KWN10	X	X		KWN-R6 installed
WBN-2-FU -212-B17/1 -B	TRIP BKR 7A-ELEC BD RM AHU D-B	B569	KWN10	✓	✓		
WBN-1-FU -212-B17/11 -B	TRIP BKR 7B SPARE	B569	KWN10	—	—		Fuse not installed
WBN-2-FU 212-B17/11 -B	TRIP BKR 7B	B569	KWN10	—	—		
WBN-1-FU -212-B17/12 -B	CLOSE BKR 7B SPARE	B569	KWN10	—	—		
WBN-2-FU -212-B17/12 -B	CLOSE BKR 7B	B569	KWN10	—	—		
WBN-1-FU 212-B17/13 -B	COMPARTMENT 7B - SPARE	S156	CP350C5				
WBN-2-FU -212-B17/13 -B	SPENT FUEL PIT PUMP C-5	S156	CP6A				AC
WBN-1-FU -212-B17/2 -B	ELECT BD RM AHU C-B BKR 7A CLOSE	B569	KWN10	X	X		KWN-R6 installed
WBN-2-FU -212-B17/2 -B	CLOSE BKR 7A-ELECT BD RM AHU D-B	B569	KWN10	✓	✓		
WBN-1-FU -212-B17/21A -B	CROM CLR FAN 1B-B MTR 1 BKR 7C AUX TRIP	B569	KWN6	X	X		KWN10 installed
WBN-2-FU -212-B17/21A -B	AUX TRIP BKR 7C	B569	KWN10	—	—		Fuse not installed
WBN-1-FU 212-B17/21N -B	CROM CLR FAN 1B-B MTR 1 BKR 7C NOR TRIP	B569	KWN6	—	—		one KWN6 & one KWN10
WBN-2-FU -212-B17/21N -B	NOR TRIP BKR 7C	B569	KWN6	—	—		
WBN-1-FU 212-B17/22A -B	CROM CLR FAN 1B-B MTR 1 BKR 7C AUX CLOSE	B569	KWN6	✓	✓		Fuse not installed
WBN-2-FU -212-B17/22A -B	AUX CLOSE BKR 7C	B569	KWN6	—	—		
WBN-1-FU -212-B17/22N -B	CROM CLR FAN 1B-B MTR-1 BKR 7C NOR CLOSE	B569	KWN6	X	X		Fuse not installed KWN10
WBN-2-FU -212-B17/22N -B	NOR CLOSE BKR 7C	B569	KWN6	—	—		
WBN-1-FU 212-B17/23 -B	CROM CLR FAN 1B-B MTR 1	S156	CP6A-150	—	—		Fuse not installed
WBN-2-FU 212-B17/23 -B	CRD MECH CLR FAN 2B-B(MTR 1	S156	CP6A	—	—		
WBN-1-FU -212-B17/3 -B	ELECT BD RM AHU C-B	S156	CP470C5	—	—		AC
WBN-2-FU -212-B17/3 -B	ELEC BD RM AHU D-B SUPPLY	S156	CP470C5	—	—		
WBN-1-FU -212-B17/31A -B	REAC LOW COMPT CLR FAN 1B-B BKR 7D AUX TRIP	B569	KWN6	✓	✓		
WBN-2-FU 212-B17/31A -B	AUX TRIP BKR 7D	B569	KWN6	X	X		KWN10 installed
WBN-1-FU -212-B17/31N -B	REAC LOW COMPT CLR FAN 1B-B BKR 7D NOR TRIP	B569	KWN6	✓	✓		
WBN-2-FU 212-B17/31N -B	NOR TRIP BKR 7D	B569	KWN6	X	X		KWN10 installed
WBN-1-FU -212-B17/32A -B	REAC LOW COMPT CLR FAN 1B-B BKR 7D AUX CLOSE	B569	KWN6	✓	✓		
WBN-2-FU -212-B17/32A -B	AUX CLOSE BKR 7D	B569	KWN6	X	X		KWN10 installed
WBN-1-FU -212-B17/32N -B	REAC LOW COMPT CLR FAN 1B-B BKR 7D NOR CLOSE	B569	KWN6	✓	✓		
WBN-2-FU -212-B17/32N -B	NOR CLOSE BKR 7D	B569	KWN6	X	X		KWN10 installed
WBN-1-FU -212-B17/33 -B	REAC LOW COMPT CLR FAN 1B-B	S156	CP6A-81	—	—		
WBN-2-FU 212-B17/33 -B	REAC LWR CMPT CLR FAN 2B-B	S156	CP6A	—	—		AC
WBN-1-FU -212-B18/13 -B	REAC MOV BD 1B1-B NOR FDR	S156	CP350C5	—	—		
WBN-1-FU -212-B18/21A -B	AUX TRIP BKR 8C SPARE	B569	KWN10	✓	✓		SPARE
WBN-2-FU -212-B18/21A -B	AUX TRIP BKR 8C	B569	KWN10	✓	✓		
WBN-1-FU -212-B18/21N -B	NOR TRIP BKR 8C SPARE	B569	KWN10	✓	✓		
WBN-2-FU -212-B18/21N -B	NOR TRIP BKR 8C	B569	KWN10	✓	✓		
WBN-1-FU -212-B18/22A -B	AUX CLOSE BKR 8C SPARE	B569	KWN10	✓	✓		
WBN-2-FU -212-B18/22A -B	AUX CLOSE BKR 8C	B569	KWN10	✓	✓		
WBN-1-FU -212-B18/22N -B	NOR CLOSE BKR 8C SPARE	B569	KWN10	✓	✓		
WBN-2-FU -212-B18/22N -B	NOR CLOSE BKR 8C	B569	KWN10	✓	✓		
WBN-1-FU -212-B18/23 -B	COMPARTMENT 8C SPARE	S156	CP470C5	—	—		AC
WBN-1-FU -212-B18/33 -B	DSL AUX BD 1B1-B NOR FDR/1B2-B ALT FDR	S156	CP500C5	—	—		
WBN-1-FU -212-B19/1 -B	SD BD 1B1-B ALT FDR TO C&A VT BD 1B2-B TRIP	B569	KWN10	✓	✓		
WBN-2-FU -212-B19/1 -B	TRIP BKR 9A	B569	KWN10	✓	✓		
WBN-1-FU -212-B19/11 -B	SD BD 1B1-B NOR FDR TO REAC VT BD 1B-B TRIP	B569	KWN10	✓	✓		
WBN-2-FU -212-B19/11 -B	TRIP BKR 9B	B569	KWN10	✓	✓		
WBN-1-FU -212-B19/12 -B	SD BD 1B1-B NOR FDR TO REAC VT BD 1B-B CLOSE	B569	KWN10	✓	✓		
WBN-2-FU -212-B19/12 -B	CLOSE BKR 9B	B569	KWN10	✓	✓		
WBN-1-FU -212-B19/13 -B	REAC VT BD 1B-B NOR FDR	S156	CP500C5	—	—		AC
WBN-1-FU -212-B19/2 -B	SD BD 1B1-B ALT FDR TO C&A VT BD 1B2-B CLOSE	B569	KWN10	✓	✓		

Prepared By RL Pierce 1-25-90
Reviewed By W. Berry 1-25-90

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 1990

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/DPlus	agrees with Sys & Sum	SECTION
WBN 2 FU 212 819/2 -B	CLOSE BKR 9A	B569	KWN10	✓	✓	
WBN-1-FU -212-819/3 -B	C&A VT BD 182-B ALT FDR	S156	CP500C5			
WBN-1-FU -212-819/31 -B	SPARE	S156	CP500C5			
WBN-1-FU -212-821/11 -B	480V SD BD 182-B NOR FDR BKR 52N PTS-PRI	B569	JKS6			AC
WBN-2-FU -212-821/11 -B	480V SD BD 282-B NOR FDR BKR 52N PTS-PRI	B569	JKS6			
WBN 1 FU 212-821/12 -B	480V SD BD 182-B NOR FDR BKR 52N PTS-SEC	B569	KTN6			
WBN-2-FU -212-821/12 -B	480V SD BD 282-B NOR FDR BKR 52N PTS-SEC	B569	KTN6			
WBN-1-FU 212 821/13 -B	480V SD BD 182-B NOR FDR BKR 52N TRIP	B569	KWN10			
WBN-2-FU -212-821/13 -B	480V SD BD 282-B NOR FDR BKR 52N TRIP	B569	KWN10			
WBN-1-FU -212-821/14 -B	480V SD BD 182-B NOR FDR BKR 52N CLOSE	B569	KWN10			
WBN-2-FU -212-821/14 -B	480V SD BD 282-B NOR FDR BKR 52N CLOSE	B569	KWN10			
WBN-1-FU -212-821/15 -B	480V SD BD 182-B NOR FDR BKR 52N IND LTS ISOL	B569	KWN6			
WBN 2 FU 212 821/15 -B	480V SD BD 282-B NOR FDR BKR 52N IND LTS ISOL	B569	KTN6	X	X	(KTN6 & KWN6)
WBN-1-FU -212-821/16 -B	480V SD BD 182-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-2-FU -212-821/16 -B	480V SD BD 282-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-1-FU -212-821/17 -B	480V SD BD 182-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN-2-FU -212-821/17 -B	480V SD BD 282-B NOR FDR BKR 52N IND LTS ISOL	B569	FRN-R1			
WBN 1 FU 212 821/31 -B	TRIP BKR 10	B569	KWN10			(no Fuse installed)
WBN-2-FU -212-821/31 -B	TRIP BKR 10	B569	KWN10			
WBN-1-FU -212-821/32 -B	CLOSE BKR 10	B569	KWN10			
WBN-2-FU -212-821/32 -B	CLOSE BKR 10	B569	KWN10			
WBN-1-FU -212-8210/11 -B	SD BD 182-B NOR FDR TO C&A VT BD 182-B TRIP	B569	KWN10			
WBN-2-FU -212-8210/11 -B	TRIP BKR 10B	B569	KWN10			
WBN 1 FU 212 8210/12 -B	SD BD 182-B NOR FDR TO C&A VT BD 182-B CLOSE	B569	KWN10			
WBN-2-FU -212-8210/12 -B	CLOSE BKR 10B	B569	KWN10			
WBN-1-FU -212-8210/13 -B	C&A VT BD 182-B NOR FDR	S156	CP500C5			AC
WBN-1-FU -212-8210/21 -B	CROM CLR FAN ID-B MTR 2 BKR 10C TRIP	B569	KWN10			
WBN-1-FU -212-8210/22 -B	CROM CLR FAN ID-B MTR 2 BKR 10C CLOSE	B569	KWN10	X		(KWN-R10 installed)
WBN 1 FU 212 8210/23 -B	CROM CLR FAN ID B MTR 2	S156	CF6A-150			
WBN-1-FU -212-8210/3 -B	125V VIT BATT CHGR II NOR FDR	S156	CP500C5			AC
WBN 1 FU 212 8210/31 -B	SD BD 182-B NOR FDR TO REAC VT BD 18-B TRIP	B569	KWN10			
WBN-1-FU -212-8210/32 -B	SD BD 182-B NOR FDR TO REAC VT BD 18-B CLOSE	B569	KWN10			
WBN-1-FU -212-8210/33 -B	REAC VT BD 18-B ALT FDR	S156	CP500C5			
WBN-1-FU -212-8211/1 -B	480V SD BD 182-B BUS PTS-PRI	B569	JKS6			
WBN-2-FU -212-8211/1 -B	480V SD BD 282-B BUS PTS-PRI	B569	JKS6			
WBN 1 FU -212-8211/2 -B	480V SD BD 182-B BUS PTS-SEC	B569	KTN6			
WBN-2-FU -212-8211/2 -B	480V SD BD 282-B BUS PTS-SEC	B569	KTN6			AC
WBN-1-FU -212-8211/3 -B	480V SD BD 182-B BUS GRND IND PTS-PRI	B569	JKS6			
WBN-2-FU -212-8211/3 -B	480V SD BD 282-B BUS GRND IND PTS-PRI	B569	JKS6			
WBN-1-FU -212-8211/4 -B	480V SD BD 182-B BUS GRND IND PTS-SEC	B569	KTN6			
WBN 2 FU 212 8211/4 -B	480V SD BD 282-B BUS GRND IND PTS-SEC	B569	KTN6			
WBN-1-FU -212-8212/11 -B	480V SD BD 182-B SPARE BKR 52S PTS-PRI	B569	JKS6			
WBN-2-FU -212-8212/11 -B	480V SD BD 282-B SPARE BKR 52S PTS-PRI	B569	JKS6			
WBN-1-FU -212-8212/12 -B	480V SD BD 182-B SPARE BKR 52S PTS-SEC	B569	KTN6			
WBN-2-FU -212-8212/12 -B	480V SD BD 282-B SPARE BKR 52S PTS-SEC	B569	KTN6			
WBN 1 FU 212 8212/13 -B	480V SHTDN BD 182-B SPARE BKR 52S TRIP	B569	KWN10			
WBN-2-FU -212-8212/13 -B	480V SD BD 282-B SPARE BKR 52S-TRIP	B569	KTN10			omitted in evaluation
WBN-1-FU -212-8212/14 -B	480V SHTDN BD 182-B SPARE BKR 52S-CLOSE	B569	KWN10			
WBN-2-FU -212-8212/14 -B	480V SD BD 282-B SPARE BKR 52S-CLOSE	B569	KTN10			
WBN-1-FU -212-8212/15 -B	480V SHTDN BD 182-B SPARE BKR 52S IND LTS	B569	KTN6			
WBN 2 FU 212 8212/15 -B	480V SD BD 282-B SPARE BKR 52S IND LTSNT	B569	KTN6			
WBN-1-FU -212-8212/16 -B	180V SHTDN BD 182-B	W120	1510D32G010			
WBN 2 FU 212 8212/16 -B	BUS PROTECTION BKR 12B	W120	1510D32G010			AC
WBN-1-FU -212-8212/31 -B	480V SD BD 182-B BUS TIE BKR 52T PTS-PRI	B569	JKS6			
WBN-2-FU -212-8212/31 -B	480V SD BD 282-B BUS TIE BKR 52T PTS-PRI	B569	JKS6			AC
WBN-1-FU -212-8212/32 -B	480V SD BD 182-B BUS TIE BKR 52T PTS-SEC	B569	KTN6			

Prepared By RRPierce 1-25-90
Reviewed By W. Berry 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 1990 95

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/D with	agrees w/LE & SOURCE	LOCATION
WBN-2-FU -212-B212/32 -B	480V SD BD 2B2-B BUS TIE BKR 52T PTS-SEC	B569	KTN6			AC
WBN-1-FU -212-B212/33 -B	480V SD BD 1B2-B BUS TIE BKR 52T TRIP	B569	KWN10	—	—	(not listed in W/D PKG)
WBN-2-FU -212-B212/33 -B	480V SD BD 2B2-B BUS TIE BKR 52T TRIP	B569	KWN10			
WBN 1 FU 212 B212/34 B	480V SD BD 1B2-B BUS TIE BKR 52T CLOSE	B569	KWN10	✓	✓	(not listed in W/D PKG)
WBN-2-FU -212-B212/34 -B	480V SD BD 2B2-B BUS TIE BKR 52T CLS	B569	KWN10			
WBN-1-FU -212-B212/35 -B	480V SD BD 1B2-B BUS TIE BKR 52T IND LTS	B569	KTN6	✓	✓	(not listed in W/D PKG)
WBN-2-FU -212-B212/35 -B	480V SD BD 2B2-B BUS TIE BKR 52T IND LTS ISOL	B569	KTN6			
WBN 1 FU 212 B212/36 B	480V SD BD 1B2-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-B212/36 -B	480V SD BD 2B2-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1			
WBN-1-FU -212-B212/37 -B	480V SD BD 1B2-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1	✓	X	(FUSETRON 1AMP)
WBN-2-FU -212-B212/37 -B	480V SD BD 2B2-B BUS TIE BKR 52T IND LTS ISOL	B569	FRN-R1			
WBN-1-FU -212-B212/38 -B	480V SD BD 1B2-B BUS TIE INTL FUSE	W120	1510932G010	—	X	(FUSETRON 1AMP)
WBN 2-FU 212 B212/38 B	BUS PROTECTION BKR 120	W120	1510932G010	—	—	AC
WBN-1-FU -212-B22/11 -B	CONTROL RM AIR COND B-B CPRSR-TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-B22/11 -B	TRIP BKR 2B-ELECT BD RM CHLR PKG B-B	B569	KWN10	✓	✓	
WBN-1-FU -212-B22/12 -B	CONTROL RM AIR COND B-B CPRSR-CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-B22/12 -B	CLOSE BKR 2B-ELECT BD RM CHLR PKG B-B	B569	KWN10	✓	✓	
WBN 1 FU 212 B22/21 B	TRIP BKR 2C	B569	KWN10	—	—	(Fuse not installed)
WBN-2-FU -212-B22/21 -B	TRIP BKR 2C	B569	KWN10	—	—	(Fuse not installed)
WBN-1-FU -212-B22/22 -B	CLOSE BKR 2C	B569	KWN10	—	—	(Fuse not installed)
WBN-2-FU -212-B22/22 -B	CLOSE BKR 2C	B569	KWN10	—	—	(Fuse not installed)
WBN-1-FU -212-B22/31 -B	CONTRL ROOM AIR COND B-B CPRSR					
WBN 1 FU 212 B22/31A -B	AUX TRIP BKR 2D	B569	KWN10	—	—	(FUSE NOT INSTALLED)
WBN-2-FU -212-B22/31A -B	TRAIN B CNTL CKT FOR CCS PUMP C-S-AUX TRIP	B569	KWN10	—	—	(Fuse not installed)
WBN-1-FU -212-B22/31N -B	NOR TRIP BKR 2D	B569	KWN10	—	—	(Fuse not installed)
WBN 2 FU 212 B22/31N B	TRAIN B CNTL CKT FOR CCS PUMP C-S-NOR TRIP	B569	KWN10	—	—	(Fuse not installed)
WBN-1-FU -212-B22/32 -B	CONTRL ROOM AIR COND B-B CPRSR					
WBN-1-FU -212-B22/32A -B	AUX CLOSE BKR 2D	B569	KWN10	—	—	(Fuse not installed)
WBN-2-FU -212-B22/32A -B	TRAIN B CNTL CKT FOR CCS PUMP C-S-AUX CLOSE	B569	KWN10	—	—	(Fuse not installed)
WBN 1 FU 212 B22/32N B	NOR CLOSE BKR 2D	B569	KWN10	—	—	(Fuse not installed)
WBN-2-FU -212-B22/32N -B	TRAIN B CNTL CKT FOR CCS PUMP C-S-NOR CLOSE	B569	KWN10	—	—	(Fuse not installed)
WBN 2-FU -212-B22/40 -B	TRAIN B CNTL CKT FOR CCS PUMP C-S	T268	312.062	—	—	NOT IN W/D DATA
WBN-1-FU -212-B23/11 -B	REAC BLDG POLAR CRANE BKR 3B TRIP	B569	KWN6	X	X	(KWN10 installed)
WBN-2-FU -212-B23/11 -B	TRIP BKR 3B	B569	KWN6	—	—	(Fuse not installed)
WBN-1-FU -212-B23/12 -B	REAC BLDG POLAR CRANE	S156	CP6A 87	—	—	AC
WBN-2-FU -212-B23/12 -B	REAC BLDG POLAR CRANE	S156	CP6A	—	—	
WBN 2 FU 212 B23/21 B	TRIP BKR 3C	B569	KWN10	✓	✓	
WBN-1-FU -212-B23/21A -B	SD BD RM A&B CHILL PKG B-B BKR 3C AUX TRIP	B569	KWN10	—	—	(no Fuse installed)
WBN-1-FU -212-B23/21N -B	SD BD RM A&B CHILL PKG B-B BKR 3C NOR TRIP	B569	KWN10			
WBN-2-FU -212-B23/22 -B	CLOSE BKR 3C	B569	KWN10	✓	✓	
WBN-1-FU -212-B23/22A -B	SD BD RM A&B CHILL PKG B-B BKR 3C AUX CLOSE	B569	KWN10	—	—	(no Fuse installed)
WBN-1-FU -212-B23/22N -B	SD BD RM A&B CHILL PKG B-B BKR 3C NOR CLOSE	B569	KWN10			
WBN 1 FU 212 B24/11 B	480V SD BD 1B2-B EMERG FDR BKR 52E PTS PRI	B569	JK56	✓	✓	
WBN-2-FU -212-B24/11 -B	480V SD BD 2B2-B EMERG FDR BKR 52E PTS-PRI	B569	JK56	—	—	AC
WBN-1-FU -212-B24/12 -B	480V SD BD 1B2-B EMERG FDR BKR 52E PTS-SEC	B569	KWN6	—	—	
WBN-2-FU -212-B24/12 -B	480V SD BD 2B2-B EMERG FDR BKR 52E PTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-B24/13 -B	480V SD BD 1B2-B ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN 2 FU 212 B24/13 B	480V SD BD 2B2-B ALT FDR BKR 52E TRIP	B569	KWN10	✓	✓	
WBN 1 FU 212 B24/14 B	480V SD BD 1B2-B ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-B24/14 -B	480V SD BD 2B2-B ALT FDR BKR 52E CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-B24/15 -B	480V SD BD 1B2-B ALT FDR BKR 52E IND LTS ISOL	B569	KWN-R6	✓	✓	
WBN-2-FU -212-B24/15 -B	480V SD BD 2B2-B ALT FDR BKR 52E IND LTS ISOL	B569	KWN6	✓	✓	
WBN 1 FU 212 B24/16 B	480V SD BD 1B2-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-B24/16 -B	480V SD BD 2B2-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-1-FU -212-B24/17 -B	480V SD BD 1B2-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	
WBN-2-FU -212-B24/17 -B	480V SD BD 2B2-B ALT FDR BKR 52E IND LTS ISOL	B569	FRN-R1	✓	X	

Prepared By K.K. Pierce 1-25-90
Reviewed By W. Bleay 1-25-90

WBN-EEB-MS-TI07-0005
Attachment I

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 1990 96

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/ DBM	agrees w/ DBM	SITE LOCATION
WBN-1-FU -212-824/31A -B	STA FIRE PMP 1B-B BKR 4D AUX TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-824/31A -B	STA FIRE PMP 2B-B BKR 4D AUX TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-824/31N -B	STA FIRE PMP 1B-B BKR 4D NOR TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-824/31N -B	STA FIRE PMP 2B-B BKR 4D NOR TRIP	B569	KWN10	✓	✓	
WBN-1-FU -212-824/32A -B	STA FIRE PMP 1B-B BKR 4D AUX CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-824/32A -B	STA FIRE PMP 2B-B BKR 4D AUX CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-824/32N -B	STA FIRE PMP 1B-B BKR 4D NOR CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-824/32N -B	STA FIRE PMP 2B-B BKR 4D NOR CLOSE	B569	KWN10	✓	✓	
WBN-1-FU -212-825/1 -B	480V SD BD 1B2-B BUS PTS-PRI	B569	JKS6	—	—	
WBN-2-FU -212-825/1 -B	480V SD BD 2B2-B BUS PTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-825/2 -B	480V SD BD 1B2-B BUS PTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-825/2 -B	480V SD BD 2B2-B BUS PTS-SEC	B569	KWN6	—	—	
WBN-1-FU -212-825/3 -B	480V SD BD 1B2-B BUS GRND IND LTS-PRI	B569	JKS6	—	—	AC
WBN-2-FU -212-825/3 -B	480V SD BD 2B2-B BUS GRND IND LTS-PRI	B569	JKS6	—	—	
WBN-1-FU -212-825/4 -B	480V SD BD 1B2-B BUS GRND IND LTS-SEC	B569	KTN6	—	—	
WBN-2-FU -212-825/4 -B	480V SD BD 2B2-B BUS GRD IND LTS-SEC	B569	KTN6	—	—	
WBN-1-FU -212-825/5 -B	480V SD BD 1B2-B NOR DC CONT BUS UV RELAY	B569	KWN6	✓	✓	
WBN-2-FU -212-825/5 -B	480V SD BD 2B2-B NOR DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU -212-825/6 -B	480V SD BD 1B2-B EMERG DC CONT BUS UV RELAY	B569	KWN6	✓	✓	
WBN-2-FU -212-825/6 -B	480V SD BD 2B2-B EMERG DC CONT BUS UV RLY	B569	KWN6	✓	✓	
WBN-1-FU -212-827/1 -B	AUX BLDG GEN EXH FAN B BKR 7A TRIP	B569	KWN10	✓	✓	(not installed)
WBN-2-FU -212-827/1 -B	TRIP BKR 7A	B569	KWN10	✓	✓	
WBN-1-FU -212-827/11A -B	CROM CLR FAN 1D-B MTR 1 BKR 7B AUX TRIP	B569	KWN6	—	—	(KWN10 installed)
WBN-2-FU -212-827/11A -B	AUX TRIP BKR 7B	B569	KWN6	—	—	(Fuse not installed)
WBN-1-FU -212-827/11N -B	CROM CLR FAN 1D-B MTR 1 BKR 7B NOR TRIP	B569	KWN6	—	—	(KWN-R6 instl.)
WBN-2-FU -212-827/11N -B	NOR TRIP BKR 7B	B569	KWN6	—	—	(Fuse not installed)
WBN-1-FU -212-827/12A -B	CROM CLR FAN 1D-B MTR BKR 7B AUX CLOSE	B569	KWN6	—	—	(KWN10 installed)
WBN-2-FU -212-827/12A -B	AUX CLOSE BKR 7B	B569	KWN6	—	—	(Fuse not installed)
WBN-1-FU -212-827/12N -B	CROM CLR FAN 1D-B MTR 1 BKR 7B NOR CLOSE	B569	KWN6	—	—	(KWN-R6 installed)
WBN-2-FU -212-827/12N -B	NOR CLOSE BKR 7B	B569	KWN6	—	—	(Fuse not installed)
WBN-1-FU -212-827/13 -B	CROM CLR FAN 1D-B MTR-1	S156	CP6A-150	—	—	AC
WBN-2-FU -212-827/13 -B	CRD MECH CLR FAN D-B(MTR 1)	S156	CP6A	—	—	
WBN-1-FU -212-827/2 -B	AUX BLDG GEN EXH FAN B BKR 7A CLOSE	B569	KWN10	—	—	Fuse not installed
WBN-2-FU -212-827/2 -B	CLOSE BKR 7A	B569	KWN10	✓	✓	
WBN-1-FU -212-827/21 -B	TRIP BKR 7C SPARE	B569	KWN10	✓	✓	
WBN-2-FU -212-827/21 -B	TRIP BKR 7C	B569	KWN10	X	X	(KWN AMPS?)
WBN-1-FU -212-827/22 -B	CLOSE BKR 7C SPARE	B569	KWN10	✓	✓	
WBN-2-FU -212-827/22 -B	CLOSE BKR 7C	B569	KWN10	✓	✓	
WBN-1-FU -212-827/23 -B	SPARE	S156	CP470C5	—	—	
WBN-2-FU -212-827/23 -B	FUEL HDLG EXH FAN B	S156	CP6A	—	—	AC
WBN-1-FU -212-827/3 -B	AUX BLDG GEN EXH FAN B	S156	CP470C5	—	—	
WBN-2-FU -212-827/3 -B	AUX BLDG GEN EXH FAN 2B	S156	CP6A	—	—	
WBN-1-FU -212-827/31A -B	REAC LO COMPT CLR FAN 1D-B BKR 7D AUX TRIP	B569	KWN6	✓	✓	(KWN-R6 installed)
WBN-2-FU -212-827/31A -B	AUX TRIP BKR 7D	B569	KWN10	✓	X	
WBN-1-FU -212-827/31N -B	REAC LO COMPT CLR FAN 1D-B BKR 7D NOR TRIP	B569	KWN6	✓	✓	(KWN-R6 installed)
WBN-2-FU -212-827/31N -B	NOR TRIP BKR 7D	B569	KWN10	✓	X	
WBN-1-FU -212-827/32A -B	REAC LO COMPT CLR FAN 1D-B BKR 7D AUX CLOSE	B569	KWN6	✓	✓	(KWN-R6 installed)
WBN-2-FU -212-827/32A -B	AUX CLOSE BKR 7D	B569	KWN10	✓	X	
WBN-1-FU -212-827/32N -B	REAC LO COMPT CLR FAN 1D-B BKR 7D NOR CLOSE	B569	KWN6	✓	✓	(KWN-R6 installed)
WBN-2-FU -212-827/32N -B	NOR CLOSE BKR 7D	B569	KWN10	✓	X	
WBN-1-FU -212-827/33 -B	REAC LO COMPT CLR FAN 1D-B	S156	CP6A-31	—	—	
WBN-2-FU -212-827/33 -B	REAC LO CMPT CLR FAN D-B	S156	CP6A	—	—	
WBN-1-FU -212-828/13 -B	REAC MOV BD 1B2-B NOR FDR	S156	CP350C5	—	—	AC
WBN-2-FU -212-828/13 -B	REAC MOV BD 2B2-B NOR FDR	S156	CP6A	—	—	
WBN-1-FU -212-828/23 -B	SPARE	S156	CP500C5	—	—	
WBN-2-FU -212-828/23 -B	SPARE	S156	CP6A	—	—	

Prepared By W.K. Pierce 1-25-90
Reviewed By W. Berry 1-25-90

PRINTED IN U.S.A.

WBN-EEB-MS-TI07-0005
Attachment I

EQIS CUSTOMIZED LISTING 11:02 THURSDAY, JANUARY 18, 1996 97

UNID	DESCRIPTION	MFG REF #	MFG MOD #	agrees w/ WP Pkg	agrees DWG S/L & Schedule	LOCATION
WBN-1-FU -212-828/3 -B	250V SPARE BATT CHGR ALT FDR	S156	CP6A	—	—	
WBN-2-FU 212-828/3 -B	SPARE	S156	CP6A	—	—	
WBN-1-FU -212-828/33 -B	DSL AUX BD 1B1-B ALT FDR/1B2-B NOR FDR	S156	CP500C5	—	—	AC
WBN-2-FU -212-828/33 -B	ALT FDR 480V DSL AUX 2B1-B	S156	CP6A	—	—	
WBN-1-FU 212-829/1 -B	SPENT FUEL PIT PMP B-B BKR 9A TRIP	B569	KWN10	—	—	(no fuse installed)
WBN-2-FU -212-829/1 -B	TRIP BKR 9A	B569	KWN10	✓	✓	
WBN-1-FU -212-829/13 -B	C&A VT BD 1B1-B ALT FDR	S156	CP500C5	—	—	AC
WBN-2-FU -212-829/13 -B	CRA VT BD 2B1-B ALT FDR	S156	CP6A	—	—	
WBN-1-FU 212-829/2 -B	SPENT FUEL PIT PMP B-B BKR 9A CLOSE	B569	KWN10	—	—	(no fuse installed)
WBN-2-FU -212-829/2 -B	CLOSE BKR 9A	B569	KWN10	✓	✓	
WBN-1-FU 212-829/21 -B	CNTMT AIR RETURN FAN 1B-B BKR 9C TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-829/21 -B	TRIP BKR 9C	B569	KWN10	✓	✓	
WBN-1-FU -212-829/22 -B	CNTMT AIR RETURN FAN 1B-B - BKR 9C CLOSE	B569	KWN10	✓	✓	
WBN-2-FU -212-829/22 -B	CLOSE BKR 9C	B569	KWN10	✓	✓	
WBN-1-FU -212-829/23 -B	CONT AIR RETURN FAN 1B-B	S156	CP6A-85	—	—	
WBN-2-FU -212-829/23 -B	CNTMT AIR RETURN FAN B-B	S156	CP6A	—	—	
WBN-1-FU 212-829/24 -B	CONTAINMENT AIR RETURN FAN 1B-B FUSE BLOWN	T268	FLAS 5	—	—	AC
WBN-2-FU -212-829/24 -B	CNTMT AIR RETURN FAN B-B	S156	CP6A	—	—	
WBN-1-FU -212-829/3 -B	SPENT FUL PIT PMP B-B	S156	CP4/0C5	—	—	
WBN-2-FU -212-829/3 -B	REAC VT BD 2B-B ALT FDR	S156	CP6A	—	—	
WBN-1-FU -212-829/30 -B	CONT AIR RETURN FAN 1B-B	T268	312.062	—	—	(not in w/p Data)
WBN-2-FU 212-829/30 -B	FILTERING MODULE	T268	312.062	—	—	
WBN-1-FU -212-829/31 -B	480V SHTDN BD RM A&B AHU C-B BKR TRIP	B569	KWN10	✓	✓	
WBN-2-FU -212-829/31 -B	480V SHTDN BD RM A&B AHU D-B TRIP BKR	B569	KWN10	✓	✓	
WBN-1-FU -212-829/32 -B	480V SHTDN BD RM A&B AHU C-B BKR CLOSE	B569	KWN10	✓	✓	(KWN10 & KLC10 installed)
WBN-2-FU -212-829/32 -B	480V SHTDN BD RM A&B AHU D-B CLOSE BKR	B569	KWN10	✓	✓	
WBN-1-FU 212-829/33 -B	480V SHTDN BD RM A&B AHU C-B SUPPLY	S156	CP4/0C5	—	—	AC
WBN-2-FU -212-829/33 -B	480V SHTDN BD RM A&B AHU D-B SUPPLY	S156	CP4/0C5	—	—	
WBN-1-FU -213-A11/1A -A	INCOMING FEEDER - ALTERNATE	S156	A6Y3-1			
WBN-2-FU -213-A11/1A -A	INCOMING FEEDER - ALTERNATE	S156	A6Y3-1			
WBN-1-FU 213-A11/1N -A	INCOMING FEEDER NORMAL	S156	A6Y3-1			
WBN-2-FU -213-A11/1N -A	INCOMING FEEDER - NORMAL	S156	A6Y3-1			
WBN-1-FU -213-A110/1A -A	RWST TO RHR PMP FCV	S156	TRM1			
WBN-2-FU -213-A110/1A -A	RWST TO RHR PUMP FCV	S156	TRM1			
WBN-1-FU -213-A110/1N -A	RWST TO RHR PMP FCV	S156	TRM1			
WBN-2-FU -213-A110/1N -A	RWST TO RHR PUMP FCV	S156	TRM1			
WBN-1-FU -213-A110/10 -A	RWST TO RHR PUMP FCV	T268	312.062			
WBN-2-FU -213-A110/10 -A	RWST TO RHR PUMP FCV	T268	312.062			
WBN-1-FU 213-A110/11A -A	SIS PUMPS RECIRC TO RWST	S156	TRM1			
WBN-2-FU -213-A110/11A-A	SIS PUMP RECIRC TO RWST	S156	TRM1			
WBN-1-FU -213-A110/11N-A	SIS PUMPS RECIRC TO RWST	S156	TRM1			
WBN-2-FU -213-A110/11N-A	SIS PUMP RECIRC TO RWST	S156	TRM1			
WBN-1-FU 213-A110/19 -A	SIS PUMPS RECIRC TO RWST	T268	312.062			
WBN-2-FU -213-A110/19 -A	SIS PUMP RECIRC TO RWST	T268	312.062			
WBN-1-FU 213-A110/20 -A	SIS PUMPS RECIRC TO RWST	T268	312.062			
WBN-2-FU -213-A110/20 -A	SIS PUMP RECIRC TO RWST	T268	312.062			
WBN-1-FU -213-A110/31A-A	RHR SYS ISOL VLV	S156	TRM1			
WBN-2-FU -213-A110/31A-A	RHR SYS ISLN VLV	S156	TRM1			
WBN-1-FU -213-A110/31N-A	RHR SYS ISOL VLV	S156	TRM1			
WBN-2-FU 213-A110/31N -A	RHR SYS ISLN VLV	S156	TRM1			
WBN-1-FU -213-A110/32 -A	RHR SYS ISOL VLV	S156	TRS30			
WBN-2-FU -213-A110/32 -A	RHR SYS ISLN VLV	S156	TRS30			
WBN-1-FU -213-A110/39 -A	RHR SYS ISOL VLV	T268	312.062			
WBN-2-FU 213-A110/39 -A	RHR SYS ISLN VLV	T268	312.062			
WBN-1-FU 213-A110/40 -A	RHR SYS ISOL VLV	T268	312.062			
WBN-2-FU -213-A110/40 -A	RHR SYS ISLN VLV	T268	312.062			

Prepared By RRPrice 1-25-96
Reviewed By W. Berry 1-25-96

Prepared By
Reviewed By

ATTACHMENT NO. M12070A

CALC NO. WBN-EEB-MS-TI07-0005

PREPARED S.J. Hunt DATE 1-23-91

125 VDC VITAL CONTROL POWER SYSTEMS FAULT CALCULATION CHECKED CHS DATE 1-23-91

PURPOSE

THE PURPOSE OF THIS ATTACHMENT IS TO EVALUATE AND DOCUMENT THE ADEQUACY OF THE BUSSMAN KLM-1. ONE AMP FUSE WHICH IS TO ISOLATE THE LIMIT SWITCH CIRCUITS FROM THE PCV CIRCUITS TO INSURE THE OPERATION OF PCV-68-340A-A AND PCV-68-334-B, THAT SUPPORT MODIFICATIONS TO BE IMPLEMENTED UNDER DCN M-12070-A (DUE TO APPENDIX R CONCERNS).

THE FOLLOWING BASELINE CALCULATIONS EVALUATE THE MODIFICATIONS FOR THEIR IMPACT. SINCE DIFFERENT ASPECTS OF A DESIGN MODIFICATION ARE EVALUATED OR DETERMINED IN THE CALCULATION CONTROLLING THAT PARTICULAR FEATURE, INTERFACES OR REFERENCES BETWEEN THE CALCULATIONS ARE NECESSARY. THE EVALUATIONS FOR THIS MODIFICATION ARE IDENTIFIED BY "ATTACHMENT NO. M12070A" OR THE DCNS ARE OTHERWISE IDENTIFIED AS BEING EVALUATED IN THE FOLLOWING CALCULATIONS.

BASELINE CALCULATION	CALCULATION NO.
125VDC VOLTAGE ANALYSIS	WBN-EEB-MS-TI11-0004
120V PROTECTION/COORDINATION	WBN-EEB-MS-TI07-0018
120V AC CONTROL TRANSFORMER SIZING	WBN-EEB-MS-TI02-0019
120V PENETRATION PROTECTION	WBN-EEB-MS-TI08-0028
125 VDC VITAL CONTROL POWER SYSTEM FAULT CALCULATIONS	WBN-EEB-MS-TI07-0005

ATTACHMENT NO M12070A

CALC. NO. WBN-EEB-MS-TI07-0005

PREPARED L.J. Hunter DATE 1-23-91

125VDC VITAL CONTROL POWER SYS. FAULT CALC. CHECKED CHS DATE 1-23-91

1.0 SCOPE

THIS ATTACHMENT EVALUATES AND VERIFIES THAT THE PROPOSED DESIGN IS ADEQUATE.

THE IMPACT OF THE DCN ON THIS CALCULATION IS THE ADDITION OF ONE FUSE AND RESISTOR FOR EACH OF TWO PRESSURE CONTROL VALVE CIRCUITS FOR ISOLATION OF A LIMIT SWITCH CIRCUIT DUE TO APPENDIX R CONCERNS. EACH OF THE LOADS ARE IDENTIFIED BELOW.

1-PCV-68-340A-A 1-PCV-68-334-B

2.0 ASSUMPTIONS

SEE "ASSUMPTIONS" IDENTIFIED IN THE BASELINE CALCULATION. (SECTIONS 2.0)

3.0 SOURCES OF DESIGN INPUT/REFERENCES

3.1 DCN M-12070-A

3.2 WBN-EEB-MS-TI07-0005, 125VDC VITAL CONTROL POWER SYSTEMS FAULT CALCULATIONS.

3.3 WBPEVAR8907005 R0, VERIFICATION OF FLAS-5 AND MIS-5 DC FUSES AS ADEQUATE REPLACEMENTS OF KAZ ACTUATORS.

3.4 TVA DESIGN GUIDE, DG-E2.4.6 R0

3.5 WBNP CABLE SCHEDULE

3.6 WBN-EEB-MS-TI15-0011, 480V NON-CLASS 1E POWER CABLE PROTECTION TIME-CURRENT CURVES, PAGES C12 AND C23.

3.7 BUSS ELECTRONIC AND SMALL DIMENSION FUSES, PAGE 3-3-14 OF CATALOG SFB, DATED JANUARY, 1989.

3.8 WESTINGHOUSE LETTER WAT-D-7592, EZC MINALITES, RIMS NO. B26 88 0208 353

ATTACHMENT NO. M12070A
CALCULATION NO. WBN EEB-MS-TI07-0005
PREPARED J. Hunt DATE 1-23-91
CHECKED CHS DATE 1-23-91

4.0 DESIGN INPUT DATA (REF 3.1)

4.1 THE SIZE OF THE NEW CONTROL CIRCUIT CABLES IS #12 AWG. AND THE EXISTING CONTROL CIRCUIT CABLES IS #14 AWG.

4.2 THE FUSE TO BE INSTALLED SHALL CLEAR A FAULT CONDITION OCCURRING AT THE LIMIT SWITCH CIRCUITS BEFORE THE UPSTREAM PROTECTIVE DEVICE DOES, THEREBY ALLOWING THE CONTINUED OPERATION OF THE PCV'S. THE FUSE CONTINUOUS CURRENT RATING SHALL BE AT LEAST 125% OF THE LOAD CURRENT. THE FUSE INTERRUPTING RATING (I.R.) SHALL BE GREATER THAN THE MAXIMUM CALCULATED SHORT CIRCUIT CURRENT IN THE CIRCUIT. DUE TO LOW CABLE RESISTANCE ON THE NEGATIVE SIDE OF THE LIMIT SWITCH, A 10 OHM RESISTOR IS ADDED TO LOWER SHORT CIRCUIT CURRENT FOR COORDINATION OF FUSES.

4.3 TECHNICAL DATA

4.3.1 LOCATION OF FUSES TO BE INSTALLED:
1-PNL-278-L11A AND 1-PNL-278-L11B

4.3.2 EQUIPMENT ISOLATED BY FUSE:
INDICATING LIGHTS AND LIMIT SWITCHS OF
1-PVC-68-340A-A AND 1-PVC-68-334-B

4.3.3 CONTROL CIRCUIT POWER SOURCE:
125VDC VITAL BATTERY BOARD I CKT. A11/B11
125VDC VITAL BATTERY BOARD II CKT A11/B11

4.3.4 FUSE TO BE INSTALLED:
FROM MANUFACTURES DATA.
BUSSMANN KLM-1 1 AMP, IR=10,000 AMPS @ 250VDC
RESISTOR TO BE INSTALLED:
LEEDS AND NORTHRUP #011933 10 OHMS 10 WATTS

4.3.5 INDICATING LAMP DATA:
WESTINGHOUSE EZC MINALITES MODEL NOS. 449D187G14, G24
125VDC, 3200 OHMS (REFERENCE 3.8)

Prepared By: [illegible] Date 1-23-91
Checked By: CHS Date 1/23/91

4.3.5 CABLE IMPEDANCE (USING MINIMUM RESISTANCE 25°C)

BATTERY BOARD	VALVE ID	CABLE ID	CABLE SIZE (AWG)	CABLE LENGTH (FT)	25°C CABLE RESISTANCE (OHMS/1000FT)	TOTAL CABLE RESISTANCE (OHMS)
I	1-PCV-68-340A-A (PAGE 12)	1V5607A	1-2C #14	89	2.62	0.2332
		1V5608A	1-2C #14	89	2.62	0.2332
		1V5612A	1-4C #14	563	2.62	1.4751
		1V5613A	4-1C #14	130	2.62	0.3406
		1V5614A	1-1C #14	12	2.62	0.0314
		1V5610A	1-5C #12	130	1.65	0.2145
II	1-PCV-68-334-B (PAGE 13)	1V5593B	1-2C #14	83	2.62	0.2175
		1V5594B	1-2C #14	83	2.62	0.2175
		1V5598B	1-4C #14	873	2.62	2.2873
		1V5599B	4-1C #14	130	2.62	0.3406
		1V5600B	1-1C #14	12	2.62	0.0314
		1V5596B	1-5C #12	500	1.65	0.8250

5.0 DOCUMENTATION OF INPUTS AND ASSUMPTIONS
SEE "DOCUMENTATION OF INPUTS AND ASSUMPTIONS" IN BASE CALCULATION (SECTION 5.0)

PREPARED [illegible] DATE 1-23-91
CHECKED CHS DATE 1-23-91

6.0 COMPUTATIONS AND ANALYSES

6.1 FUSE SIZING AND SELECTION:

6.1.1 FUSE MINIMUM CURRENT RATING SHALL BE AT LEAST 125% OF THE LOAD CURRENT. (REFERENCE 3.8)

TWO PARELLEL LIGHTS ARE ON AT WORST CASE LOAD CONDITIONS. (SEE PG 9)
IGNORING CABLE RESISTANCE FOR CONSERVATIVE RESULTS, THE LOAD CURRENT FOR THE PCV CIRCUIT LISTED BELOW IS:

$$\text{LOAD CURRENT} = \frac{\text{MAX. VOLTAGE (EQUALIZATION)}}{\text{LAMP RESISTANCE + FUSE RESISTOR (PG 9)}}$$

1-PCV-68-340A-A, $I_{LOAD} = \frac{140\,VDC}{1610\ OHMS} = 0.087$ AMPS

1-PCV-68-334-B, $I_{LOAD} = \frac{140\,VDC}{1610\ OHMS} = 0.087$ AMPS

FUSE MINIMUM CURRENT RATING = MULTIPLYING FACTOR × I

1-PCV-68-340A-A, FUSE MIN. I = 1.25 × 0.087 = 0.109 AMPS

1-PCV-68-334-B, FUSE MIN. I = 1.25 × 0.087 = 0.109 AMPS

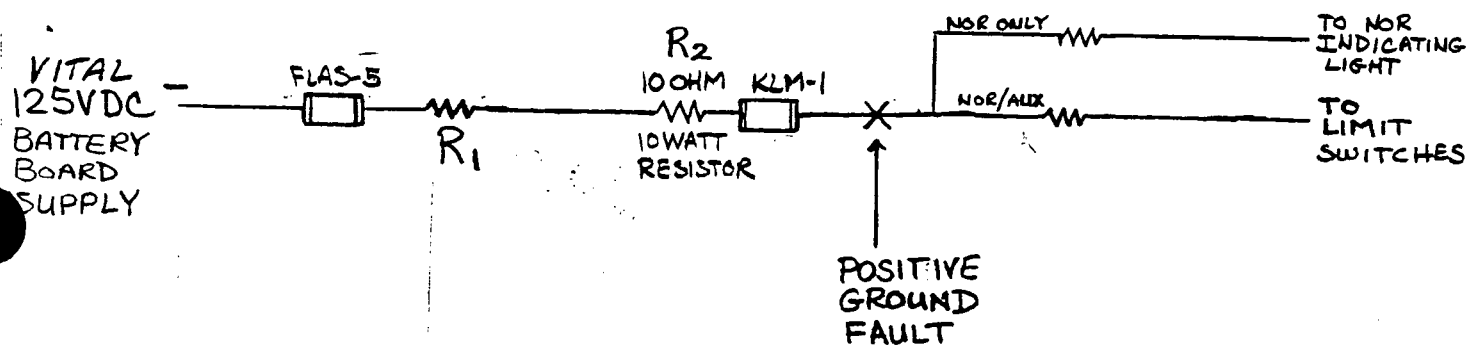
PREPARED [illegible] DATE 1-23-91
CHECKED CHS DATE 1-23-91

6.0 COMPUTATIONS AND ANALYSES (CONTINUED)

6.2 SHORT CIRCUIT ANALYSES:

WORST CASE CONSIDERATIONS FOR SHORT CIRCUIT AT THE LIMIT SWITCH CIRCUIT DURING MAXIMUM VOLTAGE (EQUALIZATION):

CONSIDER A POSITIVE GROUND FAULT ON THE NEGATIVE POLARITY SIDE OF THE LIMIT SWITCH CIRCUIT FOR EITHER VALVE CIRCUIT. (SEE PAGES 12 AND 13)



R_1 = RESISTANCE OF CABLE (LISTED IN TABLE BELOW)
R_2 = RESISTOR TO BE INSTALLED, 10 OHM 10 WATT

VITAL BATTERY BOARD VOLTAGE (MAX)	VALVE ID	R_1 CABLE ID	R_1 CABLE RESISTANCE (OHMS)	R_1+R_2 RESISTANCE (OHMS)	I_{SC} (MAX) AMPS
140VDC	1-PCV-68-340A-A	1V5607A	0.2332	10.2332	13.7
140VDC	1-PCV-68-334-B	1V5593B	0.2175	10.2175	13.7

$$I_{SC} = \frac{\text{BATTERY BOARD VOLTAGE (MAXIMUM)}}{\text{APPLICABLE RESISTANCE}}$$

BASED ON THE ABOVE INFORMATION, THE KLM-1 1 AMP FUSE CAN PROVIDE ADEQUATE ISOLATION OF THE LIMIT SWITCH CIRCUITS FROM THE PCV CONTROL CIRCUIT FOR SHORT CIRCUIT PROTECTION.
(REFER TO TIME-CURRENT CURVE IN SECTION 7.0 IN THIS ATTACHMENT, PAGE NO. 8)

PREPARED [illegible] DATE 1-23-91
CHECKED CHS DATE 1-23-91

7.0 SUPPORTING GRAPHICS

THE GRAPHICS FOR THIS ATTACHMENT CONSIST OF PAGE 8 (TIME-CURRENT CURVE NO. 1A) - PAGE 13.

8.0 SUMMARY OF RESULTS

AS SHOWN IN SECTION 6. OF THIS ATTACHMENT, THE KLM-1 ONE AMP FUSE PROVIDES ADEQUATE ISOLATION OR ELECTRICAL PROTECTION BETWEEN THE LIMIT SWITCH CIRCUIT AND THE PCV CIRCUIT. THE RESISTOR IN SERIES WITH THE KLM-1 FUSE AS SHOWN ON PAGE 9 PROVIDES COORDINATION BETWEEN THE KLM-1 ONE AMP FUSE AND THE FLAS-5 FIVE AMP FUSES AS SHOWN ON TIME-CURRENT CURVE 1A, PAGE 8.

9.0 CONCLUSION

BASED ON THE SUMMARY OF RESULTS FROM SECTION 8.0, THE KLM-1 ONE AMP FUSE PROVIDES ELECTRICAL PROTECTION BETWEEN THE LIMIT SWITCH CIRCUIT AND THE PCV CIRCUIT TO MEET 10 CFR 50 APPENDIX R CONCERNS, AND PROVIDES COORDINATION WITH THE FLAS-5 FIVE AMP FUSE.

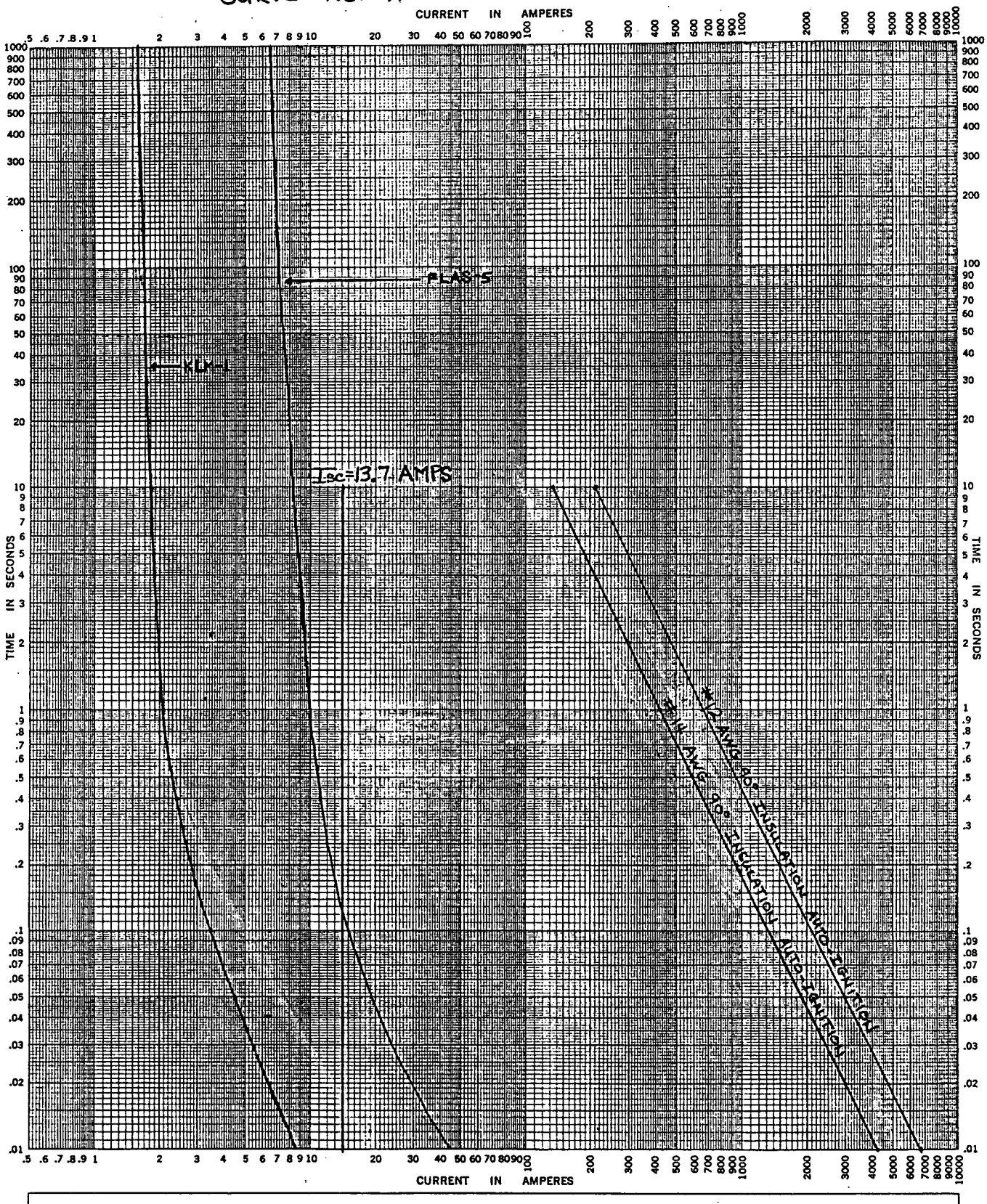
10.0 APPENDICES

NOT APPLICABLE

11.0 ATTACHMENTS

PAGE NO.	TITLE
8	TIME-CURRENT CHARACTERISTIC CURVE NO. 1A
9	LIMIT SWITCH ISOLATION CIRCUIT
10	CABLE SCHEMATIC FOR TRAIN A
11	CABLE SCHEMATIC FOR TRAIN B
12	1-PCV-68-340A-A RESISTIVE LOOP CIRCUIT
13	1-PCV-68-334-B RESISTIVE LOOP CIRCUIT
14	RECORD OF TELEPHONE CONVERSATION.
15	BUSS FUSE TIME-CURRENT CHARACTERISTIC CURVES

CURVE NO. 1A ATTACHMENT M12070A



_____ TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links. In _____

BASIS FOR DATA Standards _____ Dated _____

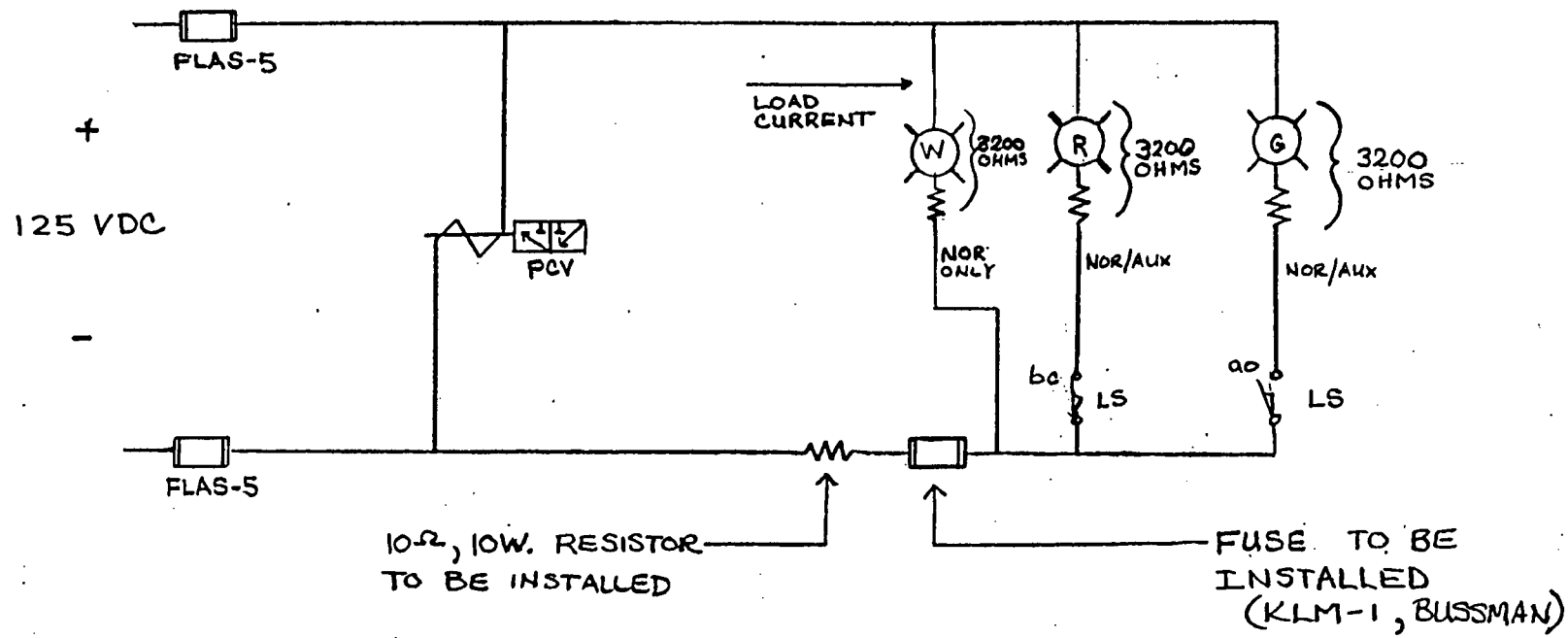
1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____
2. Curves are plotted to _____ Test points so variations should be _____

No. _____

Date _____

K•E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

PREPARED BY: [illegible]	DATE 1-23-91
CHECKED BY: C.H. Sudderth	DATE 1/23/91

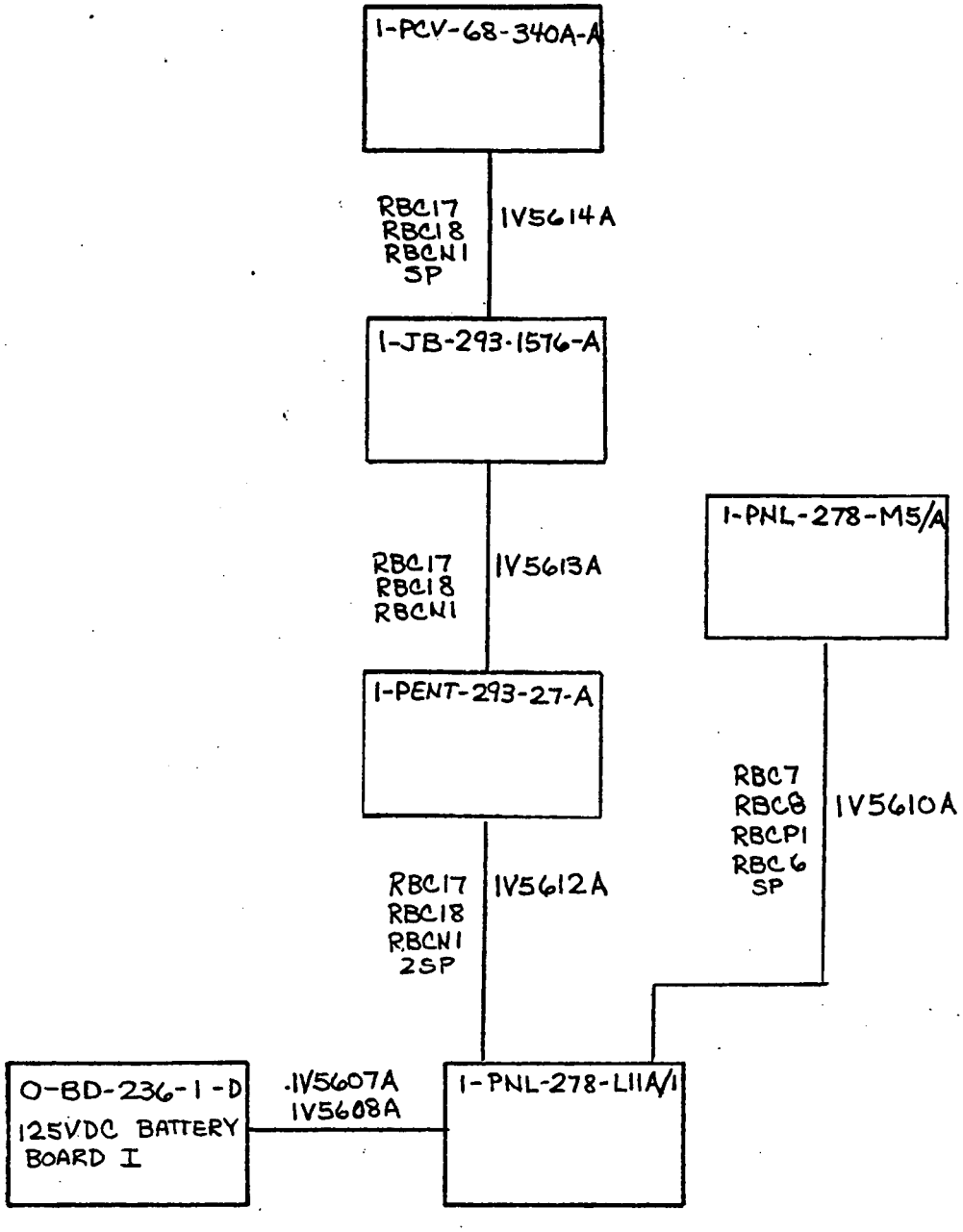


LIMIT SWITCH CIRCUIT
1-PCV-68-340A-A
1-PCV-68-334-B
PRESSURE CONTROL VALVE
TRAINS A AND B

Prepared By: [illegible] Date 1-23-91
Checked By: CHS Date 1-23-91

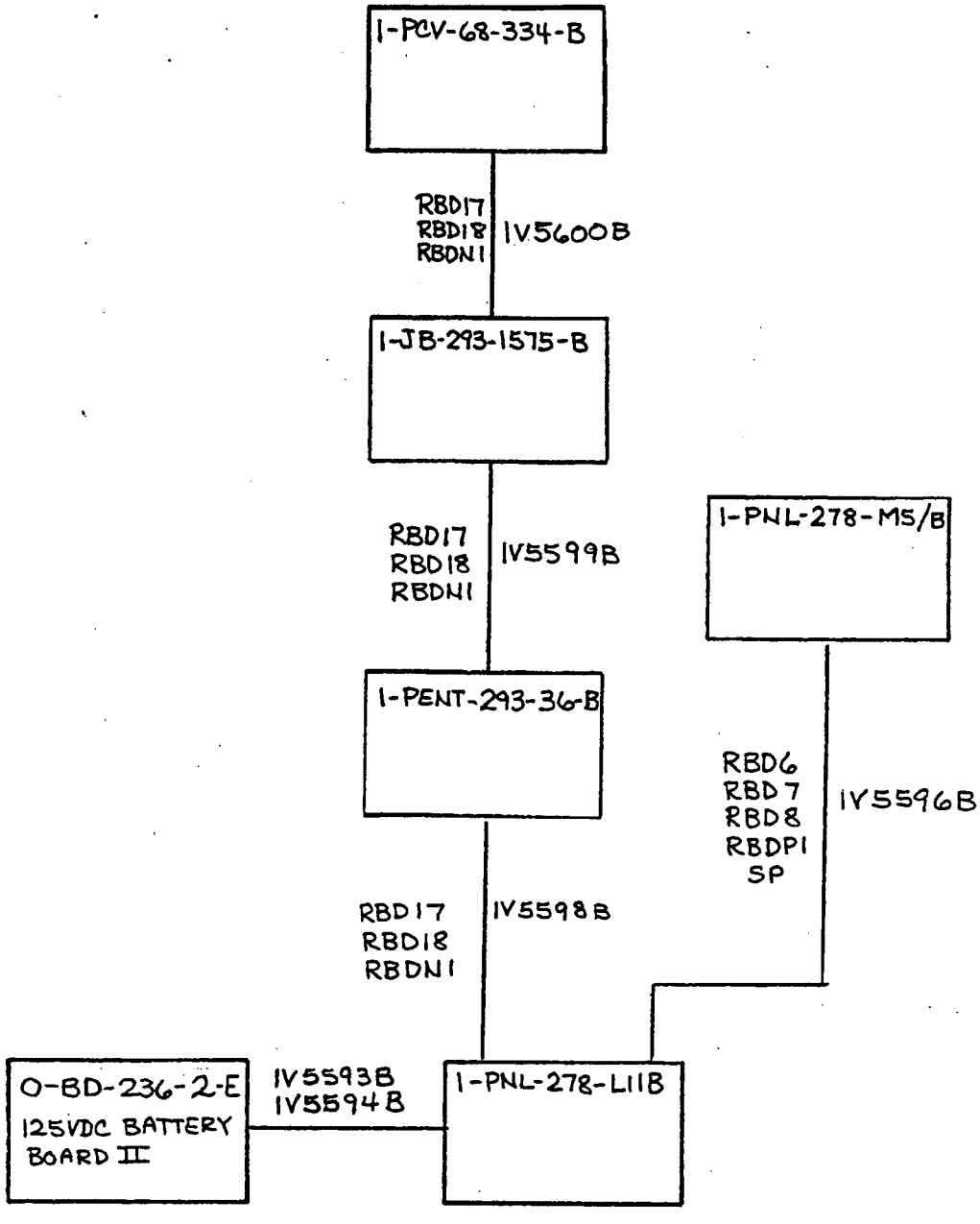
Prepared By [illegible] Date 1-23-91
Checked By CHS Date 1-23-91

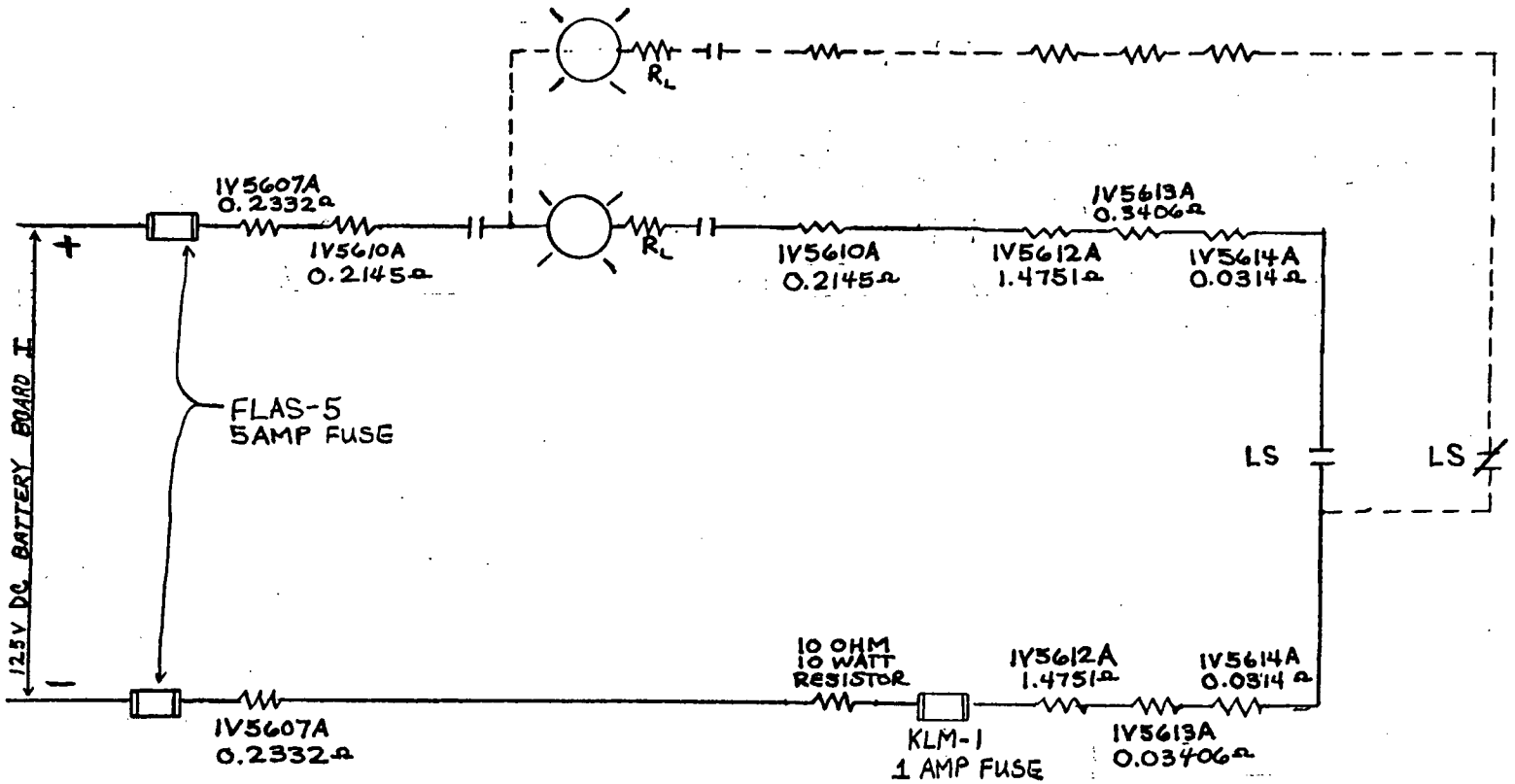
CABLE SCHEMATIC FOR TRAIN A



Prepared By J.C. Hart Date 1-23-91
Checked By CHS Date 1-23-91

CABLE SCHEMATIC FOR TRAIN B

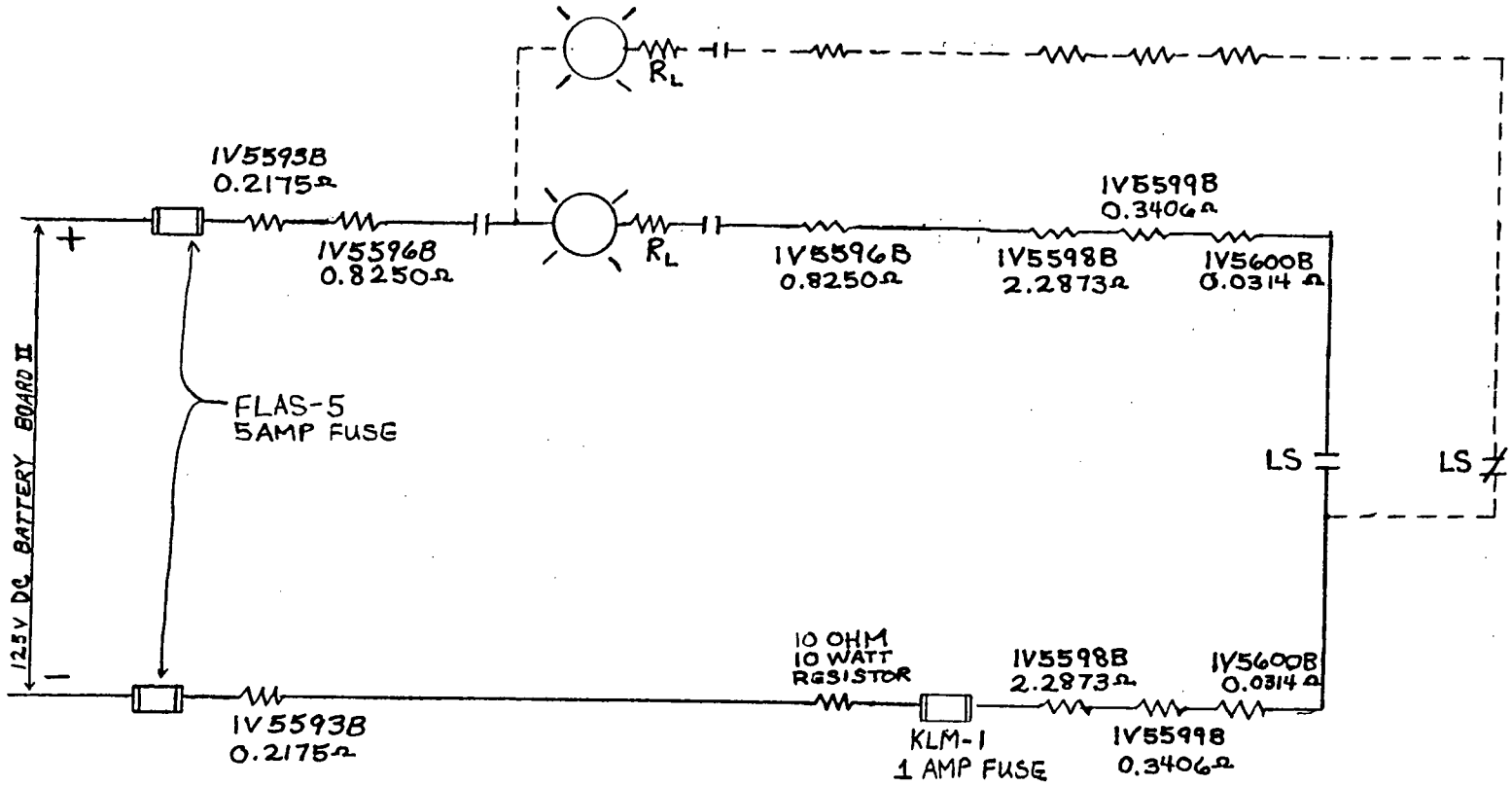




1-PCV-68-340A-A
PRESSURE CONTROL VALVE
TRAIN A

R_L = {3200 OHM RESISTOR INDICATING LIGHT
LS = LIMIT SWITCH

Prepared By [illegible] Date 7-23-91
Checked By CHS Date 1-23-91



1-PCV-68-334-B
PRESSURE CONTROL VALVE
TRAIN B

R_L = 3200 OHM INDICATING LIGHT RESISTOR.

LS = LIMIT SWITCH

Prepared By [illegible] Date 1-23-91
Checked By CHS Date 1-23-91

RECORD OF TELEPHONE CONVERSATION

Date 1/14/91

TO Project File/E001.BJ01.20
Name/File No.

FROM Scott Hunter

CLIENT/PROJECT TVA/WBNP

SUBJECT DCN M-12070-A/Isolation of Limit switch circuit to meet Appendix R requirements

CHARGE: DEPT. NO. 547 CLIENT SYMBOL TVA OFS NO. 2031

Concerning DCN M-12070-A, the pressure power relief valve control circuits PCV-68-340A-A and PCV-68-334-B:

The two PROPOSED fuses on the positive polarity side of the limit switch circuit are not required due to the ~~3900~~ 3300 ohm resistors for the indicating lights, which will provide isolation for the positive supply cables.

It is difficult to coordinate the source FLAS-5 fuse with a new downstream fuse for the negative polarity cable. To provide isolation on the negative side, a 10 ohm 10 watt resistor will be provided in series with a KLM-1 Bussman fuse. This combination provides excellent coordination with negligible effect on the circuit.

Per ~~conservations~~ CONVERSATIONS among C. Brush (TVA), S Hunter and D Van Tassell (Ebasco), we are preceeding on this basis.

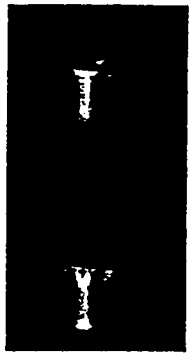
cc: J Simmons
C Brush (TVA)
B Leo
B Esnes
G Livesey
J Mann
A Yerem
D Van Tassell

Ferrule Type—Power Electronic

Type BAN

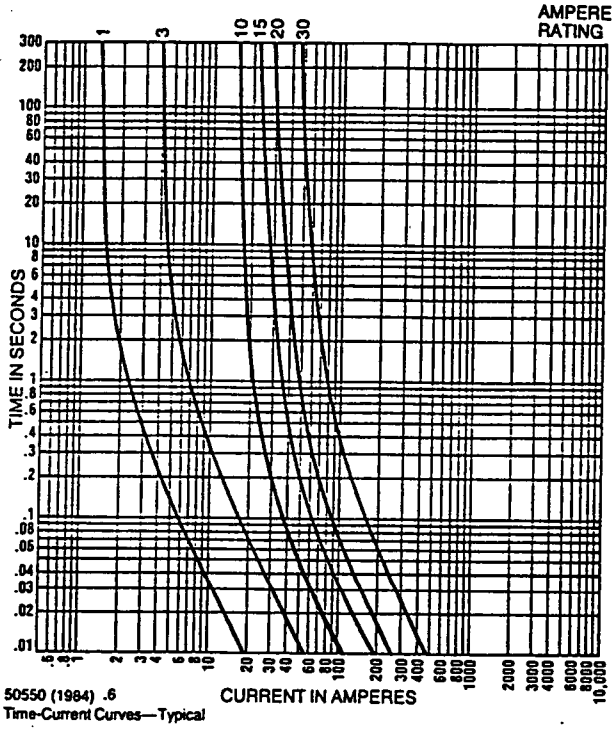
13/32" × 1½" (10.3mm × 38.1mm)
Non-Time-Delay

Fibre; formerly 5AB. Mount in Buss fuseholders, fuseblocks, and clips. Shipping weight per 100—1.4 lbs (635g).



Electrical Ratings (Catalog Symbol and Amperes)

250 Volts	250 Volts	250 Volts	250 Volts
BAN-1	BAN-5	BAN-12	BAN-30
BAN-2	BAN-6	BAN-15	—
BAN-3	BAN-8	BAN-20	—
BAN-4	BAN-10	BAN-25	—



50550 (1984) .6
Time-Current Curves—Typical

Type KTK/KLM

13/32" × 1½" (10.3mm × 38.1mm)
Non-Time-Delay

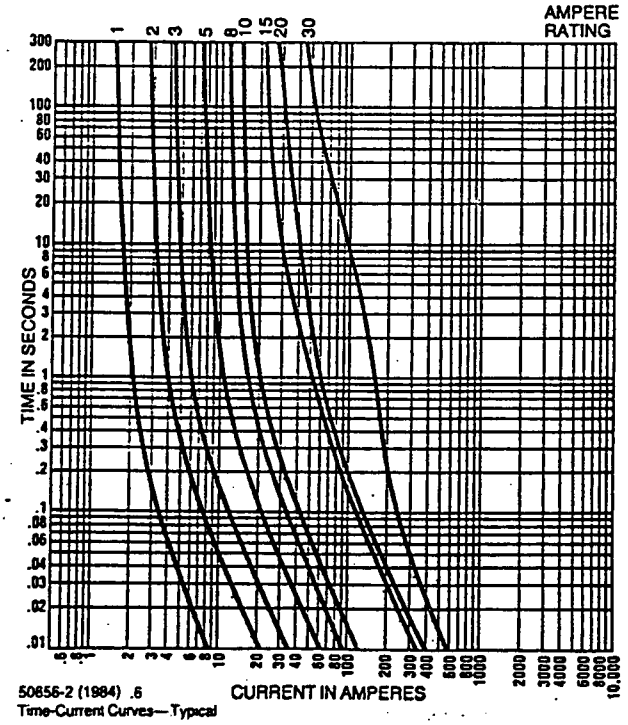
A Limitron® fast-acting fuse. Melamine. For circuits with high available short-circuit currents. Interrupting rating—100,000AIC. Type KLM is the military designation. KLM's have a dc rating of 500 volts or less. Mount in Buss fuseholders, fuseblocks, and clips. Shipping weight per 100—31 oz. (877g). U.L. File E19180; Guide JDYX (KTK). CSA File 53787; Class 1422-01 (KTK).

Electrical Ratings (Catalog Symbol and Amperes)

600 Volts		600 Volts		600 Volts		600 Volts	
KTK-1/10	U.L. Listed & CSA	KTK-1	U.L. Listed & CSA	KTK-5	U.L. Listed & CSA	KTK-15	U.L. Listed
KTK-1/8		KTK-1½		KTK-6		KTK-20	
KTK-2/10		KTK-2		KTK-7		KTK-25	
KTK-¼		KTK-2½		KTK-8		KTK-30	
KTK-3/10		KTK-3		KTK-9		—	
KTK-½		KTK-3½		KTK-10		—	
KTK-¾		KTK-4		KTK-12		—	

Electrical Ratings (Catalog Symbol and Amperes)

600 Volts	600 Volts	600 Volts	600 Volts
KLM-1/10	KLM-1	KLM-5	KLM-15
KLM-1/8	KLM-1½	KLM-6	KLM-20
KLM-2/10	KLM-2	KLM-7	KLM-25
KLM-¼	KLM-2½	KLM-8	KLM-30
KLM-3/10	KLM-3	KLM-9	—
KLM-½	KLM-3½	KLM-10	—
KLM-¾	KLM-4	KLM-12	—



50656-2 (1984) .6
Time-Current Curves—Typical

U.L. File E19180; CSA File 53787

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Prepared by Philip Barker Date 5/30/91
Checked by Brian Fitzgerald Date 5/30/91

PB 6/28/91

PURPOSE

The purpose of this attachment is to evaluate and support the modifications implemented under ECN 3614. The modifications involve the addition of solenoid valve FCV-63-187, FCV-63-188, FCV-63-185 and FCV-63-186.

The following Baseline Calculations evaluate the modifications for this Minicalc # WBPE2928803004 impact. Since different aspects of a design modification are evaluated or determined in the calculation controlling that particular feature, interfaces or references between the calculations are necessary. The evaluations for this modification are identified by "Attachment No. 3614" and are included in the following calculations.

Baseline Calculation	Calculation No.
125V DC Vital Battery and Charger Capacity Evaluation	WBN-EEB-MS-TI11-0003
125V DC Voltage Analysis *	WBN-EEB-MS-TI11-0004
125V DC Vital Control Power System Fault Calculations	WBN-EEB-MS-TI07-0005

*This calculation deals with Safety Related loads powered from the 125V DC Vital Battery Boards, since this attachment (No. 3614) is Non Safety Related, analysis for this calculation is not required.

1.0 SCOPE

This attachment modifies circuit breaker No. 217 loading for 125V DC Vital Power System Board I, to reflect implementation of ECN No. 3614. ECN 3614 adds four (4) solenoid valves and four (4) indicating lamp loads to breaker No. 217 of Vital Battery Board I.

2.0 ASSUMPTIONS

See "Assumptions" in Base Calculation

3.0 SOURCES OF DESIGN INPUT/REFERENCES

3.1 Calculation WBPE2928803004, RIMS B26 880331 486

3.2 ECN 3614 R0

3.3 Departmental Guidelines for Electrical Mini Calculation Roll Up, ELEC-004 (DATED 04-30-91) PB 6/28/91 BF 6-28-91

3.4 Calculation WBN-EEB-MS-TI02-0019, 120V AC CONTROL TRANSFORMER SIZING (R0) BF 6-28-91 PB 6/28/91

4.0 DESIGN INPUT DATA

4.1 Indicating Lights - 6.0 VA (Ref. 3.4, pg. 9)

4.2 Solenoid valve 35.1 watts (Ref. 3.1, pg. 7)

5.0 JUSTIFICATION OF ASSUMPTIONS

See "Justification of Assumptions" in Base Calculation

6.0 COMPUTATION/ANALYSIS

Load circuits for the heaviest loaded battery (Vital Board III) were utilized from calculation WBN-EEB-MS- TI11-0003 to calculate the subdistribution circuit breaker and fuse loading. Appendix "A" - Table 1 gives specific load data for breaker #217 as follows:

BKR NO.	BRK SIZE	MAX LOAD AMPS	% OF RATING
217	30A	2.31A	7.70

For Vital Battery Board 1, the following will apply:

BKR NO.	BRK SIZE	MAX LOAD AMPS	% OF RATING
217	30A	3.63A	12.1

6.0 COMPUTATION/ANALYSIS (Continued)

The associated fuse assembly, column and circuit numbers for the (4) solenoid valves are as follows:

SOLENOID VALVE NO.	BOARD NO.	FUSE TYPE	COLUMN & CIRCUIT NO.
FCV-63-185	0-BD-236-0001	FLAS-5	D27
FCV-63-186	0-BD-236-0001	FLAS-5	D40
FCV-63-187	0-BD-236-0001	FLAS-5	D42
FCV-63-188	0-BD-236-0001	FLAS-5	D45

Fault current and insulation damage is adequately covered in the Baseline Calc.

7.0 GRAPHICS

None

8.0 SUMMARY OF RESULTS

8.1 The addition of new loads (Solenoids & Indicating lamps) to circuit No. 217 of Vital Battery Board 1 will increase the loading to 12.1% of the circuit breaker rating.

8.2 The short circuit analysis previously performed as part of this calculation will not be adversly effected by the increase of this load to Breaker No. 217.

8.3 The FLAS 5 Fuse Protection for each valve is acceptable.

9.0 CONCLUSION

The addition of the four (4) solenoids & four (4) indicating lamps is acceptable

10.0 APPENDICES

None

Attachment No. P-01012-A

Calculation No. WBN EEB-MS-TI07-0005

Prepared by [illegible] Date 06-18-91

Checked by [illegible] Date 6-20-91

Sheet 1

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10.0	Appendices		
	Appendix "1" - Bussmann KWN Limitron Fast-Acting Fuse Characteristics. Bussman Catalog FLC, 1985, Section 1-8, Page 1.	-	1
	Appendix "2" - Record of telephone conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM, Sept. 8, 1988	-	1
	Appendix "3" - Bussmann time-current characteristic curves for KWN Fast-acting fuses.	-	1

This attachment contains 11 total pages.

1.0 PURPOSE & SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support the modifications to be implemented under DCN P-01012-A. Among the modifications, 2 fuses are added to the elapsed time meters to isolate them from the Class 1E Control Circuits.

This Attachment documents the roll-up of mini-calculation No. WBPE0268809043, which affects all the baseline calculations shown below. This attachment is tailored to the specific baseline calculation shown in the heading above.

BASELINE CALCULATION	CALCULATION NO.
125V DC VITAL BATTERY AND CHARGER CAPACITY EVALUATION	WBN EEB-MS-TI11-0003
125V DC VOLTAGE ANALYSIS*	WBN EEB-MS-TI11-0004
125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATION	WBN EEB-MS-TI07-0005

* The elapsed time meter is energized after the 480V circuit breaker transitions to open position. Therefore, the load of the elapsed time meter does not coincide with the breaker closing circuit and does not affect the voltage analysis in baseline calculation WBN EEB-MS-TI11-0004.

1.2 Scope

The scope of this attachment is to determine the size and type of fuse necessary to isolate a non-class 1E Elapsed Time Meter (ETM) circuit. The fuse shall isolate the faulted ETM circuit from the remaining class 1E circuit to allow the continued operation of the class 1E circuit. This attachment considers Datcon Elapsed Time Meters.

2.0 CRITERIA

See Section 1.1 of Baseline Calculation.

3.0 SOURCES OF DESIGN INPUT INFORMATION

3.1 TVA Drawings:

1-45W749-2 R0 480V Shutdown BD 1A2-A & 2A2-A Single Line
1-45W749-4 R0 480V Shutdown BD 1B2-B & 2B2-B Single Line
1-45W760-26-1 R0 High Pressure Fire Protection System Schematic Diag.
1-45B6212-032 R000 WBN Safety Related Fuse Report

3.2 DCN No. P-01012-A

3.3 TVA Baseline Calculation WBN EEB-MS-TI11-0003, 125V DC Vital Battery and Charger Capacity Evaluation.

3.4 Departmental Guidelines for Electrical Mini Calculation Roll-Up, ELEC-004, dated 04/30/91.

4.0 DESIGN INPUT DATA

Input Data	Source of Data
4.1 Shutdown Board I.D. NO./Compartment	
1-BD-212-A2-A/4D Train A	Reference 3.2
1-BD-212-B2-B/4D Train B	Reference 3.2
4.2 Equipment Monitored by ETM's	
High Pressure Fire Pump 1A-A (1-A2-A/4D)	TVA Dwg. 1-45W760-26-1, R0
High Pressure Fire Pump 1B-B (1-B2-B/4D)	TVA Dwg. 1-45W760-26-1, R0
4.3 Existing Fuse Data	
Bussmann KWN Limitron Fast-Acting Fuse 10A	TVA Dwg. 1-45W749-2 R0, 1-45W749-4 R0, and 1-45B6212-032, R000
IC_{DC} = 100 KA	Appendix 1
4.4 Control Circuit Power Source	
125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Reference 3.3
4.5 Elapsed Time Meter Data:	
Manufacturer: Datcon Instrument Co. Volts 125 DC Amps 0.43	Appendix 2

4.6 Feeder Cable Data

The size and type of the positive Feeder cable that runs from the Vital Battery Boards I, II, III and IV to the Shutdown Boards is the same for all four cases.

Feeder Cable: #8 AWG 2-1C WDD 600V CPJ
Minimum Resistance/1000 ft. 0.654 ohms @25°C
Reference 3.3.4 of Baseline Calculation

The size and type of the negative Feeder cable is the same as that of the positive Feeder cable. The lengths of the positive and negative cables are equal.

Feeder Cable

From/To: Vital Batt. Bd./ Shutdown Bd.	Cable No/ Length In Ft.*	Bus/ Feeder Type
I/1A2-A	1B16D/175	Nor/Nor
I/1A2-A	1B19D/175	BU/Alt
III/1A2-A	1B17F/245	Nor/Alt
III/1A2-A	1B18F/300	BU/Nor
II/1B2-B	1B30E/185	Nor/Nor
II/1B2-B	1B33E/185	BU/Alt
IV/1B2-B	1B31G/300	Nor/Alt
IV/1B2-B	1B32G/300	BU/Nor

* Note: Cable lengths are from Baseline Calculation (Appendix E, Tables 7, 8, 9 and 10).

The shutdown boards identified on the table above have two 125V DC Buses, one is a Normal Bus and the other a Backup Bus. Each Bus has two feeders, a normal feeder and an alternate feeder. The feeders bring the 125V DC power to the Shutdown Boards from the Vital Batteries through the Vital Battery Boards. ~~The Shutdown Boards, therefore, have four possible sources of power.~~

WJH 6/28/91 GP 6/28/91 WJH 6/28/91 GP 6/28/91

5.0 DOCUMENTATION OF INPUTS & ASSUMPTIONS

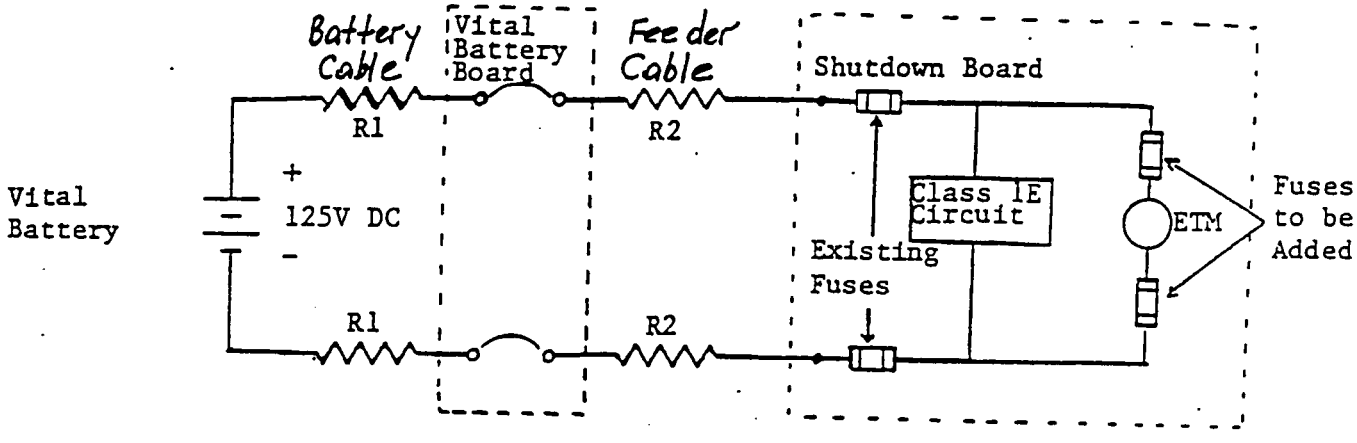
For General Assumptions see Section 5.0 of Baseline Calculation. ~~This attachment only has one unverified assumption as follows:~~

~~TVA has placed Contract No. 75835A (DCN No. M-12564-A) for testing and proving the coordination between the 1 Amp and the 10 Amp type KWN fuses. It is assumed that the coordination will be proven by these tests (unverified).~~ SEE APPENDIX 'A' OF ATTACHMENT M17941A.

R5
PB 3/18/92
[illegible]
3-18-92

6.0 COMPUTATION AND ANALYSES

6.1 Equivalent Circuit



6.2 Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board.

$$Rc = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\ \text{ft}} \times \text{Length of Feeder Cable}$$

$$Rc = 2 \times \frac{0.654}{1000\ \text{ft}} \times 175 = 0.2289\ \text{ohms}$$

6.3 Short Circuit current available at Elapsed Time Meter.

According to the Baseline Calculation, the short circuit current (If) at the shutdown board can be calculated as:

$$I_f = 120/(Req + Rc)$$

Where Req = the equivalent resistance of the source = 0.006279 Ohm

Thus,

$$I_f = 120/(0.0068279 + 0.2289) = 509\ \text{Amps}$$

6.4 Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

Load Current = 0.430 Amps

Fuse minimum rating = 1.25 x Load Current = 1.25 x 0.43 = 0.5375 Amps

2) Interrupting Current rating for fuse selected shall be greater than I_{SC} = 509 Amps

3) Based upon the results above, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KWN (10 Amp), a 1 Amp fuse type Bussmann KWN or approved equal fuse be used. (1 Amp Bussman fuse has a IC_{DC} = 100 kA).

4) Appendix 3 demonstrates the coordination provided up to and including the maximum anticipated fault current.

7.0 SUPPORTING GRAPHICS

See Appendix 3

8.0 SUMMARY OF RESULTS

Bussman KWN Limitron Fast Acting 1 Amp Fuses coordinate with the existing 10 Amp fuses and satisfy the protection criteria established in the Baseline Calculation.

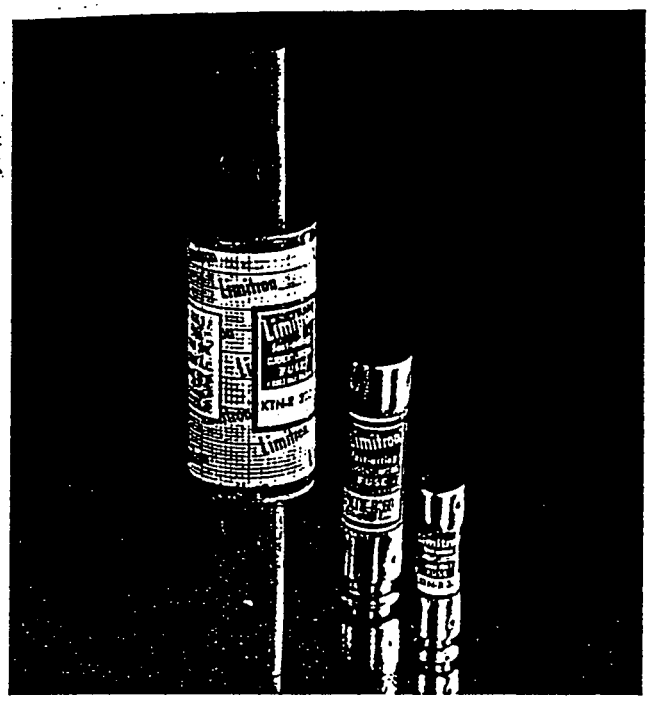
9.0 CONCLUSION

Bussman KWN Limitron Fast acting 1 Amp fuses are appropriate to isolate the non-class 1E elapsed Time Meter from the class 1E circuit.

ATTACHMENT No. P-01012-A
CALCULATION No. WBNEEB-MS-TI07-0005

Appendix 1 Sheet 9

LIMITRON® Fast-Acting—KTN-R And KTS-R (KWN-R KWS-R)



CATALOG SYMBOL KTN-R(250V); KTS-R (600V)
FAST-ACTING
1 TO 600 AMPERES
250 AND 600 VOLTS AC (OR LESS)
CURRENT LIMITING
INTERRUPTING RATING—200,000A RMS SYM.
U.L. LISTED—CLASS RK-1
CSA HRC-I
APPLICABLE TO CLASS 1E NUCLEAR EQUIPMENT
FUSEBLOCKS—SEE SECTION 2

Single-element, fast-acting fuses with minimal time-delay. Provides a high degree of short-circuit current limitation (component protection). Particularly suited for circuits and loads with no heavy surge currents of motors, transformers, solenoids, and welders. LIMITRON fuses are commonly used to protect circuit breakers with lower interrupting ratings. If used in circuits with surge currents (motors, etc.) must be sized to prevent unwanted opening and thus only provide short-circuit protection. Incorporate Class R rejection feature. Can be inserted in non-rejection type fuseholders. Thus, can physically and electrically replace fast acting Class H, K1, K5, RK5, and other RK1 fuses.

Protecting Low Interrupting Capacity Circuit Breakers
These fuses can be used to limit the short-circuit current to meet the interrupting capacity requirements of existing equipment. On older systems where the available short-circuit current exceeds the interrupting capacity of the circuit breakers, fuses can be installed in series with existing equipment.

On new installations, use these fuses to limit the available short-circuit current to lighting panel circuit breakers and provide a much higher degree of short-circuit protection plus a substantial savings on equipment costs. Lower interrupting capacity circuit breakers can be used rather than more expensive higher interrupting capacity circuit breakers.

Lighting and Heating Circuits—Fuse Sizing
The reliability of fast-acting fuses makes these fuses well suited for lighting and heating circuits and other non-inductive loads. Size fast-acting fuses at least 125% of the continuous load plus 100% of the non-continuous load. The fuse ampere rating should not be greater than conductor ampacity. (See Fuse Sizing Guide, Section 1-19).

Protection of Motors and Motor Circuits—Fuse Sizing
When fast acting fuses are specified for motor circuit protection, they should be sized at approximately 300% of motor full load current to allow for starting transients. Refer to Section 430-52 and Table 430-152 of the National Electrical Code for maximum size non-time-delay fuses that can be used on motor circuits. This size will provide motor branch circuit protection (short-circuit protection) for the motor circuit components but not motor running overload protection. Where back-up motor running protection is desired, FUSETRON or LOW-PEAK dual-element fuses are recommended.

Component Short-Circuit Protection—Current Limiting
Per NEC 110-10, protective devices shall clear a fault without "extensive damage" to the circuit components. Knowing the withstand rating of a component, the selection of a fuse which would provide requisite protection can be easily determined by reference to the "Current Limiting" Table or Graph. In most cases, selection of fuse size simply made in accord with load requirements will limit fault current to values below component withstand ratings. (See Section 1-19).

High Interrupting Rating
These fuses have the maximum U.L. interrupting rating of 200,000 amperes. This rating affords compliance with NEC Sections 110-9 and 230-98 in today's large capacity systems. Gives safe protection to both equipment and personnel. Meets the requirements of future system expansion and increases in available utility short-circuit current (See Section 1-19).

Selective Coordination (Blackout Prevention)
When the up-stream and down-stream fuses are "selectively coordinated", only the fuse nearest to the faulted circuit opens . . . up-stream fuses are not affected. Buss fuses can be easily selectively co-ordinated. All that is necessary to provide fuse selectivity is to simply have an adequate ampere rating ratio between the main fuse and feeder fuse and branch circuit fuses. These ampere rating ratios for the various types of fuses are shown in the "Selectivity Guide" (Section 1-19).

LIMITRON Fuses For DC or AC Applications—KWN And KWS
Type KWN-R and KWS-R LIMITRON fast-acting fuses are UL listed as Class RK 1 with an ac rating of 250 volts (KWN-R) and 600 volts (KWS-R) respectively; interrupting rating 200,000 amperes. They can also be applied at 250 volts DC and 600 volts DC respectively with an interrupting rating of 100,000 amperes. Dimensions are the same as KTN-R and KTS-R LIMITRONS. Ampere ratings are 1, 3, 6, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, and 600 amperes.

RECORD OF TELEPHONE CONVERSATION

ATTACHMENT No. P-01012-A
CALCULATION No. WBN EEB-MS-TI07-0005

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Datcon 125VDC Elapsed Time Meters (ETM)

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO. _____

DISCUSSION WITH Jim Eckenrod, Datcon Instrument Co.
(717) 569-5713 East Petersburg, PA

Mr. Eckenrod verified ETM voltage rating (125VDC) and supplied current rating (0.43 A). Model 771, Style UT, Part No. 56181-02.

COMMENTS:

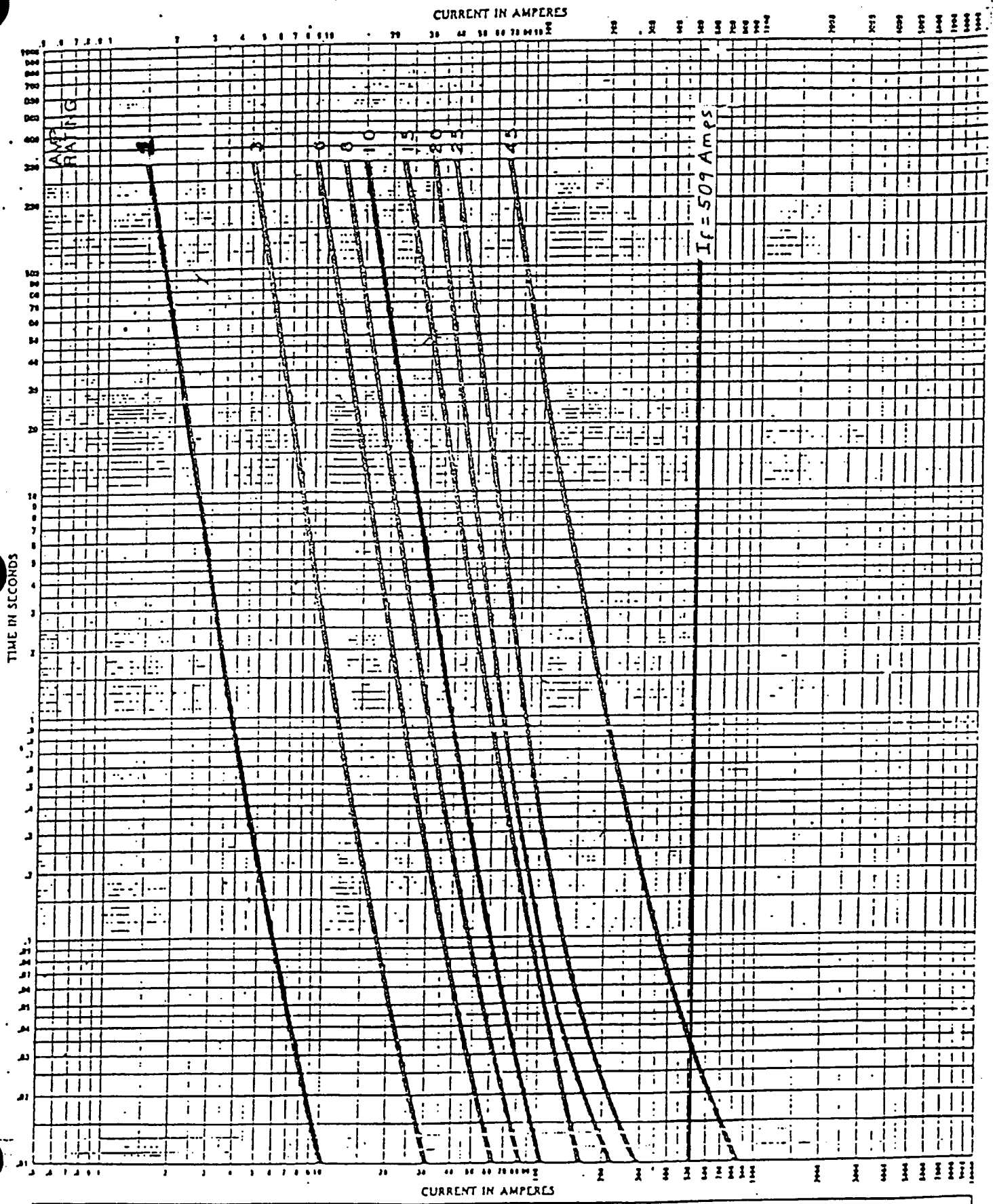
BY Luis F. Medero NAME — Assoc Elect. Eng. TITLE — ELECT. DEPT. NO.

CC:

Appendix 3 sheet 11

Attachment No. P-01012-A

Calculation No. WBN EEB-MS-TI07-0005



KLC, TOTAL CLEARING ... TIME-CURRENT CHARACTERISTIC CURVES BUSSMANN MFG. DIVISION

For KTN, KTS, KWN & KWS LIMITRON FAST-ACTING FUSES McGraw-Edison Co. St. Louis 7, Mo.

BASIS FOR DATA Standards ... Dated

1. Tests made at ... Volts ac at ... p.f. Starting at 25C with no initial load

2. Curves are plotted to ... Test results on transparency should be

No. 50549

Attachment No. P-01013-A

Calculation No. WBN EEB-MS-TI07-0005

Prepared by [illegible] Date 06-18-91

Checked by WJH Date 6-20-91

Sheet 1

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4.0	Design Input Data	4,5,6	3
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10.0	Appendices		
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	Appendix "2" - Record of telephone conversations with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM, Sept. 8, 1988.	-	1
	Appendix "3" - Record of telephone conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM, Sept. 8, 1988	-	1
	Appendix "4" - Bussmann time-current characteristic curves for KWN Fast-acting fuses.	-	1

This attachment contains 12 pages.

1603x

1.0 PURPOSE & SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support the modifications to be implemented under DCN P-01013-A. Among the modifications, 2 fuses are added to the elapsed time meters to isolate them from the Class 1E Control Circuits.

This Attachment documents the roll-up of mini-calculation No. WBPE0268810004, which affects all the baseline calculations shown below. This attachment is tailored to the specific baseline calculation shown in the heading above.

BASELINE CALCULATION	CALCULATION NO.
125V DC VITAL BATTERY AND CHARGER CAPACITY EVALUATION	WBN EEB-MS-TI11-0003
125V DC VOLTAGE ANALYSIS*	WBN EEB-MS-TI11-0004
125V DC VITAL CONTROL POWER SYSTEM FAULT CALCULATION	WBN EEB-MS-TI07-0005

* The elapsed time meter is energized after the 480V circuit breaker transitions to open position. Therefore, the load of the elapsed time meter does not coincide with the breaker closing circuit and does not affect the voltage analysis in baseline calculation WBN EEB-MS-TI11-0004.

1.2 Scope

The scope of this attachment is to determine the size and type of fuse necessary to isolate a non-class 1E Elapsed Time Meter (ETM) circuit. The fuse shall isolate the faulted ETM circuit from the remaining class 1E circuit to allow the continued operation of the class 1E circuit. This attachment considers Hobbs and Datcon Elapsed Time Meters.

2.0 CRITERIA

See Section 1.1 of Baseline Calculation.

3.0 SOURCES OF DESIGN INPUT INFORMATION

3.1 TVA Drawings:

1-45W749-2 R0 480V Shutdown BD 1A2-A & 2A2-A Single Line
1-45W749-4 R0 480V Shutdown BD 1B2-B & 2B2-B Single Line
1-45W760-26-1 R0 High Pressure Fire Protection System Schematic Diag.
1-45B6212-032 R000 WBN Safety Related Fuse Report

3.2 DCN No. P-01013-A

3.3 TVA Baseline Calculation WBN EEB-MS-TI11-0003, 125V DC Vital Battery and Charger Capacity Evaluation.

3.4 Departmental Guidelines for Electrical Mini Calculation Roll-Up, ELEC-004, dated 04/30/91.

4.0 DESIGN INPUT DATA

Input Data	Source of Data
4.1 Shutdown Board I.D. NO./Compartment	
2-BD-212-A2-A/4D Train A (Hobbs ETM)	Reference 3.2
2-BD-212-B2-B/4D Train B (Datcon ETM)	Reference 3.2
4.2 Equipment Monitored by ETM's	
High Pressure Fire Pump 2A-A (2-A2-A/4D)	TVA Dwg. 1-45W760-26-1, R0
High Pressure Fire Pump 2B-B (2-B2-B/4D)	TVA Dwg. 1-45W760-26-1, R0
4.3 Existing Fuse Data	
Bussmann KWN Limitron Fast-Acting Fuse 10A	TVA Dwg. 1-45W749-2 R0, 1-45W749-4 R0, and 1-45B6212-032, R000
IC_{DC} = 100 KA	Appendix 1
4.4 Control Circuit Power Source	
125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Reference 3.3
4.5 Elapsed Time Meter Data:	
Manufacturer: Hobbs Division Volts 125 DC Amps 0.667	Appendix 2
Manufacturer: Datcon Instrument Co. Volts 125 DC Amps 0.43	Appendix 3

4.6 Feeder Cable Data

The size and type of the positive Feeder cable that runs from the Vital Battery Boards I, II, III and IV to the Shutdown Boards is the same for all cases.

Feeder Cable: #8 AWG 2-1C WDD 600V CPJ
Minimum Resistance/1000 ft. 0.654 ohms @25°C
Reference 3.3.4 of Baseline Calculation

The size and type of the negative Feeder cable is the same as that of the positive Feeder cable. The lengths of the positive and negative cables are equal.

Feeder Cable

From/To: Vital Batt. Bd./ Shutdown Bd.	Cable No/ Length In Ft.*	Bus/ Feeder Type
I/2A2-A	2B17D/300	Nor/Alt
I/2A2-A	2B18D/300	BU/Nor
III/2A2-A	2B16F/225	Nor/Nor
III/2A2-A	2B19F/225	BU/Alt
II/2B2-B	2B31E/275	Nor/Alt
II/2B2-B	2B32E/275	BU/Nor
IV/2B2-B	2B30G/175	Nor/Nor
IV/2B2-B	2B33G/175	BU/Alt

* Note: Cable lengths are from Baseline Calculation (Appendix E, Tables 7, 8, 9 and 10).

The shutdown boards identified on the table above have two 125V DC Buses, one is a Normal Bus and the other a Backup Bus. Each Bus has two feeders, a normal feeder and an alternate feeder. The feeders bring the 125V DC power to the Shutdown Boards from the Vital Batteries through the Vital Battery Boards. ~~The Shutdown Boards, therefore, have four possible sources of power~~.

WTH 6/28/91 GP 6/28/91

WTH 6/28/91
GP 6/28/91

5.0 DOCUMENTATION OF INPUTS & ASSUMPTIONS

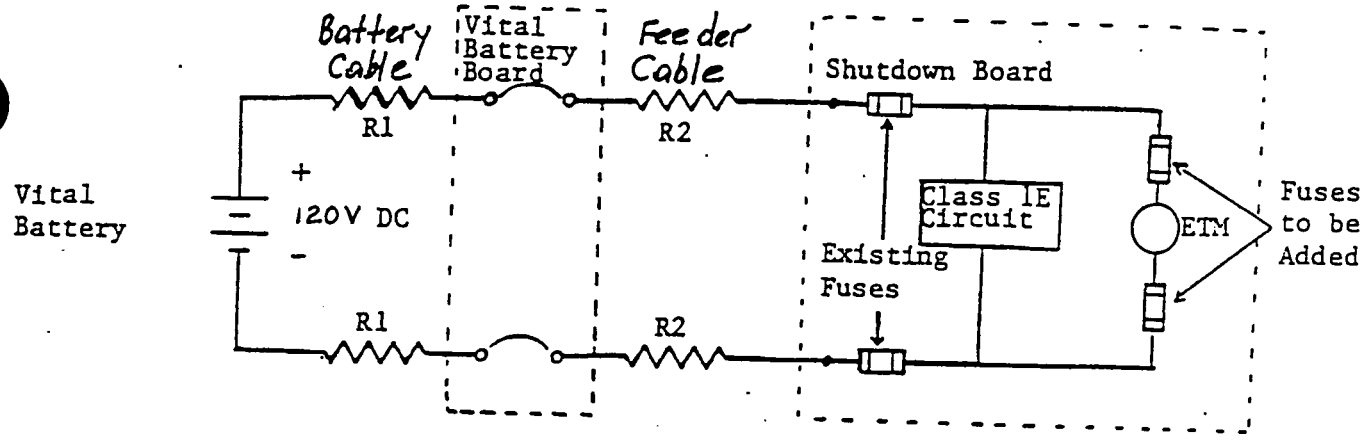
For General Assumptions see Section 5.0 of Baseline Calculation. ~~This attachment only has one unverified assumption as follows:~~

~~TVA has placed Contract No. 75835A (DCN No. M-12564-A) for testing and proving the coordination between the 1 Amp and the 10 Amp type KWN fuses. It is assumed that the coordination will be proven by these tests (unverified).~~ SEE APPENDIX 'A' OF ATTACHMENT M17941A.

R5
PB 3/18/92
[signature]
3-18-92

6.0 COMPUTATION AND ANALYSES

6.1 Equivalent Circuit



6.2 Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board.

$$Rc = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\ \text{ft}} \times \text{Length of Feeder Cable}$$

$$Rc = 2 \times \frac{0.654}{1000\ \text{ft}} \times 175 = 0.2289\ \text{ohms}$$

6.3 Short Circuit current available at Elapsed Time Meter.

According to the Baseline Calculation, the short circuit current (If) at the shutdown board can be calculated as:

$$If = 120/(Req + Rc)$$

Where Req = the equivalent resistance of the source = 0.0068279 Ohm

Thus,

$$If = 120/(0.0068279 + 0.2289) = 509\ \text{Amps}$$

6.6 Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

For the Datcon ETM the fuse minimum rating is 1.25 x 0.43 = 0.5375 Amps

For the Hobbs ETM the fuse minimum rating is 1.25 x 0.667 = 0.834 Amps

2) Interrupting Current rating for fuse selected shall be greater than I_{SC} = 509 Amps

3) Based upon the results above, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KWN (10 Amp), a 1 Amp fuse type Bussmann KWN or approved equal fuse be used for both the Datcon and Hobbs ETMs. (1 Amp Bussman fuse has a IC_{DC} = 100 kA).

4) Appendix 4 demonstrates the coordination provided up to and including the maximum anticipated fault current.

7.0 SUPPORTING GRAPHICS

See Appendix 4

8.0 SUMMARY OF RESULTS

Bussman KWN Limitron Fast Acting 1 Amp Fuses coordinate with the existing 10 Amp fuses and satisfy the protection criteria established in the Baseline Calculation.

9.0 CONCLUSION

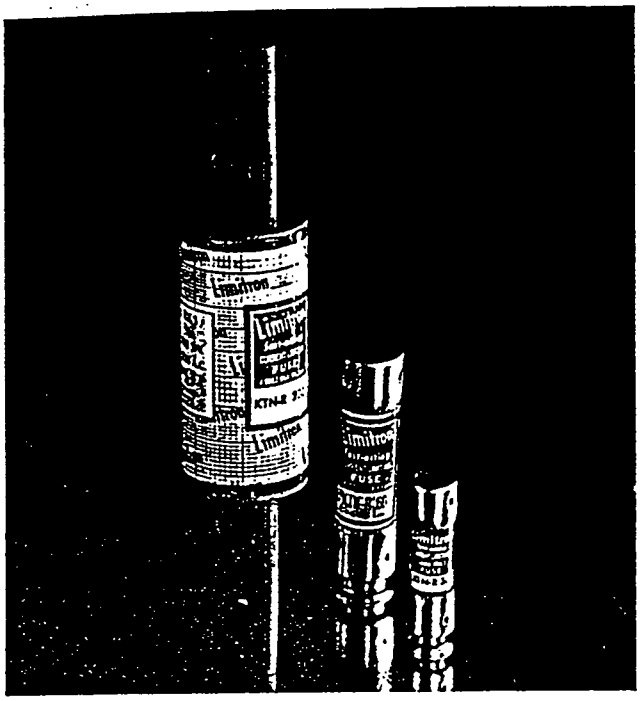
Bussman KWN Limitron Fast acting 1 Amp fuses are appropriate to isolate the non-class 1E elapsed Time Meter~~s~~ from the class 1E circuit~~s~~.

GP 6/28/91 WJH 6/28/91 GP 6/28/91 WJH 6/28/91

ATTACHMENT No. P-01013-A
CALCULATION No. WBN EEB-MS-TI07-0005

Appendix 1 sheet 9

LIMITRON® Fast-Acting—KTN-R And KTS-R (KWN-R KWS-R)



CATALOG SYMBOL KTN-R(250V); KTS-R (600V)
FAST-ACTING
1 TO 600 AMPERES
250 AND 600 VOLTS AC (OR LESS)
CURRENT LIMITING
INTERRUPTING RATING—200,000A RMS SYM.
U.L. LISTED—CLASS RK-1
CSA HRC-I
APPLICABLE TO CLASS 1E NUCLEAR EQUIPMENT
FUSEBLOCKS—SEE SECTION 2

Single-element, fast-acting fuses with minimal time-delay. Provides a high degree of short-circuit current limitation (component protection). Particularly suited for circuits and loads with no heavy surge currents of motors, transformers, solenoids, and welders. LIMITRON fuses are commonly used to protect circuit breakers with lower interrupting ratings. If used in circuits with surge currents (motors, etc.) must be sized to prevent unwanted opening and thus only provide short-circuit protection. Incorporate Class R rejection feature. Can be inserted in non-rejection type fuseholders. Thus, can physically and electrically replace fast acting Class H, K1, K5, RK5, and other RK1 fuses.

Protecting Low Interrupting Capacity Circuit Breakers
These fuses can be used to limit the short-circuit current to meet the interrupting capacity requirements of existing equipment. On older systems where the available short-circuit current exceeds the interrupting capacity of the circuit breakers, fuses can be installed in series with existing equipment.

On new installations, use these fuses to limit the available short-circuit current to lighting panel circuit breakers and provide a much higher degree of short-circuit protection plus a substantial savings on equipment costs. Lower interrupting capacity circuit breakers can be used rather than more expensive higher interrupting capacity circuit breakers.

Lighting and Heating Circuits—Fuse Sizing
The reliability of fast-acting fuses makes these fuses well suited for lighting and heating circuits and other non-inductive loads. Size fast-acting fuses at least 125% of the continuous load plus 100% of the non-continuous load. The fuse ampere rating should not be greater than conductor ampacity. (See Fuse Sizing Guide, Section 1-19).

Protection of Motors and Motor Circuits—Fuse Sizing
When fast acting fuses are specified for motor circuit protection, they should be sized at approximately 300% of motor full load current to allow for starting transients. Refer to Section 430-52 and Table 430-152 of the National Electrical Code for maximum size non-time-delay fuses that can be used on motor circuits. This size will provide motor branch circuit protection (short-circuit protection) for the motor circuit components but not motor running overload protection. Where back-up motor running protection is desired, FUSETRON or LOW-PEAK dual-element fuses are recommended.

Component Short-Circuit Protection—Current Limiting
Per NEC 110-10, protective devices shall clear a fault without "extensive damage" to the circuit components. Knowing the withstand rating of a component, the selection of a fuse which would provide requisite protection can be easily determined by reference to the "Current Limiting" Table or Graph. In most cases, selection of fuse size simply made in accord with load requirements will limit fault current to values below component withstand ratings. (See Section 1-19).

High Interrupting Rating
These fuses have the maximum U.L. interrupting rating of 200,000 amperes. This rating affords compliance with NEC Sections 110-9 and 230-98 in today's large capacity systems. Gives safe protection to both equipment and personnel. Meets the requirements of future system expansion and increases in available utility short-circuit current (See Section 1-19).

Selective Coordination (Blackout Prevention)
When the up-stream and down-stream fuses are "selectively coordinated", only the fuse nearest to the faulted circuit opens . . . up-stream fuses are not affected. Buss fuses can be easily selectively co-ordinated. All that is necessary to provide fuse selectivity is to simply have an adequate ampere rating ratio between the main fuse and feeder fuse and branch circuit fuses. These ampere rating ratios for the various types of fuses are shown in the "Selectivity Guide" (Section 1-19).

LIMITRON Fuses For DC or AC Applications—KWN And KWS
Type KWN-R and KWS-R LIMITRON fast-acting fuses are UL listed as Class RK 1 with an ac rating of 250 volts (KWN-R) and 600 volts (KWS-R) respectively; interrupting rating 200,000 amperes. They can also be applied at 250 volts DC and 600 volts DC respectively with an interrupting rating of 100,000 amperes. Dimensions are the same as KTN-R and KTS-R LIMITRONS. Ampere ratings are 1, 3, 6, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, and 600 amperes.

11046/5-74

RECORD OF TELEPHONE CONVERSATION

ATTACHMENT NO. P-01013-A Appendix 2 sheet 10

DATE 9-8-88

CALCULATION NO. WBN EEB-MS-TI07-0005

NAME/FILE NO.

FROM

CLIENT/PROJECT

SUBJECT Information on Hobbs 125 VDC Elapsed Time Meters (ETM)

CHARGE: DEPT. NO. CLIENT SYMBOL OFS NO.

DISCUSSION WITH Meg Hicks, Sales Dept. Hobbs Division. (217) 753-7793 Springfield, IL

Ms. Meg Hicks verified ETM voltage Rating (125 VDC) and supplied ampere rating (0.667 A), for ETM Part No. 15005.

COMMENTS:

BY Luis A Madero NAME Assoc. Elect. Eng. TITLE ELECT. DEPT. NO.

CC:

TOTAL P.01

Appendix 3 sheet 11

RECORD OF TELEPHONE CONVERSATION

ATTACHMENT No. P-01013-A

CALCULATION No. WBN EEB-MS-TI07-0005

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Datcon 125VDC Elapsed Time Meters (ETM)

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO. _____

DISCUSSION WITH Jim Eckenrod, Datcon Instrument Co.
(717) 569-5713 East Petersburg, PA

Mr. Eckenrod verified ETM voltage rating (125VDC) and supplied current rating (0.43 A). Model 771, Style UT, Part No. 56181-02.

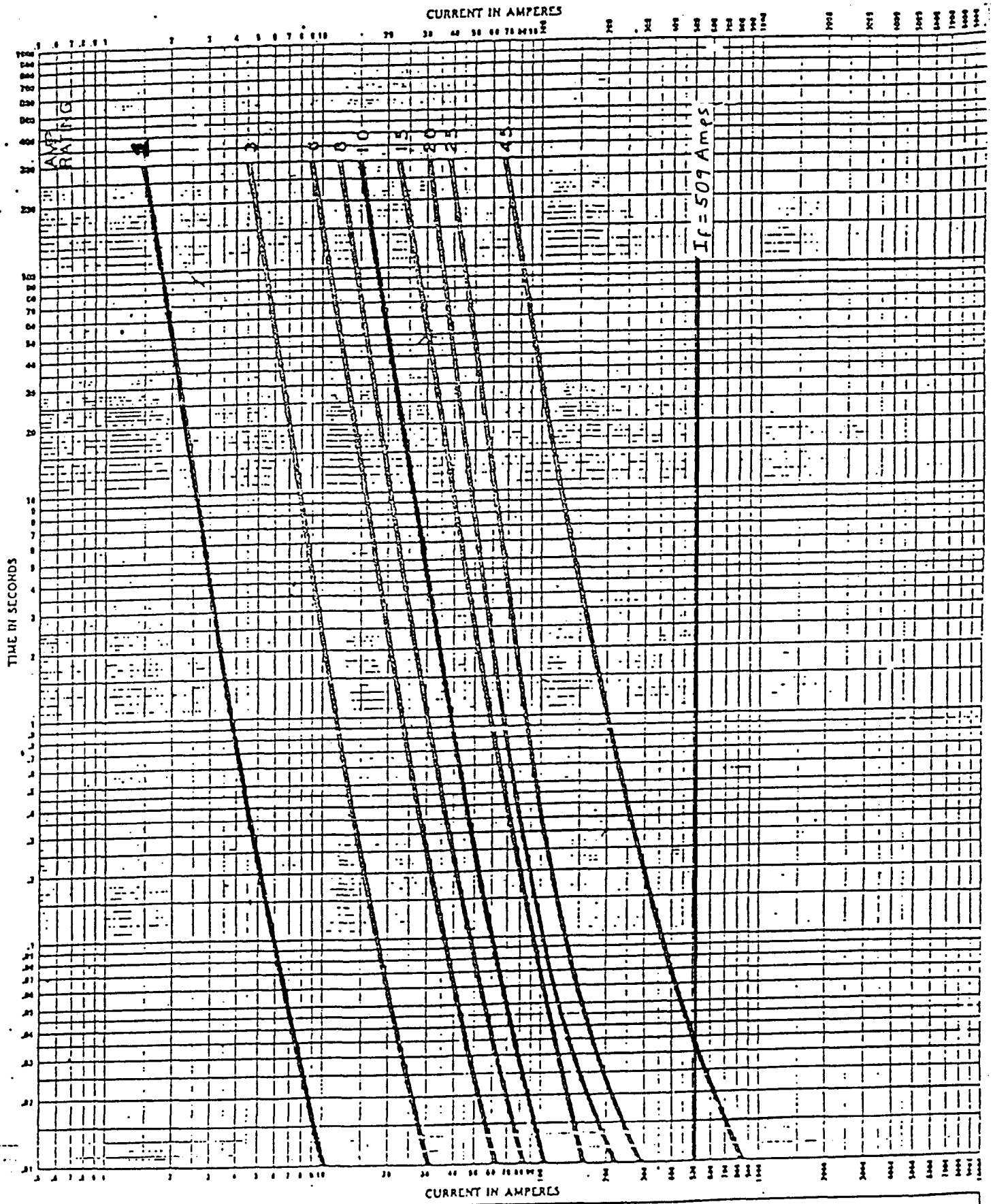
COMMENTS:

BY Luis A Medero NAME — Assoc Elect. Eng. TITLE — ELECT. DEPT. NO.

CC:

Attachment No. P-01013-A Appendix 4 sheet 12

Calculation No. WBN EEB-MS-TI07-0005



KLC, TOTAL CLEARING ... TIME-CURRENT CHARACTERISTIC CURVES BUSSMANN MFG. DIVISION

For KTN, KTS, KWN & KWS LIMITRON FAST-ACTING FUSES McGraw-Edison Co. St. Louis 7, Mo.

BASIS FOR DATA Standards ... Dated

1. Tests made at ... Volts ac at ... p.f. Starting at 25C with no initial load

2. ... Test points on transition should be

No. 50549

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by [illegible] Date 6-17-91
Checked by [illegible] Date 06-20-91

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3.0	Applicable Codes and Standards	4	-
4.0	Assumptions	4	-
5.0	References	5	1
6.0	Design Input Data	5	-
7.0	Analysis	6	1
8.0	Summary of Results	6	-
.0	Conclusions	6	-

10.0 Appendixes (Including Supporting Graphics)

1 Calculation sheets for Datcon Elapsed Time Meters located at 1-BD-211-A-A/8, 1-BD-211-B-B/8, 1-BD-211-B-B/9 (6 pages).

2 Calculation sheets for Hobbs Elapsed Time Meter located at 1-BD-211-A-A/9 (6 pages).

3 Datcon Instrument Co. Elapsed Time Meter Data (1 page).

4 Hobbs Division Elapsed Time Meter Data (1 page).

5 Bussmann Time-Current Characteristics Curves for KLC and KWN Fast-Acting Fuses; obtained by mail from Bussmann Mfg. Co. August 1988 (1 page).

6 Record of Telephone Conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM September 8, 1988 (1 page).

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-17-91
Checked by [illegible] Date 06-20-91

7 Record of Telephone Conversation with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM September 8, 1988 (1 page).

8. ~~Record of Telephone Conversation with Jeff Crittenden of Bussmann Mfg. Co. verifying the DC Interrupting Current (10 KA) Rating of a Bussman KLC Limitron Fast-Acting Fuse September 8, 1988 (1 page)~~.

6p 6/28/91
WTH 6/28/91

9 Bussmann KWN Limitron Fast-Acting Fuse DC Interrupting Current (100 KA) Data from Bussmann Catalog FLC 1985 Section 1-8 Page 1 (1 page).

This Attachment contains 21 pages.

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-17-91
Checked by [illegible] Date 06-20-91

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support the modifications to be inplemented under DCN P-01014-A. Among the modifications, 2 fuses are added to the elapsed time meters to isolate them from the class IE control circuit.

This attachment documents the roll-up of mini calculation No. WBPE0678809042 which effects all the baseline calculations show below. This attachment is tailored to the specific baseline calculation shown in the heading above.

BASELINE CALCULATION	CALCULATION NO.
125V DC Voltage Analysis*	WBN-EEB-MS-TI11-0004
125V DC Battery Sizing	WBN-EEB-MS-TI11-0003
125V DC Short Ckt/Protection	WBN-EEB-MS-TI07-0005

* The Elapsed Time Meter is energized after the 6.9KV circuit breaker transitions to closed position. Therefore, the load of the Elapsed Time Meter is not a coincident load with the breaker closing circuit and will not affect the existing voltage analysis in the Calculation No. WBN EEB-MS-TI11-0004.

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WMt Date 6-17-91
Checked by [illegible] Date 06-20-91

1.2 Scope

The scope of this attachment is to determine the size and type of fuse to be added to isolate a non-class 1E Elapsed Time Meter (ETM) circuit. The fuse shall isolate the faulted ETM circuit from the remaining class 1E circuit to allow the continued operation of the Class 1E control function.

This attachment considers three Datcon and one Hobbs Elapsed Time Meters.

2.0 CRITERIA

The fuse to be added shall isolate a fault condition occurring at the Elapsed Time Meter (ETM) to allow the continued operation of the remaining Class 1E circuit. For a fault in the Elapsed Time Meter (ETM) circuit, the existing control circuit fuse shall act as a backup only when the ETM fuse fails to clear this fault.

ETM fuse shall be selected to coordinate with the upstream fuse. ~~based upon Manufacturer's suggestion and generally accepted industry practice, by having a minimum of 3 to 1 ratio between ratings of the upstream and downstream fuses if similar types of fuses are used~~. The continuous current rating of the fuse shall be at least 125% of the load. Fuse interrupting current (IC) shall be greater than the maximum anticipated fault current in the circuit. GP 6/28/91 WTH 6/28/91

3.0 APPLICABLE CODES AND STANDARDS

See Baseline Calculation.

4.0 ASSUMPTIONS

4.1 See baseline calculation.

~~4.2 TVA has placed a contract no. 75835A (DGN #M-12564-A) for testing and prove the coordination between 1 KWN and 15 KLG fuses. It is assumed (unverified) that the coordination will be proved by these tests.~~
SEE APPENDIX 'A' OF ATTACHMENT M17941A. R5 PB 3/18/92 3-18-92

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-17-91
Checked by [illegible] Date 06-20-91

5.0 REFERENCES

5.1 TVA Drawings:

1-45W760-67-1 R2 Essential Raw Cooling Water System Schematic Diag.
1-45W760-67-2 R1 Essential Raw Cooling Water System Schematic Diag.
1-45W724-1 R0 6900V Shutdown BD 1A-A Single Line
1-45W724-2 R0 6900V Shutdown BD 1B-B Single Line

5.2 Bussmann Time-Current Characteristics Curves for KLC and KWN Fast-Acting Fuses.

5.3 Record of Telephone Conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM. (1 page) September 8, 1988.

5.4 Record of Telephone Conversation with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM. (1 page) September 8, 1988.

5.5 ~~Record of Telephone Conversation with Jeff Grittenden of Bussmann Mfg. Co. verifying the DC Inaterrupting Current (10 KA) Rating of a Bussmann KLC Limitron Fast-Acting Fuse. (1 page) September 8, 1988.~~ GP 6/28/91 WTH 6/28/91

5.6 Bussmann KWN Limitron Fast-Acting Fuse DC Interrupting Current (100 KA) Data from Bussmann Catalog FLC 1985 Section 1-8 Page 1.

5.7 Departmental Guidelines for Electrical Mini Calculation Roll-Up, ELEC-004, dated 4/30/91.

6.0 DESIGN INPUT DATA

See Section A of Appendix 1 and 2.

Attachment No. P-01014-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WPH Date 6-20-91
Checked by [illegible] Date 06-20-91

7.0 ANALYSIS

Each of the Shutdown Boards identified on Section A of the attachments to this calculation have four cable feeders from the 125V DC Vital Battery Boards. They are: Normal Bus Normal Feeder, Normal Bus Alternate Feeder, Backup Bus Normal Feeder and Backup Bus Alternate Feeder.

For the purpose of calculating the short-circuit current at the Elapsed Time Meter (ETM), the shortest cable feeder route was used in the calculation (combined length of feeder from Vital Battery to Vital Battery Board, and of feeder from Vital Battery Board to Shutdown Board). This will give a conservative result. See Section B of the attached Appendix 1 and 2.

8.0 SUMMARY OF RESULTS

Bussmann KWN Limitron Fast-Acting 1 Amp Fuses coordinate with the existing 15 Amp KLC fuses and satisfy the protection criteria.

9.0 CONCLUSION

A Bussman KWN Limitron Fast Acting 1 Amp fuse shall be used to isolate the non-class 1E Elapsed Time Meter from a class 1E circuit.

Attachment No. P-01014-A
Calc No. WBN-EEB-MS-TI07-0005

Appendix 1 Sheet 1 of 4

Prepared by WJH Date 6-17-91

Checked by [signature] Date 06-20-91

A. Technical Data

1. This attachment applies to the Datcon ETM's located at the following shutdown boards:

Shutdown Board I.D. No./Compartment	Source of Data
1-BD-211-A-A/8	TVA Dwg. 1-45W760-67-1 R2
1-BD-211-B-B/8	TVA Dwg. 1-45W760-67-2 R1
1-BD-211-B-B/9	TVA Dwg. 1-45W760-67-2 R1

2. Equipment Monitored by ETM's

ERCW Pump A-A (1-A-A/8)	TVA Dwg. 1-45W760-67-1 R2
ERCW Pump F-B (1-B-B/8)	TVA Dwg. 1-45W760-67-2 R1
ERCW Pump E-B (1-B-B/9)	TVA Dwg. 1-45W760-67-2 R1

3. Existing Fuse Data

Bussmann KLC Limitron Fast-Acting Fuse 15A	TVA Dwg. 1-45W724-1 R0
IC_{DC} = ~~10 KA~~ 150 KA	~~Appendix 8~~ TVA Elec Des Std DS-E8.1.1 GP 6/20/91 WTH 6/20/91

4. Control Circuit Power Source

125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Baseline Calculation

5. Elapsed Time Meter Data:

Manufacturer: Datcon Instrument Co. Volts 125 DC Amps 0.43	Appendix 3 and Appendix 6

Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 1 Sheet 2 of 4

Prepared by WJH Date 6-17-91

Checked by [illegible] Date 06-20-91

6. Feeder Cable Data from baseline calculation

a. The size and type of the positive Battery cable that runs from the Vital Battery Boards I, II, III and IV to the Shutdown Boards is the same for all four cases except the backup normal feeder from the battery board III (cable # 1B2F) which is #6 AWG 2-1C WDE-1. (See Baseline Calculation)

Feeder Cable (See Baseline Calculation)

Vital Batt. Bd./ Shutdown Bd.	Cable No/ Length In Ft.	Bus/ Feeder Type	Minimum Resistance at 15 C° ohms/1000 ft.
I/1A-A	1B4D/90	Nor/Nor	0.654
I/1A-A	1B1D/70	BU/Alt	0.654
III/1A-A	1B3F/95	Nor/Alt	0.654
III/1A-A	1B2F/130	BU/Nor	0.41
II/1B-B	1B9E/75	Nor/Nor	0.654
II/1B-B	1B6E/115	BU/Alt	0.654
IV/1B-B	1B8G/100	Nor/Alt	0.654
IV/1B-B	1B7G/45	BU/Nor	0.654

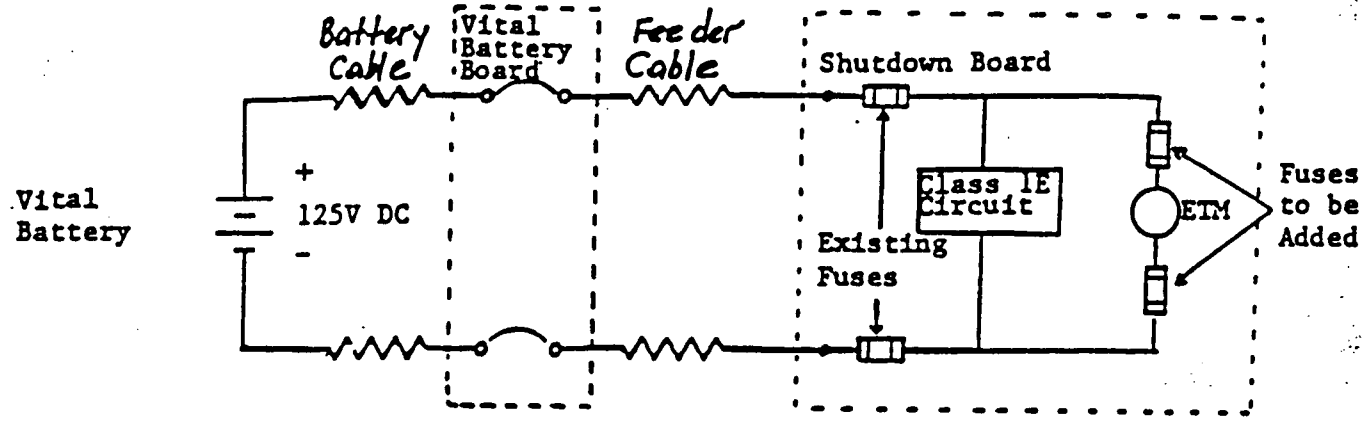
7. Load current for the DC ETM's (Datcon) is 0.43 Amps (Appendix 6).

8. The short circuit current at the four vital battery boards is
I = 17575A (See baseline calculation).

$$R_{equivalent} = \frac{120}{17,575} = 0.0068279 \text{ ohms}$$

B. Short Circuit Current

Equivalent Circuit



Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 1 Sheet 3 of 4

Prepared by WJH Date 6-25-91

Checked by [illegible] Date 06-26-91

1) Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board. (from Section A.6 of this Appendix)

$$\text{Res."} = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\text{ ft}} \times \text{Length of Feeder Cable}$$

$$\text{Res."} = 2 \times \frac{0.654}{1000\text{ ft}} \times 45 = 0.05886 \text{ ohms}$$

2) Short Circuit current available at Elapsed Time Meter.

Requivalent = 0.0068279 ohms (from Section A.8 of this Appendix)
(From Section B.1 above)

$$\text{Res."} = 58.86 \times 10^{-3} \text{ ohms}$$

$$I_{SC} = \frac{\text{VBattery}}{\text{Requivalent} + \text{Res"}}$$

$$= \frac{120\text{V}}{(6.83 + 58.86) \times 10^{-3} \text{ ohms}} = 1{,}827 \text{ A}$$

C. Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

Load Current = 0.43 Amps from Section A.5

Fuse minimum rating = 1.25 x Load Current = 1.25 x 0.43 = 0.5375 Amps

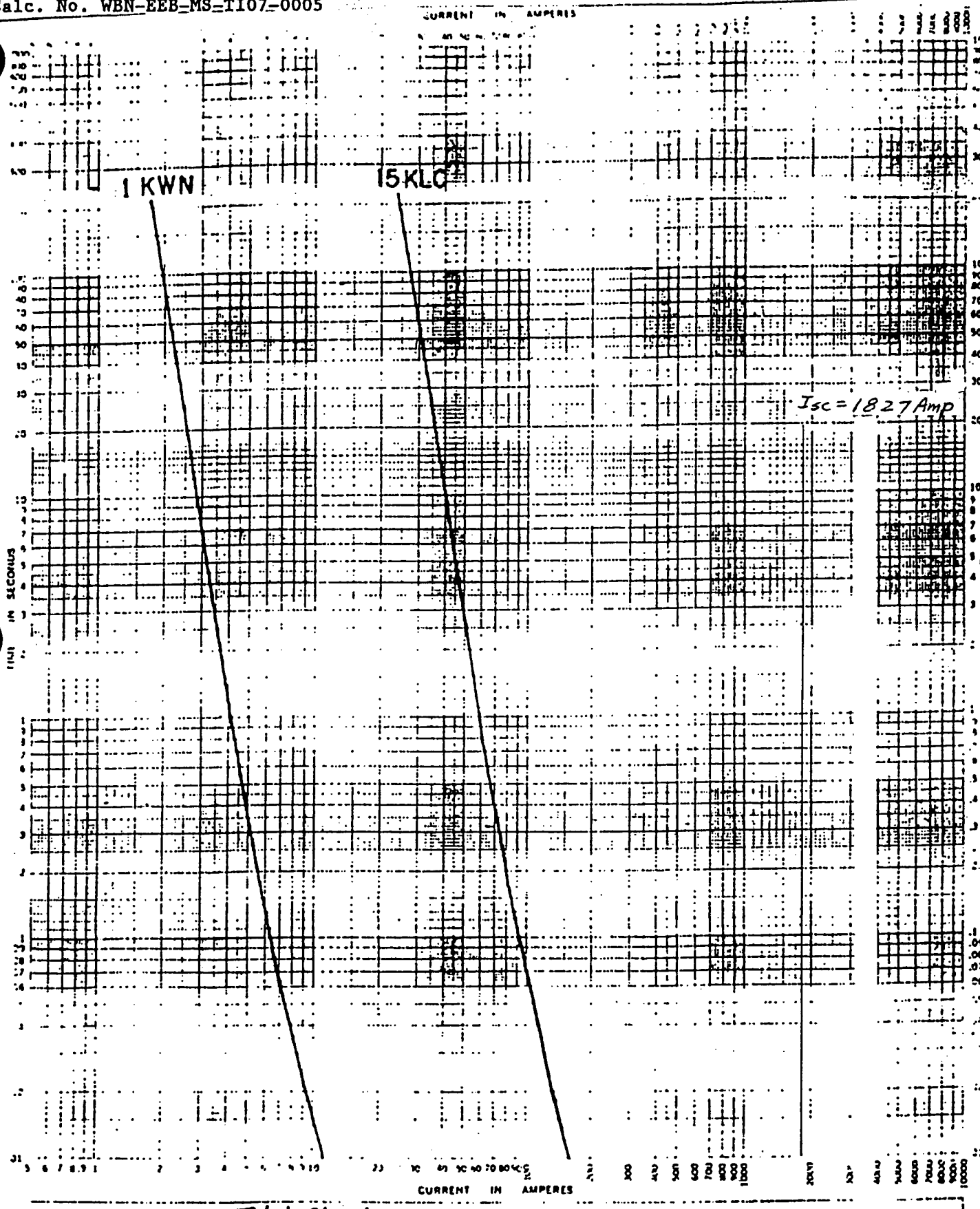
2) Interrupting current rating for fuse selected shall be greater than I_{SC} determined in Section B.2.

3) Based upon the result of Sec. B, C.1 and C.2 calculations, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KLC (15 Amp), it is required that Bussmann type KWN (1 Amp) or approved equal fuse be used. Fuse IC_{DC} = 100 KA.

4) Sheet 4 demonstrates the coordination provided up to and including the maximum anticipated fault current.

Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 1 Sheet 4 of 4



Total Clearing
For KLC, KWN Limitron Fast Acting Fuses TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links In
BASIS FOR DATA Standards Bussmann Mfg. Div. Curves Dated 8-22-74 No. 50549
1. Tests made at Volts a-c at p-f. starting at 25C with no initial load
2. Curves are plotted to ..... Test points so variations should be.

No.
Date 9-30-88

K·E TIME-CURRENT CHARACTERISTIC - 48 9288

Attachment No. P-01014-A
Calc No. WBN-EEB-MS-TI07-0005

Appendix 2 Sheet 1 of 4

Prepared by WJH Date 6-20-91

Checked by [illegible] Date 06-20-91

A. Technical Data

1. This attachment applies to the Hobbs ETM located at the following shutdown board:

Shutdown Board I.D. No./Compartment	Source of Data
1-BD-211-A-A/9	TVA Dwg. 1-45W760-67-1 R2

2. Equipment Monitored by ETM

ERCW Pump B-A	TVA Dwg. 1-45W760-67-1 R2

3. Existing Fuse Data

Bussmann KLC Limitron Fast-Acting Fuse 15A	TVA Dwg. 1-45W724-1 R0
IC_{DC} = ~~10 KA~~ 150 KA	~~Appendix 8~~ TVA Elec Des Std DS-EB.1.1

GP 6/28/91 WTN 6/28/91

4. Control Circuit Power Source

125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Baseline Calculation

5. Elapsed Time Meter Data:

Manufacturer: Hobbs Division Volts 125 DC Amps 0.667	Appendix 4 and Appendix 7

6. Feeder Cable Data from baseline calculation

The size and type of the positive Feeder cable that runs from the Vital Battery Boards I and III to the Shutdown Boards is the same for all four cases except the backup normal feeder from the battery board III (cable #1B2F) is #6 AWG 2-1C WDE-1. (See Baseline Calculation)

Feeder Cable (See Baseline Calculation)

Vital Batt. Bd./ Shutdown Bd.	Cable No./ Length In Ft.	Bus/ Feeder Type	Minimum Resistance at 25°C ohms/1000 ft
I/1A-A	1B4D/90	Nor/Nor	0.654
I/1A-A	1B1D/70	BU/Alt	0.654
III/1A-A	1B3F/95	Nor/Alt	0.654
III/1A-A	1B2F/130	BU/Nor	0.41

Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 2 Sheet 2 of 4

Prepared by CJH Date 6-17-91

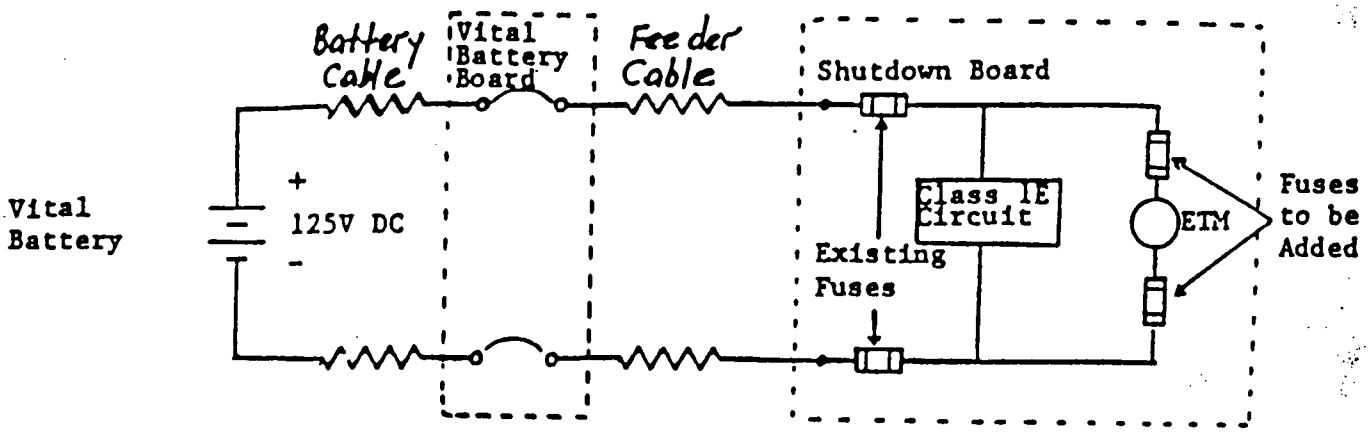
Checked by [illegible] Date 06-20-91

7. Load current for the DC ETM's (Hobbs) are 0.667 Amps (Appendix 7).

8. Load short circuit current at the four vital battery boards is
$I = 17575A$ (See baseline calculation).
$R_{equivalent} = \frac{120}{17575} = 0.0068279$ ohms

B. Short Circuit Current

Equivalent Circuit



Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 2 Sheet 3 of 4

Prepared by WFH Date 6-25-91

Checked by Don Ferrell Date 06-26-91

1) Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board. (from Section A.6 of this Appendix)

$$Res." = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\ ft} \times \text{Length of Feeder Cable}$$

$$Res." = 2 \times \frac{0.654}{1000\ ft} \times 70 = 0.09156 \text{ ohms}$$

2) Short Circuit current available at Elapsed Time Meter.

Requivalent = 0.0068279 ohms (from Section A.8 of this Appendix)
From Section B.1 above

$$Res." = 91.56 \times 10^{-3} \text{ ohms}$$

$$I_{SC} = \frac{VBattery}{R_{equivalent} + Res."}$$

$$= \frac{120V}{(6.83 + 91.56) \times 10^{-3} \text{ ohms}} = 1{,}220 \text{ A}$$

Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

Load Current = 0.667 Amps from Section A.5

Fuse minimum rating = 1.25 x Load Current = 1.25 x 0.667 = 0.8338 Amps

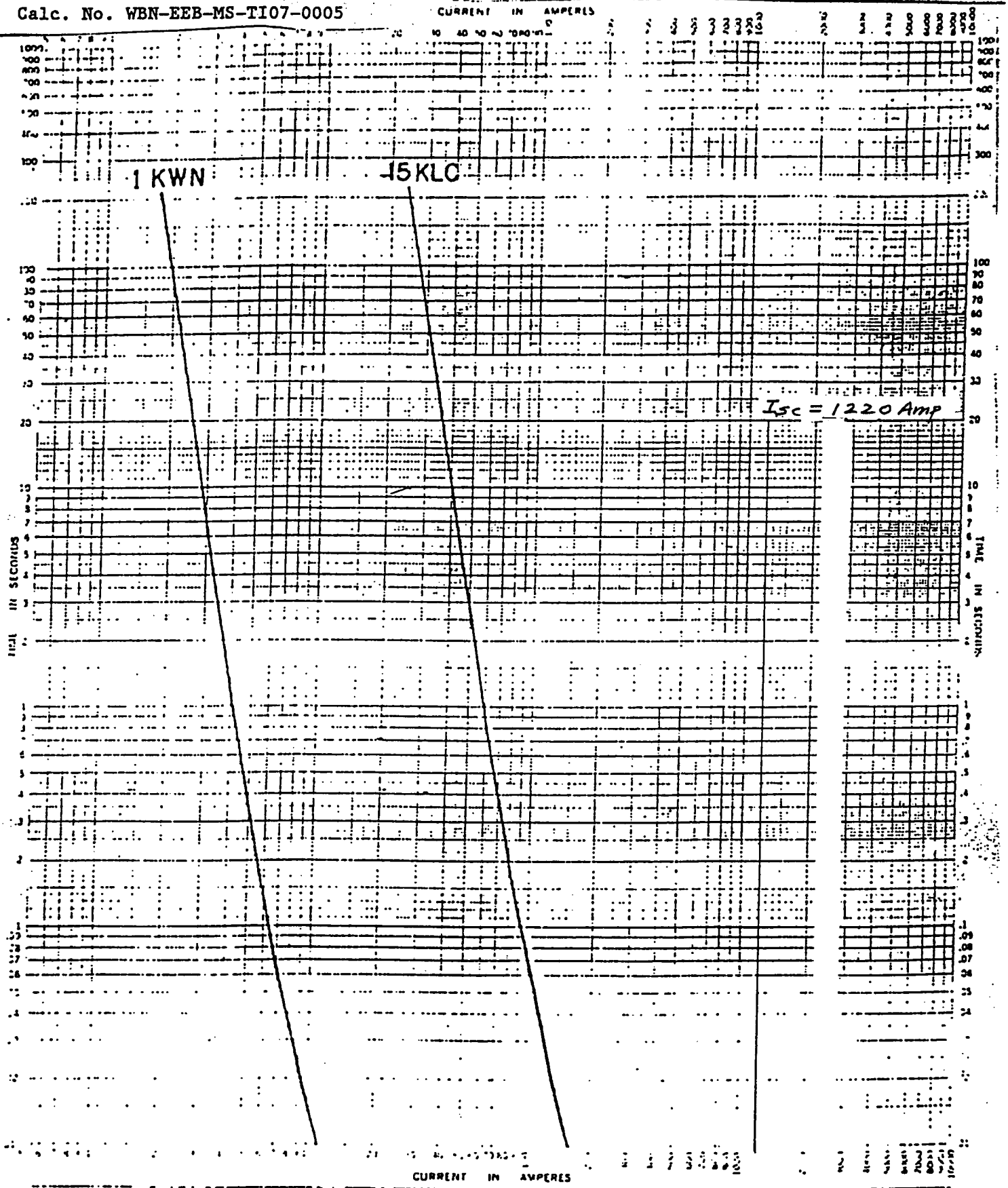
2) Interrupting current rating for fuse selected shall be greater than I_{SC} determined in section B.2.

3) Based upon the result of Sec. B, C.1 and C.2 calculations, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KLC (15 Amp), it is required that Bussmann type KWN (1 Amp) or approved equal fuse be used. Fuse IC_{DC} = 100 KA.

4) Sheet 4 demonstrates the coordination provided up to and including the maximum anticipated fault current.

Attachment No. P-01014-A
Calc. No. WBN-EEB-MS-TI07-0005

Appendix 2 Sheet 4 of 4



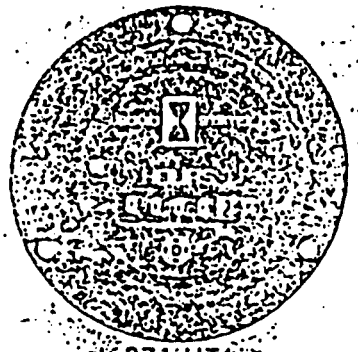
Total Clearing
For KLC, KWN Limitron Fast Acting Fuses TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links, In
BASIS FOR DATA Standards Bussmann Mfg. Div. Curves Dated 8-22-74 No. 50549
1. Tests made at Volts a c at p f, starting at 25C with no initial load No.
2. Curves are plotted in Test points to variations should be Date

K-E TIME-CURRENT CHARACTERISTIC 46 5258

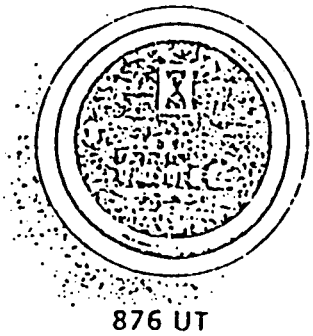
are housed in heavy duty [illegible] rated to 5000.0 hours. [illegible] polarity protection to pr[illegible] damage to the Motor if not proper[illegible]

[illegible] Motors are shown page 4

S[illegible]d State

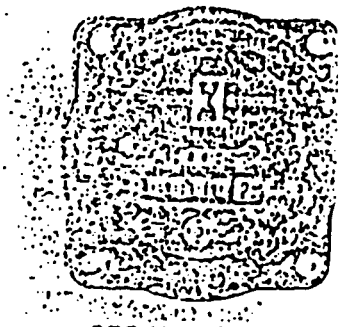


871 UT

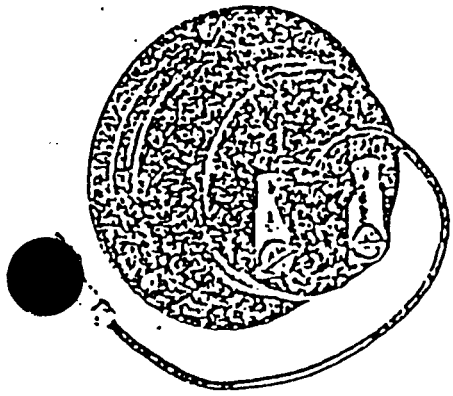


876 UT

876 EM



873 UT Aircraft



871 UT Inhibited

Model	Style	Part Number	Voltage
871	UT	56456-03	12/24V DC
871	UT	56456-07	36/72V DC
876	UT	56458-04	12/24V DC
876	UT	56458-08	36/72V DC
876	EM	56458-10	12/24V DC
873	UT Aircraft	56457-03	12/24V DC
873	UT Aircraft	56457-04	36/72V DC
871	UT Inhibited	56557-09	12/24V DC
876	UT Inhibited	56556-20	12/24V DC

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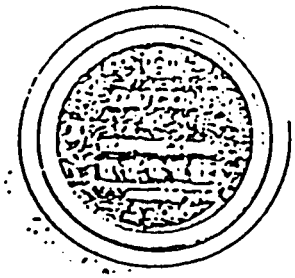
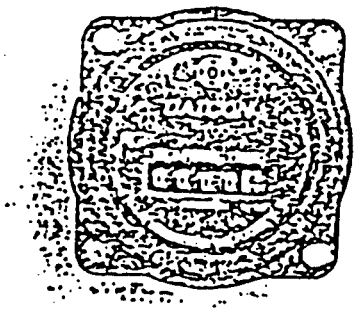
Electro-Mechanical

771 UT



776 UT

776 EM



773 UT Aircraft

Model	Style	Part Number	Voltage
771	UT	56181-00	4/40V DC
771	UT	56492-00	3/50V DC
771	UT	56181-02	30/130V DC
776	UT	56288-01	4/40V DC
776	UT	56494-00	3/50V DC
776	UT	56288-03	30/130V DC

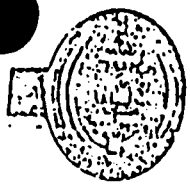
Model	Style	Part Number	Voltage
776	EM	56288-06	4/40V DC
776	EM	56494-01	3/50V DC
776	EM	56288-07	30/130V DC
773	UT Aircraft	56194-00	4/40V DC
773	UT Aircraft	56493-00	3/50V DC

Calc. No. WBN EEB MS T1070005

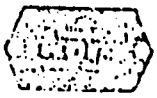
Attachment No. P-01014-A SHEET 16 APPENDIX 4

Isolation of Non-Class 1E Elapsed

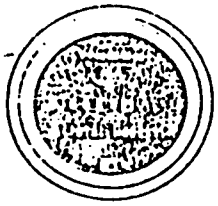
HOBBS SOLID-STATE DIOCHRON III HOUR METERS



80001



80005



80003

The new Hobbs Diochron III Hour Meter is the ultimate in reliable measurement of elapsed time. A visible record of time running time right on the equipment is vital for scheduled maintenance and helps reduce down-time.

Diochron III features the latest in electronics with a custom integrated circuit and a proven, ruggedized, read-out mechanism. Diochron III records up to 9,999,9 hours and automatically recycles at zero. This series was specifically designed for use on construction, material handling and farm equipment and heavy duty assemblies on aircraft and marine applications as well as electronic applications where direct current is available.

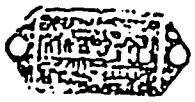
Diochron III Hour Meters are unaffected by typical short-duration, high-voltage transient currents. They are accurate within ± 1% of entire voltage range and stable within ± 1%, between 0°F and 140°F. Temperature range: 26°F to 185°F. Withstands vibrations from 7 to 500 Hz at 5 g's.

Voltage	Mounting	Part Number
12-24 V DC	2—Screw "Mini"	80000
12-24 V DC	3—Screw (Black) 2.25" dia.	80001
12-24 V DC	Bracket (Chrome) 2.25" dia.	80002
12-24 V DC	Bracket (Chrome) 2.50" dia.	80003
12-24 V DC	4—Screw (Aircraft) 2.50" dia.	80004*
12-24 V DC	4—Screw (Aircraft) 2.50" dia.	80005**
36-72 V DC	2—Screw "Mini"	80006
[illegible] V DC	3—Screw (Black)	80007
[illegible] V DC	Bracket (Chrome) 2.25" dia.	80008
[illegible] V DC	Bracket (Chrome) 2.25" dia.	80009

*Total Hours (Aircraft) **Flight Hours (Aircraft)

HOBBS ALTERNATING CURRENT METERS

20016



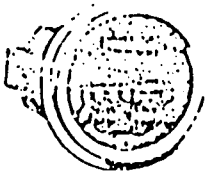
20028

A highly reliable instrument for recording operating time for leasing, maintenance, testing and warranty programs. Polycarbonate, shock resistant, tamper proof case. Records up to 100,000 hours and automatically recycles to zero. Accuracy: ± 1% [illegible] temperature: −65°F to +154°F. UL recognized component. Power rating: 3 watt. Screw Termination. Available in Minimeter and Deluxe styles.

Voltage	Hertz (Cycles)	Minimeter 2"x1" Part No.	3 Screw 2.7" Dia. Part No.
120	50	20020	20018
120	60	20001	20017
240	50	20029	20018
240	60	20007	20019

HOBBS SOLID-STATE DIOCHRON II HOUR METERS

24963



23651

Discreet individual components record operating hours of gas, diesel, or battery powered equipment. Key components are potted for shock protection.

Diochron II Hour Meters are unaffected by typical, short duration high voltage transient currents. They are accurate within ± 1% of entire voltage range. Temperature range: 26°F to +185°F (155° maximum above 60 volts). Withstands vibrations from 7 to 500 Hz at 10 g's.

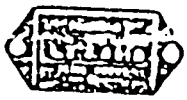
Equipped with face dials with automatic recycling numbers recycled up to 10,000 hours in one-tenth hour increments.

Voltage	Mounting	Part No.
12V DC	3-screw	24963 (16000)
12V DC	Stirrup	24957 (16001)
24-72V DC	3-screw	24962 (16002)
24-72V DC	Stirrup	24956 (16003)
12V DC	Flange	24569
12V DC	Stirrup	23651
24-72V DC	Flange	24570
24-72V DC	Stirrup	23653

Hobbs Div.
Springfield, IL (217) 753-7600

HOBBS MINIMETERS SERIES

15001



15000

15002

15006

Dirt and moisture sealed, escapement controlled DC hour meters include jewelled movement, shockproof odometer, and permanently lubricated parts. Easy to read black face dials. Records hours in tenths. Accuracy: ± 1%. Rundown: 5 seconds. Oper. temp. range: −65° to +160°. Meets Military Spec. MIL-L-3971B.

"Long Stud" Model. Similar to above models, except for 2" case size and longer studs for easy replacement of any Hobbs meter. Fits any panel up to 1" thick.

Part No.	Range (VDC)	Mount	Replaces Part No.
15000	4-40	2 screw	
15001	4-40	3 screw	5500
15002	4-40	Bracket	5601
15003	40-130	2 screw	
15004	40-130	3 screw	
15005	40-130	Bracket	
[illegible]	4-40	[illegible]	5611 & 5612
15007①	4-40	Aircraft	
15017②	4-40	Bracket	5601
15031③	4-40	Bracket	5601
15066④	4-40	Bracket	5601

① Reads Total Hours
② Reads Flight Hours
③ Long Stud
④ Black Bezel
⑤ Bezel Matches S-W Heavy-Duty Gauges

A-03

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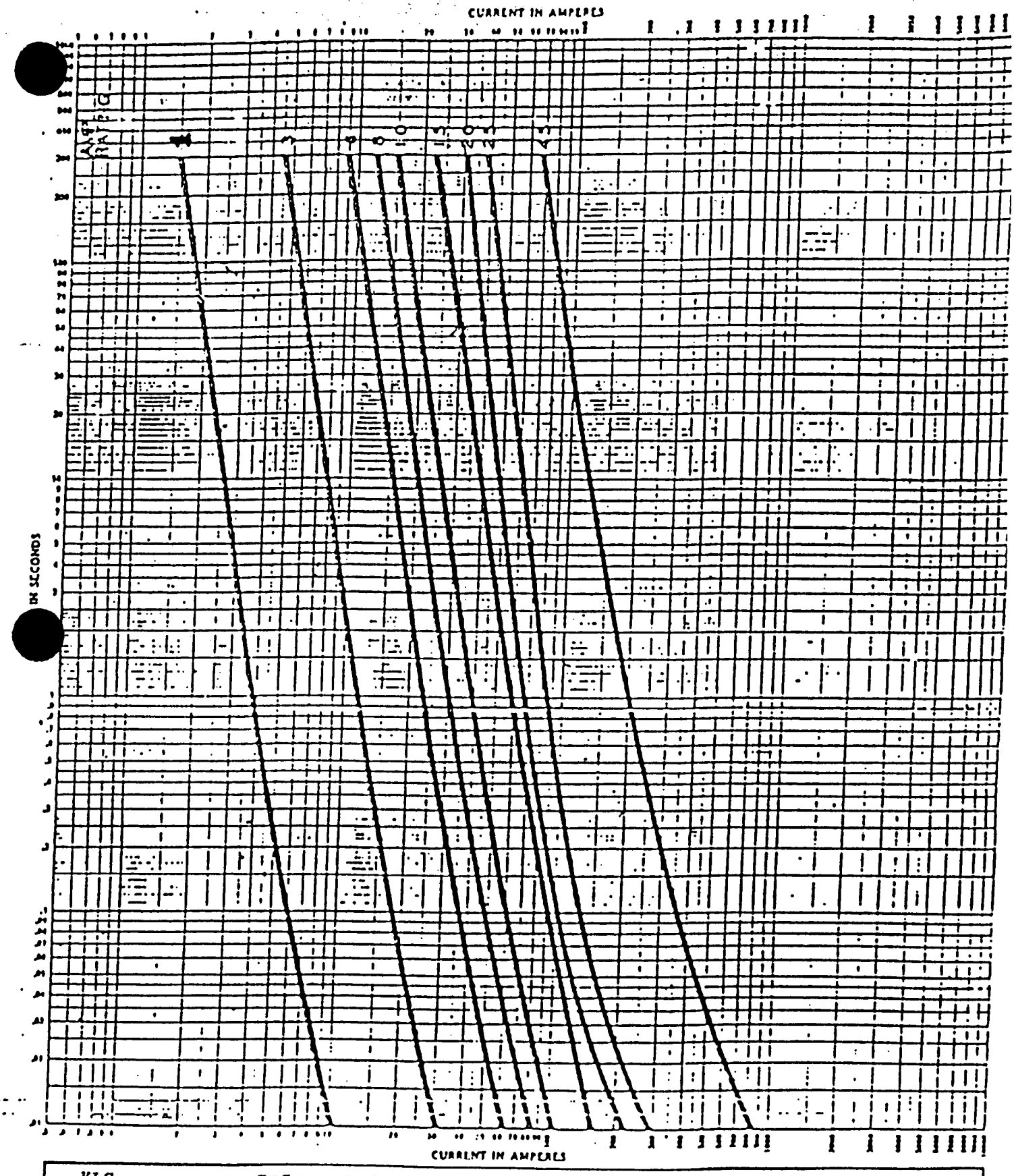
Attachment No. P-01014-A SHEET 17 APPENDIX 5
Calc. No. WBN EEB MS TI07 0005



KLC, KTN, KTS, KWN & KWS TOTAL CLEARING LIMITRON FAST-ACTING FUSES ... TIME-CURRENT CHARACTERISTIC CURVES BUSSMANN MFG. DIVISION ... St Louis 7, Mo

BASIS FOR DATA Standards ... Dated ...

1. Tests made at ... Volts ac or ... p.f. Starting at 25C with no initial load ...
2. Curves are plotted to ... Test points on curves should be ...

No. 50549

Attachment No. P-01014-A
Calc. No. WBN EEB MS TI07 0005

SHEET 18 APPENDIX 6

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Datcon 125VDC Elapsed Time Meters (ETM)

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO _____

DISCUSSION WITH Jim Eckenrod, Datcon Instrument Co.
(717) 569-5713 East Petersburg, PA

Mr. Eckenrod verified ETM voltage rating (125VDC) and supplied current rating (0.43 A). Model 771, Style UT, Part No. 56181-02.

COMMENTS:

BY Luis Valdero NAME — Assoc Elect. Eng. TITLE — ELECT. DEPT. NO.

CC:

Attachment No. P-01014-A
Calc. No. WBN EEB MS TI07 0005

SHEET 19 APPENDIX 7

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

NAME/FILE NO.

PROJECT Information on Hobbs 125 VDC Elapsed Time Meters (ETM)

DEPT. NO. CLIENT SYMBOL OPS NO.

ON WITH Meg Hicks, Sales Dept. Hobbs Division.
(217) 753-7793 Springfield, IL

Meg Hicks verified ETM voltage rating (125 VDC)
& supplied ampere rating (0.667 A). for ETM Part
15005.

BY Luis A Madero NAME Assoc. Elect. Eng. TITLE ELECT. DEPT. NO.

Attachment No. P-01014-A
Calc. No. WBN EEB MS TI07 0005

SHEET 20 APPENDIX 8

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Interrupting Current Rating of Bussmann KLC Limitron Fast-Acting 15A Fuse

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO. _____

DISCUSSION WITH Jeff Crittenden of Bussmann Mfg. Co.
(314) 394-2877 St. Louis, MO

Mr. Crittenden supplied the DC Interrupting Current Rating of an equivalent fuse to the Bussmann KLC Limitron Fast-Acting 15 Amp Fuse. He used the KTN fuse whose Interrupting Current Rating is 10 KA. The KLC fuse was designed for military specifications, and it appears that no DC tests were conducted.

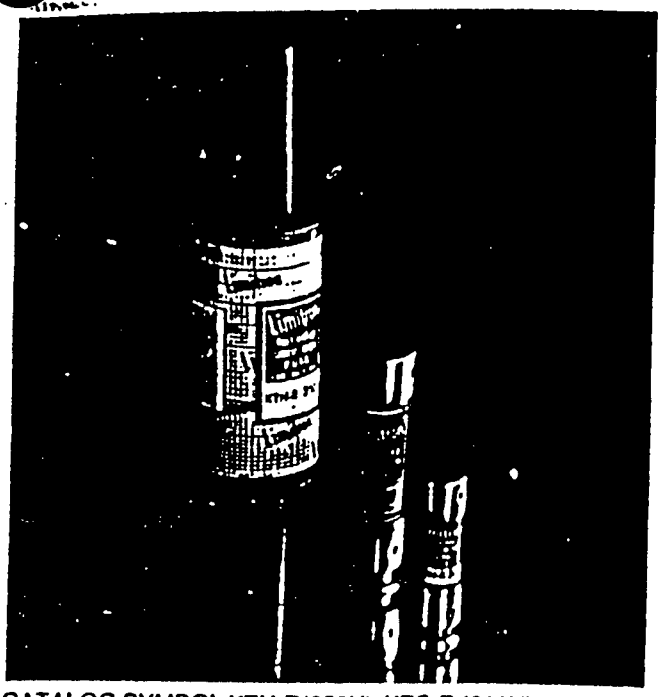
COMMENTS:

For KLC interrupting ratings see
TVA Elec Design Std DS-E8.1.1

GDG 6/28/91
WTH 6/28/91

BY [signature] NAME Asst. Elect Eng. TITLE ELECT DEPT. NO.

LIMITRON, Fast-Acting—KTN-R And KTS-R (KWN-R KWS-R)



CATALOG SYMBOL KTN-R(250V); KTS-R (600V)
FAST-ACTING
1 TO 600 AMPERES
AND 600 VOLTS AC (OR LESS)
RENT LIMITING
INTERRUPTING RATING—200,000A RMS SYM.
U.L. LISTED—CLASS RK-1
CSA HRC-I
APPLICABLE TO CLASS 1E NUCLEAR EQUIPMENT
FUSEBLOCKS—SEE SECTION 2

Single-element, fast-acting fuses with minimal time-delay. Provides a high degree of short-circuit current limitation (component protection). Particularly suited for circuits and loads with no heavy surge currents of motors, transformers, solenoids, and welders. LIMITRON fuses are commonly used to protect circuit breakers with lower interrupting ratings. If used in circuits with surge currents (motors, etc.) must be sized to prevent unwanted opening and thus only provide short-circuit protection. Incorporate Class R rejection feature. Can be inserted in non-rejection type fuseholders. Thus, can physically and electrically replace fast acting Class H, K1, K5, RK5, and other RK1 fuses.

Protecting Low Interrupting Capacity Circuit Breakers
These fuses can be used to limit the short-circuit current to meet the interrupting capacity requirements of existing equipment. On older systems where the available short-circuit current exceeds the interrupting capacity of the circuit breakers, fuses can be installed in series with existing equipment.

On new installations, use these fuses to limit the available short-circuit current to lighting panel circuit breakers provide a much higher degree of short-circuit protection substantial savings on equipment costs. Lower interrupting capacity circuit breakers can be used rather than more expensive higher interrupting capacity circuit breakers.

Lighting and Heating Circuits—Fuse Sizing
The reliability of fast-acting fuses makes these fuses well suited for lighting and heating circuits and other non-inductive loads. Size fast-acting fuses at least 125% of the continuous load plus 100% of the non-continuous load. The fuse ampere rating should not be greater than conductor ampacity. (See Fuse Sizing Guide, Section 1-19).

Protection of Motors and Motor Circuits—Fuse Sizing
When fast acting fuses are specified for motor circuit protection, they should be sized at approximately 300% of motor full load current to allow for starting transients. Refer to Section 430-52 and Table 430-152 of the National Electrical Code for maximum size non-time-delay fuses that can be used on motor circuits. This size will provide motor branch circuit protection (short-circuit protection) for the motor circuit components but not motor running overload protection. Where back-up motor running protection is desired, FUSETRON or LOW-PEAK dual-element fuses are recommended.

Component Short-Circuit Protection—Current Limiting
Per NEC 110-10, protective devices shall clear a fault without "extensive damage" to the circuit components. Knowing the withstand rating of a component, the selection of a fuse which would provide requisite protection can be easily determined by reference to the "Current Limiting" Table or Graph. In most cases, selection of fuse size simply made in accord with load requirements will limit fault current to values below component withstand ratings. (See Section 1-19).

High Interrupting Rating
These fuses have the maximum U.L. interrupting rating of 200,000 amperes. This rating affords compliance with NEC Sections 110-9 and 230-98 in today's large capacity systems. Gives safe protection to both equipment and personnel. Meets the requirements of future system expansion and increases in available utility short-circuit current (See Section 1-19).

Selective Coordination (Blackout Prevention)
When the up-stream and down-stream fuses are "selectively coordinated", only the fuse nearest to the faulted circuit opens . . . up-stream fuses are not affected. Buss fuses can be easily selectively co-ordinated. All that is necessary to provide fuse selectivity is to simply have an adequate ampere rating ratio between the main fuse and feeder fuse and branch circuit fuses. These ampere rating ratios for the various types of fuses are shown in the "Selectivity Guide" (Section 1-19).

LIMITRON Fuses For DC or AC Applications—KWN And KWS
Type KWN-R and KWS-R LIMITRON fast-acting fuses are UL listed as Class RK 1 with an ac rating of 250 volts (KWN-R) and 600 volts (KWS-R) respectively; interrupting rating 200,000 amperes. They can also be applied at 250 volts DC and 600 volts DC respectively with an interrupting rating of 100,000 amperes. Dimensions are the same as KTN-R and KTS-R LIMITRONS. Ampere ratings are 1, 3, 6, 10, 15, 20, 25, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 225, 250, 300, 350, 400, 450, 500, and 600 amperes.

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-20-91

Checked by [illegible] Date 06-20-91

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--	Table of Contents	1	1
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3.0	Applicable Codes and Standards	3	-
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6.0	Design Input Data	4	-
7.0	Analysis	-	-
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1 Calculation sheets for Datcon Elapsed Time Meters located at 2-BD-211-A-A/8, 2-BD-211-B-B/8, 2-BD-211-B-B/9 (4 pages).

2 Calculation sheets for Hobbs Elapsed Time Meter located at 2-BD-211-A-A/9 (4 pages).

3 Datcon Instrument Co. Elapsed Time Meter Data, (1 page).

4 Hobbs Division Elapsed Time Meter Data, (1 page).

5 Bussmann Time-Current Characteristics Curves for KLC and KWN Fast-Acting Fuses; obtained by mail from Bussmann Mfg. Co. August 1988, (1 page).

6 Record of Telephone Conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM, September 8, 1988, (1 page).

7 Record of Telephone Conversation with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM, September 8, 1988, (1 page).

8 ~~Record of Telephone Conversation with Jeff Crittenden of Bussmann Mfg. Co. verifying the DC Interrupting Current (10 KA) Rating of a Bussmann KLC Limitron Fast Acting Fuse, September 8, 1988, (1 page)~~. GP 6/28/91 WJH 6/28/91

9 Bussmann KWN Limitron Fast-Acting Fuse DC Interrupting Current (100 KA) Data from Bussmann Catalog FLC 1985 Section 1-8 Page 1, (1 page).

This Attachment Package contains 20 pages.

1194x

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-20-91

Checked by [illegible] Date 06-20-91

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support the modifications to be inplemented under DCN P-01015-A. Among the modifications, 2 fuses are added to the elapsed time meter to isolate them from the Class 1E control circuit.

This attachment documents the roll-up of mini calculation No. WBPE0678810003 which effects all the baseline calculations show below. This attachment is tailored to the specific baseline calculation shown in the heading above.

BASELINE CALCULATION	CALCULATION NO.
125V DC Voltage Analysis*	WBN EEB-MS-TI11-0004
125V DC Battery Sizing	WBN EEB-MS-TI11-0003
125V DC Short Ckt/Protection	WBN EEB-MS-TI07-0005

* The Elapsed Time Meter is energized after the 6.9KV circuit breaker transitions to closed position. Therefore, the load of the Elapsed Time Meter is not a coincident load with the breaker closing circuit and will not affect the existing voltage analysis in the calculation No. WBN EEB-MS-TI11-0004.

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WM Date 6-20-91

Checked by Jon Terrell Date 06-20-91

1.2 Scope

The scope of this attachment is to determine the size and type of fuse to be added to isolate a non-class 1E Elapsed Time Meter (ETM) circuit. The fuse shall isolate the faulted ETM circuit from the remaining class 1E circuit to allow the continued operation of the Class 1E control function.

This calculation considers three Datcon and one Hobbs Elapsed Time Meters.

2.0 CRITERIA

The fuse to be added shall isolate a fault condition occurring at the Elapsed Time Meter (ETM) to allow the continued operation of the remaining Class 1E circuit. For a fault in the Elapsed Time Meter (ETM) circuit, the existing control circuit fuse shall act as a backup only when the ETM fuse fails to clear this fault.

ETM fuse shall be selected, to coordinate with the upstream fuse. ~~based upon Manufacturer's suggestion and generally accepted industry practice, by having a minimum of 3 to 1 ratio between ratings of the upstream and downstream fuses if similar types of fuses are used~~. The continuous current rating of the fuse shall be at least 125% of the load. Fuse interrupting current (IC) shall be greater than the maximum anticipated fault current in the circuit. GP 6/28/91 WM 6/28/91

3.0 APPLICABLE CODES AND STANDARDS

See Baseline Calculation.

4.0 ASSUMPTIONS

4.1 See baseline calculation.

~~4.2 TVA has placed a contront no. 75835A (DCN #M-12564-A) for testing and prove the coordination between 1KWN and 15 KLC fuses. It is assumed (unverified) that the coordination will be proved by these tests.~~ SEE APPENDIX 'A' OF ATTACHMENT M17941A. R5 PB 3/18/92 3-18-92

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WJH Date 6-20-91
Checked by [illegible] Date 06-20-91

.0 REFERENCES

5.1 TVA Drawings:

1-45W760-67-1 R2 Essential Raw Cooling Water System Schematic Diag.
1-45W760-67-2 R1 Essential Raw Cooling Water System Schematic Diag.
1-45W724-1 R0 6900V Shutdown BD 1A-A Single Line
1-45W724-2 R0 6900V Shutdown BD 1B-B Single Line

5.2 Datcon Instrument Co. Catalog No. 3878; obtained by mail from Datcon Instrument Co. 1988.

5.3 Hobbs 125V DC Hour Meter Data; obtained from Information Handling System VSMF Cartridge 6192 Frame 4194.

5.4 Bussman Time-Current Characteristic Curves for KLC and KWN Fast-Acting Fuses; obtained by mail from Bussmann Mfg. Co. (1 page) August 1988.

5.5 Record of Telephone Conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM. (1 page) September 8, 1988.

5.6 Record of Telephone Conversation with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM. (1 page) September 8, 1988.

5.7 ~~Record of Telephone Conversation with Jeff Crittenden of Bussmann Mfg. Co. verifying the DC Interrupting Current (10KA) Rating of a Bussman KLC Limitron Fast Acting Fuse. (1 page) September 8, 1988.~~ GP 6/20/91 WTH 6/28/91

5.8 Departmental Guidelines for Electrical Mini Calculation Roll-Up, ELEC-004, dated 4/30/91.

6.0 DESIGN INPUT DATA

See Section A of Appendix 1 and 2.

7.0 ANALYSIS

Each of the Shutdown Boards identified on Section A of the attachments to this calculation have four cable feeders from the 125V DC Vital Battery Boards. They are: Normal Bus Normal Feeder, Normal Bus Alternate Feeder, Backup Bus Normal Feeder and Backup Bus Alternate Feeder.

For the purpose of calculating the short-circuit current at the Elapsed Time Meter (ETM), the shortest cable feeder route was used in the calculation (combined length of feeder from Vital Battery to Vital Battery Board, and of feeder from Vital Battery Board to Shutdown Board). This will give a conservative result. See Section B of the attached Calculation sheets.

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Prepared by WTH Date 6-20-91
Checked by [illegible] Date 06-20-91

8.0 SUMMARY OF RESULTS

The shutdown boards 125V DC Control Circuit is adequately protected and will isolate the Non Class 1E Elapsed Time Meter from the Class 1E 125V DC circuit during a fault.

9.0 CONCLUSION

A Bussman KWN Limitron Fast Acting 1 Amp fuse shall be used to isolate the non-class 1E Elapsed Time Meter from a class 1E circuit.

10.0 Appendixes (Total Pages - 19)

1 Calculation sheets for Datcon Elapsed Time Meters located at 2-BD-211-A-A/8, 2-BD-211-B-B/8, 2-BD-211-B-B/9 (4 pages).

2 Calculation sheets for Hobbs Elapsed Time Meter located at 2-BD-211-A-A/9 (4 pages).

3 Datcon Instrument Co. Elapsed Time Meter Data, (1 page).

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5 Bussmann Time-Current Characteristics Curves for KLC and KWN Fast-Acting Fuses; obtained by mail from Bussmann Mfg. Co. August 1988, (1 page).

6 Record of Telephone Conversation with Jim Eckenrod of Datcon Instrument Co. verifying voltage and current ratings of Datcon ETM, September 8, 1988, (1 page).

7 Record of Telephone Conversation with Meg Hicks of Hobbs Division verifying voltage and current ratings of Hobbs ETM, September 8, 1988, (1 page).

8 ~~Record of Telephone Conversation with Jeff Crittenden of Bussman Mfg. Co. verifying the DC Interrupting Current (10 KA) Rating of a Bussmann KLC Limitron Fast Acting Fuse, September 8, 1988, (1 page)~~. GP 6/20/91 WTH 6/28/91

8 Bussmann KWN Limitron Fast-Acting Fuse DC Interrupting Current (100 KA) Data from Bussmann Catalog FLC 1985 Section 1-8 Page 1, (1 page).

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 1 Sheet 1 of 4

Prepared by WJH Date 6-20-91

Checked by [illegible] Date 06-20-91

A. Technical Data

1. This attachment applies to the Datcon ETM's located at the following shutdown boards:

Shutdown Board I.D. No./Compartment	Source of Data
2-BD-211-A-A/8	TVA Dwg. 1-45W760-67-1 R2
2-BD-211-B-B/8	TVA Dwg. 1-45W760-67-2 R1
2-BD-211-B-B/9	TVA Dwg. 1-45W760-67-2 R1

2. Equipment Monitored by ETM's

ERCW Pump D-A (2-A-A/8)	TVA Dwg. 1-45W760-67-1 R2
ERCW Pump H-B (2-B-B/8)	TVA Dwg. 1-45W760-67-2 R1
ERCW Pump G-B (2-B-B/9)	TVA Dwg. 1-45W760-67-2 R1

3. Existing Fuse Data

Bussmann KLC Limitron Fast-Acting Fuse 15A	TVA Dwg. 1-45W724-1 R0
IC_{DC} = ~~10 KA~~ 150KA	~~Appendix 8~~ TVA Elec Design Std DS-EB.1.1 GP 6/20/91 WTH 6/20/91

4. Control Circuit Power Source

125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Baseline Calculation

5. Elapsed Time Meter Data:

Manufacturer: Datcon Instrument Co. Volts 125 DC Amps 0.43	Appendix 3 and Appendix 6

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 1 Sheet 2 of 4

Prepared by WM Date 6-20-91

Checked by Jon Terrell Date 06-20-91

6. Feeder Cable Data form baseline calculation

The size and type of the positive Feeder cable that runs from the Vital Battery Boards I, II, III and IV to the Shutdown Boards is the same for all four cases. (Except back up alternate feeder from Battery Board III cable # 2B1F is #6 AWG 2-1C WDE-1 see Baseline Calculation)

Feeder Cable (See Baseline Calculation)

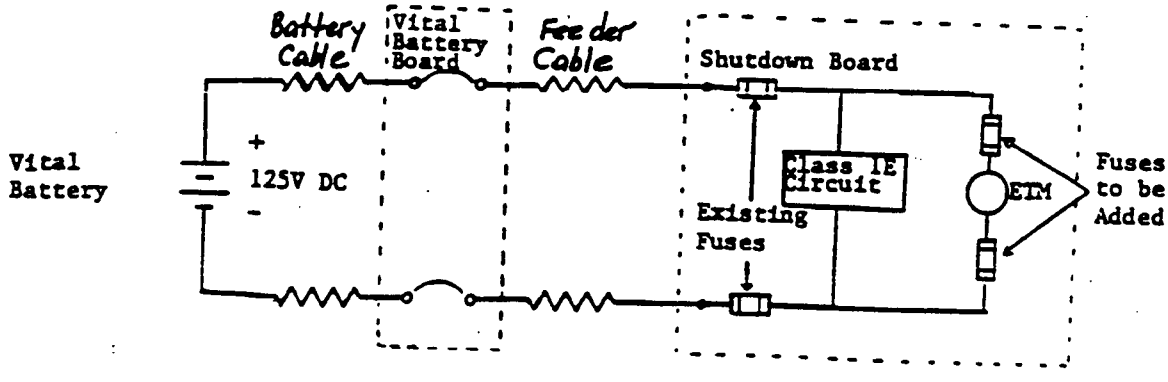
Vital Batt. Bd../ Shutdown Bd.	Cable No/ Bus/ Length In Ft.	Feeder Type	Minimum Resistance at 25°C ohms/1000 ft
I/2A-A	2B3D/90	Nor/Alt	0.654
I/2A-A	2B2D/50	BU/Nor	0.654
III/2A-A	2B4F/75	Nor/Nor	0.654
III/2A-A	2B1F/55	BU/Alt	0.41
II/2B-B	2B8E/100	Nor/Alt	0.654
II/2B-B	2B7E/140	BU/Nor	0.654
IV/2B-B	2B9G/100	Nor/Nor	0.654
IV/2B-B	2B6G/80	BU/Alt	0.654

The other Shutdown Board has similar configuration, as shown in the table.

7. The short circuit current at the four vital battery board is
$I = 17{,}575A$ (See Baseline Calculation)
$R_{equivalent} = \frac{120}{17575} = 0.0068279$ ohms.

B. Short Circuit Current

Equivalent Circuit



Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 1 Sheet 3 of 4

Prepared by WJH Date 6-25-91

Checked by [illegible] Date 06-26-91

1) Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board. (from Section A.6 of this Appendix)

$$Res." = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\ ft} \times \text{Length of Feeder Cable}$$

$$Res." = 2 \times \frac{0.654}{1000\ ft} \times 50 = 0.0654 \text{ ohms}$$

2) Short Circuit current available at Elapsed Time Meter.

Requivalent = 0.0068279 ohms (from Section A.7 of this Appendix)
From Section B1 above

$$Res." = 65.4 \times 10^{-3} \text{ ohms}$$

$$I_{SC} = \frac{V_{Battery}}{R_{equivalent} + Res"}$$

$$= \frac{120V}{(6.83 + 65.4) \times 10^{-3} \text{ ohms}} = 1{,}661 \text{ A}$$

C. Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

Load Current = 0.43 Amps from Section A.5

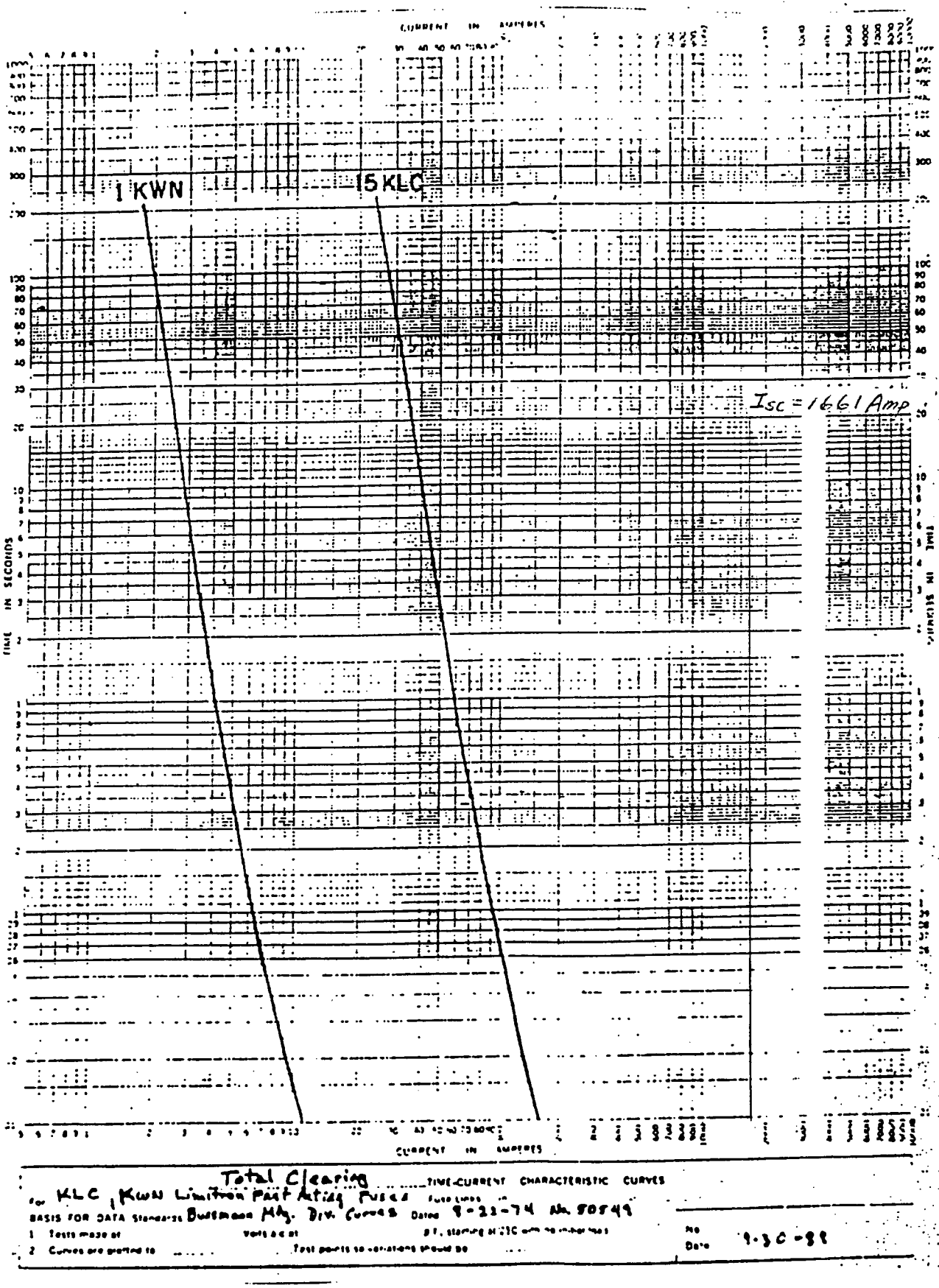
Fuse minimum rating = 1.25 x Load Current = 1.25 x 0.43 = 0.5375 Amps

2) Interrupting current rating for fuse selected shall be greater than I_{SC} determined in Section B.2.

3) Based upon the result of Sec. B, C.1 and C.2 calculations, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KLC (15 Amp), it is required that Bussmann type KWN (1 Amp) or approved equal fuse be used. Fuse IC_{DC} = 100 KA.

4) Sheet 4 demonstrates the coordination provided up to and including the maximum anticipated fault current.

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005



Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 2 Sheet 1 of 4

Prepared by WJH Date 6-18-91

Checked by [signature] Date 06-20-91

A. Technical Data

1. This attachment applies to the Hobbs ETM located at the following shutdown board:

Shutdown Board I.D. No./Compartment	Source of Data
2-BD-211-A-A/9	TVA Dwg. 1-45W760-67-1 R2

2. Equipment Monitored by ETM

ERCW Pump C-A	TVA Dwg. 1-45W760-67-1 R2

3. Existing Fuse Data

Bussmann KLC Limitron Fast-Acting Fuse 15A	TVA Dwg. 1-45W724-1 R0
IC_{DC} = ~~10 KA~~ 150KA	~~Appendix 8~~ TVA Elec Design Std DS-E8.1.1 | GP 6/28/91 WTH 6/28/91

4. Control Circuit Power Source

125V Vital Battery: Gould 125V DC 60 Cell NCX-2250. Max Short Circuit Current at Terminals: 18,360A	Baseline Calculation

5. Elapsed Time Meter Data:

Manufacturer: Hobbs Division Volts 125 DC Amps 0.667	Appendix 4 and Appendix 7

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 2 Sheet 2 of 4

Prepared by WMt Date 6-20-91

Checked by [illegible] Date 06-20-91

6. Feeder Cable Data from baseline calculation

a. The size and type of the negative Battery cable is the same as that of the positive cable. The lengths of the positive and negative cables are equal (except back up alternate feeder from Battery Board III cable #2B1F is #6 AWG 2-1C WDE-1 See Baseline Calculation).

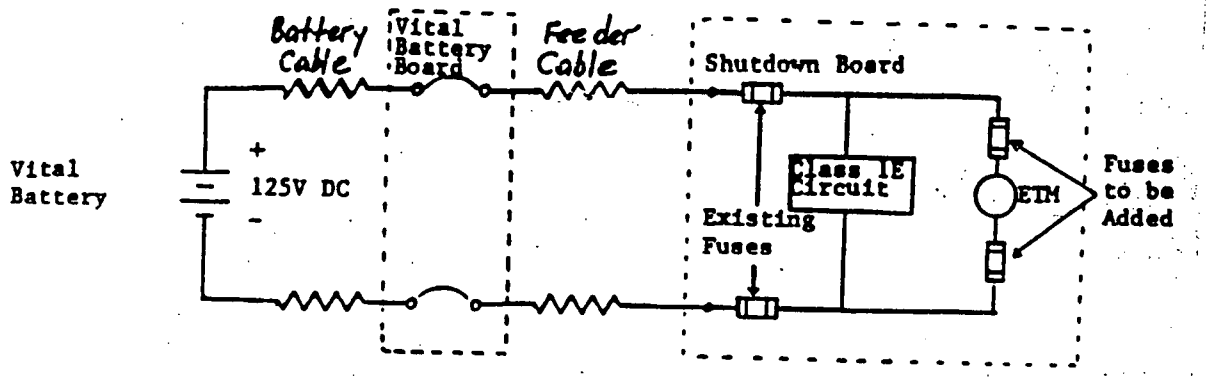
Feeder Cable (See Baseline Calculation)

Vital Batt. Bd./ Shutdown Bd.	Cable No./ Bus/ Length In Ft.	Feeder Type	Minimum Resistance at 25°C ohms/1000 ft
I/2A-A	2B3D/90	Nor/Alt	0.654
I/2A-A	2B2D/50	BU/Nor	0.654
III/2A-A	2B4F/75	Nor/Nor	0.654
III/2A-A	2B1F/55	BU/Alt	0.41

7. The short circuit current at the four vital battery board is I = 17,575A (See baseline calculation). $R_{equivalent} = \frac{120}{17,575} = 0.0068279$ ohms

Short Circuit Current

Equivalent Circuit



Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 2 Sheet 3 of 4

Prepared by CSH Date 6-25-91

Checked by [illegible] Date 06-26-91

1) Total Feeder Cable Resistance from 125V Vital Battery Board to Shutdown Board. (from Section A.6.b of this Appendix)

$$Res." = 2 \times R2 = 2 \times \frac{\text{Resistance}}{1000\ ft} \times \text{Length of Feeder Cable}$$

$$Res." = 2 \times \frac{0.41}{1000\ ft} \times 55 = 0.0451 \text{ ohms}$$

2) Short Circuit current available at Elapsed Time Meter.

Requivalent = 0.0068279 ohms (from Section A.7 of this Appendix)
From Section B above

$$Res." = 45.1 \times 10^{-3} \text{ ohms}$$

$$I_{SC} = \frac{VBattery}{R_{equivalent} + Res}$$

$$= \frac{120V}{(6.83 + 45.1) \times 10^{-3} \text{ ohms}} = 2{,}311 \text{ A}$$

Fuse Selection

1) Fuse current rating shall be greater than 125% of the load current.

Load Current = 0.667 Amps from Section A.5

Fuse minimum rating = 1.25 x Load Current = 1.25 x 0.667 = 0.8338 Amps

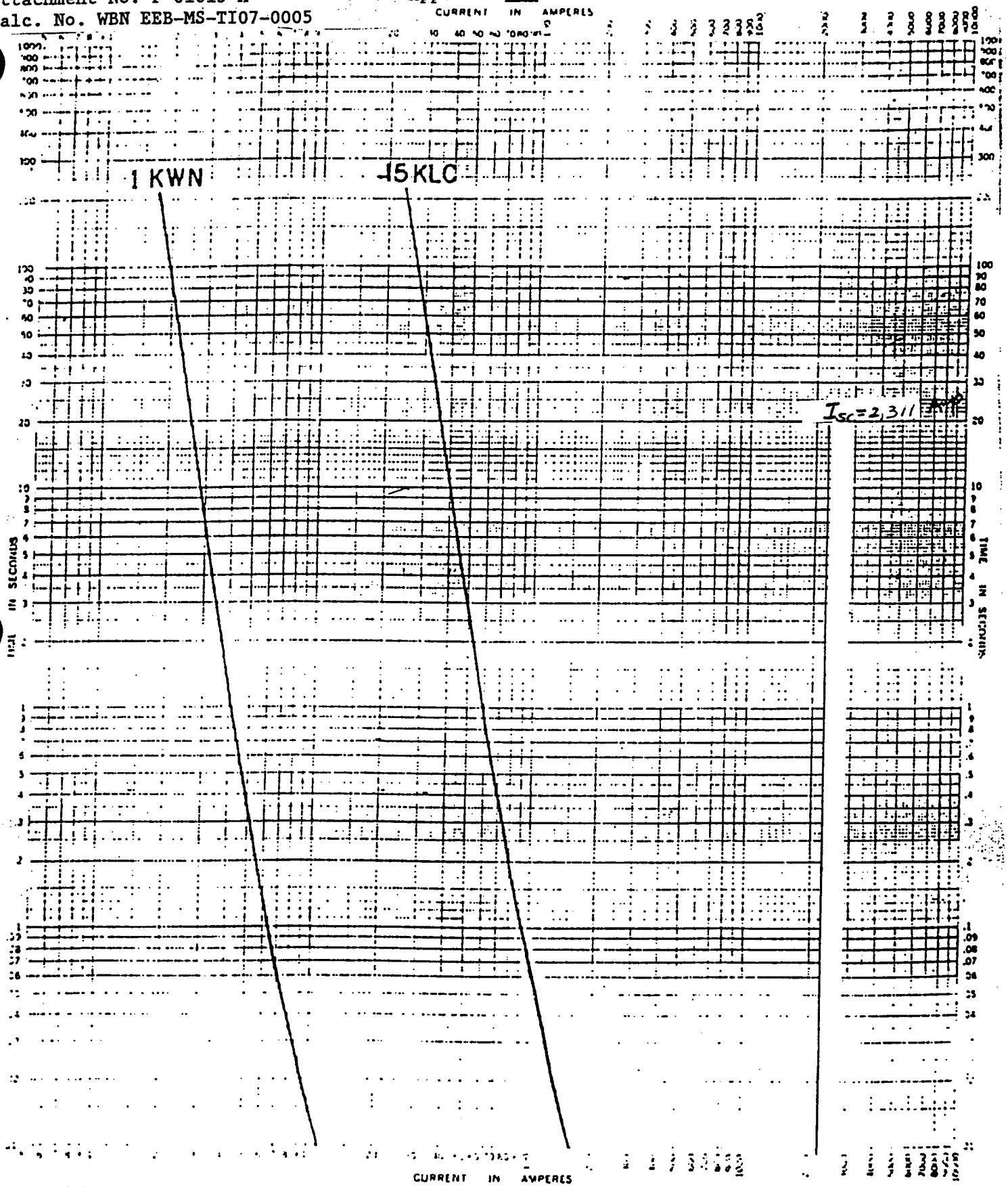
2) Interrupting current rating for fuse selected shall be greater than I_{SC} determined in section B.2.

3) Based upon the result of Sec. B, C.1 and C.2 calculations, and in order to achieve appropriate fuse coordination with existing upstream fuse Bussmann type KLC (15 Amp), it is required that Bussmann type KWN (1 Amp) or approved equal fuse be used. Fuse IC_{DC} = 100 KA.

4) Sheet 4 demonstrates the coordination provided up to and including the maximum anticipated fault current.

Attachment No. P-01015-A
Calc. No. WBN EEB-MS-TI07-0005

Appendix 2 Sheet 4 of 4



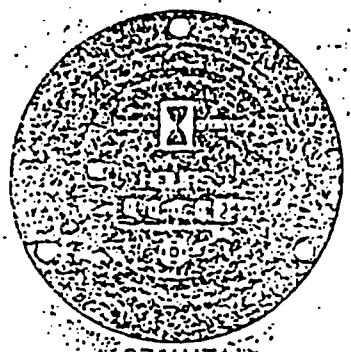
Total Clearing
For KLC, KWN Limitron Fast Acting Fuses TIME-CURRENT CHARACTERISTIC CURVES
BASIS FOR DATA Standards Bussmann Mfg. Div. Curves Fuse Links. In Dated 8-22-74 No. 50549
1. Tests made at Volts a.c. at p.f. starting at 25C with no initial load No.
2. Curves are plotted in Test points so variations should be . Date

K+E TIME-CURRENT CHARACTERISTIC 46 5258

Hour Meters

[illegible] are housed in heavy duty [illegible] record to 9999.9 hours. [illegible] polarity protection to prevent damage to the Meter if not properly [illegible] Solid State and Electro-Mechanical Hour Meters are shown [illegible] page 4

Solid State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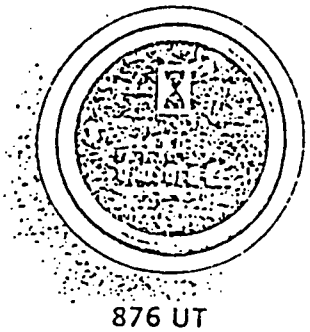
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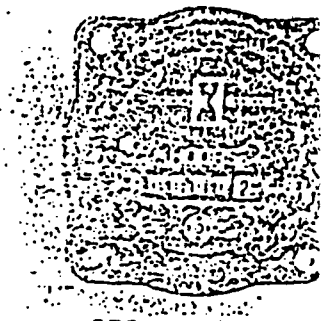
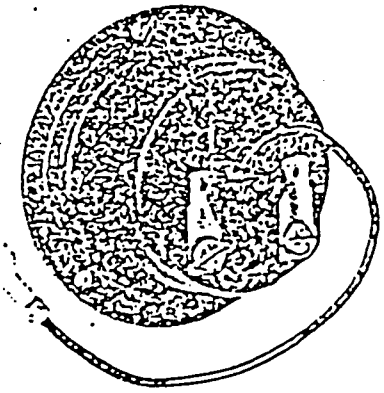
876 EM


873 UT Aircraft

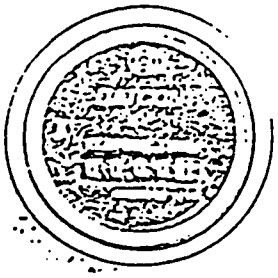

871 UT Inhibited

Model	Style	Part Number	Voltage
871	UT	56456-03	12/24V DC
871	UT	56456-07	36/72V DC
876	UT	56458-04	12/24V DC
876	UT	56458-08	36/72V DC
876	EM	56458-10	12/24V DC
873	UT Aircraft	56457-03	12/24V DC
873	UT Aircraft	56457-04	36/72V DC
871	UT Inhibited	56557-09	12/24V DC
876	UT Inhibited	56556-20	12/24V DC

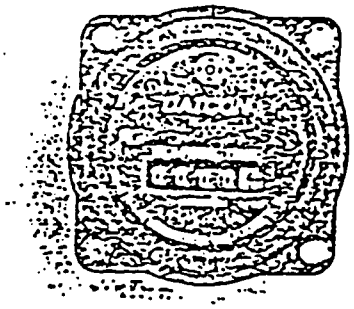
BEST AVAILABLE COPY

Electro-Mechanical

771 UT


776 UT

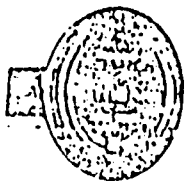
776 EM


773 UT Aircraft

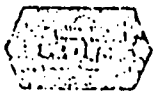
Model	Style	Part Number	Voltage
771	UT	56181-00	4/40V DC
771	UT	56492-00	8/50V DC
771	UT	56181-02	30/130V DC
776	UT	56288-01	4/40V DC
776	UT	56494-00	8/50V DC
776	UT	56288-03	30/130V DC

Model	Style	Part Number	Voltage
776	EM	56288-06	4/40V DC
776	EM	56494-01	8/50V DC
776	EM	56288-07	30/130V DC
773	UT Aircraft	56194-00	4/40V DC
773	UT Aircraft	56493-00	8/50V DC

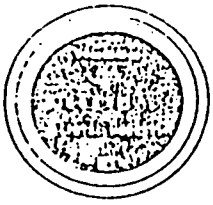
HOBBS SOLID-STATE DIOCHRON III HOUR METERS



80001



80005



80003

The new Hobbs Diochron III Hour Meter is the ultimate in reliable measurement of elapsed time. A visible record of total running time right on the equipment is vital for scheduled maintenance and helps reduce down-time.

Diochron III features the latest in electronics with a custom integrated circuit and a proven, ruggedized, heart of mechanism. Diochron III records up to 9,999.9 hours and automatically recycles to zero. This series was specifically designed for use on construction, material handling and farm equipment and has broad acceptance on aircraft and marine applications as well as electronic applications where direct current is available.

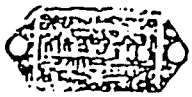
Diochron III Hour Meters are unaffected by typical short-duration, high-voltage transient currents. They are accurate within ± 1% of entire voltage range and stable within ± 1%, between 0°F and 140°F. Temperature range: 26°F to 185°F. Withstands vibrations from 7 to 500 Hz at 5 g's.

Voltage	Mounting	Part Number
12-24 V DC	2—Screw "Mini"	80000
12-24 V DC	3—Screw (Black) 2.25" dia	80001
12-24 V DC	Bracket (Chrome) 2.25" dia.	80002
12-24 V DC	Bracket (Chrome) 2.50" dia	80003
12-24 V DC	4—Screw (Aircraft) 2.50" dia.	80004*
12-24 V DC	4—Screw (Aircraft) 2.50" dia.	80005**
36-72 V DC	2—Screw "Mini"	80006
36-72 V DC	3—Screw (Black)	80007
36-72 V DC	Bracket (Chrome) 2.25" dia	80008
36-72 V DC	Bracket (Chrome) 2.25" dia	80009

*Total Hours (Aircraft) **Flight Hours (Aircraft)

HOBBS ALTERNATING CURRENT METERS

20016



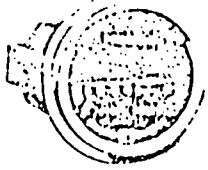
20020

A highly reliable instrument for recording operating time for leasing, maintenance, testing and warranty programs. Polycarbonate, shock resistant, tamper proof case. Records up to 100,000 hours and automatically recycles to zero. Accuracy: ± 1% [illegible] temperature: −65°F to +154°F UL recognized component. Power rating: 3 watts. [illegible] Termination. Available in Minimeter and Deluxe styles.

Voltage	Hertz (Cycles)	Minimeter 2"x1" Part No.	3 Screw 2.7" Dia. Part No.
120	50	20020	20016
120	60	20001	20017
240	50	20029	20018
240	60	20007	20019

HOBBS SOLID-STATE DIOCHRON II HOUR METERS

24963



23651

Discreet individual components record operating hours of gas, diesel, or battery powered equipment. Key components are potted for shock protection.

Diochron II Hour Meters are unaffected by typical, short duration high voltage transient currents. They are accurate within ± 1% of entire voltage range. Temperature range: 25°F to +185°F (150° maximum above 60 volts). Withstands vibrations from 7 to 500 Hz at 10 g's.

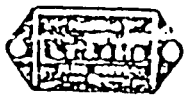
Easy-to-read face dials with automatic recycling odometers record up to 10,000 hours in one-tenth hour increments.

Voltage	Mounting	Part No.
12V DC	3-screw	24963 (16000)
12V DC	Stirrup	24957 (16001)
24-72V DC	3-screw	24962 (16002)
24-72V DC	Stirrup	24956 (16003)
12V DC	Flange	24569
12V DC	Stirrup	23651
24-72V DC	Flange	24570
24-72V DC	Stirrup	23653

Hobbs Div.
Springfield, IL (217) 753-7600

HOBBS MINIMETERS SERIES

15001



15000

15002

15006

Dirt and moisture sealed, escapement controlled DC hour meters include jewelled movement, shockproof odometer, and permanently lubricated parts. Easy to read black face dials. Records hours in tenths. Accuracy: ± 1%. Rundown: 5 seconds. Oper. temp. range: −65° to +160°. Meets Military Spec. MIL-L-39718.

"Long Stud" Model. Similar to above models, except for 2" case size and longer studs for easy replacement of any Hobbs meter. Fits any panel up to 1" thick.

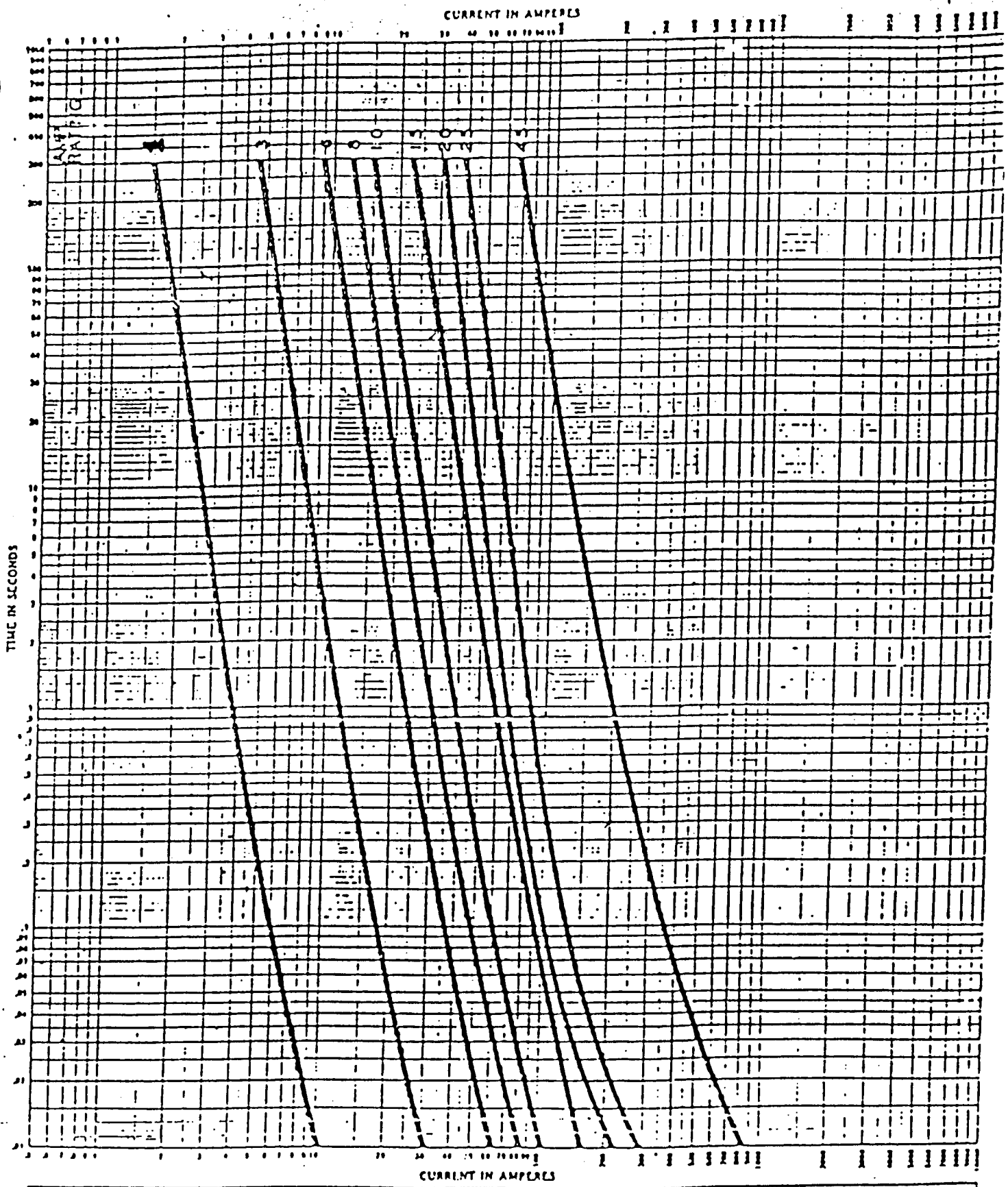
Part No.	Range (VDC)	Mount	Replaces Part No.
15000	4-40	2 screw	
15001	4-40	3 screw	5500
15002	4-40	Bracket	5601
15003	40-130	2 screw	
15004	40-130	3 screw	
15005	40-130	Bracket	
[illegible]	[illegible]	[illegible]	5511 & 5612
15007①	4-40	Aircraft	
15017②	4-40	Bracket	5601
15031③	4-40	Bracket	5601
15066④	4-40	Bracket	5601

① Reads Total Hours
② Reads Flight Hours
③ Long Studs
④ Black Bezel
⑤ Bezel Matches S-W Heavy-Duty Gauges

A-03

BEST AVAILABLE COPY

SHEET 16 APPENDIX 5



KLC, TOTAL CLEARING TIME-CURRENT CHARACTERISTIC CURVES BUSSMANN MFG. DIVISION
For KTN, KTS, KWN & KWS LIMITRON FAST-ACTING FUSES St Louis 7, Mo

BASIS FOR DATA Standards Dated

1. Tests made at Volts at p.f. Starting at 25C with no initial load
2. Curves are plotted to Test points on transformers should be

No. 50549

Attachment No. F-01015-A
Calc. No. WBN EEB MS TI07 0005

SHEET 17 APPENDIX 6

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Datcon 125VDC Elapsed Time Meters (ETM)

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO _____

DISCUSSION WITH Jim Eckenrod, Datcon Instrument Co.
(717) 569-5713 East Petersburg, PA

Mr. Eckenrod verified ETM voltage rating (125VDC) and supplied current rating (0.43 A). Model 771, Style UT, Part No. 56181-02.

COMMENTS:

BY Luis F. Montero — NAME
Assoc. Elect. Eng. — TITLE
ELECT. — DEPT. NO.

CC:

Attachment No. P-01015-A SHEET 18 APPENDIX 7
Calc. No. WBN EEB MS TI07 0005

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

NAME/FILE NO.

OM

IENT/PROJECT

BJECT Information on Hobbs 125 VDC Elapsed Time Meters (ETM)

ARGE: DEPT. NO. CLIENT SYMBOL OFS NO

SCUSSION WITH Meg Hicks, Sales Dept. Hobbs Division.
(217) 753-7793 Springfield, IL

Ms. Meg Hicks verified ETM voltage Rating (125 VDC) and supplied ampere rating (0.667 A). for ETM Part No. 15005.

MMENTS:

BY Jesus A Madero NAME Assoc. Elect. Eng. TITLE ELECTL DEPT. NO.

Attachment No. P-01015-A
Calc. No. WBN EEB MS TI07 0005

SHEET 19 APPENDIX 8

RECORD OF TELEPHONE CONVERSATION

DATE 9-8-88

TO _____ NAME/FILE NO.

FROM _____

CLIENT/PROJECT _____

SUBJECT Interrupting Current Rating of Bussmann KLC Limitron Fast-Acting 15A Fuse

CHARGE: DEPT. NO. _____ CLIENT SYMBOL _____ OFS NO. _____

DISCUSSION WITH Jeff Crittenden of Bussmann Mfg. Co.
(314) 394-2877 St. Louis, MO

Mr. Crittenden supplied the DC Interrupting Current Rating of an equivalent fuse to the Bussmann KLC Limitron Fast-Acting 15 Amp Fuse. He used the KTN fuse whose Interrupting Current Rating is 10 KA. The KLC fuse was designed for military specifications, and it appears that no DC tests were conducted.

COMMENTS:

For interrupting ratings of KLC fuses:
see TVA Elec Design Std DS-E8.1.1

GP 6/28/91
GTH 6/28/91

BY [signature] NAME

Asst. Elect Eng. TITLE

ELBCT DEPT. NO.

C:

Attachment No. M-12564-A

1.0 Purpose and Scope

1.1 Purpose

The purpose of this attachment is to evaluate the modifications to be implemented under Design Change Notice (DCN) M-12564-A. This DCN was issued to resolve problems identified in Revision 2 of Calculation WBN-EEB-MS-TI07-0005.

1.2 The following problems and their corresponding resolutions are addressed by this calculation.

- FRN and FRS fuses require replacement by fuses with 20,000 amp interrupting rating (Ref. Section 9.1).
- Load group fuses require replacement or elimination to provide selective coordination for an Appendix R event (Ref. Section 9.12).
- Lighting contactors have not been tested for short-circuit withstand capability and have no short-circuit withstand rating.
- Cable 2G920 is not protected for cable damage (Ref. Section 9.5).
- Non-standard fuses used in MVSG & LVSG control circuits.

2.0 Assumptions

See "Assumptions" identified in the Base Calculation (Section 2.0).

3.0 Sources of Design Input

3.1 TVA Drawings

1-45W703-1, Rev. 1, Wiring Diagrams 125-V Vital Battery Board I - Sheet 1

1-45W703-2, Rev. 1, Wiring Diagrams 125-V Vital Battery Board II - Sheet 2

Attachment No. M-12564-A

1-45W703-3, Rev. 1, Wiring Diagrams 125-V Vital Battery Board III - Sheet 3

1-45W703-4, Rev. 1, Wiring Diagrams 125-V Vital Battery Board IV - Sheet 4

3.2 Tennessee Valley Authority (TVA) Base Calculation WBN-EEB-MS-TI07-0005, 125-Vdc Vital Control Power System Fault Calculations

3.3 Master Fuse Report, Drawing Series 1-45B6236

3.4 Siemens interoffice memorandum, dated January 30, 1987 (Attachment A)

4.0 Design Input Data

	Data	Source
4.1	Interrupting Rating of FRN-R and FRS-R Fuses - 20 kA	Reference 3.2
4.2	Coordination Curves of 300 A HLB, 1000 A AK2-50-3, and 1600 A Chase Shawmut	Reference 3.3, Curve 7
4.3	Existing Fuse Data	Reference 3.1
4.4	Thru current withstand testing of lighting contactors - 8500-A dc for 50 msec	Reference 3.4

5.0 Justification of Assumptions

See "Justification of Assumptions" in Base Calculation (Section 5.0).

6.0 Computation and Analysis

6.1 Criteria

- Fuses installed in the dc system shall be capable of interrupting a fault without exceeding their interrupting ratings (Ref. Section 1.1.2).

- Fuses and breakers shall be selectively coordinated so that the device nearest an overload should be the first to operate.

- Lighting contactors shall be capable of withstanding the fault current available from the system on a thru-current basis (interrupting duty not required).

- Branch circuit cables shall be protected from thermal damage (Ref. Section F.2)

6.2 FRN/FRS Fuse Replacement

The FRN/FRS fuse problem identified in the base calculation (Reference (3.4) regarding their current interrupting capacity has been resolved by Bussman. Underwriters Laboratories (UL) has successfully tested the FRN and FRS fuse lines to interrupt 20 kA of fault current at the fuses' rated voltages, 125 and 300 Vdc, respectively. This testing is documented in the Reference 3.2 letter, a copy of which is attached in Attachment A.

6.3 Load Group Fuse Replacement/Elimination

Most load group fuse problems identified in the baseline calculation regarding selective coordination is being resolved by eliminating the safety-related load group fuses and replacing them with dummy fuses of equal or greater continuous rating (Appendix 3). Cable 1B22 identified in Appendix E, Table II of the base calculation is an exception that is addressed later in this analysis.

As can be seen in Curve 7 of the baseline calculation, the 1600-A battery fuse and 1000-A (800-A for the fifth vital battery) battery breaker will selectively coordinate with the dc switchboard breakers with ratings up to 300 A for all magnitudes of fault current with ratings.

The following table summarizes those fuses to be replaced with dummy fuses and the largest downstream breaker:

125-V Board	Fuse to be Replaced	Largest Downstream Breaker (A)	Reference Drawing
I	201	30	1-45W703-1
I	301	30	1-45W703-1
I	303	50	1-45W703-1

Attachment No. M-12564-A

I	305	20	1-45W703-1
I	307	15	1-45W703-1
II	201	30	1-45W703-2
II	301	30	1-45W703-2
II	303	50	1-45W703-2
II	305	20	1-45W703-2
II	307	15	1-45W703-2
III	201	30	1-45W703-3
III	301	30	1-45W703-3
III	303	50	1-45W703-3
III	305	20	1-45W703-3
III	307	15	1-45W703-3
IV	201	30	1-45W703-4
IV	301	30	1-45W703-4
IV	303	50	1-45W703-4
IV	305	20	1-45W703-4
IV	307	15	1-45W703-4

As can be seen from this table, the largest downstream breaker has a 50-A trip, therefore, selective coordination between the battery breakers and fuses and individual load breakers will be achieved. The load group fuses shown above can be eliminated without affecting protection.

It should be noted from Reference 3.4 that none of the fuses being removed are used for electrical penetration protection.

The circuit breaker (208) for Cable 1B22 is 100 A and does not selectively coordinate with the associated upstream sub-bus fuse. Circuit protection, cable protection, and selective coordination can be achieved by changing the circuit breaker from 100 A to 90 A and by changing the fuse from 150 A to 200 A. Time current characteristics are shown in Attachment B. 90A breaker is acceptable based on full load current from page 60 of WBNEEBMSTI110003R2. Appendix R loading is not affected per Appendix H of this calculation pages 91-95. GP 1/21/92

6.4 Lighting Contactor Replacement GP 1/21/92

The lighting contactors were identified in the baseline calculation as having a maximum of 5247 amps of fault current available. The existing contactors have not been tested for short-circuit withstand or interrupting. The replacement lighting contactors have been tested for

a thru-current rating of 8500-A dc for up to 50 msec. This current is greater than the available fault current and is therefore acceptable for this application.

6.5 Cable 2G920

Cable 2G920 was previously assessed as not being protected from thermal damage by its primary protective device, a 30-A Westinghouse HFB circuit breaker. This breaker has been changed to a 15-A breaker as shown on as-built drawing 1-45W703-4, Rev. 1. As can be seen in curve 1 of reference 3.3, the 2/c-#12, 75°C cable is protected by the 15-A breaker.

6.6 MVSG & LVSG Control Circuit Fuses

Non-standard fuse sizes and types were identified in walkdowns as being used in some MVSG & LVSG control circuits. To provide improved fuse control, fuses shall be standardized as follows:

MVSG close and trip circuits - FRNR15 (or FRN15)
MVSG elevator circuits - OT10
MVSG indicator lights - FRNR1 (or FRN1)
LVSG close and trip circuits - KWNR10 (KWN10)
LVSG indicator lights - KWNR1 (KWN1)

Acceptablity of these fuses was verified in R0 of the base calculation.

7.0 **Supporting Graphics**

See Attachment B.

8.0 **Summary of Results**

8.1 FRN/FRS Fuse Replacement

FRN and FRS fuses identified as requiring replacement in the baseline calculation due to their inability to interrupt the available short circuit do not require replacement.

8.2a Load Group Fuse Replacement/Elimination

The fuses identified in Section 6.3 can be replaced by "dummy fuses" without having a negative impact on selective coordination on the dc system.

8.3 ~~Lighting Contactors~~ 2b Load Group Fuse / Breaker Replacement - Unit Annunciator Inverter Fdr

GP 1/14/92 Use of a 200A load group fuse and 90A circuit breaker will provide adequate circuit protection, cable protection and selective coordination.

Attachment No. M-12564-A

8.3 Lighting Contactors 6/12/92

The Siemens 720-200 series of lighting contactors has been tested and shown to be capable of withstanding the available fault current on a thru-current basis. Replacement of lighting contactors with Siemens 720-200 Series lighting contactors is acceptable.

8.4 Cable 2G920

Cable 2G920 is protected from thermal damage by its existing primary protective device and requires no further action.

8.5 MVSG & LVSG Control Circuit Fuses

Use of the fuses specified in Section 6.6 will provide an acceptable size and type for a standardized configuration.

9.0 **Conclusions**

Based on the above analysis, the proposed changes in DCN M-12564-A are acceptable.

CALCULATION NO. WBN-EEB-MS-TI07-0005
ATTACHMENT NO. M-12564-A
ATTACHMENT A
PAGE 1 OF 8

Underwriters Laboratories Inc.

MCI Mail No. 254-3343
Cable ULINC NORTHBROOK
Telex No. 6502543343

NOTICE OF AUTHORIZATION TO APPLY THE UL MARK

September 25, 1990

PREPARED 12-17-91

CHECKED 12-17-91

Bussmann
Cooper Industries
Attn: Mr. Walter Curtis
P.O. BOX 14460
St. Louis, MISSOURI 63178

Our Reference: File E4273, Project 90NK20729

Subject: 125V 20K FRN-R 0-600, LPN-RK 0-600
300V 20K FRS-R 0-600, LPS-RK 0-10 AND 31-600
DC RATING

Dear Mr. Curtis,

We have completed our engineering investigation under the above project number and find the product complies with the applicable requirements. Records covering the product are now being prepared and will be sent to you in the near future.

This letter temporarily supplements the Follow-Up Service Inspection Procedure for a period of 90 days from the date of this notice and will serve as authorization to apply the UL Listing mark to products constructed:

> Identical to CAT. NOS. ABOVE submitted to UL for this investigation. The UL records covering this product will be in the Follow-Up Services Inspection Procedure, File E4273, Vol. 2,3.

Products produced which bear the UL Mark shall be identical to those which were evaluated by UL and found to comply with UL's requirements. If changes in construction are discovered, authorization to use the UL Mark may be withdrawn and products that bear the UL Mark may have to be revised (in the field or at the manufacturer's facility) to bring them into compliance with UL's requirements.

Regards,

T. Skibbs (3534)
Engineering Assistant
Electrical Department

Reviewed by:

Dale A. Hallerberg (3224)
Senior Project Engineer
Electrical Department

An independent,
not-for-profit organization
testing for public safety

CALCULATION NO. WBN-EEB-MS-TI07-0005

ATTACHMENT NO. M-12564-A

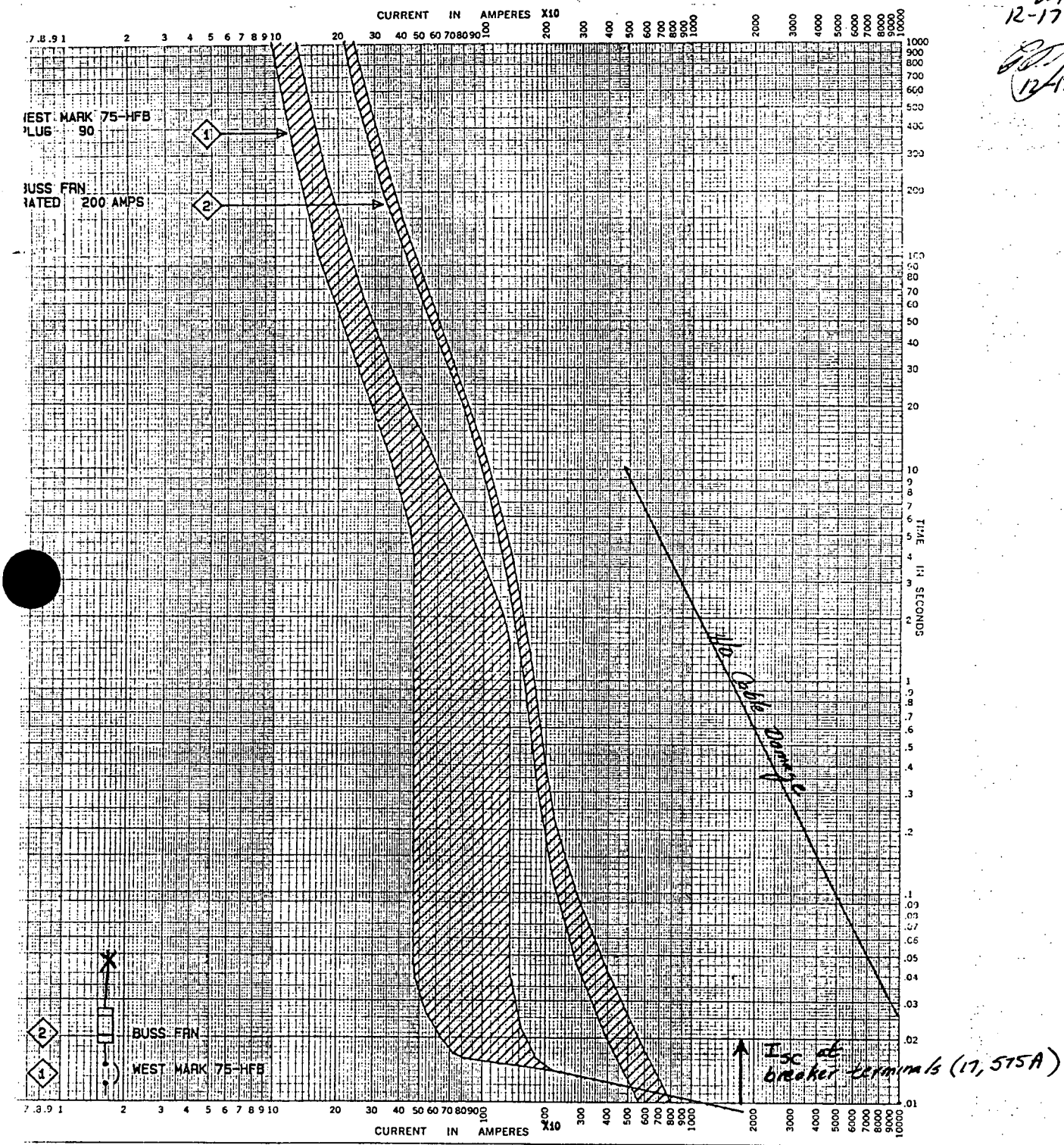
ATTACHMENT B

PAGE 8 OF 8

PREPARED

CHECKED 12-17-91

12-17-91



TIME-CURRENT CHARACTERISTIC CURVES

Fuse Links. In

GIS FOR DATA Standards Dated

s made at Volts a-c at p-f., starting at 25C with no initial load

s are plotted to 125 V. Test points so variations should be

No.

Date 12-16-91

TIME-CURRENT CHARACTERISTIC 48 5258

KEUFFEL & ESSER CO. MILWAUKEE

Calculation No. WBN EEB-MS-TI07-0005
Attachment No. M12187A/M14241A

Prepared by J.I.H. Date 02-10-92

Checked by WJH Date 2-12-92

Sheet 1

TABLE OF CONTENTS

Section	Description	Page No.	Number of Pages
--	Table of Contents	1	1
1.0	Purpose and Scope	2,3	2
2.0	Criteria	3	-
3.0	Applicable Codes & Standards	3	-
4.0	Assumptions	3	-
5.0	References	3	-
6.0	Design Input Data	3	-
7.0	Computation/Analysis	3, 4-10	7
8.0	Summary of Calculation Results	3	-
9.0	Conclusions	3	-

This Calculation Package contains 10 total pages.

THIS SHEET ADDED BY REV 4

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support modifications to be implemented under DCN M-12187-A and M-14241-A.

This attachment documents the length increase of cables 1B11D, 1B12F, 1B13F, 1B14D, 1B16D, 1B17F, 1B18F, 1B19D, 1B25E, 1B28E, 1B30E, 1B33E, 2B11F, 2B12D, 2B13D, 2B14F, 2B16F, 2B17D, 2B18D, 2B19F, 2B25G, 2B26E, 2B27E, 2B28G, 2B30G, 2B31E, 2B32E and 2B33G (DCN M-12187-A); and cables 1B26G, 1B27G, 1B31G & 1B32G (DCN M-14241-A).

This attachment is tailored to the specific baseline calculations shown below.

BASELINE CALCULATION	CALCULATION NO.
125V DC Voltage Analysis	WBN EEB-MS-TI11-0004
125V DC Vital Control Power System Fault Calculations	WBN EEB-MS-TI07-0005
Cable Ampacity-NV4 and NV5 Cables in Class 1E Raceways	WBPEVAR8909010

THIS SHEET ADDED BY REV 4

1.2 Scope

The scope of this attachment is to revise Appendix E "Coordination" and Appendix F "Cable Damage & Auto-Ignition" of the Baseline Calculation to determine the impact of changes in cable size and length of the conductors listed in Section 1.1 above.

2.0 CRITERIA

See Section 1.0 of Baseline Calculation as applicable.

3.0 APPLICABLE CODES AND STANDARDS

See Baseline Calculation

4.0 ASSUMPTIONS

None

5.0 REFERENCES

DCN M-12187-A & DCN M-14241-A

6.0 DESIGN INPUT DATA

The cables modified due to interactions of auxiliary and control power are (Ref. 5.0, DCN M-12187-A): 1B11D, 1B12F, 1B13F, 1B14D, 1B16D, 1B17F, 1B18F, 1B19D, 1B25E, 1B28E, 1B30E, 1B33E, 2B11F, 2B12D, 2B13D, 2B14F, 2B16F, 2B17D, 2B18D, 2B19F, 2B25G, 2B26E, 2B27E, 2B28G, 2B30G, 2B31E. 2B32E and 2B33G. Cables modified due to excessive side wall pressure are: 1B26G, 1B27G, 1B31G and 1B32G (Ref. 5.0, DCN M-14241-A).

7.0 COMPUTATION/ANALYSIS

Appendices E (Tables 7, 8, 9, 10 & 13) and F (Table 15) of the Baseline Calculation are revised in this section as shown in pages 4 through 11.

8.0 SUMMARY OF CALCULATION RESULTS

According to Section 7.0, the cable length and size changes evaluated do not change previous results and conclusions for the circuits analyzed in Appendices E and F of the Baseline Calculation.

9.0 CONCLUSION

Previous results and conclusions concerning the feeders to the 480V Shutdown Board Control Circuits are still valid. Cable size and length should be specified in DCNs M-12187-A and M-14241-A as shown in pages 4 & 5 of this attachment.

THIS SHEET ADDED BY REV 4

Sheet 4

PAGE ~~67~~ R4
PREPARED WJH DATE 1/29/90
CHECKED SCP DATE 1-31-90

Attachment M12187A / M14241A

APPENDIX E TABLE 7 CALC WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD I

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
1	109	1000	101	1600	B56D	WDN	3-300MCM	35	7		P
1	109	1000	101	1600	B57D	WDN	3-300MCM	10	7		P
1	109	1000	101	1600	B55D	WDN	3-300MCM	25	7		P
1	201	30	201	100	1B1D	WDD	2-1/C #8	70	2	97	F
1	202	30	201	100	1B11D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~175~~ 267	2	~~97~~ *	P
1	203	30	201	100	1B16D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~175~~ 267	2	~~97~~ *	P
1	204	30	201	100	1B4D	WDD	2-1/C #8	90	2	97	F
1	205	30	201	100	1B14D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~175~~ 267	2	~~97~~ *	P
1	206	30	201	100	1B19D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~175~~ 267	2	~~97~~ *	P
1	213	30	205	100	B23	WDD-1	2-1/C #8	154	2	97	P
1	214	30	205	100	B20	WDD-1	2-1/C #8	462	2	97	P
1	215	30	205	100	1B44	WDD-1	2-1/C #8	264	2	97	P
1	216	30	205	100	B45	WDD-1	2-1/C #8	900	2	97	P
1	220	15	207	60	1M2468	WGB-1	1-2C #12	504	1	59	P
1	221	15	207	60	1B47	WGB	1-2C #12	382	1	59	P
1	222	15	207	60	B1	WLN	1-2C #10	603	1	93	P
1	223	15	207	60	B501R	WDF-1	2-1/C #4	1414	1	373	P
1	225	300	209	400	B15D	WDN	2-300MCM	90	7		P
1	226	300	210	400	B10D	WDN	2-300MCM	40	7		P
1	301	30	301	100	2B2D	WDD	2-1/C #8	50	2	97	F
1	302	30	301	100	2B12D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~300~~ 414	2	~~97~~ *	P
1	303	30	301	100	2B17D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~300~~ 414	2	~~97~~ *	P
1	304	30	301	100	2B3D	WDD	2-1/C #8	90	2	97	F
1	305	30	301	100	2B13D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~300~~ 414	2	~~97~~ *	P
1	306	30	301	100	2B18D	~~WDD-1~~ ‡	2-1/C ~~#8~~ #6	~~300~~ 414	2	~~97~~ *	P
1	313	15	305	60	1B40A	WLB	1-2C #12	296	1	59	P
1	319	15	305	60	1B36A	WGB-2	1-2C #12	370	1	59	P
1	321	15	305	60	2SG220A	WLB	1-2C #12	557	1	59	P
1	325	125	311	200	B5A	WDG	2-1C #2	55	6		P
1	326	300	310	400	B30D	WDN	2-300MCM	45	7		P
1	327	300	309	400	B31D	WDN	2-300MCM	45	7		P

* 155 ft
‡ changed to WDE-2

R4 J.I.H. 02-12-92
WJH 2-13-92

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PREPARED CWH DATE 1/29/90
CHECKED GCP DATE 1-31-90

Attachment M12187A/M14241A
APPENDIX E TABLE 8 CALCULATION WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD II

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
2	109	1000	101	1600	B60E	WDN	3-300MCM	25	7		P
2	109	1000	101	1600	B61E	WDN	3-300MCM	25	7		P
2	109	1000	101	1600	B62E	WDN	3-300MCM	10	7		P
2	201	30	201	100	1B6E	WDD	2-1/C #8	115	2	97	F
2	202	30	201	100	1B25E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~185~~ 330	2	~~97~~ *	P
2	203	30	201	100	1B30E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~185~~ 330	2	~~97~~ *	P
2	204	30	201	100	1B9E	WDD	2-1/C #8	75	2	97	F
2	205	30	201	100	1B28E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~185~~ 320	2	~~97~~ *	P
2	206	30	201	100	1B33E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~185~~ 320	2	~~97~~ *	P
2	207	50	203	150	B90	WDE-1	2-1/C #6	993	3	155	P
2	214	30	205	100	B46	WDD-1	2-1/C #8	822	2	97	P
2	215	30	205	100	1B45	WDD-1	2-1/C #8	261	2	97	P
2	219	15	207	60	1G920	WGB-1	1-2C #12	465	1	59	P
2	221	15	207	60	B53	WLN	1-2C #10	551	1	93	P
2	223	15	207	60	B503P	WDF-1	2-1/C #4	1402	1	373	P
2	225	300	209	400	B16E	WDN	2-300MCM	55	7		P
2	226	300	210	400	B11E	WDN	2-300MCM	50	7		P
2	301	30	301	100	2B7E	WDD	2-1/C #8	140	2	97	P
2	302	30	301	100	2B26E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~275~~ 375	2	~~97~~ *	P
2	303	30	301	100	2B31E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~275~~ 375	2	~~97~~ *	P
2	304	30	301	100	2B8E	WDD	2-1/C #8	100	2	97	F
2	305	30	301	100	2B27E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~275~~ 375	2	~~97~~ *	P
2	306	30	301	100	2B32E	~~WDD~~ ‡	2-1/C ~~#8~~ #6	~~275~~ 375	2	~~97~~ *	P
2	313	15	305	60	1B41B	WLB	1-2C #12	509	1	59	P
2	319	15	305	60	1B37B	WFB-1	1-2C #10	492	1	93	P
2	321	15	305	60	2S6221B	WLB	1-2C #12	503	1	59	P
2	325	125	311	200	B6B	WDG	2-1/C #2	55	6		P
2	326	300	310	400	B34E	WDN	2-300MCM	50	7		P
2	327	300	309	400	B35E	WDN	2-300MCM	50	7		P

* 155 ft
‡ Changed to WDE-2

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R4 J.I.H. 02-12-92
W/H 2-13-92

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Attachment M12187A/M14241A Sheet 6

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CHECKED GCP DATE 1-31-90

125V DC VITAL POWER SYSTEM BOARD III

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL	
3	109	1000	101	1600	B65F	WDN	3-300MCM	35	7		P	
3	109	1000	101	1600	B66F	WDN	3-300MCM	35	7		P	
3	109	1000	101	1600	B67F	WDN	3-300MCM	10	7		P	
3	201	30	201	100	1B2F	WDE	2-1/C #6	130	2	155	P	
3	202	30	201	100	1B12F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~250~~ 378	2	~~97~~ *	P	R4
3	203	30	201	100	1B17F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~245~~ 378	2	~~97~~ *	P	
3	204	30	201	100	1B3F	WDD	2-1/C #8	95	2	97	F	
3	205	30	201	100	1B13F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~225~~ 378	2	~~97~~ *	P	
3	206	30	201	100	1B18F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~300~~ 378	2	~~97~~ *	P	R4
3	208	100	203	150	1B22	WDK	2-1/C #4/0	357	5		F	
3	213	30	205	100	B24	WDD-1	2-1/C #8	411	2	97	P	
3	214	30	205	100	B47	WDD-1	2-1/C #8	458	2	97	P	
3	215	30	205	100	2B44	WDD-1	2-1/C #8	568	2	97	P	
3	220	15	207	60	2M2468	WGB-1	1-2C #12	462	1	59	P	
3	221	15	207	60	2B47	WGB-1	1-2C #12	408	1	59	P	
3	223	15	207	60	B500	WDF-2	2-1/C #4	1072	1	373	P	
3	225	300	209	400	B17F	WDN	2-300MCM	55	7		P	
3	226	300	210	400	B12F	WDN	2-300MCM	50	7		P	
3	301	30	301	100	2B1F	WDE-1	2-1/C #6	55	2	155	F	
3	302	30	301	100	2B11F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~225~~ 246	2	~~97~~ *	P	
3	303	30	301	100	2B16F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~225~~ 246	2	~~97~~ *	P	R4
3	304	30	301	100	2B4F	WDD	2-1/C #8	75	2	97	F	
3	305	30	301	100	2B14F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~225~~ 246	2	~~97~~ *	P	
3	306	30	301	100	2B19F	~~WDD-1~~ ‡	2-1/C ~~#8~~ 6	~~225~~ 246	2	~~97~~ *	P	R4
3	313	15	305	60	2B40A	WLB	1-2C #12	128	1	59	P	
3	319	15	305	60	2B36A	WLB	1-2C #12	504	1	59	P	
3	321	15	305	60	1S6220A	WDF-2	2-1/C #4	517	1	373	P	
3	325	125	311	200	B7A	WDG-1	2-1/C #2	55	6		P	
3	326	300	310	400	B38F	WDN	2-300MCM	50	7		P	
3	327	300	309	400	B39F	WDN	2-300MCM	50	7		P	

* 155 ft
‡ changed to WDE-2 R4

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WJH 2-12-92

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Attachment M12187A / M14241A

APPENDIX E TABLE 10 CALC WBN-EEB-MS-TI07-0005

125V DC VITAL POWER SYSTEM BOARD IV

BOARD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH IN CABLE SCHEDULE	CURVE NO	REQUIRED LENGTH CO-ORD	PASS/FAIL
4	109	1000	101	1600	B70G	WDN	3-300MCM	40	7		P
4	109	1000	101	1600	B71G	WDN	3-300MCM	40	7		P
4	109	1000	101	1600	B72G	WDN	3-300MCM	10	7		P
4	201	30	201	100	1B7G	WDD	2-1/C #8	45	2	97	F
4	202	30	201	100	1B26G	~~WDD~~ ‡	2-1/C ~~#8~~ 6	~~300~~ 390	2	~~97~~ *	P
4	203	30	201	100	1B31G	~~WDD~~ ‡	2-1/C ~~#8~~ 6	~~300~~ 390	2	~~97~~ *	P
4	204	30	201	100	1B8G	WDD	2-1/C #8	100	2	97	F
4	205	30	201	100	1B27G	~~WDD~~ ‡	2-1/C ~~#8~~ 6	~~200~~ 390	2	~~97~~ *	P
4	206	30	201	100	1B32G	~~WDD~~ ‡	2-1/C ~~#8~~ 6	~~300~~ 390	2	~~97~~ *	P
4	208	60	203	150	2B22	WDF	2-1/C #4	375	4	260	P
4	214	30	205	100	B51	WFB	1-2C #10	880	2	97	P
4	215	30	205	100	2B45	WDD-1	2-1/C #8	603	2	97	P
4	219	30	205	100	2G920	WGB	1-2C #12	258	2	97	P
4	221	15	207	60	B54	WLN	1-2C #10	463	1	93	P
4	222	15	207	60	B2	WLN	1-2C #10	393	1	93	P
4	223	15	207	60	B502	WDF-2	2-1/C #4	1102	1	373	P
4	225	300	209	400	B18G	WDN	2-300MCM	85	7		P
4	226	300	210	400	B13G	WDN	2-300MCM	45	7		P
4	301	30	301	100	2B6G	WDD	1-2C #8	80	2	97	F
4	302	30	301	100	2B25G	~~WDD~~ ‡	1-2C ~~#8~~ 6	~~175~~ 220	2	~~97~~ *	P
4	303	30	301	100	2B30G	~~WDD~~ ‡	1-2C ~~#8~~ 6	~~175~~ 220	2	~~97~~ *	P
4	304	30	301	100	2B9G	WDD	1-2C #8	100	2	97	F
4	305	30	301	100	2B28G	~~WDD~~ ‡	1-2C ~~#8~~ 6	~~175~~ 220	2	~~97~~ *	P
4	306	30	301	100	2B33G	~~WDD~~ ‡	1-2C ~~#8~~ 6	~~175~~ 220	2	~~97~~ *	P
4	313	15	305	60	2B41B	WLB	1-2C #12	473	1	59	P
4	319	15	305	60	2B37B	WFB-1	1-2C #10	389	1	93	P
4	321	15	305	60	1SG221B	WGB-1	1-2C #12	576	1	59	P
4	325	125	311	200	B8B	WDG	2-1/C #2	60	6		P
4	326	300	310	400	B42G	WDN	2-300MCM	65	7		P
4	327	300	309	400	B43G	WDN	2-300MCM	65	7		P

* 155 ft
‡ WDE-2

R4 J.I.H. 02-12-92
WJH 2-12-92

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Attachment M12187A/M14241A Sheet 8

APPENDIX E TABLE 13 CALCULATION WBN-EEB-MS-TI07-0005

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PREPARED WJH DATE 1/29/90

CHECKED GCP DATE 1-31-90

LVSG FEEDERS

SWGR	FUNCTION	BAT BD	BKR NO.	CABLE NUMBER	CABLE SIZE	CONDUIT NUMBER	LENGTH	Additional Conduits
1A1-A	NOR BUS NOR FDR	I	202	1B11D	#8 6	1B1040D,1044D	99	1B1232D
	NOR BUS ALT FDR	III	202	1B12F	#8	1B1045F,1049F	181	1B1231F
	B/U BUS NOR FDR	III	205	1B13F	#8	1B1046F,1049F	181	1B1231F
	B/U BUS ALT FDR	I	205	1B14D	#8	1B1041D,1044D	99	1B1232D
1A2-A	NOR BUS NOR FDR	I	203	1B16D	#8 6	1B1042D,1044D	109	1B1232D
	NOR BUS ALT FDR	III	203	1B17F	#8	1B1047F,1049F	176	1B1231F
	B/U BUS NOR FDR	III	206	1B18F	#8	1B1048F,1049F	176	1B1231F
	B/U BUS ALT FDR	I	206	1B19D	#8	1B1043D,1044D	109	1B1232D
1B1-B	NOR BUS NOR FDR	II	202	1B25E	#8 6	1B1055E,1059E	101	1B1237E,1238E
	NOR BUS ALT FDR	IV	202	1B26G	#8	1B1050G,1054G	192	~~1228G,1229G~~ 1B1228G,1229G
	B/U BUS NOR FDR	IV	205	1B27G	#8	1B1051G,1054G	192	1B1228G,1229G
	B/U BUS ALT FDR	II	205	1B28E	#8	1B1056E,1059E	101	1B1237E,1238E
1B2-B	NOR BUS NOR FDR	II	203	1B30E	#8 6	1B1057E,1059E	96	1B1237E,1238E
	NOR BUS ALT FDR	IV	203	1B31G	#8	1B1052G,1054G	192	1B1228G,1229G
	B/U BUS NOR FDR	IV	206	1B32G	#8	1B1053G,1054G	192	1B1228G,1229G
	B/U BUS ALT FDR	II	206	1B33E	#8	1B1058E,1059E	96	1B1237E,1238E
2A1-A	NOR BUS NOR FDR	III	302	2B11F	#8 6	2B1045F,1049F	101	2B1236F
	NOR BUS ALT FDR	I	302	2B12D	#8	2B1040D,1044D	192	2B1235D,1234D
	B/U BUS NOR FDR	I	305	2B13D	#8	2B1041D,1044D	192	2B1235D,1234D
	B/U BUS ALT FDR	III	305	2B14F	#8	2B1046F,1049F	101	2B1236F
2A2-A	NOR BUS NOR FDR	III	303	2B16F	#8 6	2B1047F,1049F	101	2B1236F
	NOR BUS ALT FDR	I	303	2B17D	#8	2B1042D,1044D	192	2B1235D,1234D
	B/U BUS NOR FDR	I	306	2B18D	#8	2B1043D,1044D	192	2B1235D,1234D
	B/U BUS ALT FDR	III	306	2B19F	#8	2B1048F,1049F	101	2B1236F
2B1-B	NOR BUS NOR FDR	IV	302	2B25G	#8 6	2B1050G,1054G	93	
	NOR BUS ALT FDR	II	302	2B26E	#8	2B1055E,1059E	192	2B1233E
	B/U BUS NOR FDR	II	305	2B27E	#8	2B1056E,1059E	192	2B1233E
	B/U BUS ALT FDR	IV	305	2B28G	#8	2B1051G,1054G	96	
2B2-B	NOR BUS NOR FDR	IV	303	2B30G	#8 6	2B1052G,1054G	88	
	NOR BUS ALT FDR	II	303	2B31E	#8	2B1057E,1059E	203	2B1233E
	B/U BUS NOR FDR	II	306	2B32E	#8	2B1058E,1059E	203	2B1233E
	B/U BUS ALT FDR	IV	306	2B33G	#8	2B1053G,1054G	91	

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Attachment M12187A / M14241A

APPENDIX F TABLE 15 CALCULATION WBN-EEB-MS-TI07-0005

125V CONTROL POWER SYSTEM BOARDS

BD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH (CABLE SCH)	CABLE LEN COORD	RESIST OHMS/1000	CABLE RESISTANCE	CURVE NO	RACE-WAY	AUTO-IGN
1	223	15	207	60	B501R	WDF-1	2-1/C #4	1414	373	0.259	0.732452	1	T	P
1	220	15	207	60	1M2468	WGB-1	1-2C #12	504	59	1.65	1.663200	1	T	~~P~~
1	222	15	207	60	B1	WLN	1-2C #10	603	93	1.04	1.254240	1	T	P
1	319	15	305	60	1B36A	WGB-2	1-2C #12	370	59	1.65	1.221000	1	T	~~P~~
1	321	15	305	60	2SG220A	WLB	1-2C #12	557	59	1.65	1.838100	1	T	~~P~~
1	313	15	305	60	1B40A	WLB	1-2C #12	296	59	1.65	0.976800	1	T	~~P~~
1	221	15	207	60	1B47	WGB	1-2C #12	382	59	1.65	1.260600	1	T	~~P~~
2	223	15	207	60	B503P	WDF-1	2-1/C #4	1402	373	0.259	0.726236	1	T	P
2	313	15	305	60	1B41B	WLB	1-2C #12	509	59	1.65	1.679700	1	T	~~P~~
2	321	15	305	60	2SG221B	WLB	1-2C #12	503	59	1.65	1.659900	1	T	~~P~~
2	219	15	207	60	16920	WGB-1	1-2C #12	465	59	1.65	1.534500	1	T	~~P~~
2	221	15	207	60	B53	WLN	1-2C #10	551	93	1.04	1.146080	1	T	P
2	319	15	305	60	1B37B	WFB-1	1-2C #10	492	93	1.04	1.023360	1	T	P
3	313	15	305	60	2B40A	WLB	1-2C #12	128	59	1.65	0.422400	1	T	~~P~~
3	319	15	305	60	2B36A	WLB	1-2C #12	504	59	1.65	1.663200	1	T	~~P~~
3	220	15	207	60	2M2468	WGB-1	1-2C #12	462	59	1.65	1.524600	1	T	~~P~~
3	221	15	207	60	2B47	WGB-1	1-2C #12	408	59	1.65	1.346400	1	T	~~P~~
3	223	15	207	60	B500	WDF-2	2-1/C #4	1072	373	0.259	0.555296	1	T	P
3	321	15	305	60	1SG220A	WDF-2	2-1/C #4	517	373	0.259	0.267806	1	T	P
4	319	15	305	60	2B37B	WFB-1	1-2C #10	389	93	1.04	0.809120	1	T	P
4	313	15	305	60	2B41B	WLB	1-2C #12	473	59	1.65	1.560900	1	T	~~P~~
4	223	15	207	60	B502	WDF-2	2-1/C #4	1102	373	0.259	0.570836	1	T	P
4	221	15	207	60	B54	WLN	1-2C #10	463	93	1.04	0.963040	1	T	P
4	222	15	207	60	B2	WLN	1-2C #10	393	93	1.04	0.817440	1	T	P
4	321	15	305	60	1SG221B	WGB-1	1-2C #12	576	59	1.65	1.900800	1	T	~~P~~
1	201	30	201	100	1B1D	WDD	2-1/C #8	70	97	0.654	0.091560	2	C	P
1	204	30	201	100	1B4D	WDD	2-1/C #8	90	97	0.654	0.117720	2	C	P
1	306	30	301	100	2B18D	~~WDD-1~~ ‡	2-1/C #8/6	~~300~~ 414	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3395	2	C	P
1	205	30	201	100	1B14D	~~WDD-1~~ ‡	2-1/C #8/6	~~175~~ 267	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .2189	2	C	P
1	304	30	301	100	2B3D	WDD	2-1/C #8	90	97	0.654	0.117720	2	C	P
1	216	30	205	100	B45	WDD-1	2-1/C #8	900	97	0.654	1.177200	2	T	P
1	302	30	301	100	2B12D	~~WDD-1~~ ‡	2-1/C #8/6	~~300~~ 414	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3395	2	C	P
1	215	30	205	100	1B44	WDD-1	2-1/C #8	264	97	0.654	0.345312	2	T	P
1	202	30	201	100	1B11D	~~WDD-1~~ ‡	2-1/C #8/6	~~175~~ 267	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .2189	2	C	P
1	206	30	201	100	1B19D	~~WDD-1~~ ‡	2-1/C #8/6	~~175~~ 267	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .2189	2	C	P
1	305	30	301	100	2B13D	~~WDD-1~~ ‡	2-1/C #8/6	~~300~~ 414	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3395	2	C	P
1	214	30	205	100	B20	WDD-1	2-1/C #8	462	97	0.654	0.604296	2	T	P
1	301	30	301	100	2B2D	WDD	2-1/C #8	50	97	0.654	0.065400	2	C	P
1	303	30	301	100	2B17D	~~WDD-1~~ ‡	2-1/C #8/6	~~300~~ 414	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3395	2	C	P
1	203	30	201	100	1B16D	~~WDD-1~~ ‡	2-1/C #8/6	~~175~~ 267	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .2189	2	C	P
1	213	30	205	100	B23	WDD-1	2-1/C #8	154	97	0.654	0.201432	2	T	P
2	302	30	301	100	2B26E	~~WDD~~ ‡	2-1/C #8/6	~~275~~ 375	~~97~~ *	.41 ~~0.654~~	~~0.359700~~ .3075	2	C	P
2	205	30	201	100	1B28E	~~WDD~~ ‡	2-1/C #8/6	~~185~~ 320	~~97~~ *	.41 ~~0.654~~	~~0.241980~~ .2624	2	C	P

R2 GP 6/25/9 WJH 6/28/91

R4 J.L.H. 02-12-92 WJH 2-12-92

* 155 ft
‡ WDE-2

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Sheet 10

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PREPARED WJH DATE 1/29/90
CHECKED SCP DATE 1-31-90

Attachment M12187A/ M14241A

APPENDIX F TABLE 15 CALCULATION WBN-EEB-MS-TI07-0005

125V CONTROL POWER SYSTEM BOARDS

BD	BKR NO	BKR SIZE	FUSE NO	FUSE SIZE	CABLE NO	TYPE	SIZE	LENGTH (CABLE SCH)	CABLE LEN COORD	RESIST OHMS/1000	CABLE RESISTANCE	CURVE NO	RACE-WAY	AUTO-IGN	
2	203	30	201	100	1B30E	~~WDD~~ ‡	2-1/C #8 L	~~185~~ 330	~~97~~ *	.41 ~~0.654~~	~~0.241980~~ .2706	2	C	P	
2	303	30	301	100	2B31E	~~WDD~~ ‡	2-1/C #8 L	~~275~~ 375	~~97~~ *	.41 ~~0.654~~	~~0.359700~~ .3075	2	C	P	R4
2	215	30	205	100	1B45	WDD-1	2-1/C #8	261	97	0.654	0.341388	2	T	P	
2	304	30	301	100	2B8E	WDD	2-1/C #8	100	97	0.654	0.130800	2	C	P	
2	201	30	201	100	1B6E	WDD	2-1/C #8	115	97	0.654	0.150420	2	C	P	
2	305	30	301	100	2B27E	~~WDD~~ ‡	2-1/C #8 L	~~275~~ 375	~~97~~ *	.41 ~~0.654~~	~~0.359700~~ .3075	2	C	P	
2	301	30	301	100	2B7E	WDD	2-1/C #8	140	97	0.654	0.183120	2	C	P	R4
2	306	30	301	100	2B32E	~~WDD~~ ‡	2-1/C #8 L	~~275~~ 375	~~97~~ *	.41 ~~0.654~~	~~0.359700~~ .3075	2	C	P	
2	206	30	201	100	1B33E	~~WDD~~ ‡	2-1/C #8 L	~~185~~ 320	~~97~~ *	.41 ~~0.654~~	~~0.241980~~ .2624	2	C	P	
2	214	30	205	100	B46	WDD-1	2-1/C #8	822	97	0.654	1.075176	2	T	P	
2	202	30	201	100	1B25E	~~WDD~~ ‡	2-1/C #8 L	~~185~~ 330	~~97~~ *	.41 ~~0.654~~	~~0.241980~~ .2706	2	C	P	
2	204	30	201	100	1B9E	WDD	2-1/C #8	75	97	0.654	0.098100	2	C	P	
3	204	30	201	100	1B3F	WDD	2-1/C #8	95	97	0.654	0.124260	2	C	P	
3	201	30	201	100	1B2F	WDE	2-1/C #6	130	154	0.41	0.106600	2	C	P	
3	202	30	201	100	1B12F	~~WDD-1~~ ‡	2-1/C #8 L	~~250~~ 378	~~97~~ *	.41 ~~0.654~~	~~0.327000~~ .31	2	C	P	R4
3	306	30	301	100	2B19F	~~WDD-1~~ ‡	2-1/C #8 L	~~225~~ 246	~~97~~ *	.41 ~~0.654~~	~~0.294300~~ .2017	2	C	P	
3	203	30	201	100	1B17F	~~WDD-1~~ ‡	2-1/C #8 L	~~245~~ 378	~~97~~ *	.41 ~~0.654~~	~~0.320460~~ .31	2	C	P	
3	304	30	301	100	2B4F	WDD	2-1/C #8	75	97	0.654	0.098100	2	C	P	
3	215	30	205	100	2B44	WDD-1	2-1/C #8	568	97	0.654	0.742944	2	T	P	
3	302	30	301	100	2B11F	~~WDD-1~~ ‡	2-1/C #8 L	~~225~~ 246	~~97~~ *	.41 ~~0.654~~	~~0.294300~~ .2017	2	C	P	R4
3	205	30	201	100	1B13F	~~WDD-1~~ ‡	2-1/C #8 L	~~225~~ 378	~~97~~ *	.41 ~~0.654~~	~~0.294300~~ .31	2	C	P	
3	213	30	205	100	B24	WDD-1	2-1/C #8	411	97	0.654	0.537588	2	T	P	
3	206	30	201	100	1B18F	~~WDD-1~~ ‡	2-1/C #8 L	~~300~~ 378	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .31	2	C	P	
3	303	30	301	100	2B16F	~~WDD-1~~ ‡	2-1/C #8 L	~~225~~ 246	~~97~~ *	.41 ~~0.654~~	~~0.294300~~ .2017	2	C	P	
3	305	30	301	100	2B14F	~~WDD-1~~ ‡	2-1/C #8 L	~~225~~ 246	~~97~~ *	.41 ~~0.654~~	~~0.294300~~ .2017	2	C	P	
3	301	30	301	100	2B1F	WDE-1	2-1/C #6	55	154	0.41	0.045100	2	C	P	
3	214	30	205	100	B47	WDD-1	2-1/C #8	458	97	0.654	0.599064	2	T	P	
4	301	30	301	100	2B6G	WDD	1-2C #8	80	97	0.654	0.104640	2	C	P	
4	206	30	201	100	1B32G	~~WDD~~ ‡	2-1/C #8 L	~~300~~ 390	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3198	2	C	P	R4
4	205	30	201	100	1B27G	~~WDD~~ ‡	2-1/C #8 L	~~200~~ 390	~~97~~ *	.41 ~~0.654~~	~~0.261600~~ .3198	2	C	P	
4	201	30	201	100	1B7G	WDD	2-1/C #8	45	97	0.654	0.058860	2	C	P	
4	215	30	205	100	2B45	WDD-1	2-1/C #8	603	97	0.654	0.788724	2	T	P	
4	302	30	301	100	2B25G	~~WDD~~ ‡	1-2C #8 L	~~175~~ 220	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .1804	2	C	P	
4	304	30	301	100	2B9G	WDD	1-2C #8	100	97	0.654	0.130800	2	C	P	
4	203	30	201	100	1B31G	~~WDD~~ ‡	2-1/C #8 L	~~300~~ 390	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3198	2	C	P	
4	214	30	205	100	B51	WFB	1-2C #10	880	61	1.04	1.830400	2	T	XP	R2
4	204	30	201	100	1B8G	WDD	2-1/C #8	100	97	0.654	0.130800	2	C	P	89/6/25
4	219	30	205	100	2G920	WGB	1-2C #12	258	39	1.65	0.851400	2	T	XP	WJH 6/28/89
4	305	30	301	100	2B28G	~~WDD~~ ‡	1-2C #8 L	~~175~~ 220	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .1804	2	C	P	
4	303	30	301	100	2B30G	~~WDD~~ ‡	1-2C #8 L	~~175~~ 220	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .1804	2	C	P	
4	202	30	201	100	1B26G	~~WDD~~ ‡	2-1/C #8 L	~~300~~ 390	~~97~~ *	.41 ~~0.654~~	~~0.392400~~ .3198	2	C	P	
4	306	30	301	100	2B33G	~~WDD~~ ‡	1-2C #8 L	~~175~~ 220	~~97~~ *	.41 ~~0.654~~	~~0.228900~~ .1804	2	C	P	R4
2	207	50	203	150	B90	WDE-1	2-1/C #6	993	236	0.41	0.814260	4	C	P	

* 155 ft
‡ WDE-2

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R4 J.I.H. 02-12-92
WJH 2-12-92

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This Attachment contains 25 pages.

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1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate and support DCN S-12854-A.

The DCN change description: Revision 1 to calculation WBPEVAR8907013 "Master Fuse List for Class 1E Fuses Process Description" is being issued to resolve the punch list items against the Master Fuse List. This DCN shall revise the MFL for any changes resulting from resolving punch list items.

This attachment is applicable to the five protection baseline calculations listed below for Unit 1 and Unit 2 required for Unit 1 operation only and is included in its entirety in each of these calculations. The attachment only partially applies to any one of these baseline calculations. It has not been customized for each of the baseline calculations because it deals with the selection of replacement electical fuses for all of the low-voltage (0-600 Volt) fuses that are currently in use in Class 1E circuits listed in the MFL and are known to be obsolete. It is identified as Attachment No. S12854 in the calculations.

BASELINE CALCULATION	CALCULATION NO.
125 VDC Vital Control Power System Fault Calculations	WBN-EEB-MS-TI07-0005
Watts Bar NP Containment Penetration Protection Study, Voltage Level V4 and V5	WBN-EEB-MS-TI08-0015
LV Electrical Penetration Protection Analysis	WBN-EEB-MS-TI08-0028
120 VAC Short Circuit Coordination Study and Protection	WBN-EEB-MS-TI07-0018
480 V 1E Coordination/Protection	WBN-EEB-MS-TI08-0008*

* This Baseline Calculation is referrenced for completeness only. Rev 15 of this calculation evaluated acceptance of CP6 and CP6A cable protectors. No Attachment to this calculatioin for DCN S-12854-A required.

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1.2 Scope

The scope of this attachment is to identify fuses which are acceptable substitutions for the low voltage (600 V and below) Class 1E fuses currently in use at WBNP Unit 1 and Unit 2 required for Unit 1 operation only which are known to be obsolete.

2.0 CRITERIA

Logic dictates that when a required component is no longer available due to obsolescence a replacement component must be evaluated for acceptability. This is particularly true for Class 1E fuses due to the nature of (1) the critical application and (2) the inherent functional design properties of an electrical fuse (when it reacts to a fault current and opens the circuit it is not resettable and must be replaced).

The replacement fuse must meet the following criteria:

1. Have an operating voltage rating which equals or exceeds the circuit voltage.

2. Have a continuous current rating the same as the original fuse.

3. Have a fault current interrupting capacity rating equal to or exceeding the obsolete fuse.

4. Must have performance requirements as taken credit for in the baseline calculations (or as specified by vendors). For example, it must provide cable protection or coordination with other protective devices, etc, depending on the application.

5. Is physically interchangeable with the original fuse.

3.0 APPLICABLE CODES AND STANDARDS

3.1 TVA Electrical Design Standard DS-E8.1.1 R7, "Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or less)".

3.2 TVA Electrical Design Standard DS-E8.1.2 R4, "Substitution Standard for Midget and Small Dimension Fuses".

4.0 METHODOLOGY

A review will be made of the low voltage (0-600 Volts) fuses currently in use in Class 1E applications at WBNP. A currently manufactured fuse type will be evaluated and established as a replacement for the fuses which have been identified as being obsolete.

THIS SHEET ADDED BY REV 4

5.0 ASSUMPTIONS

For General Assumptions see applicable Baseline Calculation. This attachment does not have any unverified assumptions.

6.0 REFERENCES

6.1 WBNP Safety Related Fuse Report dated 5/14/91

6.2 Letter from Gould Shawmut dated 10/28/91 RIMS #T80 920121 940

6.3 Design criteria WB-DC-30-27 R0

6.4 Baseline Calculation WBN-EEB-MS-TI08-0015 R7 dated 7/22/91

6.5 Baseline Calculation WBN-EEB-MS-TI08-0028 R13 dated 12/18/91

6.6 Baseline Calculation WBN-EEB-MS-TI07-0005 R3 dated 1/23/92

6.7 Baseline calculation WBN-EEB-MS-TI07-0018 R10 dated 10/9/91

6.8 Letter from Gould Shawmut dated 11-27-91, RIMS #T80920121939

6.9 Fax data from Gould Shawmut dated 1-21-92, RIMS #T80920121942

6.10 Conax (Penetration) Design Qualification Report IPS-752 Rev. A RIMS #EEB820115315.

6.11 Gould Shawmut Advisor, 1991

6.12 Baseline Calculation WBN-EEB-MS-TI08-0008 R17 dated 9/18/91

7.0 COMPUTATION/ANALYSIS

7.1 In accordance with the Standard referred to in 3.1, "Change out of electrically and dimensionally identical fuses (identical basic part number) with fuses having a - R suffix (Class R rejection type) is not considered a fuse substitution." Therefore, the following change due to obsolesence is considered a direct replacement and not a substitution:

MFG	OBSOLETE TYPE	REPLACEMENT TYPE
Gould/Shawmut	TR	TR-R
Gould/Shawmut	TRS	TRS-R
Bussmann	FRN	FRN-R
Bussmann	FRS	FRS-R
Bussmann	KWN	KWN-R

The Gould/Shawmut AT-DE type fuse is obsolete. The installed fuse may be an AT-DE(AMP)R which is a rejection type or AT-DE(AMP) which is not a rejection type. The replacement fuse indicated in this attachment for the AT-DE type fuse is the same whether the presently installed fuse is an AT-DE(AMP) or an AT-DE(AMP)R.

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7.2 In accordance with the letter from Gould Shawmut (Reference 6.2), the A6Y(Amp)-2 part number has been replaced with the ATM (Amp) designation. The ATM (Amp) is a form, fit and function replacement for the A6Y(Amp)-2 and is not considered a fuse substitution.

7.3 The following obsolete fuses are to be replaced by the indicated available fuse:

OBSOLETE FUSE TYPE	MFG	REPLACEMENT FUSE TYPE	MFG	JUSTIFICATION COMMENT
CP6A-39*	Gould/Shawmut	A4J250	Gould/Shawmut	1
CP6A-81*	Gould/Shawmut	A4J225	Gould/Shawmut	2
CP6A-85	Gould/Shawmut	CPH 4/0 C5	Gould/Shawmut	3
CP6A-87*	Gould/Shawmut	CPH 350 C5	Gould/Shawmut	4
CP6A-14*	Gould/Shawmut	CPH 4/0 C5	Gould/Shawmut	5
CP6A-150	Gould/Shawmut	A4J300	Gould/Shawmut	6
CP6A-197*	Gould/Shawmut	A4J225	Gould/Shawmut	7
AT-DE30R	Gould/Shawmut	TR-30R	Gould/Shawmut	8
AT-DE7R	Gould/Shawmut	TR-7R	Gould/Shawmut	9
EON20	Reliance	A2K-( )R	Gould/Shawmut	10
ECN400	Reliance	FRN-R 400	Bussmann	11
MDR2	Bussmann	FNM2	Bussmann	12
MB05	Bussmann	ABC2	Bussmann	13
AT-DE20	Gould/Shawmut	TR-20R	Gould/Shawmut	14

* Existing curves in the Baseline Calculation do not agree with the CP6A type cable protector curves.

JUSTIFICATION COMMENT

1. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The A4J250 is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-39 cable limiter. See Appendix 1 for a comparative time versus current coordination analysis of the two devices (plot from Ref. 6.4). It is an acceptable substitute for the CP6A-39.

2. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The A4J225 is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-81 cable limiter. See Appendix 2 for a comparative time versus current coordination analysis of the two devices (plot from Ref. 6.4). It is an acceptable substitute for the CP6A-81.

3. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The CPH 4/0 C5 cable-limiter is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-85 cable-limiter. See Appendices 3 and 4 for a comparative time versus current coordination analysis of the two devices (plots from Ref. 6.4). In either case, the time current characteristic for the CPH 4/0 C5 is acceptable and it is an acceptable substitute for the CP6A-85.

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4. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The CPH 350 C5 cable-limiter is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-87 cable-limiter. See Appendix 5 for a comparative time versus current coordination analysis of the two devices (plot from Ref. 6.4). The time-current characteristics are essentially identical. It is an acceptable substitute for the CP6A-87.

5. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The CPH 4/0 C5 cable-limiter is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-14 cable-limiter. See Appendices 6 and 7 for a comparative time versus current coordination analysis of the two devices (plots from Ref. 6.4). The time-current characteristics are essentially identical. It is an acceptable substitute for the CP6A-14.

6. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The A4J 300 fuse is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-150 cable-limiter. See Appendix 8 for a comparative time versus current coordination analysis of the two devices (plots from Ref. 6.4). The plot for the A4J300 is closely similar and it is an acceptable substitute for the CP6A-150.

7. This comment applies to Baseline Calculations WBN-EEB-MS-TI08-0015 and WBN-EEB-MS-TI08-0008. The A4J 225 fuse is recommended by the manufacturer (Ref. 6.8) to replace the CP6A-197 cable-limiter. See Appendix 9 for a comparative time versus current coordination analysis of the two devices (plot from Ref. 6.4). It is an acceptable substitute for the CP6A-197.

8. This comment applies to Baseline Calculation WBN-EEB-MS-TI08-0028. Fuse Type TR-30R is recommended by the Standard referred to in Section 3.1 to replace fuse type AT-DE30R. See Appendices 10 and 11 for a comparative time versus current coordination analysis of the two devices (plots from Ref. 6.5). It is an acceptable substitute for the AT-DE30R.

9. This comment applies to Baseline Calculation WBN-EEB-MS-TI08-0028. Fuse Type TR-7R is recommended by the Standard referred to in Section 3.1 to replace fuse type AT-DE7R. See Appendix 12 for a comparative time versus current coordination analysis of the two devices (plot from Ref. 6.5). It is an acceptable substitute for the AT-DE7R.

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10. This comment applies to Baseline Calculation WBN-EEB-MS-TI08-0028. Figure 2.AE in Ref. 6.5 shows a plot for an EON30 and states that an EON20 was actually used in the circuit. The plot for the EON30 matches the manufacturers data dated August 1968 but is suspected to be in error, since it is considerably different from the manufacturers replacement fuse which is type KON 30. The application is for protection of a No. 12 AWG and No. 10 AWG penetration. Appendix 13 shows the permissible 10 second short time overload point and thermal capability curves for both the No. 12 AWG and No. 10 AWG penetration (per Ref. 6.10) with an acceptable fuse to protect each case. It is recommended that the Gould Shawmut A2K-15R be used to replace the EON 20 on the No. 12 AWG penetration circuits and an A2K-20R be used to replace the EON 20 on the No. 10 AWG penetration circuits.

11. This comment applies to Baseline Calculation WBN-EEB-MS-TI07-0005. Although this fuse was not evaluated in R0 of the Baseline Calculation, Reliance fuse type ECN-400 is currently in use on the 125V DC Vital Battery Board IV. The fuse in use on the other 125V DC boards for the same application is the Bussmann FRN400. Curve No. 7 in Ref. 6.6 shows only the coordination plot for the FRN400 fuse with the other circuit components. The ECN-400 fuses should be replaced with Bussmann type FRN-R400.

12. This comment applies to Baseline Calculation WBN-EEB-MS-TI08-0028. Fuse type FNM 2 is recommended by the Standard referred to in Section 3.2 to replace fuse type MDR 2. See Appendices 14 and 15 for a comparative time versus current coordination analysis of the two devices (plots from Ref. 6.5). It is an acceptable substitute for the MDR 2.

13. This comment applies to Baseline Calculation WBN-EEB-MS-TI07-0018. The type MB05 fuse has been evaluated in Attachment M09836A of Ref. 6.7 and found to be required to be replaced by Bussmann type ABC2.

14. This comment applies to Baseline Calculation WBN-EEB-MS-TI08-0028. Fuse type TR-20R was evaluated in Attachment M10480A of Ref. 6.5 and found to be an acceptable replacement for fuse type AT-DE20 in that case. It is also evaluated in Appendix 16A and 16B and found to also be an acceptable substitute for the AT-DE20 in these applications.

THIS SHEET ADDED BY REV 4

8.0 SUMMARY OF CALCULATION RESULTS

Replacement fuses have been identified for all of the 0-600 Volt Class 1E fuses in use at WBNP known to be obsolete.

9.0 CONCLUSION

The replacement fuses identified in this attachment are acceptable.

10.0 APPENDICES

Appendix 1 CP6A-39 vs A4J250 Plot
Appendix 2 CP6A-81 vs A4J225 Plot
Appendix 3 CP6A-85 vs CPH 4/0 C5 Plot 1
Appendix 4 CP6A-85 vs CPH 4/0 C5 Plot 2
Appendix 5 CP6A-87 vs CPH 350 C5 Plot
Appendix 6 CP6A-14 vs CPH 4/0 C5 Plot 1
Appendix 7 CP6A-14 vs CPH 4/0 C5 Plot 2
Appendix 8 CP6A-150 vs A4J 300 Plot 1
Appendix 9 CP6A-197 vs A4J 225 Plot
Appendix 10 AT-DE30R vs TR-30R Plot 1
Appendix 11 AT-DE30R vs TR-30R Plot 2
Appendix 12 AT-DE7R vs TR-7R Plot
Appendix 13 A2K-15R and A2K-20R Plot
Appendix 14 MDR2 vs FNM 2 Plot 1
Appendix 15 MDR2 vs FNM 2 Plot 2
Appendix 16A AT-DE20R vs TR-20R Plot 1
Appendix 16B AT-DE20 vs TR-20R Plot 2

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PENETRATION CONTINUOUS

CALCULATION NO WBN-EEB-MS-TI07-0005 Prepared By [illegible] Date 2/11/92

ATTACHMENT S12854A Checked By [illegible] Date 2/12/9

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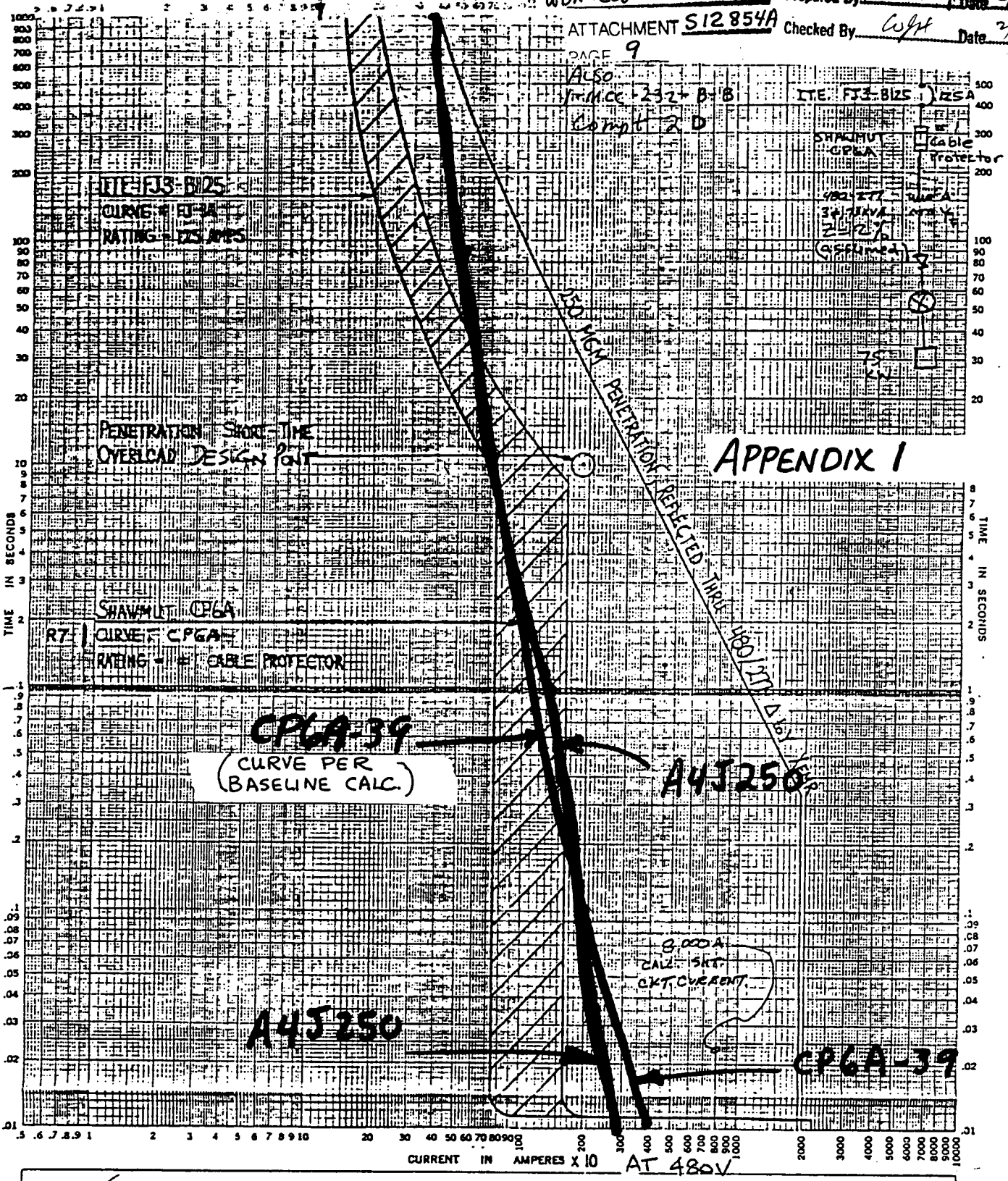

TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links, In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load

2. Curves are plotted to _____ Test points so variations should be _____

No. _____ Date _____

THIS SHEET ADDED BY REV 4

K-E TIME-CURRENT CHARACTERISTIC 48 5258 KEUFFEL & ESSER CO. MADE IN U.S.A.

WATTS BAR NUCLEAR PLANT
CONTAINMENT PENETRATION PROTECTION
STUDY. ~~CALC # EEB-MS-TI08-0015 REV. 1~~ DATE 2/6/92
APPENDIX D

SHEET —
PREPARED [illegible] DATE 11-12-89
CHECKED [illegible] DATE 12-2-89

SHEET 28 OF 47
RS 2/15/90

PAGE —
PREPARED [illegible] DATE 2-16-90
CHECKED [illegible] DATE 2-16-90

COMPUTED [illegible] DATE 8-12-86
CHECKED _____ DATE _____

(5)

~~WBN-EEB-MS-TI08-0015 R2~~ DWR 7/6/92

480 SHDN BD 1A1-A COMPT 7C
1A2-A 7D
1B1-A 7D
1B2-B 7D

Appendix D

CALCULATION NO WBN-EEB-MS-TI07-0005 Prepared By DWSlaby Date 2/11/92
ATTACHMENT S12854A Checked By CJH Date 2/12/92
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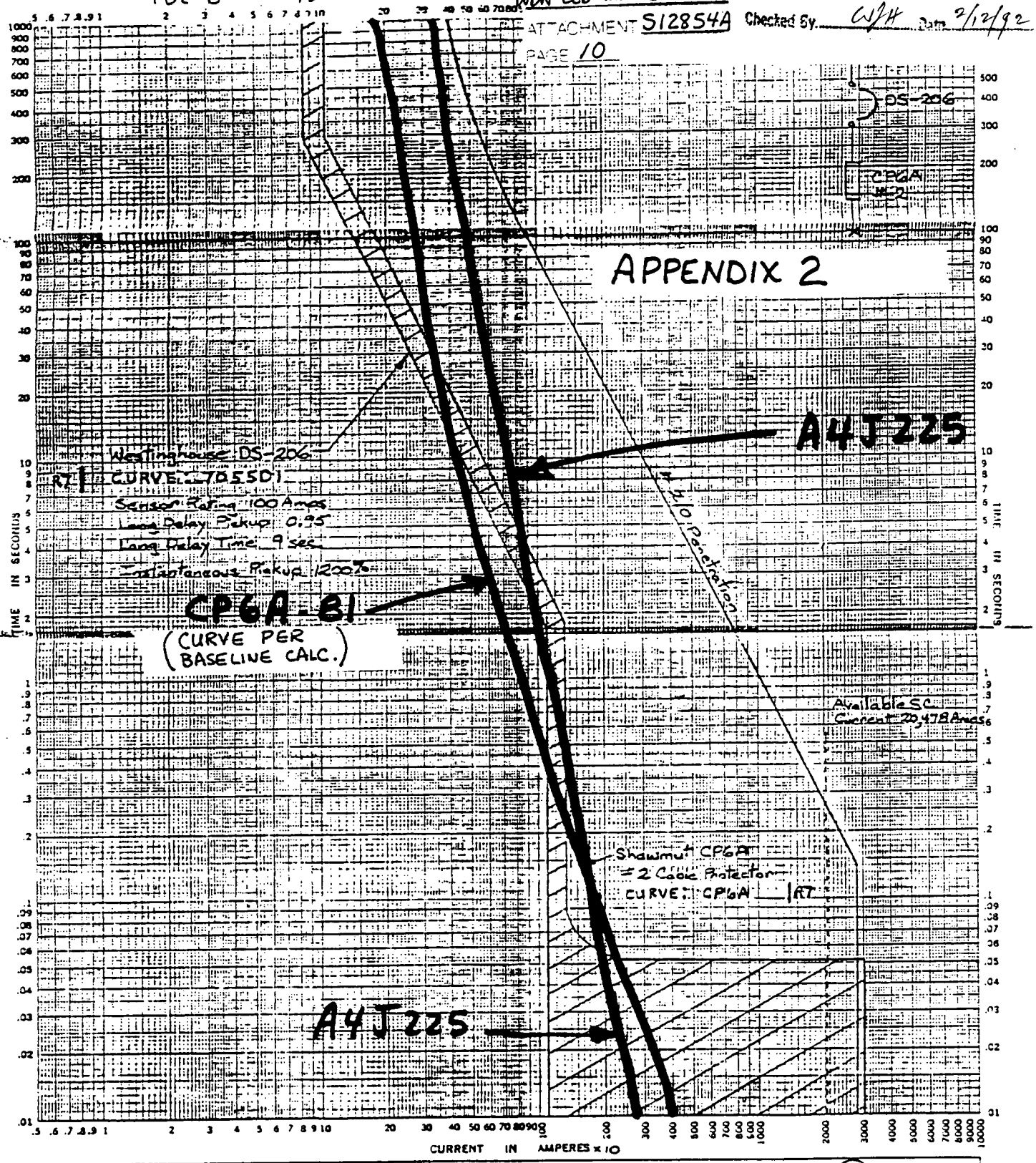

For Reactor Lower Compt Clg Fan Penetrations — TIME-CURRENT CHARACTERISTIC CURVES (2)
Fuse Links. In
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at p-f., starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be
No.
Date

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K+E TIME-CURRENT CHARACTERISTIC 48 5258

APPENDIX D
SHEET 3

THIS SHEET ADDED BY REV 4

~~WBN-EEB-MS-TI08-0015 R2~~ Dwk 3/6/92

480V SHDN BD 1A1-A compt 10C

Appendix D

CURRENT IN AMPERES X 10

CALCULATION NO WBN-EEB-MS-TI07-0005 Prepared By Dwk Date 2/11/92

ATTACHMENT S12854A Checked By WJH Date 2/12/9

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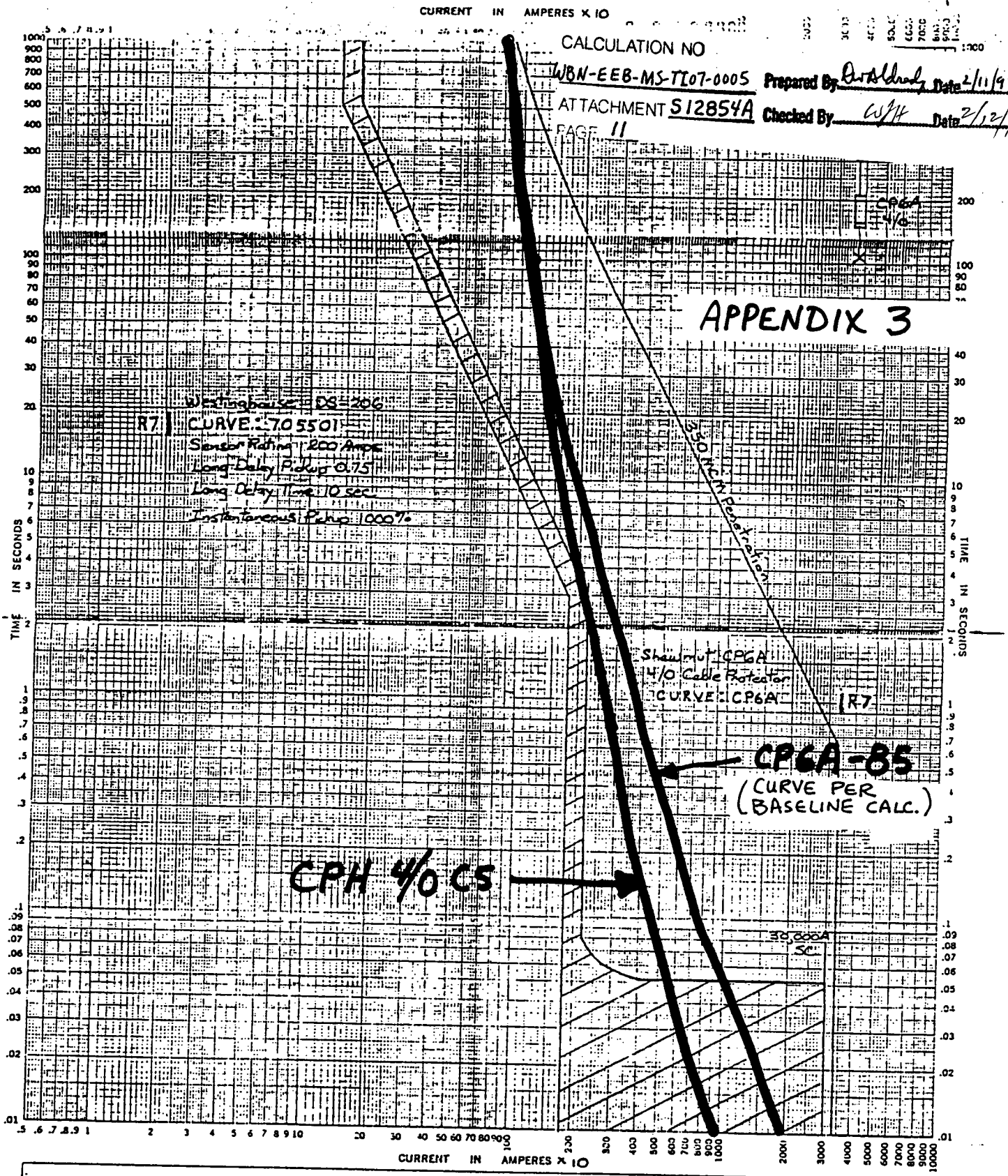


For Cntmt Air Return Fan Penetrations TIME-CURRENT CHARACTERISTIC CURVES (3)

BASIS FOR DATA Standards Dated

1. Tests made at Volts a-c at p.f., starting at 25C with no initial load

2. Curves are plotted to Test points so variations should be

No.

Date

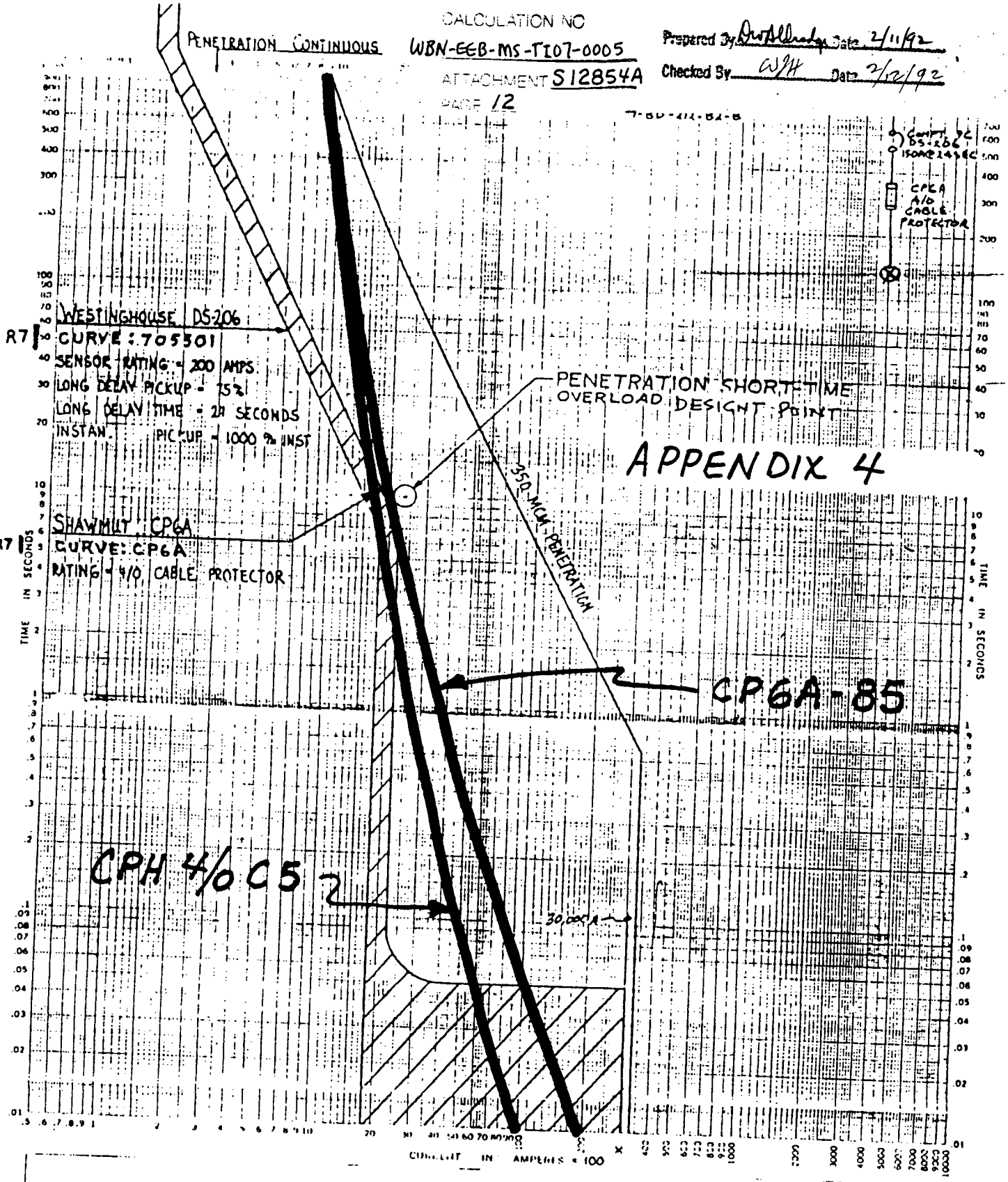
K+E TIME-CURRENT CHARACTERISTIC 48 5258 KEUFFEL & ESSER CO. MADE IN U.S.A.

This sheet was redrawn for R2

APPENDIX D SHEET 4. THIS SHEET ADDED BY REV 4

CALCULATION NO WBN-EEB-MS-TI07-0005
ATTACHMENT S12854A
PAGE 12

Prepared By: [illegible] Date 2/11/92
Checked By: WJH Date 2/12/92



For
BASIS FOR DATA Standards
1. Tests made at
2. Curves are plotted to

Volts a c at

TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links
Dated
p f, starting at 25C with no initial load
Test points on curves should be

THIS SHEET ADDED BY REV 4
No. 4
Date

K+E TIME-CURRENT CHARACTERISTIC KEUFFEL & ESSER CO. 46 5258

WATTS BAR NUCLEAR PLANT
CONTAINMENT PENETRATION PROTECTION
STUDY. CALC. # ~~EEB-MS-TI08-0015 REV. 1~~ Date 4/6/92
APPENDIX D

SHEET 5 OF ~~67~~ 85
AS 2/15/90

SHEET —
PREPARED [illegible] DATE 11-16-89
CHECKED [illegible] DATE 12-2-89

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PREPARED [illegible] DATE 2-16-90
CHECKED [illegible] DATE 2-16-90

AS 11/6/89

3

Comp E 3B

PENETRATION CONTINUOUS

CURRENT IN AMPERES × 100

480V SHUTDOWN BD. 182-B, HSBT

1-BD-212-B2-R

CALCULATION NO WBN-EEB-MS-TI07-0005

ATTACHMENT S12854A

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Prepared By DWAldredge Date 2/11/92

Checked By WJH Date 2/12/92

WESTINGHOUSE DS-416

R7 CURVE = 705501

SENSOR RATING = 300 AMPS

LONG DELAY PICKUP = 600%

LONG DELAY TIME = 20 SECONDS

INSTAN. = [illegible]

PENETRATION SHORT-TIME OVERLOAD DESIGN POINT

APPENDIX 5

SHAWMUT CP6A

R7 CURVE = CP6A

RATING = 350 MCM CABLE PROTECTOR

350 MCM PENETRATION

TIME IN SECONDS

CP6A-87 (CURVE PER BASELINE CALC.)

CPH-350 C5

CALC. SHORT CKT. CURRENT

CURRENT IN AMPERES × 100

TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____

2. Curves are plotted to _____ Test points so variations should be _____

No. 8

Date _____

K+E TIME-CURRENT CHARACTERISTIC 48 5258

WATTS BAR NUCLEAR PLANT

CONTAINMENT PENETRATION PROTECTION

STUDY. CALC. # ~~EEB-MS-TI08-0015 REV 1~~ APPENDIX D

WJH 2/6/92

SHEET 7 OF 47

COMPUTED LAH DATE 7-23-86

CHECKED JDG DATE 7-28-86

SHEET —

PREPARED [illegible] DATE 11-10-89

CHECKED [illegible] DATE 12-6-89

PAGE —

PREPARED [illegible] DATE 2-11-92

CHECKED [illegible] DATE 2-11-92

RS 4/5/90

RS 11/10/89

THIS SHEET ADDED BY REV 4

1-MCC-232-A-A 13D

CALCULATION NO WBN-EEB-MS-TI07-0005

ATTACHMENT S12854A

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Prepared By [illegible] Date 2/11/92

Checked By [illegible] Date 2/12/92

TTE FJ3-B875

CURVE # FJ-1A

RATING = 175 AMPS

SHAWMUT CP6A

R7 CURVE # CP6A

RATING - 4/0 CABLE PROTECTOR

PENETRATION SHORT-TIME OVERLOAD DESIGN POINT

(TYPICAL FOR 1-MCC-232-B-B, COMPT 13D)

APPENDIX 6

350 MCM PENETRATION

CP6A - 14 (CURVE PER BASELINE CALC.)

CPH 4/0 C5

#1

#2

22,000 A

TIME IN SECONDS

CURRENT IN AMPERES × 10

Fuse Links In

1. Tests made at

2. Curves are plotted

Test points so

34

THIS SHEET ADDED BY REV 4

TIME-CURRENT CHARACTERISTIC

ALLIS-CHALMERS CO.

WATTS BAR NUCLEAR PLANT

CONTAINMENT PENETRATION PROTECTION

STUDY. CALC. # ~~EEB-MS-TI08-0015 REV 1~~ APPENDIX B

SHEET 31 OF 47

SHEET —

PREPARED [illegible] DATE 11-10-89

CHECKED [illegible] DATE 12-2-89

COMPUTED DH DATE 7-23-86

CHECKED [illegible] DATE 7-23-86

PAGE —

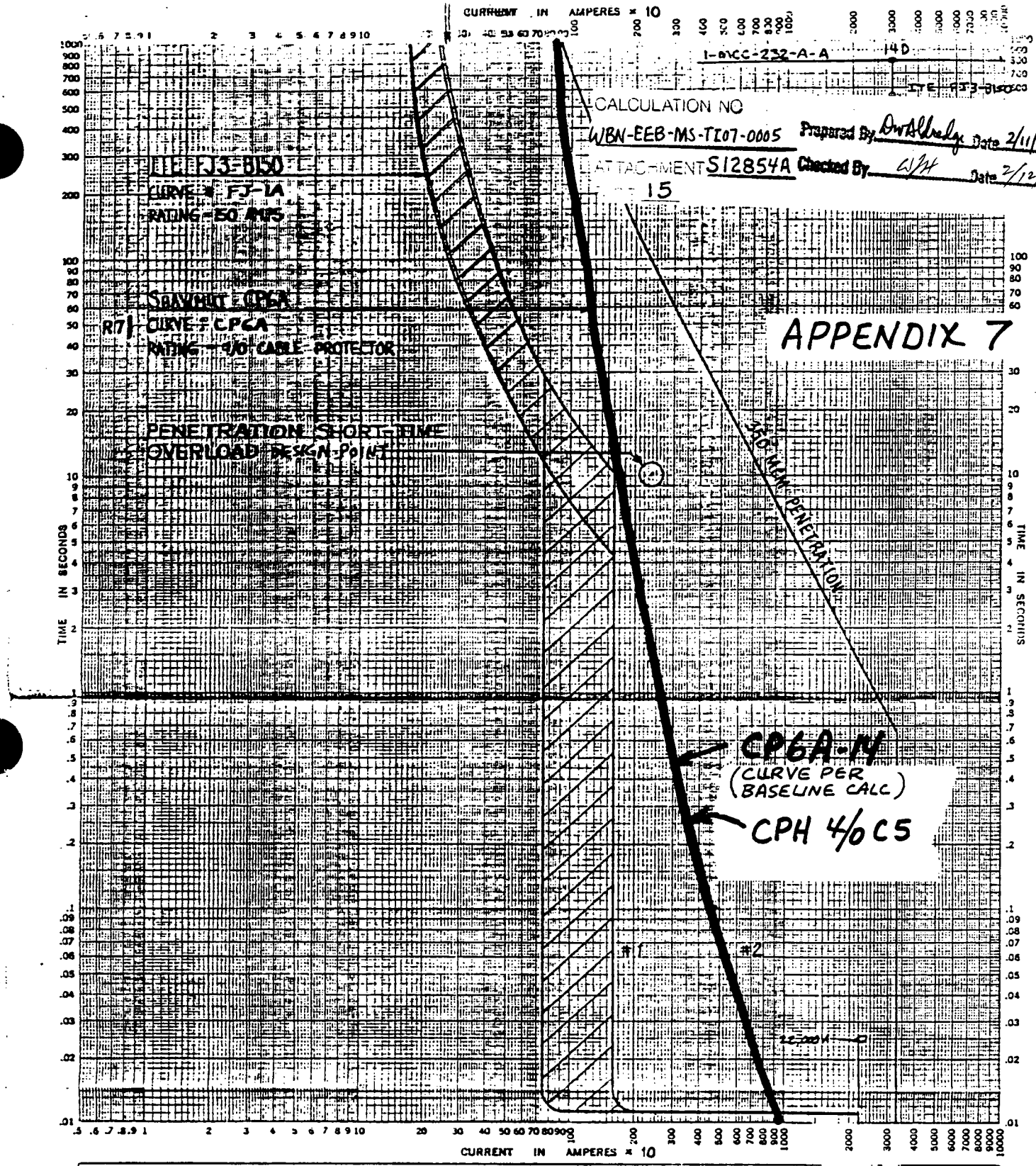
PREPARED [illegible] DATE 2-16-90

CHECKED [illegible] DATE 2-16-90

2/15/90

11/10/89

1



TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links. In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____

2. Curves are plotted to _____ Test points so variations should be _____

No. 33

Date _____

K-E TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

WATTS BAR NUCLEAR PLANT
CONTAINMENT PENETRATION PROTECTION
STUDY. CALC-# ~~EEB-MS-TI08-0015 REV.1~~ 2/6/92
APPENDIX D

SHEET —
PREPARED R. Singh DATE 11-16-89
CHECKED [illegible] DATE 12-3-89

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COMPUTED DW DATE 7-23-86
CHECKED TOJ DATE 2-29-86

KS 2/15/90

PAGE —
PREPARED R. Singh DATE 2-16-90
CHECKED [illegible] DATE 2-16-90

(2)

KS 11/10/89

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J BD 1A1-A Comp 1B, 1D
1A2-A 8A, 7A
1B1-B
1B2-B 10C, 7B

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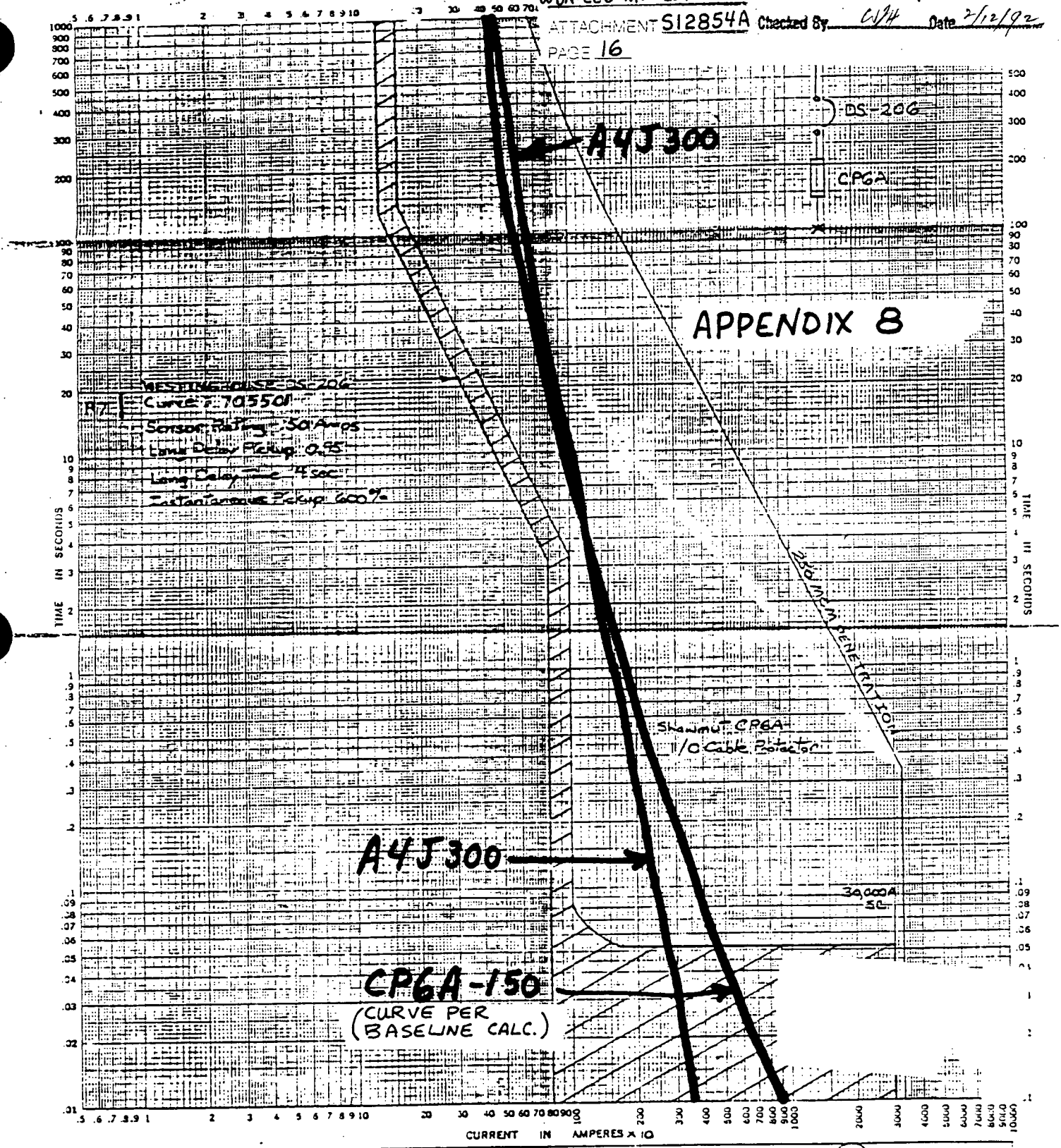

For CRDM Cooler Fan Protections — TIME-CURRENT CHARACTERISTIC CURVES (1)
Fuse Units In
BASIS FOR DATA Standards Dated
1. Tests made at Volts a-c at p-f. starting at 25C with no initial load
2. Curves are plotted to Test points so variations should be
No.
Date

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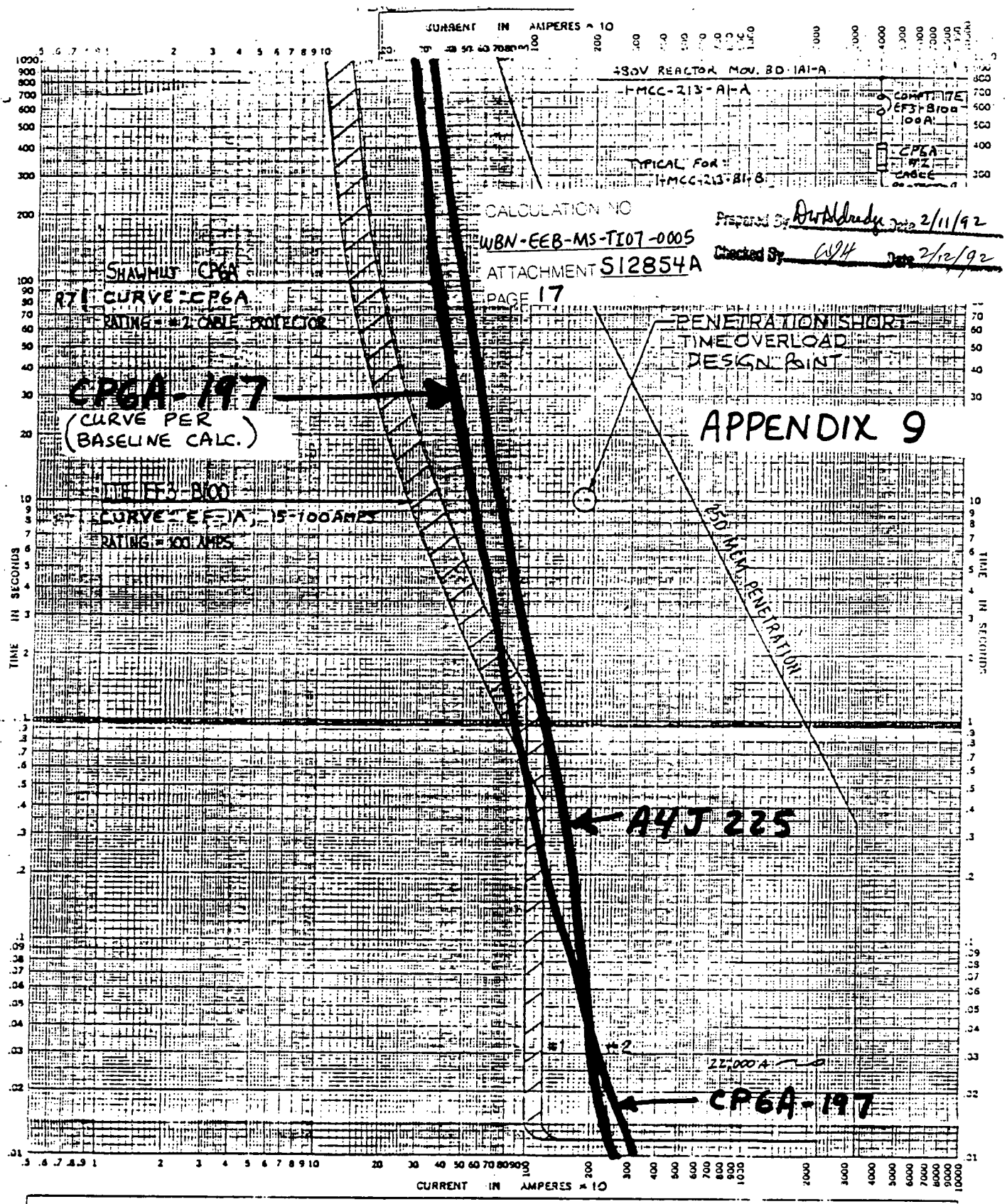
K+E TIME-CURRENT CHARACTERISTIC 46 3258

THIS SHEET ADDED BY REV 4

APPENDIX D R7
SHEET 2



TIME-CURRENT CHARACTERISTIC CURVES

For _____ Fuse Links. In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at _____ Volts a-c at _____ p.f., starting at 25C with no initial load _____

2. Curves are plotted to _____ Test points so variations should be _____

No. 9

Date _____

K-E TIME-CURRENT CHARACTERISTIC KEUFFEL & ESSER CO. 48 5258

WATTS BAR NUCLEAR PLANT
CONTAINMENT PENETRATION PROTECTION
STUDY. CALC. # ~~EEB-MS-TI03-0015 REV. 1~~ DATA 4/6/92
APPENDIX P

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CHECKED DATE 12-2-89

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COMPUTED DATE 7-23-86
CHECKED DATE 7-28-86
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PREPARED DATE 2-12-90
CHECKED DATE 2-12-90

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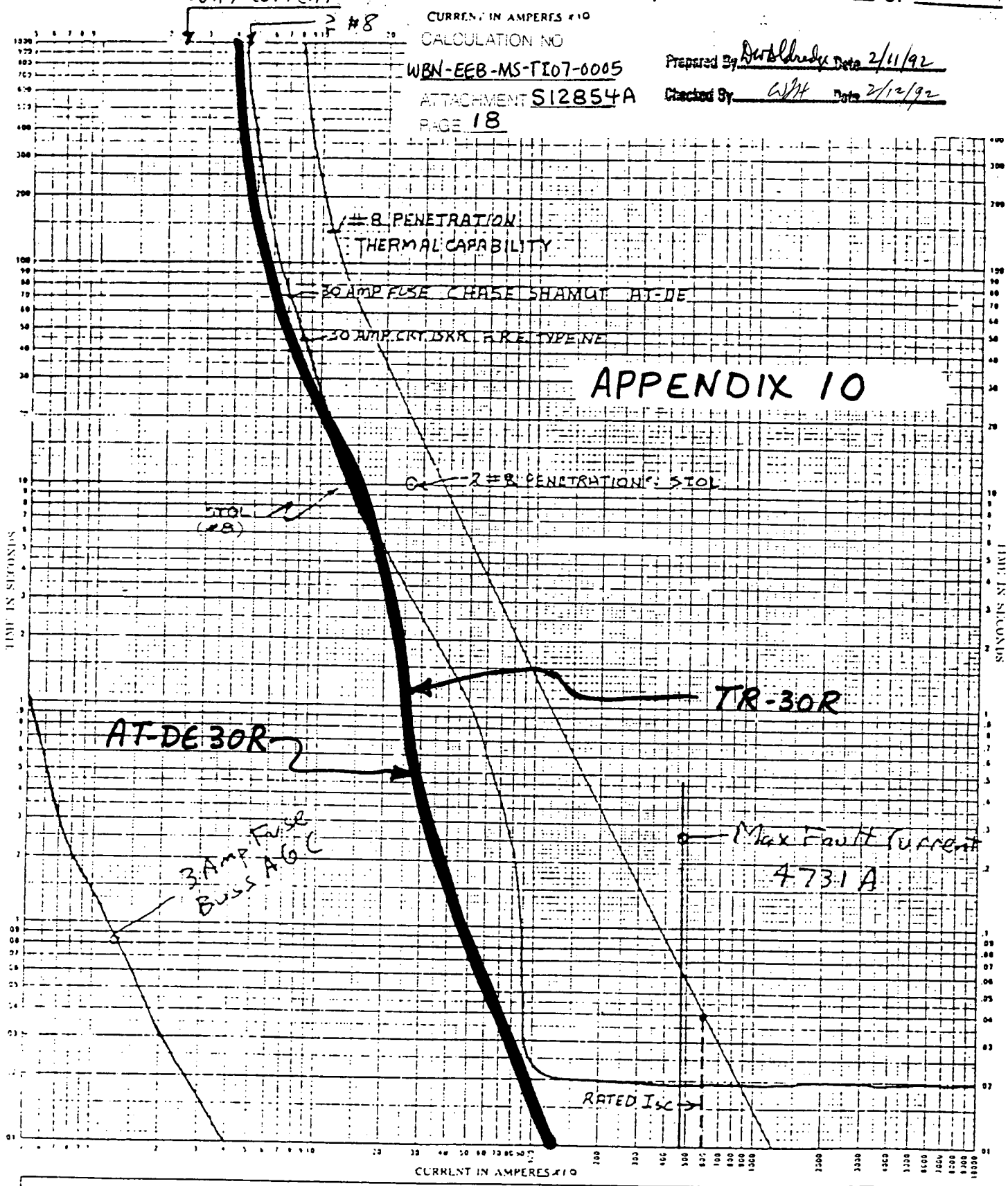

PENETRATION PROTECTION TIME-CURRENT CHARACTERISTIC CURVES

R5 Prepared James M. Gilreath Date 1-25-90
Verified [illegible] Date 1-30-90

FIGURE 2.G
PREPARED BY M. L. Pyatt DATE 7-1-82
CHECKED BY J. A. Roop DATE 4-5-83

K-Z TIME CURRENT CHARACTERISTIC 48 5238

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~~WBN-EEB-MS-TI08-0028~~ DWA 2/6/92

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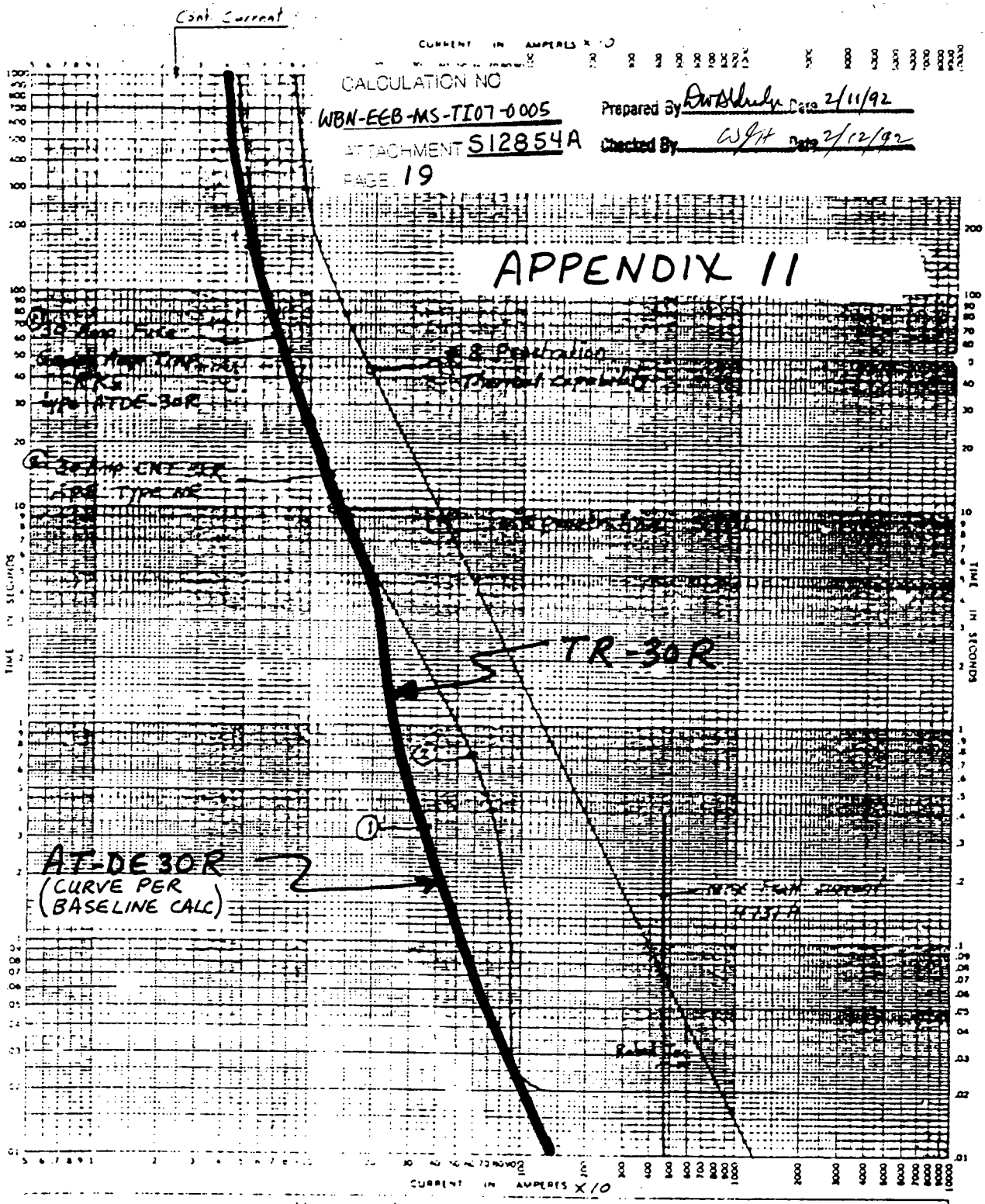

Penetration Protection TIME-CURRENT CHARACTERISTIC CURVES

Figure 2.AF

K-2

R5 Prepared Janet M. Schick Date 1-25-90

THIS SHEET ADDED BY REV 4 Verified 4 Date 1-30-90

CALCULATION NO
WBN-EEB-MS-TI07-0005 Prepared By DwAldredge Date 2/11/92
ATTACHMENT S12854A Checked By WJH Date 2/12/92
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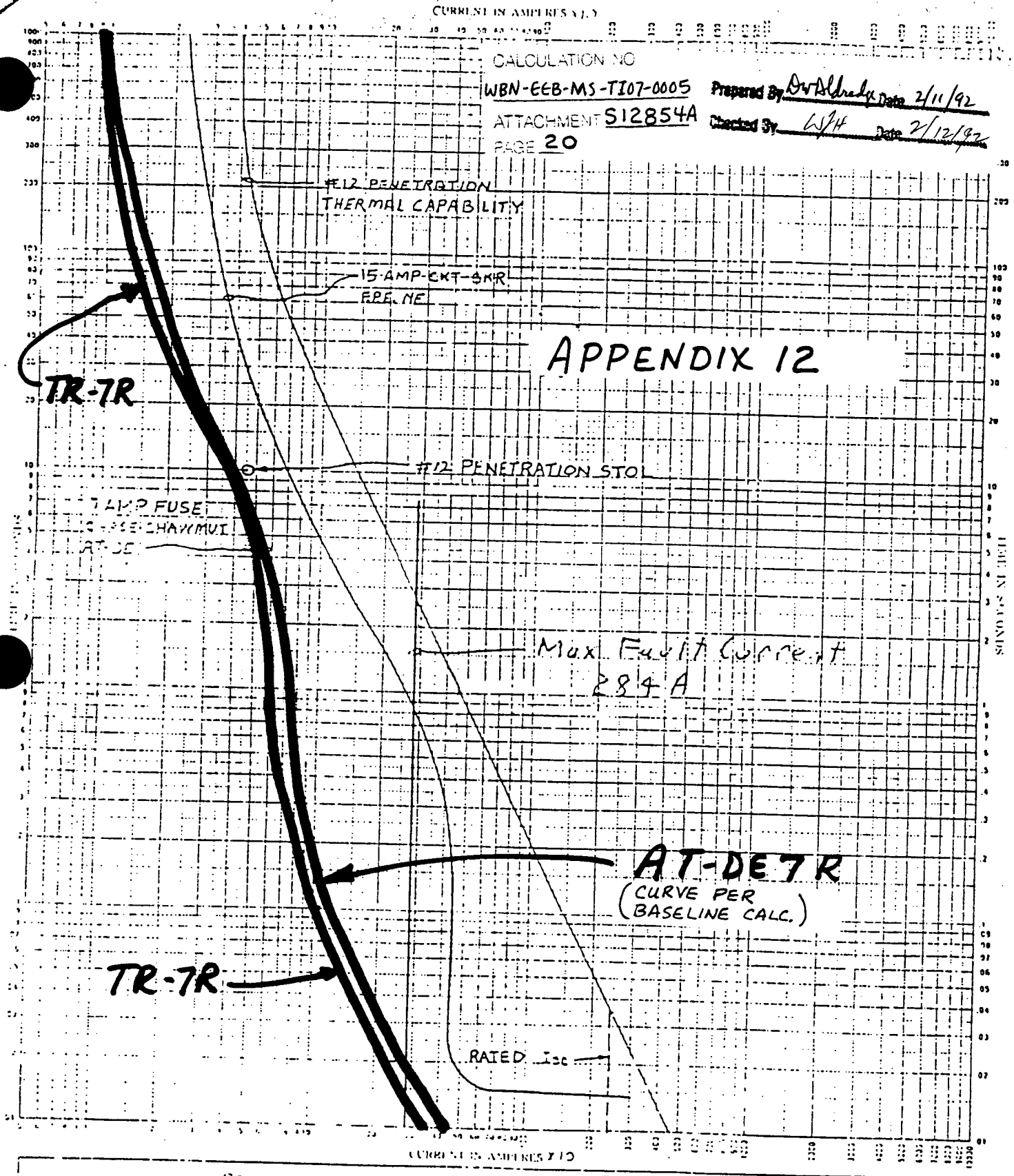

PENETRATION PROTECTION TIME-CURRENT CHARACTERISTIC CURVES

FIGURE 2.J

RS Prepared Date
Verified Date

RO PREPARED BY DATE
CHECKED BY J A Roop DATE 1-5-93

Computed Date 5-6-85
Checked Date 5-6-85

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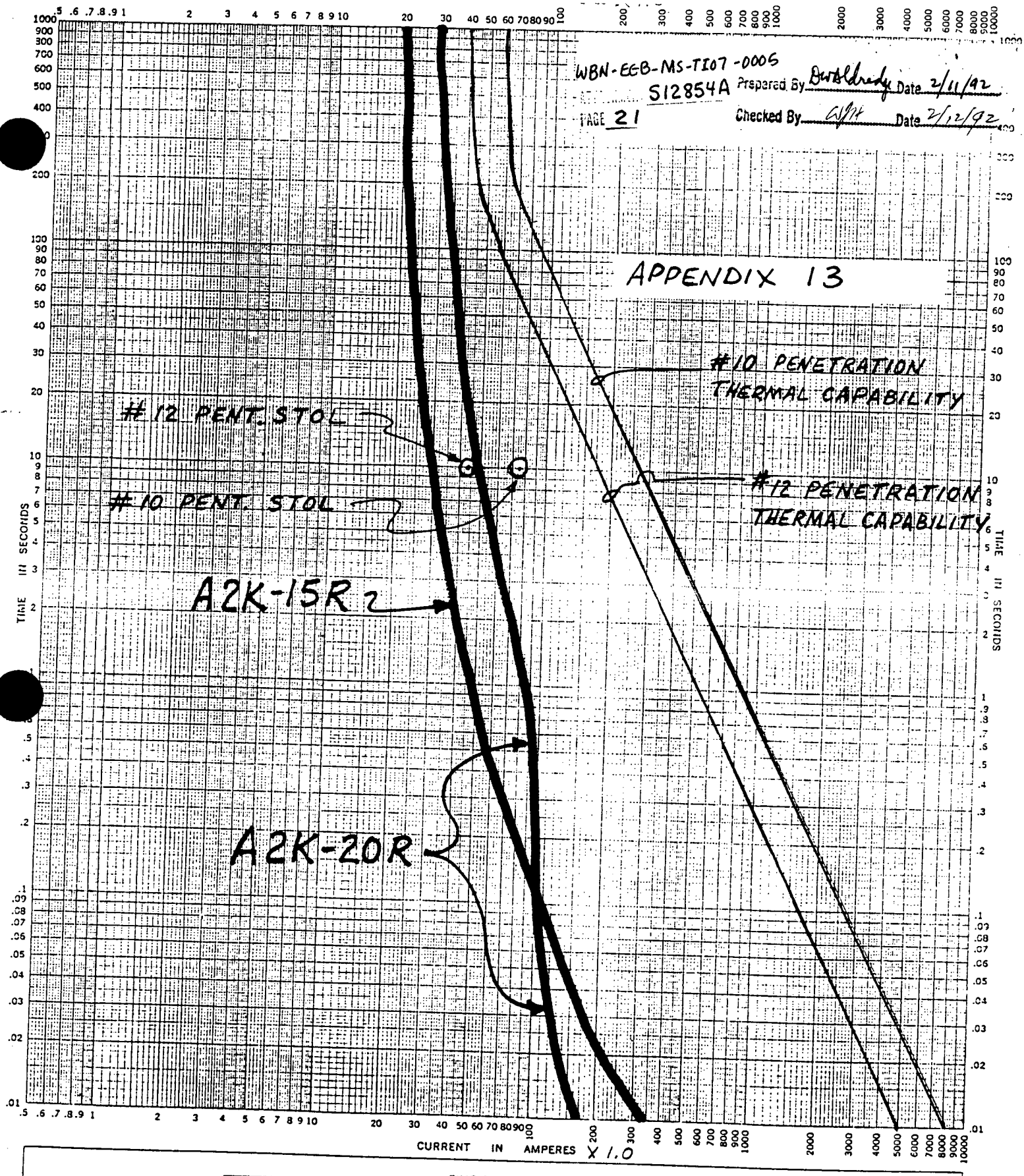
WBN-EEB-MS-TI07-0006
S12854A Prepared By Dwaldrady Date 2/11/92
PAGE 21 Checked By [illegible] Date 2/12/92



For _____ TIME-CURRENT CHARACTERISTIC CURVES
BASIS FOR DATA Standards _____ Fuse Links. In _____
1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____
2. Curves are plotted to _____ Test points so variations should be _____

No. _____
Date _____

TIME-CURRENT CHARACTERISTIC 48 5258
KEUFFEL & ESSER CO. MADE IN U.S.A.

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R5 | ~~WBN NV3 PEN 1~~ Sheet ~~15~~ of ~~XX~~ | 08

CALCULATION NO WBN-EEB-MS-TI07-0005 Prepared By Dr Aldredy Date 2/4/92

ATTACHMENT S12854A Checked By WJH Date 2/12/9

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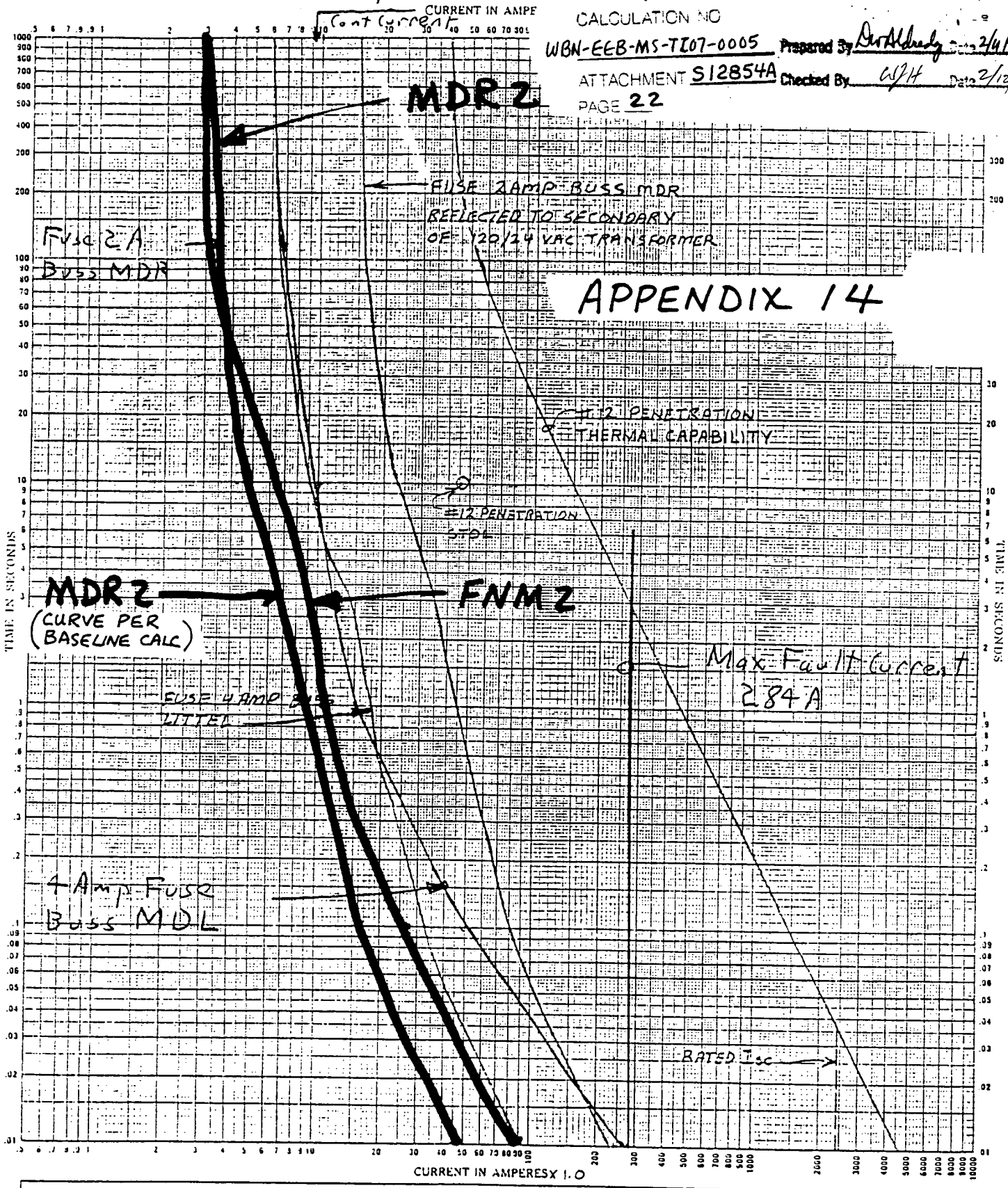

PENETRATION PROTECTION.... TIME-CURRENT CHARACTERISTIC CURVES

R5 Prepared James M Bulich Date 1-25-90

Verified H. A. Date 1-30-90

FIGURE 2.L

PREPARED BY M. L. PYATT DATE 9-1-82

CHECKED BY J.A. Roop DATE 4-5-83

TIME-CURRENT CHARACTERISTIC 48 5258

KEUFFEL & ESSER CO.

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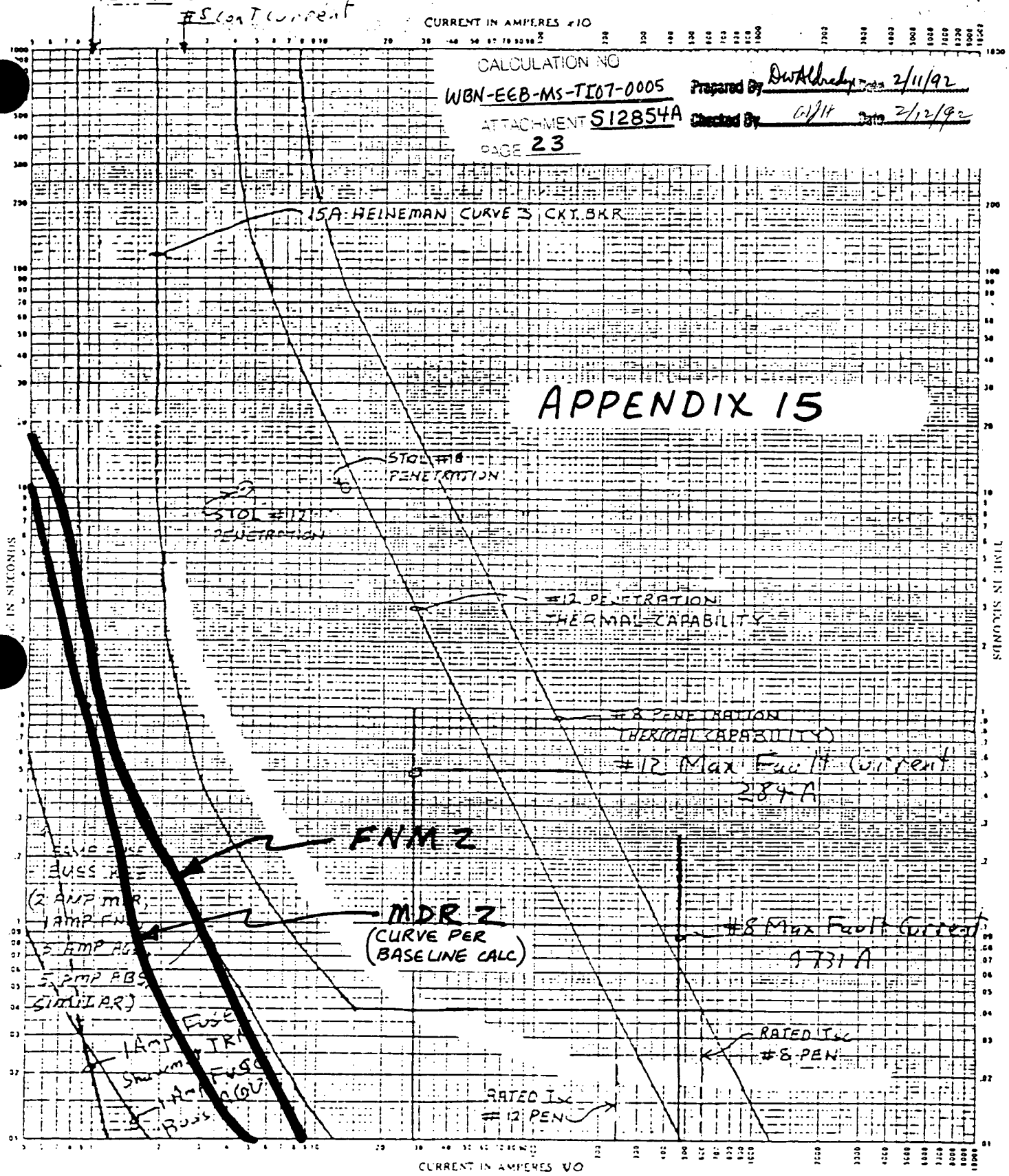

PENETRATION PROTECTION TIME CURRENT CHARACTERISTIC CURVES

FIGURE 2.C

Prepared [illegible] Date 1-25-90
Verified [illegible] Date 1-30-90

PREPARED BY [illegible] DATE 2-1-92
CHECKED BY [illegible] DATE 2-5-92

Prepared [illegible] Date 2-1-90
Verified [illegible] Date 2-1-90

K-E TIME-CURRENT CHARACTERISTIC 48 5230

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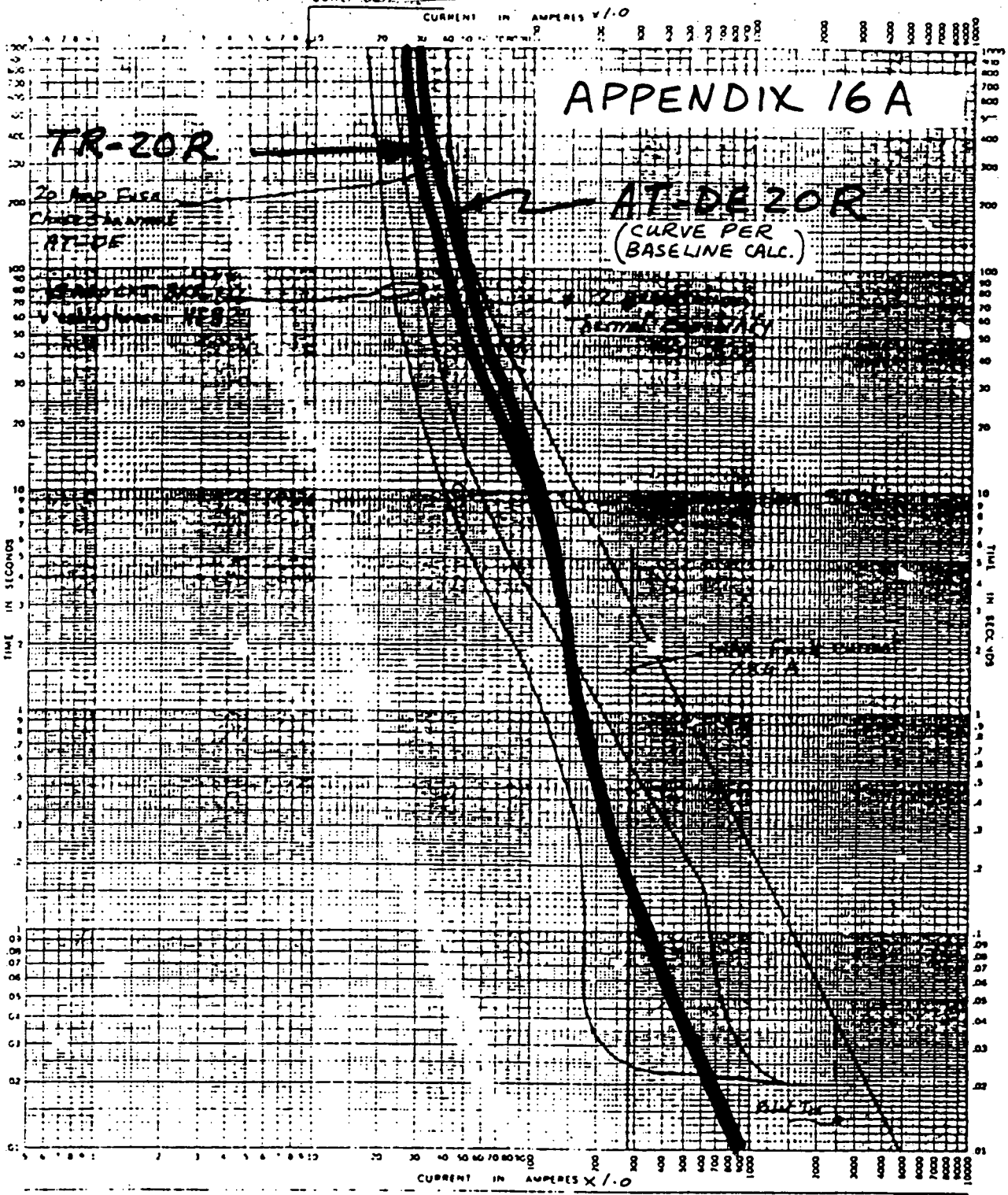
~~WBN-EEB-MS-TI08-0028~~ ~~Rev A 4/6/92~~ WBN-EEB-MS-TI07-0005 Prepared by [illegible] Date 2/11/92

ATTACHMENT S12854A ~~Checked By~~ CJH ~~Date~~ 2/12/92

Cont. Curr. 24



TIME-CURRENT CHARACTERISTIC CURVES

Figure 2.AC

THIS SHEET ADDED BY REV 4 RS Prepared James N Bulich Date 1-25-90

Verified [illegible] Date 1-30-90

Cont Current

CALC.
WBN-EEB-MS-TI07-0005
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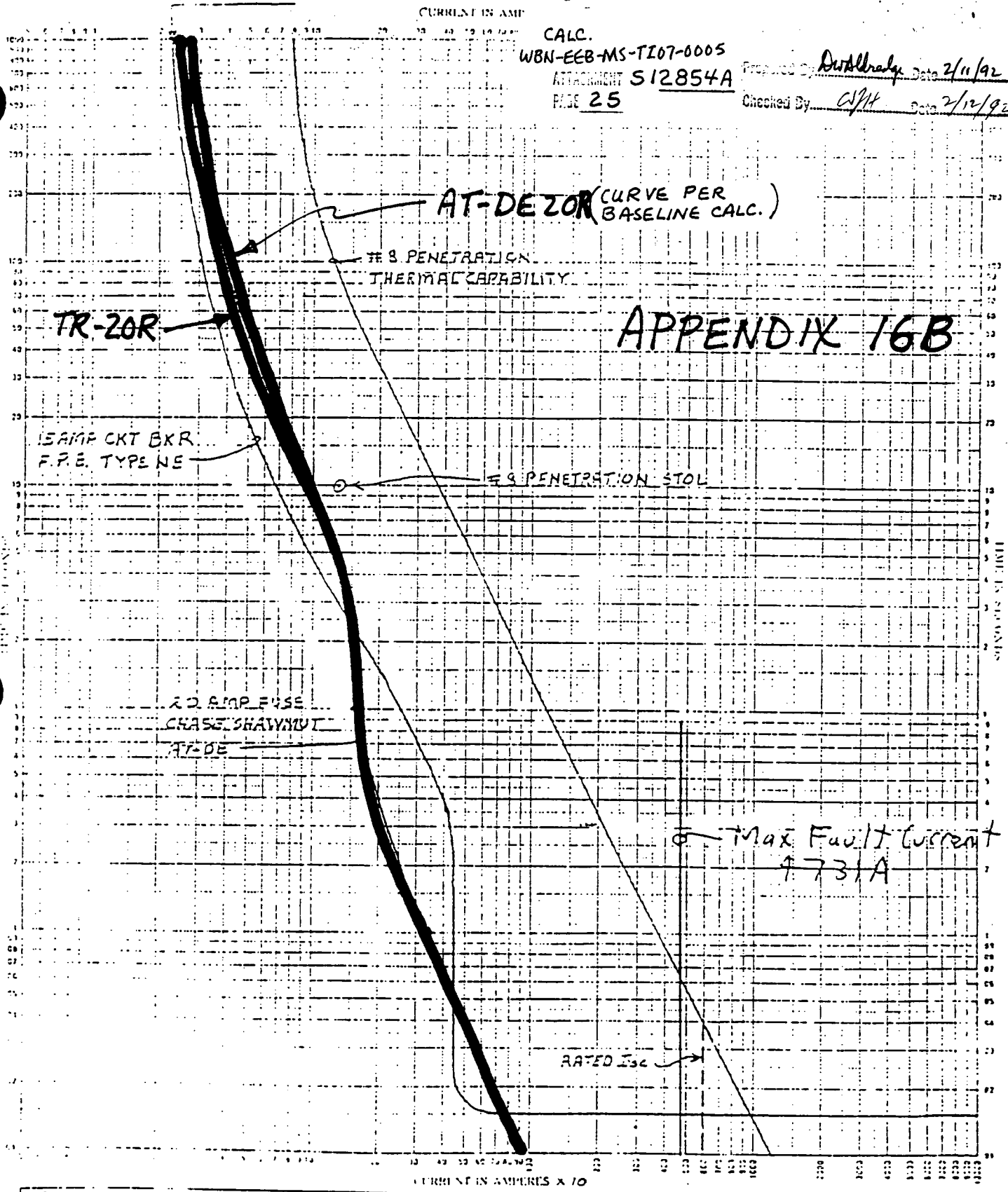
Prepared By DWAlbright Date 2/11/92
Checked By CWH Date 2/12/92



PENETRATION PROTECTION TIME-CURRENT CHARACTERISTIC CURVES

FIGURE 2.N

25 Prepared [illegible] Date 1-25-90
Verified [illegible] Date 1-30-90

PREPARED BY [illegible] DATE [illegible]
CHECKED BY J.A. Rapp DATE 4-5-83

THIS SHEET ADDED BY REV 4

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3.0	Applicable Codes and Standards	3	-
4.0	Assumptions	3	-
5.0	References	4,5	2
6.0	Design Input Data	5	-
7.0	Analysis	6,7,8,9	4
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This Attachment Package contains 17 total pages.

THIS SHEET ADDED BY REV 5

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate the modifications to be implemented under the following Design Change Notices (DCN):

1.1.1 M-17941-A, this DCN was issued to resolve problems identified in Revision 2 of calculation WBN EEB-MS-TI07-0005 which are associated with system 211.

1.1.2 S-15660-A, this DCN was issued to document the replacement fuse for 'MIS 5'.

1.2 Scope

The following problems and their corresponding resolutions are addressed by this calculation. All resolutions apply to 6900V Shutdown Boards 1A-A, 1B-B, 2A-A & 2B-B and item 1.2.5 resolution applies to all MIS 5 fuses.

1.2.1 The 30 Amp fuse within the Medium Voltage Switchgear (MVSG) relay circuit, (Ref. 5.1.5 & 5.1.6) supplies power to a 5 Amp fuse (Ref. 5.1.6 Emergency Control Bus only). The 30 Amp fuse receives power from a 30 Amp circuit breaker (Ref. 5.1.1). The 30 Amp fuse needs to be replaced with a fuse that will coordinate with both the 30 Amp circuit breaker and the 5 Amp fuse.

1.2.2 The 6 Amp fuse within the MVSG circuit feeder to the 480V Shutdown Transformer (Ref. 5.1.4) receives its power from a 15 Amp fuse. The Bussmann test report, MKT-14-HPL (Appendix "A") indicates the 15 Amp fuse and 6 Amp fuse did not coordinate. The 6 Amp fuse needs to be replaced with a fuse that will coordinate with the 15 Amp fuse.

1.2.3 The 6 Amp fuse within the MVSG Auto Transfer Lockout Circuit (Ref. 5.1.3) receives power from a 30A circuit breaker. The 6 Amp fuse within the MVSG Normal Control Bus Feeder and Transfer Switch circuit (Ref. 5.1.3) also receives power from a 30A circuit breaker. The 30 Amp circuit breaker (Ref. 5.1.2) and the 6 Amp fuse curves will be plotted to verify their coordination.

1.2.4 The 20 Amp circuit breaker within the MVSG feeder and transfer switch circuit (Ref. 5.1.3) reveives power from a 30 Amp circuit breaker (Ref. 5.1.1). The 20 Amp circuit breaker (Ref. 5.1.2) supplies a 15 Amp fuse (Ref. 5.6) for the inspection box trip push button.

1.2.5 M1S 5 fuse has in the past failed seismic test (Ref. 5.4), an alternate fuse to repalce M1S 5 must be selected.

THIS SHEET ADDED BY REV 5

1.2 Scope (Continued)

1.2.6 The 3 Amp fuse for the shutdown power-train A & B (Ref. 5.1.18) should either be an OT3 fuse or an A4J3 fuse. The Master Fuse List (MFL) calls for boards 1B-B & 2A-A fuse to be an A4J3 fuse, Boards 2B-B & 1A-A to be an OT3 fuse, walkdown criteria indicates fuses within all four boards are 'A4J3 fuses, the correct fuse will be selected as part of this calculation. The 3 Amp fuse receives power from a 30 Amp circuit breaker. The 30 Amp circuit breaker and the correct fuse curves will be plotted to verify their coordination.

2.0 CRITERIA

2.1 Fuses installed in the DC system shall be capable of interrupting the maximum possible fault without exceeding their interrupting rating (Ref. 1.1.2 Baseline Calcualtion).

2.2 Fuses and circuit breakers shall be selectively coordinated so that the device nearest an overload should be the first to operate. (Ref. 1.1.7 Baseline Calculation)

2.3 The MIS 5 replacement fuse must meet the following criteria:

A. Have an operating voltage rating which equals or exceeds the circuit voltage.
B. Have a continuous current rating the same as the original fuse.
C. Have a fault current interrupting capacity rating of at least 20,000 A since the available short circuit current at batteries I, II, III & IV is 18360 Amps (Ref 5.3 Pg. 14).
D. Must have performance requirements as taken credit for in the baseline calculations (or as specified by vendors). For example, it must provide cable protection or coordination with other protective devices, etc, depending on the application.
E. Is physically interchangeable with the original fuse.

3.0 APPLICABLE CODES AND STANDARDS

See Baseline Calculation. (Section 3.3)

4.0 ASSUMPTIONS

4.1 See assumptions identified in the Baseline Calculation (Section 2.0 & 5.0).

4.2 The UVA referenced in Baseline Calculation Section 5.0 associated with Contract No. 75835A (DCN M-12564-A) which is repeated in Attachments P-01012-A, P-01013-A, P-01014-A and P-01015-A is removed by this Attachment.

The test results from Contract No. 75835A (Test report 'MKT-14-HPL) prove that coordination exists between the 15 Amp and 1 Amp fuses. (Appendix 'A')

THIS SHEET ADDED BY REV 5

5.0 REFERENCES

5.1 TVA Drawings:

5.1.1	1-45W703-1, R1	Wiring Diagrams 125V Vital Battery Board I, Single Line Sheet 1
5.1.2	1-45W724-1, R0	Wiring Diagrams 6900V Shutdown Board 1A-A, Single line
5.1.3	1-45W760-211-1, R0	Wiring Diagram 6900V Shutdown Power Schematic Diagram
5.1.4	1-45W760-211-5, R0	Wiring Diagrams 6900V Shutdown Power Schematic Diagram
5.1.5	1-45W760-211-8, R0	Wiring Diagrams 6900V Shutdown Power 1A-A Schematic Diagrams.
5.1.6	1-45W760-211-9, R1	Wiring Diagrams 6900V Shutdown Power 1A-A Schematic Diagrams.
5.1.7	1-45W703-2, R2	Wiring Diagrams 125V Vital Battery Board II Single Line - Sheet 2.
5.1.8	1-45W703-3, R1	Wiring Diagrams 125V Vital Battery Board III Single Line - Sheet 3.
5.1.9	1-45W703-4, R1	Wiring Diagrams 125V Vital Battery Board IV Single Line - Sheet 4.
5.1.10	1-45W724-2, R0	Wiring Diagrams 6900V Shutdown Power 1B-B Single Line.
5.1.11	1-45W724-3, R0	Wiring Diagrams 6900V Shutdown Power 2A-A Single Line.
5.1.12	1-45W724-4, R0	Wiring Diagrams 6900V Shutdown Power 2B-B Single Line.
5.1.13	1-45W760-211-10, R0	Wiring Diagrams 6900V Shutdown Power 1B-B Schematic Diagrams.
5.1.14	1-45W760-211-11, R0	Wiring Diagrams 6900V Shutdown Power 1B-B Schematic Diagrams.
5.1.15	1-45W760-211-12, R0	Wiring Diagrams 6900V Shutdown Power 2A-A Schematic Diagrams.

THIS SHEET ADDED BY REV 5

5.0 REFERENCES (Continued)

5.1 TVA Drawings (Continued):

5.1.16 1-45W760-211-13, R1 Wiring Diagrams 6900V Shutdown Power 2A-A Schematic Diagrams.

5.1.17 1-45W760-211-14, R0 Wiring Diagrams 6900V Shutdown Power 2B-B Schematic Diagrams.

5.1.17 1-45W760-211-15, R1 Wiring Diagrams 6900V Shutdown Power 2B-B Schematic Diagrams.

5.1.18 1-45W760-211-17, R0 Wiring Diagram 6900V Shutdown Power-Train A & B Schematic Deiagram

5.2 TVA Baseline Calculation WBN EEB-MS-TI11-0003 R3, 125 VDC Vital Battery and Charger Capacity Evaluation

5.3 TVA Baseline Calculation WBN EEB-MS-TI07-0005 R4, 125 VDC Vital Control Power System Fault Calculations.

5.4 DCN S-12854-A - Master Fuse List (MFL) DCA S-12584-36 R0 "Master Fuse Report System 211 Safety Related".

5.5 TVA Baseline Calculation WBN EEB-MS-TI11-0004 R13, 12V DC Voltage Analysis.

5.6 Vendor Dwg. Contract No. 74-84376 Dwg. No. 0123D4593, R907 Sheet 7, General Electric Metal-Clad Switchgear Interconnection Diagram.

5.7 TVA Purchase Requisition for Littelfuse type Flas 5 Mark PNQ-30. Requisition No. 75508A, Procurement Request: W-6084 R0.

5.8 TV Baseline Calculation WBN EEB-MS-TI12-0016 R0, Vital Inverter Loading.

5.9 Buss Small dimension fuses, fuseholders, and accessories (Form SFB).

5.10 TVA Calculation #WBPEVAR8907005 (RIMS B26920130403) Attachment "H", Sheet 2 of 2.

6.0 DESIGN INPUT DATA

6.1 Control Bus indicating light (Red or amber)[Ref. 5.2 Sheet 118] continuous load = 0.05 Amps. This is the most conservative figure for indicating light Amps, (Ref. 5.8, Sect. 5.3, pg. 6).

6.2 Westinghouse relays (Ref. 5.5 Pgs D8 & E4) 14 watts, Res 1028 ohms, nominal voltage 120 volts. This is the most conservative figure for relay wattage. Since relay wattage vary from 8 watts for an Agastat relays (Ref. 5.5, Sheet B21) to 14 watts for the Westinghouse relays.

THIS SHEET ADDED BY REV 5

Calcualtion No. WBN EEB-MS-TI07-0005
Attachment No. M-17941-A
125V DC Vital Control
Power System Fault Calcultions

Prepared by Philip Bach Date 3/17/92

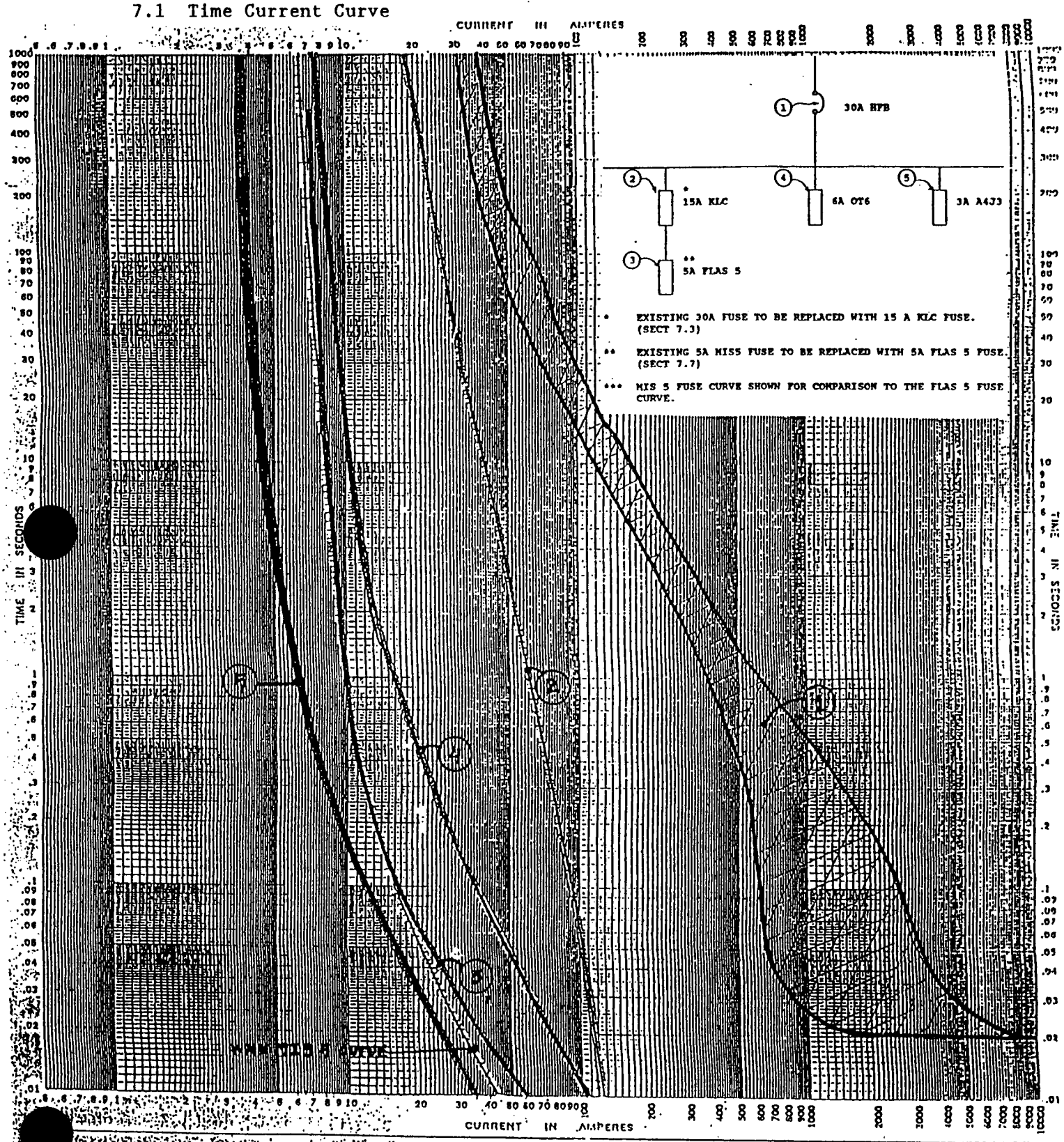
Checked by [illegible] Date 3-17-92

Sheet 6

7.0 COMPUTATION/ANALYSIS

THIS SHEET ADDED BY REV 5

7.1 Time Current Curve



For _____ TIME-CURRENT CHARACTERISTIC CURVES
Fuse Links. In _____
BASIS FOR DATA Standards _____ Dated _____
1. Tests made at _____ Volts a-c at _____ p.f., starting at 25C with no initial load _____
2. Curves are plotted to _____ Test points so variations should be _____

No. _____
Date _____

Calcualtion No. WBN EEB-MS-TI07-0005
Attachment No. M-17941-A
125V DC Vital Control
Power System Fault Calcultions

Prepared by Philip Bau Date 3/17/92

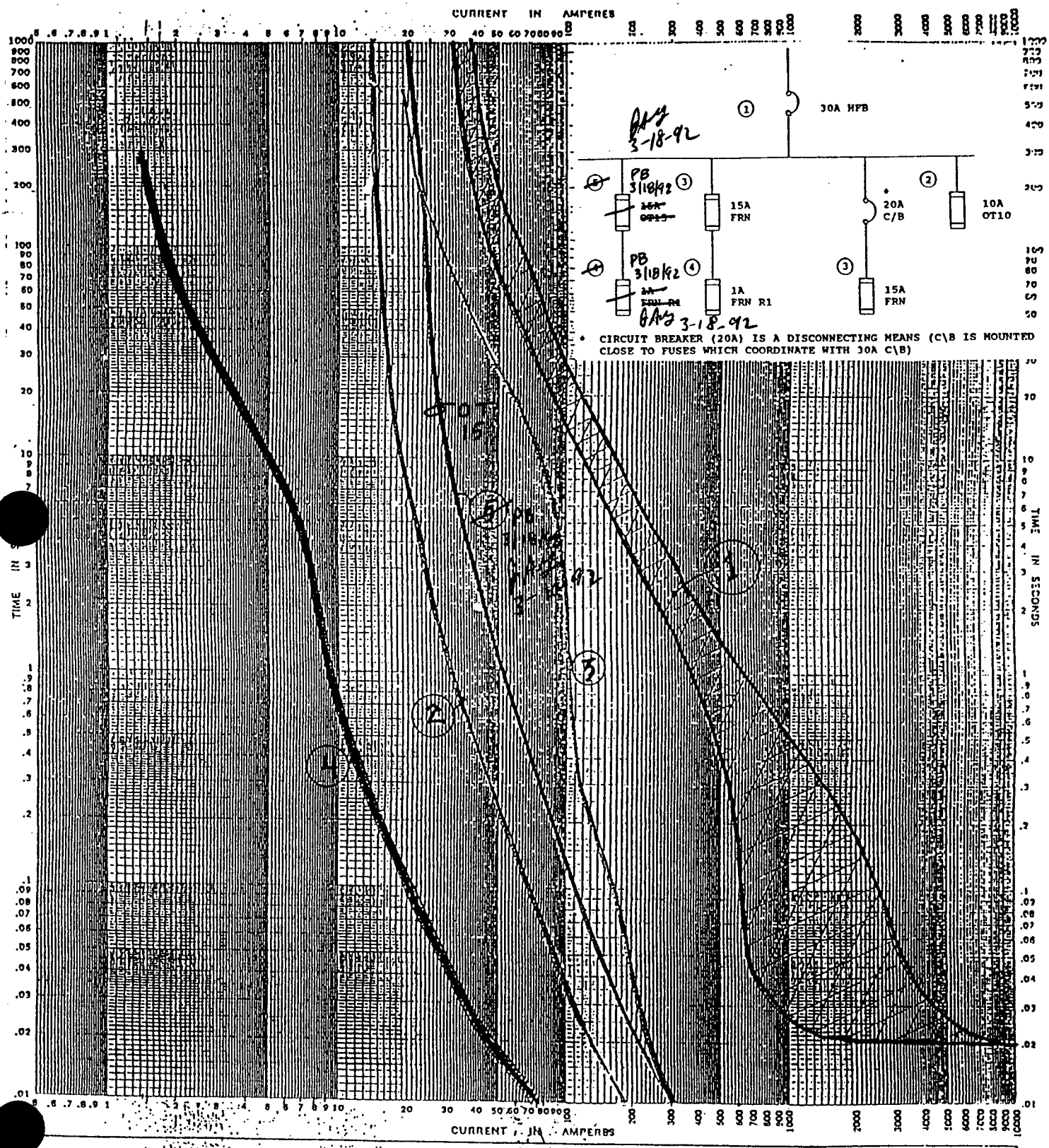
Checked by [illegible] Date 3-17-92

Sheet 7

7.0 COMPUTATION/ANALYSIS (Continued)

THIS SHEET ADDED BY REV 5

7.2 Time Current Curve



For _____ TIME-CURRENT CHARACTERISTIC CURVES

_____ Fuse Links. In _____

BASIS FOR DATA Standards _____ Dated _____

1. Tests made at _____ Volts a-c at _____ p-f., starting at 25C with no initial load _____
2. Curves are plotted to _____ Test points so variations should be _____

No. _____

Date _____

7.0 COMPUTATION/ANALYSIS (Continued)

7.3 30 Amp fuse, 30 A circuit breaker & 5 Amp fuse coordination problem (Section 1.2.1). The 30 Amp fuse will not coordinate with a 30 Amp circuit breaker (curves #10 & #11 Baseline Calc). Therefore, determine circuit load to select another fuse that will coordinate with the 30AMP circuit breaker and 5AMP fuse (Ref. 5.1.5 & 5.1.6).

7.3.1 A maximum of fourteen (14) indicating lights at 0.05 Amps each (Section 6.1) could be lit at one time (red and amber light in each box do not operate at the same time, Ref. 5.1.5 & 5.1.6.)

14 x 0.05 = 0.7 Amps

7.3.2 A maximum of twenty five (25) under voltage relays at 14 watts each (section 6.2) could be operating within this circuit at any one time (Ref. 5.1.5).

25 x 14 = 350 watts

$\frac{350 \text{ watts}}{120 \text{ volts}}$ = 2.92 Amps load current

Total circuit Load:

2.92A + 0.7A = 3.62 Amps
3.62A x 1.25% = 4.53 Amps

7.3.3 Referring to Section 7.1, the time current characteristic curves for the 30 Amp circuit breaker, 15 Amp fuse and the 5 Amp fuse indicates coordination between these devices.

7.3.4 For fuse loading an FRN 15 Amp fuse can be utilized in lieu of the OT30 Amp fuse. The 15 Amp fuse has a current rating greater than 125% of the load current.

7.4 6 Amp fuse and 15 Amp fuse problem (Section 1.2.2)

7.4.1 A maximum of two (2) indicating lights at 0.05 Amps each (Section 6.1) could be lit at one time (red and green lights in each compartment do not operate at the same time).

2 x 0.05A = 0.1 Amp load current
0.1 x 1.25% = 0.125 Amp

7.4.2 For fuse loading a FRN R1 fuse can be utilized in lieu of the OT6 fuse. The 1 Amp fuse has a current rating greater than 125% of the load current. Refering to Section 7.2, the time current characteristic curves for the 15 amp fuse and the 1 Amp fuse indicates coordination between these devices.

THIS SHEET ADDED BY REV 5

7.0 COMPUTATION/ANALYSIS (Continued)

7.5 6 Amp fuse and 30 Amp circuit breaker coordination (Section 1.2.3).

7.5.1 The time current characteristic curves for the 6 Amp fuse and 30 Amp circuit breaker indicates coordination between these devices (Ref. 7.1).

7.6 15 Amp fuse, 20 Amp circuit breaker and 30 Amp circuit breaker coordination (Section 1.2.4)

7.6.1 Normal control bus feeder and transfer switch circuit for 6900 V Shutdown Boards 1A-A & 1B-B (Ref. 5.1.3) shows a 20 Amp circuit breaker (Ref. 5.1.3) receiving power from A 30 Amp circuit breaker (Ref. 5.1.1). The 20 Amp circuit breaker and the 30 Amp circuit breaker will not coordinate. However, the G.E. vendor drawing for the inspection box (Ref. 5.6) indicates 15 Amp fuse protection for the inspection box. The 15 Amp fuse which receives its power from the 20 Amp circuit breaker will coordinate with the 30 Amp circuit breaker (Ref. 7.2) and the purpose of the 20 Amp circuit breaker is a service disconnecting means only. The 15 Amp fuse is located a short distance from the 20A circuit breaker.

7.7 MIS 5 replacement fuse selection (Section 1.2.5 & 2.3), analysis will be done with a FLAS 5 fuse.

7.7.1 The circuit nominal voltage is 125V DC with a range of 135V DC to 105V DC (Ref. 5.1.1). The FLAS 5 fuse rating is 150V DC (Ref. 5.10).

7.7.2 The continuous current rating of the MIS 5 fuse is 5 Amps, the FLAS 5 fuse continuous current rating is also 5 Amps (Ref. 5.10).

7.7.3 The fault current rating of the FLAS 5 fuse is 20,000 A (Ref. 5.10).

7.7.4 The FLAS 5 fuse time current characteristics is comparable to the MIS 5 and will coordinate with upstream protective devices similar to the MIS 5 fuse (Section 7.1).

7.7.5 The FLAS 5 fuse purchase requisition (Ref. 5.6) calls for fuse to be suitable for use in Buss Fuse Block 2837 or 2838 which is interchangable with the MIS 5 fuse block (Ref. 5.9).

7.8 The time current characteristic curves for the 30 Amp circuit breaker (Section 1.2.6) and the 'A4J3' fuse indicates coordination between these devices (Ref. 7.1).

THIS SHEET ADDED BY REV 5

8.0 SUMMARY OF RESULTS

8.1 The 30 Amp fuse, 30 Amp circuit breaker and 5 Amp fuse coordination problem (Sections 1.2.1 & 7.3). The 30 Amp fuse (OT30) needs to be replaced with a 15 Amp (FRN 15) fuse.

8.1.1 The 15 Amp fuse has a current rating greater than 125% of the load current which is 4.53 Amps (Section 7.3.3)

8.1.2 The time current characteristic curves for the 30 Amp circuit breaker, 15 Amp fuse and the 5 Amp fuse indicates coordination between these devices (Section 7.1).

8.2 The 6 Amp fuse and 15 Amp fuse coordination problem (Section 1.2.2). The 6 Amp fuse (OT6) needs to be replaced with A 1 Amp (FRN R1) fuse.

8.2.1 The 1 Amp fuse has a current rating greater than 125% of the load current which is 0.125 Amps (Section 7.4.2).

8.2.2 The time current characteristic curves for the 15 Amp fuse and the 1 Amp fuse indicates coordination between these devices (Section 7.2)

8.3 The 6 Amps fuse and circuit breaker coordination (Section 1.2.3).

8.3.1 The time current characteristic curves for the 6 Amp fuse and 30 Amp circuit breaker indicates coordination between these devices (Section 7.1).

8.4 20 Amp circuit breaker and 30 Amp circuit breaker coordination (Section 1.1.4).

8.4.1 The 20 Amp circuit breaker (Ref. 5.1.3) and the 30 Amp circuit breaker (Ref. 5.1.1) will not coordinate. However, the G.E. Vendor drawing for the inspection box (Ref. 5.6) indicates a 15 Amp fuse protection for the inspection box. The 15 Amp fuse which receives its power from the 20 Amp circuit breaker will coordinate with the 30 Amp circuit breaker (Ref. 7.2) and the purpose of the 20 Amp circuit breaker is a service disconnecting means. The 15 Amp fuse is located a short distance from the 20A circuit breaker.

8.5 MIS 5 replacement fuse selection (Sections 2.5 & 2.3). An acceptable qualified replacement fuse for the MIS 5 is the FLAS 5 fuse.

8.5.1 The circuit nominal voltage is 125V DC with a range of 135V DC to 105V DC (Ref. 5.1.1). The FLAS 5 fuse rating is 150V DC (Ref. 5.10).

THIS SHEET ADDED BY REV 5

8.0 Summary of Results (Continued)

8.5.2 The continuous current rating of the MIS 5 fuse is 5 Amps, the FLAS 5 fuse continuous current rating is also 5 Amps (Ref. 5.10).

8.5.3 The fault current rating of the FLAS 5 is 20,000 A (Ref. 5.10).

8.5.4 The FLAS 5 fuse time current characteristics is comparable to the MIS 5 and will coordinate with upstream protective devices similar to the MIS 5 fuse (Section 7.1).

8.5.5 The FLAS 5 fuse purchase requisition (Ref. 5.6) calls for FLAS 5 fuse to be sutiable for use in Buss Fuse Block 2837 or 2838 which is interchangable with the MIS 5 fuse block (Ref. 5.9).

8.6 The time current characteristic curves for the 30 Amp circuit breaker (Section 1.2.6) and the 'A4J3' fuse indicates coordination between these devices (Ref. 7.1).

9.0 CONCLUSIONS

9.1 A 15 Amp (FRN 15) fuse can replace the 30 Amp (OT30) fuse within the MVSG relay circuit.

9.2 A 1 Amp (FRN-R1) fuse can replace the 6 Amp (OT6) fuse within the MVSG 480 V shutdown transformer circuit.

9.3 The 6 Amp fuse within the MSVG auto transfer lockout circuit coordinates with its upstream 30 Amp circuit breaker.

9.4 The existing 15 Amp FRN fuses within the inspection box of the MVSG feeder and transfer switch circuit (Section 1.2.4) coordinates with its upstream 30 Amp circuit breaker.

9.5 A FLAS 5 fuse is an acceptable replacement for the MIS 5 fuse.

9.6 The 30 Amp (A4J3) fuse within the Shutdown Power Train A & B circuits coordinates with its upstream 30 Amp circuit breaker.

THIS SHEET ADDED BY REV 5

CALCULATION WBN EEB-MS-TI07-0005
ATTACHMENT No. M-17941-A PHIL BARLAM
X 1213

APPENDIX 'A'
Pg 1 OF 6
sheet 12

BUSSMANN

TO LARRY GEISLER

FROM A. BROWALD

FAX PHONE #

NO. OF PAGES 6

TEST REPORT
MKT-14-HPL

COORDINATION PERFORMANCE OF BUSSMANN FUSE COMBINATIONS AT 150VDC

Test Contractor:	Cooper Industries Bussmann Division P. O. Box 14460 St. Louis, Missouri 63178-4460
Test Laboratory:	Bussmann High Current Facility at Sauget, Illinois
Requestor:	Tennessee Valley Authority Watts Bar Nuclear Plant Power Stores Section Near Spring City, Tennessee TVA Reference No. 92NNS-75835A-01
Fuse Combinations Evaluated:	Bussmann FRN-R 15/1, 15/6, 17-1/2/6 & 20/6 KWN-R 10/1 & 10/6

THIS SHEET ADDED BY REV 5

REPORT CERTIFICATION

Test Engineer: Kenneth J. Borgwald
Senior Engineer
Cooper Industries
Bussmann Division

Report Writer: Kenneth J. Borgwald, MSEE

Contracting Officer: Dean Klohr, P.E. E12180
Vice President Engineering
Cooper Industries
Bussmann Division

Test Dates: January 22 & 23, 1992
February 13 & 14, 1992

Bussmann certifies that these fuse coordination tests were performed in accordance with the methods and procedures detailed in Underwriters Laboratories Standard #198L, DC Fuse For Industrial Use.

THIS SHEET ADDED BY REV 5

TEST EQUIPMENT

1) High Current Test Transformers
   Pennsylvania 5000KVA, 5.2% Z
   Serial No. 37494-1, 2 & 3

2) Voltage Trim Transformers
   Matra 333KVA, 7.2% Z
   Serial No. 93335098K-1, 2 & 3

3) High Current Closing Switch
   Delta Unibus
   Serial No. QD-100-3

4) Six Pulse Low Current Rectifier
   Bussmann 7200 Amp/3200 Volt

5) 400 Ampere 100 MV Switchboard Shunt
   Empro Model Lab-400-100

6) Digital Multimeter
   Fluke Model 8010A
   Serial No. 3645002

7) Data Acquisition System
   Hi Techniques Model IQ300M
   Serial No. 0891-1180

8) Resistive Load
   10 Sections of schedule 40
   3/4 inch Galvanized Pipe

9) Air Core Inductive Load
   National Electric Coil
   0.12 and 0.02 ohm (@ 60 Hz) Sections

Certification of the calibration of the Fluke Multimeter and Hi Techniques Data Acquisition System is included in the the report as Appendix A.

THIS SHEET ADDED BY REV 5

Purpose: Verify the coordination of the following line and load side, Bussmann's fuse combinations, at 150VDC, 2500 amps with a time constant in the range of 5-10 milliseconds.

Line Side	Load Side
FRN-R 15	FRN-R 1
FRN-R 15	FRN-R 6
KWN-R 10	KWN-R 1
KWN-R 10	KWN-R 6

Procedure: Prior to the testing of fuses, the test circuit was calibrated with both line and load side fuses replaced with copper shorting bars. The amplitude and time constant of the fault current was determined by measurements of an oscillographic record of the current. The oscillographic record was obtained from and electronic digital recording oscilloscope whose calibration is maintained through standards traceable to NIST. The current signal was obtained from a resistive shunt. The open circuit voltage was measured with an electronic digital voltmeter whose calibration is again maintained and traceable to NIST.

The DC test current was derived from a six pulse, double bridge, solid state rectifier bank powered by a three phase bank of high current test transformers. The current level was set with a resistive load bank located on the DC side of the rectifier; while an inductive load connected in series with the resistive load was adjusted to yield the desired circuit time constant (L/R). The current was then initiated with a high current synchronous closing switch.

With the circuit parameters determined by the calibration procedure described above, the copper shorting bars were removed and replaced with the relevant fuse series combinations. After operation of the closing switch, the DC voltage was maintained across the fuses to insure that the circuit had been interrupted and that the fuses were indeed dormant.

The fuse combinations were considered to coordinate if the smaller of the fuses safely cleared the circuit, while the larger fuse remained intact. Six tests were to be conducted on the two lower ratio (15/6 and 10/6) combinations. With coordination of the lower ratio combinations; it was not considered necessary to test the higher ratios; however, one sample of each of the higher ratios were tested to complete the record. With the oscillographic records of fuse current and voltage, some additional data such as total clearing time, melting time, clearing and melting I^2t was also available.

The procedures followed conformed to those detailed in Underwriters Laboratories Standard 198L, Standard For D-C Fuses For Industrial Use.

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APPENDIX 'A'
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Sheet 16

Results: The parameters of the test circuit as measured by the methods defined in the procedure were:

Open Circuit Voltage:	156VDC
Available Short Circuit Current:	2590 Amperes
Time Constant of Current:	8.6 Milliseconds

The following Bussmann fuse combinations were found to provide coordinated protection on the subject circuit.

FRN-R 15 and FRN-R 1
KWN-R 10 and KWN-R 1
KWN-R 10 and KWN-R 6

With regard to the combination of FRN-R 15 and FRN-R 6, it was found that although short circuit protection was provided, this combination did not coordinate. That is, in the two tests of this combination both the 15 and 6 ampere fuses opened.

Additional tests were conducted to identify a fuse in the FRN line which coordinated with FRN-R 6. The results indicated that the ampere rating of the line side Fusetron® must be increased beyond 17-1/2 ampere to 20 ampere. Thus, it was found that FRN-R 20 and FRN-R 6 did yield coordinated protection.

During the tests of the FRN-R 20/6 combination, one of the samples of the 6 ampere fuse exhibited a performance anomaly wherein one of the fuse end caps was blown off as a result of a restrike approximately 25 seconds into the voltage hold. This restrike did not affect the coordination performance.

In order to determine a measure of the coordination margin some additional tests and measurements of melting and clearing times of the line and load side fuses, respectively, were conducted. These results are tabulated in Table 1 below.

Combination	High Load Side Clearing Time Msec	Lowest Line Side Melting Msec	Ratio	Coordination
FRN-R 15/1	7.7	3.4	0.44	Yes
FRN-R 20/6	6.7	4.3	0.64	Yes
KWN-R 10/1	0.36	1.77	4.9	Yes
KWN-R 10/6	1.34	1.77	1.3	Yes
FRN-R 15/6	6.7	3.4	0.51	No

Table 1: Coordination Margins (Time)

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PB 3/19/92 PB 3/19/92

Some of the load side clearing times exceed the line side melting times in Table 1 yielding ratios less than 1.0 even though the combinations coordinated. This inconsistency is an indication that the melting/clearing time ratio is not an appropriate measure for evaluation of coordination performance. Rather the melting and clearing I^2t ratio is the relevant coordination parameter. The I^2t ratios for the various fuse combinations are tabulated in Table 2.

Combination	High Load Side Clearing I^2t	Lowest Line Side Melting I^2t	Ratio	Coordination
FRN-R 15/1	88.8	699	7.9	Yes
FRN-R 20/6	834	1320	1.6	Yes
KWN-R 10/1	0.306	129	420	Yes
KWN-R 10/6	35.4	129	3.6	Yes
FRN-R 15/6	834	699	0.84	No

Table 2: Coordination Margins (I^2t)

THIS SHEET ADDED BY REV 5

Calcualtion No. WBN EEB-MS-TI07-0005
Attachment No. M-18173-A
125V DC Vital Control
Power System Fault Calculations

Prepared by Philip Ba Date 4/21/92
Checked by [illegible] Date 4-21-92
Sheet 1

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4.0	Assumptions	3	-
5.0	References	3 thru 6	3
6.0	Design Input Data	6	-
7.0	Analysis	7 thru 9	3
8.0	Summary of Results	9, 10	1
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This Attachment Package contains 11 total pages.

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1606x

1.0 PURPOSE AND SCOPE

1.1 Purpose

The purpose of this attachment is to evaluate the modifications to be implemented under Design Change Notices (DCN) M-18173-A

This DCN was issued to resolve problems identified in Revision 2 of calculation WBN EEB-MS-TI07-0005 which are associated with systems 212 & 236.

1.2 Scope

The following problems and their corresponding resolutions are addressed by this calculation. All resolutions apply to 480 Volt Shutdown Boards 1A1-A, 2A1-A, 1A2-A 2A2-A, 1B1-B, 2B1-B, 1B2-B & 2B2-B.

1.2.1 Some of the fuse types being used in the Low Voltage Switchgear (LVSG) are not the type specified on the boards and are non-standard fuse sizes/types (Ref. 5.4 attachment M-12564-A Pg. 5 of 8).

1.2.2 Some of the fuse numbers shown on the TVA dwg. 1-45W760-78-1 (Ref. 5.1.8) are not listed in the Master Fuse List (MFL)[Ref. 5.5].

1.2.3 Selective coordination does not exist within the diesel generator remote control circuit for diesels 1A-A, 1B-B, 2A-A & 2B-B (Ref. 5.1.34).

THIS SHEET ADDED BY REV 6

2.0 CRITERIA

2.1 Fuses installed in the DC system shall be capable of safely interrupting the maximum possible fault without the short circuit current exceeding their interrupting rating (Ref. 1.1.2 Baseline Calcualtion).

2.2 Fuses and circuit breakers shall be selectively coordinated so that the device nearest an overload should be the first to operate. (Ref. 1.1.7 Baseline Calculation)

3.0 APPLICABLE CODES AND STANDARDS

See Baseline Calculation. (Section 3.3)

4.0 ASSUMPTIONS

Justified

See assumptions identified in the Baseline Calculation (Section 2.0 & 5.0).

Unverified

None within this attachment and baseline calculation.

5.0 REFERENCES

5.1 TVA Drawings:

5.1.1 1-45W749-2, R1 Wiring Diagrams 480V Shutdown BD 1A2-A & 2A2-A Single Line

5.1.2 1-45W749-1, R0 Wiring Diagrams 480V Shutdown BD 1A1-A, & 2A1-A Single line

5.1.3 1-45W749-3, R1 Wiring Diagrams 480V Shutdown BD 1B1-B, & 2B1-B Single line

5.1.4 1-45W749-4, R0 Wiring Diagrams 480V Shutdown BD 1B2-B, & 2B2-B Single line

5.1.5 1-45W760-31-18, R1 Wiring Diagrams Air Conditioning System Schematic Diagram

5.1.6 1-45W760-212-2, R0 Wiring Diagrams 480V Shutdown Power Schematic Diagrams.

THIS SHEET ADDED BY REV 6

5.0 REFERENCES (Continued)

5.1 TVA Drawings (Continued):

5.1.7	1-45W760-212-1 R0	Wiring Diagrams 480V Shutdown Power Schematic Diagrams.
5.1.8	1-45W760-78-1 R0	Wiring Diagrams Spent Fuel Pit Cooling System Schematic Diagrams
5.1.9	1-45W760-32-1 R2	Wiring Diagrams Control Air System Schematic Diagrams Sh - 1
5.1.10	1-45W760-31-13 R0	Wiring Diagrams Air Conditioning System Schematic Digrams
5.1.11	1-45W760-31-19 R0	Wiring Diagrams Air Conditioning System Schematic Digrams
5.1.12	1-45W760-31-12 R0	Wiring Diagrams Air Conditioning System Schematic Digrams
5.1.13	1-45W760-30-26 R0	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.14	1-45W760-70-2 R3	Wiring Diagrams Component Cooling System Schematic Diagrams.
5.1.15	1-45W760-70-1 R4	Wiring Diagrams Component Cooling System Schematic Diagrams.
5.1.16	1-45W760-62-2 R1	Wiring Diagrams Chemical & Volumn Control System Schematic Diagrams.
5.1.17	1-45W760-31-14 R0	Wiring Diagrams Air Conditioning System Schematic Diagrams.
5.1.18	1-45W760-31-11 R0	Wiring Diagrams Air Conditioning System Schematic Diagrams.
5.1.19	1-45W760-30-14 R0	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.20	1-45W760-30-13 R0	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.21	1-45W760-30-12 R0	Wiring Diagrams Ventilating System Schematic Diagrams.

THIS SHEET ADDED BY REV 6

5.0 REFERENCES (Continued)

5.1 TVA Drawings (Continued):

5.1.22	1-45W760-30-11 R0	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.23	1-45W760-30-10 R1	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.24	1-45W760-30-9 R1	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.25	1-45W760-30-8 R1	Wiring Diagrams Ventilating System Schematic Diagrams.
5.1.26	1-45W760-26-1 R0	Wiring Diagram Hi Press Fire Protection System Schematic Diagrams.
5.1.27	1-45W760-31-17A R0	Wiring Diagrams Air Conditioning System Schematic Diagrams.
5.1.28	1-45W760-31-17 R0	Wiring Diagrams Air Conditioning System Schematic Diagrams.
5.1.29	1-45W760-212-3 R0	Wiring Diagrams 480V Shutdown Power Schematic Diagrams.
5.1.30	1-45W760-212-2 R0	Wiring Diagrams 480V Shutdown Power Schematic Diagrams.
5.1.31	1-45W760-212-1 R0	Wiring Diagrams 480V Shutdown Power Schematic Diagrams.
5.1.32	1-45W703-1 R1	Wiring Diagram Vital Battery Board I Single Line - Sheet 1
5.1.33	1-45W703-5 R1	Wiring Diagrams 125V Vital Btry Board I Pnl 4 Connection Diagram Sht 5
5.1.34	1-45W760-82-6 R0	Wiring Diagram Standby Diesel Generator Sys Schematic Diagrams

5.2 Vendor dwg. Contract No. 75-85354, BME 16786 Sht 5 of 5. Wolfe & Mann Mfg. Co. - Bill of Materials

5.3 TVA Baseline Calculation WBN EEB-MS-TI11-0003 R3, 125V DC Vital Battery and Charger Capacity Evaluation

5.4 TVA Baseline Calculation WBN EEB-MS-TI07-0005 R5, 125V DC Vital Control Power System Fault Calculations

THIS SHEET ADDED BY REV 6

5.0 REFERENCES (Continued)

5.5 DCN S-12854-A Master fuse list (MFL) DCA 12854-37 R0 Master Fuse Report System 212 Safety Related

5.6 TVA memorandum "Peak Let Through Current Test" dated October 27, 1987, RIMS #E13871027167.

6.0 DESIGN INPUT DATA

6.1 Relay "KIA" Potter & Brumfield #MDR5058 has a load of 0.082 Amps (Ref. 5.3 Sheet 192).

6.2 Control Bus indicating light load is 0.05 Amps (Ref. 5.4 section 6.1 attachment M-17941-A Sheet 5)

Calcualtion No. WBN EEB-MS-TI07-0005
Attachment No. M-18173-A
125V DC Vital Control
Power System Fault Calculations

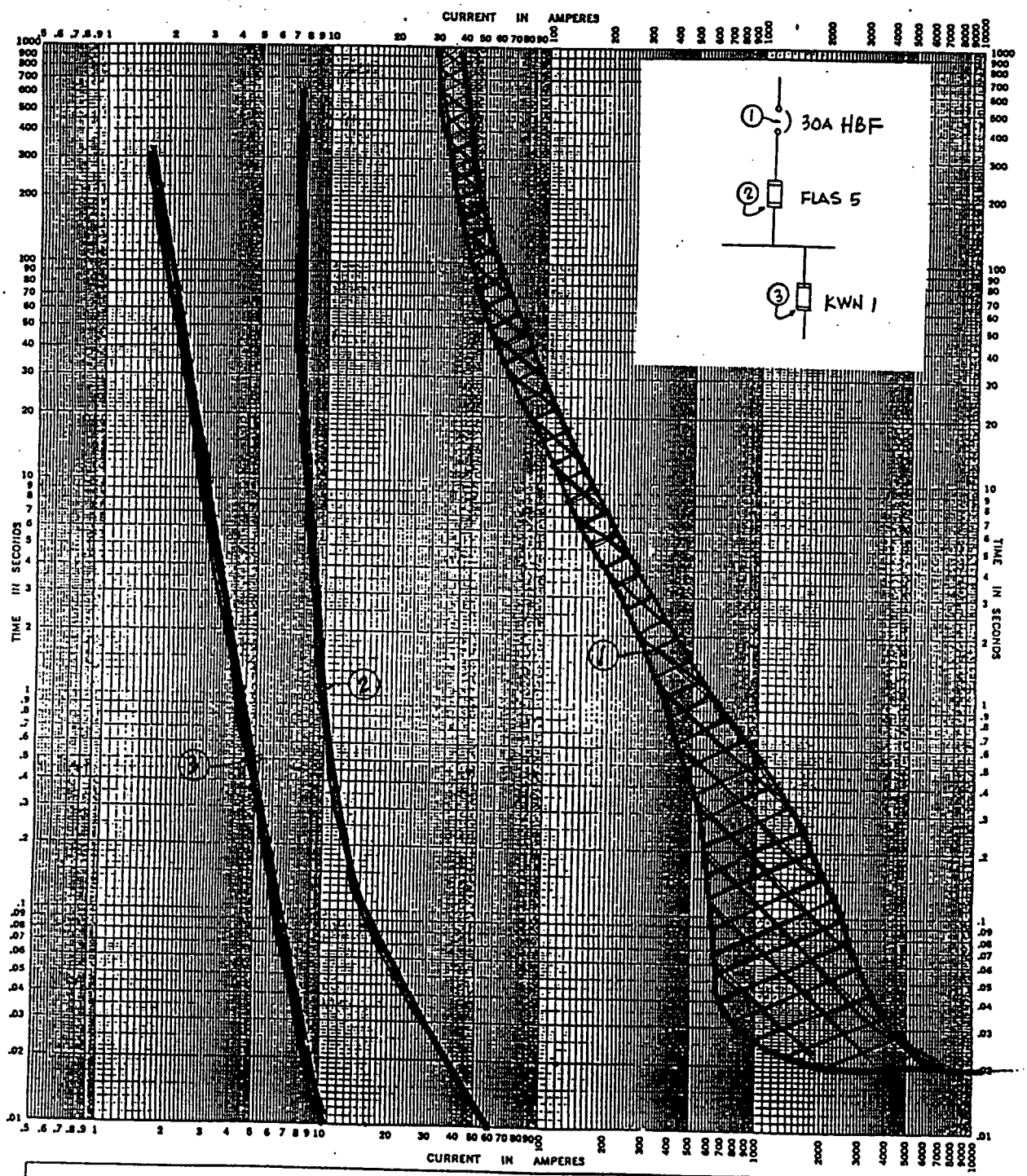
Prepared by Philip Ban Date 4/1/92

Checked by [illegible] Date 4-16-92

Sheet 7

7.0 COMPUTATION/ANALYSIS

7.1 Time Current Curve



1606x

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7.2 Some of the fuse types being used in the Low Voltage Switchgear (LVSG) are not standard fuse sizes and types (Ref. 5.4 Attachment M-12564-A Pg 5 of 8).

7.2.1 Shutdown board rooms A & B, AHU A-A (Ref. 5.1.5) fuses 1-FU-212-A29/32 should be KWN 10 fuses in lieu of KLC 10 fuses (Ref. 5.4 Attachment M-12564-A Pg 5 of 8). The KWN 10 fuse coordinates with the upstream 30A circuit breaker protection (Ref. 5.4 Curve No. 10 Pg 33).

7.2.2 Elect Board Room Air Handling Unit A-A, 0-MTR-31-30B-A (Ref. 5.1.10) fuses 1-FU-212-A19/21 should be KWN 10 fuses in lieu of KLC 10 fuses (Ref. 5.4 Attachment M-12564-A Pg. 5 of 8). The KWN 10 fuse coordinates with the upstream 30A circuit breaker protection (Ref. 5.4 curve No. 10 Pg 33).

7.2.3 480V Shutdown board 1B1-B normal feeder breaker 52N (1-BKR-212-B1/1B-B), 480V Shutdown board 1A1-A bus tie breaker 52T (1-BKR-212-A1/12D-A) and 480V shutdown board 1B1-B alternate feeder breaker 52E (1-BKR-212-B1/4B-B) [Ref. 5.1.30]. The following indicating light protection/isolation fuses for the above listed boards should be changed from 1A-FRN R1 fuse & 6A-KWN 6 fuse to 1A-KWN R1 fuses (Ref. 5.4 Attachment M-12564-A Pg 5 of 8). Refer to section 6.1 and Section 7.4 of attachment M-17941-A (Ref 5.4) for 1 Amp fuse loading acceptance criteria with two (2) indicating lights.

a) 1-FU-212-B11/15, 16 & 17
b) 1-FU-212-A112/35, 36 & 37
c) 1-FU-212-B14/15, 16 & 17

7.2.4 480V Shutdown board 1A1-A normal feeder breaker 52N (1-BKR-212-A1/1B) and 480V Shutdown board 1-A1-A Alternate feeder breaker 52E (1-BKR-212-A1/4B)[Ref.5.1.7]. The following indicating light protection isolation fuses should be changed from 1A-FRN R1 fuse & 6A-KWN 6 fuse to 1A, KWN R1 fuses (Ref. 5.4 Attachment M-12564-A Pg 5 of 8). Refer to section 6.1 and Section 7.4 of attachment M-17941-A (Ref. 5.4).

7.3 Some of the fuse numbers shown on TVA dwg. 1-45W760-78-1 (Ref. 5.1.8) are not listed in the Master Fuse List (MFL)[Ref. 5.5].

7.3.1 Fuses 1-FU-212-A17/2 & B29/2 should be a KWN 10 fuse (Trip circuit). The KWN 10 fuse coordinates with the upstream 30A circuit breaker protection (Ref. 5.4 curve No. 10 Pg 33).

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7.0 COMPUTATION/ANALYSIS (Contd)

7.4 Selective coordination does not exist within the Diesel Generator remote control circuit for Diesels 1A-A, 1B-B, 2A-A & 2B-B (Ref. 5.1.34).

7.4.1 Fuse 0-FU-236-1/C19 5A, FLAS 5 for Diesel Generator 1A-A remote control circuit (Ref. 5.1.34) coordinates with it's 30A upstream circuit breaker protection (Ref. 5.6 conclusion page 4 of 5). However, the FLAS 5 fuse will not coordinate with the downstream FLAS 5 fuses.

A larger indicating fuse (MIS 10 Amp) would be required to replace the existing FLAS 5 fuse (0-FU-236-1/C19) to achieve coordination. However, the MIS 10 Amp fuses are not qualified for class 1E circuits. The existing FLAS 5 fuse will remain unchanged, and since loss of any of the upstream or downstream FLAS 5 fuses will have the same effect on the circuit, loss of the diesel indication in the control room, No benefit is derived by achieving fuse coordination. Changing the 6A KWN 6 fuse to a 1A KWN 1 fuse will increase this portion of the circuits reliability through coordination of these downstream fuses.

7.4.2 Fuse 1-FU-82-CDP/A1, 6A KWN 6 is for relay 'KIA' (Ref. 5.1.34). The upstream protection is a 5A FLAS 5 fuse, the KWN 6 fuse will not coordinate with the FLAS 5 fuse. However, a 1A KWN 1 fuse will coordinate with the FLAS 5 (section 7.1 Time Current Curve & Ref. 5.4 Attachment M-17941-A, Appendix "A" Bussman test report MKT-14-HPL). The 'KIA' relay load is 0.082A (Sect 6.1), 0.082A x 125% = 0.103A. For fuse loading a KWN 1 fuse can be utilized in lieu of the KWN 6 fuse. The 1 Amp fuse has a current rating greater than 125% of the load current.

8.0 SUMMARY OF RESULTS

8.1 Some of the fuses being used in the Low Voltage Switchgear (LVSG) are not the type specified on the boards and are not standard fuse sizes and types (Ref. 5.4 Attachment M-12564-A Pg 5 of 8)

8.1.1 Shutdown Board Rooms A & B, AHU A-1A (Ref 5.1.5). Fuses 1-FU-212-A29/32 should be KWN 10 fuses.

8.1.2 Elect board room air handling unit A-A 0-MTR-31-30B-A (Ref. 5.1.10). Fuses 1-FU-212-A19/21 should be KWN 10 fuses.

8.1.3 480V Shutdown Board 1B1-B Normal Feeder Breaker 52N (1-BKR-212-B1/1B-B), 480V Shutdown Board 1A1-A bus tie breaker 52T (1-BKR-212-B1/4B-B)[Ref. 5.1 .30]. The following indicating light protection/isolation fuses should be changed from 1A-FRN R1 & 6A-KWN 6 to 1A KWN - R1 fuses.

a) 1-FU-212-B11/15, 16 & 17
b) 1-FU-212-A112/35, 36 & 37
c) 1-FU-212-B14/15, 16 & 17

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.0 CONCLUSIONS (Contd)

9.4 A 1A, KWN R1 fuse is an acceptable replacement fuse for the following:

a) 1-FU-212-B11/15, 16 & 17
b) 1-FU-212-A112/35, 36 & 37
c) 1-FU-212-B14/15, 16 & 17
d) 1-FU-212-A11/15, 16 & 17
e) 1-FU-212-A14/15, 16 & 17
f) 1-FU-82-CDP/A1

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8.0 SUMMARY OF RESULTS (Contd)

8.1.4 480 Shutdown board 1A1-A normal feeder breaker 52N (1-BKR-212-A1/1B) and 480V shutdown board 1A1-A alternate feeder breaker 52E (1-BKR-212-A1/4B)[Ref. 5.1.7]. The following indicating light protection/isolation fuses should be changes from 1A-FRN R1 & 6A-KWN 6 to 1A, KWN R1 fuses.

a) 1-FU-212-A11/15, 16 & 17
b) 1-FU-212-A14/15, 16 & 17

8.2 Some of the fuse numbers on TVA dwg. 1-45W760-78-1 (Ref. 5.1.8) are not listed in the master fuse list (MFL)[Ref. 5.5].

8.2.1 Fuses 1-FU-212-A17/2 & B29/2 should by a KWN 10 fuse (Trip circuit).

8.3 Selective coordination does not exist within the Diesel Generator remote control circuit for Diesels 1A-A, 1B-B, 2A-A & 2B-B (Ref. 5.1.34).

8.3.1 Fuse 0-FU236-1/C19 5A, FLAS 5 for Diesel Generator 1A-A remote control circuit (Ref. 5.1.34) coordinates with it's 30A upstream circuit breaker. However, the FLAS 5 fuse will not coordinate with the downstream FLAS 5 fuses.

Since loss of any of the upstream or downstream FLAS 5 fuses will have the same effect on the circuit, loss of the diesel indicator in the control room, no benefit is derived by fuse coordination. However, the 6A KWN 6 fuse change to a 1A KWN 1 fuse will increase this portion of the circuits reliability through coordination of these fuses.

8.3.2 Fuse 1-FU-82-CDP/A1, 6A KWN 6 is for relay 'KIA' (Ref. 5.1.34). The upstream protection is a 5A FLAS 5 fuse, the KWN 6 fuse will not coordinate with the FLAS 5 fuse. However, a 1A KWN 1 fuse will coordinate with the FLAS 5 (Section 7.1 time current curve). The 1 Amp fuse has a current rating greater than 125% of the load current.

9.0 CONCLUSIONS

9.1 A 10A, KWN 10 fuse is an acceptable replacement for the 10A, KLC 10 fuse within Shutdown Board Rooms A & B, AHU A-A circuit. (Ref. 5.1.5)

9.2 A 10A, KWN 10 fuse is an acceptable replacement for the 10A, KLC 10 fuse within Elect Board Room Air Handling unit A-A circuit. (Ref. 5.1.10)

9.3 Fuses 1-FU-212-A17/2 & B29/2 should be added to the Master Fuse List (Ref. 5.5) as a 10A, KWN 10 fuse (Trip circuit).

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