EBASCO SERVICES INCORPORATED

BY THE DATE D. E-18-88 [ED-Q0281-?8139] SHEET 78 OF 94

C-K'D. BY [illegible] DATE 5/18/88 ATTACHMENT-10 OFS NO. _____ DEPT. NO. _____

CLIENT TVA

PROJECT BFNP UNIT-2

SUBJECT FUSE PROGRAM (250 V. DC REACTOR MOV BOARDS 2A, 2B, 2C)

BC CONTACT ARR C. ATTACH

Model or Type	Manufacturer	Device	Contact Volts DC	Ripple Break Contact Inductive Rating	Ripple Break Contact Non-Inductive Rating	Coil Volts DC	Coil Current	Information Source
[illegible]	General Electric (b)	Relay	24 48 125 250	4.0A 3.0A 1.0A 0.3A	1A	200-280	=0.031A at 250VDC	GE Manual Section 7297, Page 5 Dated 6/4/79
[illegible]	General Electric	Relay	32 48 125 250	5.0A 3.0A 1.0A 0.25A	.3A	200-280	=.016A at 250VDC	CDR-1793 Memo QIR 8706230001 GE Manual Section 7293, Page 3
CR2940	General Electric (a)	Relay	240	0.2A 0.02A		165-280	.015A(Hold) =.600A (P.U.) at 250VDC	CEP-1260C, Page 367 Memo QIR 8706220001 GE letter BAJ-86-317 010
[illegible] Series	Agastat (c)	Relay	30 110 280	0.10	15A 1A .5A	96-144 200-280	.064A at 130VDC .032A at 250VDC	Brochure 70-1 1982 Agastat Timing Relay, 7000 Series Amerace Corp letter dated 11/6/73 (no accession number)
E7000 Series	Agastat	Relay	30 110 280	0.10	15A 1A .5A	130-140 200-280	.064A at 130VDC .032A at 250VDC	Brochure E70-1 1982 Agastat E7000 Series Amerace Corp letter dated 7/31/85 (BAJ 850806 005) Amerace Corp letter dated 11/6/73 (no accession number)

[illegible] being tested at 280/256V dc at TVA lab for inductive rating listed.
[illegible] ANSI/IEEE C37.90-1978 Requirements for Auxiliary Relays.

Page 1
DW137.03

EXTRACTED FROM
PM86-07

EBI 9-87

EBASCO SERVICES INCORPORATED

BY THIS DOC [illegible]-88 [ED-Q0281-88139] SHEET 79 OF ± 4

CHKD. BY CCO/[illegible] DATE 5/18/88 ATTACHMENT-11 OFS NO. _____ DEPT. NO. _____

CLIENT VA

PROJECT 3FNP UNIT-2

SUBJECT FUSE PROGRAM / 250V. DC REACTOR MOV BOARDS 2A, 2B 2C)

250V DC RMOV BD-2C FHB 2A

RCIC TURBINE TRIP SOLENOID XX-71-9 DWG 6FN6796-0, P.R

COMPONENT	LOCATION	MANUFACTURER / MODEL NO	VENDOR REF.	RATINGS (AMPS) CONTIN/VOLT	RATINGS (AMPS) MOM/LOCK/INTERRUPT	VOLTS	REMARKS
TRIP SOLENOID XX-71-9 (a)	PNL 13-2	[illegible]	[illegible]	0.1A	—	250	[illegible]
TRIP SOLENOID INTERLOCK (b)	PNL 13-2	[illegible]	—	0.076	—	250	[illegible]
[illegible] 1500Ω	PNL 13-2	—	—	0.0167	—	250	DWG 6FN6796-0 P.R
		TOTAL LOAD		0.2327			* CONTINUOUS VALUE [illegible]

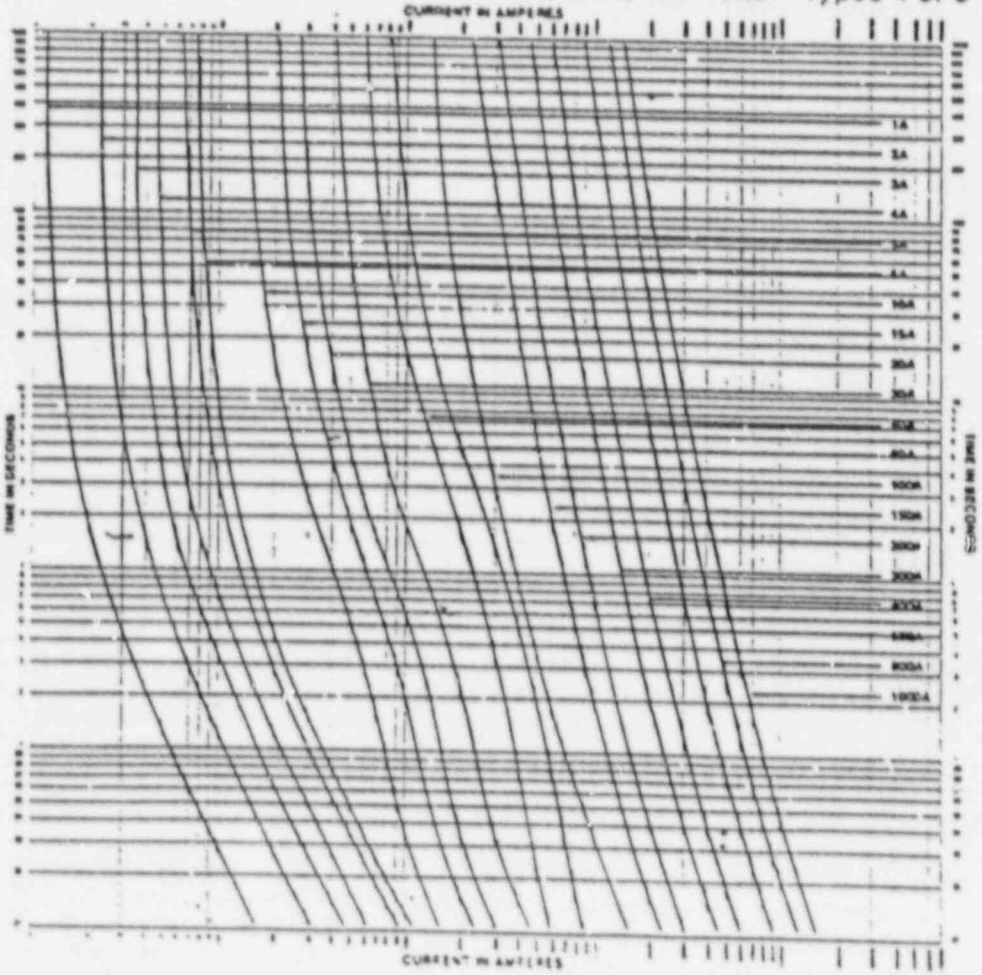
RIMS # B43870805917 SHEET #114

581 9-87

GOULD SHAWMUT

Amp-trap®
Form 600 Fuses
A2Y/A6Y

Melting Time—Current Data
1-600 Amperes, 250 or 600 Volts—Types 1, 3 or 5
650-1200 Amperes, 600 Volts—Types 4 or 5



EBASCO SERVICES INCORPORATED

BY THS EMS DATE 5-18-88 Q0281-87139] SHT 81 OF 84

CHKD. BY CGO/PS DATE 5/18/88 ATTACHMENT-13 OFS NO. DEPT. NO.

CLIENT TVA

PROJECT BFNP UNIT-2

SUBJECT FUSE PROGRAM (250 V. DC REACTOR MOV BOARDS 2A, 2B, 2C)

Gould Inc. Circuit Protection Division
[illegible]
Manufacturer of Chase-Shawmut and Tron Electric Products

GOULD
Electronics

December 19, 1987

Mr. Dan Baugher
Brown's Ferry Nuclear Plant
Electrical Technical Dept.
Box 2000
Decatur, Al. 35602

Subject: Your Request For Information on Our A6Y(1-60A) Type 11 Fuses

Dear Mr. Baugher:

From your conversation with John Wall on 12/29/87, it is my understanding that you already have a copy of the "Shawmut Advisor." The A6Y type 11 fuses are identical in size to the A2Y type 1 shown on page 63 of the Advisor. The electrical characteristics of the A6Y type 11 are identical to those shown on pages 65 and 66 for the A2Y/A6Y fuses.

I hope this information meets your requirements.

Sincerely,

Alan Wilkinson

Alan Wilkinson
Applications Engineering Manager

cc: J. Wall

AW/ss

581 9-87

EBASCO SERVICES INCORPORATED

BY THE DMS 5-18-88 [ED-Q0281-88139] SHEET 82 OF 84

CHKD. BY CCO/CB: DATE 5/18/88 ATTACHMENT-14 OFS NO. ______ DEPT. NO. ______

CLIENT TVA

PROJECT BFNP UNIT-2

SUBJECT FUSE PROGRAM (250 V. DC REACTOR MOV BOARDS 2A, 2B, 2C)

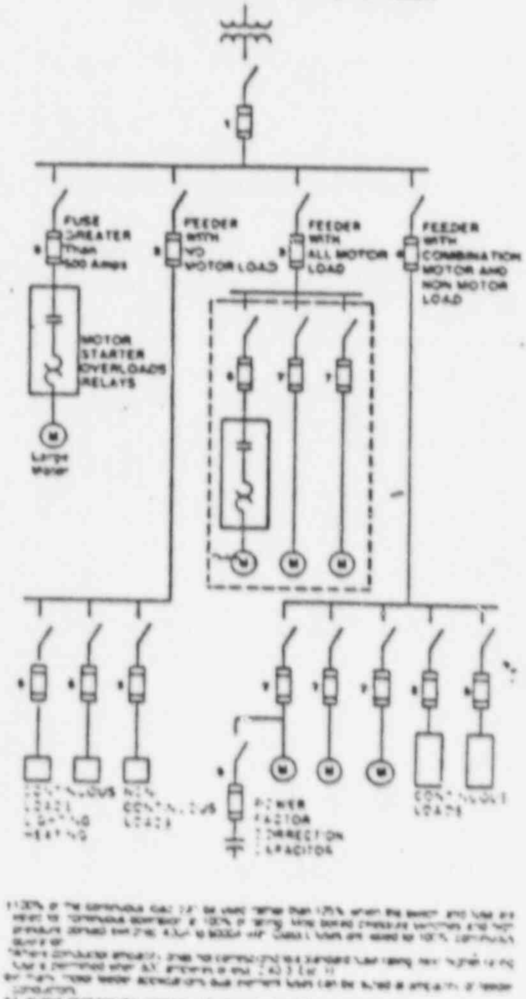
Section 3—Main, Feeder, Branch Circuit Protection

3.1 Guide For Sizing Fuses

General guidelines are given for selecting fuse ampere ratings for most circuits. Some specific applications may warrant other fuse sizing; in these cases the load characteristics and appropriate N.E.C. sections should be considered. The selections shown here are not, in all cases, the maximum or minimum ampere ratings permitted by the N.E.C. Demand factors as permitted per the N.E.C. are not included in these guidelines.

Fuse Recommendations

601 to 6000A HI-CAP Time-Delay Fuse KRP-C
1/4 to 600A LOW-PEAK Fuses LPN-RK (250V), LPS-RK (600V), or FUSETRON Fuses FRN-R (250V), FRS-R (600V)



†125% of the continuous load [illegible] be used rather than 125% when the switch and fuse are rated for continuous operation at 100% of rating. [illegible] continuous duty.
*Where conductor ampacity does not correspond to a standard fuse rating, next higher rating fuse is permitted when 800 amperes or less [illegible]
[illegible] feeder applications dual element fuses can be sized at ampacity of feeder conductors.
[illegible] short circuit current and the clearing time of the overcurrent device must be considered so that the conductor's [illegible] withstand rating is not exceeded.

Dual-Element Time-Delay Fuses (LOW-PEAK® or FUSETRON®)

1 **Main Service.** Size fuse according to method in 4.

2 **Feeder Circuit With No Motor Loads.** Fuse size must be at least 125% of continuous load† plus 100% of the non-continuous load. Do not size larger than ampacity of conductor*.

3 **Feeder Circuit With All Motor Loads.** Size fuse at 150% of full load current of largest motor plus full-load current of all other motors.

4 **Feeder Circuit With Mixed Loads.** Size fuse at sum of
  a. 150% of full-load current of largest motor plus
  b. 100% of full-load current of all other motors plus
  c. 125% of continuous, non-motor load† plus
  d. 100% of non-continuous, non-motor load.

5 **Branch Circuit With No Motor Load.** Fuse size must be at least 125% of continuous load† plus 100% of non-continuous load. Do not size larger than ampacity of conductor*.

6 **Motor Branch Circuit With Overload Relays.** Where overload relays are sized for motor running overload protection, the following provide backup, ground fault, and short-circuit protection:
  a. Motor 1.15 service factor or 40°C rise: size fuse at 125% of motor full-load current or next higher standard size.
  b. Motor less than 1.15 service factor or over 40°C rise: size fuse at 115% of motor full-load current or next higher standard size.

7 **Motor Branch Circuit With Fuse Protection Only.** Where the fuse is the only motor protection, the following fuses provide motor running overload protection and short-circuit protection.
  a. Motor 1.15 service factor or 40°C rise: size fuse at 110% to 125% of the motor full load current.
  b. Motor less than 1.15 service factor or over 40°C rise: size fuse at 100% to 115% of motor full load current.

8 **Large Motor Branch Circuit**—Fuse larger than 600 amps. For large motors, size KRP-C HI-CAP® time-delay Fuse at 150% to 225% of the motor full load current, depending on the starting method; i.e. part-winding starting, reduced voltage starting, etc.

9 **Power Factor Correction Capacitors**—Size Dual Element fuses as low as practicable, typically 150% to 175% of capacitor rated current.

Non-Time-Delay Fuses (LIMITRON® and T-TRON® fuses, typically)

1 **Main service.** Size fuse according to method in 4.

2 **Feeder Circuit With No Motor Loads.** Fuse size must be at least 125% of the continuous load† plus 100% of non-continuous load. Do not size larger than ampacity of wire.

3 **Feeder Circuit With All Motor Loads.** Size fuse at 300% of full-load current of largest motor plus full-load current of all other motors.

4 **Feeder Circuit With Mixed Loads.** Size fuse at sum of
  a. 300% of full-load current of the largest motor plus
  b. 100% of full-load current of all other motors plus
  c. 125% of continuous, non-motor load† plus
  d. 100% of non-continuous, non-motor load.

5 **Branch Circuit With No Motor Loads.** Fuse size must be at least 125% of the continuous load† plus 100% of the non-continuous load. Do not size larger than the ampacity of conductor*.

6 **Motor Branch Circuit With Overload Relays.** Size the fuse as close to but not exceeding 300% of the motor running full load current. Provides ground fault and short-circuit protection only.

7 **Motor Branch Circuit With Fuse Protection Only.** Non-time-delay fuses cannot be sized close enough to provide motor running overload protection. If sized for motor overload protection, non-time-delay fuses would open due to motor starting current. Use dual-element fuses.

Conductor Ampacity Selection

1 **Feeder Circuit And Main Circuit With Mixed Loads.** Conductor ampacity at least sum of
  a. 125% of continuous non-motor load†
  b. 100% of non-continuous non-motor load
  c. 125% of the largest motor full load current
  d. 100% of all other motors full load current

2 **Feeder Circuit With No Motor Load.** Conductor ampacity at least 125% of the continuous load† plus 100% of the non-continuous load.

3 **Feeder Circuit With All Motor Loads.** Conductor ampacity at least 125% of the largest motor full load amperes plus 100% of all other motors full load amperes.

4 **Feeder Circuit With Mixed Loads.** Size according to Method 1 above.

5 **Branch Circuit With No Motor Load.** Conductor ampacity at least 125% of the continuous load† plus 100% of the non-continuous load.

6, 7, & 8 **Motor Branch Circuits.** Conductor ampacity at least 125% of the motor full load current.

9 Conductor ampacity at least 135% of capacitor rated current. The ampacity of conductors for a capacitor connected to a motor circuit must be [illegible] the ampacity of the motor circuit conductors.

581 9-87

UNITED STATES GOVERNMENT

Memorandum

R40 860919 800

TENNESSEE VALLEY AUTHORITY

TO : E. O. Hill, EQ Project Manager, Browns Ferry Nuclear Plant

FROM : Robert L. Lewis, Plant Manager, Browns Ferry Nuclear Plant

DATE : SEP 23 1986

SUBJECT: BROWNS FERRY NUCLEAR PLANT (BFN) - ELECTRICAL ISSUES VENDOR/PLANT INTERFACE

Plant staff and Electrical Engineering Branch, Knoxville, attended meetings with Bechtel Corporation at the Bechtel Gaithersburg, Maryland offices for discussions on the electrical calculation program July 20 and 21, 1986. From these discussions, a series of questions were raised by the Bechtel staff concerning BFN plant configuration and operational assumptions to be incorporated into the electrical calculations. The following is a formal summary of the response to those questions.

1. The following float voltages and equalization charges should be applied to the DC power study.

Battery System	Float Volt.	Equalization Volt.
250 V	267.0 + 3.0 V	277.8 + 1.8 V
125 V (Dg)	133.5 + 1.5 V	138.9 + 0.9 V
125 V (Cap)	124.6 + 1.4 V	131.88 + 1.4 V
24 V	26.7 + 0.3 V	27.98 + 00.18 V
48 V	53.4 + 0.6 V	55.56 + 0.36 V

2. Plant staff has determined from the manufacturer's drawings the unit 2 control room HVAC chillers have an internal 10-minute (unit 3, 15-minute) time delay before restarting, following a loss of power. This feature provides protection for the compressors.

3. The unit 2 reactor building closed cooling water pumps will not auto-restart following a loss of offsite power.

4. The residual heat removal (RHR) shutdown cooling suction valve will not be manually or autocycled within 30 minutes following an accident (on the accident unit).

5. The unit 1 and 2 drywell blowers will not auto-restart following a loss of offsite power.

6. The reactor building and drywell floor drain pumps will only autostart on a intermittent basis during a normal plant shutdown, and as such, should not be considered a continuous power load on the shutdown boards.

EBASCO SERVICES INCORPORATED

BY THE DMS DATE 5-18-88 [ED-Q0281-88139]

CHKD. BY CCO/RB DATE 5/18/88 ATTACHMENT - 16 OFS NO _____ SHT 84 OF 84 DEPT. NO. _____

CLIENT TVA

PROJECT BFN UNIT 2

SUBJECT FUSE PROGRAM (250V DC REACTOR MOV BOARDS 2A, 2B, 2C)

05 01 88 09:22 AM GOULD CPD SLS MKTG PG1

GOULD INC., CIRCUIT PROTECTION DIVISION

FACSIMILE TRANSMISSION

TO: Bo Wier
EBASCO

DATE: 5/18

FROM: [illegible]
Applications Engineering
Phone: (617) 468-5181
Fax: (617) 468-6418

Number of pages: 2 (including this page)

Please notify me if you do not receive all pages.

5.01.2

11/86

D.C. VOLTAGE RATINGS OF GOULD FUSES

Catalog Number	Ampere Ratings	DC Voltage Rating	Comments
TR-R	0-12, 35-60, 101-600	250	4, 5
TR-R	15-30, 70-100	200	4, 5
TRS-R	0-12	600	1, 2, 5
TRS-R	15-30	300	2, 5
TRS-R	35-60	300	2, 5
TRS-R	65-600	600	1, 2, 3, 5
A4BY	601-1600	300	4, 5
A4BY	1601-6000	250	4, 5
A4BT	601-2000	500	4, 6
A2K-R	0-600	250	4, 5
A6K-R	0-600	300	4, 5
FT-R	0-600	250	4, 5
FTS-R	0-600	300	4, 5
CT	0-600	250	4, 5
CTS	0-600	300	4, 5
A4J	0-600	300	4, 5
A2Y	1-600	500	4, 5
A6Y	1-600	500	4, 5
A6Y	601-2000	250	4, 5
AIM	1/4-30	500	4, 5
A5Y Type2	1/4-30	500	4, 5
A6Y Type11	1-60	500	4, 5
A6Y Type21	61-600	500	4, 5
TI-600	-	600	4, 5
A4BQ	601-2000	500	2, 6

COMMENTS

1. MSHA Certified
2. Listed to UL198L
3. Listed to UL198M
4. Tested to UL198L parameters but not listed
5. DC Interrupting ratings are 20KA
6. DC Interrupting Ratings are 100KA

LABELING: Fuses which are MSHA Certified, or UL listed to 198L or 198M will include the DC voltage rating on the fuse label.

581 9-87

Q. A. Record

TV-72I64A
TSD-E044

EBASCO SERVICES INC
CONTROL OF CALCULATION AND CHECK LIST
(CCCL) Sheet 1 of 3

ED-Q0281-88139

NO	TASK	TASK PERFORMED	LEAD ENGINEER OR DESIGNEE
1	Assign Calculation Preparer	Name: Trilo Bhatt TNB	A. Lane 5/16/88
2	Advise preparer to follow technical direction provided by discipline branch (guides, standards, instructions, procedures etc) during pre-preparation of calculation.	YES 5/18/88	Bollue 5/18/88
3	Enter calculation identifier/ title into calculation log.		Bollue 5/18/88
4	Assign calculation verifier.	YES 5/18/88 Name: Intree Suphamark	Bollue 5/18/88
5	Is Interface review required? Yes or (No)	a) If "NO" Explain: No input from other disciplines required, No impact to other disciplines. b) If "YES", with whom?	
6	Does the calculation contain unverified assumptions?	Yes (No) If "YES"	
7	Was computer program used in performing calculation?	Yes (No) If "YES" answer questions below:	
7.1	If "YES" is code verified, documented and controlled in accordance with Ebasco Procedure A-30.	Controlled User's Manual No. N/A	
7.2	Was the calculation verified independent of unverified code.	If "YES" Evidence: N/A If "NO" Resolve: N/A	
7.3	Is software version, computer input and computer output documented?	Evidence: N/A	

Ebasco QR
No. of pages 3
RD N/A
Final [illegible] 5-20-88

C037

EBASCO SERVICES INC ED-Q0281-88139
CONTROL OF CALCULATION AND CHECK LIST
(CCCL) Page 2 of 3

ITEM NO	ITEM	YES OR NA PREPARER	YES OR NA VERIFIER
8	Is the problem stated clearly and completely?	YES THB 5/18/88	YES DB: 5/18/88
9	Is design input clearly identified and complete?	YES THB 5/18/88	YES DB: 5/18/88
10	Are references correctly listed?	YES THB 5/18/88	YES DB: 5/18/88
11	Are formula and equation, defined and referenced with the exception of AISC or Blodgett?	YES THB 5/18/88	YES DB: 5/18/88
12	Is conclusion statement added, clear and correct?	YES THB 5/18/88	YES DB: 5/18/88
13	Is the drawing revision number identified in the calculation?	YES THB 5/18/88	YES DB: 5/18/88
14	Are all comments by the checker incorporated or otherwise reconciled?	YES THB 5/18/88	YES DB: 5/18/88
15	Are all attachments identified and labeled?	YES THB 5/18/88	YES DB: 5/18/88
16	Are superceded original calculations marked superceded, or made part of historical copy?	N/A THB 5/18/88	N/A DB: 5/18/88
17	Are all calculation sheets initialed and dated by preparer and verifier?	YES THB 5/18/88	YES DB: 5/18/88
18	Are all calculation sheets and attachments arranged properly?	YES THB 5/18/88	YES DB: 5/18/88
19	Is the calculation log properly filled out?	YES THB 5/18/88	YES DB: 5/18/88
20	Is the cover sheet properly filled out?	YES THB 5/18/88	YES DB: 5/18/88
21	Is construction and operation experiences considered?	N/A THB 5/18/88	N/A DB: 5/18/88
22	Are appropriate calculation methods used?	YES THB 5/18/88	YES DB: 5/18/88
23	Is output verified to be reasonable compared to inputs?	YES THB 5/18/88	YES DB: 5/18/88
24	Is adequate system performance, safety margins, etc considered?	YES THB 5/18/88	YES DB: 5/18/88

TV-72164A
TSD-E044

EBASCO SERVICES INC
CONTROL OF CALCULATION AND CHECK LIST
(CCCL) Page 3 of 3

ED-Q0281-88139

ITEM NO	ITEM	YES OR NA PREPARER	YES OR NA VERIFIER
25	Are unverified assumptions that require subsequent verification, identified?	N/A THB 5/18/88	N/A. DB: 5/18/88
26	Drawings listed in section 4.0 of this calculation were checked for revision level at completion of the calculation.	YES THB 5/18/88	YES, DB: 5/18/88

Gudan/JRD 5-18-88

C037

BFN FUSE SUBSTITUTION PROGRAM
CONTROL DOCUMENT BF 6.12

Tennessee Valley Authority
Sequoyah Nuclear Plant
Site Director Standard Practice

DEC 10 1987

Form Page 1 of 1
Form
SDSP

FORM SDSP-1
PROCEDURE AND INSTRUCTION REVIEW AND APPROVAL COVER SHEET

(for SPS use only)

Unit	Procedure No.	2-digit Tracking No.	Title	Revision No.
ALL	SF 6.12	03	FUSE CONTROL	2

CHECK AS APPROPRIATE: [✓] Permanent Change [ ] Cancellation [ ] New procedure
[ ] Temporary change (Expiration date if less than 120 days after approval _____)

Originator list affected pages & forms: ALL-GENERAL

SPS list pages affected after word processing: (None)

ORIGINATOR: DANIEL BAUGHER (print your name) Date 24-88 Section ETS Phone 3147

ELECTRICAL TECHNICAL SECTION
Name of Responsible Section

XI [signature] 2/10/88
RSPC Signature [signature] Date 2-11-88

Technical Review Required? [✓] Yes [ ] No
Initials of Responsible Section Supervisor making determination: RMR

XI RM Rogers 6/13/88
Responsible Section Supervisor Date
(Signature AFTER any required Technical Review)

PRINCIPAL MANAGERS CONCURRENCE SIGNATURES	DATE
☐ Assistant to Site Director	
☐ Site Planning & Scheduling	
☐ Site Services Manager	
☐ Manager of Site Licensing	
☐ Project Management Manager	
☒ [signature] Project Engineer (DNE)	5/31/88
☐ Modifications Manager	
☐ Materials & Procurement Svcs Mgr	
☐ Financial Services Manager	
☐ Manager:	

QA review Required? [✓] Yes [ ] No
XI E.R. Thom Site Quality Manager 6/3/88 Date

If not QA approved by a Section Supervisor, mark the following approvals "NA."

PORC review required? [✓] Yes [ ] No
X [signature] PORC Chairman or PORC Minutes No. 6/7/88 Date
XI [signature] Plant Manager or PORC Minutes No. 6/14/88 Date

Retention Period: Lifetime

AFFECTED SECTIONS CONCURRENCY SIGNATURES	DATE
☒ [signature] Operations (UZ Supt)	5/31/88
☐ Vendor Manual Coordinator	
☐ Fire Protection Engineer	
☐ Safety Supervisor	
☐ RADCON Supervisor	
☐ Security	
☐ PORS Supervisor	
☐ Training Supervisor	
☐ Section:	
☐ Section:	
☐ Section:	
XI [signature] Site Procedures Staff Supervisor	5-31-88
☐ Site Director (SDSPs only)	Date

Responsibility: Document Control

BFN DRAFT
CONTROLLED COPY

HISTORY OF REVISION/REVIEW

REV. NO.	DATE	REVISED PAGES	REASON FOR CURRENT REVISION
	07/26/85	All	General revision in response to NRC commitment to control fuses. This document supersedes EMI-92 and OSIL-99. (841217-01)
	12/24/85	1-4,10	Correct wrong elevation and add 4KV SD Board 3ED to locations for this instruction. Including reference EMI-92. Clarification of the fuse labeling program and responsibilities (851107-07)
0	06/05/86	3	To change responsibility for the providing copies of BF6.12 to the section responsible for controlling the copies.
1	07/17/87	1	Change distribution locations. Reference the Browns Ferry Fuse Engraving report (Located in Plant DCC Office) as the controlled list of fuse Sets. Change TVA Nuclear Facilities Wording to Browns Ferry Nuclear Plant Site. Clarify 4.2, who assigns and places UNIDS After the modifications are complete.
ITCP	10/23/87	1,2,3	Page 1 & 3 to correct reference material title. Page 2 to remove requirement for procuring all fuses at QA level II. Fuses will be procured per BF 16.3.(BF6.12-04)
2	06/14/88	ALL	CAQR BFNP 870175, concurrence to proposed disposition. Reflect needs of operations, plant, power stores, and DNE.

REV 0002

TABLE OF CONTENTS

FUSE CONTROL

[NRC/C] This entire procedure is the result of an NRC commitment to control fuses. See response to NRC Inspection Report 50-260/83-27-08 (L52 830916 892).

1.0 PURPOSE

This standard practice is to ensure proper application, replacement, substitution, and labeling, and verification that fused equipment is in conformance to Electrical Design Standard DS-E1.2.3; DS-E8.1.1; and DS-E8.1.2 before it is accepted into the system.

2.0 SCOPE

This standard practice contains the requirements for replacement, substitution, labeling, and the requirements for inspection of fused equipment before it is placed in service.

3.0 REFERENCES

3.1 Electrical Design Standard DS-E1.2.3, "Master Fuse List and Fuse Labeling"

3.2 Electrical Design Standard DS-E8.1.1, "Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)"

3.3 Electrical Design Standard DS-E8.1.2, "Substitution Standard for Midget and Small Dimension Fuses"

3.4 BF-2.5, Drawing Control

3.5 Browns Ferry Nuclear Plant - Fuse Engraving Report

3.6 BF-16.3, Quality Control of Material, Components, Spare Parts, and Services

3.7 EMI-92, Low Voltage Fuse Replacement Guide

3.8 SEMI-42, Fuse Labeling

3.9 DNES 8.31, "Component Identification - Browns Ferry Nuclear Plant"

3.10 DNES 8.32, "Component Identification Implementation for Browns Ferry Nuclear Plant"

3.11 SDSP-7.6, Maintenance Request and Tracking

4.0 INSTRUCTION

4.1 Substitution and Replacement

All substitutions will be documented by Appendix B. All replacements will be documented by MR. Placement of a fuse must be consistent with the fuse label or the Fuse Engraving Report. There will be NO routine substitution of fuses unless specifically permitted. Fuses must be selected for installation in circuits as is indicated on the fuse label or as listed on the Fuse Engraving Report. Electrical schematics and connection diagrams or the EQIS and EEL data bases can be used to aid in the proper location of fuse installations. The individual responsible for fuse installation shall ensure the fuse is free from visual damage prior to installation and shall ensure the fuse(s) are installed in such a manner that the fuse size, type and catalog number are clearly visible.

4.2 Inspection of New Equipment Before Installation

Incoming fused equipment shall be inspected to verify the equipment conforms to this procedure. A fuse installed in a dc circuit should have a dc voltage rating at least equal to the highest dc voltage that could be expected in that system. This is usually the voltage applied during the equalizing charge of the batteries (280V on 250V systems and 140V on 125V systems).

Also, it shall be verified that no renewable fuses or fuse links are installed in the incoming fused equipment. Any fused equipment not meeting these requirements will not be placed in service until proper fuse replacements are made which conform to this procedure.

4.3 Labeling of Fuses in New Equipment

Fuses added or changed in the modification process shall have unique identifying numbers (UNIDS) specifying unit, function, number of fuses in the set, system, load, and fuse catalog number. UNIDS will be assigned and labels placed by the Electrical Technical Section (ETS) after modifications informs ETS that the work plan is complete (until design starts to place UNIDS on the DWGs). Starting November 4, 1988, FDCN's shall be written against ECNs to add fuse UNID labels to equipment and fuse UNIDS to drawings. FDCNs written against ECNs will only be an interim process until all ECNs without fuse UNIDS are complete. ECNs generated after November 3, 1988 shall have fuse UNIDS on drawings by DNE for fuses added or changed. BFNP Electrical Technical Section (ETS) shall be responsible for assigning fuse UNIDs until November 4, 1988. All fuse labeling shall conform to the requirements of Electrical Design Standard DS-E1.2.3. (Appendix D).

4.4 Procurement of Fuses

All fuses shall be procured in accordance with BF-16.3. No "MIN" fuses will be procured or stored at BFN.

4.5 Action to be Taken if a Fuse Operates

REV 0002

When an electrical overload device (Fuse) operates for an unknown reason, check the associated equipment, panel, MOV Board, etc.. For abnormalities to an extent practical under the existing plant operating conditions. If the equipment is not required for continued operation, do not replace the fuse. Initiate an MR to electrical maintenance to investigate the overload. When power must be restored immediately, a replacement may be inserted and an emergency MR written. If a substitution is needed, then submit Appendix B to the Electrical Technical Section to gain approval from DNE-EEB prior to any substitutions being made.

NOTE: Authorized Operations personnel can utilize a substitute in the event of dangerous emergency conditions (imminent catastrophic equipment damage, imminent danger of bodily injury, emergency shutdown of a unit, etc.). This use must be reported to ETS by MR for evaluation before the end of the next regular work day and Appendix B submitted for Design Approval. Appendix C shall be used for fuse substitution in an emergency.

- When a fuse operates for an unknown reason, check the associated equipment, panel, MOV board, etc... for abnormalities to an extent practical under the existing plant operating conditions.

- If the equipment is not required for continued operation, do not replace the fuse. Initiate an MR to Electrical Maintenance to investigate the overload.

- If fuse replacement is necessary, an MR shall be written or verbal approval given by ETS (x3147) prior to the replacement, when time permits.

- When power must be restored immediately, a substitution may be made (per Appendix C). An emergency MR shall then be written to ETS to review and confirm the substitution by the end of the next working day.

- The fuse should not be replaced or substitution made again if it blows a second time. Any action necessary to operate the plant or maintain plant status without the supplied system should be taken in accordance with plant instructions or as directed by the Shift Supervisor.

- If a fuse block is under a hold order tag, operations shall insure the correct fuse (on the UNID label) is placed into the fuse block at the time the tag is removed or an MR will be processed to Electrical Maintenance to replace the fuse (MR should identify the UNID and the incorrect fuse type in the fuse block).

4.6 Labeling of Existing Fuses

The ETS shall be responsible for labeling existing fuses with UNID numbers (BFNP Fuse Engraving Report & SEMI-42) and maintaining all fuse labels.

Controlled copies of this instruction will be issued semiannually and located in the plant at key locations as listed in Appendix A. Operation personnel will distribute this instruction at locations listed in Appendix A.

4.7 Renewable Fuses & Links

Fuses with renewable links shall not be used at BFNP since it is possible to change the internal configuration so that it does not match the ratings indicated on the label. Also, if the connections are not tight, nuisance fuse openings occur.

NOTE: Exceptions

A. Existing 161 kV capacitor switchgear fuses.

B. Existing 4 kV cooling tower capacitor switchgear.

C. Existing 4 kV intake capacitor switchgear.

D. Existing 4 kV high side fuses protecting the transformer on the 4 kV loop lines. (New loads or additions to existing substations are not exempt as of June 1, 1988.)

E. With written approval of ETS.

5.0 RESPONSIBILITIES

Cognizant Modifications Engineers	- Inform ETS (3147) when work plans are complete and provide ETS with information to update Fuse Engraving Report. - Verify incoming fused equipment conforms to this procedure before it is accepted into the system. - Insure UNIDs are added if design has placed them on the DWGs.
Cognizant Modifications Engineers/Craftsman	- Ensure fuse installations conform to this procedure.

5.0 RESPONSIBILITIES (Continued)

Operations Personnel	- Ensure that field fuse replacements and substitutions conform to this instruction. - Write MRs if fuse operates for an unknown reason and/or if a substitution has been made without prior ETS review. - Provide copies of this instruction semiannually to be filed at locations listed in Appendix A. - Determine when emergency situations exist (as defined in Section 4.5 "NOTE") requiring immediate fuse replacement.
Electrical Technical Section	- Reviews all fuse substitutions for correctness. - Labels existing fuses and maintains fuse labels. - Assigns fuse UNID's and installs fuse labels where design has not placed them on the DWGs. - Initiates Appendix B when applicable.
Electrical Craftsman	- Ensure fuse installations conform to this procedure. - Determine cause of overload.
DNE	- Obtain UNIDS (from Electrical Technical Section) and add to drawings for fuses added or changed by ECNs. - Procurement of fuses to meet the requirements of this procedure. - Substitution of procured fuses meet the requirements of this procedure. - Fuses added or changed in ECNs are sufficiently rated for the particular DC application. - Review and respond to Appendix B.

6.0 ATTACHMENTS/APPENDICES/FORMS

Appendix A - Key Plant Locations of BF-6.12
Appendix B - "Interim Fuse Substitution Approval" Form
Appendix C - DS-E8.1.1, Substitution Standard for Low-voltage Power and Control Fuses (600 volts or less); Also DS-E8.1.2, Substitution Standard for Midget and Small Dimension Fuses
Appendix D - DS-E1.2.3, Master Fuse List and Fuse Labeling

7.0 DOCUMENTATION

Maintenance Request, TVA Form 6436, shall be handled per SDSP-7.6.

REV 0002

APPENDIX A
(Page 1 of 1)

KEY PLANT LOCATIONS OF BF-6.12

UNIT 1	-	Shift Supervisor Assistant's Desk, el. 617, Control Bldg.
UNIT 2	-	Shift Supervisor Assistant's Desk, el. 617, Control Bldg.
UNIT 3	-	Shift Supervisor Assistant's Desk, el. 617, Control Bldg.
UNIT 1	-	Auxiliary Instrument Room, el. 593, p-R5, Control Bldg.
UNIT 2	-	Auxiliary Instrument Room, el. 593, p-R8, Control Bldg.
UNIT 3	-	Auxiliary Instrument Room, el. 593, p-R17, Control Bldg.
UNIT 2	-	Relay Room, el. 621, n-R13 (Fuse Locker)
UNIT 1	-	480RMOV Board 1D, el. 593, u-R4, Rx Bldg.
UNIT 2	-	480RMOV Board 2D, el. 593, u-R12, Rx Bldg.
UNIT 3	-	480RMOV Board 3D, el. 593, u-R18, Rx Bldg.
UNIT 3	-	Electrical Board Rm. 3EC, el. 583 DSL Bldg.
UNIT 3	-	Electrical Board Rm. 3ED, el. 565 DSL Bldg.
UNIT 1	-	Electrical Board Rm. A, el. 621, p-R1, Rx Bldg.
UNIT 1	-	Electrical Board Rm. B, el. 593, p-R1, Rx Bldg.
UNIT 2	-	Electrical Board Rm. C, el. 621, p-R14, Rx Bldg.
UNIT 2	-	Electrical Board Rm. D, el. 593, p-R14, Rx Bldg.
UNIT 3	-	Electrical Board Rm. E, el. 621, p-R21, Rx Bldg.
UNIT 3	-	Electrical Board Rm. F, el. 593, p-R21, Rx Bldg.

APPENDIX B
(Page 1 of 1)

"INTERIM FUSE SUBSTITUTION APPROVAL" FORM

_____ Date Substitution Requested
_____ Catalog Number of Fuse Required By The Fuse Engraving Report (Catalog Number On Fuse Label)
_____ Catalog Number Of Substitute Fuse Requested

List all fuse UNIDs where this substitution will be made

Plant Engineering Evaluation (BASIS)

_____ _____ _____/_____
Electrical Technical Section Supervisor Date Engineer Initials Phone

_____ DNE-EEB Concurrence

_____ DNE-EEB Non-Concurrence

REMARKS:

_____ _____ _____/_____
DNE-EEB Supervisor Date Engineer Initials Phone

NOTE: This form is to be filed with controlled copies of Plant Implementing Procedure (BF-6.12, Appendix B) until the Program Procedure is revised.

REV 0002

APPENDIX C
(Page 1 of 51)

QA Record B43 '87 0817 901

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

PREPD	RSGreen							ORIG ISSUE: 5-5-80
CHKD	FTRosenzweig							REV NO.: 7
APPD	JTArnett							REV DATE: 8-18-87
APPD	MJSchwegs							

1.0 GENERAL

This design standard lists, where applicable, allowable substitutes for low-voltage (600-volt or less) power and control fuses. Refer to Design Standard DS-E8.1.2 for substitution of midget and small dimension (instrumentation) fuses.

The substitutions in this standard are separated into two basic categories: AC voltage applications and DC voltage applications. The AC voltage substitutions are in Tables 1 through 5 and the DC substitutions are in Tables 6 through 8.

The substitutions allowed by this standard are only allowed for a temporary period as described below. | 7

This standard covers the power and control fuses in the 600-volt or below classification currently used at the TVA nuclear plants. The allowable substitution, unless noted otherwise, includes the whole "family" of fuses within a category (Example: FRN-R indicates the whole family from 1/10A up to 600A). As new equipment is used with fuses that are not included in the existing standard, revisions will be made to include the new usage fuses.

Due to the inherent differences in the time-current characteristic and I^2t let-through characteristic between fuses from one manufacturer to another, it is not possible to have a generically acceptable replacement fuse even though they may have the same Underwriters Laboratories (UL) classification (if applicable) and are otherwise the same (i.e., same voltage rating, current rating, interrupting rating, and physical dimensions within controlled limits). Substitution of fuses without appropriate consideration of the time-current characteristics of the particular application may produce a condition where proper coordination between main and feeder protection devices is compromised. Failure to properly consider the I^2t let-through characteristic when substituting fuses may lead to damage to downstream equipment because the resultant let-through energy when a short circuit occurs may be higher for the substitution fuse, possibly exceeding the downstream equipment interrupting rating or fault current withstand capability. For these reasons and except where noted otherwise in the tables, substitution of safety-related Class 1E fuses is allowed only on an interim emergency basis when | 7

*Changeout 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; i.e., changeout of a Bussman FRN with a Bussman FRN-R is considered a direct replacement and not a substitution. Class R fuses shall, however, always be used where specified in DNE-approved documents.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

an exact replacement fuse is not readily available. This interim period shall not exceed the lesser of 72 hours or the allowable operation time in accordance with the respective plant technical specifications based on considering the system in which the fuse is installed inoperable, unless an analysis is made by the Division of Nuclear Engineering (DNE) to verify that acceptable fault current coordination exists for upstream and downstream devices. An exact replacement fuse must be obtained and installed within 30 days; otherwise, for continued operation using the replacement fuse, a documented engineering analysis must be made by DNE to show that the substitute fuse is acceptable in all respects for that specific application. 7

Except where noted otherwise in the tables, substitution of non-Class 1E fuses* is allowed to be made on an interim emergency basis when an exact replacement fuse is not readily available. Since the substitute fuses listed do not, in most cases, have the same time-current characteristic as the original fuse, an analysis shall be made by DNE within 72 hours to verify that acceptable fault current coordination exists for upstream and downstream devices. An exact replacement fuse must be obtained and installed within 30 days; otherwise, for continued operation a documented engineering analysis must be performed by DNE for that specific application. If applicable, as is the case where the original fuse is no longer available, the substitute fuse or another fuse judged by DNE to be more suitable for the application will be designated as a permanent replacement through the field change request (FCR)-engineering change notice (ECN) process. See Appendixes A, B, and C for detailed information on fuses.

1.1 APPLICABILITY

This standard applies to all nuclear plants.

1.2 DEFINITIONS AND ABBREVIATIONS

1.2.1 Fuse Definitions

a. Arcing Time - The amount of time from the instant the fuse link has melted until the overcurrent is interrupted or cleared.

b. Clearing Time - The total time between the beginning of the overcurrent and the final opening of the circuit at rated voltage by an overcurrent protective device; the total of the melting time and the arcing time.

c. Current Limiting - A fuse operation relating to short circuits only. (When a fuse operates in its current limiting range, it will clear a short circuit in less than 1/2 cycle. Also, it will limit the instantaneous peak let-through current to a value substantially less than that obtainable in the same circuit if that fuse were replaced with a solid conductor of equal impedance.)

*See footnote on page 1.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

d. Current Rating - The current carrying capacity of a fuse. (When a fuse is subjected to a current above its ampere rating, it will open the circuit after a predetermined period of time.)

e. I^2t (Ampere-Squared Seconds) - The measure of heat energy developed within a circuit during the time it takes the fuse to clear; it can be expressed as "melting I^2t," "arcing I^2t," or the sum of them as "Clearing I^2t." ("I" stands for effective let-through current (RMS), which is squared, and "t" stands for time of opening, in seconds.)

f. Interrupting Rating - The rating which defines a fuse's ability to safely interrupt and clear short circuits. (This rating is much greater than the ampere rating of a fuse. The National Electrical Code (NEC) defines interrupting rating as "the highest current at rated voltage that an overcurrent protective device is intended to interrupt under standard test conditions.")

g. Melting Time - The amount of time required to melt the fuse link during a specified overcurrent. (See items g and h.)

h. Time-Current Characteristic - The relation of the fuse current versus the melting time, total clearing time, or average clearing time.

i. UL Classes - The category a fuse falls into when it meets the requirements of a particular UL (Underwriter's Laboratories) standard. (UL has developed basic physical specifications and electrical performance requirements for fuses with voltage ratings of 600 volts or less; these are known as UL Standards. Typical UL Classes are K, RK1, RK5, G, L, H, T, CC, and J.)

j. Voltage Rating - The maximum value of system voltage in which a fuse can be used, yet safely interrupt an overcurrent. (Exceeding the voltage rating of a fuse impairs its ability to safely clear an overload or short circuit.)

1.2.2 Abbreviations

a. AIR - Amperes interrupting rating

b. KAIR - 1000 Amperes interrupting rating

1.3 APPLICABLE CODES AND STANDARDS

1.3.1 UL 1988 Class H Fuses

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

1.3.2 UL 198C High-Interrupting Capacity Fuses Current-Limiting Type

1.3.3 UL 198D High-Interrupting Capacity Class K Fuses

1.3.4 UL 198E Class R Fuses

1.3.5 UL 198L DC Fuses for Industrial Use

1.3.6 UL 198M Mine-Duty Fuses

1.3.7 Mine Safety and Health Administration (MSHA) Standard

2.0 FUNCTIONAL DESCRIPTION

Criteria for substitutions allowed:

2.1 The substitution fuse must be of the same UL classification (if applicable) and type or better (i.e., Class RK1 fuses are allowed to be substituted for class RK5 fuses because their I^2t let-through is lower than the RK5 fuses and their time-current characteristic is such that they open quicker on medium-to-high-range fault currents). This is an illustration of one-way interchangeability (the class RK5 fuses are not a substitute for the class RK1 fuses). This same philosophy has been used throughout the fuse substitution tables. Therefore, the tables are not allowed to be used in reverse order.

2.2 The physical size of the fuse is compatible.

2.3 The current ratings are the same.

2.4 The voltage rating is equal to or higher than the installed (existing or original) fuse.

2.5 The interrupting rating is equal to or higher than the installed (existing or original) fuse.

2.6 Class R fuses may be used in nonrejection-type fuse clips as well as the rejection-type fuse clips for which they were designed. Class R fuses are identified by the "rejection" slot in one blade of bladed fuses or the grooved ring in one ferrule of fuses which use ferrules rather than blades.

APPENDIX C (Cont'd)
(Page 5 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

3.0 INDEX TO FUSE TABLES

The following tables are listed by manufacturer in alphanumeric order of fuse catalog type. Each table is for a different voltage class as indicated. The class indicates the maximum voltage at which the fuse can be used.

Table	Voltage Class
1	150 Vac
2	250 Vac
3	300 Vac
4	500 Vac
5	600 Vac
6	60 Vdc
7	150 Vdc
8	300 Vdc

4.0 REFERENCES

4.1 Gould Shawmut Advisor (Catalog), 1985 CP-SOR-384 (RIMS No. B43 861120 908)

4.2 Gould Shawmut All-Product Cross Reference Bulletin XR, July 1986 (RIMS No. B43 861120 909)

4.3 Bussmann Full-Line Condensed Catalog FLC, January 1985 (RIMS No. B43 861120 910)

4.4 Bussmann Full-Line Cross Reference Bulletin CR, July 1983 (RIMS No. B43 861120 911)

4.5 Reliance Fuse The Chosen Fuse Condensed Catalog No. F-9004 10831OOM (RIMS No. B43 861120 912)

4.6 English Electric HRC Fuses Form I No. 20-02-01 (RIMS No. B43 861120 913)

4.7 General Electric Apparatus Handbook Section 7182, page 1, March 3, 1980 (RIMS No. B43 861120 914)

4.8 General Electric Company Power Systems Management Business Department internal memo from M. J. Murray dated November 12, 1982 (RIMS No. B43 861120 915)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

4.9 Bussmann letter from Jim Calzone, Application Engineer, dated November 13, 1986 (RIMS No. B43 861120 916)

4.10 Reliance Fuse DC Voltage Ratings, August 28, 1986 (RIMS No. B43 861120 917)

4.11 Gould letter from Richard Shea, Associate Application Engineer, dated November 12, 1986 with attachment (RIMS No. B43 861120 918)

4.12 Gould letter to TVA's Doug Aldredge, dated October 30, 1986 (RIMS No. B43 861120 919)

4.13 Bussmann letter to TVA's Doug Aldredge, dated November 3, 1986 (RIMS No. B43 861120 920)

4.14 TVA letter to Bussmann Manufacturer, Attention: Martin Smith from W. S. Raughley, dated December 30, 1986 (RIMS No. B43 861229 907)

4.15 English Electric Corporation letter to TVA's Mike Johnson, dated May 8, 1979 (RIMS No. B43 861120 921)

4.16 Bussmann letter to TVA's Bill Thibodeaux, dated July 13, 1984 (RIMS No. B43 861120 922)

4.17 Shawmut letter to TVA's T. O. Anderson, dated June 6, 1975 (RIMS No. B43 861124 902)

Table 1

150-VOLT AC-RATED FUSES

(The following fuses can be used on any plant AC system of 150 volts and below. Refer to Appendix B for information on fuse AC ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussman Fuse			
FWA 10	--	2432859-10A	--
2432859-10A	--	FWA 10	--
KAA	No Sub (130-volt rectifier fuse)		

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 2

250-VOLT AC-RATED FUSES

(The following fuses can be used on any plant AC system of 250 volts and below. Refer to Appendix B for information on fuse AC ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann Fuse			
FRN	Discontinued	FRN-R LPN-R	TR-R A2D-R
FRN-R	--	LPN-RK --	TR-R A2D-R
KAB	No Sub		
KTN	Discontinued	KWN-R KTN-R	A2K-R --
KTN-R	--	KWN-R	A2K-R
KWN	Discontinued	KWN-R KTN-R	A2K-R --
KWN-R	--	KTN-R	A2K-R
LPN	Discontinued	LPN-RK	A2D-R
LPN-RK	--	--	A2D-R
NON**	--	KTN-R KWN-R	A2K-R --
Gould Shawmut			
AT-DE	Discontinued	LPN-RK FRN-R	A2D-R TR-R
A2K-R	--	KTN-R KWN-R	-- --

APPENDIX C (Cont'd)
(Page 8 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 2 (Continued)

250-VOLT AC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
A25X(0-30)-1	No Sub	--	--
A25X(35-800)-4	No Sub	--	--
FT-R**	--	KTN-R KWN-R	A2K-R --
OT**	--	KTN-R KWN-R	A2K-R --
TR	Discontinued	FRN-R LPN-RK	TR-R A2D-R
TR-R	--	FRN-R LPN-RK	A2D-R --
English Electric			
EHG(0-600)**	Discontinued Replaced by C(0-600) HG	KTN-R KWN-R	A2K-R --
HRC-8R(0-30)**	--	KTN-R KWN-R	A2K-R --
Reliance (Formerly Economy Fuse)			
EON**	Superseded by EON	KTN-R KWN-R	A2K-R --

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 2 (Continued)

250-VOLT AC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Reliance (formerly Economy Fuse)			
LEN**	Discontinued (Replaced by LEN-R)	FEN-R LPN-RK	TR-R A2D-R
LEN-R**	--	FEN-R LPN-RK	TR-R A2D-R

**When replacement is considered, replace with listed substitute fuse and implement procedure (where applicable) for use on a permanent basis.

APPENDIX C (Cont'd) REV 0002
(Page 10 of 51)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 1

300-VOLT AC-RATED FUSES

(The following fuses can be used on any plant AC system of 300 volts and below. Refer to Appendix B for information on fuse AC ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann JJN	--	--	AJT
Gould Shawmut AJT	--	JJN	--

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 4

500-VOLT AC-RATED FUSES

(The following fuses can be used on any plant AC system of 500 volts and below. Refer to Appendix B for information on fuse AC ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann KLC	--	--	ASY(0-60)-11
Gould Shawmut ASY(0-60)-11	--	KLC	--

APPENDIX C (Cont'd)
(Page 12 of 51)

REV 0002

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 5

600-VOLT AC-RATED FUSES

(The following fuses can be used on any plant AC system of 600 volts and below. Refer to Appendix B for information on fuse AC ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann			
FRS	Discontinued	LPS-RK FRS-R	TRS-R A6D-R
FRS-R	--	LPS-RK --	TRS-R A6D-R
FRS-AK15	Obsolete		
JHC	--	--	AJT
JKS	--	--	A4J
KAZ	Not a fuse (indicating actuator device)	--	TI-600
KCC	No Sub (1/0 copper cable limiter)	--	--
KDA	No Sub (No. 2 copper cable limiter)	--	--
KDB	No Sub (No. 1 copper cable limiter)	--	--
KDC	No Sub (1/0 copper cable limiter)	--	--
KDP	500-MCM copper cable limiter	--	CPM500C5
KFT	250-MCM copper cable limiter	--	CPM250C5
KFF	4/0-MCM copper cable limiter	--	CPM4/0C5

APPENDIX C (Cont'd)
(Page 13 of 51) REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 5 (Continued)

600-VOLT AC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann			
KTS	Discontinued	KTS-R	A6K-R
KTS-R	--	--	A6K-R
LPS	Discontinued	LPS-RK	A6D-R
LPS-RK	--	--	A6D-R
NOS**	--	KMS-R KTS-R	A6K-R
Gould Shawmut			
A4J	--	JKS	--
A4BY	--	KRP-C	--
A6D-R	--	LPS-RK	--
A6N5	Discontinued	--	A6NB-CS
A6NB-CS	No Sub	--	--
A6Y(0-60)-1	No Sub	--	--
A6Y(0-60)-1R	No Sub	--	--
A6Y(0-60)-11	No Sub	--	--
A6Y(70-600)-21	No Sub	--	--
A6Y(0-30)R-96	--	KWG	--

APPENDIX C (Cont'd)
(Page 14 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 5 (Continued)

400-VOLT AC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
A60X(0-30)-1	No Sub	--	--
A60X(35-600)-4	No Sub	--	--
AJT(1-10)	--	JHC	--
AJT(15-400)	No Sub	--	--
CP6A-14	Discontinued (4/0 copper cable limiter)	KPF	CPH4/0C5
CP6A-15	Discontinued (250-MCM cable limiter)	KFT	CPH250C5
CP6A-150	Discontinued (1/0 copper cable limiter)	KDC	--
CP6A-197	Discontinued (No. 2 copper cable limiter)	KDA	--
CP6A-30	Discontinued (500-MCM copper cable limiter)	KDF	CPH500C5
CP6A-39	Discontinued (No. 1 copper cable limiter)	KDB	--
CP6A-55	Discontinued (1/0 copper cable limiter)	KCC	--
CPH4/0C5	4/0 copper cable limiter	KPF	--

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 5 (Continued)

600-VOLT AC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
CPM250C5	250-MCM copper cable limiter	KFT	--
CPM500C5	500-MCM copper cable limiter	FCP	--
FTS-R**	--	KTS-R KMS-R	A6K-R
OTS**	--	KTS-R KMS-R	A6K-R --
TI-600	Not a fuse (indicating actuator device)	KAZ	--
TRS	Discontinued	FRS-R LPS-RK	TRS-R A6D-R
TRS-R	--	FRS-R LPS-RK	A6D-R --
General Electric Co.			
GFNR(0-60)	Discontinued	KTS-S	A6Y(0-60)-1R
GFNR(0-600)	Discontinued	JKS	A4J
Reliance (formerly Sprague Fuse)			
KOS**	Superseded by KOS	KTS-R KMS-R	A6K-R

**When replacement is considered, replace with listed substitute fuse and implement procedure for use on a permanent basis.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 6

60-VOLT DC-RATED FUSES

(The fuses in this table have a minimum rating of 60 volts DC and may be used on any plant DC system with a maximum DC voltage not to exceed 60 volts. Refer to Appendix C for exact ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
A2K-R	--	KWN-R	--
A25X(0-30)-1	No Sub	--	--
A25X(35-800)-4	No Sub	--	--
A48Y(601-1600) (1601-4000)	No Sub No Sub	-- --	-- --
A4J	No Sub	--	--
A5Y(0-60)-11	--	KLC	A6Y(0-60)-11 A2K-R
A6Y(0-60)-1	--	KWS-R	A6K-R
A6Y(0-60)-1R	Sub GE GF68 (0-60)	--	--
A6Y(0-60)-11	--	KWN-R	A2K-R A5Y(0-60)-11
A6Y(70-600)-21	--	KWN-R	A2K-R
A6GX(0-30)-1	No Sub	--	--
A6GX(35-800)-4	No Sub	--	--
FT-R**	--	KWN-R	A2K-R
FTS-R**	--	KWS-R	A6K-R

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 6 (Continued)

40-VOLT DC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
OT**	--	KWN-R	A2K-R
OTS**	--	KWS-R	A6K-R
TI-600	No Sub	--	--
TR-R	No Sub	--	--
TRS-R	No Sub	--	--
Bussmann			
FKN-R 15,40,50,100	--	--	TR-R
FKN-R 125,150,200	--	--	TR-R
FKS-R 15,400	--	--	TRS-R
FWA 10	--	2342E59-10A	--
JKS 10,300,350	--	--	A4J
KLC (0-60)	No Sub	--	--
KWN-R	No Sub	--	--
NON (5,15,30,80,100)**	--	KWN-R	A2K-R
2342E59-10A	--	FWA-10	--
Reliance (Formerly Economy Fuse)			
EON**	Superseded by EON	KWN-R	A2K-R
EOS**	Superseded by EOS	KWS-R	A6K-R

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 6 (Continued)

60-VOLT DC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Reliance (formerly Economy Fuse)			
LEN**	Superseded by LEN-R	--	TR-R
LEN-R (0-200)**	--	--	TR-R
English Electric			
ENG (0-400)**	Superseded by C(0-400)HG	KWN-R	A2K-R
General Electric Company			
GF6B(1-40)	Discontinued No Sub	--	--

**When replacement is considered, replace with listed substitute fuse and implement procedure for use on a permanent basis.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 7

150-VOLT DC-RATED FUSES

(The fuses in this table have a minimum rating of 150 volts DC and may be used on any plant DC system with a maximum DC voltage of 150 volts. Refer to Appendix C for exact ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
A2K-R	--	KWM-R	--
A25X(0-30)-1	No Sub	--	--
A25X(35-800)-4	No Sub	--	--
A4J	No Sub	--	--
A48Y(601-1600) (1601-4000)	No Sub No Sub	--	--
A5Y(0-60)-11	--	KLC	A6Y(0-60)-11 A2K-R
A6Y(0-60)-1	--	KMS-R	A6K-R
A6Y(0-60)-1R	Sub GE GF6B (0-60)	--	--
A6Y(0-60)-11	--	KWM-R KLC	A5Y(0-60)-11 A2K-R
A6Y(70-600)-21	--	KWM-R	--
A60X(0-30)-1	No Sub	--	--
A60X(35-800)-4	No Sub	--	--
FT-R**	--	KWM-R	A2K-R
FTS-R**	--	KMS-R	A6K-R
OT**	--	KWM-R	A2K-R

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 7 (Continued)

150-VOLT DC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
OTS**	--	KWS-R	A6K-R
TI-600	No Sub	--	--
TR-R	No Sub	--	--
TRS-R	No Sub	--	--
Bussmann			
FRN-R 15,50,125	--	--	TR-R
150,200		--	TR-R
FWA10	--	2432859-10A	--
FRS-R 15,400	--	--	TRS-R
JKS 10,300,350	--	--	A4J
KLC (0-60)	No Sub	--	--
KWN-R	No Sub	--	--
NON (5,15,30)**	--	KWN-R	A2K-R
(80,100)**	--	KWN-R	A2K-R
2432859-10A	--	FWA-10	--
Reliance (formerly Economy Fuse)			
KOS**	Superseded by KOS	KWS-R	A6K-R
English Electric			
KNG (0-400)**	Superseded by C(0-400)NG	KWN-R	A2K-R
General Electric			
GF6S (0-60)	Discontinued No Sub	--	--

**When replacement is considered, replace with listed substitute fuse and implement procedure for use on a permanent basis.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 8

300-VOLT DC-RATED FUSES

(The fuses in this table have a minimum rating of 300 volts DC and may be used on any plant DC system with a maximum DC voltage not to exceed 300 volts. Refer to Appendix C for exact ratings.)

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Gould Shawmut			
A4J	No Sub	--	--
A48Y(601-1600)	No Sub	--	--
A5Y(0-60)-11	--	KLC (0-60)	A6Y(0-60)-11
A6Y(0-60)-1	--	KMK-R	A6K-R
A6Y(0-60)-1R	Sub GE GF6B (0-60)	--	--
A6Y(0-60)-11	--	--	A5Y(0-60)-11
A6Y(70-600)-21	No Sub	--	--
A60X(0-30)-1	No Sub	--	--
A60X(35-800)-4	No Sub	--	--
FTS-R**	--	KMS-R	A6K-R
OTS**	--	KMS-R	A6K-R
TI-600	No Sub	--	--
TRS-R	No Sub	--	--

APPENDIX C (Cont'd)
(Page 22 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1

Table 8 (Continued)

300-VOLT DC-RATED FUSES

Manufacturer Catalog Type	Comment	Substitute Fuse	
		Bussmann	Gould Shawmut
Bussmann			
JKS 10,300,350	--	--	A4J
KLC (0-40)	No Sub	--	--
Reliance (formerly Economy Fuse)			
EOS**	Superseded by EOS	KWS-R --	A6Y A6K-R
General Electric			
GF68 (0-40)	Discontinued No Sub	--	--

**When replacement is considered, replace with listed substitute fuse and implement procedure for use on a permanent basis.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX A

FUSE RATING DATA

1. Alternating Current Rating

   Most of the manufacturers' published catalog data apply to AC applications. Where the data does not specifically state DC rating, the data is for AC applications only.

2. Direct Current Rating

   Most of the manufacturers' published catalog data does not apply to DC ratings for two reasons:

   a. There is not a great deal of DC usage in the marketplace, so the manufacturers have not devoted much time and expense to DC qualifications.

   b. DC current is more difficult to interrupt than AC and the difficulty is directly proportional to the length of the circuit time constant. The time constant is a function of the inductive effect of the circuit and varies with each circuit.

3. Current Interrupting Rating

   The manufacturers' published catalog data for interrupting rating apply to AC only unless specifically stated otherwise. For the UL-classified and/or -listed fuses, the AC interrupting rating is well defined.

   Data on DC interrupting rating is limited the same as other DC information.

4. Continuous Amperage Rating

   Due to industry requirements and demand, fuse amperage values available change from time to time. Amperage ratings are added and deleted in a family of fuses.

5. Voltage Rating

   Unless specifically noted on the fuse label that the voltage rating applies to DC, the voltage rating applies to AC only. The fuse can be applied at any AC voltage up to the rated value.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX A

Page 2 of 2

FUSE RATING DATA (Continued)

DC ratings have been established by the manufacturers for some fuses as indicated in Appendix C. This rating will not appear on the fuse label unless it is MSHA-certified or -listed to UL198L or UL198M. Fuses listed in Appendix C can be used at any DC voltage up to the value listed.

6. UL-Listed Class R Fuses (RK1 and RK5)

UL-listed Classes RK1 and RK5 fuses are basically UL Class K1 or K5 fuses of the same type and rating, but physically modified by the manufacturer to permit their use in specially designed rejection clips or holders.

a. Identification of Class R Fuses

RK1 or RK5 type fuses can be physically identified by the presence of a slot in one blade of the (70-600 ampere) blade-type fuses or a groove in one ferrule of the (0-60 ampere) ferrule-type fuses. The manufacturer's symbol or number identifying the type RK1 or RK5 fuse will also contain the letter "R" either before or after the ampere rating listed therein.

b. Substitution of Class R Fuses

Class R fuses will fit in fuse clips or holders designed for corresponding Class K or Class H fuses of the same amperage, but Class R fuse clips or holders will accept only Class R fuses. The purpose of this rejection feature is to prevent the use of lower-rated Class H fuses in circuits requiring fuses with Class K electrical characteristics.

7. Additional Industry Standards Listed for Information

a. NEMA FU1-1966 - Low-Voltage Cartridge Fuses

b. ANSI C97.1-1972 - American National Standard for Low-voltage Cartridge Fuses 600 Volts or Less

APPENDIX C (Cont'd)
(Page 25 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 1 of 7

KEY TO FUSE DESCRIPTION CODE
AC RATINGS

2 TD 6 CL (5) 2.0

- 2 - Number of Elements
  - 1 - Single element
  - 2 - Dual element
- TD - Time-Delay Feature
  - TD - Time Delay; ND - Nontime Delay
- 6 - Voltage Rating (AC)
  - 1 - 150 volts ac
  - 2 - 250 volts ac
  - 3 - 300 volts ac
  - 5 - 500 volts ac
  - 6 - 600 volts ac
- CL - Current Limiting Feature
  - CL - Current Limiting
  - NL - Noncurrent Limiting
- (5) - UL Class
  - H - Class H
  - J - Class J
  - 1 - Class K1 or RK1
  - 5 - Class K5 or RK5
  - L - Class L
  - T - Class T
  - U - Unknown
  - N - Not applicable
- 2.0 - Ampere Interrupting Rating (AC-RMS)
  - 2.0 - 2 x 10^5 amps
  - 1.0 - 1 x 10^5 amps
  - 0.5 - 0.5 x 10^5 amps
  - 0.1 - 0.1 x 10^5 amps

APPENDIX C (Cont'd)
(Page 26 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 2 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Bussmann		
FRN	2TD2CL(5) 2.0	4.3
FRN-R	2TD2CL(5) 2.0	4.3
FRS	2TD6CL(5) 2.0	4.3
FRS-R	2TD6CL(5) 2.0	4.3
FWA	1ND1CL(X) 2.0	4.3
FWX	1ND2CL(X) 2.0	4.3
JHC	1TD6CL(*) 2.0	4.3
JJN	1ND3CL(T) 2.0	4.3
JJS	1ND6CL(T) 2.0	4.3
JXS	1ND6CL(J) 2.0	4.3
KAA	1ND(X)CL(X) 2.0	4.3
KAB	1ND2CL(X) 2.0	4.3
KAX	1ND2CL(X) 2.0	4.3
KAZ	Not a fuse (actuator device)	4.3
KBC	1ND6CL(X) 2.0	4.3
KCC	Cable limiter	4.3
KDA	Cable limiter	4.3
KDB	Cable limiter	4.3
KDC	Cable limiter	4.3
KDP	Cable limiter	4.3

*The Bussmann JHC is UL Class J from 1-10 amps and UL Class J dimensional for 15-600 amps.

(X) 130 Volts AC

APPENDIX C (Cont'd)
(Page 27 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 3 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Bussmann		
KFT	Cable limiter	4.3
KFF	Cable limiter	4.3
KLC	1ND5CL(N) 1.0	4.9
KLU	1TD4CL(L) 2.0	4.3
KRP-C	1TD4CL(L) 2.0	4.3
KTN	1ND2CL(1) 2.0	4.3
KTN-R	1ND2CL(1) 2.0	4.3
KTS	1ND4CL(1) 2.0	4.3
KTS-R	1ND4CL(1) 2.0	4.3
KWG	Special tranformer fuse	4.3
KWN	1ND2CL(1) 2.0	4.3
KWN-R	1ND2CL(1) 2.0	4.3
KWS	1ND4CL(1) 2.0	4.3
KWS-R	1ND4CL(1) 2.0	4.3
LPN	2TD2CL(1) 2.0	4.3
LPN-RK	2TD2CL(1) 2.0	4.3
LPS	2TD4CL(1) 2.0	4.3
LPS-RK	2TD4CL(1) 2.0	4.3
NON(1-60)	1ND2NL(5) 0.5	4.3

APPENDIX C (Cont'd)
(Page 28 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 4 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Bussmann		
NON(70-600)	1ND2NL(N) 0.1	4.3
NOS(1-60)	1ND6CL(S) 0.5	4.3
NOS(70-600)	1ND6NL(N) 0.1	4.3
Gould Shawmut		
A2K-R	1ND2CL(1) 2.0	4.1
A2D-R	1TD2CL(1) 2.0	4.1
A25X(0-30)-1	1ND2CL(N) 0.5	4.1
A25X(35-600)-4	1ND2CL(N) 0.5	4.1
A3T	1ND3CL(T) 2.0	4.1
A4ST	1TD4CL(L) 2.0	4.1
A4J	1ND4CL(J) 2.0	4.1
A4ST	1TD4CL(L) 2.0	4.1
A5Y(0-60)-1	1ND5CL(N) 2.0	4.1
A6D-R	1TD4CL(1) 2.0	4.1
A6K-R	1ND4CL(1) 2.0	4.1
A6NB	Circuit breaker fuse	4.1
A6NB-CS	Circuit breaker fuse	4.1
A6Y(0-60)-1	1ND4CL(N) 2.0	4.1
A6Y(0-60)-1R	1ND4CL(N) 2.0	4.1
A6Y(70-600)-3	1ND4CL(N) 2.0	4.1
A6Y(0-60)-11	1ND4CL(N) 2.0	4.1
A6Y(70-600)-21	1ND4CL(N) 2.0	4.1

APPENDIX C (Cont'd)
(Page 28 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Concrol Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 4 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Bussmann		
MON(70-600)	1MD2NL(M) 0.1	4.3
MOS(1-60)	1MD6CL(S) 0.5	4.3
MOS(70-600)	1MD6NL(M) 0.1	4.3
Gould Shawmut		
A2K-R	1MD2CL(1) 2.0	4.1
A2D-R	1TD2CL(1) 2.0	4.1
A25X(0-30)-1	1MD2CL(M) 0.5	4.1
A25X(35-800)-4	1MD2CL(M) 0.5	4.1
A3T	1MD3CL(T) 2.0	4.1
A4BT	1TD6CL(L) 2.0	4.1
A4J	1MD6CL(J) 2.0	4.1
A4BY	1TD6CL(L) 2.0	4.1
A5Y(0-60)-1	1MD5CL(M) 2.0	4.1
A6D-R	1TD6CL(1) 2.0	4.1
A6K-R	1MD6CL(1) 2.0	4.1
A6MB	Circuit breaker fuse	4.1
A6MB-CS	Circuit breaker fuse	4.1
A6Y(0-60)-1	1MD6CL(M) 2.0	4.1
A6Y(0-60)-1R	1MD6CL(M) 2.0	4.1
A6Y(70-600)-3	1MD6CL(M) 2.0	4.1
A6Y(0-60)-11	1MD6CL(M) 2.0	4.1
A6Y(70-600)-21	1MD6CL(M) 2.0	4.1

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 5 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Gould Shawmut		
A6Y(0-30)K-96	Special transformer fuse	4.1
A60X(0-30)-1	1ND6CL(N) 1.0	4.1
A60X(35-600)-4	1ND6CL(N) 1.0	4.1
AJT	1TD6CL(J) 2.0	4.1
AT-DE	1TD2CL(5) 2.0	4.1
ATS-DE	1TD6CL(5) 2.0	4.1
CP6A-14	Cable limiter	4.12
CP6A-15	Cable limiter	4.12
CP6A-150	Cable limiter	4.12
CP6A-197	Cable limiter	4.12
CP6A-30	Cable limiter	4.12
CP6A-39	Cable limiter	4.12
CP6A-55	Cable limiter	4.12
CPH4/0C5	Cable limiter	4.1 and 4.12
CPH250C5	Cable limiter	4.1 and 4.12
CPH500C5	Cable limiter	4.1
FT	1ND2CL(5) 2.0	4.1
FTS	1ND6CL(5) 2.0	4.1
OT	1ND2CL(5) 0.5	4.1
OTS	1ND6CL(5) 0.5	4.1
TI-600	Not a fuse (actuator device)	4.1
TR	1TD2CL(5) 2.0	4.1

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 6 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
Gould Shawmut		
TR-R	1TD2CL(5) 2.0	4.1
TRS	1TD6CL(5) 2.0	4.1
TRS-R	1TD6CL(5) 2.0	4.1
General Electric Company		
(The following fuses are no longer available from General Electric Company. See Reference 4.8.)		
GF6B(1-60)	1ND6CL(H) 2.0	4.7
GF8B(0-600)	1ND6CL(J) 2.0	4.7
Reliance Fuse (formerly Economy Fuse)		
EON	Superseded by KON	--
KON	1ND2CL(5) 1.0	4.5
EOS	Superseded by KOS	--
KOS	1ND6CL(5) 1.0	4.5
LEN	Superseded by LEN-R	--
LEN-R	2TD2CL(1) 2.0	4.5
English Electric Fuse		
C(0-60)HG	1ND2CL(H) 2.0	4.6

APPENDIX C (Cont'd)
(Page 31 of 51)

REV 0602

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX B

Page 7 of 7

FUSE RATING DATA (Continued)

Type Fuse	Description Code	Source of Rating Data (Reference)
English Electric Fuse (AC Application)		
ENG (0-60)	Obsolete--replaced by C(0-60)NG	4.15
NEC-8E	1MD2CL(U) 2.0	4.4

APPENDIX C (Cont'd) REV 0002
(Page 32 of 51)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX C

Page 1 of 4

ALPHANUMERIC LISTING OF FUSES FOR REFERENCE TO DC RATINGS

Manufacturer Catalog Type	Rating		Source of Rating Data (Reference)
	Volts DC	KAIR	
Gould Shawmut			
A2K-R	250	20	4.11
A25X(0-30)-1	150	20	4.11
A25X(35-800)-4	150	20	4.11
A4J	300	20	4.11
A48Y(601-1600) (1601-4000)	300 250	20 20	4.11 4.11
A48T(601-2000)	500	100	4.11
A5Y(0-60)-11	500	20	4.11 and 4.17
A6K-R	300	20	4.11
A6Y(0-60)	500	20	4.11
A6Y(70-600)	500	20	4.11
A6Y(0-60)-11	500	20	4.11 and 4.17
A6Y(70-600)-21	500	20	4.11
A6QX(0-30)-1	300	20	4.11
A6QX(35-800)-4	500	100	4.11
FT-R	250	20	4.11
FTS-R	300	20	4.11
OT	250	20	4.11
OTS	300	20	4.11
TI-400	600	20	4.11

APPENDIX C (Cont'd)
(Page 33 of 51) REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX C

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
JNC 100,200	300	--	4.16
400,600	300	--	4.16
JNS 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

APPENDIX C (Cont'd)
(Page 34 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX C

ALPHANUMERIC LISTING OF FUSES FOR REFERENCE TO DC RATINGS (Continued)

Manufacturer Catalog Type	Rating		Source of Rating Data (Reference)
	Volts DC	KAIR	
Bussmann			
KRPC(601-6000)	250	--	4.16
KWM-R	250	100	4.3
KWS-R	600	100	4.3
LPN-RK 30,60	125	--	4.16
100,200	250	--	4.16
400,600	250	--	4.16
LPS-RK 60,100	300	--	4.16
200,400	300	--	4.16
600	300	--	4.16
MOM 5,15,30	250	10	4.14
80,100	250	10	4.14
200,400,600	250	--	4.16
MOS 30,60	300	--	4.16
100,200	600	--	4.16
400,600	600	--	4.16
2432859-10A	150	10	4.9 and 4.14
English Electric			
C(0-60)NG	250	--	4.6
KNG(0-60)	250	--	4.6
NRC-RR(0-30)	250	--	4.4

TVA

GROUP: FUSES
TITLE: Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

ELECTRICAL DESIGN STANDARD DS-E8.1.1
APPENDIX C

Page 4 of 4

ALPHANUMERIC LISTING OF FUSES FOR REFERENCE TO DC RATINGS (Continued)

Manufacturer Catalog Type	Rating Volts DC	Rating KAIR	Source of Rating Data (Reference)
General Electric Company			
(The listed fuse is no longer available from General Electric Company. See reference 4.8.)			
GF68(1-60)	600	100	4.7
Reliance Fuse (formerly Economy Fuse)			
EON(0-200)	125	20	4.10
EOS(0-200)	300	20	4.10
LEN-R(0-200)	125	20	4.10

APPENDIX C (Cont'd)
(Page 36 of 51)

REV 0002

QA Record B43 '87 0817 902

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

PREPD	FBRosenzweig						ORIG ISSUE: 6-23-82
CHKD	CHGilliland	QR		RN1		RN2	REV NO.: 4
REVIEWED	RSGreen						REV DATE: 8-18-87
APPD	EChirwood						

1.0 GENERAL

This design standard lists, where applicable, allowable substitutes for midget and small dimension (instrumentation) fuses. Refer to Design Standard DS-E8.1.1 for substitution of 600-volt (or less) power and control fuses.

Midget fuses are 13/32-inch diameter by 1-1/2-inch-long ferrule design, and small dimension fuses are generally smaller in size than the midget and are in various physical configurations. Midget fuses are used in instrumentation and power and control circuits.

This design standard covers the midget and small dimension fuses currently used at the TVA nuclear plants. For midget fuses, unless noted otherwise, the allowable substitution includes the whole "family" of fuses within a category (example: KTK indicates the whole family from 1/10 ampere up to 30 amperes). Due to voltage rating variation within a "family" of small dimension fuses, substitutions are indicated on a fuse-to-fuse basis except where fuses within a family are grouped together. As new equipment is used with new fuses that are not included in the present standard, revisions will be made to include the new fuses.

The substitutions allowed by this standard are only allowed for a temporary period as described below. 4

Due to the inherent differences in the time-current characteristic of midget and small dimension fuses from one manufacturer to another for fuses which have the same Underwriters Laboratories (UL) classification (if applicable) and/or are otherwise the same (i.e., same voltage rating, current rating, interrupting rating, and physical dimensions within controlled limits), it is not possible to have a generically acceptable replacement fuse. Substitution of fuses without appropriate consideration of the particular application may produce a condition where proper protection is jeopardized. For these reasons and except where noted otherwise in the tables, substitution of safety-related Class 1E fuses is allowed only on an interim emergency basis when an exact replacement fuse is not readily available. This interim period shall not exceed the lesser of 72 hours or the allowable operation time in accordance with the respective plant technical specifications based on considering the system in which the fuse is installed inoperable, unless an analysis is made by the Division of Nuclear Engineering (DNE) to verify that acceptable fault current coordination exists for upstream and downstream devices. An exact replacement fuse must be obtained and installed within 30 days; otherwise, for continued operation using the replacement fuse, a documented engineering analysis must be made by DNE to show that the substitute fuse is acceptable in all respects for that specific application. 4

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Except where noted otherwise in the tables, substitution of fuses for non-Class 1E equipment and/or systems shown on TVA drawings shall only be made on an interim emergency basis when an exact replacement fuse is not readily available. Since the substitute fuses listed in the tables do not, in most cases, have the exact same time-current characteristic as the original fuse, an analysis shall be made by DNE within one week to verify that acceptable fault-current protection and coordination exist. An exact replacement must be obtained and installed within 30 days; otherwise, for continued operation DNE must perform an engineering analysis for that specific application. If applicable, as in the case where the original fuse is no longer available, the substitute fuse or another fuse judged by DNE to be more appropriate for the application will be designated as a permanent replacement through the field change request (FCR)/engineering change notice (ECN) process.

For non-Class 1E fuses used in electronic instruments (i.e., digital voltmeters, etc.), vendor-engineered and -packaged equipment, and/or systems not shown on TVA drawings, substitution may be made in accordance with manufacturer's recommendation, if available.

See Appendixes A and B for detailed information on fuses.

1.1 APPLICABILITY

This standard applies to all nuclear plants.

1.2 ABBREVIATIONS AND DEFINITIONS

1.2.1 Abbreviations

a. AIR - Amperes interrupting rating

b. KAIR - 1000 Amperes interrupting rating

1.2.2 Fuse Definitions

a. Arcing Time--The amount of time from the instant the fuse link has melted until the overcurrent is interrupted or cleared.

b. Clearing Time--The total time between the beginning of the overcurrent and the final opening of the circuit at rated voltage by an overcurrent protective device; the total of the melting time and the arcing time.

c. Current Limiting--A fuse operation relating to short circuits only. (When a fuse operates in its current limiting range, it will clear a short circuit in less than 1/2 cycle. Also, it will limit the instantaneous peak let-through current to a value substantially less than that obtainable in the same circuit if that fuse were replaced with a solid conductor of equal impedance.)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

d. Current Rating--The current carrying capacity of a fuse. (When a fuse is subjected to a current above its ampere rating, it will open the circuit after a predetermined period of time.)

e. I^2t (Ampere-Squared Seconds)--The measure of heat energy developed within a circuit during the time it takes the fuse to clear. (It can be expressed as "melting I^2t," "arcing I^2t," or the sum of them as "clearing I^2t." "I" stands for effective let-through current (RMS) which is squared, and "t" stands for time of opening in seconds.)

f. Interrupting Rating--The rating which defines a fuse's ability to safely interrupt and clear short circuits. (This rating is much greater than the ampere rating of a fuse. The National Electrical Code (NEC) defines interrupting rating as "the highest current at rated voltage that an overcurrent protective device is intended to interrupt under standard test conditions.")

g. Melting Time - The amount of time required to melt the fuse link during a specified overcurrent. (See items a and b.)

h. Time-Current Characteristic--The relationship of the fuse current versus the melting time, total clearing time, or average clearing time.

i. UL Class CC Fuses - 600V, 200,000-AIR, branch circuit fuses with overall dimensions of 13/32 inch by 1-1/2 inches. (Their design incorporates a rejection feature that allows them to be inserted into rejection fuse holders and fuse blocks that reject all lower voltage, lower interrupting rating 13/32- by 1-1/2-inch fuses. They are available from 1/10 ampere through 30 amperes.)

j. UL Classes--The category a fuse falls into when it meets the requirements of a particular UL standard. (UL has developed basic physical specifications and electrical performance requirements for fuses with voltage ratings of 600 volts or less; these are known as UL Standards.)

k. UL Class G Fuses--300V, 100,000-AIR branch circuit fuses that are size rejecting to eliminate overfusing. (The fuse diameter is 13/32 inch while the length varies from 1-5/16 inch to 2-1/4 inches. These are available in ratings from 1 ampere through 60 amperes.)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

1. UL Listing--The product is tested to standards established by UL and, if passed, is labeled with the UL symbol.

m. UL Recognized--A product tested by UL to performance criteria claimed by the manufacturer; when it meets that criteria it is recognized by UL and contains the mark RU on the label.

n. Voltage Rating--The maximum value of system voltage in which a fuse can be used, yet safely interrupt an overcurrent. (Exceeding the voltage rating of a fuse impairs its ability to clear an overload or short circuit safely.)

1.3 APPLICABLE CODES AND STANDARDS

1.3.1 UL198G - Fuses for Supplementary Overcurrent Protection

1.3.2 IEC - International Electrotechnical Commission

2.0 FUNCTIONAL DESCRIPTION

Criteria for substitutions allowed:

2.1 The physical size of the fuse is compatible.

2.2 The current rating of the fuse is the same.

2.3 The fuse has the same type time-current characteristic design (i.e., time delay versus nontime delay).

2.4 The voltage rating of the fuse is equal to or higher than the installed (existing or original) fuse.

2.5 If not within a UL classification, the fuse must be UL listed or UL recognized.

3.0 INDEX TO FUSE TABLES

The following tables are listed by manufacturer in alphanumeric order of fuse catalog type. (The indicated voltage in the tables is the maximum voltage at which the fuse can be used).

Table	Contents
1	AC-Rated Fuses - Small Dimension
2	AC-Rated Fuses - Midget
3	DC-Rated Fuses - Midget and Small Dimension

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

4.0 REFERENCES

4.1 Littelfuse Industrial Fuses Catalog Form No. IFC-985 (RIMS No. B43 861121 902)

4.2 Littelfuse Circuit Protection Components Catalog No. 20, Form No. C20-185 (RIMS No. B43 861121 903)

4.3 Littelfuse Product Bulletin No. EL-3-1184 (RIMS No. B43 861121 904)

4.4 Littelfuse Cross Reference Form CR-583-3 (RIMS No. B43 861121 905)

4.5 Bussmann Full-Line Cross Reference Bulletin CR, July 1983 (RIMS No. B43 861120 911)

4.6 Gould Shawmut All-Products Cross Reference Bulletin XR, July 1986 (RIMS No. B43 861120 909)

4.7 Bussmann Electronic and Small Dimension Fuses Catalog SFB, April 1986 (RIMS No. B43 861121 906)

4.8 Bussmann Small Dimension Fuses Bulletin SFB, August 1981 (RIMS No. B43 861121 907)

4.9 TVA letter to Bussmann manufacturer, Attention: Martin Smith from W. S. Raughley, dated December 30, 1986 (RIMS No. B43 861229 907)

4.10 Gould letter from Richard Shea, Associate Application Engineer, dated November 12, 1986, with attachment (RIMS No. B43 861120 918)

4.11 Bussmann letter from Jim Calzone, Application Engineer, dated November 13, 1986 (RIMS No. B43 861120 916)

4.12 Gould Shawmut Advisor (Catalog), 1985 CP-10M-386 (RIMS No. B43 861120 908)

4.13 Electrical Design Standard DS-E8.1.1, "FUSES, Substitution Standard for Low-Voltage Power and Control Fuses (600 Volts or Less)

4.14 Littelfuse Tracer telecopy to F. B. Rosenzweig, January 1, 1987 (RIMS No. B43 870112 002).

APPENDIX C (Cont'd)
(Page 41 of 51) RIV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 1

AC-RATED FUSES - SMALL DIMENSION

(This list is in alphanumeric order. Adjacent to each fuse is the allowable substitute. Refer to Appendix A for fuse rating data.)

Bussmann Fuse		Littelfuse Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
ABC1/4	250	314.250	250
ABC2	250	314002	250
ABC3	250	314003	250
ABC5	250	314005	250
ABC6	250	314006	250
ABC15	250	314015	250
AGC1/16	250	312.062	250
AGC.5	250	312.500	250
AGC1	250	312001	250
AGC2	250	312002	250
AGC3	250	312003	250
AGC4	32	311004	32
AGC5	32	311005	32
AGU1	250	512001	250
BRS1	600	BLS1	600
FNA1	125	No Sub	--
FNA2	125	No Sub	--
FNA3	125	No Sub	--

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 1

AC-RATED FUSES - SMALL DIMENSION

(This list is in alphanumeric order. Adjacent to each fuse is the allowable substitute. Refer to Appendix A for fuse rating data.)

Bussmann Fuse		Littelfuse Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
ABC1/4	250	314.250	250
ABC2	250	314002	250
ABC3	250	314003	250
ABC5	250	314005	250
ABC6	250	314006	250
ABC15	250	314015	250
AGC1/16	250	312.062	250
AGC.5	250	312.500	250
AGC1	250	312001	250
AGC2	250	312002	250
AGC3	250	312003	250
AGC4	32	311004	32
AGC5	32	311005	32
AGU1	250	512001	250
BBS1	600	BLS1	600
FNA1	125	No Sub	--
FNA2	125	No Sub	--
FNA3	125	No Sub	--

APPENDIX C (Cont'd)
(Page 42 of 51)

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 1 (Continued)

AC-RATED FUSES - SMALL DIMENSION

Bussmann Fuse		Littelfuse Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
FNA5	125	No Sub	--
FNA10	125	No Sub	--
FNA15	125	No Sub	--
GLQ.5	300	No Sub	--
GMT.18	125	401.180	125
GMT.5	125	401.500	125
GMT1	125	401001	125
GMT1.33	125	4011.33	125
GMT2	125	401002	125
GMT3	125	401003	125
GMT5	125	401005	125
GMT10	125	401010	125
KBO5*	250	--	--
MDA10	250	326010	250
MDL.5	250	313.500	250
MDL1	250	313001	250
MDL2	125	313002	250

*Obsolete--replace with ABC5 or indicated substitute fuse.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 1 (Continued)

AC-RATED FUSES - SMALL DIMENSION

Bussmann Fuse		Littelfuse Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
FNA5	125	No Sub	--
FNA10	125	No Sub	--
FNA15	125	No Sub	--
GLQ.5	300	No Sub	--
GMT.18	125	401.180	125
GMT.5	125	401.500	125
GMT1	125	401001	125
GMT1.33	125	4011.33	125
GMT2	125	401002	125
GMT3	125	401003	125
GMT5	125	401005	125
GMT10	125	401010	125
MBO5*	250	--	--
MDA10	250	326010	250
MDL.5	250	313.500	250
MDL1	250	313001	250
MDL2	125	313002	250

*Obsolete--replace with ABC% or indicated substitute fuse.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 1 (Continued)

AC-RATED FUSES - SMALL DIMENSION

Bussmann Fuse		Littelfuse Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
MDL4	32	313004	250
MDL20	32	313020	32
MDX2	250	313002	250
MIS(1-4)	600	No Sub	--
MIS 5	600	See Note*	--
MIS(6-12)	600	No Sub	--
MTH5	250	312005	250
SC(1-30)	300	SLC(1-30)	300
WEK.5	32	No Sub	--
WEK2	32	No Sub	--

Littelfuse Fuse		Bussmann Substitute Fuse	
Catalog No.	Voltage Rating	Catalog No.	Voltage Rating
312.062	250	AGC1/16	250
312001	250	AGC1	250
31201.6	250	AGC1.6	250
312002	250	AGC2	250
312003	250	AGC3	250
312010	250	No Sub	--
314010	250	ABC10	250
FLAS5	250	No Sub	--

*Littelfuse FLAS5 can be used if the system voltage is 250 volts AC or less and the interrupting rating required is 20,000 amps or less.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 2

AC-RATED FUSES - MIDGET

(This list is in alphanumeric order. Adjacent to each fuse is the allowable substitute(s). Refer to Appendix A for fuse rating data.)

Bussmann Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
*ABU2 (Superseded by BAN2)	250	KTK2	600	KLK2	600	ATK2	600
*ABU3 (Superseded by BAN3)	250	KTK3	600	KLK3	600	ATK3	600
*AGU1	250	KTK1	600	KLK1	600	ATK1	600
*BAF1	250	KTK1	600	KLK1	600	ATK1	600
*BAF3	250	KTK3	600	KLK3	600	ATK3	600
*BAN3	250	KTK3	600	KLK3	600	ATK3	600
FNM(0-10)	250	--	--	FLM(0-10)	250	TRM(0-10)	250
FNM(12-15)	125	--	--	FLM(12-15)	250	TRM(12-15)	250
FNM(20-30)	32	--	--	FLM(20-30)	250	TRM(20-30)	250
KLN(0-30)	600	KTK(0-30)	600	KLK(0-30)	600	No Sub	--
KTK(0-30)	600	KLN(0-30)	600	KLK(0-30)	600	ATK(0-30)	600
KTK-R(0-30)	600	--	--	KLK-R(0-30)	600	ATK-R(0-30)	600
**MDL2	250	FNM2	250	FLM2	250	TRM2	250
MIC(0-15)	250	--	--	No Sub	--	No Sub	--
(20-30)	32	--	--	No Sub	--	No Sub	--

*When replacement is considered, replace with listed substitute fuse and implement procedure (where applicable) for use on a permanent basis.

**Obsolete

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 2 (Continued)

AC-RATED FUSES - MIDGET

Bussmann Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
MLN(1-5)	250	--	--	No Sub	--	GFN(1-5)	250
(10-15)	250	--	--	No Sub	--	No Sub	--
(20-30)	32	--	--	FLA(20-30)	32	No Sub	--

Littelfuse Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
FLA(1-5)	125	MLN(1-5)	250	--	--	GFN(1-5)	250
FLA(6-8)	125	No Sub		--	--	No Sub	--
FLA(10-15)	125	MLN(10-15)	250	--	--	No Sub	--
FLA(20-30)	32	MLN(20-30)	32	--	--	No Sub	--
KLK(0-30)	600	KTK(0-30) KLN(0-30)	600 600	-- --	-- --	ATM(0-30)	600
KLK-R(0-30)	600	KTK-R(0-30)	600	--	--	ATM-R(0-30)	600

Gould Shawmut Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
ATM(0-30)	600	KTK(0-30)	600	KLK(0-30)	600	--	--
ATM-R(0-30)	600	KTK-R(0-30)	600	KLK-R(0-30)	600	--	--
GFN(1-5)	250	No Sub	--	No Sub	--	--	--
TRM(0-10)	250	FNM(0-15)	250	FLM(0-15)	250	--	--
TRM(12-30)	250	No Sub	--	FLM(12-30)	250	--	--

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 3

DC-RATED FUSES - MIDGET AND SMALL DIMENSION

(This list is in alphanumeric order. Adjacent to each fuse is the allowable substitute(s). Refer to Appendix B for fuse rating data.)

Bussmann Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut Fuse	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
AGC 1/16	150	--	--	No Sub	--	--	--
*BAF 3	150	KLK 3	500	KLK 3	500	ATM 3 A5Y3-2	500 500
FNA 3	60	--	--	No Sub	--	No Sub	--
FNA 5	60	--	--	No Sub	--	No Sub	--
FNA 10	60	--	--	No Sub	--	No Sub	--
FNA 15	60	--	--	No Sub	--	No Sub	--
FNM 8	150	--	--	No Sub	--	No Sub	--
FNM 10	150	--	--	No Sub	--	No Sub	--
GMT(0-30)	60	--	--	No Sub	--	No Sub	--
KLN(0-30)	500	--	--	KLK(0-30)	500	No Sub	--
MDL 4	60	--	--	No Sub	--	No Sub	--
MIC 1	150	--	--	No Sub	--	No Sub	--
MIC 5	150	--	--	No Sub	--	No Sub	--
MIS(1-4)	300	--	--	No Sub	--	No Sub	--
MIS 5	300	--	--	See Note**	--	--	--
MIS(6-12)	300	--	--	No Sub	--	--	--
MIN 5	150	--	--	No Sub	--	No Sub	--
SC 3	300	--	--	No Sub	--	No Sub	--
SC 10	300	--	--	No Sub	--	No Sub	--
WKR 2	60	--	--	No Sub	--	No Sub	--

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2

Table 3 (Continued)

DC-RATED FUSES - MIDGET AND SMALL DIMENSION

Littelfuse Fuse		Substitute Fuse					
		Bussmann		Littelfuse		Gould Shawmut	
Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating	Cat. No.	Voltage Rating
KLK(0-30)	500	KLN(0-30)	500	No Sub	--	No Sub	--
FLASS	150	No Sub	--	No Sub	--	No Sub	--
Gould Shawmut							
ASY(0-30)-2	500	KLN(0-30)	500	KLK(0-30)	500	--	--
ATN(0-30)	500	KLN(0-30)	500	KLK(0-30)	500	--	--

*When replacement is considered, replace with listed substitute fuse and implement procedure (where applicable) for use on a permanent basis.

**Littelfuse FLASS can be used if the system voltage is 150 volts DC or less.

APPENDIX C (Cont'd)
(Page 48 of 51)

REV 0002

GROUP: FUSES TITLE: Substitution Standard for Midget and Small Dimension Fuses	ELECTRICAL DESIGN STANDARD DS-E8.1.2 APPENDIX A

Page 1 of 3

FUSE RATING DATA

1.0 ALTERNATING CURRENT RATING

Most of the manufacturers' published catalog data apply to AC applications. Where the data does not specifically state DC rating, the data is for AC applications only. AC rating data can be verified by reviewing the referenced data. If DC ratings are required and are not listed in this standard, they should be referred to DNE for evaluation on a case-by-case basis.

2.0 CURRENT INTERRUPTING RATING

Current interrupting ratings should be considered when determining the suitability of a substitute fuse. The current interrupting rating of the fuse should be greater than the maximum available short circuit fault current at the fuse location in the circuit.

2.1 Typical AC interrupting rating of UL-listed electronic fuses is 10,000 amperes for all voltage levels except 250-volt AC listed fuses. The 250-volt AC UL-listed fuses are first tested as 125-volt AC fuses, in which case they must have a 10,000-AIR. However, at 250-volts AC, these fuses may have lower interrupting ratings as shown below.

INTERRUPTING RATINGS OF UL-LISTED FUSES

AC Voltage Rating	Amp Rating of Fuse	Short Circuit Current (UL Minimum) (In Amps)
125	All Amperages	10,000 (does not include micro fuses)
250	0-1	35
	1.1-3.5	100
	3.6-10	200
	10.1-15	750
	15.1-30	1,500
300	All Amperages	10,000
500	All Amperages	10,000
600	All Amperages	10,000, 50,000 or 100,000

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2
APPENDIX A

FUSE RATING DATA (Continued)

2.0 CURRENT INTERRUPTING RATING (Continued)

2.2 Fuses designed and listed to European standards must meet a breaking/interrupting capacity test. The various capacities for the four main European fuse types are shown below (AC voltage).

INTERRUPTING RATINGS (BREAKING CAPACITY) PER EUROPEAN STANDARDS

Type	Case Size In Millimeters (mm)	Breaking Capacity (In Amps)
Quick acting, high-breaking capacity	5 x 20	1500
Quick acting, low-breaking capacity	5 x 20	35 or 10 times rated current, whichever is greater
Time-lag, low-breaking capacity	5 x 10	35 or 10 times rated current, whichever is greater
Quick acting, low-breaking capacity	6.3 x 32	35 or 10 times rated current, whichever is greater

2.3 UL and International Electrotechnical Commission (IEC) fuses' interrupting/breaking capacity are tested using AC. Their DC ratings could be different because of circuit time constant considerations. It is generally easier for a fuse to interrupt AC than it is to interrupt DC.

3.0 CONTINUOUS AMPERAGE RATING

Due to industry requirements and demand, available fuse amperage values change from time to time. Amperage ratings are added and deleted in a family of fuses.

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2
APPENDIX A

Page 3 of 3

FUSE RATING DATA (Continued)

4.0 VOLTAGE RATING

Unless specifically noted on the fuse label that the voltage rating applies to DC, the voltage rating applies to AC only. The fuse can be applied at any AC voltage up to the rated value.

DC ratings have been established by the manufacturers for some fuses as indicated in Appendix B. This rating will not appear on the fuse label unless it is certified or listed. Fuses listed in Appendix B can be used at any DC voltage up to the value listed.

APPENDIX C (Cont'd)
(Page 51 of 51)

REV 0002

TVA

GROUP: FUSES
TITLE: Substitution Standard for Midget and Small Dimension Fuses

ELECTRICAL DESIGN STANDARD DS-E8.1.2
APPENDIX B

Page 1 of 1

REFERENCE FOR DC RATINGS

Manufacturer	Rating Volts	AIR*	Source of DC Ratings (Reference)
Bussmann			
AGC 1/16	150	204	4.9
BAF3	150	204	4.9
FNA	60	200	4.9
FNM	150	204	4.9
GMT	60	200	4.7 and 4.9
KLM	500	150E**	4.7 and 4.11
MDL	60	200	4.9
MIC	150	200	4.9
MIS	300	10E**	4.9
MTH	150	200	4.9
SC3	300	138	4.9
SC10	300	134	4.9
WZR	60	200	4.9
Gould Shawmut			
AST(0-30)-2	500	20E**	4.10
AIM	500	20E**	4.10
Littelfuse			
KLK	500	150E**	4.1
FLASS	150	20E**	4.14

*AIR = Amperes interrupting rating
**E = KAIR = 1000 Amperes interrupting rating

REV 0002

APPENDIX D
(Page 1 of 4)

QA Record

B43 '87 1229 910

TVA

GROUP: GENERAL
TITLE: Master Fuse List and Fuse Labeling

ELECTRICAL DES. STANDARD DS-E1

PREP'D	FBRosenzweig	JRArnett			ORIG ISSUE: 2-11-
	JKGreene	DRWebster			REV NO.: 5
REVIEWED	DRWebster	JKGreene			REV DATE: 12-29-
APPR'D	WSRaughley	JDHutson			

1.0 GENERAL

This design standard: (a) defines the minimum required data to be contained in the master fuse list which each project is required to maintain and (b) details the requirements for fuse labels.

The Division of Nuclear Engineering (DNE) shall provide the appropriate organization with a unique identifier to be used on the fuse label by means of DNE-produced drawings, vendor drawings for which DNE has assume maintenance responsibility, or other appropriate documents.

1.1 APPLICABILITY

This design standard applies to all nuclear plants.

1.2 APPLICABLE CODES AND STANDARDS

Electrical Design Standard DS-E1.2.1, GENERAL, Electrical Nameplates - Browns Ferry Nuclear Plant

Electrical Design Standard DS-E1.2.2, GENERAL, Electrical Equipment Nameplates - Sequoyah and Subsequent Nuclear Plants

2.0 MASTER FUSE LIST REQUIREMENTS

Each project shall maintain a master fuse list issued as an output document which shall show the following information:

a. Unique identification number

b. Manufacturer's catalog number (include amperage rating, where applicable, if not part of the catalog number)

c. Manufacturer's name or identification code number

d. State whether or not the application is 1E (if not stated as part of the fuse unique identification number)

e. Identification of fuse location

3.0 FUSE LABEL IDENTIFICATION REQUIREMENTS

Fuse labels shall allow easy identification of the fuse clips or fuse blocks to which they apply.

TVA

GROUP: GENERAL
TITLE: Master Fuse List and Fuse Labeling

ELECTRICAL DESIGN STANDARD DS-E1.2.3

3.1 PLANT UNIQUE IDENTIFIERS

3.1.1 Browns Ferry - Per Component Identification Standards DNES 8.31 and DNES 8.32

3.1.2 Sequoyah - Per Sequoyah Engineering Procedure SQEP-34 and Component Identification Standards DNES 8.21 and DNES 8.22

3.1.3 Watts Bar - Per Component Identification Standards DNES 8.41 and DNES 8.42

3.1.4 Bellefonte - Per Component Identification Standards DNES 8.01 and DNES 8.02

3.2 INSCRIPTIONS

3.2.1 All fuse identification labels shall display the following information in two lines:

a. The plant unique fuse identifier in accordance with the applicable requirement of subsection 3.1.

b. The plant standardized information as to the device being supplied by the fuse, or fuse title, or fuse manufacturer's identification code and/or manufacturer's catalog number including its ampere rating.

3.2.2 A third line in the label or an auxiliary tag shall be provided where special instructions apply. (Example: "DO NOT SUBSTITUTE.")

3.3 LEGIBILITY

All information on the labels shall be legibly typewritten, engraved, or handpriated. Environment, location, overall size, letter/number size, label material, type inscription, and attachment method shall be considered to maximize legibility.

4.0 REQUIRED LABEL MATERIAL

All fuses shall be permanently labeled with a durable label that will remain intact for an extended length of time (i.e., years). The material shall be capable of withstanding the environmental conditions for the area in which the fuse label is to be used. Any of the following materials or methods is acceptable:

4.1 Engraved Lamacoid plastic attached with screws or adhesive. See Electrical Design Standards DS-E1.2.1 and DS-E1.2.2 for details concerning size, engraving, and attachment methods. |5

4.2 Mylar peel-off label allowing information to be handpriated or computer-typed. Use Perma-Shield labels by W. H. Brady Company, or equivalent.

APPENDIX D (Cont'd)
(Page 3 of 4)

REV 0002

TVA

GROUP: GENERAL
TITLE: Master Fuse List and Fuse Labeling

ELECTRICAL DESIGN STANDARD DS-E1.2.3

4.3 Vinyl-coated cloth peel-off label allowing information to be handprinted or computer-typed. After applying label, spray with a clear varnish, such as Krylon (the use of varnish as a sealer shall be limited to equipment where the use of varnish creates no fire hazard.) Use W. H. Brady Company part No. B-502 or equivalent.

4.4 Stamping or handprinting fuse information on the metal equipment and then spraying with a clear varnish, such as Krylon. The use of varnish as a sealer shall be limited to equipment where the use of varnish creates no fire hazard.

5.0 LOCATION OF LABEL

When it is not possible or permissible to place a fuse label near the fuse block as described in subsections 4.1, 4.2, or 4.3, the following method shall be used: A layout drawing or label matrix shall be made showing the fuses arranged in their relative position in the respective compartment, panel, or cabinet. If a drawing is necessary, it will be produced by OMP or DMC but must be approved by DNE. The drawing shall be permanently mounted within the enclosure in a conspicuous location and shall be covered by a clear, see-through cover that can be removed in the event that the fuse arrangement is revised.

6.0 REQUIRED ATTACHMENT METHODS FOR FUSE LABELS

Fuse labels shall be securely attached as closely as possible to the fuse block or fuse clip. Any method of attachment is acceptable if it is permanent and will withstand the environmental conditions of the area. Examples include screws or adhesive for Lamacoid labels or pressure-sensitive adhesives for peel-off labels.

No label shall be placed on any device or part which, when removed, will also remove the fuse label from the equipment. A box cover is a typical example.

7.0 REVERSIBLE FUSE BLOCK MARKINGS

Reversible fuse blocks (fuse blocks that can be inserted in an ON or OFF position), unless otherwise clearly and permanently marked, shall be marked by OMP or DMC to minimize possible confusion as to whether the fuse block is inserted in the ON or OFF position. The mark shall consist of a white painted stripe, approximately 1/4 inch wide, across the fuse block and receptacle. The stripe on the fuse block is to line up with the stripe on the receptacle only when the fuse block is inserted in the ON position. Use Phenoline 305 type of paint.

TVA

GROUP: GENERAL
TITLE: Master Fuse List and Fuse Labeling

ELECTRICAL DESIGN STANDARD DS-E1.2.3

8.0 REFERENCES

8.1 DNES 8.01, Unique Identification (UNID) of Structures, Systems, and Components for Bellefonte and Later Nuclear Plants

8.2 DNES 8.02, Unique Identification (UNID) Implementation for Bellefonte and Later Nuclear Plants

8.3 DNES 8.21, Component Identification - Sequoyah Nuclear Plant

8.4 DNES 8.22, Component Identification Implementation for Sequoyah Nuclear Plant

8.5 DNES 8.31, Component Identification - Browns Ferry Nuclear Plant

8.6 DNES 8.32, Component Identification Implementation for Browns Ferry Nuclear Plant

8.7 DNES 8.41, Component Identification - Watts Bar Nuclear Plant

8.8 DNES 8.42, Component Identification Implementation for Watts Bar Nuclear Plant

8.9 Sequoyah Engineering Procedure SQEP-34, Procedure for Implementation of the Electrical Fuse Tabulation

LAST PAGE

CONDITION ADVERSE TO QUALITY REPORT
BFP 870175

Nuclear

CAQR RECORD

SHEET 1 OF 3

REV. 0

RIMS ACCESSION NUMBER ▶ A 76870430869 = CAQR NO. BFP870175

PART A — DESCRIPTION OF THE CAQ

PLANT/PROJECT Browns Ferry (67) UNIT 0 VENDOR NA

SYSTEM Various VENDOR'S ADDRESS NA

COMPONENT Power & Control fuses CONTRACT NO. NA

ASME? YES [ ] NO [X] REFERENCES 15B501 series; DS-E8.1.1 & DS-E8.1.2

REQUIREMENT VIOLATED Design verification of fuse applications as to size, type and circuit requirements.

SOURCE OF REQUIREMENT VIOLATED Design Standards DS-E8.1.1 & DS-E8.1.2

029

DESCRIPTION OF CONDITION

The 15B501 series was issued by ECN P0282 in 11/79 to provide the plant a plant specific fuse substitution list. Subsequently, Design Standard DS-E8.1.1 was issued 5/80 based on the BFNP plant specific document with minor differences. The 15B501 series was not revised to reflect these differences nor was an exception filed. This is also the case for all subsequent revisions to DS-E8.1.1 and all revisions to DS-E8.1.2 which address additional types of fuses. Revision 4 of DS-E8.1.1 and revision 2 of DS-E8.1.2 essentially disallow most fuse substitutions and only with design analysis and approval. The BFNP plant specific document (15B501 series) has not been revised to reflect these limitations or meet other requirements of later revisions of the Design Standards.

RECOMMENDED CORRECTIVE ACTION (OPTIONAL)

CAQR INITIATED BY [signature] DATE 4/24/87 TEL. NO. 5453-BFNP

INITIATOR'S ORGANIZATION DNE-ETS-EEB-BFEP-E1 DATE/TIME CAQ DISCOVERED 4/24/87

MANAGEMENT REVIEWER S. A. Richardson DATE 4/24/87 TITLE Supervisor

RESPONSIBLE ORGANIZATION DNE/BFEP/EEB

POTENTIAL AFFECT ON OPERABILITY

OPERABILITY OF NUCLEAR UNIT IS [X] IS NOT [ ] AFFECTED.
IF "YES", INDICATE AFFECTED UNITS.

BFN 1[ ] 2[ ] 3[X] COMMON[ ] SQN 1[ ] 2[ ] COMMON[ ]

WBN 1[ ] 2[ ] COMMON[ ] BLN 1[ ] 2[ ] COMMON[ ]

CAQ COORDINATOR

DATE RECEIVED 4-29-87 4/30/87

PROCESSED BY [signature] DATE 4/29/87

TRENDING CODES

SALP (1) [A] (2) [ ] ACTIVITY (1) [QC] (2) [ ]

DETAIL DESCRIPTION (1) [QTI] (2) [ ] ROOT CAUSE [SH]

APPR [PIPA] CAUSE ORG. (1) [BFA] (2) [ ]

EQUIP IDENT. NON WBN BFN PLANT [ ] - UNIT [ ] - FUNCTION [ ] - SYSTEM [ ] - ADDRESS [ ] - SEPARATOR [ ]

BLN PLANT [ ] - UNIT/SYSTEM [ ] - COMPONENT [ ] - ADDRESS [ ] - SEPARATOR [ ]

PROCEDURE VIOLATED [DSE8.1.1]

MANUFACTURER [ ]

REQUISITION [ ] DNE EQUIPMENT [ ]

DISTRIBUTION

ORGANIZATION/MGR.			PLANT BF	BLN	SQN	WBN
DNQA, DIR	[ ]	SITE DIR.	[ ]	[ ]	[ ]	[ ]
DNE, DIR	[ ]	PMO	[ ]	[ ]	[ ]	[ ]
DNC, DIR	[ ]	SITE QA	[ ]	[ ]	[ ]	[ ]
DNS, DIR	[ ]	DNE-PE	[ ]	[ ]	[ ]	[ ]
DNSL, DIR	[ ]	DNC-CE	[ ]	[ ]	[ ]	[ ]
NSRB	[ ]	DNC-MOD	[ ]	[ ]	[ ]	[ ]
ONP, MGR	[ ]	DNSL	[ ]	[ ]	[ ]	[ ]
RIMS	[ ]	NRC RES	[ ]	[ ]	[ ]	[ ]

ORIGINATOR B. D. Williams, TS-BFNP

OTHER

RIMS ACCESSION NUMBER

TVA 19584 (ONP 1-87)

Nuclear

CAQR

REV. 0

RIMS ACCESSION NUMBER (1) CAQR NO. BF2870175

PART B EVALUATION

AFFECT ON OPERABILITY

DOES THIS CAQ IMPACT UNIT OPERABILITY? YES ☐ NO ☐

IF 'YES' NOTIFIED PLT. MGR. AND/OR OPERATIONS AT _____ TIME ON _____ DATE

SIGNIFICANCE/REPORTABILITY

	SIGNIFICANT CAQ	REPORTABILITY	REVIEWED BY	DATE
PORS	YES ☐ NO ☐	YES ☐ NO ☐		
RESPONSIBLE ORGANIZATION	YES ☒ NO ☐	YES ☐ NO ☒	[signature]	5/8/87

IF REPORTABILITY BLOCK IS CHECKED 'YES' IN ITEM 3B, GIVE A COPY TO THE ORGANIZATION RESPONSIBLE FOR DETERMINING REPORTABILITY IMMEDIATELY: SENT TO _____ DATE _____ TIME _____

GENERIC REVIEW

A REVIEW FOR POTENTIAL GENERIC IMPLICATIONS IS ☒ IS NOT ☐ REQUIRED.
(ALWAYS REQUIRED FOR SIGNIFICANT CAQ'S AND CAQ'S AFFECTING OPERABILITY)

COPY OF CAQR SENT TO ENA- PRS ON 5-8-87 FOR PERFORMANCE OF A GENERIC REVIEW.

ROOT CAUSE ANALYSIS/RECURRENCE CONTROL

ROOT CAUSE ANALYSIS REQUIRED? YES ☒ NO ☐

RECURRENCE CONTROL REQUIRED? YES ☒ NO ☐

(ALWAYS REQUIRED FOR SIGNIFICANT CAQ'S, NRC VIOLATIONS, AUDIT FINDINGS, CAQ'S AFFECTING OPERABILITY.)

IF EITHER ARE REQUIRED, FILL OUT PART D OF THIS CAQR.

EVALUATED BY

[signature] 5/8/87
NAME DATE

BNEP-EEB
ORGANIZATION

APPROVED BY

S.A. Thibodeaux 5/8/87
NAME DATE

Supervisor
TITLE

PART C REMEDIAL CORRECTIVE ACTION

DISPOSITION METHOD

RETURN TO VENDOR ☐
REWORK ☒ REPAIR ☐
ACCEPT-AS-IS ☐ SCRAP ☐
OTHER (DESCRIBE) ☐

OTHER INFORMATION

NO TAGS PLACED
REPAIR/REWORK PROCEDURE NO. BE G-12
WAS ENGINEERING REQMT VIOLATED YES ☒ NO ☐
REFERRED TO ONE/ONS TO DETR DISPOSITION YES ☐ NO ☐

DESCRIPTION OF PROPOSED DISPOSITION

See Attachment

ORGAN RESPONSIBLE FOR C/A BFE/EEB/DNE/LEE/W&A
SCHEDULED COMPLETION DATE ~~OCT. 1, 1987~~ UNIT 2 START-UP

VERIFICATION REQUIREMENTS: RETEST ☒ REINSPECT ☒ AUDITOR FOLLOW-UP ☐ QA REVIEW ☒ SUPV. REVIEW ☒ OTHER (DESCRIBE) ☐

APPROVALS	NAME	DATE	NAME	DATE
PROPOSED BY	M.U. QURAISHI	5-19-87	J. TABLEWSKI	6-25-87
SUPV. APPROVAL	S.A. Thibodeaux	6/24/87	Wm R Bingin	6-25-87
ONE/DNS APPROVAL	[signature]	6/29/87		
QA ACCEPTANCE				
QA APPROVAL				
OTHER APPROVAL				

APPROVAL

PCRC REVIEW DATE

PLANT MANAGER DATE

RIMS ACCESSION NO.

VERIFICATION OF REMEDIAL C/A

	NAME	DATE
APPROVED CORRECTIVE ACTION HAS BEEN COMPLETED AND IS READY FOR VERIFICATION		
VERIFICATION COMPLETE		
ALL TAGS REMOVED		
CAQR SHEET 2 CLOSED		

RIMS ACCESSION NUMBER

NUCLEAR

CAQR

REV. 0

RIMS ACCESSION NUMBER → [redacted] CAQR NO. BRP870175 | |

PART D ROOT CAUSE ANALYSIS/RECURRENCE CONTROL

ROOT CAUSE OF THE CAQ

The Browns Ferry Engineering Project failed to revise the Browns Fe[illegible] Plant specific fuse substitution list to eliminate conflicts with the newer Division of Nuclear Engin[illegible] fuse substitution list contained in Design Standard DS-E8.1.1 and DS-E8.1.2.

PROPOSED RECURRENCE CONTROL ACTIONS

Develop a BFN specific, DNE controlled fuse tabulation program.

ORGANIZATION RESPONSIBLE FOR RECURRENCE CONTROL BFEP / EEB / DNE / LEE / WAA

SCHEDULED COMPLETION DATE UNIT 2 START-UP

VERIFICATION REQUIREMENTS ☒ SUPERVISOR REVIEW ☐ QC INSPECTION ☐ TEST ☐ AUDITOR FOLLOWUP ☐ QA REVIEW ☒ ☐ OTHER (DESCRIBE)

APPROVALS	NAME	DATE	NAME	DATE
PROPOSED BY	M. U. QURAISHI	6/25/87	J. TARLENSKI	6-25-87
SUPV. APPROVAL	S. A. Richardson	6/25/87	[illegible]	6-25-87
DNE/DNS APPROVAL	[illegible]	6/24/87		
QA APPROVAL				
OTHER APPROVAL				

APPROVAL

PORC REVIEW DATE

PLANT MANAGER DATE

RIMS ACCESSION NO.

VERIFICATION OF RECURRENCE CONTROL	NAME	DATE
APPROVED RECURRENCE CONTROL COMPLETE-READY FOR VERIFICATION		
VERIFICATION		
CAQR SHEET 3 CLOSED		

RIMS ACCESSION NUMBER

ATTACHMENT

CAQR BFP870175

Description of Proposed Disposition:

(1) Obtain approval for use of the currently installed fuses where possible. Where installed fuse cannot be approved for use, identify fuse to be installed. This applies to fuses in the following categories for unit 2 restart:

A. Class 1E fuses
B. Non-Safety fuses required to support Appendix R commitment
C. Containment penetration protection fuses
D. Class 1E Cables/Bus protection

(2) Verify that the installed fuses in Ø1 conform to the approved fuse and that they are correctly indentified.

(3) Provide adequate documentation to assure that the as-designed and as-installed fuses can be cross referenced.

(4) Revise standards to include substitutions of approved/installed fuses.

0478d

SAMPLE FUSE TABULATION SHEET

DRAWING CHANGE AUTHORIZATION TVA - BFNP DISCIPLINE: ELECTRICAL	~~ECN~~ / DCN # : W1569 REV # : A SH # : 41 OF 81

UNID	DESCRIPTION	FUSE TYPE	MFGR	SWGR	PNL/BKR	CONNECTION DRAWING	SCHEMATIC DRAWING	EQ	APP	PEN	SAFETY CLASS
2-FU2-71-39B	CONT NOR	A2Y15-1	S156	DCRMOV 2C 03D		45N2713-1	45N714-5	Y	N	N	1E
2-FU2-71-39C	CONT EMER	A2Y15-1	S156	DCRMOV 2C 03D		45N2713-1	45N714-5	Y	N	N	1E
2-FU2-71-3A	RUN LIGHT	A2Y6-1	S156	DCRMOV 2C 06B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-3B	CONT NOR	A2Y15-1	S156	DCRMOV 2C 06B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-3C	CONT EMER	A2Y15-1	S156	DCRMOV 2C 06B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-8A	RUN LIGHT	A2Y6-1	S156	DCRMOV 2C 04B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-8B	CONT NOR	A2Y15-1	S156	DCRMOV 2C 04B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-8C	CONT EMER	A2Y15-1	S156	DCRMOV 2C 04B		2-45N2713-2	45N714-5	Y	N	N	1E
2-FU2-71-9A	RUN LIGHT	A2Y6-1	S156	DCRMOV 2C 05B		2-45N2713-2	45N714-6	Y	N	N	1E
2-FU2-71-9B	CONT NOR	A2Y15-1	S156	DCRMOV 2C 05B		2-45N2713-2	45N714-6	Y	N	N	1E
2-FU2-71-9C	CONT EMER	A2Y15-1	56	DCRMOV 2C 05B		2-45N2713-2	45N714-6	Y	N	N	1E
2-FU2-71-9D	TRIP SOL	A2Y10-1	S156	DCRMOV 2C 04A		2-45N2713-2	45N714-6	Y	N	N	1E
2-FU2-71-9E	TRIP SOL	A2Y10-1	S156	DCRMOV 2C 04A		2-45N2713-2	45N714-6	Y	N	N	1E
2-FU2-281-2CA	VM & UV CKT	A2Y6-1	S156	DCRMOV 2C 02A		45N2713-1	45N714-7	Y	N	N	1E

				Q
000	INIT. ISSUE - FUSE TAB	John P. Tomaszewski	Ankit C. Oza 8-11-88	
REV		DRAFTED BY	CHECKED BY	

THIS CHANGE IS [√] SAFETY RELATED [ ] NOT RELATED TO NUCLEAR SAFETY

BASE DRAWING	REV	DCA NUMBER	REV
2-45B721-14 SH. 3	000	DCA-W1569- 019	000

SCHEMATIC DRAWINGS
45N714-2, 250 VDC REACTOR MOV Board 1A
45N799-10 480 V SHUTDOWN AUX. POWER

OVERSIZE DOCUMENT PAGE PULLED

SEE APERTURE CARDS

NUMBER OF OVERSIZE PAGES FILMED ON APERTURE CARDS 2

APERTURE CARD/HARD COPY AVAILABLE FROM RECORD SERVICES BRANCH
FTS 492-8989