ATTACHMENT A

CORRELATION OF QUAD CITIES UNIT 1 STUDY RESULTS ON THE EFFECTS OF DC POWER FAILURES ON ECCS AVAILABILITY TO PLANT DESIGNS AT QUAD CITIES UNIT 2 AND DRESDEN UNIT 2 & 3

PREPARED FOR: COMMONWEALTH EDISON COMPANY

PROJECT NO. 8192-01

DATE: DECEMBER 1, 1988

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CORRELATION OF QUAD CITIES UNIT 1 STUDY RESULTS ON THE EFFECTS OF DC POWER FAILURES ON ECCS AVAILABILITY TO PLANT DESIGNS AT QUAD CITIES UNIT 2 AND DRESDEN UNIT 2 & 3

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I. INTRODUCTION

A design weakness was found to exist in the LPCI (RHR) swing bus transfer schemes for Dresden Units 2 & 3 and Quad Cities Units 1 & 2. The design was such that the loss of 125 Vdc Division II control power would prevent an automatic transfer from taking place. This would result in all four LPCI (RHR) pumps being unable to inject water into the reactor vessel when required.

A design modification has since been issued for each unit which causes the circuitry to respond correctly to the loss of a dc power source.

Based upon the above identified design inadequacy, CECo authorized an indepth comprehensive review of each dc system for Quad Cities Unit 1. A design review was performed and the results were presented in a report dated June 8, 1988. This report was issued to CECo on June 9, 1988, under S&L Letter No. Q327E.

II. PURPOSE

The purpose of this study is to review the Dresden Units 2 & 3 and Quad Cities Unit 2 dc power system and ascertain whether or not any other single dc failure exists at these units which could adversely impact the availability of the Emergency Core Cooling System (ECCS).

III. REVIEW APPROACH

The ECCS equipment at the subject units and their dc bus assignments along with the operational requirements will be compared to the results obtained from the Quad Cities Unit 1 review.

Any equipment or system considered to be unique or dissimilar from those already analyzed for Quad Cities Unit 1 will be reviewed in depth.

This study will address the 125 Vdc, 250 Vdc and 48 Vdc power systems. (Appendix C of this study report contains key diagrams of each station's 125 Vdc and 250 Vdc buses.)

IV. ECCS SUBSYSTEM DIFFERENCES

The Low Pressure Coolant Injection/Containment Cooling Subsystem at Dresden Units 2 & 3 fulfills the same objectives as the Low Pressure Coolant Injection mode and the Containment Cooling Mode of the Residual Heat Removal System at Quad Cities Units 1 & 2.

V. REVIEW RESULTS

A. 125 Vdc System

The emergency ac power system configuration for each unit is illustrated in Figures 1, 2, 3, and 4 of Appendix A of this report. Also included in these figures is the dc control power source assignment for each safety-related ECCS pump breaker and other bus source and tie breakers. Table 1 in Appendix B of this report provides a comparison between the four units of the assignment of 125 Vdc control power to ECCS loads and certain auxiliary equipment loads.

From these figures and this table, it is evident that the assignments of ECCS loads to dc sources of power are similar between units. The schematic and key diagrams listed in Section VII of this report were utilized to compare the operational requirements of ECCS equipment and the emergency auxiliary power system equipment between all four units. No major differences were uncovered in our review. The consequences of each 125 Vdc circuits failure on ECCS availability did not differ between the units. Thus the complete loss of any 125 Vdc source would result in the availability of "like" equipment at each unit.

B. 250 Vdc System

The only ECCS loads connected to the 250 Vdc system for each unit are those associated with the High Pressure Coolant Injection (HPCI) subsystem. Therefore, the equipment/systems available following the loss of a 250 Vdc source are the same as those presented in the Quad Cities Unit 1 Study Report.

C. 48/24 Vdc System

The 48/24 Vdc systems at Quad Cities Units 1 & 2 do not feed any ECCS equipment. The 48/24 Vdc systems at Dresden Units 2 & 3 are used to supply power to the analog trip system. Certain outputs from the analog trip system are used in ECCS applications. S&L has previously studied the effects of losing the ATS power supply (see S&L report #SL-4413 revised issue dated September 12, 1988).

The conclusion reached in report (SL-4413) is that the loss of 48/24 Vdc power supply does not degrade the safety function of the ECCS circuits below an acceptable level.

VI. CONCLUSIONS

Based on the Quad Cities Unit 1 comprehensive dc study report and this study by comparison, it is evident that the design of the Emergency Core Cooling System and supportive Auxiliary Power Systems are very similar between the four units. No other design deficiencies have been identified which could prevent the fulfillment of the design basis safety functions of the Emergency Core Cooling Systems at Dresden Units 2 & 3 and Quad Cities Units 1 & 2 following a single dc supply failure.

VII. REFERENCES

A. S&L Report - "Effects of Postulated DC Power Failure on ECCS Availability - Quad Cities Unit 1," dated June 8, 1988,

B. S&L Report SL-4413 - "Review of Analog Trip System" revised issue dated September 12, 1986.

C. Schematic and Key Diagrams:

Drawing No.	Revision	Drawing No.	Revision
4E-1303	L	4E-1438G SH. 2	W
4E-1304	E	4E-1461 SH. 1	AH
4E-1306	U	4E-1461 SH. 2	AH
4E-1317 SH. 1	V	4E-1461A	B
4E-1317 SH. 2	U	4E-1462 SH. 1	AD
4E-1318 SH. 1	B	4E-1462 SH. 2	AC
4E-1318 SH. 2	C	4E-1462 SH. 3	AD
4E-1328	D	4E-1462A	B
4E-1336	Q	4E-1527 SH. 1	C
4E-1337	K	4E-1527 SH. 2	C
4E-1342	T	4E-1527 SH. 3	B
4E-1343	Q	4E-1527A	E
4E-1344 SH. 1	A	4E-1528 SH. 1	AD
4E-1344 SH. 2	A	4E-1528 SH. 2	AB
4E-1344 SH. 3	A	4E-1438P	M
4E-1344 SH. 4	A	4E-1438Q	M
4E-1345 SH. 1	AS	4E-2303	H
4E-1345 SH. 2	AR	4E-2304	N
4E-1345 SH. 3	AR	4E-2306 SH. 1	U
4E-1346 SH. 1	AG	4E-2306 SH. 2	V
4E-1346 SH. 2	AJ	4E-2317 SH. 1	R
4E-1349 SH. 1	M	4E-2317 SH. 2	P
4E-1349 SH. 2	M	4E-2317 SH. 3	P
4E-1349 SH. 3	M	4E-2318 SH. 1	Y
4E-1350 SH. 1	Z	4E-2318 SH. 2	Y
4E-1350A SH. 2	Y	4E-2336	M
4E-1350B SH. 1	AC	4E-2342	S
4E-1350B SH. 2	AC	4E-2343	P
4E-1350B SH. 3	AD	4E-2344 SH. 1	A
4E-1351A SH. 1	Y	4E-2344 SH. 2	A
4E-1351A SH. 2	X	4E-2344 SH. 3	A
4E-1351B SH. 1	B	4E-2344 SH. 4	A
4E-1351B SH. 2	C	4E-2345 SH. 1	AG
4E-1351C	E	4E-2345 SH. 2	AG
4E-1430 SH. 1	AL	4E-2346 SH. 1	AB
4E-1430 SH. 2	AK	4E-2346 SH. 2	AC
4E-1438C	Y	4E-2348	D
4E-1438D	J	4E-2349 SH. 1	M
4E-1438D	Z	4E-2349 SH. 2	M
4E-1438E	K	4E-2349 SH. 3	M
4E-1438G SH. 1	W	4E-2350A SH. 1	X

Drawing No.	Revision
4E-2350A SH. 2	W
4E-2350B SH. 1	V
4E-2350B SH. 2	V
4E-2350C	E
4E-2430 SH. 1	AC
4E-2430 SH. 2	Z
4E-2430 SH. 3	Z
4E-2438C SH. 1	Q
4E-2438C SH. 2	R
4E-2438D	G
4E-2438E SH. 1	Q
4E-2438E SH. 2	R
4E-2438F	H
4E-2438G SH. 1	S
4E-2438G SH. 2	R
4E-2438Q SH. 1	K
4E-2438Q SH. 2	K
4E-2438P SH. 1	J
4E-2438P SH. 2	J
4E-2461 SH. 1	AC
4E-2461 SH. 2	AB
4E-2461A	B
4E-2462 SH. 1	W
4E-2462 SH. 2	W
4E-2462A	B
4E-2527 SH. 1	V
4E-2527 SH. 2	U
4E-2527 SH. 3	V
4E-2527A	E
4E-2528 SH. 1	V
4E-2528 SH. 2	R
12E-2303 SH. 2	K
12E-2304	K
12E-2306	R
12E-2321	R
12E-2322A	D
12E-2322 SH. 1	AB
12E-2322 SH. 2	AB
12E-2322 SH. 3	AB
12E-2324 SH. 1	P
12E-2324 SH. 2	P
12E-2328	D
12E-2336	M
12E-2337	M
12E-2344 SH. 1	P
12E-2344 SH. 2	P
12E-2344 SH. 3	P
12E-2344 SH. 4	P
12E-2345 SH. 1	AH
12E-2345 SH. 2	AD
12E-2345 SH. 3	AB
12E-2346 SH. 1	AC
12E-2346 SH. 2	AF

Drawing No.	Revision
12E-2346 SH. 3	AB
12E-2349 SH. 1	W
12E-2349 SH. 2	X
12E-2349 SH. 3	W
12E-2350A SH. 1	AB
12E-2350A SH. 2	AB
12E-2350B SH. 1	V
12E-2350B SH. 2	X
12E-2351A SH. 1	AE
12E-2351A SH. 2	AE
12E-2351B SH. 1	AA
12E-2351B SH. 2	AC
12E-2351B SH. 3	Z
12E-2353	N
12E-2429 SH. 1	X
12E-2429 SH. 2	X
12E-2430 SH. 1	AW
12E-2430 SH. 2	AV
12E-2435 SH. 1	X
12E-2435 SH. 2	X
12E-2436 SH. 1	Y
12E-2436 SH. 2	W
12E-2436 SH. 3	W
12E-2437 SH. 1	AH
12E-2437 SH. 2	AJ
12E-2437A	X
12E-2438 SH. 1	AL
12E-2438 SH. 2	AL
12E-2438A	Y
12E-2461 SH. 1	AV
12E-2461 SH. 2	AV
12E-2461A	D
12E-2462 SH. 1	AV
12E-2462 SH. 2	AT
12E-2462A	B
12E-2527	AV
12E-2527A	F
12E-2528	AM
12E-3303	G
12E-3304	L
12E-3306	N
12E-3321	P
12E-3322	Y
12E-3322A	D
12E-3324 SH. 1	M
12E-3324 SH. 2	M
12E-3336	H
12E-3344 SH. 1	Q
12E-3344 SH. 2	Q
12E-3344 SH. 3	Q
12E-3344 SH. 4	Q
12E-3345 SH. 1	AF
12E-3345 SH. 2	Z

Drawing No.	Revision
12E-3346 SH. 1	AE
12E-3346 SH. 2	AE
12E-3349	M
12E-3350A SH. 1	X
12E-3350A SH. 2	Y
12E-3350B	Z
12E-3353	M
12E-3354	H
12E-3355	K
12E-3356	E
12E-3357	A
12E-3374	P
12E-3429 SH. 1	P
12E-3429 SH. 2	P
12E-3430 SH. 1	AH
12E-3430 SH. 1	AH
12E-3430 SH. 2	AH
12E-3435 SH. 1	P
12E-3435 SH. 2	P
12E-3435 SH. 3	P
12E-3436 SH. 1	L
12E-3436 SH. 2	K
12E-3436 SH. 3	K
12E-3436 SH. 4	K
12E-3437 SH. 1	Z
12E-3437 SH. 2	Y
12E-3437A	R
12E-3438 SH. 1	AA
12E-3438 SH. 2	Z
12E-3438A	R
12E-3461 SH. 1	AF
12E-3461 SH. 2	AE
12E-3461A	B
12E-3462 SH. 1	Z
12E-3462 SH. 2	Y
12E-3462 SH. 3	Y
12E-3462A	B
12E-3527 SH. 1	AE
12E-3527 SH. 2	AE
12E-3527 SH. 3	AC
12E-3527A	E
12E-3528 SH. 1	AB
12E-3528 SH. 2	AA
12E-3528 SH. 3	AB

VIII. APPENDICES

APPENDIX A

FIGURE 1: QUAD CITIES UNIT 1 - EMERGENCY POWER SYSTEM

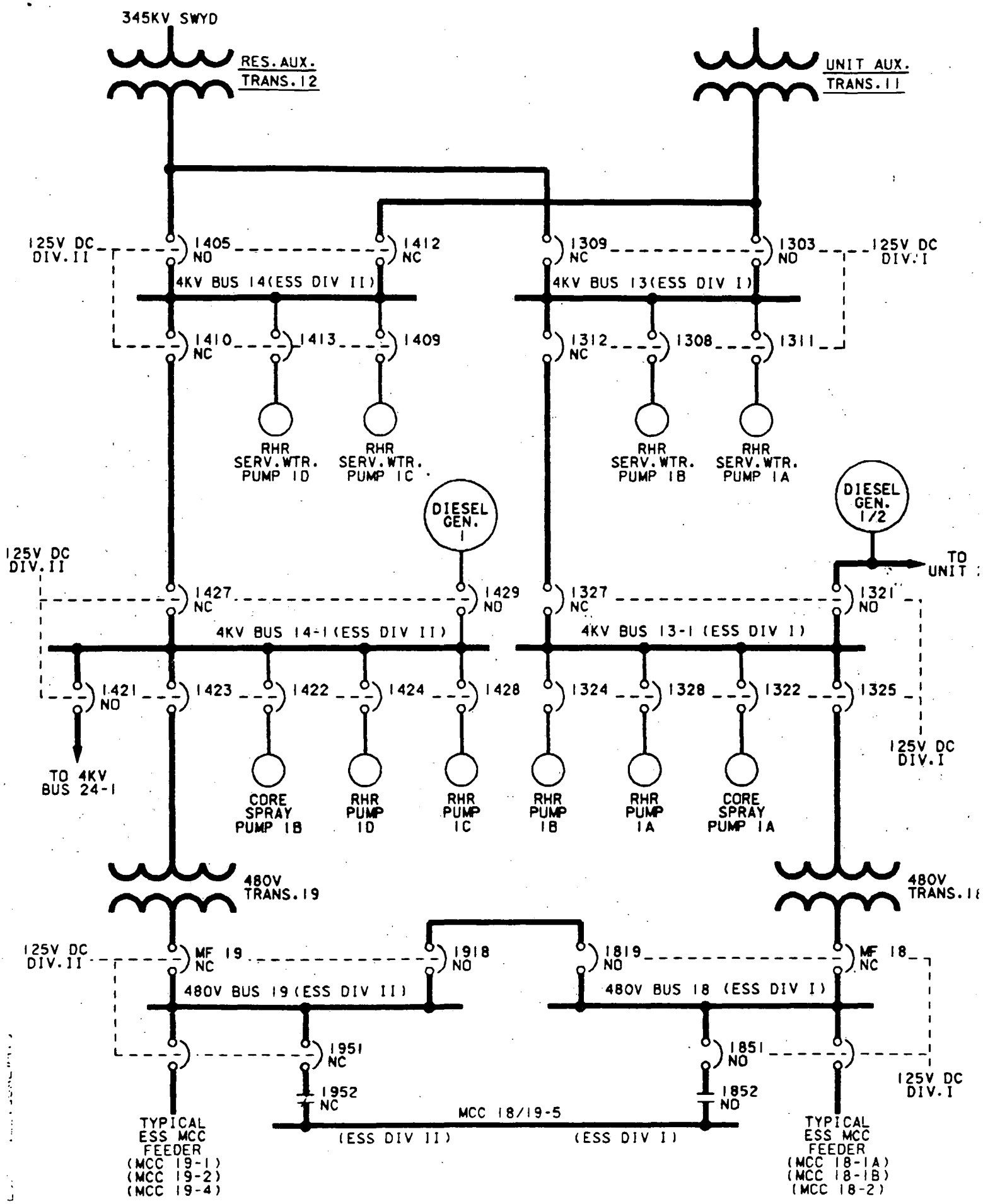
FIGURE 2: QUAD CITIES UNIT 2 - EMERGENCY POWER SYSTEM

FIGURE 3: DRESDEN UNIT 3 - EMERGENCY POWER SYSTEM

FIGURE 4: DRESDEN UNIT 2 - EMERGENCY POWER SYSTEM

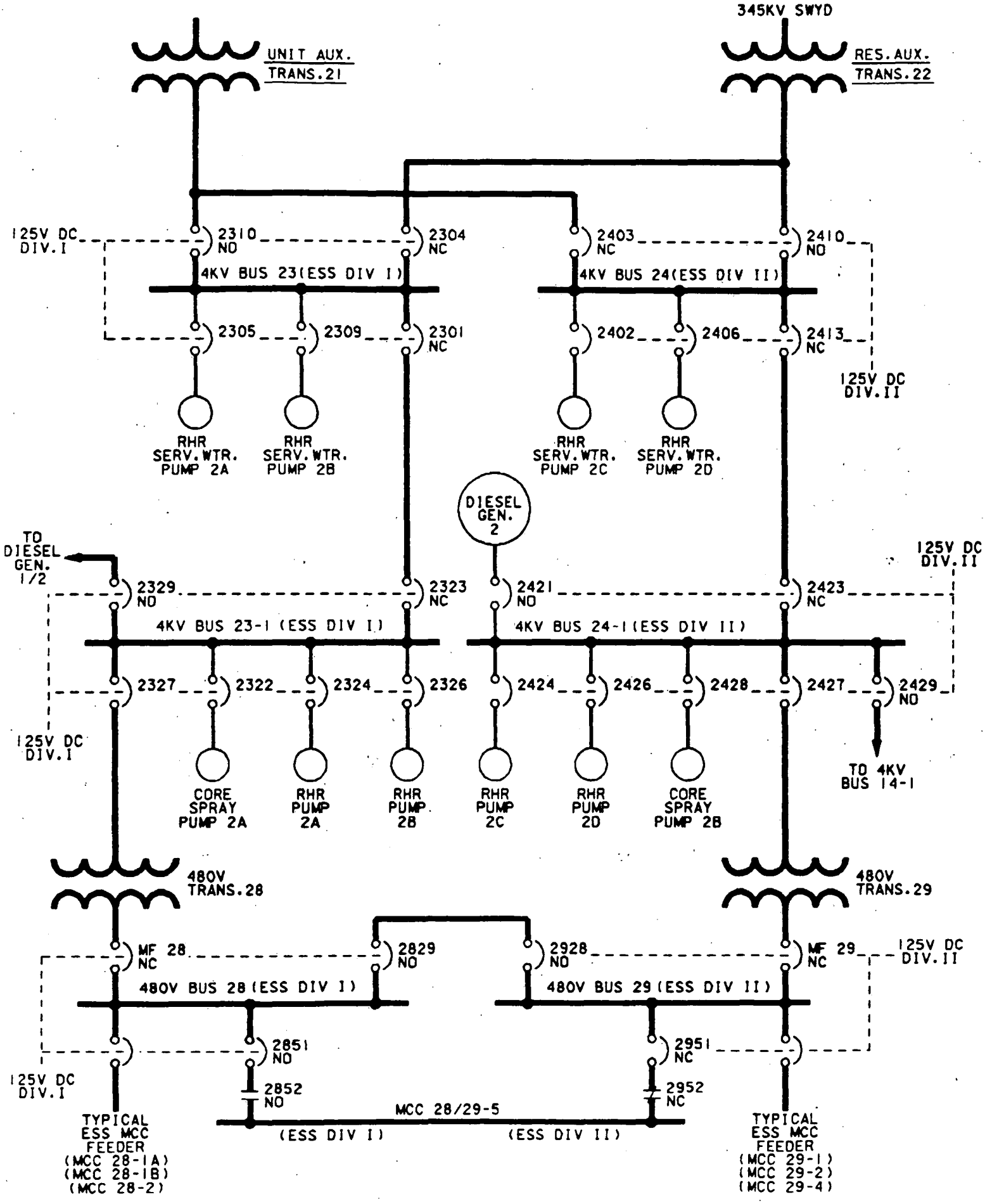
Appendix A
Figure 1

QUAD CITIES UNIT-1 EMERGENCY POWER SYSTEM



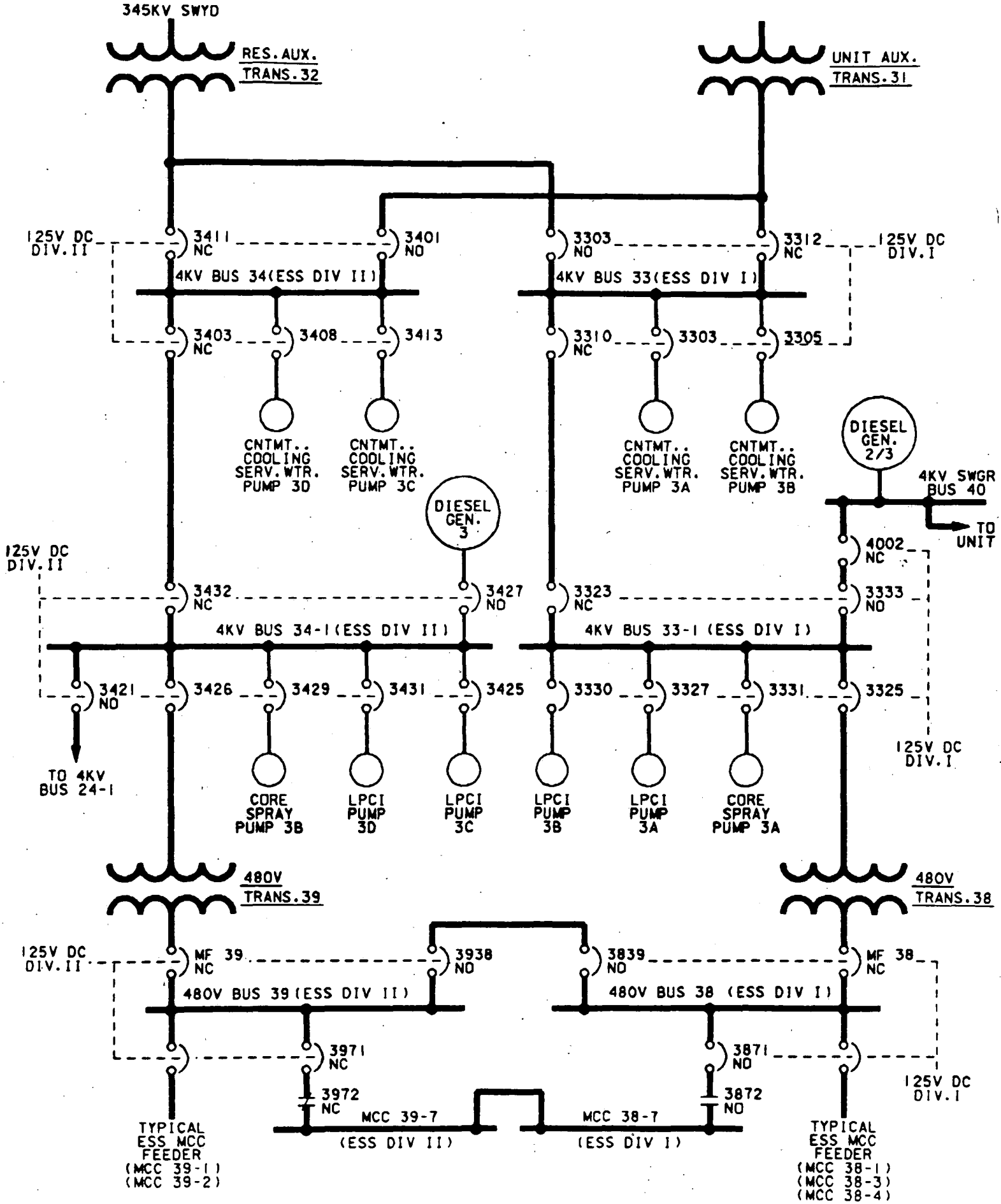
QUAD CITIES UNIT-2 EMERGENCY POWER SYSTEM

Appendix A
Figure 2



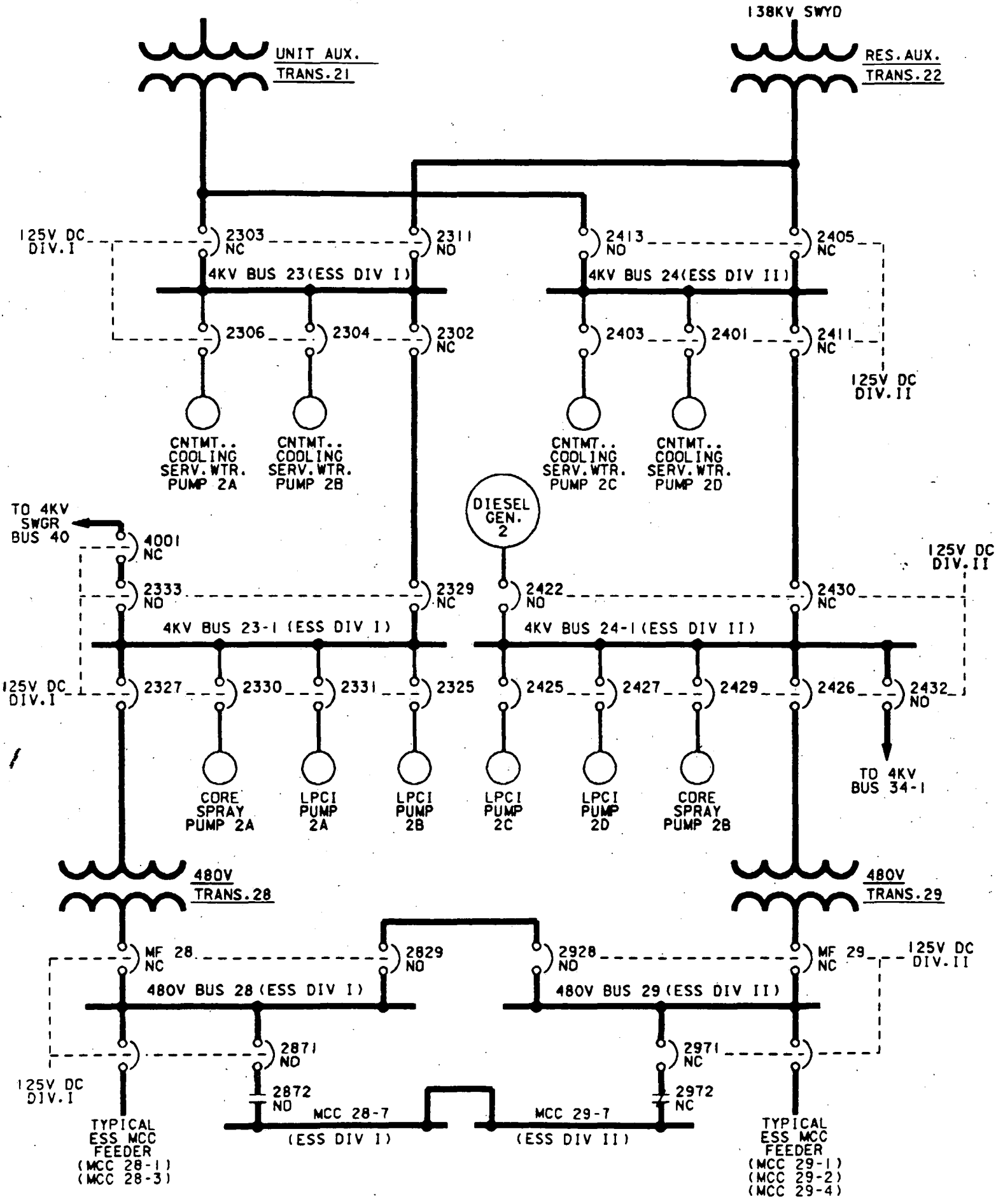
DRESDEN UNIT-3
EMERGENCY POWER SYSTEM

Appendix A
Figure 3



DRESDEN UNIT-2
EMERGENCY POWER SYSTEM

Appendix A
Figure 4



APPENDIX B

TABLE 1: DIVISIONAL ASSIGNMENT OF ECCS EQUIPMENT

TABLE 1

125 VDC SAFETY-RELATED EQUIPMENT ASSIGNMENTS (ECCS AND AUXILIARY EQUIPMENT)

Control Power	Quad Cities 1	Dresden 3	Quad Cities 2	Dresden 2
1) 125 Vdc Div. II Breaker Loads	a) 4 kV Bus 14 b) 4 kV Bus 14-1 c) 480 V Bus 19	a) 4 kV Bus 34 b) 4 kV Bus 34-1 c) 480 V Bus 39	a) 4 kV Bus 24 b) 4 kV Bus 24-1 c) 480 V Bus 29	a) 4 kV Bus 24 b) 4 kV Bus 24-1 c) 480 V Bus 29
2) 125 Vdc Div. I Breaker Loads	a) 4 kV Bus 13 b) 4 kV Bus 13-1 c) 480 V Bus 18	a) 4 kV Bus 33 b) 4 kV Bus 33-1 c) 480 V Bus 38	a) 4 kV Bus 23 b) 4 kV Bus 23-1 c) 480 V Bus 28	a) 4 kV Bus 23 b) 4 kV Bus 23-1 c) 480 V Bus 28
3) 125 Vdc Div. 1 Relay Logic Strings	a) Core Spray System 1 b) RHR (LPCI Mode/Containment Cooling Mode) System 1. c) HPCI (Reserve) d) ADS (Normal)	a) Core Spray System 1 b) LPCI/Containment Cooling System 1 c) HPCI (Reserve) d) ADS (Normal)	a) Core Spray System 1 b) RHR (LPCI Mode/Containment Cooling Mode) System 1 c) HPCI (Reserve) d) ADS (Normal)	a) Core Spray System 1 b) LPCI/Containment Cooling System 1 c) HPCI (Reserve) d) ADS (Normal)
4) 125 Vdc Div. II Relay Logic Strings	a) Core Spray System 2 b) RHR/Containment Cooling Mode) System 2 c) HPCI (Normal) d) ADS (Reserve)	a) Core Spray System 2 b) LPCI/Containment Cooling System 2 c) HPCI (Normal) d) ADS (Reserve)	a) Core Spray System 2 b) RHR (LPCI Mode/Containment Cooling Mode) System 2 c) HPCI (Normal) d) ADS (Reserve)	a) Core Spray System 2 b) LPCI/Containment Cooling System 2 c) HPCI (Normal) d) ADS (Reserve)
5) Other 125 Vdc Div. 1 Loads	a) D.G. 1/2 Controls (Normal) b) Auto Blowdown Valves (Normal)	a) D.G. 2/3 Controls (Reserve) b) Auto Blowdown Valves (Normal)	a) D.G. 1/2 Controls (Reserve) b) Auto Blowdown Valves (Normal)	a) D.G. 2/3 Controls (Normal) b) Auto Blowdown Valves (Normal)

Table 1 cont'd

Control Power	Quad Cities 1	Dresden 3	Quad Cities 2	Dresden 2
6) Other 125 Vdc Div. II Loads	a) D.G. 1 Controls b) Auto Blowdown Valves (Reserve)	a) D.G. 3 Controls b) Auto Blowdown Valves (Reserve)	a) D.G. 2 Controls b) Auto Blowdown Valves (Reserve)	a) D.G. 2 Controls b) Auto Blowdown Valves (Reserve)

Note: ("Reserve") means a standby source which is automatically connected in a given circuit if the (normal) source is lost.

APPENDIX C

FIGURE 1: QUAD CITIES UNITS 1 & 2, KEY DIAGRAM - 125 VDC SYSTEM

FIGURE 2: DRESDEN UNITS 2 & 3, KEY DIAGRAM - 125 VDC SYSTEM

FIGURE 3: QUAD CITIES UNITS 1 & 2, KEY DIAGRAM - 250 VDC SYSTEM

FIGURE 4: DRESDEN UNITS 2 & 3, KEY DIAGRAM - 250 VDC SYSTEM

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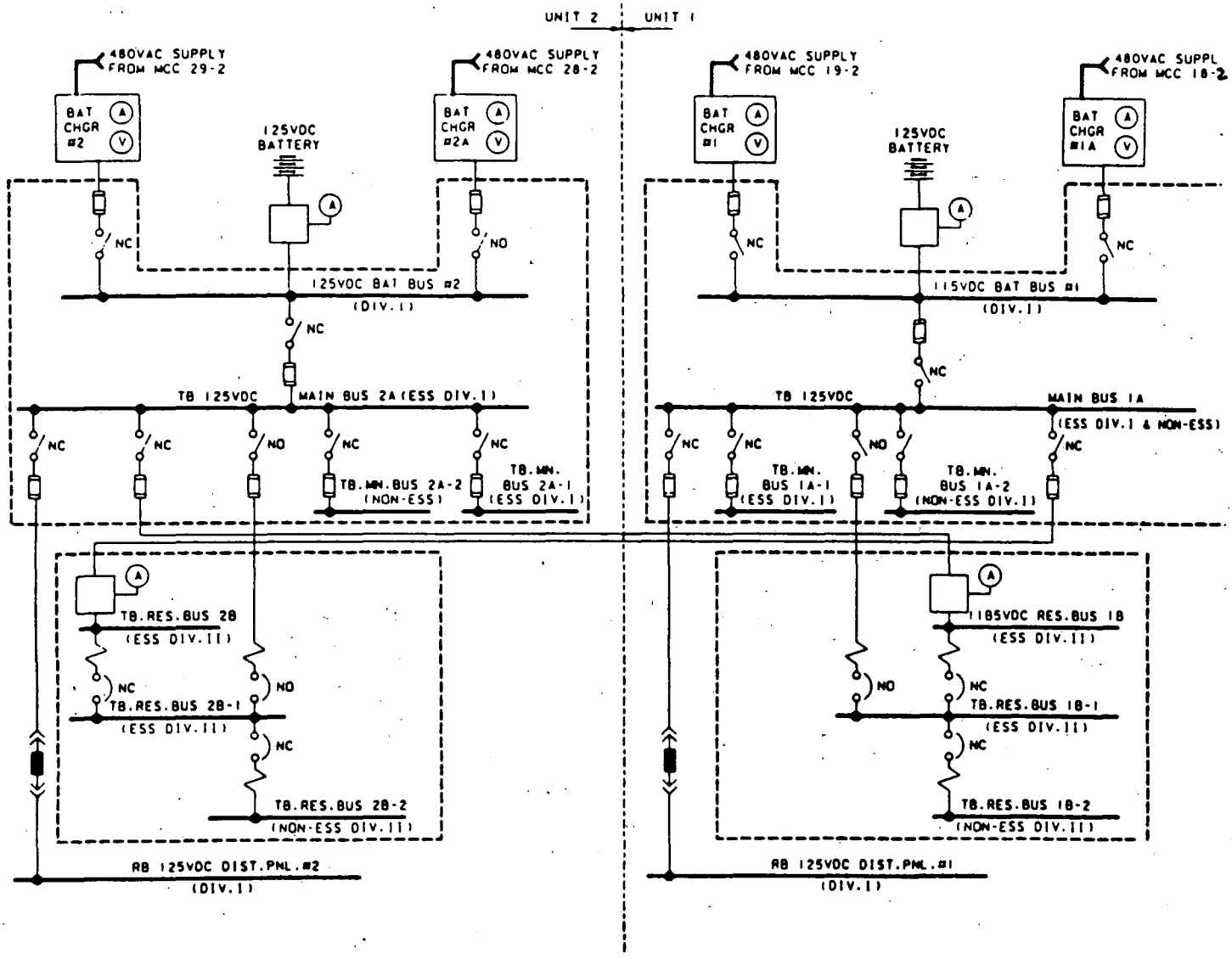
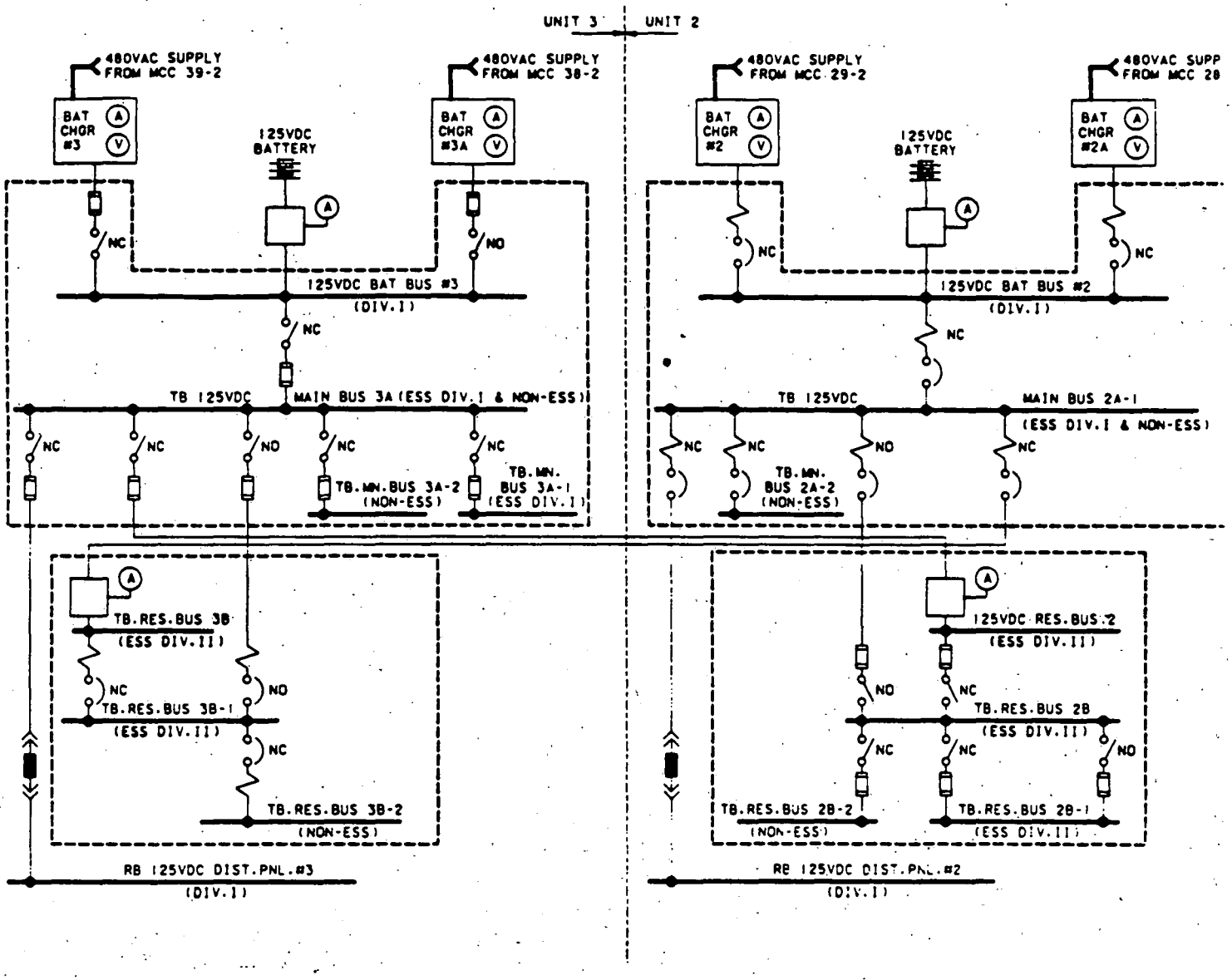
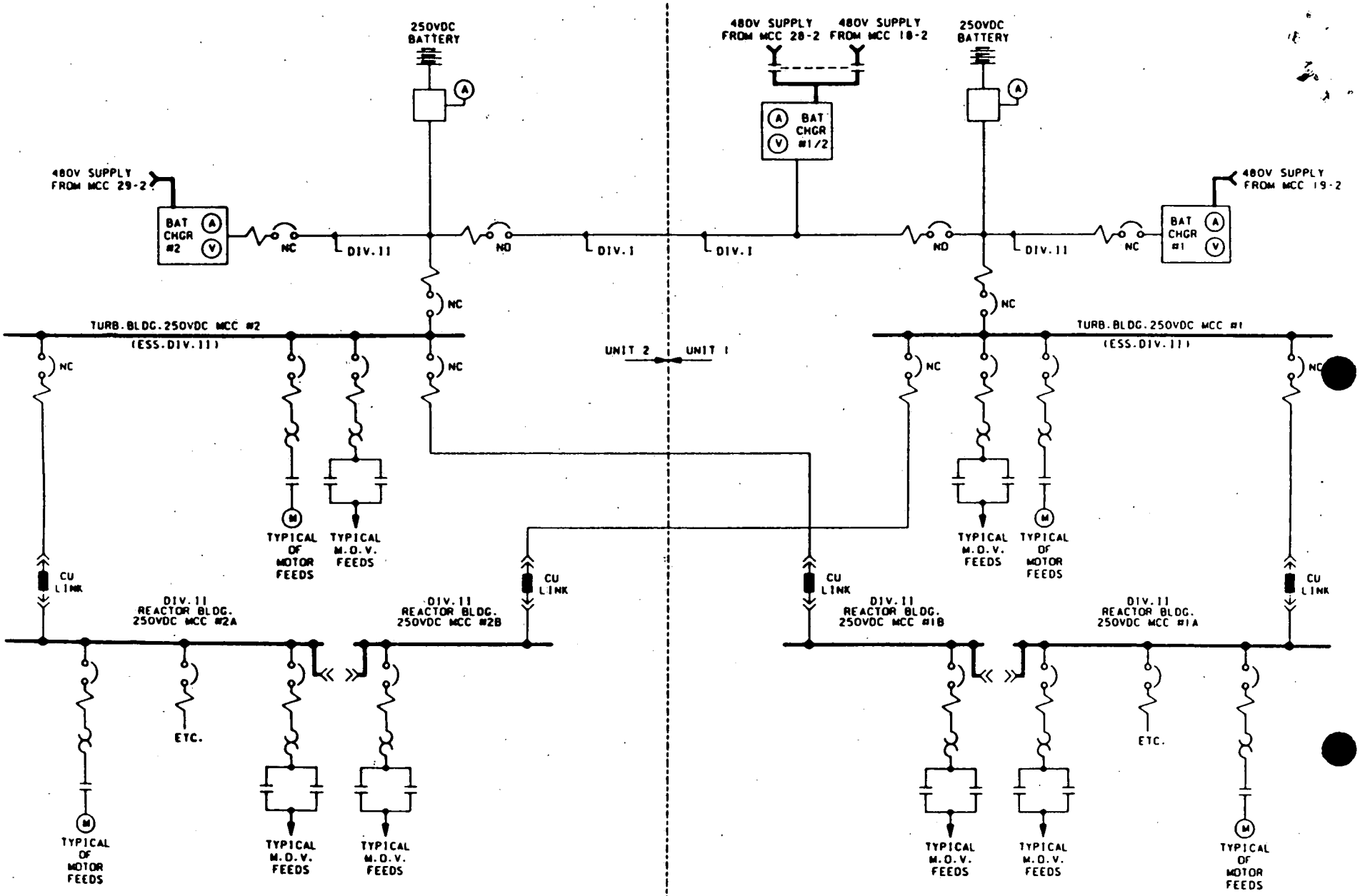


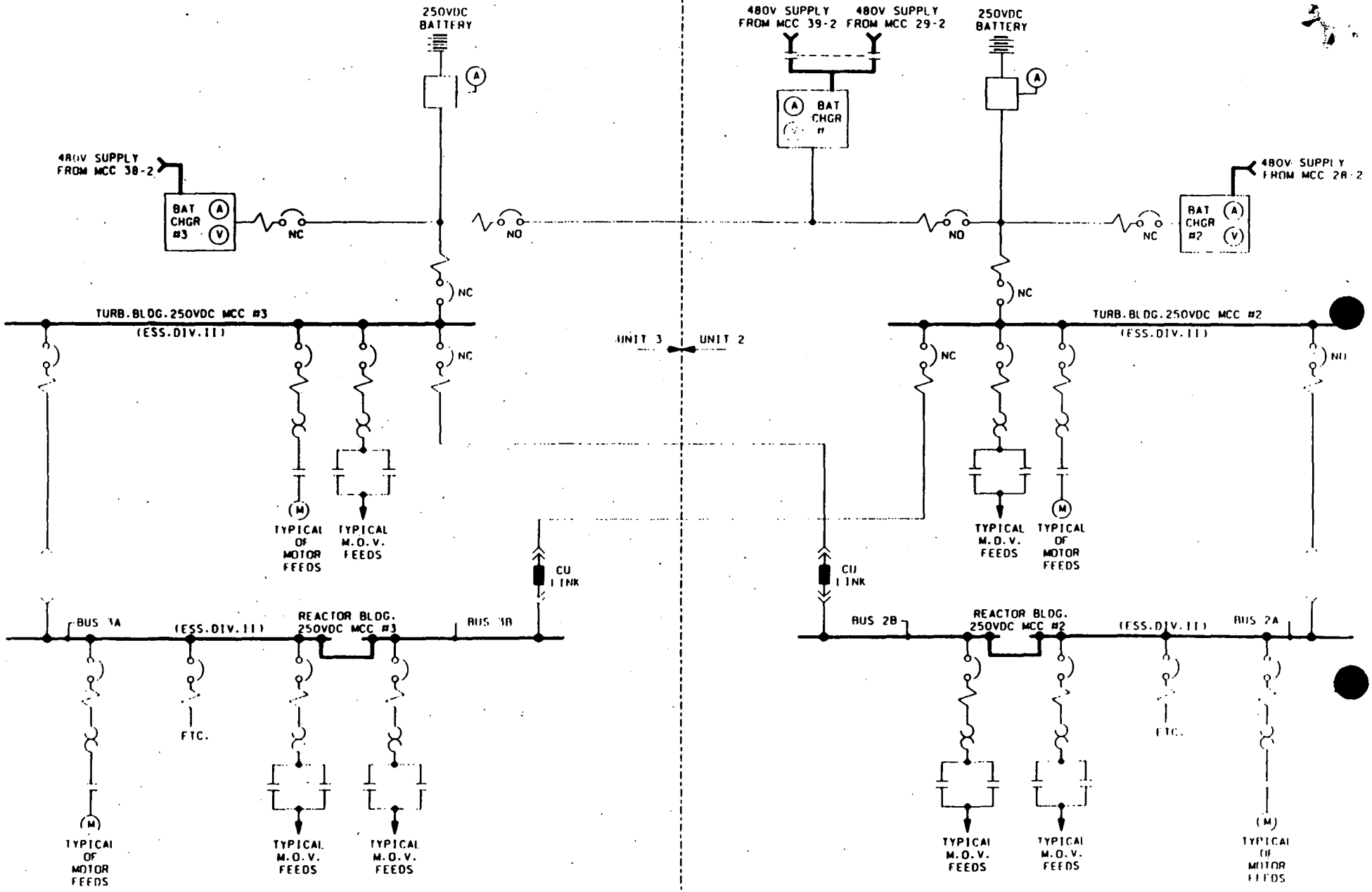
Appendix C
Figure 1:
Key Diagram -
125 Vdc System
Quad Cities Units 1 & 2



Appendix C
Figure 2:
Key Diagram -
125 Vdc System
Dresden Units 2 & 3



Appendix C
Figure 3:
Key Diagram -
250 Vdc
Quad Cities Units 1 & 2



Appendix C
Figure 4:
Key Diagram -
250 Vdc System
Dresden Units 2 & 3