

BILL OF MATERIAL

WORK ORDER NUMBER : G6025-01  
PURCHASER : TRACTION POWER SYSTEMS PO# : NTP  
USER : WMATA  
LOCATION : WASHINGTON, DC PAINT CODE: 061-T/061-T/B/S  
EQUIPMENT ID : FARRAGUT NORTH SUBSTATION-A02  
EQUIPMENT TYPE :  
DESIGNER : DAR DATE: ORDER QUANTITY: 1  
:

ITM#	PART NUMBER	ASMBY.QTY	UM	SP	VENDR#	DESCRIPTION
1	C4280-508	9.00	EA	SP	192510	DC OVERCURRENT RELAY LONG,SHORT,INSTANTANEOUS RATE-OF-RISE, 0-50MV INPT 24-125VDC CONTROL POWER UNI-BI-DIRECTIONAL, PANEL MOUNT. SMC ELECTRICAL PRODUCTS
2	C4280-921	3.00	EA	SP	192510	CURRENT TRANSDUCER BI-DIRECTIONAL, -50-0-50MV INPUT, -1-0-1MA OUTPUT, 125VDC POWER SUPPLY SMC
3	C4280-941	3.00	EA	SP	192510	WATT TRANSDUCER/SMC 0-50mVDC & 0-1000VDC INPUTS, 0-1mADC OUTPUT 24-125VDC POWER
4	C4280-902	1.00	EA	SP	192510	TRANSDUCER/VOLTAGE 0-1000VDC INPUT, 0-1mA DC OUTPUT, 24-125VDC POWER SMC
5	G6004-01-05	1.00	EA	SP	037260	DC VOLTMETER/CROMPTON TYPE 077 FOR USE WITH EXTERNAL TRANSDUCER SIMILAR TO 077-05AA-FA** 0-1mADC INPUT, 0-1000VDC SCALE, 4-1/2" SQ FLANGE
7	H-15000-50-SP	6.00	EA	SP	032086	SHUNT,15KA/CSI 15000A IN 50mV OUTPUT-SILVER PLATED CANADIAN SHUNT INC.

POWELL NORTH CANTON DIVISION SHEET 1 OF 7  
8967 PLEASANTWOOD AVE NW 04/26/2006 REV: 02  
NORTH CANTON, OHIO 44720 DATE PRINTED DISK/FILE G602501000.mtl

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8	G6001-04-10	6.00	EA	SP	037260	DC AMMETER/CROMPTON-TYPE 077 SHUNT-RATED SIMILAR TO 077-05CA-GB**, 50-0-50 mV INPUT, 15-0-15KA SCALE
9	H-20000-50-SP	3.00	EA	SP	032086	SHUNT,20KA/CSI 20000A IN 50mV OUTPUT-SILVER PLATED CANADIAN SHUNT INC.
10	G6001-04-10A	3.00	EA	SP	037260	DC AMMETER/CROMPTON-TYPE 077 SHUNT-RATED SIMILAR TO 077-05AA-EY**, 0-50 mV INPUT, 0-20KA SCALE
11	276-19	17.00	EA	SP	081725	TUBULAR HEATER HEATREX 240 VOLTS W/MOUNTING CAGE COVER, 125W @ 120 VAC HEATREX
12	USM2	18.00	EA	SP	021818	FUSE HOLDER, GOULD 2 POLE, 600V, 30A FERRAZ-SHAWMUT
13	ATM30	36.00	EA	SP	021818	FUSE, 30 AMP, MIDGET TYPE RATED 500VDC, 600VAC FERRAZ-SHAWMUT
14	A-1102	9.00	EA	SP	061100	KNIFE SW, FILNOR, 30A, 2P DPST, FRONT CONNECTED FILNOR, INC.
15	G097227	25.00	EA	SP	021818	FUSEHOLDER, 80A, 2 POLE 1500V FOR 20mm X 127mm DC FUSES FERRAZ

POWELL NORTH CANTON DIVISION  
8967 PLEASANTWOOD AVE NW  
NORTH CANTON, OHIO 44720

04/26/2006  
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DISK/FILE G602501000.mtl

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ITM#	PART NUMBER	ASMBY.QTY	UM	SP	VENDR#	DESCRIPTION
16	T089487	38.00	EA	SP	021818	FUSE 20 AMPS 1000V. NON-INDICATING FERRAZ
17	2440D	9.00	EA	SP	051250	24 CB SW TRIP CLOSE
18	24204B	9.00	EA	SP	051250	CONTROL SWITCH, SERIES 24 4-DECK, 30A, 600V,

OVAL HANDLE  
ELECTROSWITCH

19 MRL125DL-48R-MPLLRD 9.00 EA SP 036669 INDICATING LIGHT, RED  
16MM RESISTOR TYPE, LED,  
110-140V AC/DC LAMP, RED,  
LENS CAP.  
CONTROL CONCEPTS

20 MRL125DL-48G-MPLLG N 9.00 EA SP 036669 INDICATING LIGHT, GREEN  
16MM RESISTOR TYPE, LED,  
110-140V AC/DC LAMP,  
GREEN LENS CAP  
CONTROL CONCEPTS

21 MRL125DL-48W-MPLLWE 10.00 EA SP 036669 INDICATING LIGHT, WHITE  
16MM RESISTOR TYPE, LED,  
110-140V AC/DC LAMP, WITH  
WHITE LENS CAP.  
CONTROL CONCEPTS

22 1604STD 8.00 EA SP 021818 TERMINAL BLOCK, SWBD  
30A. 600V. 4 POLE  
MARATHON  
18

23 4291012-2 36.00 EA SP 231601 CELL MOUNTED SECONDARY  
CONTACTS, BLOCK OF 10,  
FOR W&B DC BREAKER MM74.

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ITM#	PART NUMBER	ASMBY.	QTY	UM	SP	VENDR#	DESCRIPTION
							FORMERLY G4687P007. WHIPP & BOURNE
24	BZ-2RW82-A2		63.00	EA	SP	141400	SWITCH, LIMIT S.P.D.T. 1 FORM C CONTACT MICROSWITCH
25	CR151B20		81.00	EA	SP	070700	12 CIRCUIT TERMINAL BLOCK 30A HEAD SCREW BOTH SIDES GENERAL ELECTRIC
26	USM1		1.00	EA	SP	231663	FUSE HOLDER, GOULD 1 POLE, 600V, 30A FERRAZ-SHAWMUT
27	OTM20		1.00	EA	SP	231663	FUSE, 20A. ONE TIME, 250VAC, 10KA I.R.,

UL LISTED  
SHAWMUT

28 016-02AA-NGNG 1.00 EA SP 037260 AC AMMETER SERIES 016  
RATED 20A, 0-20A SCALING  
3-1/2" PANEL METER  
PN 016-02AA-NGNG-C6-S2  
CROMPTON INSTRUMENTS

29 7805D 1.00 EA SP 051250 LOCKOUT RELAY, 125VDC  
COIL, 10NO & 10NC, 5 DECK  
SERIES 24  
ELECTROSWITCH

30 C4280-600 1.00 EA SP 192510 RELAY- STRUCTURE GROUND  
ADJ 30-45VDC HOT TRIP,  
5-20VDC GND TRIP,  
24-125VDC OR 120VAC POWER  
SUPPLY, DEVICE 164

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EQUIPMENT ID : FARRAGUT NORTH SUBSTATION-A02  
EQUIPMENT TYPE :  
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ITM#	PART NUMBER	ASMBY.	QTY	UM	SP	VENDR#	DESCRIPTION
							----- SMC
31	12HGA11S52		26.00	EA	SP	070701	AUXILIARY RELAY, TYPE HGA 125VDC COIL, 2-C CONTACTS FRONT-CONNECTED, SURFACE MOUNT W/ PROVISION, SOLID COVER. GENERAL ELECTRIC
32	G6025-01-32		1.00	LT	SP		KEY INTERLOCKS PER DWG DWG G602501K01
33	CR151B40		10.00	EA	SP	070701	4 CIRCUIT TERMINAL BLOCK, 30A HEAD SCREW BOTH SIDES
34	12HGA11S56		12.00	EA	SP	070701	AUXILIARY RELAY, TYPE HGA 24 VDC COIL, 2-C CONTACTS FRONT-CONNECTED, SURFACE MOUNT W/ PROVISION, SOLID COVER
35	1N4007		24.00	EA	SP	141400	DIODE/TARZANIEN NEWARK
36	B255XCXP-125VDC		6.00	EA	SP	021818	S-D/REL 3-FORM C, LATCHING 125VDC LATCH & RELEASE COILS.

37 27390 6.00 EA SP 141400 RELAY SOCKET, 12-PIN, S-D  
STRUTHERS-DUNN

38 6007-003 6.00 EA SP 192510 SURGE ARRESTOR, 750VDC  
NOMINAL VOLTAGE, METAL-  
OXIDE, 970 MCOV  
SMC ELECTRICAL PRODUCTS

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ITM#	PART NUMBER	ASMBY	QTY	UM	SP	VENDR#	DESCRIPTION
39	F089498		12.00	EA	SP	021818	FUSE, 32A, 1000V W/BLOWN FUSE INDICATOR FERRAZ
40	C4280-580		6.00	EA	SP	192510	RELAY SYS/SMC DC RECLOSING RELAY CONSISTING OF (1) C4280-560 RELAY (1) C4280-901 XDCR
41	LTHS60SDDJ		6.00	EA	SP	160147	CONTACTOR, 1000V, 80A TWO N/O MAIN POLES TYPE S 1 N/O & 1 N/C AUX CONTACT 125VDC COIL MICROELECTRICA
42	4LC120-DBEN4B2		6.00	EA	SP	162725	LOAD MEASURE RESISTOR 48 OHMS, 1500VDC, 16A, 5 SEC. ON / 45 SEC. OFF POST GLOVER
43	21305G00000005		6.00	EA	SP		MOUNTING BRACKET ASSY - SUPERCEDES:DM0133A
44	MRL125DL-48A-MPLLAR		2.00	EA	SP	036669	INDICATING LIGHT, AMBER 16MM RESISTOR TYPE, LED, 110-140V AC/DC LAMP, AMBER LENS CAP CONTROL CONCEPTS
45	A1287JFGQRPWR		6.00	EA	SP	073000	FIBERGLASS ENCLOSURE 12 X 8 X 7 WITH LEXAN WINDOW HOFFMAN ENCLOSURES, INC
46	ECG5817		6.00	EA	SP	141400	CARLTON BATES (PHILIPS RECTIFIED FORWARD CURRENT

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ITM#	PART NUMBER	ASMBY.	QTY	UM	SP	VENDR#	DESCRIPTION
							PC BOARD MOUNTING, TL=60 DEGREES C NEWARK
47	21006P00008006		9.00	EA	SP	141426	TERMINAL BLOCK STAND-OFF
48	2165-1A		36.00	EA	SP	130199	600V STANDOFF INSUL 1 1" HEIGHT W/ 1/4-20X5/16D INSERTS, RATED 600 VOLTS. GLASTIC MAR-BAL # 1100-A1
49	21305G00000004		9.00	EA	SP		TOC SWITCH ASSY W/B BKR
50	172		9.00	EA	SP	072701	DOOR SWITCH-15A, 125V NORMALLY OPEN-PUSH TO CLOSE, SCREW TERMINAL CARLINGSWITCH
51	264B903G-19		2.00	EA	SP	373233	TERMINAL BLOCK/GE,EB-1, 2 CKT, SCREW CONNECTION, 600V,100A

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8967 PLEASANTWOOD AVE NW  
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ITM#	PART NUMBER	ASMBY	QTY	UM	SP	VENDR#	DESCRIPTION
101	G6000-01-101		3.00	EA	SP	128180	DC CATHODE CKT BKR-MM74 8KA CATHODE, 750VDC, 1P COMPLETE WITH METAL PLATE ARC CHUTE, SET OF AUX SWS MECH OPERATIONS COUNTER, 125VDC CLOSING, 125VDC TRIPPING, DIRECT-ACTING SERIES CONNECTED REVERSE CURRENT TRIP DEVICE WITH TD CONTACT (DEV 32), DC ANTI-PUMP RELAY, ON/OFF POSITION INDICATOR, MANUAL RACKING DEVICE DESIGNED TO PREVENT OVER- TRAVEL, SET OF SECONDARY FINE WIRE DISCONNECTS. WITH BREAKER SHUTTER BRACKET ADDED AND THE REMOVAL OF THE SHUTTER LIFT BOLTS
102	G6000-01-102		6.00	EA	SP	128180	DC FEEDERE CKT BKR-MM74 6KA FEEDER, 750VDC, 1P COMPLETE WITH METAL PLATE ARC CHUTE, SET OF AUX SWS MECH OPERATIONS COUNTER, 125VDC CLOSING, 125VDC TRIPPING, DIRECT-ACTING SERIES CONNECT INST OVER- CURRENT TRIP DEVICE WITH TD CONTACT (DEV 76), DC ANTI-PUMP RELAY, ON/OFF POSITION INDICATOR, MANUAL RACKING DEVICE DESIGNED TO PREVENT OVER- TRAVEL, SET OF SECONDARY

POWELL NORTH CANTON DIVISION SHEET 1 OF 2  
8967 PLEASANTWOOD AVE NW 05/03/2006 REV: 02  
NORTH CANTON, OHIO 44720 DATE PRINTED DISK/FILE G602502000.mt1

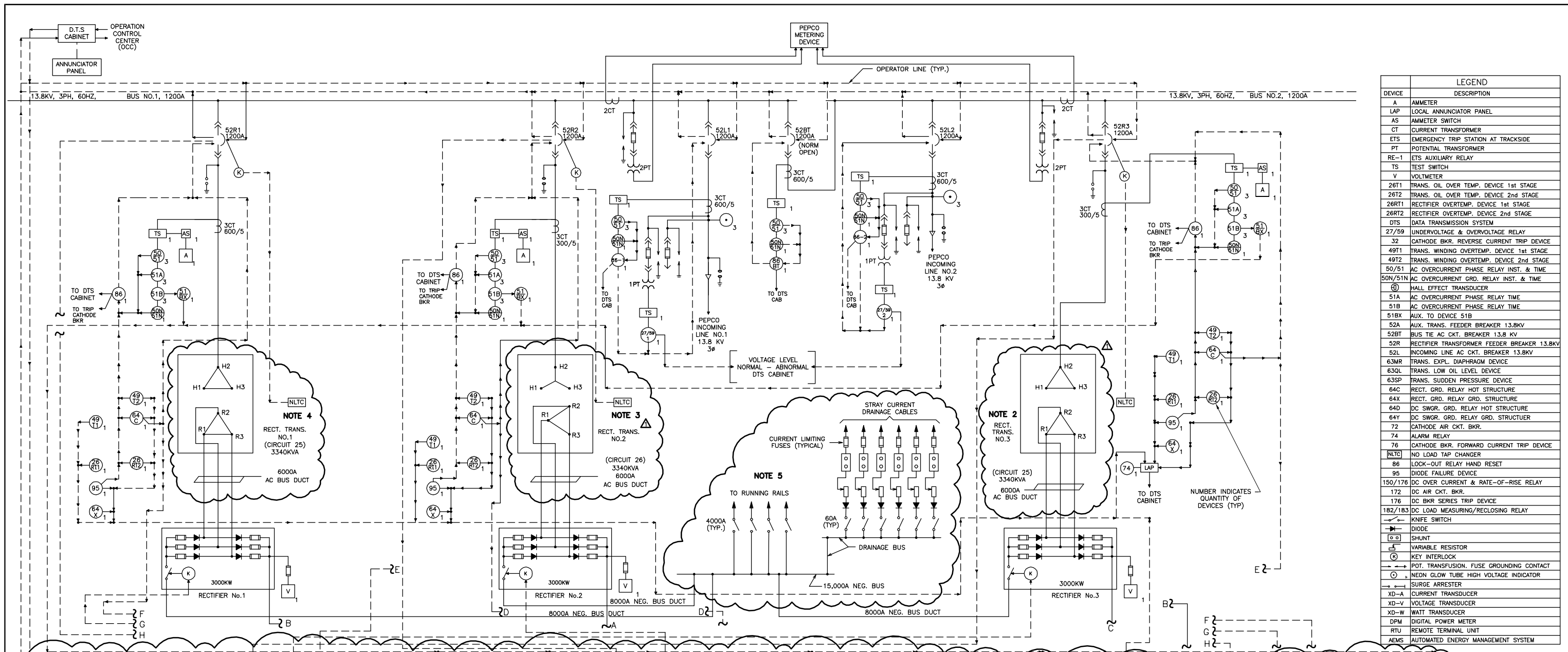
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USER : WMATA  
LOCATION : WASHINGTON, DC PAINT CODE: XX/XX/X/X  
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EQUIPMENT TYPE :

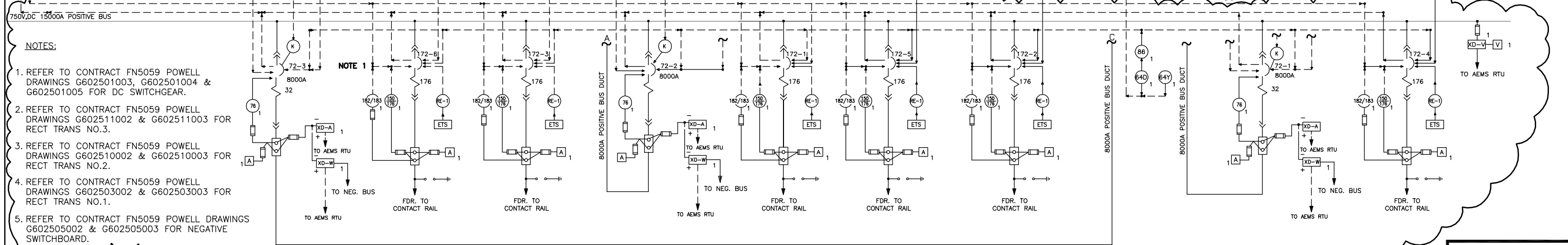
DESIGNER : DAR DATE: ORDER QUANTITY: 1  
:

ITM#	PART NUMBER	ASMBY.	QTY	UM	SP	VENDR#	DESCRIPTION
							FINE WIRE DISCONNECTS. WITH BREAKER SHUTTER BRACKET ADDED AND THE REMOVAL OF THE SHUTTER LIFT BOLTS
103	G600001G01		1.00	EA	SP		BREAKER TEST BOX-WMATA 125VDC WITH UV SWITCH
104	MM74-ACCS		1.00	EA	SP	128180	ACCESSORIES FOR W&B MM74 BREAKERS CONSISTING OF: 1-157724-03-M RACKING HDL WITH CLUTCH (WMATA SPL) 1-43191106-9 CLOSING HDL 1-157724-05 STEERING DOLLY



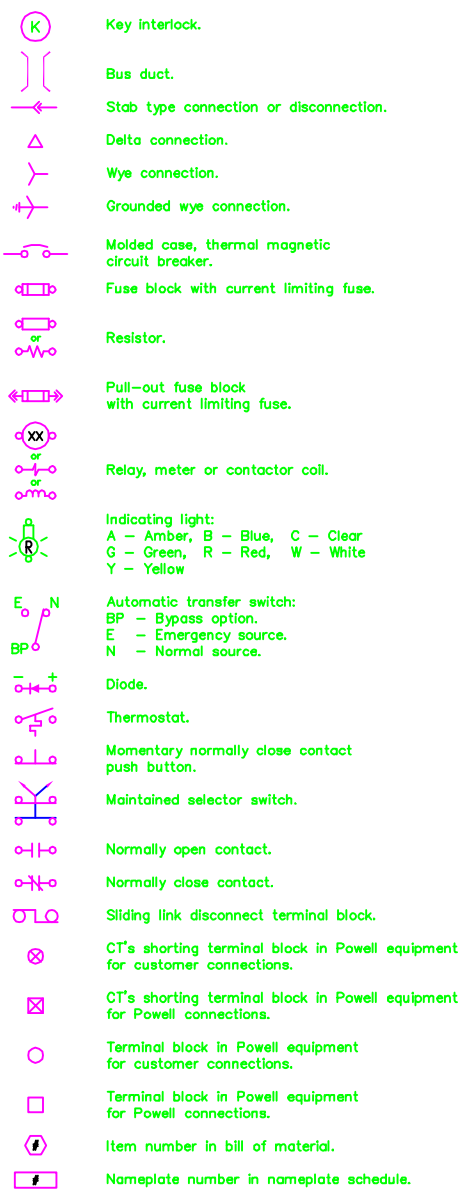
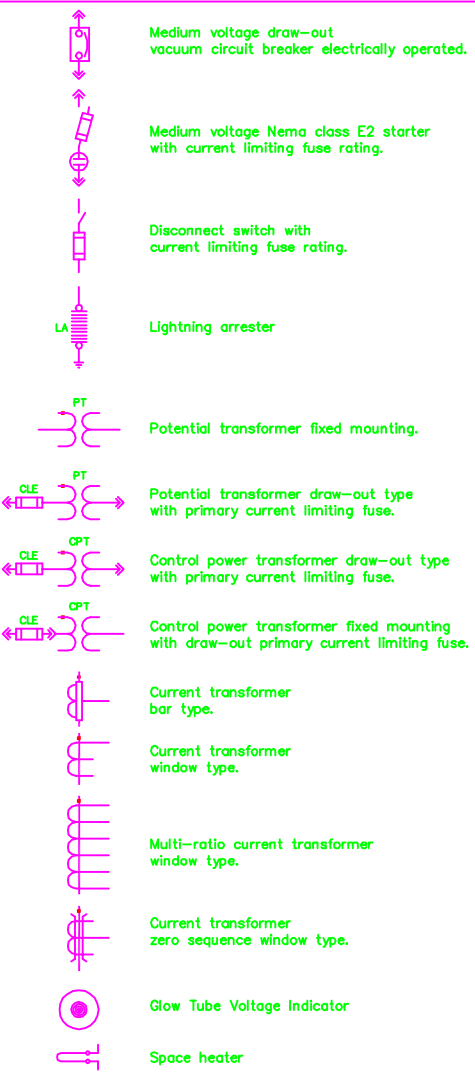


DEVICE	DESCRIPTION
A	AMMETER
LAP	LOCAL ANNUNCIATOR PANEL
AS	AMMETER SWITCH
CT	CURRENT TRANSFORMER
ETS	EMERGENCY TRIP STATION AT TRACKSIDE
PT	POTENTIAL TRANSFORMER
RE-1	ETS AUXILIARY RELAY
RE-1	ETS AUXILIARY RELAY
TS	TEST SWITCH
V	VOLTMETER
26T1	TRANS. OIL OVER TEMP. DEVICE 1st STAGE
26T2	TRANS. OIL OVER TEMP. DEVICE 2nd STAGE
26RT1	RECTIFIER OVERTEMP. DEVICE 1st STAGE
26RT2	RECTIFIER OVERTEMP. DEVICE 2nd STAGE
DTS	DATA TRANSMISSION SYSTEM
27/59	UNDERVOLTAGE & OVERVOLTAGE RELAY
32	CATHODE BKR. REVERSE CURRENT TRIP DEVICE
49T1	TRANS. WINDING OVERTEMP. DEVICE 1st STAGE
49T2	TRANS. WINDING OVERTEMP. DEVICE 2nd STAGE
50/51	AC OVERCURRENT PHASE RELAY INST. & TIME
50N/51N	AC OVERCURRENT GRD. RELAY INST. & TIME
(H)	HALL EFFECT TRANSDUCER
51A	AC OVERCURRENT PHASE RELAY TIME
51B	AC OVERCURRENT PHASE RELAY TIME
51BX	AUX. TO DEVICE 51B
52A	AUX. TRANS. FEEDER BREAKER 13.8KV
52BT	BUS TIE AC CKT. BREAKER 13.8 KV
52R	RECTIFIER TRANSFORMER FEEDER BREAKER 13.8KV
52L	INCOMING LINE AC CKT. BREAKER 13.8KV
63MR	TRANS. EXPL. DIAPHRAGM DEVICE
63QL	TRANS. LOW OIL LEVEL DEVICE
63SP	TRANS. SUDDEN PRESSURE DEVICE
64C	RECT. GRD. RELAY HOT STRUCTURE
64X	RECT. GRD. RELAY GRD. STRUCTURE
64D	DC SWGR. GRD. RELAY HOT STRUCTURE
64Y	DC SWGR. GRD. RELAY GRD. STRUCTURE
72	CATHODE AIR CKT. BKR.
74	ALARM RELAY
76	CATHODE BKR. FORWARD CURRENT TRIP DEVICE
NLTC	NO LOAD TAP CHANGER
86	LOCK-OUT RELAY HAND RESET
95	DIODE FAILURE DEVICE
150/176	DC OVER CURRENT & RATE-OF-RISE RELAY
172	DC AIR CKT. BKR.
176	DC BKR SERIES TRIP DEVICE
182/183	DC LOAD MEASURING/RECLOSED RELAY
(K)	KNIFE SWITCH
(D)	DIODE
(S)	SHUNT
(R)	VARIABLE RESISTOR
(I)	KEY INTERLOCK
(G)	POT. TRANSFUSION, FUSE GROUNDING CONTACT
(N)	NEON GLOW TUBE HIGH VOLTAGE INDICATOR
(SA)	SURGE ARRESTER
XD-A	CURRENT TRANSDUCER
XD-V	VOLTAGE TRANSDUCER
XD-W	WATT TRANSDUCER
DPM	DIGITAL POWER METER
RTU	REMOTE TERMINAL UNIT
AEMS	AUTOMATED ENERGY MANAGEMENT SYSTEM



- NOTES:**
- REFER TO CONTRACT FN5059 POWELL DRAWINGS G602501003, G602501004 & G602501005 FOR DC SWITCHGEAR.
  - REFER TO CONTRACT FN5059 POWELL DRAWINGS G602511002 & G602511003 FOR RECT TRANS NO.3.
  - REFER TO CONTRACT FN5059 POWELL DRAWINGS G602510002 & G602510003 FOR RECT TRANS NO.2.
  - REFER TO CONTRACT FN5059 POWELL DRAWINGS G602503002 & G602503003 FOR RECT TRANS NO.1.
  - REFER TO CONTRACT FN5059 POWELL DRAWINGS G602505002 & G602505003 FOR NEGATIVE SWITCHBOARD.

<p>DESIGNED SAI 8/15/08 DRAWN P. MENSAH 8/15/08 CHECKED N. PATEL 8/15/08 APPROVED R. GANERIVAL 8/15/08</p>	<p>REFERENCE DRAWINGS</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr><th>NUMBER</th><th>DESCRIPTION</th></tr> <tr><td>▲</td><td>REPLACED RECTIFIER TRANSFORMERS AND DC SWITCHGEAR</td></tr> </table>	NUMBER	DESCRIPTION	▲	REPLACED RECTIFIER TRANSFORMERS AND DC SWITCHGEAR	<p>REVISIONS</p> <table border="1" style="width:100%; border-collapse: collapse;"> <tr><th>DATE</th><th>BY</th><th>DESCRIPTION</th></tr> <tr><td>8/15/08</td><td>SAI</td><td>A02 TPSS ONE LINE DWG.</td></tr> </table>	DATE	BY	DESCRIPTION	8/15/08	SAI	A02 TPSS ONE LINE DWG.	<p><b>WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY</b></p> <p>PLANNING AND DEVELOPMENT OFFICE OF INFRASTRUCTURE AND RENEWAL MECHANICAL/ELECTRICAL/FACILITIES</p>	<p><b>A02-FARRAGUT NORTH</b></p> <p>TRACTION POWER ONE LINE DRAWING</p>	<p>CONTRACT NO.</p>
NUMBER	DESCRIPTION														
▲	REPLACED RECTIFIER TRANSFORMERS AND DC SWITCHGEAR														
DATE	BY	DESCRIPTION													
8/15/08	SAI	A02 TPSS ONE LINE DWG.													
					<p>SCALE NONE</p>	<p>DRAWING NO. A02-E-22</p>	<p>M1211-022</p>								



26RT2  
27  
27C  
27T  
27X  
30  
32  
33  
  
43  
49T2  
50  
51  
51N  
50/51  
51A  
51B  
51BX  
52  
59  
62  
64  
72  
76  
86H  
86R  
94  
94SC  
94ST  
95T  
201C  
201T

Rectifier overtemperature Trip  
Undervoltage relay.  
Loss of DC control power relay—Close ckt  
Loss of DC control power relay—trip ckt  
Auxiliary undervoltage relay.  
Annunciator relay  
Reverse Current Relay  
Door Open Relay  
R – Rectifier  
T – Transformer  
Remote/local selector switch.  
Transformer overtemperature trip  
Instantaneous overcurrent or rate-of-rise relay.  
AC time overcurrent relay.  
Residual time overcurrent relay.  
Instantaneous and time overcurrent relay.  
AC rectifier time overcurrent relay – 300%  
AC rectifier time overcurrent relay – 450%  
Aux. time overcurrent relay  
AC power circuit breaker.  
Overvoltage relay.  
Time delay relay.  
Ground detector relay.  
DC power circuit breaker  
DC overcurrent relay.  
Station lockout relay.  
Rectifier lockout relay.  
DC breaker anti-pump relay  
SCADA Close relay—AC breaker  
SCADA Trip relay—AC breaker  
Rectifier Diode fuse failure – 2nd stage  
SCADA Close relay—DC breaker  
SCADA Trip relay—DC breaker

AM  
AS  
ATS  
CAP  
CB  
CC  
CLE  
CPT  
CS  
  
DCA  
EPB  
FU/#A  
CT  
GSCT  
LA  
LCS  
LS  
  
M  
M/a  
  
MOC  
MR  
MRCT  
MX  
PFM  
PT  
RES  
RTD  
SMA  
SS  
TC  
TOC  
VARM  
VCB  
VM  
VS  
WHD  
WHM  
XDCR  
  
XFMR  
Y  
  
Ammeter.  
Ammeter switch.  
Automatic transfer switch.  
Capacitor.  
Circuit breaker.  
Breaker closing coil.  
Current limiting fuse.  
Control power transformer.  
Control switch.  
C – Close  
NAC – Normal after close.  
NAT – Normal after trip.  
PTL – Pull to lock.  
T – Trip  
DC ammeter.  
Remote Emergency Push Button  
Fuse/current rating.  
Current transformer.  
Ground sensor current transformer.  
Lightning arrester.  
Breaker latch check switch.  
Breaker spring charged limit switch.  
Shown with breaker closing springs discharged.  
Breaker closing springs charging motor.  
Breaker contact:  
a – Open when breaker open.  
b – closed when breaker open.  
Breaker mechanically operated contact.  
Metering relay.  
Multi-ratio current transformer.  
Motor contactor auxiliary relay.  
Power factor meter.  
Potential transformer.  
Resistor.  
Resistance temperature device.  
DC breaker latching contact  
Speed sensor relay.  
Breaker tripping coil.  
Breaker truck operated contact.  
Volt-ampere reactance meter.  
Vacuum circuit breaker.  
Voltmeter.  
Voltmeter switch.  
Watt-hour meter with demand attachment.  
Watt-hour meter.  
Transducer:  
AM – Current.  
VOLT– Voltage.  
WATT– watts or kilowatts.  
Transformer.  
Breaker anti-pump relay.

NOTES

CERTIFIED AS BUILT  
BY DJW DATE 12/04/2006

Confidential Information. Must not be used in any way detrimental to Powell Electrical Mfg. Co.

REVISION DESCRIPTION			
REV. BY	REV. DATE	REV. No.	REV. 2
SPR	11/14/2008		

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

LEGEND  
SPECIFICATION 16341

POWELL ELECTRICAL MFG CO.—NORTH CANTON DIV.  
8087 Pleasantwood Ave, NW North Canton, Ohio 44720  
(330) 946-1750 Fax (330) 946-1787

P.O. # FNS059  
DRAWN BY JMR DATE DRAWN 5/04/2006 DWG./DISK No. G602501L01

## **Sequence of Operation 700V DC Switchgear FARRAGUT NORTH SUBSTATION-A02**

### **Cathode Breaker 72-01, 02, & 03 (Refer to drawing G602501013)**

Before the cathode breaker 72 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, the closing and tripping control circuit fuses must be plugged in, and the 27T relay must be energized. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43AM switch in "MANUAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the 43AM switch to "MANUAL" and turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86R4 (located in the AC Switchgear rectifier transformer feeder breaker cubicle) must be reset, the rectifier doors must be closed and the 33R relay in the rectifier must be reset and the station lockout relay 86H in the DC switchgear cathode breaker #1 cubicle must be reset. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43AM switch in "MANUAL", turning the breaker control switch to "CLOSE" (contact 12/13) causes the breaker to close (red light on-green light off). With the 43AM switch In "AUTO", the breaker will automatically close when the associated rectifier transformer feeder breaker closes.

The breaker will trip automatically if the associated rectifier feeder breaker lockout relay 86R is tripped, if the station lockout relay 86H trips, if the backup DC overcurrent relay (DEV 76) operates, if the rectifier door (33R) is opened, if a rectifier hot structure (64CX) occurs, or if the associated AC rectifier feeder breaker 52R opens while the 43AM switch is in "AUTO".

### **Feeder Breaker 172-01, 02, 03, 04, 05, & 06 (Refer to drawing G602501007)**

Before a feeder breaker 172 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, and the closing and tripping control circuit fuses must be plugged in. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43L/R switch in "LOCAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86H (located in the DC Switchgear rectifier no. 1 cubicle) must be reset,. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43L/R switch in "LOCAL", turning the breaker control switch to "CLOSE" (contact 15-16/17) energizes and latches the latching relay 201X. contact 201X (4/11) initiates a signal to the 182/183 load measuring relay. If the relay determines that it is safe to close the breaker, the 182/183 relay close contact (12/13) allows the breaker to close (red light on-green light off). With the 43L/R switch In "REMOTE", a signal from SCADA energizes the 201C relay latching the 201X relay. The breaker will close if the 182/183 relay determines that it is safe.

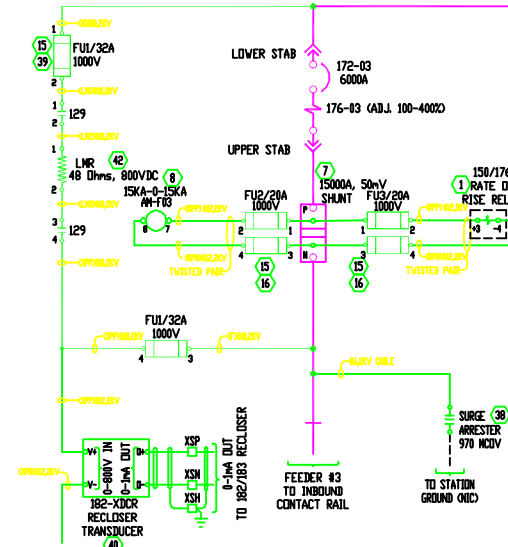
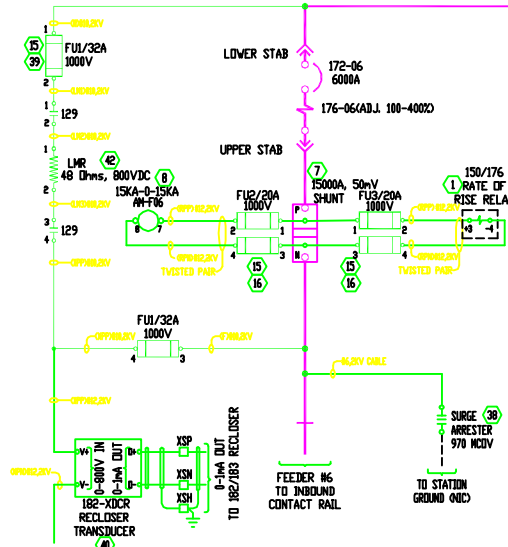
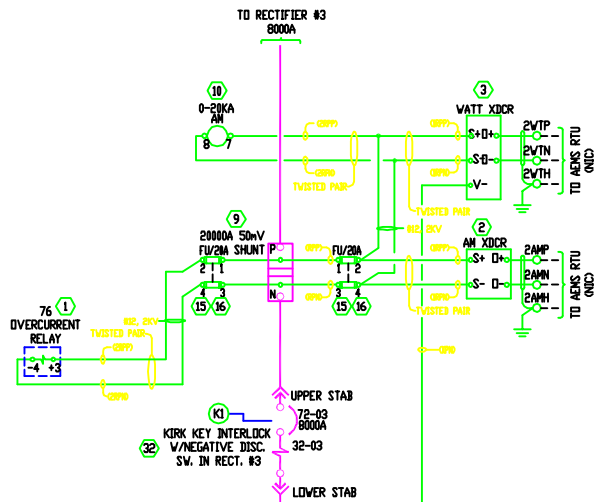
The feeder breaker will trip automatically if the station lockout relay 86H trips, if the DC overcurrent relay (DEV 76) operates, or if the direct acting series trip on the breaker operates. The 86H relay operation will cause the 201X relay to unlatch, blocking the 182/183 relay from attempting to automatically a reclose function. If the breaker trips on 76 operation from the 76 relay or the direct acting series trip device, the 201X relay stays latched and the 182/183 relay will attempt to load measure and re-close the breaker.

### **Load-measuring and Auto-Reclosing Circuit**

When the breaker trips and the 201X relay is NOT reset, the 182/183 relay compares the track voltage to pre-set values. If the track voltage is above a pre-set High set-point value, the track is assumed to be clear and the breaker is allowed to close.

If the track voltage is determined to be below the Low set-point value, the 182/183 closes its "Load Measure" contact which energizes the 129 load measuring contactor. The load measuring contactor puts a load measuring resistor in the circuit to the track. The 182/183 relay then compares the total resistance to a pre-set value. If the resistance is above the pre-set value, the track is determined to be clear and the breaker is allowed to close.

If the track voltage is between the high and low set points, the breaker is NOT allowed to close and a timer is started. The 182/183 relay continues to measure the track voltage until the condition clears or the timer times out. If the timer times out the 182/183 relay locks out and must be reset before another load measuring attempt is allowed.



UNIT #2 POWER CIRCUIT

UNIT #3 LOAD MEASURING CIRCUIT

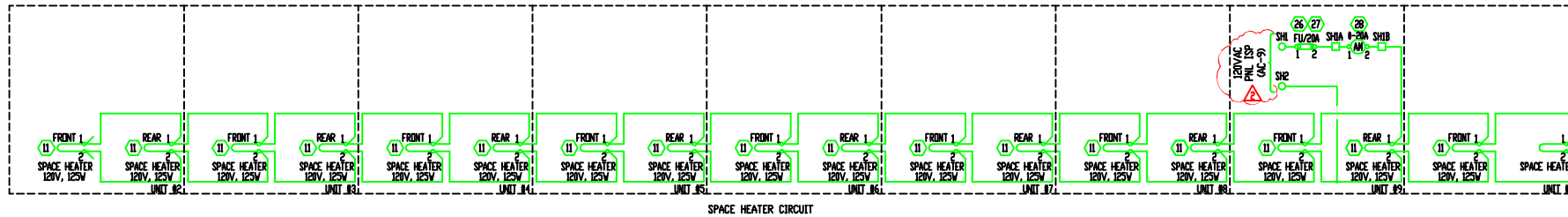
UNIT #3 POWER CIRCUIT

UNIT #4 LOAD MEASURING CIRCUIT

UNIT #4 POWER CIRCUIT

MAIN BUS 750VDC, 15000A

CONTINUED ON DRAWING 602501004



SPACE HEATER CIRCUIT

NOTES

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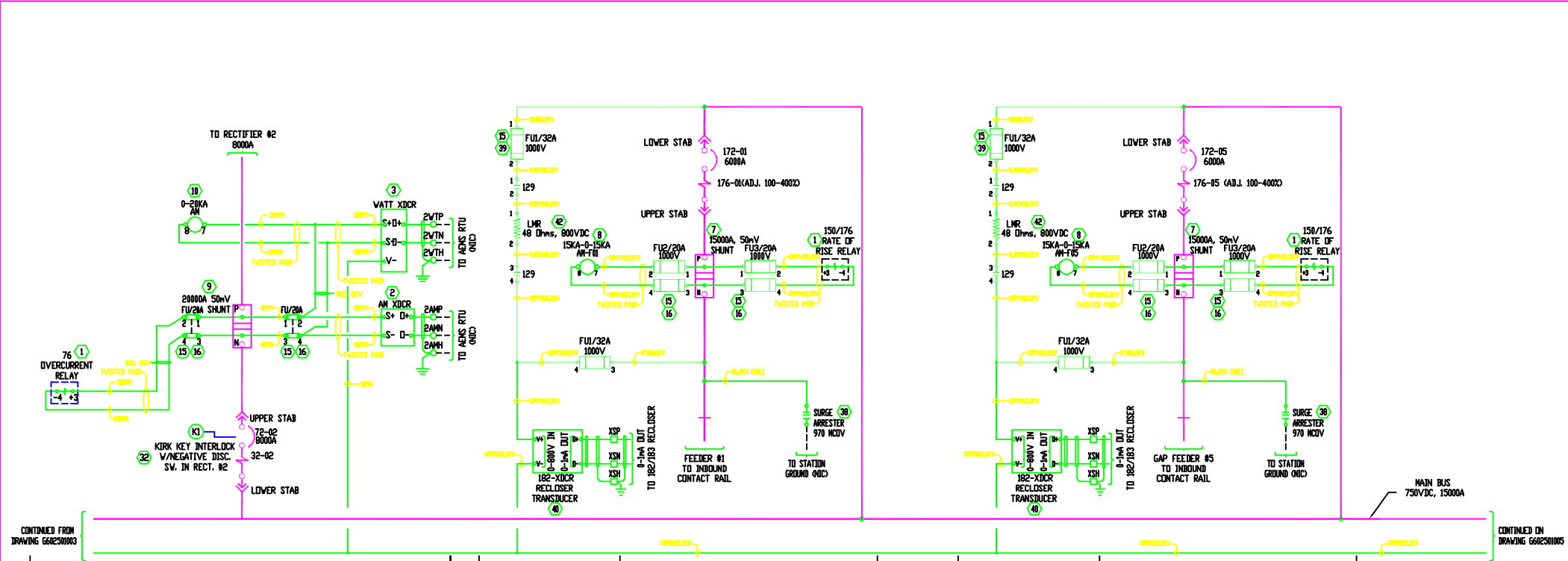
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REV. BY: SPB	REV. DATE: 11/13/2008
REV. NO.:	2

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC  
POWER DIAGRAM UNITS 2, 3 AND 4 SPECIFICATION 16341

**POWELL**  
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P.O. # FNS059  
DRAWN BY: JMR DATE DRAWN: 4/26/2006  
DWG./DISK No. G602501003

Powell Electrical Systems, Inc.  
8047 Powerswood Ave. 100  
North Canton, Ohio 44720  
Tel: 330.946.1790 Fax: 330.946.1787



CONTINUED FROM DRAWING G60250003 UNIT #5 POWER CIRCUIT UNIT #6 LOAD MEASURING CIRCUIT UNIT #6 POWER CIRCUIT UNIT #7 LOAD MEASURING CIRCUIT UNIT #7 POWER CIRCUIT CONTINUED IN DRAWING G60250005

NOTES

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
 METRO MATTERS PROJECT  
 WASHINGTON, DC

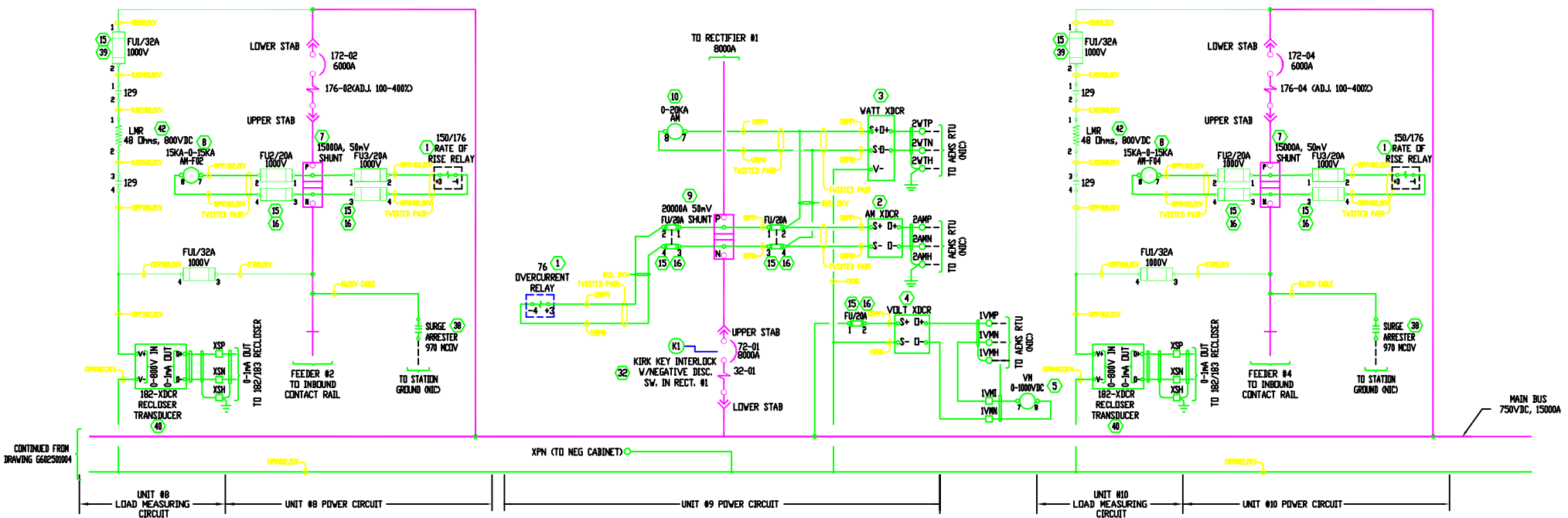
POWER DIAGRAM SPECIFICATION 16341

750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR  
 FARRAGUT NORTH SUB-A02

**POWELL**  
 Powered by Safety

P.O. # FNS059  
 DRAWN BY: JMR DATE DRAWN: 4/26/2006  
 DWG./DISK No. G602501004

Power Electrical Systems, Inc.  
 8847 Pleasantwood Ave. 100  
 North Canton, Ohio 44720  
 Tel: 330.946.1790 Fax: 330.946.1787



NOTES

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
 METRO MATTERS PROJECT  
 WASHINGTON, DC

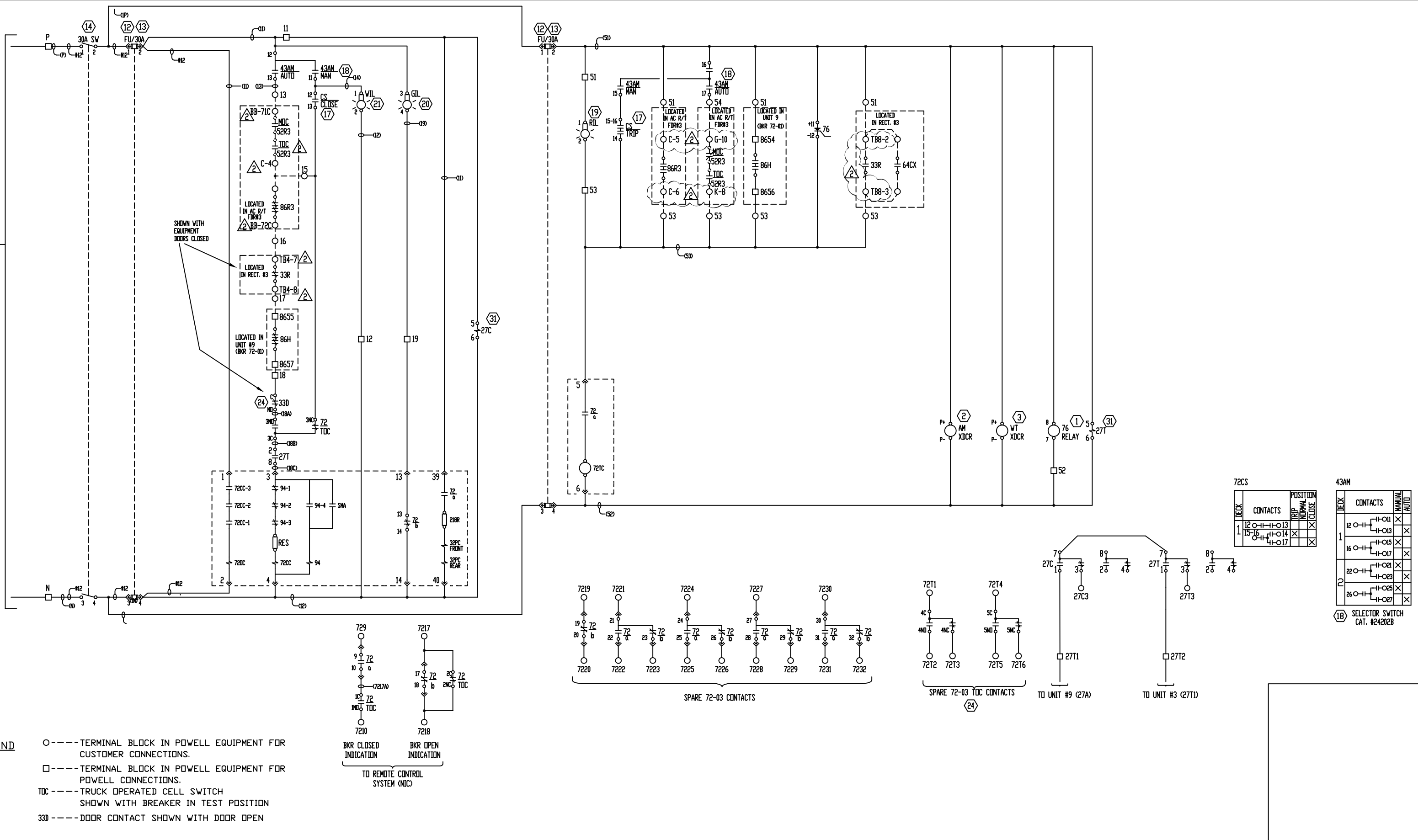
POWER DIAGRAM UNITS 8, 9 AND 10 SPECIFICATION 16341

**POWELL**  
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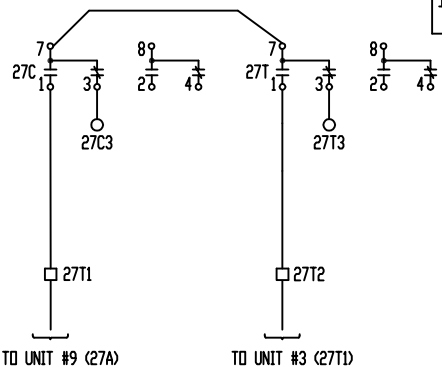
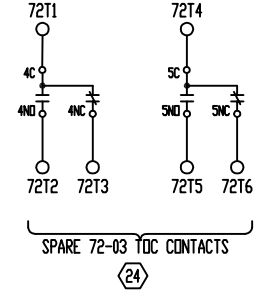
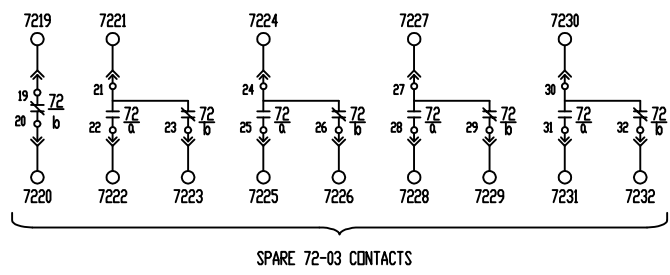
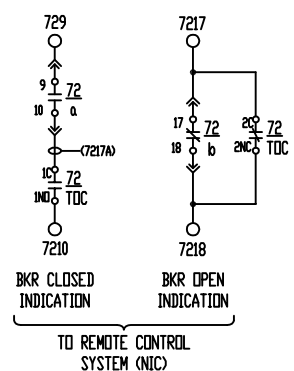
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 DRAWN BY: JMR DATE DRAWN: 4/26/2006  
 DWG./DISK No. G602501005

POWELL Electrical Systems, Inc.  
 8847 Powerswood Ave. 100  
 North Canton, Ohio 44720  
 Tel: 330.946.1790 Fax: 330.946.1787

125V DC CONTROL POWER FROM DC DISTRIBUTION PANEL



- LEGEND**
- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
  - TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
  - TOC----- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION
  - 33D----- DOOR CONTACT SHOWN WITH DOOR OPEN



72CS

DECK	CONTACTS	POSITION	
		TRIP	NORMAL CLOSE
1	12 O-11	11-O11	X
	13 O-11	11-O13	X
	15 O-11	11-O14	X
	16 O-11	11-O17	X

43AM

DECK	CONTACTS	POSITION	
		MANUAL	AUTO
1	12 O-11	11-O11	X
	13 O-11	11-O13	X
	16 O-11	11-O15	X
	22 O-11	11-O21	X
	26 O-11	11-O25	X

(18) SELECTOR SWITCH CAT. #24202B

**NOTES**  
1. FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

**CERTIFIED AS BUILT**  
BY: DJW DATE 12/04/2006

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REVISION DESCRIPTION		
FIELD AS BUILT -REVISED PER MARKUPS		
REV. BY: SPH	REV. DATE: 11/13/2008	REV. No.: 2

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

CONTROL SCHEMATIC  
CATHODE BREAKER 72-03  
SPECIFICATION 16341

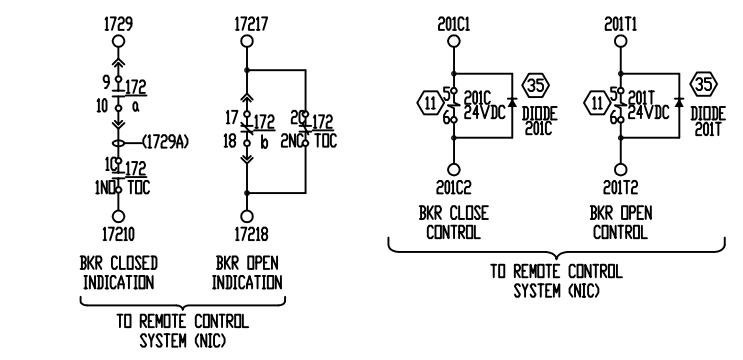
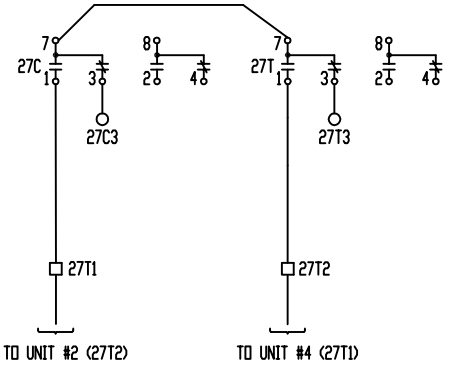
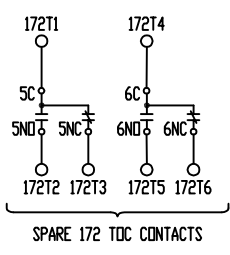
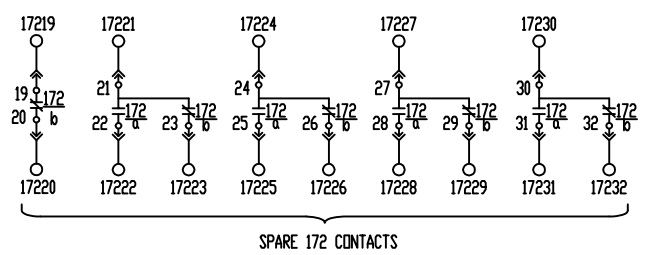
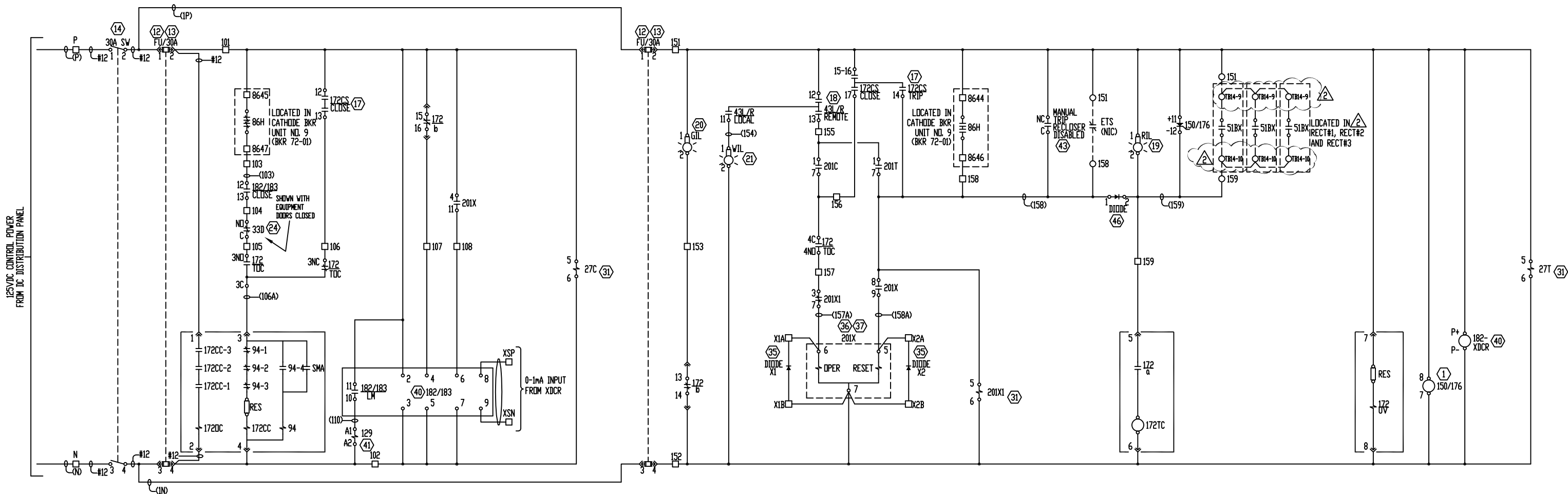
750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

**POWELL**  
Powered by Safety®

8967 Pleasantwood Ave. NW  
North Canton, Ohio 44720  
Tel: 330.966.1750 Fax: 330.966.1787

P.O. # FN5059  
DRAWN BY: DAR DATE: 4/26/2006  
DWG./DISK No. G602501006





**LEGEND**

- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC --- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION

172CS

CHECK	CONTACTS	POSITION	
		TRIP	NORMAL
1	12-0-1-1-0-13	X	X
	15-0-1-1-0-14	X	X
	4-0-1-1-0-17	X	X

CIRCUIT BREAKER CONTROL SWITCH  
⑰ CAT. #2440D

43L/R

CHECK	CONTACTS	LOCAL	REMOTE
1	12-0-1-1-0-11	X	X
	16-0-1-1-0-13	X	X
	16-0-1-1-0-15	X	X
	16-0-1-1-0-17	X	X
2	22-0-1-1-0-21	X	X
	11-0-1-1-0-23	X	X
	26-0-1-1-0-25	X	X
	11-0-1-1-0-27	X	X

SELECTOR SWITCH  
⑱ CAT. #24202B

- NOTES**
- ← INDICATES BKR. SECONDARY DISCONNECT.
  - WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
  - FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

**CERTIFIED AS BUILT**  
BY: DJW DATE 12/04/2006

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SPH	11/13/2008	2

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

CONTROL SCHEMATIC  
FEEDER BREAKER #6  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

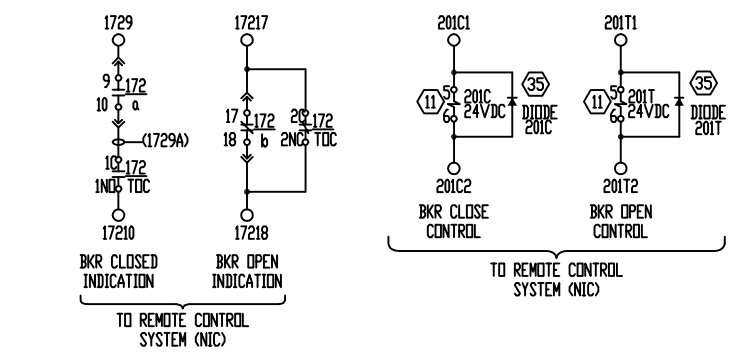
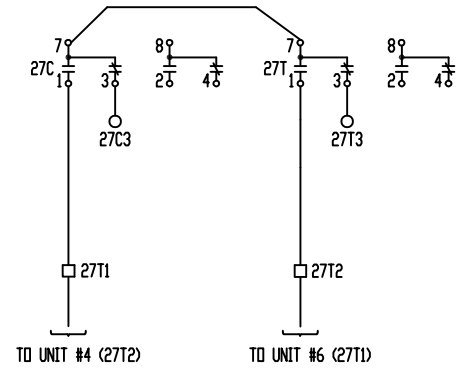
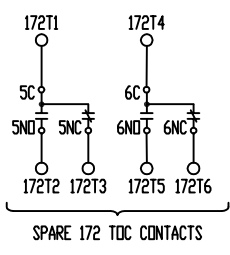
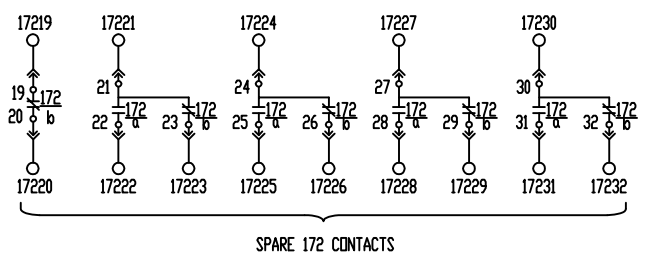
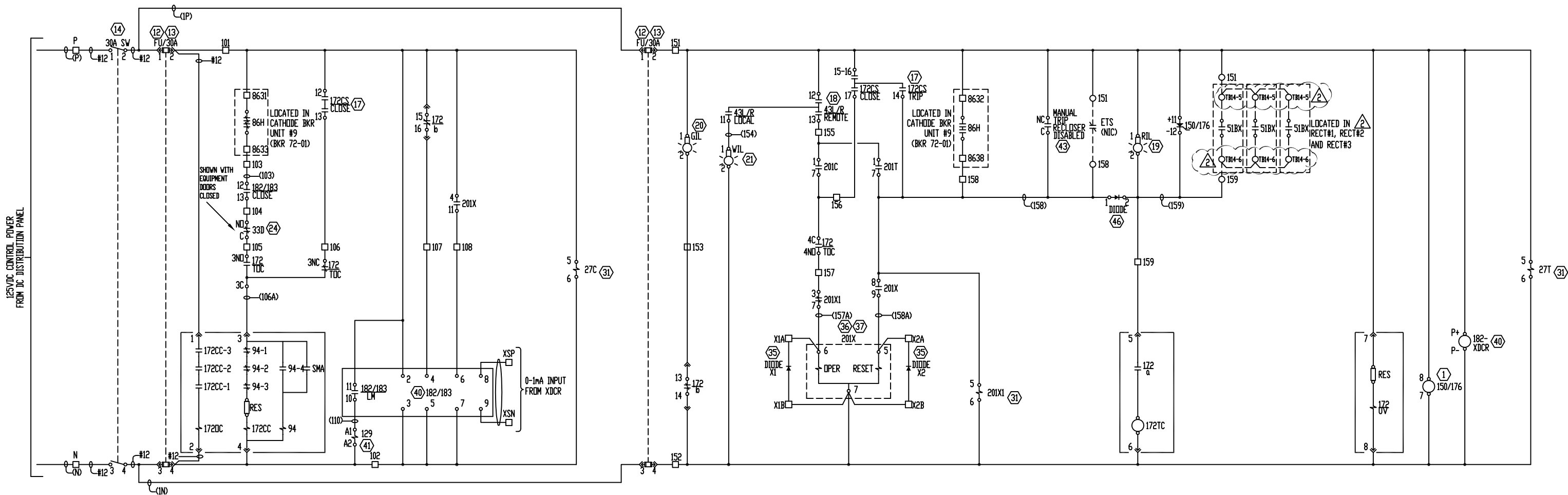
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P.O. # FN5059

DRAWN BY: DAR DATE: 4/26/2006

DWG./DISK No. G602501007



**LEGEND**

- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC --- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION

172CS		43L/R	
DECK	CONTACTS	TRIP	POSITION
1	12-0-1	1-0-11	X
	13-0-1	1-0-13	X
	14-0-1	1-0-17	X
2	22-0-1	1-0-21	X
	23-0-1	1-0-23	X
	26-0-1	1-0-27	X

CIRCUIT BREAKER CONTROL SWITCH (17) CAT. #2440D

SELECTOR SWITCH (18) CAT. #24202B

- NOTES**
- ← INDICATES BKR. SECONDARY DISCONNECT.
  - WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
  - FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

**CERTIFIED AS BUILT**  
 BY: DJW DATE 12/04/2006

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REVISION DESCRIPTION		
FIELD AS BUILT		
-REVISED PER MARKUPS		
REV. BY: SPH	REV. DATE: 11/13/2008	REV. No.: 2

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
 METRO MATTERS PROJECT  
 WASHINGTON, DC

CONTROL SCHEMATIC  
 FEEDER BREAKER #3  
 SPECIFICATION 16341

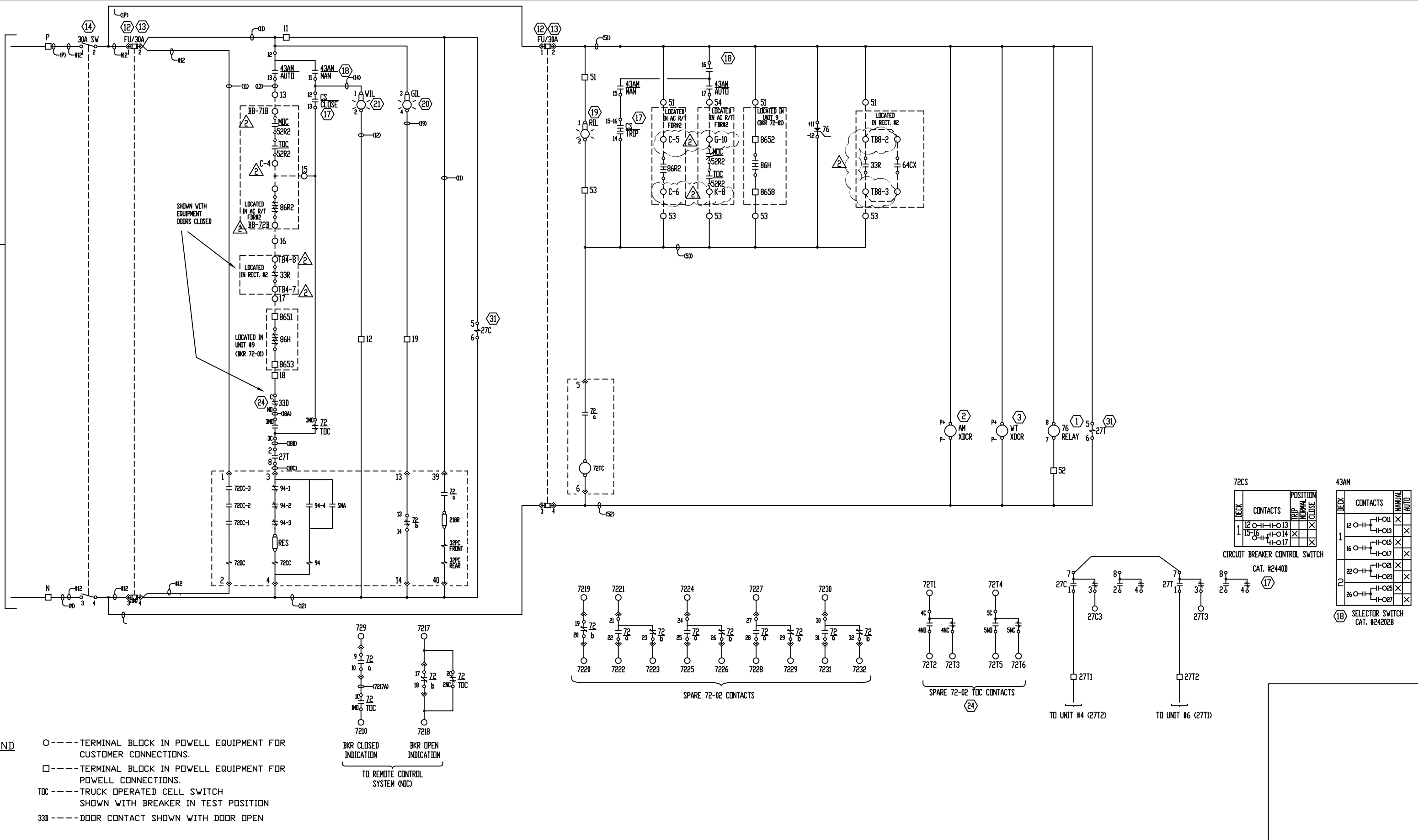
750V, 15000A, DC  
 METAL-ENCLOSED DC SWITCHGEAR  
 FARRAGUT NORTH SUB-A02

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 Tel: 330.966.1750 Fax: 330.966.1787

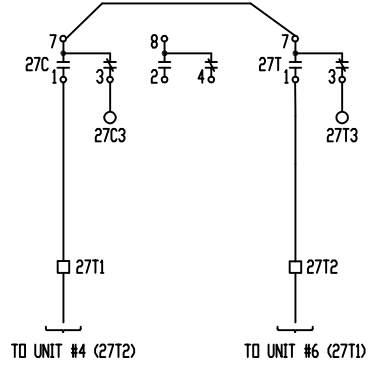
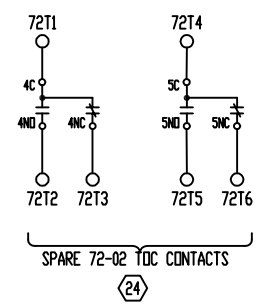
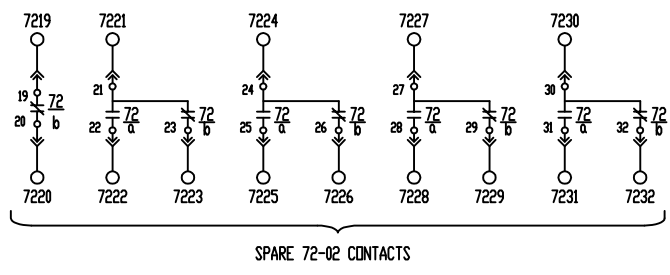
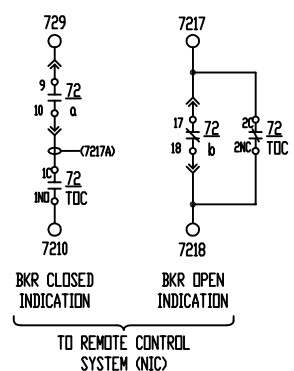
P.O. # FN5059  
 DRAWN BY: DAR DATE DRAWN: 4/26/2006 DWG./DISK No. G602501008

125V DC CONTROL POWER FROM DC DISTRIBUTION PANEL



**LEGEND**

- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC----- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION
- 33D----- DOOR CONTACT SHOWN WITH DOOR OPEN



72CS

DECK	CONTACTS	POSITION	
		TRIP	CLOSE
1	12 O-I	1-O11	X
	13 O-I	1-O13	X
	15-16 O-I	1-O14	X
2	22 O-I	1-O21	X
	23 O-I	1-O23	X
	26 O-I	1-O25	X

CIRCUIT BREAKER CONTROL SWITCH  
CAT. #2440D

43AM

DECK	CONTACTS	MANUAL	AUTO
1	12 O-I	1-O11	X
	13 O-I	1-O13	X
	16 O-I	1-O15	X
2	22 O-I	1-O21	X
	23 O-I	1-O23	X
	26 O-I	1-O25	X

(18) SELECTOR SWITCH  
CAT. #24202B

**NOTES**  
1. FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

**CERTIFIED AS BUILT**  
BY: DJW DATE: 12/04/2006

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REVISION DESCRIPTION		
FIELD AS BUILT -REVISED PER MARKUPS		
REV. BY: <u>SPH</u>	REV. DATE: <u>11/13/2008</u>	REV. No. <u>2</u>

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

CONTROL SCHEMATIC  
CATHODE BREAKER 72-02  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

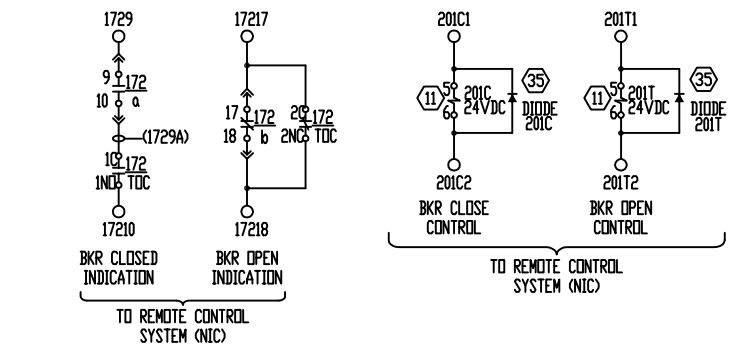
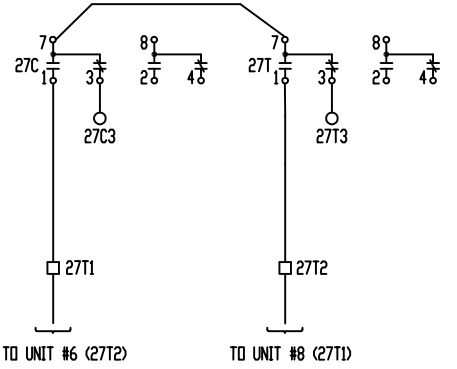
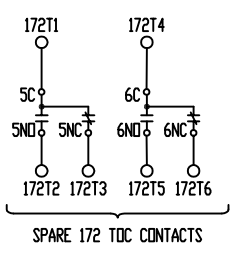
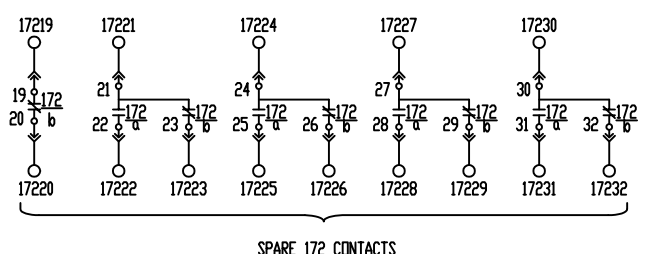
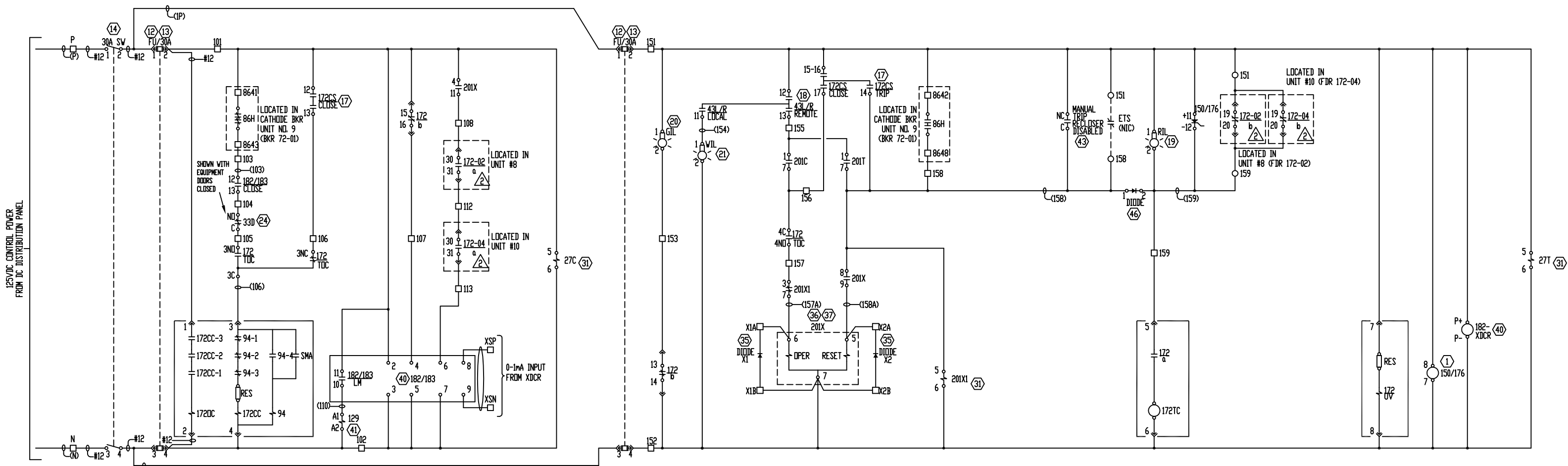
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8967 Pleasantwood Ave. NW  
North Canton, Ohio 44720  
Tel: 330.966.1750 Fax: 330.966.1787

P.O. # FN5059

DRAWN BY: <u>DAR</u>	DATE DRAWN: <u>4/26/2006</u>	DWG./DISK No. <u>G602501009</u>
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**LEGEND**

- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC --- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION

172CS	POSITION
CONTACTS	TRIP
12-13	×
15-16	×
18-19	×
21-22	×

CIRCUIT BREAKER CONTROL SWITCH  
⑰ CAT. #2440D

43L/R	CONTACTS	LOCAL	REMOTE
1	12-13	×	×
1	16-17	×	×
2	22-23	×	×
2	26-27	×	×

SELECTOR SWITCH  
⑱ CAT. #24202B

- NOTES**
- ← INDICATES BKR. SECONDARY DISCONNECT.
  - WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
  - FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS

CERTIFIED AS BUILT  
BY DJW DATE 12/04/2006

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REVISION DESCRIPTION		
FIELD AS BUILT		
-REVISED PER MARKUPS		
REV. BY <u>SPH</u>	REV. DATE <u>11/14/2008</u>	REV. No. <u>2</u>

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

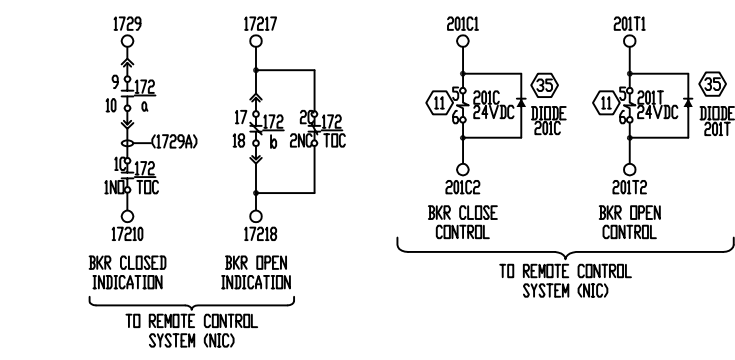
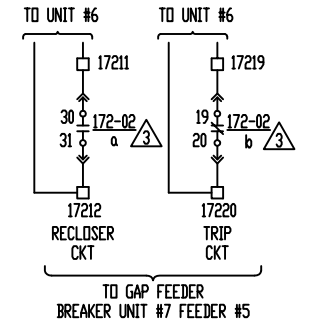
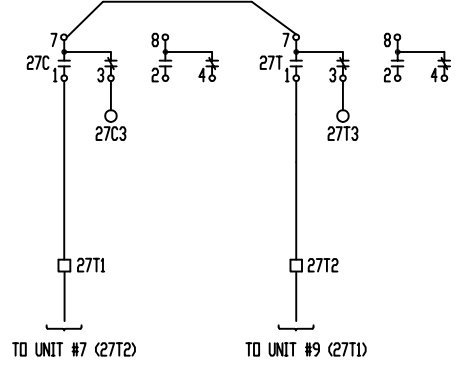
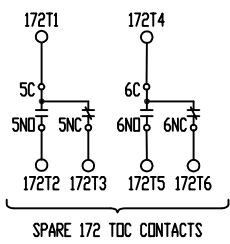
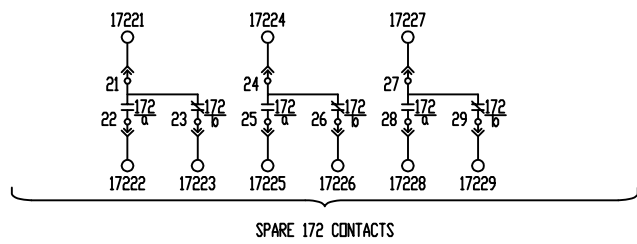
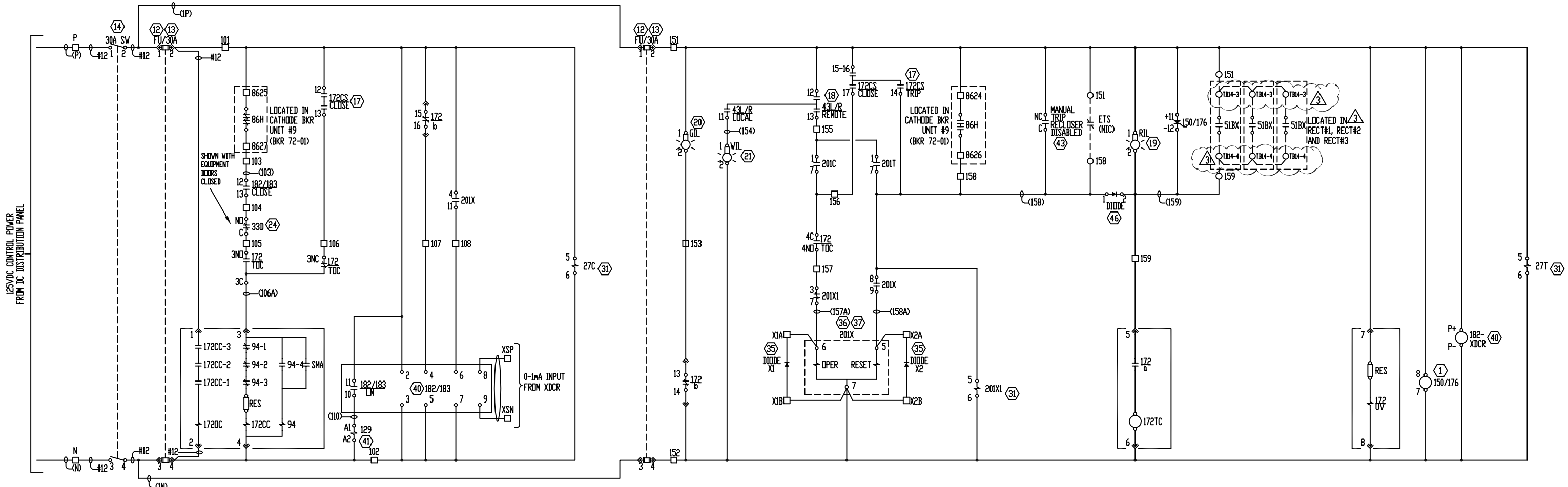
CONTROL SCHEMATIC  
GAP FEEDER BREAKER #5  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

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P.O. # FN5059  
DRAWN BY DAR DATE 4/26/2006  
DWG./DISK No. G602501011



**LEGEND**

- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC --- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION

172CS

TRIP	CONTACTS	POSITION
		TRIP
12	12-1	12-13
13	13-1	13-14
14	14-1	14-17
15	15-1	15-17

CIRCUIT BREAKER CONTROL SWITCH  
17 CAT. #2440D

43L/R

TRIP	CONTACTS	POSITION
		TRIP
12	12-1	12-13
13	13-1	13-14
14	14-1	14-17
15	15-1	15-17

SELECTOR SWITCH  
18 CAT. #24202B

- NOTES**
- ← INDICATES BKR. SECONDARY DISCONNECT.
  - WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
  - FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

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BY DJW DATE 12/04/2006

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WASHINGTON, DC

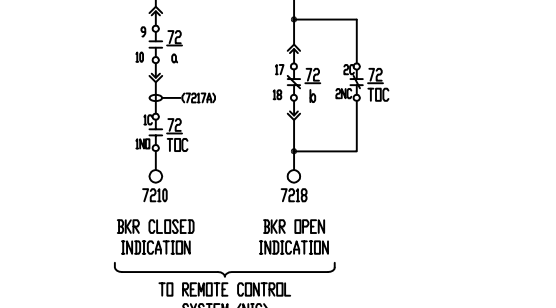
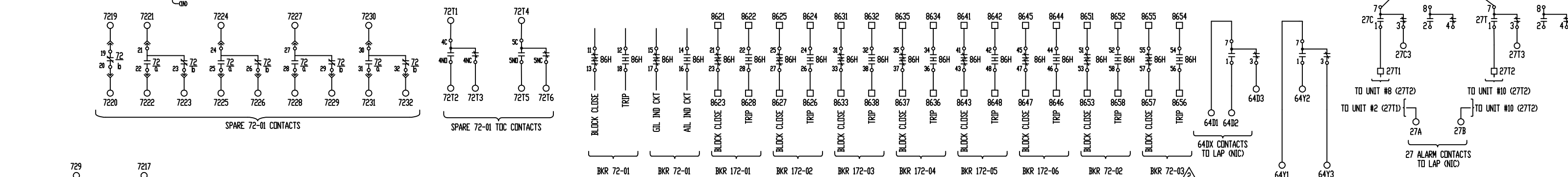
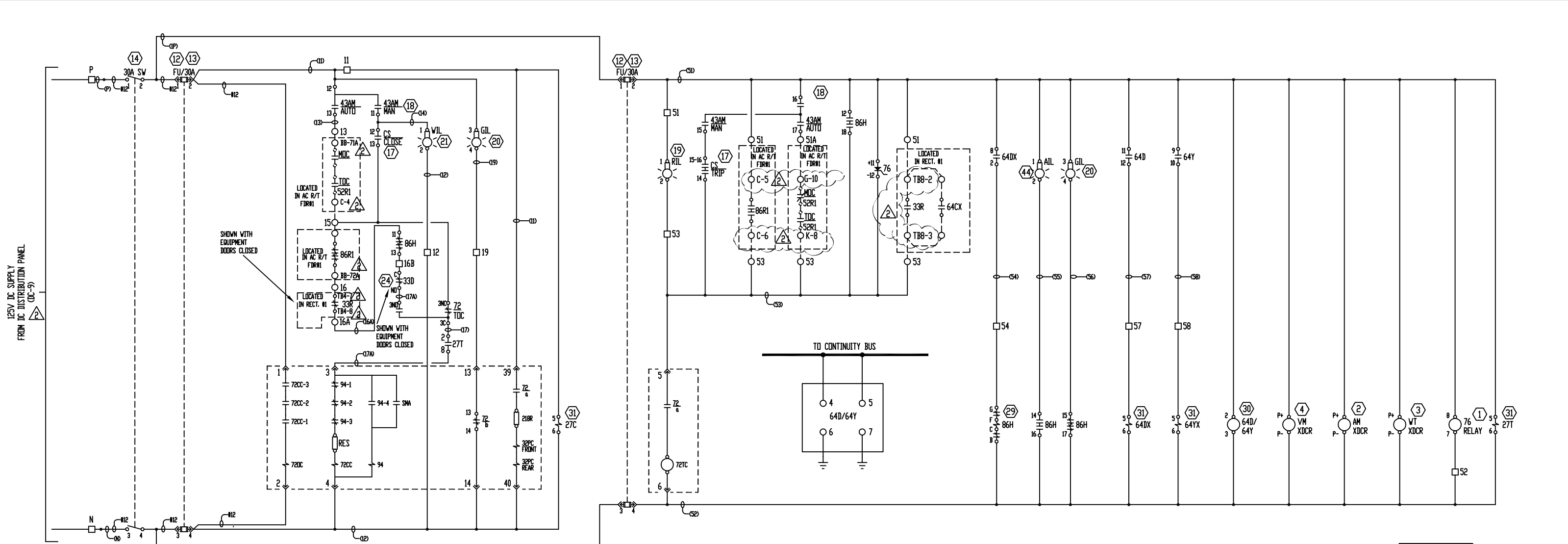
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FEEDER BREAKER #2  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

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P.O. # FN5059  
DRAWN BY DAR DATE 4/26/2006  
DWG./DISK No. G602501012



**LEGEND**

- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC----- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION
- 33D----- DOOR CONTACT SHOWN WITH DOOR OPEN

**72CS**

DECK	CONTACTS	POSITION
		NORMAL
1	12 O-I-O13	X
	15 I-I-O14	X
	16 O-I-O17	X

CIRCUIT BREAKER CONTROL SWITCH  
CAT. #2440D

**43AM**

DECK	CONTACTS	MANUAL	AUTO
1	12 O-I-O11	X	X
	16 O-I-O13	X	X
	16 O-I-O15	X	X
	16 O-I-O17	X	X
2	22 O-I-O21	X	X
	26 O-I-O23	X	X
	26 O-I-O25	X	X

**37** SELECTOR SWITCH  
CAT. #24202B

**NOTES**

- ← INDICATES BKR. SECONDARY DISCONNECT.
- WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
- FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
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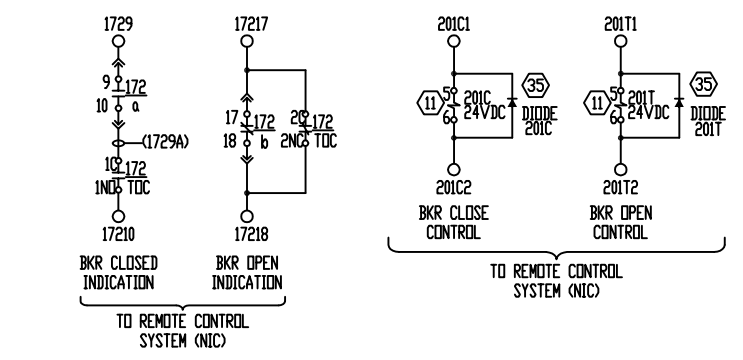
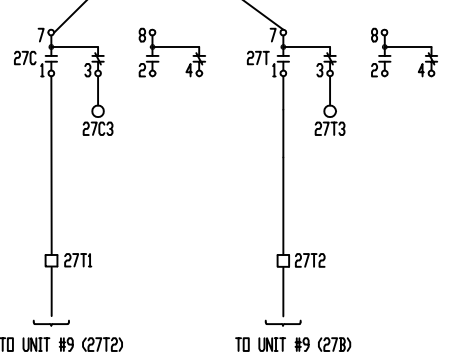
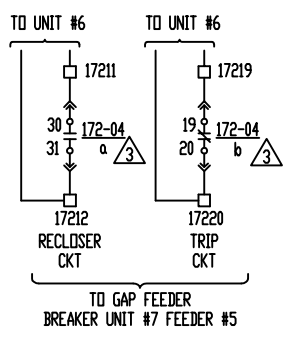
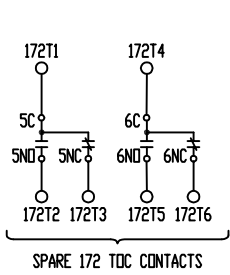
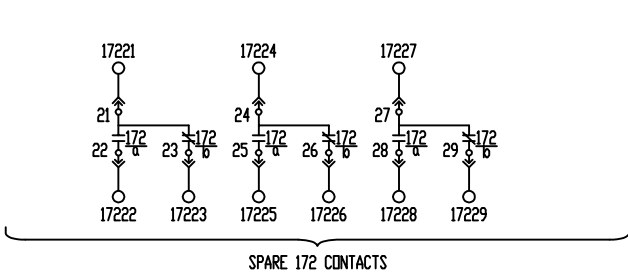
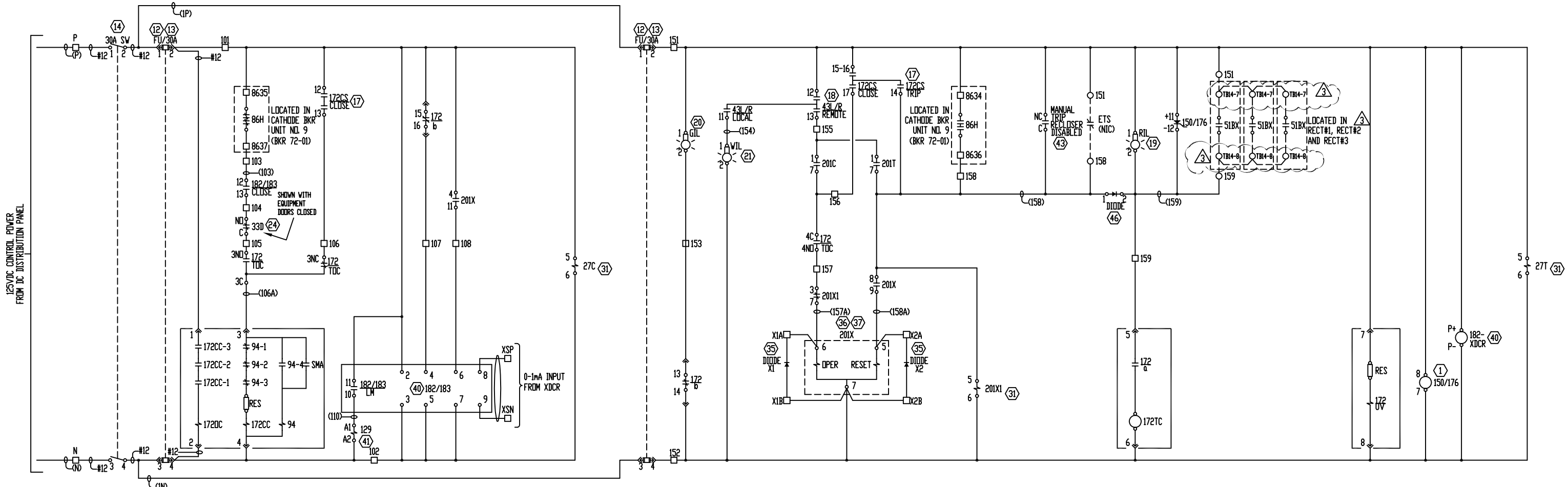
CONTROL SCHEMATIC  
CATHODE BREAKER 72-01  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

**POWELL**  
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P.O. # FN5059  
DRAWN BY: DAR DATE DRAWN: 4/26/2006  
DWG./DISK No. G60250103



**LEGEND**

- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR CUSTOMER CONNECTIONS.
- --- TERMINAL BLOCK IN POWELL EQUIPMENT FOR POWELL CONNECTIONS.
- TDC --- TRUCK OPERATED CELL SWITCH SHOWN WITH BREAKER IN TEST POSITION

172CS

CIRCUIT BREAKER CONTROL SWITCH (17) CAT. #2440D	CHECK	CONTACTS	POSITION	
			TRIP	NORMAL
1	12	12-01	×	×
	13	13-01	×	×
	14	14-01	×	×

43L/R

SELECTOR SWITCH (18) CAT. #24202B	CHECK	CONTACTS	LOCAL	REMOTE
1	12	12-01	×	×
	13	13-01	×	×
	14	14-01	×	×
2	22	22-01	×	×
	23	23-01	×	×
	24	24-01	×	×

- NOTES**
- ← INDICATES BKR. SECONDARY DISCONNECT.
  - WIRE TAGS ARE THE SAME AS TERMINAL BLOCK NUMBERS UNLESS OTHERWISE NOTED.
  - FOR CUSTOMER INTERFACE POINTS, SEE TWS INTERCONNECT TERMINATION SHEETS.

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WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

CONTROL SCHEMATIC FEEDER BREAKER #4 SPECIFICATION 16341

750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02

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P.O. # FN5059

DRAWN BY: DAR DATE: 4/26/2006

DWG./DISK No. G602501014



## Sequence of Operation 700V DC Switchgear FARRAGUT NORTH SUBSTATION-A02

### **Cathode Breaker 72-01, 02, & 03 (Refer to drawing G602501013)**

Before the cathode breaker 72 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, the closing and tripping control circuit fuses must be plugged in, and the 27T relay must be energized. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43AM switch in "MANUAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the 43AM switch to "MANUAL" and turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86R4 (located in the AC Switchgear rectifier transformer feeder breaker cubicle) must be reset, the rectifier doors must be closed and the 33R relay in the rectifier must be reset and the station lockout relay 86H in the DC switchgear cathode breaker #1 cubicle must be reset. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43AM switch in "MANUAL", turning the breaker control switch to "CLOSE" (contact 12/13) causes the breaker to close (red light on-green light off). With the 43AM switch In "AUTO", the breaker will automatically close when the associated rectifier transformer feeder breaker closes.

The breaker will trip automatically if the associated rectifier feeder breaker lockout relay 86R is tripped, if the station lockout relay 86H trips, if the backup DC overcurrent relay (DEV 76) operates, if the rectifier door (33R) is opened, if a rectifier hot structure (64CX) occurs, or if the associated AC rectifier feeder breaker 52R opens while the 43AM switch is in "AUTO".

### **Feeder Breaker 172-01, 02, 03, 04, 05, & 06 (Refer to drawing G602501007)**

Before a feeder breaker 172 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, and the closing and tripping control circuit fuses must be plugged in. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43L/R switch in "LOCAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86H (located in the DC Switchgear rectifier no. 1 cubicle) must be reset,. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43L/R switch in "LOCAL", turning the breaker control switch to "CLOSE" (contact 15-16/17) energizes and latches the latching relay 201X. contact 201X (4/11) initiates a signal to the 182/183 load measuring relay. If the relay determines that it is safe to close the breaker, the 182/183 relay close contact (12/13) allows the breaker to close (red light on-green light off). With the 43L/R switch In "REMOTE", a signal from SCADA energizes the 201C relay latching the 201X relay. The breaker will close if the 182/183 relay determines that it is safe.

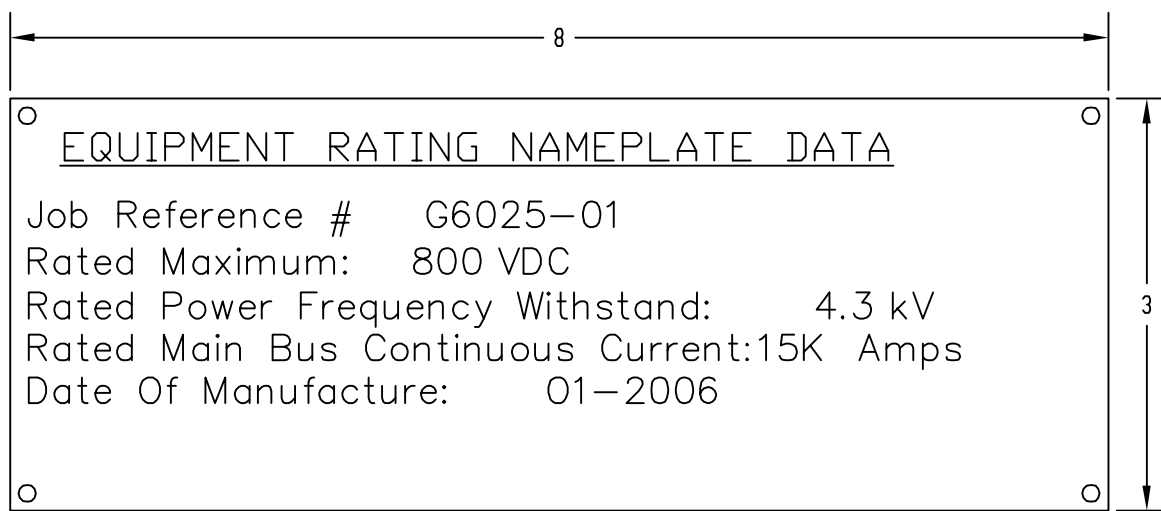
The feeder breaker will trip automatically if the station lockout relay 86H trips, if the DC overcurrent relay (DEV 76) operates, or if the direct acting series trip on the breaker operates. The 86H relay operation will cause the 201X relay to unlatch, blocking the 182/183 relay from attempting to automatically a reclose function. If the breaker trips on 76 operation from the 76 relay or the direct acting series trip device, the 201X relay stays latched and the 182/183 relay will attempt to load measure and re-close the breaker.

### **Load-measuring and Auto-Reclosing Circuit**


When the breaker trips and the 201X relay is NOT reset, the 182/183 relay compares the track voltage to pre-set values. If the track voltage is above a pre-set High set-point value, the track is assumed to be clear and the breaker is allowed to close.

If the track voltage is determined to be below the Low set-point value, the 182/183 closes its "Load Measure" contact which energizes the 129 load measuring contactor. The load measuring contactor puts a load measuring resistor in the circuit to the track. The 182/183 relay then compares the total resistance to a pre-set value. If the resistance is above the pre-set value, the track is determined to be clear and the breaker is allowed to close.

If the track voltage is between the high and low set points, the breaker is NOT allowed to close and a timer is started. The 182/183 relay continues to measure the track voltage until the condition clears or the timer times out. If the timer times out the 182/183 relay locks out and must be reset before another load measuring attempt is allowed.



RATING NAMEPLATE  
FARRAGUT NORTH SUBSTATION-A02

 CERTIFIED  
AS BUILT  
BY DJW DATE 12/04/2006



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North Canton, Ohio 44720  
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P.O. # FN5059

WMATA  
METRO MATTERS PROJECT  
WASHINGTON, DC

SPH	11/14/2008	FIELD AS BUILT - NO CHANGES	3				
REV. BY	REV. DATE	REVISION DESCRIPTION	REV. No.	DRAWN BY	DATE DRAWN	DWG./DISK NO.	
				DAR	4/26/2006	G602501NP2	

# DC SWITCHGEAR SPECIFICATIONS

## I. Equipment Classification

Metal-Enclosed LV Switchgear (per ANSI/IEEE C37.20.1)  
 System voltage 750VDC

System Grounding type:  
 Solidly grounded  
 Low resistance grounded  
 High resistance grounded  
 Ungrounded

Max. Ambient Temperature is 40°C at 3300' elevation or below.  
 Other \_\_\_\_\_ (de-rating of equipment may apply)

## V. Other Special requirements

Breaker type (  NCD  HSN  MM74)

- FOR NCD TYPE BREAKER WITH TOC ORDER ASSEMBLY 21305G00000001.
- FOR MM74 TYPE BREAKER WITH TOC ORDER ASSEMBLY 21305G00000004.
- FOR TYPE MM74 TYPE FEEDER BREAKER REQUIRING LOAD MEASURING AND AUTO RECLOSED ORDER ASSEMBLY 21305G00000002.

## II. Construction & Finish

### A. STANDARD CONSTRUCTION REQUIREMENTS

- Enclosure to be constructed of:  
 Code gauge steel
- Enclosure to be:  
 Indoor NEMA 1  
 Outdoor NEMA 3R
- Equipment accessibility:  
 Front only  
 Front & back
- Channel base:  
 Shipping purpose only  
 Permanent on equipment  
 Not required  
 (Note: Recommended leveling channels to be furnished and installed by others.)
- Equipment dimensions:  
 Total overall height 90"  
 Total overall width 250"  
 Total overall depth 90"  
 Max. shipping sect. dim. (HxWxD) 90X86X90  
 Shipped inside PCR W.D. # \_\_\_\_\_

- Nameplates: (See NP schedule for size and color) (unless specified, adhesive labels to be provided for all devices)  
 On front door (std. labels on back of door)  
 On front/back of front door  
 On interior devices  
 Not required (std. labels to be provided)
- Equipment Interior/exterior paint color (powder-coat type per MFG-025)  
 ANSI-61, light gray (int & ext)  
 ANSI-70, light gray (int & ext)  
 Touch-up paint for ea. color \_\_\_\_\_

### B. SPECIAL CONSTRUCTION REQUIREMENTS

- Special gauge steel: \_\_\_\_\_
- Door stops
- Ventilation openings with screens
- White interior panels
- Special paint color (int & ext): \_\_\_\_\_
- Key interlock required (  Main  Feeder)
- Surge arrestors (  Main  Feeder)
- Shutters required
- Cable supports required
- Removable rear covers
- TOC Required (See section V for mechanical assembly)

## III. Bussing

### A. STANDARD BUSSING REQUIREMENTS

- Main bus current rating:  
 Amps 15KA  
 Bar size (5) 1/2" X 8"
- Continuity bus (non-insulated):  
 Required:  Yes  No  
 Size 1/4" X 1"
- Main bus voltage rating: 800V
- Bus bracing (rms sym.): 200KA
- Bus arrangement:  
 Main (Incoming)  Feeder (Incoming)  
 Upper Stab  Upper Stab  
 Lower Stab  Lower Stab
- Bus to be:  
 Copper - silver plated.
- Bus insulation:  
 Not required.  
 See special bussing requirements.
- Equipment incoming service:  
 top  cable  bus  
 bottom  cable  bus  
 side (main bus)
- Feeder exit:  
 top  cable  bus  
 bottom  cable  bus

- Main bus support to be:  
 Sheet glastic with no inserts  
 Other (see Special Bussing Requirements)
- Bussing standoff insulators to be:  
 Glastic
- Field power cable connections:  
 Provide lugs  
 Provide boots
- Negative bus:  
 Not Required  
 Required  
 Size \_\_\_\_\_

### B. SPECIAL BUSSING REQUIREMENTS

- Tin plated copper bus
- Epoxy - HI-PDXY 2000 bus insulation
- Epoxy - FLUIDIZED BED bus insulation
- Stainless Steel hardware
- Silicon Bronze hardware
- Belleville washers
- Special bus arrangement: \_\_\_\_\_
- Close coupled to rectifier
- 
- 
- 
- 

## IV. Wiring

### A. STANDARD WIRING REQUIREMENTS

- Standard wiring:  
 - Wire type gray SIS (VW-1)  
 - Control & potential #14 ga. w/insulated locking spade lugs.  
 - Current #12 ga. w/insulated ring lugs.  
 - Space heater #14 ga. w/insulated locking spade lugs.  
 - Control power bus #6 ga. w/insulated ring lugs.  
 - Communication shielded #16 ga. w/insulated locking spade lugs.
- Wire markers:  
 Heat shrinkable sleeve type (white sleeve w/black letters)  
 Note: heat shrinking of wire sleeves to be by others  
 Wire labels to match terminal block numbers.
- Space heaters:  
 Required  
 watts 125W/500W  
 volts 120V/240V  
 Oper. volts 120V  
 Not required  
 Thermostat per line-up  
 Thermostat per unit  
 Thermostat provided in SWGR W.D. # \_\_\_\_\_
- Control cable entry:  
 Top  
 Bottom  
 Top and bottom
- Terminal blocks:  
 GE CR151 for control
- Bus connections:  
 Wiring connected to bus to be bundled separately

### B. SPECIAL WIRING REQUIREMENTS

- Humidistat for space heater ckt.
- 10 % spare terminal blocks.
- Special terminal blocks type:  
 Control TB type: \_\_\_\_\_
- Heat shrinking of wire sleeves required

### EQUIPMENT RATING NAMEPLATE DATA

Job Reference # G6025-01  
 Rated Maximum: 800 VDC  
 Rated Power Frequency Withstand: 4.3 kV  
 Rated Main Bus Continuous Current: 15K Amps  
 Date Of Manufacture: \*\*

## NOTES

- ⬡ denotes bill of material item reference number
- denotes nameplate symbol and number



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REVISION DESCRIPTION			WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY METRO MATTERS PROJECT WASHINGTON, DC		Powell Electrical Systems, Inc. 8967 Pleasantwood Ave. NW North Canton, Ohio 44720 Tel: 330.966.1750 Fax: 330.966.1787	
FIELD AS BUILT -NO CHANGES			SPECIFICATIONS 750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02		P.O. # FN5059	
REV. BY: SPH	REV. DATE: 11/13/2008	REV. No: 2	SPECIFICATION 16341		DRAWN BY: DAR	DATE DRAWN: 4/26/2006
					DWG./DISK No: G602501S01	

## Sequence of Operation 700V DC Switchgear FARRAGUT NORTH SUBSTATION-A02

### **Cathode Breaker 72-01, 02, & 03 (Refer to drawing G602501013)**

Before the cathode breaker 72 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, the closing and tripping control circuit fuses must be plugged in, and the 27T relay must be energized. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43AM switch in "MANUAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the 43AM switch to "MANUAL" and turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86R4 (located in the AC Switchgear rectifier transformer feeder breaker cubicle) must be reset, the rectifier doors must be closed and the 33R relay in the rectifier must be reset and the station lockout relay 86H in the DC switchgear cathode breaker #1 cubicle must be reset. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43AM switch in "MANUAL", turning the breaker control switch to "CLOSE" (contact 12/13) causes the breaker to close (red light on-green light off). With the 43AM switch In "AUTO", the breaker will automatically close when the associated rectifier transformer feeder breaker closes.

The breaker will trip automatically if the associated rectifier feeder breaker lockout relay 86R is tripped, if the station lockout relay 86H trips, if the backup DC overcurrent relay (DEV 76) operates, if the rectifier door (33R) is opened, if a rectifier hot structure (64CX) occurs, or if the associated AC rectifier feeder breaker 52R opens while the 43AM switch is in "AUTO".

### **Feeder Breaker 172-01, 02, 03, 04, 05, & 06 (Refer to drawing G602501007)**

Before a feeder breaker 172 can be operated, 125VDC control power must be available at terminals P and N, the knife switch must be closed, and the closing and tripping control circuit fuses must be plugged in. Racking the breaker into the "TEST" position causes the secondary contact fingers to make up. The breaker main contacts are open, auxiliary contact 72/b 13/14 (green light GIL on) is closed, and auxiliary contacts 72/a in the trip circuit is open (red light RIL off). The breaker is ready for a close operation. The breaker can be closed in the "TEST" position locally by placing the 43L/R switch in "LOCAL". (White light WIL on) Turning the breaker control switch 72CS to "CLOSE" (contact 12/13) energizes the closing contactor 72CC, through the truck-operated cell switch TOC contact 3NC/3C, energizing the closing solenoid 72OC and closing the breaker main contacts. The anti-pump relay 94 energizes, de-energizing the closing coil 72CC, preventing repeated close attempts until the control switch 72CS is released. The breaker main contacts are closed and auxiliary contact 72/b 13/14 is open (Green light off) and auxiliary contacts 72/a in the trip circuit is closed (red light RIL on). The breaker can be tripped locally by turning the breaker control switch 72CS (contact 15-16/14) to "TRIP" energizing the trip coil TC and tripping the breaker. Before the breaker can be closed in the "CONNECTED" position, lockout relay 86H (located in the DC Switchgear rectifier no. 1 cubicle) must be reset,. The breaker must be racked into the "CONNECTED" position (72 TOC contact 3NO/3C). With the 43L/R switch in "LOCAL", turning the breaker control switch to "CLOSE" (contact 15-16/17) energizes and latches the latching relay 201X. contact 201X (4/11) initiates a signal to the 182/183 load measuring relay. If the relay determines that it is safe to close the breaker, the 182/183 relay close contact (12/13) allows the breaker to close (red light on-green light off). With the 43L/R switch In "REMOTE", a signal from SCADA energizes the 201C relay latching the 201X relay. The breaker will close if the 182/183 relay determines that it is safe.

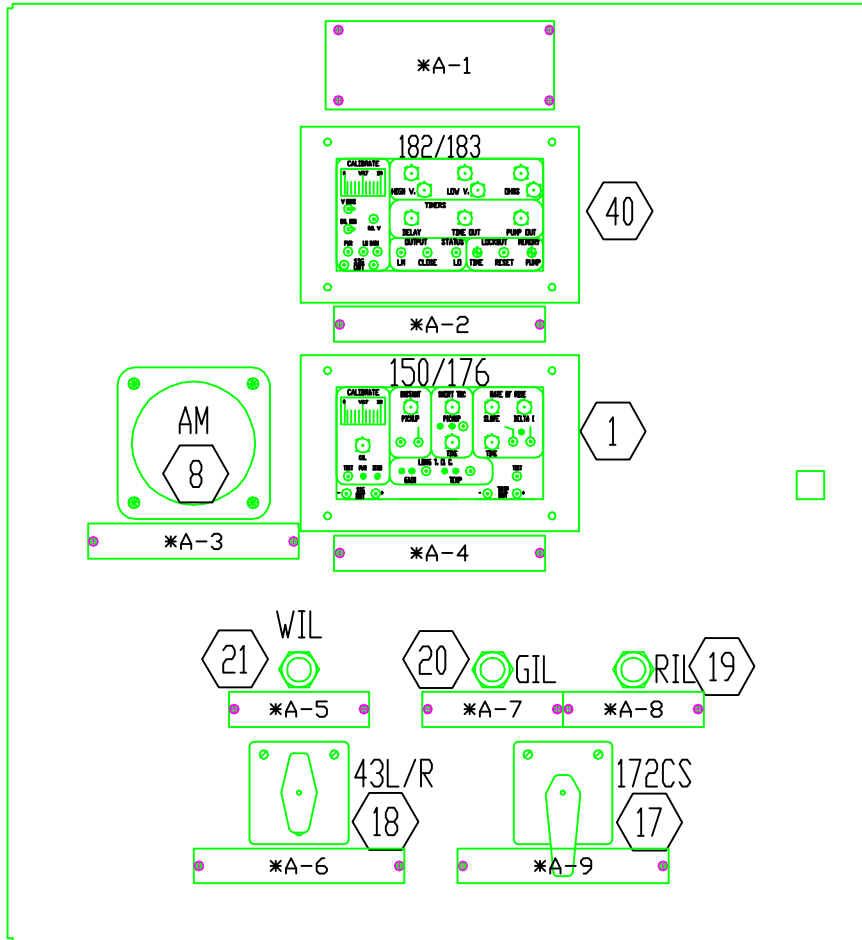
The feeder breaker will trip automatically if the station lockout relay 86H trips, if the DC overcurrent relay (DEV 76) operates, or if the direct acting series trip on the breaker operates. The 86H relay operation will cause the 201X relay to unlatch, blocking the 182/183 relay from attempting to automatically a reclose function. If the breaker trips on 76 operation from the 76 relay or the direct acting series trip device, the 201X relay stays latched and the 182/183 relay will attempt to load measure and re-close the breaker.

### **Load-measuring and Auto-Reclosing Circuit**

When the breaker trips and the 201X relay is NOT reset, the 182/183 relay compares the track voltage to pre-set values. If the track voltage is above a pre-set High set-point value, the track is assumed to be clear and the breaker is allowed to close.

If the track voltage is determined to be below the Low set-point value, the 182/183 closes its "Load Measure" contact which energizes the 129 load measuring contactor. The load measuring contactor puts a load measuring resistor in the circuit to the track. The 182/183 relay then compares the total resistance to a pre-set value. If the resistance is above the pre-set value, the track is determined to be clear and the breaker is allowed to close.

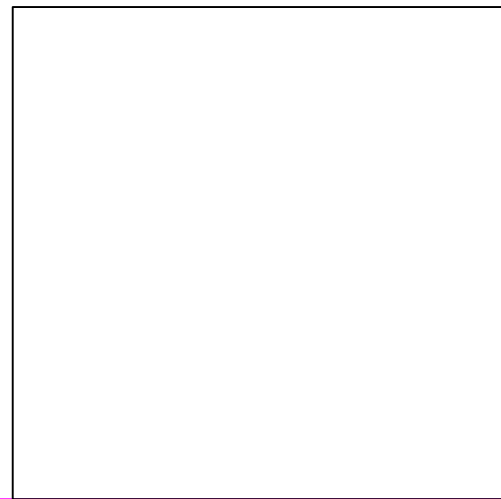
If the track voltage is between the high and low set points, the breaker is NOT allowed to close and a timer is started. The 182/183 relay continues to measure the track voltage until the condition clears or the timer times out. If the timer times out the 182/183 relay locks out and must be reset before another load measuring attempt is allowed.



DOOR DETAIL-FEEDER BREAKER  
 FARRAGUT NORTH SUBSTATION-A02  
 FDR BKR'S 31, 32, 33, 34, 35, & 36

3

 CERTIFIED  
 AS BUILT  
 BY DJW DATE 12/04/2006



 **POWELL ELECTRICAL MFG CO.-NORTH CANTON DIV.**  
 8967 Pleasantwood Ave, NW North Canton, Ohio 44720  
 (330) 966-1750 Fax (330) 966-1787

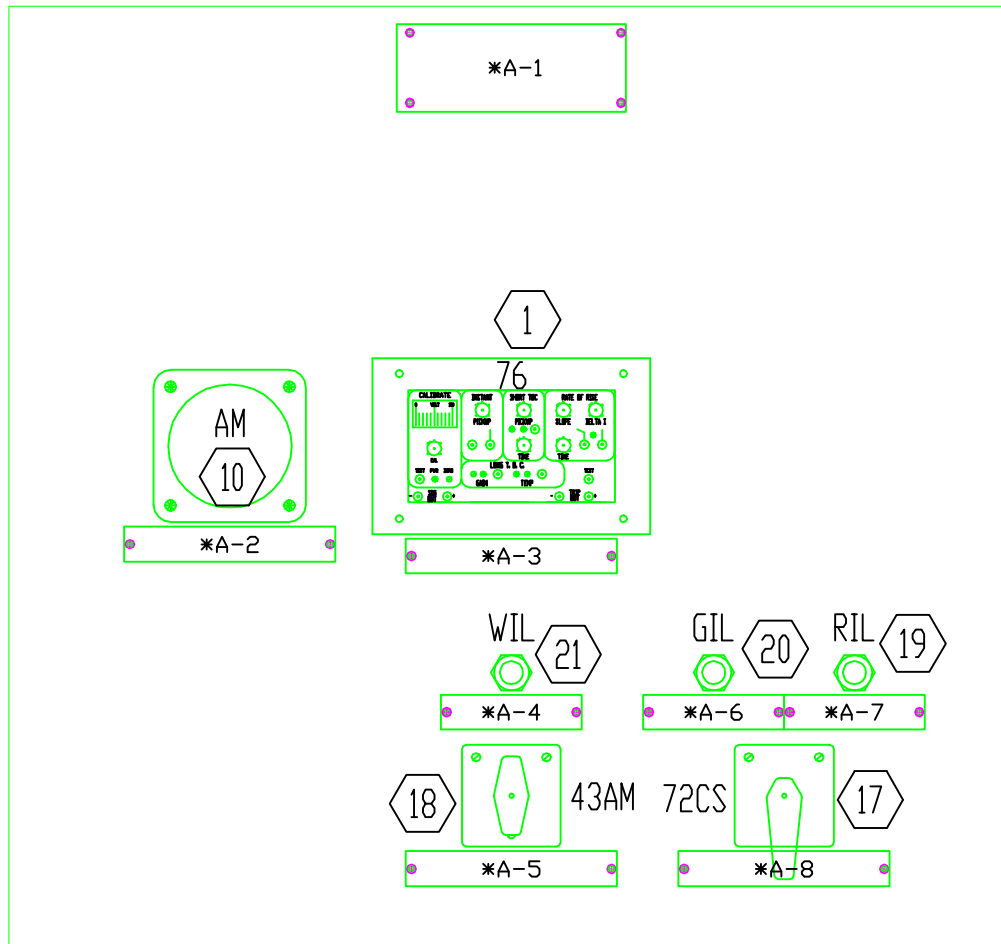
P.O. # FN5059

WMATA  
 METRO MATTERS PROJECT  
 WASHINGTON, DC

SPH	11/14/2008	FIELD AS BUILT-PER MARKUPS	3
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REV. BY	REV. DATE	REVISION DESCRIPTION	REV. No.
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DRAWN BY	DAR	DATE DRAWN	4/26/2006	DWG./DISK NO.	G602501D01
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DOOR DETAIL-CATHODE BREAKER 2 & 3  
FARRAGUT NORTH SUBSTATION-A02

 CERTIFIED AS BUILT  
BY DJW DATE 12/04/2006



**Powell Electrical Systems, Inc.**

8550 Mosley Drive  
Houston, Texas 77075-1180  
Tel: 713.944.6900 Fax: 713.947.4453

P.O. # FN5059

WMATA  
METRO MATTERS PROJECT  
WASHINGTON, DC

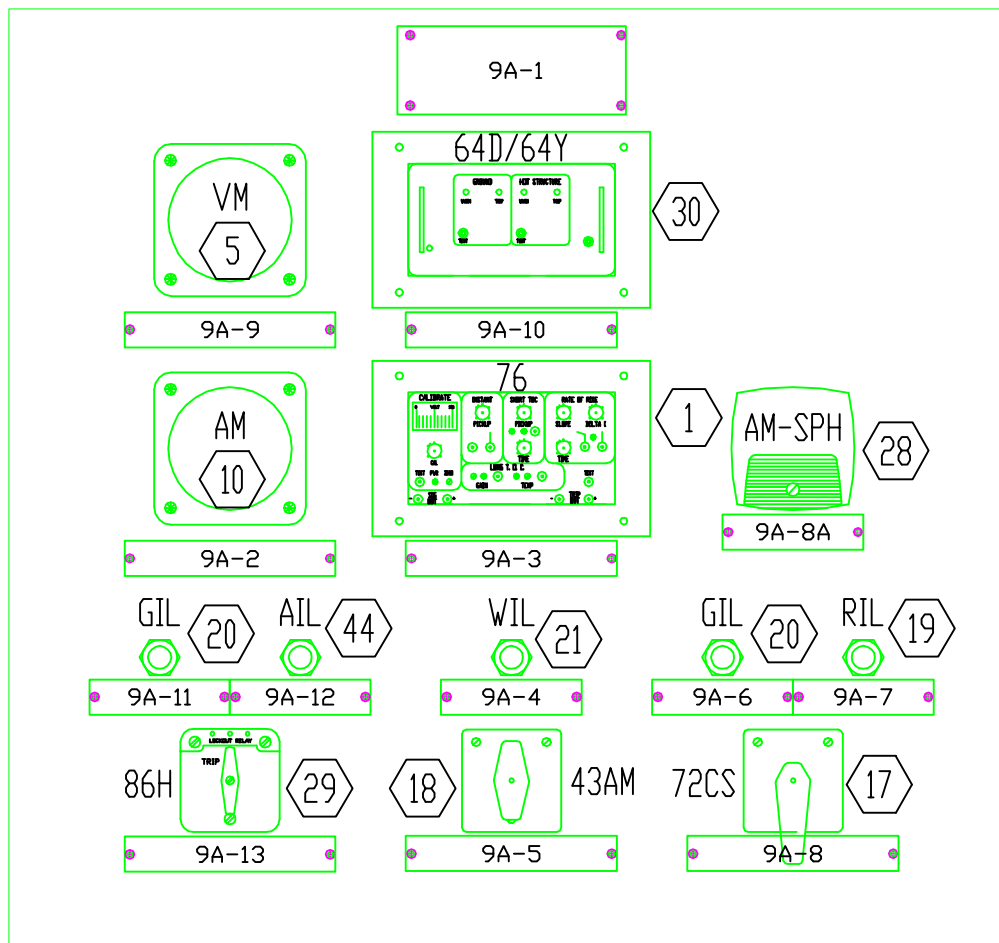
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REV. BY	REV. DATE	REVISION DESCRIPTION	REV. No.
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DRAWN BY	DATE DRAWN	4/26/2006
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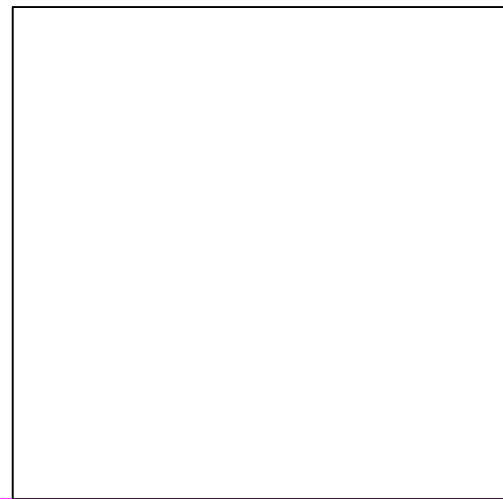
DWG./DISK NO.	G602501D02
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DOOR DETAIL-CATHODE BREAKER 1  
FARRAGUT NORTH SUBSTATION-A02

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BY DJW DATE 12/04/2006



**Powell Electrical Systems, Inc.**  
8550 Mosley Drive  
Houston, Texas 77075-1180  
Tel: 713.944.6900 Fax: 713.947.4453

P.O. # FN5059

WMATA  
METRO MATTERS PROJECT  
WASHINGTON, DC

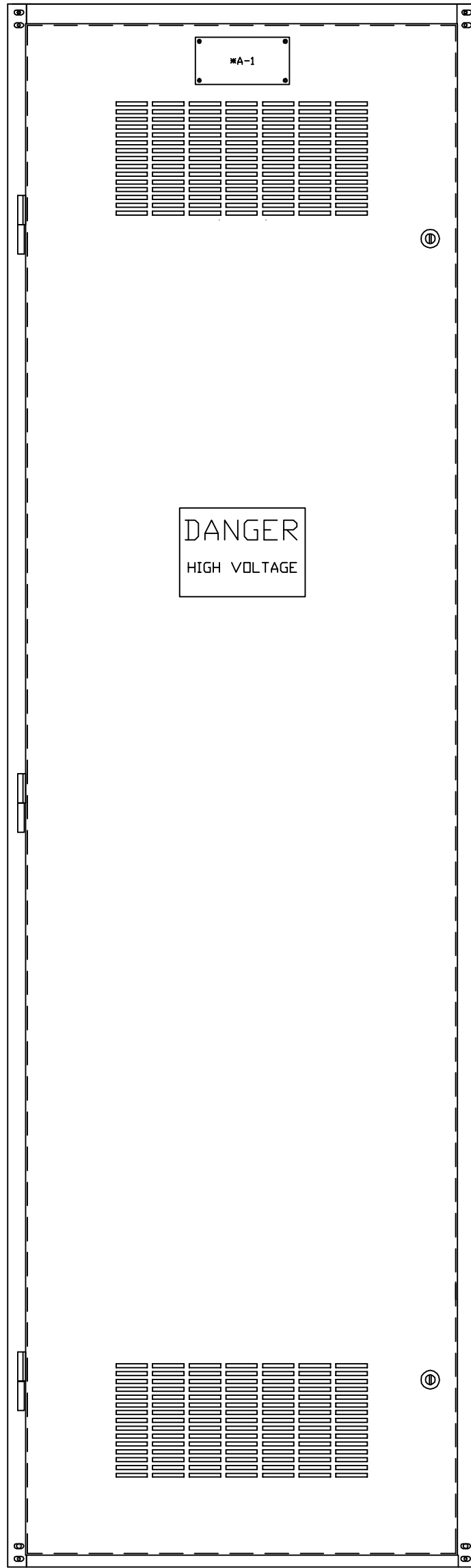
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REV. BY	REV. DATE	REVISION DESCRIPTION	REV. No.
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DRAWN BY	DAR	DATE DRAWN	4/26/2006	DWG./DISK NO.	G602501D03
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- NOTES:  
 1. THIS BORDER IS SCALED TO 150%.  
 2. \* DESIGNATES UNIT NUMBER



FARRAGUT NORTH  
 SUBSTATION-A02  
 CAT BKR'S 21, 22, 23, &  
 FDR BRK'S 31, 32, 33,  
 34, 35, & 36 

 CERTIFIED  
 AS BUILT  
 BY DJW DATE 12/04/2006

DOOR DETAIL-REAR HV COMPARTMENT

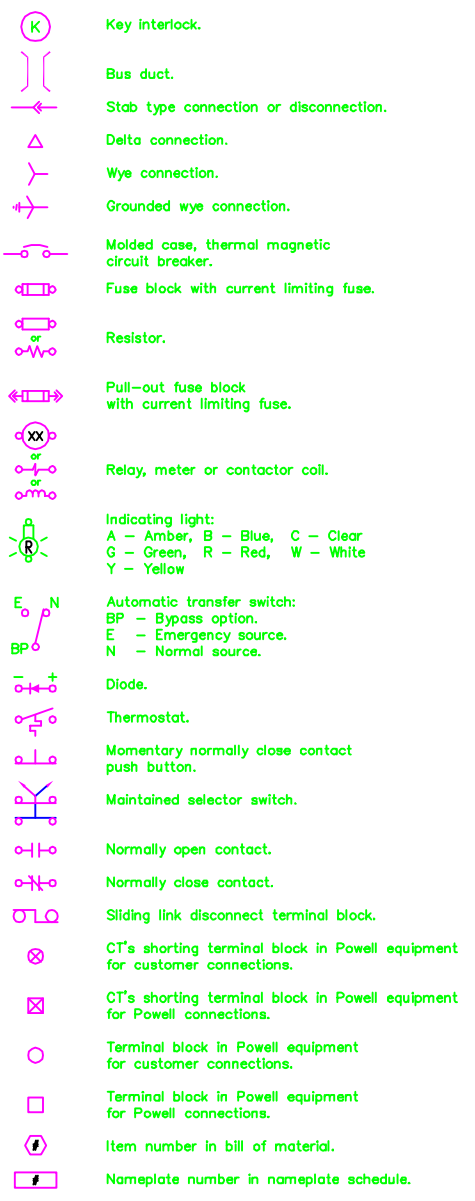
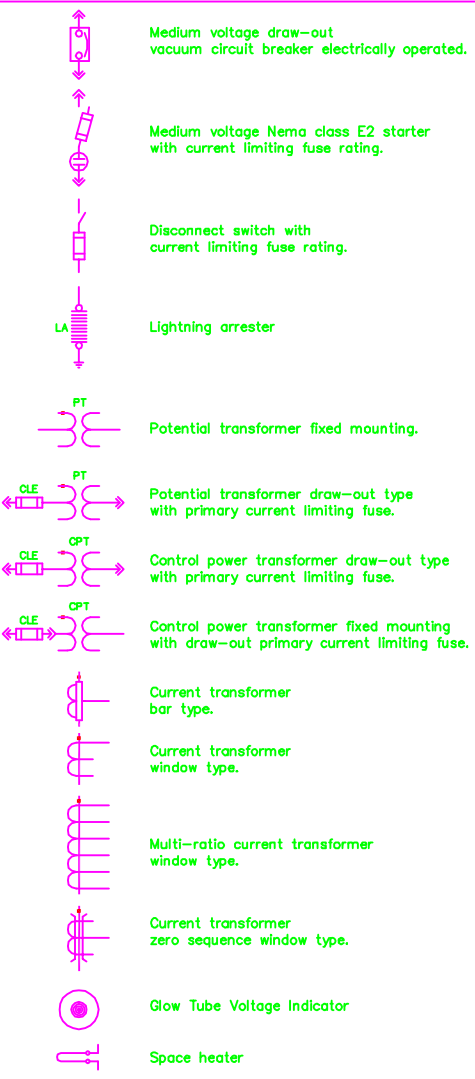


**Powell Electrical Systems, Inc.**  
 8967 Pleasantwood Ave. NW  
 North Canton, Ohio 44720  
 Tel: 330.966.1750 Fax: 330.966.1787

P.O. # FN5059

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 METRO MATTERS PROJECT  
 WASHINGTON, DC

SPH	11/14/2008	FIELD AS BUILT-PER MARKUPS	3				
REV. BY	REV. DATE	REVISION DESCRIPTION	REV. No.	DRAWN BY	DATE DRAWN	DWG./DISK NO.	
				DJW	8/16/2006	G602501D04	



26RT2  
27  
27C  
27T  
27X  
30  
32  
33  
  
43  
49T2  
50  
51  
51N  
50/51  
51A  
51B  
51BX  
52  
59  
62  
64  
72  
76  
86H  
86R  
94  
94SC  
94ST  
95T  
201C  
201T

Rectifier overtemperature Trip  
Undervoltage relay.  
Loss of DC control power relay—Close ckt  
Loss of DC control power relay—trip ckt  
Auxiliary undervoltage relay.  
Annunciator relay  
Reverse Current Relay  
Door Open Relay  
R – Rectifier  
T – Transformer  
Remote/local selector switch.  
Transformer overtemperature trip  
Instantaneous overcurrent or rate-of-rise relay.  
AC time overcurrent relay.  
Residual time overcurrent relay.  
Instantaneous and time overcurrent relay.  
AC rectifier time overcurrent relay – 300%  
AC rectifier time overcurrent relay – 450%  
Aux. time overcurrent relay  
AC power circuit breaker.  
Overvoltage relay.  
Time delay relay.  
Ground detector relay.  
DC power circuit breaker  
DC overcurrent relay.  
Station lockout relay.  
Rectifier lockout relay.  
DC breaker anti-pump relay  
SCADA Close relay—AC breaker  
SCADA Trip relay—AC breaker  
Rectifier Diode fuse failure – 2nd stage  
SCADA Close relay—DC breaker  
SCADA Trip relay—DC breaker

AM  
AS  
ATS  
CAP  
CB  
CC  
CLE  
CPT  
CS  
  
DCA  
EPB  
FU/#A  
CT  
GSCT  
LA  
LCS  
LS  
  
M  
M/a  
  
MOC  
MR  
MRCT  
MX  
PFM  
PT  
RES  
RTD  
SMA  
SS  
TC  
TOC  
VARM  
VCB  
VM  
VS  
WHD  
WHM  
XDCR  
  
XFMR  
Y  
  
Ammeter.  
Ammeter switch.  
Automatic transfer switch.  
Capacitor.  
Circuit breaker.  
Breaker closing coil.  
Current limiting fuse.  
Control power transformer.  
Control switch.  
C – Close  
NAC – Normal after close.  
NAT – Normal after trip.  
PTL – Pull to lock.  
T – Trip  
DC ammeter.  
Remote Emergency Push Button  
Fuse/current rating.  
Current transformer.  
Ground sensor current transformer.  
Lightning arrester.  
Breaker latch check switch.  
Breaker spring charged limit switch.  
Shown with breaker closing springs discharged.  
Breaker closing springs charging motor.  
Breaker contact:  
a – Open when breaker open.  
b – closed when breaker open.  
Breaker mechanically operated contact.  
Metering relay.  
Multi-ratio current transformer.  
Motor contactor auxiliary relay.  
Power factor meter.  
Potential transformer.  
Resistor.  
Resistance temperature device.  
DC breaker latching contact  
Speed sensor relay.  
Breaker tripping coil.  
Breaker truck operated contact.  
Volt-ampere reactance meter.  
Vacuum circuit breaker.  
Voltmeter.  
Voltmeter switch.  
Watt-hour meter with demand attachment.  
Watt-hour meter.  
Transducer:  
AM – Current.  
VOLT– Voltage.  
WATT– watts or kilowatts.  
Transformer.  
Breaker anti-pump relay.

NOTES

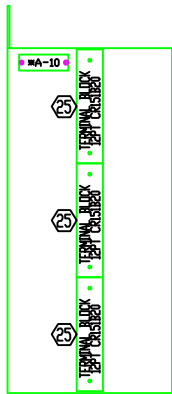
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BY DJW DATE 12/04/2006

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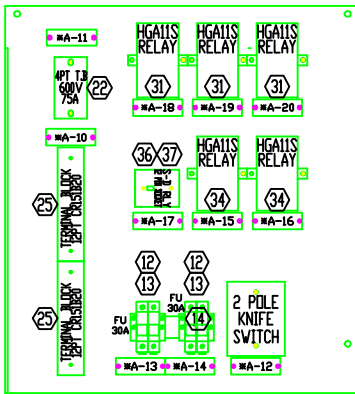
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REV. BY	REV. DATE	REV. No.	REV. 2
SPR	11/14/2008		

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC  
LEGEND  
SPECIFICATION 16341

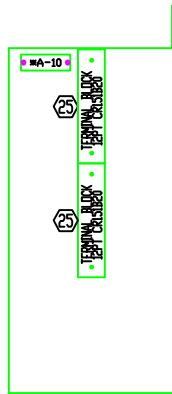
POWELL ELECTRICAL MFG CO.—NORTH CANTON DIV.  
8087 Pleasantwood Ave, NW North Canton, Ohio 44720  
(330) 946-1750 Fax (330) 946-1787  
P.O. # FNS059  
DRAWN BY JMR DATE DRAWN 5/04/2006 DWG./DISK No. G602501L01



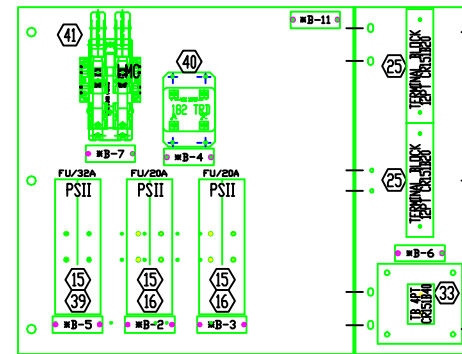
LEFT SIDE VIEW



FRONT INSTRUMENT PAN



RIGHT SIDE VIEW



REAR INSTRUMENT PAN

NOTES

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BY: DJW DATE 12/04/2006

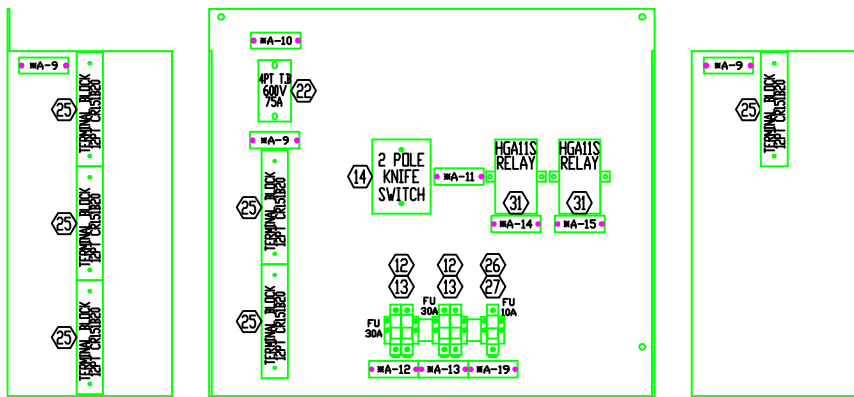
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REV. BY	REV. DATE	REV. No.	REV. 2
SPR	11/14/2008		

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY METRO MATTERS PROJECT WASHINGTON, DC	
INSTRUMENT PANS FEEDER BREAKERS 31 TO 36 SPECIFICATION 16341	750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02

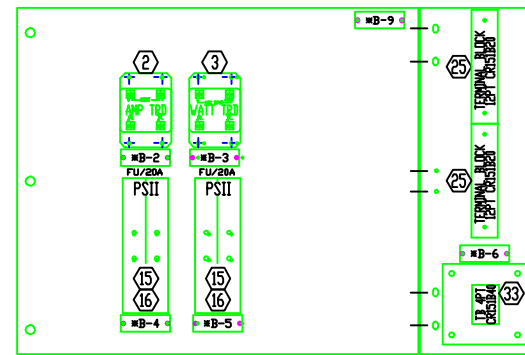
		Powell Electrical Systems, Inc. 8500 Blawie Drive Houston, Texas 77075-1180 Tel: 713.944.6900 Fax: 713.947.4463	
P.O. #	FNS059	DATE	4/26/2006
DRAWN BY	JMR	DATE	4/26/2006
DWG./DISK No.	G602501MP1		



LEFT SIDE VIEW

FRONT INSTRUMENT PAN

RIGHT SIDE VIEW



REAR INSTRUMENT PAN

NOTES

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 BY: DJV DATE 12/04/2006

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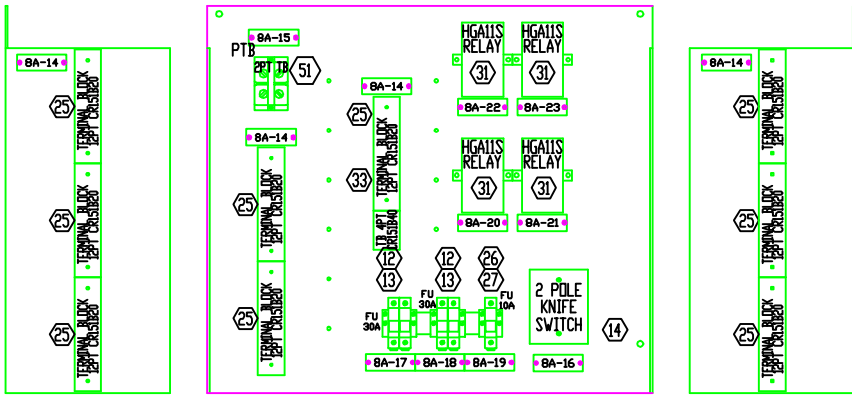


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REV. BY	REV. DATE	REV. No.
SFR	11/14/2008	2

WASHINGTON METROPOLITAN AREA TRANSIT AUTH METRO MATTERS PROJECT WASHINGTON, DC	
INSTRUMENT PANS CATHODE BREAKERS 2 AND 3 SPECIFICATION 16341	750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02

P.O. #	FNS059
DRAWN BY	JMR
DATE DRAWN	4/26/2006

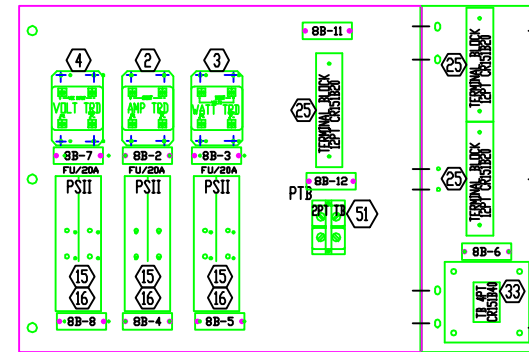
8500 Blawiey Drive Houston, Texas 77075-1180 Tel: 713.944.6900 Fax: 713.947.4463	
DWG./DISK No.	G602501MP2



LEFT SIDE VIEW

FRONT INSTRUMENT PAN

RIGHT SIDE VIEW



REAR INSTRUMENT PAN

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REVISION DESCRIPTION		
REV. BY	REV. DATE	REV. No.
SPR	11/14/2008	3

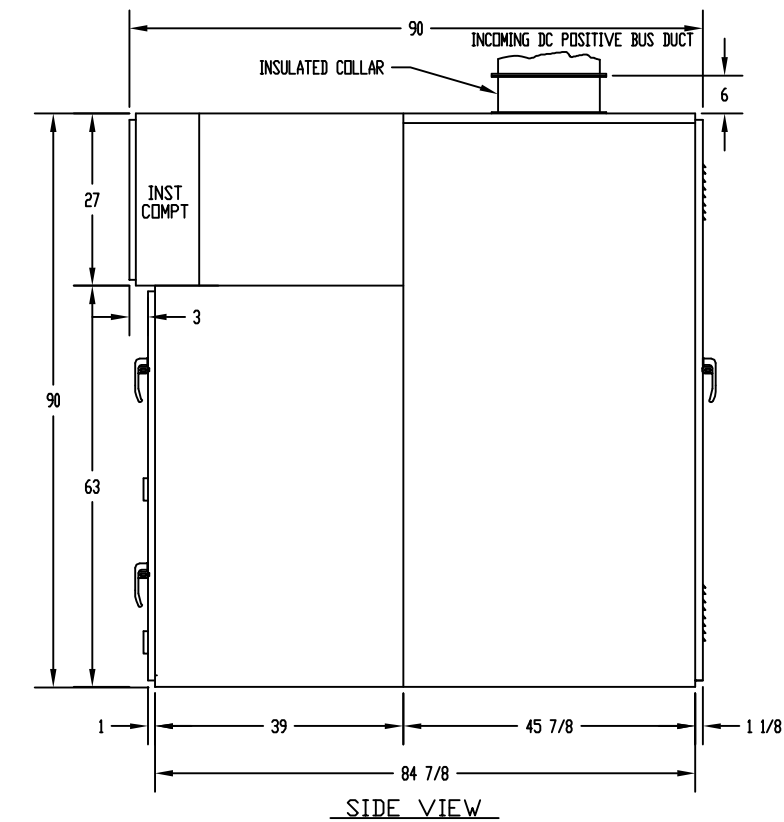
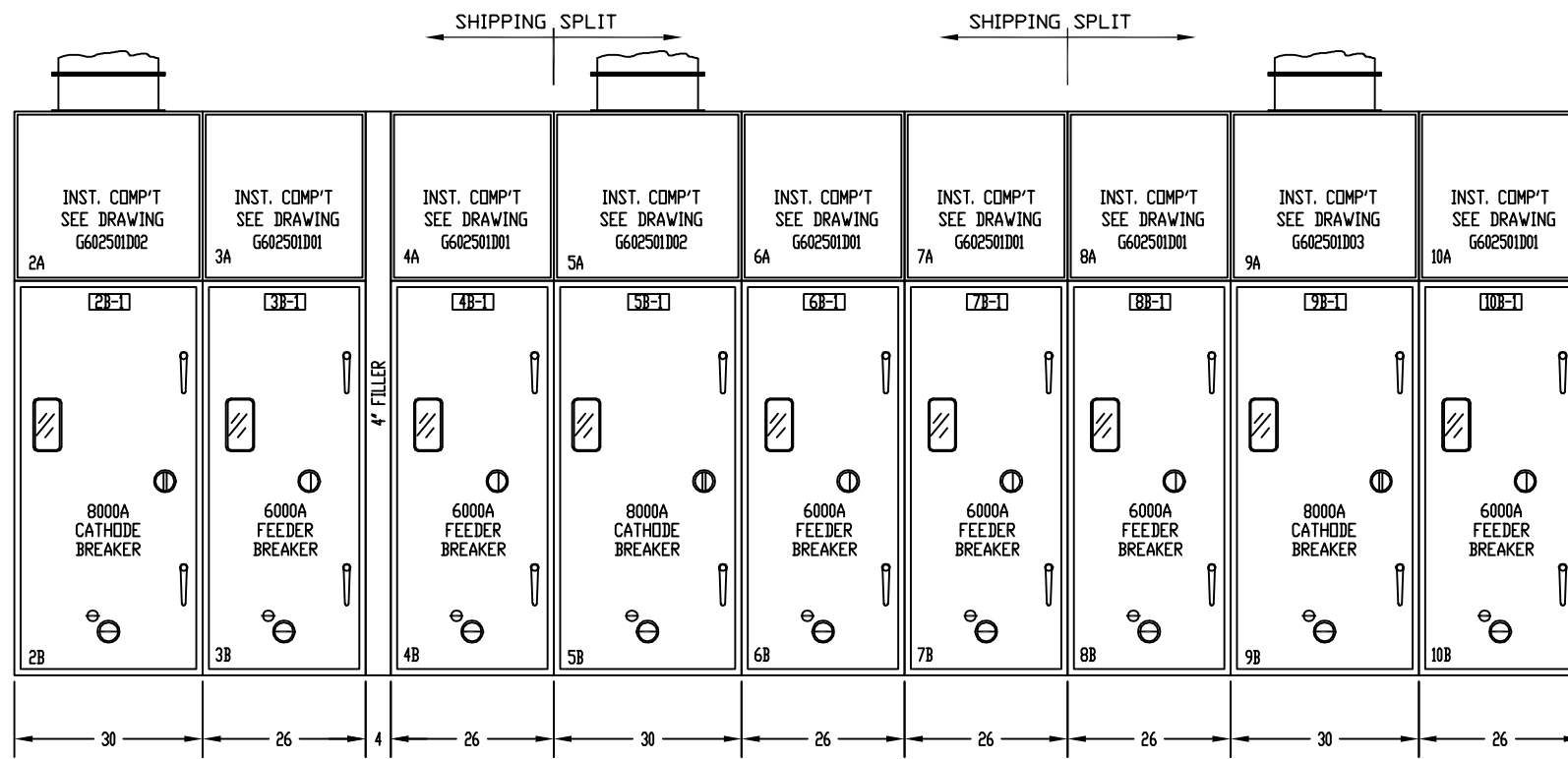
WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY METRO MATTERS PROJECT WASHINGTON, DC	
INSTRUMENT PANS CATHODE BREAKER 1	750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02

P.O. #	FNS059
DRAWN BY	JMR
DATE DRAWN	4/26/2006

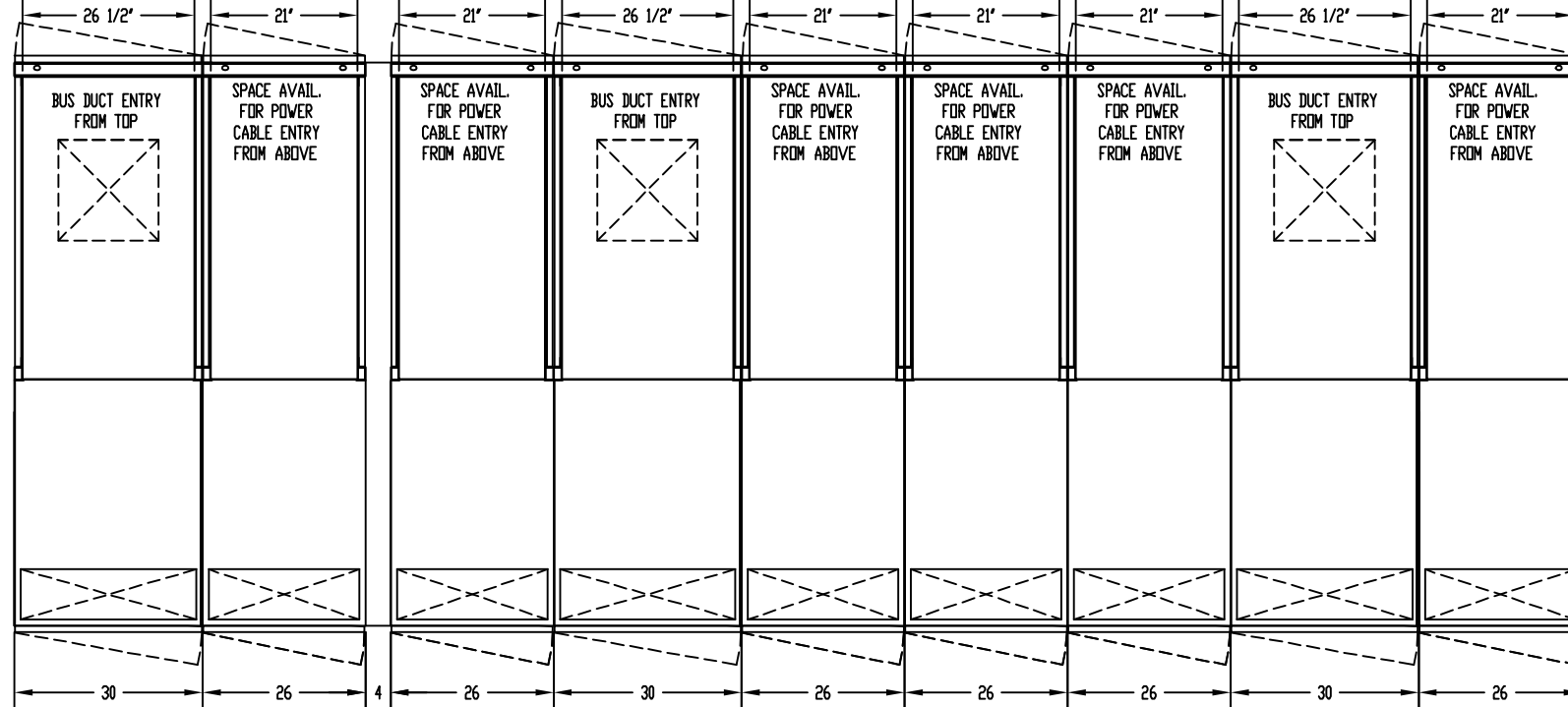
POWELL  
 Powered by Safety

8500 Blawie Drive  
 Houston, Texas 77075-1180  
 Tel: 713.944.6900 Fax: 713.947.4463

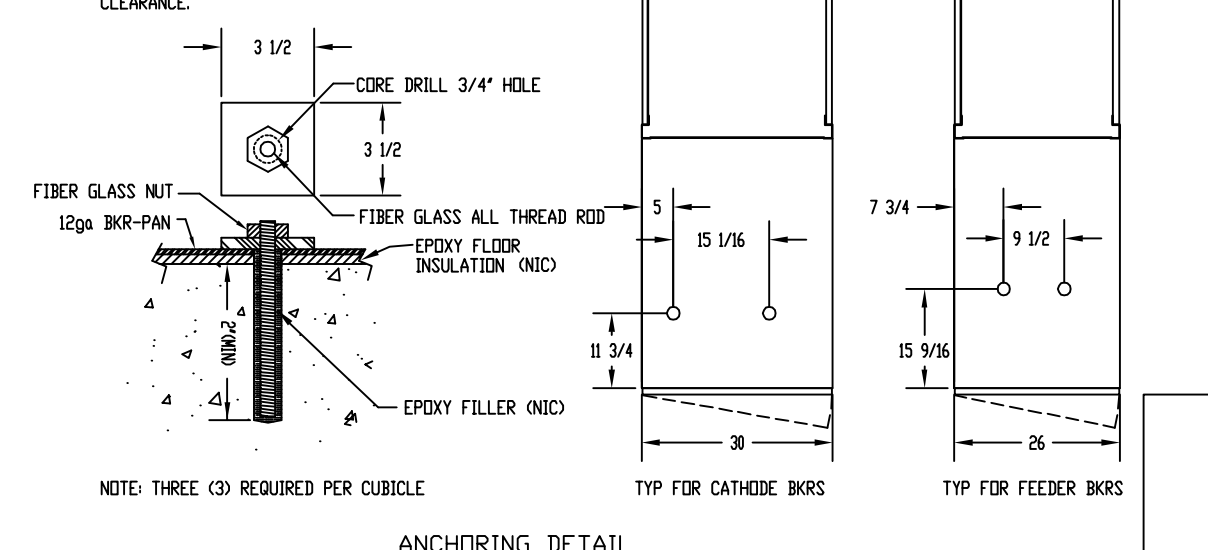
DWG./DISK No. G602501MP3



	UNIT # 02	UNIT # 03	UNIT # 04	UNIT # 05	UNIT # 06	UNIT # 07	UNIT # 08	UNIT # 09	UNIT # 10
CUBICLE	1500lbs	1200lbs	1200lbs	1500lbs	1200lbs	1200lbs	1200lbs	1500lbs	1200lbs
BREAKER	805lbs	720lbs	720lbs	805lbs	720lbs	720lbs	720lbs	805lbs	720lbs
TOTAL	2305lbs	1920lbs	1920lbs	2305lbs	1920lbs	1920lbs	1920lbs	2305lbs	1920lbs



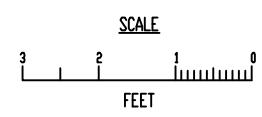
- NOTES**
1. THE FOUNDATION REQUIREMENT FOR THIS CLASS EQUIPMENT IS FOR A FLAT AND SOLID FLOOR  $\pm 1/32'$  [1.0mm] OVER  $86 5/8'$  [2200mm]. THE FINISHED FLOOR MUST BE FLAT AND LEVEL FOR A DISTANCE OF  $47 1/4'$  [1200mm] IN FRONT OF THE SWITCHGEAR.
  2. DC CIRCUIT BREAKERS ARE SHIPPED SEPARATELY FROM THE CUBICLE
  3. 60" CLEARANCE REQUIRED IN FRONT OF SWITCHGEAR FOR BREAKER CLEARANCE.



NOTES

**CERTIFIED AS BUILT**  
BY DJW DATE 12/04/2006

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REVISION DESCRIPTION		
REV. BY	REV. DATE	REV. No.
SPH	11/13/2008	2

WASHINGTON METROPOLITAN AREA TRANSIT AUTHORITY  
METRO MATTERS PROJECT  
WASHINGTON, DC

FRONT VIEW  
BASE PLAN  
SPECIFICATION 16341

750V, 15000A, DC  
METAL-ENCLOSED DC SWITCHGEAR  
FARRAGUT NORTH SUB-A02

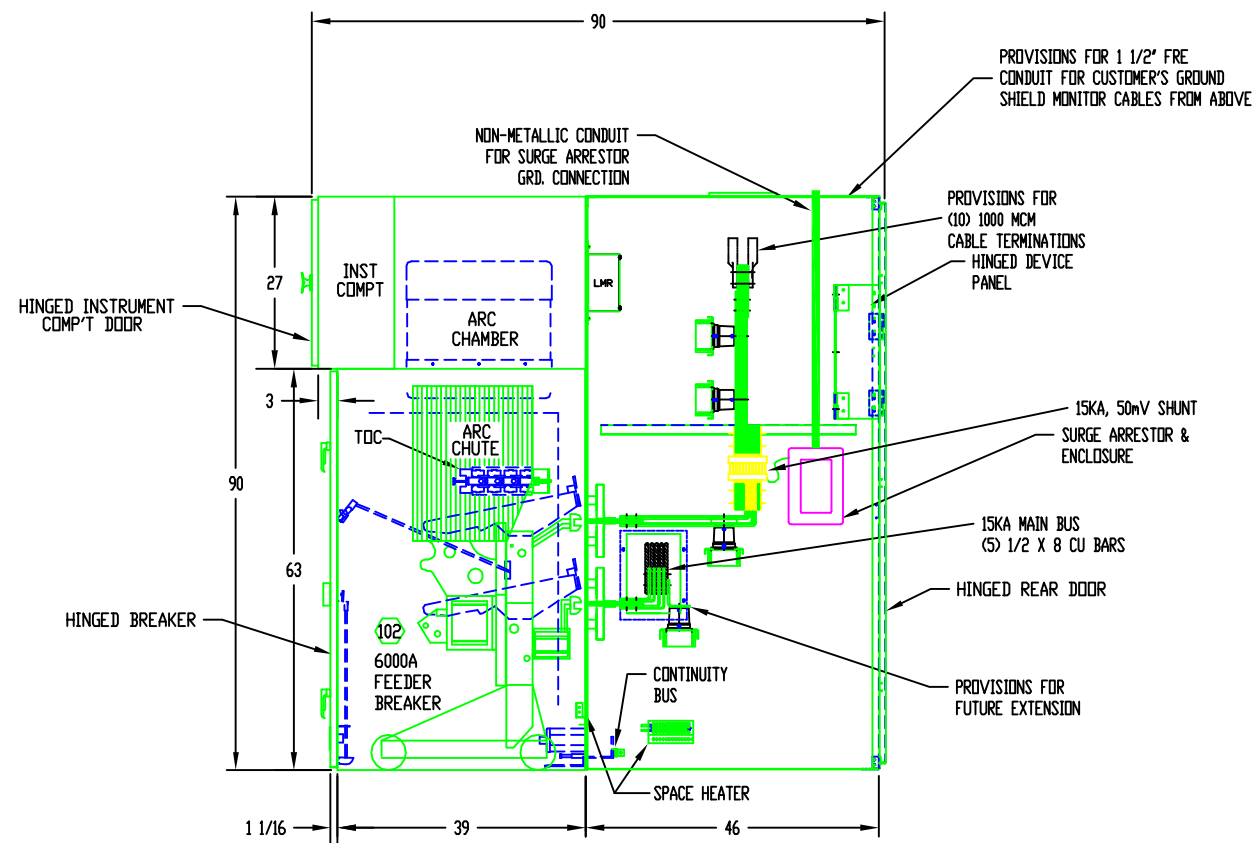
**POWELL**  
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P.O. # FN5059

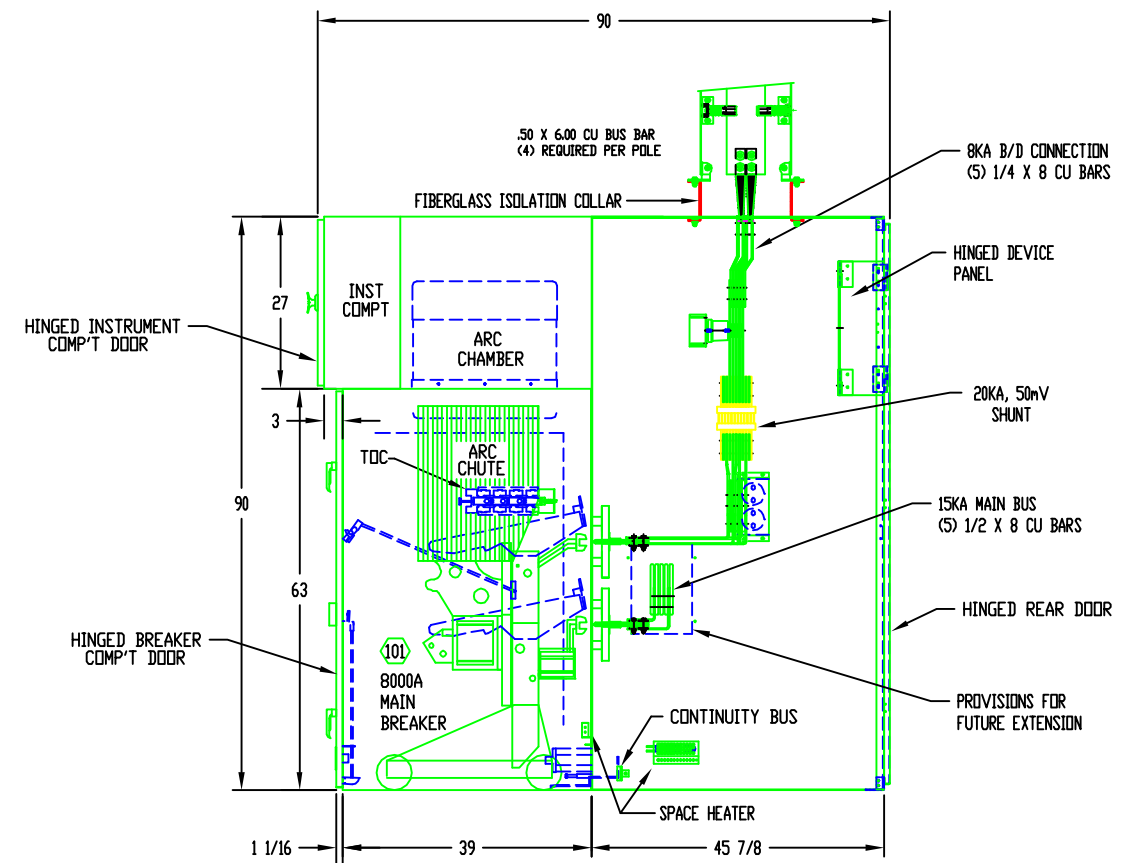
DRAWN BY DAR DATE DRAWN 04/26/2006

DWG./DISK No. G602501001

Powell Electrical Systems, Inc.  
8967 Pleasantwood Ave. NW  
North Canton, Ohio 44720  
Tel: 330.966.1750 Fax: 330.966.1787



SECTION VIEW  
UNITS #03, 04, 06, 07, 08, 10

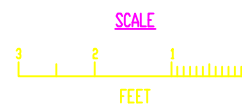


SECTION VIEW  
UNITS #02, 05, 09

NOTES

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BY: DJW DATE 12/04/2006

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REVISION DESCRIPTION		
FIELD AS BUILT - NO CHANGES		
REV. BY: SPH	REV. DATE: 11/13/2008	REV. No. 2

WASHINGTON METROPOLITAN AREA TRANSIT AUTH METRO MATTERS PROJECT WASHINGTON, DC	
SECTION VIEW	750V, 15000A, DC METAL-ENCLOSED DC SWITCHGEAR FARRAGUT NORTH SUB-A02
SPECIFICATION 16341	

		<b>Powell Electrical Systems, Inc.</b> 8967 Pleasantwood Ave. NW North Canton, Ohio 44720 Tel: 330.966.1750 Fax: 330.966.1787	
P.O. # FN5059	DRAWN BY DAR	DATE DRAWN 4/26/2006	DWG./DISK No G602501002