

13.8 kV NORMAL / EMERGENCY STANDBY POWER SYSTEM:

GENERAL:

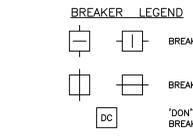
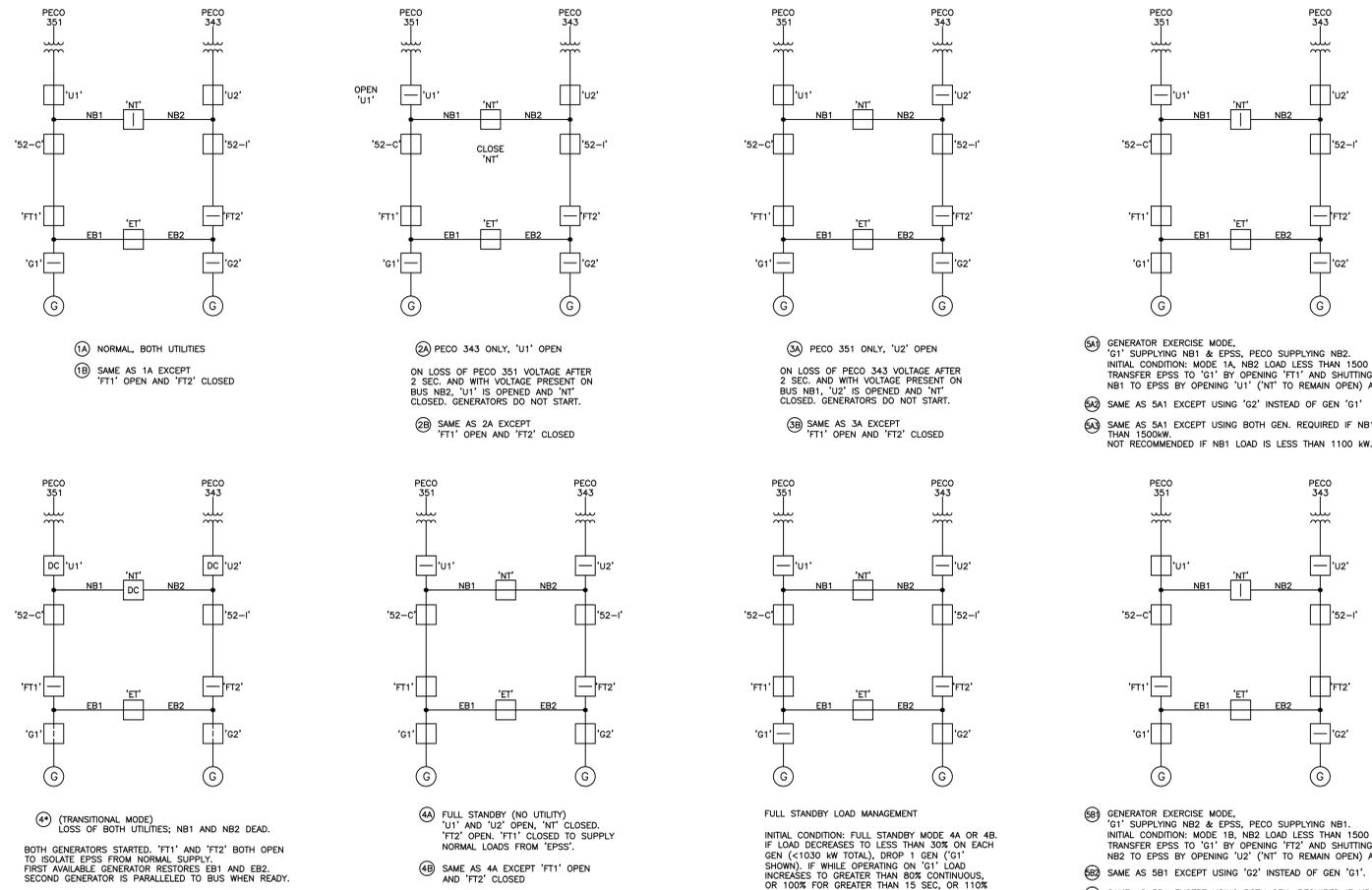
- THE OPERATION DESCRIPTIONS AND MIMIC BUS DIAGRAMS ILLUSTRATE DESIGN FUNCTION OF THE NORMAL / EMERGENCY STANDBY POWER SYSTEM.
- INSTALLATION SHALL COMPLY WITH REQUIREMENTS OF NFPA 110, 99, AND NEC.
- THE EPSS SHALL NOT BE PARALLELED WITH THE NORMAL POWER SYSTEM. ALL TRANSITIONS SHALL BE "BREAK" BEFORE "MAKE".
- ON UNPLANNED OUTAGES THE SYSTEM SHALL RESPOND AUTOMATICALLY TO RESTORE FIRST THE EPSS THEN THE NORMAL DISTRIBUTION.
- PLANNED OUTAGES, RESTORATION, AND EXERCISE PERIODS SHOULD ALWAYS BE FIRST COORDINATED WITH THE SERVING UTILITY.
- UPON LOSS OF A GENERATOR OR EXCEEDING 110% OF THE TOTAL RUNNING GENERATOR CAPACITY, LOADS SHALL BE SHED BY OPENING THE CLOSED FEEDER TIE, 'FT1' OR 'FT2', IMMEDIATELY TO PROTECT EPSS LOADS. UPON RESTORATION OF BOTH GENERATORS, FULL STANDBY OPERATION CAN BE RESUMED.

CONCEPT OF OPERATION:

- NORMAL DISTRIBUTION IS SUPPLIED FROM THE DOUBLE-ENDED NORMAL BUS, 'NB1' AND 'NB2'. NORMAL DISTRIBUTION IS NORMALLY SPLIT ('NT' OPEN), BUT CAN BE COMBINED ('NT' CLOSED) AND SUPPLIED BY EITHER UTILITY.
- EMERGENCY DISTRIBUTION IS SUPPLIED FROM THE DOUBLE-ENDED EMERGENCY BUS, 'EB1' AND 'EB2'. THE EMERGENCY BUS IS ALWAYS HOT, UNDERLYING THE EMERGENCY DISTRIBUTION SYSTEM AT ALL TIMES. UNDER NORMAL CONDITIONS THE EMERGENCY BUS IS SUPPLIED FROM THE NORMAL BUS VIA THE FEEDER TIES, EITHER 'FT1' OR 'FT2', WITH THE EMERGENCY BUS TIE ('ET') CLOSED.
- PROGRAMMED SYSTEM CONFIGURATIONS FALL INTO 5 OPERATIONAL MODES, WITH EACH MODE HAVING VARIANTS BASED ON WHICH FEEDER TIE IS USED TO CONNECT NORMAL AND EMERGENCY BUSES AND WHICH UTILITIES AND GENERATORS ARE SUPPLYING. MODE DESIGNATIONS ARE SHOWN IN DETAIL 2/E-603 AND ARE CODED AS FOLLOWS: THE FIRST DIGIT IS A NUMBER WHICH INDICATES THE BASIC CONFIGURATION, 1 THROUGH 5. THE SECOND DIGIT IS A LETTER WHICH INDICATES WHICH FEEDER TIE BREAKER IS SHUT TO INTERCONNECT THE NORMAL AND EMERGENCY BUSES, 'A' FOR 'FT1', 'B' FOR 'FT2'. THE THIRD DIGIT, WHICH ONLY APPLIES TO MODE 5 (GENERATOR EXERCISE) CONFIGURATIONS, INDICATES WHICH GENERATOR OR GENERATORS ARE EMPLOYED.
- SYSTEM CONFIGURATION MODES 1A THROUGH 3B COMPRISE THE SIX AVAILABLE CONFIGURATIONS WHERE UTILITY POWER SUPPLIES ALL LOADS.
- UPON LOSS OF BOTH UTILITIES, GENERATORS SUPPLY FIRST THE EMERGENCY BUS ONLY (FIRST AVAILABLE GENERATOR), THEN WITH BOTH GENERATORS SUPPLYING, FULL STANDBY POWER IS SUPPLIED TO THE NORMAL BUS VIA THE SELECTED FEEDER TIE. MODES 4* AND 4A/B PROVIDE EMERGENCY ONLY AND FULL STANDBY, RESPECTIVELY.
- FOR EXERCISING THE GENERATORS, A SPLIT SYSTEM MODE OF OPERATION IS PROVIDED WHEREIN 1 UTILITY SUPPLIES ITS RESPECTIVE NORMAL BUS WHILE ONE OR BOTH GENERATORS SUPPLY THE EMERGENCY BUS AND THE OTHER NORMAL BUS. THE SIX MODE 5 VARIANTS (5A1, 5A2, 5A3, 5B1, 5B2, 5B3) SHOW THESE CONFIGURATIONS. (GENERATORS CAN SUPPLY FULL CAMPUS EMERGENCY AND NORMAL LOAD FOR TESTING PURPOSES BY THE OPERATOR SELECTING MODE 4A OR 4B.)

PROTECTIVE INTERLOCKS REQUIREMENT:

- TO PROTECT AGAINST INADVERTENT PARALLELING OF UTILITY AND GENERATORS, AND TO PREVENT CLOSING A GENERATOR BREAKER INTO AN OVERLOAD SITUATION, THE FOLLOWING PROTECTIVE INTERLOCKS SHALL BE IN PLACE AT ALL TIMES, WHETHER IN AUTOMATIC OR MANUAL MODE OF OPERATION. THESE INTERLOCKS CANNOT BE DEFEATED.
- AT MOST 2 OF THE FOLLOWING MAY BE CLOSED AT THE SAME TIME: 'U1', 'U2', 'NT'.
- AT MOST 2 OF THE FOLLOWING MAY BE CLOSED AT THE SAME TIME: 'FT1', 'FT2', 'ET'.
- TO CLOSE BREAKERS 'N1', 'U1', OR 'U2', BOTH FEEDER TIES 'FT1' AND 'FT2' MUST BE OPEN OR BOTH GENERATOR BREAKERS 'G1' AND 'G2' MUST BE OPEN.
- TO CLOSE EITHER OF GENERATOR BREAKERS 'G1' OR 'G2', 'ET' MUST BE CLOSED AND 'FT1' AND 'FT2' MUST BE OPEN UNLESS THE BUS IS ALREADY SUPPLIED BY THE OTHER GENERATOR AND THE GENERATOR PARALLELING CONTROLLER IS EMPLOYED TO BRING 2ND GENERATOR ONTO THE BUS.
- BREAKER CLOSE PERMISSIVE LOGIC SHALL BE EMPLOYED TO PREVENT CLOSING A BREAKER IN VIOLATION OF THE ABOVE INTERLOCKS.



2 13.8 kV POWER SYSTEM MODES OF OPERATION
E-603 SCALE: NTS

13.8 kV NORMAL / EMERGENCY STANDBY POWER SYSTEM:

SEQUENCE OF OPERATION:

- NORMALLY, 13.8 kV POWER SYSTEM OPERATES IN MODE 1A (1B). NORMAL & EPSS DISTRIBUTION IS CARRIED BY UTILITY. EPSS BUS IS HOT. 'FT1' ('FT2') & 'ET' ARE CLOSED.
- LOSS OF POWER ON EITHER PECO CIRCUIT 351 OR 343 WILL CLOSE THE SERVICE TIE BREAKER AFTER OPENING THE RESPECTIVE SERVICE BREAKER, EITHER 'U1' OR 'U2'. AFTER 2 SECONDS, SYSTEM TRANSITIONS TO MODE 2A (2B) (LOSS OF PECO 351) OR MODE 3A (3B) (LOSS OF PECO 343). GENERATORS SHALL NOT BE STARTED ON LOSS OF ONLY 1 UTILITY, BUT SHALL CHANGE MODES TO SELECT THE ALTERNATE TIE IF THE LOST UTILITY IS THE SIDE FEEDING THE EMERGENCY BUS AND POWER IS NOT RESTORED ON. EG, IF IN MODE 1A AND INCLUR LOSS OF VOLTAGE AT 'FT1' WITH VOLTAGE PRESENT AT 'FT2', WAIT 3 SECONDS FOR VOLTAGE TO RETURN TO 'FT1'; IF NOT RETURNED AFTER 3 SECONDS, OPEN 'FT1', CLOSE 'FT2'.
- LOSS OF BOTH UTILITIES, OR LOSS OF SECOND UTILITY WHILE IN MODES 2 OR 3, RESULTS IN TRANSFER TO GENERATOR STANDBY; BOTH GENERATORS ARE STARTED, THE EPSS IS SEPARATED FROM NORMAL DISTRIBUTION BY OPENING 'FT1', AND THE FIRST GENERATOR IS BROUGHT ON TO THE EPSS BUS WITHIN 10 SECONDS TO RESTORE EMERGENCY POWER. THE SYSTEM IS NOW IN MODE 4*.
- FULL STANDBY POWER IS ACHIEVED WHEN THE SECOND GENERATOR IS READY TO RECEIVE LOAD AND IS PARALLELED TO THE EPSS BUS AT THIS POINT. ANY CLOSED UTILITY BREAKER IS OPENED, THE NORMAL TIE 'NT' IS CLOSED IF NOT ALREADY, THEN 'FT1' ('FT2') IS CLOSED TO SUPPLY THE FULL CAMPUS ON EMERGENCY STANDBY POWER. MODE 4A (4B).
- RETURN TO UTILITY POWER IS ACCOMPLISHED IN A SEQUENCE OF TRANSITIONS WHEN UTILITY POWER IS RESTORED. FEEDER TIE 'FT1' ('FT2') IS OPENED TO DISCONNECT NORMAL AND EPSS SYSTEM, WITH THE GENERATORS SUPPLYING EPSS. NORMAL BUS IS RESTORED ACCORDING TO WHICH UTILITY(IES) IS(ARE) AVAILABLE. THEN BOTH GENERATOR BREAKERS ARE OPENED AND 'FT1' ('FT2') IS SHUT, RETURNING THE ENTIRE SYSTEM TO UTILITY POWER.
- AFTER THE GENERATORS HAVE GONE THROUGH THE COOLDOWN CYCLE THEY ARE SECURED.
- MODE 5A1 ILLUSTRATES A GENERATOR EXERCISE PERIOD. STARTING IN MODES 1A OR 1B, GENERATOR 1 IS STARTED FOR EXERCISING. WHEN READY TO ASSUME LOADS, OPEN 'FT1' AND CLOSE 'G1'. THIS BRINGS THE GENERATOR ONTO AN UNLOADED OR MINIMALLY LOADED EPSS BUS BECAUSE DOWNSTREAM ATS'S ARE SELECTED TO NORMAL POWER. TO LOAD THE GENERATOR, LOCK OUT THE NORMAL TIE BREAKER 'NT', OPEN SERVICE BREAKER 'U1' AND CLOSE 'FT1'. THIS PLACES THE LEFT SIDE OF NORMAL DISTRIBUTION LOADS ON THE GENERATOR.

AUTOMATIC TRANSFER SWITCHING OPERATION:

- TRANSFER OF POWER FROM ONE SOURCE TO ANOTHER IS ACCOMPLISHED BY AN AUTOMATIC TRANSFER SWITCHING OPERATION. TRANSFERS ARE OPEN TRANSITION WITH A DELAY FOR VOLTAGE TO DECAY OFF THE BUS TO PREVENT SURGE, SPIKE AND/OR SPURIOUS TRIPS. TRANSFERS ARE EFFECTED AS FOLLOWS:
 - TO TRANSFER NB1 FROM U1 TO NB2: OPEN 'U1', AFTER DELAY, CLOSE 'NT',
 - TO TRANSFER NB2 FROM U2 TO NB1: OPEN 'U2', AFTER DELAY, CLOSE 'NT',
 - TO TRANSFER NB1 FROM U1 TO EM1: WITH 'FT2' OPEN AND EM1-EM2 SUPPLIED BY GENERATORS, OPEN 'NT', AFTER DELAY, CLOSE 'FT1', 'NT' STAYS AS-IS.
 - TO TRANSFER NB2 FROM U2 TO EM2: WITH 'FT1' OPEN AND EM1-EM2 SUPPLIED BY GENERATORS, OPEN 'U2', AFTER DELAY, CLOSE 'FT2', 'NT' STAYS AS-IS.
 - TO TRANSFER NB1 FROM EM1 TO U1: OPEN 'FT1', AFTER DELAY, CLOSE 'U1',
 - TO TRANSFER NB2 FROM EM2 TO U2: OPEN 'FT2', AFTER DELAY, CLOSE 'U2',
 - TO TRANSFER EM1-EM2 FROM NB1 TO GENERATORS (E.G. MODE 5A TESTING): METHOD 1: WITH 'FT2' AND 'NT' OPEN, OPEN 'FT1', ENERGIZE EM1-EM2 WITH FIRST AVAILABLE GENERATOR VIA PARALLELING CONTROLLER. METHOD 2: WITH 'FT2' AND 'NT' OPEN, START GENERATOR TO BE TESTED. WHEN READY, OPEN 'FT1', ENERGIZE EM1-EM2 VIA PARALLELING CONTROLLER.
 - TO TRANSFER EM1-EM2 FROM NB2 TO GENERATORS (E.G. MODE 5B TESTING): METHOD 1: WITH 'FT1' AND 'NT' OPEN, OPEN 'FT2', ENERGIZE EM1-EM2 WITH FIRST AVAILABLE GENERATOR VIA PARALLELING CONTROLLER. METHOD 2: WITH 'FT1' AND 'NT' OPEN, START GENERATOR TO BE TESTED. WHEN READY, OPEN 'FT2', ENERGIZE EM1-EM2 VIA PARALLELING CONTROLLER.
- TO TRANSFER NB1-EM2 FROM GENERATOR(S) TO NB1: OPEN BOTH FEEDER TIE BREAKERS, 'FT1' AND 'FT2', OPEN BOTH GENERATOR BREAKERS 'G1' AND 'G2', AFTER DELAY, CLOSE 'FT1'.
- TO TRANSFER EM1-EM2 FROM GENERATOR(S) TO NB2: OPEN BOTH FEEDER TIE BREAKERS, 'FT1' AND 'FT2', OPEN BOTH GENERATOR BREAKERS 'G1' AND 'G2', AFTER DELAY, CLOSE 'FT2'.
- GENERATORS SHALL NOT BE PARALLELED TO AN EMERGENCY BUS SUPPLIED FROM A UTILITY. GENERATORS SHALL NOT BE PARALLELED ACROSS 'ET'. POWER TRANSFER TO ENERGIZE A NORMAL BUS FROM AN EMERGENCY BUS OR TO ENERGIZE AN EMERGENCY BUS FROM A NORMAL BUS SHALL ALWAYS BE PERFORMED BY FIRST SEPARATING NORMAL AND EMERGENCY SYSTEMS, THEN BY RESTORING THE DEAD BUS ACROSS ONE OF THE FEEDER TIES 'FT1' OR 'FT2'.

LOAD SERVED	KVA / Phase		OCT BRKR	OCT NO	NEUTRAL		OCT NO	OCT BRKR	KVA / Phase		LOAD SERVED
	A	B			A	B			A	B	
GENERATOR #2 BLOCK HEATERS	4.77	---	2P-60	3	1	2	1P-20	0.75	---	1.26	SWITCHGR RM & EXTERIOR LTS
GEN #2 BATTERY CHARGER	0.29	---	1P-20	5	6	7	1P-20	0.30	---	1.26	SWITCHGR RM RECEP.TS
GEN #2 ALTERNATOR HEATER	---	0.30	1P-20	7	8	9	1P-20	---	0.40	---	STATION BATTERY CHARGER
FUEL TRANSFER SYSTEM GEN #2	0.75	---	2P-20	9	10	11	1P-20	0.10	---	---	STATION MONITORING & CONTROL
SPACE	0.00	---	---	11	12	13	1P-20	---	0.00	---	FIRE ALARM LOCAL PANEL
SPACE	---	0.00	---	14	15	16	1P-20	---	0.00	---	SPARE
SPACE	0.00	---	---	17	18	19	1P-20	---	0.00	---	SPARE
SPACE	---	0.00	---	20	21	22	1P-20	---	0.00	---	SPARE
ELECTRIC UNIT HEATER EUH-2	2.50	---	2P-30	23	24	25	1P-20	---	0.00	---	SPARE
SPACE	---	2.50	---	26	27	28	1P-20	---	0.00	---	SPARE
SWITCHGEAR ROOM HVAC	2.50	---	2P-30	29	30	---	---	---	0.00	---	SPARE
SPACE	---	2.50	---	---	---	---	---	---	0.00	---	SPARE
SUB TOTAL	10.81	10.82	---	---	---	---	---	---	11.96	12.48	TOTAL

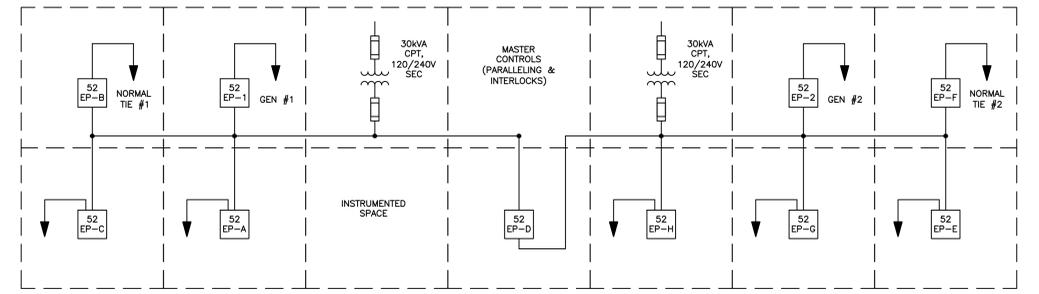
LOAD TYPE	CONNECTED KVA		NEC DEM FACTOR	DEMAND KVA	
	A	B		A	B
GENERAL LIGHTING	0.75	0.00	125%	0.94	0.00
GENERAL USE	---	---	>10KVA@100%	0.00	1.26
RECEPT	0.00	1.26	>10KVA@50%	0.00	0.00
MOTORS AND EQUIPMENT	4.77	4.77	125%	5.96	5.96
FIX ELEC. SPACE HEAT	1.44	1.45	100%	1.44	1.45
NEUTRAL RATING 100%	5.00	5.00	125%	6.25	6.25
TOTAL KVA PER PHASE	11.96	12.48	---	14.80	14.92
TOTAL DEMAND AMPERES PER PHASE	---	---	---	122	124

PANEL / FEEDER (TOTAL KVA) 29.52
(TOTAL KVA) X 1000 = TOTAL AMPS VOLTS 123

LOAD SERVED	KVA / Phase		OCT BRKR	OCT NO	NEUTRAL		OCT NO	OCT BRKR	KVA / Phase		LOAD SERVED
	A	B			A	B			A	B	
GENERATOR #1 BLOCK HEATERS	4.77	---	2P-60	3	1	2	1P-20	0.69	---	0.90	GENERATOR RM & EXTERIOR LTS
GEN #1 BATTERY CHARGER	0.29	---	1P-20	5	6	7	1P-20	0.66	---	---	GENERATOR RM RECEP.TS
GEN #1 ALTERNATOR HEATER	---	0.30	1P-20	7	8	9	1P-20	---	0.66	---	FUEL QUALITY MANAGEMNT STATION
GEN #1 CONTROLS. MOTOR DAMPER	0.16	---	1P-20	9	10	11	1P-20	0.05	---	---	FACILITY FUEL SYSTEM MONITOR
BLDG 74 PARKING LOT POLE LTS	---	0.30	1P-20	11	12	13	1P-20	---	0.28	---	REMOTE FILL STATION & GFI RECEP
ELECTRIC UNIT HEATER EUH-1	2.50	---	2P-30	13	14	15	1P-20	---	0.00	---	SPARE
FUEL TRANSFER SYSTEM GEN #1	0.75	---	2P-20	15	16	17	1P-20	---	0.00	---	SPARE
SPACE	0.00	---	---	17	18	19	1P-20	---	0.00	---	SPARE
SPACE	---	0.00	---	20	21	22	1P-20	---	0.00	---	SPARE
SPACE	0.00	---	---	23	24	25	1P-20	---	0.00	---	SPARE
SPACE	---	0.00	---	26	27	28	1P-20	---	0.00	---	SPARE
SPACE	0.00	---	---	29	30	---	---	---	0.00	---	SPARE
SUB TOTAL	8.47	8.62	---	---	---	---	---	---	1.40	1.84	TOTAL

LOAD TYPE	CONNECTED KVA		NEC DEM FACTOR	DEMAND KVA	
	A	B		A	B
GENERAL LIGHTING	0.69	0.30	125%	0.86	0.38
GENERAL USE	---	---	>10KVA@100%	0.00	1.18
RECEPT	0.00	1.18	>10KVA@50%	0.00	0.00
MOTORS AND EQUIPMENT	4.77	4.77	125%	5.96	5.96
FIX ELEC. SPACE HEAT	1.91	1.71	100%	1.91	1.71
NEUTRAL RATING 100%	2.50	2.50	125%	3.13	3.13
TOTAL KVA PER PHASE	9.87	10.46	---	11.88	12.35
TOTAL DEMAND AMPERES PER PHASE	---	---	---	99	103

PANEL / FEEDER (TOTAL KVA) 24.21
(TOTAL KVA) X 1000 = TOTAL AMPS VOLTS 101



1 EMERGENCY GENERATOR PARALLELING SWITCHGEAR DETAIL
E-603 SCALE: NTS

100% CONSTRUCTION DOCUMENTS

PATIENT SAFETY MANAGER	INFECTION PREVENTIONIST	SUPERVISOR, PROJECT SECTION	PROJECT MANAGER (CONTR)	ENGINEERS/ARCHITECT: APOGEE Raleigh, NC Indianapolis, IN Atlanta, GA Columbia, MD www.apogee-pa.com Apogee Project # 2010 228	WALDON STUDIO ARCHITECTS & PLANNERS, PC 6325 Woodside Court, Suite 310 Columbia, Maryland 21046 Tel: 410.290.9880 Fax: 410.290.9777 www.waldonstudio.com	Drawing Title	Project Title	Date
SUPERVISION, BIOMEDI M&O	ENVIRON HEALTH FIRE/SAFETY SECTION	SAFETY/OCCUPATIONAL HEALTH MANAGER	CHIEF, ACQUISITION MGT SECT, CONTRACTING OFFICER			ELECTRICAL DETAILS & SCHEDULES	COATSVILLE - VA MEDICAL CENTER AVE INSTALL EMERGENCY GENERATOR	9/23/11
VA POLICE CHIEF	PATIENT CARE SECTION	GENERAL PROPERTIES SECTION	GENERAL UTILITIES SECTION			Approved: Chief Engineering Service	Building Number	Project No. 542-11-104
Revisions	Date					Approved: Medical Center Director	Location	DRAWING No. E-603

COATSVILLE, PENNSYLVANIA
Dwg. 15 of 15

three inches = one foot
one and one half inches = one foot
one inch = one foot
three quarters inch = one foot
one half inch = one foot
three eighths inch = one foot
one quarter inch = one foot
one eighth inch = one foot

VA