Philip Mackey
L/E
Dr. Mistrick

Holy Cross Hospital – North Addition
Silver Spring, MD
10/31/05

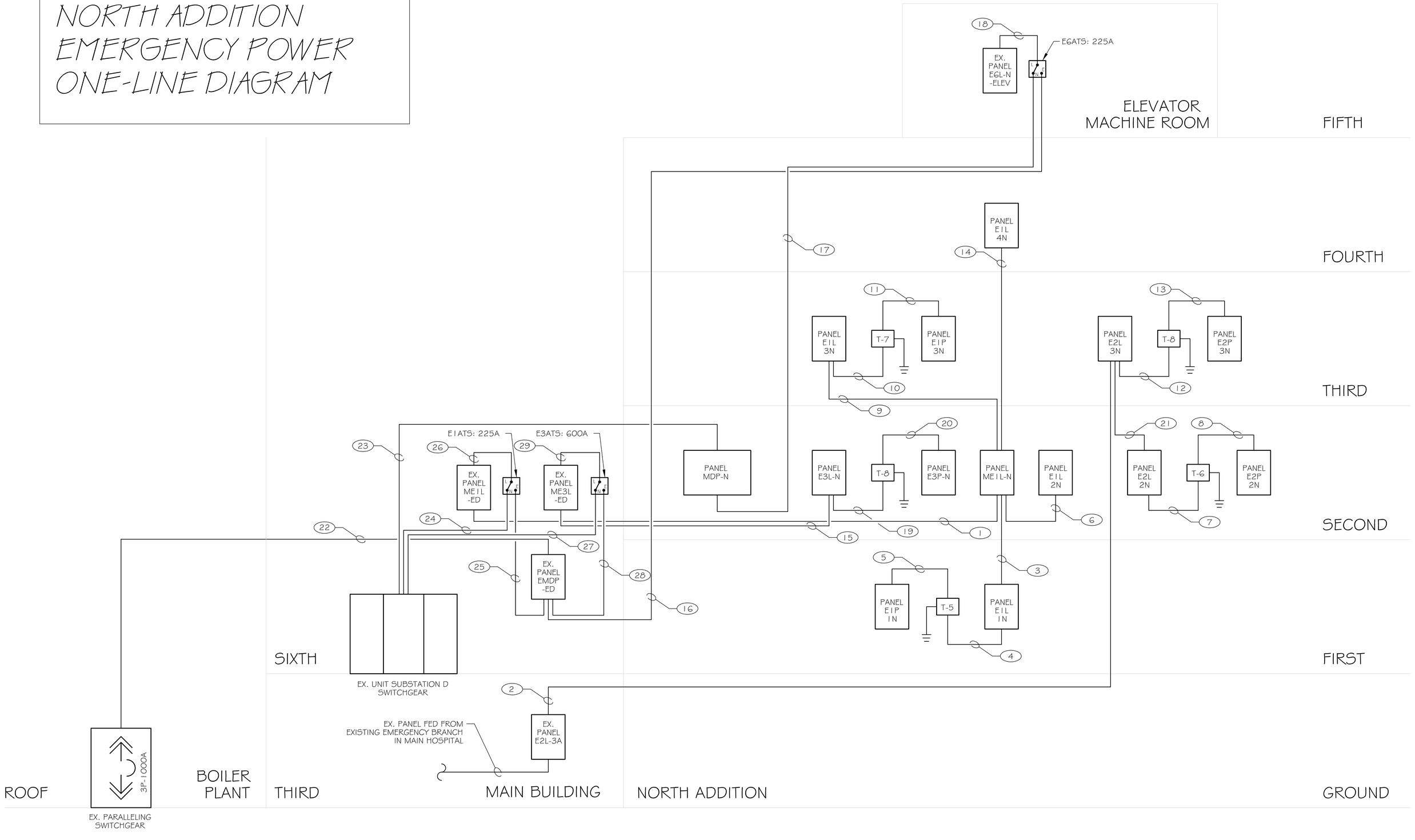
Building Electrical System Overview

Executive Summary:

The following report describes the existing emergency power distribution system and loads associated with that portion of the system. The addition of the new wing was fed by spare slots in existing unit substations located on the 6th floor penthouse of the current hospital. It is important to note that hospital emergency systems must abide by the National Electric Code Article 517 (Health Care Facilities). Thus, the emergency system must be broken into three distinct branches: life safety, critical, and mechanical. Incase of prolonged power failure, these branches ensure the hospital's essential components of the electrical system function properly. To make certain the entire system does not shut down due to a generator overload, the branches are capable of shutting down independent of each other.

To properly evaluate the current emergency system, NEC load calculations were performed on all panels and feeders to compare the sizing of these components with the current loads on the system. A one-line diagram of the emergency system component of the addition is enclosed. A table highlighting the various characteristics of each fixture, lamp, and ballast is included. The panels, circuit breakers, and feeders were all sized correctly with plenty of room for future expansion. Utility rates for the area were obtained; however, proper rate comparison could not be performed due to incomplete data concerning the entire hospital and its associated loads.

NORTH ADDITION EMERGENCY POWER ONE-LINE DIAGRAM



General Overview of Building Emergency Electrical System:

System Type:

- 3-phase
- 3-branch system: life safety, critical, mechanical
- Main emergency panel is a 480Y/277V panel rated at 1000A and 35K AIC and fed from 'Unit Substation D' which has a primary utility connection at 13.2 kV
- 3-branches are fed from the main emergency panel (EMDP-ED) with automatic transfer switches (ATS) which are switched according to a predetermined hierarchy to ensure generator stability and not to overload the entire emergency system.

Building Utilization Voltage:

- Building is fed from a primary utility voltage of 13.2 kV
- 4 substations are located in either the main electrical room or 6th floor penthouse of the hospital
- Substations are fed directly with 13.2 kV service and step that voltage down to 480Y/277 V
- (2) 750 kW generators operating at 480Y/277 V supply emergency power to panel EMDP-ED through (3) sets of 500MCM wire while the normal connection is fed by a substation located on the 6th floor penthouse.

Transformer Configuration:

As you can see from the table below, the transformers are all 480-delta to 208Y/120, 3-phase, dry type transformers:

TRANSFORMER SCHEDULE					
DESG.	**KVA**	**PRIMARY VOLTAGE**	**SECOND. VOLTAGE**	**PHASE**	**TYPE**
T-5	15	480 DELTA	208Y/120	3	DRY
T-6	15	480 DELTA	208Y/120	3	DRY
T-7	15	480 DELTA	208Y/120	3	DRY
T-8	30	480 DELTA	208Y/120	3	DRY

Hospital Emergency Power System Overview:

The emergency power branch of a hospital's electrical system is much more extensive than an emergency back-up system of a typical building. To ensure the health and well-being of both staff and patients, a sizable portion of lighting, equipment, and outlets are connected to emergency power. It would be very detrimental to a hospital if a power outage interrupted the use of medical equipment that saves lives. Therefore, a hospital's emergency power system is configured differently than most other systems.

As described in Article 517 of the National Electric Code (NEC), the system is broken into 3 separate branches: life safety, critical, and mechanical. Life safety consists of any loads that are essential in proper evacuation and egress of the hospital as described in Article 517.32 of the NEC. This includes egress lighting (similar to most other buildings), alarm and alerting systems, and power to elevators. Critical power consists of any loads that are essential to maintaining and caring for the life of a patient as described in Article 517.33 of the NEC. This includes operating room equipment, nurse call systems, lighting in critical areas where task illumination is imperative, and various other hospital equipment and outlets in select patient care areas. The mechanical branch is responsible for providing power to mechanical equipment necessary for patient care and basic hospital operation as described in Article 517.34 of the NEC. This branch will feed air handling units supplying fresh air to operating rooms and patient areas, pumps providing water to key patient spaces, and any other equipment that directly assists the care of a patient.

Emergency lighting in corridors, lobbies, and any public space is fed by the life safety branch of the emergency power system. Two 750 kW generators supply emergency power for the entire building at 480Y/277 V. Automatic transfer switches are programmed to trip according to a hierarchy structure determined by the use and importance of the loads it is serving as to not overload the emergency generators. Therefore, loads would sequentially be shut down if the generators were overloaded so that the most crucial branches of the system would remain powered. Although the ATS data and hierarchy system for the entire building was not obtained, the following table illustrates the transfer switches used in the North Addition and their associated hierarchy number (with 1 being the most important).

AUTOMATIC TRANSFER SWITCH SCHEDULE							
DESIGNATION	AMPACITY	PHASE	WIRES	PRIORITY	VOLTAGE	MOUNTING	AIC RATING
E1ATS	225 A	3	4	1	480	FLOOR	65K
E3ATS	600 A	3	4	3	480	FLOOR	65K
E6ATS	225 A	3	3	6	480	FLOOR	65K

*Priority is based on which transfer switch takes precedence over the others. A priority of 1 is the highest priority. The E6ATS would be dropped off-line first if trouble with the emergency generators occurs.

Overcurrent Protection Devices:

The overcurrent protection devices were sized in the panel schedules located in Appendix A and checked in the field to ensure proper coordination between branch circuits and panelboards. The contractor was responsible for testing the equipment and AIC ratings in a short-circuit analysis and coordination study. Most panels at 208Y/120 V and 50 A were rated 10K AIC, lighting panels at 480Y/277 V and 50 A were rated at 14K AIC, and equipment and distribution panels at 480Y/277 and 100-250 A were rated at 25K AIC.

Location of Major Electrical Equipment:

- Switchgear serving the new addition is located on the 6th floor penthouse of the Main Building.
- Major distribution panels for the 3 emergency branches are also located in the 6th floor penthouse.
- Lighting and receptacle panels for each floor are generally located in their floor's corresponding electrical room adjacent to the new elevator bank.
- A new custom modular air handling unit and associated fans and motors are all located in the 2nd floor mechanical room above the new conference rooms.
- Pumps are mostly located in the 2nd floor mechanical room, as well.

Typical Lighting System:

- Majority of lighting is fluorescent (linear and compact) downlighting utilizing 2x2, 2x4, and radial downlight fixtures being supplied by 277 V.
- Accent lighting is mostly low voltage halogen MR16 lamps at 12V.
- A few metal halide lights are used to illuminate exit/entrances and are supplied by 277 V.
- Indirect lighting is used to provide ambient light in the registration area adjacent to the main lobby.
- Daylighting provides the majority of the ambient light in the concourse due to the 2-story curtain wall spanning the length of the concourse.

*Ballast cutsheets can be found in Appendix B

Shutoff Methods:

- Lighting in corridors, lobbies, concourse, and public places are controlled by keyed switches
- Lighting in patient corridors and nurse stations are switched at the nurse's station
- Lighting in patient rooms is switched individually per room
- Lighting controls in meeting rooms and multi-purpose room are controlled by a Lutron multi-scene dimming control system with ceiling mounted occupancy sensor

Power Factor Correction:

There is no means of power factor correction on this project.

Important Design Considerations:

This section was discussed above in "Hospital Emergency Power System Overview".

Utility Rate Structure:

Although the proper utility rate calculations cannot be accurately determined due to the unknown load of the existing hospital, the following utility rate data was obtained from SMECO Energy Cooperative, an electricity provider in Southern Maryland, pertaining to large business customers:

UTILITY RATE STRUCTURE			
		JUNE-OCTOBER	NOVEMBER-MAY
STANDARD OFFER SERVICE:	Kilowatt Demand	$2.44 per kW	$2.44 per kW
	Kilowatt-hours	$0.0704 per kWh	$0.0677 per kWh
DISTRIBUTION CHARGE:	Kilowatt Demand	$2.58 per kW	$2.58 per kW
	Kilowatt-hours	$0.00131 per kWh	$0.00131 per kWh
FRANCHISE TAX:		$0.00062 per kWh	
CUSTOMER CHARGE:		$939 per month	$939 per month

*Assumed utility company responsible for transmission and distribution at 13.2 kV

Notes:

*NEC calculations can be found in the excel file 'Panel Schedule.xls'
*Panel schedules can be found in Appendix A or the excel file 'Panel Schedule.xls'

Tables:

Lamp/Ballast Information											
Fixtures	Operating Voltage	Lamp		Ballast							
		Type	Quantity	Start Type	Lamp Quantity	Quantity	Input Watts	Power Factor	Current	Ballast Factor	Dimming
C4	120	F32T8	1	IS	1	1	30	0.98	0.25	0.98	
C10	277	F32T8	1	IS	1	1	30	0.98	0.11	0.98	
A25, A32, A34	120	F32T8	2	IS	2	1	63	0.99	0.53	0.94	
A1, A2, A7, A11, A23, A27, A35	277	F32T8	2	IS	2	1	62	0.98	0.23	0.94	
A14	277	F32T8	2	Prog RS	2	1	69	0.95	0.25	0.85	X
A3, A10, C7	277	F32T8	3	IS	3	1	89	0.99	0.33	1.03	
A4, A15, A19	277	F32T8	4	IS	4	1	107	0.99	0.39	0.88	
A24	277	F32T8	4	Prog RS	2	2	69	0.95	0.25	0.85	X
A20	120	F32T8	6	IS	2[1]	1	62	0.98	0.23	0.94	
				IS	4[1]	1	107	0.99	0.39	0.88	
C5	120	F17T8	1	PS	1	1	22	0.97	0.19	1	
C10	277	F17T8	1	PS	1	1	22	0.97	0.08	1	
A7, A12, A29, C2	277	F17T8[2]	2	PS	2	1	39	0.99	0.15	1	
A6, A8, A16, A18	277	F17T8	4	IS	4	1	61	0.99	0.22	0.96	
A33	277	F17T8	4	Prog RS	2	2	42	0.95	0.15	0.85	X
A21	120	F17T8	6	IS	2[1]	1	31	0.97	0.26	0.9	
				IS	4[1]	1	58	0.98	0.49	0.9	
A30	277	F40BX	1	IS	1	1	41	0.99	0.15	1.01	
A5, A9	277	F40BX	2	IS	2	1	74	0.98	0.27	0.95	
A13	277	F40BX	3	IS	3	1	108	0.98	0.38	0.93	
A28	277	F40BX	3	Prog RS	1[1]	1	44	0.95	0.16	0.85	X
				Prog RS	2[1]	1	83	0.95	0.3	0.85	X
A31	277	F40BX	4	IS	4	1	116	0.99	0.41	0.89	
A26	277	F40BX	6	IS	3	1	108	0.98	0.38	0.93	
C11	277	F9BX[2]	2	-	2	1	19	0.95	0.07	1	
C12	277	F18BX[2]	2	-	2	1	38	0.95	0.14	1	
B10, B21, E4	277	F26TRT	1	Prog RS	1	1	28	0.98	0.11	1.02	
B14, B17, B24	277	F32TRT	1	-	1	1	34	0.95	0.12	1	
B32	277	F32TRT	1	Prog RS	1	1	36	0.95	0.13	0.95	X
B16	277	F32TRT	2	Prog RS	2	1	67	0.98	0.26	1	
B13	277	F42TRT	1	-	1	1	44	0.95	0.16	1	
B18, C14	277	F13DBX	1	Prog RS	1	1	15	0.97	0.06	0.98	
B4, B7	277	F13DBX	2	Prog RS	2	1	26	0.98	0.1	0.98	
B12	277	F18DBX	2	Prog RS	2	1	38	0.98	0.14	1	
E3	277	F26DBX	1	Prog RS	1	1	28	0.98	0.11	1.02	
B2, B5, B9	277	F26DBX	2	Prog RS	2	1	56	0.98	0.21	0.98	
B22, B27	277	F26DBX	2	Prog RS	1	1	33	0.95	0.12	0.95	X
B25	120	70W MH PAR30	1	-	1	1	89	0.9	0.32	1	
B37	277	70W MH PAR38	1	-	1	1	89	0.9	0.32	1	
E2, C9	277	100W MH	1	-	1	1	125	0.9	0.45	1	

*If possible, ballast start type was chosen as instant start, but many ballasts for particular lamp/voltage combinations were only found at programmed rapid start.

*All lighting loads calculated were assumed to be using the ballast configurations above

1. Ballast configuration is as shown due to how it was specified on the drawings
2. Ballast information for lamp configuration could not be obtained. Therefore, ballast characteristics were estimated as shown

PANEL CHARACTERISTICS				
DESIGNATION	**VOLTAGE**	**PHASE**	**WIRES**	**PROTECTION**
EX. EMDP-ED	480Y/277	3	4	1000A MCB
EX. ME1L-ED	480Y/277	3	4	225A MLO
EX. ME3L-ED	480Y/277	3	4	225A MLO
EX. E2L-3A	480Y/277	3	4	225A MLO
ME1L-N	480Y/277	3	4	100A MLO
E1L-1N	480Y/277	3	4	50A MLO
E1P-1N	208Y/120	3	4	50A MCB
E1L-2N	480Y/277	3	4	50A MLO
E1L-3N	480Y/277	3	4	50A MLO
E1P-3N	208Y/120	3	4	50A MCB
E1L-4N	480Y/277	3	4	50A MLO
E2L-2N	480Y/277	3	4	50A MLO
E2P-2N	208Y/120	3	4	50A MCB
E2L-3N	480Y/277	3	4	100A MLO
E2P-3N	208Y/120	3	4	100A MCB
E3L-N	480Y/277	3	4	250A MLO
E3P-N	208Y/120	3	4	100A MCB
E6L-N-ELEV	480-DELTA	3	3	225A MLO

*MCB – Main Circuit Breaker

*MLO – Main Lug Only

EQUIPMENT SCHEDULE			
DESIGNATION	**PHASE**	**VOLTAGE**	**AMPS**
FIRE ALARM PANEL	1	277	10
DOOR HOLD OPEN	1	120	1.5
MED GAS ALARM PANEL	1	120	2
CARD READER CONTROL PANEL	1	120	10
SECURITY POWER PANEL	1	120	10
UNDERCABINET REFRIGERATOR	1	120	7
NURSE CALL CONTROL PANEL	1	120	10
DDC: CONTROL PANEL	1	120	5
ELEVATOR SHUNT TRIP	1	120	1
SECURITY CAMERA	1	120	2
FETAL MONITOR	1	120	5
COUNTERTOP REFRIGERATOR	1	120	5
SPECIMEN REFRIGERATOR	1	120	7
STERILIZER	1	120	12
MICROSCOPE	1	120	10
CRASH CART	1	120	2
DUPLEX CONDEN. RECEIVER	3	480	22
SMOKE FAN DAMPER	1	120	5

*Amps refer to amps drawn on the corresponding circuit, VA calculations can be found in Appendix A or excel file ‘Panel Schedule.xls’

MOTOR SCHEDULE						
DESIGNATION	**SIZE**	**PHASE**	**VOLTAGE**	**FED BY PANEL**	**WIRING**	**PROTECTION**
AHU-2N SUPPLY FAN	75 HP	3	480	E3L-N	3#1+1#6GRD	200 A
PH-S-1	7 1/2 HP	3	480	E3L-N	3#10+1#10 GRD	25 A
SF-1	15 HP	3	480	E3L-N	3#10+1#10 GRD	45 A
ACCU-1	12 HP	3	480	E3L-N	3#12+1#12GRD	20 A
ACCU-1	12 HP	3	208	E3P-N	3#10+1#10GRD	30 A
AHU-2N PREHEAT PUMP	1/4 HP	1	120	E3P-N	3#12+1#12GRD	15 A
ELEVATOR #1/#2	20 HP	3	480	E6L-N-ELEV	3#6+1#10 GRD	60 A

*Load calculations for above equipment is located in Appendix A

*GRD – Ground wire

Feeder Schedule								
Feeder Number	**Serving**	**Served From**	**Conduit**	**Wire**	**Ground**	**Amperage**	**Wire Ampacity**	**Connected Load**
1	PANEL ME1L-N	EX. PANEL ME1L-ED	2"	4#1/0	1#4	100 A	230 A	59.3 A
2	PANEL E2L-3N	EX. PANEL E2L-3A	1 1/4"	4#4	1#6	75 A	125 A	59 A
3	PANEL E1L-1N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	26.1 A
4	XFMR T-5	PANEL E1L-1N	3/4"	3#10	1#10	15 KVA	50 A	11.8 A
5	PANEL E1P-1N	XFMR T-5	3/4"	4#8	1#10	50 A	70 A	27.3 A
6	PANEL E1L-2N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	14.3 A
7	XFMR T-6	PANEL E2L-2N	3/4"	3#10	1#10	15 KVA	50 A	16.0 A
8	PANEL E2P-2N	XFMR T-6	3/4"	4#8	1#10	50 A	70 A	37.0 A
9	PANEL E1L-3N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	16.1 A
10	XFMR T-7	PANEL E1L-3N	3/4"	3#10	1#10	15 KVA	50 A	2.4 A
11	PANEL E1P-3N	XFMR T-7	3/4"	4#8	1#10	50 A	70 A	5.4 A
12	XFMR T-8	PANEL E2L-3N	3/4"	3#8	1#10	30 KVA	50 A	36.3 A
13	PANEL E2P-3N	XFMR T-8	1 1/4"	4#3	1#8	100 A	145 A	83.8 A
14	PANEL E1L-4N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	50 A	12.9 A
15	PANEL E3L-N	EX. PANEL ME3L-ED	3"	4#350	1#1	250 A	505 A	205.3 A
16	E6ATS	EX. PANEL EMDP-ED	2"	3#2/0	1#6	110 A	265 A	21.9 A
17	E6ATS	PANEL MDP-N	2"	3#4/0	1#4	225 A	360 A	21.9 A
18	PANEL E6L-N-ELEV	E6ATS	2"	3#4/0	1#4	225 A	360 A	50.5 A
19	XFMR T-8	PANEL E3L-N	3/4"	3#6	1#8	30 KVA	95 A	37.0 A
20	PANEL E3P-N	XFMR T-8	1 1/4"	4#2	1#8	100 A	170 A	85.5 A
21	PANEL E2L-2N	PANEL E2L-3N	3/4"	4#8	1/#10	50 A	70 A	20.5 A
22	EX. PANEL EMDP-ED	EX. PARALLELING SWITCHGEAR	(3) 3"	3 SETS 4#500MCM	3#2/0	1000 A	1860 A	- [1]
23	PANEL MDP-N	EX. SUBSTATION D	(3) 3 1/2"	3 SETS 4#400MCM	3#3/0	800 A	1635 A	- [1]
24	EX. E1ATS	EX. SUBSTATION D	2 1/2"	4#4/0	1#4	225 A	360 A	- [1]
25	EX. E1ATS	EX. PANEL EMDP-ED	2 1/2"	4#4/0	1#4	225 A	360 A	- [1]
26	EX. PANEL ME1L-ED	EX. E1ATS	2 1/2"	4#4/0	1#4	225 A	360 A	- [1]
27	EX. E3ATS	EX. SUBSTATION D	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	- [1]
28	EX. E3ATS	EX. PANEL EMDP-ED	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	- [1]
29	EX. PANEL ME3L-ED	EX. E3ATS	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	- [1]

*Feeder designations refer to one-line diagram located above

*Amperage refers to size of protection device for that feeder

*Connected Load refers to the demand load calculated in Appendix A

1. Connected load could not be determined due to existing loads present from main hospital