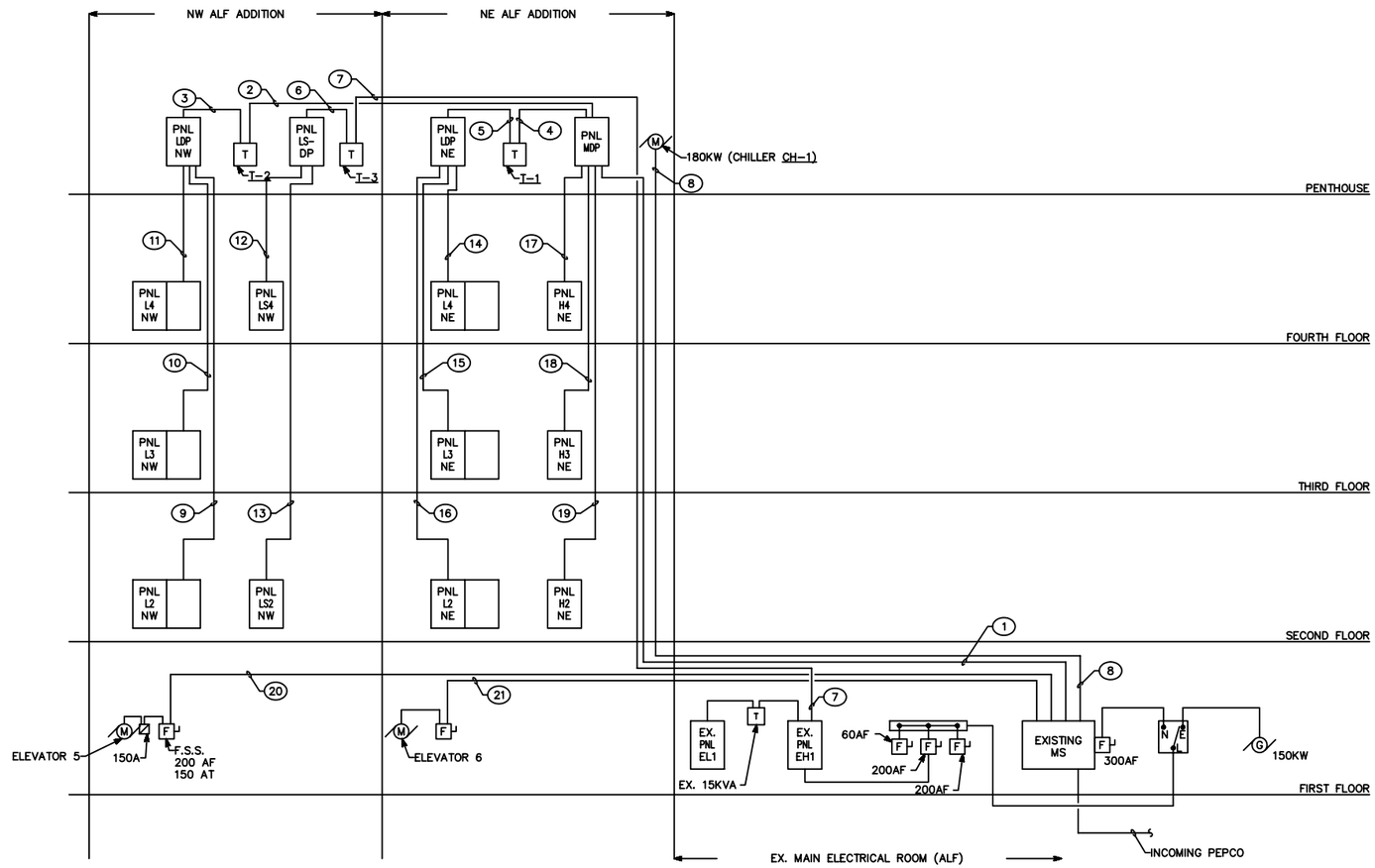
Executive Summary

The electrical system can best be described as star; one main switchboard that feeds to the main distribution panel, which then feeds the other panels. The normal power is provided to the existing Assisted Living Facility from a PEPCO owned network transformer vault. The electrical service terminates in a 2000 amp switchboard protected by a fused bolted pressure switch located in the basement of the Assisted Living Facility. From the switchboard power is fed to the distribution panel board, designated Panel MDP, rated 480Y/277 volts, 3 phase, 800A. Mechanical equipment is served directly from Panel MDP. Lighting and receptacle loads are served by dry-type transformers and 208Y/120 panelboards. The distribution panels are located in the Penthouse area of the Assisted Living Facility and panelboards are fed down from that location.

The emergency power is generated via and on-site, 150 KW diesel-fired emergency generator. The generator is located outside on grade, and provides emergency power to the egress lighting and a limited amount of refrigeration in the kitchen. Emergency power for the addition is provided for the egress lighting, and is received from the existing emergency distribution panel EH1. Emergency power is stepped down to 208Y/120 voltage and distributed to life safety panels on floors 2 and 4 of the addition.

A calculation of the NEC building design load was performed to check the existing wire sizes and over current protection devices for the main feeders and distribution panels. As the report indicates, everything was sized correctly with additional capacity for growth. The building has not yet been built, so there were no past electrical bills to analyze for power factor correction and demand charges. The addition will be built under a new rate structure than what the current building is operating. After deregulation, PEPCO revamped their rate structures with new categories and rates. When cost analysis research is done for different systems and methods of power distribution, the building will be put into the rate structure category, “GT LV”, Time Metered General Service – Low Voltage Service Schedule.



ELECTRICAL RISER DIAGRAM

NOT TO SCALE

System type

The electrical system can best be described as star; one main switchboard that feeds to the main distribution panel, which then feeds the other panels. The normal power is provided to the existing Assisted Living Facility from a PEPCO owned network transformer vault. The electrical service terminates in a 2000 amp switchboard protected by a fused bolted pressure switch located in the basement of the Assisted Living Facility. From the switchboard power is fed to the distribution panel board, designated Panel MDP, rated 480Y/277 volts, 3 phase, 800A. Mechanical equipment is served directly from Panel MDP. Lighting and receptacle loads are served by dry-type transformers and 208Y/120 panelboards. The distribution panels are located in the Penthouse area of the Assisted Living Facility and panelboards are fed down from that location.

The emergency power is generated via and on-site, 150 KW diesel-fired emergency generator. The generator is located outside on grade, and provides emergency power to the egress lighting and a limited amount of refrigeration in the kitchen. Emergency power for the addition is provided for the egress lighting, and is received from the existing emergency distribution panel EH1. Emergency power is stepped down to 208Y/120 voltage and distributed to life safety panels on floors 2 and 4 of the addition.

Building Utilization voltage

The Assisted Living Facility utilizes two voltages, 480Y/277 from the switchgear and main distribution panel, and 208Y/120 via dry-type step down transformers. The 480Y/277 voltage is used for the mechanical equipment. The 208Y/120 voltage serves the lighting and receptacle loads.

Transformer configuration

All transformers are located in the Penthouse of the Assisted Living Facility, grounded to building steel via ¾”C.W./1#4 GRD, and mounted on 4” high housekeeping pad. There are three step down transformers, two for lighting/receptacle panels in the northeast and northwest ends of the building, and one for the emergency life safety panels. All transformers step down voltage from 480Y/277-208Y/120. The two transformers serving the northeast and northwest locations are rated at 112.5 KVA. Primary feeds for both the northeast and northwest transformer are from Panel MDP, secondary voltage is fed to distribution panels LDP-NE, and LDP-NW.

Primary feed for the third transformer, rated at 45 KVA, is received from the existing panel EH1 located on the first floor of the existing electrical room. Secondary voltage feeds Panel LS-DP, which distributes power to the life safety panels located on floors two and four.

TRANSFORMER SCHEDULE

DESG.	KVA	PRI . VOLTAGE	SEC. VOLTAGE	PHASE	TYPE	PRIMARY FEEDER	SECONDARY FEEDER
T-1	112.5	480Y/277	208Y/120	3	AA	2	3
T-2	112.5	480Y/277	208Y/120	3	AA	4	5
T-3	45	480Y/277	208Y/120	3	AA	7	6

Wiring and Bus Types

FEEDER SCHEDULE

FEEDER NUMBER	SERVING	SERVED FROM	CONDUIT	WIRE	GROUND	AMPS
1	PANEL MDP	EX. MS SWITCHBOARD	(2) 3 1/2"	2 SETS 4#500 MCM	(2) 1#1	600
2	T-1	PANEL MDP	2"	4#3/0	1#6	200
3	PANEL LDP-NW	T-1	(2) 2"	2 SETS 4#3/0	(2) 1#3	400
4	T-2	PANEL MDP	2"	4#3/0	1#6	200
5	PANEL LDP-NE	T-2	(2) 2"	2 SETS 4#3/0	(2) 1#3	400
6	PANEL LS-DP	T-3	2"	4#1/0	1#6	150
7	T-3	EX. PANEL EH1	1 1/2"	3#1	1#8	70
8	CHILLER: CH-1	EX. MS SWITCHBOARD	(2) 2 1/2"	3#250 MCM	(2) #3	350
9	PANEL L2-NW	PANEL MDP-NW	2"	4#1/0	1#1	150
10	PANEL L3-NW	PANEL MDP-NW	2"	4#1/0	1#1	150
11	PANEL L4-NW	PANEL MDP-NW	2"	4#1/0	1#1	150
12	LS-4NW	PANEL LS-DP	1 1/4"	4#4	1#10	60
13	LS-2NW	PANEL LS-DP	1 1/4"	4#4	1#10	60
14	PANEL L4-NE	PANEL MDP-NE	2"	4#1/0	1#1	150
15	PANEL L3-NE	PANEL MDP-NE	2"	4#1/0	1#1	150
16	PANEL L2-NE	PANEL MDP-NE	2"	4#1/0	1#1	150
17	PANEL H4-NE	PANEL MDP	1 1/4"	4#3	1#8	100
18	PANEL H3-NE	PANEL MDP	1 1/4"	4#3	1#8	100
19	PANEL H2-NE	PANEL MDP	1 1/4"	4#3	1#8	100
20	ELEVATOR #5	EX. MS SWITCHBOARD	2"	3#3/0	1#1	150
21	ELEVATOR #6	EX. MS SWITCHBOARD	2"	3#3/0	1#1	150

Emergency Power System

Emergency power is generated via an on-site, 150 KW diesel-fired emergency generator. This unit is located outside on grade, and provides emergency power to the life safety panels. In the event of an emergency, the generator sends power through an automatic transfer switch to a bus bar located in the existing main electrical room. From there, it is tapped and protected via a 200 amp fused safety switch. The emergency power is then fed into existing panel EH1, from EH1 feeder number 7 extends emergency power to the penthouse of the addition. Feeder number 7 is connected to transformer T-3, and power is stepped down from 480Y/277 to 208Y/277 and fed to Panel LS-DP. Emergency power is then distributed to life safety panels located on floors 2 and 4. Emergency power in the addition is solely provided for egress lighting.

Overcurrent Protection

Overcurrent protection is provided via fused safety switches and molded cases circuit breakers. The existing switchboard located in the main electrical room is protected with a 300AF fused safety switch and is rated at 2000 amps, with an AIC rating of 30K. The main distribution panel is fed from the existing switchboard, 480Y/277 V, and protected by a 3-pole 600 amp Square D circuit breaker.

- Panel LS-DP (208Y/120) – protected with a 150 A, main circuit breaker
- Panel LDP-NE (208Y/120) – protected with a 400 A, main circuit breaker
- Panel LDP-NW (208Y/120) – protected with a 400 A, main circuit breaker

All other panels are fed through main lugs only. Their protection is received from circuit breakers in the associated panels they are fed from.

Locations of Switchgear and Panel Boards

The main electrical room is located in the original Assisted Living Facility Building. The electrical room houses the switchboard, which feeds electrical power to the addition. From the switchgear, (4) four feeders are extended to the addition. Two of the feeders provide power to the elevators, where electrical service is provided for the motor at ground level of the northeast and northwest end. One feeder provides power to the 180 KW chiller found on penthouse, and one provides power to the main distribution panel of the addition. The main distribution panel, PNL MDP, is located in the penthouse. Mechanical equipment is fed directly from this panel at 480Y/277V. Power is supplied to the lighting and receptacles via two-step down transfomers and two distribution panels found in the penthouse, at the northeast and northwest ends of the addition. From the subsequent distribution panels, power is fed downstream to the

panelboards found on floors 2-4. Double section panels for the 208Y/120 lighting and receptacle loads are found on floor 2-4 at both the northeast and northwest electrical rooms. Life safety panels are located on floors 2 and 4, and are served from a 208Y/120 distribution panel found in the penthouse. Panels serving the mechanical equipment are found on floors 2-4, and are in the electrical rooms on the associated floors of the north east end of the building. These panels are fed directly from the main distribution panel at 480Y/277 V, which is found in the penthouse.

Lighting systems and their operating voltage

The lighting system is made up of compact fluorescent downlights and wall sconces, fluorescent cove lighting, and an assortment of incandescent lighting in the residential units. The majority of the lighting operates at 120 volts. The general lighting systems in the residential units makes use of a fan light, which is found in the main living area and the bedroom. They fan makes use of the Lutron Nova –T, model NTFS-12-E-WH fan control switch. The rooms also have a pendant fixture over the breakfast table that uses (3) 100 watt A-19 lamps. The bathrooms use PAR downlights and a heat lamp over the shower area. They bathroom lighting is controlled with a single pole/single throw spring wound timer switch. All other lighting in the residential rooms is controlled with wall switches. Corridor lighting is provided with fluorescent downlighting, wall sconces, and cove lights, all operating at 120 V. The corridor lighting is controlled with multiple A and B switching, which have a double pole single throw timer control. The day and activity room lighting is achieved with downlighting, wall washers, and undercabinet lighting. Control of the system is achieved via wall switches.

ASHRAE/IESNA 90.1 Shutoff Requirements

Shutoff requirements are achieved with A and B switching, as well as timers for the corridors and bathroom lighting in the resident suites. The parking garage lighting is zoned to utilize daylight as much as possible. Those fixtures located closest to the windows shutoff to conserve energy during daylight hours.

Power Factor Correction

There is no power factor correction for this building. The motors used have specked a minimum power factor and corrections for their power factor are made at the motor.

Important Design Requirements

Although this building is associated with health care, it does serve the function of providing critical care, or life support needs. Therefore, the emergency power supplied is very minimal, and provided solely for egress lighting. One thing to consider and analyze in the redesign will be increasing the emergency power. As it is now, the elevators in the Assisted Living Facility Addition do not receive any emergency power for emergency recall. They have a small battery pack, when recalled, lower the elevator to the lowest level, and opens the doors. Because the average age of the residents is 84 or higher, it might be a good idea to provide emergency power to the elevators. In the event of a fire emergency, or other emergency, those reliant on walkers and wheelchairs could be evacuated from the building in a more expedient manner. The overall residential nature of the building makes the electrical system somewhat less complicated, and there is not a particular need for specific design requirements.

Primary Lamps and Ballasts

	LAMPS		BALLAST					
TYPE	NUMBER/TYPE	WATTS	BALLAST WATTS	PF	BF	INPUT CURRENT	VOLTAGE	DIMMING
A1	(2) F32T8/SPX35	32	59	0.99	0.88	0.49	120	
A3	(4) F17T8/SPX35	17	54	0.98	0.88	0.46	120	
A4	(3) F32T8/SPX35	32	85	0.99	0.88	0.71	120	
A5	(1) F17T8/SPX35	17	20	0.93	0.92	0.18	120	
A7	(2) F32T8/SPX35	32	15	0.99	0.05	0.25	277	DIMMING
A9	(1) F32T8/SPX35	32	30	0.98	0.98	0.25	120	DIMMING
B1	(2) F26DBX/SPX35	26	51	0.99	1	0.43	120	
B2	(1) 50W PAR30	50	N/A	N/A	N/A	N/A	120	
B3	(1) 100W A19	100	N/A	N/A	N/A	N/A	120	
B4	(1) 100W PAR30	100	N/A	N/A	N/A	N/A	120	
B5	(3) 100W A19	100	N/A	N/A	N/A	N/A	120	
C5	(1) 50W MH/SPX41	50	69	1	1	-	120	

Mechanical Equipment

MECHANICAL EQUIPMENT							
DESIG	EQUIPMENT TYPE	PHASE	VOLTAGE	HP or KW	AMPS	# OF UNITS	KVA
FCU-1-1 THRU FCU-1-4	FAIN COIL UNIT	1	277	1/4	2.9	4	3.21
FCU-2-1 THRU FCU-2-2	FAIN COIL UNIT	1	277	2 @ 1/15	2.2	2	1.22
FCU-3-1 THRU FCU-3-9	FAIN COIL UNIT	1	277	2 @ 1/8	2.9	9	7.23
FCU-4-1 THRU FCU-4-5	FAIN COIL UNIT	1	277	2 @ 1/8	2.9	5	4.02
FCU-5-1 THRU FCU-5-16	FAIN COIL UNIT	1	277	2 @ 1/8	2.9	16	12.85
FCU-6-1 THRU FCU-6-28	FAIN COIL UNIT	1	277	1/20	2.2	28	17.06
FCU-7-1 THRU FCU-7-13	FAIN COIL UNIT	1	277	1/6	2.2	13	7.92
FCU-8-1 THRU FCU-8-5	FAIN COIL UNIT	1	277	1/5	2.2	5	3.05
FCU-9-1 THRU FCU-9-12	FAIN COIL UNIT	1	277	1/4	2.9	12	9.64
P-CH1	PUMP	3	460	15	21	1	16.73
P-CH2	PUMP	3	460	15	21	1	16.73
P-HW1	PUMP	3	460	7 1/2	11	1	8.76
P-HW2	PUMP	3	460	7 1/2	11	1	8.76
P-DW1	PUMP	1	120	1/2	4.9	1	0.59
P-DW2	PUMP	1	120	1/2	4.9	1	0.59
P-ERU1	PUMP	1	120	1/3	3.6	1	0.43
CUH-1-1 THRU CUH-1-2	HOT WATER UNIT HEATER	1	120	0.7 KW	8	2	1.40
UH-2-1	HOT WATER UNIT HEATER	1	120	0.2 KW	3.6	1	0.20
UH-3-1 THRU UH-3-10	HOT WATER UNIT HEATER	1	120	0.5 KW	8	10	5.00
CR-1	CONDENSATE REVEIVER	3	460	1 1/2	3	1	2.39
CH-1	AIR-COOLED CHILLER	3	460	181 KW	282	1	181.00
SWP-1	SUMP PUMP	3	460	1/2	1.1	1	0.88
SF-ERU1	SUPPLY FAN	3	460	20	8	1	6.37
EF-ERU1	EXHAUST FAN	3	460	15	21	1	16.73
EF-1	EQUIP. ROOM EXHAUST	3	460	1	2.1	1	1.67
EF-2	EQUIP. ROOM EXHAUST	3	460	1	2.1	1	1.67
EF-3	EQUIP. ROOM EXHAUST	1	120	1/3	3.6	1	0.43
					TOTAL KVA		336.55
					TOTAL KVA WITH DEMAND		246.05

Demand Factor for Mechanical Equipment: 1.0 for heating and cooling, 0.5 for largest motor

NEC Load Calculations

General Lighting Loads by Occupancy

OCCUPANCY	AREA (sqft)	UNIT LOAD (VA/sqft)	TOTAL LOAD (KVA)
Residents Quarters	24,882	1	24.9
Circulation and Corridors	6,138	1.5	9.2
Resident Support Spaces	3,114	1	3.1
Parking	14,000	0.5	7.0
		TOTAL KVA	**44.2**

General Receptacle Loads by Occupancy

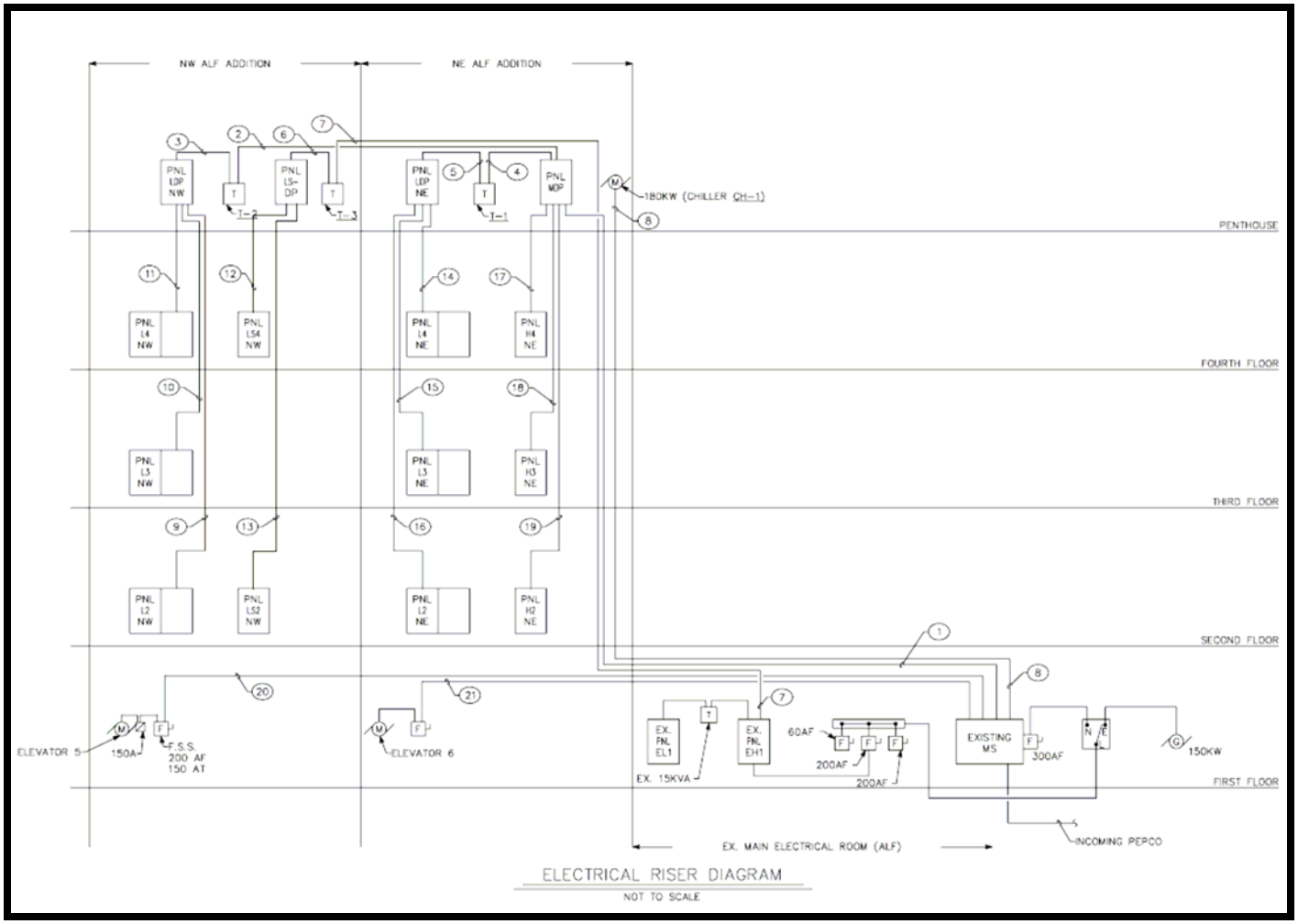
OCCUPANCY	AREA (sqft)	UNIT LOAD (VA/sqft)	TOTAL LOAD (KVA)
Residents Quarters	24,882	1	24.9
Circulation and Corridors	6,138	0.5	3.1
Resident Support Spaces	3,114	3	9.3
Parking	14,000	0.25	3.5
		TOTAL KVA	**40.8**

Connected Receptacle Loads

FLOOR	NORMAL	EMERGENCY	NORMAL KVA	EMERGENCY KVA
Parking	12	0	2.2	0.0
Second Floor	130	6	23.4	1.1
Third Floor	130	6	23.4	1.1
Fourth Floor	130	6	23.4	1.1
Penthouse	2	0	0.4	0.0
		TOTAL KVA	**72.4**	**3.2**
		DEMAND KVA	**41.2**	**3.2**

Demand Factor Receptacles: 1.0 for first 10 KVA, 0.5 for remaining KVA

Sizing the System



ELECTRICAL RISER DIAGRAM
NOT TO SCALE

The tables preceding this section tabulated the total KVA for the mechanical, lighting, and receptacle loads. The Assisted Living Facility Addition receives power from the (4) feeders that are extended from Existing Switchboard in the main electrical room of the existing building. Two of the feeders serve the elevators, one serves the rooftop chiller, and the fourth provides power to the main distribution panel of the addition, which serves the subsequent loads downstream. Below, there is a table that shows loads that the feeders are connected to, their connected KVA, and the designed wire and current protection device.

FEEDERS FROM SWITCHBOARD								
SERVING	VOLTAGE	PHASE	CONNECTED KVA	FEEDER	CONDUIT	WIRE	GRND	AMPS
Elevator 5	480	3	43.23072	20	2"	3#3/0	1#1	150
Elevator 6	480	3	43.23072	21	2"	3#3/0	1#1	150
Chiller: CH -1	480	3	180	8	(2) 2 1/2"	3#250 MCM	(2) #3	350
PNL MDP	480	3	272.15	1	(2) 3 1/2"	2 SETS 4#500 MCM	(2) 1#1	600

- **FEEDER 20: (3)-#3/0 + (1)-#1 GND, 2"C**
  - **Protected by 150 A enclosed circuit breaker and 200 AF fused safety switch**

Connected KVA: 43.23
Connected AMPS: 43.23 KVA/(1.732*0.480 V) = 51.99 A
+ 25% Growth: 54.04 KVA = 65 A
Checking wire size: From Table 310.16 – 75 degree C – Copper
3/0 – 310 A

  - **Therefore, wire and circuit breaker are sized appropriately**

*** Note: the feeders runs from the main electrical room in the existing building to the new addition, distance from electrical room to furthest elevator or Penthouse is approximately 500 ft, therefore, wire is oversized to account for voltage drop. Another factor that de-rates the conductor is the number of current carrying conductors (0.80 multiplying factor).**

- **FEEDER 21 - (same as feeder 20): (3)-#3/0 + (1)-#1 GND, 2"C**
  - **Protected by 150 A enclosed circuit breaker and 200 AF fused safety switch**

Connected KVA: 43.23
Connected AMPS: 43.23 KVA/(1.732*0.480 V) = 51.99 A
+ 25% Growth: 54.04 KVA = 65 A
Checking wire size: From Table 310.16 – 75 degree C – Copper
3/0 – 310 A

  - **Therefore, wire and circuit breaker are sized appropriately**

- **FEEDER 8: (3)-#350 MCM + (2)-#3 GND, (2)-2.5”C**
  - **Protected by 350 A circuit breaker**

Connected KVA: 180
Connected AMPS: 180 KVA/(1.732*0.480V) = 216.5 A
+ 25% Growth: 225 KVA = 271 A
Checking wire size: From Table 310.16 – 75 degree C – Copper
350 MCM – 310 A

  - **Therefore, wire and circuit breaker are sized appropriately**

- **FEEDER 1: 2 SETS (4)-#500 MCM + 2 SETS (1)-#1 GND, (2)-3.5”C**
  - **Protected by 600 A circuit breaker**

Connected KVA: 272.15
Connected AMPS: 272.15 KVA/(1.732*0.480V) = 327.4A
+ 25% Growth: 340.19 KVA = 409.19 A
Checking wire size: From Table 310.16 – 75 degree C – Copper
500 MCM – 620 A

  - **Therefore, wire and circuit breaker are sized appropriately**

POTOMAC ELECTRIC POWER COMPANY
DISTRICT OF COLUMBIA
STANDARD OFFER SERVICE RATES
EFFECTIVE FEBRUARY 8, 2005 THROUGH MAY 31, 2006

TIME METERED GENERAL SERVICE – LOW VOLTAGE SERVICE SCHEDULE "GT LV"

	Billing Months of June – October (Summer)	Billing Months of November – May (Winter)
Generation		
Kilowatt-hour Charge		
On Peak	$ 0.08682 per kwh	$ 0.06889 per kwh
Intermediate	$ 0.06632 per kwh	$ 0.07239 per kwh
Off Peak	$ 0.05645 per kwh	$ 0.05757 per kwh
Kilowatt Charge		
On Peak	$ 0.84507 per kw	
Maximum	$ 0.30248 per kw	$ 0.30248 per kw
Procurement Cost Adjustment	www.pepco.com/dc-rates/ for monthly rate	
Transmission		
All kwh	$ 0.00111 per kwh	$ 0.00111 per kwh
Kilowatt Charge		
On Peak	$ 0.71 per kw	
Maximum	$ 0.59 per kw	$ 0.59 per kw
Distribution		
Customer Charge	$ 20.93 per month	$ 20.93 per month
All kwh	$ 0.01029 per kwh	$ 0.01029 per kwh
Kilowatt Charge		
Maximum	$ 4.80 per kw	$ 4.80 per kw
Delivery Tax	$ 0.0077 per kwh	$ 0.0077 per kwh
Public Space Occupancy Surcharge	$ 0.00159 per kwh	$ 0.00159 per kwh
Administrative Credit	www.pepco.com/dc-rates/ for monthly rate	
Reliability Energy Trust Fund	$ 0.0001 per kwh	$ 0.0001 per kwh