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Lighting/Electrical

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The School of Forest Resources Building
University Park, Pennsylvania

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Technical Assignment 2

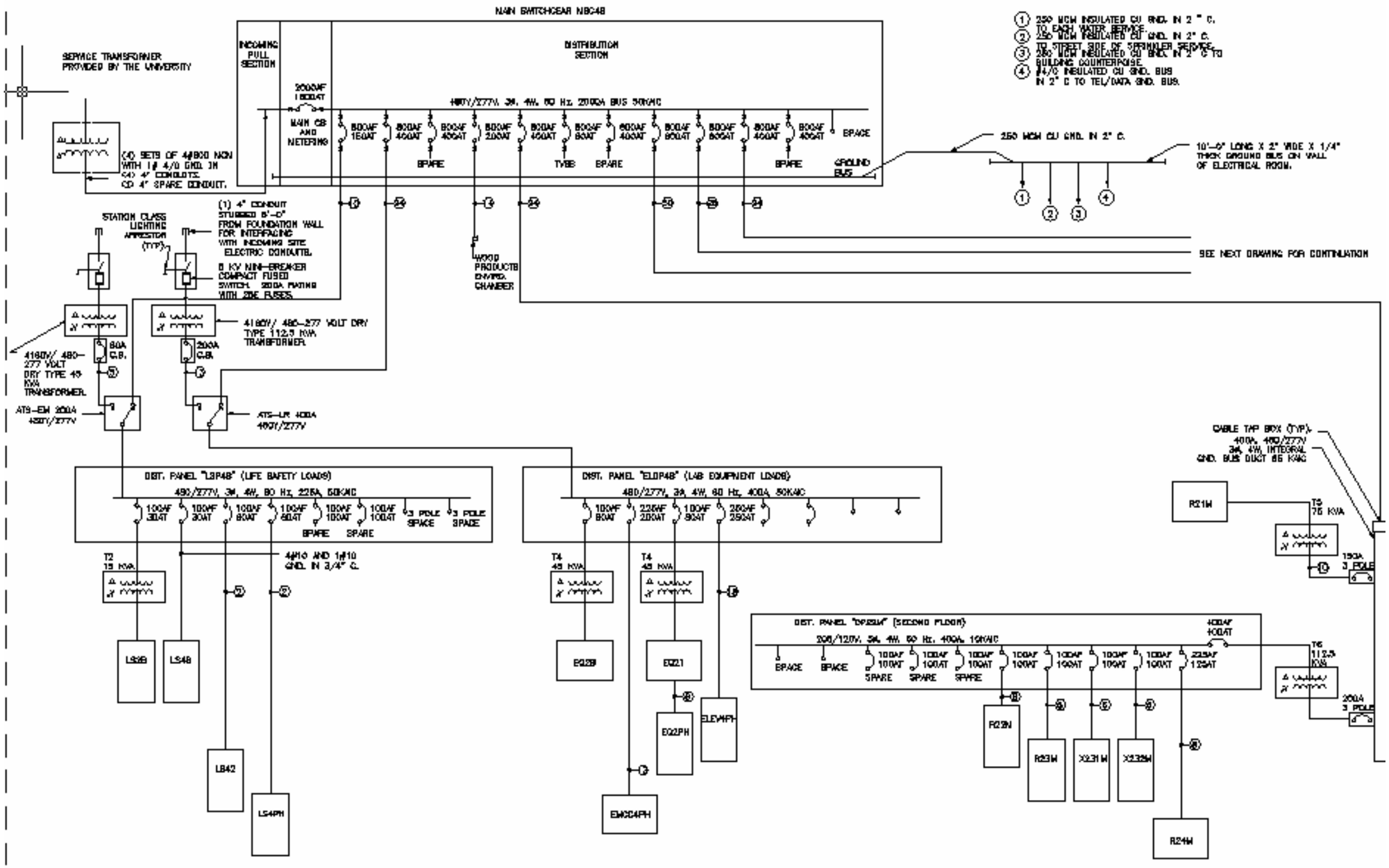
Executive Summary

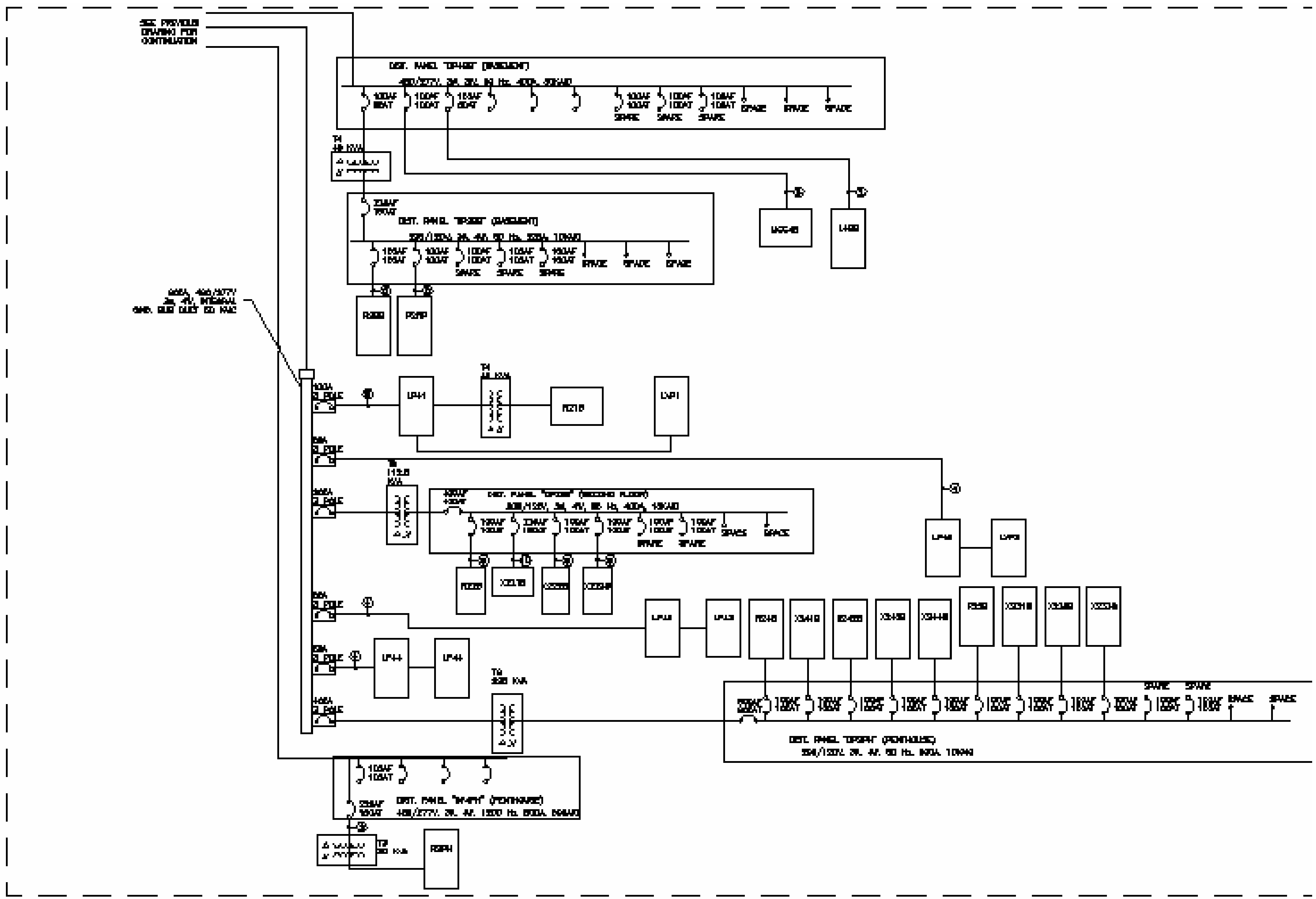
Technical Assignment 2 involved a study of the existing electrical distribution systems within The School of Forest Resources Building. The first step in analysis was breaking down the system paths and understanding how the power is distributed throughout the building. Utilizing the building drawings I created a One-Line diagram which documented the paths from the MDS in the basement to the distribution panels located on all floors.

A narrative of the equipment types is included. Panelboards are found throughout the building at both 480Y/277 and 208Y/120V. Dry-type transformers are used to step down the voltage. Circuit breakers are the most common over-current protection devices, though some panels are main lugs only. Two automatic transfer switches are used for emergency power to labs and life-safety loads in the building. Lighting systems in the building were found to be primarily 277V fluorescent.

The next examination was of the building loads. Both lighting and power systems were analyzed floor by floor to calculate a total building demand load. Factors from the National Electrical Code were used to de-rate or increase demand as required. The building demand load was calculated to be less than the actual load allowed on the main building feeders. Room for system growth was supplied by an additional conduit left open for a potential new feeder if necessary.

The final required section of the report was to examine the utility loads of the building, however this data was not available as the building is not yet in operation.


MAIN SWITCHGEAR NBG48
SERVICE TRANSFORMER PROVIDED BY THE UNIVERSITY
INCOMING PULL SECTION
DISTRIBUTION SECTION
2000AF 1600AT
MAIN CB AND METERING
480Y/277V, 3Ø, 4W, 60 Hz, 2000A BUS 50KAIC
800AF 1600AT
800AF 400AT
800AF 450AT
800AF 200AT
800AF 450AT
800AF 80AT
800AF 400AT
800AF 800AT
800AF 800AT
800AF 450AT
800AF 450AT
SPACE
SPARE
SPARE
SPARE
SPARE
GROUND BUS
(4) SETS OF 4#600 MCM WITH 1# 4/0 GND IN (4) 4" CONDUITS. (2) 4" SPARE CONDUIT.
(1) 4" CONDUIT STUBBED 5'-0" FROM FOUNDATION WALL FOR INTERFACING WITH INCOMING SITE ELECTRIC CONDUITS.
STATION CLASS LIGHTING ARRESTOR (TYP).
15 KV MINI-BREAKER COMPACT FUSED SWITCH. 200A RATING WITH 25E FUSES.
WOOD PRODUCTS ENVIRO. CHAMBER
4160V/ 480-277 VOLT DRY TYPE 45 KVA TRANSFORMER.
80A C.B.
4160V/ 480-277 VOLT DRY TYPE 112.5 KVA TRANSFORMER.
200A C.B.
ATS-EM 200A 480Y/277V
ATS-LR 400A 480Y/277V
250 MCM INSULATED CU GND. IN 2 " C.
TO EACH WATER SERVICE.
250 MCM INSULATED CU GND. IN 2" C.
TO STREET SIDE OF SPRINKLER SERVICE.
250 MCM INSULATED CU GND. IN 2" C TO BUILDING COUNTERFOISE.
#4/0 INSULATED CU GND. BUS IN 2" C TO TEL/DATA GND. BUS.
250 MCM CU GND. IN 2" C.
10'-0" LONG X 2" WIDE X 1/4" THICK GROUND BUS ON WALL OF ELECTRICAL ROOM.
SEE NEXT DRAWING FOR CONTINUATION
DIST. PANEL "L3P48" (LIFE SAFETY LOADS)
480/277V, 3Ø, 4W, 60 Hz, 225A, 50KAIC
100AF 30AT
100AF 30AT
100AF 60AT
100AF 60AT
100AF 100AT
100AF 100AT
3 POLE SPACE
3 POLE SPACE
SPARE
SPARE
T2 15 KVA
4#10 AND 1#10 GND. IN 3/4" C.
LS39
LS48
LS42
LS4PH
DIST. PANEL "ELDP48" (LAB EQUIPMENT LOADS)
480/277V, 3Ø, 4W, 60 Hz, 400A, 50KAIC
100AF 60AT
225AF 225AT
100AF 90AT
250AF 250AT
T4 45 KVA
T4 45 KVA
EQ29
EQ21
EQ22PH
ELEVMPH
EWC04PH
CABLE TAP BOX (TYP). 400A, 480/277V 3Ø, 4W, INTEGRAL GND. BUS DUCT 65 KAIC
R21W
T5 75 KVA
150A 3 POLE
DIST. PANEL "DP25W" (SECOND FLOOR)
208/120V, 3Ø, 4W, 60 Hz, 400A, 10KAIC
400AF 400AT
SPACE
SPACE
100AF 100AT
SPARE
100AF 100AT
SPARE
100AF 100AT
SPARE
100AF 100AT
100AF 100AT
100AF 100AT
100AF 100AT
225AF 125AT
T6 112.5 KVA
200A 3 POLE
R29N
R23W
X23.1W
X23.2W
R24W



SEE PREVIOUS DRAWING FOR CONTINUATION
DIST. PANEL
SPARE
SPACE
LP44
R218
LVP1
LP44

LEGEND OF FEEDER SIZES

COPPER CONDUCTORS

FEEDER SYMBOL	CONDUCTORS (3 PHASE, 3 WIRE) WITH GROUND	RACEWAY SIZE CONDUIT	CONDUCTORS (3 PHASE, 4 WIRE) WITH GROUND	RACEWAY SIZE CONDUIT	NOMINAL AMPERE RATING
1	3#4 & 1#10G.	1"			60
2			4#4 & 1#10G.	1 1/4"	
3	3#4 & 1#8G.	1"			70
4			4#4 & 1#8G.	1 1/4"	
5	3#1 & 1#8G.	1 1/2"			100
6			4#1 & 1#8G.	1 1/2"	
7	3#1/0 & 1#6G.	1 1/2"			125
8			4#1/0 & 1#6G.	2"	
9	3#1/0 & 1#6G.	1 1/2"			150
10			4#1/0 & 1#6G.	2"	
11	3#2/0 & 1#6G.	2"			175
12			4#2/0 & 1#6G.	2"	
13	3#3/0 & 1#6G.	2"			200
14			4#3/0 & 1#6G.	2"	
15	3#4/0 & 1#4G.	2"			225
16			4#4/0 & 1#4G.	2 1/2"	
17	3#250 KCMIL & 1#4G.	2 1/2"			250
18			4#250 KCMIL & 1#4G.	3"	
19	3#350 KCMIL & 1#4G.	3"			300
20			4#350 KCMIL & 1#4G.	3"	
21	3#500 KCMIL & 1#3G.	3 1/2"			350
22			4#500 KCMIL & 1#3G.	4"	
23	3#600 KCMIL & 1#3G.	3 1/2"			400
24			4#600 KCMIL & 1#3G.	4"	
25	6#250 KCMIL & 2#2G.	2-2 1/2"			500
26			8#250 KCMIL & 2#2G.	2-3"	
27	6#350 KCMIL & 2#1G.	2-3"			600
28			8#350 KCMIL & 2#1G.	2-3"	
29	6#600 KCMIL & 2#1/0G.	2-3 1/2"			800
30			8#600 KCMIL & 2#1/0G.	2-4"	
31	9#400 KCMIL &3#2/0G.	3-3"			1000
32			12#400 KCMIL &3#2/0G.	3-3"	
33	9#600 KCMIL & 3#3/0G.	3-3 1/2"			1200
34			12#600 KCMIL & 3#3/0G.	3-4"	
35	12#600 KCMIL & 4#4/0G.	4-3 1/2"			1600
36			16#600 KCMIL & 4#4/0G.	4-4"	

NOTES:

1. 600KCMIL FEEDERS SHALL BE PROVIDED WITH MAC ADAPTERS AS REQUIRED TO COORDINATE WITH BREAKER LUG SIZES.

2. SEE SPECIFICATIONS FOR ACCEPTABLE CONDUCTOR TYPES.

DRY TYPE TRANSFORMER SCHEDULE

SIZE	KVA	PRIMARY AMPS	SECONDARY AMPS	480 VOLT OVERCURRENT	208 VOLT (4) OVERCURRENT	480V FEEDER	120/208V FEEDER	GROUNDING SEE NOTE #5
T1	9	11	25	20A, 3P	30A, 3P	3#12 & 1#12G – 3/4"C.	4#10 & 1#10G – 3/4"C.	1#6 – 3/4"C
T2	15	18	42	30A, 3P	50A, 3P	3#10 & 1#10G – 3/4"C.	4#6 & 1#10G – 1"C.	1#6 – 3/4"C
T3	30	36	83	60A, 3P	100A, 3P	3#4 & 1#10G – 1"C.	4#1 & 1#8G – 1 1/2"C.	1#6 – 3/4"C
T4	45	54	125	80A, 3P	150A, 3P	3#3 & 1#8G – 1 1/4"C.	4#1/0 & 1#6G – 2"C.	1#6 – 3/4"C
T5	75	90	208	150A, 3P	250A, 3P	3#1/0 & 1#6G – 1 1/2"C.	4#250 KCMIL & 1#4G – 3"C.	1#2 – 3/4"C
T6	112.5	135	313	200A, 3P	400A, 3P	3#3/0 & 1#6G – 2"C.	4#500 KCMIL & 1#3G – 4"C.	1#1/0 – 3/4"C.
T7	150	181	417	300A, 3P	500A, 3P	3#350 KCMIL & 1#4G – 3"C.	8#250 KCMIL & 2#2G 2–3"C.	1#1/0 – 3/4"C
T8	225	270	625	400A, 3P	800A, 3P	3#500 KCMIL & 1#3G – 3 1/2"C.	8#500 KCMIL & 2#1/0G 2–4"C.	1#3/0 – 3/4"C
T9	300	361	834	600A, 3P	1000A, 3P	6#350 KCMIL & 2#1G 2–3"C.	12#400 KCMIL & 3#2/0G 3–3"C.	1#3/0 – 3/4"C
T10	500	600	1400	900A, 3P	1600A, 3P	9#350 KCMIL & 3#2/0G 3–3"C.	16#600 KCMIL & 4#4/0G 4–4"C.	1#300KCMIL–1"C.

Existing Electrical Conditions

The School of Forest Resources building is fed from an electric service provided by the user (PSU-OPP). The utility feeders connect to a delta-wye configuration step-down transformer which provides the building utilization voltage of 480/277V.

Four sets of (4) 600 MCM wires feed the 480Y/277V, 2000A, 50 KAIC, 3 phase Main Distribution Switchgear (MDS). The building's power use is monitored by the customer via a metering section in the MDS.

Ten delta-wye configuration step-down transformers are used to provide 208/120V service to distribution panels. These supply power to various loads including receptacles, fire-alarm panels, fumehoods, and a small amount of incandescent lighting.

In the case of an emergency, two automatic transfer switches are feed from two 5 kV feeders. The first ATS is connected to emergency/standby power feeds downstream of a 4160V/480-277V, dry-type, 45 kVA, delta-wye configuration transformer. This ATS is 480/277V, 200A and feeds the Life Safety Panel. This panel feeds all life safety loads in the building for emergencies, including fire alarm panels and emergency lighting. Emergency lighting fixtures operate at 277V and utilize fluorescent lamps (U-tube, linear, and compact varieties depending on location). The second ATS is downstream of a 4160V/480-277V, dry-type, 112.5 kVA, delta-wye configuration transformer connected to emergency/standby power feeds. This ATS powers a lab equipment load emergency panel as well as the elevators.

Circuit breakers are used for overcurrent protection in the building. Circuit breakers are required to provide overcurrent protection with inverse time and instantaneous tripping characteristics. A main circuit breaker with a 1600A trip rating protects the MDS. Additionally, the MDS is equipped with a transient voltage surge suppression system. Within the MDS, 10 circuit breakers ranging from 150 to 800A trip ratings protect feeders to distribution panels located throughout the building. The automatic transfer switches are protected by 5Kv fused switches, as well as circuit breakers downstream of their respective transformers. Two bus ducts in the building each serve multiple feeders that are protected by circuit breakers. The smaller distribution panels scattered throughout the building are each protected via a main circuit breaker or are main lugs only. Individual loads from these panels are also protected via breakers.

The Main Distribution Switchgear is located is located in an electrical room in the basement of the building. Adjacent to this room is an additional electrical room housing the main transformer, automatic transfer switches, and utility entrance to the building. The building contains two motor control panels, one located in the basement mechanical room and one in the penthouse. Small electrical rooms are located on each floor of the building and house many of the distribution panels. Additional panels are found throughout the building recessed in the walls. The penthouse level contains two machine rooms which house the controls for the elevators.

The lighting in the School of Forest Resources building is predominantly fluorescent, operating at 277V. 2'x2' U-tube fixtures are common in classroom locations. Linear fluorescent strips are used mainly in lab locations. Compact fluorescent downlights occur mainly in the hallway areas. Some incandescent fixtures

are used for highlights in the classroom areas and require 120V, provided by the ten step-down transformers in the building.

According to ASHRAE 90.1, each space enclosed by ceiling-height partitions shall have at least one control device to independently control the general lighting within the space independently from the rest of the building. These control requirements from are met in the building using manual switches as well as dimming panels that can be used to turn the lights off. These dimming panels are located in the classrooms to allow for flexible lighting scenarios. Occupancy sensors are located in the offices to provide control. Exterior lighting is controlled by a panel equipped with a time clock.

Luminaire Designation	Lamps	#	Ballast	Input Watts	Voltage	Current	Power Factor
FR1	F31 U/T8	2	VCN-2M32-MC	59	277	0.21	0.99
FR2	F32-SPX35	2	VCN-2M32-MC	59	277	0.21	0.99
FR4	F32TBX-SPX35-A4P	1	ICF-2S26-H1-LD	36	277	0.31	0.98
FR5	100A-19	1	Not Applicable	100	120	0.83	1
FR6	F31 U/T8	3	VCN-3P32-SC	85	277	0.31	0.99
FR6a	F31 U/T8	3	VCN-3P32-SC	85	277	0.31	0.99
FR7	F31 U/T8	3	VCN-3P32-SC	85	277	0.31	0.99
FR8	F31 U/T8	3	VCN-3P32-SC	85	277	0.31	0.99
FR9	F32-SPX35	1	VCN-1S32-SC	34	277	0.11	0.98
FR10	F32-SPX35	1	VCN-1S32-SC	34	277	0.11	0.98
FR11	F32-SPX35	3	VCN-3P32-SC	85	277	0.31	0.99
FR12	F32-SPX35	2	VCN-2M32-MC	59	277	0.21	0.99
FR13	F32-SPX35	3	VCN-3P32-SC	85	277	0.31	0.99
FR15	85W QL	1	Generator Provided	85	277	0.34	0.9
FR16	F32-SPX35	2	VCN-2M32-MC	59	277	0.21	0.99
IR2	150W/A21	1	Not Applicable	150	120	1.25	1
S1A	F32 T8	2	VCN-2M32-MC	59	277	0.21	0.99
P1	F32 T8	2	VCN-2M32-MC	59	277	0.21	0.99
P2	F32 T8	2	VCN-2M32-MC	59	277	0.21	0.99
P5	F32-SPX35	3	VCN-3P32-SC	85	277	0.31	0.99
W1	F26BX-3500L	2	VEZ-2Q26	16	277	0.21	0.98
W4	100W MH	1	71A5337BP	118	277	0.45	0.9
SL1	150W MH	1	71A5437BP	173	277	0.63	0.9

Mechanical Equipment Schedule

Motors

	HP	#	Phase	Voltage	FLA (from NEC)
HW Pumps and EFN13	1 HP	7	3	480	2.1
PCWP01 (02 Standby)	1.5 HP	2	3	480	3
EFN14	3 HP	2	3	480	4.8
HVF01	5 HP	2	3	480	7.6
AC-1	15 HP	3	3	480	21.0
CWP01 (02 Standby)	40 HP	2	3	480	52.0
EFN12	2 HP	1	3	480	3.4
RAF Penthouse	25 HP	1	3	480	34.0
EFN03	50 HP	1	3	480	65
Air Handler	60 HP	2	3	480	77.0
Air Handler	75 HP	1	3	480	96.0

Standby Fans (Emergency only fans in labs, airhandlers not connected to emergency power)

	HP	#	Phase	Voltage	FLA (from NEC)
EFN01	2	1	3	480	3.4
EFN02	3	1	3	480	4.8
EFN05	2	1	3	480	3.4
EFN06	5	1	3	480	7.6
EFN07	5	1	3	480	7.6
EFN08	1.5	1	3	480	3.0
EFN09	3	1	3	480	4.8
EFN10	5	1	3	480	7.6
EFN14	40	1	3	480	52.0
EFN15	40	1	3	480	52

Miscellaneous

	#	Phase	Voltage	Amps	VA
UH-1	4				1600
SSO-1	2				800
CUH-1	6	1	115	2.5	
CUH-2	1	1	115	2.5	
UH-1	1	1	115	1.5	
Mech Lift	1	3	480	60	
FCU	1	1	115	4.4	
Water Cooler	4	1	120		4000
Auditorium Chairs	25	1	120		30000
Fume Hoods	18	1	120		21600

Door Openers	23	1	120		9200
BP-1	1	3	480	20	
VP-1	1	3	480	20	
Water Htr.	3	1	120		1500
CP	2	1	120		1000
Water Pump	18	1	208		64800

Lighting Load Calculations

The following pages contain a floor by floor analysis of the lighting loads in the School of Forest Resources Building. NEC loads by occupancy as well as the actual loads were analyzed to calculate the total volt-amps used by the system. For the NEC loads, Table 220.3(A) from the National Electrical Code 2002 Edition was used.

Note: For office and classroom spaces, inspection showed that the NEC value was always much greater than the actual loading. Spaces not included in the NEC Table 220.3(A) were calculated using the actual watts of the fixtures for greater accuracy. These spaces include research labs, mechanical and electrical rooms, and restrooms.

Table 220.3(A) General Lighting Loads By Occupancy

Type of Occupancy	VA/ sq. ft.
Offices	3.5
Schools	3.0
Corridors/Stairs	0.5
Storage	0.25

BASEMENT LIGHTING LOADS

Spaces with Higher NEC Calculations

Lab Office	140 sq.ft. @ 3.5 VA/sq. ft. = 490 VA
CAC Lab	1032 sq.ft. @ 3.0 VA/sq. ft. = 3096 VA

Spaces with Higher Actual Loads (or unavailable NEC loads)

Wood Products Lab	11 P5 Fixtures * 85W/Fixt. / 0.99pf= 945 VA
Electrical Rooms	4 P5 Fixtures * 85W/Fixt. / 0.99pf= 344 VA
Mechanical Rooms	10 P5 Fixtures * 85W/Fixt. / 0.99pf= 859 VA
Storage Spaces	13 P5 Fixtures * 85W/Fixt. / 0.99pf= 1116 VA
	1 S1A Fixtures * 59W/Fixt. / 0.99pf= 60 VA
Rest Rooms	5 FR4 Fixtures * 36W/Fixt. / 0.98pf= 184 VA
	5 FR9 Fixtures * 34W/Fixt. / 0.98pf= 174 VA
Toxicology Lab	10 FR9 Fixtures * 34W/Fixt. / 0.98pf= 347 VA
Aquaculture Lab	38 FR16 Fixtures * 59W/Fixt. / 0.99pf= 2265 VA
Corridor	17 FR2 Fixtures * 59W/Fixt. / 0.99pf= 1013 VA
	6 FR4 Fixtures * 36W/Fixt. / 0.98pf= 220 VA
	11 W1 Fixtures * 16W/Fixt. / 0.98pf= 180 VA
	(NEC Value: 1959 sq.ft. * 0.5 VA/sq.ft.= 979.5<actual)

Total Basement Lighting VA: 11293 VA

FIRST FLOOR LIGHTING LOADS

Spaces with Higher NEC Calculations

Total Office Area	4913 sq.ft. @ 3.5 VA/sq. ft. =17196 VA
Total Class Area (Including teaching lab areas and an auditorium classroom)	10056 sq.ft. @ 3.0 VA/sq. ft. = 30168 VA

Spaces with Higher Actual Loads (or unavailable NEC loads)

Electrical Rooms	3 S1A Fixtures * 59W/Fixt. / 0.99pf= 178 VA
Storage Spaces	8 S1A Fixtures * 59W/Fixt. / 0.99pf= 477 VA
	4 FR11 Fixtures * 85W/Fixt. / 0.99pf= 344VA
Rest Rooms	4 FR4 Fixtures * 36W/Fixt. / 0.98pf= 147 VA
	8 FR9 Fixtures * 34W/Fixt. / 0.98pf= 267 VA
Corridor	86 FR4 Fixtures * 36W/Fixt. / 0.98pf= 3159 VA
	5 FR15 Fixtures * 85W/Fixt. / 0.90pf= 472 VA
	14 W1 Fixtures * 16W/Fixt. / 0.98pf= 229 VA
	(NEC Value: 5134 sq.ft. * 0.5 VA/sq.ft.= 2567<actual)

Total First Floor Lighting VA: 52637 VA

SECOND FLOOR LIGHTING LOADS

Spaces with Higher NEC Calculations

Total Office Area	4983 sq.ft. @ 3.5 VA/sq. ft. =17441 VA
Total Class Area	2787 sq.ft. @ 3.0 VA/sq. ft. = 8361 VA

Spaces with Higher Actual Loads (or unavailable NEC loads)

Wood Products Chem Lab	30 P1 Fixtures * 59W/Fixt. / 0.99pf= 1788 VA
	5 FR2 Fixtures * 59W/Fixt. / 0.99pf= 298 VA
	6 FR4 Fixtures * 36W/Fixt. / 0.98pf= 220 VA
Wood Products Phys Lab	39 P1 Fixtures * 59W/Fixt. / 0.99pf= 2324 VA
	4 FR2 Fixtures * 59W/Fixt. / 0.99pf= 239 VA
	9 FR4 Fixtures * 36W/Fixt. / 0.98pf= 331 VA
Electrical Rooms	4 S1A Fixtures * 59W/Fixt. / 0.99pf= 241 VA
Server/Telecom	4 S1A Fixtures * 59W/Fixt. / 0.99pf= 241 VA
Rest Rooms	6 FR9 Fixtures * 34W/Fixt. / 0.98pf= 208 VA
	4 FR4 Fixtures * 36W/Fixt. / 0.98pf= 147 VA
Corridor	21 FR4 Fixtures * 36W/Fixt. / 0.98pf= 771 VA
	29 FR2 Fixtures * 59W/Fixt. / 0.99pf= 1728 VA
	12 W1 Fixtures * 16W/Fixt. / 0.98pf= 196 VA
	(NEC Value: 2552 sq.ft. * 0.5 VA/sq.ft.= 1276<actual)

Total Second Floor Lighting VA: 34534 VA

THIRD FLOOR LIGHTING LOADS

Spaces with Higher NEC Calculations

Total Office Area	3992 sq.ft. @ 3.5 VA/sq. ft. =13972 VA

Spaces with Higher Actual Loads (or unavailable NEC loads)

Forest Biometrics Lab	8 P2 Fixtures * 59W/Fixt. / 0.99pf= 477 VA
Forest Science Lab	10 P2 Fixtures * 59W/Fixt. / 0.99pf= 596 VA
Forest Ecology Lab	10 P2 Fixtures * 59W/Fixt. / 0.99pf= 596 VA
Forest Soils Lab	12 P1 Fixtures * 59W/Fixt. / 0.99pf= 715 VA
Water Resources Lab	10 P1 Fixtures * 59W/Fixt. / 0.99pf= 596 VA
Genetics and	81 P1 Fixtures * 59W/Fixt. / 0.99pf= 4827 VA
Water Isotope Labs	14 FR2 Fixtures * 59W/Fixt. / 0.99pf= 834 VA
	19 FR4 Fixtures * 36W/Fixt. / 0.98pf= 698 VA
Electrical Rooms	2 S1A Fixtures * 59W/Fixt. / 0.99pf= 120 VA
Rest Rooms	6 FR9 Fixtures * 34W/Fixt. / 0.98pf= 208 VA
	4 FR4 Fixtures * 36W/Fixt. / 0.98pf= 147 VA
Corridor	22 FR4 Fixtures * 36W/Fixt. / 0.98pf= 808 VA
	29 FR2 Fixtures * 59W/Fixt. / 0.99pf= 1728 VA
	12 W1 Fixtures * 16W/Fixt. / 0.98pf= 196 VA

Total Third Floor Lighting VA: 26518 VA

FOURTH FLOOR LIGHTING LOADS

Spaces with Higher NEC Calculations

Total Office Area	4562 sq.ft. @ 3.5 VA/sq. ft. =15967VA
Total Class Area	1000 sq.ft. @ 3.0 VA/sq. ft. =3000 VA

Spaces with Higher Actual Loads (or unavailable NEC loads)

Wildlife Labs	27 P2 Fixtures * 59W/Fixt. / 0.99pf= 1609 VA
	4 S1A Fixtures * 59W/Fixt. / 0.99pf= 238 VA
Wildlife and Fisheries	84 P1 Fixtures * 59W/Fixt. / 0.99pf= 5507 VA
Ecology and Radioisotope	16 FR2 Fixtures * 59W/Fixt. / 0.99pf= 954 VA
Lab Area	15 FR4 Fixtures * 36W/Fixt. / 0.98pf= 551 VA
Electrical Rooms	2 S1A Fixtures * 59W/Fixt. / 0.99pf= 120 VA
Rest Rooms	6 FR9 Fixtures * 34W/Fixt. / 0.98pf= 208 VA
	4 FR4 Fixtures * 36W/Fixt. / 0.98pf= 147 VA
Corridor	22 FR4 Fixtures * 36W/Fixt. / 0.98pf= 808 VA
	29 FR2 Fixtures * 59W/Fixt. / 0.99pf= 1728 VA
	12 W1 Fixtures * 16W/Fixt. / 0.98pf= 196 VA

Total Fourth Floor Lighting VA: 28333 VA

PENTHOUSE LIGHTING LOADS

Spaces with Higher NEC Calculations

No spaces

Spaces with Higher Actual Loads (or unavailable NEC loads)

Equipment Rooms	15 P5 Fixtures * 85W/Fixt. / 0.99pf= 1288 VA
	7 S1A Fixtures * 59W/Fixt. / 0.99pf= 417 VA
	4 W1 Fixtures * 16W/Fixt. / 0.98pf= 65 VA

Total Penthouse Lighting VA: 1770 VA

TOTAL BUILDING LIGHTING LOAD=
11293+52637+34534+26518+28333+1770= 155085 VA

Continuous Load Multiplier= 1.25

TOTAL LIGHTING VA DEMAND LOAD

155085 * 1.25= 193856 VA

Equipment and Receptacle Load Calculations

The following pages contain a floor by floor analysis of the equipment and receptacle loads in the School of Forest Resources Building. Full load current data for all motors comes from the NEC, Table 430.150 from the National Electrical Code 2002 Edition. Volt-amp ratings for receptacles come from the panel board schedules included in the drawings.

BASEMENT EQUIPMENT/RECEPTACLE LOADS

Motors

	#	Phase	Voltage	FLA (from NEC)	VA (#*1.732*VL-L*I) for 3 phase
1 HP	7	3	480	2.1	12207
1.5 HP	1	3	480	3	2491
3 HP	2	3	480	4.8	7972
5 HP	2	3	480	7.6	12622
15 HP	3	3	480	21.0	52315
40 HP	1	3	480	52.0	46181

Miscellaneous

	#	Phase	Voltage	Amps	VA
BP-1	1	3	480	20	16608
VP-1	1	3	480	20	16608
Water Htr.	3	1	120		1500
CP	2	1	120		1000
Water Pump	18	1	208		64800
Woodshop Enclosed Environment Room	1	3	480	200	166080

Receptacles

	#	Total VA
200VA	86	17200
240VA	5	1200
250VA	4	1000
300VA	7	2100
360VA	5	1800
400VA	3	1200
450VA	4	1800
(7) floor boxes		5800

(4) receptacles @ 30A, 250V, 7500 VA, 30000 VA total

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle Basement VA load= 462484VA

FIRST FLOOR EQUIPMENT/RECEPTACLE LOADS

Miscellaneous

	#	Phase	Voltage	Amps	VA
CUH-1	3	1	115	2.5	3738
CUH-2	1	1	115	2.5	288
UH-1	1	1	115	1.5	173
Mech Lift	1	3	480	60	49882
FCU	1	1	115	4.4	506
Water Cooler	1				1000
Auditorium Chair power	25			1200	30000
Door Openers	23			400	9200

Wiremold

	#	VA
1200 VA	6	7200

Receptacles

	#	Total VA
200VA	134	17200
250VA	8	2000
300VA	2	600
400VA	2	800
Floor Boxes	27	20000

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle First Floor VA load= 142587VA

SECOND FLOOR EQUIPMENT/RECEPTACLE LOADS

Miscellaneous

	#	Phase	Voltage	Amps	VA
Water Cooler	1				1000
Fume Hood	8				9600

Wiremold

	#	VA
	59	59000

Receptacles

	#	Total VA
200VA	166	17200
400VA	10	4000
Floor Boxes	12	4200
500VA	12	6000
1800VA	35	63000

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle Second Floor VA load= 164000VA

THIRD FLOOR EQUIPMENT/RECEPTACLE LOADS

Miscellaneous

	#	Phase	Voltage	Amps	VA
Water Cooler	1				1000
Fume Hood	2				2400
CUH-1	3	1	115	2.5	3738

Wiremold

#	VA
65	65000

Receptacles

	#	Total VA
200VA	185	37000
400VA	9	3600
Floor Boxes	4	2900
900VA	9	8100
1200VA	3	3600
1600VA	12	19200

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle Third Floor VA load= 146538VA

FOURTH FLOOR EQUIPMENT/RECEPTACLE LOADS

Miscellaneous

	#	Phase	Voltage	Amps	VA

Water Cooler	1	1000
Fume Hood	8	9600

Wiremold

#	VA
59	59000

Receptacles

	#	Total VA
200VA	182	36400
Floor Boxes	3	2400
1000VA	11	11000

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle Fourth Floor VA load= 119400VA

PENTHOUSE EQUIPMENT/RECEPTACLE LOADS

Motors

#	Phase	Voltage	FLA (from NEC)	VA (#*1.732*VL-L*I) for 3 phase

2 HP	1	3	480	3.4	2825
25 HP	1	3	480	34.0	28254
50 HP	1	3	480	65	54015
60 HP	2	3	480	77.0	127974
75 HP	1	3	480	96.0	99720
				x 1.25 Largest Motor	

Miscellaneous

	#	Phase	Voltage	Amps	VA
UH-1	4				1600
SSO-1	2				800

Receptacles

	#	Total VA
200VA	12	2400

No receptacles are at 180VA or below, no derating possible.

Total Mechanical/Receptacle Penthouse VA load= 317588VA

Total Mechanical/Receptacle Building VA Demand load= 1352597VA

Total Building Demand Load: 193856 Lighting + 1352597 Power= 1546453 VA

Building Feeder Size based on VA demand load:

1546453 VA Demand/ (3*277V) = 1860 Amps

Actual Feeder Size:

4 sets of (4) 600 MCM wire, 90 degree C rating as stated in specifications.

Ampacity: 475A each * 4 sets = 1900 Amps

Note: Several assumptions were made as to the size of certain loads (environment chamber, mechanical lift) that were as conservative as possible. Additionally, it is unlikely that some loads (e.g. chair power units) which have a high VA demand would all be on at the same time. No demand factors were available however, so it was assumed they would be used concurrently. This should help to account for the relative closeness of the calculated amps and the allowable amps. For building expansion purposes, an additional conduit was provided by the designers to allow for the running of another feeder.

Utility Load Data

The School of Forest Resources Building has its own solid state metering system located in the MDS in the basement floor of the building. Electric Utility Load Data for the previous twelve months is unavailable because the building is not operational.