University of California, San Diego
Cal $(IT)^2$
Technical Assignment #2

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Advisor: Dr. Moeck

31 October 2005

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Lighting/Electrical Option
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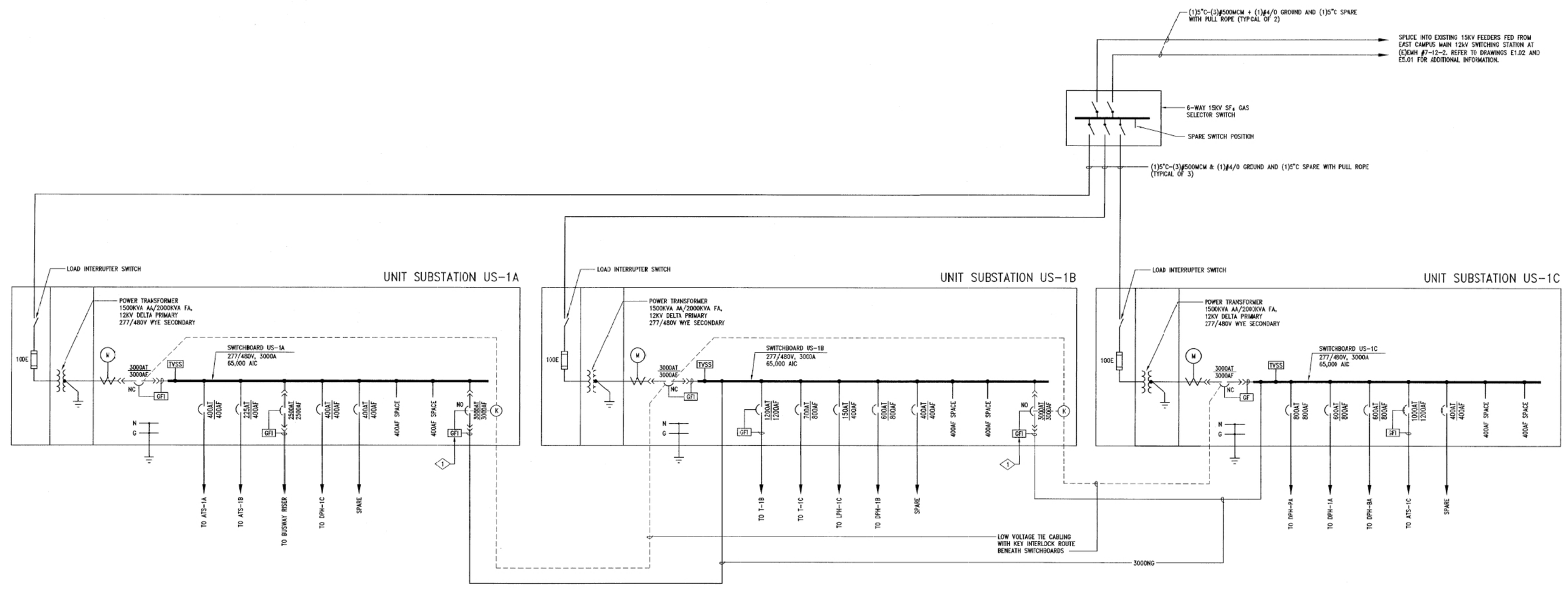
Executive Summary

This report contains a general analysis of the existing electrical system for the UCSD Cal $(IT)^2$ building. Because of the location of the building, California Energy Code Title 24 was accounted for in my analysis of lighting systems, power densities and energy consumption. Using the National Electric Code (2002), I determined the lighting, receptacle, mechanical, and other various electrical loads. From the panelboard, light fixture, and mechanical schedules, I was able to verify if my summing of Volt-Amps was correct or not. After summing all my loads, and using the proper demand factors found in the NEC, I was able to check the size of my three main unit substations and feeder sizes.

After finding my values, I found that the main power feeds into the substations and circuit breakers were sized appropriately. In fact, they were sized extremely high in case of growth, voltage drop, and number of conductors in the conduits. On top of the analysis, the utility rate structure was given to see how this building will be billed for energy.


(1)5"C-(3)#500MCM + (1)#4/0 GROUND AND (1)5"C SPARE WITH PULL ROPE (TYPCAL OF 2)
SPLICE INTO EXISTING 15KV FEEDERS FED FROM EAST CAMPUS MAIN 12kV SWITCHING STATION AT (E)EMH #7-12-2. REFER TO DRAWINGS E1.02 AND E5.01 FOR ADDITIONAL INFORMATION.
6-WAY 15KV SF6 GAS SELECTOR SWITCH
SPARE SWITCH POSITION
(1)5"C-(3)#500MCM & (1)#4/0 GROUND AND (1)5"C SPARE WITH PULL ROPE (TYPICAL OF 3)
LOAD INTERRUPTER SWITCH
UNIT SUBSTATION US-1A
POWER TRAKSFORMER 1500KVA AA/2000KVA FA, 12KV DELTA PRIMARY 277/480V WYE SECONDARY
100E
SWITCHBOARD US-1A 277/480V, 3000A 65,000 AIC
3000AT 3000AF
TVSS
NC
GFI
400AT 400AF
225AT 400AF
250AT 2500AF
400AT 400AF
400AT 400AF
400AF SPACE
400AF SPACE
NO
3000AT 3000AF
N
G
TO ATS-1A
TO ATS-1B
TO BUSWAY RISER
TO DPH-1C
SPARE
LOAD INTERRUPTER SWITCH
UNIT SUBSTATION US-1B
POWER TRANSFORMER 1500KVA AA/2000KVA FA, 12KV DELTA PRIMARY 277/480V WYE SECONDARY
100E
SWITCHBOARD US-1B 277/480V, 3000A 65,000 AIC
3000AT 3000AF
TVSS
NC
GFI
1200AT 1200AF
700AT 800AF
150AT 400AF
600AT 800AF
400AT 400AF
400AF SPACE
400AF SPACE
NO
3000AT 3000AF
N
G
TO T-1B
TO T-1C
TO LPH-1C
TO DPH-1B
SPARE
LOAD INTERRUPTER SWITCH
UNIT SUBSTATION US-1C
POWER TRANSFORMER 1500KVA AA/2000KVA FA, 12KV DELTA PRIMARY 277/480V WYE SECONDARY
100E
SWITCHBOARD US-1C 277/480V, 3000A 65,000 AIC
3000AT 3000AF
TVSS
NC
GFI
800AT 800AF
600AT 800AF
600AT 800AF
1000AT 1200AF
400AT 400AF
400AF SPACE
400AF SPACE
N
G
TO DPH-PA
TO DPH-1A
TO DPH-BA
TO ATS-1C
SPARE
LOW VOLTAGE TIE CABLING WITH KEY INTERLOCK ROUTE BENEATH SWITCHBOARDS
3000NG

PENTHOUSE/ROOF LEVEL

6TH LEVEL

5TH LEVEL

4TH LEVEL

3RD LEVEL

2ND LEVEL

1ST LEVEL

BASEMENT

ELPH-PA

EDPH-ELEV-PA

ET-ELEV-PA 15KVA T/F

ELP-ELEV-PA

50NG

20G

EDPH-PA

150NNGI

LP-L6A

LP-L6B

LP-L6C

LP-L6D

LP-L6E

LP-L6F

LP-L6G

COMMUNICATIONS

PHOTONICS

SYSTEMS ON CHIP

WIRELESS NETWORKS

DPL-5B

800NNGI

350G

TK-6B 225KVA

DPH-PA

350AT/400AF

80NG

LP-L5A

LP-L5B

LP-L5C

LP-L5D

LP-L5E

LP-L5F

MICROWAVE CIRCUIT TEST

BAND CIRCUIT TEST

CIRCUIT ASSEMBLY

HIGH SPEED DIGITAL

150NNGI

DPL-5B

800NNGI

350G

TK-5B 225KVA

350AT/400AF

400AT/400AF

70G

T-PA 45KVA T/F

150NG

70NG

LPH-PA

LRC-PA

LP-PA

LP-PB

400NG

200NG

LPH-6A

LRC-6A

225AT/225AF

225G

500NNGI

DPL-6A

LP-6A

LP-6B

LP-6C

TK-6A 150KVA

225AT/225AF

225G

LPH-5A

LRC-5A

500NNGI

DPL-5A

LP-5A

LP-5B

LP-5C

200NG

TK-5A 150KVA

400AT/400AF

400NG

LPH-4A

LRC-4A

350AT/400AF

350G

800NNGI

DPL-4A

LP-4A

LP-4B

LP-4C

TK-4A 225KVA

350AT/400AF

350G

200AT/225AF

200NG

LPH-3A

LRC-3A

800NNGI

DPL-3A

LP-3A

LP-3B

LP-3C

TK-3A 225KVA

350AT/400AF

350G

200AT/225AF

200NG

LPH-2A

LRC-2A

800NNGI

DPL-2A

LP-2A

LP-2B

LP-2C

AUDITORIUM/MULTIPURPOSE CONTROL ROOMS (TECHNICAL POWER)

LP-M2A

LP-M2B

LP-M2C

AUDITORIUM/MULTIPURPOSE CONTROL ROOMS (LIGHTING)

LP-M2D

LP-M2E

150NNGI

TK-2A 225KVA

225AT/225AF

TO STARLINE TRACK BUS-1A

200AT/225AF

200NG

LPH-1A

LRC-1A

100G

TK-1G 75KVA T/F

DPL-M1B

225NNG

100NG TO EDPH-1A

LPH-1B

LRC-1B

100NG

DPH-1A

TK-1A 225KVA T/F

DPL-M1A

800NNGI

350G

ELPH-1A

ET-1B 30KVA T/F

ELP-1E

50G

100NG

277/480V, 3ø-4W, PLUG-IN BUS RISER, 2500A

600NG

110G

225NNGI

150NNGI

350G

800NNGI

DPH-1B

TK-1D 225KVA T/F

DPL-1A

LP-1C

LP-1D

LP-1E

LP-1F

SERVER ROOM

TK-1E 75KVA T/F

LP-1G

LP-1H

OFFICES/ EQUIPMENT ROOMS

600NG

ELPH-4A

ET-4A 45KVA T/F

ELP-4A

150NG

70G

80NG

ELPH-2A

ET-2A 45KVA T/F

ELP-2A

150NG

70G

225NG

225NG

80NG

ATS-1B 225A/4P

225NG

150NG

ATS-1C 1000A/4P

1000NG

1000NG

EDPH-2A

400NG

EDPH-1B

ETK-1A 300KVA T/F

450G

1000NNGI

EDPL-1A

400NNGI

225NNGI

150NNGI

ELP-1A

ELP-1B (1)

ELP-1B (2)

ELP-1C

ELP-1D

CLEAN ROOM WING

EDPH-1A

400NG

ATS-1A 400A/4P

400NG

DPH-1C

400NG

800NG

T-1B 750KVA T/F

1200G

DSL-L1A

1600NG

2500NG

T-1C 500KVA T/F

700G

DSL-L1B

CLEAN ROOM WING

150NG

5CG

100NG

LPH-1C

LRC-1C

T-1F 30KVA T/F

LP-1B

1

E3.01

400NG

1200AT/1200AF

G

750KW/938KVA STANDBY/EMERGENCY DIESEL GENERATOR SET, 277/480V, 3ø-4W

EDSH-1A

US-1A T/F 1

US-1B T/F 1

US-1C T/F 1

2500NG

CABLE TAP BOX

15KV SELECTOR SWITCH 1

15KV FEEDERS FROM CAMPUS SWITCHING STATION

ELPH-BA

ET-BA 30KVA T/F

ELP-BA

100NG

50G

100NG

600NG

175G

400NNGI

400NNGI

TK-BA 112.5KVA T/F

400A/3P ENCLOSED CIRCUIT BREAKER

DPH-BA

100NNG

500NNG

225G

TK-BB 150KVA T/F

DPL-BA

400NNG

DC

THEATRICAL DIMMING CABINETS, REFER TO THEATRICAL LIGHTING DRAWINGS

NUMBERED NOTES

1. REFER TO DRAWING E3.01 FOR EQUIPMENT AND CABLING SPECIFICATIONS
2. PROVIDE SHIELDED ISOLATION TYPE TRANSFORMER.
3. REFER TO SHEET E3.03 AND DISTRIBUTION PANEL SCHEDULES REGARDING QUANTITY AND SIZES OF LP PANELS FED FROM THIS DISTRIBUTION PANEL.
4. REFER TO SHEET E3.03 AND PANEL SCHEDULES FOR INFORMATION ON LP PANELS FED FROM THIS DISTRIBUTION PANEL.
5. NOT USED.
6. PROVIDE 1"C WITH CONTROL WIRING FROM ATS TO GENERATOR FOR ENGINE START SIGNAL.

System Description

Cal $(IT)^2$ is serviced by the San Diego Gas & Electric Company. A 12 kV service is provided from SDG&E. This runs into a 6-way selector switch which services the three unit substations with a 3000A switchboard that provides power to UCSD Cal $(IT)^2$. Each substation uses a 2000 KVA step-down transformer from a 12 kV delta primary to a 480Y/277 V secondary system. From there, the voltage is distributed to the various distribution panels and panel boards accordingly. One 2500A, 3 phase, 4 wire 480Y/277V Plug-in Bus Riser feeds off the first unit substation distributing power to the upper floors of the tower. More step-down transformers exist to drop the 480Y/277V primary voltage to the 208Y/120V secondary system for receptacles and some lighting.

Emergency Power

Cal $(IT)^2$ uses a 750 kW 3 phase, 4 wire standby emergency diesel powered generator. In case of a power outage, there are three automatic transfer switches to transfer the power from the emergency generator to the emergency panel boards. The panel boards include certain receptacle loads, emergency lighting loads, and emergency mechanical equipment including the elevator load. The three automatic transfer switches are sized 225A, 400A, and 1000A respectively, all 4 pole.

Overcurrent Protection Devices

For overcurrent protection, my building contains many circuit breakers and load interrupter switches to protect and isolate the problem in case of such an incident. Each unit substation contains a load interrupter switch and fuse rated at 100E. Just beyond each of those are 3000A forced air circuit breakers for each switchboard. From there, each line going to a busway, distribution panel, or panel boards are circuit breakers sized accordingly. Each substation is also connected to the next with a 3000A forced air circuit breaker. In case of failure of one substation, it can be shut down and isolated to fix the problem with the others still operating.

Power Factor Correction

There are currently no capacitors in the UCSD Cal $(IT)^2$ electrical system. Once the system is up and running, a study might be done to confirm a correction is not needed.

Equipment Location

Power from the utility company is fed into the building on the eastern end facing the courtyard. It is fed directly into the electrical room on the bottom floor. The emergency generator is located on the southern end of the building in an exterior room attached to the building. The three substations that are powered from the 12kV line are located in the electrical room on the first floor which is adjacent to the pumping room and clean room electrical closet. From here, the power is distributed to the distribution panels and the main 2500A busway riser for the 6 story tower. The other panelboards are located in server rooms and electrical closets on the various floors.

Design Requirements

Because my building is located in San Diego, CA, I must take into account the standards used by California Energy Code Title 24 which is slightly stricter than the current version of the NEC. One issue surrounding Cal $(IT)^2$ is the emergency power being provided. In case of a power outage, a large portion of the power will have to serve the computer storage server rooms as well as emergency lighting, receptacles, and elevator loads for evacuation.

Another issue is the control system by which the lighting is turned on and off. Currently, a Lutron Grafic Eye system is in place with occupancy sensors for smaller rooms and the large open office areas. With Title 24, the lighting power densities must be very low compared to the NEC codes as seen in my previous lighting system report. With this small allowance, energy is saved on the electric bill as seen in the utility rate structure in the last section of this report.

Another design consideration is spare room for power addition. Because this is a technological research facility, more room should be left to add more sophisticated equipment in the future as well as growth for the building itself. Since some conductors are traveling more than 100ft in some cases, voltage drop would also be a consideration in the design of the system.

Transformer Summary

As seen below, all the transformers are step-down transformers from a primary voltage of 480/277V to a secondary voltage of 208/120V. The three main transformers in the substations are not shown in the chart. All three transformers are 2000 KVA 12kV Delta primary to a 480Y/277V secondary.

Transformers								
Designation	KVA	Voltage (primary)	Voltage (Second.)	Phase	Type	Primary Feeder	Secondary Feeder	SUBSTATION
ET-1B	30	480/277	208/120	3	DRY TYPE	2	8	A
ET-2A	45	480/277	208/120	3	DRY TYPE	4	11	A
ET-4A	45	480/277	208/120	3	DRY TYPE	4	11	A
ET-BA	30	480/277	208/120	3	DRY TYPE	2	8	A
ET-ELEV-PA	15	480/277	208/120	3	DRY TYPE	1	3	A
ETK-1A	300	480/277	208/120	3	DRY TYPE	23	31	C
T-1B	750	480/277	208/120	3	DRY TYPE	32	34	B
T-1C	500	480/277	208/120	3	DRY TYPE	27	33	B
T-1F	30	480/277	208/120	3	DRY TYPE	2	8	B
TK-1A	225	480/277	208/120	3	DRY TYPE	19	29	C
TK-1D	225	480/277	208/120	3	DRY TYPE	19	29	B
TK-1E	75	480/277	208/120	3	DRY TYPE	10	18	B
TK-1G	75	480/277	208/120	3	DRY TYPE	7	17	C
TK-2A	225	480/277	208/120	3	DRY TYPE	19	29	A
TK-3A	225	480/277	208/120	3	DRY TYPE	19	29	A
TK-4A	225	480/277	208/120	3	DRY TYPE	19	29	A
TK-5A	150	480/277	208/120	3	DRY TYPE	15	25	A
TK-5B	225	480/277	208/120	3	DRY TYPE	19	29	A
TK-6A	150	480/277	208/120	3	DRY TYPE	15	25	A
TK-6B	225	480/277	208/120	3	DRY TYPE	19	29	A
TK-BA	112.5	480/277	208/120	3	DRY TYPE	13	22	C
TK-BB	150	480/277	208/120	3	DRY TYPE	15	24	C
T-PA	45	480/277	208/120	3	DRY TYPE	4	11	A

Feeders

The following chart shows all the feeders that exist in the building. These will help distinguish the correct feeder sizing in my analysis.

Feeder Sizes			
Feeder Number	Wire	Conduit	Ground
1	4 #12	1/2"	1 #12
2	4 #6	1"	1 #10
3	5 #6	1 1/4"	1 #10
4	4 #4	1 1/4"	1 #8
5	5 #4	1 1/4"	1 #8
6	5 #2	1 1/2"	1 #8
7	4 #1	1 1/2"	1 #8
8	5 #1	2"	1 #8
9	6 #1	2"	1 #8
10	4 #1	1 1/2"	1 #6
11	5 #1/0	2"	1 #6
12	7 #1/0	2 1/2"	2 #6
13	4 #2/0	2"	1 #6
14	5 #3/0	2 1/2"	1 #6
15	4 #4/0	2 1/2"	1 #4
16	5 #4/0	2 1/2"	1 #4
17	6 #4/0	3"	1 #4
18	7 #4/0	3"	2 #4
19	4 #500MCM	3 1/2"	1 #2
20	5 #3/0	(2) 2 1/2"	1 #2
21	6 #3/0	(2) 2 1/2"	1 #2
22	7 #3/0	(2) 3"	2 #2
23	4 #4/0	(2) 2 1/2"	1 #2
24	6 #250MCM	(2) 3"	1 #1
25	7 #250MCM	(2) 3 1/2"	2 #1
26	5 #350MCM	(2) 3 1/2"	1 #1
27	4 #500MCM	(2) 3 1/2"	1 #1/0
28	5 #300MCM	(3) 3"	1 #1/0
29	7 #300MCM	(3) 3 1/2"	2 #1/0
30	5 #400MCM	(3) 3 1/2"	1 #2/0
31	7 #400MCM	(3) 4"	2 #2/0
32	4 #350MCM	(4) 3"	1 #3/0
33	5 #400MCM	(5) 3 1/2"	1 #4/0
34	5 #500MCM	(7) 4"	1 #350MCM
35	5 #500MCM	(8) 4"	1 #400MCM

Typical Lighting Systems

In Cal $(IT)^2$, most of the lighting is using 277V T8 fluorescents or 32W triple tube compact fluorescents. The ballasts used are mostly not dimmable and have a ballast factor of 0.88. Incandescent and halogen lamps are on the 120V system but are very few in quantity. The ballasts were taken from *Advance Transformers* since the actual ballasts used were not known.

Primary Lamps

Primary Lamps

Lamp Type	Lamp Watts	Qty/Ballast	Volts	Ballast	Ballast Factor	Power Factor	Input Watts	Current (Amps)
100W PAR38 Tungsten Halogen	100	N/A	120V	Electronic	N/A	N/A	100	0.43
13W T4 quad CFL	13	1	120V	Electronic	0.93	0.42	18	0.35
150W ED-17 MH	150	1	277V	Electronic	1.00	> 0.90	173	0.75
200W A-lamp incandescent	200	N/A	120V	Electronic	N/A	N/A	200	0.61
24W T5 BIAX CFL	24	2	277V	Electronic	1.00	0.99	54	0.20
25W T8 Linear FL	25	2	277V	Electronic	0.88	0.99	49	0.18
26W T4 quad CFL	26	2	277V	Electronic	1.00	0.99	56	0.21
300W PAR56 Incandescent	300	N/A	120V	Electronic	N/A	N/A	300	0.40
32W T4 Triple Tube CFL	32	1	277V	Electronic	0.98	0.98	36	0.31
32W T8 Linear FL	32	2	277V	Electronic	0.88	0.99	59	0.21
39W PAR30 Compact Metal Halide	39	1	277V	Electronic	1.00	> 0.90	54	0.24
40W T4 BIAX CFL	40	1	277V	Electronic	0.95	0.96	45	0.20
40W T5 BIAX CFL	40	1	277V	Electronic	0.95	0.96	45	0.20
42W T4 Triple Tube CFL	42	1	277V	Electronic	0.98	0.98	46	0.38
50W AR111 Tungsten Halogen	50	N/A	120V	Electronic	N/A	N/A	50	0.42
50W ED17 Compact Metal Halide	50	1	277V	Electronic	1.00	> 0.90	62	0.35
50W MR16 Tungsten Halogen	50	N/A	120V	Electronic	N/A	N/A	50	0.42
50W PAR30 Tungsten Halogen	50	N/A	120V	Electronic	N/A	N/A	50	0.41
60W MB19 Incandescent	60	N/A	120V	Electronic	N/A	N/A	60	0.50
60W PAR38 Tungsten Halogen	60	N/A	120V	Electronic	N/A	N/A	60	0.51
70W PAR38 Compact Metal Halide	70	1	277V	Electronic	1.00	> 0.90	90	0.28
90W T-21 LPS	90	1	277V	Electronic	1.00	N/A	125W	0.50

Mechanical Equipment

Below are charts listing the mechanical equipment present in the Cal (IT)2 building. All list the KVA and the total power consumed by the mechanical load is found on the bottom of the chart.

Mechanical Equipment					
Equipment	**Type**	**Voltage**	**Phase**	**Power**	**KVA**
CAC 1-1	Comp. AC fan	480V	3	5HP	3.73
AC 7-1	Evaporator Fan	480V	3	1/3HP	0.25
AC 7-1	Condenser Fan	480V	3	1/5HP	0.15
AC 7-2	Evaporator Fan	480V	3	1/3HP	0.25
AC 7-2	Condenser Fan	480V	3	1/5HP	0.15
AHU 1-1	Air Handling Unit Supply Fan Motor	480V	3	60HP	44.74
AHU 2-1	Air Handling Unit Supply Fan Motor	480V	3	30HP	22.37
AHU 2-10	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-11	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-12	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-13	Clean Room Air Handling Unit Supply Fan Motor	480V	3	40HP	29.83
AHU 2-14	Clean Room Air Handling Unit Supply Fan Motor	480V	3	40HP	29.83
AHU 2-2	Air Handling Unit Supply Fan Motor	480V	3	30HP	22.37
AHU 2-3	Air Handling Unit Supply Fan Motor	480V	3	15HP	11.19
AHU 2-4	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-5	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-6	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-7	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-8	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 2-9	Clean Room Air Handling Unit Supply Fan Motor	480V	3	10HP	7.46
AHU 7-1	Air Handling Unit Motor	480V	3	160HP	119.31
AHU 7-2	Air Handling Unit Motor	480V	3	160HP	119.31
CA 1,2	Compressor	480V	3	2 @ 15HP	22.37
CAC 1-2	Comp. AC fan	480V	3	5HP	3.73
CAC 1-3	Comp. AC fan	480V	3	5HP	3.73
CH - 1	Air Cooled Chiller	480V	3	1HP	0.75

Mechanical Equipment					
Equipment	Type	Voltage	Phase	Power	KVA
CHWP-1	Chilled Water Pump	480V	3	30HP	22.37
CHWP-2	Chilled Water Pump	480V	3	30HP	22.37
CHWP-3	Chilled Water Pump	480V	3	15HP	11.19
CHWP-4	Chilled Water Pump	480V	3	15HP	11.19
CHWP-5	Chilled Water Pump	480V	3	5HP	3.73
CHWP-6	Chilled Water Pump	480V	3	5HP	3.73
CP 1a,b	Circulating Pump	120V	1	2 @ 1/3HP	0.5
CP 2a,b	Circulating Pump	120V	1	2 @ 1/3HP	0.5
CP 3,4	Circulating Pump	480V	3	2 @ 1.5HP	2.24
CP 5,6	Circulating Pump	480V	3	2 @ 1.5HP	2.24
CS - 1	Company Switch	208V	3	36.02 kW	36.02
CS - 2	Company Switch	208V	3	36.02 kW	36.02
DR - 1	Compressed Air Dryer	208V	1	0.74 kW	0.74
EF 1-1	Fan	120V	1	0.325 kW	0.325
EF 1-2	Fan	480V	3	2HP	1.49
EF 1-3	Fan	120V	1	405 W	0.405
EF 7-1	Fan	480V	3	3HP	2.24
EF 7-2	Fan	480V	3	3HP	2.24
EF 7-3	Fan	480V	3	30HP	22.37
EF 7-4	Fan	480V	3	30HP	22.37
EF 7-5	Fan	480V	3	3HP	2.24
EF 7-6	Fan	120V	1	1/60HP	0.75
Elev 1	Elevator Motor	480V	3	40HP	29.83
Elev 2	Elevator Motor	480V	3	40HP	29.83
Elev 3	Elevator Motor	480V	3	40HP	29.83
Elev 4	Elevator Motor	480V	3	20HP	14.91
Esp 1	Elevator Sump Pump	120V	1	0.5HP	0.37
Esp 2	Elevator Sump Pump	120V	1	0.5HP	0.37
FC 1-1	Fan Coil (Cooling)	480V	3	3HP	2.24
FC 1-2	Fan Coil (Cooling)	480V	3	2HP	1.49
HWP-1	Hot Water Pump	480V	3	10HP	7.46
HWP-2	Hot Water Pump	480V	3	10HP	7.46
LNVP - 1	Liquid Nitrogen Vacuum Pump	120V	1	0.720 kW	0.72
RF 1-1	Fan	480V	3	30HP	22.37
SF 1-1	Fan	480V	3	5HP	3.73
SF 1-2	Fan	480V	3	1HP	0.75
VAC 1,2	Vacuum Pump	480V	3	2 @ 10HP	14.91
				Total Connected KVA	874.74
				Total Demand KVA	815.085

Note: A demand factor of 0.5 was applied to the largest motor.

Lighting Loads

The lighting loads were calculated using the space-by-space method of areas and occupancy types. All the unit load values were taken from the *NEC 2002 table 220.3(A)*.

Lighting Loads			
Occupancy	Area (SF)	Unit Load (VA/SF)	Total Load KVA
Office	113222	3.50	396.28
Laboratory	29470	3.00	88.41
Corridor	33155	0.50	16.58
Restrooms	4399	1.00	4.40
Storage (including Electrical Room and Server Rooms)	11429	0.25	2.86
Gallery	600	calculated	2.13
Multi-purpose	1795	calculated	2.16
Theater	3098	calculated	7.50
Lounge	825	1.50	1.24
Kitchen Areas	859	2.00	1.72
		Total Connected KVA	523.26

Based on observation, substation A contains 5/7 the lighting load and substations B and C both conatin about 1/7 of the total load.	US-1A	373.76
	US-1B	74.75
	US-1C	74.75

Note: No demand factors were applied for the lighting loads.

Substation Loads

For Cal $(IT)^2$, I studied the size of the three unit substations to make sure they were sized properly as well as the feeder sizes and transformer ratings. I separated the loads into each substation accordingly and summed the KVA with demand factors to reach my estimate. I then compared the size given and made comments.

Unit Substation US-1A

Receptacle Load

Unit Substation 1A Receptacle Load

Distribution Panel / Panel Board	180VA Receptacles	180VA Receptacles KVA	Dedicated Receptacles	Dedicated Receptacle KVA	Total KVA
ELP-ELEV-PA	2	0.36	0	0	0.36
ELP-2A	6	1.08	0	0	1.08
ELP-4A	6	1.08	0	0	1.08
ELP-BA	9	1.62	0	0	1.62
ELP-1E	12	2.16	4	1.12	3.28
LP-2A	166	29.88	7	7	36.88
LP-2B	107	19.26	2	2	21.26
LP-2C	79	14.22	6	6	20.22
LP-3A	213	38.34	0	0	38.34
LP-3B	144	25.92	0	0	25.92
LP-3C	78	14.04	7	7	21.04
LP-4A	177	31.86	7	7	38.86
LP-4B	116	20.88	2	2	22.88
LP-4C	64	11.52	7	7	18.52
LP-5A	55	9.9	7	7	16.9
LP-5B	114	20.52	2	2	22.52
LP-5C	67	12.06	3	4.8	16.86
LP-6A	92	16.56	13	13	29.56
LP-6B	114	20.52	2	2	22.52
LP-6C	57	10.26	1	1	11.26
LP-PA	9	1.62	0	0	1.62
LP-PB	0	0	22	13.2	13.2
				Total Connected KVA	385.78
				Total Demand KVA	197.89

Note: A demand factor of 1.0 was applied for the first 10 KVA and 0.5 for the remaining KVA.

Mechanical Load

Unit Substation 1A Mechanical Load			
Distribution Panel	Mechanical Equipment	KVA	Total KVA
DPH-1C	CA - 1,2	22.37	
	CP - 3,4	2.24	
	CP - 5,6	2.24	
	VAC 1,2	14.91	
	CHWP - 1	22.37	
	CHWP - 2	22.37	
	CHWP - 3	11.19	
	CHWP - 4	11.19	
	CHWP - 5	3.73	
	CHWP - 6	3.73	
	HWP - 1	7.46	
	HWP - 2	7.46	
	EF 1-2	1.49	
	SF 1-1	3.73	
	FC 1-1	2.24	
	FC 1-2	1.49	140.21
EDPH-ELEV-PA	ELEV 1	29.83	
	ELEV 2	29.83	
	ELEV 3	29.83	89.49
LPH-2A	SF 1-2	0.75	0.75
LP-PA	EF 7-6	0.75	0.75
ELP-1E	EF 1-3	0.405	0.405
		Total KVA	231.605

Note: No demand factor was applied for the mechanical load.

Equipment Loads

The equipment loads are separated into three different sections. The lab equipment loads contain the equipment used for research, special machine loads, and specialized hardware for technological advancement. The kitchen equipment contains the refrigerators, microwaves, and various other kitchen appliances used on all the floors for a kitchenette area. The miscellaneous load section is for the various equipment, such as fire alarms and security systems, that are not included in the above loads.

1A Lab Equipment Loads			
Panelboard	Connected Load KVA	Amps	Total KVA
LP-L5A	38.74	107.6	
LP-L5B	36.64	101.7	
LP-L5C	31.44	87.3	
LP-L5D	20.88	58	
LP-L5E	32.44	90.1	
LP-L5F	20.76	57.6	
LP-L6A	21.9	60.8	
LP-L6B	37.12	103.1	
LP-L6C	18.18	50.5	
LP-L6D	37.12	103.1	
LP-L6E	29.52	82	
LP-L6F	30.78	85.5	
LP-L6G	37.12	103.1	
		TOTAL	392.64

1A Misc. Equipment (incl. Fire Alarm)		
Panelboard	Connected Load KVA	Total KVA
ELP-ELEV-PA	2.22	
ELP-BA	0.4	
ELP-2A	7.8	
ELP-4A	7.8	
ELP-1E	16.48	
LP-6C	18.8	
	Total	53.5

1A Office Equipment

Panelboard	Description	Connected Load KVA	Total KVA
LP-2A	printer	1.68	
	fax	0.94	
	copier	1.92	4.54
LP-2B	printer	1.68	1.68
LP-2C	copier	1.62	
	projection screen	1	2.62
LP-3A	printer	1.68	
	fax	0.94	
	copier	1.9	4.52
LP-3B	printer	1.68	1.68
LP-3C	copier	1.68	1.68
LP-4A	printer	1.68	
	fax	0.94	
	copier	1.92	
	projection screen	1	5.54
LP-4B	printer	1.68	1.68
LP-4C	copier	1.68	1.68
LP-5A	copier	1.92	
	printer	1.68	
	projection screen	1	4.6
LP-5B	printer	1.68	1.68
LP-5C	projection screen	1	1
LP-6A	printer	1.68	
	fax	0.94	
	copier	1.92	
	projection screen	1	5.54
LP-6B	printer	1.68	1.68
LP-6C	copier	1.68	1.68
		Total	**41.8**

1A Kitchen Equipment			
Panelboard	Description	Connected Load KVA	Total KVA
LP-2A	Vending machines	3.84	3.84
LP-2B	Refrigerator	1.8	
	Coffee	1.8	
	Garbage Disposal	0.865	
	Microwave	1.56	6.025
LP-3B	Vending Machines	3.84	
	Refrigerator	1.8	
	Microwave	1.56	
	Coffee	1.8	
	Garbage Disposal	0.6	9.6
LP-4B	Vending Machines	3.84	
	Refrigerator	1.8	
	Microwave	1.56	
	Coffee	1.8	
	Garbage Disposal	0.835	9.835
LP-5A	Refrigerator	1.8	
	Coffee	1.8	
	Garbage Disposal	0.96	
	Microwave	1.56	6.12
LP-5B	Vending machines	3.84	
	Refrigerator	1.8	
	Garbage Disposal	0.8	
	Coffee	1.74	
	Microwave	1.56	9.74
LP-6B	Vending machines	3.84	
	Refrigerator	1.8	
	Garbage Disposal	0.96	
	Coffee	1.8	
	Microwave	1.56	9.96
	Total Demand KVA		**35.828**

Note: A demand factor of 0.65 was applied to all kitchen loads. *NEC 2002 table 220.20.*

Total Load for US-1A

US-1A Total Load	
Load	**Demand Load**
Lighting	373.76
Receptacles	197.9
Mechanical	216.7
Lab Equipment	392.64
Office Equipment	41.8
Kitchen Equipment	35.828
Misc. Equipment	53.5
	1312.128

The given switchboard is sized as noted:
(3000A) * (0.480 kW) * sqrt(3) = 2494 KVA
2494KVA > 1312 KVA so, US-1A is sized appropriately.

Unit Substation US-1B

Receptacle Load

Unit Substation 1B Receptacle Load					
Distribution Panel / Panel Board	180VA Receptacles	180VA Receptacles KVA	Dedicated Receptacles	Dedicated Receptacle KVA	Total KVA
DSL-L1A	5	0.9	0	0	0.9
DSL-L1B	29	5.22	0	0	5.22
LP-1B	2	0.36	0	0	0.36
LP-1G	71	12.78	7	6.1	18.88
LP-1H	20	3.6	0	0	3.6
				Total Connected KVA	28.96
				Total Demand KVA	19.48

Note: A demand factor of 1.0 was applied for the first 10 KVA and 0.5 for the remaining KVA.

Mechanical Load

Unit Substation 1B Mechanical Load			
Distribution Panel	Mechanical Equipment	KVA	Total KVA
LP-1B	DR - 1	0.74	
	CP - 1	0.5	
	CP - 2	0.5	1.74
		Total KVA	1.74

Note: No demand factor was applied for the mechanical load.

Equipment Loads

The equipment loads are separated into three different sections. The lab equipment loads contain the equipment used for research, special machine loads, and specialized hardware for technological advancement. The kitchen equipment contains the refrigerators, microwaves, and various other kitchen appliances used on all the floors for a kitchenette area. The miscellaneous load section is for the various equipment, such as fire alarms and security systems, that are not included in the above loads.

1B Lab Equipment Loads

Panelboard	Connected Load	Amps	Total
LP-L1A	50.08	139	
LP-L1B	49.72	138	
LP-L1C	85.292	181.3	
LP-L1D	63.54	176.4	
LP-L1E	55.04	152.8	
LP-L1F	33.9	94.1	
LP-L1G	55.04	152.8	
LP-L1H	18.8	52.2	
LP-L1J(1)	85.6	237.6	
LP-L1J(2)	23.92	66.4	
LP-L1K(1)	122.2	339.3	
LP-L1K(2)	21.52	59.7	
LP-L1L(1)	72.1	200.2	
LP-L1L(2)	23.92	66.4	
LP-L1M	39.82	110.5	
LP-L1N	37.04	102.8	
LP-L1P	105.3	292.3	
LP-L1Q	46.64	129.5	
LP-L1R	9.66	26.8	
LP-L1S	74.1	205.7	
LP-L1T	91.56	254.2	
LP-L1U	97.16	259.7	
LP-L1V	86.82	241	
LP-L1W	63.6	176.6	
LP-L1X	11.94	33.1	
		TOTAL	1424.312

1B Misc. Equipment

Panelboard	Connected Load KVA	Total KVA
LPH-1C	12.315	
LP-1B	6.6	
LP-1G	0.528	
	Total	19.443

1B Office Equipment			
Panelboard	Description	Connected Load KVA	Total KVA
LP-1G	copiers	3.8	
	printer	1.68	5.48
		Total	5.48

1B Kitchen Equipment			
Panelboard	Description	Connected Load KVA	Total KVA
LP-1G	U/C Refrigerator	1.52	
	Microwave	3	
	Garbage Disposal	1.92	
	Coffee	3.48	9.92
		Total	6.448

Note: A demand factor of 0.65 was applied to all kitchen loads. *NEC 2002 table 220.20.*

Total Load for US-1B

US-1B Total Load	
Load	Demand Load KVA
Lighting	74.75
Receptacles	19.48
Mechanical	1.37
Lab Equipment	1424.3
Office Equipment	5.48
Kitchen Equipment	6.45
Misc. Equipment	19.443
	1551.273

The given switchboard is sized as noted:
(3000A) * (0.480 kW) * sqrt(3) = 2494 KVA
2494KVA > 1551 KVA so, US-1B is sized appropriately.

Unit Substation US-1C

Receptacle Load

Unit Substation 1C Receptacle Load					
Distribution Panel / Panel Board	180VA Receptacles	180VA Receptacles KVA	Dedicated Receptacles	Dedicated Receptacle KVA	Total KVA
DPLM1A	789	142.02	78	76.28	218.3
DPLM1B	132	23.76	0	0	23.76
LP-M2A	28	5.04	25	25.5	30.54
LP-M2B	44	7.92	19	21	28.92
LP-M2C	140	25.2	5	8	33.2
LP-M2D	43	7.74	25	16	23.74
LP-M2E	49	8.82	0	0	8.82
				Total Connected KVA	367.28
				Total Demand KVA	188.64

Note: A demand factor of 1.0 was applied for the first 10 KVA and 0.5 for the remaining KVA.

Mechanical Load

Unit Substation 1C Mechanical Load			
Distribution Panel	Mechanical Equipment	KVA	Total KVA
DPH-PA	AHU 7-1	119.31	
	AHU 7-2	119.31	
	EF 7-5	2.24	240.86
DPH-1A	Elev 4	14.91	14.91
DPL-BA	CS - 1	36.02	
	CS - 2	36.02	72.04
DPH-BA	AHU 1-1	44.74	
	RF 1-1	22.37	67.11
EDPH-1B	CH 1-1	0.75	
	CAC 1-1	3.73	
	CAC 1-2	3.73	
	CAC 1-3	3.73	11.94

EDPH-2A	AHU 2-1	22.37	
	AHU 2-2	22.37	
	AHU 2-3	11.19	
	AHU 2-4	7.46	
	AHU 2-5	7.46	
	AHU 2-6	7.46	
	AHU 2-7	7.46	
	AHU 2-8	7.46	
	AHU 2-9	7.46	
	AHU 2-10	7.46	
	AHU 2-11	7.46	
	AHU 2-12	7.46	
	AHU 2-13	29.83	
	AHU 2-14	29.83	182.73
EDPH-PA	EF 7-1	2.24	
	EF 7-2	2.24	
	EF 7-3	22.37	
	EF 7-4	22.37	
	AC 7-1	0.15	
	AC 7-2	0.25	49.62
		Total KVA	**639.21**

Note: No demand factor was applied for the mechanical load.

Equipment Loads

The equipment loads are separated into two different sections. The lab equipment loads contain the equipment used for research, special machine loads, and specialized hardware for technological advancement. The Theater load section contains the loads associated specifically for

1C Lab Equipment Loads			
Panelboard	Connected Load KVA	Amps	Total KVA
ELP-1A	46.8	129.9	
ELP-1B(1)	100.8	279.5	
ELP-1B(2)	21.6	60	
ELP-1C	91.91	255.2	
ELP-1D	65.3	181.3	
		TOTAL	326.41

1C Theater Equipment			
Panelboard	Description	Connected Load KVA	Total KVA
LP-M1G(1)	Theater Projector	32.4	32.4
LP-M2B	Theater Drapery	2.4	2.4
		Total	34.8

Total Load for US-1C

US-1C Total Load	
Panelboard	Connected Load KVA
Lighting	74.75
Receptacles	188.64
Mechanical	579.55
Lab Equipment	326.41
Theater Equipment	34.8
	1204.15

The given switchboard is sized as noted:
(3000A) * (0.480 kW) * sqrt(3) = 2494 KVA
2494KVA > 1204.15 KVA so, US-1C is sized appropriately.

Feeder and Circuit Breaker Sizing

US-1A:

(1312.128 KVA) / (12 kV) = 109.34 A
(109.34 A)*1.25*1.25 = 170.85 A

- Multiplying by 1.25 twice allows for future growth and if there exists a voltage drop.
- Based on my calculation, the feeder size is: (4) #1 & (1) #6 ground.
- The designed feeder ((4) #500MCM & (1) #4/0 ground) was sized extremely high possibly for future growth because of the nature of the building's use.

(1312.128 KVA) / (0.48kV * sqrt(3)) = 1578 A → 2000 A Ckt. Bkr.

The Circuit Breaker designed was much higher once again. A 3000A circuit breaker exists there now.

US-1B:

(1551.273 KVA) / (12 kV) = 129.2728A
(129.2728 A)*1.25*1.25 = 202 A

- Multiplying by 1.25 twice allows for future growth and if there exists a voltage drop.
- Based on my calculation, the feeder size is: (4) #1/0 & (1) #4 ground.
- The designed feeder ((4) #500MCM & (1) #4/0 ground) was sized extremely high possibly for future growth because of the nature of the building's use.

(1551.273 KVA) / (0.48kV * sqrt(3)) = 1865.9 A → 2000 A Ckt. Bkr.

The Circuit Breaker designed was much higher once again. A 3000A circuit breaker exists there now.

US-1C:

(1204.15 KVA) / (12 kV) = 100.35 A
(100.35 A)*1.25*1.25 = 156.79 A

- Multiplying by 1.25 twice allows for future growth and if there exists a voltage drop.
- Based on my calculation, the feeder size is: (4) #2 & (1) #6 ground.
- The designed feeder ((4) #500MCM & (1) #4/0 ground) was sized extremely high possibly for future growth because of the nature of the building's use.

(1204.15 KVA) / (0.48kV * sqrt(3)) = 1448.4 A → 2000 A Ckt. Bkr.

The Circuit Breaker designed was much higher once again. A 3000A circuit breaker exists there now.

Utility Rate Structure

Below is a San Diego Gas & Electric rate structure for the San Deigo area. Since the building is not yet functioning, a utility bill is not given.

SCHEDULE AL-TOU Sheet 1

GENERAL SERVICE - TIME METERED

APPLICABILITY

Applicable to all metered non-residential customers whose monthly maximum demand equals, exceeds, or is expected to equal or exceed 20 kW. This schedule is optionally available to three-phase residential service, residential common use areas, and to metered non-residential customers whose Monthly Maximum Demand is less than 20 kW. Any customer whose Maximum Monthly Demand has fallen below 20 kW for three consecutive months may, at their option, elect to continue service under this schedule or be served under any other applicable schedule. This schedule is the utility's standard tariff for commercial and industrial customers with a Monthly Maximum Demand equaling or exceeding 20 kW.

Non-profit group living facilities taking service under this schedule may be eligible for a 20% California Alternate Rates for Energy (CARE) discount on their bill, if such facilities qualify to receive service under the terms and conditions of Schedule E-LI.

Agricultural Employee Housing Facilities, as defined in Schedule E-LI, may qualify for a 20% CARE discount on the bill if all eligibility criteria set forth in Form 142-4032 is met.

TERRITORY

Within the entire territory served by the Utility.

RATES

Description	Transm	Distr	PPP	ND	FTA[1]	CTC	RS	UDC Total
Basic Service Fees								
($/month)								
0-500 kW								
Secondary		48.52						48.52
Primary		48.52						48.52
Secondary Substa.		13858.43						13858.43
Primary Substation		13858.43						13858.43
Transmission		61.36						61.36
> 500 kW								
Secondary		194.06						194.06
Primary		194.06						194.06
Secondary Substa.		13858.43						13858.43
Primary Substation		13858.43						13858.43
Transmission		245.49						245.49
> 12 MW								
Secondary Substa.		21820.90						21820.90
Primary Substation		21820.90						21820.90
Trans. Multiple Bus		3,000.00						3,000.00
Distance Adjust. Fee								
Secondary - OH		1.23						1.23
Secondary - UG		3.17						3.17
Primary - OH		1.22						1.22
Primary - UG		3.13						3.13

[1] For residential and small commercial customers as defined in Rule 1 – Definitions, and as described in Public Utilities Code Section 331(h), FTA rates will be adjusted in accordance with the rates set forth in Schedule FTA.

(Continued)

SCHEDULE AL-TOU

GENERAL SERVICE - TIME METERED

RATES (Continued)

Description	Transm	Distr	PPP	ND		FTA[1]	CTC	RS	UDC Total	
Energy Charges ($/kWh)										
On-Peak - Summer										
Secondary	(0.00155)		0.00576	0.00046	R		0.00578	0.00378	**0.01423**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00563	0.00378	**0.01408**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00578	0.00378	**0.01423**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00544	0.00378	**0.01389**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00540	0.00378	**0.01385**	R
Semi-Peak – Summer										
Secondary	(0.00155)		0.00576	0.00046	R		0.00337	0.00378	**0.01182**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00330	0.00378	**0.01175**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00337	0.00378	**0.01182**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00321	0.00378	**0.01166**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00318	0.00378	**0.01163**	R
Off-Peak – Summer										
Secondary	(0.00155)		0.00576	0.00046	R		0.00265	0.00378	**0.01110**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00261	0.00378	**0.01106**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00265	0.00378	**0.01110**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00257	0.00378	**0.01102**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00255	0.00378	**0.01100**	R
On-Peak – Winter										
Secondary	(0.00155)		0.00576	0.00046	R		0.00483	0.00378	**0.01328**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00471	0.00378	**0.01316**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00483	0.00378	**0.01328**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00455	0.00378	**0.01300**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00453	0.00378	**0.01298**	R
Semi-Peak – Winter										
Secondary	(0.00155)		0.00576	0.00046	R		0.00339	0.00378	**0.01184**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00331	0.00378	**0.01176**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00339	0.00378	**0.01184**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00322	0.00378	**0.01167**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00320	0.00378	**0.01165**	R
Off-Peak - Winter										
Secondary	(0.00155)		0.00576	0.00046	R		0.00268	0.00378	**0.01113**	R
Primary	(0.00155)		0.00576	0.00046	R		0.00264	0.00378	**0.01109**	R
Secondary Substation	(0.00155)		0.00576	0.00046	R		0.00268	0.00378	**0.01113**	R
Primary Substation	(0.00155)		0.00576	0.00046	R		0.00259	0.00378	**0.01104**	R
Transmission	(0.00155)		0.00576	0.00046	R		0.00257	0.00378	**0.01102**	R

Notes: Transmission Energy charges include the Transmission Revenue Balancing Account Adjustment (TRBAA) of ($.00166) per kWh and the Transmission Access Charge Balancing Account Adjustment (TACBAA) of $.00009 per kWh. PPP rate is composed of: Low Income PPP rate (LI-PPP) $.00162/kWh, Non-low Income PPP rate (Non-LI-PPP) $.00256/kWh (pursuant to PU Code Section 399.8, the Non-LI-PPP rate may not exceed January 1, 2000 levels), and Procurement Energy Efficiency Surcharge Rate of $.00158/kWh.

[1] For residential and small commercial customers as defined in Rule 1 – Definitions, and as described in Public Utilities Code Section 331(h), FTA rates will be adjusted in accordance with the rates set forth in Schedule FTA.

(Continued)

SCHEDULE AL-TOU

GENERAL SERVICE - TIME METERED

RATES (Continued)

Description	Transm	Distr	PPP	ND	FTA[1]	CTC	RS	UDC Total
Demand Charges ($/kW)								
Non-Coincident								
Secondary	2.79	6.56 I				0.34	2.33	**12.02** I
Primary	2.69	6.46 I				0.31	2.25	**11.71** I
Secondary Substation	2.79					0.34	2.33	**5.46**
Primary Substation	2.69					0.03	2.25	**4.97**
Transmission	2.66					0.03	2.23	**4.92**
Maximum On-Peak								
Summer								
Secondary		4.29 I				1.50		**5.79** I
Primary		4.15 I				1.46		**5.61** I
Secondary Substation						1.50		**1.50**
Primary Substation						1.07		**1.07**
Transmission						1.06		**1.06**
Winter								
Secondary		3.65 I				0.35		**4.00** I
Primary		3.64 I				0.34		**3.98** I
Secondary Substation						0.35		**0.35**
Primary Substation						0.22		**0.22**
Transmission						0.22		**0.22**
Power Factor ($/kvar)								
Secondary		0.25						**0.25**
Primary		0.25						**0.25**
Secondary Substation		0.25						**0.25**
Primary Substation		0.25						**0.25**
Transmission								

[1] For residential and small commercial customers as defined in Rule 1 – Definitions, and as described in Public Utilities Code Section 331(h), FTA rates will be adjusted in accordance with the rates set forth in Schedule FTA.

(Continued)

SCHEDULE AL-TOU

GENERAL SERVICE - TIME METERED

RATES (Continued)

Rate Components
The Utility Distribution Company Total Rates (UDC Total) shown above are comprised of the following components (if applicable): (1) Transmission (Trans) Charges, (2) Distribution (Distr) Charges, (3) Public Purpose Program (PPP) Charges, (4) Nuclear Decommissioning (ND) Charge, (5) Trust Transfer Amount (TTA), sometimes referred to as Fixed Transition Amount (FTA), (6) Ongoing Competition Transition Charges (CTC), and (7) Reliability Services (RS).

Utility Distribution Company (UDC) Total Rate shown above excludes any applicable commodity charges associated with Schedule EECC (Electric Energy Commodity Cost) and Schedule DWR-BC (Department of Water Resources Bond Charge).

Time Periods
All time periods listed are applicable to local time. The definition of time will be based upon the date service is rendered.

	Summer May 1 - Sept 30	Winter All Other
On-Peak	11 a.m. - 6 p.m. Weekdays	5 p.m. - 8 p.m. Weekdays
Semi-Peak	6 a.m. - 11 a.m. Weekdays	6 a.m. - 5 p.m. Weekdays
	6 p.m. - 10 p.m. Weekdays	8 p.m. - 10 p.m. Weekdays
Off-Peak	10 p.m. - 6 a.m. Weekdays	10 p.m. - 6 a.m. Weekdays
	Plus Weekends & Holidays	Plus Weekends & Holidays

Non-Standard Seasonal Changeover
Customers may select on an optional basis to start the summer billing period on the first Monday of May and to start the winter billing period on the first Monday of October. Customers electing this option will be charged an additional $100 per year for metering equipment and programming.

Franchise Fee Differential
A Franchise Fee Differential of 5.78% will be applied to the monthly billings calculated under this schedule for all customers within the corporate limits of the City of San Diego. Such Franchise Fee Differential shall be so indicated and added as a separate item to bills rendered to such customers.

Large Customer CTC Adjustment
Large Customers, as defined in Rule 1 - Definitions, shall have a Transition Cost Balancing Account (TCBA) bill credit calculated each month that is equal to the CTC rates above, multiplied by the billing determinates as delivered by the Utility to the customer, multiplied by 1.38. This CTC adjustment is effective for a 12-month period, beginning January 1, 2005. Customers that would be billed a CTC for the output of their generator(s) will, for all billing periods commencing after the effective date of this provision, not be billed a CTC for that output. The Utility shall record this amount against the balance in the TCBA.

(Continued)

SCHEDULE AL-TOU

GENERAL SERVICE - TIME METERED

RATES (Continued)

Large Customer Commodity Credit
Large Customers, as defined in Rule 1 – Definitions, who are receiving bundled service will receive a commodity credit for a 24-month period beginning January 1, 2004. Large Customers will receive a monthly credit in the amount of $0.01313/kWh. This credit represents the return of an overcollection in the large customer subaccount of the Energy Resource Recovery Account (ERRA).

SPECIAL CONDITIONS

1. Definitions: The Definitions of terms used in this schedule are found either herein or in Rule 1.

2. Voltage: Service under this schedule normally will be supplied at a standard available Voltage in accordance with Rule 2.

3. Voltage Regulators: Voltage Regulators, if required by the customer, shall be furnished, installed, owned, and maintained by the customer.

4. Reconnection Charge: In the event that a customer terminates service under this schedule and re-initiates service under this or any other schedule at the same location within 12 months, there will be a Reconnection Charge equal to the greater of the Minimum Charge or the Basic Service Fee which would have been billed had the customer not terminated service.

5. Non-Coincident Demand Charge: The Non-Coincident Demand Charge shall be based on the higher of the Maximum Monthly Demand or 50% of the Maximum Annual Demand.

6. On-Peak Period Demand Charge: The On-Peak Period Demand Charge shall be based on the Maximum On-Peak Period Demand.

7. Power Factor: The Power Factor rate shall apply to those customers that have a Power Factor Test Failure and will be based on the Maximum Kilovar billing demand. Those customers that have a Power Factor Test Failure will be required to pay for the Power Factor Metering that the utility will install.

8. Parallel Generation Limitation. This schedule is not applicable to standby, auxiliary service or service operated in parallel with a customer's generating plant, except as specified in Rule 1 under the definition of Parallel Generation Limitation.

9. Seasonal Changeover Switching Limitation. Customers who elect the nonstandard Seasonal Changeover option of this schedule will be prohibited from switching service to the regular seasonal changeover for a 12-month period.

10. Limitation on Non-Standard Seasonal Changeover Availability. At the utility's sole option, the optional non-standard seasonal changeover provision is available to no more than ten additional Schedule AL-TOU and Schedule A6-TOU customers annually and; service will be provided in the order in which requests are received.

(Continued)

SPECIAL CONDITIONS (Continued)

11. Terms of Optional Service. A customer receiving service under this schedule may elect to change to another applicable rate schedule, but only after receiving service on this schedule for at least 12 consecutive months. If a customer elects to discontinue service on this schedule, the customer will not be permitted to return to this schedule for a period of one year.

12. Basic Service Fee Determination. The basic service fee will be determined each month based on the customer's Maximum Annual Demand.

13. Transmission Multiple Bus Basic Service Fee. This fee shall apply where a customer has at their option elected to be billed at this rate and is limited to where the customer is delivering power and taking service at one or more than one transmission service level bus even if at two or more different voltage levels, for service to a generation facility that is located on a single premise owned or operated by the customer. In such a case, the Utility shall, for the purposes of applying retail rates, combine by subtracting any generation delivered from any loads served provided, however, that for purposes of applying retail rates the difference resulting from this combining may not be less than zero. All other charges on this tariff shall also apply to the resulting combined loads.

    Any customer selecting this optional billing no later than six (6) months from the first effective date of this new rate shall, for billing purposes, have any previously incurred demand ratchet treated as a "zero" from the effective date of the change in billing forward. In addition, any standby charges shall be adjusted to the customer's contract level from the effective date of the change in billing forward until the customer's demand triggers a future change.

14. Billing. A customer's bill is first calculated according to the total rates and conditions listed above. The following adjustments are made depending on the option applicable to the customer:

    a. **UDC Bundled Service Customers** receive supply and delivery services solely from SDG&E. The customer's bill is based on the Total Rates set forth above. The EECC component is determined by multiplying the EECC price for this schedule during the last month by the customer's total usage.
    b. **Direct Access Customers** purchase energy from an energy service provider (ESP) and continue to receive delivery services from SDG&E. The bill for a Direct Access Customer will be calculated as if it were a UDC Bundled Service Customer, then crediting the bill by the amount of the EECC component, as determined for a UDC Bundled Customer.
    c. **Virtual Direct Access Customers** receive supply and delivery services solely from SDG&E. A customer taking Virtual Direct Access service must have a real-time meter installed at its premises to record hourly usage, since EECC change hourly. The bill for a Virtual Direct Access Customer will be calculated as if it were a UDC Bundled Service Customer, then crediting the bill by the amount of the EECC component, as determined for a UDC Bundled Customer, then adding the hourly EECC component, which is determined by multiplying the hourly energy used in the billing period by the hourly cost of energy.

    Nothing in this service schedule prohibits a marketer or broker from negotiating with customers the method by which their customer will pay the CTC charge.

15. Temporary Service. When service is turned on for cleaning and/or showing of an unoccupied premise above 20 kW facility, the minimal usage shall be billed under Schedule A, until a new tenant begins service. Should usage exceed 20kW at any time for cleaning and/or showing, the customer shall be billed the rates on this schedule.

(Continued)

SPECIAL CONDITIONS (Continued)

16. Multiple Meters on Single Premise. When a single corporate entity owns a contiguous property, not divided by any public right of way or property owned by another entity, and the utility has more than one meter serving that property, then, at the customer's request the utility will for the additional fees set forth in this Special Condition bill all of the usage at some, or all, of the meters as though the whole premise were served through a single meter. As of September 21, 2004, for new customers to be eligible for combined billing, all meters must have the same billing components. These components include but are not limited to FTA, Large Customer CTC Adjustment, Large Customer Commodity Credit, Direct Access (DA) Cost Responsibility Surcharge, DA Utility Service Credit, DA Energy Charge and DA Franchise Fee Surcharge. Meter data will be combined for the purpose of billing UDC charges, as listed in the Rates Section of this tariff. The customer must pay for the utility to install and maintain meters to record consumption in 15 minute intervals for all involved meters. The customer must also pay a distance adjustment fee determined by the utility that is based on the distance between each of the meters involved using normal utility position to determine that distance. The rate applied will be the Distance Adjustment Fee from the Rate Section of this tariff times 0.121. When Secondary level and Primary level services are combined, the usage measured at the Secondary level will be increased by 4% for losses, prior to being added to the usage measured at the Primary level. When Primary level and Transmission level services are combined, usage measured at the Primary Level will be increased by 3% for losses, prior to being added to the usage measured at the Transmission level.

17. Electric Emergency Load Curtailment Plan: As set forth in CPUC Decision 01-04-006, all transmission level customers except essential use customers, OBMC participants, net suppliers to the electrical grid, or others exempt by the Commission, are to be included in rotating outages in the event of an emergency. A transmission level customer who refuses or fails to drop load shall be added to the next curtailment block so that the customer does not escape curtailment. If the transmission level customer fails to cooperate and drop load at SDG&E's request, automatic equipment controlled by SDG&E will be installed at the customer's expense per Electric Rule 2. A transmission level customer who refuses to drop load before installation of the equipment shall be subject to a penalty of $6/kWh for all load requested to be curtailed that is not curtailed. The $6/kWh penalty shall not apply if the customer's generation suffers a verified, forced outage and during times of scheduled maintenance. The scheduled maintenance must be approved by both the ISO and SDG&E, but approval may not be unreasonably withheld.

18. Other Applicable Tariffs: Rules 21, 23 and Schedule E-Depart apply to customers with generators.

POWER CONTENT LABEL

ENERGY RESOURCES	SDG&E 2005 POWER MIX* (projected)	2004 CA POWER MIX** (for comparison)
Eligible Renewable	**7%**	**4%**
- Biomass & waste	3%	<1%
- Geothermal	1%	3%
- Small hydroelectric	<1%	1%
- Solar	<1%	<1%
- Wind	2%	<1%
Coal	**15%**	**29%**
Large Hydroelectric	**8%**	**20%**
Natural Gas	**49%**	**45%**
Nuclear	**22%**	**2%**
Other	**0%**	**0%**
Total	**100%**	**100%**

* 63% of SDG&E 2005 POWER MIX is specifically purchased from individual suppliers.

** Percentages are estimated annually by the California Energy Commission based on electricity sold to California consumers during the previous year.

For specific information about this electricity product, contact San Diego Gas & Electric. For general information about the Power Content Label, contact the California Energy Commission at 1-800-555-7794 or www.energy.ca.gov/consumer.

* 5% of SDG&E 2005 POWER MIX is specifically purchased from individual Eligible Renewable suppliers.

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