

Electrical Depth

Introduction

The existing electrical system had to be modified, due to the proposed lighting system detailed in the previous section. The following provides the necessary details that outline the electrical changes that were made in the process of redesigning the lighting system for the four spaces. The panelboards that were affected by the new systems were updated to reflect the changes. The feeders that provide the electricity to these modified panels were checked and resized if necessary. The electrical redesign was done such that it complies with the NEC 2005.

In addition to the electrical redesign of the proposed lighting system a cost analysis of replacing the existing transformers in the building with energy efficient transformers. Also, a second cost analysis was conducted on replacing the existing distributive transformer system with a central transformer system.

Existing System Overview

The Duke University School of Nursing building has a radial distribution system. The 12.47 kV campus loop runs into an outdoor pad mounted 1000 kVA transformer. This transformer is the service entrance to the building and is fed through an underground duct bank and into the main electrical room located in the basement of the building. A 480Y/277V, 2000A switchboard distributes the incoming power to all the main panel boards on each floor. Finally, these main panel boards feed the branch circuits on each respective floor.

The emergency life safety system is fed by a generator located in the basement electrical room of the building. The emergency generator is a 60 kW, 480Y/277V, 3P, 4W packaged engine generator that is fueled by natural gas. The emergency power system uses an automatic transfer switch, which provides power to all the life safety loads. These life safety loads include the fire alarm system, fire pumps, and all the emergency lighting. The luminaires designated as emergency fixtures all contain integral emergency bypass devices, to override switched fixtures. The automatic transfer switch senses a disruption in the primary electrical service and signals the generator engine to start and then transfers the load to the emergency circuits. Once the primary power is restored, the automatic transfer switch transfers the load back to primary power and signals the generator to turn off.

Note: Please refer to Appendix B for a single line diagram of the existing electrical system.

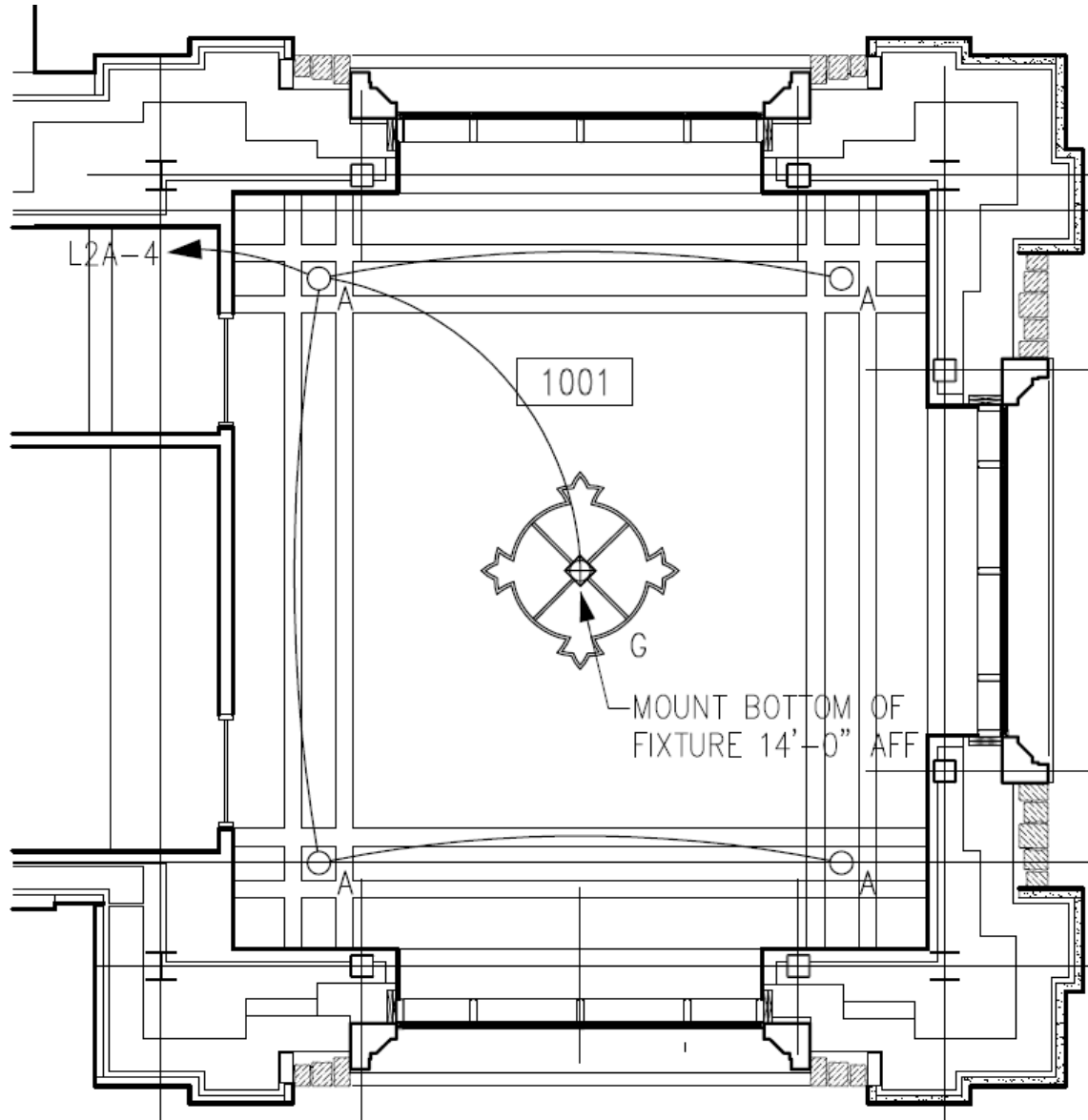
Duke Tower Main Entrance Lobby

The existing lighting design of the double high lobby utilizes circuits on one panelboard located on the second floor, panel L2A. On this panel one circuit, L2A-4, feeds all of the lights in the lobby. The existing lights were compact fluorescent direct downlights recessed in the ceiling and a single pendant fixture mounted 14-ft AFF.

The proposed lighting design will reuse the same circuit on panel L2A. The lighting design is similar to the existing lighting design with recessed compact fluorescent direct downlights and a single compact fluorescent pendant fixture mounted 14-ft AFF. However, the quantity of fixtures and lamping per fixture were changed. This change nearly cut the load on the same circuit by half.

As noted in the Lighting Depth section of this report, this circuit will be controlled by an astronomical time clock. The time clock will be located in the second floor electrical room, where panel L2A is located.

Lighting and Circuiting Plan



Note: Please refer to Appendix B for 1/8" = 1'0" Lighting and Circuiting Plan

Lighting Panels

EXISTING PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE		
MOUNTING	SURFACE		L2A						C/B MIN AIC		14,000		
Bus Rating	60A		LOCATION						PHASES:	3	WIRES:	4	
SIZE/TYPE MAINS	MLO		Second Floor Electrical Room						REMARKS				
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	400	Corridor Sconces	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	300	Lobby 1001	Flourescent Ltg.	
Flourescent Ltg.	Stair 2	1000	20	5				6	20	1400	Offices, Workrooms	Flourescent Ltg.	
Flourescent Ltg.	Skills Lab 2064	2000	20	7				8	20	2000	Physical Assesment	Flourescent Ltg.	
Flourescent Ltg.	Computer Lab, Restrooms, Work	1400	20	9				10	20	1200	Offices	Flourescent Ltg.	
Spare	--	--	20	11				12	20	--	--	Spare	
Spare	--	--	20	13				14	20	--	--	Spare	
Spare	--	--	20	15				16	20	--	--	Spare	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
				27				28					
				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL		A PHASE		5900			B PHASE			3300		C PHASE 2400	
TOTAL CONNECTED LOAD (WATTS)		11600								DEMAND LOAD		10440	

REDESIGNED PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE		
MOUNTING	SURFACE		L2A						C/B MIN AIC		14,000		
Bus Rating	60A		LOCATION						PHASES:	3	WIRES:	4	
SIZE/TYPE MAINS	MLO		Second Floor Electrical Room						REMARKS				
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	400	Corridor Sconces	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	182	Lobby 1001	Flourescent Ltg.	
Flourescent Ltg.	Stair 2	1000	20	5				6	20	1400	Offices, Workrooms	Flourescent Ltg.	
Flourescent Ltg.	Skills Lab 2064	2000	20	7				8	20	2000	Physical Assesment	Flourescent Ltg.	
Flourescent Ltg.	Computer Lab, Restrooms, Work	1400	20	9				10	20	1200	Offices	Flourescent Ltg.	
Spare	--	--	20	11				12	20	--	--	Spare	
Spare	--	--	20	13				14	20	--	--	Spare	
Spare	--	--	20	15				16	20	--	--	Spare	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
				27				28					
				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL		A PHASE		5900			B PHASE			3182		C PHASE 2400	
TOTAL CONNECTED LOAD (WATTS)		11482								DEMAND		10334	

PANELBOARD SIZING WORKSHEET															
Panel Tag----->				L2A	Panel Location:			FIRST FLOOR ELEC ROOM							
Nominal Phase to Neutral Voltage----->				277	Phase:			3							
Nominal Phase to Phase Voltage----->				480	Wires:			4							
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks					
1	A	PNL L2A			5900	w	0.80	5900	7375						
2	A				0	w	1.00	0	0						
3	B	PNL L2A			3182	w	0.80	3182	3978						
4	B				0	w	1.00	0	0						
5	C	PNL L2A			2400	w	0.80	2400	3000						
6	C				0	w	1.00	0	0						
7	A				0	w	1.00	0	0						
8	A				0	w	1.00	0	0						
9	B				0	w	1.00	0	0						
10	B				0	w	1.00	0	0						
11	C				0	w	1.00	0	0						
12	C				0	w	1.00	0	0						
13	A				0	w	1.00	0	0						
14	A				0	w	1.00	0	0						
15	B				0	w	1.00	0	0						
16	B				0	w	1.00	0	0						
17	C				0	w	1.00	0	0						
18	C				0	w	1.00	0	0						
19	A				0	w	1.00	0	0						
20	A				0	w	1.00	0	0						
21	B				0	w	1.00	0	0						
22	B				0	w	1.00	0	0						
23	C				0	w	1.00	0	0						
24	C				0	w	1.00	0	0						
25	A				0	w	1.00	0	0						
26	A				0	w	1.00	0	0						
27	B				0	w	1.00	0	0						
28	B				0	w	1.00	0	0						
29	C				0	w	1.00	0	0						
30	C				0	w	1.00	0	0						
31	A				0	w	1.00	0	0						
32	A				0	w	1.00	0	0						
33	B				0	w	1.00	0	0						
34	B				0	w	1.00	0	0						
35	C				0	w	1.00	0	0						
36	C				0	w	1.00	0	0						
37	A				0	w	1.00	0	0						
38	A				0	w	1.00	0	0						
39	B				0	w	1.00	0	0						
40	B				0	w	1.00	0	0						
41	C				0	w	1.00	0	0						
42	C				0	w	1.00	0	0						
PANEL TOTAL								11.5	14.4	Amps=	17.3				
PHASE LOADING															
PHASE TOTAL								A							
PHASE TOTAL								B							
PHASE TOTAL								C							
LOAD CATAGORIES								Connected		Demand					
								kW	kVA	DF	kW	kVA	PF		
1	receptacles							0.0	0.0		0.0	0.0			
2	computers							0.0	0.0		0.0	0.0			
3	fluorescent lighting							0.0	0.0		0.0	0.0			
4	HID lighting							0.0	0.0		0.0	0.0			
5	incandescent lighting							0.0	0.0		0.0	0.0			
6	HVAC fans							0.0	0.0		0.0	0.0			
7	heating							0.0	0.0		0.0	0.0			
8	kitchen equipment							0.0	0.0		0.0	0.0			
9	unassigned							11.5	14.4	0.95	10.9	13.6	0.80		
Total Demand Loads											10.9	13.6			
Spare Capacity								20%			2.2	2.7			
Total Design Loads											13.1	16.4	0.80	Amps=	19.7

Redesigned Feeders of Modified Panels

Feeder Sizing Worksheet	
Panelboard Tag	L2A
Panelboard Voltage	480Y/277
Calculated Design Load (kw)	13.1
Calculated Design Load (kva)	16.4
Resultant Power Factor	0.8
Calculated Design Load (amps)	19.7
Feeder Protection Size	20A
Sets	1
Wire Size	
Phase	(3) #12
Neutral	#12
Ground	#12
Conduit Size	3/4"

Based on: Copper Wire, 75 degree C, THWN,
Copper wire
75 degree C THWN insulation
IMC Conduit
Maximum 500kcmil wire
Minimum 3/4" conduit
100% neutral

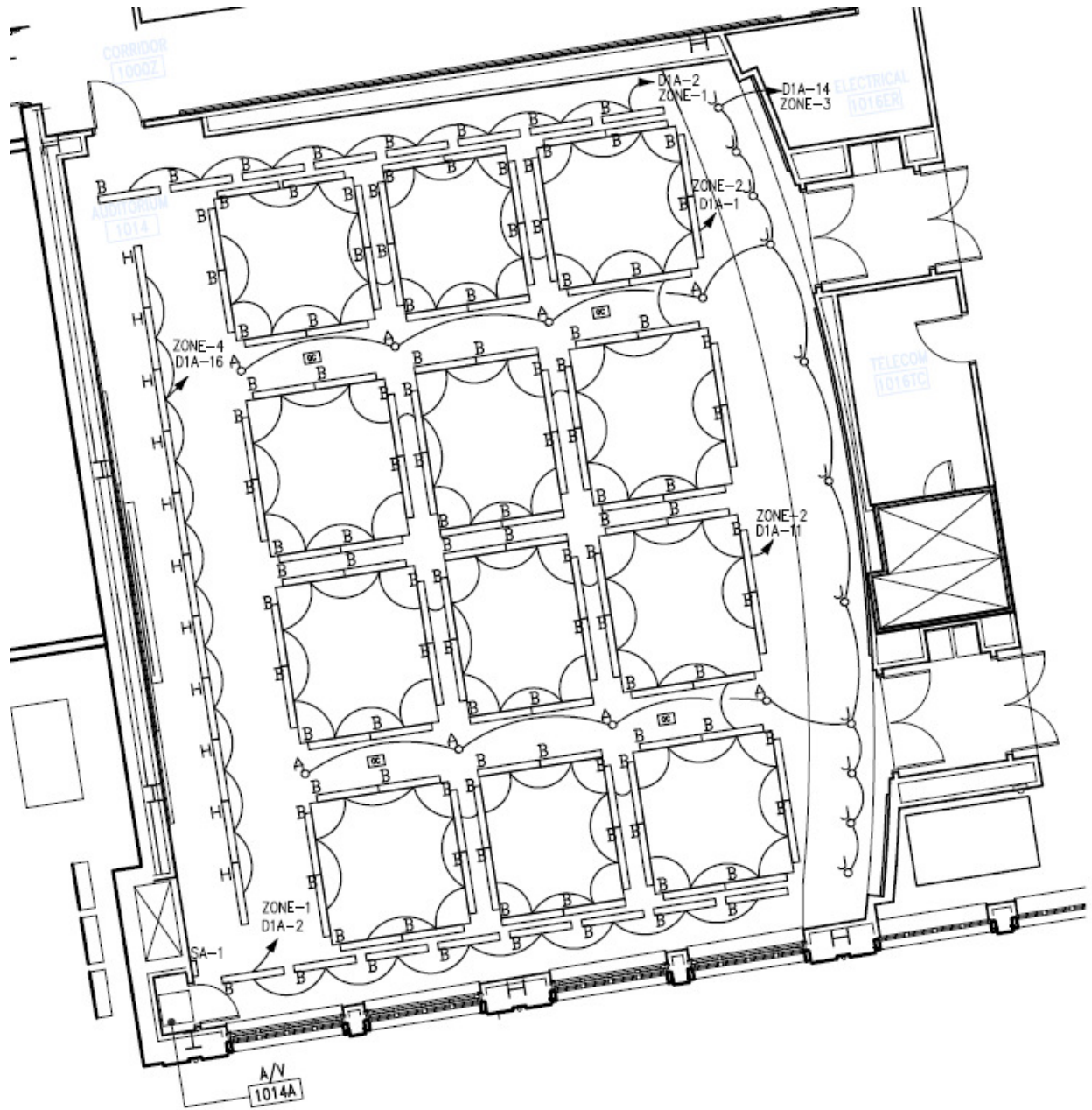
Peter | Ginny Nicholas Auditorium | Learning Center

The existing lighting design of the auditorium utilizes circuits on two panelboards located in the first floor electrical room: panel L1 and panel D1A. On panel L1, two circuits were used for the non-dimmed fluorescent loads in the auditorium: L1-7 and L1-8. On panel D1A, three circuits were used for the dimmed fluorescent loads in the auditorium: D1A-1, D1A-2, and D1A-11. The general lighting design for the space included linear fluorescent direct-indirect pendants as the main light source, compact fluorescent direct downlights, linear fluorescent wallwash board lights, and compact fluorescent wall sconces.

The proposed lighting design will not use panel L1. However, the proposed design will reuse the three previously mentioned circuits from D1A as well as two additional circuits, D1A-14 and D1A-16, which were previously spares. The proposed lighting design utilizes a fluorescent cove lighting system as the main source of light, compact fluorescent direct downlights to highlight the walkways, and linear fluorescent wallwashers to light the white boards.

As noted in the Lighting Depth section of the report, these five circuits will be controlled by a Lutron Graffic Eye 3000, plan tag SA-1. There are four lighting zones that the Lutron Graffic Eye will control. Using these four lighting zones specific lighting scenes will be setup for various activities that will take place within the space. Please refer panelboard D1A and the lighting scene matrix for specific details. This space also utilizes four Lutron LOS-CDT-2000 occupancy sensors were used to turn off the lights when the space is not occupied.

Lighting and Circuiting Plan



Note: Please refer to Appendix B for 1/8" = 1'0" Lighting and Circuiting Plan

Lighting Panels

EXISTING PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG							TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		L1							C/B MIN AIC		14,000	
Bus Rating	60A		LOCATION							PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		First Floor Electrical Room							REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	400	West Corridor & Café Sconces	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	400	East Corridor	Flourescent Ltg.	
Flourescent Ltg.	Classroom 1011	700	20	5				6	20	700	Classroom 1009	Flourescent Ltg.	
Flourescent Ltg.	Auditorium Sconces	300	20	7				8	20	2500	Auditorium-Board Lights/Basement Mech Elect Room	Flourescent Ltg.	
Flourescent Ltg.	East Seminar Rooms, Offices	1400	20	9				10	20	1000	Restrooms, Seminar, AV Room	Flourescent Ltg.	
Spare	--	--	20	11				12	20	2500	Exterior- Roadway	Flourescent Ltg.	
Flourescent Ltg.	Exterior- Roadway	2500	20	13				14	20	--	--	Spare	
Spare	--	--	20	15				16	20	--	--	Spare	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
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				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL			A PHASE 7200				B PHASE 3200				C PHASE 3900		
TOTAL CONNECTED LOAD (WATTS)			14300								DEMAND 12870		

REDESIGNED PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG							TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		L1							C/B MIN AIC		14,000	
Bus Rating	60A		LOCATION							PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		First Floor Electrical Room							REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	346	West Corridor	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	400	East Corridor Sconces, Portrait Lights	Flourescent Ltg.	
Flourescent Ltg.	Classroom 1011	700	20	5				6	20	700	Classroom 1009	Flourescent Ltg.	
Ceramic MH Ltg.	Café Wallwashers	824	20	7				8	20	500	Basement Mech/	Flourescent Ltg.	
Flourescent Ltg.	East Seminar Rooms, Offices	1400	20	9				10	20	1000	Restrooms, Seminar, AV Room	Flourescent Ltg.	
Ceramic MH Ltg.	Café Wallwashers	1648	20	11				12	20	2500	Exterior- Roadway	Flourescent Ltg.	
Flourescent Ltg.	Exterior- Roadway	2500	20	13				14	20	--	--	Spare	
Ceramic MH Ltg.	Café Downlights	1888	20	15				16	20	620	Café- Uplights	Flourescent Ltg.	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
				27				28					
				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL			A PHASE 5670				B PHASE 5708				C PHASE 5548		
TOTAL CONNECTED LOAD (WATTS)			16926								DEMAND LOAD 15233		

Lighting Panels (cont.)

EXISTING PANEL SCHEDULE															
VOLTAGE	480Y/277			TAG						TYPE PANEL		NEMA 1 ENCLOSURE			
MOUNTING	SURFACE			D1A						C/B MIN AIC		14,000			
Bus Rating	60A			LOCATION						PHASES:		3		WIRES:	4
SIZE/TYPE MAINS	MLO			First Floor Electrical Room						REMARKS:					
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION			
Dimmed Fluorescent Ltg.	Auditorium-Linear Pendants	680	20	1				2	20	680	Auditorium-Linear Pendants	Dimmed Fluorescent Ltg.			
Dimmed Fluorescent Ltg.	Case Study-Linear Pendants	680	20	3				4	20	680	Case Study-Linear Pendants	Dimmed Fluorescent Ltg.			
Dimmed Fluorescent Ltg.	Seminar 2062-Seating	600	20	5				6	20	200	Case Study-Rear Downlights	Dimmed Fluorescent Ltg.			
Dimmed Fluorescent Ltg.	Café Pendants	1440	20	7				8	20	600	Café Uplights	Dimmed Fluorescent Ltg.			
Dimmed Fluorescent Ltg.	Case Study 1104 (Phase 2)	500	20	9				10	20	500	Case Study 1104 (Phase 2)	Dimmed Fluorescent Ltg.			
Dimmed Fluorescent Ltg.	Auditorium-Rear Downlights	450	20	11				12	20	800	Seminar 2062-Perimeter	Dimmed Fluorescent Ltg.			
Spare	--	--	20	13				14	20	--	--	Spare			
Spare	--	--	20	15				16	20	--	--	Spare			
				17				18							
				19				20							
				21				22							
				23				24							
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				37				38							
				39				40							
				41				42							
SUB-TOTAL		A PHASE		3400		B PHASE		2360		C PHASE		2050			
TOTAL CONNECTED LOAD (WATTS)		7810								DEMAND I		7029			

REDESIGNED PANEL SCHEDULE															
VOLTAGE	480Y/277			TAG						TYPE PANEL		NEMA 1 ENCLOSURE			
MOUNTING	SURFACE			D1A						C/B MIN AIC		14,000			
Bus Rating	60A			LOCATION						PHASES:		3		WIRES:	4
SIZE/TYPE MAINS	MLO			First Floor Electrical Room						REMARKS:					
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	ZONE	POS NO	A PH	B PH	C PH	POS NO	ZONE	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Dimmed Fluorescent Ltg.	Auditorium- Cove Lights	1200	20	2	1				2	1	20	400	Auditorium-Side Covers	Dimmed Fluorescent Ltg.	
Dimmed Fluorescent Ltg.	Case Study-Linear Pendants	680	20		3				4		20	680	Case Study-Linear Pendants	Dimmed Fluorescent Ltg.	
Dimmed Fluorescent Ltg.	Seminar 2062-Seating	600	20		5				6		20	200	Case Study-Rear Downlights	Dimmed Fluorescent Ltg.	
Dimmed Fluorescent Ltg.	Café- Wallwashers	558	20		7				8		20	174	Café Custom Pendants	Dimmed Fluorescent Ltg.	
Dimmed Fluorescent Ltg.	Case Study 1104 (Phase 2)	500	20		9				10		20	500	Case Study 1104 (Phase 2)	Dimmed Fluorescent Ltg.	
Dimmed Fluorescent Ltg.	Auditorium- Cove Lights	1200	20	2	11				12		20	800	Seminar 2062-Perimeter	Dimmed Fluorescent Ltg.	
Spare	--	--	20		13				14	3	20	589	Auditorium- Downlights	Dimmed Fluorescent Ltg.	
Spare	--	--	20		15				16	4	20	275	Auditorium- Board Lights	Flourescent Ltg.	
					17				18						
					19				20						
					21				22						
					23				24						
					25				26						
					27				28						
					29				30						
					31				32						
					33				34						
					35				36						
					37				38						
					39				40						
					41				42						
SUB-TOTAL		A PHASE		2921		B PHASE		2635		C PHASE		2800			
TOTAL CONNECTED LOAD (WATTS)		8356								DEMAND I		7520			

PANELBOARD SIZING WORKSHEET											
Panel Tag----->				L1	Panel Location:			FIRST FLOOR ELEC ROOM			
Nominal Phase to Neutral Voltage----->				277	Phase:			3			
Nominal Phase to Phase Voltage----->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	PNL L1			5670	w	0.85	5670	6671		
2	A				0	w	1.00	0	0		
3	B	PNL L1			5708	w	0.85	5708	6715		
4	B				0	w	1.00	0	0		
5	C	PNL L1			5548	w	0.85	5548	6527		
6	C				0	w	1.00	0	0		
7	A				0	w	1.00	0	0		
8	A				0	w	1.00	0	0		
9	B				0	w	1.00	0	0		
10	B				0	w	1.00	0	0		
11	C				0	w	1.00	0	0		
12	C				0	w	1.00	0	0		
13	A				0	w	1.00	0	0		
14	A				0	w	1.00	0	0		
15	B				0	w	1.00	0	0		
16	B				0	w	1.00	0	0		
17	C				0	w	1.00	0	0		
18	C				0	w	1.00	0	0		
19	A				0	w	1.00	0	0		
20	A				0	w	1.00	0	0		
21	B				0	w	1.00	0	0		
22	B				0	w	1.00	0	0		
23	C				0	w	1.00	0	0		
24	C				0	w	1.00	0	0		
25	A				0	w	1.00	0	0		
26	A				0	w	1.00	0	0		
27	B				0	w	1.00	0	0		
28	B				0	w	1.00	0	0		
29	C				0	w	1.00	0	0		
30	C				0	w	1.00	0	0		
31	A				0	w	1.00	0	0		
32	A				0	w	1.00	0	0		
33	B				0	w	1.00	0	0		
34	B				0	w	1.00	0	0		
35	C				0	w	1.00	0	0		
36	C				0	w	1.00	0	0		
37	A				0	w	1.00	0	0		
38	A				0	w	1.00	0	0		
39	B				0	w	1.00	0	0		
40	B				0	w	1.00	0	0		
41	C				0	w	1.00	0	0		
42	C				0	w	1.00	0	0		
PANEL TOTAL								16.9	19.9	Amps=	24.0
PHASE LOADING											
								kW	kVA	%	Amps
PHASE TOTAL				A				5.7	6.7	33%	24.1
PHASE TOTAL				B				5.7	6.7	34%	24.2
PHASE TOTAL				C				5.5	6.5	33%	23.6
LOAD CATAGORIES											
				Connected			Demand				Ver. 1.02
				kW	kVA	DF	kW	kVA	PF		
1	receptacles			0.0	0.0		0.0	0.0			
2	computers			0.0	0.0		0.0	0.0			
3	fluorescent lighting			0.0	0.0		0.0	0.0			
4	HID lighting			0.0	0.0		0.0	0.0			
5	incandescent lighting			0.0	0.0		0.0	0.0			
6	HVAC fans			0.0	0.0		0.0	0.0			
7	heating			0.0	0.0		0.0	0.0			
8	kitchen equipment			0.0	0.0		0.0	0.0			
9	unassigned			16.9	19.9	0.90	15.2	17.9	0.85		
Total Demand Loads							15.2	17.9			
Spare Capacity				20%			3.0	3.6			
Total Design Loads							18.3	21.5	0.85	Amps=	25.9

PANELBOARD SIZING WORKSHEET															
Panel Tag----->				D1A	Panel Location:			FIRST FLOOR ELEC ROOM							
Nominal Phase to Neutral Voltage----->				277	Phase:			3							
Nominal Phase to Phase Voltage----->				480	Wires:			4							
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks					
1	A	PNL D1A			2921	w	0.80	2921	3651						
2	A				0	w	1.00	0	0						
3	B	PNL D1A			2835	w	0.80	2835	3544						
4	B				0	w	1.00	0	0						
5	C	PNL D1A			2800	w	0.80	2800	3500						
6	C				0	w	1.00	0	0						
7	A				0	w	1.00	0	0						
8	A				0	w	1.00	0	0						
9	B				0	w	1.00	0	0						
10	B				0	w	1.00	0	0						
11	C				0	w	1.00	0	0						
12	C				0	w	1.00	0	0						
13	A				0	w	1.00	0	0						
14	A				0	w	1.00	0	0						
15	B				0	w	1.00	0	0						
16	B				0	w	1.00	0	0						
17	C				0	w	1.00	0	0						
18	C				0	w	1.00	0	0						
19	A				0	w	1.00	0	0						
20	A				0	w	1.00	0	0						
21	B				0	w	1.00	0	0						
22	B				0	w	1.00	0	0						
23	C				0	w	1.00	0	0						
24	C				0	w	1.00	0	0						
25	A				0	w	1.00	0	0						
26	A				0	w	1.00	0	0						
27	B				0	w	1.00	0	0						
28	B				0	w	1.00	0	0						
29	C				0	w	1.00	0	0						
30	C				0	w	1.00	0	0						
31	A				0	w	1.00	0	0						
32	A				0	w	1.00	0	0						
33	B				0	w	1.00	0	0						
34	B				0	w	1.00	0	0						
35	C				0	w	1.00	0	0						
36	C				0	w	1.00	0	0						
37	A				0	w	1.00	0	0						
38	A				0	w	1.00	0	0						
39	B				0	w	1.00	0	0						
40	B				0	w	1.00	0	0						
41	C				0	w	1.00	0	0						
42	C				0	w	1.00	0	0						
PANEL TOTAL								8.6	10.7	Amps=	12.9				
PHASE LOADING															
PHASE TOTAL								A							
PHASE TOTAL								B							
PHASE TOTAL								C							
LOAD CATAGORIES								Connected		Demand					
								kW	kVA	DF	kW	kVA	PF		
1	receptacles							0.0	0.0		0.0	0.0			
2	computers							0.0	0.0		0.0	0.0			
3	fluorescent lighting							0.0	0.0		0.0	0.0			
4	HID lighting							0.0	0.0		0.0	0.0			
5	incandescent lighting							0.0	0.0		0.0	0.0			
6	HVAC fans							0.0	0.0		0.0	0.0			
7	heating							0.0	0.0		0.0	0.0			
8	kitchen equipment							0.0	0.0		0.0	0.0			
9	unassigned							8.6	10.7	0.95	8.1	10.2	0.80		
Total Demand Loads											8.1	10.2			
Spare Capacity								20%			1.6	2.0			
Total Design Loads											9.8	12.2	0.80	Amps=	14.7

Redesigned Feeders of Modified Panels

Feeder Sizing Worksheet		
Panelboard Tag	L1	D1A
Panelboard Voltage	480Y/277	480Y/277
Calculated Design Load (kw)	18.3	9.8
Calculated Design Load (kva)	21.5	12.2
Resultant Power Factor	0.85	0.8
Calculated Design Load (amps)	25.9	14.7
Feeder Protection Size	30A	20A
Sets	1	1
Wire Size		
Phase	(3) #10	(3) #12
Neutral	#10	#12
Ground	#10	#12
Conduit Size	3/4"	3/4"

Based on: Copper Wire, 75 degree C, THWN,
 Copper wire
 75 degree C THWN insulation
 IMC Conduit
 Maximum 500kcmil wire
 Minimum 3/4" conduit
 100% neutral

Control Scenes

Control Scenes				
Scenes:	Zone-1	Zone-2	Zone-3	Zone-4
Projector	OFF	OFF	Dimmed to 20%	OFF
Speaker	1/2 Switched ON	1/2 Switched ON	Dimmed to 50%	All ON
Class/Exam	All ON	All ON	All ON	All ON

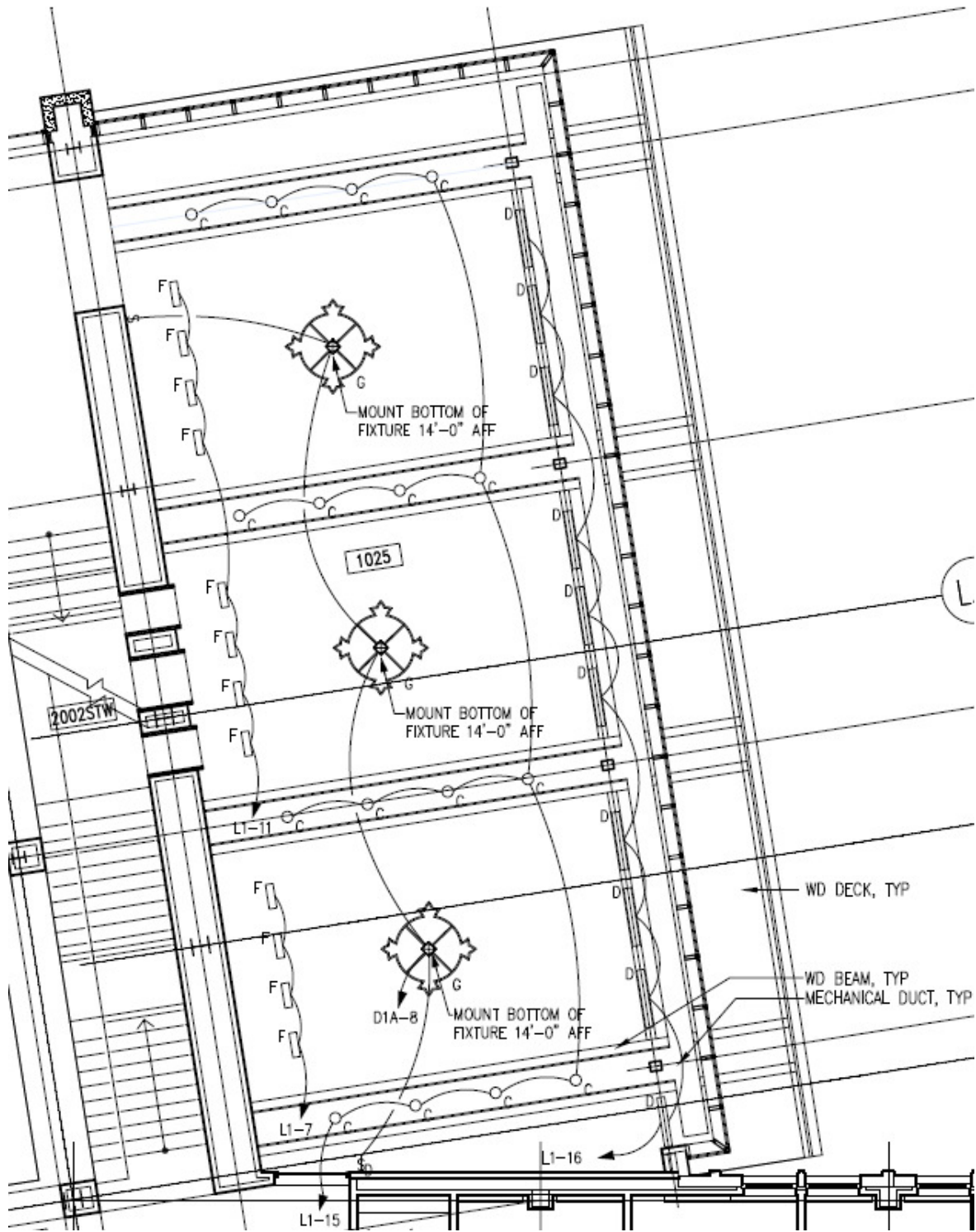
Café DUSON Student Lounge

The existing lighting design of the café utilizes circuits on two panelboard located in the first floor electrical room: panel L1 and panel D1A. On panel L1, one circuit was used for the non-dimmed fluorescent loads in the café: L1-2. On panel D1A, two circuits were used for all the dimmed fluorescent loads in the café: D1A-7 and D1A-8. The general lighting design for the space included compact fluorescent pendants as the main source of light in the space, linear fluorescent up lights to supplement the pendants, and compact fluorescent wall sconces to add light at the level of the people in the space.

The proposed lighting design will not reuse the one circuit on panel L1 but will instead use three spare circuits and one old circuit that was once used by the auditorium sconces: L1-7, L1-11, L1-15, and L1-16. This panel, L1, will handle all the non-dimmed fluorescent and ceramic metal halide loads for the café. The two previously mentioned circuits from D1A will be reused for the dimmed fluorescent loads in the café. The proposed lighting design utilizes ceramic metal halide downlights as the main source of light in the space, linear fluorescent up lights, metal halide wallwashers, and compact fluorescent custom chandeliers.

As noted in the Lighting Depth section of this report, these circuits will be controlled by an astronomical time clock. The time clock will be located in the first floor electrical room, where panel L1 and panel D1A are located. In addition to the time clock the compact fluorescent custom chandeliers will be connected to a wall dimmer and a switch in a three-way switching application. The wall dimmer will be located next to the main corridor entrance the space and the regular switch will be located next to the secondary entrance the space.

Lighting and Circuited Plan



Note: Please refer to Appendix B for 1/8" = 1'0" Lighting and Circuited Plan

Lighting Panels

EXISTING PANEL SCHEDULE													
VOLTAGE	480Y/277			TAG						TYPE PANEL			NEMA 1 ENCLOSURE
MOUNTING	SURFACE			L1						C/B MIN AIC			14,000
Bus Rating	60A			LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO			First Floor Electrical Room						REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	400	West Corridor & Café Sconces	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	400	East Corridor	Flourescent Ltg.	
Flourescent Ltg.	Classroom 1011	700	20	5				6	20	700	Classroom 1009	Flourescent Ltg.	
Flourescent Ltg.	Auditorium Sconces	300	20	7				8	20	2500	Auditorium-Board Lights/Basement Mech Elect Room	Flourescent Ltg.	
Flourescent Ltg.	East Seminar Rooms, Offices	1400	20	9				10	20	1000	Restrooms, Seminar, AV Room	Flourescent Ltg.	
Spare	--	--	20	11				12	20	2500	Exterior- Roadway	Flourescent Ltg.	
Flourescent Ltg.	Exterior- Roadway	2500	20	13				14	20	--	--	Spare	
Spare	--	--	20	15				16	20	--	--	Spare	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
				27				28					
				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL		A PHASE		7200		B PHASE		3200		C PHASE		3900	
TOTAL CONNECTED LOAD (WATTS)		14300								DEMAND		12870	

REDESIGNED PANEL SCHEDULE													
VOLTAGE	480Y/277			TAG						TYPE PANEL			NEMA 1 ENCLOSURE
MOUNTING	SURFACE			L1						C/B MIN AIC			14,000
Bus Rating	60A			LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO			First Floor Electrical Room						REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION	
Flourescent Ltg.	West Corridor	1500	20	1				2	20	346	West Corridor	Flourescent Ltg.	
Flourescent Ltg.	East Corridor	400	20	3				4	20	400	East Corridor Sconces, Portrait Lights	Flourescent Ltg.	
Flourescent Ltg.	Classroom 1011	700	20	5				6	20	700	Classroom 1009	Flourescent Ltg.	
Ceramic MH Ltg.	Café Wallwashers	824	20	7				8	20	500	Basement Mech/	Flourescent Ltg.	
Flourescent Ltg.	East Seminar Rooms, Offices	1400	20	9				10	20	1000	Restrooms, Seminar, AV Room	Flourescent Ltg.	
Ceramic MH Ltg.	Café Wallwashers	1648	20	11				12	20	2500	Exterior- Roadway	Flourescent Ltg.	
Flourescent Ltg.	Exterior- Roadway	2500	20	13				14	20	--	--	Spare	
Ceramic MH Ltg.	Café Downlights	1888	20	15				16	20	620	Café- Uplights	Flourescent Ltg.	
				17				18					
				19				20					
				21				22					
				23				24					
				25				26					
				27				28					
				29				30					
				31				32					
				33				34					
				35				36					
				37				38					
				39				40					
				41				42					
SUB-TOTAL		A PHASE		5670		B PHASE		5708		C PHASE		5548	
TOTAL CONNECTED LOAD (WATTS)		16926								DEMAND LOAD		15233	

Lighting Panels (cont.)

EXISTING PANEL SCHEDULE														
VOLTAGE	480Y/277		TAG								TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		D1A								C/B MIN AIC		14,000	
Bus Rating	60A		LOCATION								PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		First Floor Electrical Room								REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION		
Dimmed Fluorescent Ltg.	Auditorium-Linear Pendants	680	20	1				2	20	680	Auditorium-Linear Pendants	Dimmed Fluorescent Ltg.		
Dimmed Fluorescent Ltg.	Case Study-Linear Pendants	680	20	3				4	20	680	Case Study-Linear Pendants	Dimmed Fluorescent Ltg.		
Dimmed Fluorescent Ltg.	Seminar 2062-Seating	600	20	5				6	20	200	Case Study-Rear Downlights	Dimmed Fluorescent Ltg.		
Dimmed Fluorescent Ltg.	Café Pendants	1440	20	7				8	20	600	Café Uplights	Dimmed Fluorescent Ltg.		
Dimmed Fluorescent Ltg.	Case Study 1104 (Phase 2)	500	20	9				10	20	500	Case Study 1104 (Phase 2)	Dimmed Fluorescent Ltg.		
Dimmed Fluorescent Ltg.	Auditorium-Rear Downlights	450	20	11				12	20	800	Seminar 2062-Perimeter	Dimmed Fluorescent Ltg.		
Spare	--	--	20	13				14	20	--	--	Spare		
Spare	--	--	20	15				16	20	--	--	Spare		
				17				18						
				19				20						
				21				22						
				23				24						
				25				26						
				27				28						
				29				30						
				31				32						
				33				34						
				35				36						
				37				38						
				39				40						
				41				42						
SUB-TOTAL		A PHASE		3400		B PHASE				2360		C PHASE		2050
TOTAL CONNECTED LOAD (WATTS)		7810										DEMAND 1		7029

REDESIGNED PANEL SCHEDULE														
VOLTAGE	480Y/277		TAG								TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		D1A								C/B MIN AIC		14,000	
Bus Rating	60A		LOCATION								PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		First Floor Electrical Room								REMARKS			
LOAD DESCRIPTION	LOCATION	LOAD WATTS	C/B SIZE	ZONE	POS NO	A PH	B PH	C PH	POS NO	ZONE	C/B SIZE	LOAD WATTS	LOCATION	LOAD DESCRIPTION
Dimmed Fluorescent Ltg.	Auditorium- Cove Lights	1200	20	2	1				2	1	20	400	Auditorium-Side Covers	Dimmed Fluorescent Ltg.
Dimmed Fluorescent Ltg.	Case Study-Linear Pendants	680	20		3				4		20	680	Case Study-Linear Pendants	Dimmed Fluorescent Ltg.
Dimmed Fluorescent Ltg.	Seminar 2062-Seating	600	20		5				6		20	200	Case Study-Rear Downlights	Dimmed Fluorescent Ltg.
Dimmed Fluorescent Ltg.	Café- Wallwashers	558	20		7				8		20	174	Café Custom Pendants	Dimmed Fluorescent Ltg.
Dimmed Fluorescent Ltg.	Case Study 1104 (Phase 2)	500	20		9				10		20	500	Case Study 1104 (Phase 2)	Dimmed Fluorescent Ltg.
Dimmed Fluorescent Ltg.	Auditorium- Cove Lights	1200	20	2	11				12		20	800	Seminar 2062-Perimeter	Dimmed Fluorescent Ltg.
Spare	--	--	20		13				14	3	20	589	Auditorium- Downlights	Dimmed Fluorescent Ltg.
Spare	--	--	20		15				16	4	20	275	Auditorium- Board Lights	Flourescent Ltg.
					17				18					
					19				20					
					21				22					
					23				24					
					25				26					
					27				28					
					29				30					
					31				32					
					33				34					
					35				36					
					37				38					
					39				40					
					41				42					
SUB-TOTAL		A PHASE		2921		B PHASE				2635		C PHASE		2800
TOTAL CONNECTED LOAD (WATTS)		8356										DEMAND 1		7520

PANELBOARD SIZING WORKSHEET													
Panel Tag----->				L1	Panel Location:			FIRST FLOOR ELEC ROOM					
Nominal Phase to Neutral Voltage----->				277	Phase:			3					
Nominal Phase to Phase Voltage----->				480	Wires:			4					
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks			
1	A	PNL L1			5670	w	0.85	5670	6671				
2	A				0	w	1.00	0	0				
3	B	PNL L1			5708	w	0.85	5708	6715				
4	B				0	w	1.00	0	0				
5	C	PNL L1			5548	w	0.85	5548	6527				
6	C				0	w	1.00	0	0				
7	A				0	w	1.00	0	0				
8	A				0	w	1.00	0	0				
9	B				0	w	1.00	0	0				
10	B				0	w	1.00	0	0				
11	C				0	w	1.00	0	0				
12	C				0	w	1.00	0	0				
13	A				0	w	1.00	0	0				
14	A				0	w	1.00	0	0				
15	B				0	w	1.00	0	0				
16	B				0	w	1.00	0	0				
17	C				0	w	1.00	0	0				
18	C				0	w	1.00	0	0				
19	A				0	w	1.00	0	0				
20	A				0	w	1.00	0	0				
21	B				0	w	1.00	0	0				
22	B				0	w	1.00	0	0				
23	C				0	w	1.00	0	0				
24	C				0	w	1.00	0	0				
25	A				0	w	1.00	0	0				
26	A				0	w	1.00	0	0				
27	B				0	w	1.00	0	0				
28	B				0	w	1.00	0	0				
29	C				0	w	1.00	0	0				
30	C				0	w	1.00	0	0				
31	A				0	w	1.00	0	0				
32	A				0	w	1.00	0	0				
33	B				0	w	1.00	0	0				
34	B				0	w	1.00	0	0				
35	C				0	w	1.00	0	0				
36	C				0	w	1.00	0	0				
37	A				0	w	1.00	0	0				
38	A				0	w	1.00	0	0				
39	B				0	w	1.00	0	0				
40	B				0	w	1.00	0	0				
41	C				0	w	1.00	0	0				
42	C				0	w	1.00	0	0				
PANEL TOTAL								16.9	19.9	Amps= 24.0			
PHASE LOADING													
PHASE TOTAL								A					
PHASE TOTAL								B					
PHASE TOTAL								C					
LOAD CATAGORIES								Connected		Demand			
								kW	kVA	DF	kW	kVA	PF
1	receptacles							0.0	0.0		0.0	0.0	
2	computers							0.0	0.0		0.0	0.0	
3	fluorescent lighting							0.0	0.0		0.0	0.0	
4	HID lighting							0.0	0.0		0.0	0.0	
5	incandescent lighting							0.0	0.0		0.0	0.0	
6	HVAC fans							0.0	0.0		0.0	0.0	
7	heating							0.0	0.0		0.0	0.0	
8	kitchen equipment							0.0	0.0		0.0	0.0	
9	unassigned							16.9	19.9	0.90	15.2	17.9	0.85
Total Demand Loads											15.2	17.9	
Spare Capacity								20%			3.0	3.6	
Total Design Loads											18.3	21.5	0.85
											Amps=	25.9	

PANELBOARD SIZING WORKSHEET											
Panel Tag----->				D1A	Panel Location:			FIRST FLOOR ELEC ROOM			
Nominal Phase to Neutral Voltage----->				277	Phase:			3			
Nominal Phase to Phase Voltage----->				480	Wires:			4			
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	PNL D1A			2921	w	0.80	2921	3651		
2	A				0	w	1.00	0	0		
3	B	PNL D1A			2835	w	0.80	2835	3544		
4	B				0	w	1.00	0	0		
5	C	PNL D1A			2800	w	0.80	2800	3500		
6	C				0	w	1.00	0	0		
7	A				0	w	1.00	0	0		
8	A				0	w	1.00	0	0		
9	B				0	w	1.00	0	0		
10	B				0	w	1.00	0	0		
11	C				0	w	1.00	0	0		
12	C				0	w	1.00	0	0		
13	A				0	w	1.00	0	0		
14	A				0	w	1.00	0	0		
15	B				0	w	1.00	0	0		
16	B				0	w	1.00	0	0		
17	C				0	w	1.00	0	0		
18	C				0	w	1.00	0	0		
19	A				0	w	1.00	0	0		
20	A				0	w	1.00	0	0		
21	B				0	w	1.00	0	0		
22	B				0	w	1.00	0	0		
23	C				0	w	1.00	0	0		
24	C				0	w	1.00	0	0		
25	A				0	w	1.00	0	0		
26	A				0	w	1.00	0	0		
27	B				0	w	1.00	0	0		
28	B				0	w	1.00	0	0		
29	C				0	w	1.00	0	0		
30	C				0	w	1.00	0	0		
31	A				0	w	1.00	0	0		
32	A				0	w	1.00	0	0		
33	B				0	w	1.00	0	0		
34	B				0	w	1.00	0	0		
35	C				0	w	1.00	0	0		
36	C				0	w	1.00	0	0		
37	A				0	w	1.00	0	0		
38	A				0	w	1.00	0	0		
39	B				0	w	1.00	0	0		
40	B				0	w	1.00	0	0		
41	C				0	w	1.00	0	0		
42	C				0	w	1.00	0	0		
PANEL TOTAL								8.6	10.7	Amps=	12.9
PHASE LOADING											
								kW	kVA	%	Amps
PHASE TOTAL				A				2.9	3.7	34%	13.2
PHASE TOTAL				B				2.8	3.5	33%	12.8
PHASE TOTAL				C				2.8	3.5	33%	12.6
LOAD CATAGORIES											
				Connected			Demand				<small>Ver. 1.02</small>
				kW	kVA	DF	kW	kVA	PF		
1		receptacles		0.0	0.0		0.0	0.0			
2		computers		0.0	0.0		0.0	0.0			
3		fluorescent lighting		0.0	0.0		0.0	0.0			
4		HID lighting		0.0	0.0		0.0	0.0			
5		incandescent lighting		0.0	0.0		0.0	0.0			
6		HVAC fans		0.0	0.0		0.0	0.0			
7		heating		0.0	0.0		0.0	0.0			
8		kitchen equipment		0.0	0.0		0.0	0.0			
9		unassigned		8.6	10.7	0.95	8.1	10.2	0.80		
Total Demand Loads							8.1	10.2			
Spare Capacity				20%			1.6	2.0			
Total Design Loads							9.8	12.2	0.80	Amps=	14.7

Redesigned Feeders of Modified Panels

Feeder Sizing Worksheet		
Panelboard Tag	L1	D1A
Panelboard Voltage	480Y/277	480Y/277
Calculated Design Load (kw)	18.3	9.8
Calculated Design Load (kva)	21.5	12.2
Resultant Power Factor	0.85	0.8
Calculated Design Load (amps)	25.9	14.7
Feeder Protection Size	30A	20A
Sets	1	1
Wire Size		
Phase	(3) #10	(3) #12
Neutral	#10	#12
Ground	#10	#12
Conduit Size	3/4"	3/4"

Based on: Copper Wire, 75 degree C, THWN,
 Copper wire
 75 degree C THWN insulation
 IMC Conduit
 Maximum 500kcmil wire
 Minimum 3/4" conduit
 100% neutral

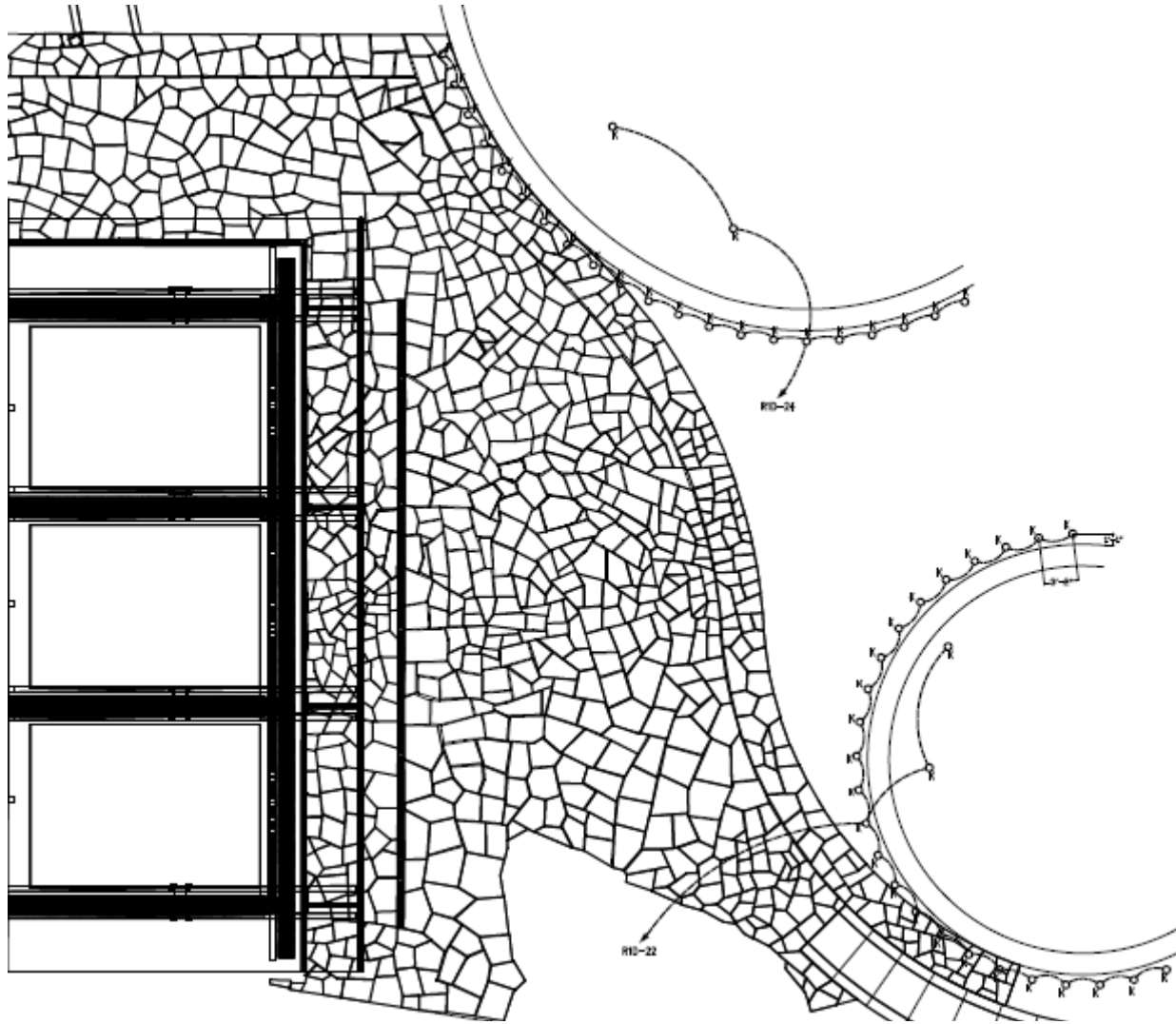
Champagne Outdoor Courtyard

The courtyard was not previously lit. The only light that this space receives is from the interior café lights and some trespass light from a few high pressure sodium street lights in the surrounding area. Since there were no lights for this space no panelboards or circuits were previously used.

The proposed lighting design will use a receptacle panel, panel R1D, since the lighting loads for this space are halogen sources and require 120V. Two previously spare circuits on panel R1D will be utilized: R1D-22 and R1D-24. The proposed lighting design uses 10W halogen sources to up light the curved retaining walls and the large trees that saved during construction. The lighting intent of up lighting these surfaces was to highlight those features and make them be seen by people within the café. Since the courtyard surface receives enough light from the café no additional light is being proposed.

As noted in the Lighting Depth section of this report, these two circuits will be controlled by an astronomical time clock. The time clock will be located in the first floor AV room, where panel R1D is located.

Lighting and Circuiting Plan



Note: Please refer to Appendix B for 1/8" = 1'0" Lighting and Circuiting Plan

Lighting Panels

EXISTING PANEL SCHEDULE													
VOLTAGE	208Y/120		TAG						TYPE PANEL		NEMA 1 ENCLOSURE		
MOUNTING	SURFACE		R1D						C/B MIN AIC		10,000		
Bus Rating	100A		LOCATION						PHASES:	3	WIRES:	4	
SIZE/TYPE MAINS	MLO		FIRST FLOOR AV ROOM						REMARKS				
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION			
RECP- AV ROOM	1260	20	1				2	20	1260	SEATING- CASE STUDY			
RECP- CORRIDOR & STAIR	1260	20	3				4	20	1260	SEATING- CASE STUDY			
RECP- SEMINAR	1260	20	5				6	20	1260	SEATING- CASE STUDY			
RECP- AV ROOM	1000	20	7				8	20	1260	SEATING- CASE STUDY			
RECP- CONF	1260	20	9				10	20	1260	SEATING- CASE STUDY			
BLACKOUT SHADES	1000	20	11				12	20	1260	SEATING- CASE STUDY			
PROJECTOR-CASE STUDY	1000	20	13				14	20	1000	PROJECTOR-CONF			
RECP-SEMINAR	1260	20	15				16	20	1000	PROJECTOR-CONF			
RECP-SEMINAR	1260	20	17				18	20	1260	RECP- CASE STUDY			
RECP- AV CLOSET	1260	20	19				20	20	1260	FLOORBOX			
PROJECTION SCREEN	1000	20	21				22	20	--	SPACE			
RECP-SEMINAR	1260	20	23				24	20	--	SPACE			
SUB-TOTAL	A PHASE	9300		B PHASE				8300		C PHASE 8560			
TOTAL CONNECTED LOAD (W)	26160										DEMAND I 23544		

REDESIGNED PANEL SCHEDULE													
VOLTAGE	208Y/120		TAG						TYPE PANEL		NEMA 1 ENCLOSURE		
MOUNTING	SURFACE		R1D						C/B MIN AIC		10,000		
Bus Rating	100A		LOCATION						PHASES:	3	WIRES:	4	
SIZE/TYPE MAINS	MLO		FIRST FLOOR AV ROOM						REMARKS				
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION			
RECP- AV ROOM	1260	20	1				2	20	1260	SEATING- CASE STUDY			
RECP- CORRIDOR & STAIR	1260	20	3				4	20	1260	SEATING- CASE STUDY			
RECP- SEMINAR	1260	20	5				6	20	1260	SEATING- CASE STUDY			
RECP- AV ROOM	1000	20	7				8	20	1260	SEATING- CASE STUDY			
RECP- CONF	1260	20	9				10	20	1260	SEATING- CASE STUDY			
BLACKOUT SHADES	1000	20	11				12	20	1260	SEATING- CASE STUDY			
PROJECTOR-CASE STUDY	1000	20	13				14	20	1000	PROJECTOR-CONF			
RECP-SEMINAR	1260	20	15				16	20	1000	PROJECTOR-CONF			
RECP-SEMINAR	1260	20	17				18	20	1260	RECP- CASE STUDY			
RECP- AV CLOSET	1260	20	19				20	20	1260	FLOORBOX			
PROJECTION SCREEN	1000	20	21				22	20	260	Courtyard uplights			
RECP-SEMINAR	1260	20	23				24	20	230	Courtyard uplights			
SUB-TOTAL	A PHASE	9300		B PHASE				8560		C PHASE 8790			
TOTAL CONNECTED LOAD (WATTS)	26650										DEMAND LOAD 23985		

PANELBOARD SIZING WORKSHEET													
Panel Tag----->				R1D	Panel Location:			FIRST FLOOR ELEC ROOM					
Nominal Phase to Neutral Voltage----->				120	Phase:			3					
Nominal Phase to Phase Voltage----->				208	Wires:			4					
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks			
1	A	PNL R1D			9300	w	0.95	9300	9789				
2	A				0	w	1.00	0	0				
3	B	PNL R1D			8300	w	0.95	8300	8737				
4	B				0	w	1.00	0	0				
5	C	PNL R1D			8560	w	0.95	8560	9011				
6	C				0	w	1.00	0	0				
7	A				0	w	1.00	0	0				
8	A				0	w	1.00	0	0				
9	B				0	w	1.00	0	0				
10	B				0	w	1.00	0	0				
11	C				0	w	1.00	0	0				
12	C				0	w	1.00	0	0				
13	A				0	w	1.00	0	0				
14	A				0	w	1.00	0	0				
15	B				0	w	1.00	0	0				
16	B				0	w	1.00	0	0				
17	C				0	w	1.00	0	0				
18	C				0	w	1.00	0	0				
19	A				0	w	1.00	0	0				
20	A				0	w	1.00	0	0				
21	B				0	w	1.00	0	0				
22	B				0	w	1.00	0	0				
23	C				0	w	1.00	0	0				
24	C				0	w	1.00	0	0				
25	A				0	w	1.00	0	0				
26	A				0	w	1.00	0	0				
27	B				0	w	1.00	0	0				
28	B				0	w	1.00	0	0				
29	C				0	w	1.00	0	0				
30	C				0	w	1.00	0	0				
31	A				0	w	1.00	0	0				
32	A				0	w	1.00	0	0				
33	B				0	w	1.00	0	0				
34	B				0	w	1.00	0	0				
35	C				0	w	1.00	0	0				
36	C				0	w	1.00	0	0				
37	A				0	w	1.00	0	0				
38	A				0	w	1.00	0	0				
39	B				0	w	1.00	0	0				
40	B				0	w	1.00	0	0				
41	C				0	w	1.00	0	0				
42	C				0	w	1.00	0	0				
PANEL TOTAL								26.2	27.5	Amps= 76.5			
PHASE LOADING								kW	kVA	% Amps			
PHASE TOTAL								A	9.3	9.8 36% 81.6			
PHASE TOTAL								B	8.3	8.7 32% 72.8			
PHASE TOTAL								C	8.6	9.0 33% 75.1			
LOAD CATAGORIES								Connected		Demand		Ver. 1.02	
								kW	kVA	DF	kW	kVA	PF
1	receptacles							0.0	0.0		0.0	0.0	
2	computers							0.0	0.0		0.0	0.0	
3	fluorescent lighting							0.0	0.0		0.0	0.0	
4	HID lighting							0.0	0.0		0.0	0.0	
5	incandescent lighting							0.0	0.0		0.0	0.0	
6	HVAC fans							0.0	0.0		0.0	0.0	
7	heating							0.0	0.0		0.0	0.0	
8	kitchen equipment							0.0	0.0		0.0	0.0	
9	unassigned							26.2	27.5	0.85	22.2	23.4	0.95
Total Demand Loads											22.2	23.4	
Spare Capacity								20%			4.4	4.7	
Total Design Loads											26.7	28.1	0.95 Amps= 78.0

Redesigned Feeders of Modified Panels

Feeder Sizing Worksheet	
Panelboard Tag	R1D
Panelboard Voltage	208Y/120
Calculated Design Load (kw)	26.7
Calculated Design Load (kva)	28.1
Resultant Power Factor	1.0
Calculated Design Load (amps)	78
Feeder Protection Size	80A
Sets	1
Wire Size	
Phase	(3) #3
Neutral	#3
Ground	#8
Conduit Size	1-1/4"

Based on: Copper Wire, 75 degree C, THWN,
Copper wire
75 degree C THWN insulation
IMC Conduit
Maximum 500kcmil wire
Minimum 3/4" conduit
100% neutral

Energy Efficient Transformers Study

A cost-feasibility study was conducted using Powersmiths Energy Savings Payback Calculator, to see if replacing the building’s current non-energy efficient transformers with their T1000-C3 series of energy efficient transformers is cost effective. The building currently uses the following transformer types.

EXISTING TRANSFORMER SCHEDULE								
TAG	PRIMARY VOLTAGE	SECONDARY VOLTAGE	SIZE	TYPE	TEMP. RISE	TAPS	MOUNTING	REMARKS
TGA	480V,3PH,3W.	208Y/120V, 3PH,4W	30	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 0003ER Basement Mechanical Room
TGS	480V,3PH,3W.	208Y/120V, 3PH,4W	15	DRY TYPE	115 DEGREE C	(1) 5% Above Normal Full Capacity (1) 5% Below Normal Full Capacity	SUSPENDED	RM 0004ER Basement Electrical Room
TGE	480V,3PH,3W.	208Y/120V, 3PH,4W	15	DRY TYPE	115 DEGREE C	(1) 5% Above Normal Full Capacity (1) 5% Below Normal Full Capacity	SUSPENDED	RM 0004ER Basement Electrical Room
T1A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 1016ER First Floor Electrical Room
T2A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 2054ER Second Floor Electrical Room
T3A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 3090ER Third Floor Electrical Room

TGA: 30kVA General Purpose Transformer (Dry Type)
 Price: 4,385 USD according to 2008 RS Means

30kVA Powersmiths T1000-C3 Transformer
 Quoted Estimated Price: 5,500 USD (25% more)

TGS|TGE: 15kVA General Purpose Transformer (Dry Type)
 Price: 3,265 USD according to 2008 RS Means

15kVA Powersmiths T1000-C3 Transformer
 Quoted Estimated Price: 4,100 USD (25% more)

T1A|T2A|T3A: 112.5kVA General Purpose Transformer (Dry Type)
 Price: 13,500 USD according to 2008 RS Means

112.5kVA Powersmiths T1000-C3 Transformer
 Quoted Estimated Price: 16,800 USD (25% more)

Since the building is already built and occupied for over a year the building electrical was known and documented. The peak kW load during normal operating hours was documented from the building’s metering system at 178 kW. This loading equates to 45% loading during normal operating hours and 15% load outside operating hours. The current arrangement of non-energy efficient transformers has an annual electric bill of approximately \$58,000 as compared to \$56,300 by using Powersmiths energy efficient transformers. This is an annual savings of about 3%.

As shown by the price comparisons for the two types of transformers, the energy efficient transformers cost about 25% more than the non-energy efficient transformers. This initial cost equates to about \$51,200 for the non-energy efficient transformers and about \$61,500 for the energy efficient transformers. Even though the initial price for the energy efficient transformers is greater, when combined with the annual energy cost savings, the energy efficient transformers will pay for themselves in just under six years. Considering an energy cost inflation rate of 4% energy efficient transformer system will save about \$76,500 over a 20 year period and about \$196,000 over a 32 year period.

Please refer to the following Powersmiths Energy Savings Payback Calculator worksheet for all the variables used in creating the prior energy estimates. The worksheet also provides environmental benefit information for using energy efficient transformers. These benefits are listed in the following table.

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
26 tons of CO ₂	5 Acres trees planted
85 tons of Coal	3 Car Emissions
205 kgs of SO ₂	4 homes heated
88 kgs of NO _x	

Given these environmental benefits and the savings on annual operating costs, it is recommended that energy efficient transformers be used in this building.



Toll Free : 1-800-747-9627 or (905) 791-1493

Project Description

Date

The ESP Calculator™

Energy Savings Payback Calculator

Duke School of Nursing

26-Mar-08

Transformers on Project

QTY	kVA	RS Means Costs	PowerSmiths Costs
2	15	\$6,530	\$8,163
1	30	\$4,385	\$5,481
	45		
	75		
3	112.5	\$40,317	\$50,396
	150		
	225		
	300		
	500		
	750		
	1000		
	1500		
	2000		
	7.5		
397.5	Total Transformer Costs	\$51,232	\$64,040

Available Full Load kW

Average kVA (calc)
 equipment operating hrs/ day
 equipment operating days/yr
 Load during normal operating hours
 Load outside operating hours

66		
12		
365	Calc Load kW	Calc Annual kWh
45%	178	778,645
15%	60	261,158
	Total Annual Load kWh:	1,039,802

Annual Cost to Operate Load Only

kWh rate
 demand rate (\$/kW/mo) ex. \$10.00

\$ 0.046	Annual Consumption: \$	47,831
\$3.27	Annual Demand: \$	6,976
	Total Cost to run load	\$ 54,807

Annual Cost of Status Quo Transformer Losses & Associated Air Conditioning (A/C) burden

Status quo Efficiency (Normal Operation) **97.0%**
 Transformer kW Losses (Normal Operation) 5.5 kW
 Status quo Efficiency (Outside op. hrs) **92.0%**
 Transformer kW Losses (Outside op. hrs) 5.2 kW
 Annual additional kWh from transformers 46,791 kWh
Annual Cost of Transformer Losses \$ 2,368

A/C System Performance (kW/ton) **1.25**
 Additional Tons of Cooling (on peak) 1.56 tons
 Annual additional kWh from A/C 16,616 kWh
Annual Cost of Associated A/C \$ 841

Summary with Status Quo Transformer

Annual Cost of feeding Building Load \$ 54,807
 Annual Cost of Transformer Losses \$ 2,368
 Annual Cost of Associated A/C \$ 841
Electrical Bill (Status Quo Transformer) \$ 58,016

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Toll Free : 1-800-747-9627 or (905) 791-1493

Using Powersmiths instead of status quo transformers

Powersmiths Efficiency (Normal Operation)	98.2%
Powersmiths kW Losses (Normal Operation)	3.3 kW
Powersmiths Efficiency (Outside op. hrs)	97.6%
Transformer kW Losses (Outside op. hrs)	1.5 kW
Annual additional kWh from transformers	20,694 kWh
Annual Cost of Powersmiths Losses	\$ 1,080
Additional Tons of Cooling (on peak)	0.93 tons
Annual additional kWh from A/C	7,349 kWh
Annual Cost of Associated A/C	\$ 383

Comparing Status Quo & Powersmiths

	Status Quo	Powersmiths	
Annual Cost of feeding Building Load	\$ 54,807	\$ 54,807	
Annual Cost of Transformer Losses	\$ 2,368	\$ 1,080	
Annual Cost of Associated A/C	\$ 841	\$ 383	Reduction
Annual estimated Electrical Bill	\$ 58,016	\$ 56,270	3%

Peak kW reduction (normal op hours)	2.2 kW
Annual kWh reduction	35,364 kWh
Reduction in Air Conditioning Load (on peak)	0.64 tons

Cost Analysis (calc)

Energy Cost Escalation (above inflation)	4.0%
Annual Power Quality Benefit	\$ -

	Annual Operating Cost	Life Cycle Operating Cost & Savings	
		20 years	32 years
Status Quo Transformers	\$3,209	\$140,631	\$360,246
Powersmiths Transformers	\$1,463	\$64,124	\$164,263
Savings with Powersmiths	\$1,746	\$76,507	\$195,984

Cost

Powersmiths Transformers	\$61,478
Status Quo Transformers	\$51,232

Payback on total cost

	5.87	years	current kWh rate:
Cost of Energy Savings	\$ 0.009	/kWh	\$0.046
Cost - Benefit Ratio	5.1	times less to save a kWh than to buy a kWh	

Leasing Option

	60 Month Term	48 Month Term	36 Month Term
Total Annual Leasing Payments	\$12,953	\$15,800	\$20,103
Net Annual Cost with savings	\$11,208	\$14,054	\$18,358

Summary of Environmental Benefits

Annual Reduction in Greenhouse Gases (per EPA)	Equivalence
26 tons of CO2	5 Acres trees planted
85 tons of Coal	3 Car Emissions
205 kgs of SO2	4 homes heated
88 kgs of NOx	

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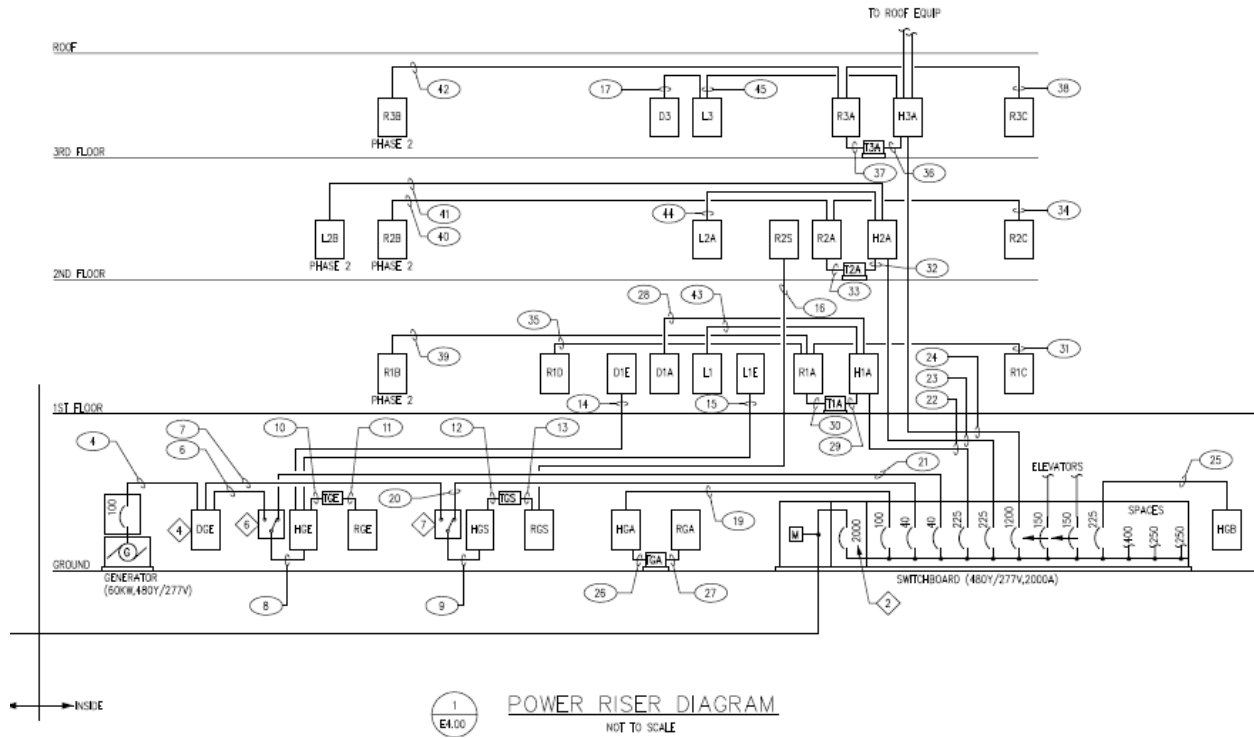
Central Transformer vs. Distributed Transformers Analysis

A cost-feasibility study was conducted on changing the existing distributed transformers to a central transformer system in the building. The existing normal power electrical system has four distribution transformers on each floor of the building. These transformers reduce the 480Y/277V supplied from the building service entrance to 208Y/120V which feed the receptacle panels in the building. The existing distribution transformers are listed in the transformer schedule below.

EXISTING DISTRIBUTION TRANSFORMER SCHEDULE								
TAG	PRIMARY VOLTAGE	SECONDARY VOLTAGE	SIZE	TYPE	TEMP. RISE	TAPS	MOUNTING	REMARKS
TGA	480V,3PH,3W.	208Y/120V, 3PH,4W	30	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 0003ER Basement Mechanical Room
T1A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 1016ER First Floor Electrical Room
T2A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 2054ER Second Floor Electrical Room
T3A	480V,3PH,3W.	208Y/120V, 3PH,4W	112.5	DRY TYPE	115 DEGREE C	(2) 2.5% Above Normal Full Capacity (2) 2.5% Below Normal Full Capacity	PAD MOUNTED ON FLOOR	RM 3090ER Third Floor Electrical Room

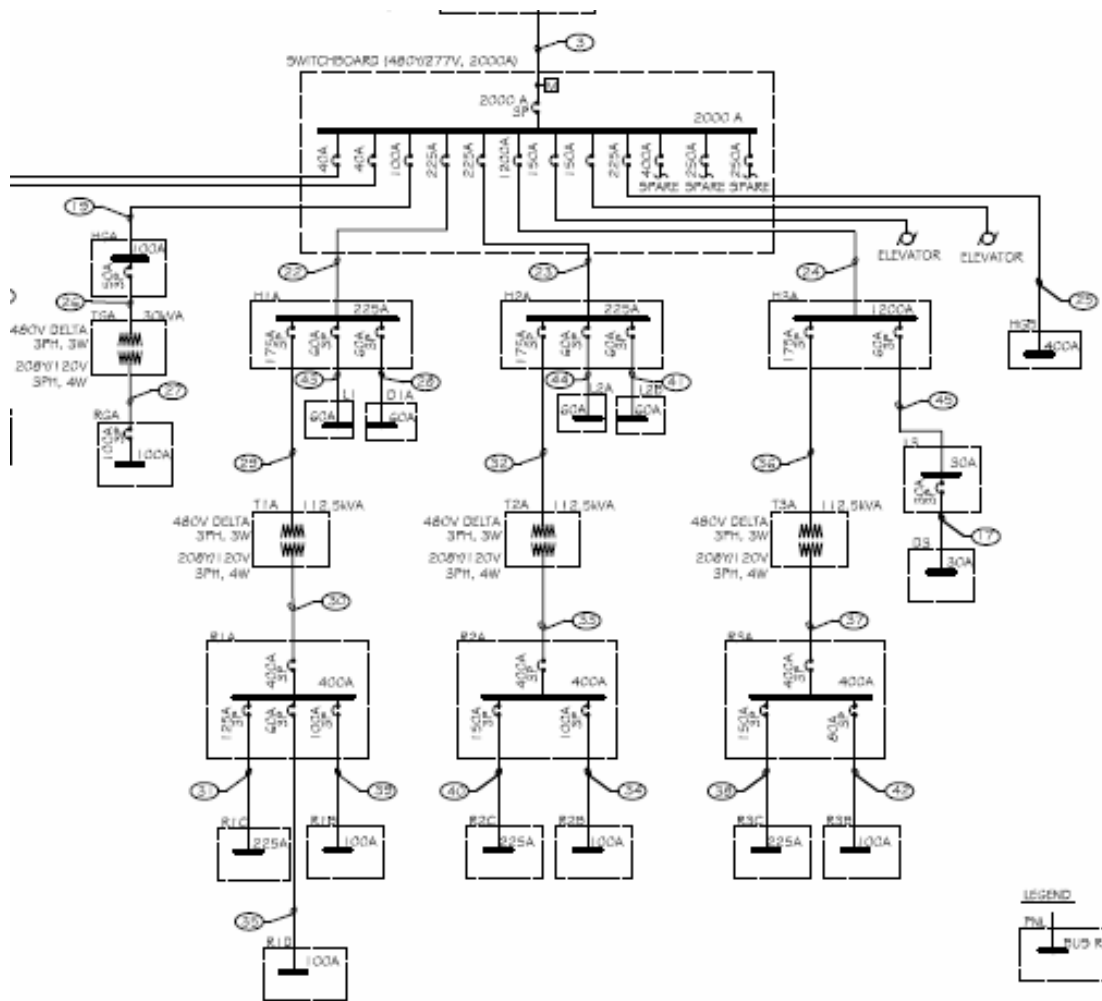
The proposed central transformer system will consolidate the four distribution transformers on the four floors into one large transformer located in the basement of the building. The central transformer will feed a new distribution panel, which then will feed the existing receptacle panels. The panels serving the existing distribution transformers will be resized and potentially reduced in sized, due to the removal of the transformer loads. The feeders and overcurrent devices serving these panelboards will be resized and potentially be reduced. The following riser diagram, single line diagrams, existing panelboard schedules, and modified panelboard schedules will detail the process in analyzing the comparison of these two systems.

Existing Riser Diagram



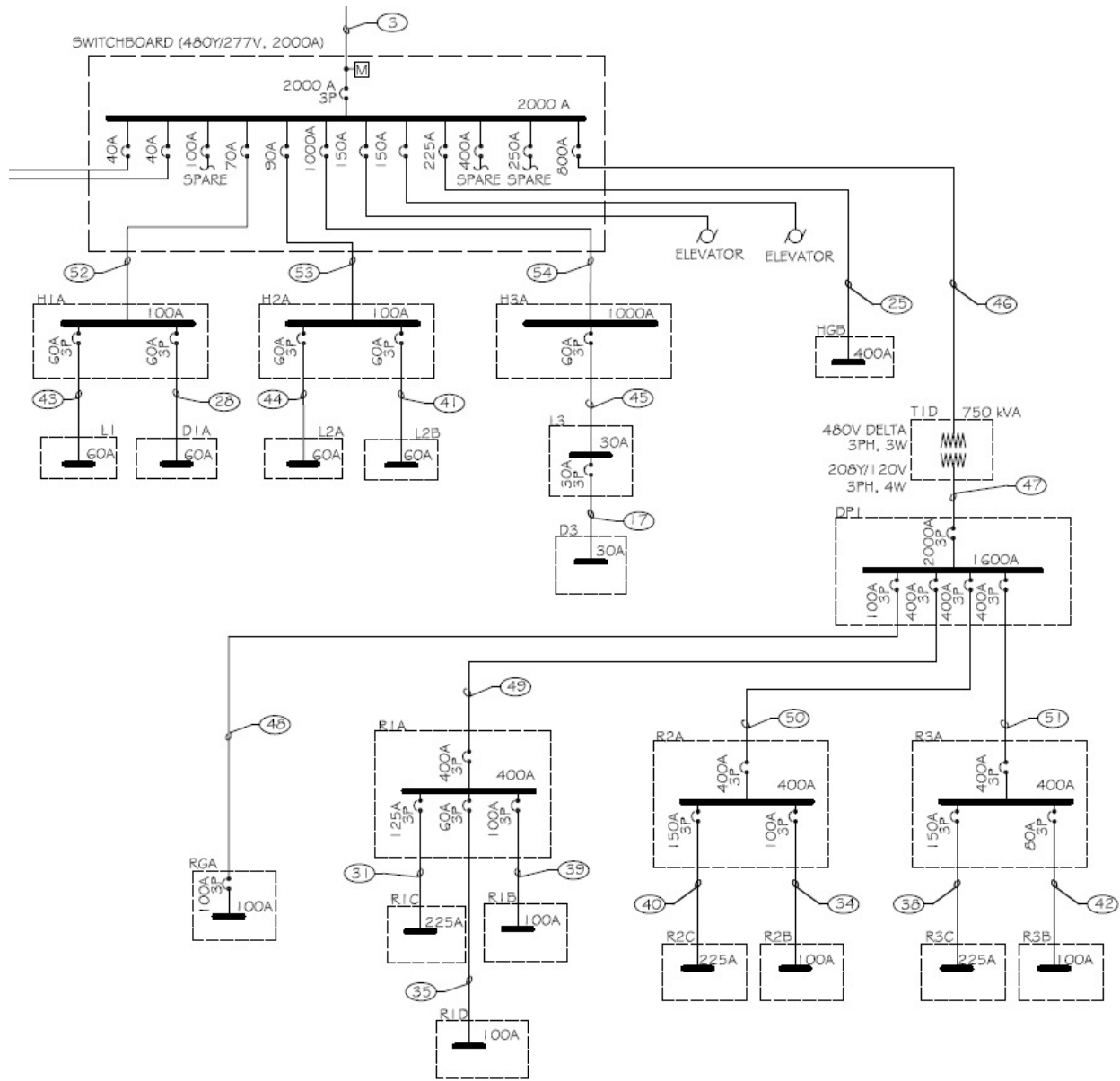
Note: Larger Riser Diagram found in Appendix B

Existing Single Line Diagram



Note: Larger and complete single line diagram of the existing system can be found in Appendix B.

Proposed Single Line Diagram of Central Transformer System:



Note: Larger and complete single line diagram of the new system can be found in Appendix B.

Evaluated Panelboards:

EXISTING PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG					TYPE PANEL		NEMA 1 ENCLOSURE			
MOUNTING	SURFACE		H1A					C/B MIN AIC		18,000			
Bus Rating	225A		LOCATION					PHASES:		3		WIRES:	4
SIZE/TYPE MAINS	MLO		FIRST FLOOR ELEC ROOM					REMARKS					
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION			
DIM PNL D1A	2343	60	1				2		46792	XFMR T1A			
	2343		3				4		46792				
	2343		5				6	175	46792				
	4350		7				8		6000				
	4350		9				10		6000				
PNL L1	4350	80	11				12	30	6000	P-DWH-1			
SPARE		20	13				14	--	--	SPACE			
SPARE		20	15				16	--	--	SPACE			
SPARE		20	17				18	--	--	SPACE			
SPACE	--	20	19				20	--	--	SPACE			
SPACE	--	20	21				22	--	--	SPACE			
SPACE	--	20	23				24	--	--	SPACE			
SUB-TOTAL	A PHASE	59485	B PHASE					59485		C PHASE	59485		
TOTAL CONNECTED LOAD (WATTS)		178455								DEMAND LOAD	160610		

MODIFIED PANEL SCHEDULE													
VOLTAGE	480Y/277		TAG					TYPE PANEL		NEMA 1 ENCLOSURE			
MOUNTING	SURFACE		H1A					C/B MIN AIC		18,000			
Bus Rating	225A		LOCATION					PHASES:		3		WIRES:	4
SIZE/TYPE MAINS	MLO		FIRST FLOOR ELEC ROOM					REMARKS					
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION			
DIM PNL D1A	2343	60	1				2		--	SPARE			
	2343		3				4		--				
	2343		5				6	175	--				
	4350		7				8		6000				
	4350		9				10		6000				
PNL L1	4350	80	11				12	30	6000	P-DWH-1			
SPARE		20	13				14	--	--	SPACE			
SPARE		20	15				16	--	--	SPACE			
SPARE		20	17				18	--	--	SPACE			
SPACE	--	20	19				20	--	--	SPACE			
SPACE	--	20	21				22	--	--	SPACE			
SPACE	--	20	23				24	--	--	SPACE			
SUB-TOTAL	A PHASE	12693	B PHASE					12693		C PHASE	12693		
TOTAL CONNECTED LOAD (WATTS)		38079								DEMAND LOAD	34271		

Note: Due to the fact that I did not have the loads for all the receptacle and distribution panels. I recreated the loads with the assumption that each receptacle circuit had seven receptacles on it and the mechanical loads were obtained from the mechanical motor schedule. Please refer to Appendix C for the recreated panel schedules and panelboard sizing worksheets. The panelboard sizing worksheets were used in determining the sizing of the new transformer, panelboards, overcurrent protectors, and feeders.

MODIFIED PANELBOARD SIZING WORKSHEET											
Panel Tag----->					H1A	Panel Location:			FIRST FLR ELEC RM		
Nominal Phase to Neutral Voltage----->					277	Phase:			3		
Nominal Phase to Phase Voltage----->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	DIM PNL D1A	3		3400	w	0.98	3400	3469		
2	A	SPARE			0	w		0	0		
3	B	DIM PNL D1A	3		2360	w	0.98	2360	2408		
4	B	SPARE			0	w		0	0		
5	C	DIM PNL D1A	3		2050	w	0.98	2050	2092		
6	C	SPARE			0	w		0	0		
7	A	PNL L1	3		6900	w	0.85	6900	8118		
8	A	P-DWH-1			6000	w	1.00	6000	6000		
9	B	PNL L1	3		3200	w	0.85	3200	3765		
10	B	P-DWH-1			6000	w	1.00	6000	6000		
11	C	PNL L1	3		4400	w	0.85	4400	5176		
12	C	P-DWH-1			6000	w	1.00	6000	6000		
13	A				0	w		0	0		
14	A				0	w		0	0		
15	B				0	w		0	0		
16	B				0	w		0	0		
17	C				0	w		0	0		
18	C				0	w		0	0		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								40.3	43.0	Amps=	51.8
PHASE LOADING											
								kW	kVA	%	Amps
PHASE TOTAL		A						16.3	17.6	41%	63.5
PHASE TOTAL		B						11.6	12.2	28%	43.9
PHASE TOTAL		C						12.5	13.3	31%	47.9
LOAD CATAGORIES											
		Connected			Demand					Ver. 1.02	
		kW	kVA	DF	kW	kVA	PF				
1	receptacles	0.0	0.0		0.0	0.0					
2	computers	0.0	0.0		0.0	0.0					
3	fluorescent lighting	22.3	25.0	0.90	20.1	22.5	0.89				
4	HID lighting	0.0	0.0		0.0	0.0					
5	incandescent lighting	0.0	0.0		0.0	0.0					
6	HVAC fans	0.0	0.0		0.0	0.0					
7	heating	0.0	0.0		0.0	0.0					
8	kitchen equipment	0.0	0.0		0.0	0.0					
9	unassigned	18.0	18.0	0.95	17.1	17.1	1.00				
Total Demand Loads					37.2	39.6					
Spare Capacity		20%			7.4	7.9					
Total Design Loads					44.6	47.6	0.94	Amps=	57.2		

EXISTING PANEL SCHEDULE												
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		H2A						C/B MIN AIC		18,000	
Bus Rating	225A		LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		SECOND FLOOR ELEC ROOM						REMARKS			
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION		
XFMR T2A	42261	175	1				2		3330	PNL L2B (PHASE 2 PNL)		
	42261		3				4		3330			
	42261		5				6	60	3330			
PNL L2A	3480	60	7				8		6000	P-DWH-1		
	3480		9				10		6000			
	3480		11				12	30	6000			
SPARE	--	--	13				14		3000	P-DWH-3		
SPARE	--	--	15				16		3000			
SPARE	--	--	17				18	15	3000			
SPACE	--	--	19				20	--	--	SPACE		
SPACE	--	--	21				22	--	--	SPACE		
SPACE	--	--	23				24	--	--	SPACE		
SPACE	--	--	25				26	--	--	SPACE		
SPACE	--	--	27				28	--	--	SPACE		
SPACE	--	--	29				30	--	--	SPACE		
SUB-TOTAL	A PHASE 58071		B PHASE						58071		C PHASE 58071	
TOTAL CONNECTED LOAD (WATTS)	174213										DEMAND LOAD 156792	

MODIFIED PANEL SCHEDULE												
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		H2A						C/B MIN AIC		18,000	
Bus Rating	225A		LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		SECOND FLOOR ELEC ROOM						REMARKS			
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION		
SPARE	--	175	1				2		3330	PNL L2B (PHASE 2 PNL)		
	--		3				4		3330			
	--		5				6	60	3330			
PNL L2A	3480	60	7				8		6000	P-DWH-1		
	3480		9				10		6000			
	3480		11				12	30	6000			
SPARE	--	--	13				14		3000	P-DWH-3		
SPARE	--	--	15				16		3000			
SPARE	--	--	17				18	15	3000			
SPACE	--	--	19				20	--	--	SPACE		
SPACE	--	--	21				22	--	--	SPACE		
SPACE	--	--	23				24	--	--	SPACE		
SPACE	--	--	25				26	--	--	SPACE		
SPACE	--	--	27				28	--	--	SPACE		
SPACE	--	--	29				30	--	--	SPACE		
SUB-TOTAL	A PHASE 15810		B PHASE						15810		C PHASE 15810	
TOTAL CONNECTED LOAD (WATTS)	47430										DEMAND LOAD 42687	

MODIFIED PANELBOARD SIZING WORKSHEET													
Panel Tag----->				H2A	Panel Location:			SECOND FLR ELEC RM					
Nominal Phase to Neutral Voltage----->				277	Phase:			3					
Nominal Phase to Phase Voltage----->				480	Wires:			4					
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks			
1	A	SPARE			0	w		0	0				
2	A	PNL L2B	3		4800	w	0.85	4800	5647				
3	B	SPARE			0	w		0	0				
4	B	PNL L2B	3		2400	w	0.85	2400	2824				
5	C	SPARE			0	w		0	0				
6	C	PNL L2B	3		3900	w	0.85	3900	4588				
7	A	PNL L2A	3		5900	w	0.85	5900	6941				
8	A	P-DWH-1	7		6000	w	1.00	6000	6000				
9	B	PNL L2A	3		3300	w	0.85	3300	3882				
10	B	P-DWH-1	7		6000	w	1.00	6000	6000				
11	C	PNL L2A	3		2400	w	0.85	2400	2824				
12	C	P-DWH-1	7		6000	w	1.00	6000	6000				
13	A	SPARE			0	w		0	0				
14	A	P-DWH-3	7		3000	w	1.00	3000	3000				
15	B	SPARE			0	w		0	0				
16	B	P-DWH-3	7		3000	w	1.00	3000	3000				
17	C	SPARE			0	w		0	0				
18	C	P-DWH-3	7		3000	w	1.00	3000	3000				
19	A				0	w		0	0				
20	A				0	w		0	0				
21	B				0	w		0	0				
22	B				0	w		0	0				
23	C				0	w		0	0				
24	C				0	w		0	0				
25	A				0	w		0	0				
26	A				0	w		0	0				
27	B				0	w		0	0				
28	B				0	w		0	0				
29	C				0	w		0	0				
30	C				0	w		0	0				
31	A				0	w		0	0				
32	A				0	w		0	0				
33	B				0	w		0	0				
34	B				0	w		0	0				
35	C				0	w		0	0				
36	C				0	w		0	0				
37	A				0	w		0	0				
38	A				0	w		0	0				
39	B				0	w		0	0				
40	B				0	w		0	0				
41	C				0	w		0	0				
42	C				0	w		0	0				
PANEL TOTAL								49.7	53.7	Amps= 64.6			
PHASE LOADING													
PHASE TOTAL								A					
PHASE TOTAL								B					
PHASE TOTAL								C					
LOAD CATAGORIES								Connected		Demand		Ver. 1.02	
								kW	kVA	DF	kW	kVA	PF
1	receptacles							0.0	0.0		0.0	0.0	
2	computers							0.0	0.0		0.0	0.0	
3	fluorescent lighting							22.7	26.7	0.90	20.4	24.0	0.85
4	HID lighting							0.0	0.0		0.0	0.0	
5	incandescent lighting							0.0	0.0		0.0	0.0	
6	HVAC fans							0.0	0.0		0.0	0.0	
7	heating							27.0	27.0	0.95	25.7	25.7	1.00
8	kitchen equipment							0.0	0.0		0.0	0.0	
9	unassigned							0.0	0.0		0.0	0.0	
Total Demand Loads											46.1	49.7	
Spare Capacity								20%			9.2	9.9	
Total Design Loads											55.3	59.6	0.93
											Amps=	71.7	

EXISTING PANEL SCHEDULE																
VOLTAGE		480Y/277		TAG					TYPE PANEL			NEMA 1 ENCLOSURE				
MOUNTING		PAD		H3A					C/B MIN AIC			18,000				
Bus Rating		1200A		LOCATION					PHASES:		3		WIRES:		4	
SIZE/TYPE MAINS		MLO		THIRD FLOOR ELEC ROOM					REMARKS							
LOAD DESCRIPTION		LOAD WATTS		C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION				
AHU-1		30678		200	1				2		21450	AHU-2				
		30678			3				4		21450					
		30678			5				6	125	21450					
CHILLER		91667		600	7				8		42151	AHU-5				
		91667			9				10		42151					
		91667			11				12	175	42151					
XFMR T3A		41394		175	13				14		3000	P-DWH-3				
		41394			15				16		3000					
		41394			17				18	15	3000					
EF-3		249		15	19				20		1243	F-VENT-4				
		249			21				22		1243					
		249			23				24	15	1243					
PNL L3		4785		60	25				26		124	EF-4				
		4785			27				28		124					
		4785			29				30	15	124					
SPARE		--		--	31				32		--	SPARE				
		--			33				34		--					
		--			35				36	--	--					
SUB-TOTAL		A PHASE		231831		B PHASE		231831		C PHASE		231831				
TOTAL CONNECTED LOAD (WATTS)		695493								DEMAND LOAD		625944				

MODIFIED PANEL SCHEDULE																
VOLTAGE		480Y/277		TAG					TYPE PANEL			NEMA 1 ENCLOSURE				
MOUNTING		PAD		H3A					C/B MIN AIC			18,000				
Bus Rating		1200A		LOCATION					PHASES:		3		WIRES:		4	
SIZE/TYPE MAINS		MLO		THIRD FLOOR ELEC ROOM					REMARKS							
LOAD DESCRIPTION		LOAD WATTS		C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION				
AHU-1		30678		200	1				2		21450	AHU-2				
		30678			3				4		21450					
		30678			5				6	125	21450					
CHILLER		91667		600	7				8		42151	AHU-5				
		91667			9				10		42151					
		91667			11				12	175	42151					
SPARE		--		175	13				14		3000	P-DWH-3				
		--			15				16		3000					
		--			17				18	15	3000					
EF-3		249		15	19				20		1243	F-VENT-4				
		249			21				22		1243					
		249			23				24	15	1243					
PNL L3		4785		60	25				26		124	EF-4				
		4785			27				28		124					
		4785			29				30	15	124					
SPARE		--		--	31				32		--	SPARE				
		--			33				34		--					
		--			35				36	--	--					
SUB-TOTAL		A PHASE		190437		B PHASE		190437		C PHASE		190437				
TOTAL CONNECTED LOAD (WATTS)		571311								DEMAND LOAD		514180				

MODIFIED PANELBOARD SIZING WORKSHEET											
Panel Tag----->					H3A	Panel Location:			THIRD FLR ELEC RM		
Nominal Phase to Neutral Voltage----->					277	Phase:			3		
Nominal Phase to Phase Voltage----->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	AHU-1	6		30678	w	0.95	30678	32293		
2	A	AHU-2	6		21450	w	0.95	21450	22579		
3	B	AHU-1	6		30678	w	0.95	30678	32293		
4	B	AHU-2	6		21450	w	0.95	21450	22579		
5	C	AHU-1	6		30678	w	0.95	30678	32293		
6	C	AHU-2	6		21450	w	0.95	21450	22579		
7	A	CHILLER	7		91667	w	0.95	91667	96491		
8	A	AHU-5	6		42151	w	0.95	42151	44370		
9	B	CHILLER	7		91667	w	0.95	91667	96491		
10	B	AHU-5	6		42151	w	0.95	42151	44370		
11	C	CHILLER	7		91667	w	0.95	91667	96491		
12	C	AHU-5	6		42151	w	0.95	42151	44370		
13	A	SPARE			0	w		0	0		
14	A	P-DWH-3	7		3000	w	1.00	3000	3000		
15	B	SPARE			0	w		0	0		
16	B	P-DWH-3	7		3000	w	1.00	3000	3000		
17	C	SPARE			0	w		0	0		
18	C	P-DWH-3	7		3000	w	1.00	3000	3000		
19	A	EF-3	6		249	w	0.95	249	262		
20	A	F-VENT-4	6		1243	w	0.95	1243	1308		
21	B	EF-3	6		249	w	0.95	249	262		
22	B	F-VENT-4	6		1243	w	0.95	1243	1308		
23	C	EF-3	6		249	w	0.95	249	262		
24	C	F-VENT-4	6		1243	w	0.95	1243	1308		
25	A	PNL L3	3		5900	w	0.90	5900	6556		
26	A	EF-4	6		124	w	0.95	124	131		
27	B	PNL L3	3		4650	w	0.90	4650	5167		
28	B	EF-4	6		124	w	0.95	124	131		
29	C	PNL L3	3		5400	w	0.90	5400	6000		
30	C	EF-4	6		124	w	0.95	124	131		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B				0	w		0	0		
41	C				0	w		0	0		
42	C				0	w		0	0		
PANEL TOTAL								587.6	619.0	Amps= 744.9	
PHASE LOADING								kW	kVA	% Amps	
PHASE TOTAL			A				196.5	207.0	33%	747.3	
PHASE TOTAL			B				195.2	205.6	33%	742.2	
PHASE TOTAL			C				196.0	206.4	33%	745.2	
LOAD CATAGORIES				Connected		Demand		Ver. 1.02			
				kW	kVA	DF	kW	kVA	PF		
1		receptacles		0.0	0.0		0.0	0.0			
2		computers		0.0	0.0		0.0	0.0			
3		fluorescent lighting		16.0	17.7	0.90	14.4	16.0	0.90		
4		HID lighting		0.0	0.0		0.0	0.0			
5		incandescent lighting		0.0	0.0		0.0	0.0			
6		HVAC fans		287.7	302.8	0.95	273.3	287.7	0.95		
7		heating		284.0	298.5	0.95	269.8	283.6	0.95		
8		kitchen equipment		0.0	0.0		0.0	0.0			
9		unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads							557.5	587.2			
Spare Capacity				20%			111.5	117.4			
Total Design Loads							668.9	704.6	0.95	Amps= 847.9	

EXISTING PANEL SCHEDULE												
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		HGA						C/B MIN AIC		25,000	
Bus Rating	100A		LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		BASEMENT ELEC ROOM						REMARKS			
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION		
XFMR TGA	8558	50	1				2	20	--	SPARE		
	8558		3				4	20	--	SPARE		
	8558		5				6	20	--	SPARE		
SPACE	--	--	7				8	20	--	SPARE		
SPACE	--	--	9				10	20	--	SPARE		
SPACE	--	--	11				12	20	--	SPARE		
SPACE	--	--	13				14	--	--	SPACE		
SPACE	--	--	15				16	--	--	SPACE		
SPACE	--	--	17				18	--	--	SPACE		
SPACE	--	--	19				20	--	--	SPACE		
SPACE	--	--	21				22	--	--	SPACE		
SPACE	--	--	23				24	--	--	SPACE		
SPACE	--	--	25				26	--	--	SPACE		
SPACE	--	--	27				28	--	--	SPACE		
SPACE	--	--	29				30	--	--	SPACE		
SUB-TOTAL		A PHASE		8558		B PHASE		8558		C PHASE		8558
TOTAL CONNECTED LOAD (WATTS)		25674								DEMAND LOAD		23107

MODIFIED PANEL SCHEDULE												
VOLTAGE	480Y/277		TAG						TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING	SURFACE		HGA (NOT NEEDED)						C/B MIN AIC		25,000	
Bus Rating	100A		LOCATION						PHASES:	3	WIRES:	4
SIZE/TYPE MAINS	MLO		BASEMENT ELEC ROOM						REMARKS			
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION		
SPACE	--	50	1				2	20	--	SPARE		
	--		3				4	20	--	SPARE		
	--		5				6	20	--	SPARE		
SPACE	--	--	7				8	20	--	SPARE		
SPACE	--	--	9				10	20	--	SPARE		
SPACE	--	--	11				12	20	--	SPARE		
SPACE	--	--	13				14	--	--	SPACE		
SPACE	--	--	15				16	--	--	SPACE		
SPACE	--	--	17				18	--	--	SPACE		
SPACE	--	--	19				20	--	--	SPACE		
SPACE	--	--	21				22	--	--	SPACE		
SPACE	--	--	23				24	--	--	SPACE		
SPACE	--	--	25				26	--	--	SPACE		
SPACE	--	--	27				28	--	--	SPACE		
SPACE	--	--	29				30	--	--	SPACE		
SUB-TOTAL		A PHASE		0		B PHASE		0		C PHASE		0
TOTAL CONNECTED LOAD (WATTS)		0								DEMAND LOAD		0

EXISTING PANEL SCHEDULE												
VOLTAGE		208Y/120		TAG					TYPE PANEL		NEMA 1 ENCLOSURE	
MOUNTING		SURFACE		RGA					C/B MIN AIC		25,000	
Bus Rating		100A		LOCATION					PHASES:		3 WIRES: 4	
SIZE/TYPE MAINS		3P100A MCB		Basement Elec Room					REMARKS			
LOAD DESCRIPTION	LOAD WATTS	C/B SIZE	POS NO	A PH	B PH	C PH	POS NO	C/B SIZE	LOAD WATTS	LOAD DESCRIPTION		
UNIT HEATERS	15	20	1	*			2	20	1260	RECPT- MECH ROOM		
ELEVATOR SUMP P-ELEV-1	372	20	3		*		4	20	1260	RECPT- MECH ROOM		
ELEVATOR SUMP	372	20	5			*	6	20	1260	RECPT- ELEV		
VENT FAN F-VENT-3	37.3	15	7	*			8	20	1260	RECPT- ELEC ROOM		
ACU-4, ACU-5, ACU-6	681	20	9		*		10	20	500	ELEV PIT LTG		
ELEV #1 CAB LTG, HVAC	100	20	11			*	12	20	2067			
ELEV #2 CAB LTG, HVAC	100	20	13	*			14	20	2067	ACCU-4		
AHU-4 LTG, RECEPES	1260	20	15		*		16	20	2067			
EF-6	186.4	15	17			*	18		2067	ACCU-5		
PARKING LOT GATE	372.0	20	19	*			20		2067			
PARKING LOT GATE	372.0	20	21		*		22		2067	ACCU-6		
REFRIGERATED AIR DRYER	1864.4	20	23			*	24		--	SPARE		
GEN BATTERY CHARGER	1000.0	20	25	*			26		--	SPARE		
GEN BLOCK HEATER	1000.0	20	27		*		28		--	SPARE		
SPARE	--	20	29			*	30		--	SPARE		
			31	*			32					
			33		*		34					
			35			*	36					
			37	*			38					
			39		*		40					
			41			*	42					
SUB-TOTAL		A PHASE 8178		B PHASE					9579		C PHASE 7917	
TOTAL CONNECTED LOAD (WATTS)		25674									DEMAND LOAD 23107	

EXISTING PANELBOARD SIZING WORKSHEET											
Panel Tag----->					120	Panel Location:			FIRST FLOOR ELEC ROOM		
Nominal Phase to Neutral Voltage----->					208	Phase:			3		
Nominal Phase to Phase Voltage----->						Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	PNL RGA			8178	w	0.90	8178	9087		
2	A				0	w	1.00	0	0		
3	B	PNL RGA			9579	w	0.90	9579	10643		
4	B				0	w	1.00	0	0		
5	C	PNL RGA			7917	w	0.90	7917	8797		
6	C				0	w	1.00	0	0		
7	A				0	w	1.00	0	0		
8	A				0	w	1.00	0	0		
9	B				0	w	1.00	0	0		
10	B				0	w	1.00	0	0		
11	C				0	w	1.00	0	0		
12	C				0	w	1.00	0	0		
13	A				0	w	1.00	0	0		
14	A				0	w	1.00	0	0		
15	B				0	w	1.00	0	0		
16	B				0	w	1.00	0	0		
17	C				0	w	1.00	0	0		
18	C				0	w	1.00	0	0		
19	A				0	w	1.00	0	0		
20	A				0	w	1.00	0	0		
21	B				0	w	1.00	0	0		
22	B				0	w	1.00	0	0		
23	C				0	w	1.00	0	0		
24	C				0	w	1.00	0	0		
25	A				0	w	1.00	0	0		
26	A				0	w	1.00	0	0		
27	B				0	w	1.00	0	0		
28	B				0	w	1.00	0	0		
29	C				0	w	1.00	0	0		
30	C				0	w	1.00	0	0		
31	A				0	w	1.00	0	0		
32	A				0	w	1.00	0	0		
33	B				0	w	1.00	0	0		
34	B				0	w	1.00	0	0		
35	C				0	w	1.00	0	0		
36	C				0	w	1.00	0	0		
37	A				0	w	1.00	0	0		
38	A				0	w	1.00	0	0		
39	B				0	w	1.00	0	0		
40	B				0	w	1.00	0	0		
41	C				0	w	1.00	0	0		
42	C				0	w	1.00	0	0		
PANEL TOTAL								25.7	28.5	Amps=	79.2
PHASE LOADING											
PHASE TOTAL		A						kW	kVA	%	Amps
PHASE TOTAL		B						8.2	9.1	32%	75.7
PHASE TOTAL		C						9.6	10.6	37%	88.7
PHASE TOTAL								7.9	8.8	31%	73.3
LOAD CATAGORIES											
		Connected			Demand					Ver. 1.02	
		kW	kVA	DF	kW	kVA	PF				
1	receptacles	0.0	0.0		0.0	0.0					
2	computers	0.0	0.0		0.0	0.0					
3	fluorescent lighting	0.0	0.0		0.0	0.0					
4	HID lighting	0.0	0.0		0.0	0.0					
5	incandescent lighting	0.0	0.0		0.0	0.0					
6	HVAC fans	0.0	0.0		0.0	0.0					
7	heating	0.0	0.0		0.0	0.0					
8	kitchen equipment	0.0	0.0		0.0	0.0					
9	unassigned	25.7	28.5	0.80	20.5	22.8	0.90				
Total Demand Loads					20.5	22.8					
Spare Capacity		20%			4.1	4.6					
Total Design Loads					24.6	27.4	0.90	Amps=	76.1		

New Transformer (TD1) Sizing

Feeder & Transformer Sizing Worksheet		
Panelboard Tag	DP1	SWBD to T1D
Panelboard Voltage	208Y/120	277Y/480
Calculated Design Load (kw)	447.6	
Calculated Design Load (kva)	523.5	
Resultant Power Factor	0.86	
Calculated Design Load (amps)	1454.2	787.0907967
Feeder Protection Size	2000A	800A
Sets	6	3
Wire Size		
3 Phase	500 KCMIL	300 KCMIL
1 Neutral	500 KCMIL	
1 Ground	250 KCMIL	1/0 AWG
Conduit Size	3"	2"
Transformer		
Size	750 kVA	
Secondary Protection	1816.363377	2000A
Primary Protection	787.0907967	800A
Remarks		

Based on: Copper Wire, 75 degree C, THWN,

Copper wire

75 degree C THWN insulation

IMC Conduit

Maximum 500kcmil wire

Minimum 3/4" conduit

100% neutral

Dry type transformers with primary and secondary feeders exceeding 25 feet

Cost Analysis of Equipment

*Pricing information from 2008 RS Means

Previous Equipment		
Item	Size	Cost
Panel H1A	225A Bus Bar	\$1,045
H1A Circuit Breaker	225A	\$1,239
Panel H2A	225A Bus Bar	\$1,045
H2A Circuit Breaker	225A	\$1,239
Panel H3A	1200A Bus Bar	\$4,425
H3A Circuit Breaker	1200A	\$12,055
Panel HGA	100A Bus Bar	\$763
HGA Circuit Breaker	100A	\$606
TGA Primary Circuit Breaker	50A	\$499
Xfmr TGA	30 kVA	\$4,385
Xfmr T1A	112.5 kVA	\$13,439
Xfmr T2A	112.5 kVA	\$13,439
Xfmr T3A	112.5 kVA	\$13,439
Total Equipment Cost		\$67,618

New Equipment		
Item	Size	Cost
Distribution Panel DP1	1600A Bus Bar	\$5,025
Panel H1A	100A Bus Bar	\$763
H1A Circuit Breaker	70A	\$606
Panel H2A	100A Bus Bar	\$763
H2A Circuit Breaker	90A	\$606
Panel H3A	1000A Bus Bar	\$3,660
H3A Circuit Breaker	1000A	\$6,065
XFMR T1D	750 kVA	\$34,620
Total Equipment Cost		\$52,108

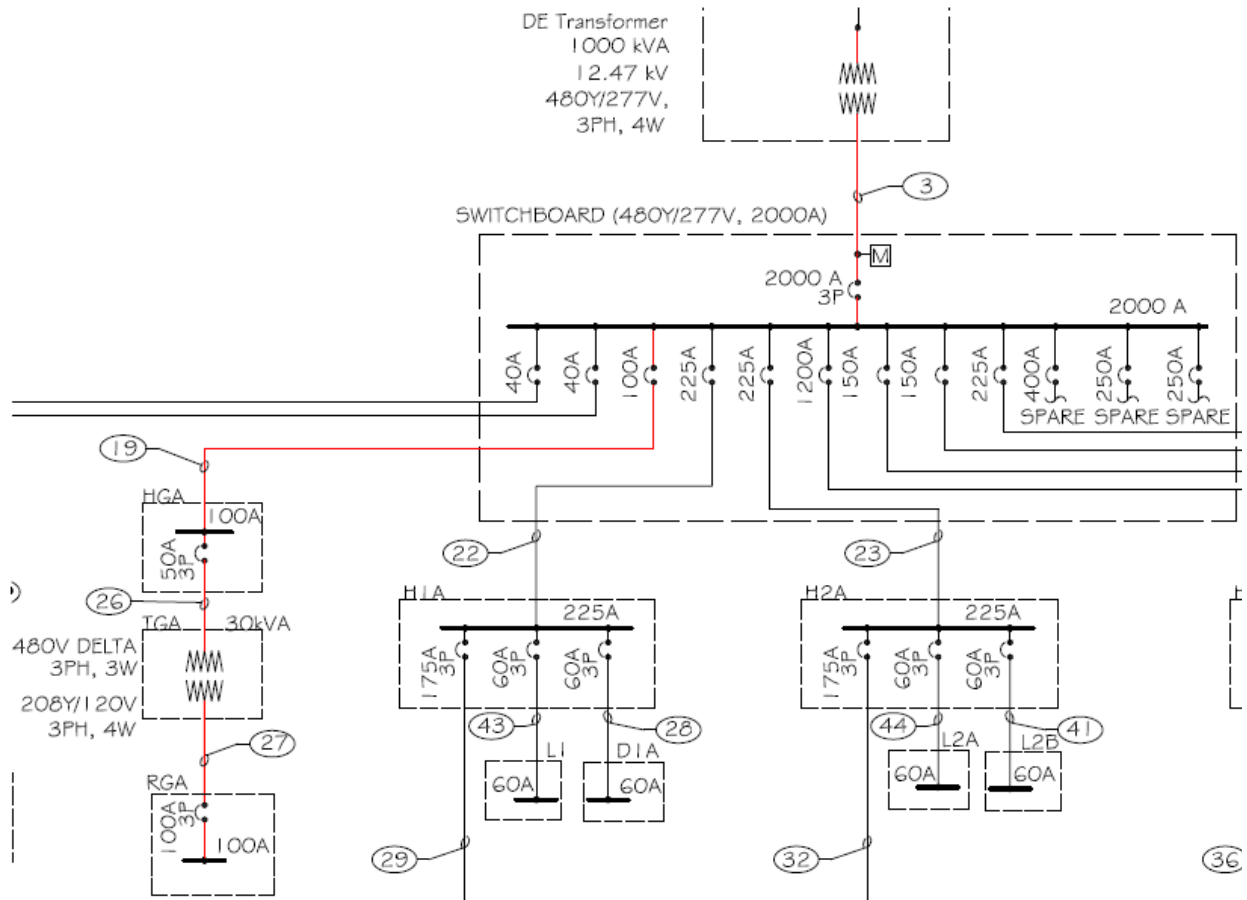
Previous Feeders									
Feeder #	Length/100	Sets	Phase Wire Size	Cost/c.l.f.	Neutral Wire Size	Cost/c.l.f.	Ground Conductors	Cost/c.l.f.	Total Cost per Feeder
Feeder 19	0.0825	1	#1 AWG	\$286	#1 AWG	\$286	#8 AWG	86	\$54
Feeder 22	0.72	1	4/0 AWG	\$626	4/0 AWG	\$626	#4 AWG	166.5	\$1,021
Feeder 23	0.855	1	4/0 AWG	\$626	4/0 AWG	\$626	#4 AWG	166.5	\$1,213
Feeder 24	1.0025	3	600 KCMIL	\$1,603	600 KCMIL	\$1,603	3/0 AWG	516	\$11,194
Feeder 26	0.02	1	#6 AWG	\$118	--	\$0	#10 AWG	60.5	\$4
Feeder 27	0.0325	1	#1 AWG	\$286	#1 AWG	\$286	#6 AWG	118	\$22
Feeder 29	0.675	1	2/0 AWG	\$419	--	\$0	#6 AWG	118	\$362
Feeder 32	0.805	1	2/0 AWG	\$419	--	\$0	#6 AWG	118	\$432
Feeder 36	0.945	1	2/0 AWG	\$419	--	\$0	#6 AWG	118	\$507
Feeder 30	0.025	1	500 KCMIL	\$1,303	500 KCMIL	\$1,303	1/0 AWG	344	\$74
Feeder 33	0.0325	1	500 KCMIL	\$1,303	500 KCMIL	\$1,303	1/0 AWG	344	\$96
Feeder 37	0.0325	1	500 KCMIL	\$1,303	500 KCMIL	\$1,303	1/0 AWG	344	\$96
Total Feeder Cost									\$15,076

New Feeders									
Feeder #	Length/100	Sets	Phase Wire Size	Cost/c.l.f.	Neutral Wire Size	Cost/c.l.f.	Ground Conductors	Cost/c.l.f.	Total Cost per Feeder
Feeder 46	0.1	3	300 KCMIL	\$847	--	\$847	1/0 AWG	344	\$611
Feeder 47	0.0325	6	500 KCMIL	\$1,303	500 KCMIL	\$1,303	250 AWG	727	\$650
Feeder 48	0.0575	1	#3 AWG	\$196	#3 AWG	\$196	#8 AWG	86	\$27
Feeder 49	0.6975	2	3/0 AWG	\$516	3/0 AWG	\$516	#3 AWG	196	\$1,713
Feeder 50	0.8375	2	3/0 AWG	\$516	3/0 AWG	\$516	#3 AWG	196	\$2,057
Feeder 51	0.9775	2	3/0 AWG	\$516	3/0 AWG	\$516	#3 AWG	196	\$2,401
Feeder 52	0.72	1	#3 AWG	\$196	#3 AWG	\$196	#8 AWG	86	\$344
Feeder 53	0.855	1	#3 AWG	\$196	#3 AWG	\$196	#8 AWG	86	\$409
Feeder 54	1.0025	3	400 KCMIL	\$1,084	400 KCMIL	\$1,084	2/0 AWG	419	\$7,780
Total Feeder Cost									\$15,993

Total Equipment Cost	
Total Equipment Savings	\$15,510
Total Feeder Savings	(\$917)
Total Cost of Distributed Transformer System	\$82,694
Total Cost of Central Transformer System	\$68,101
Total Savings	\$14,593

After performing the cost analysis study, it is recommended that a central transformer system be utilized. The major reason for the savings of \$14,593 is the resized transformers. The original system contained three large transformers (112.5 kVA) and a medium size transformer (30 kVA) at a total cost of \$44,702 as compared to \$34,620 for a single (750 kVA) transformer. The resized feeders actually cost more than the existing system but when compared to the total costs of the system it is basically negligible

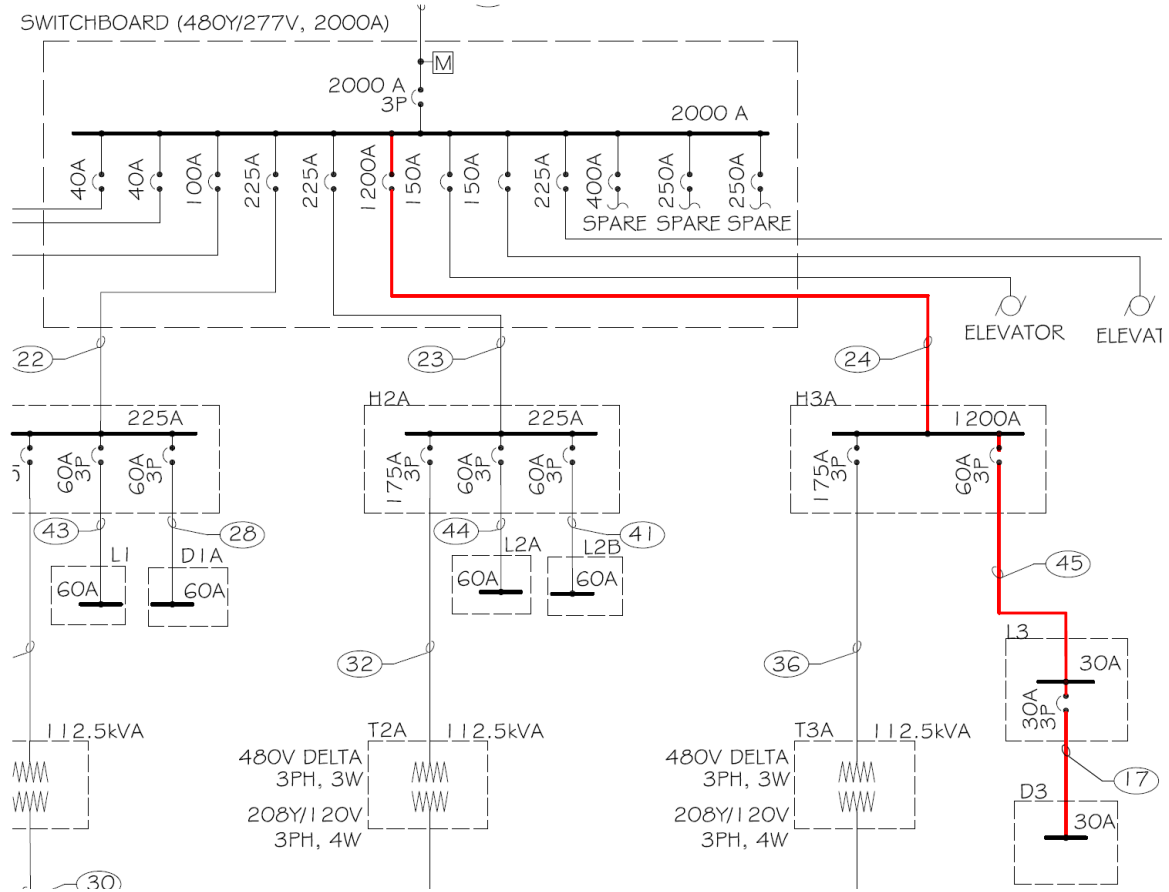
Short Circuit Analysis



Per Unit Short Circuit Method			
Point	Location	Available Fault	Standard Breaking Rating
A	Utility Transformer Secondary Side	20,413	25,000
B	Main Switchboard	19,355	25,000
C	HGA Panelboard	17,188	25,000
D	Transformer TGA	16,929	25,000
E	RGA Panelboard	552	14,000

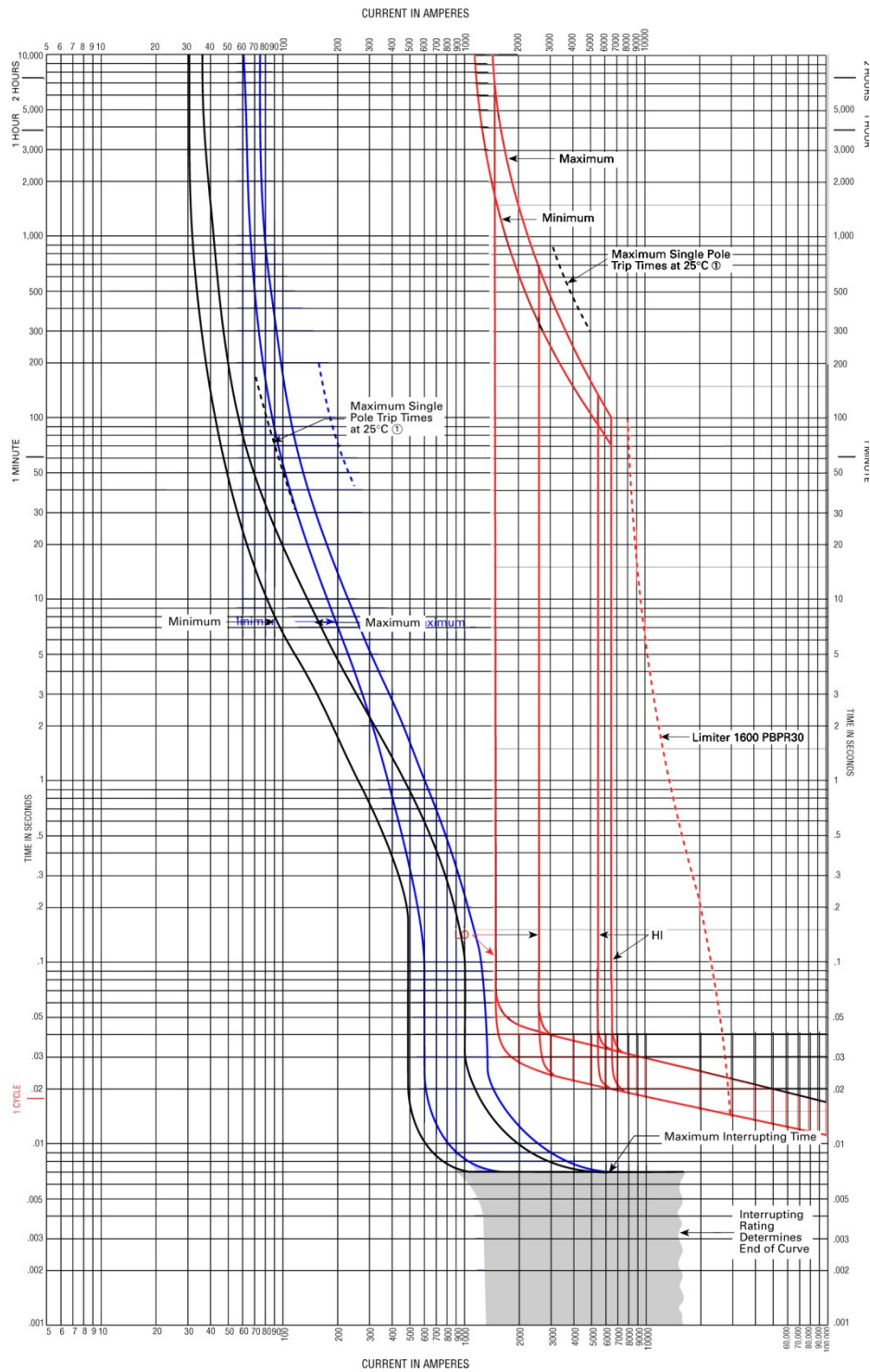
Per Unit Short Circuit Method			
Base kVA	10,000		
Available Utility Fault (kVA)	1,000,000		
System Voltage (kV)	0.48		
Utility Transformer Primary Side			
Utility Transformer Size (kVA)	1,000	X (p.u.) = (Base kVA/Utility S.C. kVA)	0.01
Utility Transformer Secondary Side			
Average % Z.	5.8	X (p.u.) = (%X * base kVA)/(100 *xfmr kVA)	0.534718
Average X/R	2.38	R(p.u.) = (%R * base KVA)/(100 *xfmr kVA)	0.224671
R (%)	2.246712314		
X (%)	5.347175308	$\Sigma X(p.u.)$	0.544718
		$\Sigma R(p.u.)$	0.224671
		$\Sigma Z(p.u.)$	0.589232
		$I_{sc rms sym}$	20413.23
Main Switchboard			
# of sets	6	X(p.u.)	0.026761
length	75.5	R(p.u.)	0.019443
Wire Size	400 KCMIL		
X _L	0.049		
R	0.0356	$\Sigma X(p.u.)$	0.571479
X	0.000616583	$\Sigma R(p.u.)$	0.244114
R	0.000447967	$\Sigma Z(p.u.)$	0.621434
		$I_{sc rms sym}$	19355.45
HGA Panelboard			
# of sets	1	X(p.u.)	0.036491
length	14.75	R(p.u.)	0.102431
Wire Size	#1		
X _L	0.057		
R	0.16	$\Sigma X(p.u.)$	0.60797
X	0.00084075	$\Sigma R(p.u.)$	0.346545
R	0.00236	$\Sigma Z(p.u.)$	0.6998
		$I_{sc rms sym}$	17187.94
Transformer TGA Primary Side			
# of sets	1	X(p.u.)	0.006689
length	2.25	R(p.u.)	0.009838
Wire Size	#6		
X _L	0.0685	$\Sigma X(p.u.)$	0.614659
R	0.51	$\Sigma R(p.u.)$	0.356383
X	0.000154125	$\Sigma Z(p.u.)$	0.710503
R	0.000226667		
		$I_{sc rms sym}$	16929.03
Transformer TGA Secondary Side			
Transformer Size (kVA)	30		
Average % Z.	6.4	X (p.u.) = (%X * base kVA)/(100 *xfmr kVA)	14.44387
Average X/R	0.92	R(p.u.) = (%R * base KVA)/(100 *xfmr kVA)	15.69986
R (%)	4.709958475		
X (%)	4.333161797	$\Sigma X(p.u.)$	15.05853
		$\Sigma R(p.u.)$	15.7097
		$\Sigma Z(p.u.)$	21.7613
		$I_{sc rms sym}$	552.7304
RGA Panelboard			
# of sets	1	X(p.u.)	0.004948
length	2	R(p.u.)	0.013889
Wire Size	#1		
X _L	0.057		
R	0.16	$\Sigma X(p.u.)$	15.06348
X	0.000114	$\Sigma R(p.u.)$	15.72359
R	0.00032	$\Sigma Z(p.u.)$	21.77475
		$I_{sc rms sym}$	552.389

Overcurrent Protection Device Coordination Study



Protection Device Coordination Study

Black Line = 30A | Blue Line = 60A | Red Line = 1200A



Coordination Study Analysis

After overlaying the overcurrent time delay curves of a 30A, 60A, and 1200A circuit breaker, there is limit overlap. The 60A circuit breaker starts to overlap the 30A circuit breaker with its lower limit starting at 200A and 2 sec and continues to 5000A and 0.07 sec. The 30A lower limit however remains ahead of the lower limit of the 60A circuit breaker. This means that there is a slight chance that the 30A circuit breaker will trip before the 60A breaker starting at 200A and 2 sec. Other than this overlap the circuit breakers will trip in the proper order: the 30A circuit breaker will trip before the 60A and the 1200A will trip before both the 30A and the 60A.