Final Report | AE Senior Thesis

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Franklin Square Hospital Center

Patient Tower and Emergency Department Addition

Baltimore, MD

Size	356,000 square feet
Occupant	MedStar Health Facilities
Overall Cost	$175 million
Number of Stories	7 stories

Building Owner	Franklin Square Hospital Center
Project Manager	Lillibridge Healthcare Services, Inc.
Architect	Wilmot/ Sanz Inc
MEP Engineer	Leach Wallace Associates
Structural Engineer	Rathgeber/Goss Associates
Civil Engineer	Dewberry & Davis

Architectural

Medical institutions are shaped for function rather then aesthetics. The rigid geometric shape of the hospital allows for a new adult emergency, pediatric emergency and fast track departments on the first level with a nurse's station located in the center of each. The patient tower allows for 291 private patient rooms each with a window, private bath and ample space for visitors and belongings. The main visitor's lobby enters into an inviting three-story open atrium space.

Structural

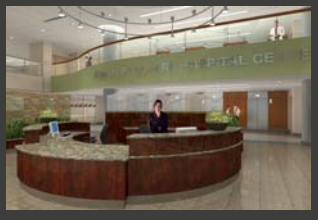
The building foundation sits on cassions with a shaft diameter ranging from 1'-6" to 5'-0". Typical concrete column sizes are 22x22 and 21x21 with vertical bars 8#9 and 8#11 respectively. W-shape steel column sizes vary and sit on concrete pier footings. Composite and concrete beams are used throughout the addition.

Lighting + Electrical

Normal power to the hospital is supplied by two 13.2 KV underground feeders that terminate in a 15 KV class switchgear rated at 1200 amperes. Emergency power to the hospital is supplied by two 480Y/277 volt, diesel engine generator sets. T8 luminaires with electronic ballasts will be utilized wherever possible due to their energy efficiency.

Mechanical

Six new air handling units shall be installed in the penthouse of the patient tower along with the new heating hot water plant. The building will be served by variable air volume terminal units with hot water reheat and the return system will be a variable volume system with return air terminal units.



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Executive Summary

The New Patient Care Tower Addition to Franklin Square Hospital Center is a big step for healthcare in Baltimore, Maryland. The overall purpose for the new addition is to improve patient's needs and comfort and provide the best healthcare possible.

This final report encompasses work focused on the lighting and electrical design of Franklin Square Hospital Center. An acoustical breadth and mechanical breadth are also provided.

The lighting depth focuses on the redesign of four distinct spaces: the main entrance and parking lot area, gift shop, emergency department lobby and waiting area, and team station. The hospital's main goals evolve around patient care therefore the lighting design of these spaces will reflect this main goal.

An electrical redesign of the panel boards that serve the normal and emergency power to the four spaces will be evaluated and recalculated for the new lighting designs. Electrical depth topics including a cost comparison of copper vs. aluminum feeders and a comparison of energy loss vs. increased feeder size will be evaluated. A short circuit analysis of a single path through a distribution system will be performed along with a coordination study.

The following report explains the process, detailed results, and conclusions of the research performed on the building. The proposed redesigns will allow Franklin Square Hospital Center to continue and improve the care of their most important customers.

Building Overview

Franklin Square Hospital Center is medical institution that provides healthcare to the people of the Baltimore area as well as visiting patients. A new 356,000 square feet addition includes a six floor patient tower atop of new emergency and pediatric emergency departments.

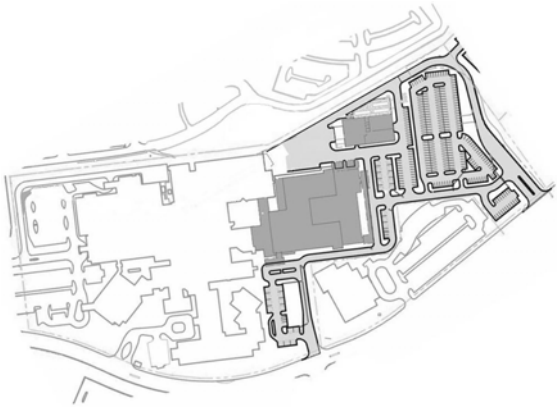
The New Patient Care Tower will provide 291 private rooms with improved environments. Each room will have a window to provide sunlight for added comfort. Private bathrooms and seating areas are also designed for each room.

The emergency department expansion will greatly speed the triage process upon the patient's arrival. The triage will have more privacy by implementing walls where curtains previously were. Easy access to diagnostic services and an expanded laboratory will greatly decrease the patient's waiting time.

Franklin Square was the first hospital in the Baltimore County area to open the doors to a pediatric emergency department in 2004. This new addition will further improve the care of children. Additional triage and inpatient rooms will be more spacious to accommodate visiting family members.

A large 3-story atrium space provides a welcoming notion to visitors. Features such as a bamboo garden, fireplaces and a gentle waterfall imply the cozy environment. The new modern style within will reflect the high-quality care delivered by the medical professionals.

Figure 1 | Patient Tower and Emergency Department Addition



Building Statistics

Building Name | Franklin Square Hospital Center Patient Tower and Emergency Department Addition

Location | 9000 Franklin Square Drive, Baltimore, MD 21237

Building Occupant Name | MedStar Health Facilities

Size | 356,000 sq. ft.

Number of Stories | 7 stories

Primary Project Team

Owner | Franklin Square Hospital Center - http://www.franklinsquare.org/

Project Manager | Lillibridge Healthcare Services, Inc. - http://www.lillibridge.com/

Architect | Wilmot/ Sanz Inc. - http://www.wilmot.com/

MEP Engineer | Leach Wallace Associates - http://www.leachwallace.com/home.cfm

Structural Engineer | Rathgeber/Goss Associates - http://www.rath-goss.com/

Civil Engineer | Dewberry & Davis - http://www.dewberry.com/

Dates of Construction | Fall 2007 - Summer 2010

Overall Project Cost | $175 million

Project Delivery Method | Design - Bid – Build

Architecture

Medical institutions are shaped for function rather than aesthetics. The rigid geometric shape of the hospital allows for a new adult emergency, pediatric emergency and fast track departments on the first level with a nurse's station in the center of each. The new patient tower allows for 291 private patient rooms each with a window, private bath and ample space for visitors. The entrance lobby is an inviting three-story open atrium space.

Building Code Analysis

Building Code | IBC 2006 Edition with Baltimore County Amendments

Fire Protection Code | NFPA 101, Life Safety Code 2006, International Fire Code 2006 Edition with Baltimore County Amendments

Health Department Code | AIA Guidelines for Hospital and Health Care Facilities, 2006

Handicapped Requirements | ADAAG, American with Disabilities Act – Public Law 101-336

Electrical Code | NEC 2005

Mechanical Code | International Mechanical Code 2006

Plumbing Code | National Standard Plumbing Code 2003 with 2004 Supplement

Energy Code | International Energy Code 2006

Zoning | Baltimore County Zoning Regulations

Historical Requirements | None

Building Enclosure

The exterior façade of the addition will resemble the façade of the existing hospital. Portland cement stucco, red face brick and precast concrete cladding units are assembled to create the matching façade. A curtain wall system composed of aluminum framing and argon filled PPG Solarban 80 insulating spandrel tempered glass is used throughout the first level and entryways. Roof construction will consist of two types of roofing. EP single-ply membrane roofing that includes a non-traffic-bearing sheet membrane system intended for weather exposure as primary roofing used on the new patient tower and entry canopies. The remaining rooftop area is covered by a modified bitumen roofing system. This system consists of two plies of type IV fiberglass felts installed in type III asphalt and coated in one ply of mineral surfaced, Class A fire rated, SBS/SIS modified cap sheet that solidly bonds to the underlying plies when heat is applied by torch, to insure a solid bond.

Sustainability Features

Not LEED Certified but there is post-design consideration for certification. Patient care was a higher concern when designing this medical center therefore the importance of facility sustainability has been sacrificed at times.

Construction

The Franklin Square Hospital Center addition consists of the construction of a new seven story tower with walk-out emergency department ground floor, six floors of new patient rooms including one floor of ICU rooms, a penthouse floor, a roof designed for a future heliport, a new three story entry lobby with a new gift shop, a new meditation room, and a new admitting suite. There will be renovations to the materials management building and existing ICU to construct new corridor tie-ins. The central energy plant will receive new boilers, chillers, generators, electrical switchgear and cooling towers. Site work includes the construction of the entrance plaza and installation of additional utilities.

Electrical System

Normal power to the hospital is supplied by the Baltimore Electric Utility Company. Two 13.2KV underground feeders enter the building at the northwest corner and terminate in a 15KV class switchgear rated at 1200A. Wiring size is #12AWG minimum for a typical 20A, 120V or 277V lighting or receptacle branch circuit with a maximum total length of 60 feet and 150 feet respectively.

The uninterrupted power system is 3Φ on-line solid state system rated at 180KVA/162KW. The input current is 260A with a power factor up to 0.98 lagging. The output voltage is 208Y/120VAC 3Φ 5W.

Emergency power of 480Y/277V 3Φ 4W, to the hospital is supplied by three 480Y/277V, diesel engine generator sets of 2000KW capacity. The generator sets are mounted on a heavy duty steel base to maintain proper alignment between components and provide power within 10 seconds. The emergency power bus is rated at 10,000A at 480Y/277V

Lighting System

Track lighting, linear/perimeter lighting, cold cathode lighting and custom fixtures are found through the entire building. All incandescent lamps will have a long life of 2500 hours and a voltage of 130V if available. Fluorescent T8 lamps contain a low amount of mercury, have a minimum life of 15,000 hours and have a CCT of 4100K. All fluorescent ballasts are electronic, "Class P" type, have a sound rating of "A" and have a high power factor of 0.95 or greater. Compact fluorescent twin-tube lamps are rated at an average life of 10,000. High intensity discharge lamps have a minimum of 20,000 hours of lamp life. Ultrasonic and infrared occupancy sensors are supplied in rooms including the lobby along with many others.

Mechanical System

Six new air handling units shall be installed in the penthouse of the patient tower along with the new heating hot water plant. The building will be served by variable air volume terminal units with hot water reheat and the return system will be a variable volume system with return air terminal units.

Structural System

The building foundation sits on caissons with a shaft diameter ranging from 1'-6" to 5'-0". Typical concrete column sizes are 22x22 and 21x21 with vertical bars 8#9 and 8#11 respectively. W-shape steel column size varies and sits on concrete pier footings. Composite and concrete beams are used throughout the addition.

Fire Protection

The building is protected with an automatic sprinkler system along with an approved automatic fire alarm system throughout the new facility. Portable fire extinguishers, manual pull stations, magnetic door closers along with an annunciation system, using horns and strobes, are located throughout the building. Selected doors on staircases are equipped with hardware to prevent re-entry

Sprayed fireproofing is applied to all new structural steel and metal decking where indicated for UL assembly. In renovated areas, the fireproofing is patched where it has been removed. Fire partitions range as well as fire and smoke barriers are rated at one or two hours.

Transportation

The building is serviced by four elevators of which two are for public use and two are strictly used as service elevators. All of the elevators are geared traction type and have a rated speed of 350 fpm. The public elevators provide access to all seven the patient tower floors and have a rated load of 3000 lbs. Service elevator #1 has a rated load of 7500 lbs and #2 has a rated load of 5000 lbs.

Two staircases connect the ground level through the seventh floor of the patient tower. These are located at the northeast and southeast ends of the tower. A centralized staircase located next to the main lobby connects the ground level to the roof. One other stair connects the exterior first floor level, next to the meditation garden, to the second floor.

Telecommunications

VOIP, data and video communications originate at local area network switch equipment that is placed on vertical freestanding equipment racks. The CATV system requires RG-6 co-axial cables in each of the patient rooms, waiting areas and other locations throughout the facility. Category 6 cables are used for the hospital standard voice/data system.

Lighting Depth

Main Entrance + Parking Lot | Exterior Space

Spatial Summary

The glass canopy stretches alongside the main entrance of Franklin Square Hospital Center. Adjacent to the canopy is a grand three story atrium space. The canopy is also located next to a car drop off area.

In the center of the parking area are walkways leading to a centralized plaza seating area under a wooden terrace. Along the walkways are wooden park benches and a curving natural rock bench. The plaza area is a pleasant place where families and workers can gather and escape from the hospital for some fresh air.

Drawings

Figure 2 | Main Entrance and Parking Lot Site Plan

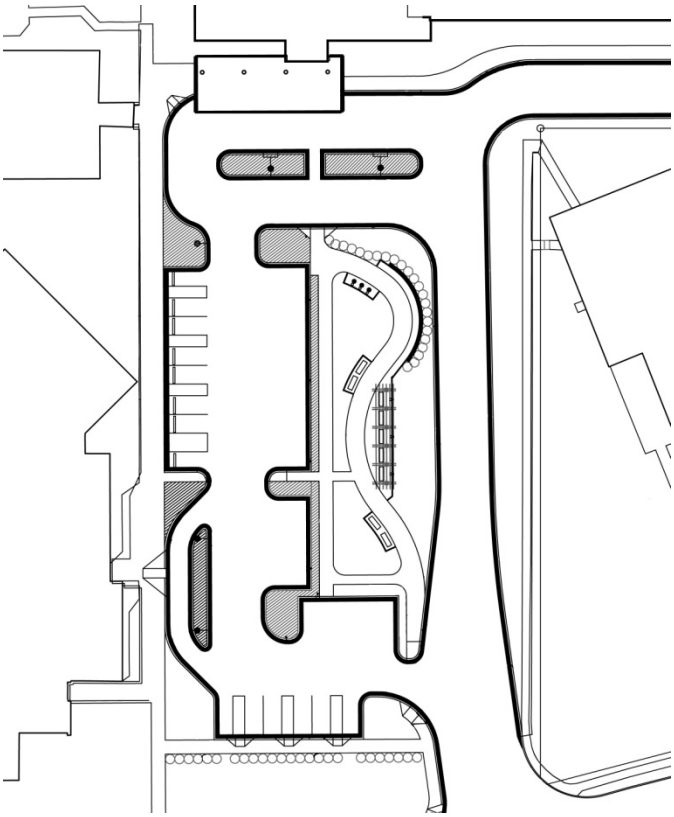


Figure 3 | South Elevation and Main Entry Canopy Elevation

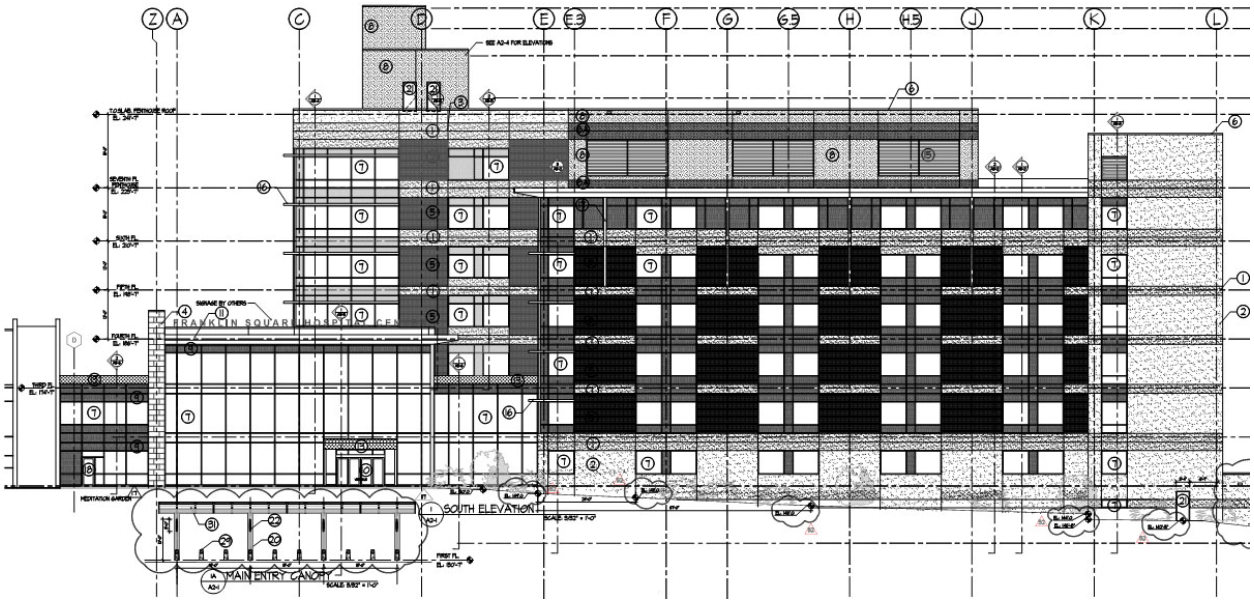


Figure 4 | South Elevation Main Entry Canopy Elevation

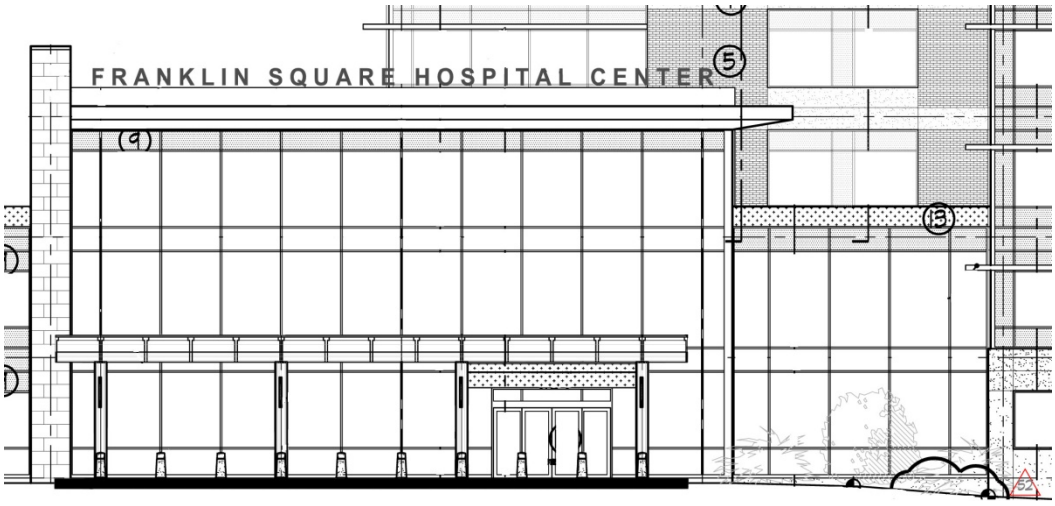
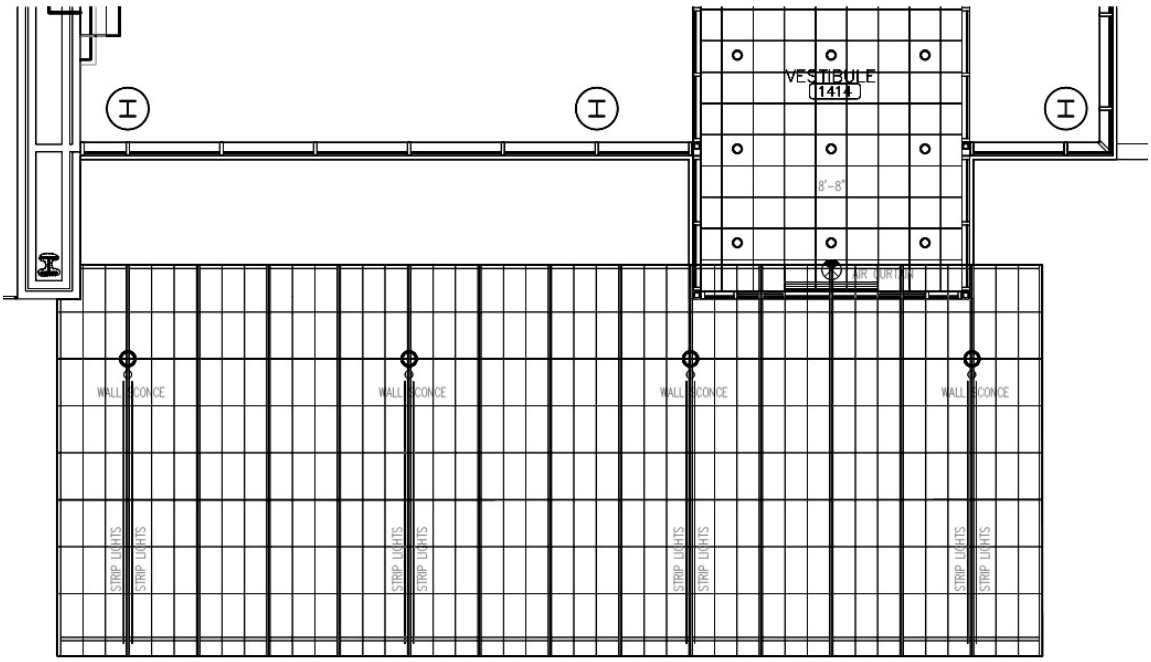


Figure 5 | Main Entry Canopy Reflected Ceiling Plan



Surface Materials

Entrance/Canopy

Roof – Aluminum composite paneling

Walls – Aluminum curtain wall system (GL-6,-6T)

Doors – Aluminum entrance sliding doors (GL-6,-6T)

Canopy Area

Canopy – Glass canopy

Columns – metal tube columns

Paving materials

Roadways – Black asphalt

Walkways - precast concrete pavers and slab on grade concrete

Tasks/Activities

Walking and driving are the main activities in the parking lot area. Under the canopy, a major task would be loading and unloading patients that may or may not need assistance. Safety is essential especially during the night. Signage and traffic markings on the roads must have adequate illumination in order for people to read them and react to them.

Design Criteria

Outdoor, Building Exteriors, Active/Parking Areas (IESNA Handbook)

Appearance of Space and Luminaires (Very Important/Important)

The appearance of the outdoor space should look clean and organized with poles aligned with each other. If the poles and luminaires were cluttered, the visitors and occupants might get the impression that the hospital is cluttered and unorganized as well. The first impression is the outside of the building so it must appear how the hospital wants to be reflected, remarkable.

Color Appearance and Color Contrast (Very Important/Not Important)

CRI is not critical in the parking area but should be at least 80 under the canopy where the pedestrian traffic is the greatest. The CCT for all the luminaires outside should be within the range of 3500K to 4000K to resemble the sun during the nighttime hours.

Direct Glare (Very Important/Very Important)

Direct glare should be avoided outdoors because it is very distracting for drivers and can be disabling for pedestrians. Both of these issues are a high safety concern.

Light Distribution on Surfaces (Important/Important)

Provide uniformity along the roadways and walkways to enable safety and easy navigation of the circulation of traffic.

Light Pollution/Trespass (Very Important/Very Important)

Full cutoff luminaires can be used to avoid light pollution. Light trespass onto adjacent sites can be reduced by the height of the luminaries and the photometric distribution of the reflector that is chosen.

Modeling of Faces or Objects (Very Important/Very Important)

Modeling of faces in the outdoor space is achieved through the photometric spread of the ambient lighting system.

Peripheral Detection (Very Important/Very Important)

The perimeter of the parking area should be illuminated to avoid accidents.

Point(s) of Interest (Very Important/Important)

The point of interest of this outdoor space is the main entrance storefront façade during the day. At night it shifts to the canopy outside of the lobby as well as the main lobby/atrium space that will be illuminated inside.

Reflected Glare (Very Important/Very Important)

Reflected glare from the curtain wall during the day should be avoided. Also avoid the reflected glare from the cars at nighttime.

Shadows (Very Important/Very Important)

Shadows create a visually pleasing area but should be avoided on the walkways and main roadways.

Source/Task/Eye geometry (Very Important/Very Important)

Keeping the luminance ratio between the outdoor spaced to a minimum will create a pleasant and more human sized outdoor area.

Sparkle/Desirable Reflected Highlights (Important/Not Important)

Sparkle is provided by the interior illumination of the lobby/atrium space at night. The desirable highlights that the space contains are shown to the people outside when the curtain wall façade becomes transparent at night.

Surface Characteristics (Very Important/Important)

The walkways have a much higher reflectance value then the roadways therefore the light levels must be adapted for each specific surface that is being illuminated.

Illuminance

Horizontal Illuminance (Very Important/Important) – Category B/N.A. – 5/0.2 fc

Vertical Illuminance (Very Important/Very Important) – Category A/N.A. – 3/1 fc

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Parking Lots and Drives – 0.15 W/ft^2

Walkways less than 10 ft wide – 1.0 W/linear foot

Main Entries – 30 W/linear foot of door width

Canopies – 1.25 W/ft^2

Controls Criteria

Photo sensors or a timer can be used to switch the outdoor luminaires.

Luminance Ratios (max:min)

The maintained illuminance uniformity ratio, maximum-to-minimum should not be greater then 20:1 for basic parking lots

Psychological Aspects

The outdoor area should provide a transitional space for the visitor or patient at night before they reach the main canopy. A feeling of excitement should increase the interest of the occupant to enter the space to actually see the interior features that they got glimpses of from the outside.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 6 | Main Entrance and Parking Lot Luminaire Schedule

MAIN ENTRANCE + PARKING LOT LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
A		Williams	OER1717	OER1717/100PSMH 277/TFT/S/SQ/SLV	17" square area luminaire. Fabricated .08"aluminum housing with an extruded aluminum frame with latches to provide easy access to ballast, lamp and reflector. Clear .187" thick high-impact, heat-resistant tempered glass lens.	MXR100/C/U/MED/O 12570 - GE quartz metal halide ED17	109	277	IMH/100/D/277 Philips Advance
B		Cooper Lighting	Acorn	ANE/70/P/H/7/33/A	8" textured polycarbonate globe with internal type III refractor. Cast aluminum housing finished in standard black polyester powder coat.	CMH70CU830MED/O 31070 - GE ceramic metal halide ED17	79	277	IMH/70/D/277 Philips Advance
C		Philips Color Kinetics	eW Graze Powercore	523/000030/15	4' linear LED surface mounted luminaire with a 30° x 60° beam angle. Extruded anodized aluminum housing and clear polycarbonate lens. Certified IP66 for a wet location environment.	4000K White LED lamps included	60	277	Integrated with luminaire
D		Cooper Lighting	WP Series	683/4/WP/CFL/1/26/277V/SM	Solid aluminum with open bottom and enclosed top wall mounted luminaire coated with premium polyester powder paint. Dark Sky and ADA compliant. UL approved for wet location.	F26DBX/841/ECO4P 97613 - GE CF plug in T4	31	277	VEZ/1T42/M2/BS Philips Advance
E		Cooper Lighting	Rio	1235/RD/M/4LED/120/12/NSS	5" round, open fascia with clear diffuse lens. Die-cast aluminum alloy housing that is corrosion-resistant. Certified IP68 for a standard wet environment.	White LED lamps included	4	120	Integrated with luminaire

See Appendix A for full luminaire schedule and cut sheets

Figure 7 | Main Entrance and Parking Lot Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
A	1.0	0.69	0.88	-	0.61
B	1.0	0.72	0.88	-	0.63
C	1.0	0.85	0.88	-	0.75
D	1.05	0.84	0.88	-	0.78
E	1.0	0.85	0.88	-	0.75

Controls

An astronomical time clock will be used to automatically turn the lights on at night when they are needed. In the morning the time clock will also turn the lights back off.

Figure 8 | Main Entrance and Parking Lot Control Schedule

MAIN ENTRANCE + PARKING LOT CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
X		Watt Stopper	Astronomical Time Clock	MSC-100	5-channel Astronomical Time Clock used for fully automating a Wireless Micro lighting control system. Provides ON/OFF control signals based on time of day, day of week, holiday and calculated sunrise/sunset time.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the main entrance and parking lot redesign.

Figure 9 | Exterior Pseudo Color and Render (fc)

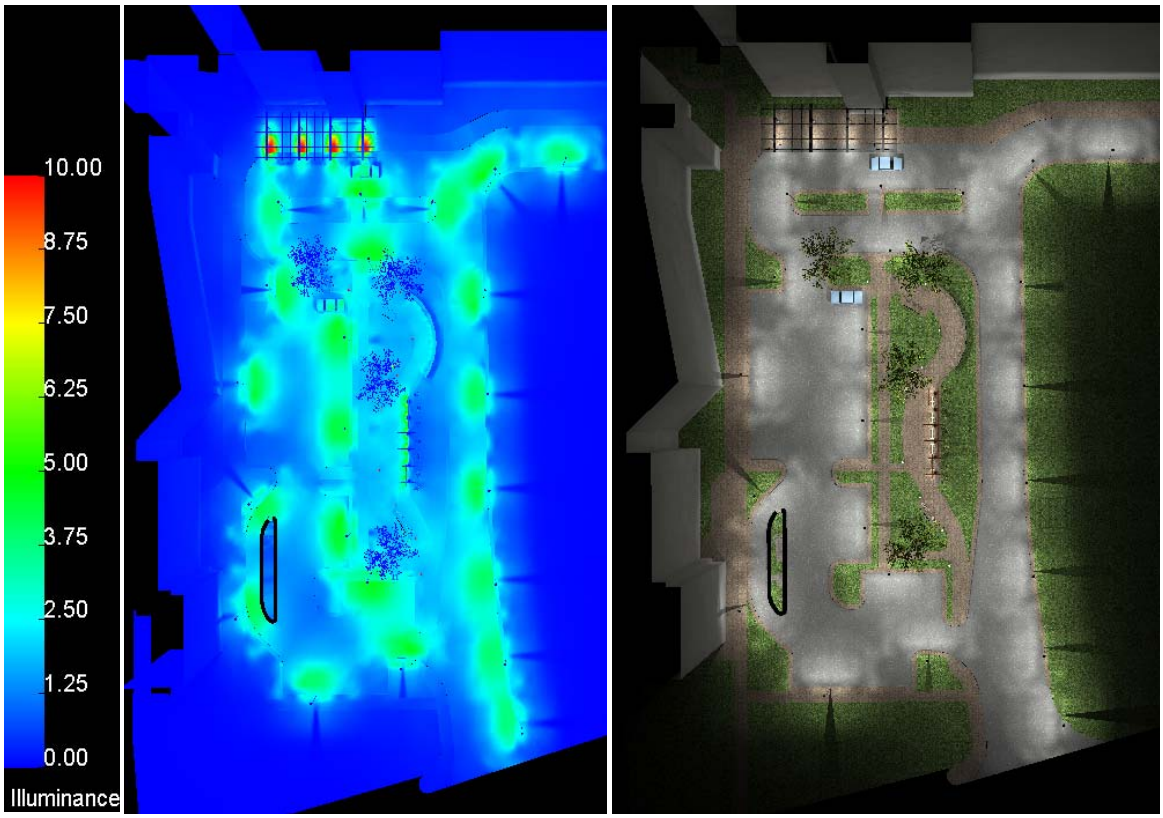


Figure 10 | Exterior View Render and Pseudo Color (fc)

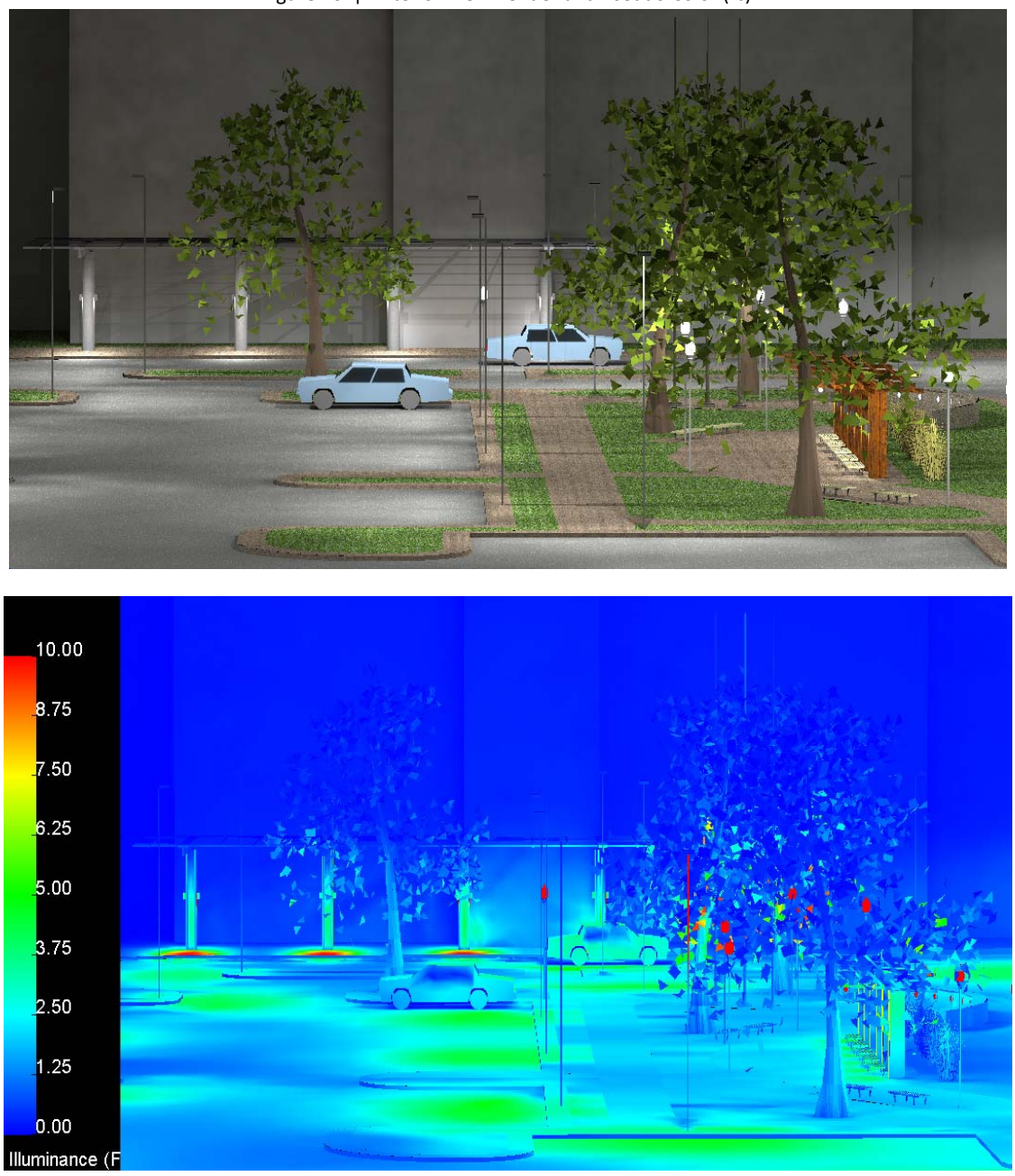


Figure 11 | Exterior View Render and Pseudo Color (fc)

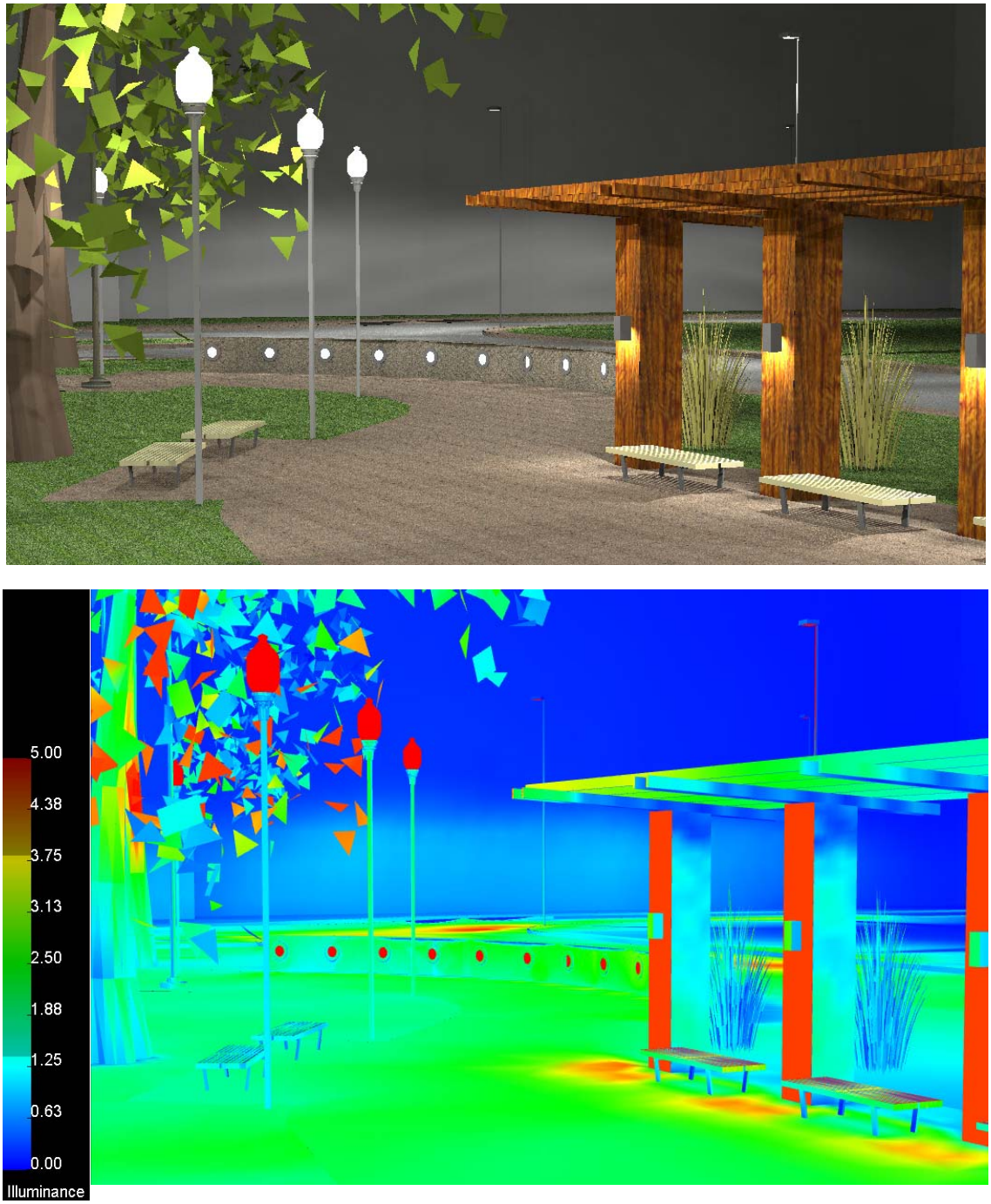


Figure 12 | Canopy Horizontal Illuminance (fc)

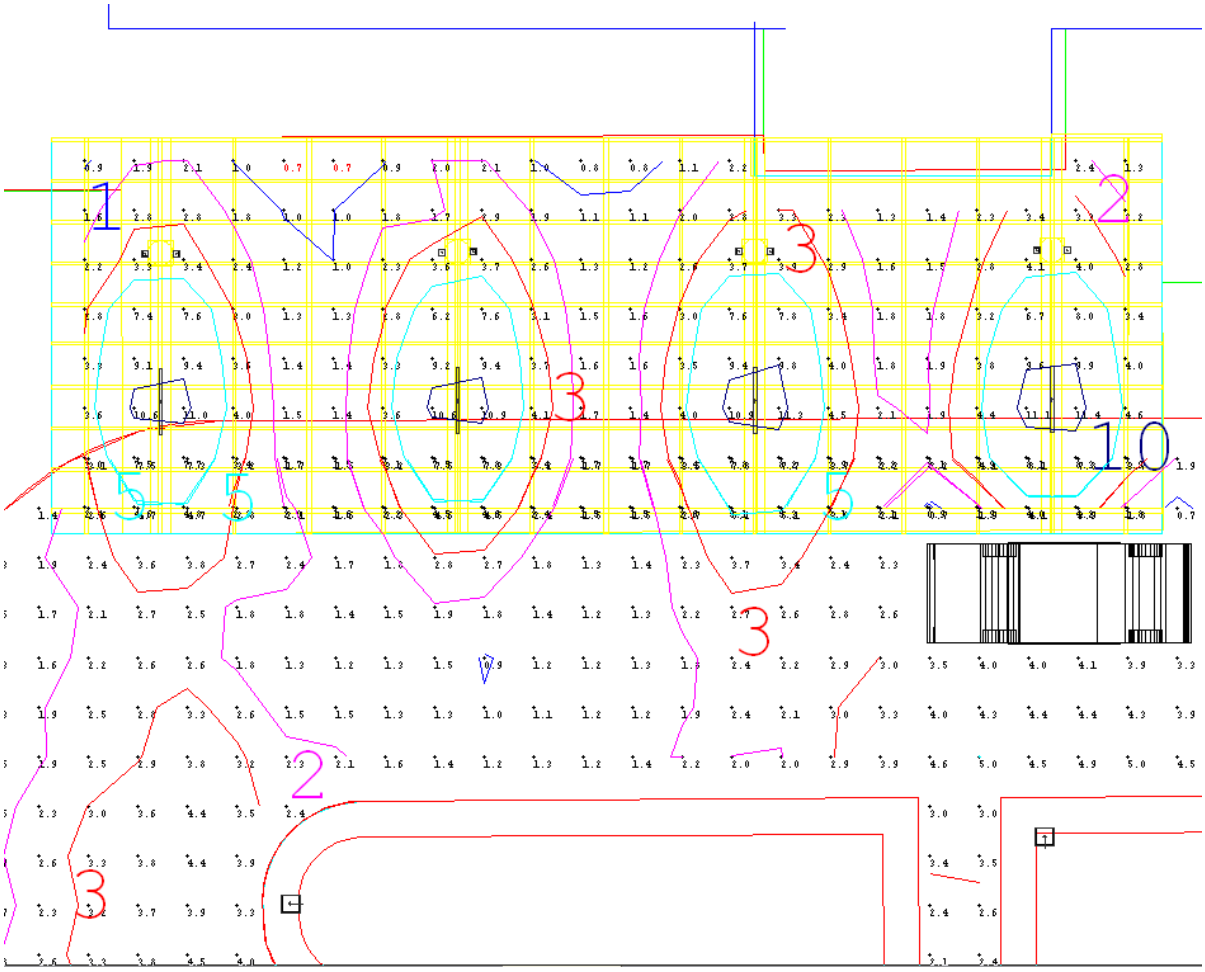
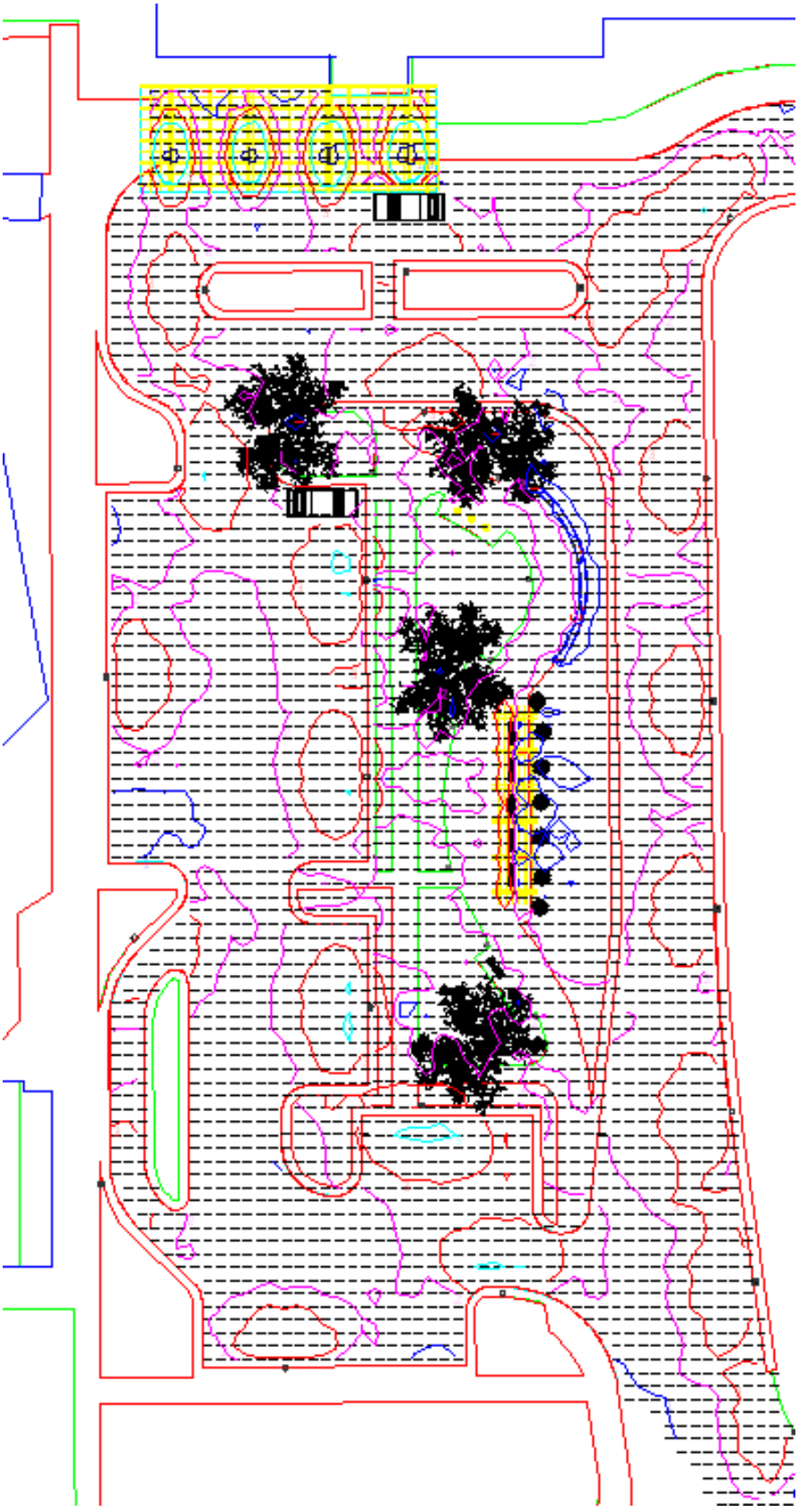


Figure 13 | Main Entrance and Parking Lot Horizontal Illuminance (fc)



Energy Code Compliance

Figure 14 | Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Parking Lots and Drives	30693	0.15	4603.95	2398
Walkways Less Then 10 Feet Wide	5127.5	1	5127.5	949
Main Entries	8	30 W/LF of door width	240	124
Canopy	1465	1.25	1831.25	364

Performance Summary

The new lighting design for the exterior space provides illumination to aid visitors to the entrance and attract them to the plaza in the center of the parking lot. The ambient illumination of the parking lot is provided by the pole mounted metal halide luminaires. Decorative acorn luminaires are added to the plaza area to increase the walkway horizontal illuminance to ensure safety through the winding path. Wall mounted sconces are placed on the vertical members of the wooden terrace in the plaza. A curving rock bench lines the right side of the pathway as a visitor walks towards the main entry. Step lights were placed low on the bench to create a pattern on the pathway that is aesthetically subtle.

The acorn luminaires, sconces and the step lights bring the space to a smaller scale that is more comfortable compared to the scale of the 20 foot pole mounted luminaires.

The glass canopy is illuminated by metal halide wall sconces and LED strip luminaires mounted to aluminum frame on the ceiling of the canopy. The canopy design is simple so not to distract the visitors from seeing the features in the atrium.

The lighting design for this space meets ASHRAE Standard 90.1 – 2007 requirements and also complies with IESNA recommendations. The wall sconces are ADA compliant. The one recommendation that it did not meet was to obtain a horizontal illuminance of 5 footcandles at the main entrance. This value is assumed to be met with the glow from the three story atrium that is adjacent to the main entrance. The luminaires in the atrium will be on during the night time and give the atrium a sense of openness as the glass will seem to vanish into the night.

Figure 15 | Main Entrance and Parking Lot Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Roadway	2.43	8.1	0.5	16.2
Canopy Entrance	3.66	13.2	0.6	22.0
Plaza Walkways	2.11	4.9	0.3	16.3

Electrical Redesign

For complete spatial description of the main entrance and parking lot, see page 7.

Electrical Design Objectives/Criteria

The redesigned lighting space will be circuited to the existing panelboards that served the existing lighting circuits. The other existing loads on the panelboard will remain the same.

Two panelboards with a voltage system of 480Y/277V, 3PH, 4W will feed the new luminaires. One of the panels is normal power while the other is emergency power. All of the exterior luminaires are controlled with an astronomical time clock that will turn them on at night and turn them off in the morning. The luminaires will be wired through this equipment before reaching the panelboards.

The following are existing lighting panelboards which are highlighted to specify the redesigned circuit. The panelboard worksheets and schedules are based and calculated for the new lighting design.

See Appendix A for complete lighting plans with circuiting

Figure 16 | Existing Panelboard LPSL1 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPSL1 (NORMAL)			MAINS: MLO							AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOCATION: MAIN ELEC RM GRD FLR
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	5.7	7.5	-	-	-	-	2	-	-	-	-
3	FRONT ENTRY DRIVE POLE LTS	3	20	3/4"C.W/3#10+1#10GRD.	-	-	5.7	7.5	-	-	4	FRONT ENTRY DRIVE POLE LTS	3	20	3/4"C.W/3#10+1#10GRD.
5	-	-	-	-	-	-	-	-	5.3	7	6	-	-	-	-
7	-	-	-	-	0	0	-	-	-	-	8	-	-	-	-
9	SPARE	3	20	-	-	-	0	0	-	-	10	SPARE	3	20	-
11	-	-	-	-	-	-	-	-	0	0	12	-	-	-	-
13	LTG: EMPL/MAIN ENT CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	11.5	10	-	-	-	-	14	SIGNAGE: PENTHOUSE	1	20	3/4"C.W/2#12+1#12GRD.
15	LTG: ED/AMBUL ENT CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	3.64	10	-	-	16	SIGNAGE: PENTHOUSE	1	20	3/4"C.W/2#12+1#12GRD.
17	SIGNAGE: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	10	10	18	SIGNAGE: STAIR B	1	20	3/4"C.W/2#12+1#12GRD.
19	SIGNAGE: ED ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	10	10	-	-	-	-	20	SIGNAGE: STAIR B	1	20	3/4"C.W/2#12+1#12GRD.
21	SIGNAGE: EMPL ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	10	4	-	-	22	ENTRANCE PLAZA BOLLARDS	1	20	3/4"C.W/2#12+1#12GRD.
23	SIGNAGE: EMPL ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	10	0	24	SPARE	1	20	-
25	SIGNAGE: MAIN ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	10	0	-	-	-	-	26	SPARE	1	20	-
27	SIGNAGE: MAIN ENTRY CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	-	-	10	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	53 A		TOTAL PHASE A	65 A		-		-			CONNECTED LOAD	43.7 KVA		
	DEMAND LOAD	66 A		TOTAL PHASE B	-		51 A		-						
				TOTAL PHASE C	-		-		42 A						

Figure 17 | New Panelboard LPSL1 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LPSL1	Panel Location:			Main Elec Rm Ground Floor			
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	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
2	A	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
3	B	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
4	B	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
5	C	Lighting	3	Front dr pole	4.6	A	0.90	1147	1274		
6	C	Lighting	3	Front dr pole	6.33	A	0.90	1578	1753		
7	A	Spare	9	-		A	1.00	0	0		
8	A	Spare	9	-		A	1.00	0	0		
9	B	Spare	9	-		A	1.00	0	0		
10	B	Spare	9	-		A	1.00	0	0		
11	C	Spare	9	-		A	1.00	0	0		
12	C	Spare	9	-		A	1.00	0	0		
13	A	Lighting	3	Empl canopy	9.75	A	0.90	2431	2701		
14	A	Lighting	3	Penthouse	10	A	0.90	2493	2770		
15	B	Lighting	3	D amb cano	3.64	A	0.90	907	1008		
16	B	Lighting	3	Penthouse	10	A	0.90	2493	2770		
17	C	Lighting	3	Amb canopy	10	A	0.90	2493	2770		
18	C	Lighting	3	Stair B	10	A	0.90	2493	2770		
19	A	Lighting	3	ED canopy	10	A	0.90	2493	2770		
20	A	Lighting	3	Stair B	10	A	0.90	2493	2770		
21	B	Lighting	3	Empl canopy	10	A	0.90	2493	2770		
22	B	Lighting	3	Plaza lums	3.8	A	0.90	947	1053		
23	C	Lighting	3	Empl canopy	10	A	0.90	2493	2770		
24	C	Spare	9	-		A	1.00	0	0		
25	A	Lighting	3	Main canopy	10	A	0.90	2493	2770		
26	A	Spare	9	-		A	1.00	0	0		
27	B	Lighting	3	Main canopy	10	A	0.90	2493	2770		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C					A	1.00	0	0		
PANEL TOTAL								37.4	41.5	Amps=	50.0

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	15.1	16.8	40%	60.7	
PHASE TOTAL	B	12.1	13.4	32%	48.4	
PHASE TOTAL	C	10.2	11.3	27%	40.9	

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		37.4	41.5		37.4	41.5	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		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		0.0	0.0		0.0	0.0			
Total Demand Loads						37.4	41.5			
Spare Capacity			20%			7.5	8.3			
Total Design Loads						44.9	49.9	0.90	Amps=	60.0

Figure 18 | New Panelboard LPSL1 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPSL1	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Main Elec Rm Ground Floor	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Front dr pole	1147	-	1	*			2	-	1578	Front dr pole	Lighting
Lighting	Front dr pole	1147	20A/3P	3		*		4	20A/3P	1578	Front dr pole	Lighting
Lighting	Front dr pole	1147	-	5			*	6	-	1578	Front dr pole	Lighting
Spare	-	0	-	7	*			8	-	0	-	Spare
Spare	-	0	-	9		*		10	-	0	-	Spare
Spare	-	0	-	11			*	12	-	0	-	Spare
Lighting	Empl canopy	2431	20A/1P	13	*			14	20A/1P	2493	Penthouse	Lighting
Lighting	ED amb canopy	907	20A/1P	15		*		16	20A/1P	2493	Penthouse	Lighting
Lighting	Amb canopy	2493	20A/1P	17			*	18	20A/1P	2493	Stair B	Lighting
Lighting	ED canopy	2493	20A/1P	19	*			20	20A/1P	2493	Stair B	Lighting
Lighting	Empl canopy	2493	20A/1P	21		*		22	20A/1P	947	Plaza lums	Lighting
Lighting	Empl canopy	2493	20A/1P	23			*	24	-	0	-	Spare
Lighting	Main canopy	2493	20A/1P	25	*			26	-	0	-	Spare
Lighting	Main canopy	2493	20A/1P	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	15.13	TOTAL DESIGN LOAD (KW)	44.87
CONNECTED LOAD (KW) - B Ph.	12.06	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	10.20	TOTAL DESIGN LOAD (AMPS)	60

Feeder Size Calculation

60 A * 125% = 75 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Figure 19 | Existing Panelboard E1DP-1 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1DP-1 (LIFE SAFETY)			MAINS: MLO							AMPS: 250			AIC: 100,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE	LOCATION: EMERG DIST RM GRD FLOOR		
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	27.3	16.7	-	-	-	-	2	-	-	-	-
3	PANEL E1LG1	3	100	FEEDER 50	-	-	27.3	16.7	-	-	4	PANEL E1L31	3	100	FEEDER 105
5	-	-	-	-	-	-	-	-	27.3	16.7	6	-	-	-	-
7	-	-	-	-	24.6	15.9	-	-	-	-	8	-	-	-	-
9	PANEL E1LG5	3	100	FEEDER 64	-	-	24.6	15.9	-	-	10	PANEL E1L41	3	100	FEEDER 122
11	-	-	-	-	-	-	-	-	24.6	15.9	12	-	-	-	-
13	-	-	-	-	26.3	15.9	-	-	-	-	14	-	-	-	-
15	PANEL E1L11	3	100	FEEDER 71	-	-	26.3	15.9	-	-	16	PANEL E1L51	3	100	FEEDER 139
17	-	-	-	-	-	-	-	-	26.3	15.9	18	-	-	-	-
19	-	-	-	-	20.2	15.9	-	-	-	-	20	-	-	-	-
21	PANEL E1L21	3	100	FEEDER 88	-	-	20.2	15.9	-	-	22	PANEL E1L61	3	100	FEEDER 156
23	-	-	-	-	-	-	-	-	20.2	15.9	24	-	-	-	-
25	WALLPACKS	1	20	3/4"C.W/2#10+1#10GRD.	7.2	12.8	-	-	-	-	26	-	-	-	-
27	SPARE	1	20	-	-	-	0	12.8	-	-	28	PANEL E1L71	3	100	FEEDER 172
29	SPARE	1	20	-	-	-	-	-	0	12.8	30	-	-	-	-
31	-	-	-	-	11	0	-	-	-	-	32	-	-	-	-
33	JOCKEY PUMP	3	15	3/4"C.W/2#10+1#10GRD.	-	-	11	0	-	-	34	SPARE	3	100	-
35	-	-	-	-	-	-	-	-	11	0	36	-	-	-	-
37	-	-	-	-	0	0	-	-	-	-	38	-	-	-	-
39	100AF PREPARED SPACE	3	-	-	-	-	0	0	-	-	40	100AF PREPARED SPACE	3	-	-
41	-	-	-	-	-	-	-	-	0	0	42	-	-	-	-

	CONNECTED LOAD	189 A	TOTAL PHASE A	194 A	
	DEMAND LOAD	191 A	TOTAL PHASE B	187 A	
	25% GROWTH	238 A	TOTAL PHASE C	187 A	

Figure 20 | New Panelboard E1DP-1 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				E1DP-1	Panel Location:			Emerg Dist Rm Ground Floor			
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	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
2	A	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
3	B	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
4	B	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
5	C	Lighting	3	Panel E1LG1	27.3	A	0.90	6806	7562		
6	C	Lighting	3	Panel E1L31	16.7	A	0.90	4163	4626		
7	A	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
8	A	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
9	B	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
10	B	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
11	C	Lighting	3	Panel E1LG9	24.6	A	0.90	6133	6814		
12	C	Lighting	3	Panel E1L41	15.9	A	0.90	3964	4404		
13	A	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
14	A	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
15	B	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
16	B	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
17	C	Lighting	3	Panel E1L11	26.3	A	0.90	6557	7285		
18	C	Lighting	3	Panel E1L51	15.9	A	0.90	3964	4404		
19	A	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
20	A	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
21	B	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
22	B	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
23	C	Lighting	3	Panel E1L21	20.2	A	0.90	5036	5595		
24	C	Lighting	3	Panel E1L61	15.9	A	0.90	3964	4404		
25	A	Lighting	3	Wallpacks	7.41	A	0.90	1847	2053		
26	A	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
27	B	Spare	9	-		A	1.00	0	0		
28	B	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
29	C	Spare	9	-		A	1.00	0	0		
30	C	Lighting	3	Panel E1L71	12.8	A	0.90	3191	3546		
31	A	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
32	A	Spare	9	-		A	1.00	0	0		
33	B	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
34	B	Spare	9	-		A	1.00	0	0		
35	C	HVAC	6	Jockey pump	11	A	0.85	2590	3047		
36	C	Spare	9	-		A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C					A	1.00	0	0		
PANEL TOTAL								140.9	157.1	Amps=	189.1

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					48.2	53.7	34%	194.0
PHASE TOTAL	B					46.4	51.7	33%	186.6
PHASE TOTAL	C					46.4	51.7	33%	186.6

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		133.2	148.0		133.2	148.0	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		7.8	9.1		7.8	9.1	0.85		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						140.9	157.1			
Spare Capacity			20%			28.2	31.4			
Total Design Loads						169.1	188.5	0.90	Amps=	226.9

Figure 21 | New Panelboard E1DP-1 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E1DP-1	MIN. C/B AIC:	100K
SIZE/TYPE BUS:	250A	PANEL LOCATION:	Emerg Dist Rm Ground Floor	OPTIONS:	
SIZE/TYPE MAIN:	250A/3P C/B	PANEL MOUNTING:	SURFACE		(4) 300, (1) #4 G, 2-1/2" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Panel E1LG1	6806	-	1	*			2	-	4163	Panel E1L31	Lighting
Lighting	Panel E1LG1	6806	100A/3P	3		*		4	100A/3P	4163	Panel E1L31	Lighting
Lighting	Panel E1LG1	6806	-	5			*	6	-	4163	Panel E1L31	Lighting
Lighting	Panel E1LG5	6133	-	7	*			8	-	3964	Panel E1L41	Lighting
Lighting	Panel E1LG5	6133	100A/3P	9		*		10	100A/3P	3964	Panel E1L41	Lighting
Lighting	Panel E1LG5	6133	-	11			*	12	-	3964	Panel E1L41	Lighting
Lighting	Panel E1L11	6557	-	13	*			14		3964	Panel E1L51	Lighting
Lighting	Panel E1L11	6557	100A/3P	15		*		16	100A/3P	3964	Panel E1L51	Lighting
Lighting	Panel E1L11	6557	-	17			*	18		3964	Panel E1L51	Lighting
Lighting	Panel E1L21	5036	-	19	*			20		3964	Panel E1L61	Lighting
Lighting	Panel E1L21	5036	100A/3P	21		*		22	100A/3P	3964	Panel E1L61	Lighting
Lighting	Panel E1L21	5036	-	23			*	24	-	3964	Panel E1L61	Lighting
Lighting	Wallpacks	1847	20A/1P	25	*			26	-	3191	Panel E1L71	Lighting
Spare	-	0	20A/1P	27		*		28	100A/3P	3191	Panel E1L71	Lighting
Spare	-	0	20A/1P	29			*	30	-	3191	Panel E1L71	Lighting
HVAC	Jockey pump	2590	-	31	*			32	20A/1P	0	-	Spare
HVAC	Jockey pump	2590	15A/3P	33		*		34	20A/1P	0	-	Spare
HVAC	Jockey pump	2590	-	35			*	36	20A/1P	0	-	Spare
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	48.21	TOTAL DESIGN LOAD (KW)	169.14
CONNECTED LOAD (KW) - B Ph.	46.37	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	46.37	TOTAL DESIGN LOAD (AMPS)	227

Feeder Size Calculation

226.9 A * 125% = 283.625 A

300A Circuit Breaker, (4) 300 KCMIL CU THWN, (1) #4 AWG CU Ground, 2½" EMT Conduit

Gift Shop | Special Purpose Space

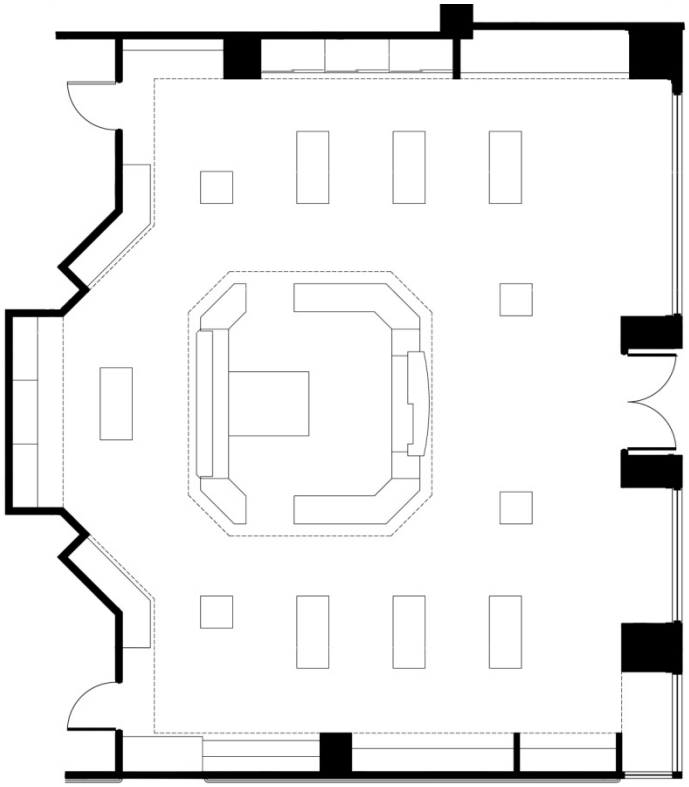
Spatial Summary

Visitors and occasionally patients visit the gift shop to shop for a desired item whether it is a needed candy bar or a get well teddy bear and a balloon. It is located on the first level of the hospital adjacent to the main entrance lobby. The space resembles a square with notches cut out of the northwest and southwest corners. These notches allow for additional display areas for merchandise.

The display tables are fixed in positions as seen on the floor plan. The tables and shelving that lines the walls of the gift shop display of a variety of different items such as flowers, stuffed animals, cards and balloons. Centrally located in the space is a check out area. Along the eastern wall, a show window is located between the gift shop and the main entrance lobby.

Drawings

Figure 22 | Gift Shop Floor Plan



Surface Materials

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges. (ACT-1)

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Storefront Walls – From the floor, a 7’ tempered clear float glass with 1.5’ of clear float glass above it with a mullion between them (GL-2, -1).

Floor – The floor is covered with 6’ wide condensed cushion with mark 2x backing 02751 Datum Strata isle colored carpet by C&A (CPT-2).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Softer Tan by Sherman Williams (IPS2-A).

Base – The base is a 4” high almond colored rubber base by Roppe (RB4-A).

Figure 23 | Gift Shop Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
CPT-2	15211 Isle datum strata carpet	0.36
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-B	SW 6142 Macadamia paint	0.97
RB4-A	P184 Almond rubber base	0.72

Figure 24 | Gift shop glass transmittance properties

MATERIALS	DESCRIPTION	TRANSMITTANCE
GL-1	1/4" Clear float glass	0.88
GL-2	1/4" Tempered clear float glass	0.88

Furnishings

A centralized checkout area is surrounded by the display tables and shelves. Assume all furniture systems are wooden and are located as shown on the plan in a fixed position.

Tasks/Activities

The major tasks in the area occur in the checkout area with the use of visual display terminals and reading. The shopper's task is just to look at the merchandise which all needs to be illuminated. The checkout area requires a higher Illuminance value then the circulation and display areas of the gift shop.

Design Criteria

Interior, Merchandising Spaces, Sales Transaction Area/General Merchandise Display (IESNA Handbook)

Appearance of Space and Luminaires (Important/Important)

The arrangement of furnishings and luminaires must be organized in a way that customers will enjoy the space. A uniform layout of downlights creates a pleasant atmosphere in addition to the track fixtures that follow the walls of the space.

Color Appearance and Color Contrast (Important/Very Important)

A lamp with CRI of at least 80 would be acceptable for a retail space.

Daylighting Integration and Control (Important/Important)

There is no direct daylight into the space. Some daylight will enter from the atrium through the storefront glazing on the east wall.

Direct Glare (Very Important/Important)

A greater amount of small downlights are used to avoid direct glare.

Flicker and Strobe effect (Somewhat Important/Somewhat Important)

To avoid flicker and strobe effects, compact fluorescent lamps are used in this space.

Light Distribution on Surfaces (Somewhat Important/Important)

The illumination of the space should be distributed unevenly due to the fact that there are displays that will have higher Illuminance values then the circulation path.

Uniform Light Distribution on Surfaces (Important/Important)

The circulation areas of the space and the work plane at the checkout counter should both be uniform.

Luminances of Room Surfaces (Somewhat Important/Somewhat Important)

Luminances of the walls should be consistent as well as furnishings. The merchandise will vary therefore the displays are not as important.

Modeling of Faces or Objects (Important/Important)

The modeling of the merchandise is very important to sell the items. Point sources are used to create ambient lighting in addition to creating more directions that the light is coming from to illuminate the face.

Point(s) of Interest (Somewhat Important/Somewhat Important)

Points of interest are created when using the track fixtures for the displays.

Reflected Glare (Important/Important)

Reflected glare causes uncomfortable feelings that are unwanted to customers that are shopping. These are avoided by using matte finished oh displays, walls and floors.

Shadows (Somewhat Important/Not Important)

Shadows in the checkout area interfere with the employees but are avoid by having many luminaires in the area behind the counter.

Source/Task/Eye geometry (Important/Somewhat Important)

The increased sources with smaller apertures allows for less direct glare. The checkout uses VDT screens hence no large luminaires are located directly behind the counter.

Sparkle/Desirable Reflected Highlights (Not Important/Important)

The displays of the merchandise is essential to a retail store so sparkle is obtained by using many point sources from the ceiling as well as the track fixtures to highlight specific objects.

System Control and Flexibility (Not Important/Somewhat Important)

The flexibility of the system is found in the adjustable track luminaires.

Illuminance

Horizontal Illuminance (Important/Important) – Category D/E – 30/50 fc

Vertical Illuminance (Not Important/Important) – Category N.A./C – N.A./10 fc

VDT Criteria

Visual display terminals will only be used at the checkout area and with many luminaires in that area; the veiling reflections will be avoided.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Sales Area – 1.7 W/ft^2

Additional Interior Lighting Power Allowance - [1000 Watts + (Area * 1.0 W/ft^2)] = 2630 W

Controls Criteria

Switching controls three different zones in the gift shop. The zones include the ambient lighting of the space, the track luminaires and the perimeter lighting.

Accent Lighting Considerations

Accent lighting for retail spaces is very important to attract the customer to the merchandise. Point sources are used in these situations to provide focal points to the products. The displays can be up to three times brighter then the surroundings.

Luminance Ratios (max:min)

Ambient lighting – 5:1 or less

Accent lighting – 15:1 or less

Psychological Aspects

Pleasantness or calmness is aimed to be the psychological impress that customers get when they occupy the gift shop. Since the illumination level is uniform and the illumination level isn't extremely high the space is comforting and inviting.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 25 | Gift Shop Luminaire Schedule

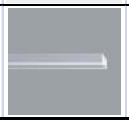
GIFT SHOP LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
F		ERCO	Lightcast Downlight	22209.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 7, 30° cut-off angle.	(2)F18DBX/830/ ECO4P 97599 - GE CF plug in T4	43	277	VEZ/2Q18/ M2/BS/27 7 Philips Advance
G		ERCO	Logotec Spotlight Narrow	72409.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
H		ERCO	Logotec Spotlight Flood	72410.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
I		ERCO	Logotec Spotlight Wide Flood	72411.000	Cast aluminum powder-coated housing and bracket. Silver spherolit mirror-finished anodised aluminum reflector with safety glass.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
J		ERCO	Logotec Recessed Spherolit Wallwasher	81215.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
K		ERCO	Logotec Recessed Spotlight	81210.000	Size 5, recessed housing of cast aluminum white powder-coated. White plastic mounting ring. Aluminum silver spherolit reflector mirror-finished anodised with a softec lens.	CMH20T/U830G U6.5 85086 - GE ceramic metal halide T4	24	277	IMH/G20/ G/277 Philips Advance
W		ERCO	ERCO Track	78303.000	Silver finished anodised aluminum 3-circuit track allowing for three separate switchable circuits.	-	-	277	-

Figure 26 | Gift Shop Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
F	1.0	0.81	0.94	0.95	0.72
G	1.0	0.66	0.92	0.95	0.58
H	1.0	0.66	0.92	0.95	0.58
I	1.0	0.66	0.92	0.95	0.58
J	1.0	0.66	0.92	0.95	0.58
K	1.0	0.66	0.92	0.95	0.58

See Appendix A for full luminaire schedule and cut sheets

Controls

The luminaires within the gift shop are controlled in 3 zones of single switches. One zone is the task lighting over the checkout area and one recessed Logotec spotlight that illuminates the Franklin Square Hospital Center logo on the front of the checkout desk. The second zone is all the ambient downlights excluding the downlights in the checkout area. The final zone controls the fixtures that specifically highlight the merchandise including all the Logotec luminaires with an exception to the one recessed spot light highlighting the.

See Appendix A for full equipment schedule, cut sheets, and tick mark diagram

Performance Data

The following are renders and calculation grids that summarize the gift shop lighting redesign.

Figure 27 | Gift Shop Plan Pseudo Color and Render (fc)

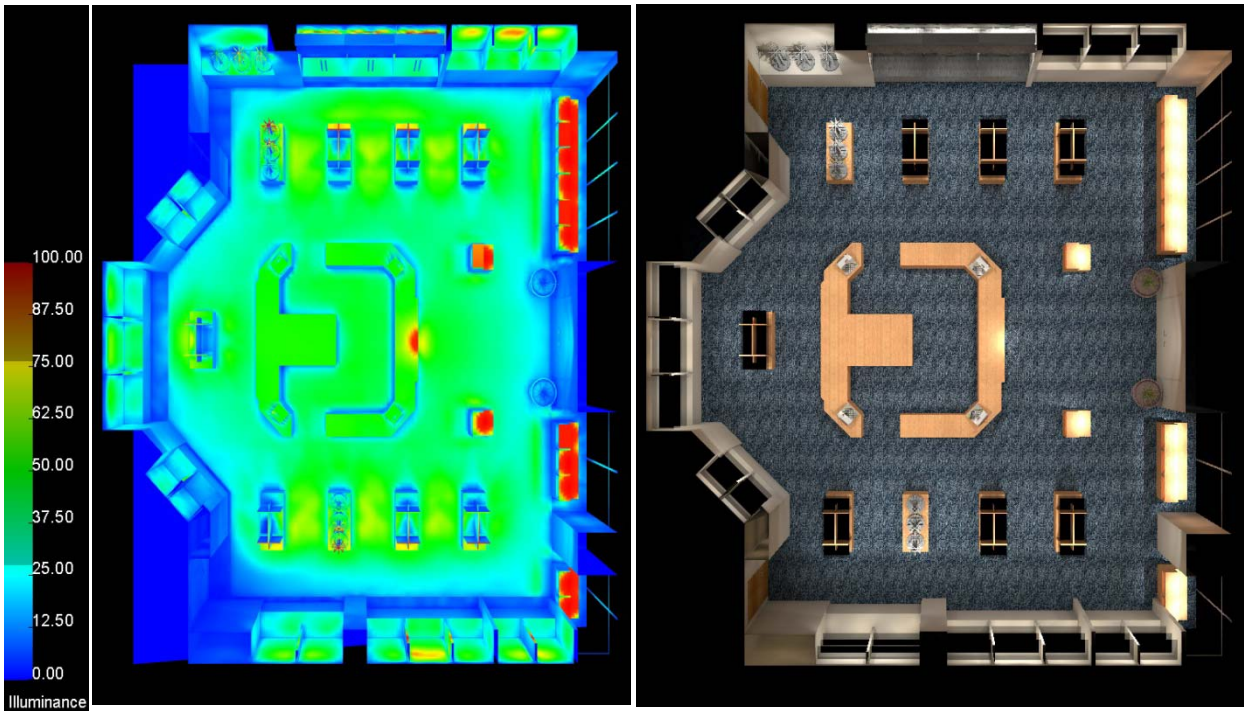


Figure 28 | Gift Shop Front Perspective Pseudo Color and Render (fc)

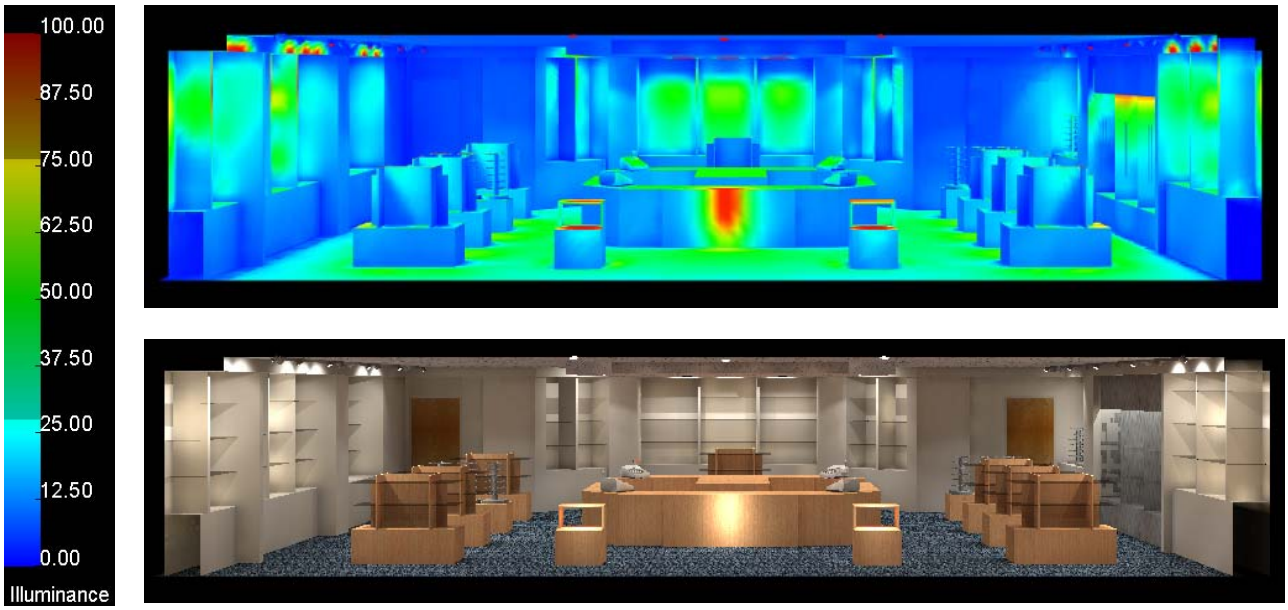


Figure 29 | Gift Shop Perspective Pseudo Color and Render (fc)

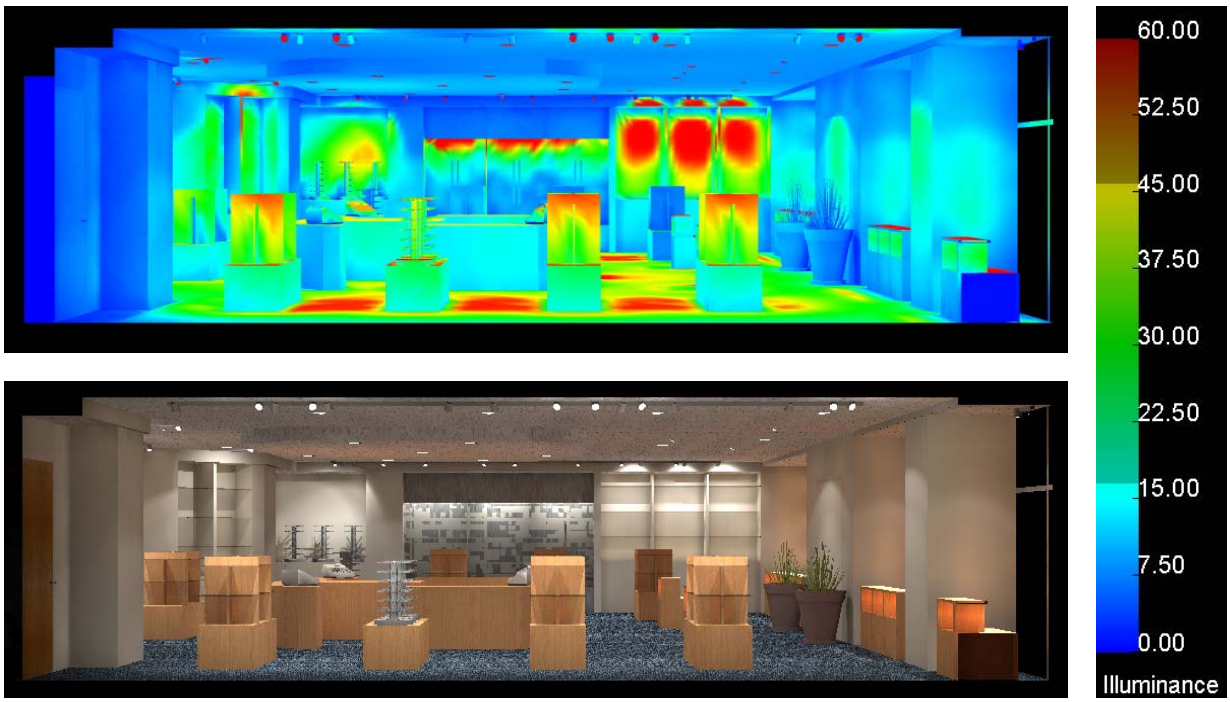


Figure 30 | Gift Shop Perspective Pseudo Color and Render (fc)

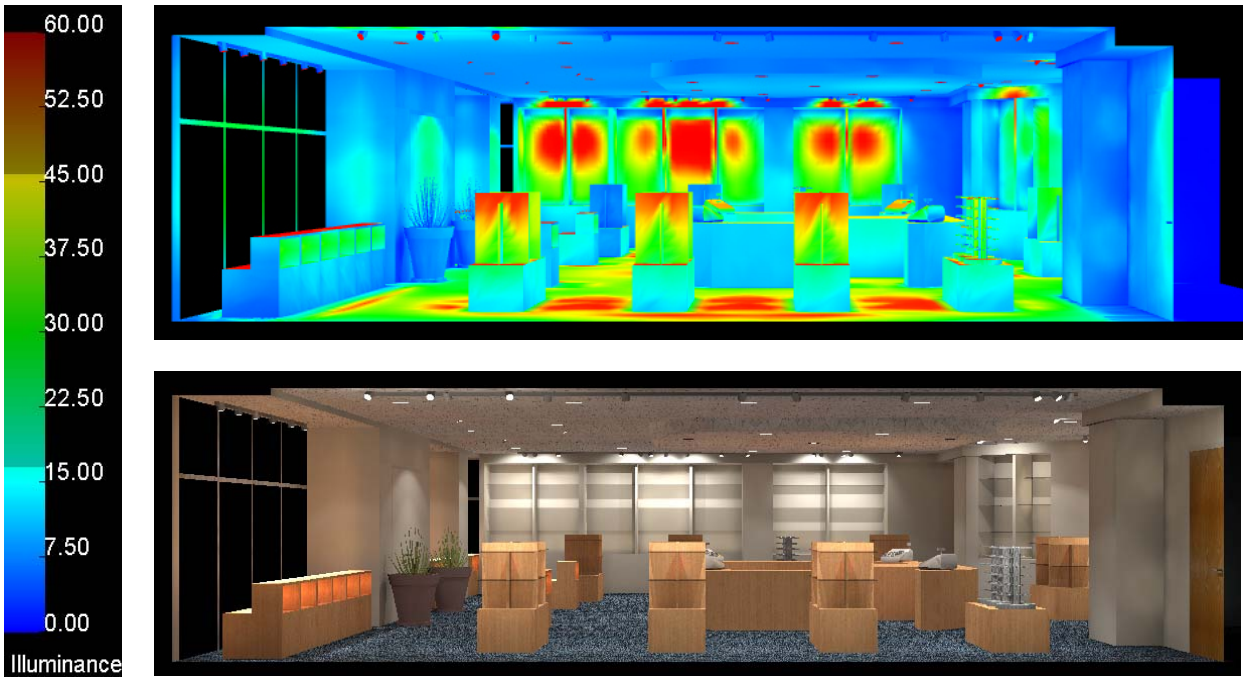


Figure 31 | Gift Shop Perspective Pseudo Color and Render (fc)

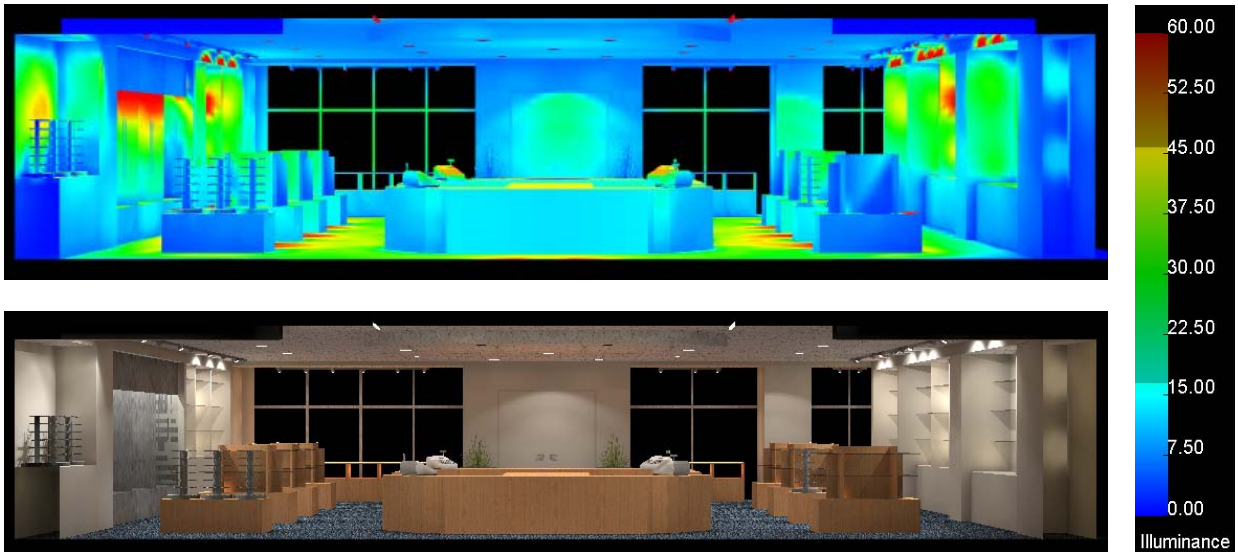


Figure 32 | Gift Shop Front Desk View Pseudo Color and Render (fc)

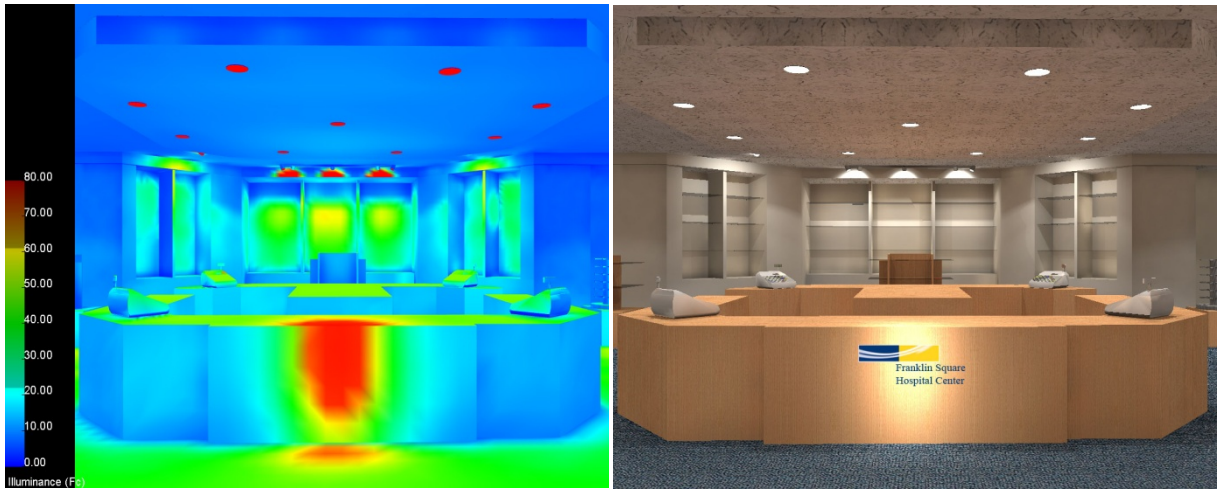


Figure 33 | Gift Shop View Pseudo Color and Render (fc)

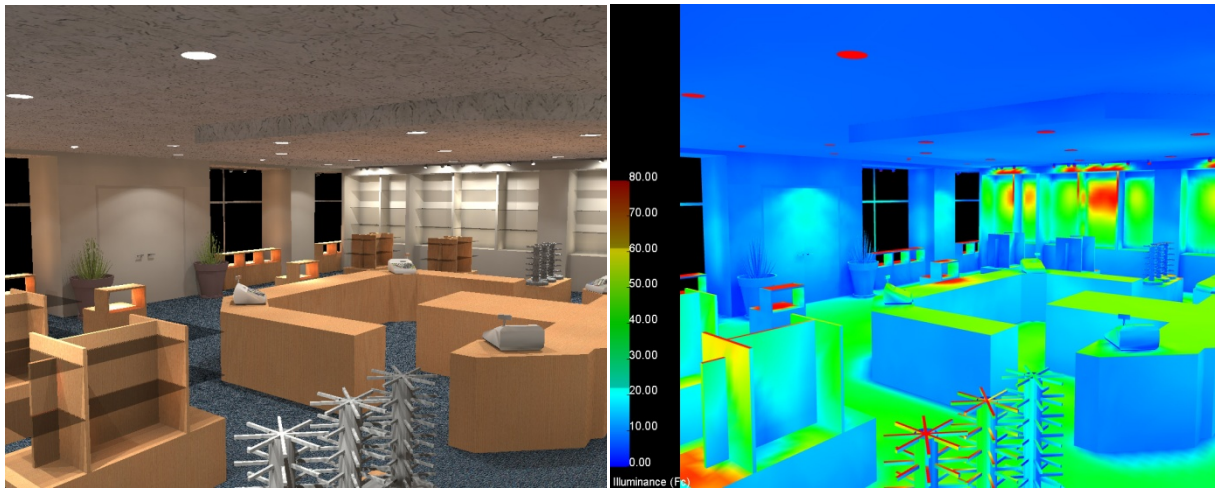


Figure 34 | Gift Shop View Pseudo Color and Render (fc)

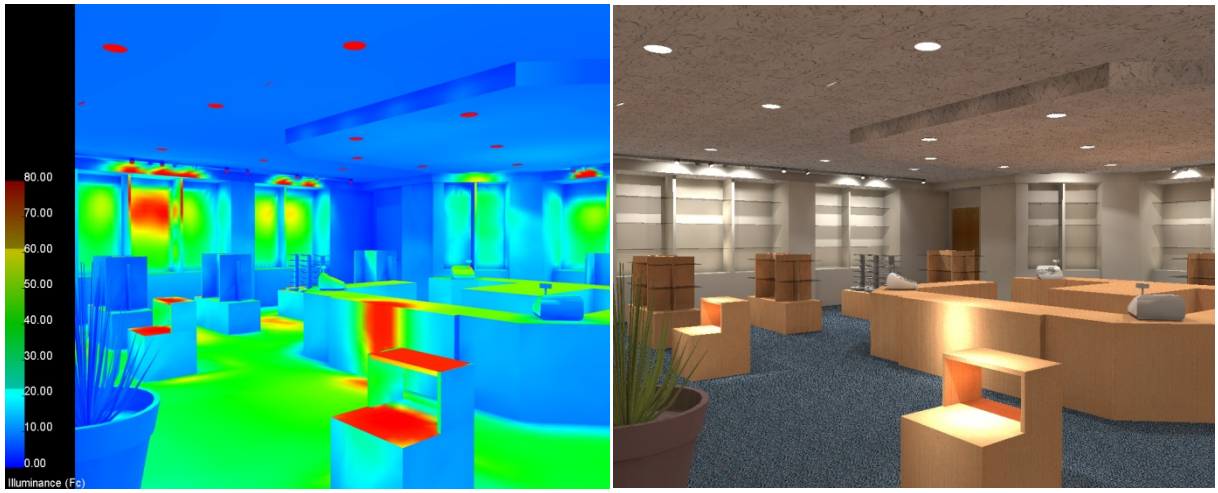


Figure 35 | Floor Horizontal Illuminance (fc)

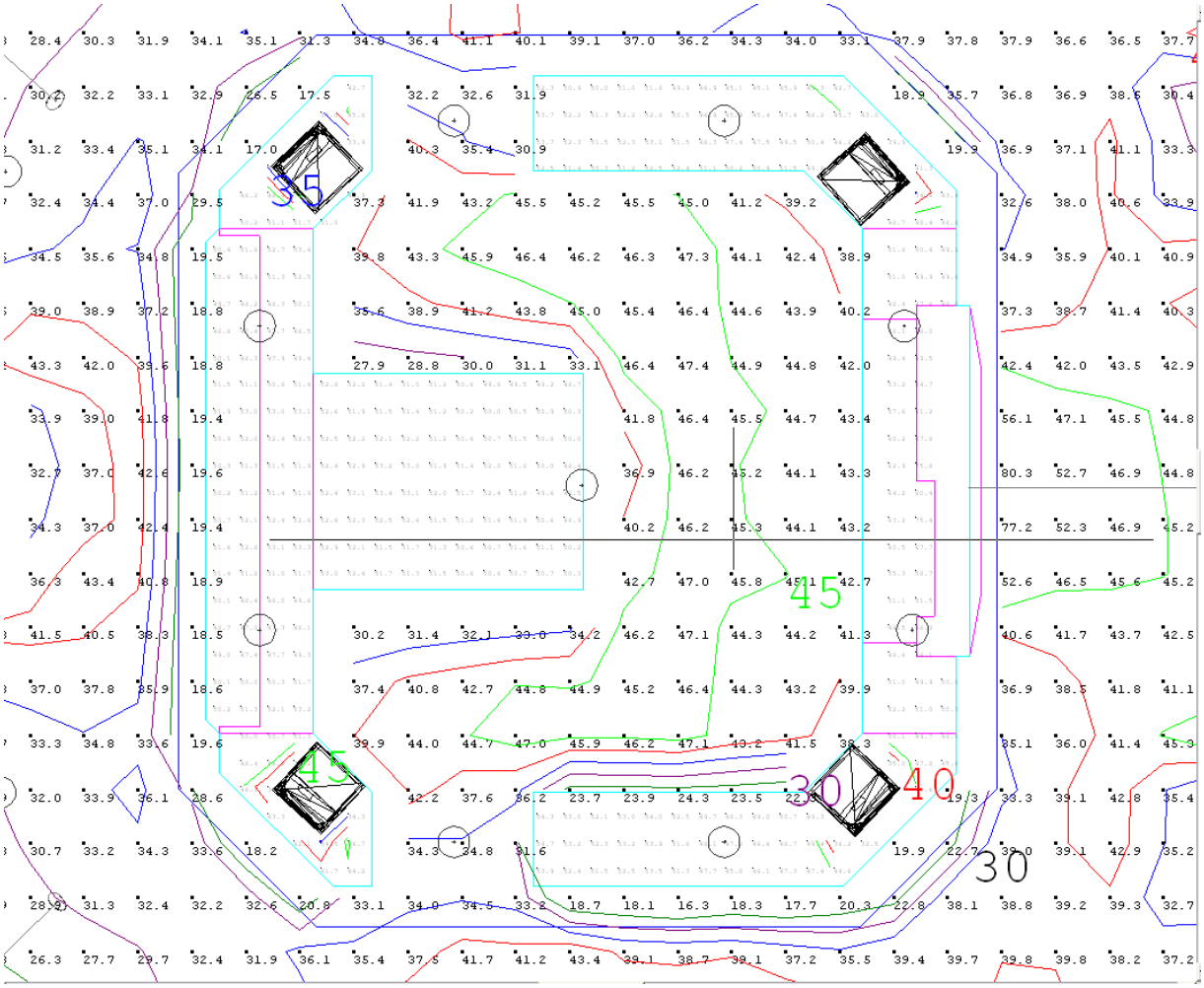
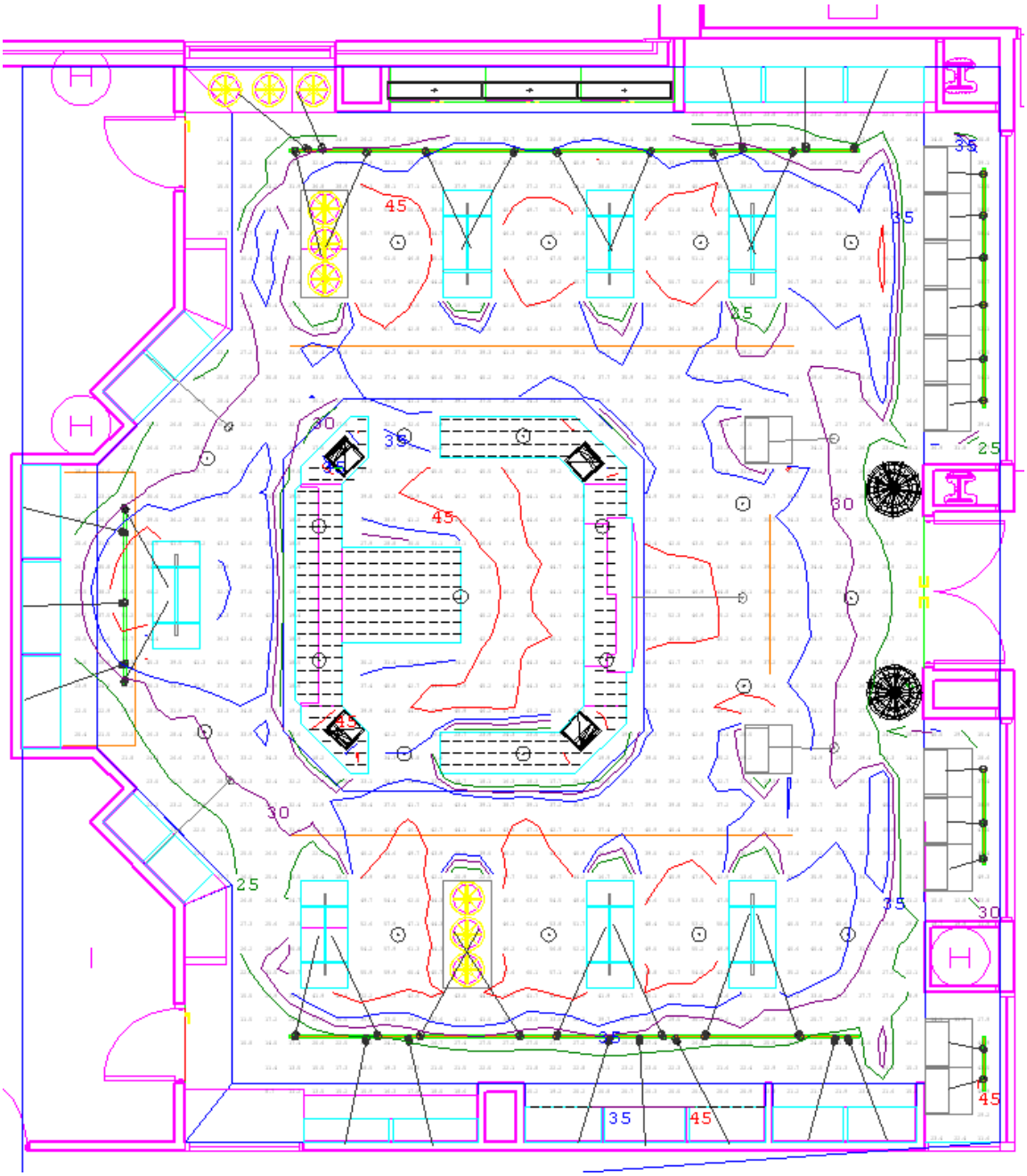


Figure 36 | Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 37 | Gift Shop Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Sales Area	1630	1.7	2771	1378
Accent Lighting	-	1	2630	744

Additional Interior Lighting Power Allowance: [1000 Watts + (Area * 1.0 W/SF)] = 2630 W

Performance Summary

The lighting redesign of the gift shop creates an easy and nonchalant environment for browsing. The lighting throughout the space is not completely uniform due to the accent lighting that highlights the merchandise. The ambient lighting through the space is provided by compact fluorescent downlights. These same luminaires are used for the task lighting on the checkout desk. The horizontal illumination on the desk surface at 2.5 feet is uniform to ensure the cashier can perform tasks under proper lighting conditions.

The track mounted wide flood and flood wallwasher luminaires provide an even distribution for the area on the wall display case or floor mounted shelving unit that is being highlighted. The flexibility with using track heads in the gift shop situation allows adjustments to be made depending on different merchandise for the seasons and so forth.

The store-front display cases adjacent to the three story atrium space are also highlighted with track luminaires. Narrow spots create a point of interest using a high luminance to catch the eye of people walking past to draw them into the gift shop. The adjustability of the track fixtures allows for variety of scenarios and displays to grab people's attention.

Another detail within the space is the recessed narrow spot track luminaire that provides accent light to the Franklin Square Hospital Center logo on the front of the desk. This logo is the first place that will draw a person's eye will travel when they enter the gift shop through the double doors. The spot luminaire should not be directly in someone's line of sight when working behind the desk. Veiling reflections from the desk may occur but the cash registers are places on the corners of the desk to avoid any glare from the accent light.

The gift shop lighting design meets ASHRAE Standard 90.1 – 2007 requirements and complies with the recommendations of IESNA. The one issue with the design would be that the wall washers provide a higher then desired vertical illumination. The calculations that were performed were done in a gift shop without merchandise. The reflectance of the walls will decrease with merchandise assuming it is not all white items. The decrease in reflectance will decrease the amount of illumination throughout the space.

Figure 38 | Gift Shop Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	50.24	80.4	32.1	2.50
Floor	34.55	80.3	8.6	9.34
Wall Display Case (vertical)	19.88	91.6	4.5	20.36

Electrical Redesign

For complete spatial description of the gift shop, see page 26.

Electrical Design Objectives/Criteria

The gift shop is served by two panels, one normal power and the other, emergency power. Both panelboards have a 480Y/277V, 3PH, 4W voltage system. These panelboards were recalculated for the branch circuits that were affected but the lighting redesign.

The gift shop is controlled by three single pole switches. These three lighting zones within the room are all on the same branch circuit that was redesigned. The following are existing lighting panelboards which are highlighted to specify the redesigned circuit. The panelboard worksheets and schedules are based and calculated for the new lighting design.

See Appendix A for complete lighting plans with circuiting

Figure 39 | Existing Panelboard LP11 Schedule

WIRING PANEL SCHEDULE

	PANEL: LP11 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 1406
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: N TEAM STAT, PAT RM #1-7	1	20	3/4"C.W/2#12+1#12GRD.	13.8	12.6	-	-	-	-	2	LTG: WAIT, CNTRL CORR, CONF	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: NORTH CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	14.5	4.7	-	-	4	LTG: MAIL, MAT STOR, CORR	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PAT RM #8-21, NOURISH	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	14.1	10.5	6	LTG: WAIT, ADMIT OFF, MEDIT	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: PAT RM #22-33, MEDS 1216	1	20	3/4"C.W/2#12+1#12GRD.	13.1	13.5	-	-	-	-	8	LTG: GIFT SHOP	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: S TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	14	2	-	-	10	LTG: COFFEE SHOP	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: PAT RM #34-48	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	11.9	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	-	-	-	-	26	0	-	-	-	-	32	SPACE	1	-	-
33	ACU-4: MAIN ENT VESTIBULE	3	40	M110	-	-	26	0	-	-	34	SPACE	1	-	-
35	-	-	-	-	-	-	-	-	26	0	36	SPACE	1	-	-
37	-	-	-	-	1.6	0	-	-	-	-	38	SPACE	1	-	-
39	EF-9: CHAPEL STORAGE	3	15	M99	-	-	1.6	0	-	-	40	SPACE	1	-	-
41		-	-	-	-	-	-	-	1.6	0	42	SPACE	1	-	-
	CONNECTED LOAD	69 A		TOTAL PHASE A	81 A		-		-			CONNECTED LOAD	57.5 KVA		
	DEMAND LOAD	80 A		TOTAL PHASE B	-		63 A		-						
				TOTAL PHASE C	-		-		64 A						

Figure 40 | New Panelboard LP11 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LP11	Panel Location:			Electrical Room 1406			
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	Lighting	3	Team, rm 1-	13.8	A	0.90	3440	3823		
2	A	Lighting	3	Wait, corr, co	12.6	A	0.90	3141	3490		
3	B	Lighting	3	N corridors	14.5	A	0.90	3615	4017		
4	B	Lighting	3	Mail, mat, co	4.7	A	0.90	1172	1302		
5	C	Lighting	3	m 8-21, Nou	14.1	A	0.90	3515	3906		
6	C	Lighting	3	Wait, off, mec	10.5	A	0.90	2618	2909		
7	A	Lighting	3	m 22-33, me	13.1	A	0.90	3266	3629		
8	A	Lighting	3	Gift shop	11.71	A	0.90	2919	3244		
9	B	Lighting	3	Team, corrs	14	A	0.90	3490	3878		
10	B	Lighting	3	Coffee shop	2	A	0.90	499	554		
11	C	Lighting	3	Rm 34-48	11.9	A	0.90	2967	3296		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C				0	A	1.00	0	0		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
32	A				0	A	1.00	0	0		
33	B	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
34	B				0	A	1.00	0	0		
35	C	HVAC Fans	6	ACU-4 Vestil	26	A	0.85	6122	7202		
36	C				0	A	1.00	0	0		
37	A	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
38	A				0	A	1.00	0	0		
39	B	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
40	B				0	A	1.00	0	0		
41	C	HVAC Fans	6	EF-9 Chape	1.6	A	0.95	421	443		
42	C				0	A	1.00	0	0		
PANEL TOTAL								50.3	57.0	Amps=	68.6

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	19.3	21.8	38%	78.8
PHASE TOTAL	B	15.3	17.4	31%	62.8
PHASE TOTAL	C	15.6	17.7	31%	64.0

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		30.6	34.0		30.6	34.0	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		19.6	22.9		19.6	22.9	0.86		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						50.3	57.0			
Spare Capacity			20%			10.1	11.4			
Total Design Loads						60.3	68.4	0.88	Amps=	82.3

Figure 41 | New Panelboard LP11 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP11	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	225A	PANEL LOCATION:	Electrical Room 1406	OPTIONS:	
SIZE/TYPE MAIN:	110A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #2, (1) #6 G, 1-1/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Team, rm 1-7	3440	20A/1P	1	*			2	20A/1P	3141	Wait, corr, conf	Lighting
Lighting	N corridors	3615	20A/1P	3		*		4	20A/1P	1172	Mail, mat, corr	Lighting
Lighting	Rm 8-21, Nour	3515	20A/1P	5			*	6	20A/1P	2618	Wait, off, medit	Lighting
Lighting	Rm 22-33, med	3266	20A/1P	7	*			8	20A/1P	2919	Gift shop	Lighting
Lighting	Team, corrs	3490	20A/1P	9		*		10	20A/1P	499	Coffee shop	Lighting
Lighting	Rm 34-48	2967	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	-	31	*			32	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	40A/3P	33		*		34	-	0	0	0
HVAC Fans	ACU-4 Vestib	6122	-	35			*	36	-	0	0	0
HVAC Fans	EF-9 Chapel	421	-	37	*			38	-	0	0	0
HVAC Fans	EF-9 Chapel	421	15A/3P	39		*		40	-	0	0	0
HVAC Fans	EF-9 Chapel	421	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	19.31	TOTAL DESIGN LOAD (KW)	60.32
CONNECTED LOAD (KW) - B Ph.	15.32	POWER FACTOR	0.88
CONNECTED LOAD (KW) - C Ph.	15.64	TOTAL DESIGN LOAD (AMPS)	82

Feeder Size Calculation

82.3 A * 125% = 102.875 A

110A Circuit Breaker, (4) #2 AWG CU THWN, (1) #6 AWG CU Ground, 1¼ EMT Conduit

Figure 42 | Existing Panelboard E1L11 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1L11 (LIFE SAFETY)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 1406
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	18	0	-	-	-	-	2	-	-	-	-
3	XFMR T-8	3	45	FEEDER 72	-	-	18	0	-	-	4	SPACE	3	-	-
5	-	-	-	-	-	-	-	-	18	0	6	-	-	-	-
7	LTG: NORTH WING EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	6.3	0	-	-	-	-	8	SPARE	1	20	-
9	LTG: SOUTH WING EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	8.8	0	-	-	10	SPARE	1	20	-
11	LTG: WEST EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	4.7	0	12	SPARE	1	20	-
13	SPACE	1	-	-	0	0	-	-	-	-	14	SPACE	1	-	-
15	SPACE	1	-	-	-	-	0	0	-	-	16	SPACE	1	-	-
17	SPACE	1	-	-	-	-	-	-	0	0	18	SPACE	1	-	-
19	SPACE	1	-	-	0	0	-	-	-	-	20	SPACE	1	-	-
21	SPACE	1	-	-	-	-	0	0	-	-	22	SPACE	1	-	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	25 A		TOTAL PHASE A	24 A		-		-			CONNECTED LOAD	20.5 KVA		
	DEMAND LOAD	26 A		TOTAL PHASE B	-		27 A		-						
				TOTAL PHASE C	-		-		23 A						

Figure 43 | New Panelboard E1L11 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP11	Panel Location:			Electrical Room 1406		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	l. PF	Watts	VA	Remarks	
1	A	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
2	A					A	1.00	0	0		
3	B	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
4	B					A	1.00	0	0		
5	C	Transformer	-	xfmr T-8	18	A	0.90	4487	4986		
6	C					A	1.00	0	0		
7	A	Lighting	3	North egress	6.3	A	0.90	1571	1745		
8	A	Spare	9			A	1.00	0	0		
9	B	Lighting	3	South egress	8.8	A	0.90	2194	2438		
10	B	Spare	9			A	1.00	0	0		
11	C	Lighting	3	West egress	4.74	A	0.90	1182	1313		
12	C	Spare	9			A	1.00	0	0		
13	A					A	1.00	0	0		
14	A					A	1.00	0	0		
15	B					A	1.00	0	0		
16	B					A	1.00	0	0		
17	C					A	1.00	0	0		
18	C					A	1.00	0	0		
19	A					A	1.00	0	0		
20	A					A	1.00	0	0		
21	B					A	1.00	0	0		
22	B					A	1.00	0	0		
23	C					A	1.00	0	0		
24	C					A	1.00	0	0		
25	A					A	1.00	0	0		
26	A					A	1.00	0	0		
27	B					A	1.00	0	0		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								18.4	20.5	Amps=	24.6

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	6.1	6.7	33%	24.3	
PHASE TOTAL	B	6.7	7.4	36%	26.8	
PHASE TOTAL	C	5.7	6.3	31%	22.7	

LOAD CATAGORIES		Connected			Demand				Ver. 104
		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	4.9	5.5		4.9	5.5	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	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	13.5	15.0		13.5	15.0	0.90		
Total Demand Loads					18.4	20.5			
Spare Capacity		20%			3.7	4.1			
Total Design Loads					22.1	24.5	0.90	Amps=	29.5

Figure 44 | New Panelboard E1L11 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP11	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 1406	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Transformer	xfmr T-8	4487	-	1	*			2	-	0	0	0
Transformer	xfmr T-8	4487	45A/3P	3		*		4	-	0	0	0
Transformer	xfmr T-8	4487	-	5			*	6	-	0	0	0
Lighting	North egress	1571	20A/1P	7	*			8	20A/1P	0	0	Spare
Lighting	South egress	2194	20A/1P	9		*		10	20A/1P	0	0	Spare
Lighting	West egress	1182	20A/1P	11			*	12	20A/1P	0	0	Spare
0	0	0	-	13	*			14	-	0	0	0
0	0	0	-	15		*		16	-	0	0	0
0	0	0	-	17			*	18	-	0	0	0
0	0	0	-	19	*			20	-	0	0	0
0	0	0	-	21		*		22	-	0	0	0
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	6.06	TOTAL DESIGN LOAD (KW)	22.09
CONNECTED LOAD (KW) - B Ph.	6.68	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	5.67	TOTAL DESIGN LOAD (AMPS)	30

Feeder Size Calculation

29.5 A * 125% = 36.875 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Lobby + Waiting Area | Circulation Space

Spatial Summary

The first area the patients see when they enter the emergency department is the lobby and reception/security desk. Paperwork will be filled out and directions will be given to the patient. The waiting areas and pediatric waiting areas are located adjacent to the reception desk. Ample seating is located against the walls of the space.

This essential circulation space brings visitors and patients into the hospital for the first time. It needs to have an inviting and welcoming impression but also be organized and easy to navigate. It is located on the ground floor of the hospital. The 2,447 square foot area encompasses a lobby with a reception/security desk, two emergency department waiting rooms and a pediatric emergency department waiting room.

The spaces are very geometric and are each rectangular in shape. The reception/security desk has an aesthetically pleasing curve on the side which breaks up the rough box shape of the rest of the space.

Drawings

Figure 45 | Lobby and Waiting Area Plan

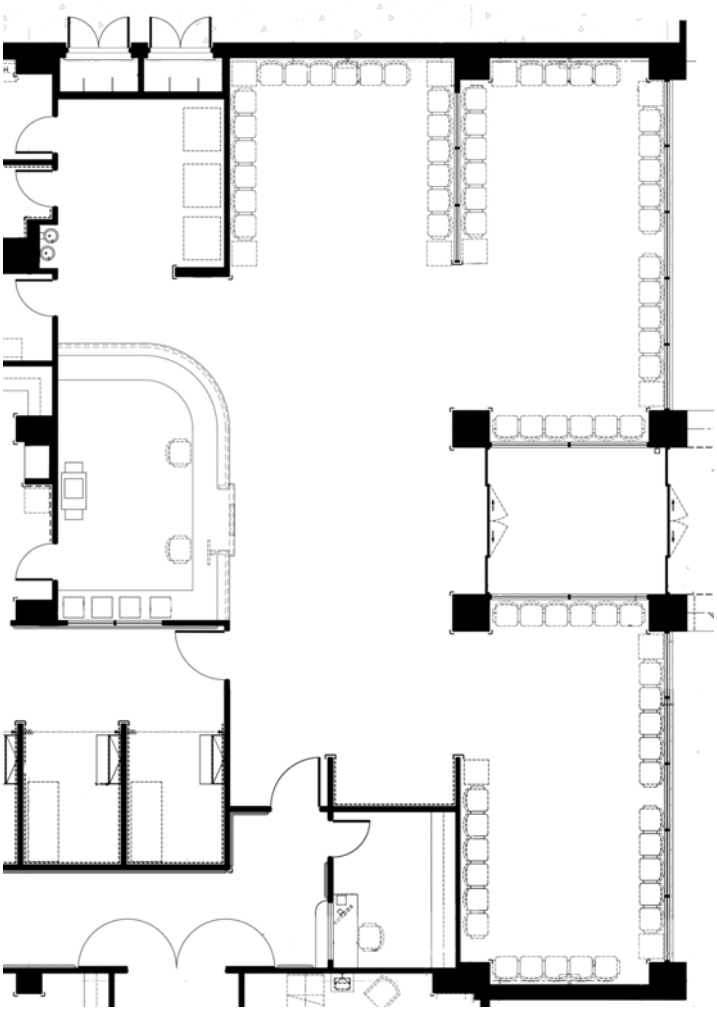


Figure 46 | Reception/Security Desk East Elevation

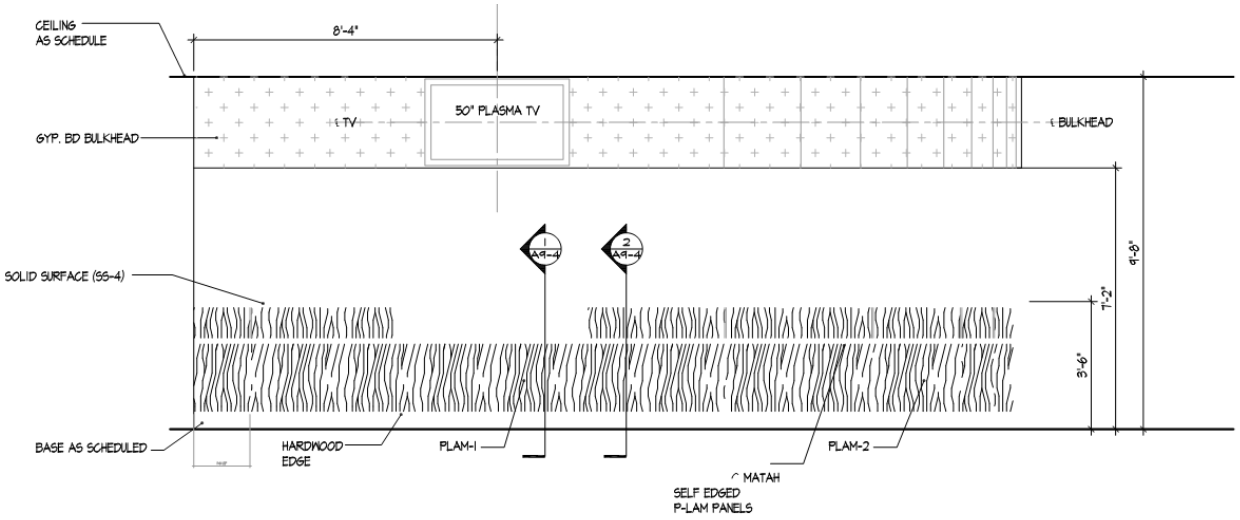


Figure 47 | Reception/Security Desk North Elevation

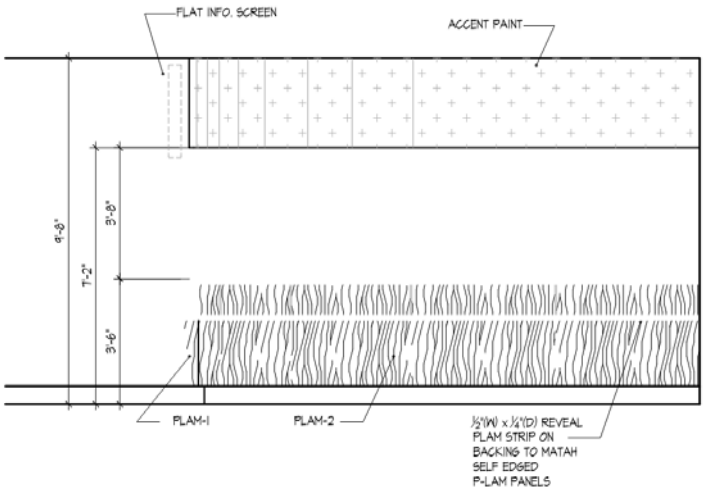


Figure 48 | Reception/Security Desk North Elevation

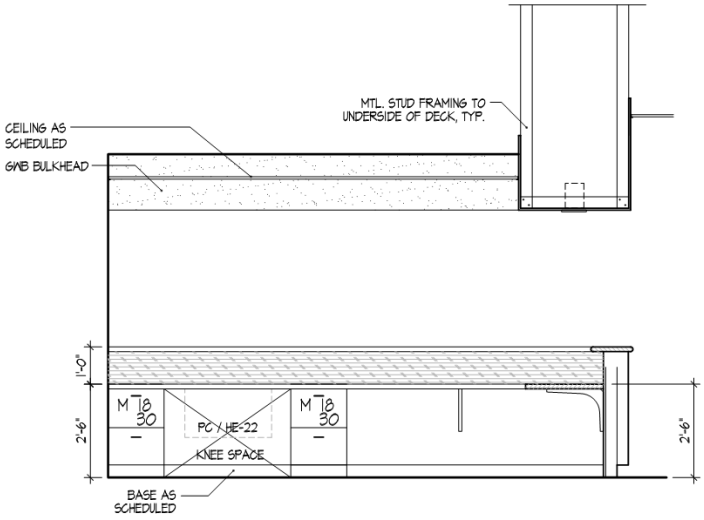


Figure 49 | Reception/Security Desk East Elevation

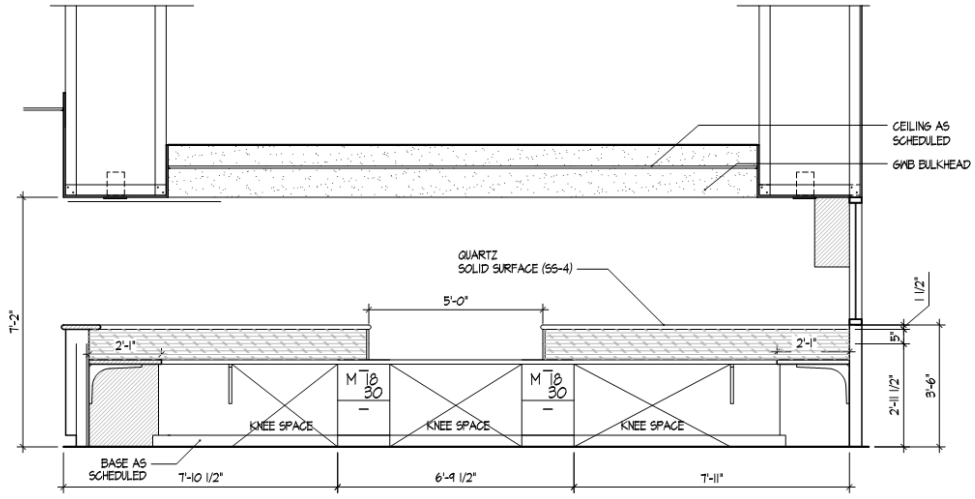
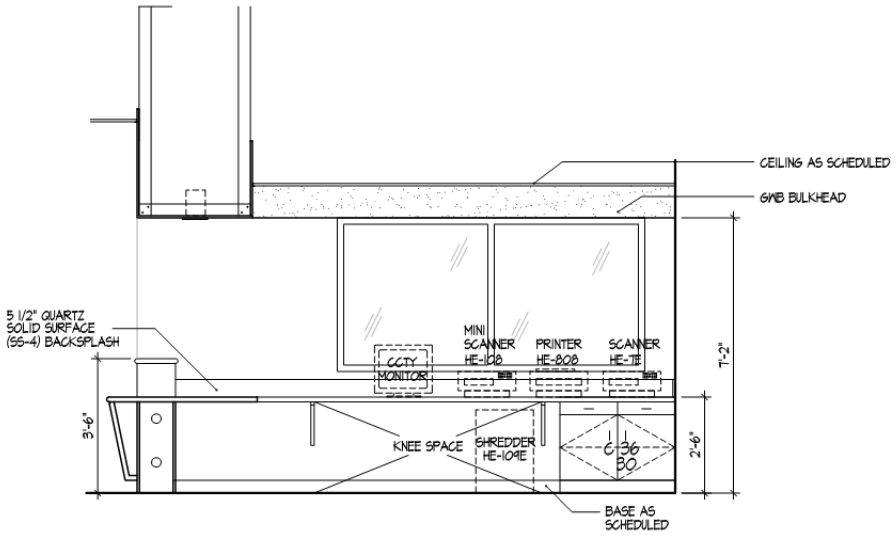


Figure 50 | Reception/Security Desk South Elevation



Surface Materials

Lobby

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer and Arabesque by Forbo (LIN-1, -4, -5).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Softer Tan by Sherman Williams (IPS2-A).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Reception/Security

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor – The floor is covered with linoleum of color Shell by Forbo (LIN-1).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Decorous Amber (orange) by Sherman Williams (IPS2-D).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Waiting

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan and Ruskin Room Green (green) by Sherman Williams (IPS2-A, -E).

Storefront Walls – From the floor, a 2.75’ Solarban tempered glass with 5.25’ of Solarban tempered glass above and 2’ Solarban glass at the top all with mullions between them (GL-6T, -6).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer and Arabesque by Forbo (LIN-1, -4, -5).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Soulmate (purple) by Sherman Williams (IPS2-H).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Pediatrics Waiting

Ceiling – The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges (ACT-1).

Walls – The walls are painted the color Softer Tan and Ruskin Room Green (green) by Sherman Williams or the walls have a vinyl wall covering of a watercolor mural “ journey” that is 68”h x 252”w by Genesys/4walls.com (IPS2-A, -E, VWC-1).

Storefront Walls – From the floor, a 2.75’ Solarban tempered glass with 5.25’ of Solarban tempered glass above and 2’ Solarban glass at the top all with mullions between them (GL-6T, -6).

Floor – The floor is covered with linoleum of different colors including Shell, Indian Summer, Water Melon and Red Violet by Forbo (LIN-1, -4, -8, -11).

Door Frame - The door frames are painted the color Macadamia by Sherman Williams (IPS7-B).

Bulkhead – The bulkheads are painted the color Soulmate (purple) by Sherman Williams (IPS2-H).

Base – The base is a 6” high black colored rubber base by Roppe (RE6-B).

Figure 51 | Lobby and Waiting Area Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-D	SW 0007 Decorous amber paint	0.5
IPS2-E	SW 0042 Ruskin room green paint	0.5
IPS2-H	SW 6270 Soulmate paint	0.49
IPS7-B	SW 6142 Macadamia paint	0.97
LIN-1	ME-3075 Shell linoleum	0.45
LIN-4	ME-3164 Indian summer linoleum	0.17
LIN-5	ME-3123 Arabesque linoleum	0.23
LIN-8	ME-3133 Water melon linoleum	0.41
LIN-11	345 Red violet linoleum	0.31
RB6-B	P100 Black rubber base	0.18
VWC-1	M 5370 1 Mural vinyl wall covering	0.23

Figure 52 | Lobby and Waiting Area Glass Transmittance Properties

MATERIALS	DESCRIPTION	TRANSMITTANCE
GL-6	1" Insulated solarban glass	0.68
GL-6T	1" Insulated solarban tempered glass	0.68

Furnishings

The reception/security desk is fixed in location as well as the chairs provided for visitors and patients in the waiting areas. The desk is covered in a natural wood laminate with wood edging.

Tasks/Activities

The main tasks in this space occur at the reception/security desk which is reading, writing and conversing with patients and visitors. Within the waiting areas, the main tasks include reading and writing. Once the visitors and patients enter into the lobby they should be guided to the reception/security desk and to the respective waiting areas from there.

Design Criteria

Interior, Health Care Facilities, Waiting Areas, Local for Reading (IESNA Handbook)

Appearance of Space and Luminaires (Important)

The appearance of the space should be comforting with one or two luminaire types at most to avoid causing visual clutter. The luminaires should be organized in a manner that would not distract the visitors or patients from what they are doing.

Color Appearance and Color Contrast (Very Important)

The CRI should be no less than 70 with a CCT of about 4100K since it is exposed to daylighting.

Daylighting Integration and Control (Very Important)

Daylighting affects the space in a kinetic way throughout the entire day. This creates a more please atmosphere for the patients and visitors as they wait to he attended to. It can be controlled with blinds or shades to allow the occupants to adjust the intensity of the sun as the day progresses.

Direct Glare (Important)

Direct glare is avoided in the space by incorporating smaller luminaires versus less larger apertures.

Flicker and Strobe effect (Very Important)

Using compact fluorescent lamps in the space allows for no flicker or strobe effect.

Light Distribution on Surfaces (Very Important)

The distribution of light on the surfaces in the circulation space should be no more than a 3:1 ratio of luminance.

Uniform Light Distribution on Surfaces (Somewhat Important)

Each surface should be uniformly illuminated, especially the floor, so the visitors and patients can find their way through the space.

Luminances of Room Surfaces (Very Important)

The walls of the space should each have a uniform luminance value. Scalloping is avoided since the luminaires are far enough away from the walls.

Modeling of Faces or Objects (Very Important)

Modeling of faces in a waiting area is essential to increase comfort level.

Reflected Glare (Important)

Televisions are present in the waiting areas therefore the reflected glare from the storefront will be avoided by the use of blinds or shades. The visual display terminals at the reception/security desk will not have luminaires placed directly behind them.

Source/Task/Eye geometry (Important)

The ambient lighting throughout the space is consistent to improve visibility for the visitors and patients.

Illuminance

Horizontal Illuminance (Important) – Category D – 30 fc

Vertical Illuminance (Important) – Category B – 5 fc

VDT Criteria

The televisions located in the waiting rooms on the south façade of the building can be shaded using the blinds or shades to avoid the glare from daylight. The VDT at the reception/security desk do not have luminaires behind them and the ambient light of the space illuminates them without glare.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Lobby – 1.3 W/ft^2

Controls Criteria

Photo sensors can be added to the space to reduce the total building load in addition to the existing switches behind the reception/security desk.

Accent Lighting Considerations

There are no accent lights within this circulation space.

Luminance Ratios (max:min)

Information desk – 3:1 to 5:1

Paper task and adjacent VDT screen - 3:1 or less

Psychological Aspects

The desired psychological impression a visitor or patient should have when they enter this space is relaxation. In healthcare facilities, especially emergency waiting areas, this is difficult to achieve. To achieve this goal through the lighting system, the light has to take the attention away from the occupants. This can be attained by illuminating the walls or peripheral objects and the uses of indirect lighting or lower levels of direct illumination. The reflectance of the walls should be lower with a rich color or material to enhance the feeling of relaxation.

A main focal point should be created on the wall behind the reception/security desk. This would allow the visitors and patients to see their destination right when they enter the space. A higher illumination on the painted wall behind the desk or on artwork that is hung on the wall is all that is necessary to create this focal point. The difference in the luminance ratios cause's people to become attracted that point in the space.

The counterpart system involves a feeling of tension. This can be created with simple downlights that do not directly provide luminance on the walls or ceiling. In this scenario the light comes straight down on a person, giving them the impression of being under a spot light.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 53 | Lobby and Waiting Area Luminaire Schedule

LOBBY + WAITING AREA LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
L		Winona Lighting	Illustra Satro	4801/30/FQ/277V/OA/BAL/STD	Intersecting 2-piece standard brushed aluminum finish with an etched opal acrylic 30" lens. Pendant is mounted 2.5 feet from ceiling	(4)F26DBX/830/ECO4P 97611 - GE CF plug in T4	116	277	(2)VEZ/2Q26/M2/BS Philips Advance
F		ERCO	Lightcast Downlight	22209.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 7, 30° cut-off angle.	(2)F18DBX/830/ECO4P 97599 - GE CF plug in T4	43	277	VEZ/2Q18/M2/BS/277 Philips Advance
M		ERCO	Lightcast Downlight	22267.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 5, 30° cut-off angle.	F18TBX/830/A/ECO 97625 - GE CF plug in T4	22	277	VEZ/1Q18/M2/BS Philips Advance
N		Elliptipar	Style 204	M204/150G/T/02/2/00/0	Extruded high purity aluminum housing with a semi-gloss white reflector. Semi-recessed adjustable wall washer. Microprismatic tempered glass lens.	CMH150TU/830/G12 20017 - GE ceramic metal halide T6	161	277	IMH/150/H/277 Philips Advance

See Appendix A for full luminaire schedule and cut sheets

Figure 54 | Lobby and Waiting Area Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
L	1.05	0.84	0.82	0.95	0.69
F	1.0	0.81	0.94	0.95	0.72
M	1.0	0.84	0.94	0.95	0.75
N	1.0	0.79	0.92	0.95	0.69

Controls

Occupancy sensors are placed within the waiting area to save energy

Figure 55 | Lobby and Waiting Area Control Schedule

LOBBY + WAITING AREA CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
Y		Watt Stopper	Dual Technology Line Voltage Ceiling Sensor	DT-355	Passive infrared and ultrasonic dual technologies provide 360 of coverage. Ceiling mounted with a flat and unobtrusive appearance. No adjustments are necessary after line voltage installation.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the lobby and waiting area lighting redesign.

Figure 56 | Lobby and Waiting Area Plan Pseudo Color and Render (fc)

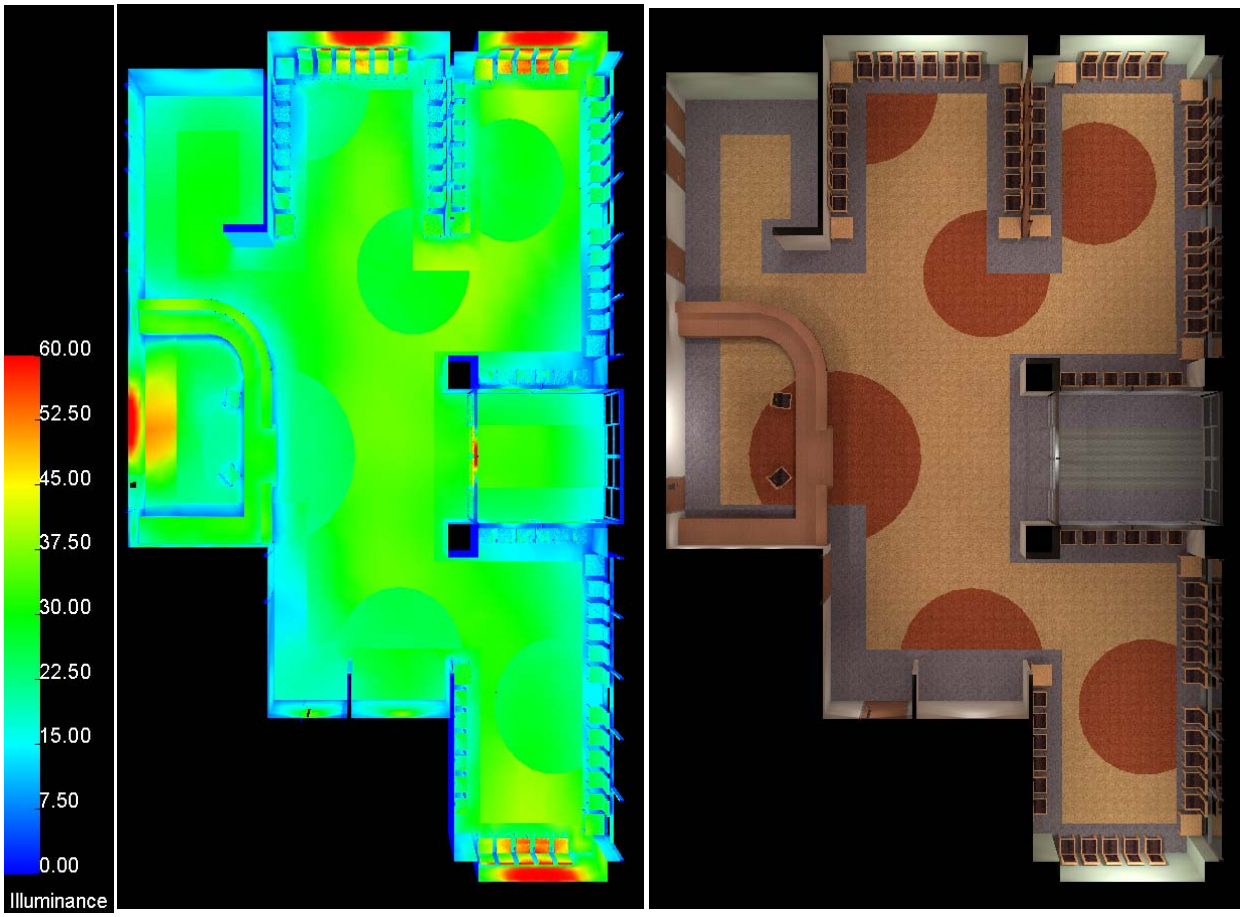


Figure 57 | Lobby and Waiting Area Perspective Pseudo Color and Render (fc)

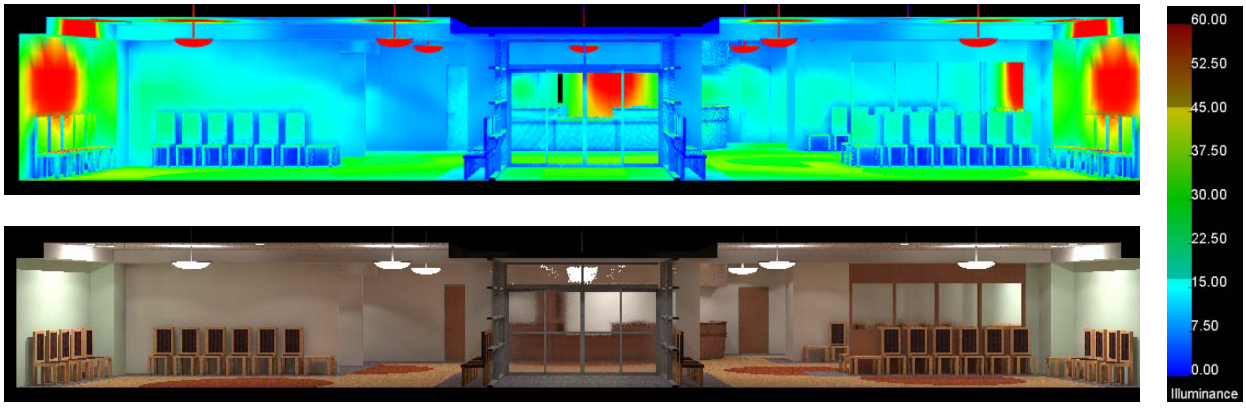


Figure 58 | Lobby and Waiting Area Perspective Pseudo Color and Render (fc)

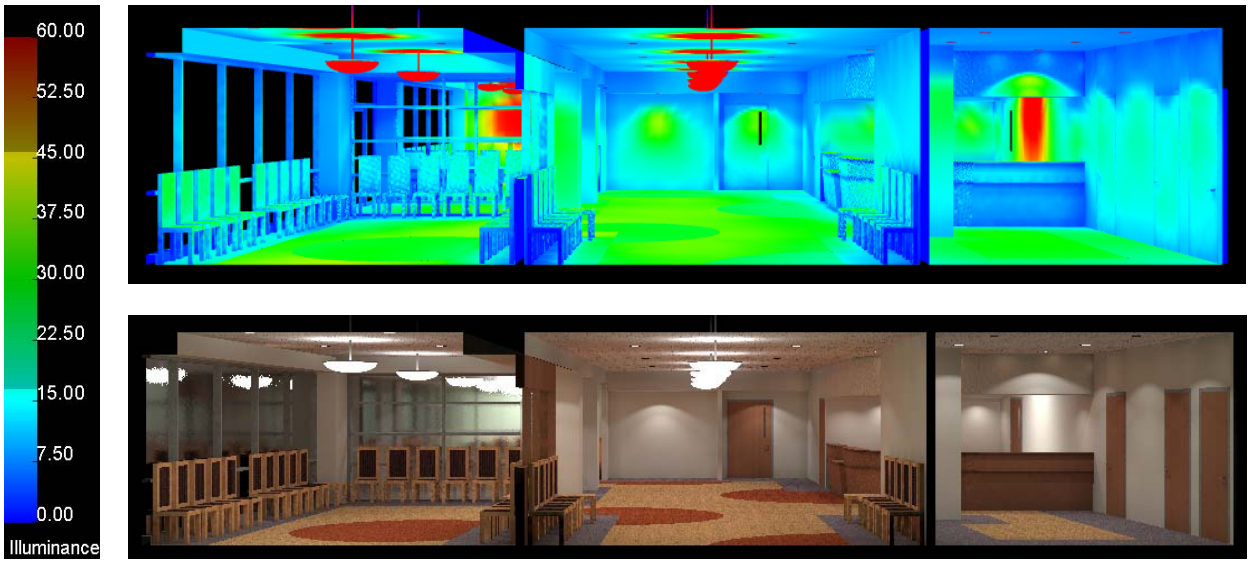


Figure 59 | Lobby and Waiting Area View Render and Pseudo Color (fc)

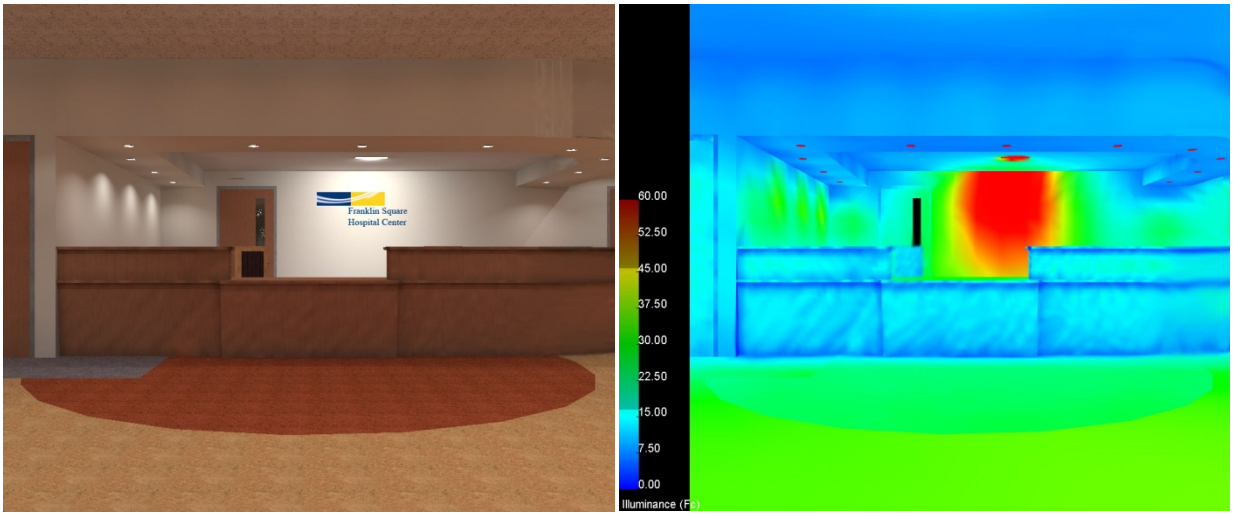


Figure 60 | Lobby and Waiting Area View Pseudo Color and Render (fc)

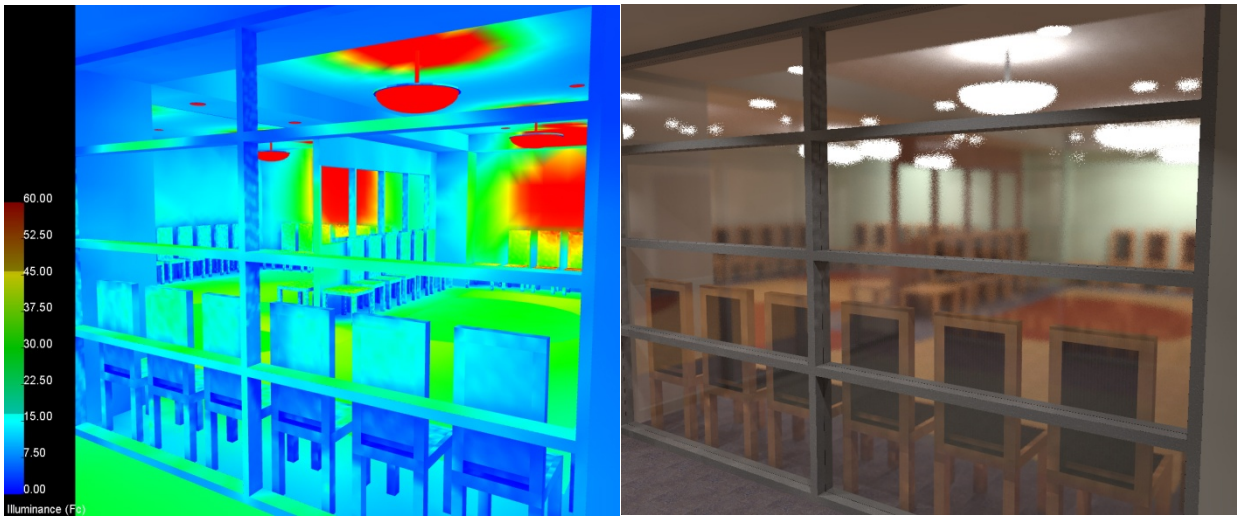


Figure 61 | Lobby and Waiting Area View Render and Pseudo Color (fc)

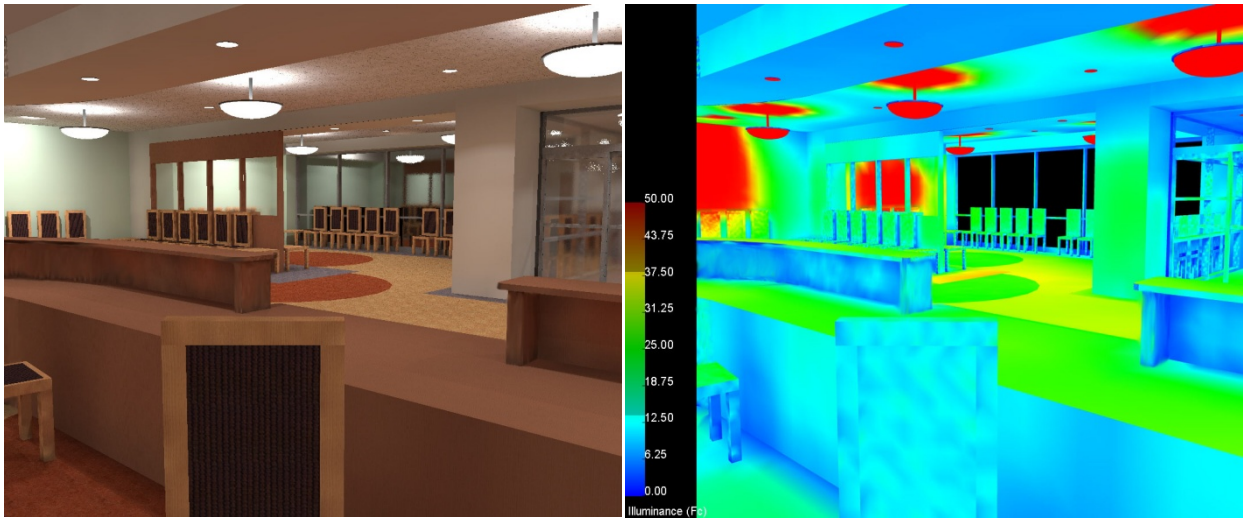


Figure 62 | Lobby and Waiting Area View Pseudo Color and Render (fc)

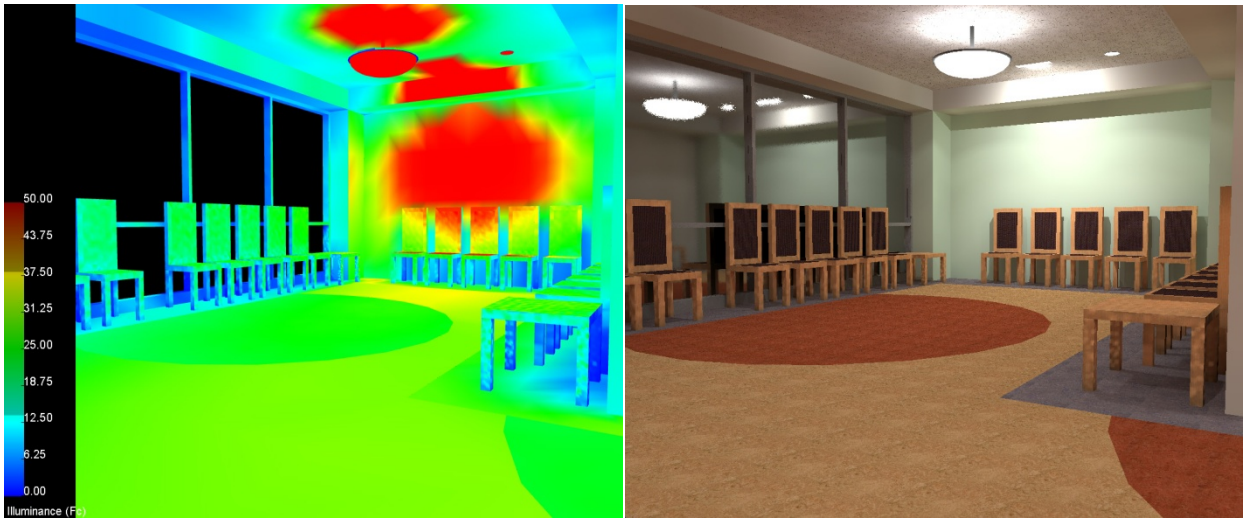
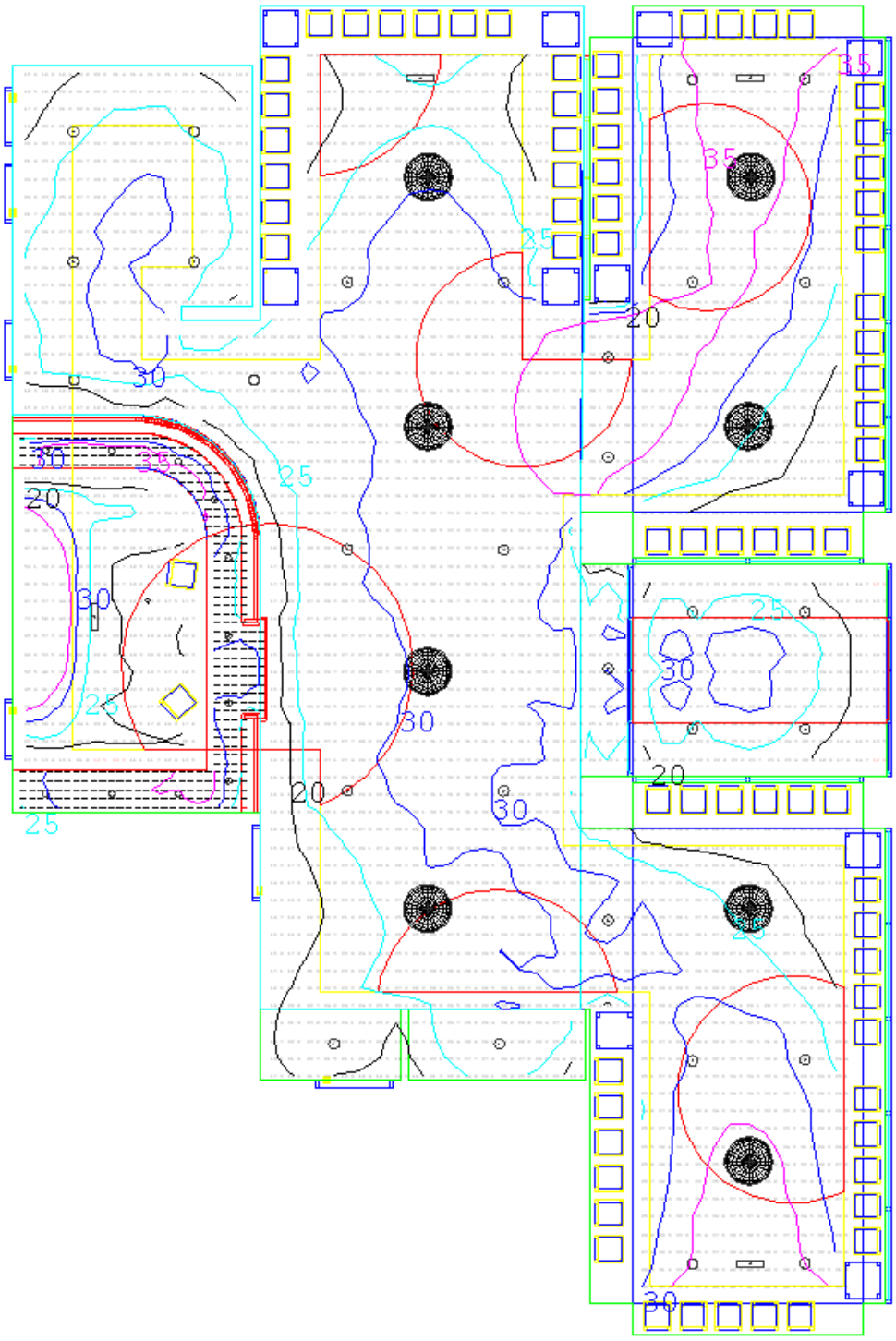


Figure 63 | Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 64 | Lobby and Waiting Area Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Lobby	2776	1.3	3608.8	2760
Hospital Transition	180.7	1	180.7	172

Performance Summary

Ambient lighting in the redesigned lobby and waiting area reaches the floor directly and indirectly. The pendant luminaire is a direct-indirect fixture that allows lighting to reflect from the ceiling. The extra illumination on the ceiling makes the ceiling height look taller than normal. Direct downlights also add to the ambient lighting in the space. Smaller downlights supply task lighting for the receptionist and security attendant.

Most of the ambient light at the reception desk area is reflected off the wall behind the desk. The wall behind the desk is washed to highlight the Franklin Square Hospital Center logo that hangs there. this sign is important because the visitors enter the lobby and go straight to the reception desk to check in and immediately see the illuminated signage. This wall washer is found in the waiting area as well to accent the walls painted Ruskin Room Green.

The metal halide wallwasher's angle should be adjusted because the visitors sitting in the seats against the wall will encounter direct glare from the light source. A wall graze system was not implemented because the wall construction is flat gypsum wall board. A grazing system can accentuate any small flaws in a flat wall and this was avoided.

The space meets the ASHRAE Standard 90.1 -2007 lighting power density requirements and the IESNA recommendations.

Figure 65 | Lobby and Waiting Area Performance Summary

GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	31.18	39.8	21.9	1.82
Floor	27.96	73.7	10.6	6.95
Vestibule	24.26	32.5	12.6	2.58

Electrical Redesign

For complete spatial description of the lobby and waiting area, see page 45.

Electrical Design Objectives/Criteria

The lobby and waiting room area lighting is powered by one normal power and two emergency power panelboards that all have a 480Y/277V, 3PH, 4W voltage system. The task lighting and signage lighting by the reception desk are switched by a single pole located behind the desk. The vestibule is also switched by a single pole located on the column adjacent to the vestibule.

The remaining lighting loads will remain on until the occupancy sensor gets a vacant signal and switched the lights off. The emergency room is usually busy at any time of the day and night therefore these occupancy sensors may not be appropriate for the space.

The store-front façade in the pediatric emergency and emergency waiting room could use daylight sensors to dim or switch the luminaires in the space. HID uses step dimming which could cause confusion to the visitors that would occupy the space therefore it was not implemented in the research.

The redesigned lighting system is calculated and connected to the existing panelboards.

See Appendix A for complete lighting plans with circuiting

Figure 66 | Existing Panelboard LPG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPG5 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: ER CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	13.3	12.7	-	-	-	-	2	LTG: PEDS TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: ER PSYCH WING, WAIT TLTS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	9.6	11.2	-	-	4	LTG: PEDS RM #1-9, PLAYROOM	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: ER WAITING, CASHIER	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	12.4	14.2	6	LTG: CENTRAL TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
7	SPARE	1	20	-	0	13.6	-	-	-	-	8	LTG: TEAM #0324, 0320, CORRS	1	20	3/4"C.W/2#12+1#12GRD.
9	SPARE	1	20	-	-	-	0	0	-	-	10	SPARE	1	20	-
11	SPARE	1	20	-	-	-	-	-	0	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	-	-	-	-	3	0	-	-	-	-	20	SPACE	1	-	-
21	DECON TANK PUMP	3	15	3/4"C.W/3#12+1#12GRD.	-	-	3	0	-	-	22	SPACE	1	-	-
23	-	-	-	-	-	-	-	-	3	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	29 A		TOTAL PHASE A	43 A		-		-			CONNECTED LOAD	26.6 KVA		
	DEMAND LOAD	47 A		TOTAL PHASE B	-		24 A		-						
				TOTAL PHASE C	-		-		30 A						

Figure 67 | New Panelboard LPG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LPG5	Panel Location:			Electrical Room 0703			
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	Lighting	3	ER corridors	13.3	A	0.90	3316	3684		
2	A	Lighting	3	eds team, c	12.7	A	0.90	3166	3518		
3	B	Lighting	3	R psych, wa	9.14	A	0.90	2279	2532		
4	B	Lighting	3	Peds 1-9 pla	11.2	A	0.90	2792	3102		
5	C	Lighting	3	ER wait, cas	12.4	A	0.90	3091	3435		
6	C	Lighting	3	teams, cor	14.2	A	0.90	3540	3933		
7	A	Spare	9	-	0	A	1.00	0	0		
8	A	Lighting	3	Teams, corr	14.14	A	0.90	3525	3917		
9	B	Spare	9	-	0	A	1.00	0	0		
10	B	Spare	9	-	0	A	1.00	0	0		
11	C	Spare	9	-	0	A	1.00	0	0		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
20	A				0	A	1.00	0	0		
21	B	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
22	B				0	A	1.00	0	0		
23	C	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								24.1	26.6	Amps=	32.0

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					10.8	11.9	45%	43.1
PHASE TOTAL	B					5.9	6.5	24%	23.3
PHASE TOTAL	C					7.4	8.2	31%	29.6

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		21.7	24.1		21.7	24.1	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		2.4	2.5		2.4	2.5	0.95		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						24.1	26.6			
Spare Capacity			20%			4.8	5.3			
Total Design Loads						28.9	31.9	0.90	Amps=	38.4

Figure 68 | New Panelboard LPG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ER corridors	3316	20A/1P	1	*			2	20A/1P	3166	Peds team, cor	Lighting
Lighting	ER psych, wait	2279	20A/1P	3		*		4	20A/1P	2792	Peds 1-9 play	Lighting
Lighting	ER wait, cash	3091	20A/1P	5			*	6	20A/1P	3540	C teams, corrs	Lighting
Spare	-	0	20A/1P	7	*			8	20A/1P	3525	Teams, corrs	Lighting
Spare	-	0	20A/1P	9		*		10	20A/1P	0	-	Spare
Spare	-	0	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
HVAC Pump	Decon Pump	789	-	19	*			20	-	0	0	0
HVAC Pump	Decon Pump	789	15A/3P	21		*		22	-	0	0	0
HVAC Pump	Decon Pump	789	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	10.80	TOTAL DESIGN LOAD (KW)	28.89
CONNECTED LOAD (KW) - B Ph.	5.86	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	7.42	TOTAL DESIGN LOAD (AMPS)	38

Feeder Size Calculation

38.4 A * 125% = 48 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Figure 69 | Existing Panelboard E2LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E2LG5 (CRITICAL)			MAINS: MLO							AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: TREAT RM #4-6, TEAM 0224	1	20	3/4"C.W/2#12+1#12GRD.	13.2	12.4	-	-	-	-	2	LTG: FAST TR #1-8, 11-16, TEAM ST	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: PEDS #4-12, TREAT RM #1-3	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.3	13.6	-	-	4	LTG: FAST TR #19-10, PSYCH TRT	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PEDS #1-9, TEAM ST 0120	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	13.3	12.9	6	LTG: TRIAGE #1-10, WORK RM	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: TREAT RM #1-6, TEAM 0320	1	20	3/4"C.W/2#12+1#12GRD.	10.1	9.9	-	-	-	-	8	LTG: TEAM 0324, TREAT RM #7-11	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: TREAT RM #1-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.9	6.01	-	-	10	LTG: TEAM 0324, TREAT RM #1-6	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: TEAM 0220, TREAT RM #7-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.8	0	12	SPARE	1	20	-
13	LTG: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	2.99	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPARE	1	20	-	-	-	-	-	0	0	24	SPARE	1	20	-
25	SPARE	1	20	-	0	0	-	-	-	-	26	SPARE	1	20	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	43 A		TOTAL PHASE A	49 A		-		-			CONNECTED LOAD	35.8 KVA		
	DEMAND LOAD	54 A		TOTAL PHASE B	-		45 A		-						
				TOTAL PHASE C	-		-		36 A						

Figure 70 | New Panelboard E2LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					E2LG5	Panel Location:			Electrical Room 0703		
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	Lighting	3	Rm 4-6, tean	13.2	A	0.90	3291	3656		
2	A	Lighting	3	1-8 11-16, t	12.4	A	0.90	3091	3435		
3	B	Lighting	3	ed 4-12,rm 1	12.3	A	0.90	3066	3407		
4	B	Lighting	3	19-10 psyc	13.6	A	0.90	3390	3767		
5	C	Lighting	3	eds 1-9, tea	13.3	A	0.90	3316	3684		
6	C	Lighting	3	r 1-10, wk r	12.38	A	0.90	3086	3429		
7	A	Lighting	3	R 1-6, team	9.13	A	0.90	2276	2529		
8	A	Lighting	3	Team, r 7-11	9.9	A	0.90	2468	2742		
9	B	Lighting	3	Room 1-12	12.9	A	0.90	3216	3573		
10	B	Lighting	3	Team, rm 1-	6.01	A	0.90	1498	1665		
11	C	Lighting	3	eam, rm 7-1	9.8	A	0.90	2443	2715		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Lighting	3	Amb canopy	2.99	A	0.90	745	828		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C	Spare	9	-	0	A	1.00	0	0		
24	C	Spare	9	-	0	A	1.00	0	0		
25	A	Spare	9	-	0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								31.9	35.4	Amps=	42.6

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					11.9	13.2	37%	47.6
PHASE TOTAL	B					11.2	12.4	35%	44.8
PHASE TOTAL	C					8.8	9.8	28%	35.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		31.9	35.4		31.9	35.4	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		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		0.0	0.0		0.0	0.0			
Total Demand Loads						31.9	35.4			
Spare Capacity			20%			6.4	7.1			
Total Design Loads						38.3	42.5	0.90	Amps=	51.2

Figure 71 | New Panelboard E2LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E2LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #6, (1) #8 G, 1" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Rm 4-6, team	3291	20A/1P	1	*			2	20A/1P	3091	F 1-8 11-16, tm	Lighting
Lighting	Ped 4-12,rm 1-3	3066	20A/1P	3		*		4	20A/1P	3390	F 19-10 psych	Lighting
Lighting	Peds 1-9, team	3316	20A/1P	5			*	6	20A/1P	3086	Tr 1-10, wk rm	Lighting
Lighting	R 1-6, team	2276	20A/1P	7	*			8	20A/1P	2468	Team, r 7-11	Lighting
Lighting	Room 1-12	3216	20A/1P	9		*		10	20A/1P	1498	Team, rm 1-6	Lighting
Lighting	Team, rm 7-12	2443	20A/1P	11			*	12	20A/1P	0	-	Spare
Lighting	Amb canopy	745	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
Spare	-	0	20A/1P	23			*	24	20A/1P	0	-	Spare
Spare	-	0	20A/1P	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	11.87	TOTAL DESIGN LOAD (KW)	38.27
CONNECTED LOAD (KW) - B Ph.	11.17	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	8.85	TOTAL DESIGN LOAD (AMPS)	51

Feeder Size Calculation

51.2 A * 125% = 64 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Figure 72 | Existing Panelboard E1LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E1LG5 (LIFE SAFETY)			MAINS: MLO							AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	-	-	-	-	14.3	0	-	-	-	-	2	-	-	-	-
3	XFMR T-7	3	45	FEEDER 65	-	-	14.3	0	-	-	4	SPACE	3	-	-
5	-	-	-	-	-	-	-	-	14.3	0	6	-	-	-	-
7	LTG: FAST TR/TRIAGE EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	7.6	0	-	-	-	-	8	SPARE	1	20	-
9	LTG: STAIR C	1	20	3/4"C.W/2#12+1#12GRD.	-	-	3.4	0	-	-	10	SPARE	1	20	-
11	LTG: SE ER EGRESS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.7	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPACE	1	-	-	0	0	-	-	-	-	20	SPACE	1	-	-
21	SPACE	1	-	-	-	-	0	0	-	-	22	SPACE	1	-	-
23	SPACE	1	-	-	-	-	-	-	0	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	21 A		TOTAL PHASE A	22 A		-		-			CONNECTED LOAD	17.6 KVA		
	DEMAND LOAD	23 A		TOTAL PHASE B	-		18 A		-						
				TOTAL PHASE C	-		-		24 A						

Figure 73 | New Panelboard E1LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					E1LG5	Panel Location:			Electrical Room 0703		
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	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
2	A					A	1.00	0	0		
3	B	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
4	B					A	1.00	0	0		
5	C	Transformer	-	xfmr T-7	14	A	0.90	3490	3878		
6	C					A	1.00	0	0		
7	A	Lighting	3	North egress	7.25	A	0.90	1807	2008		
8	A	Spare	9	-		A	1.00	0	0		
9	B	Lighting	3	South egress	3.4	A	0.90	848	942		
10	B	Spare	9	-		A	1.00	0	0		
11	C	Lighting	3	West egress	9.7	A	0.90	2418	2687		
12	C	Spare	9	-		A	1.00	0	0		
13	A	Spare	9	-		A	1.00	0	0		
14	A	Spare	9	-		A	1.00	0	0		
15	B	Spare	9	-		A	1.00	0	0		
16	B	Spare	9	-		A	1.00	0	0		
17	C	Spare	9	-		A	1.00	0	0		
18	C	Spare	9	-		A	1.00	0	0		
19	A					A	1.00	0	0		
20	A					A	1.00	0	0		
21	B					A	1.00	0	0		
22	B					A	1.00	0	0		
23	C					A	1.00	0	0		
24	C					A	1.00	0	0		
25	A					A	1.00	0	0		
26	A					A	1.00	0	0		
27	B					A	1.00	0	0		
28	B					A	1.00	0	0		
29	C					A	1.00	0	0		
30	C					A	1.00	0	0		
31	A					A	1.00	0	0		
32	A					A	1.00	0	0		
33	B					A	1.00	0	0		
34	B					A	1.00	0	0		
35	C					A	1.00	0	0		
36	C					A	1.00	0	0		
37	A					A	1.00	0	0		
38	A					A	1.00	0	0		
39	B					A	1.00	0	0		
40	B					A	1.00	0	0		
41	C					A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								15.5	17.3	Amps=	20.8

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	5.3	5.9	34%	21.3
PHASE TOTAL	B	4.3	4.8	28%	17.4
PHASE TOTAL	C	5.9	6.6	38%	23.7

LOAD CATAGORIES		Connected			Demand				Ver. 104
		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	5.1	5.6		5.1	5.6	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	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	10.5	11.6		10.5	11.6	0.90		
Total Demand Loads					15.5	17.3			
Spare Capacity		20%			3.1	3.5			
Total Design Loads					18.7	20.7	0.90	Amps=	24.9

Figure 74 | New Panelboard E1LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E1LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Transformer	xfmr T-7	3490	-	1	*			2	-	0	0	0
Transformer	xfmr T-7	3490	45A/3P	3		*		4	-	0	0	0
Transformer	xfmr T-7	3490	-	5			*	6	-	0	0	0
Lighting	North egress	1807	20A/1P	7	*			8	20A/1P	0	-	Spare
Lighting	South egress	848	20A/1P	9		*		10	20A/1P	0	-	Spare
Lighting	West egress	2418	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	-	13	*			14	-	0	-	Spare
Spare	-	0	-	15		*		16	-	0	-	Spare
Spare	-	0	-	17			*	18	-	0	-	Spare
0	0	0	-	19	*			20	-	0	0	0
0	0	0	-	21		*		22	-	0	0	0
0	0	0	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	5.30	TOTAL DESIGN LOAD (KW)	18.65
CONNECTED LOAD (KW) - B Ph.	4.34	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	5.91	TOTAL DESIGN LOAD (AMPS)	25

Feeder Size Calculation

24.9 A * 125% = 31.125 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Team Station | Work Space

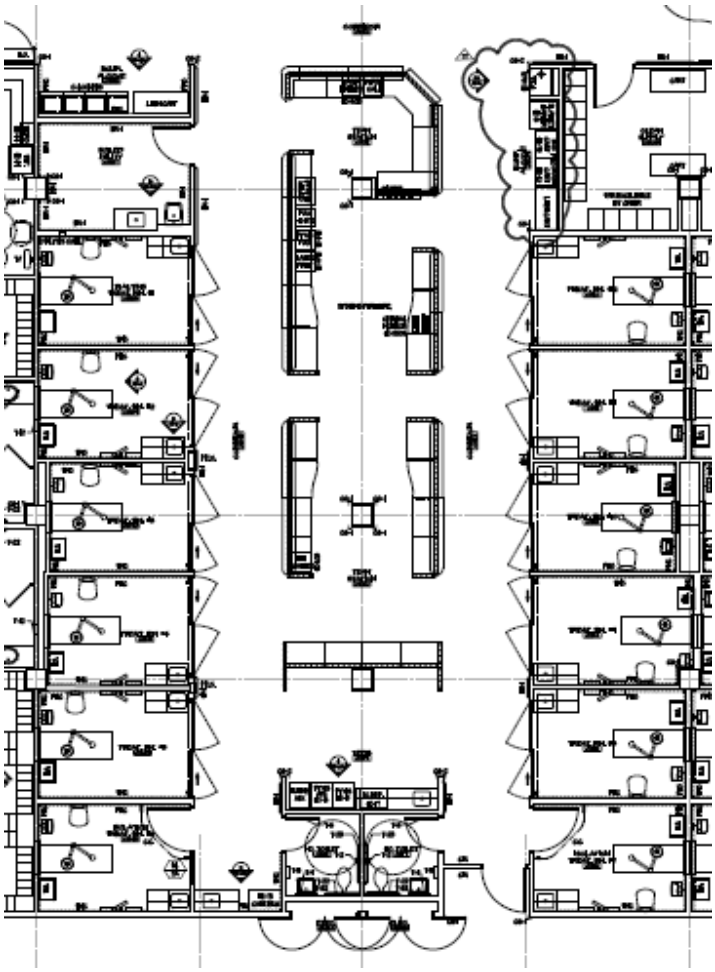
Spatial Summary

The team station is located within the emergency department and is responsible for 12 treatment rooms. The station is a twenty four hours a day work area for many doctors and to organize and file patient information and documents. Partition walls are 4.5 feet tall allowing for visual connects between patients and nurses. Visitors and patients are able to speak with the employees and have their questions answered quickly.

Team stations are located throughout the entire hospital with many on each floor, depending on the number of patient rooms. This particular team station is located on the ground floor of the emergency department on the south west side of the hospital. It is rectangular in shape and is approximately 847 square feet

Drawings

Figure 75 | Team Station Plan



Surface Materials

Ceiling | The ceiling consists of 2x2 acoustical ceiling tiles by Armstrong with angled tegular edges. (ACT-1)

Walls | The walls are painted the color Softer Tan by Sherman Williams (IPS2-A).

Floor | The floor is covered with 12”x12” vinyl composition tiles, by Imperial Texture, that are placed in a specified pattern using four different colors (VCT-1, -2,- 3, -7).

Bulkhead | The bulkheads are painted the color Ruskin Room Green (green) by Sherman Williams (IPS2-E).

Base | The base is a 6” high black colored rubber base by Roppe (RE6-B).

Figure 76 | Team Station Material Reflectance Properties

MATERIALS	DESCRIPTION	REFLECTANCE
ACT-1	Fine fissured #1732 2x2 acoustical ceiling tile	0.74
IPS2-A	SW 6141 Softer tan paint	0.81
IPS2-E	SW 0042 Ruskin room green paint	0.5
RB6-B	P100 Black rubber base	0.18
VCT-1	51873 Brushed sand vinyl composition tile	0.61
VCT-2	51916 Dutch delft vinyl composition tile	0.56
VCT-3	51867 Cantaloupe vinyl composition tile	0.52
VCT-7	51885 Granny smith vinyl composition tile	0.59

Furnishings

The reflectance for the Herman Miller Furniture System is approximated by an average horizontal of and average vertical reflectance value of 0.30.

Frame base and vertical connectors – black umber (BU)

Exterior tiles – cherry (V3)

Interior tiles below work surface – painted black umber (BU)

Interior tiles above work surface – Painted just tan (JT)

Work surface – Laminate 2x wheat (LW)

Trans. Counters – Corian with Mojave/ black umber supports (BU)

Crash rail (2 heights) – C/S Acrovyn #103 Beige (BG)

Figure 77 | Herman Miller System material reflectance properties

MATERIALS	DESCRIPTION	REFLECTANCE
BU	Black umber paint	0.18
BG	#103 Beige paint	0.77
JT	Just tan paint	0.71
LW	Wheat work surface laminate	0.48
V3	Cherry exterior tiles	0.14

Tasks/Activities

The team station is primarily a working environment. The lighting inside the space should be slightly different then the surroundings to allow the patients and visitors to understand that the team station is a private area for the nurses' only.

Design Criteria

Interior, Health Care, Nursing Stations, General/Desk (IESNA Handbook)

Appearance of Space and Luminaires (Important/Not Important)

It is Important for the architectural and lighting layout to be clean and uniform throughout the entire area to reduce "visual clutter". The luminaires should help guide people around the space for example if cove lighting is only around the team station then the patients and visitors see this as a private area that they are not allowed to enter.

Color Appearance and Color Contrast (Very Important/Important)

Color rendering is crucial in healthcare facilities. Patients' symptoms and certain problems deal with colors that need to be seen under a high CRI lamp. Lamps with a CRI of 70 or better are recommended for a pleasant appearance of skin-tones.

Daylighting Integration and Control (Very Important/Not Important)

Daylight integration is very difficult to achieve in the team station since it is not near any windows. The next best thing to simulate the change of time over the course of the day is to use controls and settings. A daytime and nighttime scene can be set and with just push of a button the Illuminance levels of the space will adapt.

Direct Glare (Important/Somewhat Important)

Direct glare can be controlled with the choice of an indirect luminaire that or a lens or parabolic reflector to lessen the glare.

Flicker and Strobe effect (Very Important/Somewhat Important)

The use of high frequency electronic ballasts can eliminate the annoyance of flicker and strobe effect.

Light Distribution on Surfaces (Very Important/Important)

The surfaces of different objects in the space should not exceed a 3:1 ratio of luminance but the space should not create a lack of interest with exactly one uniform luminance.

Uniform Light Distribution on Task Plane (Very Important/Important)

Shadows and patterns of other light sources are distracting and can be reduced by using more luminaires or integrate luminaires that have a wide angle to cover more area of the task plane.

Luminances of Room Surfaces (Very Important/Somewhat Important)

Luminance values in the space should be uniform for each surface including the floor, cabinets and bulkheads over the work plane. Dark area towards the top of the bulkheads should be avoided for uniformity.

Modeling of Faces or Objects (Very Important/Very Important)

Non-verbal communication of patients is very important in hospital settings therefore the lighting design of the space should incorporate reflected Illuminance as well as direct. Creating more shadows on the face helps to create a more defined and easy to read facial expressions.

Reflected Glare (Important/Not Important)

Avoid veiling reflections from cabinet table tops and glossy or metallic hospital equipment. Do not place luminaires directly behind computer terminals.

Source/Task/Eye geometry (Important/Not Important)

Avoid placing luminaires behind screens of any sort such as a computer terminal or a nurse call system display.

Illuminance

Horizontal Illuminance (Important/Important) – Category D/E – 30/50 fc

Vertical Illuminance (Important/Somewhat Important) – Category B/C – 5/10 fc

VDT Criteria

Visual display terminals are used in the team station all hours of the day therefore the lighting design must reduce veiling reflections that cause glare.

Power Allowance (ASHRAE /IESNA Std. 90.1-2007)

Nurses' Station – 1.0 W/ft^2

Controls Criteria

Nurse Stations are usually located in the center of many patient rooms therefore a multilevel control system is necessary. A higher Illuminance would be used during daytime hours while a lower Illuminance level would be used during nighttime hours. The luminaires that are used for the night should not be visible to the patients through their doorways.

Luminance Ratios

Paper task and adjacent VDT screen - 3:1

Psychological Aspects

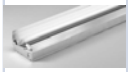
A private psychological effect within the team station will help visitors and patients understand that they are not supposed to be in that space. This private feeling also plays a role on the nurses that will occupy the space. They will be able to work more efficiently in a more intimate space due to these psychological impressions.

Lighting Plans

See Appendix A for lighting plans

Luminaires

Figure 78 | Team Station Luminaire Schedule

TEAM STATION LUMINAIRE SCHEDULE									
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION	LAMP	INPUT WATTS	VOLTAGE	BALLAST
O		Zumtobel	ML	ML4F/22/2245/OL/U	Cold-rolled steel housing with powder-coated white finish. High-reflectance white interior reflector and shaped extruded white opal acrylic lens.	(2)F24W/T5/841/ECO 46701 - GE linear T5	52	277	ICN/2S24 @277V Philips Advance
M		ERCO	Lightcast Downlight	22267.000	Cast aluminum housing designed with a heat sink. White powder coated cast aluminum mounting ring. Bright anodised aluminum darklight reflector. Size 5, 30° cut-off angle.	F18TBX/830/A/ECO 97625 - GE CF plug in T4	22	277	VEZ/1Q18/M2/BS Philips Advance
P		Elliptipar	Style 306	F306/A132/S/00/2/00/0	Extruded high purity aluminum housing with clear anodized specular finish. Adjustable reflector that can be joined to other fixtures to aim together. Indirect cove lighting lay-in installation.	F32T8/SP41/ECO/C 15904 - GE linear T8	35	277	VEZ/132/SC Philips Advance

See Appendix A for full luminaire schedule and cut sheets

Figure 79 | Team Station Light Loss Factors

TYPE	BF	LLD	LDD	RSDD	TOTAL LLF
O	1.0	0.92	0.94	0.95	0.82
M	1.0	0.84	0.94	0.95	0.75
P	1.0	0.95	0.82	0.95	0.74

Controls

A Grafik Eye preset dimming control system will allow the team stations luminaires to be dimmed. This is desired to help the patients in the area with the natural circadian rhythms. The linear cove luminaires will be dimmed to the desired level and preset for easy control. The control system can hold up to four different lighting scenes.

Figure 80 | Team Station Control Schedule

TEAM STATION CONTROL SCHEDULE					
TYPE	IMAGE	MANUFACTURER	PRODUCT NAME	CATALOG NUMBER	DESCRIPTION
		Lutron	GRAFIK Eye 3000 Series	GRX/3104/T/BE	Preset dimming control that allows for the setup of lighting scenes. Easy pushbutton recall of four lighting scenes, plus off. Provides lockout options to prevent any accidental changes.

See Appendix A for full equipment schedule and cut sheets

Performance Data

The following are renders and calculation grids that summarize the team station lighting redesign.

Figure 81 | Team Station Plan Pseudo Color and Render (fc)

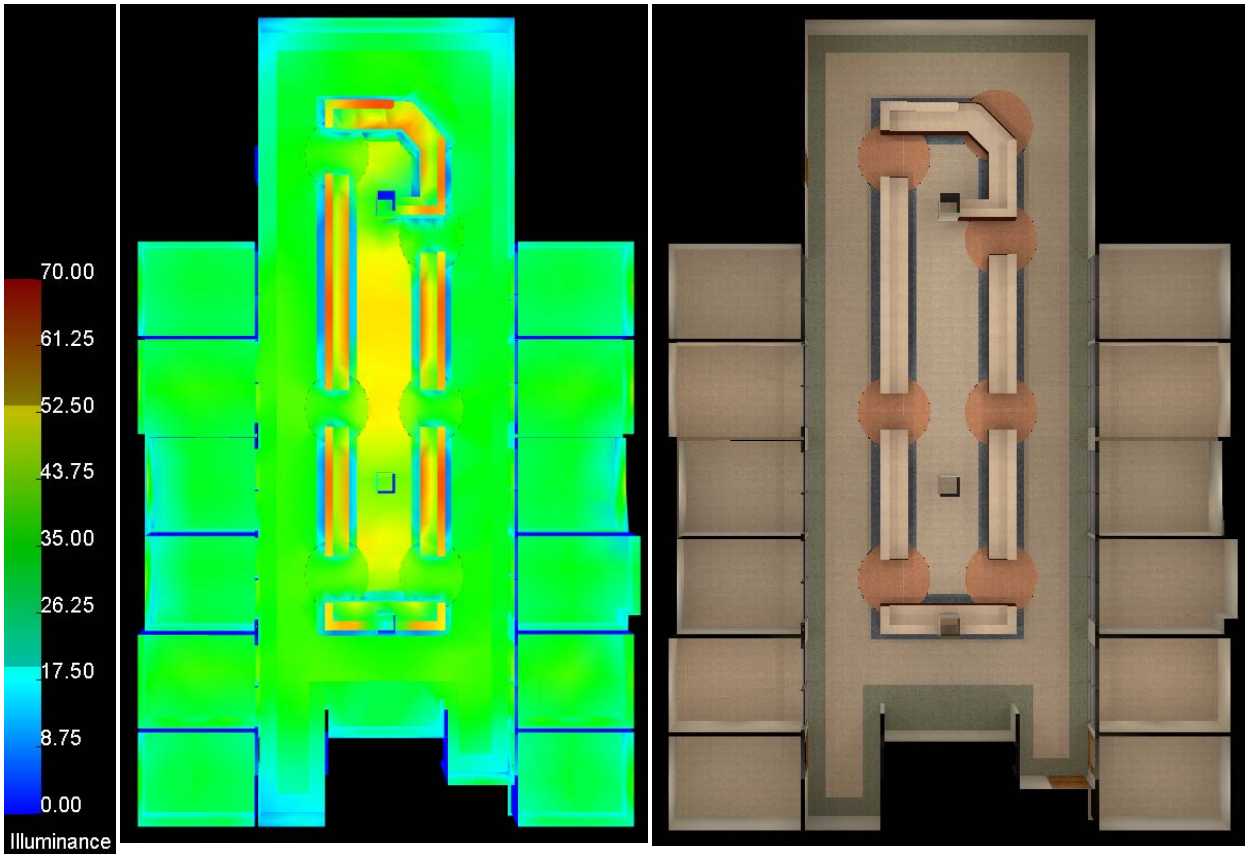


Figure 82 | Team Station Perspective Pseudo Color and Render (fc)

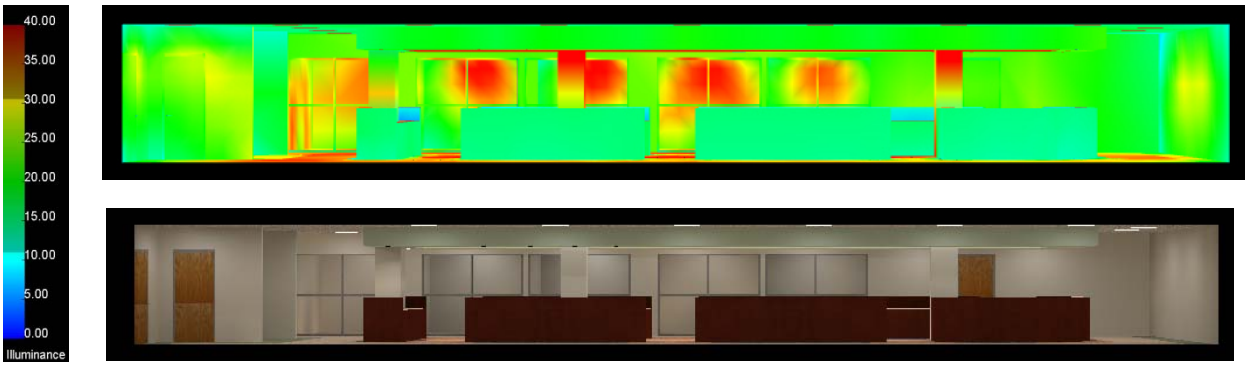


Figure 83 | Team Station View Pseudo Color and Render (fc)

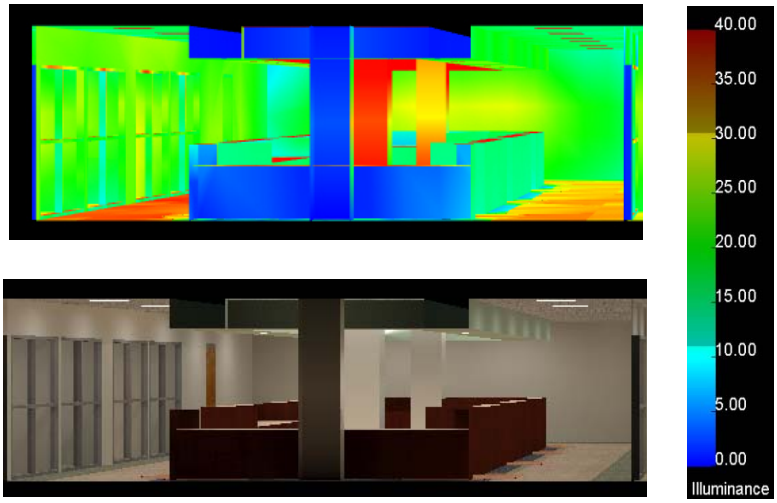


Figure 84 | Team Station View Pseudo Color and Render (fc)

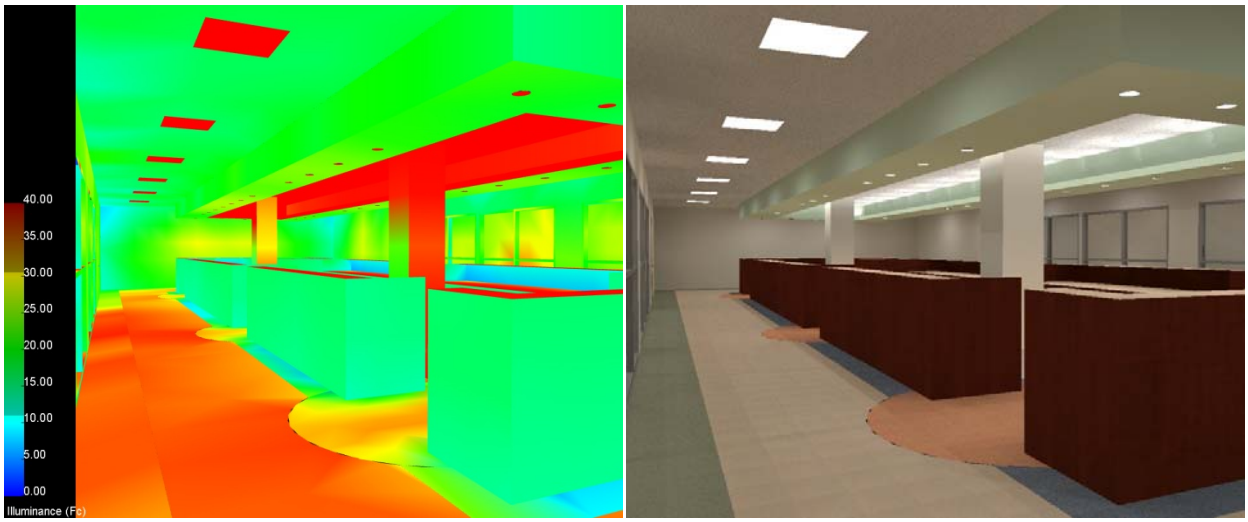


Figure 85 | Team Station View Pseudo Color and Render (fc)

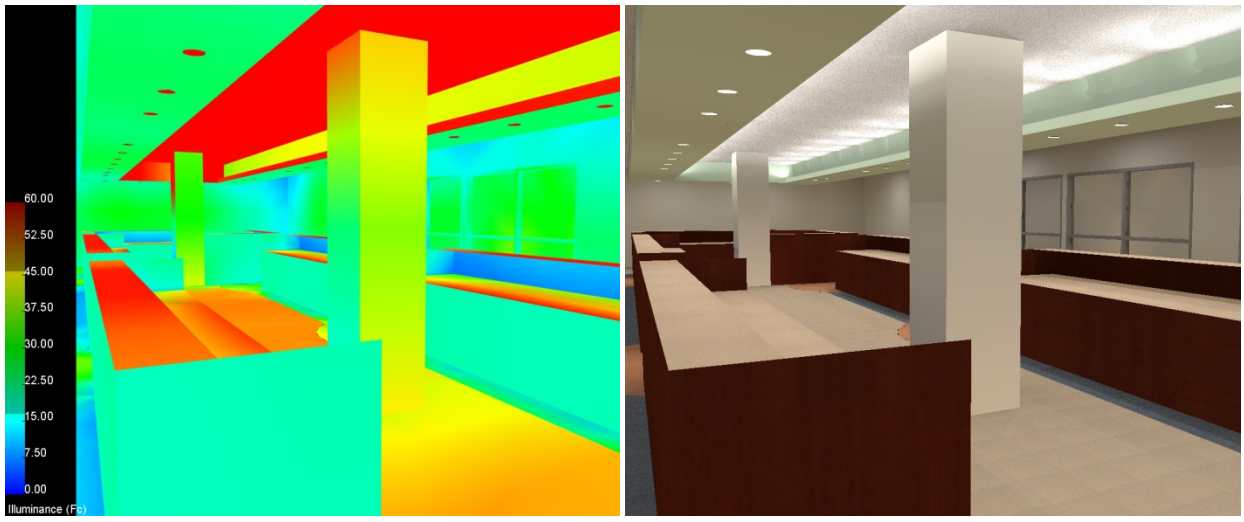


Figure 86 | Floor Horizontal Illuminance Contours (fc)

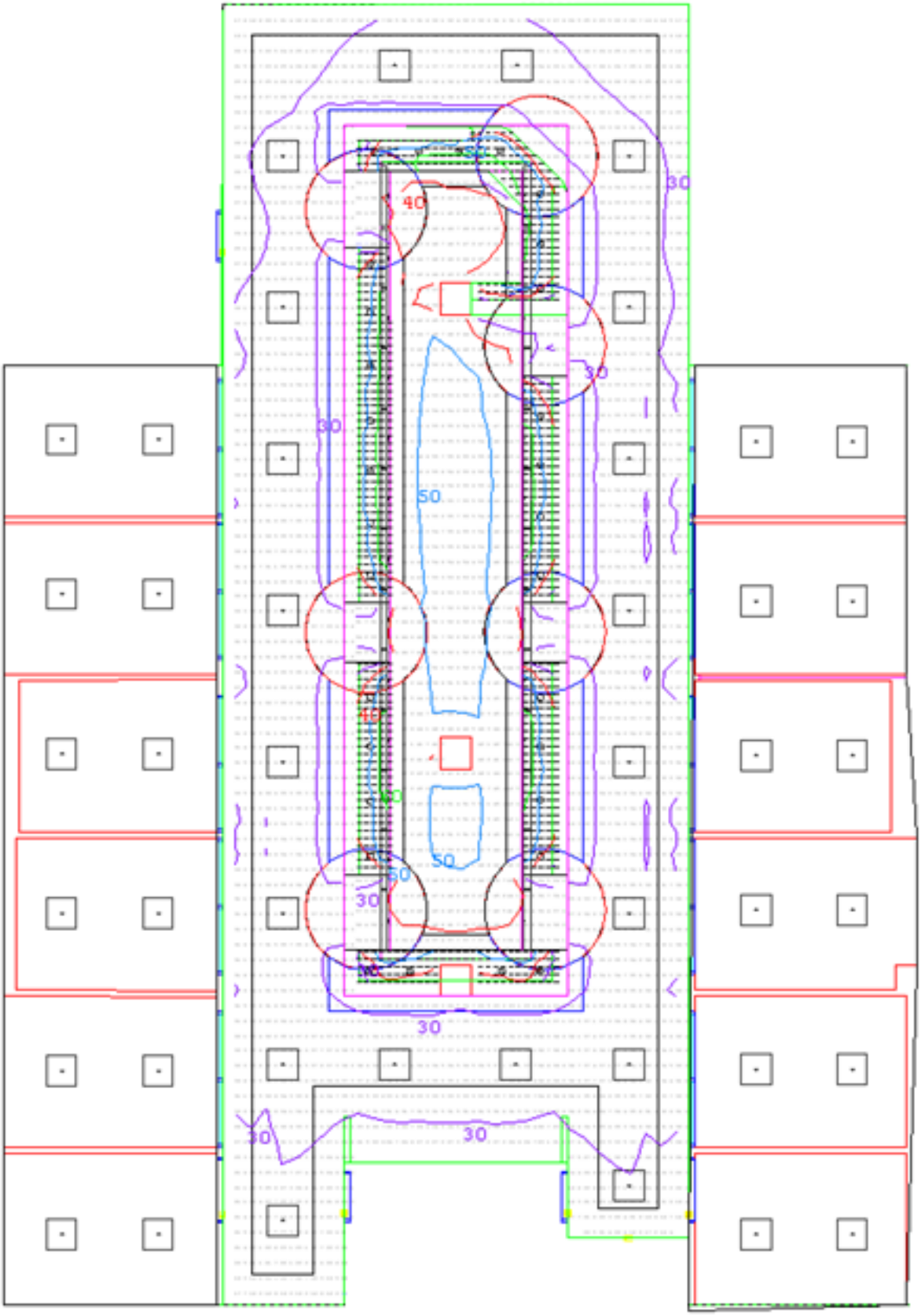


Figure 87 | 50% Dimmed Team Station Plan Pseudo Color and Render (fc)

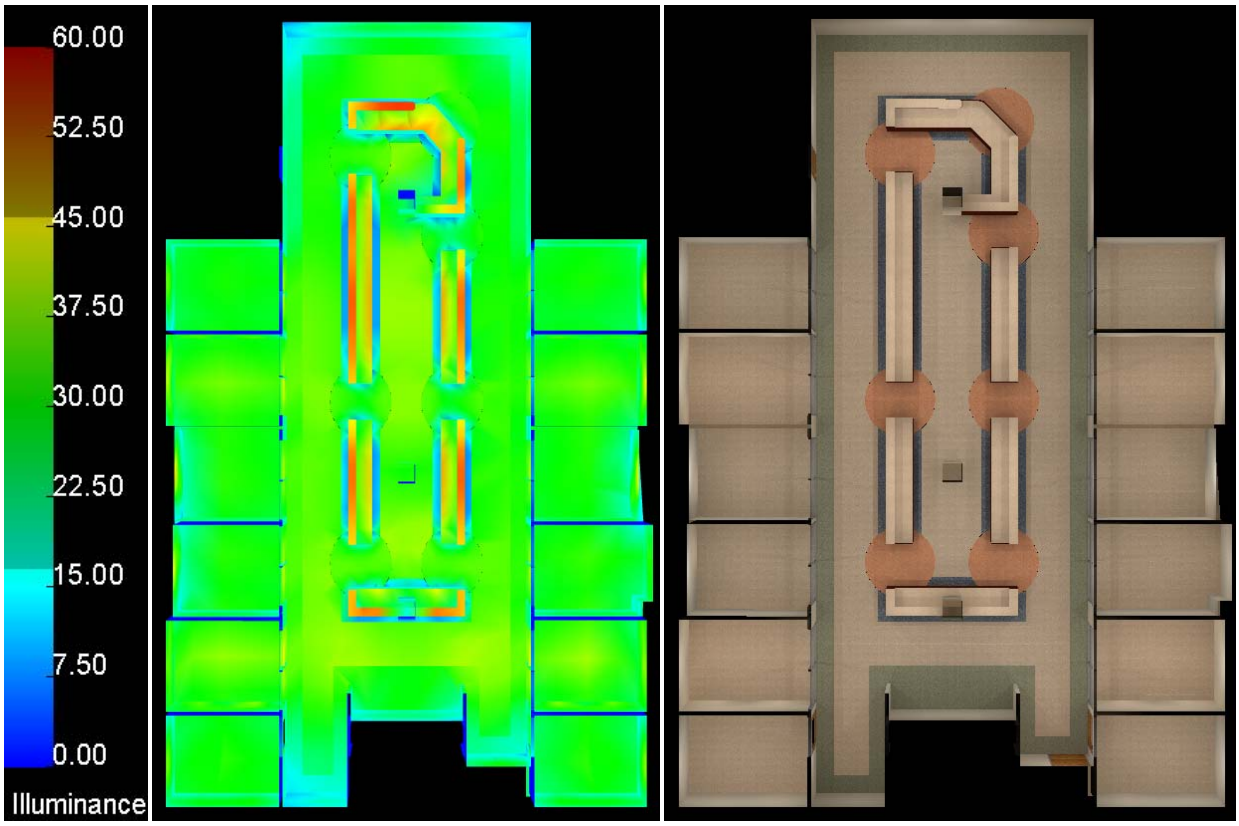


Figure 88 | 50% Dimmed Team Station Perspective Pseudo Color and Render (fc)

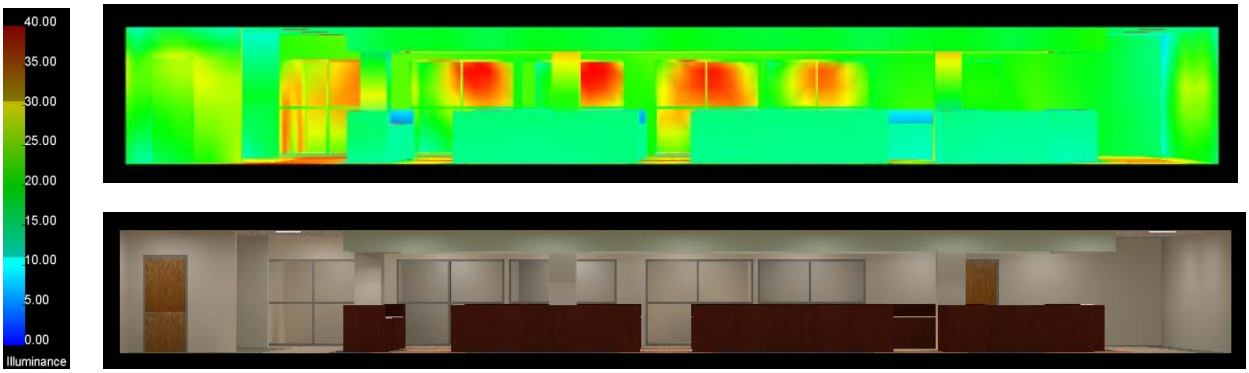


Figure 89 | 50% Dimmed Team Station View Pseudo Color and Render (fc)

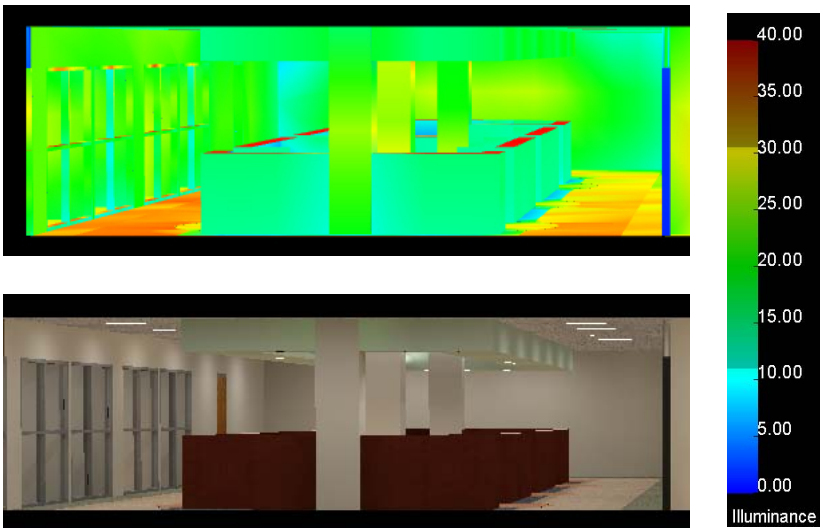


Figure 90 | Team Station View Pseudo Color and Render (fc)

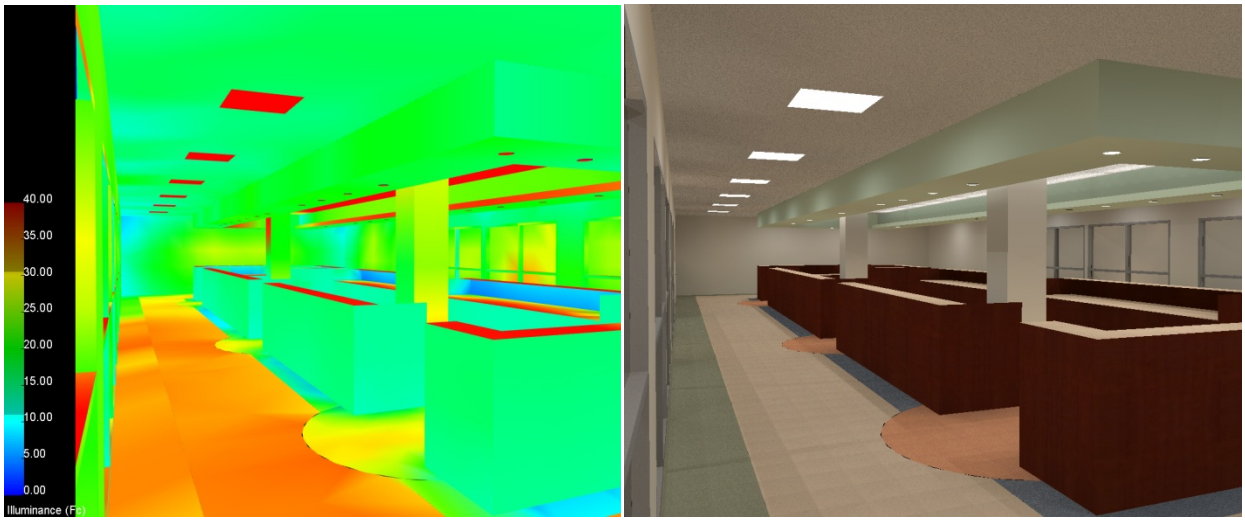


Figure 91 | Team Station View Pseudo Color and Render (fc)

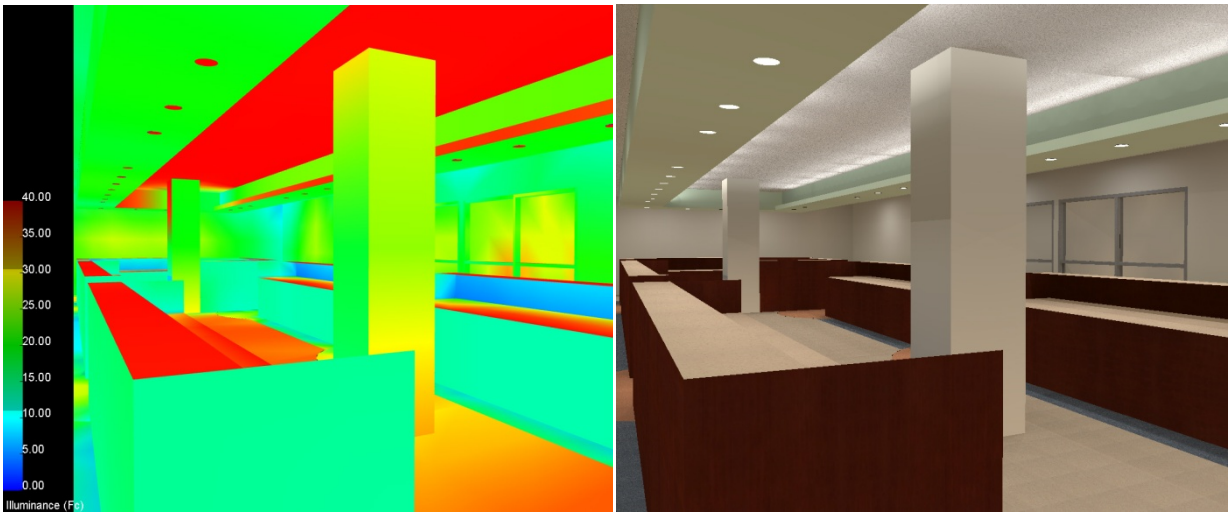
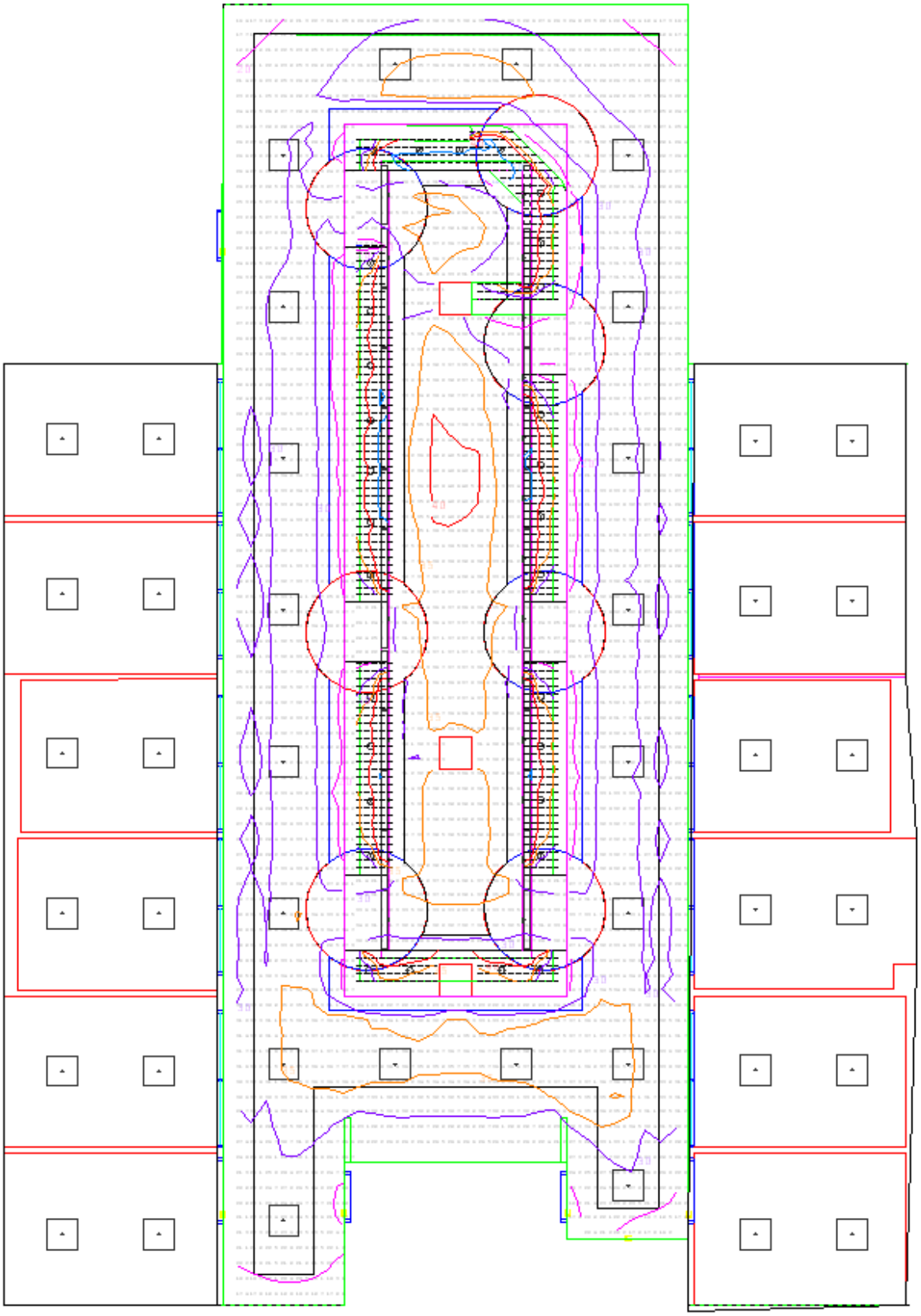


Figure 92 | 50% Dimmed Floor Horizontal Illuminance Contours (fc)



Energy Code Compliance

Figure 93 | Team Station Energy Calculation Summary

ASHRAE Standard 90.1 - 2007

SPACE	AREA (SF)	ALLOWABLE LIGHTING POWER DENSITY (W/SF)	ALLOWABLE WATTS	TOTAL WATTS USED
Nurse Station	837.1	1	837.1	1700
Emergency	1664.2	2.7	4493.34	910

Performance Summary

The ambient lighting for team station is impacted by the adjacent corridors and the patients' rooms that are surrounding. The main source of ambient lighting comes from within the station itself. The linear cove luminaires create a high luminance on the ceiling that is then reflected into the space. The ceiling wash creates a sense of openness to the emergency department.

Downlights are located over the working surfaces and provide ample illumination for tasks. The corridor luminaires contain a new diffuser technology. It distributed the light but as patients look at it while lying on a hospital bed; they will not be blinded directly from the source from underneath. The diffuser optics shields the lamps from view while directing the illumination elsewhere in a glare-free efficient way.

The design of this space was based primarily on the IESNA recommendations and the ASHRAE Standard 90.1 -2007 lighting power density allowances of which both were met. A hospital setting is focused on the care of patients and this lighting design also reflects that.

Figure 94 | Team Station Performance Summary

NO DIMMING				
GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	48.73	65.4	17.3	3.78
Corridor Floor	30.33	39.1	16.0	2.44
Team Station Floor	44.26	56.0	20.7	2.71

50% DIMMED COVE LUMINAIRES				
GRID LOCATIONS	AVG (fc)	MAX (fc)	MIN (fc)	MAX/MIN
Desk Surface (2.5' AFF)	39.32	53.8	13.7	3.93
Corridor Floor	28.87	38.5	15.8	2.44
Team Station Floor	33.04	40.9	14.4	2.84

Electrical Redesign

For complete spatial description of the team station, see page 71.

Electrical Design Objectives/Criteria

The team station redesign of the electrical system includes two panelboards with a 480Y/277V, 3PH, 4W voltage system. One panelboard is on normal power and the other, emergency.

The team station luminaires for task and ambient lighting are connected through a grafik eye control system before reach the panelboard. The grafik eye terminal contains a 12V DC power source for the interface.

The panelboard schedules below contain the highlighted circuits that were redesigned.

See Appendix A for complete lighting plans with circuiting

Figure 95 | Existing Panelboard LPG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: LPG5 (NORMAL)			MAINS: MLO								AMPS: 100			AIC: 35,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3								MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: ER CORRIDORS	1	20	3/4"C.W/2#12+1#12GRD.	13.3	12.7	-	-	-	-	2	LTG: PEDS TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: ER PSYCH WING, WAIT TLTS	1	20	3/4"C.W/2#12+1#12GRD.	-	-	9.6	11.2	-	-	4	LTG: PEDS RM #1-9, PLAYROOM	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: ER WAITING, CASHIER	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	12.4	14.2	6	LTG: CENTRAL TEAM STAT/CORRS	1	20	3/4"C.W/2#12+1#12GRD.
7	SPARE	1	20	-	0	13.6	-	-	-	-	8	LTG: TEAM #0324, 0320, CORRS	1	20	3/4"C.W/2#12+1#12GRD.
9	SPARE	1	20	-	-	-	0	0	-	-	10	SPARE	1	20	-
11	SPARE	1	20	-	-	-	-	-	0	0	12	SPARE	1	20	-
13	SPARE	1	20	-	0	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	-	-	-	-	3	0	-	-	-	-	20	SPACE	1	-	-
21	DECON TANK PUMP	3	15	3/4"C.W/3#12+1#12GRD.	-	-	3	0	-	-	22	SPACE	1	-	-
23	-	-	-	-	-	-	-	-	3	0	24	SPACE	1	-	-
25	SPACE	1	-	-	0	0	-	-	-	-	26	SPACE	1	-	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	29 A		TOTAL PHASE A	43 A		-		-			CONNECTED LOAD	26.6 KVA		
	DEMAND LOAD	47 A		TOTAL PHASE B	-		24 A		-						
				TOTAL PHASE C	-		-		30 A						

Figure 96 | New Panelboard LPG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LPG5	Panel Location:			Electrical Room 0703		
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	Lighting	3	ER corridors	13.3	A	0.90	3316	3684		
2	A	Lighting	3	eds team, c	12.7	A	0.90	3166	3518		
3	B	Lighting	3	R psych, wa	9.14	A	0.90	2279	2532		
4	B	Lighting	3	Peds 1-9 pla	11.2	A	0.90	2792	3102		
5	C	Lighting	3	ER wait, cas	12.4	A	0.90	3091	3435		
6	C	Lighting	3	teams, cor	14.2	A	0.90	3540	3933		
7	A	Spare	9	-	0	A	1.00	0	0		
8	A	Lighting	3	Teams, corr	14.14	A	0.90	3525	3917		
9	B	Spare	9	-	0	A	1.00	0	0		
10	B	Spare	9	-	0	A	1.00	0	0		
11	C	Spare	9	-	0	A	1.00	0	0		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Spare	9	-	0	A	1.00	0	0		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
20	A				0	A	1.00	0	0		
21	B	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
22	B				0	A	1.00	0	0		
23	C	HVAC Pump	6	Decon Pump	3	A	0.95	789	831		
24	C				0	A	1.00	0	0		
25	A				0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								24.1	26.6	Amps=	32.0

PHASE LOADING		kW	kVA	%	Amps	
PHASE TOTAL	A	10.8	11.9	45%	43.1	
PHASE TOTAL	B	5.9	6.5	24%	23.3	
PHASE TOTAL	C	7.4	8.2	31%	29.6	

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		21.7	24.1		21.7	24.1	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		2.4	2.5		2.4	2.5	0.95		
7	heating		0.0	0.0		0.0	0.0			
8	kitchen equipment		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						24.1	26.6			
Spare Capacity			20%			4.8	5.3			
Total Design Loads						28.9	31.9	0.90	Amps=	38.4

Figure 97 | New Panelboard LPG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LPG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #8, (1) #8 G, 3/4" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	ER corridors	3316	20A/1P	1	*			2	20A/1P	3166	Peds team, cor	Lighting
Lighting	ER psych, wait	2279	20A/1P	3		*		4	20A/1P	2792	Peds 1-9 play	Lighting
Lighting	ER wait, cash	3091	20A/1P	5			*	6	20A/1P	3540	C teams, corrs	Lighting
Spare	-	0	20A/1P	7	*			8	20A/1P	3525	Teams, corrs	Lighting
Spare	-	0	20A/1P	9		*		10	20A/1P	0	-	Spare
Spare	-	0	20A/1P	11			*	12	20A/1P	0	-	Spare
Spare	-	0	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
HVAC Pump	Decon Pump	789	-	19	*			20	-	0	0	0
HVAC Pump	Decon Pump	789	15A/3P	21		*		22	-	0	0	0
HVAC Pump	Decon Pump	789	-	23			*	24	-	0	0	0
0	0	0	-	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	10.80	TOTAL DESIGN LOAD (KW)	28.89
CONNECTED LOAD (KW) - B Ph.	5.86	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	7.42	TOTAL DESIGN LOAD (AMPS)	38

Feeder Size Calculation

38.4 A * 125% = 48 A

100A Circuit Breaker, (4) #8 AWG CU THWN, (1) #8 AWG CU Ground, ¾" EMT Conduit

Figure 98 | Existing Panelboard E2LG5 Schedule

WIRING PANEL SCHEDULE

	PANEL: E2LG5 (CRITICAL)			MAINS: MLO							AMPS: 100			AIC: 25,000
	VOLTAGE: 480Y/277	WIRES: 4		PHASE: 3							MOUNTING: SURFACE			LOC: ELEC RM 0703
CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT	A	A	B	B	C	C	CIR	DESCRIPTION	P	AMP	BRANCH CIRCUIT
1	LTG: TREAT RM #4-6, TEAM 0224	1	20	3/4"C.W/2#12+1#12GRD.	13.2	12.4	-	-	-	-	2	LTG: FAST TR #1-8, 11-16, TEAM ST	1	20	3/4"C.W/2#12+1#12GRD.
3	LTG: PEDS #4-12, TREAT RM #1-3	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.3	13.6	-	-	4	LTG: FAST TR #19-10, PSYCH TRT	1	20	3/4"C.W/2#12+1#12GRD.
5	LTG: PEDS #1-9, TEAM ST 0120	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	13.3	12.9	6	LTG: TRIAGE #1-10, WORK RM	1	20	3/4"C.W/2#12+1#12GRD.
7	LTG: TREAT RM #1-6, TEAM 0320	1	20	3/4"C.W/2#12+1#12GRD.	10.1	9.9	-	-	-	-	8	LTG: TEAM 0324, TREAT RM #7-11	1	20	3/4"C.W/2#12+1#12GRD.
9	LTG: TREAT RM #1-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	12.9	6.01	-	-	10	LTG: TEAM 0324, TREAT RM #1-6	1	20	3/4"C.W/2#12+1#12GRD.
11	LTG: TEAM 0220, TREAT RM #7-12	1	20	3/4"C.W/2#12+1#12GRD.	-	-	-	-	9.8	0	12	SPARE	1	20	-
13	LTG: AMBULANCE CANOPY	1	20	3/4"C.W/2#12+1#12GRD.	2.99	0	-	-	-	-	14	SPARE	1	20	-
15	SPARE	1	20	-	-	-	0	0	-	-	16	SPARE	1	20	-
17	SPARE	1	20	-	-	-	-	-	0	0	18	SPARE	1	20	-
19	SPARE	1	20	-	0	0	-	-	-	-	20	SPARE	1	20	-
21	SPARE	1	20	-	-	-	0	0	-	-	22	SPARE	1	20	-
23	SPARE	1	20	-	-	-	-	-	0	0	24	SPARE	1	20	-
25	SPARE	1	20	-	0	0	-	-	-	-	26	SPARE	1	20	-
27	SPACE	1	-	-	-	-	0	0	-	-	28	SPACE	1	-	-
29	SPACE	1	-	-	-	-	-	-	0	0	30	SPACE	1	-	-
31	SPACE	1	-	-	0	0	-	-	-	-	32	SPACE	1	-	-
33	SPACE	1	-	-	-	-	0	0	-	-	34	SPACE	1	-	-
35	SPACE	1	-	-	-	-	-	-	0	0	36	SPACE	1	-	-
37	SPACE	1	-	-	0	0	-	-	-	-	38	SPACE	1	-	-
39	SPACE	1	-	-	-	-	0	0	-	-	40	SPACE	1	-	-
41	SPACE	1	-	-	-	-	-	-	0	0	42	SPACE	1	-	-
	CONNECTED LOAD	43 A		TOTAL PHASE A	49 A		-		-			CONNECTED LOAD	35.8 KVA		
	DEMAND LOAD	54 A		TOTAL PHASE B	-		45 A		-						
				TOTAL PHASE C	-		-		36 A						

Figure 99 | New Panelboard E2LG5 Worksheet

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				E2LG5	Panel Location:			Electrical Room 0703			
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	Lighting	3	km 4-6, tean	13.2	A	0.90	3291	3656		
2	A	Lighting	3	1-8 11-16, t	12.4	A	0.90	3091	3435		
3	B	Lighting	3	ed 4-12,rm 1	12.3	A	0.90	3066	3407		
4	B	Lighting	3	19-10 psyc	13.6	A	0.90	3390	3767		
5	C	Lighting	3	eds 1-9, tea	13.3	A	0.90	3316	3684		
6	C	Lighting	3	r 1-10, wk r	12.38	A	0.90	3086	3429		
7	A	Lighting	3	R 1-6, team	9.13	A	0.90	2276	2529		
8	A	Lighting	3	Team, r 7-11	9.9	A	0.90	2468	2742		
9	B	Lighting	3	Room 1-12	12.9	A	0.90	3216	3573		
10	B	Lighting	3	Team, rm 1-	6.01	A	0.90	1498	1665		
11	C	Lighting	3	eam, rm 7-1	9.8	A	0.90	2443	2715		
12	C	Spare	9	-	0	A	1.00	0	0		
13	A	Lighting	3	Amb canopy	2.99	A	0.90	745	828		
14	A	Spare	9	-	0	A	1.00	0	0		
15	B	Spare	9	-	0	A	1.00	0	0		
16	B	Spare	9	-	0	A	1.00	0	0		
17	C	Spare	9	-	0	A	1.00	0	0		
18	C	Spare	9	-	0	A	1.00	0	0		
19	A	Spare	9	-	0	A	1.00	0	0		
20	A	Spare	9	-	0	A	1.00	0	0		
21	B	Spare	9	-	0	A	1.00	0	0		
22	B	Spare	9	-	0	A	1.00	0	0		
23	C	Spare	9	-	0	A	1.00	0	0		
24	C	Spare	9	-	0	A	1.00	0	0		
25	A	Spare	9	-	0	A	1.00	0	0		
26	A				0	A	1.00	0	0		
27	B				0	A	1.00	0	0		
28	B				0	A	1.00	0	0		
29	C				0	A	1.00	0	0		
30	C				0	A	1.00	0	0		
31	A				0	A	1.00	0	0		
32	A				0	A	1.00	0	0		
33	B				0	A	1.00	0	0		
34	B				0	A	1.00	0	0		
35	C				0	A	1.00	0	0		
36	C				0	A	1.00	0	0		
37	A				0	A	1.00	0	0		
38	A				0	A	1.00	0	0		
39	B				0	A	1.00	0	0		
40	B				0	A	1.00	0	0		
41	C				0	A	1.00	0	0		
42	C				0	A	1.00	0	0		
PANEL TOTAL								31.9	35.4	Amps=	42.6

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	11.9	13.2	37%	47.6
PHASE TOTAL	B	11.2	12.4	35%	44.8
PHASE TOTAL	C	8.8	9.8	28%	35.5

LOAD CATAGORIES			Connected			Demand				Ver. 104
			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		31.9	35.4		31.9	35.4	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		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		0.0	0.0		0.0	0.0			
Total Demand Loads						31.9	35.4			
Spare Capacity			20%			6.4	7.1			
Total Design Loads						38.3	42.5	0.90	Amps=	51.2

Figure 100 | New Panelboard E2LG5 Schedule

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	E2LG5	MIN. C/B AIC:	35K
SIZE/TYPE BUS:	100A	PANEL LOCATION:	Electrical Room 0703	OPTIONS:	
SIZE/TYPE MAIN:	100A/3P C/B	PANEL MOUNTING:	SURFACE		(4) #6, (1) #8 G, 1" C

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
Lighting	Rm 4-6, team	3291	20A/1P	1	*			2	20A/1P	3091	F 1-8 11-16, tm	Lighting
Lighting	Ped 4-12,rm 1-3	3066	20A/1P	3		*		4	20A/1P	3390	F 19-10 psych	Lighting
Lighting	Peds 1-9, team	3316	20A/1P	5			*	6	20A/1P	3086	Tr 1-10, wk rm	Lighting
Lighting	R 1-6, team	2276	20A/1P	7	*			8	20A/1P	2468	Team, r 7-11	Lighting
Lighting	Room 1-12	3216	20A/1P	9		*		10	20A/1P	1498	Team, rm 1-6	Lighting
Lighting	Team, rm 7-12	2443	20A/1P	11			*	12	20A/1P	0	-	Spare
Lighting	Amb canopy	745	20A/1P	13	*			14	20A/1P	0	-	Spare
Spare	-	0	20A/1P	15		*		16	20A/1P	0	-	Spare
Spare	-	0	20A/1P	17			*	18	20A/1P	0	-	Spare
Spare	-	0	20A/1P	19	*			20	20A/1P	0	-	Spare
Spare	-	0	20A/1P	21		*		22	20A/1P	0	-	Spare
Spare	-	0	20A/1P	23			*	24	20A/1P	0	-	Spare
Spare	-	0	20A/1P	25	*			26	-	0	0	0
0	0	0	-	27		*		28	-	0	0	0
0	0	0	-	29			*	30	-	0	0	0
0	0	0	-	31	*			32	-	0	0	0
0	0	0	-	33		*		34	-	0	0	0
0	0	0	-	35			*	36	-	0	0	0
0	0	0	-	37	*			38	-	0	0	0
0	0	0	-	39		*		40	-	0	0	0
0	0	0	-	41			*	42	-	0	0	0

CONNECTED LOAD (KW) - A Ph.	11.87	TOTAL DESIGN LOAD (KW)	38.27
CONNECTED LOAD (KW) - B Ph.	11.17	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	8.85	TOTAL DESIGN LOAD (AMPS)	51

Feeder Size Calculation

51.2 A * 125% = 64 A

100A Circuit Breaker, (4) #6 AWG CU THWN, (1) #8 AWG CU Ground, 1” EMT Conduit

Electrical Depth

Overview

The main distribution of Franklin Square Hospital Center is a secondary selective system allowing for multiple paths of supply power. Two service entrances with separate transformers create two radial systems that are connected with a tie breaker. The tie breaker is located on the bus bar and remains open unless one of the feeders fails. When this happens the tie breaker closes and the entire load runs through a single feeder. Both substation feeders are sized to accommodate this increased load. Transformers located in substations step-down the voltage from 13.2KV to 480Y/277V, 3PH, 4W which is run throughout the building. Other transformers step this voltage down to 208Y/120V, 3PH, 4W for mostly lighting and receptacle loads. Three emergency generators fed by a 480Y/277V, 3PH, 4W voltage system are each rated at 2000KW along with another service entrance, supply power to equipment and life safety branches when needed. An uninterruptable power system (UPS) rated at 180KVA/162KW provides 208Y/120V, 3PH, 4W emergency power to the building.

Figure 101 | Electrical Redesign Summary

ELECTRICAL PANELBOARD REDESIGN					
PANELBOARD TAG	VOLTAGE SYSTEM	REDESIGN SPACES			
		MAIN ENTRANCE + PARKING LOT	GIFT SHOP	LOBBY + WAITING AREA	TEAM STATION
LPSL1 (Normal)	480Y/277 V	X			
E1DP-1 (Emergency)	480Y/277 V	X			
LP11 (Normal)	480Y/277 V		X		
E1L11 (Emergency)	480Y/277 V		X		
LPG5 (Normal)	480Y/277 V			X	X
E2LG5 (Emergency)	480Y/277 V			X	X
E1LG5 (Emergency)	480Y/277 V			X	

Depth Topic 1 | Copper feeders vs. aluminum feeders

Introduction

Franklin Square Hospital Center utilizes copper feeders for the building's electrical distribution system. Copper conductors are typically more expensive when compared to aluminum conductors. The price variation is due to the economic difference between the two conductor materials. The current price for copper is higher since there is not an abundance of it as there is of aluminum. Copper ore is mined in select areas of the world then put through a series of processes to purify the copper. Similarly, aluminum ore is also mined but the abundance of deposits around the world allow for more production of aluminum.

Method

A cost analysis of conductors and associated conduits was performed to determine the cost savings. The conductors table (Table X) lists the sizes of aluminum THWN wire that will replace the copper THWN size based on amperage and the cost per linear foot associated with each. Table 310.16 of the National Electric Code 2008 (NEC 2008) was used to determine the allowable ampacities of each copper and aluminum conductor. The conduit table (Table X) lists the prices per linear foot of electrical metallic tubing (EMT) and aluminum conduit. The maximum number of conductors allowed in EMT was referenced from Table C.1 in Annex C of the NEC 2008. Table C.8 found in Annex C of the NEC 2008 lists the maximum number of conductors in rigid metal conduit which is used with the copper conductors. The estimated prices are referenced from RSMeans Electrical Cost Data 2010.

Figure 102 | Copper and Aluminum Conductor Prices

CONDUCTORS					
CU			AL		
SIZE	AMPS	COST/LF	SIZE	AMPS	COST/LF
12AWG	25	$0.69	10AWG	30	$0.72
10AWG	35	$0.84	8AWG	40	$0.88
8AWG	50	$1.18	6AWG	50	$1.05
6AWG	65	$1.61	4AWG	65	$1.30
4AWG	85	$2.23	2AWG	90	$1.65
3AWG	100	$2.60	1AWG	100	$2.70
2AWG	115	$3.10	1/0AWG	120	$2.43
1AWG	130	$3.75	2/0AWG	135	$2.78
1/0AWG	150	$4.55	3/0AWG	155	$3.20
2/0AWG	175	$5.55	4/0AWG	180	$3.50
3/0AWG	200	$6.75	250KCMIL	205	$4.00
4/0AWG	230	$8.20	300KCMIL	230	$4.90
250KCMIL	255	$9.50	400KCMIL	270	$5.85
300KCMIL	285	$11.00	500KCMIL	310	$6.55
350KCMIL	310	$12.50	500KCMIL	310	$6.55
400KCMIL	335	$14.00	600KCMIL	340	$7.70
500KCMIL	380	$16.50	750KCMIL	385	$8.85
600KCMIL	420	$18.72	900KCMIL	425	$9.87
700KCMIL	460	$20.94	1250KCMIL	485	$11.41
750KCMIL	475	$21.78	1250KCMIL	485	$11.41
800KCMIL	490	$22.61	1500KCMIL	520	$12.30
900KCMIL	520	$24.28	1500KCMIL	520	$12.30
1000KCMIL	545	$25.67	1750KCMIL	545	$12.94
1250KCMIL	590	$28.17	-	-	-
1500KCMIL	625	$30.11	-	-	-
1750KCMIL	650	$31.50	-	-	-
2000KCMIL	665	$32.33	-	-	-

Figure 103 | EMT and Aluminum Conduit Prices

CONDUITS			
EMT		ALUMINUM	
SIZE	COST/LF	SIZE	COST/LF
0.5"	$4.01	0.5"	$6.06
0.75"	$5.45	0.75"	$9.65
1"	$6.90	1"	$11.50
1.25"	$8.85	1.25"	$14.10
1.5"	$10.35	1.5"	$15.95
2"	$12.35	2"	$19.40
2.5"	$22.00	2.5"	$27.50
3"	$26.50	3"	$35.00
3.5"	$29.00	3.5"	$44.00
4"	$31.50	4"	$52.00
6"	$41.50	5"	$101.00
-	-	6"	$144.00

Figure 104 | Feeder Schedule

FEEDER SCHEDULE																								
TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)															CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
P10	EMERGENCY SWITCHGEAR	SWITCHBORAD EMDP-3	710	4"	$178,920.00	6"	$817,920.00	8	750KCMIL	$123,697.78	1250KCMIL	$64,783.56	1	750KCMIL	$15,462.22	1250KCMIL	$8,097.94	8	250KCMIL	$53,960.00	400KCMIL	$33,228.00	$372,040.00	$924,029.50
P11	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-4	48	3.5"	$6,960.00	5"	$24,240.00	5	600KCMIL	$4,493.33	900KCMIL	$2,369.33	1	600KCMIL	$898.67	900KCMIL	$473.87	5	250KCMIL	$2,280.00	400KCMIL	$1,404.00	$14,632.00	$28,487.20
P12	GENSET #1	EMERGENCY SWITCHGEAR	41	3"	$8,692.00	3.5"	$14,432.00	8	500KCMIL	$5,412.00	750KCMIL	$2,902.80	-	-	-	-	-	8	400KCMIL	$4,592.00	600KCMIL	$2,525.60	$18,696.00	$19,860.40
P13	GENSET #2	EMERGENCY SWITCHGEAR	56	3"	$11,872.00	3.5"	$19,712.00	8	500KCMIL	$7,392.00	750KCMIL	$3,964.80	-	-	-	-	-	8	400KCMIL	$6,272.00	600KCMIL	$3,449.60	$25,536.00	$27,126.40
P14	GENSET #3	EMERGENCY SWITCHGEAR	67	3"	$14,204.00	3.5"	$23,584.00	8	500KCMIL	$8,844.00	750KCMIL	$4,743.60	-	-	-	-	-	8	400KCMIL	$7,504.00	600KCMIL	$4,127.20	$30,552.00	$32,454.80
P15	CHILLER SUBSTATION 2	ATS E3-3P	43	2.5"	$2,838.00	3.5"	$5,676.00	3	300KCMIL	$1,419.00	500KCMIL	$844.95	1	300KCMIL	$473.00	500KCMIL	$281.65	3	1/0AWG	$586.95	3/0AWG	$412.80	$5,316.95	$7,215.40
P16	ATS 3-3P	EMCC	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
P17	SWITCHBOARD EMDP-4	ATS E3-3P	53	2.5"	$3,498.00	3.5"	$6,996.00	3	300KCMIL	$1,749.00	500KCMIL	$1,041.45	1	300KCMIL	$583.00	500KCMIL	$347.15	3	1/0AWG	$723.45	3/0AWG	$508.80	$6,553.45	$8,893.40
P18	CHILLER SUBSTATION 2	SWITCHBOARD NCP1	103	3"	$13,647.50	4"	$26,780.00	5	400KCMIL	$7,210.00	600KCMIL	$3,965.50	1	400KCMIL	$1,442.00	600KCMIL	$793.10	5	4/0AWG	$4,223.00	300KCMIL	$2,523.50	$26,522.50	$34,062.10
P19	SWITCHBOARD NCP1	XFMR T-1P	58	1.25"	$513.30	1.5"	$925.10	1	2AWG	$179.80	1/0AWG	$140.94	-	-	-	-	-	1	6AWG	$93.38	4AWG	$75.40	$786.48	$1,141.44
P20	XFMR T-1P	PANEL RPCP	11	2.5"	$242.00	1.25"	$155.10	1	4AWG	$24.53	2AWG	$18.15	1	4AWG	$24.53	2AWG	$18.15	1	2AWG	$34.10	1/0AWG	$26.73	$325.16	$218.13
P21	SWITCHBOARD NCP1	ATS E1-1P	47	2"	$580.45	2"	$911.80	1	1AWG	$176.25	2/0AWG	$130.66	1	1AWG	$176.25	2/0AWG	$130.66	1	6AWG	$75.67	4AWG	$61.10	$1,008.62	$1,234.22
P22	ATS E1-1P	EX. PANEL E1LCP	37	2"	$456.95	2"	$717.80	1	1/0AWG	$168.35	3/0AWG	$118.40	1	1/0AWG	$168.35	3/0AWG	$118.40	1	6AWG	$59.57	4AWG	$48.10	$853.22	$1,002.70
P23	SWITCHBOARD EMDP-4	ATS E1-1P	12	2"	$148.20	2"	$232.80	1	1/0AWG	$54.60	3/0AWG	$38.40	1	1/0AWG	$54.60	3/0AWG	$38.40	1	6AWG	$19.32	4AWG	$15.60	$276.72	$325.20
P24	EX. PANEL E1LCP	EX. XFMR T-2P	11	0.75"	$59.95	0.75"	$106.15	1	10AWG	$9.19	8AWG	$9.72	-	-	-	-	-	1	10AWG	$9.19	8AWG	$9.72	$78.32	$125.58
P25	EX. XFMR T-2P	EX. PANEL E1RCP	9	1"	$62.10	1.25"	$126.90	1	6AWG	$14.49	4AWG	$11.70	1	6AWG	$14.49	4AWG	$11.70	1	8AWG	$10.62	6AWG	$9.45	$101.70	$159.75
P26	ATS E3-2P	PANEL E3LCP1	87	3"	$6,916.50	4"	$13,572.00	3	400KCMIL	$3,654.00	600KCMIL	$2,009.70	1	400KCMIL	$1,218.00	600KCMIL	$669.90	3	2/0AWG	$1,448.55	4/0AWG	$913.50	$13,237.05	$17,165.10
P27	EMCC	PANEL E3LCP	17	1"	$117.30	1.25"	$239.70	1	6AWG	$27.37	4AWG	$22.10	1	6AWG	$27.37	4AWG	$22.10	1	8AWG	$20.06	6AWG	$17.85	$192.10	$301.75
P28	CHILLER SUBSTATION 1	ATS E3-1P	35	3.5"	$5,075.00	5"	$17,675.00	5	600KCMIL	$3,276.39	900KCMIL	$1,727.64	1	600KCMIL	$655.28	900KCMIL	$345.53	5	250KCMIL	$1,662.50	400KCMIL	$1,023.75	$10,669.17	$20,771.92
P29	ATS E3-1P	SWGR E3CP1	82	3.5"	$11,890.00	5"	$41,410.00	5	600KCMIL	$7,676.11	900KCMIL	$4,047.61	1	600KCMIL	$1,535.22	900KCMIL	$809.52	5	250KCMIL	$3,895.00	400KCMIL	$2,398.50	$24,996.33	$48,665.63
P30	EMERGENCY SWITCHGEAR	ATS E3-1P	68	3.5"	$9,860.00	5"	$34,340.00	5	600KCMIL	$6,365.56	900KCMIL	$3,356.56	1	600KCMIL	$1,273.11	900KCMIL	$671.31	5	250KCMIL	$3,230.00	400KCMIL	$1,989.00	$20,728.67	$40,356.87
P31	SWITCHBOARD EMDP-3	EX. ATS-5	34	2.5"	$2,244.00	3.5"	$4,488.00	3	300KCMIL	$1,122.00	500KCMIL	$668.10	1	300KCMIL	$374.00	500KCMIL	$222.70	3	1/0AWG	$464.10	3/0AWG	$326.40	$4,204.10	$5,705.20
P32	EMCC	XFMR T-3P	27	1.25"	$238.95	1.5"	$430.65	1	2AWG	$83.70	1/0AWG	$65.61	-	-	-	-	-	1	6AWG	$43.47	4AWG	$35.10	$366.12	$531.36
P33	EFMR T-3P	PANEL E3RCP	10	2.5"	$220.00	3"	$350.00	1	4/0AWG	$82.00	300KCMIL	$49.00	1	4/0AWG	$82.00	300KCMIL	$49.00	1	2AWG	$31.00	1/0AWG	$24.30	$415.00	$472.30
P34	SWITCHBOARD EMDP-3	EX. ATS-2	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
P35	SWITCHBOARD EMDP-3	EX. ATS-3	79	2.5"	$5,214.00	3.5"	$10,428.00	3	300KCMIL	$2,607.00	500KCMIL	$1,552.35	1	300KCMIL	$869.00	500KCMIL	$517.45	3	1/0AWG	$1,078.35	3/0AWG	$758.40	$9,768.35	$13,256.20
P36	SWITCHBOARD EMDP-3	EX. ATS-6	85	2.5"	$5,610.00	3.5"	$11,220.00	3	300KCMIL	$2,805.00	500KCMIL	$1,670.25	1	300KCMIL	$935.00	500KCMIL	$556.75	3	1/0AWG	$1,160.25	3/0AWG	$816.00	$10,510.25	$14,263.00
P37	SWITCHBOARD EMDP-3	EX. ATS-4	67	2"	$827.45	2.5"	$1,842.50	1	3/0AWG	$452.25	250KCMIL	$268.00	1	3/0AWG	$452.25	250KCMIL	$268.00	1	6AWG	$107.87	4AWG	$87.10	$1,839.82	$2,465.60
P38	SWITCHBOARD EMDP-3	EX. ATS-1	38	2"	$469.30	2.5"	$1,045.00	1	3/0AWG	$256.50	250KCMIL	$152.00	1	3/0AWG	$256.50	250KCMIL	$152.00	1	6AWG	$61.18	4AWG	$49.40	$1,043.48	$1,398.40
P39	CHILLER SWITCHGEAR 1	ATS E3-2P	22	3"	$1,749.00	4"	$3,432.00	3	400KCMIL	$924.00	600KCMIL	$508.20	1	400KCMIL	$308.00	600KCMIL	$169.40	3	2/0AWG	$366.30	4/0AWG	$231.00	$3,347.30	$4,340.60
P40	EMERGENCY SWITCHGEAR	ATS E3-2P	49	3"	$3,895.50	4"	$7,644.00	3	400KCMIL	$2,058.00	600KCMIL	$1,131.90	1	400KCMIL	$686.00	600KCMIL	$377.30	3	2/0AWG	$815.85	4/0AWG	$514.50	$7,455.35	$9,667.70
P41	SWITCHBOARD NCP1	EX. PANEL LPCP	66	1.25"	$584.10	1.5"	$1,052.70	1	3AWG	$171.60	1AWG	$178.20	1	3AWG	$171.60	1AWG	$178.20	1	8AWG	$77.88	6AWG	$69.30	$1,005.18	$1,478.40
P42	EX. PANEL LPCP	EX. XFMR T-4P	127	0.75"	$692.15	1"	$1,460.50	1	6AWG	$204.47	4AWG	$165.10	-	-	-	-	-	1	10AWG	$106.05	8AWG	$112.18	$1,002.67	$1,737.78
P43	EX. XFMR T-4P	EX. PANEL RPCP2	130	1.25"	$1,150.50	1.5"	$2,073.50	1	3AWG	$338.00	1AWG	$351.00	1	3AWG	$338.00	1AWG	$351.00	1	8AWG	$153.40	6AWG	$136.50	$1,979.90	$2,912.00
P44	SWITCHBOARD NCP1	EX. PANEL LPSL	69	1.25"	$610.65	1.5"	$1,100.55	1	3AWG	$179.40	1AWG	$186.30	1	3AWG	$179.40	1AWG	$186.30	1	8AWG	$81.42	6AWG	$72.45	$1,050.87	$1,545.60
M1	SWGR E3CP1	CH-1	89	3"	$7,075.50	3.5"	$11,748.00	3	400KCMIL	$3,738.00	600KCMIL	$2,055.90	-	-	-	-	-	1	250KCMIL	$845.50	400KCMIL	$520.65	$11,659.00	$14,324.55
M2	CHILLER SUBSTATION 2	CH-2	45	3"	$3,577.50	3.5"	$5,940.00	3	400KCMIL	$1,890.00	600KCMIL	$1,039.50	-	-	-	-	-	1	250KCMIL	$427.50	400KCMIL	$263.25	$5,895.00	$7,242.75
M3	SWGR E3CP1	P-CHW-1	88	2.5"	$1,936.00	3"	$3,080.00	1	350KCMIL	$1,100.00	500KCMIL	$576.40	-	-	-	-	-	1	3AWG	$228.80	1AWG	$237.60	$3,264.80	$3,894.00
M4	CHILLER SUBSTATION 2	P-CHW-2	28	2.5"	$616.00	3"	$980.00	1	350KCMIL	$350.00	500KCMIL	$183.40	-	-	-	-	-	1	3AWG	$72.80	1AWG	$75.60	$1,038.80	$1,239.00
M5	SWGR E3CP1	P-CHW-3	83	2.5"	$1,826.00	3"	$2,905.00	1	350KCMIL	$1,037.50	500KCMIL	$543.65	-	-	-	-	-	1	3AWG	$215.80	1AWG	$224.10	$3,079.30	$3,672.75
7	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-1	493	4"	$108,706.50	6"	$496,944.00	7	750KCMIL	$75,155.11	1250KCMIL	$39,360.57	1	750KCMIL	$10,736.44	1250KCMIL	$5,622.94	7	400KCMIL	$48,314.00	600KCMIL	$26,572.70	$242,912.06	$568,500.21
8	EMERGENCY SWITCHGEAR	SWITCHBOARD EMDP-2	479	4"	$105,619.50	6"	$482,832.00	7	750KCMIL	$73,020.89	1250KCMIL	$38,242.83	1	750KCMIL	$10,431.56	1250KCMIL	$5,463.26	7	400KCMIL	$46,942.00	600KCMIL	$25,818.10	$236,013.94	$552,356.19
9	EMERGENCY SWITCHGEAR	FIRE PUMP CONTROLLER/ATS	425	4"	$40,162.50	4"	$66,300.00	3	600KCMIL	$23,870.83	900KCMIL	$12,587.08	-	-	-	-	-	3	3/0AWG	$8,606.25	250KCMIL	$5,100.00	$72,639.58	$83,987.08
10	FIRE PUMP CONTROLLER/ATS	FIRE PUMP	20	4"	$1,890.00	4"	$3,120.00	3	600KCMIL	$1,123.33	900KCMIL	$592.33	-	-	-	-	-	3	3/0AWG	$405.00	250KCMIL	$240.00	$3,418.33	$3,952.33
11	SUBSTATION 3	PANEL FDP-2	42	3"	$3,339.00	4"	$6,552.00	3	400KCMIL	$1,764.00	600KCMIL	$970.20	1	400KCMIL	$588.00	600KCMIL	$323.40	3	2/0AWG	$699.30	4/0AWG	$441.00	$6,390.30	$8,286.60
12	SUBSTATION 3	ATS E2-2	50	2.5"	$3,300.00	3.5"	$6,600.00	3	300KCMIL	$1,650.00	500KCMIL	$982.50	1	300KCMIL	$550.00	500KCMIL	$327.50	3	1/0AWG	$682.50	3/0AWG	$480.00	$6,182.50	$8,390.00
13	ATS E2-2	PANEL E2DP-2	15	2.5"	$990.00	3.5"	$1,980.00	3	300KCMIL	$495.00	500KCMIL	$294.75	1	300KCMIL	$165.00	500KCMIL	$98.25	3	1/0AWG	$204.75	3/0AWG	$144.00	$1,854.75	$2,517.00
14	SWITCHBOARD EMDP-2	ATS E2-2	27	2.5"	$1,782.00	3.5"	$3,564.00	3	300KCMIL	$891.00	500KCMIL	$530.55	1	300KCMIL	$297.00	500KCMIL	$176.85	3	1/0AWG	$368.55	3/0AWG	$259.20	$3,338.55	$4,530.60
15	SUBSTATION 3	ATS E1-1	31	2.5"	$682.00	3"	$1,085.00	1	250KCMIL	$294.50	400KCMIL	$181.35	1	250KCMIL	$294.50	400KCMIL	$181.35	1	4AWG	$69.13	2AWG	$51.15	$1,340.13	$1,498.85
16	ATS E1-1	PANEL E1DP-1	19	2.5"	$418.00	3"	$665.00	1	250KCMIL	$180.50	400KCMIL	$111.15	1	250KCMIL	$180.50	400KCMIL	$111.15	1	4AWG	$42.37	2AWG	$31.35	$821.37	$918.65
17	SWITCHBOARD EMDP-1	ATS E1-1	21	2.5"	$462.00	3"	$735.00	1	250KCMIL	$199.50	400KCMIL	$122.85	1	250KCMIL	$199.50	400KCMIL	$122.85	1	4AWG	$46.83	2AWG	$34.65	$907.83	$1,015.35
18	SUBSTATION 3	ATS E3-4	65	2.5"	$4,290.00	3.5"	$8,580.00	3	300KCMIL	$2,145.00	500KCMIL	$1,277.25	1	300KCMIL	$715.00	500KCMIL	$425.75	3	1/0AWG	$887.25	3/0AWG	$624.00	$8,037.25	$10,907.00

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
19	ATS E3-4	PANEL E3DP-4	17	2.5"	$1,122.00	3.5"	$2,244.00	3	300KCMIL	$561.00	500KCMIL	$334.05	1	300KCMIL	$187.00	500KCMIL	$111.35	3	1/0AWG	$232.05	3/0AWG	$163.20	$2,102.05	$2,852.60
20	SWITCHBOARD EMDP-1	ATS E3-4	31	2.5"	$2,046.00	3.5"	$4,092.00	3	300KCMIL	$1,023.00	500KCMIL	$609.15	1	300KCMIL	$341.00	500KCMIL	$203.05	3	1/0AWG	$423.15	3/0AWG	$297.60	$3,833.15	$5,201.80
21	PANEL E3DP-4	PANEL E3LG1	79	3.5"	$2,291.00	4"	$4,108.00	1	500KCMIL	$1,303.50	750KCMIL	$699.15	1	500KCMIL	$1,303.50	750KCMIL	$699.15	1	3AWG	$205.40	1AWG	$213.30	$5,103.40	$5,719.60
22	PANEL E3DP-4	XFMR T-1	71	1.25"	$628.35	1.5"	$1,132.45	1	2AWG	$220.10	1/0AWG	$172.53	-	-	-	-	-	1	6AWG	$114.31	4AWG	$92.30	$962.76	$1,397.28
23	XFMR T-1	PANEL E3RG1	11	2.5"	$242.00	3"	$385.00	1	250KCMIL	$104.50	400KCMIL	$64.35	1	250KCMIL	$104.50	400KCMIL	$64.35	1	2AWG	$34.10	1/0AWG	$26.73	$485.10	$540.43
24	SUBSTATION 3	PANEL FDP-1	42	2.5"	$2,772.00	3.5"	$5,544.00	3	300KCMIL	$1,386.00	500KCMIL	$825.30	1	300KCMIL	$462.00	500KCMIL	$275.10	3	1/0AWG	$573.30	3/0AWG	$403.20	$5,193.30	$7,047.60
25	PANEL FDP-1	XFMR T-2	24	2"	$889.20	2.5"	$1,980.00	3	3/0AWG	$486.00	250KCMIL	$288.00	1	3/0AWG	$162.00	250KCMIL	$96.00	3	3AWG	$187.20	1AWG	$194.40	$1,724.40	$2,558.40
26	XFMR T-2	PANEL DRP-1	12	2.5"	$792.00	3.5"	$1,584.00	3	300KCMIL	$396.00	500KCMIL	$235.80	1	300KCMIL	$132.00	500KCMIL	$78.60	3	1/0AWG	$163.80	3/0AWG	$115.20	$1,483.80	$2,013.60
27	SUBSTATION 3	ATS E2-1	36	2.5"	$2,376.00	3.5"	$4,752.00	3	300KCMIL	$1,188.00	500KCMIL	$707.40	1	300KCMIL	$396.00	500KCMIL	$235.80	3	1/0AWG	$491.40	3/0AWG	$345.60	$4,451.40	$6,040.80
28	ATS E2-1	PANEL E2DP-1	17	2.5"	$1,122.00	3.5"	$2,244.00	3	300KCMIL	$561.00	500KCMIL	$334.05	1	300KCMIL	$187.00	500KCMIL	$111.35	3	1/0AWG	$232.05	3/0AWG	$163.20	$2,102.05	$2,852.60
29	SWITCHBOARD EMDP-1	ATS E2-1	19	2.5"	$1,254.00	3.5"	$2,508.00	3	300KCMIL	$627.00	500KCMIL	$373.35	1	300KCMIL	$209.00	500KCMIL	$124.45	3	1/0AWG	$259.35	3/0AWG	$182.40	$2,349.35	$3,188.20
30	PANEL E2DP-1	XFMR T-3	27	2"	$1,000.35	2.5"	$2,227.50	3	3/0AWG	$546.75	250KCMIL	$324.00	1	3/0AWG	$182.25	250KCMIL	$108.00	3	3AWG	$210.60	1AWG	$218.70	$1,939.95	$2,878.20
31	XFMR T-3	PANEL E2RDP-1	12	2.5"	$792.00	3.5"	$1,584.00	3	300KCMIL	$396.00	500KCMIL	$235.80	1	300KCMIL	$132.00	500KCMIL	$78.60	3	1/0AWG	$163.80	3/0AWG	$115.20	$1,483.80	$2,013.60
32	SUBSTATION 2	PANEL MDP-72	184	3"	$24,380.00	4"	$47,840.00	5	400KCMIL	$12,880.00	600KCMIL	$7,084.00	1	400KCMIL	$2,576.00	600KCMIL	$1,416.80	5	4/0AWG	$7,544.00	300KCMIL	$4,508.00	$47,380.00	$60,848.80
33	SUBSTATION 2	ATS E3-2	27	2.5"	$1,782.00	3.5"	$3,564.00	3	300KCMIL	$891.00	500KCMIL	$530.55	1	300KCMIL	$297.00	500KCMIL	$176.85	3	1/0AWG	$368.55	3/0AWG	$259.20	$3,338.55	$4,530.60
34	ATS E3-2	PANEL E3DP-72	203	2.5"	$13,398.00	3.5"	$26,796.00	3	300KCMIL	$6,699.00	500KCMIL	$3,988.95	1	300KCMIL	$2,233.00	500KCMIL	$1,329.65	3	1/0AWG	$2,770.95	3/0AWG	$1,948.80	$25,100.95	$34,063.40
35	SWITCHBOARD EMDP-2	ATS E3-2	39	2.5"	$2,574.00	3.5"	$5,148.00	3	300KCMIL	$1,287.00	500KCMIL	$766.35	1	300KCMIL	$429.00	500KCMIL	$255.45	3	1/0AWG	$532.35	3/0AWG	$374.40	$4,822.35	$6,544.20
36	SUBSTATION 1	PANEL MDP-71	152	3"	$20,140.00	4"	$39,520.00	5	400KCMIL	$10,640.00	600KCMIL	$5,852.00	1	400KCMIL	$2,128.00	600KCMIL	$1,170.40	5	4/0AWG	$6,232.00	300KCMIL	$3,724.00	$39,140.00	$50,266.40
37	SUBSTATION 1	ATS E2-3	79	2.5"	$5,214.00	3.5"	$10,428.00	3	300KCMIL	$2,607.00	500KCMIL	$1,552.35	1	300KCMIL	$869.00	500KCMIL	$517.45	3	1/0AWG	$1,078.35	3/0AWG	$758.40	$9,768.35	$13,256.20
38	ATS E2-3	PANEL E2DP-3	15	2.5"	$990.00	3.5"	$1,980.00	3	300KCMIL	$495.00	500KCMIL	$294.75	1	300KCMIL	$165.00	500KCMIL	$98.25	3	1/0AWG	$204.75	3/0AWG	$144.00	$1,854.75	$2,517.00
39	SWITCHBOARD EMDP-1	ATS E2-3	18	2.5"	$1,188.00	3.5"	$2,376.00	3	300KCMIL	$594.00	500KCMIL	$353.70	1	300KCMIL	$198.00	500KCMIL	$117.90	3	1/0AWG	$245.70	3/0AWG	$172.80	$2,225.70	$3,020.40
40	PANEL E3DP-4	PANEL E3L35	157	2.5"	$3,454.00	3.5"	$6,908.00	1	350KCMIL	$1,962.50	500KCMIL	$1,028.35	1	350KCMIL	$1,962.50	500KCMIL	$1,028.35	1	4AWG	$350.11	2AWG	$259.05	$7,729.11	$9,223.75
41	SUBSTATION 1	ATS E3-1	58	2.5"	$3,828.00	3.5"	$7,656.00	3	300KCMIL	$1,914.00	500KCMIL	$1,139.70	1	300KCMIL	$638.00	500KCMIL	$379.90	3	1/0AWG	$791.70	3/0AWG	$556.80	$7,171.70	$9,732.40
42	ATS E3-1	PANEL E3DP-71	185	2.5"	$12,210.00	3.5"	$24,420.00	3	300KCMIL	$6,105.00	500KCMIL	$3,635.25	1	300KCMIL	$2,035.00	500KCMIL	$1,211.75	3	1/0AWG	$2,525.25	3/0AWG	$1,776.00	$22,875.25	$31,043.00
43	SWITCHBOARD EMDP-1	ATS E3-1	21	2.5"	$1,386.00	3.5"	$2,772.00	3	300KCMIL	$693.00	500KCMIL	$412.65	1	300KCMIL	$231.00	500KCMIL	$137.55	3	1/0AWG	$286.65	3/0AWG	$201.60	$2,596.65	$3,523.80
44	SUBSTATION 1	ATS E3-3	52	2.5"	$3,432.00	3.5"	$6,864.00	3	300KCMIL	$1,716.00	500KCMIL	$1,021.80	1	300KCMIL	$572.00	500KCMIL	$340.60	3	1/0AWG	$709.80	3/0AWG	$499.20	$6,429.80	$8,725.60
45	ATS E3-3	PANEL E3DP-73	179	2.5"	$11,814.00	3.5"	$23,628.00	3	300KCMIL	$5,907.00	500KCMIL	$3,517.35	1	300KCMIL	$1,969.00	500KCMIL	$1,172.45	3	1/0AWG	$2,443.35	3/0AWG	$1,718.40	$22,133.35	$30,036.20
46	SWITCHBOARD EMDP-2	ATS E3-3	42	2.5"	$924.00	3"	$1,470.00	1	250KCMIL	$399.00	400KCMIL	$245.70	1	250KCMIL	$399.00	400KCMIL	$245.70	1	4AWG	$93.66	2AWG	$69.30	$1,815.66	$2,030.70
47	PANEL FDP-1	PANEL LPG1	121	2"	$1,494.35	2"	$2,347.40	1	1/0AWG	$550.55	3/0AWG	$387.20	1	1/0AWG	$550.55	3/0AWG	$387.20	1	6AWG	$194.81	4AWG	$157.30	$2,790.26	$3,279.10
48	PANEL LPG1	XFMR T-4	12	1"	$82.80	1.25"	$169.20	1	4AWG	$26.76	2AWG	$19.80	-	-	-	-	-	1	8AWG	$14.16	6AWG	$12.60	$123.72	$201.60
49	XFMR T-4	PANEL RPG1	12	2"	$148.20	2"	$232.80	1	1/0AWG	$54.60	3/0AWG	$38.40	1	1/0AWG	$54.60	3/0AWG	$38.40	1	6AWG	$19.32	4AWG	$15.60	$276.72	$325.20
50	PANEL E1DP-1	PANEL E1LG1	155	1.25"	$1,371.75	1.5"	$2,472.25	1	3AWG	$403.00	1AWG	$418.50	1	3AWG	$403.00	1AWG	$418.50	1	8AWG	$182.90	6AWG	$162.75	$2,360.65	$3,472.00
51	PANEL E1LG1	XFMR T-5	18	0.75"	$98.10	0.75"	$173.70	1	10AWG	$15.03	8AWG	$15.90	-	-	-	-	-	1	10AWG	$15.03	8AWG	$15.90	$128.16	$205.50
52	XFMR T-5	PANEL E2RG1	14	1"	$96.60	1.25"	$197.40	1	6AWG	$22.54	4AWG	$18.20	1	6AWG	$22.54	4AWG	$18.20	1	8AWG	$16.52	6AWG	$14.70	$158.20	$248.50
53	PANEL E2DP-1	PANEL E2LG1	152	2"	$1,877.20	2"	$2,948.80	1	1/0AWG	$691.60	3/0AWG	$486.40	1	1/0AWG	$691.60	3/0AWG	$486.40	1	6AWG	$244.72	4AWG	$197.60	$3,505.12	$4,119.20
54	PANEL E2LG1	XFMR T-6	14	1"	$96.60	1.25"	$197.40	1	4AWG	$31.22	2AWG	$23.10	-	-	-	-	-	1	8AWG	$16.52	6AWG	$14.70	$144.34	$235.20
55	XFMR T-6	PANEL E2RG1	14	2"	$172.90	2"	$271.60	1	1/0AWG	$63.70	3/0AWG	$44.80	1	1/0AWG	$63.70	3/0AWG	$44.80	1	6AWG	$22.54	4AWG	$18.20	$322.84	$379.40
56	PANEL DRP-1	PANEL RPG2	304	2.5"	$6,688.00	3"	$10,640.00	1	4/0AWG	$2,492.80	300KCMIL	$1,489.60	1	4/0AWG	$2,492.80	300KCMIL	$1,489.60	1	4AWG	$677.92	2AWG	$501.60	$12,351.52	$14,120.80
57	PANEL E2RDP-1	PANEL E2RG2	275	2.5"	$6,050.00	3"	$9,625.00	1	4/0AWG	$2,255.00	300KCMIL	$1,347.50	1	4/0AWG	$2,255.00	300KCMIL	$1,347.50	1	4AWG	$613.25	2AWG	$453.75	$11,173.25	$12,773.75
58	PANEL DRP-1	PANEL RPG3	141	2.5"	$3,102.00	3"	$4,935.00	1	4/0AWG	$1,156.20	300KCMIL	$690.90	1	4/0AWG	$1,156.20	300KCMIL	$690.90	1	4AWG	$314.43	2AWG	$232.65	$5,728.83	$6,549.45
59	PANEL E2RDP-1	PANEL E2RG3	130	2.5"	$2,860.00	3"	$4,550.00	1	4/0AWG	$1,066.00	300KCMIL	$637.00	1	4/0AWG	$1,066.00	300KCMIL	$637.00	1	4AWG	$289.90	2AWG	$214.50	$5,281.90	$6,038.50
60	PANEL DRP-1	PANEL RPG4	361	2.5"	$7,942.00	3"	$12,635.00	1	4/0AWG	$2,960.20	300KCMIL	$1,768.90	1	4/0AWG	$2,960.20	300KCMIL	$1,768.90	1	4AWG	$805.03	2AWG	$595.65	$14,667.43	$16,768.45
61	PANEL E2RDP-1	PANEL E2RG4	334	2.5"	$7,348.00	3"	$11,690.00	1	4/0AWG	$2,738.80	300KCMIL	$1,636.60	1	4/0AWG	$2,738.80	300KCMIL	$1,636.60	1	4AWG	$744.82	2AWG	$551.10	$13,570.42	$15,514.30
62	PANEL FDP-1	PANEL LPG5	226	1.25"	$2,000.10	1.5"	$3,604.70	1	3AWG	$587.60	1AWG	$610.20	1	3AWG	$587.60	1AWG	$610.20	1	8AWG	$266.68	6AWG	$237.30	$3,441.98	$5,062.40
63	PANEL E2DP-1	PANEL E2LG5	159	1.25"	$1,407.15	1.5"	$2,536.05	1	3AWG	$413.40	1AWG	$429.30	1	3AWG	$413.40	1AWG	$429.30	1	8AWG	$187.62	6AWG	$166.95	$2,421.57	$3,561.60
64	PANEL E1DP-1	PANEL E1LG5	168	1.25"	$1,486.80	1.5"	$2,679.60	1	3AWG	$436.80	1AWG	$453.60	1	3AWG	$436.80	1AWG	$453.60	1	8AWG	$198.24	6AWG	$176.40	$2,558.64	$3,763.20
65	PANEL E1LG5	XFMR T-7	18	0.75"	$98.10	1"	$207.00	1	6AWG	$28.98	4AWG	$23.40	-	-	-	-	-	1	10AWG	$15.03	8AWG	$15.90	$142.11	$246.30
66	XFMR T-7	PANEL E1RG5	10	1.25"	$88.50	1.5"	$159.50	1	3AWG	$26.00	1AWG	$27.00	1	3AWG	$26.00	1AWG	$27.00	1	8AWG	$11.80	6AWG	$10.50	$152.30	$224.00
67	PANEL E3RG1	PANEL E3RG5	10	3"	$265.00	2"	$194.00	1	1/0AWG	$45.50	3/0AWG	$32.00	1	1/0AWG	$45.50	3/0AWG	$32.00	1	6AWG	$16.10	4AWG	$13.00	$372.10	$271.00
68	PANEL DRP-1	PANEL RPG6	278	2.5"	$6,116.00	3"	$9,730.00	1	4/0AWG	$2,279.60	300KCMIL	$1,362.20	1	4/0AWG	$2,279.60	300KCMIL	$1,362.20	1	4AWG	$619.94	2AWG	$458.70	$11,295.14	$12,913.10
69	PANEL E2RDP-1	PANEL E2RG6	248	2.5"	$5,456.00	3"	$8,680.00	1	4/0AWG	$2,033.60	300KCMIL	$1,215.20	1	4/0AWG	$2,033.60	300KCMIL	$1,215.20	1	4AWG	$553.04	2AWG	$409.20	$10,076.24	$11,519.60
70	PANEL FDP-1	PANEL LP11	124	1.25"	$1,097.40	1.5"	$1,977.80	1	3AWG	$322.40	1AWG	$334.80	1	3AWG	$322.40	1AWG	$334.80	1	8AWG	$146.32	6AWG	$130.20	$1,888.52	$2,777.60
71	PANEL E1DP-1	PANEL E1L11	157	1.25"	$1,389.45	1.5"	$2,504.15	1	3AWG	$408.20	1AWG	$423.90	1	3AWG	$408.20	1AWG	$423.90	1	8AWG	$185.26	6AWG	$164.85	$2,391.11	$3,516.80

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
72	PANEL E1L11	XFMR T-8	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
73	XFMR T-8	PANEL E1R11	14	1.25"	$123.90	1.5"	$223.30	1	3AWG	$36.40	1AWG	$37.80	1	3AWG	$36.40	1AWG	$37.80	1	8AWG	$16.52	6AWG	$14.70	$213.22	$313.60
74	PANEL E2DP-1	PANEL E2L11	151	1.25"	$1,336.35	1.5"	$2,408.45	1	3AWG	$392.60	1AWG	$407.70	1	3AWG	$392.60	1AWG	$407.70	1	8AWG	$178.18	6AWG	$158.55	$2,299.73	$3,382.40
75	PANEL E3DP-4	XFMR T-9	114	0.75"	$621.30	1"	$1,311.00	1	6AWG	$183.54	4AWG	$148.20	-	-	-	-	-	1	10AWG	$95.19	8AWG	$100.70	$900.03	$1,559.90
76	XFMR T-9	PANEL E3R12 (VIA ECB)	76	1.25"	$672.60	1.5"	$1,212.20	1	3AWG	$197.60	1AWG	$205.20	1	3AWG	$197.60	1AWG	$205.20	1	8AWG	$89.68	6AWG	$79.80	$1,157.48	$1,702.40
77	PANEL E2DP-1	XFMR T-10	162	2.5"	$3,564.00	3"	$5,670.00	1	250KCMIL	$1,539.00	400KCMIL	$947.70	-	-	-	-	-	1	4AWG	$361.26	2AWG	$267.30	$5,464.26	$6,885.00
78	XFMR T-10	PANEL E2R11	14	2.5"	$616.00	3"	$980.00	2	250KCMIL	$266.00	400KCMIL	$163.80	1	250KCMIL	$133.00	400KCMIL	$81.90	2	1/0AWG	$127.40	3/0AWG	$89.60	$1,142.40	$1,315.30
79	PANEL FDP-1	XFMR T-11	137	2.5"	$3,014.00	3"	$4,795.00	1	250KCMIL	$1,301.50	400KCMIL	$801.45	-	-	-	-	-	1	4AWG	$305.51	2AWG	$226.05	$4,621.01	$5,822.50
80	XFMR T-11	PANEL RP11	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
81	PANEL RP11	PANEL RP12	76	2"	$938.60	1.25"	$1,071.60	1	6AWG	$122.36	4AWG	$98.80	1	6AWG	$122.36	4AWG	$98.80	1	6AWG	$122.36	4AWG	$98.80	$1,305.68	$1,368.00
82	PANEL E2R11	PANEL E2R12	79	2"	$975.65	2"	$1,532.60	1	1/0AWG	$359.45	3/0AWG	$252.80	1	1/0AWG	$359.45	3/0AWG	$252.80	1	6AWG	$127.19	4AWG	$102.70	$1,821.74	$2,140.90
83	PANEL RP11	PANEL RP13	246	2"	$3,038.10	2"	$4,772.40	1	1/0AWG	$1,119.30	3/0AWG	$787.20	1	1/0AWG	$1,119.30	3/0AWG	$787.20	1	6AWG	$396.06	4AWG	$319.80	$5,672.76	$6,666.60
84	PANEL E2R11	PANEL E2R13	239	2"	$2,951.65	2"	$4,636.60	1	1/0AWG	$1,087.45	3/0AWG	$764.80	1	1/0AWG	$1,087.45	3/0AWG	$764.80	1	6AWG	$384.79	4AWG	$310.70	$5,511.34	$6,476.90
85	PANEL RP11	PANEL RP14	216	2"	$2,667.60	2"	$4,190.40	1	1/0AWG	$982.80	3/0AWG	$691.20	1	1/0AWG	$982.80	3/0AWG	$691.20	1	6AWG	$347.76	4AWG	$280.80	$4,980.96	$5,853.60
86	PANEL E2R11	PANEL E2R14	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
87	PANEL FDP-2	PANEL LP21	135	1.25"	$1,194.75	1.5"	$2,153.25	1	3AWG	$351.00	1AWG	$364.50	1	3AWG	$351.00	1AWG	$364.50	1	8AWG	$159.30	6AWG	$141.75	$2,056.05	$3,024.00
88	PANEL E1DP-1	PANEL E1L21	180	1.25"	$1,593.00	1.5"	$2,871.00	1	3AWG	$468.00	1AWG	$486.00	1	3AWG	$468.00	1AWG	$486.00	1	8AWG	$212.40	6AWG	$189.00	$2,741.40	$4,032.00
89	PANEL E1L21	XFMR T-12	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
90	XFMR T-12	PANEL E1R21	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
91	PANEL E2DP-2	PANEL E2L21	161	1.25"	$1,424.85	1.5"	$2,567.95	1	3AWG	$418.60	1AWG	$434.70	1	3AWG	$418.60	1AWG	$434.70	1	8AWG	$189.98	6AWG	$169.05	$2,452.03	$3,606.40
92	PANEL E3DP-4	XFMR T-13	130	0.75"	$708.50	1"	$1,495.00	1	6AWG	$209.30	4AWG	$169.00	-	-	-	-	-	1	10AWG	$108.55	8AWG	$114.83	$1,026.35	$1,778.83
93	XFMR T-13	PANEL E3R22 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
94	PANEL E2DP-2	XFMR T-14	167	2.5"	$3,674.00	3"	$5,845.00	1	250KCMIL	$1,586.50	400KCMIL	$976.95	-	-	-	-	-	1	4AWG	$372.41	2AWG	$275.55	$5,632.91	$7,097.50
95	XFMR T-14	PANEL E2R21	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
96	PANEL FDP-2	XFMR T-15	149	2.5"	$3,278.00	3"	$5,215.00	1	250KCMIL	$1,415.50	400KCMIL	$871.65	-	-	-	-	-	1	4AWG	$332.27	2AWG	$245.85	$5,025.77	$6,332.50
97	XFMR T-15	PANEL RP21	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
98	PANEL RP21	PANEL RP22	77	2"	$950.95	2"	$1,493.80	1	1/0AWG	$350.35	3/0AWG	$246.40	1	1/0AWG	$350.35	3/0AWG	$246.40	1	6AWG	$123.97	4AWG	$100.10	$1,775.62	$2,086.70
99	PANEL E2R21	PANEL E2R22	81	2"	$1,000.35	2"	$1,571.40	1	1/0AWG	$368.55	3/0AWG	$259.20	1	1/0AWG	$368.55	3/0AWG	$259.20	1	6AWG	$130.41	4AWG	$105.30	$1,867.86	$2,195.10
100	PANEL RP21	PANEL RP23	296	2.5"	$6,512.00	3"	$10,360.00	1	4/0AWG	$2,427.20	300KCMIL	$1,450.40	1	4/0AWG	$2,427.20	300KCMIL	$1,450.40	1	4AWG	$660.08	2AWG	$488.40	$12,026.48	$13,749.20
101	PANEL E2R21	PANEL E2R23	288	2"	$3,556.80	2"	$5,587.20	1	1/0AWG	$1,310.40	3/0AWG	$921.60	1	1/0AWG	$1,310.40	3/0AWG	$921.60	1	6AWG	$463.68	4AWG	$374.40	$6,641.28	$7,804.80
102	PANEL RP21	PANEL RP24	266	2"	$3,285.10	2"	$5,160.40	1	1/0AWG	$1,210.30	3/0AWG	$851.20	1	1/0AWG	$1,210.30	3/0AWG	$851.20	1	6AWG	$428.26	4AWG	$345.80	$6,133.96	$7,208.60
103	PANEL E2R21	PANEL E2R24	259	2.5"	$5,698.00	3"	$9,065.00	1	4/0AWG	$2,123.80	300KCMIL	$1,269.10	1	4/0AWG	$2,123.80	300KCMIL	$1,269.10	1	4AWG	$577.57	2AWG	$427.35	$10,523.17	$12,030.55
104	PANEL FDP-2	PANEL LP31	128	2"	$1,580.80	2"	$2,483.20	1	1/0AWG	$582.40	3/0AWG	$409.60	1	1/0AWG	$582.40	3/0AWG	$409.60	1	6AWG	$206.08	4AWG	$166.40	$2,951.68	$3,468.80
105	PANEL E1DP-1	PANEL E1L31	168	1.25"	$1,486.80	1.5"	$2,679.60	1	3AWG	$436.80	1AWG	$453.60	1	3AWG	$436.80	1AWG	$453.60	1	8AWG	$198.24	6AWG	$176.40	$2,558.64	$3,763.20
106	PANEL E1L31	XFMR T-16	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
107	XFMR T-16	PANEL E1R31	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
108	PANEL E2DP-2	PANEL E2L31	158	1.25"	$1,398.30	1.5"	$2,520.10	1	3AWG	$410.80	1AWG	$426.60	1	3AWG	$410.80	1AWG	$426.60	1	8AWG	$186.44	6AWG	$165.90	$2,406.34	$3,539.20
109	PANEL E3DP-4	XFMR T-17	126	0.75"	$686.70	1"	$1,449.00	1	6AWG	$202.86	4AWG	$163.80	-	-	-	-	-	1	10AWG	$105.21	8AWG	$111.30	$994.77	$1,724.10
110	XFMR T-17	PANEL E3R32 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
111	PANEL E2DP-2	XFMR T-18	165	2.5"	$3,630.00	3"	$5,775.00	1	250KCMIL	$1,567.50	400KCMIL	$965.25	-	-	-	-	-	1	4AWG	$367.95	2AWG	$272.25	$5,565.45	$7,012.50
112	XFMR T-18	PANEL E2R31	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
113	PANEL FDP-2	XFMR T-19	141	2.5"	$3,102.00	3"	$4,935.00	1	250KCMIL	$1,339.50	400KCMIL	$824.85	-	-	-	-	-	1	4AWG	$314.43	2AWG	$232.65	$4,755.93	$5,992.50
114	XFMR T-19	PANEL RP31	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
115	PANEL RP31	PANEL RP32	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
116	PANEL E2R31	PANEL E2R32	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
117	PANEL RP31	PANEL RP33	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
118	PANEL E2R31	PANEL E2R33	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
119	PANEL RP31	PANEL RP34	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
120	PANEL E2R31	PANEL E2R34	214	2"	$2,642.90	2"	$4,151.60	1	1/0AWG	$973.70	3/0AWG	$684.80	1	1/0AWG	$973.70	3/0AWG	$684.80	1	6AWG	$344.54	4AWG	$278.20	$4,934.84	$5,799.40
121	PANEL FDP-2	PANEL LP41	152	1.25"	$1,345.20	1.5"	$2,424.40	1	3AWG	$395.20	1AWG	$410.40	1	3AWG	$395.20	1AWG	$410.40	1	8AWG	$179.36	6AWG	$159.60	$2,314.96	$3,404.80
122	PANEL E1DP-1	PANEL E1L41	191	1.25"	$1,690.35	1.5"	$3,046.45	1	3AWG	$496.60	1AWG	$515.70	1	3AWG	$496.60	1AWG	$515.70	1	8AWG	$225.38	6AWG	$200.55	$2,908.93	$4,278.40
123	PANEL E1L41	XFMR T-20	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
124	XFMR T-20	PANEL E1R41	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00

FEEDER SCHEDULE (CONT.)

TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS						
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
125	PANEL E2DP-2	PANEL E2L41	182	1.25"	$1,610.70	1.5"	$2,902.90	1	3AWG	$473.20	1AWG	$491.40	1	3AWG	$473.20	1AWG	$491.40	1	8AWG	$214.76	6AWG	$191.10	$2,771.86	$4,076.80
126	PANEL E3DP-4	XFMR T-21	151	0.75"	$822.95	1"	$1,736.50	1	6AWG	$243.11	4AWG	$196.30	-	-	-	-	-	1	10AWG	$126.09	8AWG	$133.38	$1,192.15	$2,066.18
127	XFMR T-21	PANEL E3R42 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
128	PANEL E2DP-2	XFMR T-22	189	2.5"	$4,158.00	3"	$6,615.00	1	250KCMIL	$1,795.50	400KCMIL	$1,105.65	-	-	-	-	-	1	4AWG	$421.47	2AWG	$311.85	$6,374.97	$8,032.50
129	XFMR T-22	PANEL E2R41	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
130	PANEL FDP-2	XFMR T-23	164	2.5"	$3,608.00	3"	$5,740.00	1	250KCMIL	$1,558.00	400KCMIL	$959.40	-	-	-	-	-	1	4AWG	$365.72	2AWG	$270.60	$5,531.72	$6,970.00
131	XFMR T-23	PANEL RP41	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
132	PANEL RP41	PANEL RP42	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
133	PANEL E2R41	PANEL E2R42	79	2"	$975.65	2"	$1,532.60	1	1/0AWG	$359.45	3/0AWG	$252.80	1	1/0AWG	$359.45	3/0AWG	$252.80	1	6AWG	$127.19	4AWG	$102.70	$1,821.74	$2,140.90
134	PANEL RP41	PANEL RP43	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
135	PANEL E2R41	PANEL E2R43	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
136	PANEL RP41	PANEL RP44	218	2"	$2,692.30	2"	$4,229.20	1	1/0AWG	$991.90	3/0AWG	$697.60	1	1/0AWG	$991.90	3/0AWG	$697.60	1	6AWG	$350.98	4AWG	$283.40	$5,027.08	$5,907.80
137	PANEL E2R41	PANEL E2R44	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
138	PANEL FDP-2	PANEL LP51	164	1.25"	$1,451.40	1.5"	$2,615.80	1	3AWG	$426.40	1AWG	$442.80	1	3AWG	$426.40	1AWG	$442.80	1	8AWG	$193.52	6AWG	$172.20	$2,497.72	$3,673.60
139	PANEL E1DP-1	PANEL E1L51	204	1.25"	$1,805.40	1.5"	$3,253.80	1	3AWG	$530.40	1AWG	$550.80	1	3AWG	$530.40	1AWG	$550.80	1	8AWG	$240.72	6AWG	$214.20	$3,106.92	$4,569.60
140	PANEL E1L51	XFMR T-24	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
141	XFMR T-24	PANEL E1R51	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
142	PANEL E2DP-2	PANEL E2L51	155	1.25"	$1,371.75	1.5"	$2,472.25	1	3AWG	$403.00	1AWG	$418.50	1	3AWG	$403.00	1AWG	$418.50	1	8AWG	$182.90	6AWG	$162.75	$2,360.65	$3,472.00
143	PANEL E3DP-4	XFMR T-25	163	0.75"	$888.35	1"	$1,874.50	1	6AWG	$262.43	4AWG	$211.90	-	-	-	-	-	1	10AWG	$136.11	8AWG	$143.98	$1,286.89	$2,230.38
144	XFMR T-25	PANEL E3R52 (VIA ECB)	78	1.25"	$690.30	1.5"	$1,244.10	1	3AWG	$202.80	1AWG	$210.60	1	3AWG	$202.80	1AWG	$210.60	1	8AWG	$92.04	6AWG	$81.90	$1,187.94	$1,747.20
145	PANEL E2DP-2	XFMR T-26	201	2.5"	$4,422.00	3"	$7,035.00	1	250KCMIL	$1,909.50	400KCMIL	$1,175.85	-	-	-	-	-	1	4AWG	$448.23	2AWG	$331.65	$6,779.73	$8,542.50
146	XFMR T-26	PANEL E2R51	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
147	PANEL FDP-2	XFMR T-27	176	2.5"	$3,872.00	3"	$6,160.00	1	250KCMIL	$1,672.00	400KCMIL	$1,029.60	-	-	-	-	-	1	4AWG	$392.48	2AWG	$290.40	$5,936.48	$7,480.00
148	XFMR T-27	PANEL RP51	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
149	PANEL RP51	PANEL RP52	74	2"	$913.90	2"	$1,435.60	1	1/0AWG	$336.70	3/0AWG	$236.80	1	1/0AWG	$336.70	3/0AWG	$236.80	1	6AWG	$119.14	4AWG	$96.20	$1,706.44	$2,005.40
150	PANEL E2R51	PANEL E2R52	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
151	PANEL RP51	PANEL RP53	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
152	PANEL E2R51	PANEL E2R53	245	2"	$3,025.75	2"	$4,753.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	1/0AWG	$1,114.75	3/0AWG	$784.00	1	6AWG	$394.45	4AWG	$318.50	$5,649.70	$6,639.50
153	PANEL RP51	PANEL RP54	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
154	PANEL E2R51	PANEL E2R54	214	2"	$2,642.90	2"	$4,151.60	1	1/0AWG	$973.70	3/0AWG	$684.80	1	1/0AWG	$973.70	3/0AWG	$684.80	1	6AWG	$344.54	4AWG	$278.20	$4,934.84	$5,799.40
155	PANEL FDP-2	PANEL LP61	176	1.25"	$1,557.60	1.5"	$2,807.20	1	3AWG	$457.60	1AWG	$475.20	1	3AWG	$457.60	1AWG	$475.20	1	8AWG	$207.68	6AWG	$184.80	$2,680.48	$3,942.40
156	PANEL E1DP-1	PANEL E1L61	216	1.25"	$1,911.60	1.5"	$3,445.20	1	3AWG	$561.60	1AWG	$583.20	1	3AWG	$561.60	1AWG	$583.20	1	8AWG	$254.88	6AWG	$226.80	$3,289.68	$4,838.40
157	PANEL E1L61	XFMR T-28	17	0.75"	$92.65	1"	$195.50	1	6AWG	$27.37	4AWG	$22.10	-	-	-	-	-	1	10AWG	$14.20	8AWG	$15.02	$134.22	$232.62
158	XFMR T-28	PANEL E2R61	15	1.25"	$132.75	1.5"	$239.25	1	3AWG	$39.00	1AWG	$40.50	1	3AWG	$39.00	1AWG	$40.50	1	8AWG	$17.70	6AWG	$15.75	$228.45	$336.00
159	PANEL E2DP-2	PANEL E2L61	207	1.25"	$1,831.95	1.5"	$3,301.65	1	3AWG	$538.20	1AWG	$558.90	1	3AWG	$538.20	1AWG	$558.90	1	8AWG	$244.26	6AWG	$217.35	$3,152.61	$4,636.80
160	PANEL E3DP-4	XFMR T-29	174	0.75"	$948.30	1"	$2,001.00	1	6AWG	$280.14	4AWG	$226.20	-	-	-	-	-	1	10AWG	$145.29	8AWG	$153.70	$1,373.73	$2,380.90
161	XFMR T-29	PANEL E3R62 (VIA ECB)	79	1.25"	$699.15	1.5"	$1,260.05	1	3AWG	$205.40	1AWG	$213.30	1	3AWG	$205.40	1AWG	$213.30	1	8AWG	$93.22	6AWG	$82.95	$1,203.17	$1,769.60
162	PANEL E2DP-2	XFMR T-30	214	2.5"	$4,708.00	3"	$7,490.00	1	250KCMIL	$2,033.00	400KCMIL	$1,251.90	-	-	-	-	-	1	4AWG	$477.22	2AWG	$353.10	$7,218.22	$9,095.00
163	XFMR T-30	PANEL E2R61	15	2.5"	$660.00	3"	$1,050.00	2	250KCMIL	$285.00	400KCMIL	$175.50	1	250KCMIL	$142.50	400KCMIL	$87.75	2	1/0AWG	$136.50	3/0AWG	$96.00	$1,224.00	$1,409.25
164	PANEL FDP-2	XFMR T-31	189	2.5"	$4,158.00	3"	$6,615.00	1	250KCMIL	$1,795.50	400KCMIL	$1,105.65	-	-	-	-	-	1	4AWG	$421.47	2AWG	$311.85	$6,374.97	$8,032.50
165	XFMR T-31	PANEL RP61	13	2.5"	$572.00	3"	$910.00	2	250KCMIL	$247.00	400KCMIL	$152.10	1	250KCMIL	$123.50	400KCMIL	$76.05	2	1/0AWG	$118.30	3/0AWG	$83.20	$1,060.80	$1,221.35
166	PANEL RP61	PANEL RP62	75	2"	$926.25	2"	$1,455.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	1/0AWG	$341.25	3/0AWG	$240.00	1	6AWG	$120.75	4AWG	$97.50	$1,729.50	$2,032.50
167	PANEL E2R61	PANEL E2R62	80	2"	$988.00	2"	$1,552.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	1/0AWG	$364.00	3/0AWG	$256.00	1	6AWG	$128.80	4AWG	$104.00	$1,844.80	$2,168.00
168	PANEL RP61	PANEL RP63	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
169	PANEL E2R61	PANEL E2R63	244	2"	$3,013.40	2"	$4,733.60	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	1/0AWG	$1,110.20	3/0AWG	$780.80	1	6AWG	$392.84	4AWG	$317.20	$5,626.64	$6,612.40
170	PANEL RP61	PANEL RP64	217	2"	$2,679.95	2"	$4,209.80	1	1/0AWG	$987.35	3/0AWG	$694.40	1	1/0AWG	$987.35	3/0AWG	$694.40	1	6AWG	$349.37	4AWG	$282.10	$5,004.02	$5,880.70
171	PANEL E2R61	PANEL E2R64	215	2"	$2,655.25	2"	$4,171.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	1/0AWG	$978.25	3/0AWG	$688.00	1	6AWG	$346.15	4AWG	$279.50	$4,957.90	$5,826.50
172	PANEL E1DP-1	PANEL E1L71	227	1.25"	$2,008.95	1.25"	$3,200.70	1	3AWG	$590.20	1AWG	$612.90	-	-	-	-	-	1	8AWG	$267.86	6AWG	$238.35	$2,867.01	$4,051.95
173	PANEL E1L71	XFMR T-32	9	0.75"	$49.05	1.25"	$126.90	1	6AWG	$14.49	4AWG	$11.70	1	6AWG	$14.49	4AWG	$11.70	1	10AWG	$7.52	8AWG	$7.95	$85.55	$158.25
174	XFMR T-32	PANEL E1R71	9	1.25"	$79.65	1.5"	$143.55	1	3AWG	$23.40	1AWG	$24.30	1	3AWG	$23.40	1AWG	$24.30	1	8AWG	$10.62	6AWG	$9.45	$137.07	$201.60
175	PANEL E2DP-1	PANEL E2L71	228	2"	$2,815.80	2.5"	$6,270.00	1	3/0AWG	$1,539.00	250KCMIL	$912.00	1	3/0AWG	$1,539.00	250KCMIL	$912.00	1	6AWG	$367.08	4AWG	$296.40	$6,260.88	$8,390.40
176	PANEL MDP-71	PANEL LP71	39	2"	$481.65	2.5"	$1,072.50	1	3/0AWG	$263.25	250KCMIL	$156.00	1	3/0AWG	$263.25	250KCMIL	$156.00	1	6AWG	$62.79	4AWG	$50.70	$1,070.94	$1,435.20
177	PANEL LP71	XFMR T-33	38	1.25"	$336.30	1.5"	$606.10	1	2AWG	$117.80	1/0AWG	$92.34	-	-	-	-	-	1	6AWG	$61.18	4AWG	$49.40	$515.28	$747.84

FEEDER SCHEDULE (CONT.)																							
TAG	FROM	TO	LENGTH (FEET)	CONDUIT (PER SET)				CONDUTORS (PER SET)														CU TOTAL COST	AL TOTAL COST
				CU		AL		PHASE CONDUCTORS					NEUTRAL CONDUCTORS					GROUND CONDUCTORS					
				SIZE	COST	SIZE	COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST	NO.	CU SIZE	CU COST	AL SIZE	AL COST		
178	XFMR T-33	PANEL RP71	12	2.5"	$264.00	3"	$420.00	1	250KCMIL	$114.00	400KCMIL	$70.20	1	250KCMIL	$114.00	400KCMIL	$70.20	1	2AWG	$37.20	1/0AWG	$29.16	$529.20	$589.56
179	PANEL E3DP-71	XFMR T-34	12	1.25"	$106.20	1.5"	$191.40	1	2AWG	$37.20	1/0AWG	$29.16	-	-	-	-	-	1	6AWG	$19.32	4AWG	$15.60	$162.72	$236.16
180	XFMR T-34	PANEL E3R71	10	2.5"	$220.00	3"	$350.00	1	250KCMIL	$95.00	400KCMIL	$58.50	1	250KCMIL	$95.00	400KCMIL	$58.50	1	2AWG	$31.00	1/0AWG	$24.30	$441.00	$491.30
181	PANEL FDP-1	PANEL LPSL1 (VIA CONTRACTOR)	61	1.24"	$0.00	1.5"	$972.95	1	3AWG	$158.60	1AWG	$164.70	1	3AWG	$158.60	1AWG	$164.70	1	8AWG	$71.98	6AWG	$64.05	$389.18	$1,366.40
182	BGE FEEDER #3	FIRE PUMP CONTROLLER/ATS	125	4"	$11,812.50	4"	$19,500.00	3	600KCMIL	$7,020.83	900KCMIL	$3,702.08	-	-	-	-	-	3	3/0AWG	$2,531.25	250KCMIL	$1,500.00	$21,364.58	$24,702.08
183	PANEL E2DP-1	UPS-1	83	3"	$2,199.50	4"	$4,316.00	1	500KCMIL	$1,369.50	750KCMIL	$734.55	1	500KCMIL	$1,369.50	750KCMIL	$734.55	1	3AWG	$215.80	1AWG	$224.10	$5,154.30	$6,009.20
184	UPS-1	PANEL U2RDP	19	3"	$1,007.00	3.5"	$1,672.00	2	350KCMIL	$475.00	500KCMIL	$248.90	1	350KCMIL	$237.50	500KCMIL	$124.45	2	2/0AWG	$210.90	4/0AWG	$133.00	$1,930.40	$2,178.35
185	PANEL U2RDP	PANEL U2RG1	9	1.25"	$79.65	1.5"	$143.55	1	3AWG	$23.40	1AWG	$24.30	1	3AWG	$23.40	1AWG	$24.30	1	8AWG	$10.62	6AWG	$9.45	$137.07	$201.60
186	PANEL U2RDP	PANEL U2R12	102	1.25"	$902.70	1.5"	$1,626.90	1	3AWG	$265.20	1AWG	$275.40	1	3AWG	$265.20	1AWG	$275.40	1	8AWG	$120.36	6AWG	$107.10	$1,553.46	$2,284.80
187	PANEL U2RDP	PANEL U2R22	106	1.25"	$938.10	1.5"	$1,690.70	1	3AWG	$275.60	1AWG	$286.20	1	3AWG	$275.60	1AWG	$286.20	1	8AWG	$125.08	6AWG	$111.30	$1,614.38	$2,374.40
188	PANEL U2RDP	PANEL U2R32	122	1.25"	$1,079.70	1.5"	$1,945.90	1	3AWG	$317.20	1AWG	$329.40	1	3AWG	$317.20	1AWG	$329.40	1	8AWG	$143.96	6AWG	$128.10	$1,858.06	$2,732.80
189	PANEL U2RDP	PANEL U2R42	134	1.25"	$1,185.90	1.5"	$2,137.30	1	3AWG	$348.40	1AWG	$361.80	1	3AWG	$348.40	1AWG	$361.80	1	8AWG	$158.12	6AWG	$140.70	$2,040.82	$3,001.60
190	PANEL U2RDP	PANEL U2R52	146	1.25"	$1,292.10	1.5"	$2,328.70	1	3AWG	$379.60	1AWG	$394.20	1	3AWG	$379.60	1AWG	$394.20	1	8AWG	$172.28	6AWG	$153.30	$2,223.58	$3,270.40
191	PANEL U2RDP	PANEL U2R62	158	1.25"	$1,398.30	1.5"	$2,520.10	1	3AWG	$410.80	1AWG	$426.60	1	3AWG	$410.80	1AWG	$426.60	1	8AWG	$186.44	6AWG	$165.90	$2,406.34	$3,539.20
192	PANEL E3DP-71	PANEL E3L71	18	1.5"	$186.30	2"	$349.20	1	1/0AWG	$81.90	3/0AWG	$57.60	1	1/0AWG	$81.90	3/0AWG	$57.60	1	6AWG	$28.98	4AWG	$23.40	$379.08	$487.80
193	EX. PANEL 480-L2N	PANEL 480-L2N	25	2"	$308.75	2.5"	$687.50	1	3/0AWG	$168.75	250KCMIL	$100.00	1	3/0AWG	$168.75	250KCMIL	$100.00	1	6AWG	$40.25	4AWG	$32.50	$686.50	$920.00
194	PANEL RP21	PANEL RP25	74	1.25"	$654.90	1.5"	$1,180.30	1	3AWG	$192.40	1AWG	$199.80	1	3AWG	$192.40	1AWG	$199.80	1	8AWG	$87.32	6AWG	$77.70	$1,127.02	$1,657.60
195	PANEL RP11	PANEL RP15	161	1.25"	$1,424.85	1.5"	$2,567.95	1	3AWG	$418.60	1AWG	$434.70	1	3AWG	$418.60	1AWG	$434.70	1	8AWG	$189.98	6AWG	$169.05	$2,452.03	$3,606.40
196	PANEL LP31	PANEL LP31X	74	1"	$510.60	1.25"	$1,043.40	1	6AWG	$119.14	4AWG	$96.20	1	6AWG	$119.14	4AWG	$96.20	1	10AWG	$61.79	8AWG	$65.37	$810.67	$1,301.17
197	PANEL E2DP-2	UPS-1	75	3"	$1,987.50	4"	$3,900.00	1	500KCMIL	$1,237.50	750KCMIL	$663.75	1	500KCMIL	$1,237.50	750KCMIL	$663.75	1	3AWG	$195.00	1AWG	$202.50	$4,657.50	$5,430.00

Conclusion

Overall, I would not recommend the use of aluminum feeders in the Franklin Square Hospital Center. Even though the aluminum feeders would cost $394,416.00 less than the original copper feeders, the conduit change from EMT to Aluminum will cost an additional $1.9 million. The total price increase if the conductors and conduits were replaced by aluminum would come to $1,520,162.80. This additional cost is based on the cost analysis shown below.

Figure 105 | Copper vs. Aluminum Cost Analysis Summary

COST SUMMARY ANALYSIS			
	CONDUCTORS	CONDUITS	TOTAL
CU	$964,984.17	$983,269.65	$1,948,253.82
AL	$570,568.17	$2,897,848.45	$3,468,416.62
SAVINGS	$394,416.00	-$1,914,578.80	-$1,520,162.80

Depth Topic 2 | Compare energy savings vs. first costs for increasing feeder sizes

Introduction

Feeders are appropriately sized by calculating the load that they carry. When there is a larger load on a particular feeder it might be warm when touched. The heat that is given off by the feeder is wasted energy that can be saved by increasing the feeder size. Although larger conductors save energy, they also increases the initial cost of the electrical system. Depending on the budget and owner, this may be a viable solution to save energy.

Method

A comparison between the energy savings and the increased initial cost of the system will be performed. The system for this analysis includes the lighting and appliance panel boards found throughout the building. The existing feeder size will be calculated and increased by 1, 2, and 3 sizes to produce a cost comparison. The increased feeder sizes will most likely increase the conduit sizes but were not considered in this analysis.

After determining the lengths of the feeders, the voltage drop must be calculated. The voltage drop factor was found in Table 1.3-13 in the 14th edition of Eaton 2006 Consulting Application Guide. An assumed power factor of 0.80 was applied to each panel board. Voltage drop across each conductor was calculated using the following equation:

$$Voltage\ Drop\ (Volts) = \ Current\ (Amps) * Length\ of\ Feeder\ (Ft) * \frac{Voltage\ Drop\ Factor}{100}$$

The voltage drop was then multiplied by the demand load on each respective panel board. The demand load was analyzed at 50%, 60% and 80% of the total demand load on each panel. The value calculated is the amount of watts that are lost along each feeder run. Using the primary voltage service (Schedule P) from BGE utility company the electricity rate can be applied. Transmission costs will not vary when the wire size is changed therefore they are excluded from the calculation. The utility company breaks down the generation portion of the rate into categories for summer months and non-summer months as well as peak, intermediate-peak and off-peak hours of the day. All of these rates and hours can be seen in the tables below.

Figure 106 | BGE Utility Generation Rates

NON-SUMMER GENERATION RATE (OCTOBER 1 - MAY 31)				
	RATE ($/kWh)	HOURS PER DAY	HOURS PER YEAR	COST PER YEAR ($/kWh)
PEAK	0.10797	8	1944	$209.89
INTERMEDIATE-PEAK	0.10734	6	1458	$156.50
OFF-PEAK	0.08803	10	2430	$213.91

* GENERATION RATES ARE FROM MARCH 1 - MAY 31, 2010

SUMMER GENERATION RATE (JUNE 1 - SEPTEMBER 30)				
	RATE ($/kWh)	HOURS PER DAY	HOURS PER YEAR	COST PER YEAR ($/kWh)
PEAK	0.10797	10	1220	$131.72
INTERMEDIATE-PEAK	0.10734	6	732	$78.57
OFF-PEAK	0.08803	8	976	$85.92

* GENERATION RATES ARE FROM MARCH 1 - MAY 31, 2010

TOTAL COST PER YEAR ($/kWh)	$876.52

The hours of each day were calculated in their respective rate. An assumed 7 day week of defined weekdays by the utility was implied. Holidays are considered off-peak hours but were not included in the calculation. The total cost per year if 1kW was used is $876.52 which is then multiplied by the hours used. To convert the value to kW it was then divided by 1,000.

The cost of the energy loss per year was then compared to the initial cost of the feeders. The estimated prices of the feeders are referenced from RSMeans Electrical Cost Data 2010 (Figure 107). The cost data allows for the initial cost of each feeder size to be calculated.

Figure 107 | Copper Conductor Prices

CU		
SIZE	AMPS	COST/LF
12AWG	25	$0.69
10AWG	35	$0.84
8AWG	50	$1.18
6AWG	65	$1.61
4AWG	85	$2.23
3AWG	100	$2.60
2AWG	115	$3.10
1AWG	130	$3.75
1/0AWG	150	$4.55
2/0AWG	175	$5.55
3/0AWG	200	$6.75
4/0AWG	230	$8.20
250KCMIL	255	$9.50
300KCMIL	285	$11.00
350KCMIL	310	$12.50
400KCMIL	335	$14.00
500KCMIL	380	$16.50
600KCMIL	420	$18.75
700KCMIL	460	$20.94
750KCMIL	475	$21.78
800KCMIL	490	$22.61
900KCMIL	520	$24.28
1000KCMIL	545	$25.67
1250KCMIL	590	$28.17
1500KCMIL	625	$30.11
1750KCMIL	650	$31.50
2000KCMIL	665	$32.33

Figure 108 | Energy Savings vs. First Cost Feeder Schedule

ENERGY SAVINGS VS. FIRST COST FEEDER SCHEDULE

						50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		EXISTING SIZE				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		1 SIZE LARGER				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		2 SIZES LARGER				50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD		3 SIZES LARGER		
LENGTH (FEET)	50% DEMAND	60% DEMAN	80% DEMAN	DEMAND LOAD (A)	FACTOR	VOLTAGE DROP	ENERGY LOSS PER	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	CU SIZE	COST
155	13.5	16.2	21.6	27	0.0404	0.84537	$10.00	1.014444	$14.40	$1.35	$25.61	1	3AWG	$403.00	0.0323	0.675878	$8.00	0.811053	$11.52	1.081404	$20.47	1	2AWG	$480.50	0.0267	0.558698	$6.61	0.670437	$9.52	0.893916	$16.92	1	1AWG	$581.25	0.0222	0.464535	$5.50	0.557442	$7.92	0.743256	$14.07	1	1/0AWG	$705.25
14	21.5	25.8	34.4	43	0.0742	0.223342	$4.21	0.2680104	$6.06	$0.36	$10.77	1	6AWG	$22.54	0.0485	0.145985	$2.75	0.175182	$3.96	0.233576	$7.04	1	4AWG	$31.22	0.0404	0.121604	$2.29	0.145925	$3.30	0.1945664	$5.87	1	3AWG	$36.40	0.0323	0.097223	$1.83	0.116668	$2.64	0.155557	$4.69	1	2AWG	$43.40
152	13	15.6	20.8	26	0.0222	0.438672	$5.00	0.5264064	$7.20	$0.70	$12.80	1	1/0AWG	$691.60	0.0187	0.369512	$4.21	0.443414	$6.06	0.591219	$10.78	1	2/0AWG	$843.60	0.0158	0.312208	$3.56	0.37465	$5.12	0.4995328	$9.11	1	3/0AWG	$1,026.00	0.0136	0.268736	$3.06	0.322483	$4.41	0.429978	$7.84	1	4/0AWG	$1,246.40
14	18	21.6	28.8	36	0.0222	0.055944	$0.88	0.0671328	$1.27	$0.09	$2.26	1	1/0AWG	$63.70	0.0187	0.047124	$0.74	0.056549	$1.07	0.075398	$1.90	1	2/0AWG	$77.70	0.0158	0.039816	$0.63	0.047779	$0.90	0.0637056	$1.61	1	3/0AWG	$94.50	0.0136	0.034272	$0.54	0.041126	$0.78	0.054835	$1.38	1	4/0AWG	$114.80
121	46	55.2	73.6	92	0.0222	1.235652	$49.82	1.4827824	$71.74	$1.98	$127.54	1	1/0AWG	$550.55	0.0187	1.040842	$41.97	1.24901	$60.43	1.665347	$107.43	1	2/0AWG	$671.55	0.0158	0.879428	$35.46	1.055314	$51.06	1.4070848	$90.77	1	3/0AWG	$816.75	0.0136	0.756976	$30.52	0.908371	$43.95	1.211162	$78.13	1	4/0AWG	$992.20
12	74.5	89.4	119.2	149	0.0222	0.198468	$12.96	0.2381616	$18.66	$0.32	$33.18	1	1/0AWG	$54.60	0.0187	0.167178	$10.92	0.200614	$15.72	0.267485	$27.95	1	2/0AWG	$66.60	0.0158	0.141252	$9.22	0.169502	$13.28	0.2260032	$23.61	1	3/0AWG	$81.00	0.0136	0.121584	$7.94	0.145901	$11.43	0.194534	$20.33	1	4/0AWG	$98.40
141	86.5	103.8	138.4	173	0.0136	1.658724	$125.76	1.9904688	$181.10	$2.65	$321.95	1	4/0AWG	$1,156.20	0.0124	1.512366	$114.67	1.814839	$165.12	2.419786	$293.55	1	250KCMIL	$1,339.50	0.0111	1.353812	$102.64	1.624574	$147.81	2.1660984	$262.77	1	300KCMIL	$1,551.00	0.0102	1.244043	$94.32	1.492852	$135.82	1.990469	$241.47	1	350KCMIL	$1,762.50
130	43	51.6	68.8	86	0.0136	0.76024	$28.65	0.912288	$41.26	$1.22	$73.35	1	4/0AWG	$1,066.00	0.0124	0.69316	$26.13	0.831792	$37.62	1.109056	$66.88	1	250KCMIL	$1,235.00	0.0111	0.62049	$23.39	0.744588	$33.68	0.992784	$59.87	1	300KCMIL	$1,430.00	0.0102	0.57018	$21.49	0.684216	$30.95	0.912288	$55.02	1	350KCMIL	$1,625.00
168	11.5	13.8	18.4	23	0.0404	0.780528	$7.87	0.9366336	$11.33	$1.25	$20.14	1	3AWG	$436.80	0.0323	0.624036	$6.29	0.748843	$9.06	0.998458	$16.10	1	2AWG	$520.80	0.0267	0.515844	$5.20	0.619013	$7.49	0.8253504	$13.31	1	1AWG	$630.00	0.0222	0.428904	$4.32	0.514685	$6.23	0.686246	$11.07	1	1/0AWG	$764.40
159	27	32.4	43.2	54	0.0404	1.734372	$41.05	2.0812464	$59.11	$2.77	$105.08	1	3AWG	$413.40	0.0323	1.386639	$32.82	1.663967	$47.26	2.218622	$84.01	1	2AWG	$492.90	0.0267	1.146231	$27.13	1.375477	$39.06	1.8339696	$69.44	1	1AWG	$596.25	0.0222	0.953046	$22.55	1.143655	$32.48	1.524874	$57.74	1	1/0AWG	$723.45
226	23.5	28.2	37.6	47	0.0404	2.145644	$44.20	2.5747728	$63.64	$3.43	$113.14	1	3AWG	$587.60	0.0323	1.715453	$35.34	2.058544	$50.88	2.744725	$90.46	1	2AWG	$700.60	0.0267	1.418037	$29.21	1.701644	$42.06	2.2688592	$74.78	1	1AWG	$847.50	0.0222	1.179042	$24.29	1.41485	$34.97	1.886467	$62.17	1	1/0AWG	$1,028.30
10	16.5	19.8	26.4	33	0.0404	0.06666	$0.96	0.079992	$1.39	$0.11	$2.47	1	3AWG	$26.00	0.0323	0.053295	$0.77	0.063954	$1.11	0.085272	$1.97	1	2AWG	$31.00	0.0267	0.044055	$0.64	0.052866	$0.92	0.070488	$1.63	1	1AWG	$37.50	0.0222	0.03663	$0.53	0.043956	$0.76	0.058608	$1.36	1	1/0AWG	$45.50
10	67	80.4	107.2	134	0.0222	0.14874	$8.74	0.178488	$12.58	$0.24	$22.36	1	1/0AWG	$45.50	0.0187	0.12529	$7.36	0.150348	$10.60	0.200464	$18.84	1	2/0AWG	$55.50	0.0158	0.10586	$6.22	0.127032	$8.95	0.169376	$15.92	1	3/0AWG	$67.50	0.0136	0.09112	$5.35	0.109344	$7.71	0.145792	$13.70	1	4/0AWG	$82.00
248	48	57.6	76.8	96	0.0136	1.618944	$68.11	1.9427328	$98.08	$2.59	$174.37	1	4/0AWG	$2,033.60	0.0124	1.476096	$62.10	1.771315	$89.43	2.361754	$158.99	1	250KCMIL	$2,356.00	0.0111	1.321344	$55.59	1.585613	$80.05	2.1141504	$142.32	1	300KCMIL	$2,728.00	0.0102	1.214208	$51.09	1.45705	$73.56	1.942733	$130.78	1	350KCMIL	$3,100.00
278	77	92.4	123.2	154	0.0136	2.911216	$196.48	3.4934592	$282.94	$4.66	$503.00	1	4/0AWG	$2,279.60	0.0124	2.654344	$179.15	3.185213	$257.97	4.24695	$458.62	1	250KCMIL	$2,641.00	0.0111	2.376066	$160.37	2.851279	$230.93	3.8017056	$410.54	1	300KCMIL	$3,058.00	0.0102	2.183412	$147.36	2.620094	$212.20	3.493459	$377.25	1	350KCMIL	$3,475.00
79	159.5	191.4	255.2	319	0.0087	1.0962435	$153.26	1.3154922	$220.70	$1.75	$392.35	1	500KCMIL	$1,303.50	0.0082	1.033241	$144.45	1.239889	$208.01	1.653186	$369.80	1	600KCMIL	$1,481.25	0.0078	0.982839	$137.41	1.179407	$197.86	1.5725424	$351.76	1	700KCMIL	$1,654.26	0.0077	0.9702385	$135.64	1.164286	$195.33	1.552382	$347.25	1	750KCMIL	$1,720.62
11	78	93.6	124.8	156	0.0124	0.106392	$7.27	0.1276704	$10.47	$0.17	$18.62	1	250KCMIL	$104.50	0.0111	0.095238	$6.51	0.114286	$9.38	0.152381	$16.67	1	300KCMIL	$121.00	0.0102	0.087516	$5.98	0.105019	$8.62	0.1400256	$15.32	1	350KCMIL	$137.50	0.0097	0.083226	$5.69	0.099871	$8.19	0.133162	$14.57	1	400KCMIL	$154.00
61	33	39.6	52.8	66	0.0404	0.813252	$23.52	0.9759024	$33.87	$1.30	$60.22	1	3AWG	$158.60	0.0323	0.650199	$18.81	0.780239	$27.08	1.040318	$48.15	1	2AWG	$189.10	0.0267	0.537471	$15.55	0.644965	$22.39	0.8599536	$39.80	1	1AWG	$228.75	0.0222	0.446886	$12.93	0.536263	$18.61	0.715018	$33.09	1	1/0AWG	$277.55
9	38.5	46.2	61.6	77	0.0404	0.139986	$4.72	0.1679832	$6.80	$0.22	$12.09	1	3AWG	$23.40	0.0323	0.11192	$3.78	0.134303	$5.44	0.179071	$9.67	1	2AWG	$27.90	0.0267	0.092516	$3.12	0.111019	$4.50	0.1480248	$7.99	1	1AWG	$33.75	0.0222	0.076923	$2.60	0.092308	$3.74	0.123077	$6.65	1	1/0AWG	$40.95
130	20	24	32	40	0.0404	1.0504	$18.41	1.26048	$26.52	$1.68	$47.14	1	3AWG	$338.00	0.0323	0.8398	$14.72	1.00776	$21.20	1.34368	$37.69	1	2AWG	$403.00	0.0267	0.6942	$12.17	0.83304	$17.52	1.11072	$31.15	1	1AWG	$487.50	0.0222	0.5772	$10.12	0.69264	$14.57	0.92352	$25.90	1	1/0AWG	$591.50
87	166	199.2	265.6	332	0.0097	1.400874	$203.83	1.6810488	$293.52	$2.24	$521.81	3	400KCMIL	$3,654.00	0.0087	1.256454	$182.82	1.507745	$263.26	2.010326	$468.01	3	500KCMIL	$4,306.50	0.0082	1.184244	$172.31	1.421093	$248.13	1.8947904	$441.12	3	600KCMIL	$4,893.75	0.0078	1.126476	$163.91	1.351771	$236.02	1.802362	$419.60	3	700KCMIL	$5,465.34
17	8.5	10.2	13.6	17	0.0742	0.107219	$0.80	0.1286628	$1.15	$0.17	$2.05	1	6AWG	$27.37	0.0485	0.070083	$0.52	0.084099	$0.75	0.112132	$1.34	1	4AWG	$37.91	0.0404	0.058378	$0.43	0.070054	$0.63	0.0934048	$1.11	1	3AWG	$44.20	0.0323	0.0466735	$0.35	0.056008	$0.50	0.074678	$0.89	1	2AWG	$52.70
10	43.5	52.2	69.6	87	0.0136	0.05916	$2.26	0.070992	$3.25	$0.09	$5.77	1	4/0AWG	$82.00	0.0124	0.05394	$2.06	0.064728	$2.96	0.086304	$5.27	1	250KCMIL	$95.00	0.0111	0.048285	$1.84	0.057942	$2.65	0.077256	$4.71	1	300KCMIL	$110.00	0.0102	0.04437	$1.69	0.053244	$2.44	0.070992	$4.33	1	350KCMIL	$125.00
11	61	73.2	97.6	122	0.0485	0.325435	$17.40	0.390522	$25.06	$0.52	$44.54	1	4AWG	$24.53	0.0404	0.271084	$14.49	0.325301	$20.87	0.433734	$37.11	1	3AWG	$28.60	0.0323	0.216733	$11.59	0.26008	$16.69	0.3467728	$29.67	1	2AWG	$34.10	0.0267	0.179157	$9.58	0.214988	$13.79	0.286651	$24.52	1	1AWG	$41.25
37	11	13.2	17.6	22	0.0222	0.090354	$0.87	0.1084248	$1.25	$0.14	$2.23	1	1/0AWG	$168.35	0.0187	0.076109	$0.73	0.091331	$1.06	0.121774	$1.88	1	2/0AWG	$205.35	0.0158	0.064306	$0.62	0.077167	$0.89	0.1028896	$1.59	1	3/0AWG	$249.75	0.0136	0.055352	$0.53	0.066422	$0.77	0.088563	$1.37	1	4/0AWG	$303.40
9	16.5	19.8	26.4	33	0.0742	0.110187	$1.59	0.1322244	$2.29	$0.18	$4.08	1	6AWG	$14.49	0.0485	0.072023	$1.04	0.086427	$1.50	0.115236	$2.67	1	4AWG	$20.07	0.0404	0.059994	$0.87	0.071993	$1.25	0.0959904	$2.22	1	3AWG	$23.40	0.0323	0.0479655	$0.69	0.057559	$1.00	0.076745	$1.78	1	2AWG	$27.90
66	24	28.8	38.4	48	0.0404	0.639936	$13.46	0.7679232	$19.39	$1.02	$34.46	1	3AWG	$171.60	0.0323	0.511632	$10.76	0.613958	$15.50	0.818611	$27.55	1	2AWG	$204.60	0.0267	0.422928	$8.90	0.507514	$12.81	0.6766848	$22.78	1	1AWG	$247.50	0.0222	0.351648	$7.40	0.421978	$10.65	0.562637	$18.94	1	1/0AWG	$300.30
69	23	27.6	36.8	46	0.0404	0.641148	$12.93	0.7693776	$18.61	$1.03	$33.09	1	3AWG	$179.40	0.0323	0.512601	$10.33	0.615121	$14.88	0.820162	$26.46	1	2AWG	$213.90	0.0267	0.423729	$8.54	0.508475	$12.30	0.6779664	$21.87	1	1AWG	$258.75	0.0222	0.352314	$7.10	0.422777	$10.23	0.563702	$18.18	1	1/0AWG	$313.95
215	46	55.2	73.6	92	0.0222	2.19558	$88.53	2.634696	$127.48	$3.51	$226.63	1	1/0AWG	$978.25	0.0187	1.84943	$74.57	2.219316	$107.38	2.959088	$190.90	1	2/0AWG	$1,193.25	0.0158	1.56262	$63.00	1.875144	$90.73	2.500192	$161.29	1	3/0AWG	$1,451.25	0.0136	1.34504	$54.23	1.614048	$78.09	2.152064	$138.83	1	4/0AWG	$1,763.00
216	50	60	80	100	0.0222	2.3976	$105.08	2.87712	$151.31	$3.84	$269.00	1	1/0AWG	$982.80	0.0187	2.0196	$88.51	2.42352	$127.46	3.23136	$226.59	1	2/0AWG	$1,198.80	0.0158	1.7064	$74.78	2.04768	$107.69	2.73024	$191.45	1	3/0AWG	$1,458.00	0.0136	1.4688	$64.37	1.76256	$92.70	2.35008	$164.79	1	4/0AWG	$1,771.20
239	46	55.2	73.6	92	0.0222	2.440668	$98.41	2.9288016	$141.71	$3.91	$251.92	1	1/0AWG	$1,087.45	0.0187	2.055878	$82.89	2.467054	$119.37	3.289405	$212.21	1	2/0AWG	$1,326.45	0.0158	1.737052	$70.04	2.084462	$100.85	2.7792832	$179.30	1	3/0AWG	$1,613.25	0.0136	1.495184	$60.29	1.794221	$86.81	2.392294	$154.33	1	4/0AWG	$1,959.80
246	52.5	63	84	105	0.0222	2.86713	$131.94	3.440556	$189.99	$4.59	$337.76	1	1/0AWG	$1,119.30	0.0187	2.415105	$111.14	2.898126	$160.04	3.864168	$284.51	1	2/0AWG	$1,365.30	0.0158	2.04057	$93.90	2.448684	$135.22	3.264912	$240.39	1	3/0AWG	$1,660.50	0.0136	1.75644	$80.83	2.107728	$116.39	2.810304	$206.92	1	4/0AWG	$2,017.20
79	23	27.6	36.8	46	0.0222	0.403374	$8.13	0.4840488	$11.71	$0.65	$20.82	1	1/0AWG	$359.45	0.0187	0.339779	$6.85	0.407735	$9.86	0.543646	$17.54	1	2/0AWG	$438.45	0.0158	0.287086	$5.79	0.344503	$8.33	0.4593376	$14.82	1	3/0AWG	$533.25	0.0136	0.247112	$4.98	0.296534	$7.17	0.395379	$12.75	1	4/0AWG	$647.80
76	42	50.4	67.2	84	0.0404	1.289568	$47.47	1.5474816	$68.36	$2.06	$121.53	1	3AWG	$197.60	0.0323	1.031016	$37.96	1.237219	$54.66	1.649626	$97.17	1	2AWG	$235.60	0.0267	0.852264	$31.38	1.022717	$45.18	1.3636224	$80.32	1	1AWG	$285.00	0.0222	0.708624	$26.09	0.850349	$37.57	1.133798	$66.78	1	1/0AWG	$345.80
76	48.5	58.2	77.6	97	0.0742	2.735012	$116.27	3.2820144	$167.43	$4.38	$297.65	1	6AWG	$122.36	0.0485	1.78771	$76.00	2.145252	$109.44	2.860336	$194.55	1	4AWG	$169.48	0.0404	1.489144	$63.31	1.786973	$91.16	2.3826304	$162.06	1	3AWG	$197.60	0.0323	1.190578	$50.61	1.428694	$72.88	1.904925	$129.57	1	2AWG	$235.60
102	21.5	25.8	34.4	43	0.0404	0.885972	$16.70	1.0631664	$24.04	$1.42	$42.74	1	3AWG	$265.20	0.0323	0.708339	$13.35	0.850007	$19.22	1.133342	$34.17	1	2AWG	$316.20	0.0267	0.585531	$11.03	0.702637	$15.89	0.9368496	$28.25	1	1AWG	$382.50	0.0222	0.486846	$9.17	0.584215	$13.21	0.778954	$23.49	1	1/0AWG	$464.10
157	13	15.6	20.8	26	0.0404	0.824564	$9.40	0.9894768	$13.53	$1.32	$24.05	1	3AWG	$408.20	0.0323	0.659243	$7.51	0.791092	$10.82	1.054789	$19.23	1	2AWG	$486.70	0.0267	0.544947	$6.21	0.653936	$8.94	0.8719152	$15.90	1	1AWG	$588.75	0.0222	0.453102	$5.16	0.543722	$7.43	0.724963	$13.22	1	1/0AWG	$714.35
14	21	25.2	33.6	42	0.0404	0.118776	$2.19	0.1425312	$3.15	$0.19	$5.60	1	3AWG	$36.40	0.0323	0.094962	$1.75	0.113954	$2.52	0.151939	$4.47	1	2AWG	$43.40	0.0267	0.078498	$1.44	0.094198	$2.08	0.1255968	$3.70	1	1AWG	$52.50	0.0222	0.065268	$1.20	0.078322	$1.73	0.104429	$3.08	1	1/0AWG	$63.70
151	13	15.6	20.8	26	0.0404	0.793052	$9.04	0.9516624	$13.01	$1.27	$23.13	1	3AWG	$392.60	0.0323	0.634049	$7.22	0.760859	$10.40	1.014478	$18.50	1	2AWG	$468.10	0.0267	0.524121	$5.97	0.628945	$8.60	0.8385936	$15.29	1	1AWG	$566.25	0.0222	0.435786	$4.97	0.522943	$7.15	0.697258	$12.71	1	1/0AWG	$687.05
14	106	127.2	169.6	212	0.0124	0.184016	$17.10	0.2208192	$24.62	$0.29	$43.77	2	250KCMIL	$266.00	0.0111	0.164724	$15.30	0.197669	$22.04	0.263558	$39.18	2	300KCMIL	$308.00	0.0102	0.151368	$14.06	0.181642	$20.25	0.2421888	$36.00	2	350KCMIL	$350.00	0.0097	0.143948	$13.37	0.172738	$19.26	0.230317	$34.24	2	400KCMIL	$392.00
124	40	48	64	80	0.0404	2.00384	$70.26	2.404608	$101.17	$3.21	$179.86	1	3AWG	$322.40	0.0323	1.60208	$56.17	1.922496	$80.89	2.563328	$143.80	1	2AWG	$384.40	0.0267	1.32432	$46.43	1.589184	$66.86	2.118912	$118.87	1	1AWG	$465.00	0.0222	1.10112	$38.61	1.321344	$55.59	1.761792	$98.83	1	1/0AWG	$564.20
15	213.5	256.2	341.6	427	0.0124	0.39711	$74.31	0.476532	$107.01	$0.64	$190.24	2	250KCMIL	$285.00	0.0111	0.355478	$66.52	0.426573	$95.79	0.568764	$170.30	2	300KCMIL	$330.00	0.0102	0.326655	$61.13	0.391986	$88.03	0.522648	$156.49	2	350KCMIL	$375.00	0.0097	0.3106425	$58.13	0.372771	$83.71	0.497028	$148.82	2	400KCMIL	$420.00
161	36.5	43.8	58.4	73	0.0404	2.374106	$75.95	2.8489272	$109.38	$3.80	$194.44	1	3AWG	$418.60	0.0323	1.89811	$60.73	2.277731	$87.45	3.036975	$155.46	1	2AWG	$499.10	0.0267	1.569026	$50.20	1.882831	$72.28	2.5104408	$128.51	1	1AWG	$603.75	0.0222	1.304583	$41.74	1.5655	$60.10	2.087333	$106.85	1	1/0AWG	$732.55
259	94	112.8	150.4	188	0.0136	3.311056	$272.81	3.9732672	$392.84	$5.30	$698.39	1	4/0AWG	$2,123.80	0.0124	3.018904	$248.74	3.622685	$358.18	4.830246	$636.77	1	250KCMIL	$2,460.50	0.0111	2.702406	$222.66	3.242887	$320.63	4.3238496	$570.01	1	300KCMIL	$2,849.00	0.0102	2.483292	$204.61	2.97995	$294.63	3.973267	$523.79	1	350KCMIL	$3,237.50
266	54.5	65.4	87.2	109	0.0222	3.218334	$153.74	3.8620008	$221.39	$5.15	$393.58	1	1/0AWG	$1,210.30	0.0187	2.710939	$129.50	3.253127	$186.48	4.337502	$331.53	1	2/0AWG	$1,476.30	0.0158	2.290526	$109.42	2.748631	$157.56	3.6648416	$280.11	1	3/0AWG	$1,795.50	0.0136	1.971592	$94.18	2.36591	$135.62	3.154547	$241.11	1	4/0AWG	$2,181.20
288	95	114	152	190	0.0222	6.07392	$505.77	7.288704	$728.31	$9.72	$1,294.78	1	1/0AWG	$1,310.40	0.0187	5.11632	$426.03	6.139584	$613.49	8.186112	$1,090.65	1	2/0AWG	$1,598.40	0.0158	4.32288	$359.96	5.187456	$518.35	6.916608	$921.51	1	3/0AWG	$1,944.00	0.0136	3.72096	$309.84	4.465152	$446.17	5.953536	$793.20	1	4/0AWG	$2,361.60
296	47	56.4	75.2	94	0.0136	1.892032	$77.95	2.2704384	$112.24	$3.03	$199.54	1	4/0AWG	$2,427.20	0.0124	1.725088	$71.07	2.070106	$102.34	2.760141	$181.93	1	250KCMIL	$2,812.00	0.0111	1.544232	$63.62	1.853078	$91.61	2.4707712	$162.86	1	300KCMIL	$3,256.00	0.0102	1.419024	$58.46	1.702829	$84.18	2.270438	$149.65	1	350KCMIL	$3,700.00
81	39.5	47.4	63.2	79	0.0222	0.710289	$24.59	0.8523468	$35.41	$1.14	$62.96	1	1/0AWG	$368.55	0.0187	0.598307	$20.71	0.717968	$29.83	0.95729	$53.03	1	2/0AWG	$449.55	0.0158	0.505521	$17.50	0.606625	$25.20	0.8088336	$44.81	1	3/0AWG	$546.75	0.0136	0.435132	$15.07	0.522158	$21.69	0.696211	$38.57	1	4/0AWG	$664.20
78	45.5	54.6	72.8	91	0.0404	1.433796	$57.18	1.7205552	$82.34	$2.29	$146.39	1	3AWG	$202.80	0.0323	1.146327	$45.72	1.375592	$65.83	1.834123	$117.04	1	2AWG	$241.80	0.0267	0.947583	$37.79	1.1371	$54.42	1.5161328	$96.75	1	1AWG	$292.50	0.0222	0.787878	$31.42	0.945454	$45.25	1.260605	$80.44	1	1/0AWG	$354.90
77	58	69.6	92.8	116	0.0222	0.991452	$50.40	1.1897424	$72.58	$1.59	$129.03	1	1/0AWG	$350.35	0.0187	0.835142	$42.46	1.00217	$61.14	1.336227	$108.69	1	2/0AWG	$427.35	0.0158	0.705628	$35.87	0.846754	$51.66	1.1290048	$91.83	1	3/0AWG	$519.75	0.0136	0.607376	$30.88	0.728851	$44.46	0.971802	$79.05	1	4/0AWG	$631.40
106	27.5	33	44	55	0.0404	1.17766	$28.39	1.413192	$40.88	$1.88	$72.67	1	3AWG	$275.60	0.0323	0.941545	$22.70	1.129854	$32.68	1.506472	$58.10	1	2AWG	$328.60	0.0267	0.778305	$18.76	0.933966	$27.02	1.245288	$48.03	1	1AWG	$397.50	0.0222	0.64713	$15.60	0.776556	$22.46	1.035408	$39.93	1	1/0AWG	$482.30
180	10	12	16	20	0.0404	0.7272	$6.37	0.87264	$9.18	$1.16	$16.32	1	3AWG	$468.00	0.0323	0.5814	$5.10	0.69768	$7.34	0.93024	$13.05	1	2AWG	$558.00	0.0267	0.4806	$4.21	0.57672	$6.07	0.76896	$10.78	1	1AWG	$675.00	0.0222	0.3996	$3.50	0.47952	$5.04	0.63936	$8.97	1	1/0AWG	$819.00
15	13.5	16.2	21.6	27	0.0404	0.08181	$0.97	0.098172	$1.39	$0.13	$2.48	1	3AWG	$39.00	0.0323	0.065408	$0.77	0.078489	$1.11	0.104652	$1.98	1	2AWG	$46.50	0.0267	0.054068	$0.64	0.064881	$0.92	0.086508	$1.64	1	1AWG	$56.25	0.0222	0.044955	$0.53	0.053946	$0.77	0.071928	$1.36	1	1/0AWG	$68.25
161	10.5	12.6	16.8	21	0.0404	0.682962	$6.29	0.8195544	$9.05	$1.09	$16.09	1	3AWG	$418.60	0.0323	0.546032	$5.03	0.655238	$7.24	0.87365	$12.86	1	2AWG	$499.10	0.0267	0.451364	$4.15	0.541636	$5.98	0.7221816	$10.63	1	1AWG	$603.75	0.0222	0.375291	$3.45	0.450349	$4.97	0.600466	$8.84	1	1/0AWG	$732.55
15	215	258	344	430	0.0124	0.3999	$75.36	0.47988	$108.52	$0.64	$192.93	2	250KCMIL	$285.00	0.0111	0.357975	$67.46	0.42957	$97.14	0.57276	$172.70	2	300KCMIL	$330.00	0.0102	0.32895	$61.99	0.39474	$89.27	0.52632	$158.70	2	350KCMIL	$375.00	0.0097	0.312825	$58.95	0.37539	$84.89	0.50052	$150.92	2	400KCMIL	$420.00
135	19.5	23.4	31.2	39	0.0404	1.06353	$18.18	1.276236	$26.18	$1.70	$46.54	1	3AWG	$351.00	0.0323	0.850298	$14.53	1.020357	$20.93	1.360476	$37.21	1	2AWG	$418.50	0.0267	0.702878	$12.01	0.843453	$17.30	1.124604	$30.76	1	1AWG	$506.25	0.0222	0.584415	$9.99	0.701298	$14.38	0.935064	$25.57	1	1/0AWG	$614.25
15	190	228	304	380	0.0124	0.3534	$58.85	0.42408	$84.75	$0.57	$150.67	2	250KCMIL	$285.00	0.0111	0.31635	$52.68	0.37962	$75.87	0.50616	$134.87	2	300KCMIL	$330.00	0.0102	0.2907	$48.41	0.34884	$69.71	0.46512	$123.94	2	350KCMIL	$375.00	0.0097	0.27645	$46.04	0.33174	$66.30	0.44232	$117.86	2	400KCMIL	$420.00
74	18.5	22.2	29.6	37	0.0404	0.553076	$8.97	0.6636912	$12.91	$0.88	$22.96	1	3AWG	$192.40	0.0323	0.442187	$7.17	0.530624	$10.33	0.707499	$18.36	1	2AWG	$229.40	0.0267	0.365523	$5.93	0.438628	$8.54	0.5848368	$15.17	1	1AWG	$277.50	0.0222	0.303918	$4.93	0.364702	$7.10	0.486269	$12.62	1	1/0AWG	$336.70
214	58	69.6	92.8	116	0.0222	2.755464	$140.08	3.3065568	$201.72	$4.41	$358.61	1	1/0AWG	$973.70	0.0187	2.321044	$118.00	2.785253	$169.92	3.71367	$302.07	1	2/0AWG	$1,187.70	0.0158	1.961096	$99.70	2.353315	$143.57	3.1377536	$255.23	1	3/0AWG	$1,444.50	0.0136	1.688032	$85.82	2.025638	$123.58	2.700851	$219.69	1	4/0AWG	$1,754.80
217	50	60	80	100	0.0222	2.4087	$105.56	2.89044	$152.01	$3.85	$270.24	1	1/0AWG	$987.35	0.0187	2.02895	$88.92	2.43474	$128.05	3.24632	$227.64	1	2/0AWG	$1,204.35	0.0158	1.7143	$75.13	2.05716	$108.19	2.74288	$192.34	1	3/0AWG	$1,464.75	0.0136	1.4756	$64.67	1.77072	$93.12	2.36096	$165.55	1	4/0AWG	$1,779.40
245	57.5	69	92	115	0.0222	3.127425	$157.62	3.75291	$226.98	$5.00	$403.51	1	1/0AWG	$1,114.75	0.0187	2.634363	$132.77	3.161235	$191.19	4.21498	$339.90	1	2/0AWG	$1,359.75	0.0158	2.225825	$112.18	2.67099	$161.54	3.56132	$287.18	1	3/0AWG	$1,653.75	0.0136	1.9159	$96.56	2.29908	$139.05	3.06544	$247.20	1	4/0AWG	$2,009.00
244	52.5	63	84	105	0.0222	2.84382	$130.87	3.412584	$188.45	$4.55	$335.01	1	1/0AWG	$1,110.20	0.0187	2.39547	$110.23	2.874564	$158.74	3.832752	$282.20	1	2/0AWG	$1,354.20	0.0158	2.02398	$93.14	2.428776	$134.12	3.238368	$238.43	1	3/0AWG	$1,647.00	0.0136	1.74216	$80.17	2.090592	$115.44	2.787456	$205.23	1	4/0AWG	$2,000.80
80	14.5	17.4	23.2	29	0.0222	0.25752	$3.27	0.309024	$4.71	$0.41	$8.38	1	1/0AWG	$364.00	0.0187	0.21692	$2.76	0.260304	$3.97	0.347072	$7.06	1	2/0AWG	$444.00	0.0158	0.18328	$2.33	0.219936	$3.35	0.293248	$5.96	1	3/0AWG	$540.00	0.0136	0.15776	$2.01	0.189312	$2.89	0.252416	$5.13	1	4/0AWG	$656.00
78	40.5	48.6	64.8	81	0.0404	1.276236	$45.31	1.5314832	$65.24	$2.04	$115.98	1	3AWG	$202.80	0.0323	1.020357	$36.22	1.224428	$52.16	1.632571	$92.73	1	2AWG	$241.80	0.0267	0.843453	$29.94	1.012144	$43.12	1.3495248	$76.65	1	1AWG	$292.50	0.0222	0.701298	$24.90	0.841558	$35.85	1.122077	$63.73	1	1/0AWG	$354.90
75	42.5	51	68	85	0.0222	0.707625	$26.36	0.84915	$37.96	$1.13	$67.48	1	1/0AWG	$341.25	0.0187	0.596063	$22.20	0.715275	$31.97	0.9537	$56.84	1	2/0AWG	$416.25	0.0158	0.503625	$18.76	0.60435	$27.02	0.8058	$48.03	1	3/0AWG	$506.25	0.0136	0.4335	$16.15	0.5202	$23.25	0.6936	$41.34	1	4/0AWG	$615.00
122	28	33.6	44.8	56	0.0404	1.380064	$33.87	1.6560768	$48.77	$2.21	$86.71	1	3AWG	$317.20	0.0323	1.103368	$27.08	1.324042	$38.99	1.765389	$69.32	1	2AWG	$378.20	0.0267	0.912072	$22.38	1.094486	$32.23	1.4593152	$57.30	1	1AWG	$457.50	0.0222	0.758352	$18.61	0.910022	$26.80	1.213363	$47.65	1	1/0AWG	$555.10
168	8.5	10.2	13.6	17	0.0404	0.576912	$4.30	0.6922944	$6.19	$0.92	$11.00	1	3AWG	$436.80	0.0323	0.461244	$3.44	0.553493	$4.95	0.73799	$8.80	1	2AWG	$520.80	0.0267	0.381276	$2.84	0.457531	$4.09	0.6100416	$7.27	1	1AWG	$630.00	0.0222	0.317016	$2.36	0.380419	$3.40	0.507226	$6.05	1	1/0AWG	$764.40
15	12	14.4	19.2	24	0.0404	0.07272	$0.76	0.087264	$1.10	$0.12	$1.96	1	3AWG	$39.00	0.0323	0.05814	$0.61	0.069768	$0.88	0.093024	$1.57	1	2AWG	$46.50	0.0267	0.04806	$0.51	0.057672	$0.73	0.076896	$1.29	1	1AWG	$56.25	0.0222	0.03996	$0.42	0.047952	$0.61	0.063936	$1.08	1	1/0AWG	$68.25
158	12	14.4	19.2	24	0.0404	0.765984	$8.06	0.9191808	$11.60	$1.23	$20.63	1	3AWG	$410.80	0.0323	0.612408	$6.44	0.73489	$9.28	0.979853	$16.49	1	2AWG	$489.80	0.0267	0.506232	$5.32	0.607478	$7.67	0.8099712	$13.63	1	1AWG	$592.50	0.0222	0.420912	$4.43	0.505094	$6.38	0.673459	$11.33	1	1/0AWG	$718.90
15	119.5	143.4	191.2	239	0.0124	0.22227	$23.28	0.266724	$33.53	$0.36	$59.60	2	250KCMIL	$285.00	0.0111	0.198968	$20.84	0.238761	$30.01	0.318348	$53.35	2	300KCMIL	$330.00	0.0102	0.182835	$19.15	0.219402	$27.58	0.292536	$49.03	2	350KCMIL	$375.00	0.0097	0.1738725	$18.21	0.208647	$26.23	0.278196	$46.62	2	400KCMIL	$420.00
128	49	58.8	78.4	98	0.0222	1.392384	$59.80	1.6708608	$86.12	$2.23	$153.09	1	1/0AWG	$582.40	0.0187	1.172864	$50.37	1.407437	$72.54	1.876582	$128.96	1	2/0AWG	$710.40	0.0158	0.990976	$42.56	1.189171	$61.29	1.5855616	$108.96	1	3/0AWG	$864.00	0.0136	0.852992	$36.64	1.02359	$52.76	1.364787	$93.79	1	4/0AWG	$1,049.60
13	145	174	232	290	0.0124	0.23374	$29.71	0.280488	$42.78	$0.37	$76.05	2	250KCMIL	$247.00	0.0111	0.209235	$26.59	0.251082	$38.29	0.334776	$68.08	2	300KCMIL	$286.00	0.0102	0.19227	$24.44	0.230724	$35.19	0.307632	$62.56	2	350KCMIL	$325.00	0.0097	0.182845	$23.24	0.219414	$33.46	0.292552	$59.49	2	400KCMIL	$364.00
157	102.5	123	164	205	0.0102	1.641435	$147.47	1.969722	$212.36	$2.63	$377.53	1	350KCMIL	$1,962.50	0.0097	1.560973	$140.24	1.873167	$201.95	2.497556	$359.02	1	400KCMIL	$2,198.00	0.0087	1.400048	$125.79	1.680057	$181.13	2.240076	$322.01	1	500KCMIL	$2,590.50	0.0082	1.319585	$118.56	1.583502	$170.72	2.111336	$303.50	1	600KCMIL	$2,943.75
74	10.5	12.6	16.8	21	0.0742	0.576534	$5.31	0.6918408	$7.64	$0.92	$13.58	1	6AWG	$119.14	0.0485	0.376845	$3.47	0.452214	$4.99	0.602952	$8.88	1	4AWG	$165.02	0.0404	0.313908	$2.89	0.37669	$4.16	0.5022528	$7.40	1	3AWG	$192.40	0.0323	0.250971	$2.31	0.301165	$3.33	0.401554	$5.91	1	2AWG	$229.40
215	49.5	59.4	79.2	99	0.0222	2.362635	$102.51	2.835162	$147.61	$3.78	$262.42	1	1/0AWG	$978.25	0.0187	1.990148	$86.35	2.388177	$124.34	3.184236	$221.05	1	2/0AWG	$1,193.25	0.0158	1.681515	$72.96	2.017818	$105.06	2.690424	$186.77	1	3/0AWG	$1,451.25	0.0136	1.44738	$62.80	1.736856	$90.43	2.315808	$160.76	1	4/0AWG	$1,763.00
218	51.5	61.8	82.4	103	0.0222	2.492394	$112.51	2.9908728	$162.01	$3.99	$288.02	1	1/0AWG	$991.90	0.0187	2.099449	$94.77	2.519339	$136.47	3.359118	$242.61	1	2/0AWG	$1,209.90	0.0158	1.773866	$80.07	2.128639	$115.31	2.8381856	$204.99	1	3/0AWG	$1,471.50	0.0136	1.526872	$68.92	1.832246	$99.25	2.442995	$176.45	1	4/0AWG	$1,787.60
245	46	55.2	73.6	92	0.0222	2.50194	$100.88	3.002328	$145.26	$4.00	$258.25	1	1/0AWG	$1,114.75	0.0187	2.10749	$84.97	2.528988	$122.36	3.371984	$217.53	1	2/0AWG	$1,359.75	0.0158	1.78066	$71.80	2.136792	$103.39	2.849056	$183.80	1	3/0AWG	$1,653.75	0.0136	1.53272	$61.80	1.839264	$88.99	2.452352	$158.21	1	4/0AWG	$2,009.00
244	55.5	66.6	88.8	111	0.0222	3.006324	$146.25	3.6075888	$210.60	$4.81	$374.40	1	1/0AWG	$1,110.20	0.0187	2.532354	$123.19	3.038825	$177.40	4.051766	$315.37	1	2/0AWG	$1,354.20	0.0158	2.139636	$104.09	2.567563	$149.88	3.4234176	$266.46	1	3/0AWG	$1,647.00	0.0136	1.841712	$89.59	2.210054	$129.01	2.946739	$229.36	1	4/0AWG	$2,000.80
79	11.5	13.8	18.4	23	0.0222	0.201687	$2.03	0.2420244	$2.93	$0.32	$5.20	1	1/0AWG	$359.45	0.0187	0.16989	$1.71	0.203867	$2.47	0.271823	$4.38	1	2/0AWG	$438.45	0.0158	0.143543	$1.45	0.172252	$2.08	0.2296688	$3.70	1	3/0AWG	$533.25	0.0136	0.123556	$1.25	0.148267	$1.79	0.19769	$3.19	1	4/0AWG	$647.80
78	40.5	48.6	64.8	81	0.0404	1.276236	$45.31	1.5314832	$65.24	$2.04	$115.98	1	3AWG	$202.80	0.0323	1.020357	$36.22	1.224428	$52.16	1.632571	$92.73	1	2AWG	$241.80	0.0267	0.843453	$29.94	1.012144	$43.12	1.3495248	$76.65	1	1AWG	$292.50	0.0222	0.701298	$24.90	0.841558	$35.85	1.122077	$63.73	1	1/0AWG	$354.90
75	41.5	49.8	66.4	83	0.0222	0.690975	$25.13	0.82917	$36.19	$1.11	$64.34	1	1/0AWG	$341.25	0.0187	0.582038	$21.17	0.698445	$30.49	0.93126	$54.20	1	2/0AWG	$416.25	0.0158	0.491775	$17.89	0.59013	$25.76	0.78684	$45.79	1	3/0AWG	$506.25	0.0136	0.4233	$15.40	0.50796	$22.17	0.67728	$39.42	1	4/0AWG	$615.00
134	21	25.2	33.6	42	0.0404	1.136856	$20.93	1.3642272	$30.13	$1.82	$53.57	1	3AWG	$348.40	0.0323	0.908922	$16.73	1.090706	$24.09	1.454275	$42.83	1	2AWG	$415.40	0.0267	0.751338	$13.83	0.901606	$19.91	1.2021408	$35.40	1	1AWG	$502.50	0.0222	0.624708	$11.50	0.74965	$16.56	0.999533	$29.44	1	1/0AWG	$609.70
191	8	9.6	12.8	16	0.0404	0.617312	$4.33	0.7407744	$6.23	$0.99	$11.08	1	3AWG	$496.60	0.0323	0.493544	$3.46	0.592253	$4.98	0.78967	$8.86	1	2AWG	$592.10	0.0267	0.407976	$2.86	0.489571	$4.12	0.6527616	$7.32	1	1AWG	$716.25	0.0222	0.339216	$2.38	0.407059	$3.43	0.542746	$6.09	1	1/0AWG	$869.05
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
182	12	14.4	19.2	24	0.0404	0.882336	$9.28	1.0588032	$13.36	$1.41	$23.76	1	3AWG	$473.20	0.0323	0.705432	$7.42	0.846518	$10.68	1.128691	$18.99	1	2AWG	$564.20	0.0267	0.583128	$6.13	0.699754	$8.83	0.9330048	$15.70	1	1AWG	$682.50	0.0222	0.484848	$5.10	0.581818	$7.34	0.775757	$13.06	1	1/0AWG	$828.10
15	98	117.6	156.8	196	0.0124	0.18228	$15.66	0.218736	$22.55	$0.29	$40.08	2	250KCMIL	$285.00	0.0111	0.16317	$14.02	0.195804	$20.18	0.261072	$35.88	2	300KCMIL	$330.00	0.0102	0.14994	$12.88	0.179928	$18.55	0.239904	$32.97	2	350KCMIL	$375.00	0.0097	0.14259	$12.25	0.171108	$17.64	0.228144	$31.36	2	400KCMIL	$420.00
152	20	24	32	40	0.0404	1.22816	$21.53	1.473792	$31.00	$1.97	$55.12	1	3AWG	$395.20	0.0323	0.98192	$17.21	1.178304	$24.79	1.571072	$44.07	1	2AWG	$471.20	0.0267	0.81168	$14.23	0.974016	$20.49	1.298688	$36.43	1	1AWG	$570.00	0.0222	0.67488	$11.83	0.809856	$17.04	1.079808	$30.29	1	1/0AWG	$691.60
13	148	177.6	236.8	296	0.0124	0.238576	$30.95	0.2862912	$44.57	$0.38	$79.23	2	250KCMIL	$247.00	0.0111	0.213564	$27.70	0.256277	$39.89	0.341702	$70.92	2	300KCMIL	$286.00	0.0102	0.196248	$25.46	0.235498	$36.66	0.3139968	$65.17	2	350KCMIL	$325.00	0.0097	0.186628	$24.21	0.223954	$34.86	0.298605	$61.98	2	400KCMIL	$364.00
214	46	55.2	73.6	92	0.0222	2.185368	$88.11	2.6224416	$126.88	$3.50	$225.57	1	1/0AWG	$973.70	0.0187	1.840828	$74.22	2.208994	$106.88	2.945325	$190.01	1	2/0AWG	$1,187.70	0.0158	1.555352	$62.71	1.866422	$90.30	2.4885632	$160.54	1	3/0AWG	$1,444.50	0.0136	1.338784	$53.98	1.606541	$77.73	2.142054	$138.19	1	4/0AWG	$1,754.80

ENERGY SAVINGS VS. FIRST COST FEEDER SCHEDULE (CONT.)																																											
						50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD					50% DEMAND LOAD		60% DEMAND LOAD		80% DEMAND LOAD				
LENGTH (FEET)	50% DEMAND	60% DEMAN	80% DEMAN	DEMAND LOAD (A)	FACTOR	VOLTAGE DROP	ENERGY LOSS PER	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	EXISTING SIZE CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	1 SIZE LARGER CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	2 SIZES LARGER CU SIZE	COST	FACTOR	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	VOLTAGE DROP	ENERGY LOSS PER YEAR ($)	NO.	3 SIZES LARGER CU SIZE	COST
217	50	60	80	100	0.0222	2.4087	$105.56	2.89044	$152.01	$3.85	$270.24	1	1/0AWG	$987.35	0.0187	2.02895	$88.92	2.43474	$128.05	3.24632	$227.64	1	2/0AWG	$1,204.35	0.0158	1.7143	$75.13	2.05716	$108.19	2.74288	$192.34	1	3/0AWG	$1,464.75	0.0136	1.4756	$64.67	1.77072	$93.12	2.36096	$165.55	1	4/0AWG	$1,779.40
245	46	55.2	73.6	92	0.0222	2.50194	$100.88	3.002328	$145.26	$4.00	$258.25	1	1/0AWG	$1,114.75	0.0187	2.10749	$84.97	2.528988	$122.36	3.371984	$217.53	1	2/0AWG	$1,359.75	0.0158	1.78066	$71.80	2.136792	$103.39	2.849056	$183.80	1	3/0AWG	$1,653.75	0.0136	1.53272	$61.80	1.839264	$88.99	2.452352	$158.21	1	4/0AWG	$2,009.00
244	52.5	63	84	105	0.0222	2.84382	$130.87	3.412584	$188.45	$4.55	$335.01	1	1/0AWG	$1,110.20	0.0187	2.39547	$110.23	2.874564	$158.74	3.832752	$282.20	1	2/0AWG	$1,354.20	0.0158	2.02398	$93.14	2.428776	$134.12	3.238368	$238.43	1	3/0AWG	$1,647.00	0.0136	1.74216	$80.17	2.090592	$115.44	2.787456	$205.23	1	4/0AWG	$2,000.80
80	11.5	13.8	18.4	23	0.0222	0.20424	$2.06	0.245088	$2.96	$0.33	$5.27	1	1/0AWG	$364.00	0.0187	0.17204	$1.73	0.206448	$2.50	0.275264	$4.44	1	2/0AWG	$444.00	0.0158	0.14536	$1.47	0.174432	$2.11	0.232576	$3.75	1	3/0AWG	$540.00	0.0136	0.12512	$1.26	0.150144	$1.82	0.200192	$3.23	1	4/0AWG	$656.00
78	39	46.8	62.4	78	0.0404	1.228968	$42.01	1.4747616	$60.50	$1.97	$107.55	1	3AWG	$202.80	0.0323	0.982566	$33.59	1.179079	$48.37	1.572106	$85.99	1	2AWG	$241.80	0.0267	0.812214	$27.77	0.974657	$39.98	1.2995424	$71.08	1	1AWG	$292.50	0.0222	0.675324	$23.09	0.810389	$33.24	1.080518	$59.10	1	1/0AWG	$354.90
74	41.5	49.8	66.4	83	0.0222	0.681762	$24.80	0.8181144	$35.71	$1.09	$63.49	1	1/0AWG	$336.70	0.0187	0.574277	$20.89	0.689132	$30.08	0.918843	$53.48	1	2/0AWG	$410.70	0.0158	0.485218	$17.65	0.582262	$25.42	0.7763488	$45.18	1	3/0AWG	$499.50	0.0136	0.417656	$15.19	0.501187	$21.88	0.66825	$38.89	1	4/0AWG	$606.80
146	21.5	25.8	34.4	43	0.0404	1.268156	$23.90	1.5217872	$34.41	$2.03	$61.18	1	3AWG	$379.60	0.0323	1.013897	$19.11	1.216676	$27.51	1.622235	$48.91	1	2AWG	$452.60	0.0267	0.838113	$15.79	1.005736	$22.74	1.3409808	$40.43	1	1AWG	$547.50	0.0222	0.696858	$13.13	0.83623	$18.91	1.114973	$33.62	1	1/0AWG	$664.30
204	8	9.6	12.8	16	0.0404	0.659328	$4.62	0.7911936	$6.66	$1.05	$11.84	1	3AWG	$530.40	0.0323	0.527136	$3.70	0.632563	$5.32	0.843418	$9.46	1	2AWG	$632.40	0.0267	0.435744	$3.06	0.522893	$4.40	0.6971904	$7.82	1	1AWG	$765.00	0.0222	0.362304	$2.54	0.434765	$3.66	0.579686	$6.50	1	1/0AWG	$928.20
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
155	12	14.4	19.2	24	0.0404	0.75144	$7.90	0.901728	$11.38	$1.20	$20.23	1	3AWG	$403.00	0.0323	0.60078	$6.32	0.720936	$9.10	0.961248	$16.18	1	2AWG	$480.50	0.0267	0.49662	$5.22	0.595944	$7.52	0.794592	$13.37	1	1AWG	$581.25	0.0222	0.41292	$4.34	0.495504	$6.25	0.660672	$11.12	1	1/0AWG	$705.25
15	94.5	113.4	151.2	189	0.0124	0.17577	$14.56	0.210924	$20.97	$0.28	$37.27	2	250KCMIL	$285.00	0.0111	0.157343	$13.03	0.188811	$18.77	0.251748	$33.36	2	300KCMIL	$330.00	0.0102	0.144585	$11.98	0.173502	$17.25	0.231336	$30.66	2	350KCMIL	$375.00	0.0097	0.1374975	$11.39	0.164997	$16.40	0.219996	$29.16	2	400KCMIL	$420.00
164	20	24	32	40	0.0404	1.32512	$23.23	1.590144	$33.45	$2.12	$59.47	1	3AWG	$426.40	0.0323	1.05944	$18.57	1.271328	$26.74	1.695104	$47.55	1	2AWG	$508.40	0.0267	0.87576	$15.35	1.050912	$22.11	1.401216	$39.30	1	1AWG	$615.00	0.0222	0.72816	$12.76	0.873792	$18.38	1.165056	$32.68	1	1/0AWG	$746.20
13	151	181.2	241.6	302	0.0124	0.243412	$32.22	0.2920944	$46.39	$0.39	$82.47	2	250KCMIL	$247.00	0.0111	0.217893	$28.84	0.261472	$41.53	0.348629	$73.83	2	300KCMIL	$286.00	0.0102	0.200226	$26.50	0.240271	$38.16	0.3203616	$67.84	2	350KCMIL	$325.00	0.0097	0.190411	$25.20	0.228493	$36.29	0.304658	$64.52	2	400KCMIL	$364.00
215	46	55.2	73.6	92	0.0222	2.19558	$88.53	2.634696	$127.48	$3.51	$226.63	1	1/0AWG	$978.25	0.0187	1.84943	$74.57	2.219316	$107.38	2.959088	$190.90	1	2/0AWG	$1,193.25	0.0158	1.56262	$63.00	1.875144	$90.73	2.500192	$161.29	1	3/0AWG	$1,451.25	0.0136	1.34504	$54.23	1.614048	$78.09	2.152064	$138.83	1	4/0AWG	$1,763.00
217	51	61.2	81.6	102	0.0222	2.456874	$109.83	2.9482488	$158.15	$3.93	$281.16	1	1/0AWG	$987.35	0.0187	2.069529	$92.51	2.483435	$133.22	3.311246	$236.83	1	2/0AWG	$1,204.35	0.0158	1.748586	$78.17	2.098303	$112.56	2.7977376	$200.11	1	3/0AWG	$1,464.75	0.0136	1.505112	$67.28	1.806134	$96.89	2.408179	$172.24	1	4/0AWG	$1,779.40
244	46	55.2	73.6	92	0.0222	2.491728	$100.47	2.9900736	$144.67	$3.99	$257.19	1	1/0AWG	$1,110.20	0.0187	2.098888	$84.63	2.518666	$121.86	3.358221	$216.65	1	2/0AWG	$1,354.20	0.0158	1.773392	$71.50	2.12807	$102.96	2.8374272	$183.05	1	3/0AWG	$1,647.00	0.0136	1.526464	$61.55	1.831757	$88.63	2.442342	$157.56	1	4/0AWG	$2,000.80
244	55.5	66.6	88.8	111	0.0222	3.006324	$146.25	3.6075888	$210.60	$4.81	$374.40	1	1/0AWG	$1,110.20	0.0187	2.532354	$123.19	3.038825	$177.40	4.051766	$315.37	1	2/0AWG	$1,354.20	0.0158	2.139636	$104.09	2.567563	$149.88	3.4234176	$266.46	1	3/0AWG	$1,647.00	0.0136	1.841712	$89.59	2.210054	$129.01	2.946739	$229.36	1	4/0AWG	$2,000.80
80	11.5	13.8	18.4	23	0.0222	0.20424	$2.06	0.245088	$2.96	$0.33	$5.27	1	1/0AWG	$364.00	0.0187	0.17204	$1.73	0.206448	$2.50	0.275264	$4.44	1	2/0AWG	$444.00	0.0158	0.14536	$1.47	0.174432	$2.11	0.232576	$3.75	1	3/0AWG	$540.00	0.0136	0.12512	$1.26	0.150144	$1.82	0.200192	$3.23	1	4/0AWG	$656.00
79	39	46.8	62.4	78	0.0404	1.244724	$42.55	1.4936688	$61.27	$1.99	$108.93	1	3AWG	$205.40	0.0323	0.995163	$34.02	1.194196	$48.99	1.592261	$87.09	1	2AWG	$244.90	0.0267	0.822627	$28.12	0.987152	$40.49	1.3162032	$71.99	1	1AWG	$296.25	0.0222	0.683982	$23.38	0.820778	$33.67	1.094371	$59.86	1	1/0AWG	$359.45
75	41.5	49.8	66.4	83	0.0222	0.690975	$25.13	0.82917	$36.19	$1.11	$64.34	1	1/0AWG	$341.25	0.0187	0.582038	$21.17	0.698445	$30.49	0.93126	$54.20	1	2/0AWG	$416.25	0.0158	0.491775	$17.89	0.59013	$25.76	0.78684	$45.79	1	3/0AWG	$506.25	0.0136	0.4233	$15.40	0.50796	$22.17	0.67728	$39.42	1	4/0AWG	$615.00
158	21.5	25.8	34.4	43	0.0404	1.372388	$25.86	1.6468656	$37.24	$2.20	$66.21	1	3AWG	$410.80	0.0323	1.097231	$20.68	1.316677	$29.78	1.75557	$52.93	1	2AWG	$489.80	0.0267	0.906999	$17.09	1.088399	$24.61	1.4511984	$43.76	1	1AWG	$592.50	0.0222	0.754134	$14.21	0.904961	$20.47	1.206614	$36.38	1	1/0AWG	$718.90
216	8	9.6	12.8	16	0.0404	0.698112	$4.90	0.8377344	$7.05	$1.12	$12.53	1	3AWG	$561.60	0.0323	0.558144	$3.91	0.669773	$5.64	0.89303	$10.02	1	2AWG	$669.60	0.0267	0.461376	$3.24	0.553651	$4.66	0.7382016	$8.28	1	1AWG	$810.00	0.0222	0.383616	$2.69	0.460339	$3.87	0.613786	$6.89	1	1/0AWG	$982.80
15	11.5	13.8	18.4	23	0.0404	0.06969	$0.70	0.083628	$1.01	$0.11	$1.80	1	3AWG	$39.00	0.0323	0.055718	$0.56	0.066861	$0.81	0.089148	$1.44	1	2AWG	$46.50	0.0267	0.046058	$0.46	0.055269	$0.67	0.073692	$1.19	1	1AWG	$56.25	0.0222	0.038295	$0.39	0.045954	$0.56	0.061272	$0.99	1	1/0AWG	$68.25
207	12	14.4	19.2	24	0.0404	1.003536	$10.56	1.2042432	$15.20	$1.61	$27.02	1	3AWG	$538.20	0.0323	0.802332	$8.44	0.962798	$12.15	1.283731	$21.60	1	2AWG	$641.70	0.0267	0.663228	$6.98	0.795874	$10.05	1.0611648	$17.86	1	1AWG	$776.25	0.0222	0.551448	$5.80	0.661738	$8.35	0.882317	$14.85	1	1/0AWG	$941.85
15	94.5	113.4	151.2	189	0.0124	0.17577	$14.56	0.210924	$20.97	$0.28	$37.27	2	250KCMIL	$285.00	0.0111	0.157343	$13.03	0.188811	$18.77	0.251748	$33.36	2	300KCMIL	$330.00	0.0102	0.144585	$11.98	0.173502	$17.25	0.231336	$30.66	2	350KCMIL	$375.00	0.0097	0.1374975	$11.39	0.164997	$16.40	0.219996	$29.16	2	400KCMIL	$420.00
176	20	24	32	40	0.0404	1.42208	$24.93	1.706496	$35.90	$2.28	$63.82	1	3AWG	$457.60	0.0323	1.13696	$19.93	1.364352	$28.70	1.819136	$51.02	1	2AWG	$545.60	0.0267	0.93984	$16.48	1.127808	$23.73	1.503744	$42.18	1	1AWG	$660.00	0.0222	0.78144	$13.70	0.937728	$19.73	1.250304	$35.07	1	1/0AWG	$800.80
13	154.5	185.4	247.2	309	0.0124	0.249054	$33.73	0.2988648	$48.57	$0.40	$86.34	2	250KCMIL	$247.00	0.0111	0.222944	$30.19	0.267532	$43.48	0.35671	$77.29	2	300KCMIL	$286.00	0.0102	0.204867	$27.74	0.24584	$39.95	0.3277872	$71.02	2	350KCMIL	$325.00	0.0097	0.1948245	$26.38	0.233789	$37.99	0.311719	$67.54	2	400KCMIL	$364.00
227	6.5	7.8	10.4	13	0.0404	0.596102	$3.40	0.7153224	$4.89	$0.95	$8.69	1	3AWG	$590.20	0.0323	0.476587	$2.72	0.571904	$3.91	0.762538	$6.95	1	2AWG	$703.70	0.0267	0.393959	$2.24	0.47275	$3.23	0.6303336	$5.75	1	1AWG	$851.25	0.0222	0.327561	$1.87	0.393073	$2.69	0.524098	$4.78	1	1/0AWG	$1,032.85
9	9	10.8	14.4	18	0.0404	0.032724	$0.26	0.0392688	$0.37	$0.05	$0.66	1	3AWG	$23.40	0.0323	0.026163	$0.21	0.031396	$0.30	0.041861	$0.53	1	2AWG	$27.90	0.0267	0.021627	$0.17	0.025952	$0.25	0.0346032	$0.44	1	1AWG	$33.75	0.0222	0.017982	$0.14	0.021578	$0.20	0.028771	$0.36	1	1/0AWG	$40.95
228	92.5	111	148	185	0.0158	3.33222	$270.17	3.998664	$389.05	$5.33	$691.64	1	3/0AWG	$1,539.00	0.0136	2.86824	$232.55	3.441888	$334.87	4.589184	$595.33	1	4/0AWG	$1,869.60	0.0124	2.61516	$212.03	3.138192	$305.33	4.184256	$542.80	1	250KCMIL	$2,166.00	0.0111	2.34099	$189.80	2.809188	$273.32	3.745584	$485.90	1	300KCMIL	$2,508.00
18	51	61.2	81.6	102	0.0222	0.203796	$9.11	0.2445552	$13.12	$0.33	$23.32	1	1/0AWG	$81.90	0.0187	0.171666	$7.67	0.205999	$11.05	0.274666	$19.65	1	2/0AWG	$99.90	0.0158	0.145044	$6.48	0.174053	$9.34	0.2320704	$16.60	1	3/0AWG	$121.50	0.0136	0.124848	$5.58	0.149818	$8.04	0.199757	$14.29	1	4/0AWG	$147.60
10	29	34.8	46.4	58	0.0124	0.03596	$0.91	0.043152	$1.32	$0.06	$2.34	1	250KCMIL	$95.00	0.0111	0.03219	$0.82	0.038628	$1.18	0.051504	$2.09	1	300KCMIL	$110.00	0.0102	0.02958	$0.75	0.035496	$1.08	0.047328	$1.92	1	350KCMIL	$125.00	0.0097	0.02813	$0.72	0.033756	$1.03	0.045008	$1.83	1	400KCMIL	$140.00
39	12	14.4	19.2	24	0.0158	0.073944	$0.78	0.0887328	$1.12	$0.12	$1.99	1	3/0AWG	$263.25	0.0136	0.063648	$0.67	0.076378	$0.96	0.101837	$1.71	1	4/0AWG	$319.80	0.0124	0.058032	$0.61	0.069638	$0.88	0.0928512	$1.56	1	250KCMIL	$370.50	0.0111	0.051948	$0.55	0.062338	$0.79	0.083117	$1.40	1	300KCMIL	$429.00
12	13.5	16.2	21.6	27	0.0124	0.020088	$0.24	0.0241056	$0.34	$0.03	$0.61	1	250KCMIL	$114.00	0.0111	0.017982	$0.21	0.021578	$0.31	0.028771	$0.54	1	300KCMIL	$132.00	0.0102	0.016524	$0.20	0.019829	$0.28	0.0264384	$0.50	1	350KCMIL	$150.00	0.0097	0.015714	$0.19	0.018857	$0.27	0.025142	$0.48	1	400KCMIL	$168.00
275	46.5	55.8	74.4	93	0.0136	1.7391	$70.88	2.08692	$102.07	$2.78	$181.46	1	4/0AWG	$2,255.00	0.0124	1.58565	$64.63	1.90278	$93.06	2.53704	$165.45	1	250KCMIL	$2,612.50	0.0111	1.419413	$57.85	1.703295	$83.31	2.27106	$148.10	1	300KCMIL	$3,025.00	0.0102	1.304325	$53.16	1.56519	$76.55	2.08692	$136.09	1	350KCMIL	$3,437.50
304	52	62.4	83.2	104	0.0136	2.149888	$97.99	2.5798656	$141.11	$3.44	$250.85	1	4/0AWG	$2,492.80	0.0124	1.960192	$89.34	2.35223	$128.66	3.136307	$228.72	1	250KCMIL	$2,888.00	0.0111	1.754688	$79.98	2.105626	$115.17	2.8075008	$204.74	1	300KCMIL	$3,344.00	0.0102	1.612416	$73.49	1.934899	$105.83	2.579866	$188.14	1	350KCMIL	$3,800.00
334	48	57.6	76.8	96	0.0136	2.180352	$91.73	2.6164224	$132.10	$3.49	$234.84	1	4/0AWG	$2,738.80	0.0124	1.987968	$83.64	2.385562	$120.44	3.180749	$214.12	1	250KCMIL	$3,173.00	0.0111	1.779552	$74.87	2.135462	$107.81	2.8472832	$191.67	1	300KCMIL	$3,674.00	0.0102	1.635264	$68.80	1.962317	$99.07	2.616422	$176.13	1	350KCMIL	$4,175.00
361	50.5	60.6	80.8	101	0.0136	2.479348	$109.75	2.9752176	$158.04	$3.97	$280.95	1	4/0AWG	$2,960.20	0.0124	2.260582	$100.06	2.712698	$144.09	3.616931	$256.16	1	250KCMIL	$3,429.50	0.0111	2.023586	$89.57	2.428303	$128.98	3.2377368	$229.31	1	300KCMIL	$3,971.00	0.0102	1.859511	$82.31	2.231413	$118.53	2.975218	$210.71	1	350KCMIL	$4,512.50

Conclusion

The initial cost of the conductor increases exponentially as the size is increased however; the payback period of this initial cost is not too long. After about 5 years the hospital would be making additional cost savings with larger feeder sizes. The reason that energy is saved by just increasing the size of a conductor is because there is less resistance in larger conductors. The

Figure 109 | Energy Cost Savings vs. Initial Cost Summary Graph

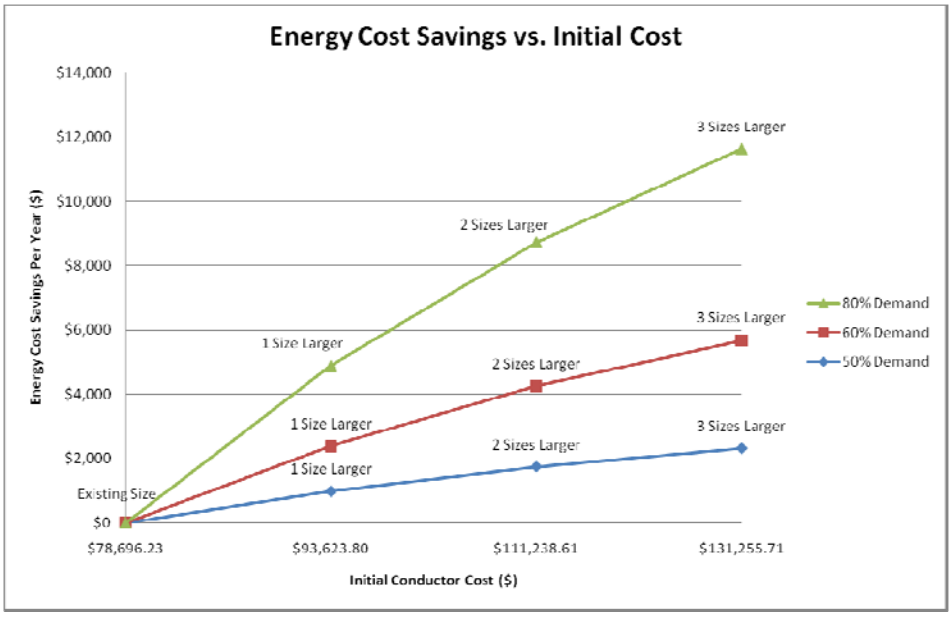


Figure 110 | Energy Cost Savings vs. Initial Cost Summary at Different Demand Loads

SUMMARY OF ENERGY SAVINGS PER YEAR - 60% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$9,688.22	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$8,282.68	$1,405.55	10.6
2 SIZES LARGER	$111,238.61	$32,542.38	$7,172.92	$2,515.30	12.9
3 SIZES LARGER	$131,255.71	$52,559.48	$6,337.81	$3,350.41	15.7

SUMMARY OF ENERGY SAVINGS PER YEAR - 50% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$6,727.93	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$5,751.86	$976.08	15.3
2 SIZES LARGER	$111,238.61	$32,542.38	$4,981.20	$1,746.74	18.6
3 SIZES LARGER	$131,255.71	$52,559.48	$4,401.26	$2,326.67	22.6

SUMMARY OF ENERGY SAVINGS PER YEAR - 80% DEMAND LOAD ($)					
	INITIAL CONDUCTOR COST ($)	INITIAL COST DIFFERENCE ($)	ENERGY LOSS PER YEAR ($)	ENERGY COST SAVINGS PER YEAR ($)	SIMPLE PAYBACK PERIOD (YRS)
EXISTING SIZE	$78,696.23	-	$17,223.51	-	-
1 SIZE LARGER	$93,623.80	$14,927.57	$14,724.76	$2,498.75	6.0
2 SIZES LARGER	$111,238.61	$32,542.38	$12,751.87	$4,471.64	7.3
3 SIZES LARGER	$131,255.71	$52,559.48	$11,267.22	$5,956.29	8.8

Protective Device Coordination Study

A protective device coordination study that addresses a single-path through Franklin Square Hospital Center's distribution system was performed to ensure the system is able to clear the fault current in the least amount of time possible. The path passes through transformer T-2S3 located in Unit Substation 3 to the Switchboard within the Substation. From there the path enters the Distribution Panel FDP-1 to the Panel Board LP11. The path can be seen in figures 110 and 111 below.

The overlay of three time current curves provided by Eaton, in figure 112 shows that this single-path through the distribution system is not coordinated. The 100A and 800A breakers are coordinated but the 2500A breaker overlaps with the time current curve of the 800A. The overlap may lead the 2500A breaker to trip first which would short out the feeders and equipment.

The distribution system specifies a 3000A circuit breaker instead of a 2500A breaker. Unfortunately a time current curve could not be obtained for a 3000A circuit breaker to check the coordination between the 800A and 100A breakers. If no overlap between the breakers, the system will perform correctly with the smaller circuit breaker tripping before the larger breaker trips.

See Appendix B for Time Current Curve Cut Sheets

Figure 111 | Location of Protective Device Coordination Path

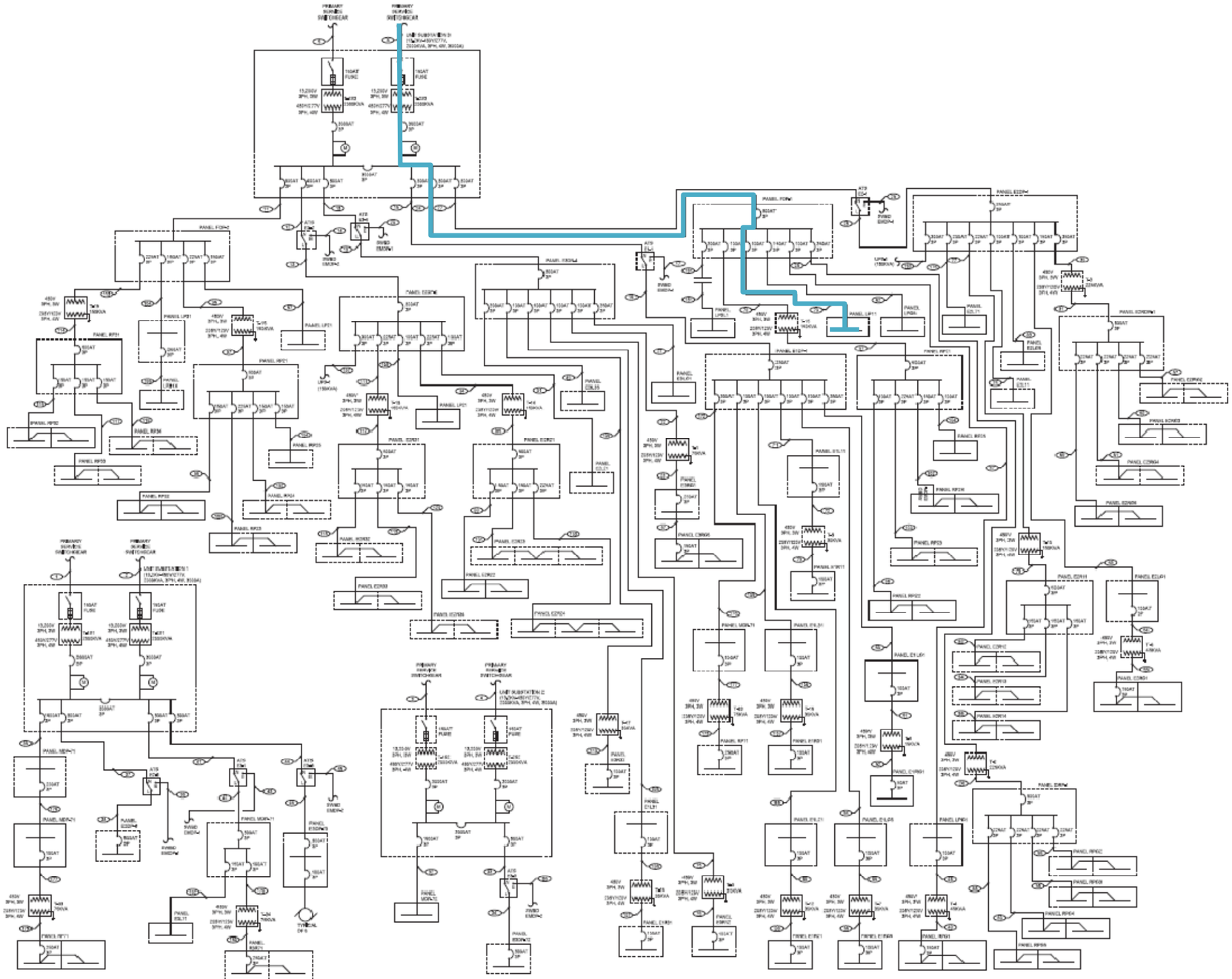


Figure 112 | Simplified Protective Device Coordination Path

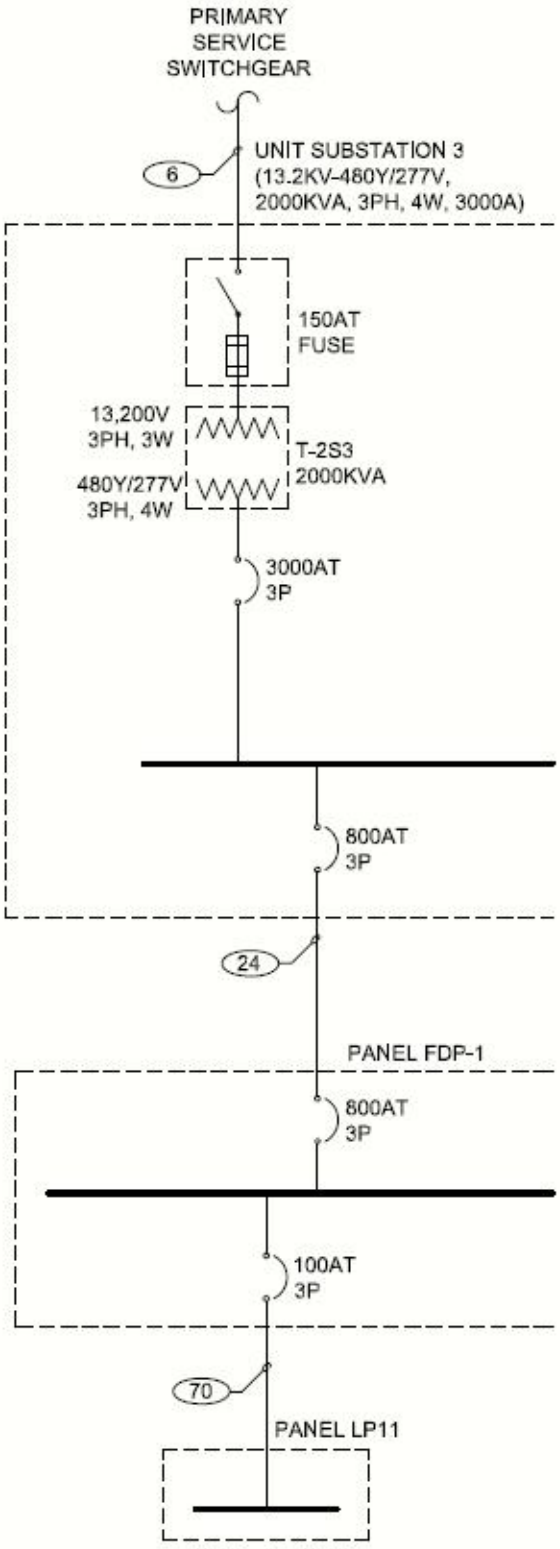
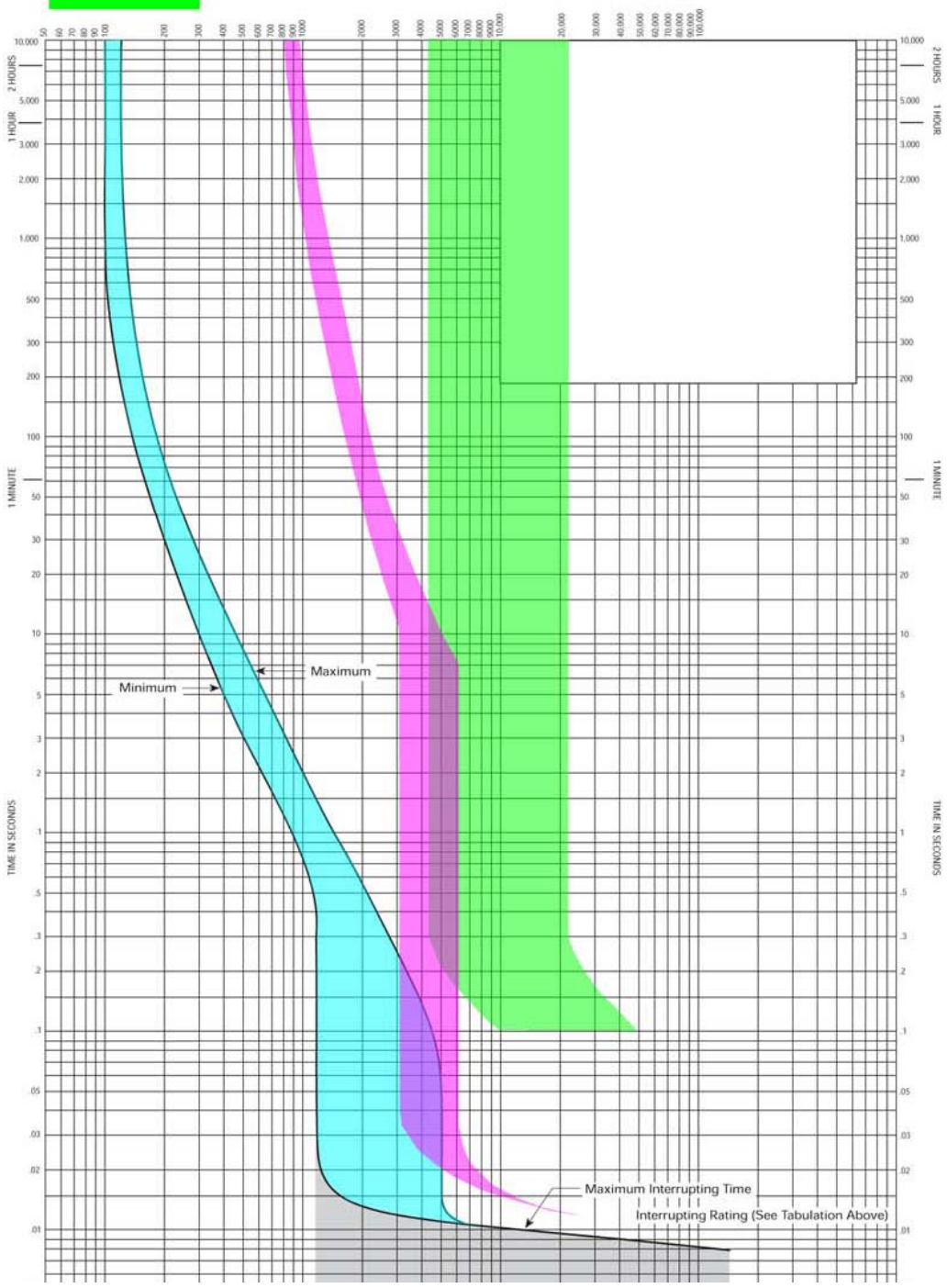


Figure 113 | Trip Curves

Series AB DE-ION GHC – 100A

Series C, M-Frame Type MDLB – 800A

Series C, R-Frame Type CRD – 2500A



Short Circuit Analysis

A short circuit analysis determines the maximum interrupting capacities of a distribution system. The following short circuit analysis provides a calculation at each component along the one-path via the per unit method. Since the building is still under construction the utility short circuit is unknown and assumed to be 100,000kVA.

Figure 114 | Short Circuit Analysis

SHORT CIRCUIT ANALYSIS (PER UNIT METHOD)								
		System Voltage		480				
		Base KVA		2000	∑ X	∑ R	∑ Z	I_{sc}(A)
		Utility Company Available Fault (kVA)		100000				
Utility Primary								
		$X_{(p.u.)} = (KVA_{base}) / (Utility\ S.C.\ KVA)$	=	0.02	0.02	0	0.02	**120281.3**
Transformer Secondary								
%Z =	5.75	$X_{(p.u.)} = (\%X * KVA_{base}) / (100 * KVA_{xfrmr})$	=	0.0548	0.0748	0.00457	0.074939	**32100.92**
X/R =	12	$R_{(p.u.)} = (\%R * KVA_{base}) / (100 * KVA_{xfrmr})$	=	0.00457				
%X =	5.48							
%R =	0.457							
KVA =	2000							
Switchboard								
Wire =	500	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.001011	0.075811	0.005208	0.07599	**31657.16**
Length =	20	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.000638				
Sets =	8							
X =	0.0466							
R =	0.0294							
Distribution Panel FDP-1								
Wire =	300	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.005991	0.081803	0.010725	0.082503	**29158.14**
Length =	42	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.005517				
Sets =	3							
X =	0.0493							
R =	0.0454							
Panel Board LP11								
Wire =	3	$X_{(p.u.)} = (L * X_L * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.065498	0.147301	0.287357	0.322911	**7449.802**
Length =	124	$R_{(p.u.)} = (L * R * KVA_{base})/ (1000^2 * Sets * KV^2)$	=	0.276632				
Sets =	1							
X =	0.06085							
R =	0.257							

Unlike the coordination study above provided by Eaton time current curves, a 100A, 800A, and 3000A breaker were analyzed. In the short circuit analysis summary the available fault for each unit shows that the smaller breakers will trip before the larger circuit breakers.

Figure 115 | Short Circuit Analysis Summary

SHORT CIRCUIT ANALYSIS SUMMARY		
Unit Location	Available Fault (A)	Standard Breaker Rating (A)
Substation 3 transformer - T-2S3	32,101	65,000
Substation 3 Switchboard	31,657	50,000
Distribution Panel FDP-1	29,159	50,000
Panelboard LP11	7,450	14,000

Acoustical Breadth

Overview

The emergency room waiting area in Franklin Square Hospital Center has numerous functions. It is located next to the emergency room entrance canopy so the main entrance is a lobby and reception area. After the patron visits the receptionist they are directed to the waiting area or the pediatric waiting area. The specialized waiting area for pediatric patients is located to the left and to the right are two emergency waiting rooms. The space is an open plan with decorative wood and glass partition dividing the two emergency rooms. Other then the entrance vestibule which divides the pediatric and emergency waiting areas, the designated areas within the overall space flow into each other.

Open plans such as this, often cause acoustical problems. Noise will travel from one area to another since there are no boundaries. With a pediatric emergency wing, the hospital will care for many younger patients. Children seem to have a tolerance for louder behaviors and in this space their voices will travel over to the reception area and into the other emergency waiting areas. This is an undesirable solution therefore the acoustical reverberation time of the existing pediatric emergency waiting area will be calculated. Proposed scenarios will be calculated to improve the existing acoustical design.

Space Overview:

Area: 513.3 ft^2

Length: Approximately 32.5 ft

Width: Approximately 16.6 ft

Figure 116 | Emergency Lobby and Waiting Area

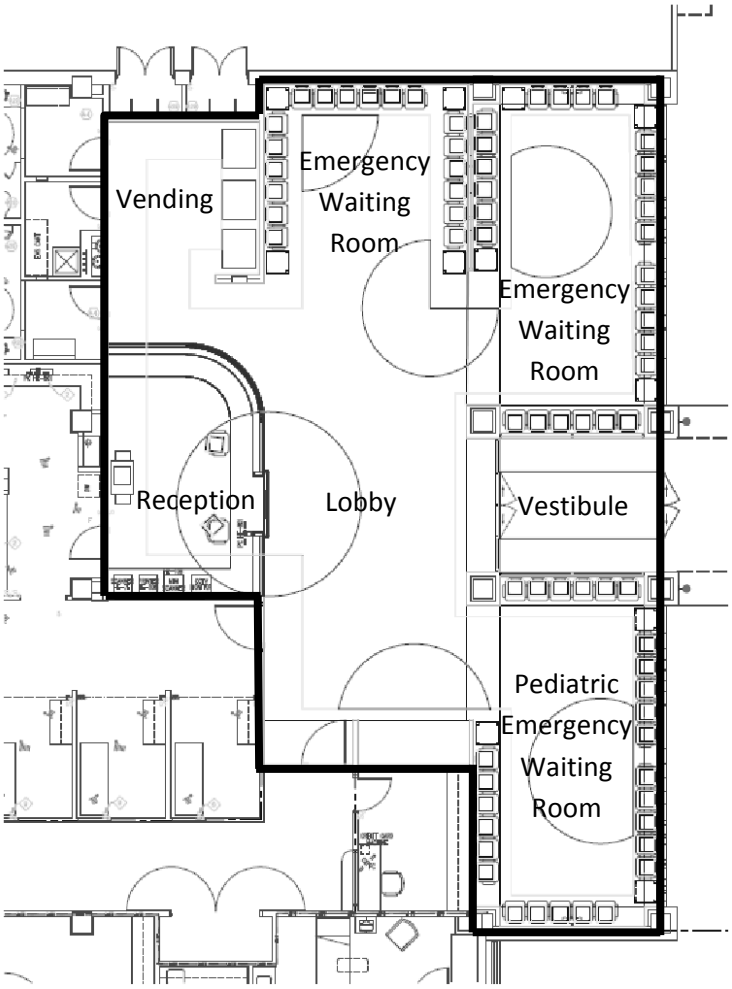
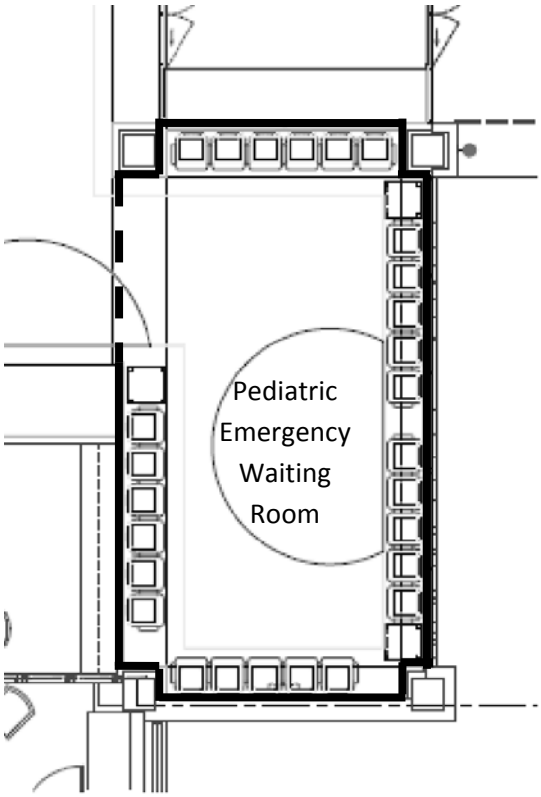


Figure 117 | Pediatric Emergency Waiting Area



Design Criteria

The acoustical analysis of the pediatric emergency waiting room will focus on the reverberation of six frequencies. The space is considered to be in the category of a lobby and large meeting room which has a preferred reverberation time of 0.65 to 0.75. The reverberation time is calculated using the Sabine formula:

Existing Condition

After calculating the average reverberation time of the existing conditions, the T_{60} time was below the desired criteria. The space is not "dead" but the absorption coefficients of some materials are high, such as the acoustical tile located on the ceiling. The open space is 100% absorptive meaning all of the sound is lost through the opening. Sound waves cannot be reflected since there is no surface present. Materials within the space will be adjusted to meet the desired reverberation time. The linoleum tile on concrete floor is a hard surface that reflects the sound. More reflective materials will be used to redesign the acoustical environment.

Figure 118 | Existing Acoustical Conditions

Existing Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Linoleum on Concrete	513.3	0.02	0.03	0.03	0.03	0.03	0.02
Walls	5/8" GWB on 2x4 Studs	358.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Ceiling	Gypsum Board	214.7	0.29	0.10	0.10	0.10	0.07	0.02
Ceiling	Acoustic Tile 3/4"	351.0	0.72	0.84	0.70	0.79	0.76	0.81
Opening	N/A	90.0	0.75	0.75	0.75	0.75	0.75	0.75
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	15.40	15.40	15.40	15.40	10.27
	103.88	35.82	17.91	14.33	25.07	32.24
	187.50	85.23	61.36	40.91	23.86	13.64
	62.26	21.47	21.47	21.47	15.03	4.29
	252.72	294.84	245.70	277.29	266.76	284.31
	67.50	67.50	67.50	67.50	67.50	67.50
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79
$a = \sum S\alpha$	699.51	550.22	474.70	491.17	463.04	460.03
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.33	0.42	0.49	0.47	0.50	0.51

Average T_{60}	**0.46**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Proposed Scenarios

Proposed Scenario 1

Scenario one encloses the pediatric emergency waiting room area by extending the gypsum board on 2x4 stud walls and adding a wooden door. The flooring material is replaced with a more absorptive carpet material while the acoustical ceiling tile is replaced with a less absorptive material of gypsum board. These changes increase the reverberation time by .21 seconds, placing it within the desired range.

Figure 119 | Proposed Acoustical Conditions

Proposed Scenario 1 - Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Carpet, heavy, on concrete	513.3	0.02	0.06	0.14	0.37	0.60	0.65
Walls	5/8" GWB on 2x4 Studs	420.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Doors	Solid core wood panel, 1 3/4"	28.0	0.10	0.07	0.05	0.04	0.04	0.04
Ceiling	Gypsum Board	565.7	0.29	0.10	0.10	0.10	0.07	0.02
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	30.80	71.86	189.92	307.98	333.65
	121.86	42.02	21.01	16.81	29.41	37.82
	187.50	85.23	61.36	40.91	23.86	13.64
	2.80	1.96	1.40	1.12	1.12	1.12
	164.05	56.57	56.57	56.57	39.60	11.31
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79
$a = \sum S\alpha$	501.86	246.54	257.56	359.60	451.39	445.32
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.46	0.95	0.91	0.65	0.52	0.52

Average T_{60}	**0.67**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Proposed Scenario 2

The second scenario resembles the existing condition leaving the opening space intact. The flooring material was replaces with carpet and the ceiling material replaced with gypsum board. The reverberation time calculated from this analysis was determined to be 0.56 seconds which is below the preferred range.

Figure 120 | Proposed Acoustical Conditions

Proposed Scenario 2 - Pediatric Waiting Room Reverberation Time								
Surface	Material	Area (ft^2)	Absorbtion Coefficient					
			125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
Floor	Carpet, heavy, on concrete	513.3	0.02	0.06	0.14	0.37	0.60	0.65
Walls	5/8" GWB on 2x4 Studs	358.2	0.29	0.10	0.05	0.04	0.07	0.09
Storefront Walls	Glass 3/32"	340.9	0.55	0.25	0.18	0.12	0.07	0.04
Ceiling	Gypsum Board	565.7	0.29	0.10	0.10	0.10	0.07	0.02
Opening	N/A	90.0	0.75	0.75	0.75	0.75	0.75	0.75
Chairs	Fabric upholstered seats, unoccupied	81.0	0.19	0.37	0.56	0.67	0.61	0.59

	Sα					
	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz
	10.27	30.80	71.86	189.92	307.98	333.65
	103.88	35.82	17.91	14.33	25.07	32.24
	187.50	85.23	61.36	40.91	23.86	13.64
	164.05	56.57	56.57	56.57	39.60	11.31
	67.50	67.50	67.50	67.50	67.50	67.50
Volume = 4663.3 ft^3	15.39	29.97	45.36	54.27	49.41	47.79

$a = \sum S\alpha$	548.58	305.88	320.56	423.50	513.43	506.12
$T_{60} = .05\ V/a = .05\ V/\sum S\alpha$	0.43	0.76	0.73	0.55	0.45	0.46

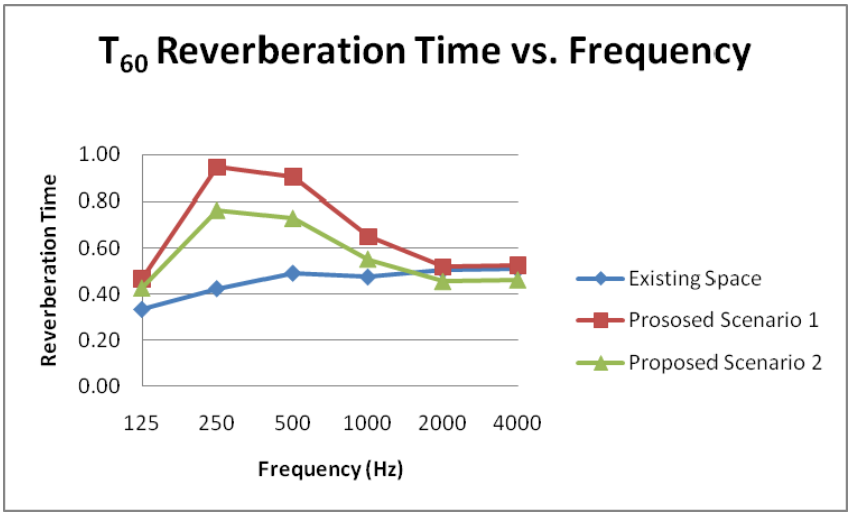
Average T_{60}	**0.56**
Target Reverberation Time	$0.65 \leq T \leq 0.75$

Conclusion

Human speech ranges across all frequencies from 80Hz to a peak at 1-3 kHz. The definition of pediatrics is the branch of medicine concerned with infants and children. This younger group of people tend to have a higher voice frequency until puberty is reached therefore the high frequency of 2-4 kHz is low in all designs.

The graph below shows the details of the reverberant conditions previously calculated. Scenario 1 has the highest reverberant times for all the frequencies listed, though it is still lower in the high frequencies. The low frequency bands of 250 and 500 Hz are not problematic in a waiting room setting.

Figure 121 | Reverberation Time vs. Frequency Graph



The existing design and scenario 2 do not meet the desired reverberation time criteria. Both designs incorporate the open area between the adjacent spaces. All the sound lost in this area is essential to reach the preferred range of reverberation time. When the space is enclosed in scenario 1, the sound is reflected back into the space allowing the desired criteria to be met.

The open space allows the adjacent noise to enter the pediatric emergency waiting room. This additional noise would possibly mask the conversations in the space leading to an elevated sound level as people speak louder to be heard. Also the noise created within the space will also travel throughout the rest of the adjacent spaces. This could lead to uncomfortable noise levels and annoyance with other patrons. Enclosing the space would diminish the noise of the children escaping as well as meet the preferred reverberation time.

Mechanical Breadth

Overview

The emergency waiting room areas, lobby and vestibule are located on the ground floor on the east side of the building which is approximately 45° north of east. The exterior wall is constructed of a glass store-front curtain wall. The heating and cooling loads are affected by this large amount of glass. The pediatric emergency waiting area's existing store-front glazing will be analyzed using Trane TRACE 700 software. The existing condition will then be compared to an alternative exterior glazing system. The glazing with a low coiling coil total capacity and a lower magnitude heating coil total capacity is desired to create a more efficient mechanical system. Average monthly energy consumption will also be considered.

Existing Conditions

The existing pediatric emergency waiting area has an exterior wall that is approximately 95% insulating glazing. The room is served by a variable volume reheat system. The cooling system is supplied and returned by ceiling diffusers. The heating is supplied from the floor and returned from ceiling diffusers.

Proposed Scenario

When assigning a different glazing type, the main variables addressed were the U-factor and the shading coefficient (Figure 121). The U-factor measures the conduction across the surface of the glazing. The conduction heating load is affect by implementing glazing with different U-factors. The shading coefficient variable indicated how much solar energy penetrates the interior space. This directly contributes to the cooling loads of the system due to solar radiation. Multiplying the shading coefficient by 0.87 computes the solar heat gain coefficient (SHGC).

By increasing the U-factor, shading coefficient and the SHGC in the proposed scenario the heating and cooling load magnitudes will vary.

Figure 122 | Existing and Proposed Conditions

	GLAZING TYPE	U-FACTOR (Btu/h-ft^2-°F)	SHADING COEFFICIENT	SOLAR HEAT GAIN COEFFICIENT
EXISTING CONDITION	6mm Dbl Low-E (e2=.04) Clr 13mm Argon	0.233	0.48	0.4176
PROPOSED SCENARIO	6mm Dbl Low-E (e3=.2) Clr 13mm Argon	0.295	0.79	0.6873

Results

The following graphs summarize the results calculated by Trane TRACE 700. The energy consumption and the cooling and heating loads are based on the existing mechanical system. Electric energy consumed is based on the cooling loads while the gas energy consumed is based on the heating loads of their respective scenarios

Figure 123 | Cooling and Heating Load Bar Graph

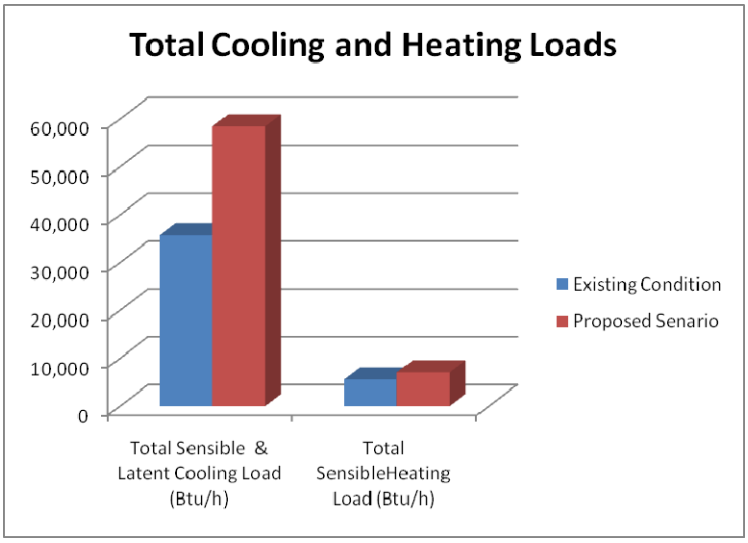


Figure 124 | Monthly Electric Energy Consumption Graph

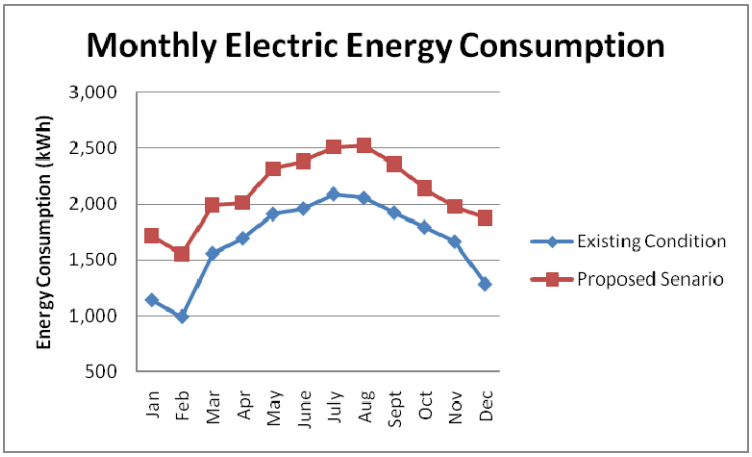


Figure 125 | Monthly Gas Energy Consumption Graph

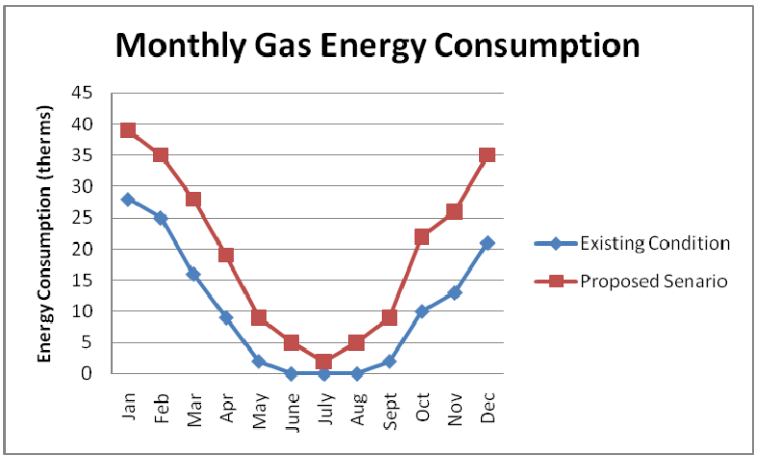


Figure 126 | Existing Condition Cooling Load Graph

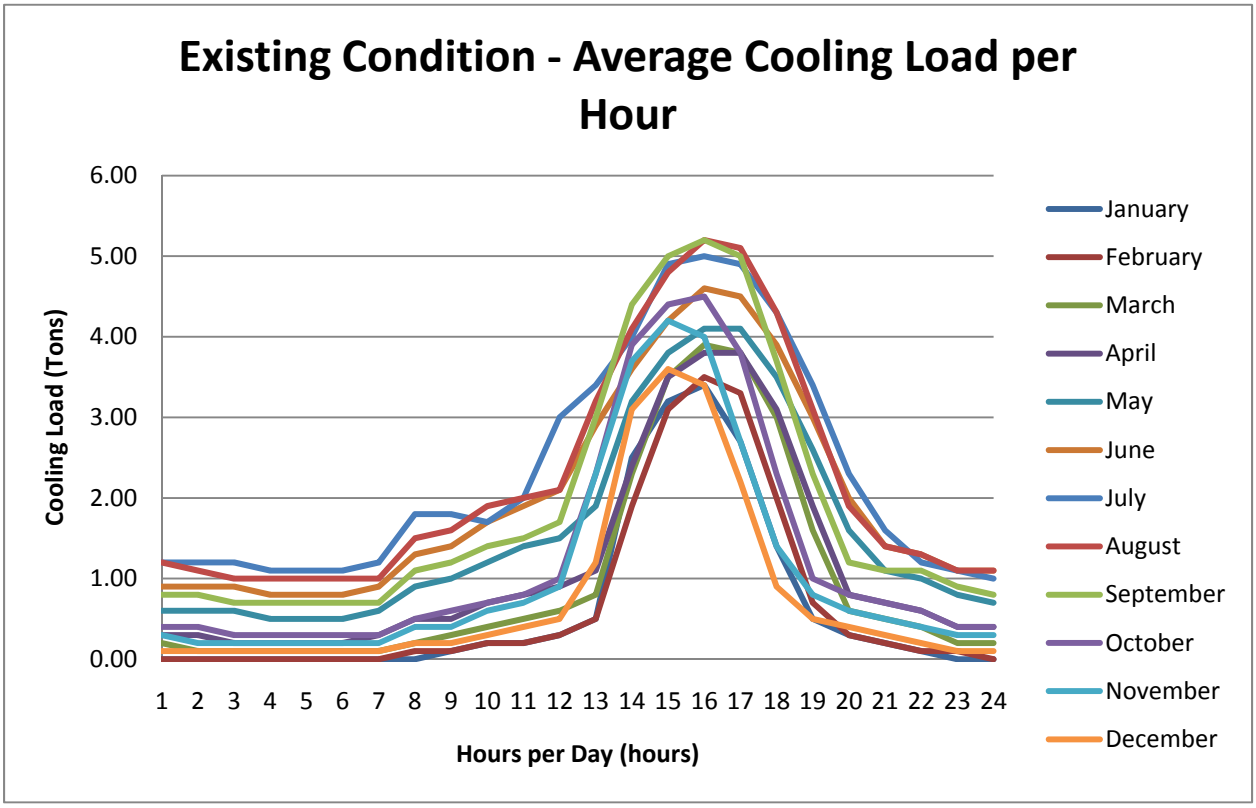


Figure 127 | Proposed Scenario Cooling Load Graph

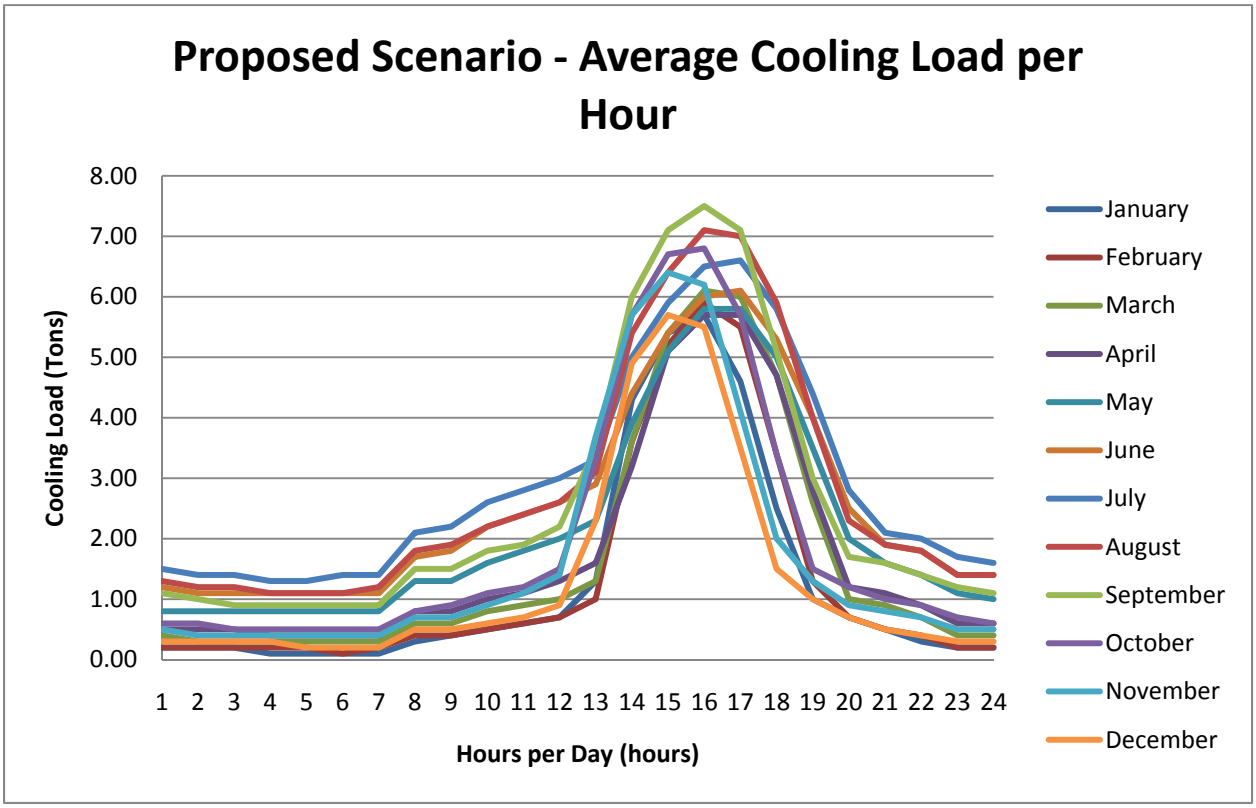


Figure 128 | Existing Condition Heating Load Graph

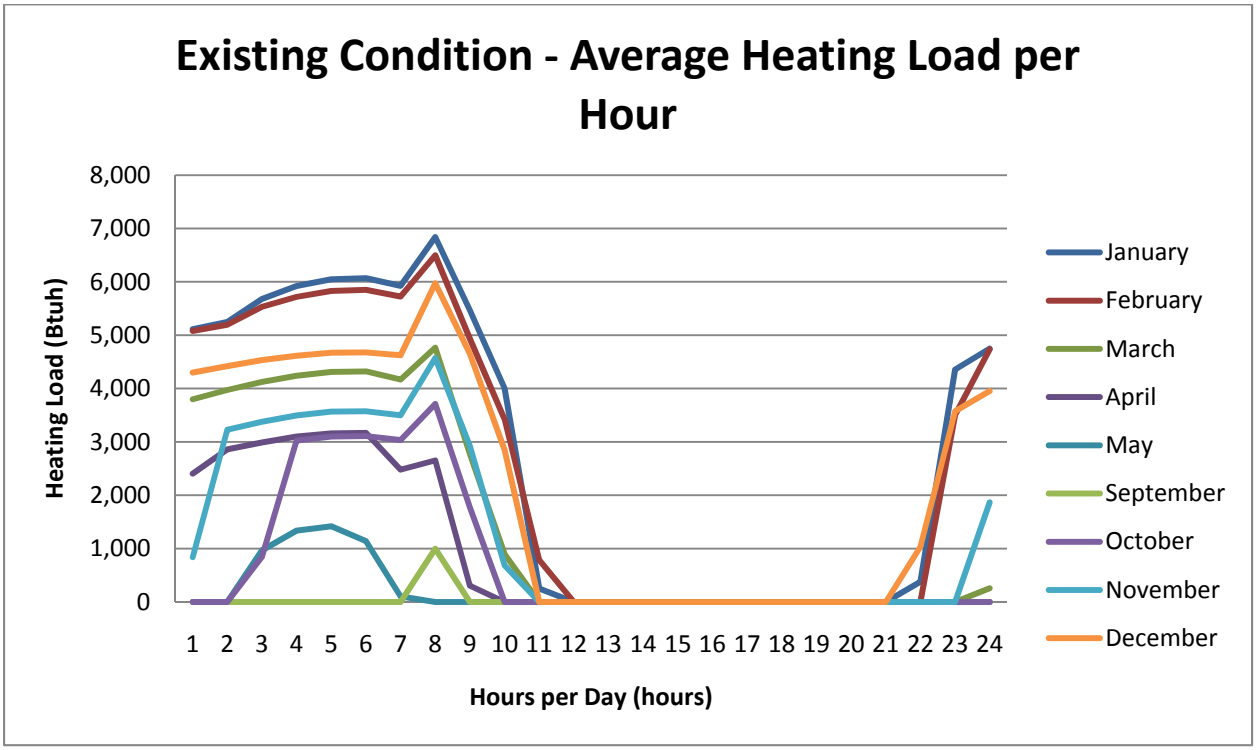
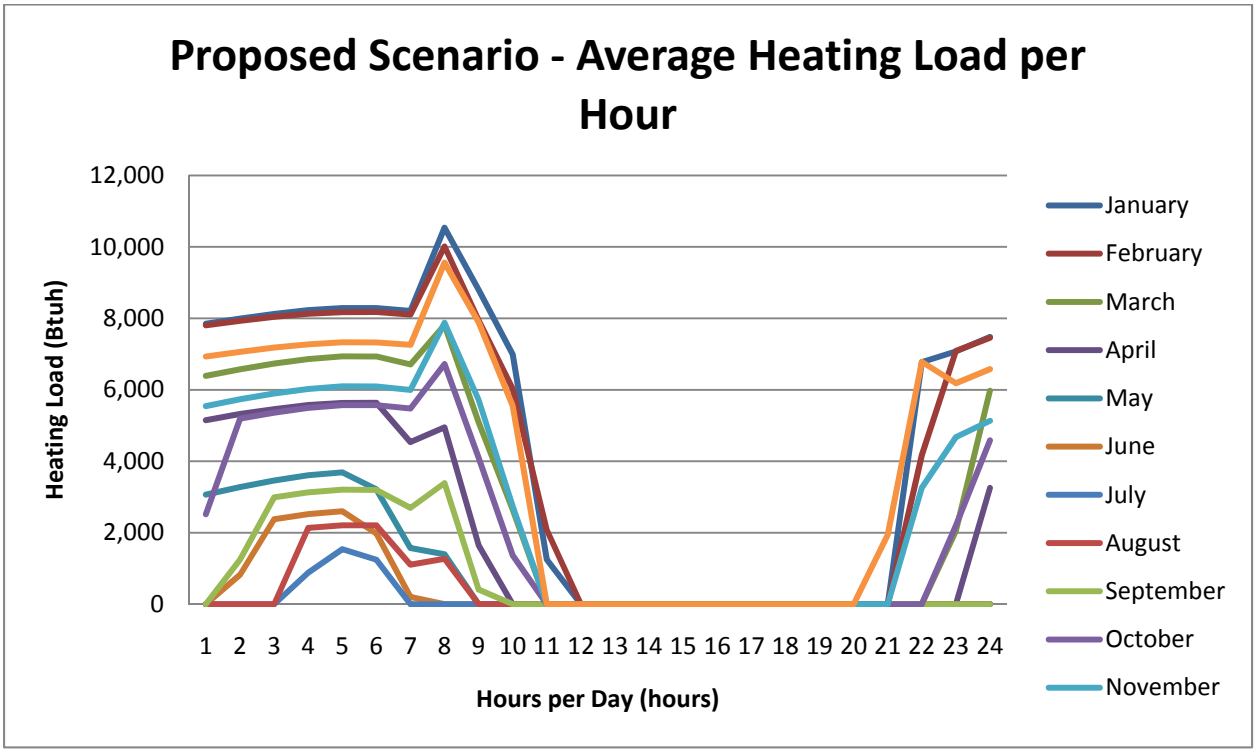


Figure 129 | Proposed Scenario Heating Load Graph



Conclusion

Based on the results above, the existing condition has a 35,684 Btu/h cooling load and a 5,548 Btu/h heating load while the proposed scenario has a 58,430 Btu/h cooling load and a 7,049 heating load. These numbers reflect the change of solar radiation in the space as a result of the shading coefficient and SHGC as well as the heat loss from the U-factor variable.

Overall, the existing condition has a more efficient glazing based on the heating and cooling loads. The proposed scenario consumes an additional 12% electric energy and 31% more gas energy when compared to the existing condition. Since Baltimore has a drastic change of seasons from winter to summer the proposed scenario glazing is not effective. The proposed glazing is more suited for a location with a mild climate change such as San Francisco, California.

See Appendix C for Trane TRACE 700 Results

Summary + Conclusions

The main goal of this final thesis report was to understand how the building is affected when small details within different building systems are altered. Proving whether or not the proposed scenario was an advantage entailed research, cost analyses, comparisons, aesthetics, life cycle costs and so forth. The intent was to comprehend that all the building systems rely on each other to perform efficiently.

The lighting design was intended to improve the functionality of the building, especially the four spaces redesigned. Better lighting designs lead to more productivity. In the case of a hospital, productivity is highly important. Increased productivity increases patient care. The desired outcome was to create a lighting design that was aesthetically pleasing for patients but also a very effective working area for the doctors and nurses.

A lighting redesign is not complete without a revaluation of the electrical system. The lighting loads were reviewed and resized on the respective panel boards to properly carry the new loads. The short circuit and coordination study proves that the breakers will perform correctly if a fault were to occur. Conductor materials have different properties and cross dimensional areas sometimes leading to upsizing conduits. This increased cost occasionally defeats the purpose of using different conductor materials. Voltage drop calculations determine that increasing wire sizes saves a substantial amount of energy. The increased conductor size initially increases the cost but over a time period the life cycle cost of the system will end up saving additional money.

Room acoustics are based on the material properties present in the space. Reverberation time is based on the absorption coefficients of all the surfaces within the space. Auditoriums are usually large volume reverberant areas while others such as the pediatric emergency waiting are small undesirably acoustically dead. Proposed options configure several reverberation times by changing the specification of well known materials to create a more comfortable place to spend time.

A proposed scenario to change a store front glazing greatly affected the mechanical system. The effect was so drastic that the proposed scenario was disregarded. The pediatric emergency waiting room has an exterior glazing façade that directly impacts the heating and cooling demand loads. Daylight penetration and cold winters are major criteria for selecting a glazing material with the proper qualities.

Through the research and proposed design changes found in this report, Franklin Square Hospital Center will be able to increase their productivity and improve the medical care to patients.

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Adobe Photoshop CS3

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Friends, Family and especially my fellow AE Students

Appendix A | Lighting

Appendix B | Electrical

Appendix C | Mechanical