Senior Thesis Final Report

Pennsylvania State Employees Credit Union Corporate Headquarters

Harrisburg, PA

Sarah Wujcik | Lighting + Electrical
Faculty Advisor: Dr. Houser | Professor Dannerth
04.04.2012

Pennsylvania State Employees Credit Union Corporate Headquarters

STATISTICS

location | harrisburg, pa
size | 234,000 sq.ft.
stories | 3 above grade
construction | August 2011 - August 2013
Cost | $54.6 million
Delivery Method | design-bid-build

BUILDING TEAM

owner | Pennsylvania State Employees Credit Union
cm | Quandel Construction Services
architect | Crabtree, Rohrbaugh & Associates
mep | BALA Consulting Engineers
civil | Kurowski & Wilson Engineers Consultants
lighting | Grenald Waldron Associates
structural | Centerpoint Engineering Inc
codes | Protection Engineering Group

ARCHITECTURE

- clean, modern aesthetic brings outside in through large glass curtain walls, views, and sustainable materials
- muti-use structure with offices, daycare, conference center, and fitness center

STRUCTURAL

- exposed steel structure consisting of W12 shapes with various weights
- foundation consists of spread footings and strip footings
- raised floor system on top of composite metal deck system
- lateral resistant system consisting of ordinary steel concentrically braced frames in East-West direction and ordinary steel moment frames in North-South direction

MECHANICAL

- 17 air handling units with a total of 307,750 SCFM
- two hot water boilers with an MBH of 2,250
- one steam boiler with an MBH of 4,125
- exhaust heat recovery unit with a capacity of 3,260

ELECTRICAL

- primary selective distribution system with two service entrances
- double-ended main substation with two switchboards and a fire pump substation with additional switchboard
- mechanical and lighting panels operate 480Y/277V and receptacles and other loads operate on 208Y/120V
- two emergency generators, which include a 2,500kW diesel generator for normal building loads and a 800kW microturbine generator for data center loads
- microturbine generator operates in parallel with utility

LIGHTING

- variety of LED, linear fluorescent, metal halide, and halogen sources
- daylight integration, occupancy, and vacancy controls
- programmable control system

sarah wujcik | lighting + electrical | 2012 ae senior thesis

http://www.engr.psu.edu/ae/thesis/portfolios/2012/SJW5121/index.html

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Building Statistics

Location | Harrisburg, PA

Building occupant | Pennsylvania State Employee Credit Union

Type of building | mixed use

Size | 238,000 square feet + 1,000 square foot maintenance storage building

Number of stories above grade | three

Dates of construction | August 2011 – August 2013

Project delivery method | design-bid-build

Primary Project Team

Owner | Pennsylvania State Employee Credit Union

Architect | Crabtree, Rohrbaugh & Associates Architects

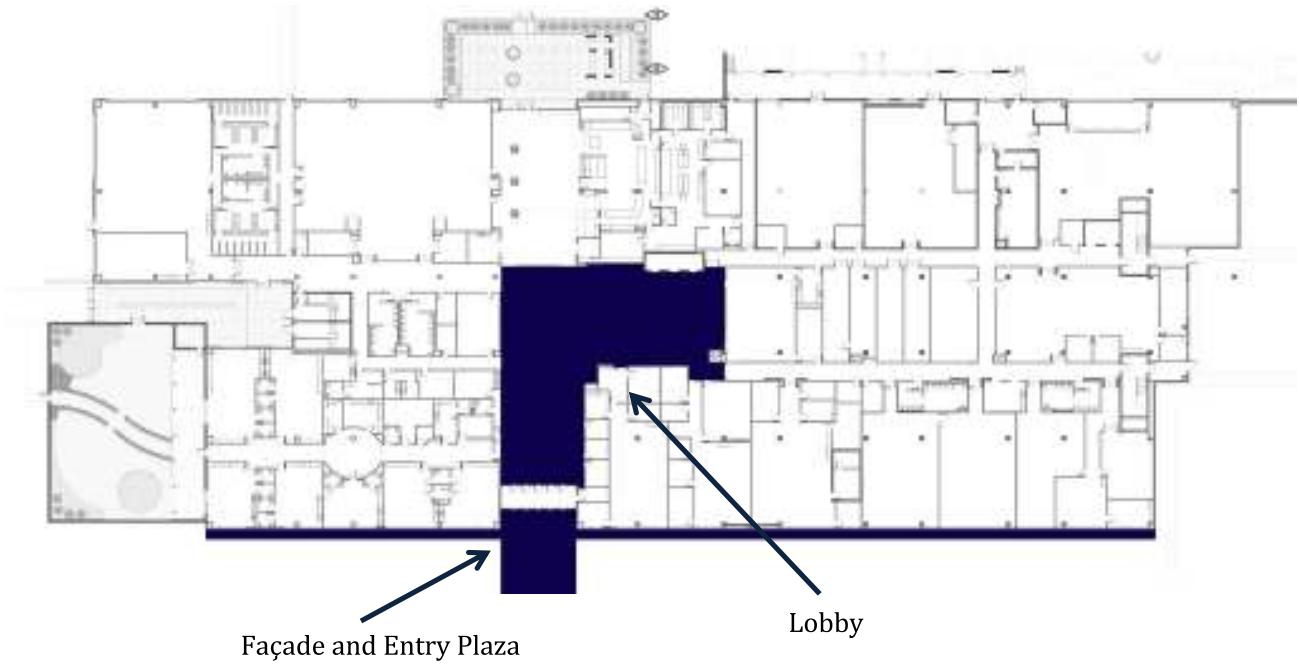
Construction manager | Quandel Construction Services

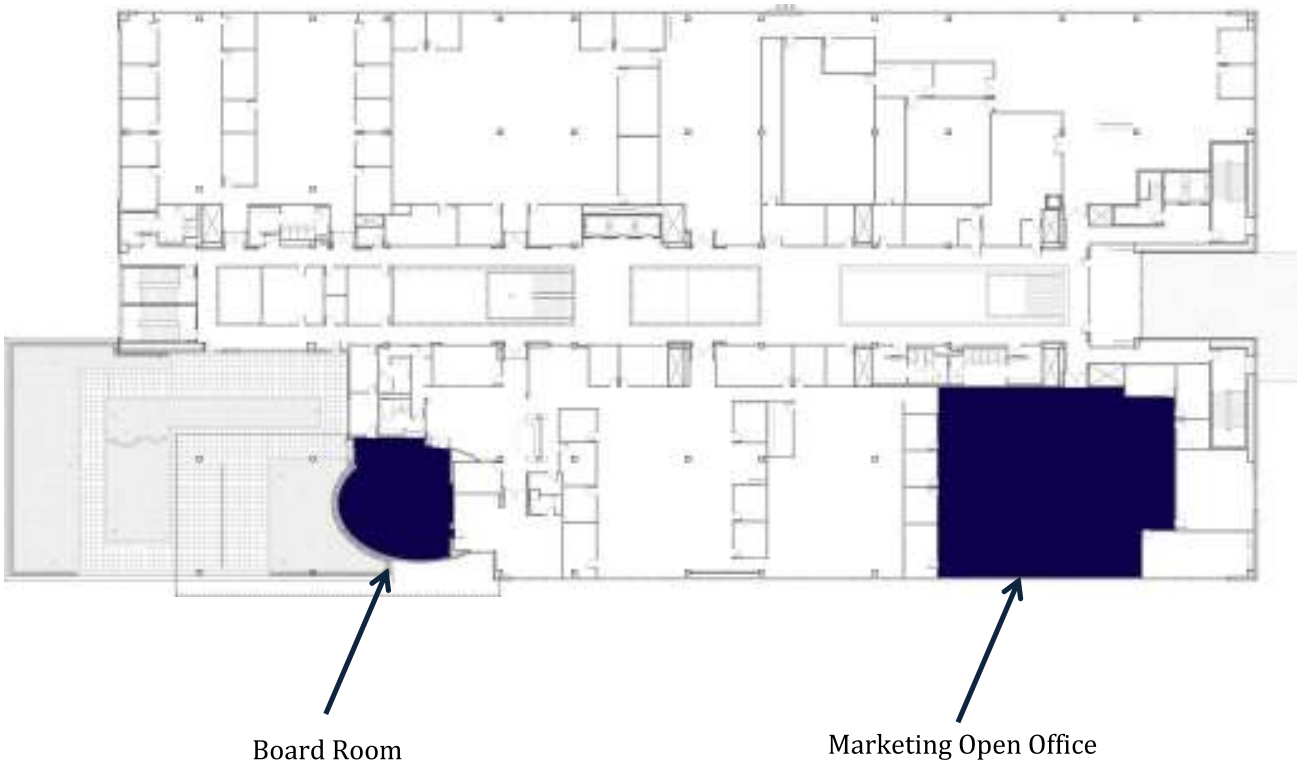
Mechanical, Electrical, Plumbing Engineers | BALA Consulting Engineers

Fire Protection | Protection Engineering Group

Lighting | Grenald Waldron Associates

Structural engineer | Centerpoint Engineering Inc


Façade and Entry Plaza
Lobby


Board Room
Marketing Open Office

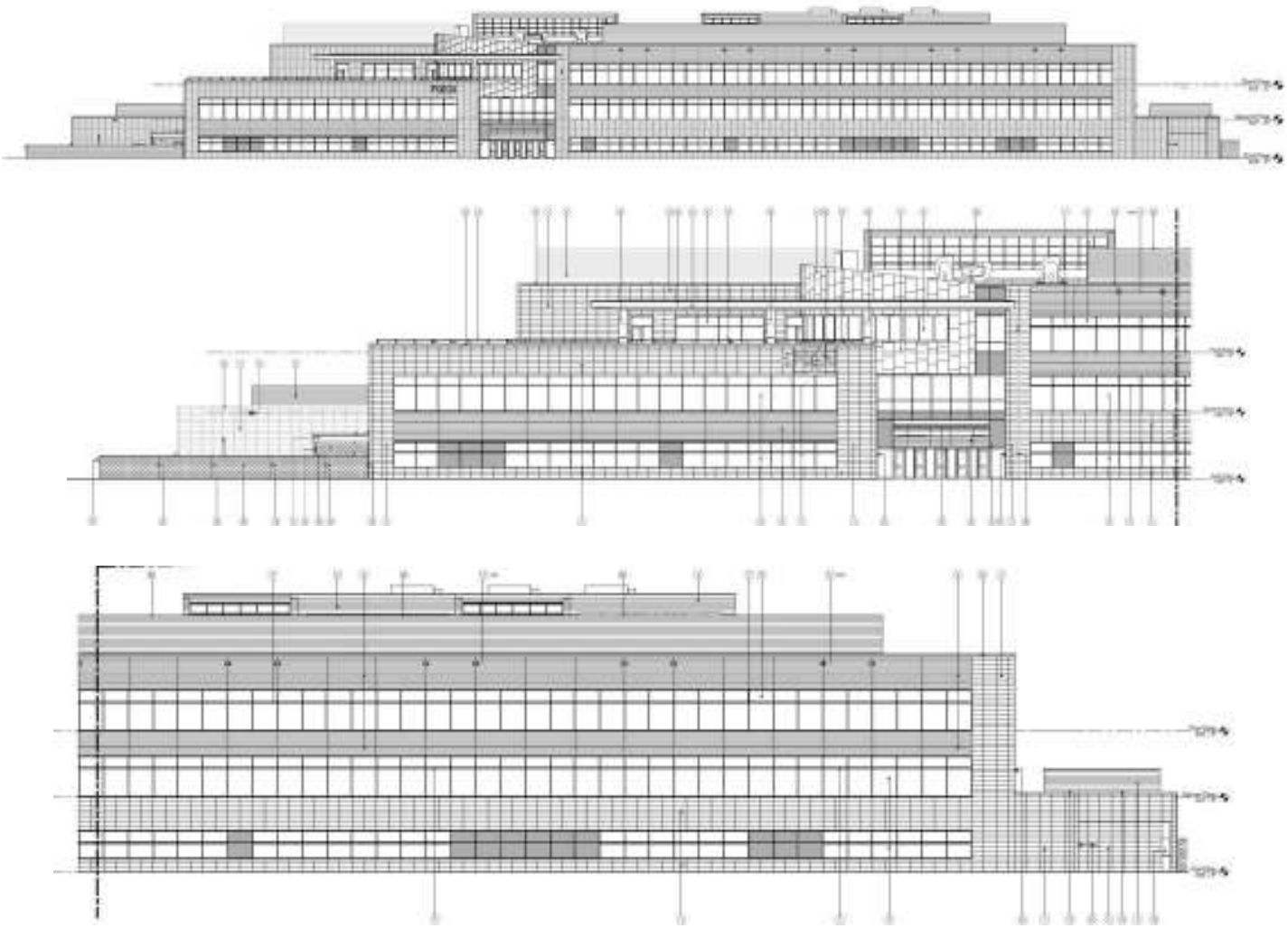
Lighting Depth

Introduction

The Pennsylvania State Employees Credit Union Corporate Headquarters was designed in efforts to create a clean, flexible, energy efficient design with full lighting controls. The building combines sustainability and modernity through design and materials. As a LEED Gold certified complex, the three story, 234,000 square foot building strives to bring the outside in through its large glazed curtain walls and naturalistic materials. Located in Harrisburg, PA and costing $54 million, the building provides offices, a data center, a conference center, a daycare, a fitness center, and a presidential suite. A roof garden comprises the third floor western end of the building. Materials that comprise the façade include terracotta stone, glazing, and metal panel work. Large glazed curtain walls allow for 75% views, while metal panel work accent the architectural features.

Currently, PSECU has branches in both Harrisburg, PA and Philadelphia, PA. Therefore, the complex serves to bring all of the necessary resources together in order to create a branchless company. Construction began in August 2011 and will end in August 2013 with the building opening in October 2013.

Outdoor Space | Building Façade and Entry Plaza



Description

The Façade and entry plaza are the first impression of the Pennsylvania State Employees Credit Union Corporate Headquarters. The façade is 513 feet long with a height of 64 feet. The entry plaza is 85 feet long and 40 feet wide. The PSECU Corporate Headquarters is south facing. A water feature is located in the center with benches along the perimeter. A redesign of the entry plaza is described in depth in the Landscape Architecture Breadth.

The façade incorporates a vast amount of glazing, which adds an element of transparency to PSECU Corporate Headquarters. As employees approach the entrance, attention is drawn to the water feature, which brings tranquility to the space. Highlighting the entrance is a large glass curtain wall with curved metal panels, which incorporates transparency into its design. Overhangs serve both a functional and architectural purpose through shielding the workspaces from harsh sun angles and adding three-dimensionality to the façade.

Material Finishes

Facade Material Finishes

The main façade materials are terracotta and glazing. Glazing covers the façade through both clear glazing and spandrel glazing. Metal panels are another material that encompasses the façade.

The entry plaza was redesigned as part of the Landscape Architecture Breadth. Refer to that section for further details. The plaza materials include precast concrete slabs, a water feature, and plantings with gravel as the base. An opaque glass canopy was designed with steel framing.

Terracotta Brick

Design Goals

As a space that provides the initial impression for both occupants and passerbyers, the façade lighting and plaza design should draw attention. The organic impression of the entry plaza will be highlighted. Facial recognition is important in order for safety and therefore is an important aspect to consider. The lighting design will also emphasize strong lines and angles, along with emphasize the organic and natural materials on the plaza.

As a result of the PSECU Corporate Headquarters being a LEED Gold building, reducing skyglow is a very important design goal. Therefore, the façade lighting will be minimal with only highlighting the key architectural details.

Tasks | Activities

The façade is the primary means of egress into the Pennsylvania State Employees Credit Union Corporate Headquarters. Therefore, highlighting the center entry facade is extremely important for directing patrons into the building. A road runs directly to the plaza for drop off purposes, thus highlighting the walkways will be important in order for the patrons to feel safe. Another important safety criterion is to highlight faces to allow patrons to see those around them.

Design Criteria and Considerations

The design criteria below are an accumulation of Illuminating Engineering Society Lighting Handbook Tenth Edition, ASHRAE Standard 90.1-2010 Edition, and LEED for New Construction Version 2.2.

Illuminating Engineering Society Design Criteria

Accent Opportunities

Focusing on small aspects and details of the façade brings them to the forefront. For example, highlighting the overhang systems, despite a small detail will highlight the length of the building. Accenting is important in creating an impression of the building.

Aesthetic Considerations

As a result of the main façade materials being terracotta tile and glass, these materials must be highlighted. Through incorporating fixtures into the façade and not placing fixtures on the façade, PSECU Corporate Headquarters will have a high end impression. If fixtures must be visible, high end fixtures will be utilized.

Color Appearance and Color Contrast

Color Appearance is very important in order to not diminish the material colors. Using cooler color temperatures and good color rendering properties will enhance the façade materials through highlighting the terracotta, glass, and aluminum.

Direct Glare

Glare is an important factor to not affect any pedestrians. As a result of no road running along the façade, glare is not a critical criterion, but should still be considered to prevent any discomfort.

Flicker

Flicker can be distracting and bothersome to users. This can be preventing through usage of electronic ballasts.

Light Distribution

An even uniformity is not critical in designing the lighting for a façade, but using non-uniform lighting is critical in order to show depth. Also, uniformity should be incorporated in the entry in order to be a means of way-finding.

Light Trespass

As a result of the Pennsylvania State Employees Credit Union Corporate Headquarters applying for LEED Gold status upon completion, light trespass is critical to the design. Cutoff fixtures will good optics will be implemented into the design in order to focus on this criterion. Therefore, luminaires and optics must be carefully selected. The design will highlight aspects suddenly in order to abide by light trespass regulations.

Maintenance

Maintenance is important in order to retain the original lighting design. Therefore, locality of fixtures should be considered.

Modeling of Faces

Within the entry plaza and building entrance, modeling of faces is very important in order to enhance safety.

Reflected Glare

Reflections from the glass curtain walls will be important in order to prevent any discomfort for pedestrians. This can be avoided through using luminaires with good optics and through modeling the space.

Shadows

Shadows should be both highlighted and prevented. Highlighting shadows on the façade creates the impression of depth. In the entry plaza shadows should be minimized in order to promote safety. Therefore, uniformity on the plaza should be considered.

Source-Task-Eye Geometry

In order to enhance the architecture, luminaires will not be visible and should have good cutoff in order to prevent direct view of lamps.

Visual Tasks

In order to promote safety, highlighting the plaza will be important to prevent any accidents. This will be possible through focusing on horizontal illuminance. The stairs at the end of the plaza will be highlighted in order for pedestrians to clearly see them.

Horizontal Illuminance

Lighting for Common Applications: Building Entries: Canopied Entries: Medium Activity: LZ3: 15 lux at 0' A.F.F.
Lighting for Common Applications: Paths to Curb: Medium Activity: LZ3: 6 lux at 0' A.F.F.

In order to provide a safe pathway and means of circulation, horizontal illuminance should be met within the plaza and canopy areas.

Vertical Illuminance

Lighting for Common Applications: Building Entries: Canopied Entries: Medium Activity: LZ3: 8 lux at 0' A.F.F.
Lighting for Common Applications: Paths to Curb: Medium Activity: LZ3: 2 lux at 5' A.F.F.

Vertical illuminance will enhance safety through modeling faces and highlighting objects, such as the water feature. Therefore, vertical illuminance should be a focal point of the lighting design of the plaza.

ASHRAE Design Criteria

Building Grounds: Walkways < 10ft: Zone 3: 0.8W/ linear ft
Building Grounds: Walkways > 10ft: Zone 3: 0.16W/ sq ft
Building Entrances and Exits: Main Entries: Zone 3: 30W/ linear ft of door width

LEED Design Criteria

*See Appendix A for complex listing of LEED credits

Credit 8.0 **Light Pollution Reduction**

Reducing light pollution through incorporating cut-off fixtures and minimizing uplight will be critical in order to achieve this requirement.

Luminaires and Equipment

Lighting Equipment Schedule

Lighting Equipment Schedule				
Type		Description	Manufacturer	Lamp
	RF1	12 feet tall light column with die-cast aluminum housing, 8" diameter lens with refractor rings for anti-glare, 5" diameter pole with silver finish	Selux	(2) 32 watt T8, 3500K, 85 CRI
	SL2	4 foot long x 1" wide x 1" deep surface mount LED strip LED with clear anodized aluminum housing and soft focus lens. 120 degree beam	Lightwild	11.3 watts, 149 lumen/watt, 80+ CRI, 3500K

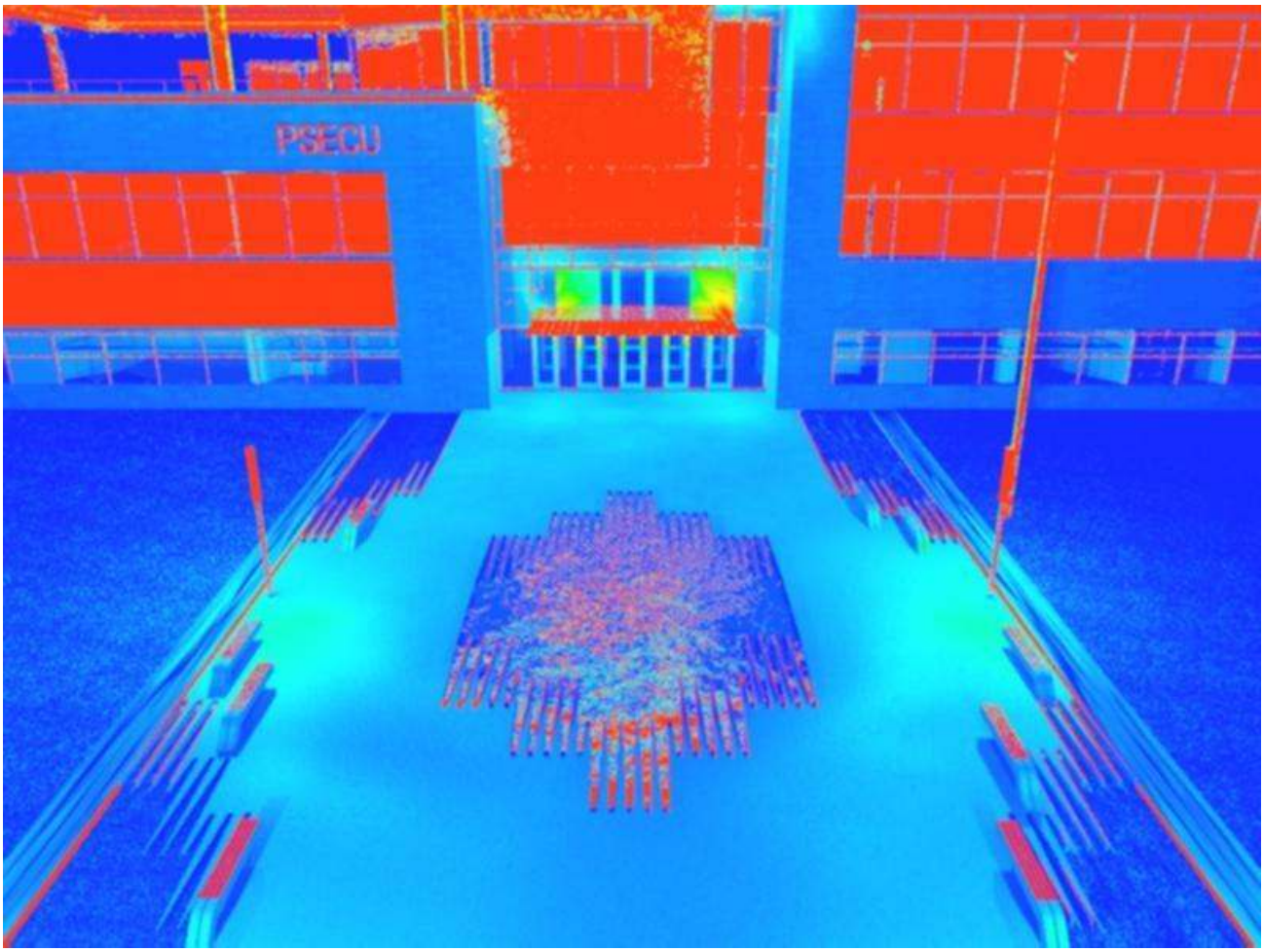
Light Loss Factors

Lighting Equipment Schedule					
Type		LLD	LDD	BF	LLF
	RF1	0.93	0.92	1.00	0.86
	SL2	0.93	0.92	1.00	0.86

Renderings

Calculation Summary

Plaza Calculation Summary		
		Horizontal (0')
	Average Illuminance (fc)	0.57
	Maximum Illuminance (fc)	5.63
	Minimum Illuminance (fc)	0.06
	Maximum:Average	9.9
Design Criteria	Average Illuminance (fc)	0.6



Energy Code Compliance

Lighting Power Density Walkways > 10'	
Area	2400 sq ft
Watts	442 W
Designed	0.18 W/sq ft
Criteria	0.18W/ sq ft

Lighting Power Density Building Entry	
Length	23 ft
Watts	45 W
Designed	1.97 W/ linear ft
Criteria	30W/linear ft of door width

Lighting Power Density Roof Garden	
Area	10050 sq ft
Watts	732W
Designed	0.072 W/sq ft
Criteria	0.18W/ sq ft

Evaluation of Design

Strong lines and angles are emphasized throughout the plaza lighting. The under bench lighting provides lower light levels and a more comfortable environment, while the light columns provide good facial recognition qualities. The metal panel mesh under the large overhang is highlighted by surface mounted fixtures behind it to provide a glow to the façade. This element emphasizes the metal panel overhang and curved wall. The design goal of organic growth is accentuated by the randomness of the benches. Handrail lighting provides safety lighting, while hiding the fixture to emphasize the landscape further.

Overall the design is under power density and meets the IES recommended horizontal illuminance values. Due to the direct component of the fixtures, skyglow is minimized. The emphasis on the entry reduces light trespass and the fixture selection reduces glare.

Electrical Redesign

The electrical redesign addresses the changes to the lighting and how the redesigned space will be controlled. The following looks at the Outdoor Space, which is the Façade and Entry Plaza.

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The plaza will be controlled by the Lutron Quantum system, along with motion sensors. The following outlines the design of the panelboard and control system.

Panelboard Summary

A total of ten panelboards encompass the lighting panels for the four space redesigned. The panels consist of both normal and normal/emergency panelboards.

PANELBOARDS						
PANEL TAG	VOLTAGE	SYSTEM	FAÇADE AND ENTRY PLAZA	LOBBY	BOARD ROOM	MARKETING OFFICE
ELP1E	480Y/277V 3PH 4W	N/E		X		
ELP1W	480Y/277V 3PH 4W	N/E	X	X		
LP1W	480Y/277V 3PH 4W	N		X		
LP3W	480Y/277V 3PH 4W	N		X		
LP3E	480Y/277V 3PH 4W	N		X		
ELP3W	480Y/277V 3PH 4W	N/E			X	
LP3W	480Y/277V 3PH 4W	N			X	
LP3E	480Y/277V 3PH 4W	N/E				X
ELP3E	480Y/277V 3PH 4W	N				X
SLP3	480Y/277V 3PH 4W	?	X			

Controls

The façade lighting and plaza lighting operate on the Lutron Quantum building control system. The Lutron Quantum system communicates with a Lutron Energi Savr Node which communicates with a Wattstopper EW Low Voltage motion sensors. The motion sensor switches between high and low level light levels with a time clock to switch off at an owner specified time. Both Ecosystem H-Series Ballasts and Lutron Ecosystem Hi-lume A-Series LED Drivers communicate with the Lutron system. The motion sensors are located throughout the site with the closest motion sensor to the plaza mounted on the façade. The lighting operates on low-voltage.

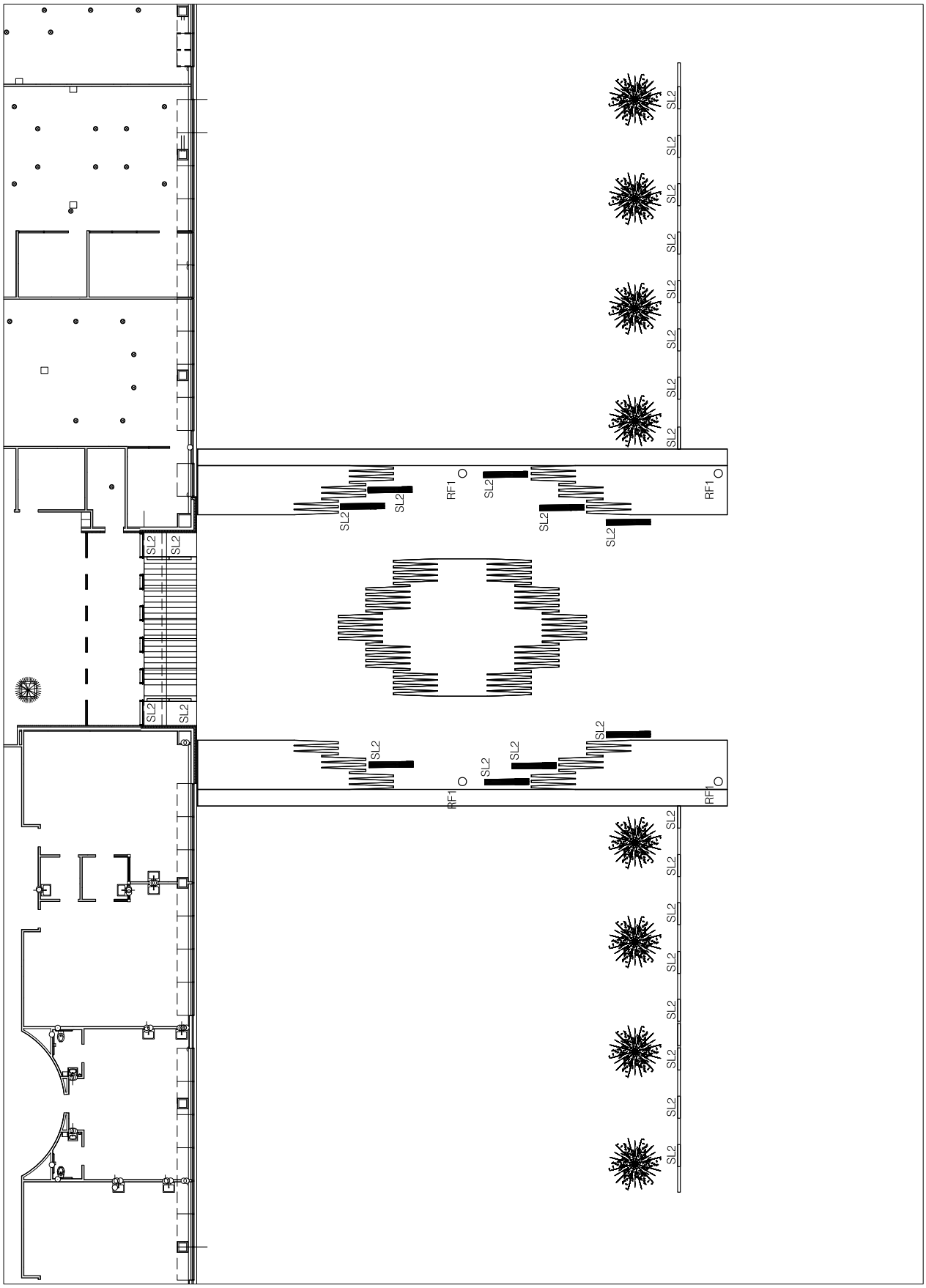
Lighting | Electrical Plans

See Appendix A

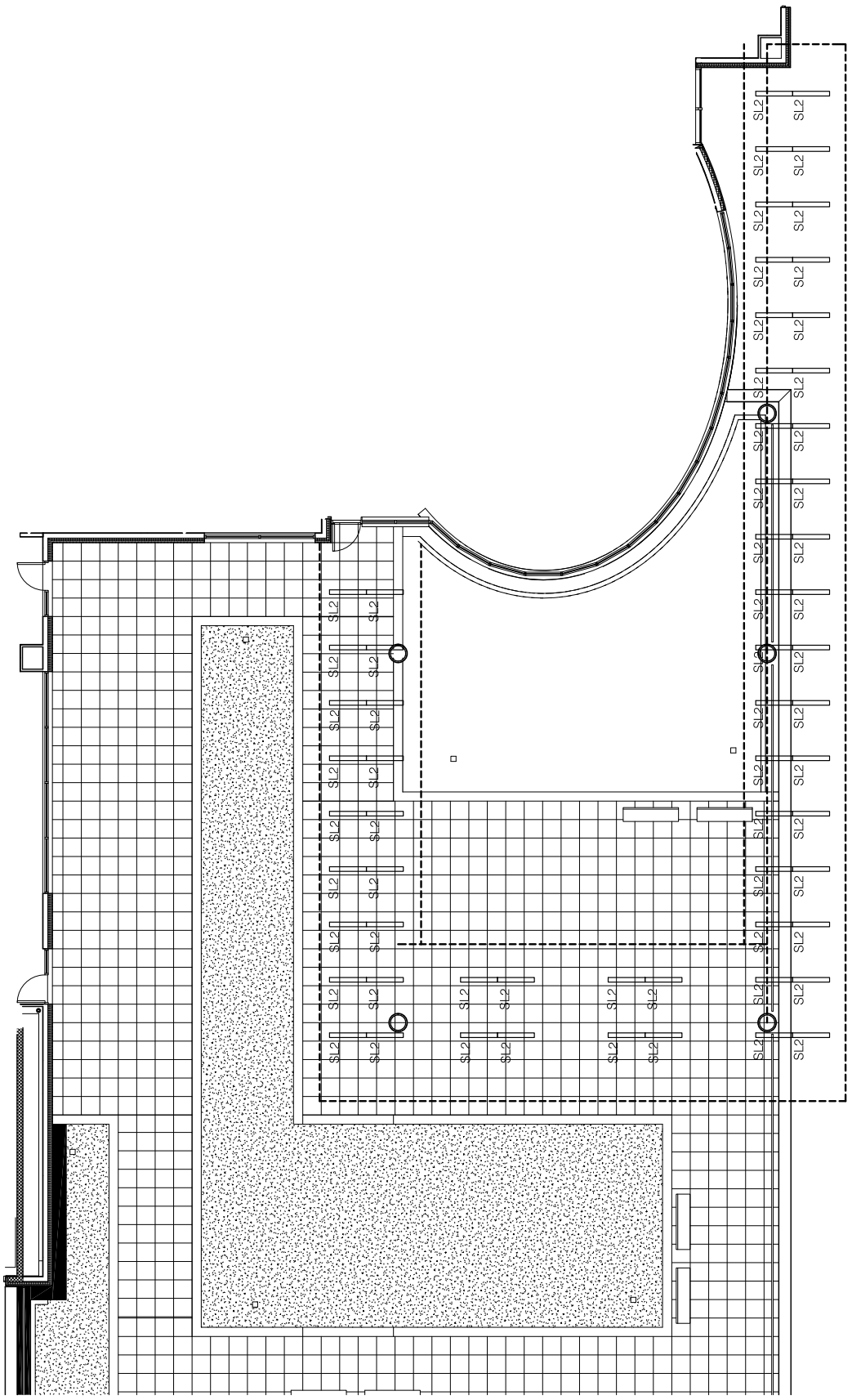
THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS

HARRISBURG, PA

SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
1/16" = 1'	04/03/2012	SARAH WUJCIK	ENTRY PLAZA LIGHTING PLAN	L.07



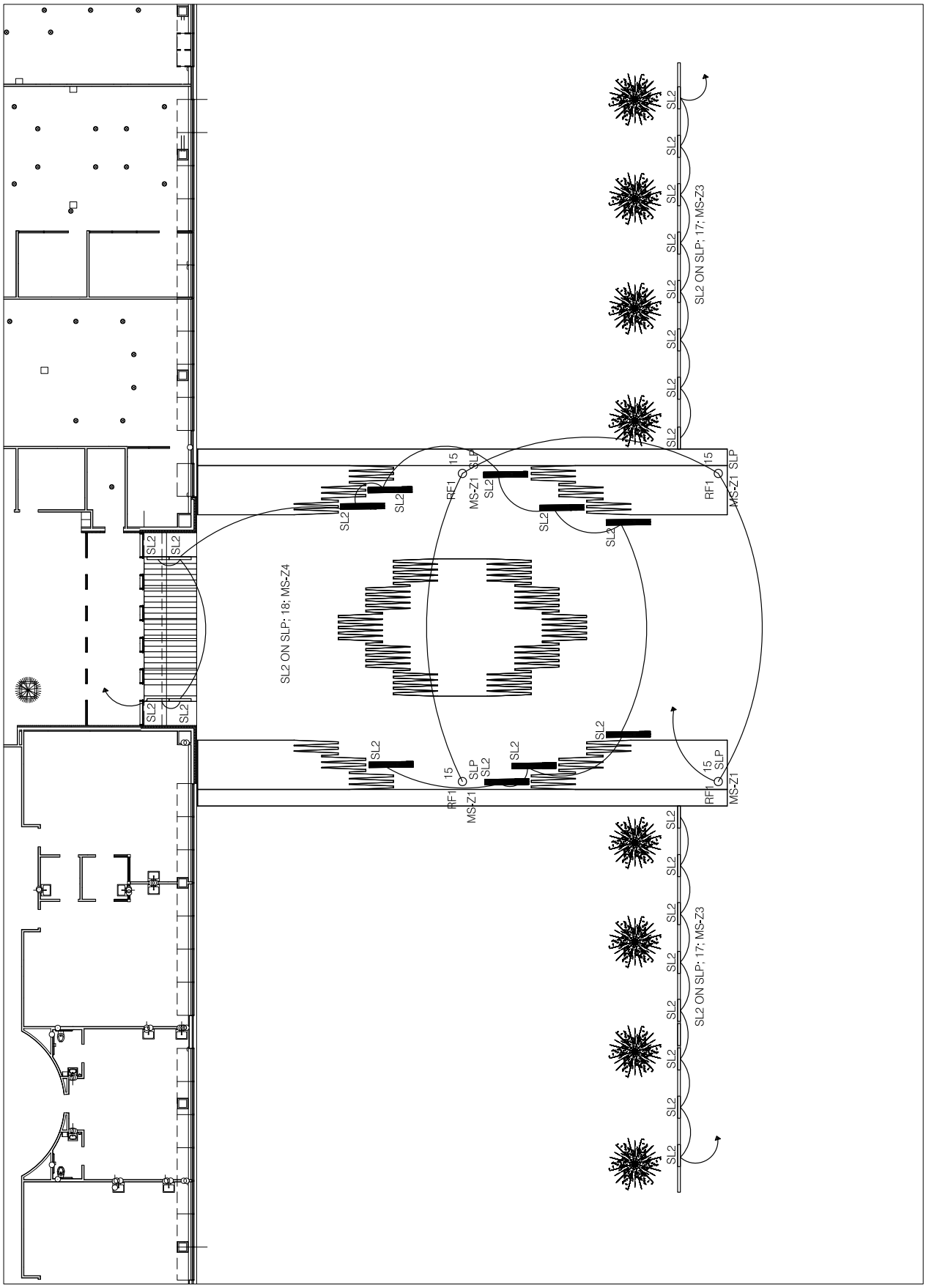
THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 3/32" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: ROOF GARDEN LIGHTING PLAN	SHEET TITLE: L.08

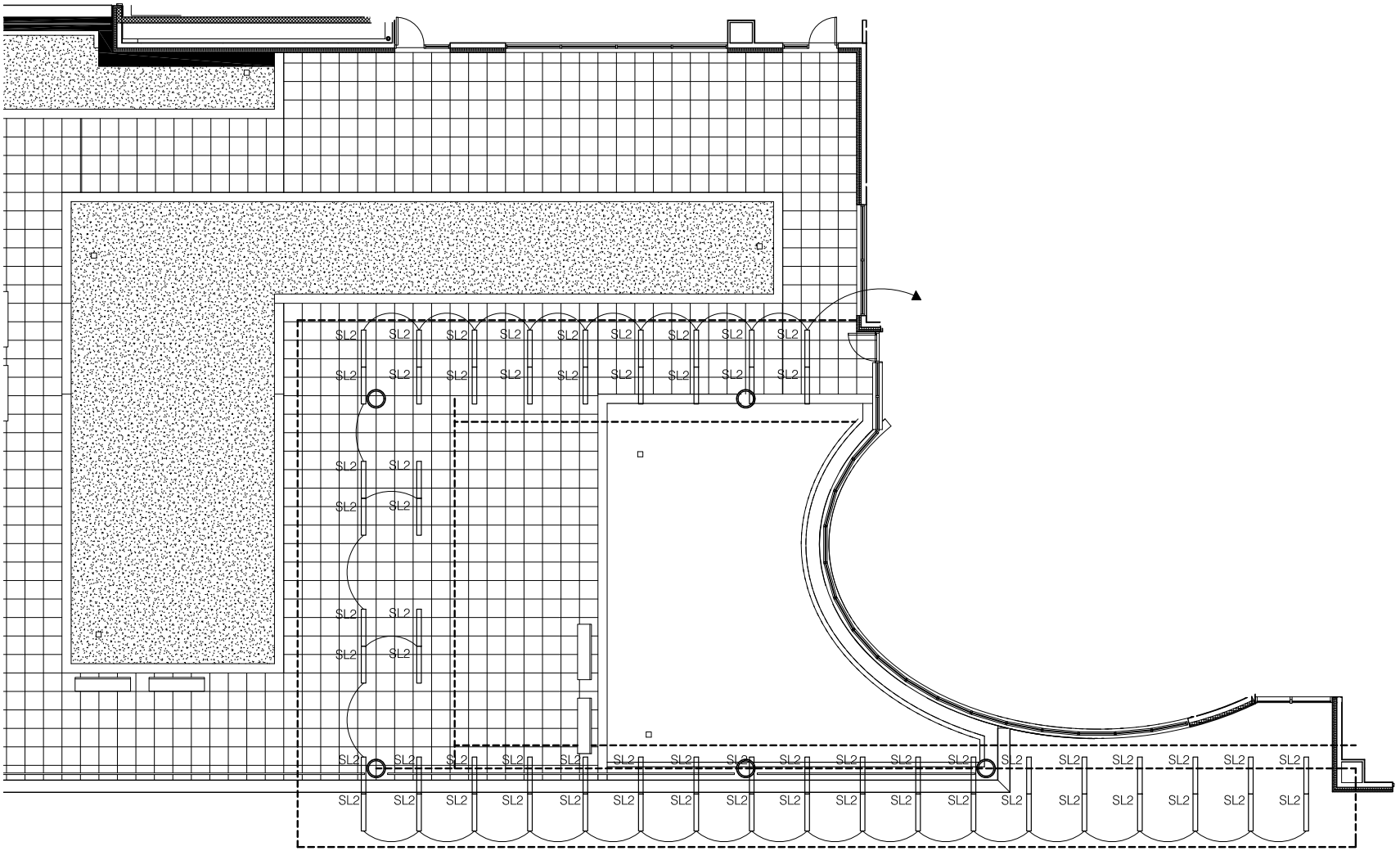


THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS

HARRISBURG, PA

SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
1/16" = 1'	04/03/2012	SARAH WUJCIK	ENTRY PLAZA CIRCUITING DIAGRAM	E.08





THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
3/32" = 1'

ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
ROOF GARDEN
CIRCUITING DIAGRAM

SHEET TITLE:
E.09

Existing Panelboards

No existing panelboard. Only drawings.

Existing Control Layout

See Appendix D

Panelboard Worksheets

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					SLP	Panel Location:			MAIN ELECTRIC RM		
Nominal Phase to Neutral Voltage------->					277	Phase:			3		
Nominal Phase to Phase Voltage-------->					480	Wires:			4		
Pos	Ph.	Load Type	Cat.	Location	Load	Units	I. PF	Watts	VA	Remarks	
1	A	ZSL5A, ZSL5B	1	SITE	2711	w	0.70	2711	3873		
2	A	ZSL1	1	SITE	4061	w	1.00	4061	4061		
3	B	ZSL6A, ZSL6B	1	SITE	2001	w	0.70	2001	2859		
4	B	ZSL2	1	SITE	0	w		0	0		
5	C	ZSL7A, ZSL7B	1	SITE	3056	w	1.00	3056	3056		
6	C	ZSL3	1	SITE	0	w		0	0		
7	A	ZSL8A, ZSL8B	1	SITE	3444	w	0.70	3444	4920		
8	A	ZSL4	1	SITE	0	w	1.00	0	0		
9	B				0	w		0	0		
10	B	ZSL10	1	SITE	0	w	1.00	0	0		
11	C	ZSL11	1	SITE	0	w	1.00	0	0		
12	C	ZSL12	1	SITE	0	w	1.00	0	0		
13	A				0	w		0	0		
14	A				0	w		0	0		
15	B	MS-Z1	1	SITE	280	w	0.90	280	311		
16	B	MS-Z2	1	SITE	701	w	0.70	701	1001		
17	C	MS-Z3	1	SITE	362	w	0.70	362	517		
18	C	MS-Z4	1	SITE	125	w	0.70	125	179		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				6	w		0	0		
32	A				0	w		0	0		
33	B				6	w		0	0		
34	B				0	w		0	0		
35	C				6	w		0	0		
36	C				0	w		0	0		
37	A				0	w		0	0		
38	A				0	w		0	0		
39	B				0	w		0	0		
40	B	SPARE	2		3500	w	0.90	3500	3889		
41	C	SPARE	2		3500	w	0.90	3500	3889		
42	C				0	w		0	0		
PANEL TOTAL								23.7	28.6	Amps=	34.4

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL		A				10.2	12.9	46%	46.4
PHASE TOTAL		B				6.5	8.1	29%	29.1
PHASE TOTAL		C				7.0	7.3	26%	26.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	LIGHTING		16.7	20.8		16.7	20.8	0.81		
2	SPARE		7.0	7.8		7.0	7.8	0.90		
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						23.7	28.6			
Spare Capacity			25%			5.9	7.1			
Total Design Loads						29.7	35.7	0.83	Amps=	43.0

Revised Panelboards

PANELBOARD SCHEDULE

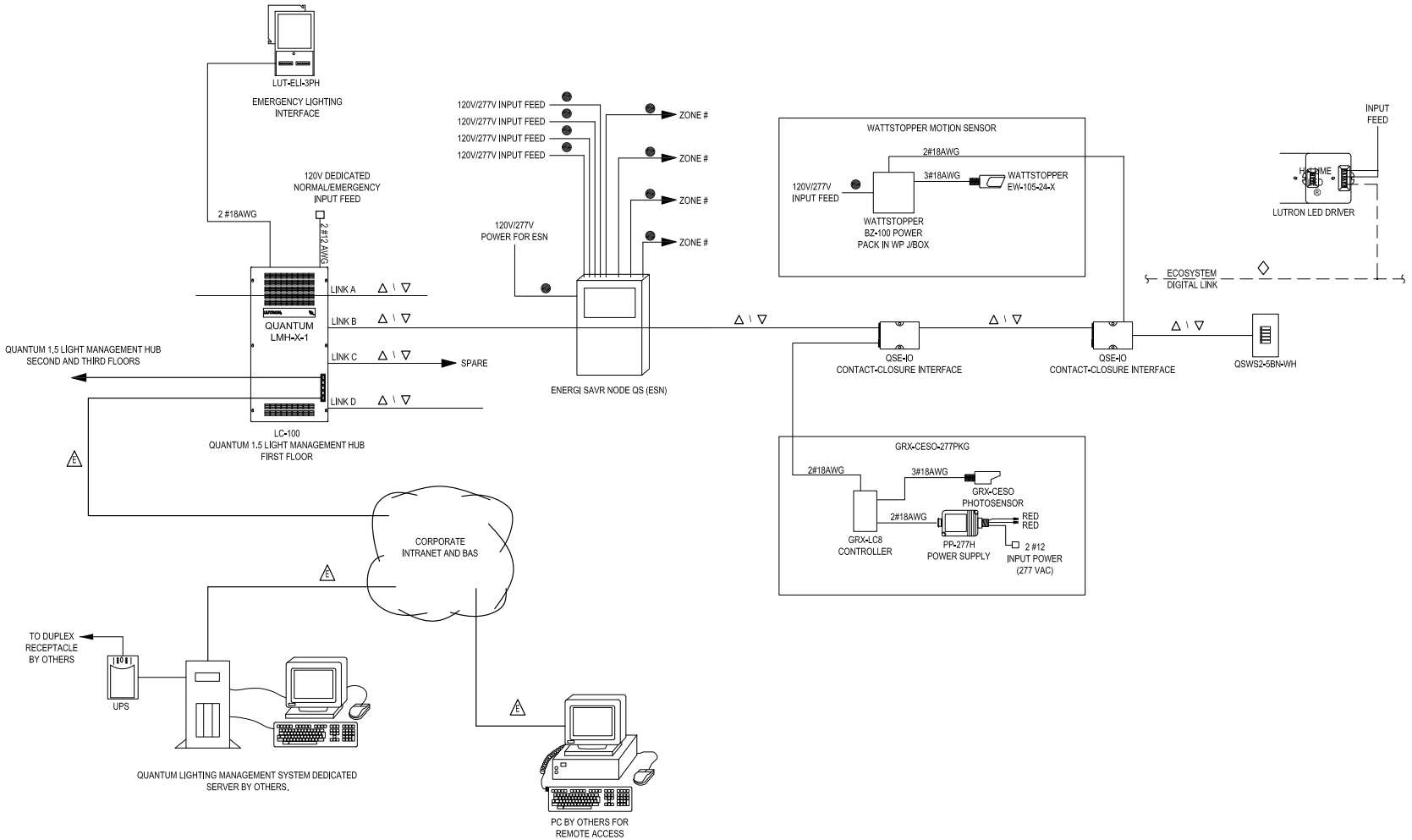
VOLTAGE:	480Y/277V,3PH,4W		PANEL TAG:	SLP						MIN. C/B AIC:	25K		
SIZE/TYPE BUS:	50A		PANEL LOCATION:	MAIN ELECTRIC RM						OPTIONS:	PROVIDE FEED THROUGH LUGS		
SIZE/TYPE MAIN:	50A/3P C/B		PANEL MOUNTING:	SURFACE									
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION	
ZSL5A, ZSL5B	SITE	2711	20A/1P	1	3873VA/ 4061VA			2	20A/1P	4061	SITE	ZSL1	
ZSL6A, ZSL6B	SITE	2001	20A/1P	3		2859VA/ 0VA		4	20A/1P	0	SITE	ZSL2	
ZSL7A, ZSL7B	SITE	3056	20A/1P	5			3056VA/ 0VA	6	20A/1P	0	SITE	ZSL3	
ZSL8A, ZSL8B	SITE	3444	20A/1P	7	4920VA/ 0VA			8	20A/1P	0	SITE	ZSL4	
		0	20A/1P	9		0VA/ 0VA		10	20A/1P	0	SITE	ZSL10	
ZSL11	SITE	0	20A/1P	11			0VA/ 0VA	12	20A/1P	0	SITE	ZSL12	
		0	20A/1P	13	0VA/ 0VA			14	20A/1P	0			
MS-Z1	SITE	280	20A/1P	15		311VA/ 1001VA		16	20A/1P	701	SITE	MS-Z2	
MS-Z3	SITE	362	20A/1P	17			517VA/ 179VA	18	20A/1P	125	SITE	MS-Z4	
		0	20A/1P	19	0VA/ 0VA			20	20A/1P				
		0	20A/1P	21		0VA/ 0VA		22	20A/1P				
		0	20A/1P	23			0VA/ 0VA	24	20A/1P				
		0	20A/1P	25	0VA/ 0VA			26	20A/1P				
		0	20A/1P	27		0VA/ 0VA		28	20A/1P				
		0	20A/1P	29			0VA/ 0VA	30	20A/1P				
		0	20A/1P	31	0VA/ 0VA			32	20A/1P				
		0	20A/1P	33		0VA/ 0VA		34	20A/1P				
		0	20A/1P	35			0VA/ 0VA	36	20A/1P				
		0	20A/1P	37	0VA/ 0VA			38	20A/1P				
		0	20A/1P	39		0VA/ 3889VA		40	20A/1P	3500		SPARE	
SPARE		3500	20A/1P	41			3889VA/ 0VA	42	20A/1P				
CONNECTED LOAD (KW) - A Ph.		10.22								TOTAL DESIGN LOAD (KW)			29.68
CONNECTED LOAD (KW) - B Ph.		6.48								POWER FACTOR			0.83
CONNECTED LOAD (KW) - C Ph.		7.04								TOTAL DESIGN LOAD (AMPS)			43

Revised Dimming Wiring Diagrams

See Appendix D

Lighting Control Equipment Schedule

Type	Manufacturer	Product Name	Catalog Number	Description	Location
LC-100	LUTRON	QUANTUM LIGHT MANAGEMENT HUB	QP2-2P0CSE-120	Centralized connection for Lutron EcoSystem, supports up to 8 EcoSystem loops	DATA CENTER
QSN-100	LUTRON	ENERGY SAVR NODE QS	QSN-2ECO-S	Controls occupancy sensors, daylight sensors, and EcoSystem Wallstations	DATA CENTER
EHD-100	LUTRON	ECOSYSTEM H-SERIES BALLASTS	EHD T528 M U 1 10	Fluorescent Dimming Ballast with dimming capabilities to 1% output	EXTERIOR
LD-100	LUTRON	HI-LUME A-SERIES LED DRIVER	L3D 25 XXX A UNV 1	Dims continuously to 1% light levels, continuous flicker free dimming, line-voltage phase control	EXTERIOR
MS-100	WATTSTOPPER	EW LOW VOLTAGE OUTDOOR MOTION SENSOR	EW-205-24-W	Motion sensor with capabilities to cover 270 degrees. Operates on 24 VDC and allows for high and low switching.	EXTERIOR



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
NOT TO SCALE

ISSUE DATE:
04/04/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
PARKING AREAS
CONTROL DIAGRAM

SHEET TITLE:
C.04

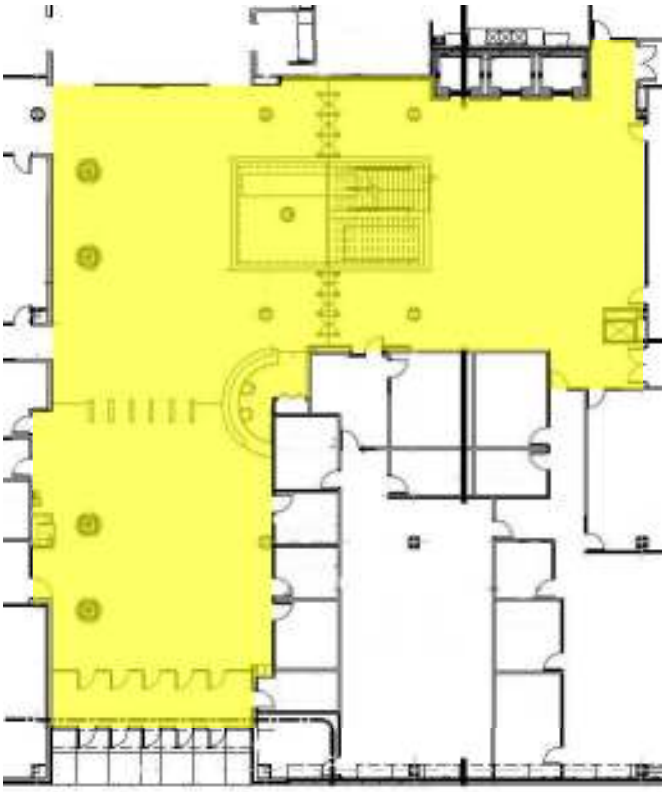
Feeder Resizing

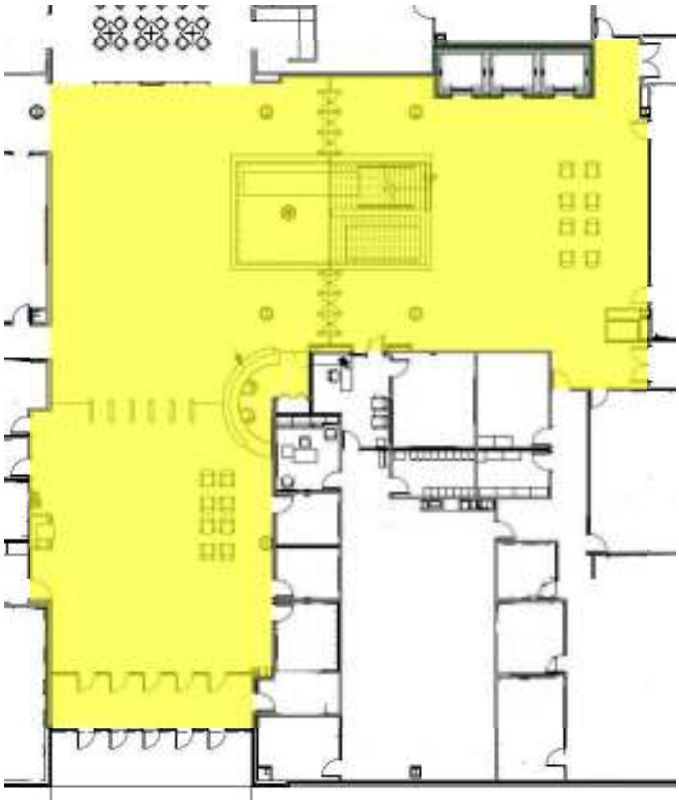
Panel SLP Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	29.7
Resultant Power Factor	0.83
Calculated Design Load (kVA)	35.7
Calculated Design Load (Amps)	43
Feeder Protection Size(Amps)	50
Number of Sets	1
Phase Conductor	(3) #8
Neutral Conductor	(1) #8
Ground Conductor	(1) #10
Total Phase Conductor Area (sq in)	0.1098
Neutral Conductor Area (sq in)	0.0366
Ground Conductor Area (sq in)	0.0211
Total Conductor Area (sq in)	0.1675
Conduit Size	0.75" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	1.8
Voltage Drop (%)	0.4

Panelboard Cut Sheets

See Appendix G

Circulation Space | Lobby





Description

Located in the center of the PSECU Corporate Headquarters with the entry point on the south facing side of the building is the lobby. The lobby is broken down into three different lobbies. The outer lobby is the main entrance of the building. It houses the reception desk and security turnstiles. Therefore, the space requires excellent facial recognition. The outer lobby is two stories tall with a curved wood panel wall system covering the ceiling and eastern wall. A South facing curtain wall provides daylight and views to the outer lobby. The curtain wall is protected by an overhang, corridor over the entry vestibule, and the building's shape due to the entry being set back from the exterior walls. The outer lobby is also the access point to the daycare center. Next you reach the inner lobby, which is located directly in the center of the PSECU Corporate Headquarters and is three stories tall. Above the space is series of a south facing tilted skylights. A water feature is located below the open stairwell to add tranquility to the space. The space is the access point to the cafeteria, conference center, fitness center, and elevator lobby. In order to reach the elevator lobby, you must enter through additional security turnstiles. The elevator lobby encompasses a seating area, access to the main elevators, and access to the open stairwell. Despite their differences in architecture and purposes, all three spaces flow well into one general lobby.

Material Finishes

Lobby materials include wood panels, ceramic tiles, and terracotta brick tiles. The mixture of materials focuses the eye on different aspects of the space and directs employees through the lobby.

Flooring

Porcelain Anthracite Lappato Rettificato Ceramic Tile

The right image explains how the ceramic tile will define different spaces within the lobby.

Rubber-Tire Entrance Mat

Wall finishes

Terracotta Brick

Wood panels are beech steamed quartered with Eggers' Gardall finish

Ceiling finishes

Wood panels are beech steamed quartered with Eggers' Gardall finish

Floor Finishes

Type	Description	Manufacturer	Color	Reflectance
EM1	Rubber-Tire Entrance Mat	American Floor Products Co.	Century Flooring	0.5
CT1	Porcelain Tile	Emil Silverstone	Anthracite Lappato Rettificato	0.7
CT2	Porcelain Tile	Emil Silverstone	Bianco Naturale Pettificato	0.7

Wall Finishes

Type	Description	Manufacturer	Color	Reflectance
BRK	Terracotta Brick	Terreal North America	Red Brick	0.15
WD	Beech steamed wood panels quartered with Eggers' Gardall finish	Armstrong Worls Industires, Inc.	Beech	0.26
PNT	Interior Latex Eg-Shel Deep Base	Sherwin Williams ProGreen 200 Low VOC	Dovetail	0.6

Ceiling Finishes

Type	Description	Manufacturer	Color	Reflectance
MTL	Smooth, flat finish aluminum panels	N.A.	Aluminum	0.7
WD1	Beech steamed wood panels quartered with Eggers' Gardall finish	Armstrong Worls Industires, Inc.	Beech	0.26
PNT	Interior Latex Eg-Shel Deep Base	Sherwin Williams ProGreen 200 Low VOC	Dovetail	0.6

Glazing Schedule						
Type	Description	T_{vis}	R_{ext}	U_w	SC	SHGC
IG-2	1" thick Insulating Vision Insulated Glass with Low E coating	0.35	0.07	0.32	0.31	0.27
LG-1	Laminated Insulated Glass	0.34	0.24	0.28	0.32	0.28
SPANDREL	1" thick Insulating Spandrel Glass with Low E coating	0	0.07	0.33	0.31	0.23

Furnishings

As a result of the space serving as the main circulation space, not many furnishings are within the space. A small seating area is located adjacent to the main desk. The curved main desk serves as an information and security area for patrons. Seating is also located behind the curved desk. Exposed steel columns surround the open stairwell.

Design Goals

As the main entry point into the Pennsylvania State Employees Credit Union Corporate Headquarters, the lobby serves a variety of functions. It is the first impression of the PSECU Corporate Headquarters occupants will receive and therefore should make an impression. The space should evoke the impression that it is a public space and therefore the Flynn Impression of public will be incorporated into the design. The lighting will also help to direct circulation through the space. Also, the first impression is the curved wood panel wall and ceiling that frames the space. Therefore, this element will be highlighted in order to bring the eye upward in order to see the intricate architecture. The lobby houses security turnstiles, so these areas should be highlight in order to create a safe environment and to have excellent facial recognition. The lobby is also an informal gathering location where employees may meet for conversational purposes. Therefore reducing facial shadows is a key design goal. The main feature of the inner lobby is its openness to the other floors and the large slanted skylight that frames the space and runs the length of the building. The inner lobby is also a transition space which connects to the elevator lobby, open stairwells, cafeteria, fitness center, and conference center. The elevator lobby is the entry point to the elevators and open stairwell. Thus the elevator lobby should be highlighted to draw the eye to it. A common area is located in the center of the elevator lobby and therefore lower light levels should be used in this area to create a more relaxed environment.

The outer lobby, inner lobby, and elevator lobby will all emphasize strong lines and angles, along with emphasize natural materials and create a hierarchy of light.

Tasks | Activities

The main task in the lobby is circulation; therefore horizontal and vertical illuminances are both important factors. Another key feature of the lobby is it serves as the main security hub. Facial recognition will be important in order to recognize faces. Casual meetings will also occur in the space, which again requires modeling of faces. A small seating area is located next to the main desk, so reading will occur here. The space may also hold company parties and gatherings, so different lighting scenes will be important in the lobby.

Design Criteria and Considerations

The design criteria below are an accumulation of Illuminating Engineering Society Lighting Handbook Tenth Edition, ASHRAE Standard 90.1-2010 Edition, and LEED for New Construction Version 2.2.

Illuminating Engineering Society Design Criteria

Accent Opportunities

Way finding can be enhanced through accenting different aspects of the space. It also highlights important aspects, such as signs and decorative detail. The PSECU sign should be highlighted along with the security desk.

Aesthetic Considerations

The lobby is the main egress area within the building. It serves as both a welcoming and inhibitory space as a result of the security. Despite this the lobby should positively impact any anyone who enters the space. Therefore, luminaires should be out of site and if this is not feasible, luminaires should be decorative and high quality.

Color Appearance and Color Contrast

As the main circulation space within the building, color appearance and contrast will enhance the overall design. Both a circulation and a meeting place, the lobby should have good color rendering properties. Facial recognition will also be important. Wood panels line the wall and ceiling of the outer lobby, which will also need good color rendering properties to appropriately show detail and color properties.

Daylight Integration and Controls

Sloped skylights that line the ceiling of the inner lobby and a glass curtain wall at the building entry provide daylight penetration to the lobby spaces. Therefore, daylight integration is an extremely important criterion. Through integrating daylight sensors, potential energy savings are possible, which is a key design feature of the PSECU Corporate Headquarters. Harsh sun rays need to be considered for the skylights in order to prevent any discomfort.

Direct Glare

Controlling glare from luminaires is essential in order to maintain user comfort. Through selecting luminaires with sufficient optics and minimizing the view of the lamp will allow this to be achievable.

Flicker

Flicker can be distracting and bothersome to users. This can be preventing through usage of electronic ballasts.

Light Distribution Across Task Plane

Lobby spaces do not need an even light distribution across the work plane. Non-uniformity will be incorporated as a means of path finding. Peripheral light wall also be utilized in order to incorporate a spacious impression.

Luminances of Room surfaces

To create focal points, luminance ratios will be incorporated. Through highlighting aspects of the design, higher luminance values can be achieved, which will enhance the overall design. Incorporating the luminances of the room surfaces with daylight is important in order to avoid discomfort.

Maintenance

In order to maintain the lighting design, accessibility is important. This will be more difficult in the lobby due to the high ceiling heights. Therefore, the inaccessibility of these fixtures will need to be considered in order to maintain the design.

Modeling of Faces

As a security hub, facial recognition is extremely important. Good skin color rendering and appropriate vertical illuminances will allow this to be achievable. Also, as a meeting place, facial recognition is important. Minimizing facial shadows will facilitate the lobby as a meeting place.

Psychological Impressions

Impression including public vs. private and spaciousness will be incorporated into the design. The impressions of public and spaciousness will be incorporated into the normal workday lighting design, while private will be used for company functions. The design will highlight the perimeter surfaces and integrate non-uniformity into the illuminance levels. Lower light levels and perimeter emphasis will create a private environment.

Reflected Glare

Reflected glare is important to consider when specular materials, such as the wood panels and ceramic floor, are used within the space. Through controlling both the electric lighting and daylighting will be able to minimize glare.

Room Surface Characteristics

The lobby is the first impression of the building. Glass, wood panels, terracotta brick, and other specular materials are incorporated to present a high end impression. Through incorporating both specular and semi-specular materials in the space, light must be well controlled in order to minimize glare and reflections.

Shadows

Minimizing shadows on the walls and floor will enhance the impression of spaciousness. Also, through the use of wide distribution luminaires and well-spaced luminaires, shadows can be diminished.

System Flexibility and Controls

Though little furniture is within the lobby, flexibility is critical. If the space were to be used as a venue for a company function, flexibility will be critical. Also, flexibility in the lighting is important in order to light under different situations. Scene controls will be incorporated for this effect.

Horizontal Illuminance

Lighting for Common Applications: Transition Spaces: Lobbies: Circulation: General: At Building Entries: 100 lux at 0' A.F.F.
Lighting for Common Applications: Transition Spaces: Lobbies: Security Screening: 200 lux at 3' A.F.F.

Horizontal illuminance is important for circulation throughout the space. It can also create focus on certain aspects of the space, such as the security desk and security turnstiles.

Vertical Illuminance

Lighting for Common Applications: Transition Spaces: Lobbies: Circulation: General: At Building Entries: 30 lux at 5' A.F.F.
Lighting for Common Applications: Transition Spaces: Lobbies: Security Screening: 100 lux at 5' A.F.F.

Vertical illuminance is a key design criterion in a security area. Facial recognition is very important in order to create a safe entry into the building. It is also important for meeting people and informal meetings.

ASHRAE Design Criteria

Space-by-Space Method:

LEED Design Criteria

*See Appendix A for complex listing of LEED credits

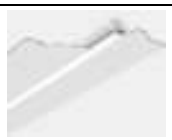
Credit 6.1 **Controllability of Systems**, Lighting
Credit 8.1 **Daylight & Views**, Daylight 75% of Spaces

Incorporating lighting controls, such as control panels, occupancy and vacancy sensors, and daylight harvesting sensors will reduce energy consumption and enhance occupant satisfaction through controlling light levels through dimming.

A glass curtain wall and skylights provide daylight to the space. This enhances occupant satisfaction through bringing the outside into the space.

Luminaires and Equipment

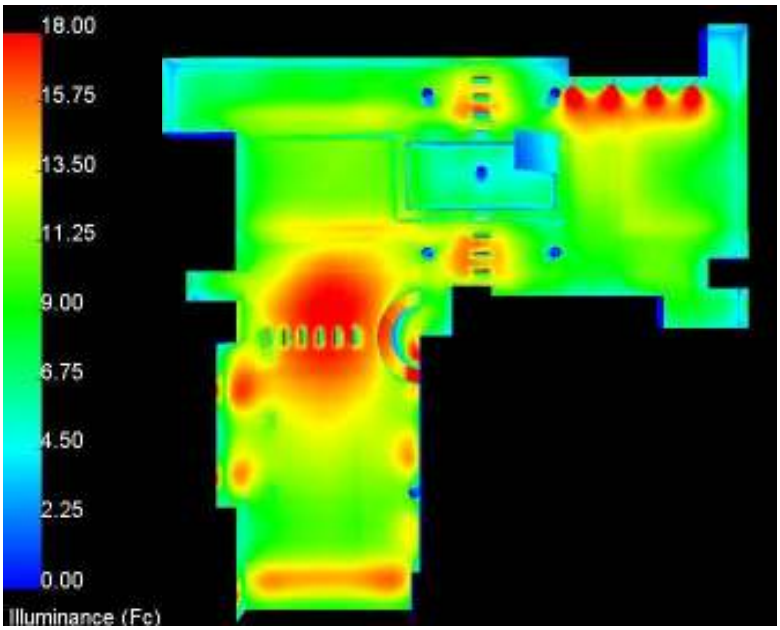
Lighting Equipment Schedule

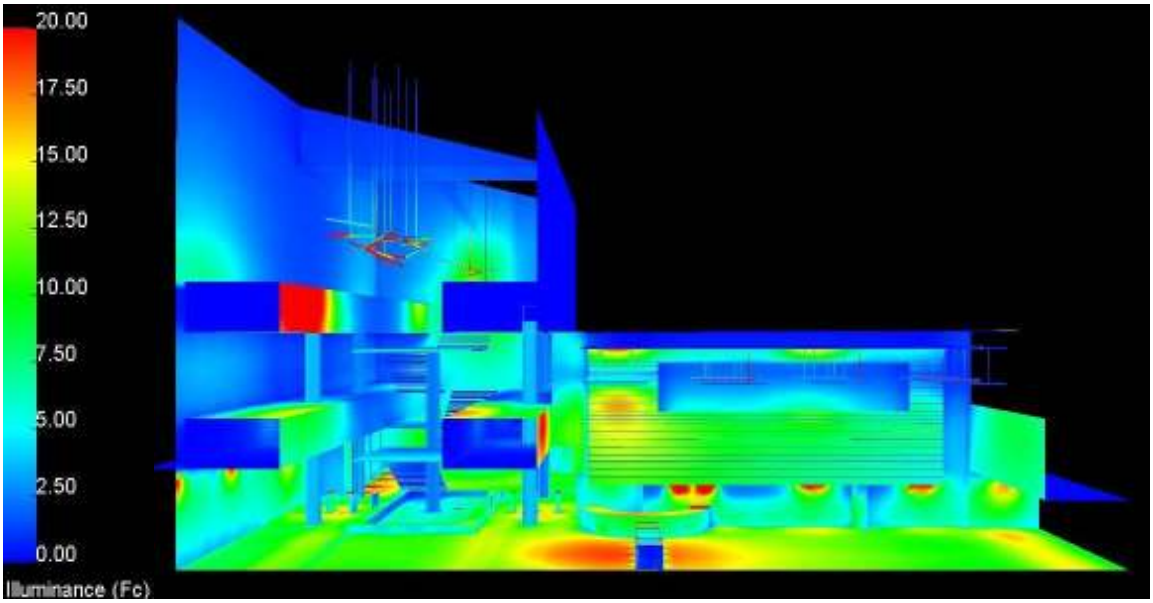
Lighting Equipment Schedule				
Type		Description	Manufacturer	Lamp
	PF1	8 foot direct indirect fluorescent pendant with soft glow lens, extruded aluminum housing with aluminum finish, suspended 4 feet, 42% uplight. Integral ballast.	Litecontrol	(2) 54 watt T5HO, 85 CRI, 3500K CCT
	PF3	8 foot direct indirect fluorescent pendant with soft glow lens, extruded aluminum housing with aluminum finish, suspended 4 feet, 42% uplight. Integral ballast.	Litecontrol	(2) 28 watt T5, 85 CRI, 3500K CCT
	PF4	Suspended 2" wide x 6' long x 2" deep direct pendant mounted direct and indirect. Staggered mounting with extra diffuse lens and white finish. Integral ballast.	Architectural Lighting Works	(2) 21watt T5, 85 CRI, 3500K CCT
	RL1	4 foot long x 2" wide LED linear recessed fixture with extruded aluminum housing and white enamel reflector. Integral electronic driver.	Amerlux LLC	21.6 watt LED array, 120 white LEDs, 73.6 lumens/ watt, 80+ CRI, 3500K CCT
	WL1	Recessed LED wall wash with 5" square aperture. Extruded aluminum housing. Dimmable to 10% output. 50,000 hour life. Integral driver	Edison Price Lighting	LED array, 14 watt, 18 input watts, 800 lumen output, 3500K CCT, 85+ CRI

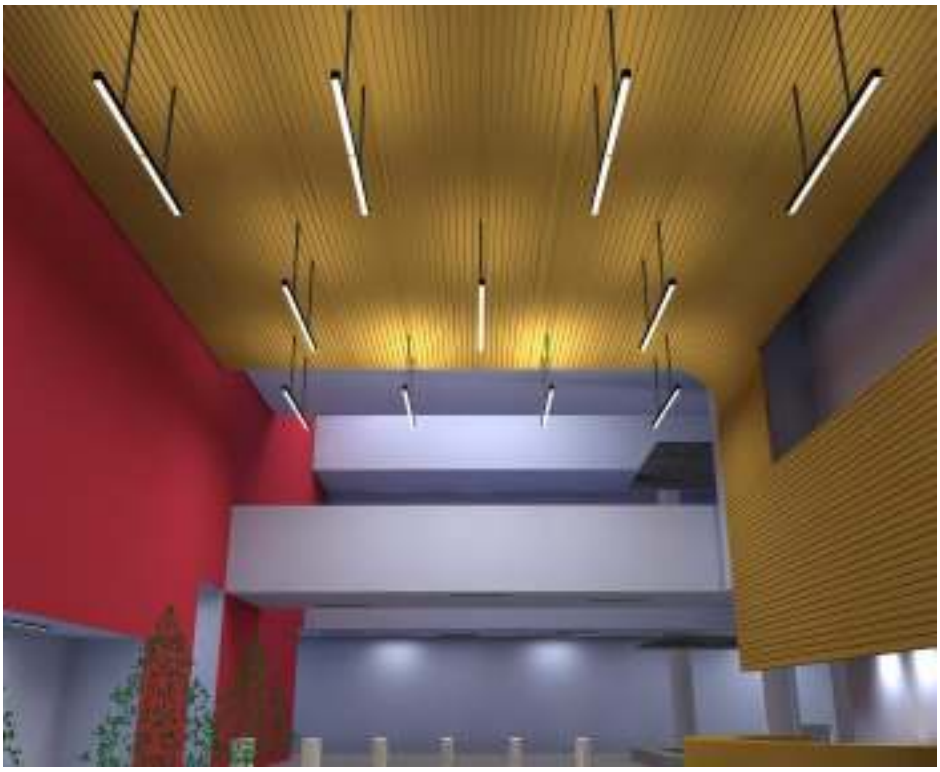
Light Loss Factors

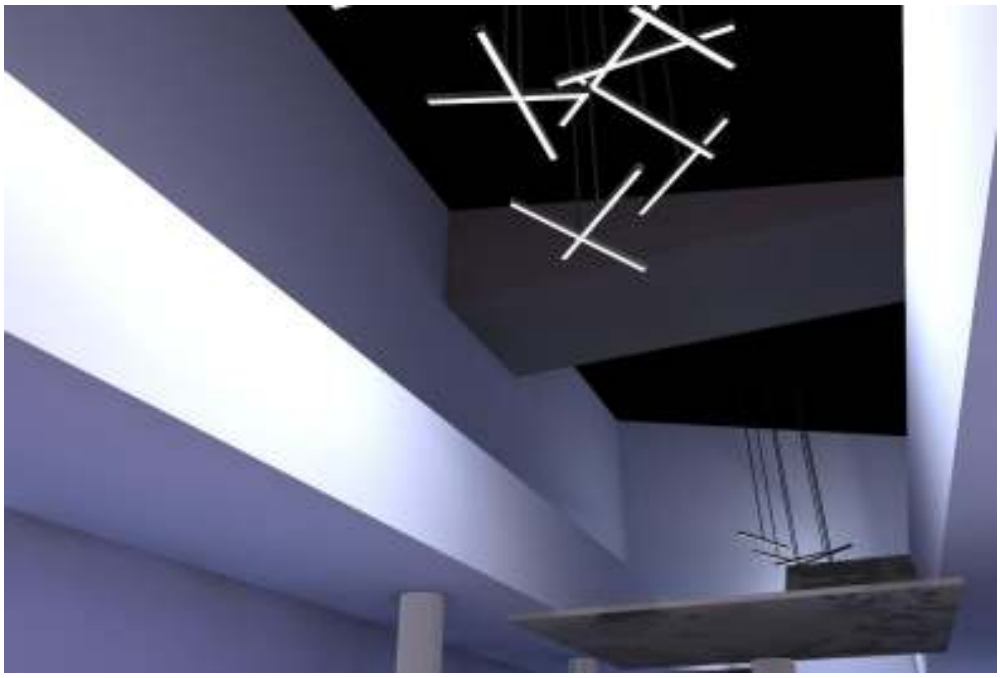
Lighting Equipment Schedule					
Type		LLD	LDD	BF	LLF
	PF1	0.93	0.92	1.00	0.86
	PF3	0.93	0.92	1.00	0.86
	PF4	0.93	0.92	1.00	0.86
	RL1	0.70	0.92	-	0.64
	WL1	0.70	0.92	-	0.64

Renderings




20.00
17.50
15.00
12.50
10.00
7.50
5.00
2.50
0.00
Illuminance (Fc)





Calculation Summary

Vestibule Calculation Summary			
		Horizontal (0')	Vertical (5')
	Average Illuminance (fc)	11.9	6.5
	Maximum Illuminance (fc)	15	8.6
	Minimum Illuminance (fc)	7.8	4.7
	Maximum:Average	1.25	1.4
Design Criteria	Average Illuminance (fc)	10	3

Outer Lobby Calculation Summary			
		Horizontal (3')	Vertical (5')
	Average Illuminance (fc)	12.1	5.4
	Maximum Illuminance (fc)	17.9	5.9
	Minimum Illuminance (fc)	6.7	4.7
	Maximum:Average	1.5	1.1
Design Criteria	Average Illuminance (fc)	10	3

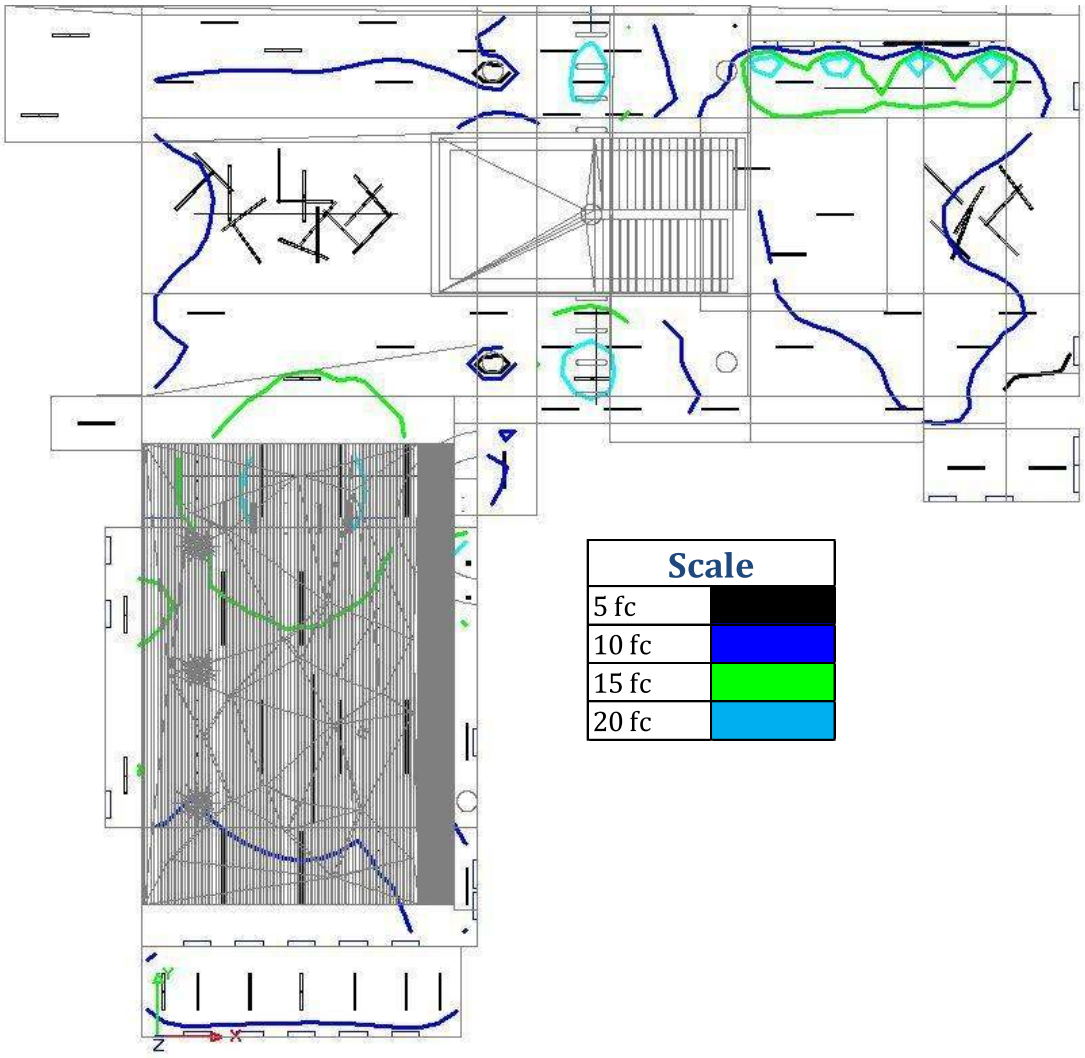
Outer Lobby Security Calculation Summary			
		Horizontal (3')	Vertical (5')
	Average Illuminance (fc)	18.9	8.6
	Maximum Illuminance (fc)	22	10.1
	Minimum Illuminance (fc)	12.9	7.3
	Maximum:Average	1.2	1.2
Design Criteria	Average Illuminance (fc)	20	10

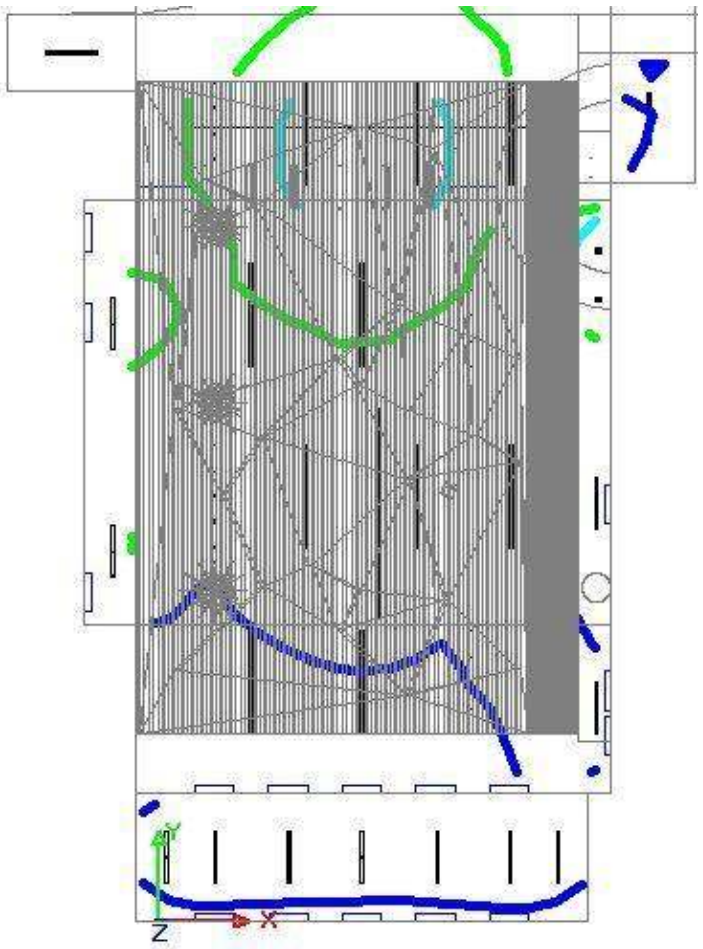
Outer Lobby Security Calculation Summary			
		Information Desk Horizontal (3'-6")	Information Desk Vertical (5')
	Average Illuminance (fc)	16.7	10.9
	Maximum Illuminance (fc)	38	11.2
	Minimum Illuminance (fc)	10.7	10.4
	Maximum:Average	2.27	1.03
Design Criteria	Average Illuminance (fc)	15	5

Inner Lobby Calculation Summary			
		Horizontal (0')	Vertical (5')
	Average Illuminance (fc)	11.5	4.2
	Maximum Illuminance (fc)	18.1	4.3
	Minimum Illuminance (fc)	8.1	3.9
	Maximum:Average	1.5	1.03
Design Criteria	Average Illuminance (fc)	10	5

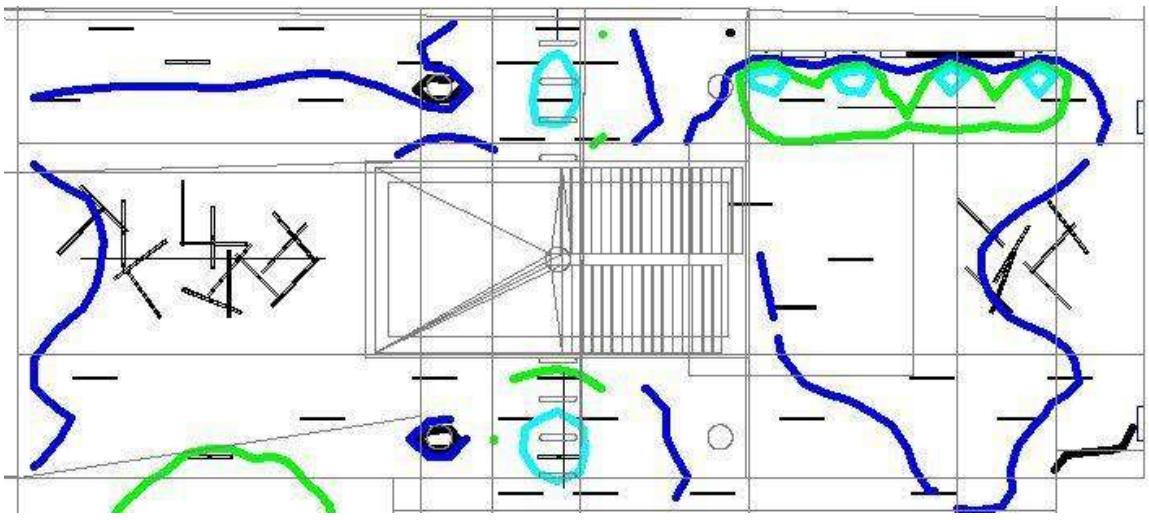
Inner Lobby Security Calculation Summary			
		Horizontal (0')	Vertical (5')
	Average Illuminance (fc)	18.05	8.3
	Maximum Illuminance (fc)	21.6	8.7
	Minimum Illuminance (fc)	11.6	7.3
	Maximum:Average	1.2	1.05
Design Criteria	Average Illuminance (fc)	20	10

Elevator Lobby Calculation Summary			
		Horizontal (0')	Vertical (5')
	Average Illuminance (fc)	10.57	4.9
	Maximum Illuminance (fc)	28.2	5.2
	Minimum Illuminance (fc)	4.8	4.5
	Maximum:Average	2.7	1.05
Design Criteria	Average Illuminance (fc)	10	5





Scale	
5 fc	
10 fc	
15 fc	
20 fc	



Scale	
5 fc	
10 fc	
15 fc	
20 fc	

Energy Code Compliance

Lighting Power Density	
Area	7727.2 sq ft
Watts	4226.9 W
Designed	0.55 W/sq ft
Criteria	1.3 W/sq ft

Evaluation of Design

As the main entry point into the Pennsylvania State Employees Credit Union Corporate Headquarters, the lobby should make an immediate impression. The Flynn Impression of public was incorporated into the design through uniformity in the lighting and overall brightness of the space. Also, guided circulation was a key design criterion, which was emphasized through the staggered linear pendants in the outer lobby and staggered recessed linear LED fixtures along the pathways. The inner lobby emphasized random circulation because it is a junction point to many different spaces. This was again replicated in the elevator lobby over the seating area. The pendants are both indirect and direct to both provide downlight for the inner lobby and elevator lobby, but also to highlight the skylights at night. Another key design criterion was to emphasize strong lines and angles. This was accomplished thorough linear lighting, along with the staggering of the pendants to create strong angles. The wood panel wall and ceiling were accentuated through the indirect component of the linear fluorescent pendants. As the space has tall ceilings, the lighting aimed to draw the eye upward to appreciate the hidden architectural details, such as the wood walls and skylights. The security areas are an important area, which are highlighted through higher light levels. The linear fluorescent pendants in the outer lobby have a higher wattage lamp over the security area and the linear recessed LED luminaires are more frequent over the inner lobby security area.

Overall, the outer lobby, inner lobby, and elevator lobby all met IES horizontal and vertical illuminance levels. Some are higher due to the security areas requiring higher illuminance levels, but the overall high vertical illuminances highlight faces and allow for good facial recognition. In addition, the space is 60% under the allowable power density. Therefore, the design is very energy efficient with only additional energy savings through photosensor dimming.

Electrical Redesign

The electrical redesign addresses the changes to the lighting and how the redesigned space will be controlled. The following looks at the Circulation Space, which is the Lobby.

Description

The Lobby is the main entry point into the Pennsylvania State Employees Credit Union Corporate Headquarters. It also serves as a security screening area. The large curved wood panel wall and ceiling is the main feature of the outer lobby, which is highlighted through linear fluorescent pendants. The pattern guides the circulation through the space and into the inner lobby. The inner lobby is a large atrium space. The second and third floor corridors line the space and the large slanted skylight provides daylight to the space. The linear fluorescent pendants are mounted between 40'-0" and 45'-0" in a design to mimic how the space is a junction point. From the inner lobby occupants can enter the fitness center, the conference center, the cafeteria, and go through additional security to enter the office spaces. Once through the security turnstiles, the elevator lobby serves as another junction point. The open stairwell creates a lightness, while the elevators are highlighted through wall recessed linear LED fixtures.

Five panelboards service the lobbies along with portions of the adjacent corridors. The circuits will be kept the same with the removal of the existing fixtures. The relighted space will be entered onto new circuits in order to control the lighting more effectively. Also, the space operates on the Lutron Quantum system. The following details the electrical redesign for the Lobby.

Panelboard Summary

A total of ten panelboards encompass the lighting panels for the four space redesigned. The panels consist of both normal and normal/emergency panelboards.

PANELBOARDS						
PANEL TAG	VOLTAGE	SYSTEM	FAÇADE AND ENTRY PLAZA	LOBBY	BOARD ROOM	MARKETING OFFICE
ELP1E	480Y/277V 3PH 4W	N/E		X		
ELP1W	480Y/277V 3PH 4W	N/E	X	X		
LP1W	480Y/277V 3PH 4W	N		X		
LP3W	480Y/277V 3PH 4W	N		X		
LP3E	480Y/277V 3PH 4W	N		X		
ELP3W	480Y/277V 3PH 4W	N/E			X	
LP3W	480Y/277V 3PH 4W	N			X	
LP3E	480Y/277V 3PH 4W	N/E				X
ELP3E	480Y/277V 3PH 4W	N				X
SLP3	480Y/277V 3PH 4W	?	X			

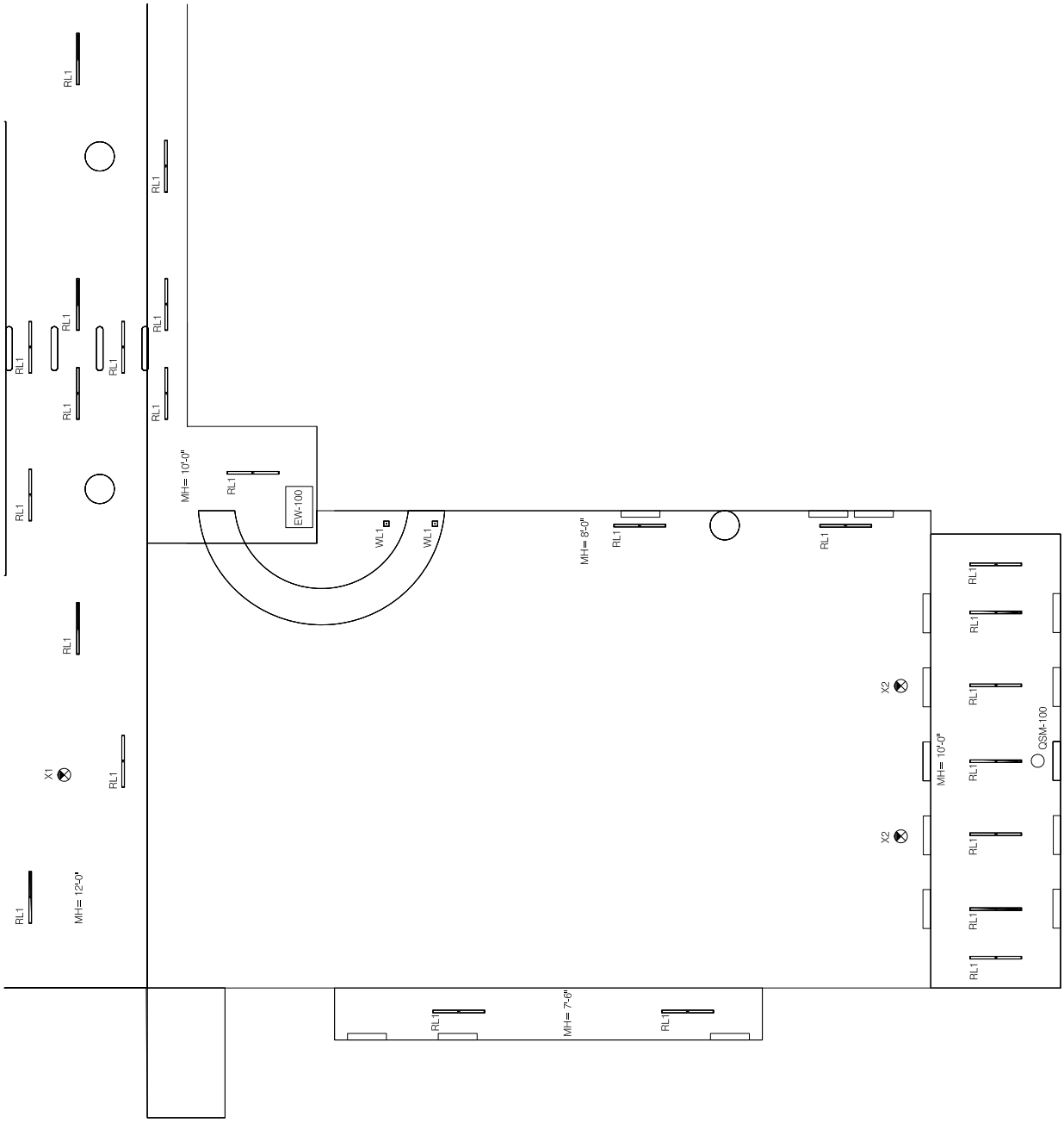
Controls

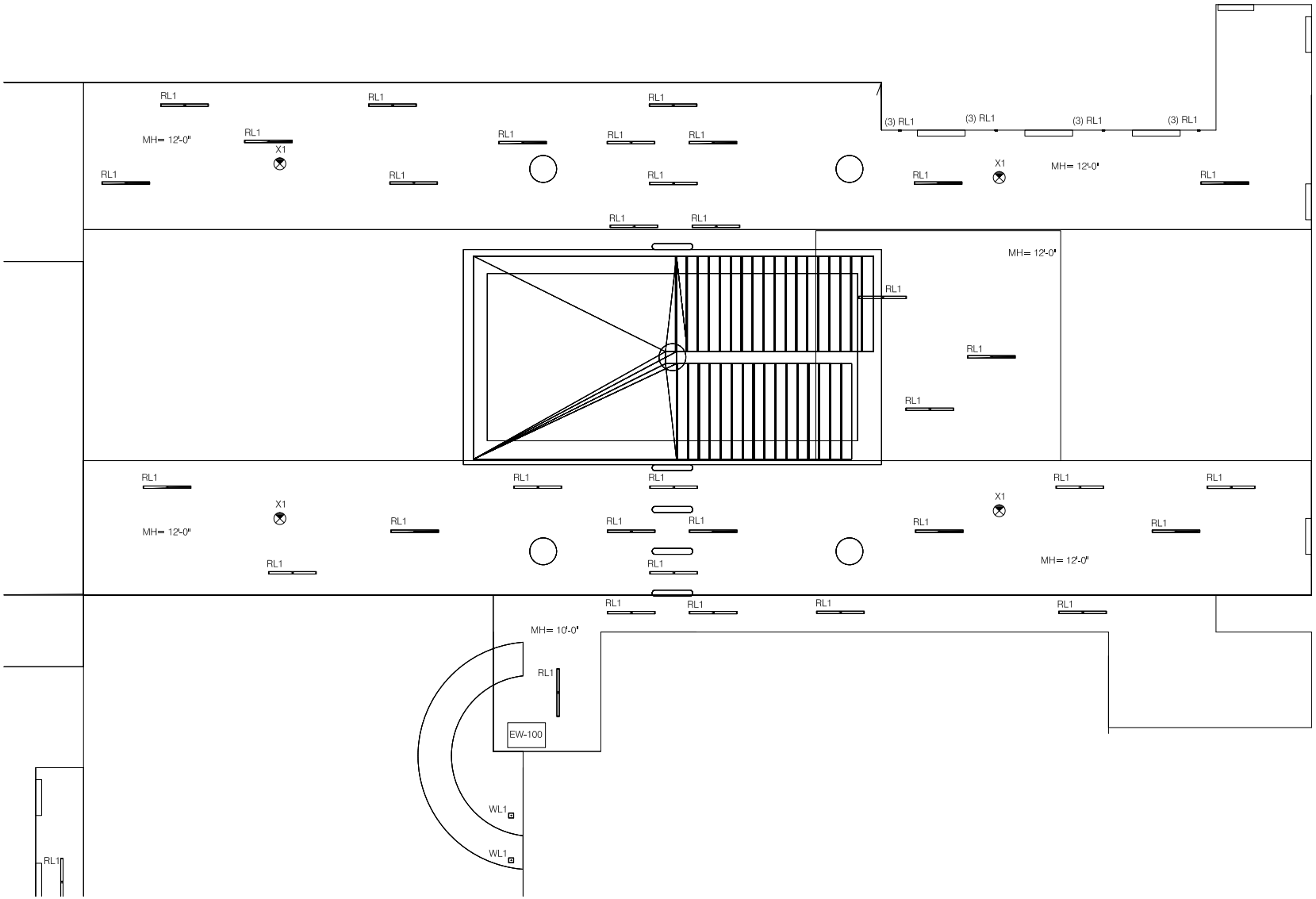
The Lobby operates on the Lutron Quantum building control system. The Lutron Quantum system communicates with a Lutron Energi Savr Node which communicates with a variety of spaces within the Pennsylvania State Employees credit Union Corporate Headquarters, including the Lobby. Both Ecosystem H-Series Ballasts and Lutron Ecosystem Hi-lume A-Series LED Drivers communicate with the Lutron EcoSystem Wallstation in order to dim the space. The four button Lutron EcoSystem Wallstation is set for three scenes including day and night settings. The Lutron EcoSystem Wallstation is located behind the security desk. Lutron Quantum Sensor Modules are located on both the third and first floor. The lighting operates on line-voltage dimming with programmable zones through the Lutron EcoSystem Wallstation. The EcoSystem Wallstation communicates with the Lutron Energi Savr Node that relays information to the Quantum Lighting Management Hub.

Lighting | Electrical Plans

See Appendix A

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: FIRST FLOOR LOBBY LIGHTING PLAN	SHEET TITLE: L03





THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
1/8" = 1'

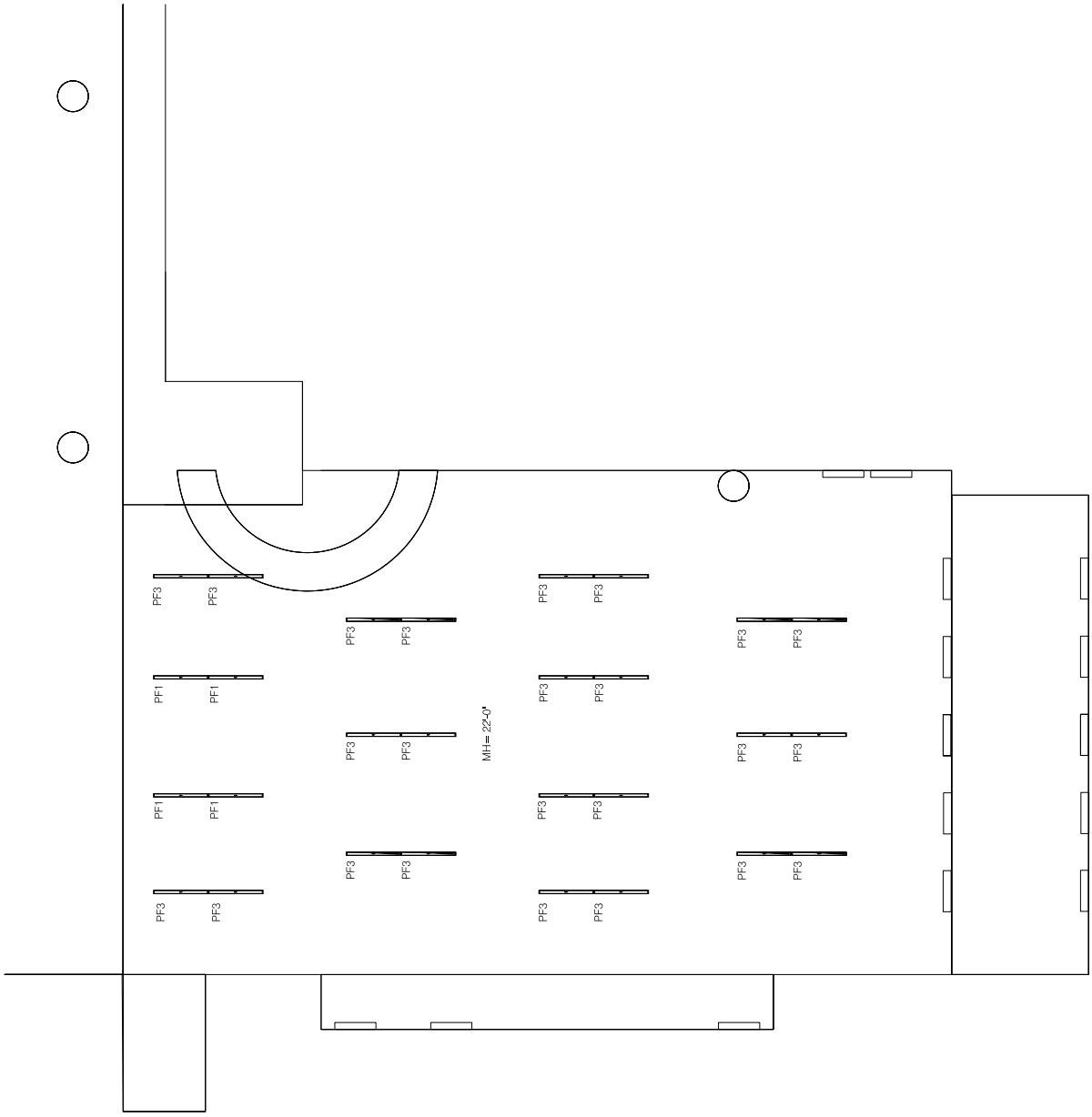
ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

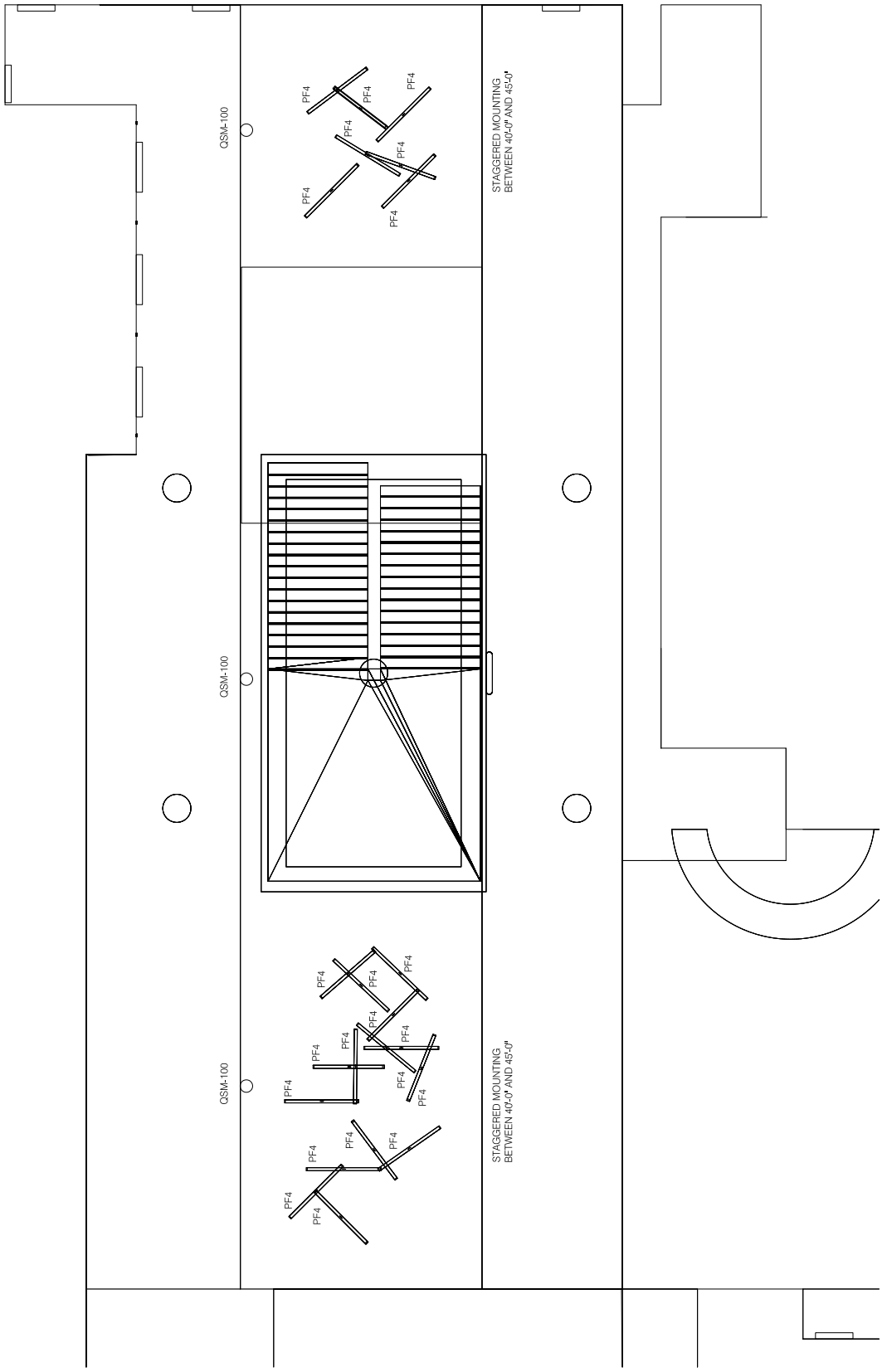
TITLE:
FIRST FLOOR
LOBBY LIGHTING PLAN

SHEET TITLE:
L.04

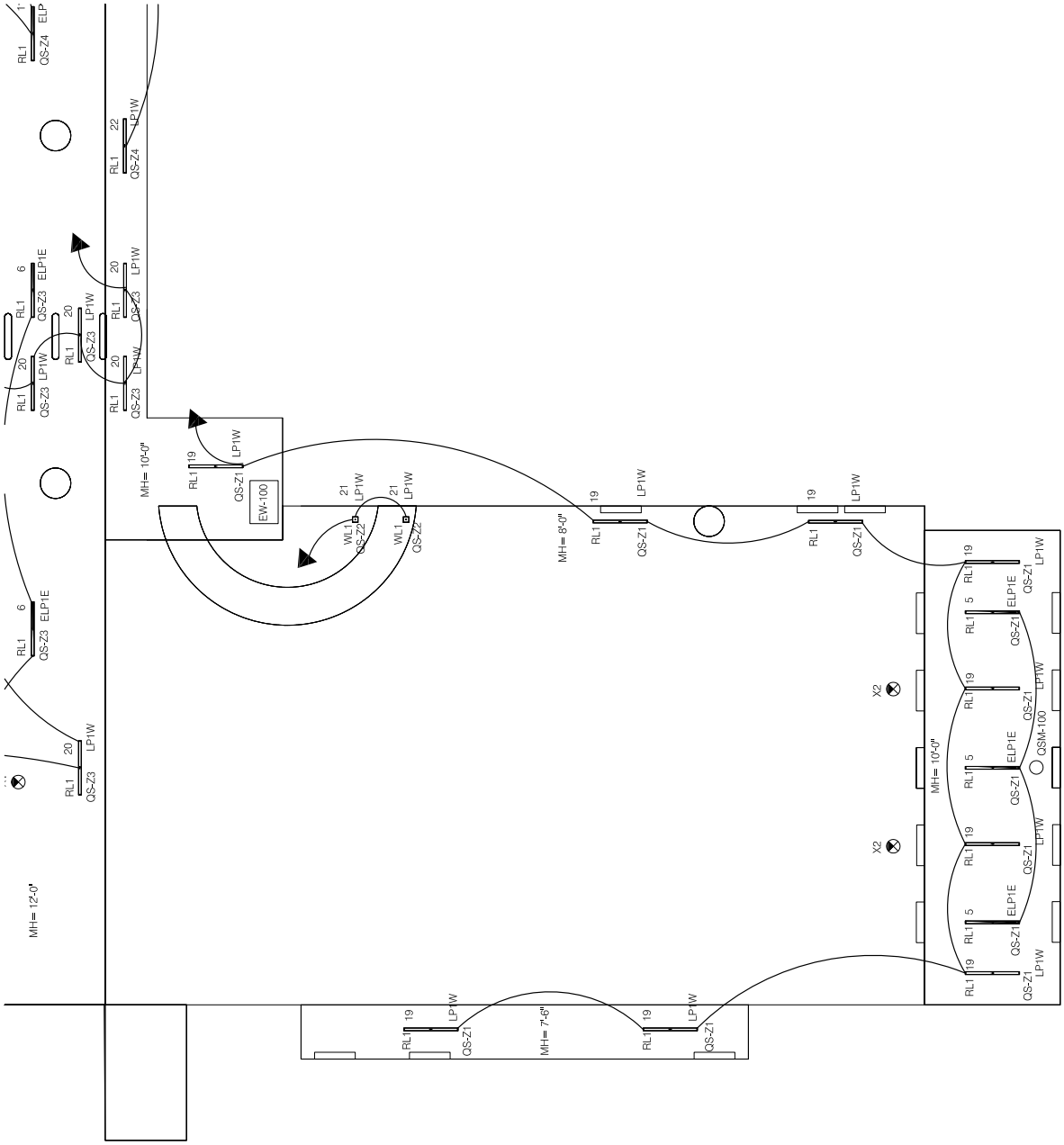
THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: SECOND FLOOR LOBBY LIGHTING PLAN	SHEET TITLE: L.05



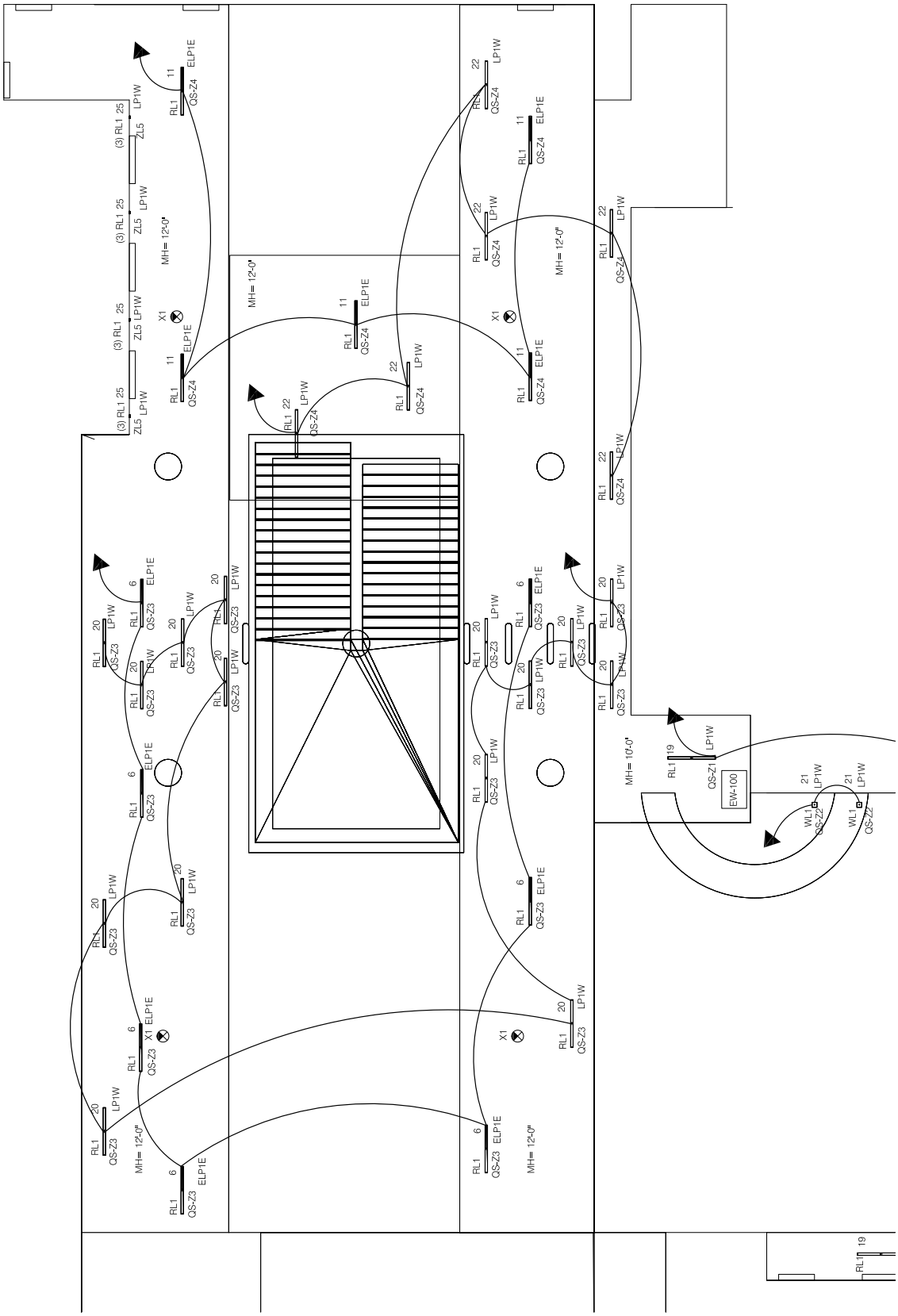
THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: THIRD FLOOR LOBBY LIGHTING PLAN	SHEET TITLE: L.06

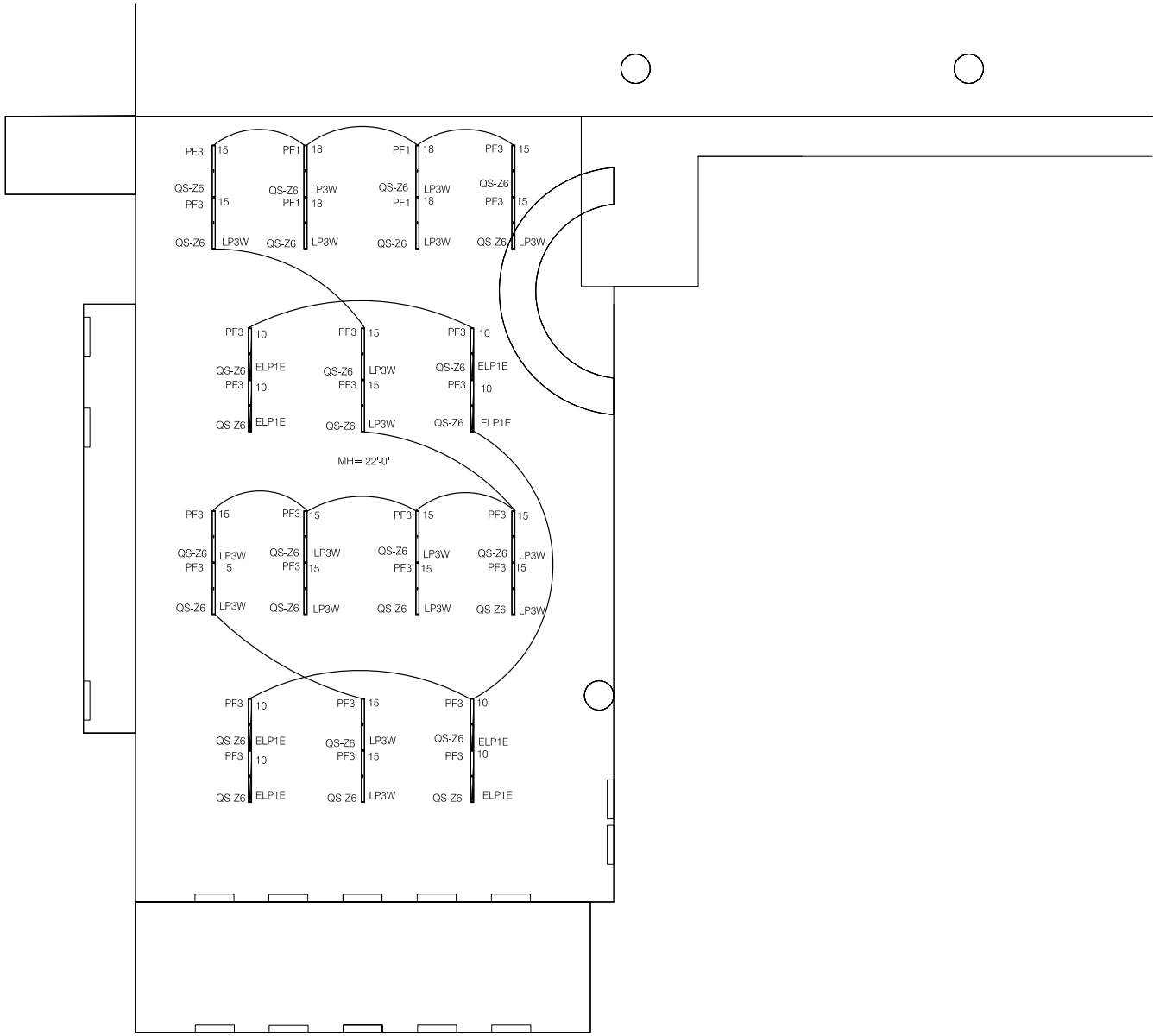


THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: FIRST FLOOR LOBBY CIRCUITING DIAGRAM	SHEET TITLE: E.03



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: FIRST FLOOR LOBBY CIRCUITING DIAGRAM	SHEET TITLE: E.04





THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

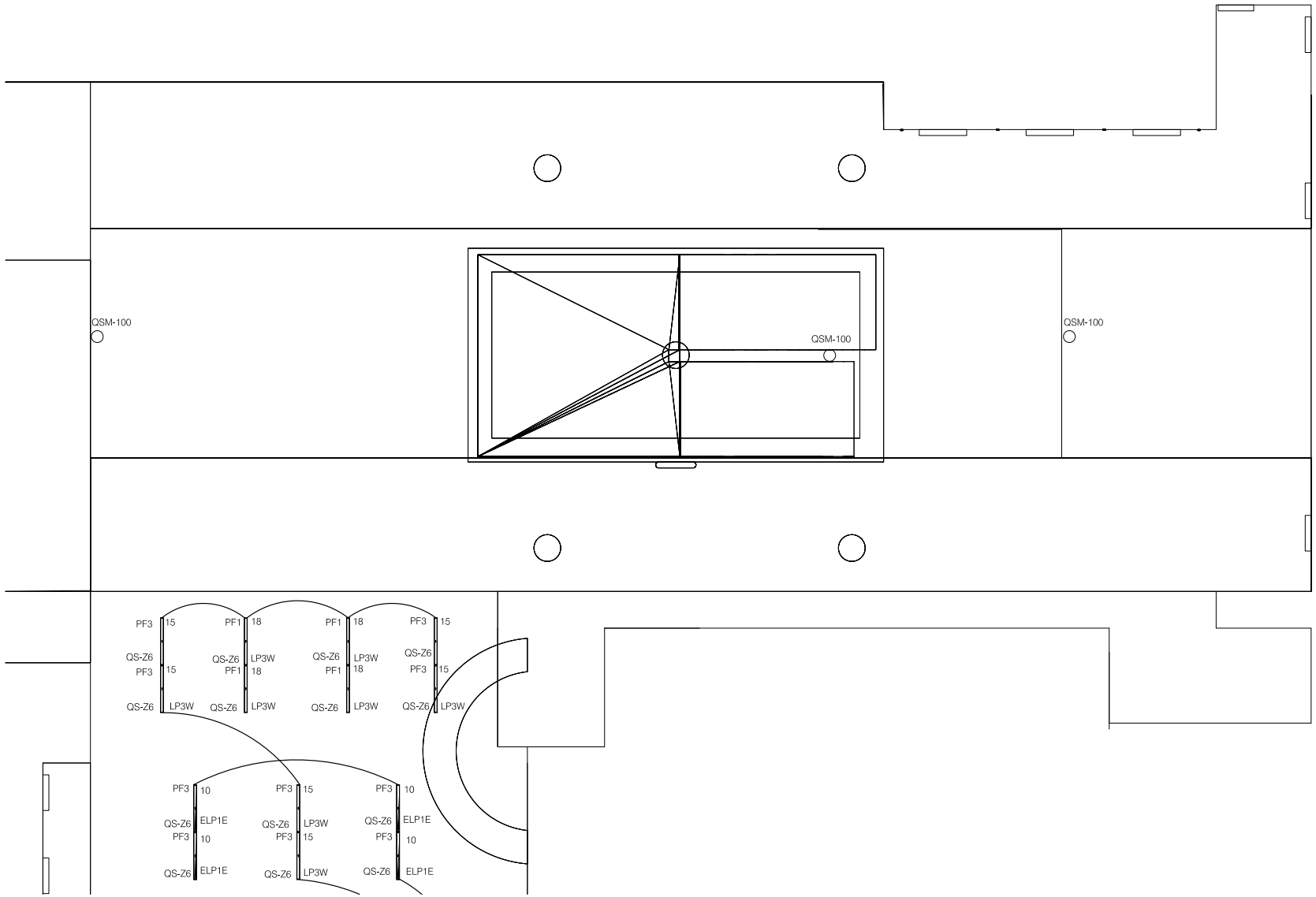
SCALE:
1/8" = 1'

ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
SECOND FLOOR
LOBBY CIRCUITING DIAGRAM

SHEET TITLE:
E.05



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
1/8" = 1'

ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

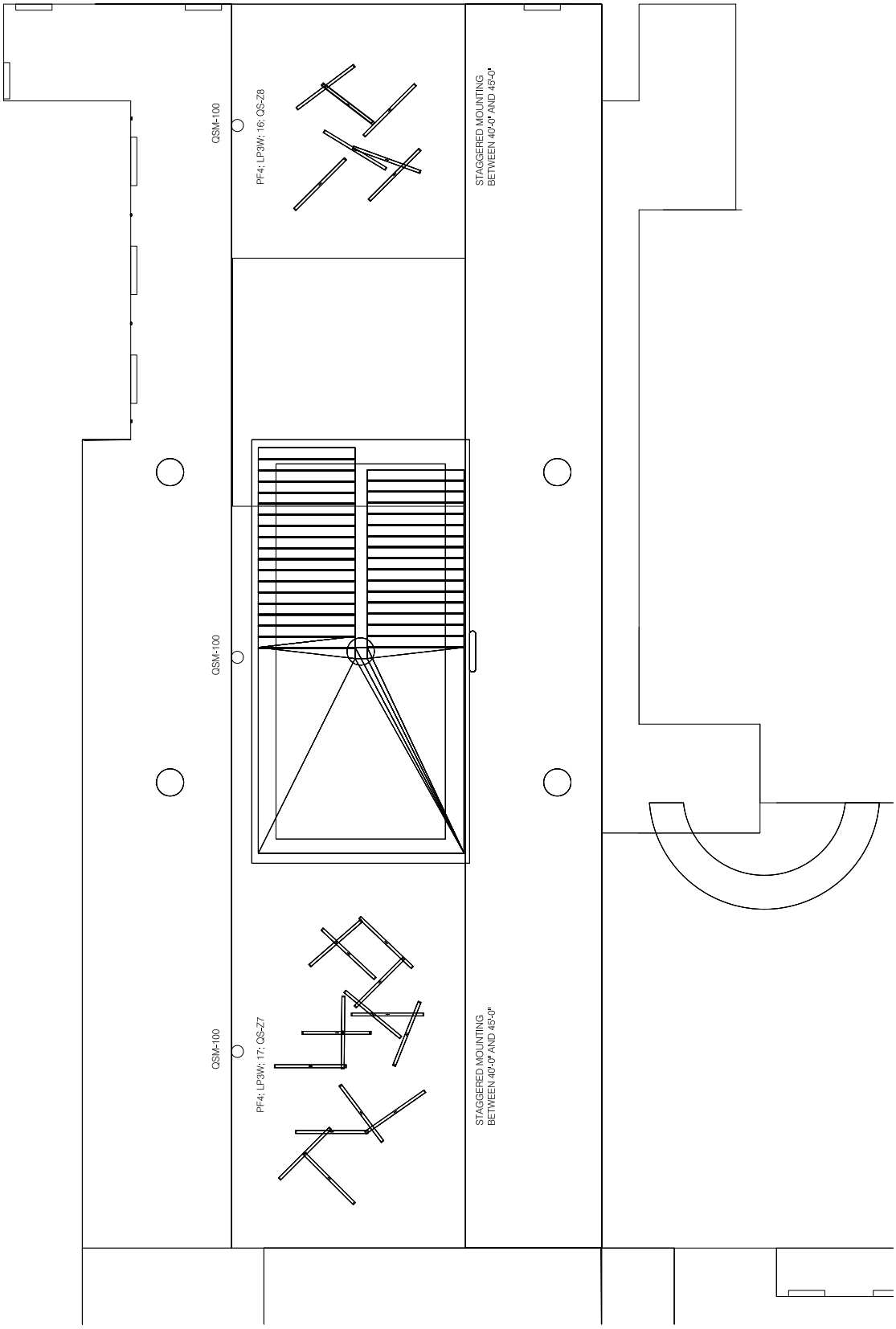
TITLE:
SECOND FLOOR
LOBBY CIRCUITING DIAGRAM

SHEET TITLE:
E.06

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS

HARRISBURG, PA

SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
1/8" = 1'	04/03/2012	SARAH WUJCIK	THIRD FLOOR LOBBY CIRCUITING DIAGRAM	E.07



Existing Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W			PANEL TAG:	LP1W			AIC RATING:	25K			
SIZE/TYPE BUS:	400A			PANEL LOCATION:	ELECTR A149			MODIFICATIONS:				
SIZE/TYPE MAIN:	400A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	MDP2-1							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
150E	LP1W;1	T-RP1W	150A	3	25537 VA/ 0VA			3	60A	T-RP1FC	LP1W;2	60F
	LP1W;3	-	-	-		32937 VA/ 0VA		-	-	-	LP1W;4	
	LP1W;5	-	-	-			31887 VA/ 0VA	-	-	-	LP1W;6	
20A	LP1W;7	LIGHTING RM A180,A398	20A	1	978 VA/ 2604 VA			1	20A	LIGHTING RM A102	LP1W;8	20A
20A	LP1W;9	LIGHTING	20A	1		1197 VA/ 1839 VA		1	20A	LIGHTING RM A145-1	LP1W;10	20A
20A	LP1W;11	LIGHTING RM A335, A164	20A	1			1581 VA/ 3814 VA	1	20A	LIGHTING RM A154, A153	LP1W;12	20A
20A	LP1W;13	LIGHTING RM A146, A147, A136, A137, A139	20A	1	2599 VA/ 3875 VA			1	20A	LIGHTING RM A123, A122, A121, A120, A110	LP1W;14	20A
20A	LP1W;15	LIGHTING RM A105, A106, A273, A111, A110,	20A	1		3257 VA/ 3343 VA		1	20A	LIGHTING RM A174, A160	LP1W;16	20A
20A	LP1W;17	LIGHTING RM A166, B105, A164, B108	20A	1			4122 VA/ 0 VA				LP1W;18	
	LP1W;19										LP1W;20	
	LP1W;21										LP1W;22	
	LP1W;23										LP1W;24	
	LP1W;25										LP1W;26	
	LP1W;27										LP1W;28	
	LP1W;29										LP1W;30	
15F	LP1W;31	SUB-METER	15A	3	6 VA/ 0 VA						LP1W;32	
	LP1W;33	-	-	-		6 VA/ 0 VA					LP1W;34	
	LP1W;35	-	-	-			6 VA/ 0 VA				LP1W;36	
	LP1W;37	SPARE	20A	1	0VA/ 0VA			1		SPARE	LP1W;38	
	LP1W;39	SPARE	20A	1		0VA/ 0VA		1		SPARE	LP1W;40	
	LP1W;41	SPARE	20A	1			0VA/ 0VA	1		SPARE	LP1W;42	
				LOAD PER PHASE	35599 VA	42579 VA	41410 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	29209 VA	100.00%	29209 VA
EQUIP	41018 VA	80.00%	32814 VA
RECEPT CONV	34180 VA	80.00%	27344 VA
RECEPT KITCHEN	3320 VA	65.00%	2158 VA
RECEPT OFFICE	17740 VA	80.00%	14192 VA
RECEPT OFFICE EQUIP	2000 VA	80.00%	1600 VA
RECEPT PANTRY	5740 VA	80.00%	4592 VA
POWER AV	7800 VA	80.00%	6240 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	1472-7 VA
TOTAL EST DEMAND	123289 VA
TOTAL CONNECTED CURRENT	177 A
TOTAL ESTIMATED DEMAND CURRENT	148 A

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W			PANEL TAG:	LP3W			AIC RATING:	25K			
SIZE/TYPE BUS:	400A			PANEL LOCATION:	ELECTR A327			MODIFICATIONS:				
SIZE/TYPE MAIN:	400A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	MDP2-1							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
150E	LP3W;1	T-RP3W	150A	3	32018 VA/ 2483 VA			1	20A	LIGHTING COMMONS A325	LP3W;2	
	LP3W;3	-	-	-		31808 VA/ 3895 VA		1	20A	LIGHTING VP FINANCE A319	LP3W;4	
	LP3W;5	-	-	-			32078 VA/ 2942 VA	1	20A	LIGHTING BOARDROOM	LP3W;6	
20A	LP3W;7	LIGHTING INFORMATION TECH	20A	1	2854 VA/ 3050 VA			1	20A	LIGHTING VP A340	LP3W;8	
20A	LP3W;9	LIGHTING ROOF GARDEN	20A	1		3135 VA/ 0 VA					LP3W;10	
20A	LP3W;11	LIGHTING MEN'S RESTRM A345	20A	1			4079 VA/ 0 VA				LP3W;12	
	LP3W;13										LP3W;14	
	LP3W;15										LP3W;16	
	LP3W;17										LP3W;18	
	LP3W;19										LP3W;20	
	LP3W;21										LP3W;22	
	LP3W;23										LP3W;24	
	LP3W;25										LP3W;26	
	LP3W;27										LP3W;28	
	LP3W;29										LP3W;30	
15F	LP3W;31	SUB-METER	15A	3	6 VA/ 0 VA						LP3W;32	
	LP3W;33	-	-	-		6 VA/ 0 VA					LP3W;34	
	LP3W;35	-	-	-			6 VA/ 0 VA				LP3W;36	
	LP3W;37	SPARE	20A	1	0VA/ 0VA			1	20A	SPARE	LP3W;38	
	LP3W;39	SPARE	20A	1		0VA/ 0VA		1	20A	SPARE	LP3W;40	
	LP3W;41	SPARE	20A	1			0VA/ 0VA	1	20A	SPARE	LP3W;42	
				LOAD PER PHASE	40411 VA	38844 VA	39105 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	22052 VA	100.00%	22052 VA
EQUIP	25653 VA	80.00%	20522 VA
RECEPT CONV	19440 VA	80.00%	15552 VA
RECEPT KITCHEN	500 VA	100.00%	500 VA
RECEPT OFFICE	11520 VA	80.00%	9216 VA
RECEPT OFFICE EQUIP	3600 VA	80.00%	2880 VA
RECEPT PANTRY	1580 VA	80.00%	1264 VA
WKSTN FEED	22580 VA	80.00%	18064 VA
POWER AV	9200 VA	80.00%	7360 VA
CONTROLS	0 VA	0.00%	0 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	118361 VA
TOTAL EST DEMAND	99646 VA
TOTAL CONNECTED CURRENT	142 A
TOTAL ESTIMATED DEMAND CURRENT	120 A

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W LIFE SAFETY			PANEL TAG:	ELP1W			AIC RATING:	25K			
SIZE/TYPE BUS:	250A			PANEL LOCATION:	ELECTR A149			MODIFICATIONS:				
SIZE/TYPE MAIN:	250A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	EMDP							

Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
20A	ELP1W;1	EXIT SIGNS	20A	1	164 VA / 2832 VA			1	20A	BUILDING EGRESS LIGHTING	ELP1W;2	30A
30A	ELP1W;3	EMERG LIGHTING RM A154, A153, A166	20A	1		1720 VA/ 1806 VA		1	20A	EMERG LIGHTING RM A153, A154, A146, A147	ELP1W;4	30A
	ELP1W;5										ELP1W;6	
	ELP1W;7										ELP1W;8	
	ELP1W;9										ELP1W;10	
	ELP1W;11										ELP1W;12	
	ELP1W;13										ELP1W;14	
	ELP1W;15										ELP1W;16	
	ELP1W;17										ELP1W;18	
	ELP1W;19										ELP1W;20	
	ELP1W;21										ELP1W;22	
	ELP1W;23										ELP1W;24	
	ELP1W;25										ELP1W;26	
	ELP1W;27										ELP1W;28	
	ELP1W;29										ELP1W;30	
100F	ELP1W;31	ELP2W	100A	3	2130 VA/ 0 VA						ELP1W;32	
	ELP1W;33	-	-	-		3215 VA/ 0 VA					ELP1W;34	
	ELP1W;35	-	-	-			0 VA/ 0 VA				ELP1W;36	
	ELP1W;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	ELP1W;38	
	ELP1W;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	ELP1W;40	
	ELP1W;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	ELP1W;42	
			LOAD PER PHASE		4184 VA	6741 VA	0 VA/ 0 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	10601	100.00%	10601 VA
EXIT SIGNS	324 VA	100.00%	324 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	14126 VA
TOTAL EST DEMAND	14126 VA
TOTAL CONNECTED CURRENT	17 A
TOTAL ESTIMATED DEMAND CURRENT	17 A

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W LIFE SAFETY			PANEL TAG:	ELP1E			AIC RATING:	25K			
SIZE/TYPE BUS:	250A			PANEL LOCATION:	ELECTR B160			MODIFICATIONS:	MLO W/ FEED THRU LUGS			
SIZE/TYPE MAIN:	250A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	EMDP							

Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
20A	ELP1E;1	EXIT SIGNS	20A	1	164 VA / 2832 VA			1	20A		ELP1E;2	30A
30A	ELP1E;3	BUILDING EGRESS LIGHTING	20A	1		468 VA/2401 VA		1	20A		ELP1E;4	30A
	ELP1E;5										ELP1E;6	
	ELP1E;7										ELP1E;8	
	ELP1E;9										ELP1E;10	
	ELP1E;11										ELP1E;12	
	ELP1E;13										ELP1E;14	
	ELP1E;15										ELP1E;16	
	ELP1E;17										ELP1E;18	
	ELP1E;19										ELP1E;20	
	ELP1E;21										ELP1E;22	
	ELP1E;23										ELP1E;24	
	ELP1E;25										ELP1E;26	
	ELP1E;27										ELP1E;28	
	ELP1E;29										ELP1E;30	
100F	ELP1E;31	ELP2E	100A	3	4708 VA/0 VA						ELP1E;32	
	ELP1E;33	-	-	-		3553 VA/ 0 VA					ELP1E;34	
	ELP1E;35	-	-	-			0 VA/ 0 VA				ELP1E;36	
	ELP1E;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	ELP1E;38	
	ELP1E;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	ELP1E;40	
	ELP1E;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	ELP1E;42	
			LOAD PER PHASE		7704 VA	6422 VA	0 VA/ 0 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	13714 VA	100.00%	13714 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	14126 VA
TOTAL EST DEMAND	14126 VA
TOTAL CONNECTED CURRENT	17 A
TOTAL ESTIMATED DEMAND CURRENT	17 A

Existing Control Layout

See Appendix D

Panelboard Worksheets

PANELBOARD SIZING WORKSHEET

Panel Tag---------->				LP1W	Panel Location:			ELECTRIC RM A149		
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	T-RP1W	1		25537	VA	1.00	25537	25537	
2	A	T-RP1FC	1		0	VA	1.00	0	0	
3	B	-	1		32937	VA	1.00	32937	32937	
4	B	-	1		0	W		0	0	
5	C	-	1		318887	VA	1.00	318887	318887	
6	C	-	1		0	w		0	0	
7	A	LIGHTING	2	RM180, 1398	978	VA	0.90	880	978	
8	A	LIGHTING	2	RMA102	2115	VA	0.90	1904	2115	
9	B	LIGHTING	2		165	VA	0.90	149	165	
10	B	LIGHTING	2	RM A145	1053	VA	0.90	948	1053	
11	C	LIGHTING	2	RM A335, A164	1581	VA	0.90	1423	1581	
12	C	LIGHTING	2	RM A154	3814	VA	0.90	3433	3814	
13	A	LIGHTING	2	RM A146	2599	VA	0.90	2339	2599	
14	A	LIGHTING	2	RM A123	3875	VA	0.90	3488	3875	
15	B	LIGHTING	2	RMA105	3257	VA	0.90	2931	3257	
16	B	LIGHTING	2	RM A174	3343	VA	0.90	0	0	
17	C	LIGHTING	2	RM A166	4122	VA	0.90	3710	4122	
18	C				0	w	0.90	0	0	
19	A	LIGHTING	2	LOBBY	195	w	0.70	195	279	
20	A	LIGHTING	2	LOBBY	324	w	0.70	324	463	
21	B	LIGHTING	2	LOBBY	36	w	0.70	36	51	
22	B	LIGHTING	2	LOBBY	130	w	0.70	130	186	
23	C				0	w		0	0	
24	C				0	w		0	0	
25	A	LIGHTING	2	LOBBY	260	w	0.70	260	371	
26	A				0	w		0	0	
27	B				0	w		0	0	
28	B				0	w		0	0	
29	C				0	w		0	0	
30	C				0	w		0	0	
31	A	SUB-METER	3		6	w	1.00	6	6	
32	A				0	w		0	0	
33	B	-	3		6	w	1.00	6	6	
34	B				0	w		0	0	
35	C	-	3		6	w	1.00	6	6	
36	C				0	w		0	0	
37	A	SPARE	3		0	w		0	0	
38	A	SPARE	3		0	w		0	0	
39	B	SPARE	3		0	w		0	0	
40	B	SPARE	3		0	w		0	0	
41	C	SPARE	3		0	w		0	0	
42	C	SPARE	3		0	w		0	0	
PANEL TOTAL								399.5	402.3	Amps= 484.1

PHASE LOADING		kW	kVA	%	Amps
PHASE TOTAL	A	34.9	36.2	9%	130.8
PHASE TOTAL	B	37.1	37.7	9%	135.9
PHASE TOTAL	C	327.5	328.4	82%	1185.6

LOAD CATAGORIES		Connected			Demand				Ver. 1.04
		kW	kVA	DF	kW	kVA	PF		
1	TRANSFORMERS	377.4	377.4		377.4	377.4	1.00		
2	LIGHTING	22.1	24.9		22.1	24.9	0.89		
3	SPARE	0.0	0.0		0.0	0.0	1.00		
9	unassigned	0.0	0.0		0.0	0.0			
Total Demand Loads					399.5	402.3			
Spare Capacity		25%			99.9	100.6			
Total Design Loads					499.4	502.9	0.99	Amps=	605.1

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP3W	Panel Location:			ELECTRIC RM A327		
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	T-RP3W	1		32018	VA	1.00	32018	32018		
2	A	LIGHTING COMMONS	2	RM A325	2080	VA	1.00	2080	2080		
3	B	-	1		31808	VA	1.00	31808	31808		
4	B	LIGHTING VP FINANCE	2	RM A319	3895	W		3895	4869		
5	C	-	1		32078	VA	1.00	32078	32078		
6	C	LIGHTING BOARD RM	2		2942	w		2942	3678		
7	A	LIGHTING INFO TECH	2		2854	VA	1.00	2854	2854		
8	A	LIGHTING VP	2	RM A340	3050	VA	1.00	3050	3050		
9	B	LIGHTING ROOF GARDEN	2		3135	VA	1.00	3135	3135		
10	B				0	VA		0	0		
11	C	LIGHTING MEN'S RESTRM	2	RM A345	3782	VA	1.00	3782	3782		
12	C				0	VA		0	0		
13	A				0	VA		0	0		
14	A				0	VA		0	0		
15	B	LIGHTING	2	LOBBY	1024	W	0.90	1024	1138		
16	B	LIGHTING	2	LOBBY	336	W	0.90	336	373		
17	C	LIGHTING	2	LOBBY	720	W	0.90	720	800		
18	C	LIGHTING	2	LOBBY	440	w	0.90	440	489		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A	SUB-METER			6	w	1.00	6	6		
32	A				0	w		0	0		
33	B	-			6	w	1.00	6	6		
34	B				0	w		0	0		
35	C	-			6	w	1.00	6	6		
36	C				0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								120.2	122.2	Amps=	147.0

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					40.0	40.0	33%	144.4
PHASE TOTAL	B					40.2	41.3	34%	149.2
PHASE TOTAL	C					40.0	40.8	33%	147.4

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	TRANSFORMERS		95.9	95.9		95.9	95.9	1.00		
2	LIGHTING		24.3	26.2		24.3	26.2	0.92		
3	SPARE		0.0	0.0		0.0	0.0			
9	unassigned		0.0	0.0		0.0	0.0	1.00		
Total Demand Loads						120.2	122.2			
Spare Capacity			25%			30.0	30.5			
Total Design Loads						150.2	152.7	0.98	Amps=	183.8

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					ELP1E	Panel Location:			ELECTRIC RM B160		
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	EXIT SIGNS	1		164	W	1.00	164	164		
2	A		1		0	W	1.00	0	0		
3	B	BUILDING EGRESS LIGHTING	2		468	W	1.00	468	468		
4	B	-	2		2237	W	1.00	2237	2237		
5	C	LIGHTING	2	LOBBY	512	W	0.90	512	569		
6	C	-	1		28832	w	1.00	28832	28832		
7	A				0	W		0	0		
8	A				0	W		0	0		
9	B				0	W		0	0		
10	B				0	W		0	0		
11	C				0	W		0	0		
12	C				0	W		0	0		
13	A				0	W		0	0		
14	A				0	W		0	0		
15	B				0	W		0	0		
16	B				0	W		0	0		
17	C				0	W		0	0		
18	C				0	w		0	0		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A	ELP2E	3		4708	w	1.00	4708	4708		
32	A				0	w		0	0		
33	B	-	3		3553	w	1.00	3553	3553		
34	B				0	w		0	0		
35	C	-	3		0	w	1.00	0	0		
36	C				0	w		0	0		
37	A	SPARE	3		0	w		0	0		
38	A	SPARE	3		0	w		0	0		
39	B	SPARE	3		0	w		0	0		
40	B	SPARE	3		0	w		0	0		
41	C	SPARE	3		0	w		0	0		
42	C	SPARE	3		0	w		0	0		
PANEL TOTAL								40.5	40.5	Amps=	48.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					4.9	4.9	12%	17.6
PHASE TOTAL	B					6.3	6.3	15%	22.6
PHASE TOTAL	C					29.3	29.4	73%	106.1

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	EXIT SIGNS		29.0	29.0		29.0	29.0	1.00		
2	LIGHTING		3.2	3.3		3.2	3.3	0.98		
3	SPARE		8.3	8.3		8.3	8.3	1.00		
9	unassigned		0.0	0.0		0.0	0.0			
Total Demand Loads						40.5	40.5			
Spare Capacity			25%			10.1	10.1			
Total Design Loads						50.6	50.7	1.00	Amps=	61.0

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					ELP1W	Panel Location:			ELECTRIC RM A149	
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	EXIT SIGNS	1		164	W	1.00	164	164	
2	A	BUILDING EGRESS LIGHTING	2		2832	W	1.00	2832	2832	
3	B	EMERG LIGHTING	2	RM A154	1720	W	1.00	1720	1720	
4	B	EMERG LIGHTING	2	RM A153	1806	W	1.00	1806	1806	
5	C	LIGHTING	2	LOBBY	64.8	W	0.70	65	93	
6	C	LIGHTING	2	LOBBY	152	w	0.70	152	217	
7	A				0	W		0	0	
8	A				0	W		0	0	
9	B				0	W		0	0	
10	B				0	W		0	0	
11	C	LIGHTING	1	LOBBY	108	W	0.70	108	154	
12	C				0	W		0	0	
13	A				0	W		0	0	
14	A				0	W		0	0	
15	B				0	W		0	0	
16	B				0	W		0	0	
17	C				0	W		0	0	
18	C				0	w		0	0	
19	A				0	w		0	0	
20	A				0	w		0	0	
21	B				0	w		0	0	
22	B				0	w		0	0	
23	C				0	w		0	0	
24	C				0	w		0	0	
25	A				0	w		0	0	
26	A				0	w		0	0	
27	B				0	w		0	0	
28	B	SPARE	3		3500	w	0.90	3500	3889	
29	C	SPARE	3		3500	w	0.90	3500	3889	
30	C	SPARE	3		3500	w	0.90	3500	3889	
31	A	ELP2W	3		2130	w	1.00	2130	2130	
32	A	SPARE	3		3500	w	0.90	3500	3889	
33	B	-	3		3215	w	1.00	3215	3215	
34	B				0	w		0	0	
35	C	-	3		0	w	1.00	0	0	
36	C				0	w		0	0	
37	A	SPARE	3		0	w		0	0	
38	A	SPARE	3		0	w		0	0	
39	B	SPARE	3		0	w		0	0	
40	B	SPARE	3		0	w		0	0	
41	C	SPARE	3		0	w		0	0	
42	C	SPARE	3		0	w		0	0	
PANEL TOTAL								26.2	27.9	Amps= 33.6

PHASE LOADING							kW	kVA	%	Amps
PHASE TOTAL		A					8.6	9.0	32%	32.5
PHASE TOTAL		B					10.2	10.6	38%	38.4
PHASE TOTAL		C					7.3	8.2	30%	29.8

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	EXIT SIGNS		0.3	0.3	1.00	0.3	0.3	0.85		
2	LIGHTING		6.6	6.7	1.00	6.6	6.7	0.99		
3	SPARE		19.3	20.9	1.00	19.3	20.9	0.93		
9	unassigned		0.0	0.0	1.00	0.0	0.0			
Total Demand Loads						26.2	27.9			
Spare Capacity			25%			6.5	7.0			
Total Design Loads						32.7	34.9	0.94	Amps=	41.9

Revised Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W		PANEL TAG:	LP1W				MIN. C/B AIC:	25K			
SIZE/TYPE BUS:	700A		PANEL LOCATION:	ELECTRIC RM A149				OPTIONS:	PROVIDE FEED THROUGH LUGS			
SIZE/TYPE MAIN:	700A/3P C/B		PANEL MOUNTING:	SURFACE								
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
T-RP1W		25537	20A/1P	1	29850VA/ 216VA			2	20A/1P	0		T-RP1FC
-		32937	20A/1P	3		30730VA/ 0VA		4	20A/1P	0		-
-	0	318887	20A/1P	5			27770VA/ 0VA	6	20A/1P	0	0	-
LIGHTING	RM180, 1398	880	20A/1P	7	2672VA/ 0VA			8	20A/1P	1904	RMA102	LIGHTING
LIGHTING	B313	149	20A/1P	9		1976VA/ 4057VA		10	20A/1P	948	RM A145	LIGHTING
LIGHTING	RM A335, A164	1423	20A/1P	11			2366VA/ 2904VA	12	20A/1P	3433	A325	LIGHTING
LIGHTING	B301	2339	20A/1P	13	3966VA/ 533VA			14	20A/1P	3488	RM 313	LIGHTING
LIGHTING	B 313	2931	20A/1P	15		280VA/ 107VA		16	20A/1P	0	RM 313	
LIGHTING	B341	3710	20A/1P	17			3878VA/ 256VA	18	20A/1P	0	RM 313	0
LIGHTING	LOBBY	195	20A/1P	19	0VA/ 0VA			20	20A/1P	324	LOBBY	LIGHTING
LIGHTING	LOBBY	36	20A/1P	21		0VA/ 0VA		22	20A/1P	130	LOBBY	LIGHTING
		0	20A/1P	23			0VA/ 0VA	24	20A/1P	0		
LIGHTING	LOBBY	260	20A/1P	25	371VA/ 0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/ 0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/ 0VA	30	20A/1P	0		
SUB-METER		6	20A/1P	31	6VA/ 0VA			32	20A/1P	0		0
-		6	20A/1P	33		6VA/ 0VA		34	20A/1P	0	0	0
-	0	6	20A/1P	35			6VA/ 0VA	36	20A/1P	0	0	0
SPARE	0	0	20A/1P	37	0VA/ 0VA			38	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	39		0VA/ 0VA		40	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	41			0VA/ 0VA	42	20A/1P	0	0	SPARE
CONNECTED LOAD (KW) - A Ph.		34.93								TOTAL DESIGN LOAD (KW)		499.41
CONNECTED LOAD (KW) - B Ph.		37.14								POWER FACTOR		0.99
CONNECTED LOAD (KW) - C Ph.		327.46								TOTAL DESIGN LOAD (AMPS)		605

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W		PANEL TAG:	LP3W				MIN. C/B AIC:	25K			
SIZE/TYPE BUS:	200A		PANEL LOCATION:	ELECTRIC RM A327				OPTIONS:	PROVIDE FEED THROUGH LUGS			
SIZE/TYPE MAIN:	200A/3P C/B		PANEL MOUNTING:	SURFACE								
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
T-RP3W		32018	20A/1P	1	32018VA/ 2080VA			2	20A/1P	2080	RM A325	LIGHTING COMMONS
-		31808	20A/1P	3		31808VA/ 3895VA		4	20A/1P	3895	RM A319	LIGHTING VP FINANCE
-	0	32078	20A/1P	5			32078VA/ 2942VA	6	20A/1P	2942	0	LIGHTING BOARD RM
LIGHTING INFO TECH	0	2854	20A/1P	7	2854VA/ 3050VA			8	20A/1P	3050	RM A340	LIGHTING VP
LIGHTING ROOF GARDEN	B313	3135	20A/1P	9		3135VA/ 0VA		10	20A/1P	0	0	0
LIGHTING MEN'S RESTRM	RM A345	3782	20A/1P	11			3782VA/ 0VA	12	20A/1P	0	A325	0
0	B301	0	20A/1P	13	0VA/ 0VA			14	20A/1P	0	RM 313	0
LIGHTING	B 313	1024	20A/1P	15		1138VA/ 373VA		16	20A/1P	336	RM 313	LIGHTING
LIGHTING	B341	720	20A/1P	17			1173VA/ 373VA	18	20A/1P	440	RM 313	LIGHTING
0	0	0	20A/1P	19	0VA/ 0VA			20	20A/1P	0	0	0
0	0	0	20A/1P	21		0VA/ 0VA		22	20A/1P	0	0	0
0	0	0	20A/1P	23			0VA/ 0VA	24	20A/1P	0	0	0
0	0	0	20A/1P	25	0VA/ 0VA			26	20A/1P	0		0
0		0	20A/1P	27		0VA/ 0VA		28	20A/1P	0		0
0		0	20A/1P	29			0VA/ 0VA	30	20A/1P	0		0
SUB-METER		6	20A/1P	31	6VA/ 0VA			32	20A/1P	0		0
-		6	20A/1P	33		6VA/ 0VA		34	20A/1P	0	0	0
-	0	6	20A/1P	35			6VA/ 0VA	36	20A/1P	0	0	0
SPARE	0	0	20A/1P	37	0VA/ 0VA			38	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	39		0VA/ 0VA		40	20A/1P	0	0	SPARE
SPARE	0	0	20A/1P	41			0VA/ 0VA	42	20A/1P	0	0	SPARE
CONNECTED LOAD (KW) - A Ph.		40.01								TOTAL DESIGN LOAD (KW)		150.23
CONNECTED LOAD (KW) - B Ph.		40.20								POWER FACTOR		0.98
CONNECTED LOAD (KW) - C Ph.		39.97								TOTAL DESIGN LOAD (AMPS)		184

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	ELP1E	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	70A	PANEL LOCATION:	ELECTRIC RM B160	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	70A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
EXIT SIGNS		164	20A/1P	1	164VA/ 0VA			2	20A/1P	0		
BUILDING EGRESS LIGHTING		468	20A/1P	3		468VA/ 2237VA		4	20A/1P	2237		-
LIGHTING	LOBBY	512	20A/1P	5			569VA/ 28832VA	6	20A/1P	28832		
		0	20A/1P	7	0VA/ 0VA			8	20A/1P	0		
		0	20A/1P	9		0VA/ 0VA		10	20A/1P	0		
		0	20A/1P	11			0VA/ 0VA	12	20A/1P	0		
		0	20A/1P	13	0VA/ 0VA			14	20A/1P	0		
		0	20A/1P	15		0VA/ 0VA		16	20A/1P	0		
		0	20A/1P	17			0VA/ 0VA	18	20A/1P	0		
		0	20A/1P	19	0VA/ 0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/ 0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/ 0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/ 0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/ 0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/ 0VA	30	20A/1P	0		
ELP2E		4708	20A/1P	31	0VA/ 0VA			32	20A/1P	0		
-		3553	20A/1P	33		0VA/ 0VA		34	20A/1P	0		
-		0	20A/1P	35			0VA/ 0VA	36	20A/1P	0		
SPARE		0	20A/1P	37	0VA/ 0VA			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		0VA/ 0VA		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			0VA/ 0VA	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A Ph.	4.87	TOTAL DESIGN LOAD (KW)	50.59
CONNECTED LOAD (KW) - B Ph.	6.26	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	29.34	TOTAL DESIGN LOAD (AMPS)	61

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	ELP1W	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	50A	PANEL LOCATION:	ELECTRIC RM A149	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	50A/3P C/B	PANEL MOUNTING:	SURFACE		

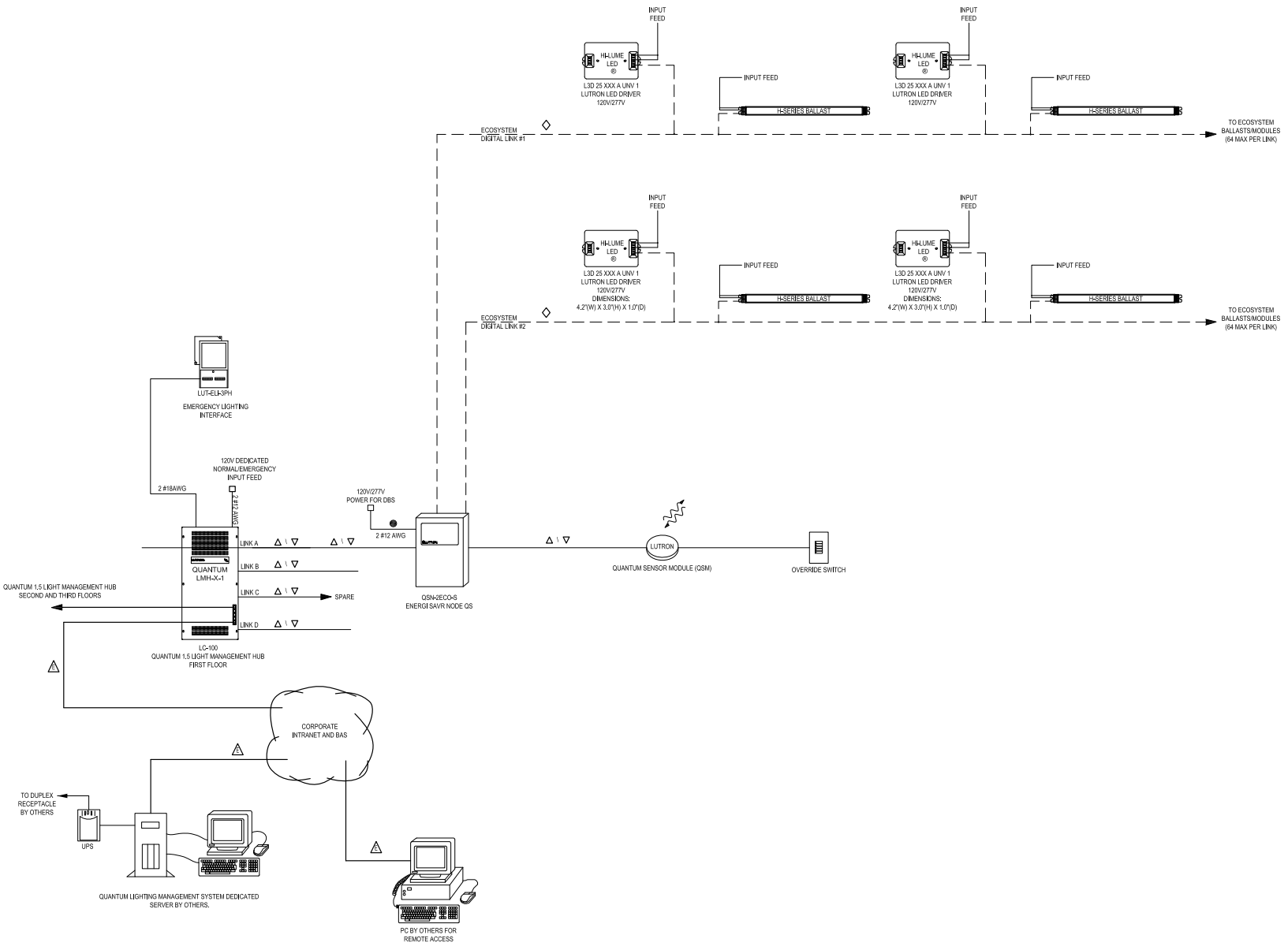
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
EXIT SIGNS		164	20A/1P	1	164VA/ 2832VA			2	20A/1P	2832		
EMERG LIGHTING		1720	20A/1P	3		1720VA/ 1806VA		4	20A/1P	1806		EMERG LIGHTING
LIGHTING	LOBBY	65	20A/1P	5			93 VA/ 217 VA	6	20A/1P	152	LOBBY	LIGHTING
		0	20A/1P	7	0VA/ 0VA			8	20A/1P	0		
		0	20A/1P	9		0VA/ 0VA		10	20A/1P	0		
LIGHTING	LOBBY	108	20A/1P	11			154VA/ 0VA	12	20A/1P	0		
		0	20A/1P	13	0VA/ 0VA			14	20A/1P	0		
		0	20A/1P	15		0VA/ 0VA		16	20A/1P	0		
		0	20A/1P	17			0VA/ 0VA	18	20A/1P	0		
		0	20A/1P	19	0VA/ 0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/ 0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/ 0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/ 0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/ 3889VA		28	20A/1P	3500		SPARE
SPARE		3500	20A/1P	29			3889VA/ 3889VA	30	20A/1P	3500		SPARE
ELP2W		2130	20A/1P	31	2130VA/ 3889VA			32	20A/1P	3500		SPARE
-		3215	20A/1P	33		3215VA/ 0VA		34	20A/1P	0		
-		0	20A/1P	35			0VA/ 0VA	36	20A/1P	0		
SPARE		0	20A/1P	37	0VA/ 0VA			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		0VA/ 0VA		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			0VA/ 0VA	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A Ph.	8.63	TOTAL DESIGN LOAD (KW)	32.74
CONNECTED LOAD (KW) - B Ph.	10.24	POWER FACTOR	0.94
CONNECTED LOAD (KW) - C Ph.	7.32	TOTAL DESIGN LOAD (AMPS)	42

Revised Dimming Wiring Diagrams

See Appendix D

Lighting Control Equipment Schedule					
Type	**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Location**
LC-100	LUTRON	QUANTUM LIGHT MANAGEMENT HUB	QP2-2P0CSE-120	Centralized connection for Lutron EcoSystem, supports up to 8 EcoSystem loops	DATA CENTER
QSN-100	LUTRON	ENERGY SAVR NODE QS	QSN-2ECO-S	Controls occupancy sensors, daylight sensors, and EcoSystem Wallstations	DATA CENTER
EHD-100	LUTRON	ECOSYSTEM H-SERIES BALLASTS	EHD T528 M U 1 10	Fluorescent Dimming Ballast with dimming capabilities to 1% output	LOBBY
LD-100	LUTRON	HI-LUME A-SERIES LED DRIVER	L3D 25 XXX A UNV 1	Dims continuously to 1% light levels, continuous flicker free dimming, line-voltage phase control	LOBBY
QSM-100	LUTRON	QUANTUM SENSOR MODULE	QSM2-4W-C	Quantum wireless sensor module that communicates with EcoSystem wallstation, occupancy sensors, and daylgiht sensors. Communicates with Grafik Eye QS	LOBBY
EW-100	LUTRON	ECOSYSTEM 4 BUTTON WALLSTATION	CC-4BRL-WH	Communicates with EcoSystem Ballasts and EnergiSavr Node. Up to three lighting scenes and on/off.	LOBBY



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
NOT TO SCALE

ISSUE DATE:
04/04/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
LOBBY CONTROL DIAGRAM

SHEET TITLE:
C.03

Feeder Resizing

Panel LP1W Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	499.4
Resultant Power Factor	0.99
Calculated Design Load (kVA)	502.9
Calculated Design Load (Amps)	605.1
Feeder Protection Size(Amps)	700
Number of Sets	2
Phase Conductor	(3) #400
Neutral Conductor	(1) #400
Ground Conductor	(1) #1/0
Total Phase Conductor Area (sq in)	1.7589
Neutral Conductor Area (sq in)	0.5863
Ground Conductor Area (sq in)	0.1855
Total Conductor Area (sq in)	2.5307
Conduit Size	3" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	2
Voltage Drop (%)	0.4

Panel LP3W Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	150.2
Resultant Power Factor	0.98
Calculated Design Load (kVA)	152.7
Calculated Design Load (Amps)	183.8
Feeder Protection Size(Amps)	200
Number of Sets	1
Phase Conductor	(3) #3/0
Neutral Conductor	(1) #3/0
Ground Conductor	(1) #6
Total Phase Conductor Area (sq in)	0.8037
Neutral Conductor Area (sq in)	0.2679
Ground Conductor Area (sq in)	0.0507
Total Conductor Area (sq in)	1.1223
Conduit Size	2" RGS
Feeder Length (ft)	40
Voltage Drop (volts)	1.3
Voltage Drop (%)	0.3

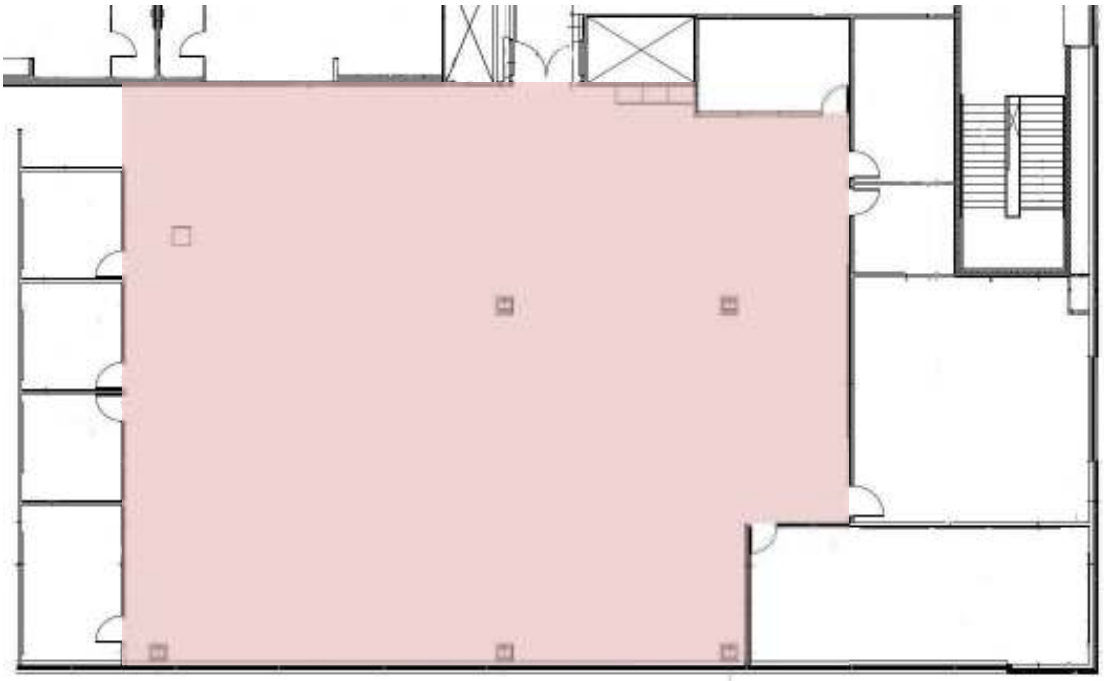
Panel ELP1E Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	50.6
Resultant Power Factor	1.00
Calculated Design Load (kVA)	50.7
Calculated Design Load (Amps)	61
Feeder Protection Size(Amps)	70
Number of Sets	1
Phase Conductor	(3) #6
Neutral Conductor	(1) #6
Ground Conductor	(1) #8
Total Phase Conductor Area (sq in)	0.1521
Neutral Conductor Area (sq in)	0.0507
Ground Conductor Area (sq in)	0.0366
Total Conductor Area (sq in)	0.2394
Conduit Size	1" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	1.6
Voltage Drop (%)	0.3

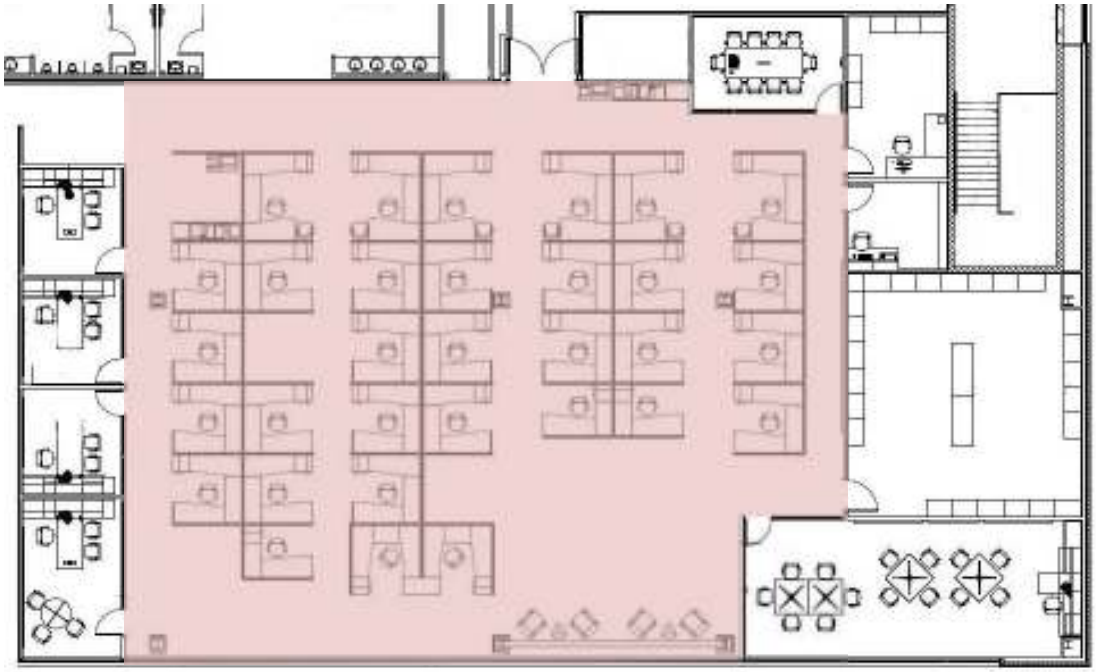
Panel ELP1W Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	32.7
Resultant Power Factor	0.94
Calculated Design Load (kVA)	34.9
Calculated Design Load (Amps)	41.9
Feeder Protection Size(Amps)	50
Number of Sets	1
Phase Conductor	(3) #8
Neutral Conductor	(1) #8
Ground Conductor	(1) #10
Total Phase Conductor Area (sq in)	0.1098
Neutral Conductor Area (sq in)	0.0366
Ground Conductor Area (sq in)	0.0211
Total Conductor Area (sq in)	0.1675
Conduit Size	0.75" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	1.8
Voltage Drop (%)	0.4

Panelboard Cut Sheets

See Appendix G

Large Workspace | Marketing Open Office





Description

Occupying the southwestern side of the building and located on the third floor, the Marketing Office is a large open office space with high VDT and reading and writing usage. The south facing glass curtain wall provides views to the exterior while incorporating daylight penetration. Two large penetrations into the roof with north facing clearstories add additional daylight penetration. The penetrations are five feet tall with two feet being the plenum space. The penetrations run 75 feet long and the clearstories run 74 feet long and are 2'-6"tall with Solarban 70XL PPG certified glass. See the M.A.E. daylighting section for further details. Offices, conference rooms, and collaboration spaces line the western, northern, and eastern sides of the space. The perimeter spaces have glass walls facing the open office. To the north of the space is the large corridor with common spaces. Approximately thirty-two cubicles cover the space with an additional seating area along the curtain wall. Each workstation includes a u-shaped desk, a chair, and a computer. Cubicles have glass partitions to allow for deeper daylight penetration. A marker board and tack board are located on the eastern side of the space for collaboration and brainstorming. The walls are off white and the floor is a combination of the below carpet tiles. The ceiling is a combination of two foot by two foot and two foot by four foot acoustical ceiling tiles. A light shelf has a reflectance of 60% and allows for deeper daylight penetration while the overhang is louvered and protects the space from harsh direct sun angles.

Material Finishes

Flooring


Shaw Contract Laser Cut Illuminate Carpet Tile


Shaw Contract Blur Tile Illuminate Carpet Tile


Shaw Contract Illuminate Carpet Tile

Design Goals

As a result of the space facing south, incorporating daylighting into the design was an important consideration in order to not only provide more natural lighting, but also to lower the PSECU Corporate Headquarters' reliance on electric lighting. As a space where collaboration is important, the lighting design must be comfortable for employees. This includes reduced glare and having high uniformity levels. PSECU also desired a space where the furniture was movable and the lighting therefore needed to incorporate this criterion. As a space with heavy VDT usage, glare must be considered in order to create a comfortable workspace. Warmer color temperatures and good color rendering are important for the marketing office. Also, strong lines and angles, along with bringing the outside in should be emphasized in order to incorporate the overall design goals into the space.

Tasks | Activities

As one of the major departments within the Pennsylvania State Employees Credit Union Corporate Headquarters, the majority of the work is reading, writing, and VDT usage. Also, the impression of the space should promote collaboration among coworkers. The Flynn Impression of visual will be incorporated into the lighting design through integrating uniform light levels and peripheral emphasis with high wall reflectances. A marker board and tack board should be highlighted on the eastern wall for collaboration purposes.

Design Criteria and Considerations

The design criteria below are an accumulation of Illuminating Engineering Society Lighting Handbook Tenth Edition, ASHRAE Standard 90.1-2010 Edition, and LEED for New Construction Version 2.2.

Illuminating Engineering Society Design Criteria

Accent Opportunities

Accenting certain facets of the space will affect how employees perceive the spatial brightness and it will also offer visual relief. Through accenting architectural elements, such as the addition of the clearstories, the workspace will be perceived as more comfortable. Task boards and the seating area should be highlight to attract users and help achieve tasks.

Aesthetic Considerations

As a result of the card key access to the Marketing Open Office, the space will only be occupied with Marketing Department employees. Therefore, the space is not considered to need to be aesthetically appealing. Despite this, it is a place where employees will spend the majority of their day and therefore creating a comfortable environment through selecting appropriate luminaires, distributions, and optics are important considerations.

Color Appearance and Color Contrast

VDT usage is the primary task of Marketing employees, but reading and writing will also occur. Therefore, color contrast must be integrated into the design. Color contrast and appearance emphasizes materials and surfaces. As a result of the Marketing Office facing south, good color rendering and cooler color temperatures should be incorporated in order to reduce any contrast between electric and daylight.

Daylight Integration and Controls

The design of PSECU Corporate Headquarters is based around integrating daylight into the majority of the spaces, therefore designing conscious of daylighting penetration is necessary. As a result of the Marketing Office facing south, the design must consider direct sunlight and the implementation of shading and dimming. Currently, overhangs, light shelves, and roller blinds provide shading for the space. Implementing daylight dimming will create a comfortable environment through continuing to have good uniformity throughout the space. Shading will control the harsh sun beams, which will help to prevent any glare issues.

Direct Glare

Minimizing glare allows for a more comfortable work environment. When VDT usage is high, such as with a work space, glare must be minimized in order to allow for users to perform tasks with little to no discomfort. Glare is created through too high or too low luminance ratios. Therefore, considering luminance ratios is important in order to minimize glare. Through carefully selecting high quality luminaires and distributions, direct view of the lamps are avoided and therefore direct glare is minimized.

Flicker

Flicker can be distracting for employees, especially with high VDT usage within the space. In order to minimize this, electronic ballasts will be incorporated into the design.

Light Distribution Across Task Plane

Uniformity across the work plane for illuminance values is an important consideration because it can adversely affect the performance of tasks if uniformity is ignored. Integrating luminaires with a wider distribution and semi-indirect luminaires will allow increase uniformity and therefore enhance the design. In considering the walkways between cubicles and surrounding the cubicles, lower uniformity will not adversely affect the design.

Luminances of Room surfaces

Incorporating similar luminance levels between the ceiling, floor, and walls will decrease contrast and glare. A maximum luminance task to light source ratio for the Marketing office is 1:40 in order to maintain visual comfort.

Maintenance

Accessibility and ease of maintenance of the luminaires is important in order to have a successful design. If a lamp burned out, maintenance must be able to easily change the lamp. If maintenance cannot easily change the lamp, the design can be altered due to shadows and low light levels in the area.

Modeling of Faces

Collaboration between employees is encouraged in an open office environment. Therefore good color rendering properties and surface materials should be considered in order to encourage collaboration.

Psychological Impressions

The Flynn Impression of public vs. private will be incorporated into the lighting design of the open office. Low light levels within the cubicles will create a private environment. Higher light levels in the surrounding spaces and walkways will create a public space, which will be the areas in which collaboration will occur. Additionally, higher light levels at the perimeters of the space will create the impression of spaciousness within the Marketing Office.

Reflected Glare

Reflected glare can create discomfort of the users while performing tasks. In order to minimize this, luminaire placement, luminaire distributions, and optics will be considered in the lighting design.

Room Surface Characteristics

Surface characteristics are important for the design because integrating higher reflectance values with low specularity will be more feasible to achieve the uniformity ratios than with high specular materials. Glazing is also important to consider due to its high specularity and as a result of the entire exterior wall being a glass curtain wall.

Shadows

To maintain uniformity on the work plane, shadows should be minimized. Shadows affect contrast ratios and make certain tasks difficult to complete.

Source-Task-Eye Geometry

Source-task-eye geometry enhances task visibility. In order to incorporate this into the design, luminaires will be located away from the offending zone in order to enhance source-task-eye geometry and avoid veiling reflections.

System Flexibility and Controls

Open offices must be flexible in order to rearrange the furniture layout. Therefore, the lighting must also be flexible if this were to happen.

Controls are an important criterion in order to create an energy efficient design. Occupancy sensors along with control of the lighting system in the space will reduce energy consumption and create a more feasible design.

Horizontal Illuminance

Lighting for Offices: Reading and Writing: VDT Screen and Keyboard: CSA/ISO Types II: Positive Polarity: 300 lux

Horizontal Illuminance is the primary plane for the open office. It is very important in order for employees to perform tasks. The work plane surface is measured at a height of 2'-6" above the finished floor.

Vertical Illuminance

Lighting for Offices: Reading and Writing: VDT Screen and Keyboard: CSA/ISO Types II: Positive Polarity: 150 lux

Vertical illuminance enhances task viewing flexibility and performing secondary tasks, such as collaboration. Therefore, lighting faces and other vertical surfaces is important in order to perform necessary tasks. Vertical illuminance is measured at a height of 3'-6" above finished floor.

ASHRAE Design Criteria

Space-by-Space Method: Allowance: Open Office Plan: 0.98 W/sq.ft.

LEED Design Criteria

Credit 6.1 **Controllability of Systems**, Lighting
Credit 8.1 **Daylight & Views**, Daylight 75% of Spaces

Incorporating lighting controls, such as occupancy and vacancy sensors, and daylight harvesting sensors will reduce energy consumption and enhance occupant satisfaction through controlling light levels through dimming.

A glass curtain wall and skylights provide daylight to the space. This enhances occupant satisfaction through bringing the outside into the space. This is especially critical in work spaces where occupants are in the space for long periods of time.

Luminaires and Equipment

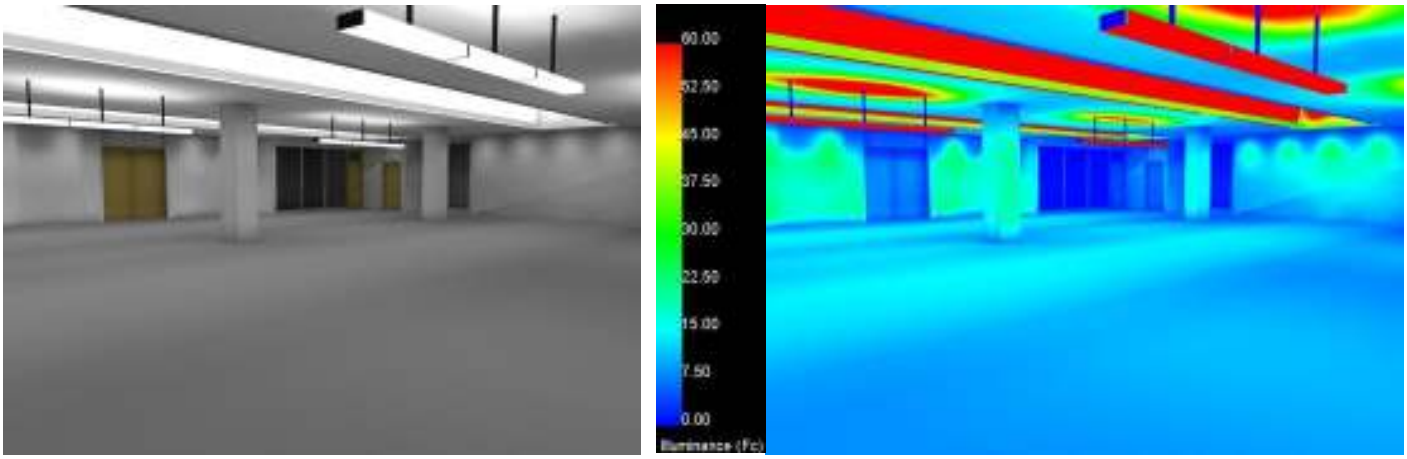
Lighting Equipment Schedule

Lighting Equipment Schedule				
Type		Description	Manufacturer	Lamp
	DL1	Recessed LED downlight with 5" square aperture. Extruded aluminum housing. Dimmable to 10% output. 40 degree beam, 50,000 hour life.	Edison Price Lighting	LED array, 14 watt, 18 input watts, 800 lumen output, 3500K CCT, 85+ CRI
	PF2	4' long x 8" wide x 2" deep semi-indirect pendant mounted 8 ft A.F.F. with die cast aluminum housing and white paint finish.	Peerless	(1) 28 watt T5 fluorescent, 85 CRI, 3500K CCT, 32 input watts
	SF1	4' long x 7" wide x 3" deep linear fluorescent wall mounted assymetric indirect fixture with extruded aluminum housing and white painted finish	Litecontrol	(1) 28 watt T5 fluorescent, 85 CRI, 3500K CCT, 32 input watts
	WL1	Recessed LED wall wash with 5" square aperture. Extruded aluminum housing. Dimmable to 10% output. 50,000 hour life.	Edison Price Lighting	LED array, 14 watt, 18 input watts, 800 lumen output, 3500K CCT, 85+ CRI

Light Loss Factors

Light Loss Factors					
Type		LLD	LDD	BF	LLF
	DL1	0.70	0.92	-	0.64
	PF2	0.93	0.92	1.00	0.86
	SF1	0.93	0.92	1.00	0.86
	WL1	0.70	0.92	-	0.64

Renderings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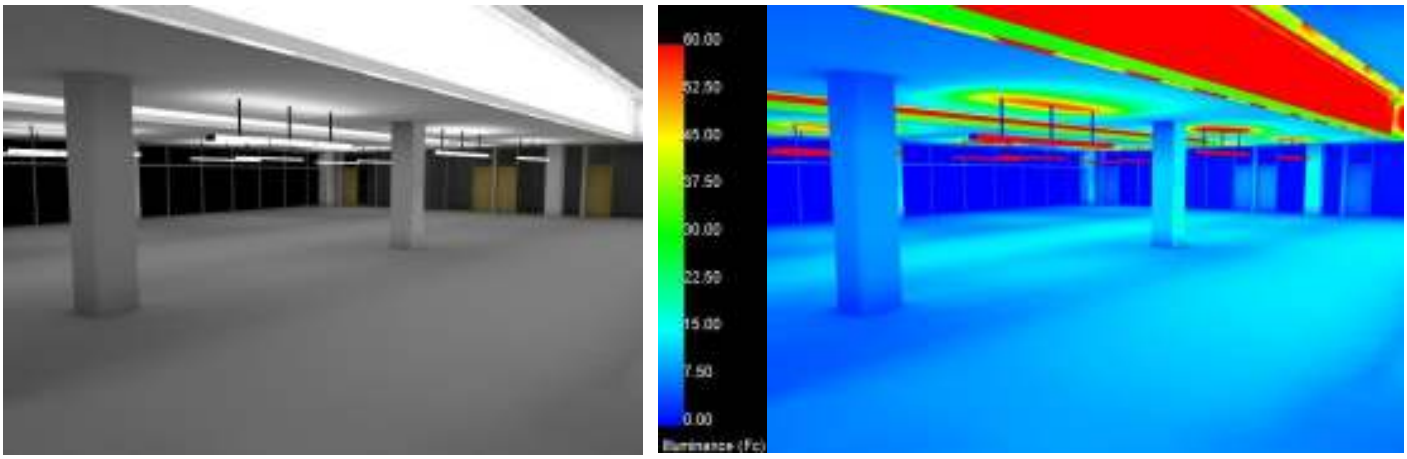
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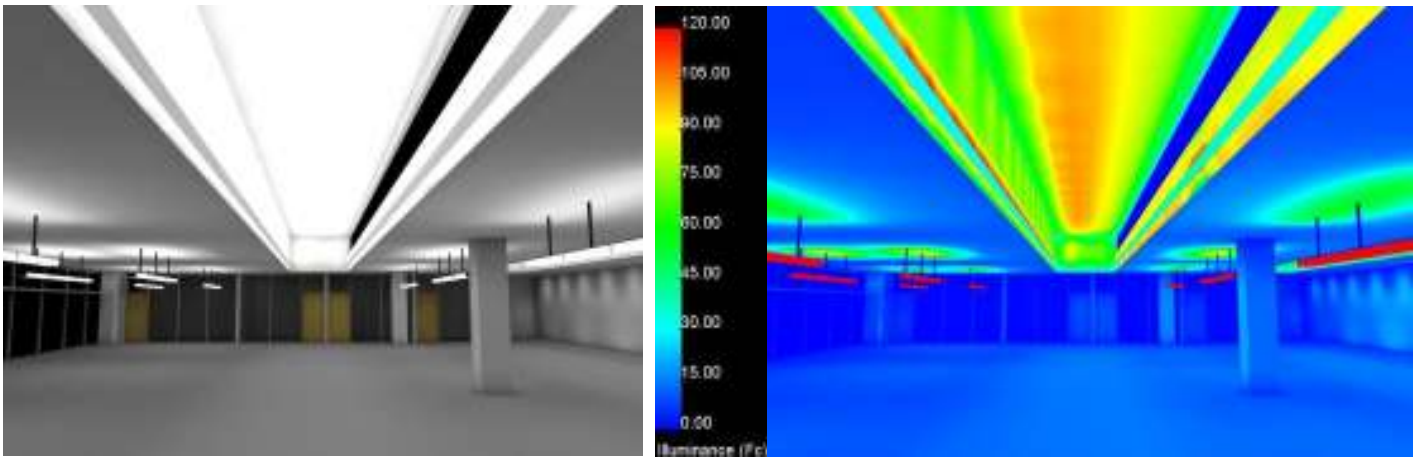
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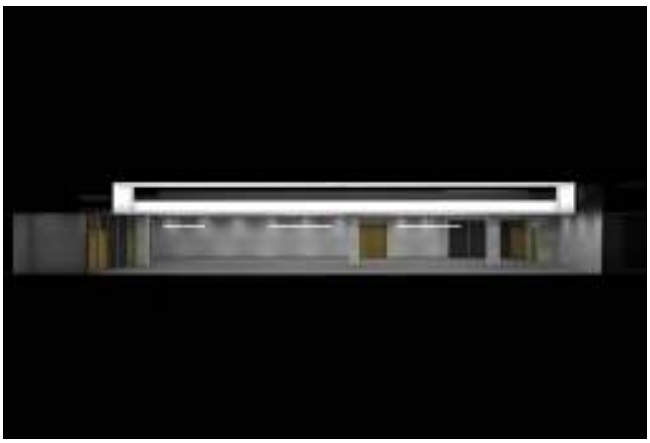

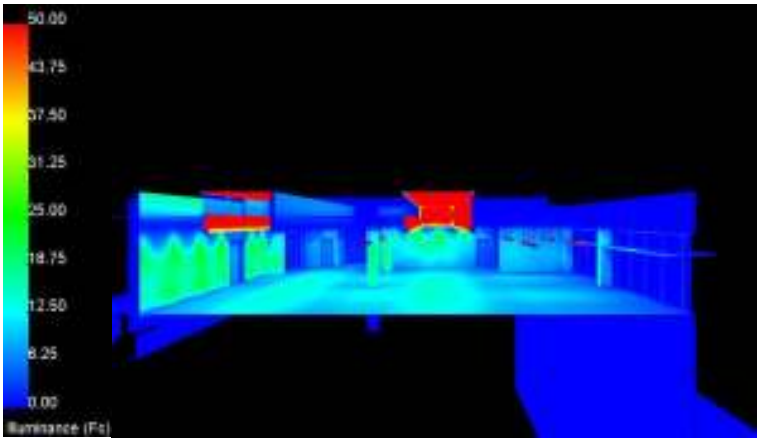
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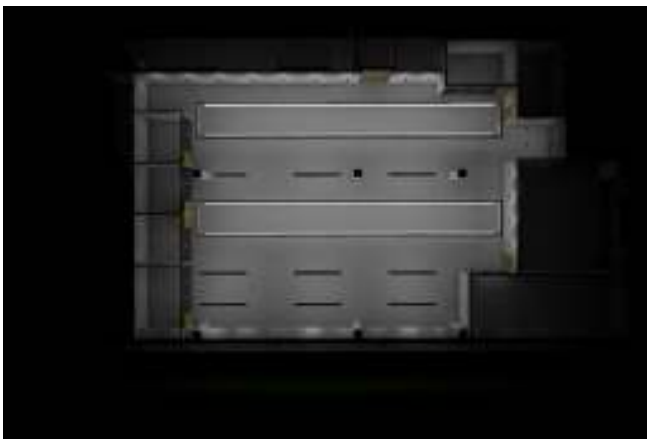
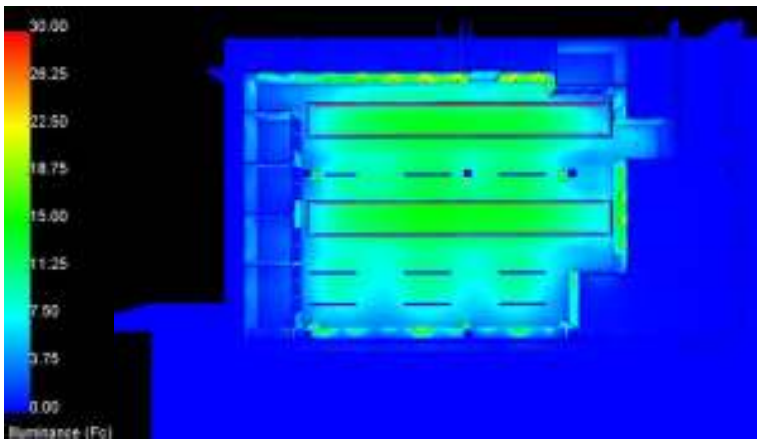
Illuminance (Fc)

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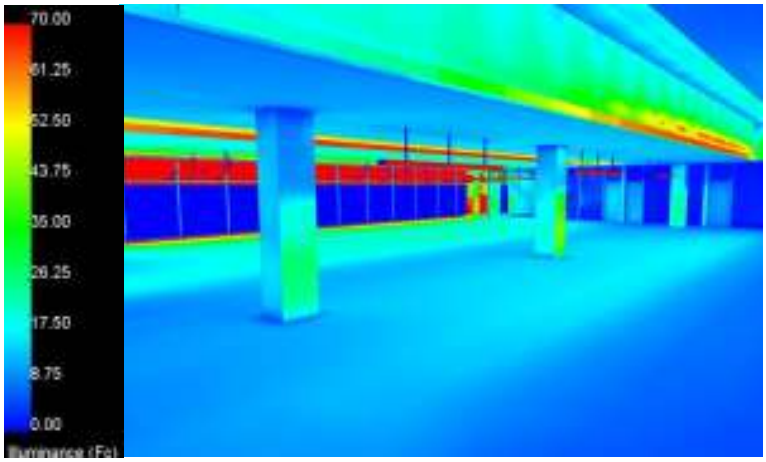
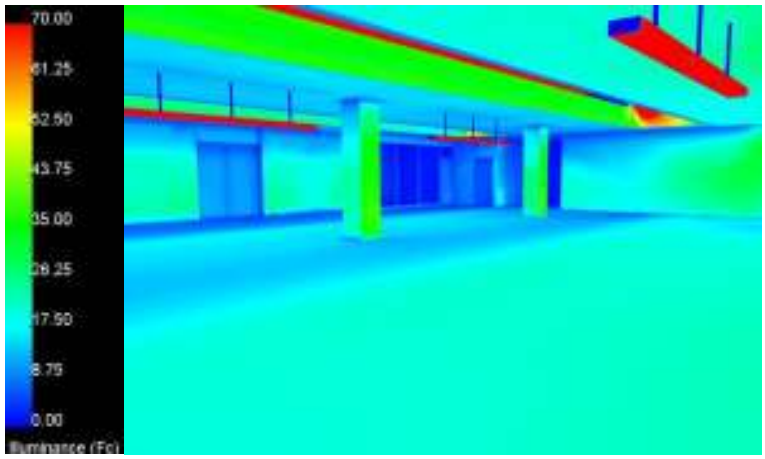
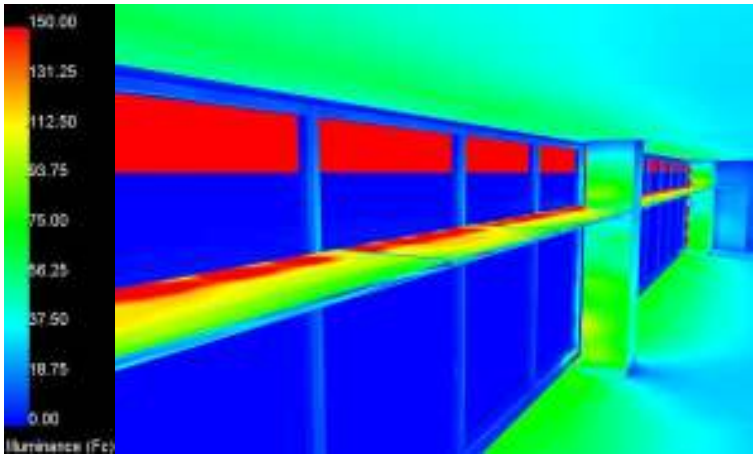
Illuminance (Fc)

Renderings with Overcast Sky Conditions

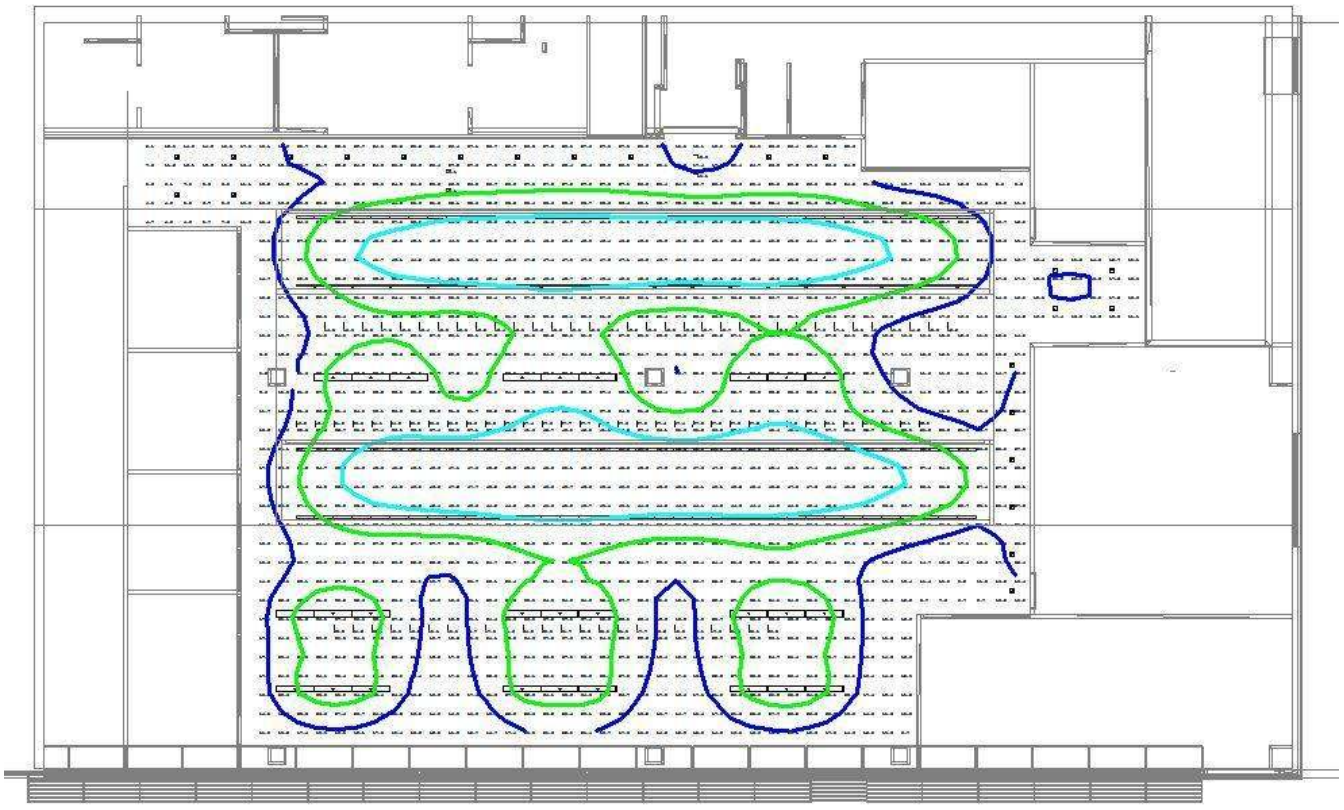






Calculation Summary

Marketing Open Office Calculation Summary				
		Workplane (2.5')	Vertical (4')	Walkways Horizontal (0')
	Average Illuminance (fc)	30.5	23.2	14.9
	Maximum Illuminance (fc)	44.6	26.4	25.6
	Minimum Illuminance (fc)	10.5	16.5	5.3
	Maximum:Average	1.46	1.1	1.72
Design Criteria	Average Illuminance (fc)	30	15	15
	Maximum:Average	1.5:1	-	-



Scale	
20 fc	
30 fc	
40 fc	

Energy Code Compliance

Lighting Power Density	
Area	5560 sq ft
Watts	3274 W
Designed	0.59 W/sq ft
Criteria	0.98 W/sq ft

Evaluation of Design

As a space where occupants spend the majority of their days, creating a comfortable space that evokes creativity and collaboration are important attributes. Opening up the ceiling created the impression of openness and integrating daylight sensors and a lightshelf help to create comfort through bringing the outside in. Visual clarity was an important design goal, which was achieved through uniform lighting and peripheral emphasis. The uniformity ratio of maximum illuminance to average illuminance is 1.46 on the workplane, which satisfies IES design criteria, along with creating uniformity to allow for the furniture to be rearranged if desired. The horizontal illuminance levels also met IES Design Criteria and the vertical illuminance level is 23 footcandles. This allows for good facial recognition and the indirect lighting creates ambient lighting rather than direct lighting in order to reduce glare, veiling reflections, and harsh facial shadows. Also, a color rendering index of 80+ allows for good color rendering, which is important where marketing materials are printed and reviewed.

The overall design criterion of strong lines and angles is achieved through the strong lines of the ceiling penetrations and the layout of the fixtures. The design criterion of bringing the outside in was achieved through the integration of daylight. Overall, the lighting power density is 30% under the allowable power density, which was achieved through efficient linear fluorescent and LED fixtures.

Electrical Redesign

The electrical redesign addresses the alterations to the lighting and how the redesigned space will be controlled. The following looks at the open office space relighted, which is the Marketing Office.

Description

The Marketing Open office is 5560 square feet with cubicles for approximately 35 employees. A glass curtain wall is south-facing with a lightshelf to provide deeper daylight penetration and a louvered overhang to protect the space from harsh sun angles. The marketing office has perimeter offices and conference rooms for employee use, which are not considered in the redesign. In order to increase the amount of daylight in the space, the ceiling height was increased in two areas of the space and north-facing clearstories were added. The areas increased are 75 feet long and 8 feet wide. The plenum space is 2 feet with an additional 3 feet added. The north facing clearstories are 74 feet long and 2'-6" tall. A mechanical study was performed to analyze the new heating and cooling loads in order to determine if a mechanical redesign was necessary. Reference renderings for details on the ceiling penetrations.

The lighting redesign consists of using wall mounted assymetrical indirect fixtures along the walls of the penetrations. LED wall wash fixtures are located along the perimeter areas for walkway lighting and to highlight the marker boards. Linear fluorescent pendants are hung 8 feet above finished floor in the south most section of the space and in the center of the space. The linear fluorescent pendants and indirect linear fluorescent fixtures provide ambient lighting and reduce glare as a result of the indirect component. During the day, the linear fluorescent pendants will dim due to daylight penetration through the curtain wall. The indirect surface mounted fixtures will dim in accordance with daylight penetration through the clearstories. Two daylight algorithms are necessary, which is calculated in the M.A.E. focus portion of the thesis report. The system will be controlled with daylight sensors and a Lutron control system in order to maximize daylighting and minimize electric loads.

Panelboard Summary

A total of ten panelboards encompass the lighting panels for the four space redelighted. The panels consist of both normal and normal/emergency panelboards.

PANELBOARDS						
PANEL TAG	VOLTAGE	SYSTEM	FAÇADE AND ENTRY PLAZA	LOBBY	BOARD ROOM	MARKETING OFFICE
ELP1E	480Y/277V 3PH 4W	N/E		X		
ELP1W	480Y/277V 3PH 4W	N/E	X	X		
LP1W	480Y/277V 3PH 4W	N		X		
LP3W	480Y/277V 3PH 4W	N		X		
LP3E	480Y/277V 3PH 4W	N		X		
ELP3W	480Y/277V 3PH 4W	N/E			X	
LP3W	480Y/277V 3PH 4W	N			X	
LP3E	480Y/277V 3PH 4W	N/E				X
ELP3E	480Y/277V 3PH 4W	N				X
SLP3	480Y/277V 3PH 4W	?	X			

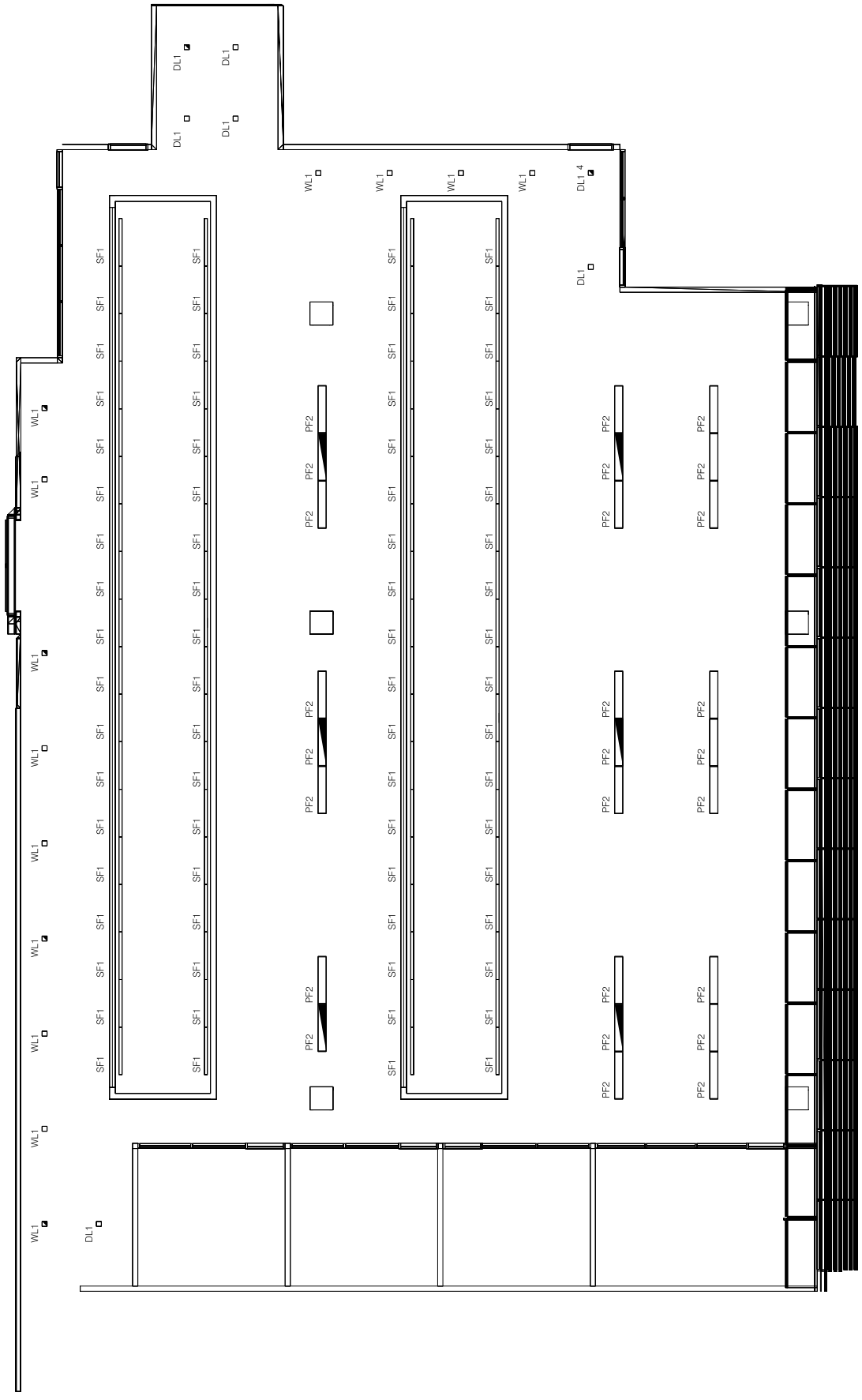
Controls

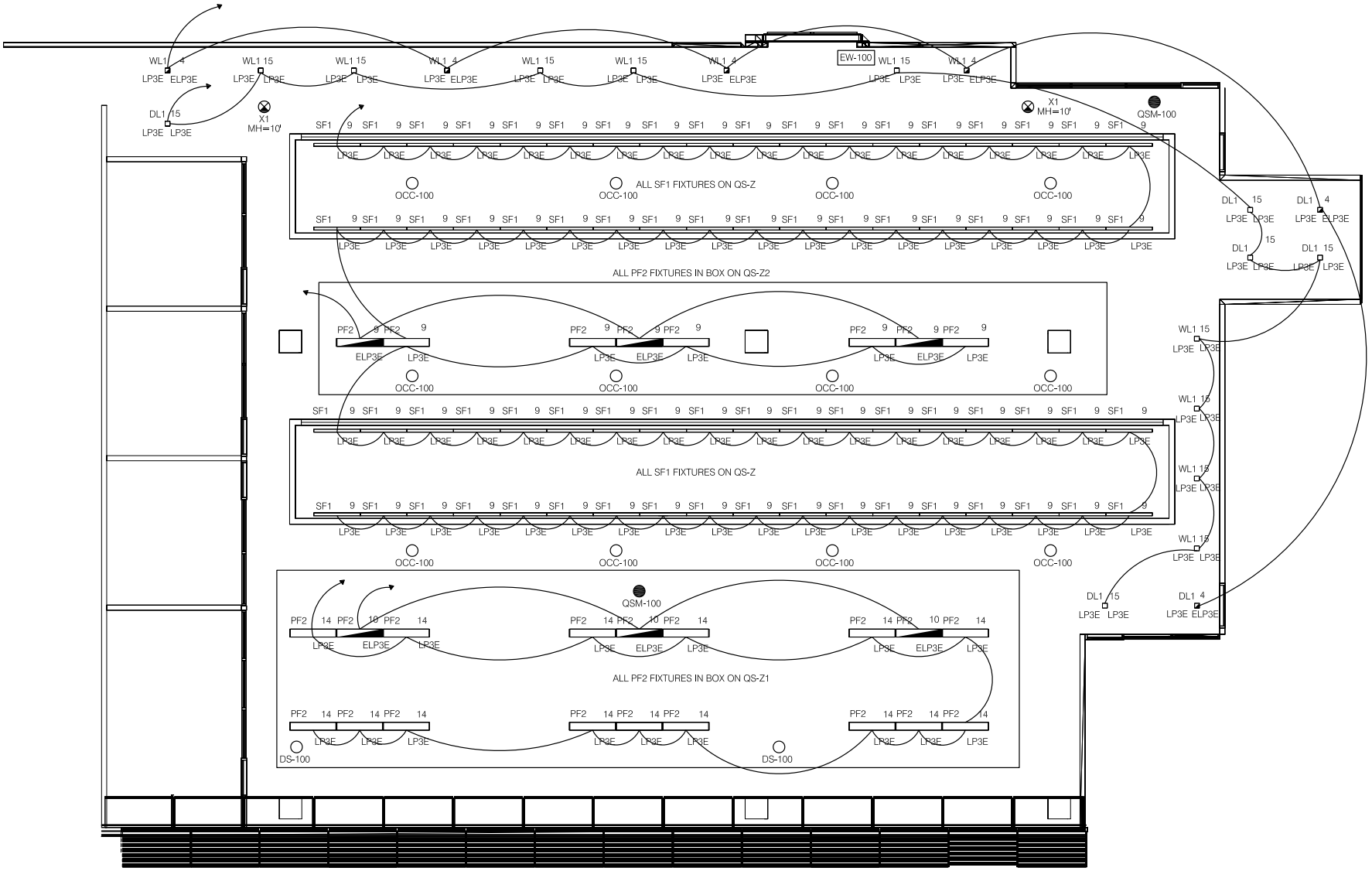
The Marketing Open Office operates on the Lutron Quantum building control system. The Lutron Quantum system communicates with a Lutron Energi Savr Node which communicates with a variety of spaces within the Pennsylvania State Employees credit Union Corporate Headquarters, including the Marketing Office. Both occupancy sensors and photosensors communicate with the EcoSystem Wallstation located at the main entry to the space and Lutron Quantum System Modules located on the ceiling of the open office. The EcoSystem Wallstation communicates with the Lutron Energi Savr Node that relays information to the Quantum Lighting Management Hub. The lighting operates on line-voltage dimming with programmable zones through the Lutron EcoSystem Wallstation. Lutron Ecosystem H-Series Ballasts and Lutron Ecosystem Hi-lume A-Series LED Drivers communicate with the Lutron EcoSystem Wallstation in order to dim the space.

Lighting | Electrical Plans

See Appendix A

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: MARKETING OFFICE LIGHTING PLAN	SHEET TITLE: L02





THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
1/8" = 1'

ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
MARKETING OFFICE
CIRCUITING DIAGRAM

SHEET TITLE:
E.02

Existing Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W			PANEL TAG:	LP3E			AIC RATING:	25K			
SIZE/TYPE BUS:	400A			PANEL LOCATION:	ELECTR B311			MODIFICATIONS:				
SIZE/TYPE MAIN:	400A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	MDP1-1							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
150E	LP3E;1	T-RP3E	150A	3	29850VA/ 216 VA			1	20A	LIGHTING	LP3E;2	20A
	LP3E;3	-	-	-		30730VA/ 0VA		3	15A	EMERGENCY LIGHTING INTERFACE	LP3E;4	15F
	LP3E;5	-	-	-			27770 VA/ 0VA	-	-	-	LP3E;6	
20A	LP3E;7	LIGHTING LUNCH RM B326	20A	1	3952 VA/ 0VA			-	-	-	LP3E;8	
20A	LP3E;9	LIGHTING MARKETING RM313	20A	1		3711VA/ 4057VA		1	20A	LIGHTING INFORMATION TECH	LP3E;10	20A
20A	LP3E;11	LIGHTING INFORMATION TECH	20A	1			2366VA/ 2904VA	1	20A	LIGHTING COMMONS A325	LP3E;12	20A
	LP3E;13	LIGHTING FINANCE B301	20A	1	3966 VA/ 0 VA						LP3E;14	
	LP3E;15										LP3E;16	
20A	LP3E;17	LIGHTING CLEAN AGENT B341	20A	1			3878VA/ 0VA				LP3E;18	
	LP3E;19										LP3E;20	
	LP3E;21										LP3E;22	
	LP3E;23										LP3E;24	
	LP3E;25										LP3E;26	
	LP3E;27										LP3E;28	
	LP3E;29										LP3E;30	
15F	LP3E;31	SUB-METER	15A	3	6 VA/ 0 VA						LP3E;32	
	LP3E;33	-	-	-		6 VA/ 0 VA					LP3E;34	
	LP3E;35	-	-	-			6 VA/ 0 VA				LP3E;36	
	LP3E;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	LP3E;38	
	LP3E;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	LP3E;40	
	LP3E;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	LP3E;42	
			LOAD PER PHASE		37990 VA	38504 VA	36924 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
EQUIP	9448 VA	80.00%	7558 VA
LIGHTING	24498 VA	100.00%	24498 VA
OTHER	552 VA	100.00%	552 VA
POWER AV	3700 VA	80.00%	2960 VA
RECEPT CONV	18140 VA	80.00%	14512 VA
RECEPT OFFICE	7140 VA	80.00%	5712 VA
RECEPT OFFICE EQUIP	4900 VA	80.00%	3920 VA
WKSTN FEED	43340 VA	80.00%	34672 V
SIVOIA QS SHADE CONTROLLER	1500 VA	100.00%	1500 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	113218 VA
TOTAL EST DEMAND	95884 VA
TOTAL CONNECTED CURRENT	136 A
TOTAL ESTIMATED DEMAND CURRENT	115 A

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W LIFE SAFETY			PANEL TAG:	ELP3E			AIC RATING:	25K			
SIZE/TYPE BUS:	250A			PANEL LOCATION:	ELECTR B311			MODIFICATIONS:				
SIZE/TYPE MAIN:	250A MLO			PANEL MOUNTING:	SURFACE							
				SUPPLY FROM:	ELP2E							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING
20A	ELP3E;1	LIGHTING INFORMATION TECH	20A	1	2340 VA/ 0VA						ELP3E;2	
20A	ELP3E;3	EXIT SIGNS FINANCE B301	20A	1		128 VA/ 1608 VA		1	20A	LIGHTING COMMONS A325	ELP3E;4	20A
	ELP3E;5										ELP3E;6	
	ELP3E;7										ELP3E;8	
	ELP3E;9										ELP3E;10	
	ELP3E;11										ELP3E;12	
	ELP3E;13										ELP3E;14	
	ELP3E;15										ELP3E;16	
	ELP3E;17										ELP3E;18	
	ELP3E;19										ELP3E;20	
	ELP3E;21										ELP3E;22	
	ELP3E;23										ELP3E;24	
	ELP3E;25										ELP3E;26	
	ELP3E;27										ELP3E;28	
	ELP3E;29										ELP3E;30	
	ELP3E;31										ELP3E;32	
	ELP3E;33										ELP3E;34	
	ELP3E;35										ELP3E;36	
	ELP3E;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	ELP3E;38	
	ELP3E;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	ELP3E;40	
	ELP3E;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	ELP3E;42	
			LOAD PER PHASE		2340 VA	1736 VA	0 VA					

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	3948 VA	100.00%	3948 VA
EXIT SIGNS	128 VA	100.00%	128 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	4076 VA
TOTAL EST DEMAND	4076 VA
TOTAL CONNECTED CURRENT	5A
TOTAL ESTIMATED DEMAND CURRENT	5A

Existing Control Layout

See Appendix D

Panelboard Worksheets

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP3E	Panel Location:			ELECTRIC RM B311		
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	T-RP3E	1		29850	w	1.00	29850	29850		
2	A	LIGHTING	2		216	w	1.00	216	216		
3	B	-	2		30730	w	1.00	30730	30730		
4	B	EMERGENCY LIGHTING INTERFACE	2		0	w		0	0		
5	C	-	2		27770	w	1.00	27770	27770		
6	C	-	2		0	w		0	0		
7	A	LIGHTING LUNCH RM	2		2672	w	1.00	2672	2672		
8	A	-	2		0	w		0	0		
9	B	LIGHTING MARKETING RM	3	MARKETING	2464	w	1.00	2464	2464		
10	B	LIGHTING INFORMATION TECH	2		4057	w	1.00	4057	4057		
11	C	LIGHTING INFORMATION TECH	2		2366	w	1.00	2366	2366		
12	C	LIGHTING COMMONS	2		2904	w	1.00	2904	2904		
13	A	LIGHTING FINANCE	2		3966	w	1.00	3966	3966		
14	A	MARKETING LIGHTING	3	MARKETING	480	w	0.90	480	533		
15	B	MARKETING LIGHTING	4	MARKETING	252	w	0.70	252	360		
16	B				0	w	0.00	0	0		
17	C	LIGHTING CLEAN AGENT	2		3878	w	1.00	3878	3878		
18	C				230	w	0.90	230	256		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A	SUB-METER	2		6	w	1.00	6	6		
32	A				0	w		0	0		
33	B	-	2		6	w	1.00	6	6		
34	B				0	w		0	0		
35	C	-	2		6	w	1.00	6	6		
36	C	SPARE	2	B311	0	w		0	0		
37	A	SPARE	2	B311	0	w		0	0		
38	A	SPARE	2	B311	0	w		0	0		
39	B	SPARE	2	B311	0	w		0	0		
40	B	SPARE	2	B311	0	w		0	0		
41	C	SPARE	2	B311	0	w		0	0		
42	C	SPARE	2	B311	0	w		0	0		
PANEL TOTAL								111.9	112.0	Amps=	134.8

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					37.2	37.2	33%	134.5
PHASE TOTAL	B					37.5	37.6	34%	135.8
PHASE TOTAL	C					37.2	37.2	33%	134.2

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	TRANSFORMERS		29.9	29.9		29.9	29.9	1.00		
2	LIGHTING		78.6	78.6		78.6	78.6	1.00		
3	FLUORESCENT LIGHTING		2.9	3.0		2.9	3.0	0.98		
4	LED LIGHTING		0.3	0.4		0.3	0.4	0.70		
9	unassigned		0.2	0.3		0.2	0.3	0.90		
Total Demand Loads						111.9	112.0			
Spare Capacity			25%			28.0	28.0			
Total Design Loads						139.8	140.0	1.00	Amps=	168.5

Default Power Factor =	0.80	
Default Demand Factor =	100	%

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					ELP3E	Panel Location:			ELECTRIC B311		
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 INFORMATON TECH	1		2340	w	1.00	2340	2340		
2	A				0	w	1.00	0	0		
3	B	EXIT SIGNS FINANCE/ MARKETING	2	B301	128	w	1.00	128	128		
4	B	MARKETING LIGHTING	4	B313	84	w	0.70	84	120		
5	C	LIGHTING COMMONS	1	A325	1195	w	1.00	1195	1195		
6	C				0	w		0	0		
7	A				0	w		0	0		
8	A				0	w		0	0		
9	B	MARKETING LIGHTING	3	B313	96	w	0.90	96	107		
10	B	MARKETING LIGHTING	3	B313	96	w	0.90	96	107		
11	C				0	w		0	0		
12	C				0	w		0	0		
13	A				0	w		0	0		
14	A				0	w		0	0		
15	B				0	w		0	0		
16	B				0	w		0	0		
17	C				0	w		0	0		
18	C				0	w		0	0		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A	SPARE			3500	w	0.90	3500	3889		
33	B				0	w		0	0		
34	B	SPARE			3500	w	0.90	3500	3889		
35	C	SPARE			3500	w	0.90	3500	3889		
36	C				0	w		0	0		
37	A	SPARE			3500	w	0.90	3500	3889		
38	A	SPARE			3500	w	0.90	3500	3889		
39	B	SPARE			3500	w	0.90	3500	3889		
40	B	SPARE			3500	w	0.90	3500	3889		
41	C	SPARE			3500	w	0.90	3500	3889		
42	C	SPARE			3500	w	0.90	3500	3889		
PANEL TOTAL								35.4	39.0	Amps=	46.9

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					12.8	14.0	37%	50.6
PHASE TOTAL	B					10.9	12.1	32%	43.8
PHASE TOTAL	C					11.7	12.1	32%	43.6

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	LIGHTING		3.5	3.5		3.5	3.5	1.00		
2	EMERGENCY SIGNS		0.1	0.1		0.1	0.1	1.00		
3	FLUORESCENT LIGHTING		0.2	0.2		0.2	0.2	0.90		
4	LED LIGHTING		0.1	0.1		0.1	0.1	0.70		
9	unassigned		31.5	35.0		31.5	35.0	0.90		
Total Demand Loads						35.4	39.0			
Spare Capacity			20%			7.1	7.8			
Total Design Loads						42.5	46.8	0.91	Amps=	56.3

Revised Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP3E	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	200A	PANEL LOCATION:	ELECTRIC RM B311	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	200A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
T-RP3E		29850	20A/1P	1	29850VA/ 216VA			2	20A/1P	216		LIGHTING
-		30730	20A/1P	3		30730VA/ 0VA		4	20A/1P	0		EMERGENCY LIGHTING INTERFACE
-		27770	20A/1P	5			27770VA/ 0VA	6	20A/1P	0		-
LIGHTING LUNCH RM		2672	20A/1P	7	2672VA/ 0VA			8	20A/1P	0		-
LIGHTING MARKETING RM	B313	2464	20A/1P	9		1976VA/ 4057VA		10	20A/1P	4057		LIGHTING INFORMATION TECH
LIGHTING INFORMATION TECH		2366	20A/1P	11			2366VA/ 2904VA	12	20A/1P	2904	A325	LIGHTING COMMONS
LIGHTING FINANCE	B301	3966	20A/1P	13	3966VA/ 533VA			14	20A/1P	480	RM 313	MARKETING LIGHTING
MARKETING LIGHTING	B 313	252	20A/1P	15		280VA/ 107VA		16	20A/1P	0	RM 313	
LIGHTING CLEAN AGENT	B341	3878	20A/1P	17			3878VA/ 256VA	18	20A/1P	230	RM 313	0
		0	20A/1P	19	0VA/ 0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/ 0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/ 0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/ 0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/ 0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/ 0VA	30	20A/1P	0		
SUB-METER		6	20A/1P	31	6VA/ 0VA			32	20A/1P	0		
-		6	20A/1P	33		6VA/ 0VA		34	20A/1P	0		
-		6	20A/1P	35			6VA/ 0VA	36	20A/1P	0	B311	SPARE
SPARE	B311	0	20A/1P	37	0VA/ 0VA			38	20A/1P	0	B311	SPARE
SPARE	B311	0	20A/1P	39		0VA/ 0VA		40	20A/1P	0	B311	SPARE
SPARE	B311	0	20A/1P	41			0VA/ 0VA	42	20A/1P	0	B311	SPARE

CONNECTED LOAD (KW) - A Ph.	37.19	TOTAL DESIGN LOAD (KW)	139.82
CONNECTED LOAD (KW) - B Ph.	37.51	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	37.15	TOTAL DESIGN LOAD (AMPS)	169

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	ELP3E	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	60A	PANEL LOCATION:	ELECTRIC B311	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	60A/3P C/B	PANEL MOUNTING:	SURFACE		FOR PANELBOARD 1L1B

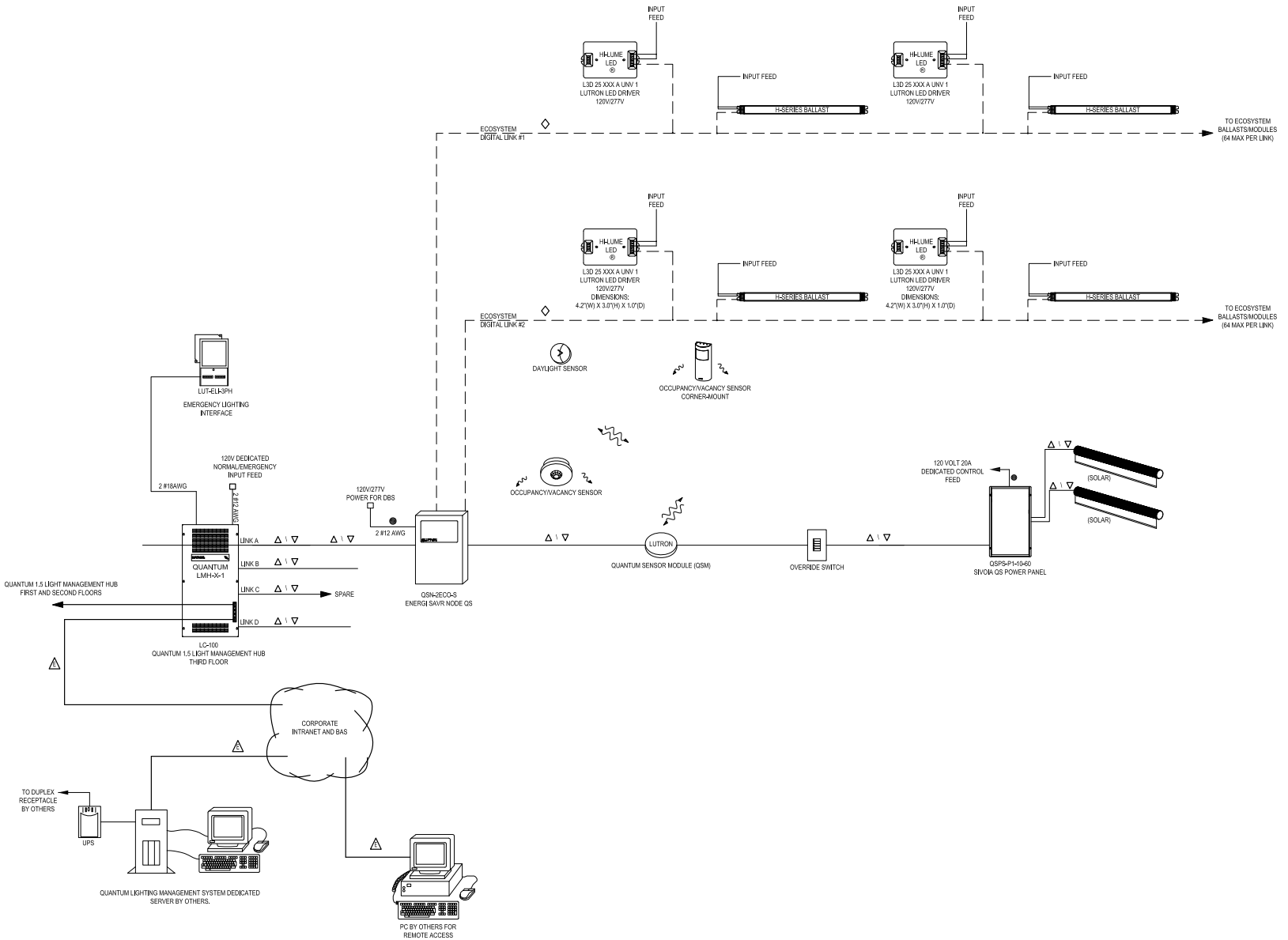
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING INFORMATON TECH		2340	20A/1P	1	2340VA/ 0VA			2	20A/1P	0		
EXIT SIGNS FINANCE/ MARKETING	B301	128	20A/1P	3		128VA/120VA		4	20A/1P	84	B313	MARKETING LIGHTING
LIGHTING COMMONS	A325	1195	20A/1P	5			1195VA/ 0VA	6	20A/1P	0		
		0	20A/1P	7	0VA/ 0VA			8	20A/1P	0		
MARKETING LIGHTING	B313	96	20A/1P	9		107VA/ 107VA		10	20A/1P	96	B313	MARKETING LIGHTING
		0	20A/1P	11			0VA/ 0VA	12	20A/1P	0		
		0	20A/1P	13	0VA/ 0VA			14	20A/1P	0		
		0	20A/1P	15		0VA/ 0VA		16	20A/1P	0		
		0	20A/1P	17			0VA/ 0VA	18	20A/1P	0		
		0	20A/1P	19	0VA/ 0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/ 0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/ 0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/ 0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/ 0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/ 0VA	30	20A/1P	0		
		0	20A/1P	31	0VA/ 3889VA			32	20A/1P	3500		SPARE
		0	20A/1P	33		0VA/ 3889VA		34	20A/1P	3500		SPARE
SPARE		3500	20A/1P	35			3889VA/ 0VA	36	20A/1P	0		
SPARE		3500	20A/1P	37	3889VA/ 3889VA			38	20A/1P	3500		SPARE
SPARE		3500	20A/1P	39		3889VA/ 3889VA		40	20A/1P	3500		SPARE
SPARE		3500	20A/1P	41			3889VA/ 3889VA	42	20A/1P	3500		SPARE

CONNECTED LOAD (KW) - A Ph.	12.84	TOTAL DESIGN LOAD (KW)	42.53
CONNECTED LOAD (KW) - B Ph.	10.90	POWER FACTOR	0.91
CONNECTED LOAD (KW) - C Ph.	11.70	TOTAL DESIGN LOAD (AMPS)	56

Revised Dimming Wiring Diagrams

See Appendix D

Lighting Control Equipment Schedule					
Type	**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Location**
LC-100	LUTRON	QUANTUM LIGHT MANAGEMENT HUB	QP2-2P0CSE-120	Centralized connection for Lutron EcoSystem, supports up to 8 EcoSystem loops	DATA CENTER
QSN-100	LUTRON	ENERGY SAVR NODE QS	QSN-2ECO-S	Controls occupancy sensors, daylight sensors, and EcoSystem Wallstations	DATA CENTER
OCC-100	LUTRON	OCCUPANCY/VACANCY SNESOR	L2F2-OCRB-P-WH	Ceiling mounted occupancy sensor with up to 12' diameter coverage	MARKETING OFFICE
EHD-100	LUTRON	ECOSYSTEM H-SERIES BALLASTS	EHD T528 M U 1 10	Fluorescent Dimming Ballast with dimming capabilities to 1% output	MARKETING OFFICE
DS-100	LUTRON	PHOTOSENSOR	LRFX-DCRB-WH	Wireless closed loop sliding setpoint daylight sensor that is compatible with up to 10 dimming and switching devices.	MARKETING OFFICE
LD-100	LUTRON	PHOTOSENSOR	L3D 25 XXX A UNV 1	Dims continuously to 1% light levels, continuous flicker free dimming, line-voltage phase control	MARKETING OFFICE
QSM-100	LUTRON	QUANTUM LIGHT MANAGEMENT HUB	QSM2-4W-C	Quantum wireless sensor module that communicates with EcoSystem wallstation, occupancy sensors, and daylgiht sensors. Communicates with Grafik Eye QS	MARKETING OFFICE
EW-100	LUTRON	ECOSYSTEM 4 BUTTON WALLSTATION	CC-4BRL-WH	Communicates with EcoSystem Ballasts and EnergiSavr Node. Up to three lighting scenes and on/off.	MARKETING OFFICE



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
NOT TO SCALE

ISSUE DATE:
04/04/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
MARKETING OPEN OFFICE CONTROL DIAGRAM

SHEET TITLE:
C.02

Feeder Resizing

Panel LP3E Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	139.8
Resultant Power Factor	1.00
Calculated Design Load (kVA)	140
Calculated Design Load (Amps)	168.5
Feeder Protection Size(Amps)	225
Number of Sets	1
Phase Conductor	(3) #2/0 AWG
Neutral Conductor	(1) #2/0 AWG
Ground Conductor	(1) #4 AWG
Total Phase Conductor Area (sq in)	0.6669
Neutral Conductor Area (sq in)	0.2223
Ground Conductor Area (sq in)	0.0824
Total Conductor Area (sq in)	0.9716
Conduit Size	2" RGS
Feeder Length (ft)	60
Voltage Drop (volts)	3.7
Voltage Drop (%)	0.8

Panel ELP3E Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	42.5
Resultant Power Factor	0.91
Calculated Design Load (kVA)	46.8
Calculated Design Load (Amps)	56.3
Feeder Protection Size(Amps)	60
Number of Sets	1
Phase Conductor	(3) #6 AWG
Neutral Conductor	(1) #6 AWG
Ground Conductor	(1) #10 AWG
Total Phase Conductor Area (sq in)	0.1521
Neutral Conductor Area (sq in)	0.0507
Ground Conductor Area (sq in)	0.0211
Total Conductor Area (sq in)	0.2239
Conduit Size	1" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	2.2
Voltage Drop (%)	0.5

Panelboard Cut Sheets

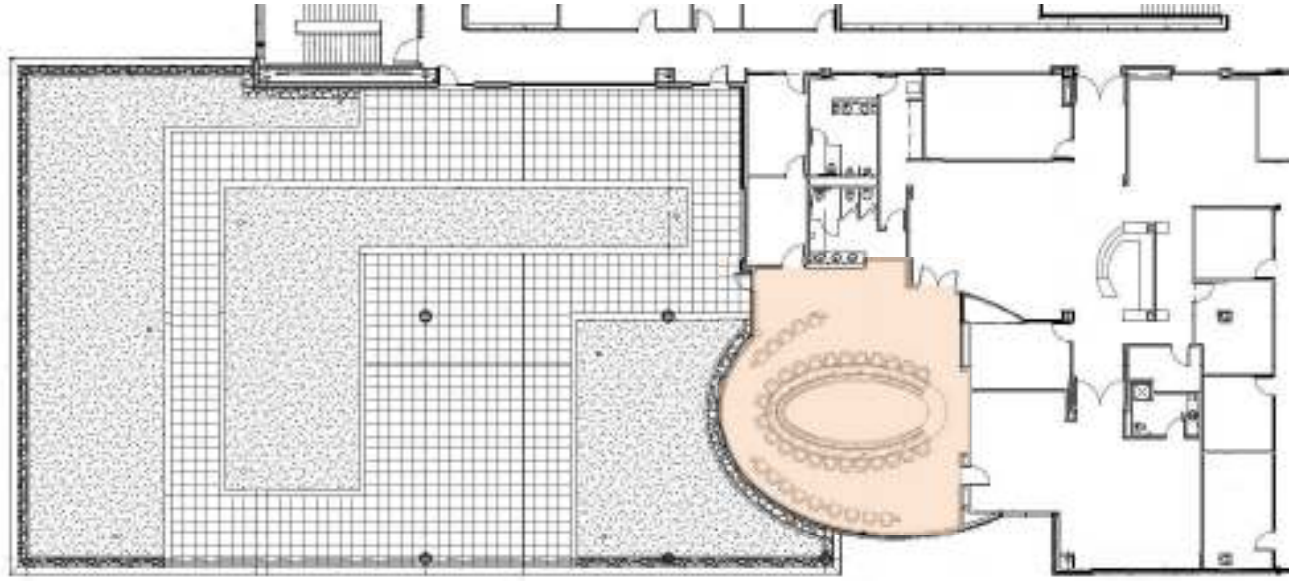
See Appendix G

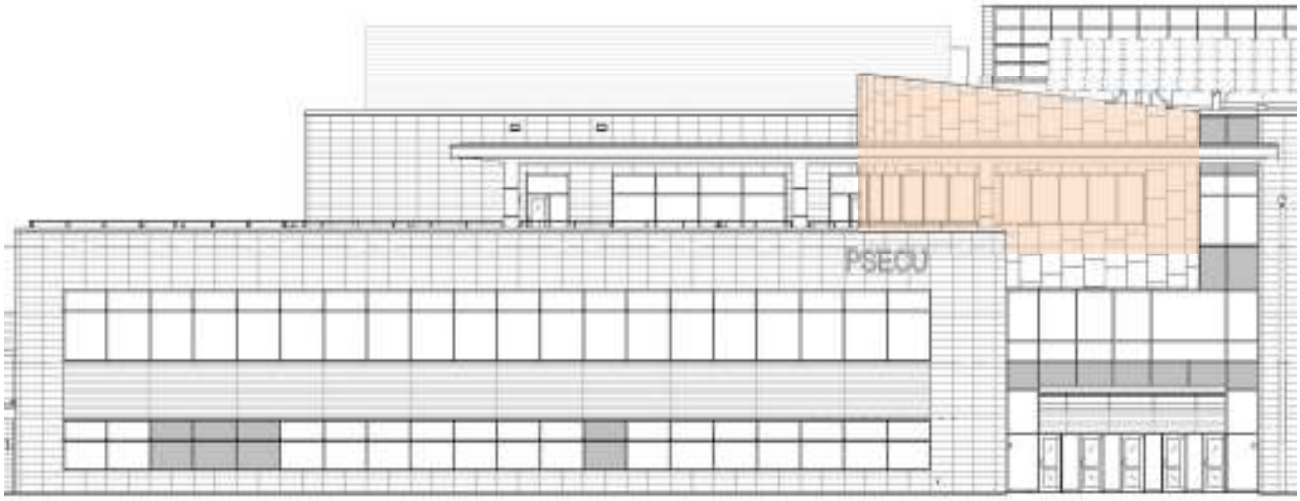
Special Purpose Space | Board Room

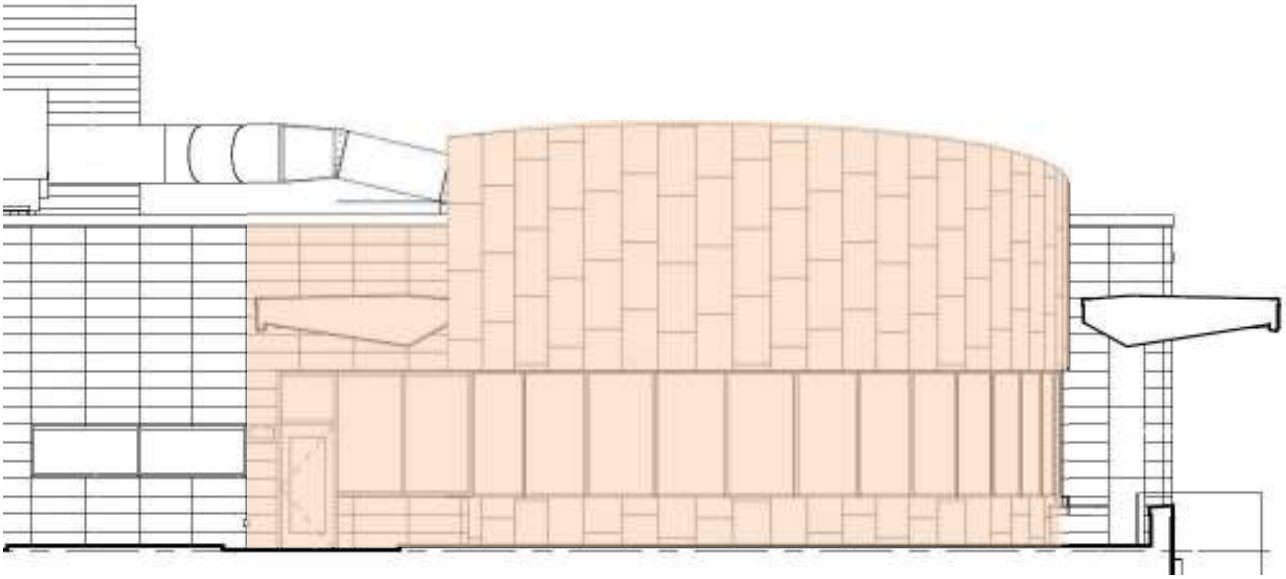
Lighting Redesign

Description

Located on the southwestern side of the building and on the third floor is the Board Room. It is a branch of the PSECU Administrative office. From the administrative office there are two entry points, one through President's office and another through the Administration waiting area and reception desk. The main feature of the space is an oval-shaped conference table that mimics the oval-shape of the space. The conference table faces a retractable projector screen with the PSECU logo behind the screen. Alterations from the original design include a custom wooden fixture and an oval-shaped dome over the center of the conference table. The custom wooden fixture mimics the shape of the conference table and is directly above it. It serves to encase downlights for task lighting and LED linear fixtures that are directed towards the dome for ambient lighting. This design evolved from the desire to reduce harsh facial shadows. The downlights are also placed to light the sides of faces in order to also reduce harsh facial shadows. Surrounding the Board Room is a kitchen, which is located north of the space for luncheons. A curved curtain wall looks out onto the vegetative roof garden and onto the building entrance. The exterior of the Board Room is a metal panel system, which serves as a major architectural feature of the façade. The Board Room also has a door leading to the roof garden. Walkways within the vegetative roof garden provide a space of tranquility, which contrasts the intense atmosphere of the Board Room. A large overhang is a major facet of the architecture of the PSECU Corporate Headquarters, which also serves to protect the Board Room from direct sun from both the south and west. The design of the Board Room with incorporate the Flynn Impression of spaciousness versus closure.







Material Finishes

A large oval conference table is the focal point of the space. The wood is beech stained. The Board Room seats 24 executives and the surrounding chairs seat an additional 14 executives. On the northern side of the space are a wall clock, mailbox unit, and credenza. Most of the wall surface is glazing, therefore little wall furnishings are within the space. An oval-shaped curtain wall shapes the space along with gypsum wall board. The northern and eastern walls vary between textile wall coverings and wood panels. All of the special surfaces are deeper color tones. The ceiling consists of varying ceiling heights to create visual interest. Gypsum wall board and a 2' x 8' beech stained wood panel system are the ceiling materials. The lowest ceiling height, located on the northern section of the space, is off white painted gypsum wall board and is a height of 10'-6". The outer cove is also off white painted gypsum wall board and shapes the curved glass curtain wall. It is a height of 10'-8". The inner cove consists of the beech stained wood panel system

and is 12'-0". The oval-shaped dome is 14'-0" at its peak and is off white gypsum wall board. It serves to reflect the indirect lighting onto the faces of the executives.

Flooring

Shaw Contract Hill Tribe Ashlar Weave Accent Carpet Tile

Wall finish

Maharam Abalone Textile Wall Covering

Maharam Barley Textile Wall Covering

Wood panels are beech steamed quartered with Eggers' Gardall finish

Ceiling Finish

Natural Beech Wood Ceiling System

Finishes			
Type	**Description**	**Color**	**Reflectance**
CPT3	Shaw Contract Hill Tribe Ashlar Weave Accent Carpet Tile		0.25
TWC2	Maharam Abalone Textile Wall Covering	Abalone	0.5
	Maharam Barley Textile Wall Covering	Barley	0.3
WD	Beech steamed quartered with Eggers' Gardall finish Wood Panels	Beech	0.35
PNT	ProGreen 200 Low VOC Interior Latex Eg-Shel Deep Base	Flat White Egg Shell	0.85
WD2	Natural Beech Wood Ceiling System	Beech	0.35

Glazing Schedule						
Type	**Description**	**T_{vis}**	**R_{ext}**	**U_w**	**SC**	**SHGC**
IG-2	1" thick Insulating Vision Insulated Glass with Low E coating	0.35	0.07	0.32	0.31	0.27

Design Goals

As a space that will have different scene controls, the Flynn Impression of spacious vs closure was a key design goal for the space. Spaciousness will be the scene control for dining or general meetings where overall illuminance will be important, while closure would be the scene control setting for Board meetings, presentations, and video conferences. Other design goals consist of excellent facial recognition and avoiding facial shadows. This will be important for Board Meetings and video conferences where facial recognition is important. The last design consideration was to create many scene settings for a variety of meetings types in order to establish the appropriate impression.

Tasks | Activities

Activities in the Board Room consist of reading, writing, video conferences, dining, meetings, and general gatherings. Therefore, facial recognition and glare are important considerations. As a result of the variety of activities to occur within this space, both horizontal and vertical illuminance levels must be met, along with different scene control settings.

Design Criteria and Considerations

The design criteria below are an accumulation of Illuminating Engineering Society Lighting Handbook Tenth Edition, ASHRAE Standard 90.1-2010 Edition, and LEED for New Construction Version 2.2.

Qualitative Criteria

The qualitative design criteria for the Board Room are the following:

Illuminating Engineering Society Lighting Handbook Tenth Edition

Accent Opportunities

Accenting is important for the Board Room to vary the perceived brightness of the space and to bring attention to certain elements within the space. In the space, faces are highlighted to bring attention to them through vertical illuminance and ambient lighting.

Aesthetics

As a branch of the Administrative Office, aesthetics are extremely important due to the types of activities to occur within the space. The architect put a lot of detail into the architectural elements in the space, such as the textile wall coverings and cove details, so the lighting should highlight these elements.

Color Appearance and Color Contrast

Due to communication between executives being the most important aspect of the space, color appearance and contrast is an essential aspect of the design. Warm color temperatures and good color rendering will enhance the space due to the deeper color tones of the wood panels and architectural details.

Daylight Integration and Controls

Daylight has an important function in the space due to the curtain wall onto the vegetative roof garden. Direct sun is shielded through a large overhang, but diffuse daylight will still penetrate the Board Room. Incorporating daylight dimming into the design will create a comfortable environment, while black out shades will create a specific impression.

Direct Glare

Discomfort glare and disability glare should both be avoided in order to create a comfortable environment, especially when reading and writing are essential. This can be achieved through minimizing the luminance ratios between fixtures and surfaces.

Flicker

Flicker is distracting and bothersome in situations where intense concentration is essential. Minimizing this through using electronic ballasts will enhance the overall appearance and impression of the space.

Light Distribution across the Task Plane

Uniformity is an important criterion when tasks are primarily reading and writing. It is also important because seats are movable and therefore the exact location of furniture is not always known. Through incorporating luminaires with wide distributions and indirect fixtures providing ambient lighting will enhance this.

Maintenance

Maintaining the fixtures is important in order to continue the original lighting design. Ease of accessibility of the fixtures is important in order to allow for this to happen.

Modeling of Faces

Discussion is the primary task of the Board Room, thus modeling of faces is essential around the conference table and surrounding chairs. This will be enhanced through using both indirect and direct lighting around the conference table. Also, high color rendering properties are essential to create a comfortable environment and to enhance the architectural details, such as the wood panels.

Psychological Impressions | Spacious vs. Closure

The impression of closure will be incorporated in order to facilitate the tense discussions and decisions that will occur in the Board Room. When in a conference mode, only bounce lighting will be the source for the areas surrounding the conference table. Spaciousness will be incorporated through general ambient lighting. This mode will incorporate more people into the conference in the surrounding chairs, along with provide lighting for general gatherings.

Reflected Glare

Reflected glare can create discomfort of the users while performing tasks. In order to minimize this, luminaire placement, luminaire distributions, and optics will be considered in the lighting design.

Room Surface Characteristics

Surface characteristics are important for the design because integrating higher reflectance values with low specularity will be more feasible to achieve the uniformity ratios than with high specular materials. Glazing will also be carefully considered due to its high specularity.

Shadows

Harsh shadows can be disabling when trying to read and write. Therefore, the lighting design must incorporate both lighting in front of faces and behind the conference table to minimize shadows, but lighting in front of the user must be done carefully as to not cause glare.

Source-Task-Eye Geometry

Source-task-eye geometry enhances task visibility. In order to incorporate this into the design, luminaires will be located away from the offending zone. This will avoid any veiling reflections.

System Flexibility and Controls

Moving furniture is unlikely in the space, but scene controls are necessary. Through scene controls different types of meetings will be feasible. For example, for meetings using the projector screen, fixtures grazing the PSECU sign will be turned off to prevent any glare on the screen. For meetings that are discussion based, higher light levels at the conference table and on faces will encourage discussion.

Quantitative Criteria

The qualitative design criteria for the Board Room are the following:

Illuminating Engineering Society Lighting Handbook Tenth Edition

Horizontal Illuminance

Conferencing: Meeting: Discourse: 300 lux

Achieving appropriate horizontal illuminance across the task plane allows for users to more successfully achieve tasks. In considering the tasks to be performed in the Board Room, uniformity in the horizontal illuminance will be an important criterion. The work plane surface is measured at a height of 2'-6".

Vertical Illuminance

Conferencing: Meeting: White Boards: Analog or Digital Reading: 150 lux

Facial recognition is an extremely important aspect of the Board Room for video conferences, Board Meetings, presentations, and discussion. Therefore, minimizing facial shadows and maintaining vertical brightness will allow for a more comfortable environment.

ASHRAE Design Criteria

Space-by-Space Method: Allowance: Conference/Meeting/Multipurpose: 1.23 W/sq.ft.

LEED Design Criteria

Credit 6.1 **Controllability of Systems**, Lighting

Incorporating lighting controls, such as dimming, occupancy and vacancy sensors, and daylight harvesting sensors will reduce energy consumption and enhance occupant satisfaction through creating a comfortable environment.

Credit 8.1 **Daylight & Views**, Daylight 75% of Spaces

An oval-shaped curtain wall provides daylight to the space. This enhances occupant satisfaction through bringing the outside into the space. This is especially critical in work spaces where occupants are in the space for long periods of time.

Luminaires and Equipment

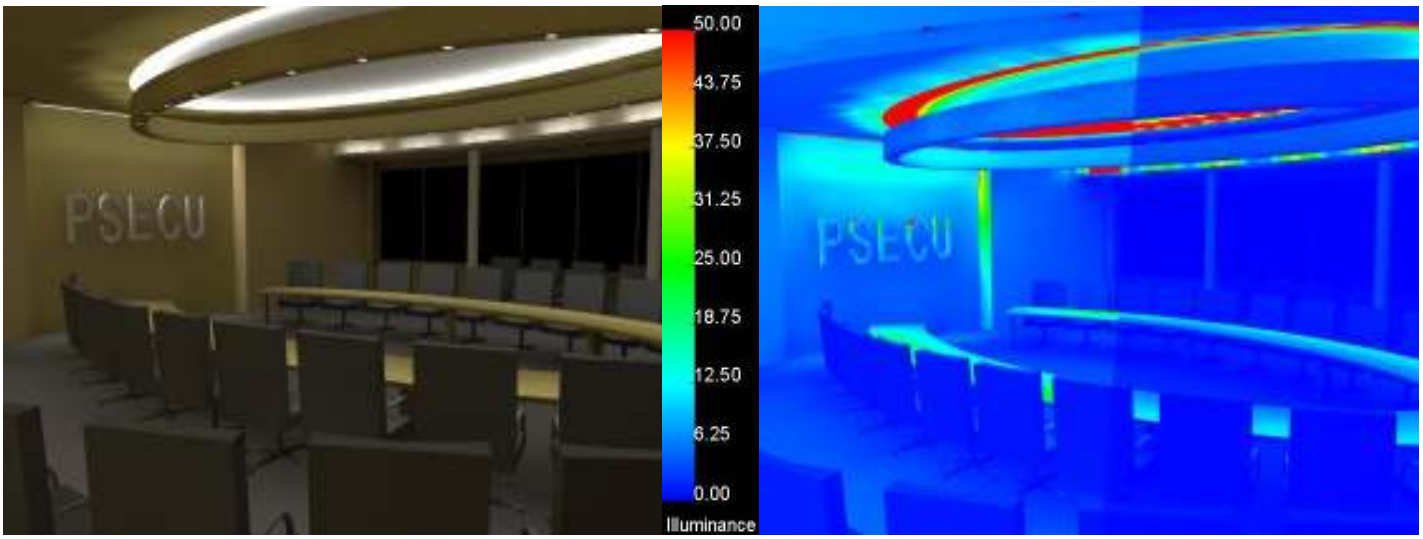
Lighting Equipment Schedule				
Type		Description	Manufacturer	Lamp
	AL1	Recessed LED adjustable downlight with 3" aperture and 18 degree beam. Extruded aluminum finish	Edison Price Lighting	LED arrray with 800 lumen output, 3000K CCT, 85+ CRI
	CL1	3' long x 6.5" wide LED asymmetric, surface mount, cove fixture with stainless steel finish	Winona Lighting	LED array, 44 watt, 1050 lumen output, 3000K CCT, 85+ CRI
	SL1	1' LED adjustable surface mount fixture, 50 degree x 70 degree beam,	Philips Color Kinetics	LED array, 12.1 watt, 446 lumen output, 3000K CCT, 85+ CRI
	TL1	2" aperture LED cylinder, black die-cast aluminum finish, 26 degree beam, aluminum housing	Philips Lightoiler	LED array, 10 watt, 414 lumen output, 3000K CCT, 85+ CRI
	WF1	4' recessed fluorescent direct-indirect wall wash fixture, 3" wide x 5" tall, integral dimming ballast, white powder finish	Cooper Lighting Neo-Ray	(1) 28 watt T5 lamp, 3000K CCT, 85 CRI
	WF2	4' long x 6" wide recessed fluorescent grazer with open optics, steel housing, matte white housing, integral electronic dimming ballast	Focal Point	(1) 28 watt T5 lamp, 3000K CCT, 85 CRI

Light Loss Factors				
Type	LLD	LDD	BF	LLF
AL1	0.70	0.92	-	0.64
CL1	0.70	0.92	-	0.64
SL1	0.70	0.92	-	0.64
TL1	0.70	0.92	-	0.64
WF1	0.93	0.92	1.00	0.86
WF2	0.93	0.92	1.00	0.86

Renderings

All On

The all on setting is for general gatherings, luncheons, and cleaning. The focal point in this setting is the dome shaped cove and the PSECU sign. The space has uniform lighting with a maximum to average illuminance ratio of 2.9 across the space and 1.55 on conference table. In this setting, the walls are highlighted to evoke the Flynn Impression of spaciousness. The pseudocolor rendering below is measured in footcandles.

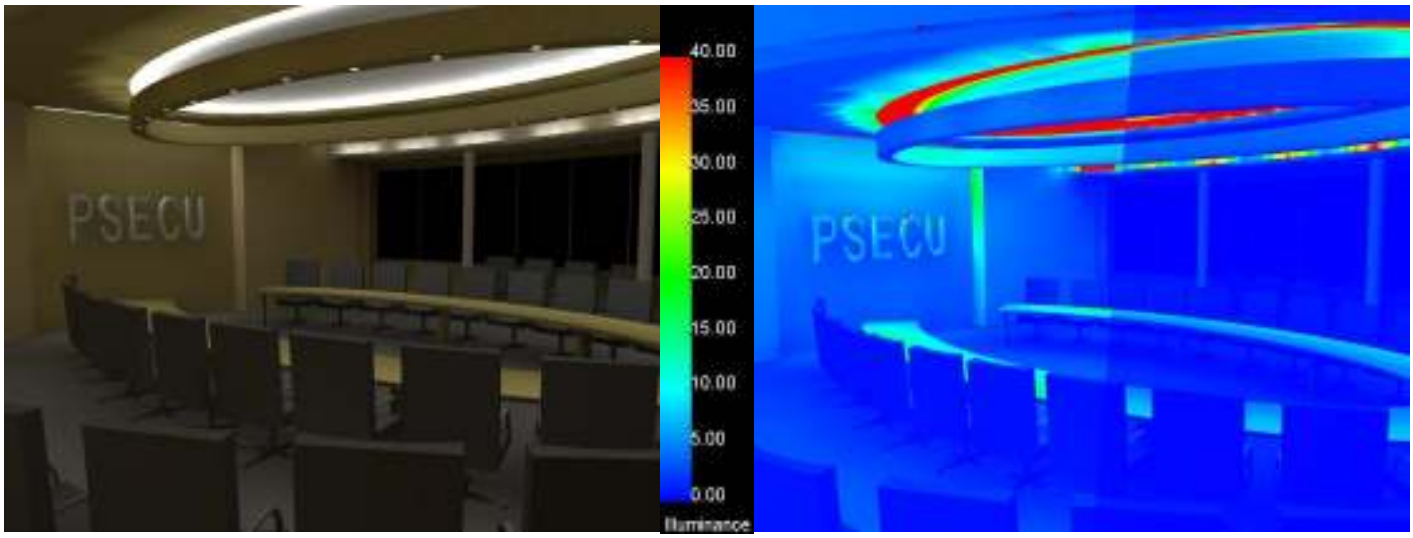


General Meeting | 30 fc on Work Plane

The general meeting setting is for video conferences and Board Room meetings where interaction among PSECU Executives is important. The Flynn Impression of spaciousness is a key design feature in this setting. Facial recognition is very important in this setting. Therefore, the ambient lighting from the indirect component of the custom fixture and direct lighting from downlight component of the custom fixture provide the majority of the lighting. The pseudocolor rendering below is measured in footcandles.

The lighting setting has the following dimming levels:

- AL1 dimmed to 60% output
- CL1 at full output
- SL1 at full output
- TL1 at full output
- WF1 dimmed to 50% output
- WF2 dimmed to 50% output

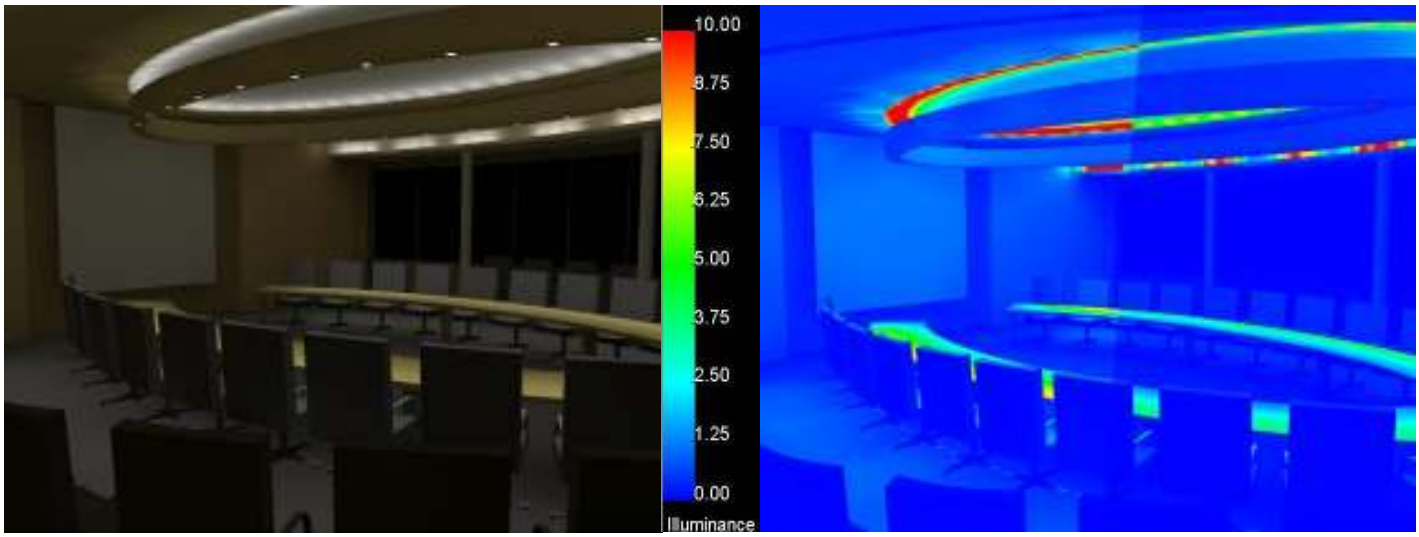


Audiovisual Meeting with Reading | 13 fc on Workplane

The audiovisual setting is for meetings with the projector screen with reading and writing as the primary tasks. The majority of the lighting is from the indirect lighting in the custom fixture with additional task plane lighting from the adjustable downlights. The cove provides task lighting for the surrounding conference chairs. The wall graze fixture behind the audio visual screen is off to reduce glare on the screen.

The lighting setting has the following dimming levels:

- AL1 dimmed to 40% output
- CL1 dimmed to 30% output
- SL1 dimmed to 10% output
- TL1 off
- WF1 off
- WF2 off

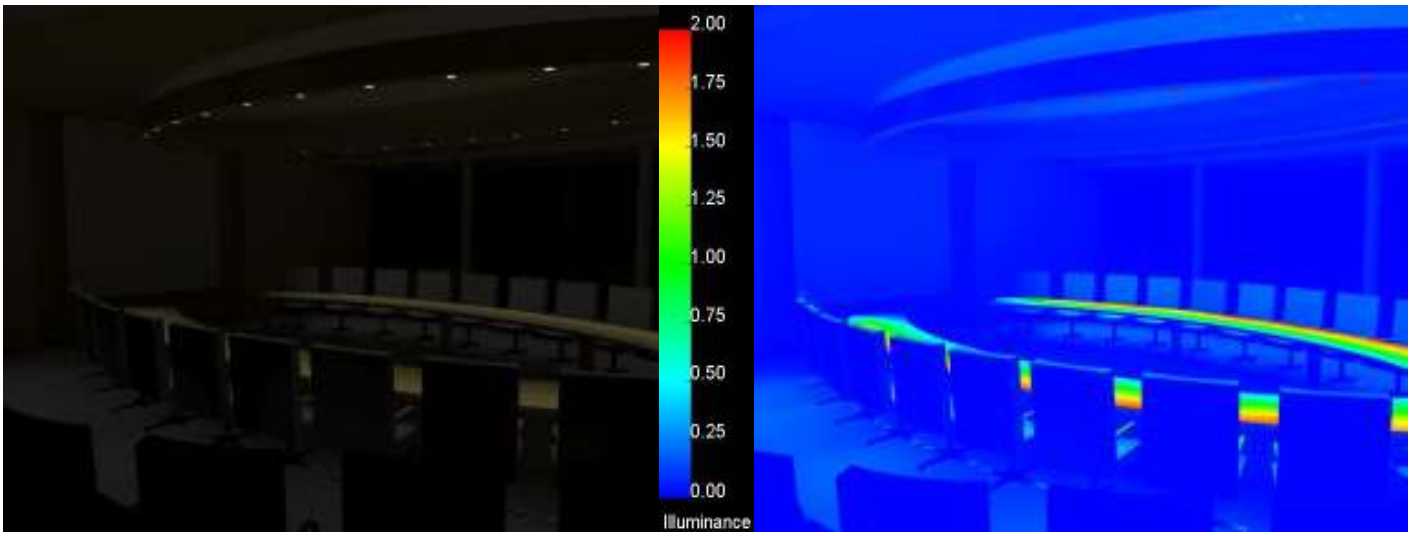

10.00
8.75
7.50
6.25
5.00
3.75
2.50
1.25
0.00
Illuminance

Audiovisual Meeting | 3 fc on Work Plane

The Flynn Impression of Closure is the key design feature of the audiovisual setting. The control setting creates a tense environment in order to replicate the tense decisions being made in the space. The custom fixture provides the lighting for the space. None of the perimeter lighting is on in order to focus all of the attention to the conference table.

The lighting setting has the following dimming levels:

AL1 dimmed to 10% output
CL1 off
SL1 dimmed to 10%
TL1 off
WF1 off
WF2 off



Calculation Summary

Board Room Calculation Summary (All On)				
		Workplane (2.5')	Workplane at Board Table (2.5')	Vertical (4')
	Average Illuminance (fc)	20.38	40.3	21.5
	Maximum Illuminance (fc)	59.7	62.3	28.5
	Minimum Illuminance (fc)	3.1	13.9	16.4
	Maximum:Average	2.93	1.55	1.33
Design Criteria	Average Illuminance (fc)	-	30	15
Design Criteria	Maximum:Average	-	3:1	-

Board Room Calculation Summary (General Meeting)				
		Workplane (2.5')	Workplane at Board Table (2.5')	Vertical (4')
	Average Illuminance (fc)	15.4	28.2	15.8
	Maximum Illuminance (fc)	39	40.6	20.1
	Minimum Illuminance (fc)	2.5	11.9	12.7
	Maximum:Average	2.53	1.44	1.26
Design Criteria	Average Illuminance (fc)	-	30	15
Design Criteria	Maximum:Average	-	3:1	-

Board Room Calculation Summary (Audio Visual w/ Reading)				
		Workplane (2.5')	Workplane at Board Table (2.5')	Vertical (4')
	Average Illuminance (fc)	3.69	12.99	6.02
	Maximum Illuminance (fc)	21.6	22	9.2
	Minimum Illuminance (fc)	0.1	0.8	3.9
	Maximum:Average	5.85	1.72	1.52
Design Criteria	Average Illuminance (fc)	-	-	-
Design Criteria	Maximum:Average	-	-	-

Board Room Calculation Summary (Audio Visual Presentation)				
		Workplane (2.5')	Workplane at Board Table (2.5')	Vertical (4')
	Average Illuminance (fc)	0.68	2.91	1.28
	Maximum Illuminance (fc)	5.1	5.3	2
	Minimum Illuminance (fc)	0	0	0.7
	Maximum:Average	7.5	1.82	1.61
Design Criteria	Average Illuminance (fc)	-	3	-
Design Criteria	Maximum:Average	-	-	-

Energy Code Compliance

Lighting Power Density	
Area	1600 sq ft
Designed	1.33 W/sq ft
Criteria	1.23 W/sq ft

The space is over power density due to the variety of fixtures to create the appropriate settings in the space. The power density is tradable and therefore all of the tradable spaces will be added together in order to determine the feasibility of the lighting designs.

Evaluation of Design

Flexibility is of utmost importance in a conference room setting. A Lutron Grafik Eye control system allows for this by providing four lighting scenes that allow for different meeting settings. The Flynn Impression of spacious vs. closure was a key design feature, which was accomplished through the lighting control system. Spaciousness was accomplished through a scene with uniform lighting with peripheral emphasis. Closure was accomplished through a scene with nonuniform light levels and emphasis on the board table. As a space with deeper tone materials and intricate architectural details, the lighting highlights each through excellent color rendering with LED and linear fluorescent lamps. The design goal of reducing facial shadows was accomplished through the indirect lighting within the custom fixture along with providing necessary light levels through the downlight components. Strong lines were a key design emphasis, which was achieved through highlighting the circular elements, especially the curves of the board table and custom fixture. Emphasis on the natural materials was another overall design goal, which was accentuated through peripheral lighting and the introduction of a wood panel custom fixture. The warmer color temperature of 3000K emphasizes the warm tones of the space. Overall, the Board Room lighting is a multifunctional space in which the lighting successfully allows for different impressions, while still emphasizing the overall design goals of strong lines and emphasizing natural materials.

Electrical Redesign | Board Room

The electrical redesign addresses the changes to the lighting and how the redesigned space will be controlled. The following looks at the Special Purpose space relighted, which is the Board Room.

Description

The Board Room consists of a large oval conference table with additional chairs set around the perimeter of the space. A projector screen is at the front of the space with the letters PSECU behind the projector screen. A custom wooden pendant replicates the shape of the table and hangs above the table. It houses LED adjustable downlights and LED cove lighting that projects light into the dome in order to provide general illuminance to the space. Windows line the curved south and west facing walls, which look out onto the roof garden. The redesigned lighting consists of the custom pendant, LED track lighting around the perimeter of the space, fluorescent wall washers, and LED accent lights on the PSECU logo. All lighting is dimmable and is controlled by a Lutron Quantum and Grafik Eye control system.

Panelboard Summary

A total of ten panelboards encompass the lighting panels for the four space redesigned. The panels consist of both normal and normal/emergency panelboards.

PANELBOARDS						
PANEL TAG	VOLTAGE	SYSTEM	FAÇADE AND ENTRY PLAZA	LOBBY	BOARD ROOM	MARKETING OFFICE
ELP1E	480Y/277V 3PH 4W	N/E		X		
ELP1W	480Y/277V 3PH 4W	N/E	X	X		
LP1W	480Y/277V 3PH 4W	N		X		
LP3W	480Y/277V 3PH 4W	N		X		
LP3E	480Y/277V 3PH 4W	N		X		
ELP3W	480Y/277V 3PH 4W	N/E			X	
LP3W	480Y/277V 3PH 4W	N			X	
LP3E	480Y/277V 3PH 4W	N/E				X
ELP3E	480Y/277V 3PH 4W	N				X
SLP3	480Y/277V 3PH 4W	?	X			

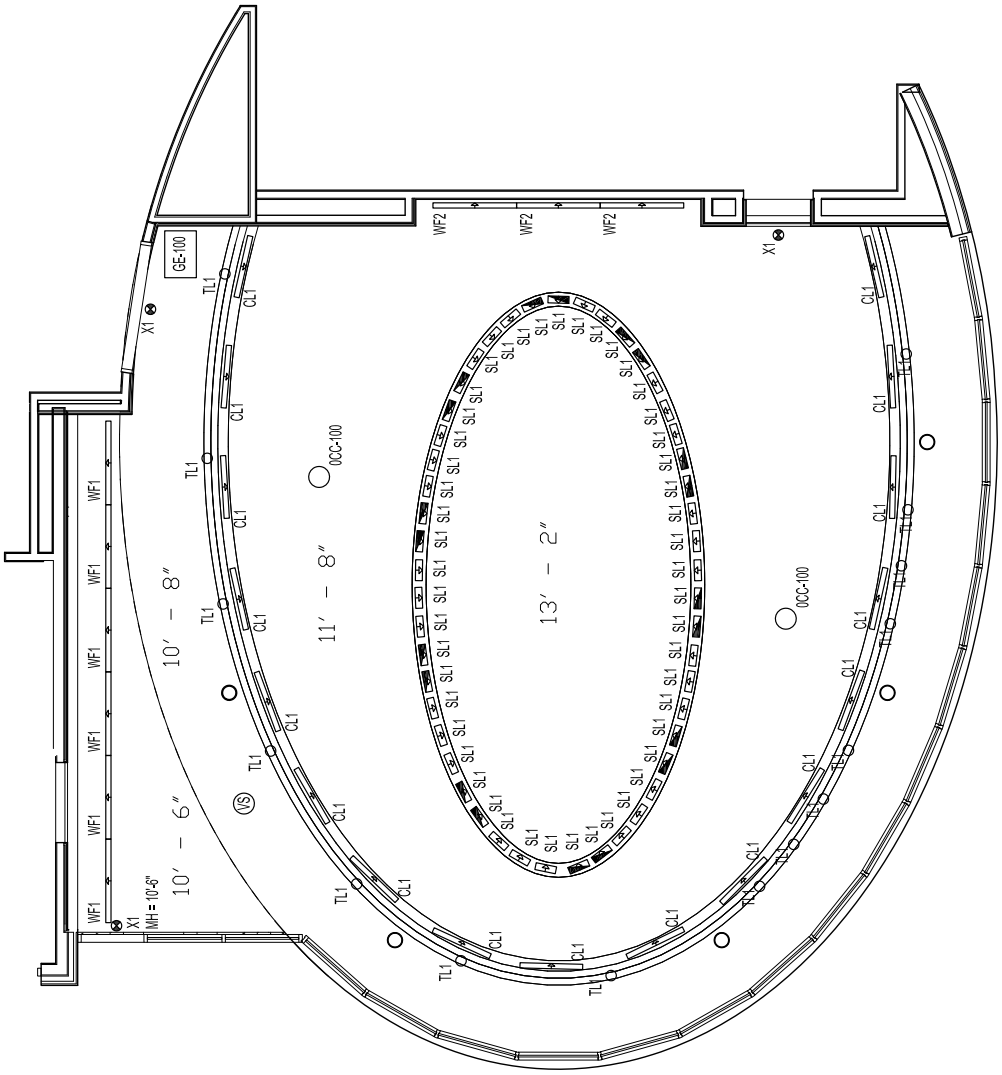
Controls

Flexibility in controls is of utmost importance in a conference room. The building operates through a Lutron Quantum system with computer controllability located in the Data Center. The Quantum system is connected to a Grafik Eye QS Control Unit, which is located in the Board Room. The Grafik Eye QS system allows for control of both the lighting and shades through scene controls. The space will have four scenes, which are with all of the fixtures on, a general meeting scene with 30 footcandles on the workplane and lower levels in the peripheral areas, an audiovisual mode with reading and writing, and an audiovisual mode for presentations. The Grafik Eye also communicates with the occupancy sensors located within the space. The control system operates on line-voltage dimming and it has programmable zones. The space will also have Ecosystem H-Series Ballasts that the Grafik Eye can communicate with to group the zones.

Lighting | Electrical Plans

See Appendix A

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/16" = 1'	ISSUE DATE: 03/31/2012	DRAWN BY: SARAH WUJCIK	TITLE: BOARD ROOM LIGHTING PLAN	SHEET TITLE: L01



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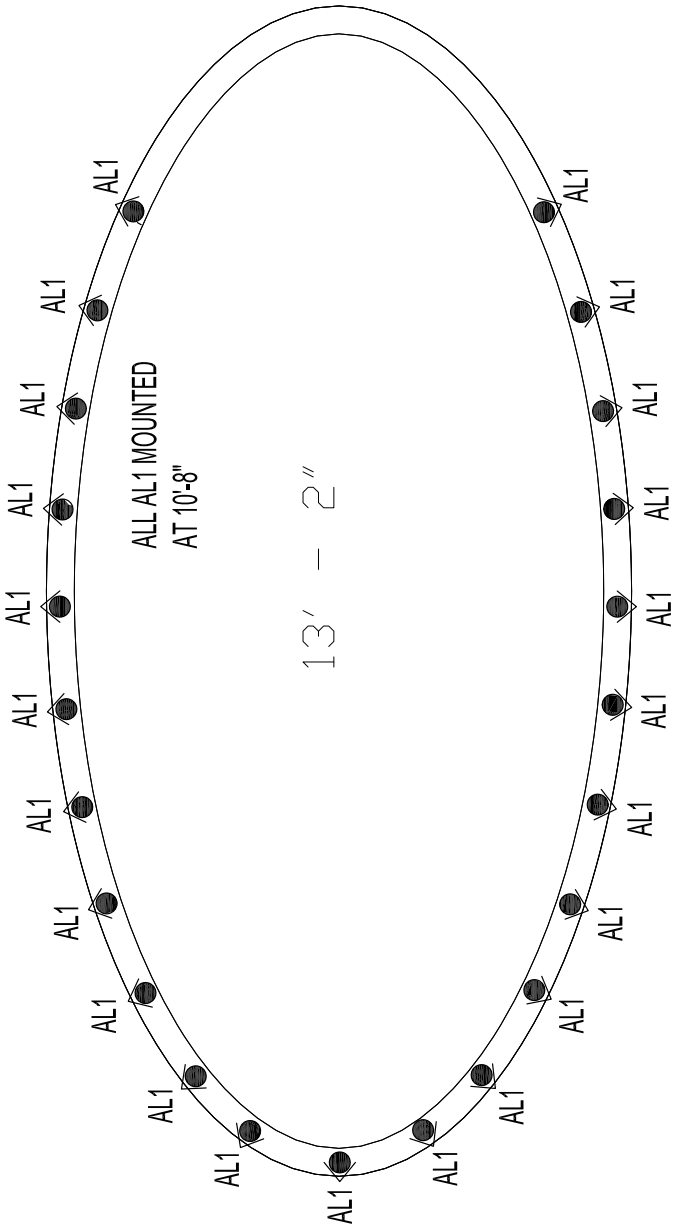
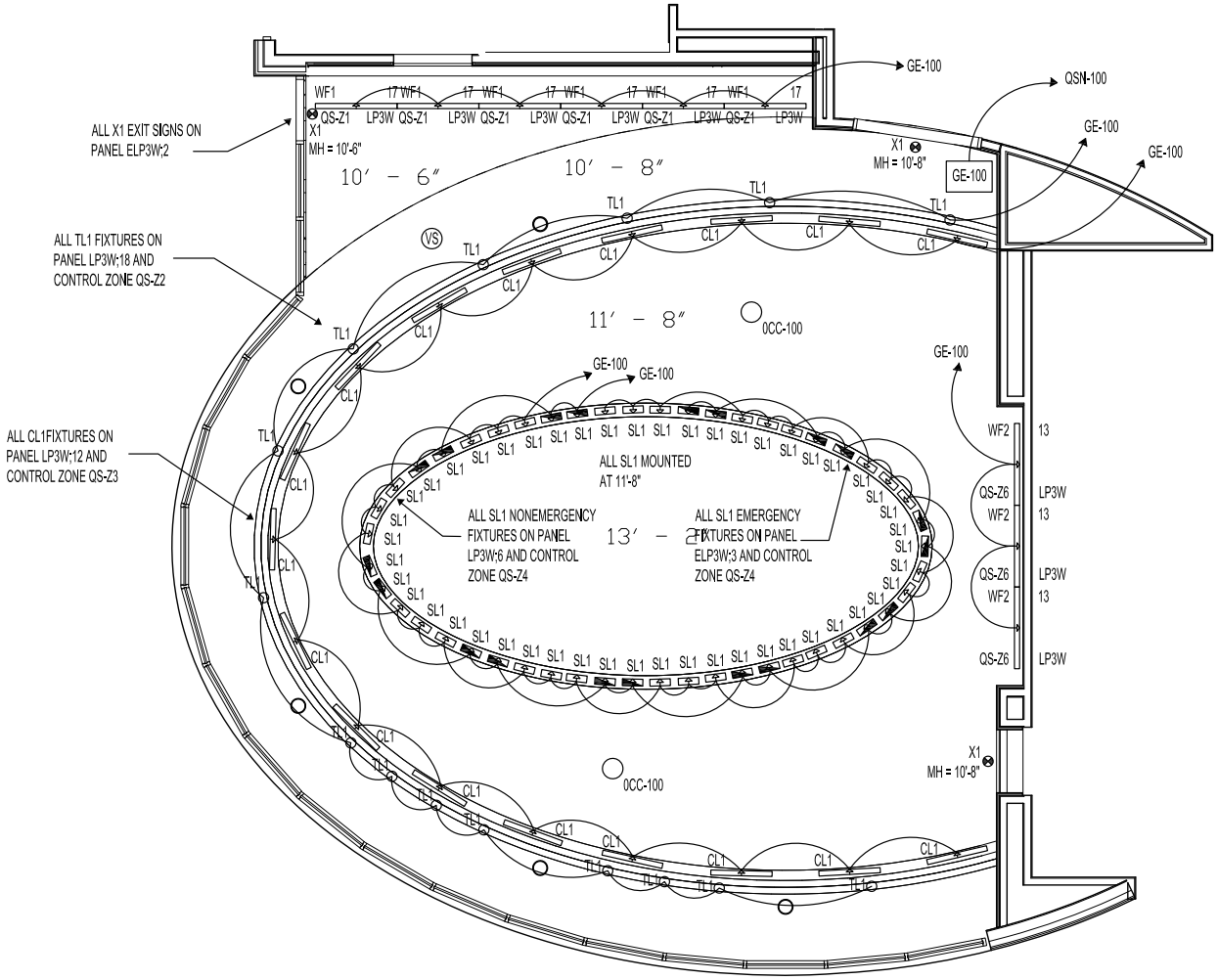




THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

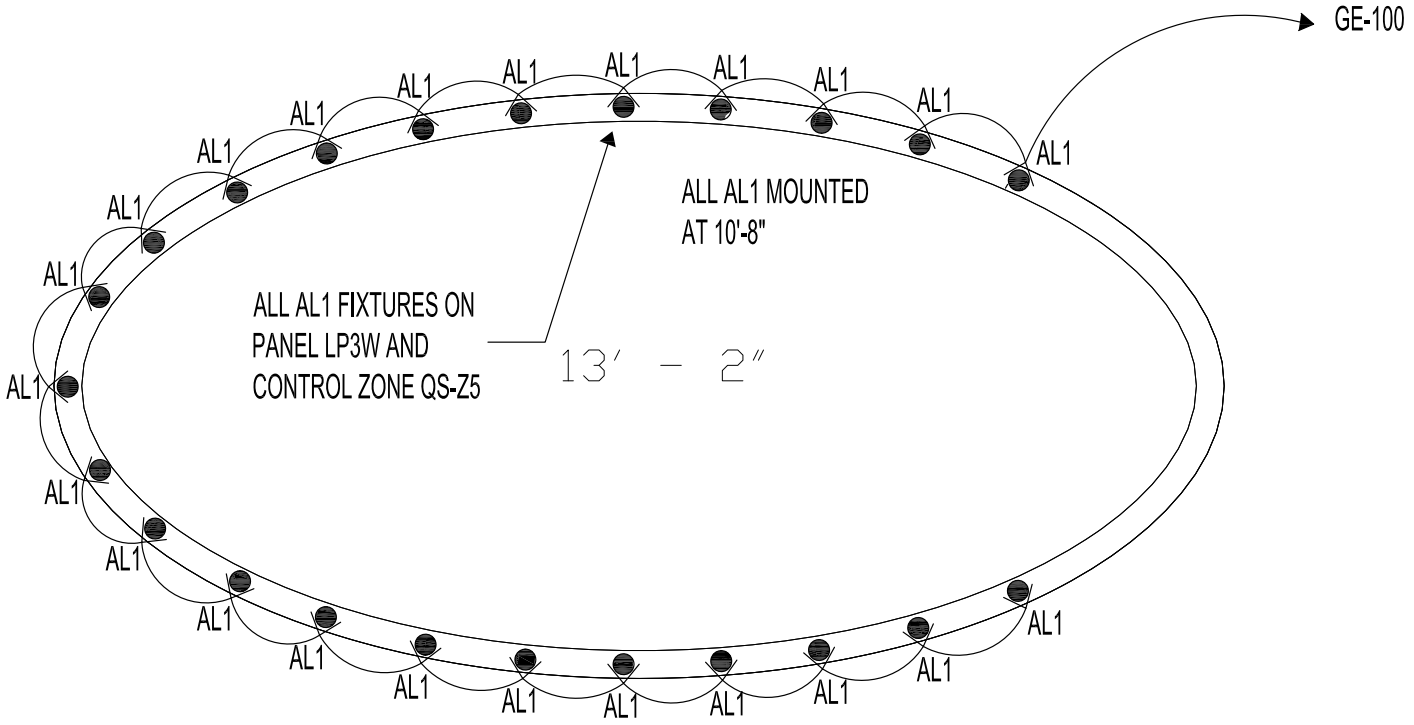
SCALE:
1/16" = 1'

ISSUE DATE:
03/31/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
BOARD ROOM CIRCUITING DIAGRAM

SHEET TITLE:
E.01



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
1/8" = 1'

ISSUE DATE:
03/31/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
BOARD ROOM CIRCUITING DIAGRAM FOR CUSTOM FIXTURE

SHEET TITLE:
E.01.2

Existing Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W LIFE SAFETY				PANEL TAG:	ELP3W				AIC RATING:	25K		
SIZE/TYPE BUS:	250A				PANEL LOCATION:	ELECTR A327				MODIFICATIONS:			
SIZE/TYPE MAIN:	250A MLO				PANEL MOUNTING:	SURFACE							
					SUPPLY FROM:	ELP2W							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING	
20A	ELP3W;1	LIGHTING CORPORATE LEGAL	20A	1	986 VA/ 104 VA			1	20A	EXIT SIGNS	ELP3W;2	20A	
	ELP3W;3					0 VA/ 1881 VA		1	20A	LIGHTING	ELP3W;4	20A	
	ELP3W;5										ELP3W;6		
	ELP3W;7										ELP3W;8		
	ELP3W;9										ELP3W;10		
	ELP3W;11										ELP3W;12		
	ELP3W;13										ELP3W;14		
	ELP3W;15										ELP3W;16		
	ELP3W;17										ELP3W;18		
	ELP3W;19										ELP3W;20		
	ELP3W;21										ELP3W;22		
	ELP3W;23										ELP3W;24		
	ELP3W;25										ELP3W;26		
	ELP3W;27										ELP3W;28		
	ELP3W;29										ELP3W;30		
	ELP3W;31										ELP3W;32		
	ELP3W;33										ELP3W;34		
	ELP3W;35										ELP3W;36		
	ELP3W;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	ELP3W;38		
	ELP3W;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	ELP3W;40		
	ELP3W;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	ELP3W;42		
			LOAD PER PHASE		1090 VA	1881 VA	0 VA						

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	2867 VA	100.00%	2867 VA
EXIT SIGNS	104 VA	100.00%	104 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	2971 VA
TOTAL EST DEMAND	2971 VA
TOTAL CONNECTED CURRENT	4 A
TOTAL ESTIMATED DEMAND CURRENT	4 A

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W				PANEL TAG:	LP3W				AIC RATING:	25K		
SIZE/TYPE BUS:	400A				PANEL LOCATION:	ELECTR A327				MODIFICATIONS:			
SIZE/TYPE MAIN:	400A MLO				PANEL MOUNTING:	SURFACE							
					SUPPLY FROM:	MDP2-1							
Wiring	Circuit Number	Load Name	Trip	POLES	A	B	C	POLES	TRIP	LOAD NAME	CIRCUIT NUMBER	WIRING	
150E	LP3W;1	T-RP3W	150A	3	32018 VA/ 2483 VA			1	20A	LIGHTING COMMONS A325	LP3W;2	20A	
	LP3W;3	-	-	-		31808 VA/ 3895 VA		1	20A	LIGHTING VP FINANCE	LP3W;4	20A	
	LP3W;5	-	-	-			32078 VA/ 2942 VA	1	20A	LIGHTING BOARDRM	LP3W;6	20A	
20A	LP3W;7	LIGHTING INFORMATION TECH	20A	1	2854 VA/ 3050 VA			1	20A	LIGHTIGN VP A340	LP3W;8	20A	
20A	LP3W;9	LIGHTING ROOF GARDEN	20A	1		3135 VA/ 0 VA					LP3W;10		
20A	LP3W;11	LIGHTING MEN'S RESTRM A345	20A	1			4079 VA/ 0 VA				LP3W;12		
	LP3W;13										LP3W;14		
	LP3W;15										LP3W;16		
	LP3W;17										LP3W;18		
	LP3W;19										LP3W;20		
	LP3W;21										LP3W;22		
	LP3W;23										LP3W;24		
	LP3W;25										LP3W;26		
	LP3W;27										LP3W;28		
	LP3W;29										LP3W;30		
15F	LP3W;31	SUB-METER	15A	3	6 VA/ 0 VA						LP3W;32		
	LP3W;33	-	-	-		6 VA/ 0 VA					LP3W;34		
	LP3W;35	-	-	-			6 VA/ 0 VA				LP3W;36		
	LP3W;37	SPARE	20A	1	0 VA/ 0 VA			1	20A	SPARE	LP3W;38		
	LP3W;39	SPARE	20A	1		0 VA/ 0 VA		1	20A	SPARE	LP3W;40		
	LP3W;41	SPARE	20A	1			0 VA/ 0 VA	1	20A	SPARE	LP3W;42		
			LOAD PER PHASE										

LOAD CLASSIFICATION	CONNECTED LOAD	DEMAND FACTOR	EST DEMAND
LIGHTING	22052 VA	100.00%	22052 VA
EQUIP	25653 VA	80.00%	20522 VA
RECEPT CONV	19440 VA	80.00%	15552 VA
RECEPT KITCHEN	500 VA	100.00%	500 VA
RECEPT OFFICE	11520 VA	80.00%	9216 VA
RECEPT OFFICE EQUIP	3600 VA	80.00%	2880 VA
RECEPT PANTRY	1580 VA	80.00%	1264 VA
WKSTN FEED	22580 VA	80.00%	18064 VA
POWER AV	9200 VA	80.00%	7360 VA
CONTROLS	0 VA	0.00%	0 VA

PANEL TOTAL	
TOTAL CONNECTED LOAD	118361 VA
TOTAL EST DEMAND	99646 VA
TOTAL CONNECTED CURRENT	142 A
TOTAL ESTIMATED DEMAND CURRENT	120 A

Existing Control Layout

See Appendix D

Panelboard Worksheets

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					LP3W	Panel Location:			ELECTRIC RM A327		
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	T-RP3W	1	ELEC RM A327	32018	w	1.00	32018	32018		
2	A	LIGHTING COMMON AREAS A325	2	A325	2483	w	1.00	2483	2483		
3	B	-	2	A325	31808	w	1.00	31808	31808		
4	B	LIGHTING VP FINANCE	2	FINANCE	3895	w	1.00	3895	3895		
5	C	-	2	FINANCE	32078	w	1.00	32078	32078		
6	C	LIGHTING BOARDRM SL1	4	BOARD RM	350.9	w	0.70	351	501		
7	A	LIGHTING INFO TECH	2	INFO TECH	2854	w	1.00	2854	2854		
8	A	LIGHTING VP A340	2	VP OFFICE	3050	w	1.00	3050	3050		
9	B	LIGHTING ROOF GARDEN	2	ROOF GARDEN	3135	w	1.00	3135	3135		
10	B	-	2	ROOF GARDEN	3135	w	1.00	3135	3135		
11	C	LIGHTING MEN'S RESTRM A345	2	RESTRM	4079	w	1.00	4079	4079		
12	C	LIGHTING BOARDRM CL1	4	BOARD RM	748	w	0.70	748	1069		
13	A	LIGHTING BOARD RM WF2	3	BOARD RM	96	w	0.90	96	107		
14	A				0	w		0	0		
15	B				0	w		0	0		
16	B				0	w		0	0		
17	C	LIGHTING BOARD RM WF1	3	BOARD RM	192	w	0.90	192	213		
18	C	LIGHTING BOARD RM TL1	4	BOARD RM	150	w	0.70	150	214		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A				0	w		0	0		
33	B				0	w		0	0		
34	B				0	w		0	0		
35	C				0	w		0	0		
36	C				0	w		0	0		
37	A	SPARE			0	w		0	0		
38	A	SPARE			0	w		0	0		
39	B	SPARE			0	w		0	0		
40	B	SPARE			0	w		0	0		
41	C	SPARE			0	w		0	0		
42	C	SPARE			0	w		0	0		
PANEL TOTAL								120.1	120.6	Amps=	145.2

PHASE LOADING						kW	kVA	%	Amps
PHASE TOTAL	A					40.5	40.5	34%	146.3
PHASE TOTAL	B					42.0	42.0	35%	151.5
PHASE TOTAL	C					37.6	38.2	32%	137.7

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	transformers		32.0	32.0		32.0	32.0	1.00		
2	lighting		86.5	86.5		86.5	86.5	1.00		
3	lighting fluor		0.3	0.3		0.3	0.3	0.95		
4	lighting LED		1.3	0.9		1.3	0.9	0.70		
Total Demand Loads						120.1	119.7			
Spare Capacity			25%			30.0	29.9			
Total Design Loads						150.1	149.7	1.00	Amps=	180.1

Default Power Factor =	0.80	
Default Demand Factor =	100	%

PANELBOARD SIZING WORKSHEET

Panel Tag---------->					ELP3W	Panel Location:			ELECTRIC RM A327		
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 CORPORATE LEGAL	1	LEGAL DEPT	986	w	1.00	986	986		
2	A	EXIT SIGNS BOARD RM	3	BOARD RM	104	w	1.00	104	104		
3	B	LIGHTING BOARD RM	2	BOARD RM	242	w	0.90	242	269		
4	B				0	w		0	0		
5	C				0	w		0	0		
6	C				0	w		0	0		
7	A				0	w		0	0		
8	A				0	w		0	0		
9	B				0	w		0	0		
10	B				0	w		0	0		
11	C				0	w		0	0		
12	C				0	w		0	0		
13	A				0	w		0	0		
14	A				0	w		0	0		
15	B				0	w		0	0		
16	B				0	w		0	0		
17	C				0	w		0	0		
18	C				0	w		0	0		
19	A				0	w		0	0		
20	A				0	w		0	0		
21	B				0	w		0	0		
22	B				0	w		0	0		
23	C				0	w		0	0		
24	C				0	w		0	0		
25	A				0	w		0	0		
26	A				0	w		0	0		
27	B				0	w		0	0		
28	B				0	w		0	0		
29	C				0	w		0	0		
30	C				0	w		0	0		
31	A				0	w		0	0		
32	A	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
33	B				0	w		0	0		
34	B	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
35	C				0	w		0	0		
36	C	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
37	A	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
38	A	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
39	B	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
40	B	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
41	C	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
42	C	SPARE	4	ELEC RM A327	3500	w	0.90	3500	3889		
PANEL TOTAL								32.8	36.4	Amps=	43.8

PHASE LOADING					kW	kVA	%	Amps
PHASE TOTAL	A				11.6	12.8	36%	46.1
PHASE TOTAL	B				10.7	11.9	34%	43.1
PHASE TOTAL	C				10.5	10.9	31%	39.3

LOAD CATAGORIES			Connected			Demand				Ver. 1.04
			kW	kVA	DF	kW	kVA	PF		
1	lighting		1.0	1.0		1.0	1.0	1.00		
2	LED Lighting		0.2	0.3		0.2	0.3	0.90		
3	emergency signs		0.1	0.1		0.1	0.1	1.04		
4	spare		31.5	35.0		31.5	35.0	0.90		
Total Demand Loads						32.8	36.4			
Spare Capacity			25%			8.2	9.1			
Total Design Loads						41.0	45.4	0.90	Amps=	54.7

Default Power Factor =	0.80	
Default Demand Factor =	100	%

Revised Panelboards

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	LP3W	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	200A	PANEL LOCATION:	ELECTRIC RM A327	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	200A/3P C/B	PANEL MOUNTING:	SURFACE		

DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
T-RP3W	ELEC RM A327	32018	20A/1P	1	32018VA/ 2483VA			2	20A/1P	2483	A325	LIGHTING COMMON AREAS A325
-	A325	31808	20A/1P	3		31808VA/ 3895VA		4	20A/1P	3895	FINANCE	LIGHTING VP FINANCE
-	FINANCE	32078	20A/1P	5			32078VA/ 351VA	6	20A/1P	351	BOARD RM	LIGHTING BOARDRM SL1
LIGHTING INFO TECH	INFO TECH	2854	20A/1P	7	2854VA/ 3050VA			8	20A/1P	3050	VP OFFICE	LIGHTING VP A340
LIGHTING ROOF GARDEN	ROOF GARDEN	3135	20A/1P	9		3135VA/ 3135VA		10	20A/1P	3135	ROOF GARDEN	-
LIGHTING MEN'S RESTRM A345	RESTRM	4079	20A/1P	11			4079VA/ 748VA	12	20A/1P	748	BOARD RM	LIGHTING BOARDRM CL1
LIGHTING BOARD RM WF2	BOARD RM	96	20A/1P	13	96VA/ 0VA			14	20A/1P	0		
		0	20A/1P	15		0VA/0VA		16	20A/1P	0		
LIGHTING BOARD RM WF1	BOARD RM	192	20A/1P	17			192VA/ 150VA	18	20A/1P	150	BOARD RM	LIGHTING BOARD RM TL1
		0	20A/1P	19	0VA/0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/0VA	30	20A/1P	0		
		0	20A/1P	31	0VA/0VA			32	20A/1P	0		
		0	20A/1P	33		0VA/0VA		34	20A/1P	0		
		0	20A/1P	35			0VA/0VA	36	20A/1P	0		
SPARE		0	20A/1P	37	0VA/0VA			38	20A/1P	0		SPARE
SPARE		0	20A/1P	39		0VA/0VA		40	20A/1P	0		SPARE
SPARE		0	20A/1P	41			0VA/0VA	42	20A/1P	0		SPARE

CONNECTED LOAD (KW) - A Ph.	40.50	TOTAL DESIGN LOAD (KW)	150.09
CONNECTED LOAD (KW) - B Ph.	41.97	POWER FACTOR	1.00
CONNECTED LOAD (KW) - C Ph.	37.60	TOTAL DESIGN LOAD (AMPS)	180

PANELBOARD SCHEDULE

VOLTAGE:	480Y/277V,3PH,4W	PANEL TAG:	ELP3W	MIN. C/B AIC:	25K
SIZE/TYPE BUS:	60A	PANEL LOCATION:	ELECTRIC RM A327	OPTIONS:	PROVIDE FEED THROUGH LUGS
SIZE/TYPE MAIN:	60A/3P C/B	PANEL MOUNTING:	SURFACE		

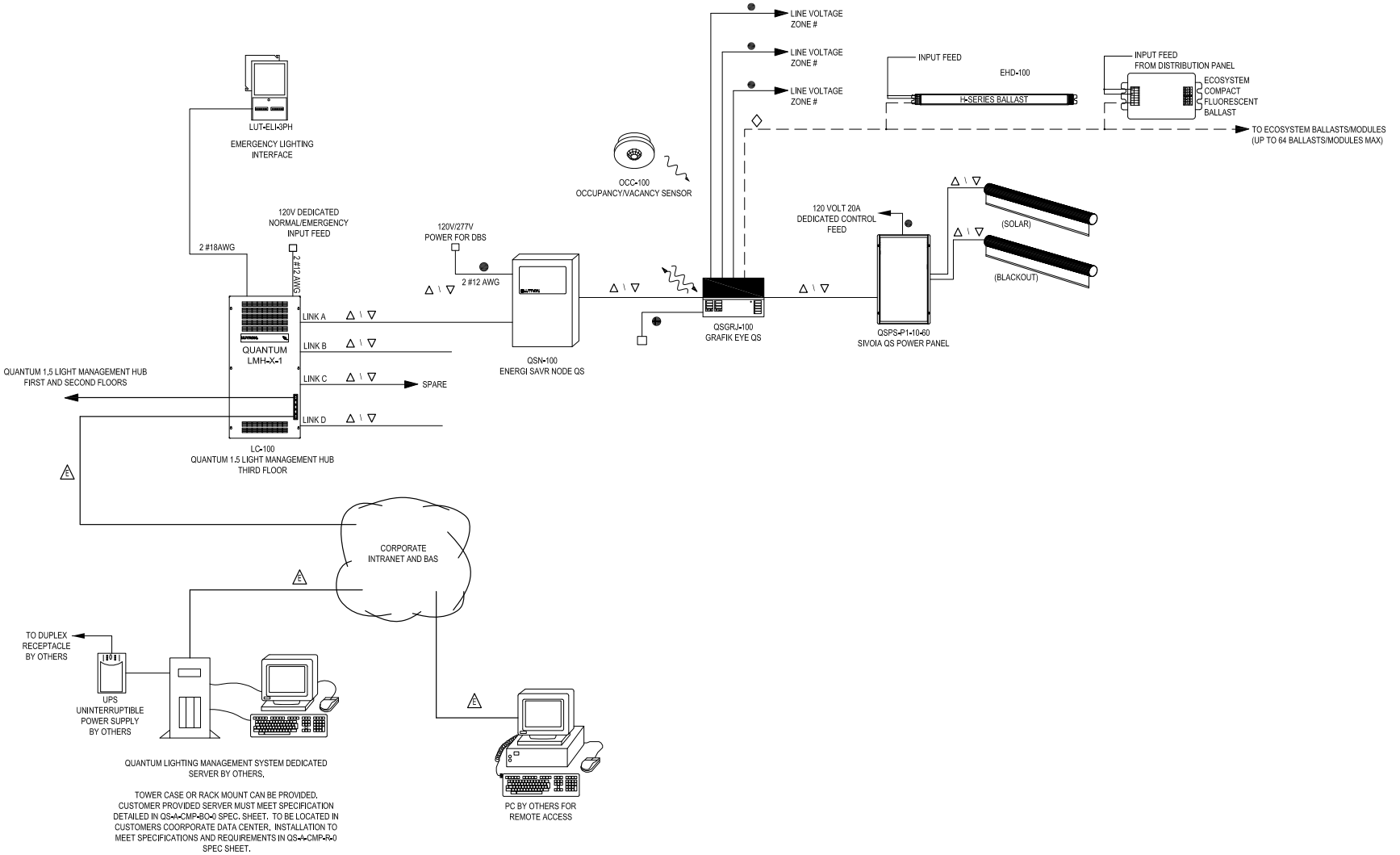
DESCRIPTION	LOCATION	LOAD (WATTS)	C/B SIZE	POS. NO.	A	B	C	POS. NO.	C/B SIZE	LOAD (WATTS)	LOCATION	DESCRIPTION
LIGHTING CORPORATE LEGAL	LEGAL DEPT	986	20A/1P	1	986VA/ 104VA			2	20A/1P	104	BOARD RM	EXIT SIGNS BOARD RM
LIGHTING BOARD RM	BOARD RM	242	20A/1P	3		242VA/ 0VA		4	20A/1P	0		
		0	20A/1P	5			0VA/0VA	6	20A/1P	0		
		0	20A/1P	7	0VA/0VA			8	20A/1P	0		
		0	20A/1P	9		0VA/0VA		10	20A/1P	0		
		0	20A/1P	11			0VA/0VA	12	20A/1P	0		
		0	20A/1P	13	0VA/0VA			14	20A/1P	0		
		0	20A/1P	15		0VA/0VA		16	20A/1P	0		
		0	20A/1P	17			0VA/0VA	18	20A/1P	0		
		0	20A/1P	19	0VA/0VA			20	20A/1P	0		
		0	20A/1P	21		0VA/0VA		22	20A/1P	0		
		0	20A/1P	23			0VA/0VA	24	20A/1P	0		
		0	20A/1P	25	0VA/0VA			26	20A/1P	0		
		0	20A/1P	27		0VA/0VA		28	20A/1P	0		
		0	20A/1P	29			0VA/0VA	30	20A/1P	0		
		0	20A/1P	31	0VA/ 3500VA			32	20A/1P	3500	ELEC RM A327	SPARE
		0	20A/1P	33		0VA/ 3500VA		34	20A/1P	3500	ELEC RM A327	SPARE
		0	20A/1P	35			0VA/ 3500VA	36	20A/1P	3500	ELEC RM A327	SPARE
SPARE	ELEC RM A327	3500	20A/1P	37	3500VA/ 3500VA			38	20A/1P	3500	ELEC RM A327	SPARE
SPARE	ELEC RM A327	3500	20A/1P	39		3500VA/ 3500VA		40	20A/1P	3500	ELEC RM A327	SPARE
SPARE	ELEC RM A327	3500	20A/1P	41			3500VA/ 3500VA	42	20A/1P	3500	ELEC RM A327	SPARE

CONNECTED LOAD (KW) - A Ph.	11.59	TOTAL DESIGN LOAD (KW)	41.04
CONNECTED LOAD (KW) - B Ph.	10.74	POWER FACTOR	0.90
CONNECTED LOAD (KW) - C Ph.	10.50	TOTAL DESIGN LOAD (AMPS)	55

Revised Dimming Wiring Diagrams

See Appendix D

Lighting Control Equipment Schedule					
Type	**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Location**
LC-100	LUTRON	LIGHT MANAGEMENT HUB	QP2-2P0CSE-120	Centralized connection for Lutron EcoSystem, supports up to 8 EcoSystem loops	DATA CENTER
QSN-100	LUTRON	ENERGY SAVR NODE QS	QSN-2ECO-S	Controls occupancy sensors, daylight sensors, and EcoSystem Wallstations	DATA CENTER
GE-100	LUTRON	GRAFIK EYE QS	QSGRJ-16E	Contrls Board Room lighting with line voltage zones	BOARD ROOM
OCC-100	LUTRON	OCCUPANCY/VACANCY SNESOR	L2F2-OCRB-P-WH	Ceiling mounted occupancy sensor with up to 12' diameter coverage	BOARD ROOM
EHD-100	LUTRON	ECOSYSTEM H-SERIES BALLASTS	EHD T528 M U 1 10	Fluorescent Dimming Ballast with dimming capabilities to 1% output	BOARD ROOM



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
NOT TO SCALE

ISSUE DATE:
3/31/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
BOARD ROOM CONTROL DIAGRAM

SHEET TITLE:
C.01

Feeder Resizing

Panel LP3W Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	150.1
Resultant Power Factor	1.00
Calculated Design Load (kVA)	149.7
Calculated Design Load (Amps)	180.1
Feeder Protection Size(Amps)	200
Number of Sets	1
Phase Conductor	(3) #3/0 AWG
Neutral Conductor	(1) #3/0 AWG
Ground Conductor	(1) #4 AWG
Total Phase Conductor Area (sq in)	0.8037
Neutral Conductor Area (sq in)	0.2679
Ground Conductor Area (sq in)	0.0824
Total Conductor Area (sq in)	1.154
Conduit Size	2-1/2" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	1.5
Voltage Drop (%)	0.3

Panel ELP3W Feeder Sizing	
Panelboard Voltage	480Y/277V
Calculated Design Load (kW)	41
Resultant Power Factor	0.90
Calculated Design Load (kVA)	45.4
Calculated Design Load (Amps)	54.7
Feeder Protection Size(Amps)	60
Number of Sets	1
Phase Conductor	(3) #6 AWG
Neutral Conductor	(1) #6 AWG
Ground Conductor	(1) #10 AWG
Total Phase Conductor Area (sq in)	0.1521
Neutral Conductor Area (sq in)	0.0507
Ground Conductor Area (sq in)	0.0211
Total Conductor Area (sq in)	0.2239
Conduit Size	1" RGS
Feeder Length (ft)	30
Voltage Drop (volts)	2.2
Voltage Drop (%)	0.5

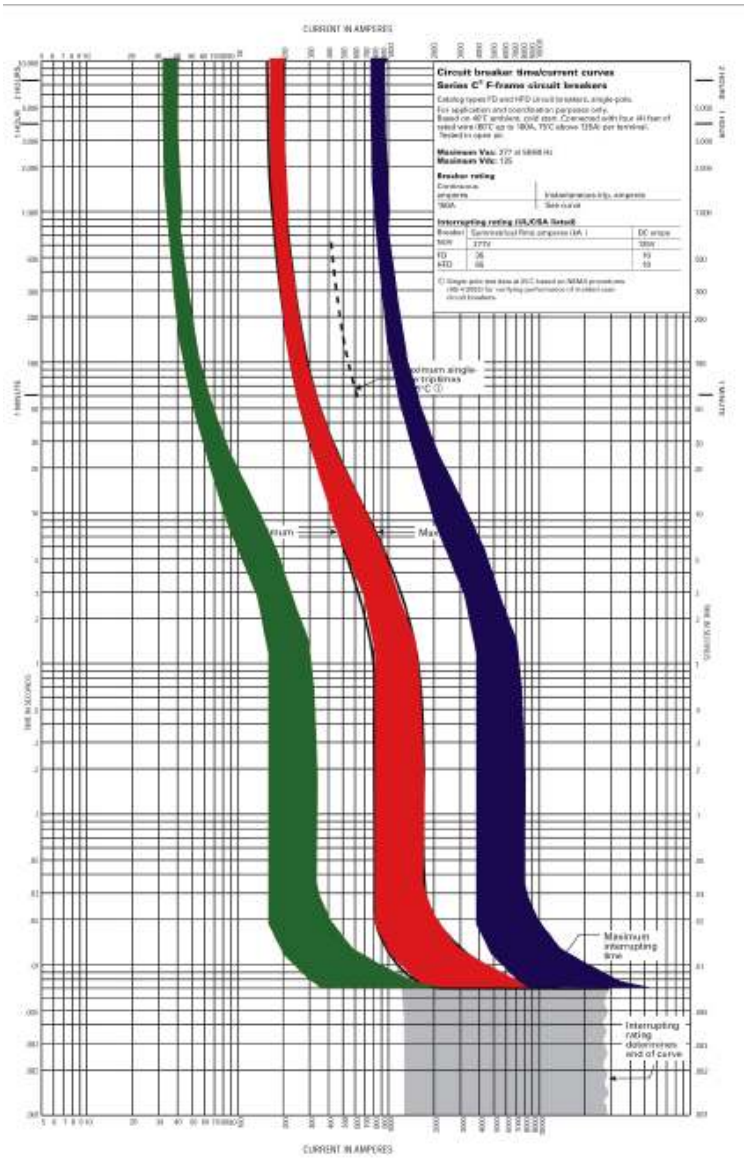
Panelboard Cut Sheets

See Appendix G

Electrical Redesign | Protective Device Coordination and Short Circuit Analysis

A protective device coordination study was performed and a single path of the electrical distribution system from the utility through the double-ended main substation and to a lighting panel was completed. The path studied is from then utility to the double-ended main substation MDP2 to a 400 Amp circuit breaker followed by panel LP1W.

Fault Point	Panel Transformer	Source (Fault Point)	Source I (amps)	Conduit Type	Wire/Bus Size	Wire/Bus Type	'C' value	E (volts)	L (length)	X'FMR KVA	X'FMR Z	f	M	Isc
1	UTILITY	-	3,000											3,000
2	MDP2	1	3000	M	3 Set(s) of 500 KCML	CU	22185	480	100			0.016	0.98	2952
3	CIRCUIT BREAKER	2	2952	M	2 Set(s) of 300 KCML	CU	18176	480	200			0.059	0.94	2789
4	LP1W	3	2789	M	2 Set(s) of 300 KCML	CU	18176	480	55			0.015	0.99	2747
5	T-RP1FC	4	2747	M	1 Set(s) of 4	CU	3806	208	20			0.120	0.89	2452
6	RP1FC	5	2452	M	1 Set(s) of 2/0	CU	10755	208	20			0.038	0.96	2362



According to the trip curve, the 400 A circuit breaker will trip before the 2500A circuit breaker and also before the 300A circuit breaker. Therefore, the over-current protection analysis proves that the equipment will be protected.

Electrical Depth 1 | Cost-benefit Analysis of Increasing Feeder Sizes

The Pennsylvania State Employees Credit Union Corporate Headquarters encompasses a large datacenter that runs 24 hours a day. Therefore, a study was performed to compare the energy and cost of increasing feeder sizes in the PSECU Corporate Headquarters. Although the existing wire sizes have a lower initial cost, the amount of energy lost during electrical transmission is greater than a larger wire size.

In order to complete this study, cost of wire sizes was obtained through R.S. Means Electrical Cost Data 2012 and calculations were completed in order to determine the more cost effective solution.

Method

The following will detail the method taken in determining the most cost effective solution.

The existing feeders were documented, which includes the number of sets of wire and the size and type of conduit, phase conductors, neutral conductors, and ground conductors. Using R.S. Means Electrical Cost Data and the feeder data, the cost of each wire was computed taking into account the labor, materials, overhead, and profit. The load and length were also documented. The loads were the size of the overcurrent protection for each feeder and the length was computed through measuring each feeder run. As the building is still under construction and no load data exists, assumptions were made as to the percentage of the load was the demand load. The study will look at the loads under 30%, 50%, 70%, and 100% of the design load. The feeders to the generators and emergency branches were not considered as they will not operate on normal/emergency power. Also, an assumption that the data center double-ended substation will operate on the utility for this study was made.

Next, the voltage drop was computed using the Siemens Voltage Drop Calculator provided by Professor Dannerth. In order to find the energy loss from each feeder, the calculated voltage drop, load for each feeder (Amps), and the number of hours in a year were multiplied to find the kilowatt-hours for each feeder. As stated before, the loads were assumed to run 24 hours a day and 365 days a year. In order to find the annual cost of energy lost, the utility rate, along with the kWh found above were multiplied.

The following are the utility rates provided by Pennsylvania Power and Light. Note that the rates are estimates based on PPL data and therefore demand rates are unknown.

Distribution Rate for Primary Service: $0.0043/kWh

Generation: $0.097/kWh

Transmission: $0.0041

The feeder sizes were increased by one and two sizes and the results were analyzed. The results were compared based on the wire size and demand load.

The following is a summary of the results with the calculations in Appendix E

Results

Excluding utility

COST ANALYSIS AT 30% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	26557.54	19195.95	14200.09
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	7361.59	12357.45
TOTAL INITIAL COST ($)	291114.24	346338.80	371937.63
TOTAL INITIAL COST INCREASE ($)	0.00	55224.56	25598.83
SIMPLE PAYBACK PERIOD (YEARS)	N/A	7.50	2.07

COST ANALYSIS AT 50% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	44262.57	36864.99	31993.25
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	7397.58	12269.32
TOTAL INITIAL COST ($)	291114.24	346338.80	371937.63
TOTAL INITIAL COST INCREASE ($)	0.00	55224.56	80823.39
SIMPLE PAYBACK PERIOD (YEARS)	N/A	7.47	6.59

COST ANALYSIS AT 70% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	61967.59	51610.99	44790.54
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	10356.60	17177.05
TOTAL INITIAL COST ($)	291114.24	346338.80	371937.63
TOTAL INITIAL COST INCREASE ($)	0.00	55224.56	80823.39
SIMPLE PAYBACK PERIOD (YEARS)	N/A	5.33	4.71

Only Utility

COST ANALYSIS AT 30% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	14967.35	12848.07	10463.89
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	2119.28	4503.46
TOTAL INITIAL COST ($)	55700.00	73900.00	89800.00
TOTAL INITIAL COST INCREASE ($)	0.00	18200.00	34100.00
SIMPLE PAYBACK PERIOD (YEARS)	N/A	8.59	7.57

COST ANALYSIS AT 50% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	24945.57	21413.46	17439.82
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	3532.11	7505.75
TOTAL INITIAL COST ($)	55700.00	73900.00	89800.00
TOTAL INITIAL COST INCREASE ($)	0.00	18200.00	34100.00
SIMPLE PAYBACK PERIOD (YEARS)	N/A	5.15	4.54

COST ANALYSIS AT 70% DEMAND LOAD - EXISTING VS NEW WIRE SIZE			
	EXISTING WIRE SIZE	1 SIZE INCREASE	2 SIZE INCREASE
TOTAL COST OF ENERGY LOSS PER YEAR ($)	34923.80	29978.83	24415.75
TOTAL COST SAVINGS IN ENERGY PER YEAR ($)	0.00	4944.97	10508.05
TOTAL INITIAL COST ($)	55700.00	73900.00	89800.00
TOTAL INITIAL COST INCREASE ($)	0.00	18200.00	34100.00
SIMPLE PAYBACK PERIOD (YEARS)	N/A	3.68	3.25

Analysis of Results

The total cost is the sum of both the conduit and conductor cost, while the total cost savings per year is the difference between the existing wire total cost of energy loss per year and the each larger wire total cost of energy loss per year. This shows that as the wire size increases, the total cost saving in energy per year increases. Despite this advantage, the increase in cost as the wire size increases must be considered. In order to determine if increasing the size of the wires is beneficial, a payback period was determined. The payback period was determined by dividing the total initial cost per linear foot by the total energy savings per year. The calculations determined that the payback period decreases as the wire size increases. Therefore, it would be economical to increase the wire size by at least one size. The further the wire size is increased, the more economical the investment.

The findings also show that as the demand load increases, the cost savings increases. For example, with one size wire increase, the difference between the 30% demand load and 50% demand load cost savings in energy per year is negligible, but if the load were 70% demand, the cost savings in energy per year is much more. If purely the data center, which is 100% of the load were to increase the wire sizes, the payback period would be very small with large cost savings.

In the case of the utility wire only, the payback period again decreases with increases in wire size with the shortest payback period being with 70% demand load. I increased the wire size and kept the number of sets constant, but if the sets were to increase, the energy loss does not decrease. This is an interesting result, which led me to increase the wire size rather than the number of sets.

Overall, increasing the wire size is economically beneficial and therefore should be considered, especially for the data center where the load is 100%.

Electrical Depth 2 | Photovoltaic Array

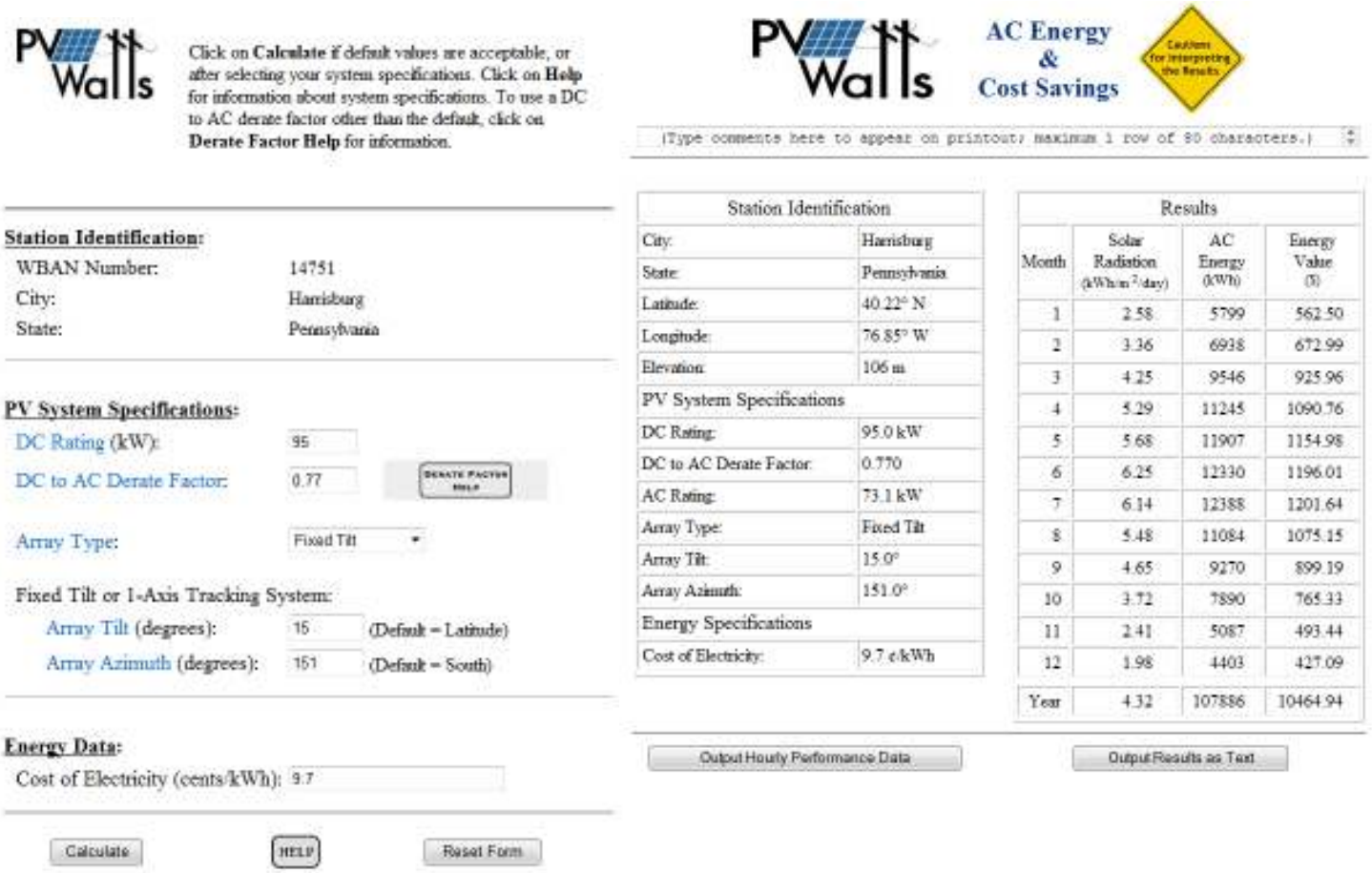
Introduction

In order to maximize the green footprint of the PSECU Corporate Headquarters, a solar photovoltaic array was designed for the building. The study determines if the initial cost of the photovoltaic system is outweighed by the payback and cost savings.

System Advisor Model was used to calculate the system capacity and cost. Utility rates and payment incentives were input in order to find a payback period. Hand calculations were performed to size the wires to the Panelboard.

Method

The Pennsylvania State Employees Credit Union Corporate Headquarters is located in Harrisburg, PA. The photovoltaic array is to be located on the roof and is south facing. The azimuth for PV Watts is 151 degrees and the azimuth for System Advisor Model is 29 degrees. The array will be tilted 15 degrees. The estimated area to be covered by the array on the roof is 9500 square feet. In the schematic phase of design the total kilowatts produced by the system can be estimated through 9500 sq.ft/(100kW/sq ft) = 950kW. This data was input into PV Watts in order to find a rough estimate of the energy produced and cost savings of the system.



PVWatts

Click on **Calculate** if default values are acceptable, or after selecting your system specifications. Click on **Help** for information about system specifications. To use a DC to AC derate factor other than the default, click on **Derate Factor Help** for information.

Station Identification:

WBAN Number:	14751
City:	Harrisburg
State:	Pennsylvania

PV System Specifications:

DC Rating (kW):	95
DC to AC Derate Factor:	0.77
Array Type:	Fixed Tilt

Fixed Tilt or 1-Axis Tracking System:

Array Tilt (degrees):	15	(Default = Latitude)
Array Azimuth (degrees):	151	(Default = South)

Energy Data:

Cost of Electricity (cents/kWh): 9.7

Calculate HELP Reset Form

PVWatts — AC Energy & Cost Savings

(Type comments here to appear on printout; maximum 1 row of 80 characters.)

Station Identification	
City:	Harrisburg
State:	Pennsylvania
Latitude:	40.22° N
Longitude:	76.85° W
Elevation:	106 m
PV System Specifications	
DC Rating:	95.0 kW
DC to AC Derate Factor:	0.770
AC Rating:	73.1 kW
Array Type:	Fixed Tilt
Array Tilt:	15.0°
Array Azimuth:	151.0°
Energy Specifications	
Cost of Electricity:	9.7 ¢/kWh

Results

Month	Solar Radiation (kWh/m²/day)	AC Energy (kWh)	Energy Value ($)
1	2.58	5799	562.50
2	3.36	6938	672.99
3	4.25	9546	925.96
4	5.29	11245	1090.76
5	5.68	11907	1154.98
6	6.25	12330	1196.01
7	6.14	12388	1201.64
8	5.48	11084	1075.15
9	4.65	9270	899.19
10	3.72	7890	765.33
11	2.41	5087	493.44
12	1.98	4403	427.09
Year	4.32	107886	10464.94

Output Hourly Performance Data Output Results as Text

PV Watts predicts that the system will produce 107,886 kWh of energy and will have a cost savings of $10,464.94.

Next, the module was selected, which is the SunPower 230 E18 series solar panel. This panel was selected due to the high efficiency. The inverter selected was Fronius IG Plus 10.0-1 UNI PV Inverter. The data from the module and inverter cut sheets were input into the worksheet and the number of modules per string and number of strings was found. The following table outlines how the feasibility of the system was determined:

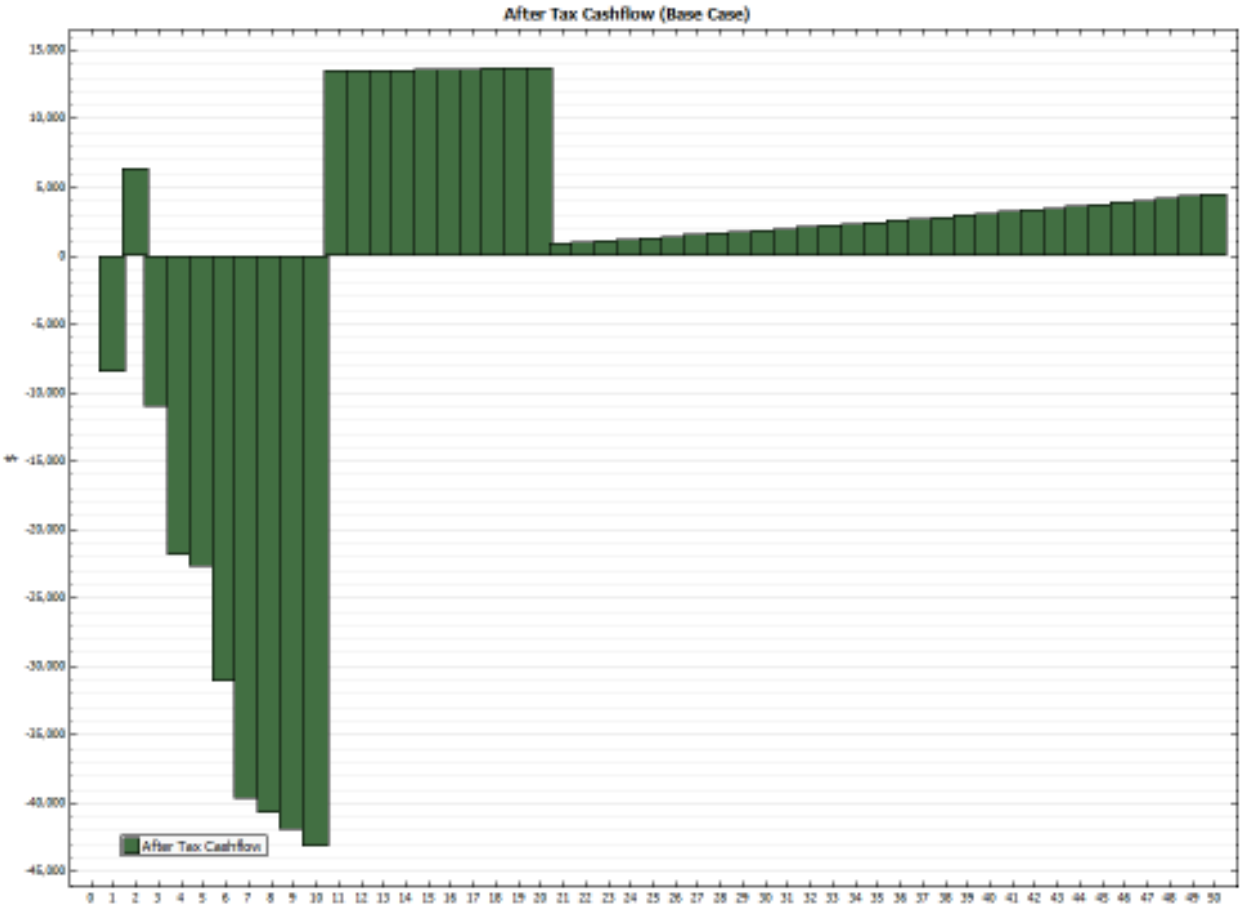
Location Inputs		
Min Temp	-21	°C
Max Temp	30	°C
Roof	30	°C
Array Size	19110	W
Max Roof Temp	**60**	**°C**
Sunpower 230		
Pmax	230	W
Vmpp	40.5	V
Impp	5.68	A
Voc	48.2	V
ISC	3.5	A
Temp Coeff	-0.38	%/°K
Pronius IG Plus 6.0		
PV Array	5100-6900	W
MPPT Min Voltage	230	V
Max Voltage	600	V
OUTPUTS		
Solon Black XT 290 Wp		
Modules Per String	10	
Number of Strings	38	
Number of Panles	380	
Array Rated Power	87400	W
Max Voltage	56.625	V
High Temp V	35.114	V
Array Output Voltage		
Max Voltage	566.2536	OK
High Temp V	292.6125	OK

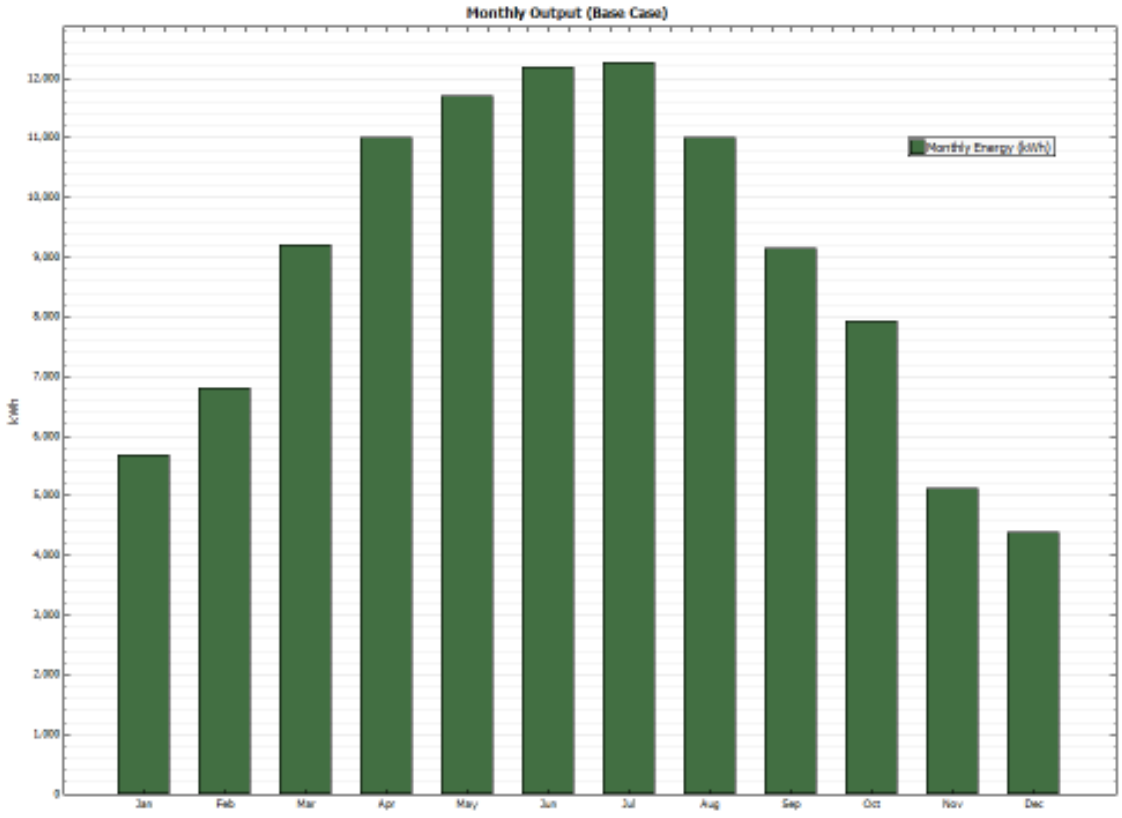
The next step was to perform an in-depth analysis of the system in order to find the system cost and energy produced, along with a payback period. As a nonprofit firm, incentives do not apply to the system. I therefore did two analyses, which include one with PSECU paying for the system and therefore using Solar Renewable Energy Credits (SRECs) to help pay for the system and another with an 'angel donor' who would donate the system after it was paid off. The 'angel donor' would qualify for incentives and therefore the system would more easily be paid off.

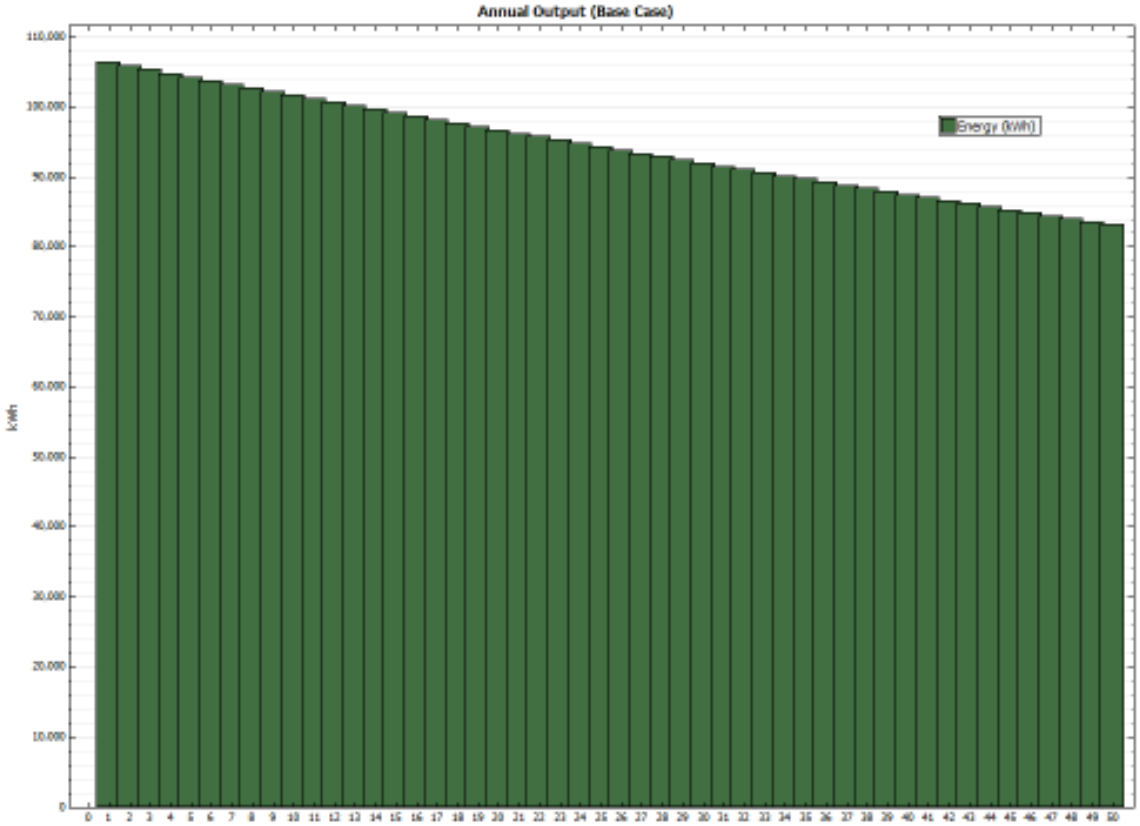
First Method

The first analysis was PSECU paying for the system. I assumed the SREC value is $200/kWh and the period for receiving SRECs at this rate is 20 years. The utility rate was assumed to be $0.097/kWh, the climate is Harrisburg, PA, the analysis period is 50 years with a 10 year 7.75%/year loan. The module and inverter information was input in order to find the most accurate results. The following are the results from System Advisor Model:

Summary of Photovoltaic System	
Total System Capacity	87.4824kW
Total Direct Cost	$351,958.25
Total Installed Cost per Capacity	$4,504.58/kW
Net Annual Energy	106,410kWh
LCOE Nominal	$0.1698/kWh
LCOE Real	$0.1216/kWh
First Year Revenue with System	$10,321.76
Payback Period	19.524 years
Total Land Area	0.29 acres




Monthly Output (Base Case)
kWh
Monthly Energy (kWh)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Annual Output (Base Case)
kWh
Energy (kWh)

Analysis of First Method

With a payback period of 19 years, the system may not be a realistic solution because it the system typically lasts 20 years before repairs and replacement is needed for components of the system. The after 5tax cashflow graph shows how the system costs more than it produces for 10 years and then has an increase in cost savings due to the Solar Renewable Energy Credits. The monthly output graph shows how the system produces more energy in the summer than the winter months and the annual output graph shows how the system degrades through a period of 50 years. This excludes replacement of components.

Second Method

The second analysis was with an angel donor. The donor would pay for the system and donate it after it was paid off. PSECU would benefit from the cost savings, but it would not belong to them until the donor donates it to the firm. This would allow PSECU to benefit from the Pennsylvania Sunshine Solar Rebate Program. SRECs would also be applied for additional incentives. The following are the results from the analysis:

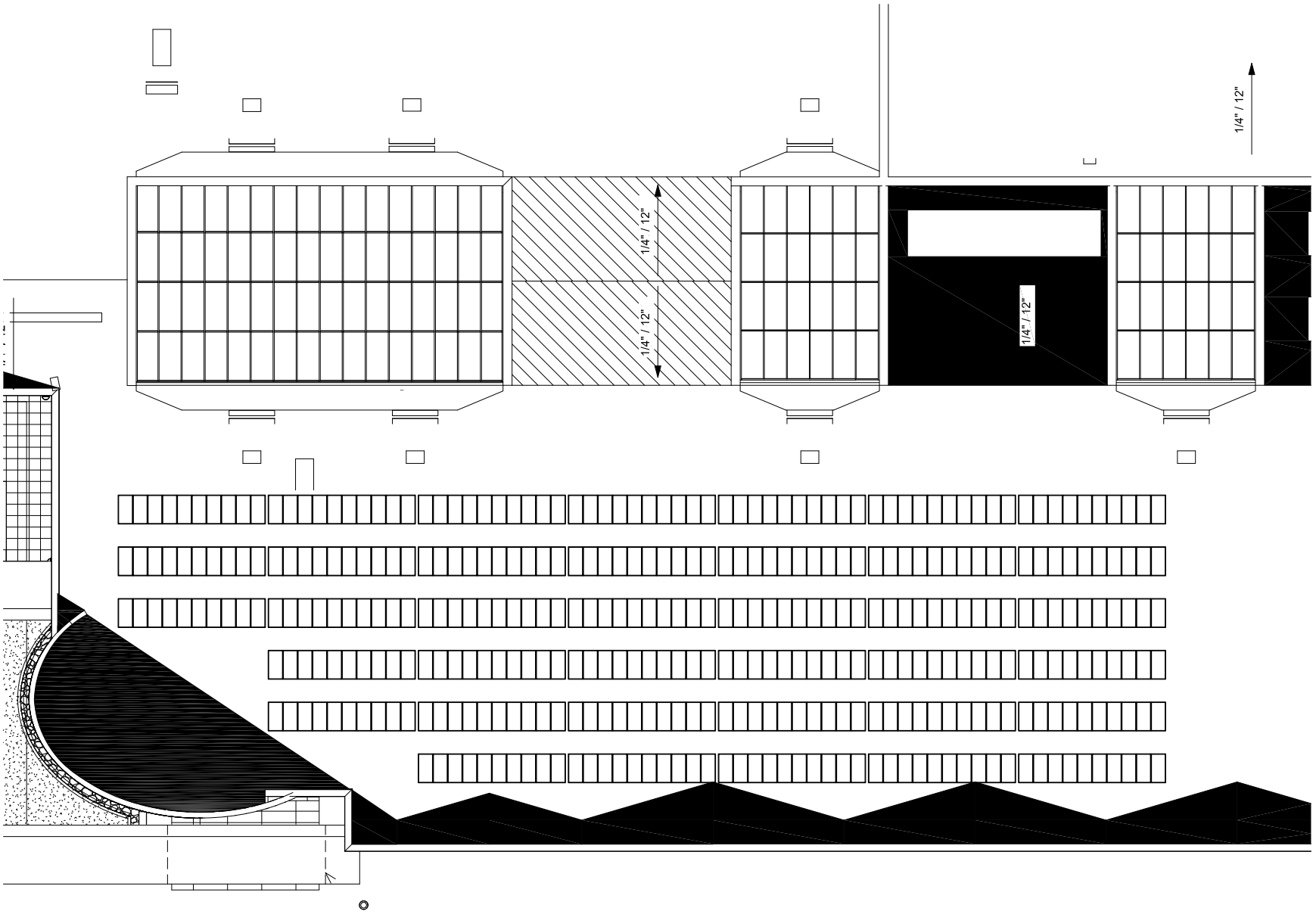
Summary of Photovoltaic System	
Total System Capacity	87.4824kW
Total Direct Cost	$351,958.25
Total Installed Cost per Capacity	$394,071.53
Net Annual Energy	106,410kWh
LCOE Nominal	$0.1262/kWh
LCOE Real	$0.0904/kWh
First Year Revenue with System	$10,321.76
Payback Period	14.97 years
Total Land Area	0.29 acres

Analysis of Second Method

With a payback period of 14 years, this method is a more realistic solution. The system has the same energy production as the first method. The nominal levelized cost of energy and real levelized cost of energy are lower, which means that the cost per unit of energy is lower. This allows for the project to be paid off more quickly.

Photovoltaic Layout

See Appendix H



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
1/16" = 1'

ISSUE DATE:
04/04/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
PHOTOVOLTAIC MODULE
ROOF PLAN LAYOUT

SHEET TITLE:

Wire Sizing Calculations

Assumptions:
Wire size is USE-2 at 90 °C because it has heat and moisture resistant insulation
Inverter operates at 277V
Maximum usable Current for Inverter = 28.1A

Isc = 6.05 A
Add 25% Safety Factor and 25% for wires and fuses as a good engineering practice

Maximum Wire Amps for 1 string = 1.25 x 1.25 x 6.05 = 9.46A
Maximum Wire Amps for 2 string = 9.46A x 2 = 18.91 A

NEC 2008 Table 310.15B
Conduit is mounted 1/2" to 3-1/2" above roof
Ambient Temperature Adjustment = 22°C
Maximum Module Temperature = 45°C
Maximum Temperature = 67 °C

NEC 2008 Table 310.16
Correction Factor = 0.58

Red and White Insulation Wires from Single String to Combiner Box:
25A x 0.58 = 14.5A which is greater than 9.46A, therefore wire size is #14 AWG

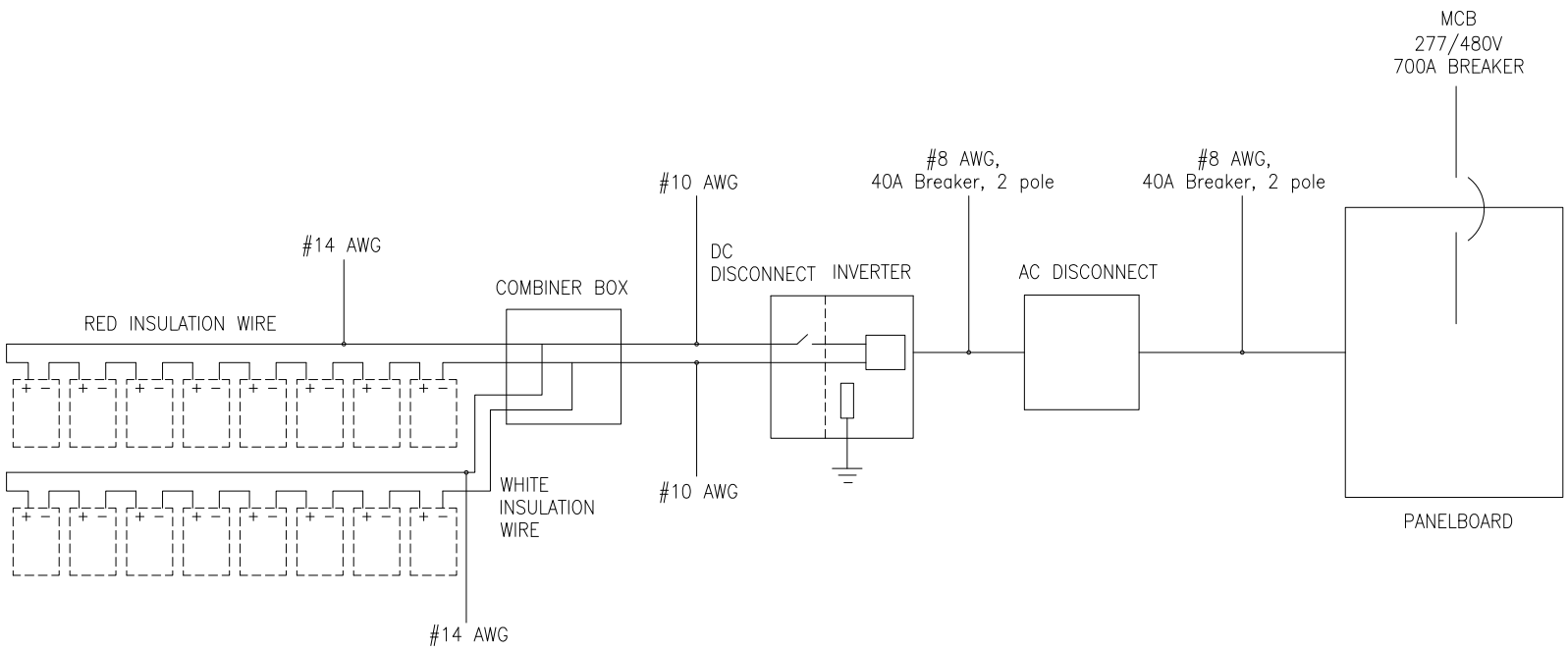
From Combiner Box to Inverter
40A x 0.58 = 23.2A which is greater than 18.91A, therefore wire size is #10 AWG

From Inverter to AC Disconnect
28.1A x 1.25 = 25.125A, therefore breaker size is 40A, 2 pole and wire size is #8AWG

From AC Disconnect to Panelboard
Use #8AWG and 40A 2 pole breaker

Panelboard has 19 photovoltaic loads
Size of Panelboard = 35.125 x 19 = 667.375A, therefore use 700A 2 pole breaker or 2 panelboards at 350A 2 pole and 300A 2 pole breakers

Typical Wiring Diagram



TYPICAL FOR 19 STRINGS IN PARALLEL

PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS

ADDRESS:
HARRISBURG, PA

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NOT TO SCALE

ISSUE:
03/26/2012

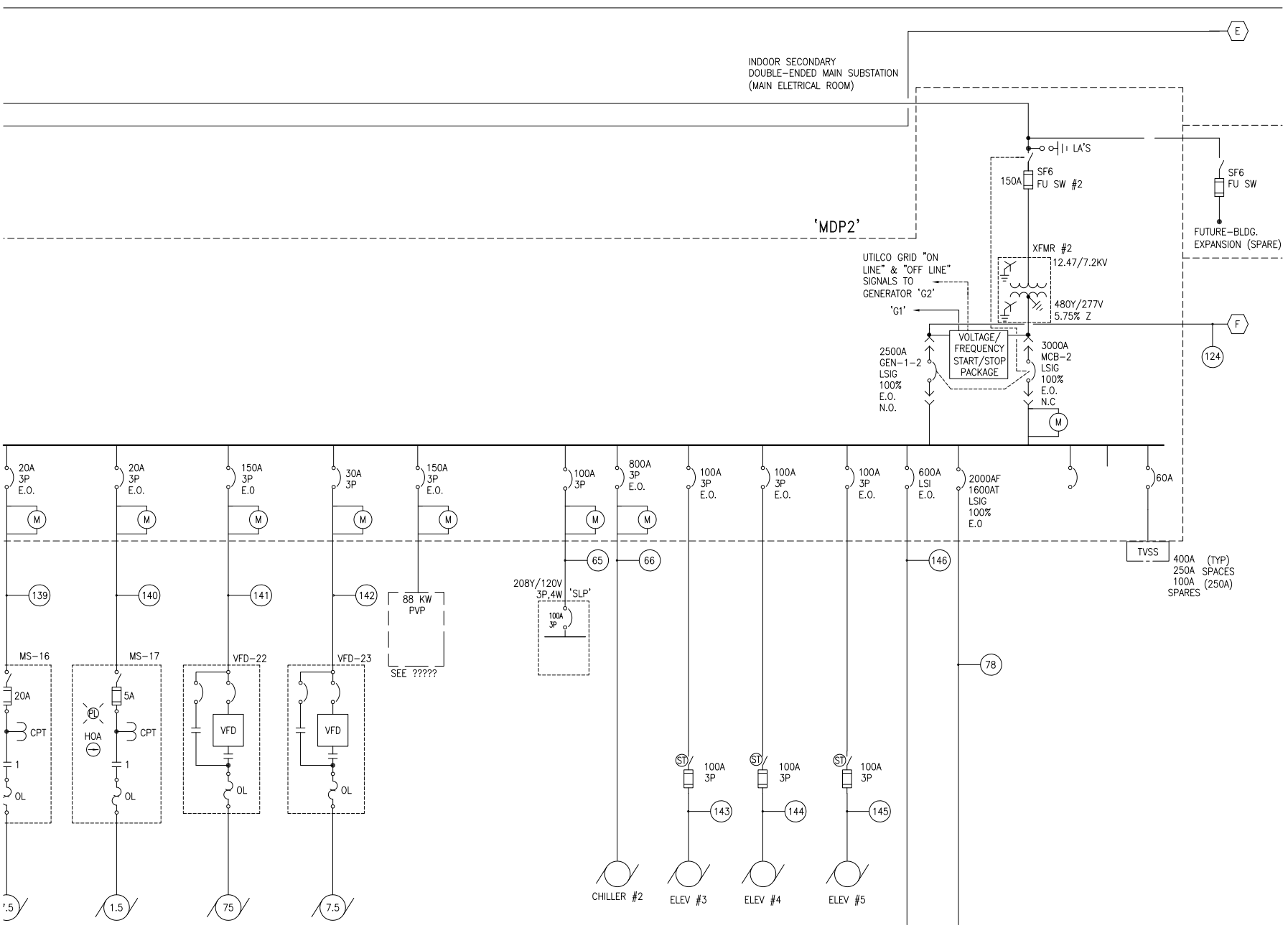
DRAWN BY:
SARAH WUJCIK

TYPICAL PHOTOVOLTAIC ARRAY LAYOUT

SHEET TITLE:

Single-Line Diagram

The 88kW solar photovoltaic panel load is connected to panelboard PVP. Panelboard PVP connects to Switchboard MDP2, which connects directly to the utility. MDP2 is a double-ended main substation.



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HARRISBURG, PA

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ISSUE:
04/04/2012

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SARAH WUJCIK

PHOTOVOLTAIC PANELBOARD SINGLE-LINE

SHEET TITLE:

Cutsheets

See Appendix H

Analysis

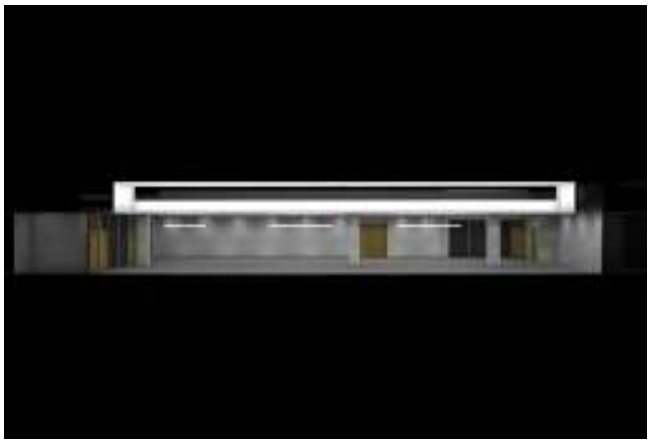
With a payback period of 14.97 years, the 'angel donor' would be the best situation for funding a photovoltaic array for the PSECU Corporate Headquarters. As this is may be unrealistic for the PSECU, a payback period of 19.5 years is assumed to be the most accurate. Due to a photovoltaic system lasting approximately 20 years before performance declines and repairs and replacement for components are necessary, a photovoltaic array is not the most profitable solution in terms of monetary value. Despite this, it is a practical solution as a LEED Gold building to reduce energy consumption from the utility. Additionally, more panels could be added to the surrounding grounds to increase the energy produced and possibly decrease the payback period.

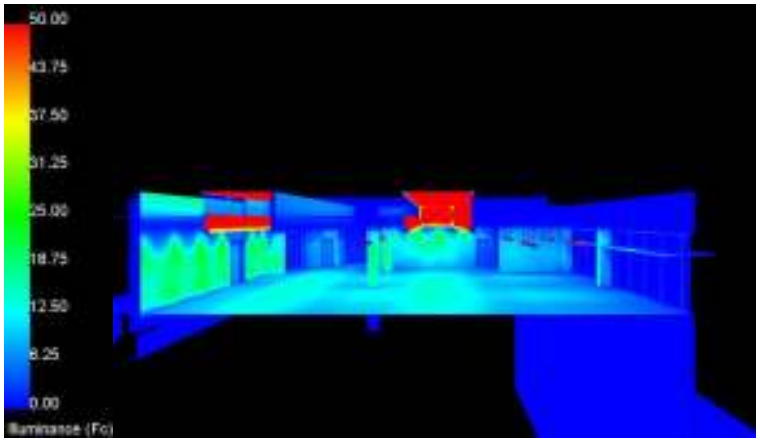
M.A.E. Focus | Daylighting Analysis

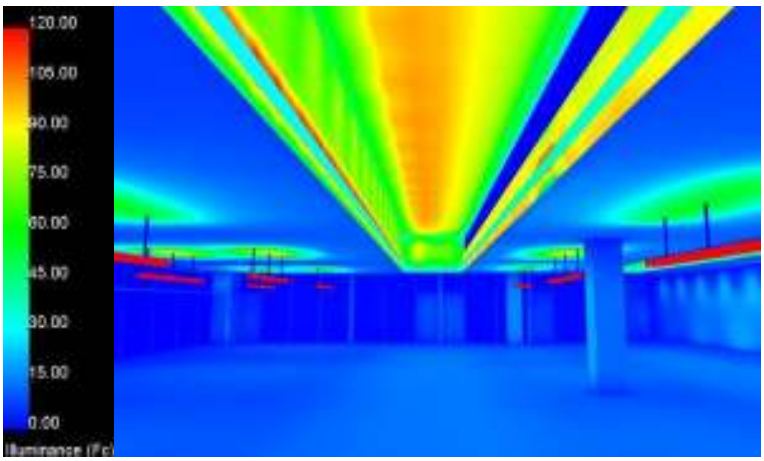
Introduction

As a result of the addition of the north facing clearstories to the marketing open office, a daylighting analysis was performed. A glare study was completed using Radiance and a shade analysis was completed using Daysim. The first study looked at the space and calculated the percentage of illuminance values above 1000 lux in order to find the number of hours each year that the shades will be down. A successful design means the shades will be down only 250 hours each year. The marketing open office was compared to this value to measure the success of the daylighting design. The second study was a glare analysis in which the marketing open office was compared with and without the shades during the winter and summer solstices.

The marketing open office has a ten foot high ceiling with indirect direct lighting, along with indirect lighting at the ceiling penetrations. The south facing curtain wall runs 72 feet long and the space is 65 feet deep. The space currently has an overhang and lightshelf. The designs of each of these elements were analyzed in order to maximize daylight penetration and protect the space from harsh sun angles. The walls are off white with a reflectance of 85%, the floor is carpeted with a reflectance of 35%, and the ceiling is acoustical ceiling tile with a reflectance of 85%. Cubicles with glass partitions are the only furniture in the space. Automated roller blinds line the curtain wall with an openness of 1% and a reflectance of 50%. The glazing is Solarban 70XL Solargray Solar Control Low-E Glass with a visible transmittance of 32%, reflectance of 15%, solar heat gain coefficient of 0.24 and a light to solar gain ratio of 1.34. The original glass specified was a Solarban 60. In order to improve the solar heat gain and light to solar gain ratio, I selected a Solarban 70XL glass specified by the architect. Below are renderings of the space.



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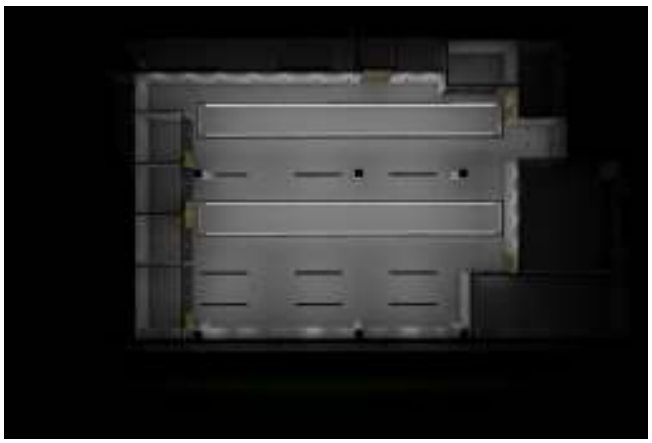
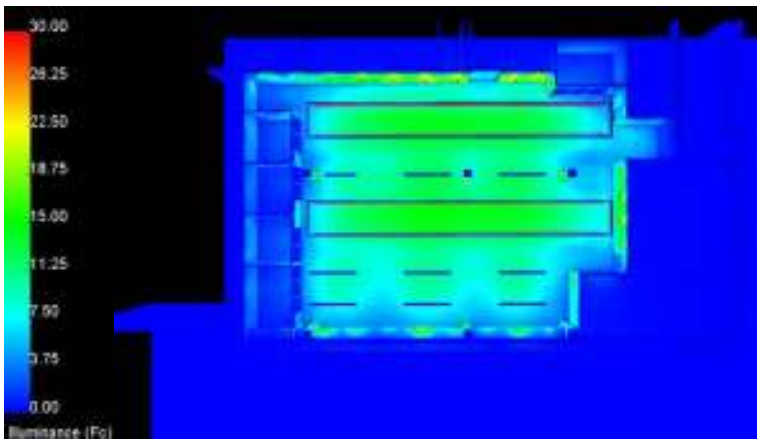
75.00
60.00
45.00
30.00
15.00
0.00

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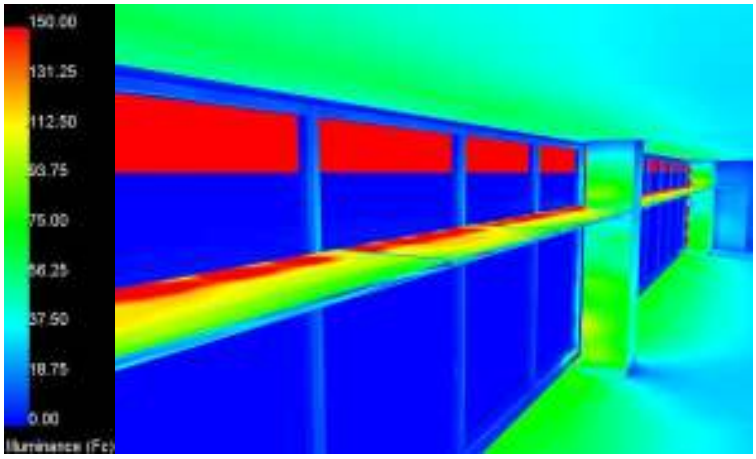
11.25
7.50
3.75
0.00

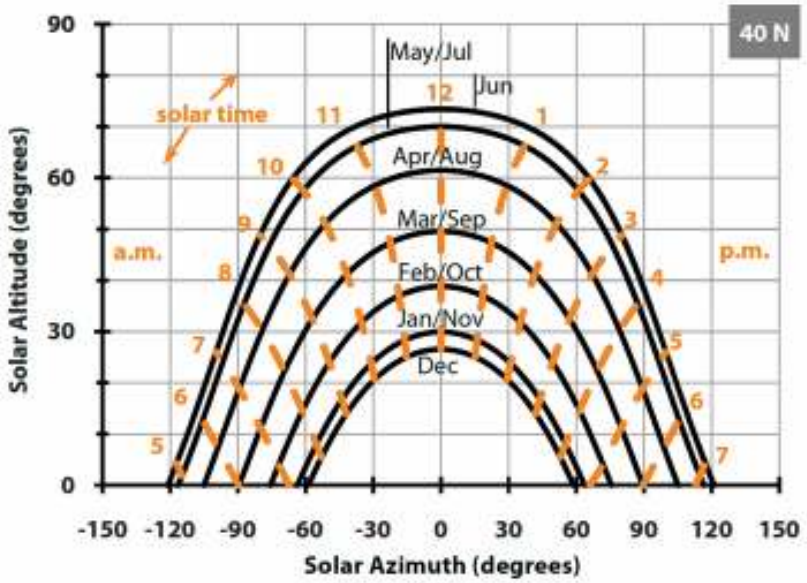

150.00
131.25
112.50
93.75
75.00
56.25
37.50
18.75
0.00

Method

The clearstory glazing selected was Solarban60 Solargray Solar Control Low-E Glass. The visible transmittance is 35% with a visible reflectance of 7%. The solar heat gain coefficient is 0.28 and the light to solar heat gain ratio is 1.26. This glass type was selected because the clearstories are north facing and thus do not need the very high performing glass that is specified for the south facing locations. Solargray was selected because it was one of the types specified by the architect. Solarban 60 was also specified in order to have good solar heat gain coefficient properties in order to not drastically increase the heating and cooling loads of the marketing open office. The mechanical depth determined if the heating and cooling loads needed to be resized.

The model was built in AutoCAD and imported into Daysim through material and geometry .rad files. The model was analyzed utilizing no shading in order to find the illuminance values across the workplane. The number of bounces was set to zero in order to only use direct light. The commands gen_dc and ds_illum were utilized to remove the bounce light and create a file with only direct sunlight. The file was taken into excel where the number of hours a year with the shades down was calculated. Calculations found that the shades will be down for 407 hours of the year. According to the Illuminating Engineering Society, good daylighting design dictates that the maximum hours per year with the shades down should be 250. Therefore, the marketing open office is receiving too much daylight and thus the space should be redesigned with a smaller amount of glazing at the south facing curtain wall to reduce harsh daylight conditions.

As the overhang and lightshelf manufacturers and materials were specified, but not the design, I calculated the lengths of the overhang and lightshelf in order to maximize daylight penetration while minimizing direct daylighting.



Designing for the overhang to protect the space for 8 months of the year, the solar altitude for 40 degrees latitude is 70 degrees. The maximum angle to design the overhang for is 70 degrees. The curtain wall is 10 feet tall with the overhang at 8 feet above finished floor. In calculating the length of the overhang to protect the lower section of glazing from direct sunlight, the length is greater than is feasible for the design. Therefore, shading is necessary to protect the space from direct daylight penetration. In calculating the

length of the overhang and lightshelf due to the upper section of glazing, the length must be greater than 5.5 feet. The length of the overhang and lightshelf were both determined to be 3 feet with a total length of 6 feet. This is due to the manufacturer's set lengths.

In order to determine the glare source and the magnitude of the glare source from particular locations in the space, Radiance was utilized. The space was modeled in AutoCAD and converted into a rad file, along with the materials. A bat file was created that included the view positions and directions.

```
PATH = y:\AE565\RADIANCE\BIN\
SET RAYPATH = y:\AE565\RADIANCE\LIB

GENSKY 12 21 12:00 +s -a 40.22 -o 76.85 -m 75 > skysum.rad

OCONV skysum.rad skygl.rad material.rad room.rad > decrun1.oct
rpict -vp 420 300 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt decrun1.oct > decrun1.pic
pfilt -e -2 decrun1.pic > decrun12.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > decrun2.oct
rpict -vp 420 300 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt decrun2.oct > decrun2.pic
pfilt -e -2 decrun2.pic > decrun22.pic

OCONV skysum.rad skygl.rad material.rad room.rad > decrun11.oct
rpict -vp 720 480 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt decrun11.oct > decrun11.pic
pfilt -e -2 decrun11.pic > decrun112.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > decrun22.oct
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pfilt -e -2 decrun22.pic > decrun222.pic



OCONV skysum.rad skygl.rad material.rad room.rad > dec2run1.oct
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pfilt -e -2 dec2run1.pic > dec2run12.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > dec2run2.oct
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pfilt -e -2 dec2run2.pic > dec2run22.pic

OCONV skysum.rad skygl.rad material.rad room.rad > dec2run11.oct
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OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > dec2run22.oct
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rpict -vp 420 300 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt junerun1.oct > junerun1.pic
pfilt -e -2 junerun1.pic > junerun12.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > junerun2.oct
rpict -vp 420 300 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt junerun2.oct > junerun2.pic
pfilt -e -2 junerun2.pic > junerun22.pic


OCONV skysum.rad skygl.rad material.rad room.rad > junerun11.oct
rpict -vp 720 480 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt junerun11.oct > junerun11.pic
pfilt -e -2 junerun11.pic > junerun112.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > junerun22.oct
rpict -vp 720 480 48 -vd -1 -1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt junerun22.oct > junerun22.pic
pfilt -e -2 junerun22.pic > junerun222.pic



OCONV skysum.rad skygl.rad material.rad room.rad > june2run1.oct
rpict -vp 420 240 48 -vd 1 1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt june2run1.oct > june2run1.pic
pfilt -e -2 june2run1.pic > june2run12.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > june2run2.oct
rpict -vp 420 240 48 -vd 1 1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt june2run2.oct > june2run2.pic
pfilt -e -2 june2run2.pic > june2run22.pic


OCONV skysum.rad skygl.rad material.rad room.rad > june2run11.oct
rpict -vp 180 180 48 -vd 1 1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt june2run11.oct > june2run11.pic
pfilt -e -2 june2run11.pic > june2run112.pic

OCONV skysum.rad skygl.rad material.rad room.rad shade1.rad > june2run22.oct
rpict -vp 180 180 48 -vd 1 1 0 -x 800 -y 800 -vth -vv 180 -vh 180 @opt.opt june2run22.oct > june2run22.pic
pfilt -e -2 june2run22.pic > june2run222.pic
```
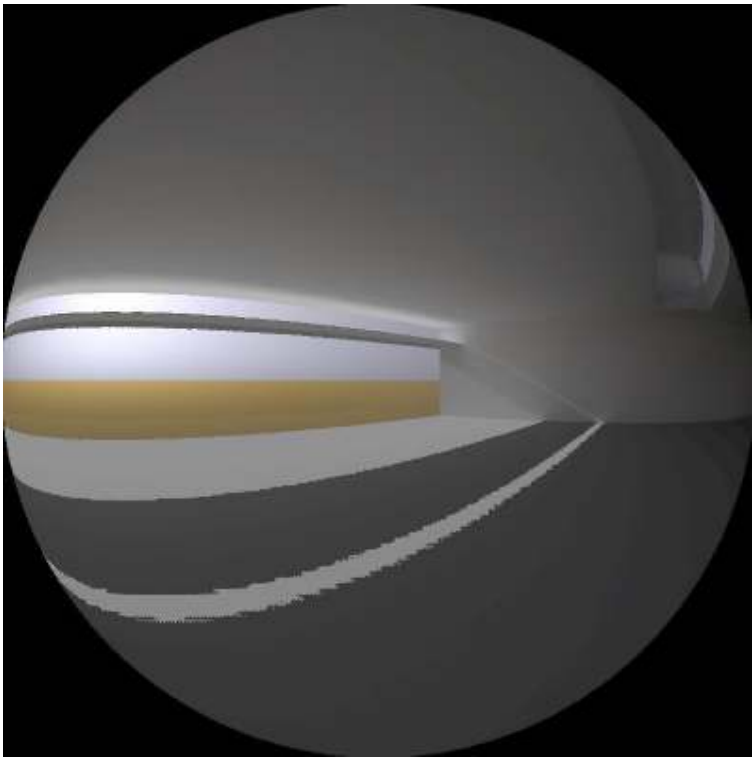

The material file is the following:

```
void plastic l_ceiling 0 0 5 0.870 0.870 0.870 0.0000 0.0000

void plastic l_ext_walls 0 0 5 0.20 0.20 0.20 0.0000 0.0000

void plastic l_floor 0 0 5 0.350 0.350 0.350 0.0000 0.0000

void glass l_glass 0 0 3 0.7630 0.7630 0.7630

void plastic l_ground 0 0 5 0.20 0.20 0.20 0.0000 0.0000

void plastic l_int_walls 0 0 5 0.850 0.850 0.850 0.0000 0.0000

void plastic l_lightshelf 0 0 5 0.70 0.70 0.70 0.0000 0.0000

void plastic l_roof 0 0 5 0.20 0.20 0.20 0.0000 0.0000

void glass l_skylight_glass 0 0 3 0.7630 0.7630 0.7630

void plastic l_skylight 0 0 5 0.850 0.850 0.850 0.0000 0.0000

void plastic l_overhang 0 0 5 0.60 0.60 0.60 0.0000 0.0000
```

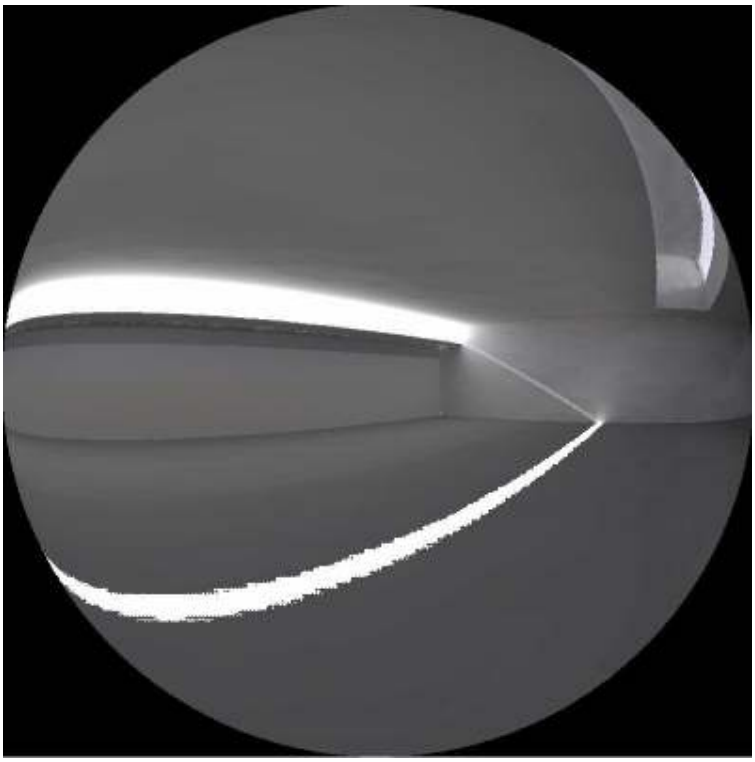
The bat file contains runs for using shades and not using shades on June 21st at 12:00 PM and December 21st at 12:00 PM. Two views facing the curtain wall and two views facing the clearstories were analyzed in order to determine how the glare source changed. The following are the resulting images:

December 21st 12:00 PM | Facing Curtain Wall

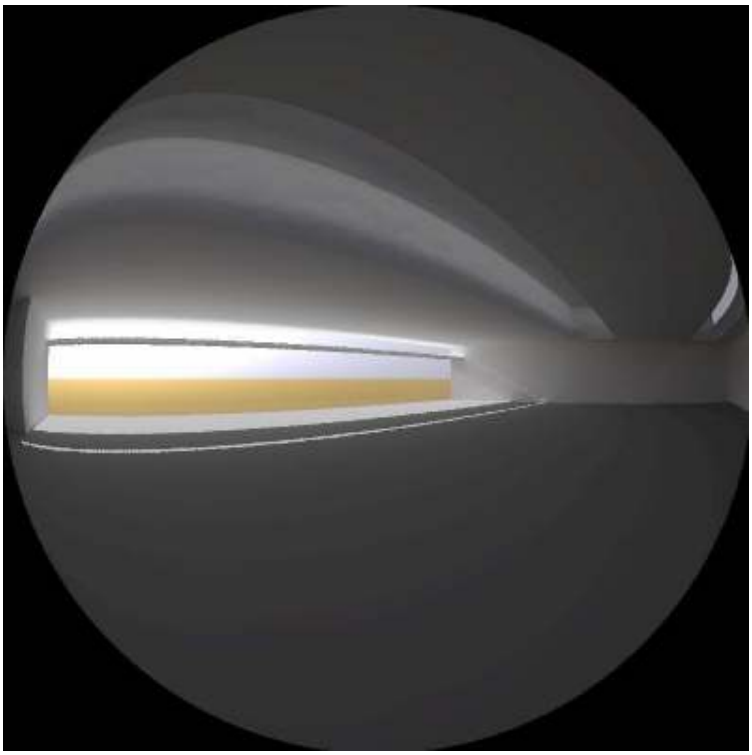
View Direction is (35', 25',4')



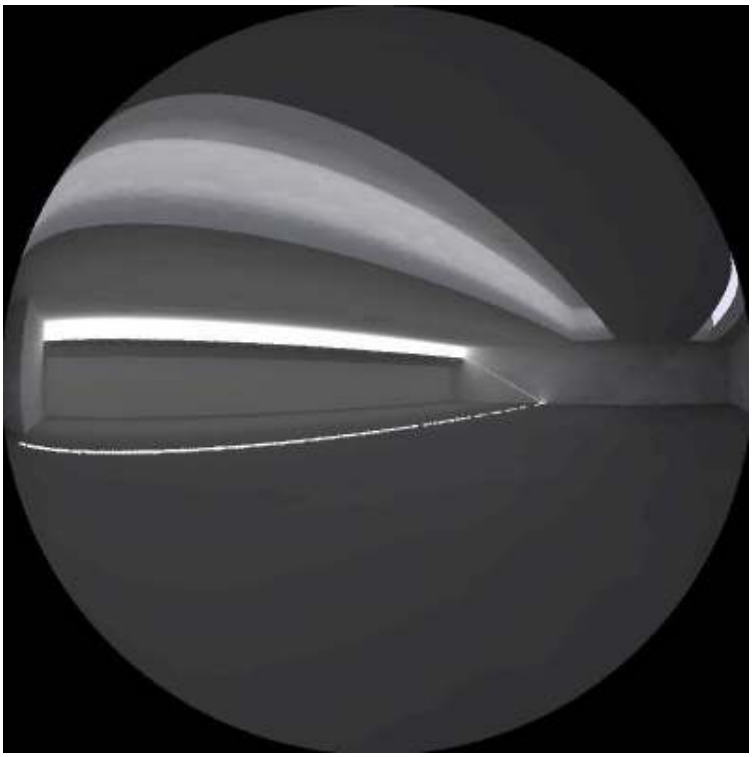
View Direction is (35', 25',4') | With Shading



View Direction is (60', 40',4')

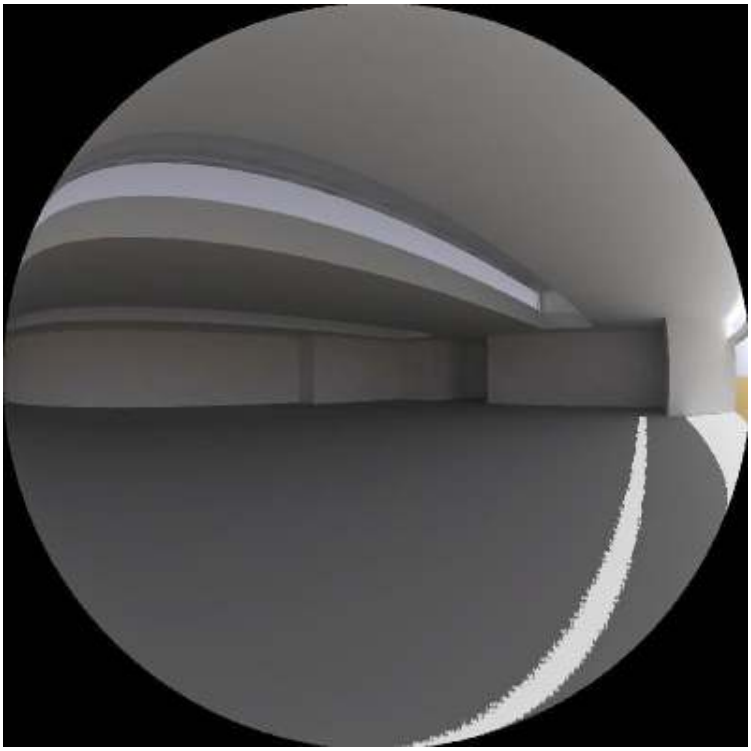


View Direction is (60', 40',4') | With Shading



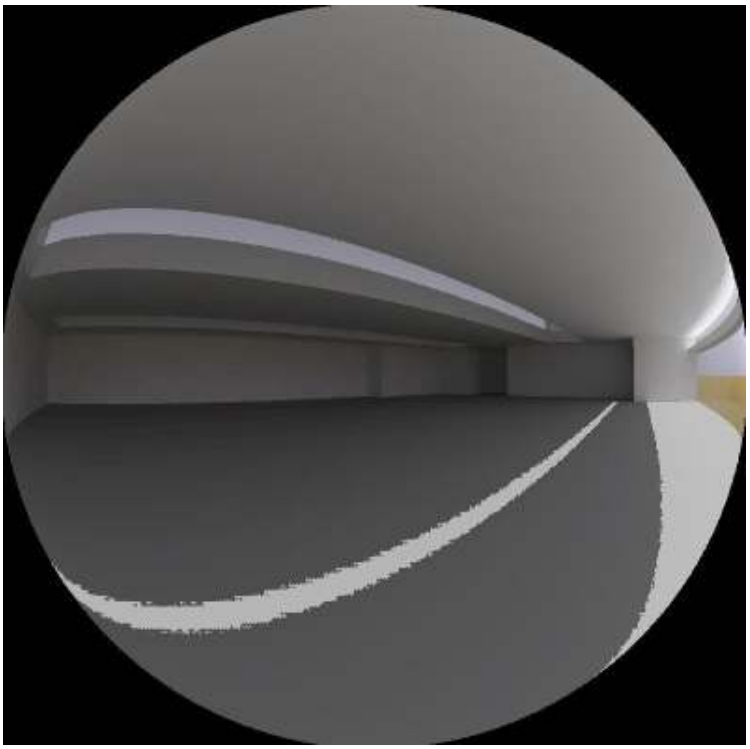
December 21st 12:00 PM | Facing Clearstories

View Direction is (35', 20',4')

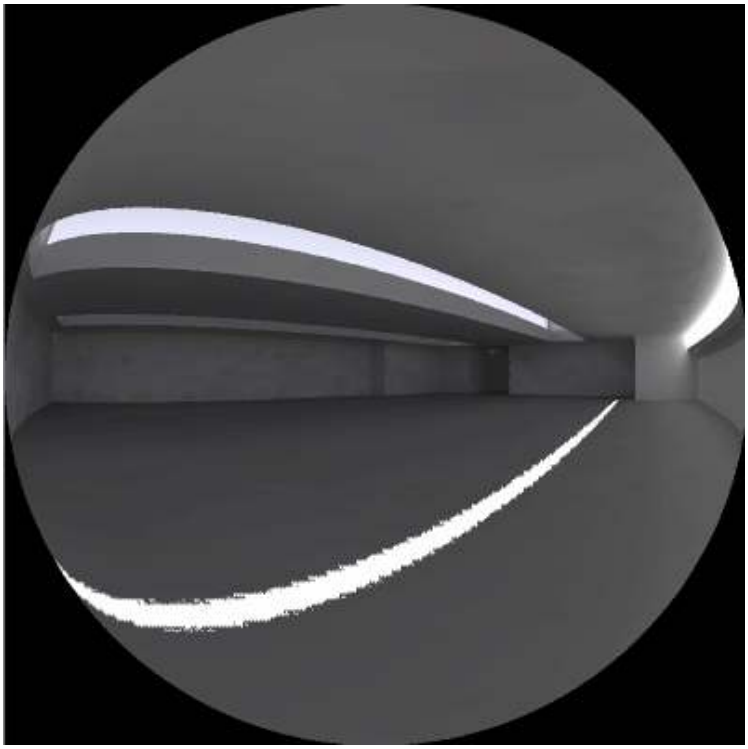


View Direction is (35', 20',4') | With Shading

View Direction is (15', 15',4')

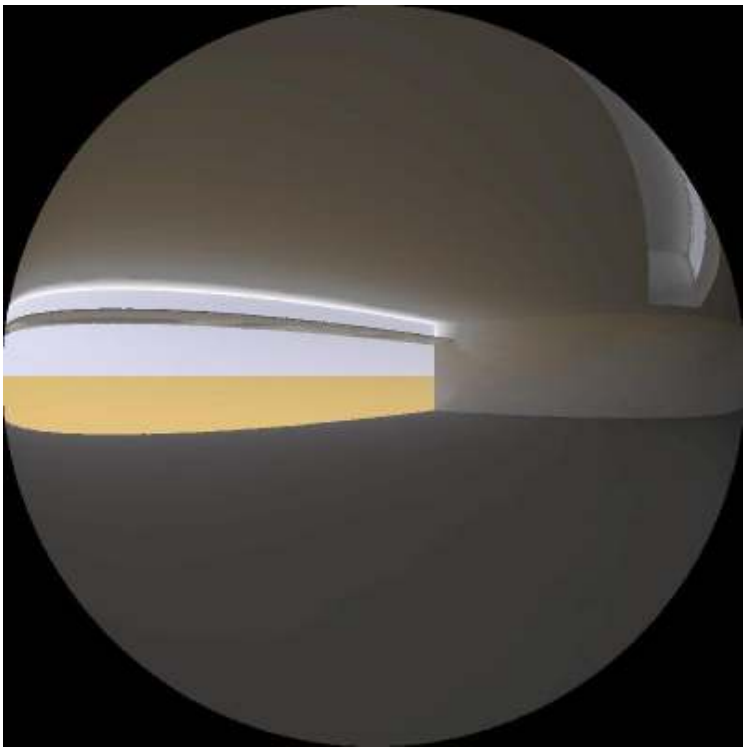


View Direction is (15', 15',4') | With Shading



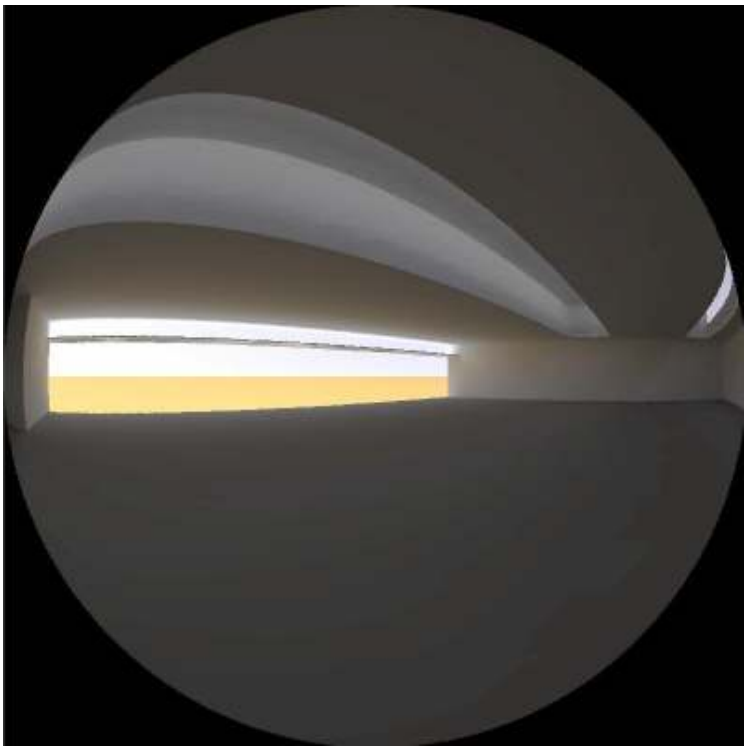
June 21st 12:00 PM | Facing Curtain Wall

View Direction is (35', 25',4')

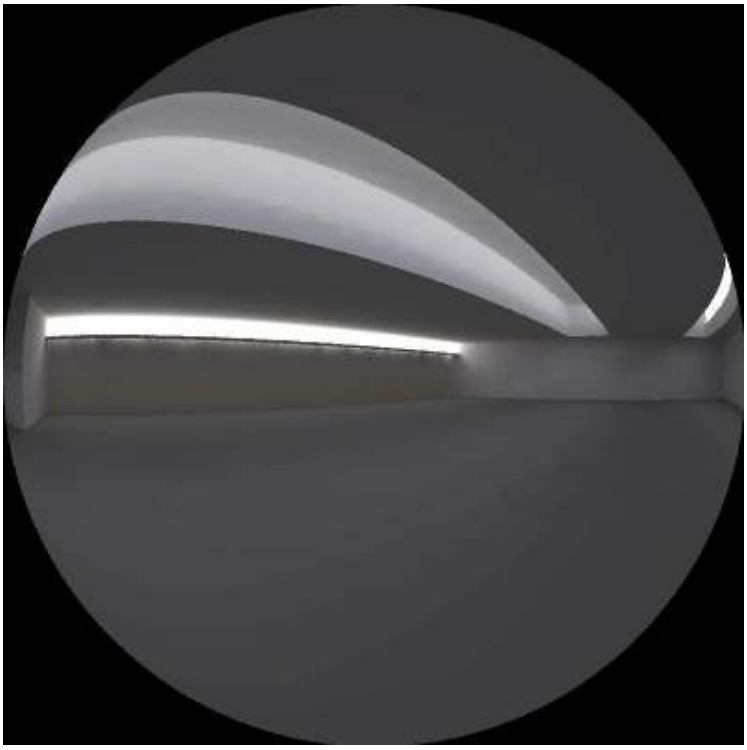


View Direction is (35', 25',4') | With Shading

View Direction is (60', 40',4')

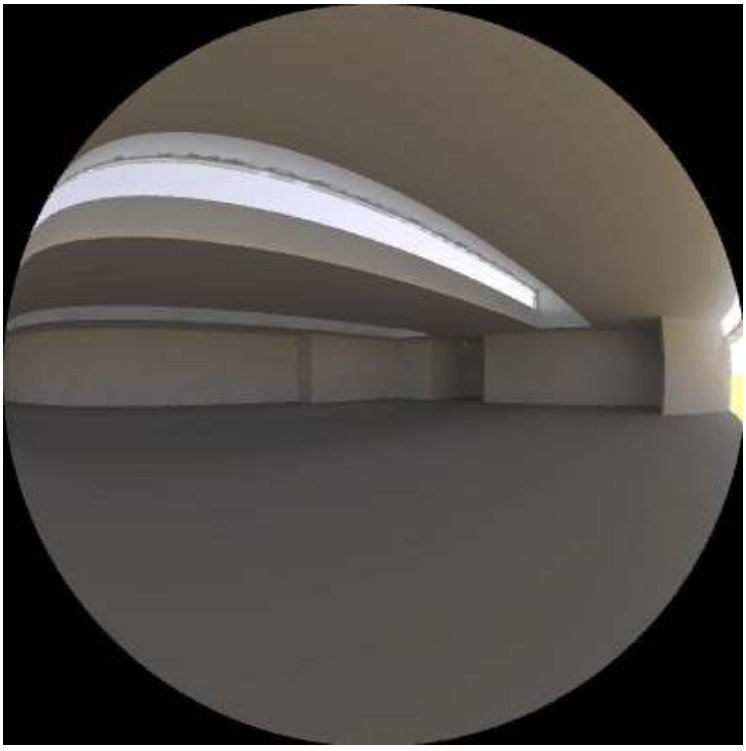


View Direction is (60', 40',4') | With Shading



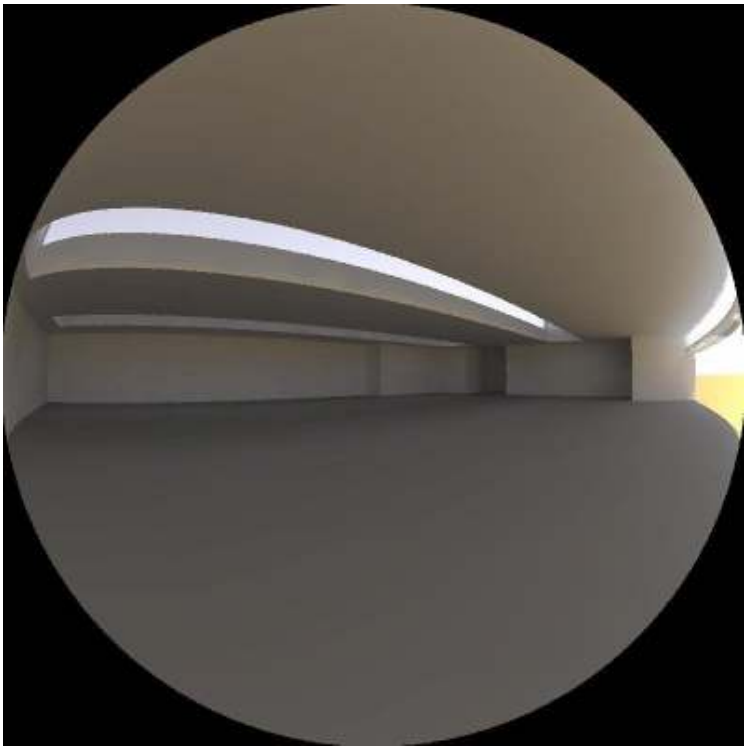
June 21st 12:00 PM | Facing Clearstories

View Direction is (35', 20',4')

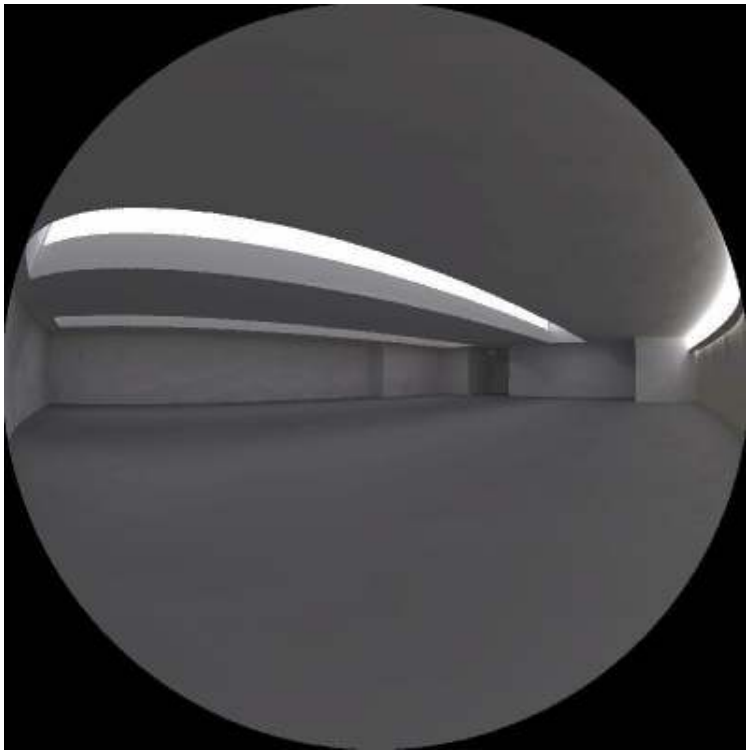


View Direction is (35', 20',4') | With Shading

View Direction is (15', 15',4')



View Direction is (15', 15',4') | With Shading



Next, the findglare command was performed in order to find the glare source, the solid angle of the glare source, and the luminance of the glare source. The following is the results of the findglare command:

	December 21st 12:00 PM							
	Facing Curtain Wall				Facing Clearstories			
	VD= (35',25',4')		VD=(60',40',4')		VD= (35',20',4')		VD=(15',15',4')	
	No Shading	Shading	No Shading	Shading	No Shading	Shading	No Shading	Shading
Solid Angle	6.084	6.086	6.096	6.0857	6.086	6.102	6.1125	6.102
Average Luminance	1277.2	231.76	644.8	231.767	459.337	214.65	674.1	214.6

	June 21st 12:00 PM							
	Facing Curtain Wall				Facing Clearstories			
	VD= (35',25',4')		VD=(60',40',4')		VD= (35',20',4')		VD=(15',15',4')	
	No Shading	Shading	No Shading	Shading	No Shading	Shading	No Shading	Shading
Solid Angle	6.084	6.09	6.085	6.091	6.09	6.09	6.1078	6.098
Average Luminance	590.43	163.28	390.71	163.29	252.3	120.21	283.581	120.213

Analysis

In comparing the statistics, the shading conditions have lower average luminance values at the glare source. While this was expected, the average luminance value changed as the view direction and location changed. Therefore, the calculation is based on the view direction and the perspective of the occupant. This is an important comparison as luminance is a measure of how the source appears to the eye. Despite the addition of the clearstories, the south facing glazing is the dominant glare source, even when the view direction is towards the clearstories.

In comparing the solid angle for each condition, the solid angle is constant. This is due to the angle of view staying constant across the conditions.

When comparing the images, the shade down condition appears brighter. This is due to the glazing above the lightshelf appearing brighter when the shades are down and the contrast between the upper and lower windows is greater. In actuality, the average luminance when the shades are up is much greater than the shade down conditions.

Overall, the analysis determined that the daylighting design needs to be readdressed due to the number of hours with the shades down. Solutions could be to add a fritting to the glazing and/or to reduce the height of the glazing by adding additional spandrel glazing.

The glare analysis found that the south facing curtain wall is the major glare source of the space, which will be addressed through shading. Also, when the shades are down, the north facing clearstories will add diffuse daylighting, which positively impacts the space due to daylighting creating a more comfortable work environment.

Breadth 1 | Mechanical

As a result of the addition of north facing clearstories in the open office, a mechanical analysis was performed in order to determine if the alterations in heating and cooling loads required an adjustment in the supply loads to the space. Please refer to the open office lighting redesign section for further clarification of the redesign.

Both Trace 700 and hand calculations were performed in order to estimate the loads. The hand calculations allowed for the data to be evaluated and compared in order to make a conclusion. The following details the method used and results found.

Method

The Pennsylvania State Employees Credit Union Corporate Headquarters is located in Harrisburg, PA. The space under question is the open marketing office that is located on the third floor of the building and is south facing. A glass curtain wall is the only exterior wall with the perimeter walls leading into small offices and the main corridor. Therefore, the interior walls are considered negligible. The height of the space is 10 feet. The roof of the building is 2 feet above the open office ceiling. Therefore the roof must be considered in the heating and cooling load calculations. The two clearstories also add additional square footage to the space and therefore add both skylight loads and roof loads to the calculations. The two increases in ceiling height run in the back and center of the space. The opening runs 75' long and 5' above the acoustical ceiling tile ceiling. The clearstories run 74 feet long and 3'6" tall and are north facing in order to provide diffuse light to the space. The roof area of the original space is 5,330 square feet with 720 square feet for the glass curtain walls. The relighted space has a roof area of 5,956 square feet, a glass curtain wall area of 720 square feet, and a skylight area of 370 square feet.

Additionally, the spatial loads include 40 people with a sensible load of 250 BTU/hr. This is an overestimate due to the possible addition of cubicles. The original lighting design included suspended linear fluorescent pendants. In the lighting redesign the lighting includes suspended linear fluorescent pendants and surface mounted linear fluorescent indirect lighting. Therefore, the lighting was assumed to be fluorescent hung below the ceiling. A power density of 0.98 Watts per square foot is allowable for the space. Additional spatial loads include those from computers and other electronic equipment. Thirty-five computers were assumed with a load of 135 watts per computer and three fax machines have a load of 15 watts per machine. The total was 4770 watts for the miscellaneous loads in the open office. These loads are considered negligible in the winter.

U values for the materials were determined through the building specifications and drawings and can be found in the table below. Calculations were performed with the following temperature assumptions. Spatial temperatures were determined in the mechanical drawings set forth by the mechanical engineer. In winter the set point temperature is 72°F with a minimum outside temperature of 8.3°F. The mechanical engineer determined the winter supply temperature to be 85°F and the room temperature to be 72°F. In the summer the set point temperature is 92.8°F with a minimum outdoor temperature of 75°F. The mechanical engineer determined the summer supply temperature to be 75°F ant the room temperature to be 55.4°F. The space was assumed to be positively pressurized to the outside and therefore no infiltration was assumed.

The equation $q=u \times Area \times \Delta T$ was used in the calculations to determine the heating and cooling loads of the space. The equation $q= 1.1 \times cfm \times \Delta T$ was used to determine the amount of air supplied to the space.

The following are the inputs for both the Trace 700 and hand calculations:

Summary of Input			
Location	Harrisburg, PA		
People	40		
Sensible Load from People	250 BTU/hr		
Lighting	Fluorescent, hung below ceiling		
Lighting Power Density	0.98 W/sq ft		
Miscellaneous Loads	Computers and Monitors	4725 W	
	Fax Machines	45 W	
	Total Miscellaneous Loads	4770 W	
Infiltration	Neutral, Average Construction		
Cooling Dry bulb	75 °F		
Heating Dry bulb	70 °F		
Relative Hunidity	50 °F		
Construction	Slab	4" LW Concrete	
	Roof	4" LW Concrete	
	Wall	Frame Wall	
	Partition	0.75" Gypsum Frame	
	Glass Type	Window	0.28 u factor
		Skylight	0.28 u factor
	Wall Height	12 ft	
	Floor to Floor Height	10 ft	
	Plenum Height	2 ft	

Existing Condition Inputs	
Roof Area	5330 sq ft
Glass	720 sq ft

Redesigned Condition Inputs	
Roof Area	5956 sq ft
Glass Area	720 sq ft
Glass Roof Area	6.66%
Skylight Area	370 sq ft

U Values	
Roof	0.2135
Glass	0.28
Skylight Glass	0.28
Interior Walls	0.38796

The following are the calculations performed. Trace 700 results can be found in Appendix I.

Existing Conditions	
Winter Condition	
Setpoint Temperature	72°F
Outside Temperature	8.3°F
ΔT	63.7°F
q=u x Area x ΔT	
q(window)	12841.9 BTU/hr
q(roof)	72487.73 BTU/hr
q(interior walls)	0 BTU/hr
q(people)	0 BTU/hr
q(lighting)	0 BTU/hr
q(miscellaneous)	0 BTU/hr
q (total)	85329.63 BTU/hr

Existing Conditions	
Summer Condition	
Setpoint Temperature	92.8°F
Outside Temperature	17.8°F
ΔT	17.8°F
q=u x Area x ΔT	
q(window)	3588.5 BTU/hr
q(roof)	20255.6 BTU/hr
q(interior walls)	0 BTU/hr
q(people)	10000 BTU/hr
q(lighting)	17822.24 BTU/hr
q(miscellaneous)	16275.2 BTU/hr
q (total)	67941.5 BTU/hr

Spatial Load	
Winter Condition	
46 Floor Grilles at 80cfm	3680 cfm
12 Floor Grilles at 200 cfm	2400 cfm
2 supply AHU at 4950 cfm	9900 cfm
Supply Temperature	85°F
Room Temperature	72°F
ΔT	13°F
q=1.1 x cfm x ΔT	
q(winter)	228514 BTU/hr

Spatial Load	
Summer Condition	
46 Floor Grilles at 80cfm	3680 cfm
12 Floor Grilles at 200 cfm	2400 cfm
2 supply AHU at 4950 cfm	9900 cfm
Supply Temperature	75°F
Room Temperature	55.4°F
ΔT	19.6°F
q=1.1 x cfm x ΔT	
q(summer)	344528.8 BTU/hr

Redesigned Condition	
Winter Condition	
Setpoint Temperature	72°F
Outside Temperature	8.3°F
ΔT	63.7°F
q=u x Area x ΔT	
q(window)	12841.9 BTU/hr
q(roof)	81001.3 BTU/hr
q(skylight)	6599.3 BTU/hr
q(interior walls)	0 BTU/hr
q(people)	0 BTU/hr
q(lighting)	0 BTU/hr
q(miscellaneous)	0 BTU/hr
q (total)	100442.5 BTU/hr

Redesigned Condition	
Summer Condition	
Setpoint Temperature	92.8°F
Outside Temperature	17.8°F
ΔT	17.8°F
q=u x Area x ΔT	
q(window)	3588.5 BTU/hr
q(roof)	22634.6 BTU/hr
q(skylight)	1844.1 BTU/hr
q(interior walls)	0 BTU/hr
q(people)	10000 BTU/hr
q(lighting)	17822.24 BTU/hr
q(miscellaneous)	16275.2 BTU/hr
q (total)	72164.6 BTU/hr

Analysis

The Trace 700 results provided a comparison of the heating and cooling loads with both sensible and latent loads. For my comparison only the sensible loads should be included in order to find more accurate results and therefore hand calculations were required.

Under winter conditions, the original load is 85,330 BTU/hr with a spatial load of 228,514 BTU/hr. The spatial load is the current amount of supply cooling and heating to the space. With the addition of the clearstories, the heating load increases to 100,442 BTU/hr. This is under the spatial load and therefore no redesign is required for the heating load.

Under summer conditions, the original load is 67,942 BTU/hr with a spatial load of 334,530 BTU/hr. With the addition of the clearstories, the cooling load increased to 72,165 BTU/hr. The redesigned summer cooling load is under the spatial cooling load and therefore no redesign is required in the cooling load.

Conclusion

The addition of clearstories to the marketing open office allows for more natural lighting within the space. This benefits the space due to natural lighting creating a more comfortable work environment for occupants. In addition, the increase in ceiling height in the two sections allows for indirect lighting that reduces glare and makes the open office feel more spacious. This is especially important in a workspace where occupants spend the majority of their day.

Through calculating the change in heating and cooling loads, it was determined that no redesign is necessary in the heating and cooling loads to the marketing open office.

Breadth 2 | Landscape Architecture

Introduction

As the main entry to the Pennsylvania State Employees Credit Union Corporate Headquarters, the landscape architecture should create an impression of the Pennsylvania State Employees Credit Union. The building is LEED Gold certified and utilizes natural materials throughout the structure. Wood is a key material throughout the building. Daylighting is another key feature of the building due to the large skylights and large glass curtain walls. Energy efficient lighting, along with a micro turbine generator shows the PSECU's emphasis on sustainability. The landscape architecture design will incorporate these themes in order to create a fluid design that is a smooth transition from the parking area to the interior.

Design Goals

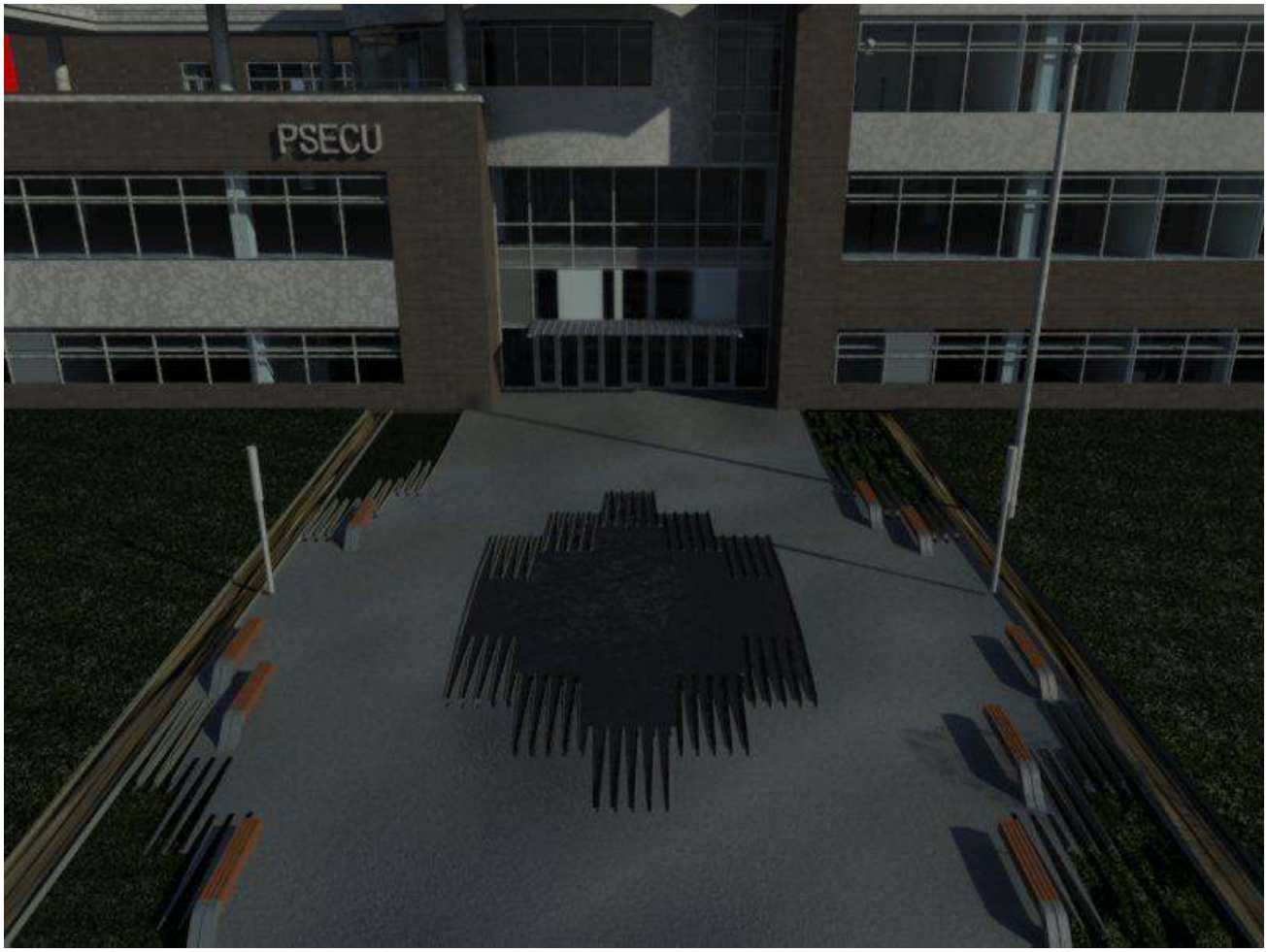
Organic growth was a major inspiration for the design. The idea of 'order in disorder' inspired the design to create a natural space that encourages growth, while having order in the placement of these features. A water feature is incorporated in the original design and thus must be incorporated in order to satisfy the PSECU as a client. Strong lines and angles will be incorporated in order to have fluidity throughout the lighting designs of the building. The strong architectural features of the façade are the strong lines of the glazing and overhangs, but the curved metal panel wall serves as a contradiction and therefore should be incorporated into the landscape design.

Overall, the key design goals are to create a space that encourages growth while emphasizing the strong lines and angles of the architecture.

Materials

The flooring is precast concrete in linear vertical strips, custom benches with wood seats and a concrete curved leg. The plantings have a gravel base have minimal flower plantings and mainly greens. The water feature is at the center of the plaza.

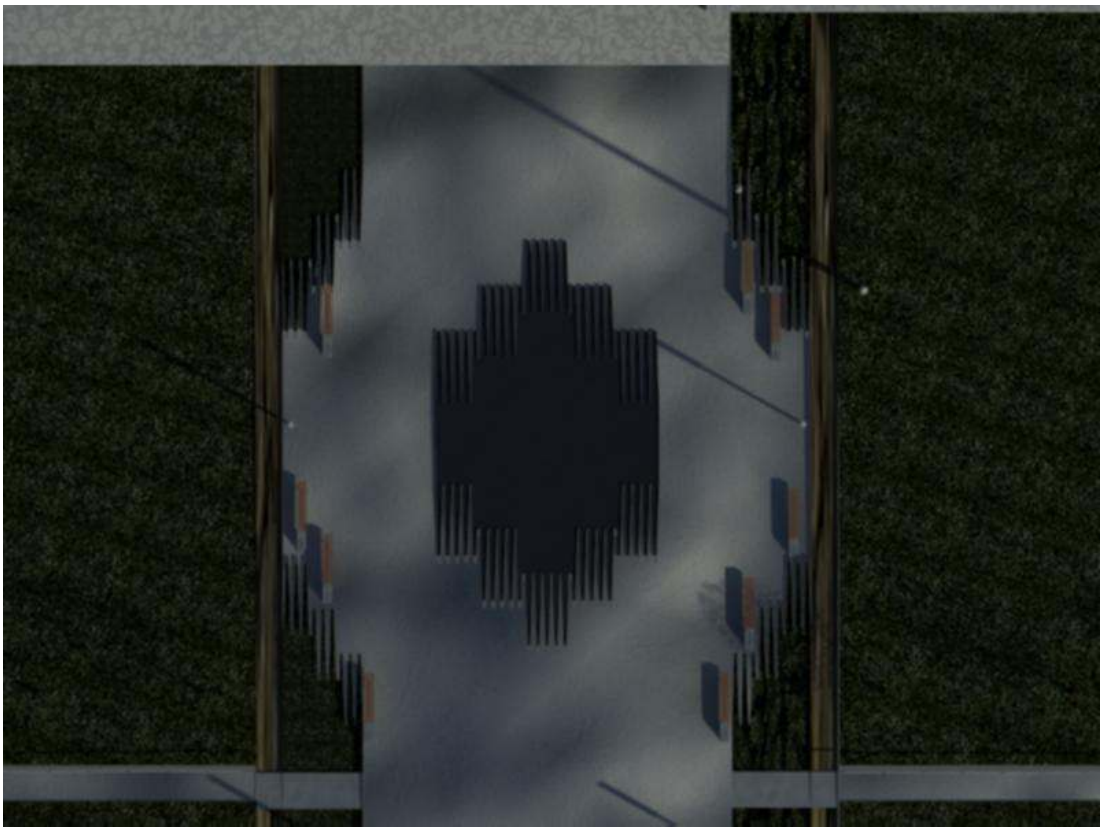
Renderings

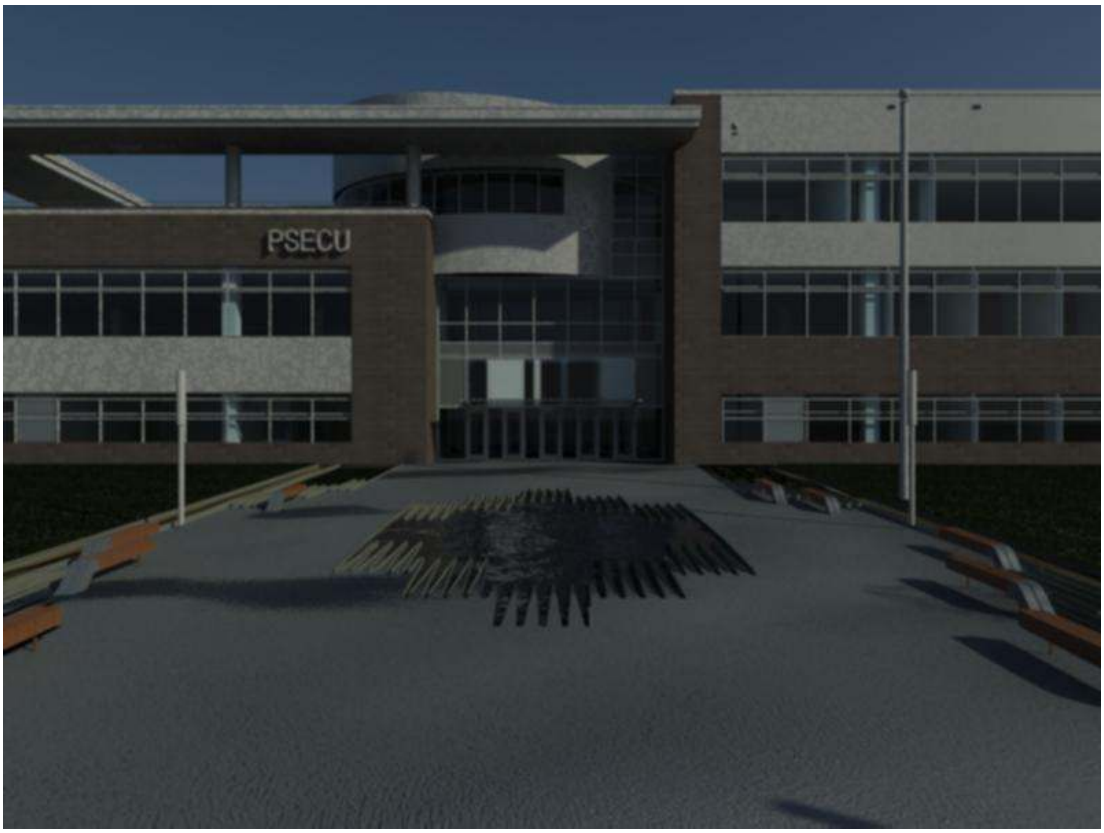


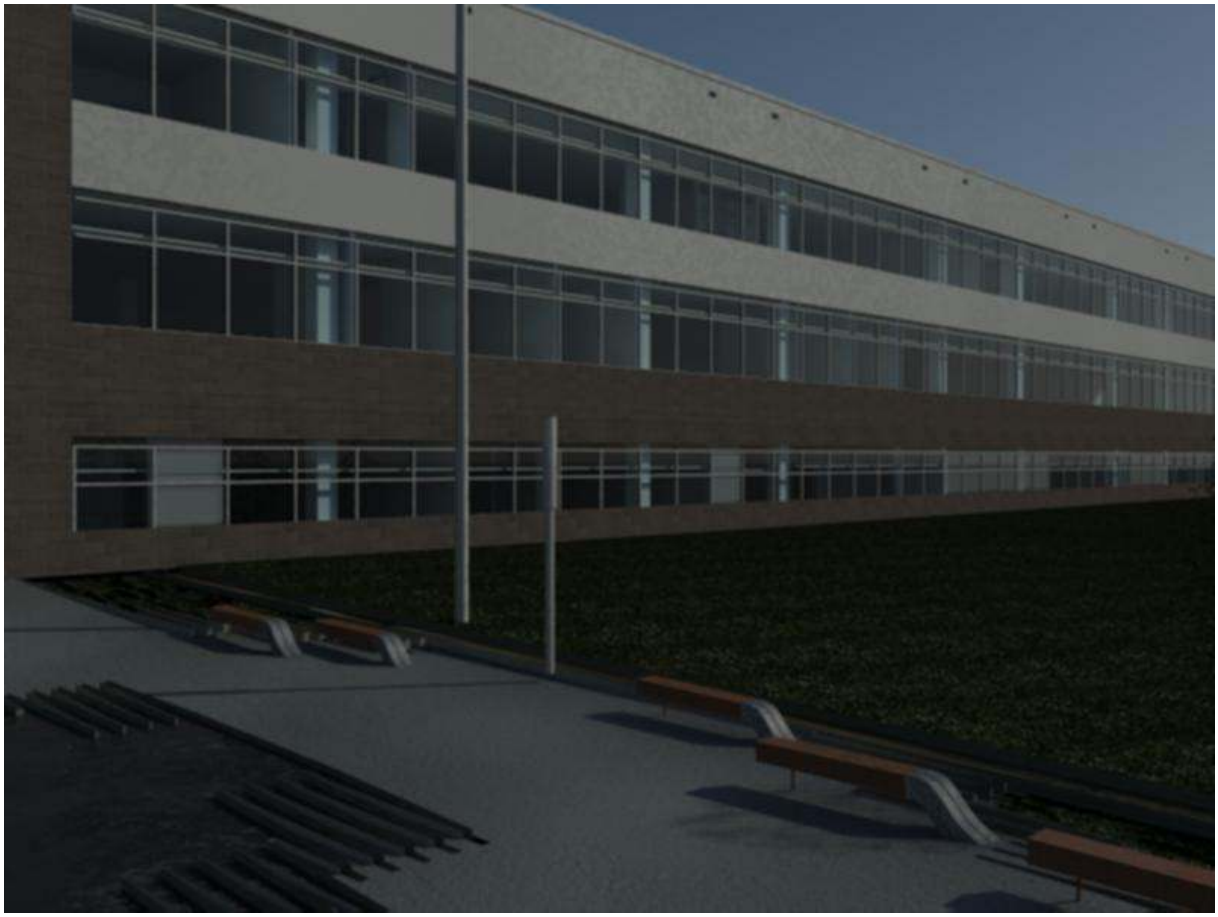
The idea of the water feature and plantings expanding into the plaza and encouraging growth was the inspiration for the design. The water is even with the ground to create more of a pond than an elaborate feature. The organic impression of the space allows for a smooth transition from the asphalt parking area to the organic and sustainable building. The lighting is located under the benches to highlight the benches while creating a random pattern of light that is also emphasized in the lobby. The light columns serve to create a safe environment through excellent facial recognition while also emphasizing straight lines.

While encouraging organic growth and disorder, the space also guides patrons into the space through dividing the pathway and the plantings separating to guide the eye towards the exterior of the plaza. The concrete flooring is in strips that emphasize the strong lines of the building and also serving to guide patrons.

The canopy above the entry was redesigned to emphasize strong lines. The opaque glass mimics the spandrel glass of the façade, while the strips of metal framing provide support, while highlighting straight lines and angles. The lighting is hidden in the steel framing to emphasize the canopy rather than the fixture.




PSECU



The benches have a curved element incorporated into them to appear as if the benches are a part of the concrete flooring. The curved element was inspired by the curved metal panel wall feature. The inspiration for the design arose from the idea of organic growth.

Evaluation of Design

The design both satisfies the criteria and creates an aesthetically pleasing space. It serves to connect the parking area to the interior of the PSECU Corporate Headquarters. Both the strong linear lines of the façade and the curved element above the main entrance are featured through the design. Organic growth is promoted through the design of the plantings and randomness is encouraged through the lighting, while guided circulation is encouraged through the strong lines.

Overall, the design satisfies the design goals of strong lines and angles, along with encouraging organic growth. This connection to nature emphasizes the PSECU Corporate Headquarters emphasis on sustainability.

Summary and Conclusions

The purpose of the Penn State Architectural Engineering Senior Thesis is to provide an in-depth analysis of the variety of architectural engineering topics to further comprehend the integration of all of the building systems. Senior thesis provides a comprehensive understanding of how all of the building systems work together and their effects on total energy consumption, cost, system efficiency, and a variety of other aspects. This report analyzes the Pennsylvania State Employees Credit Union Corporate Headquarters and integrates new concepts in order to enhance the sustainability and performance of the building.

The entry plaza was redesigned in the landscape architecture breadth to encourage organic growth, while creating an aesthetically pleasing space. The lobby was transformed into a bright space that emphasizes natural materials and strong lines and angles. The space is very energy efficient and uses luminaires as a means to guide circulation, while emphasizing the architectural details. The Marketing Office was transformed into a bright, open space with clearstories that help to reduce the PSECU Corporate Headquarters' reliance on electric lighting. A daylight study was performed in order to determine the amount of dimming, the amount of time with shades down, and the energy savings from incorporating the system into the design. A mechanical analysis was also completed to determine if the mechanical equipment needed a redesign as a result of the addition of clearstories. The last space relighted was the Board Room, which was redesigned to incorporate a custom wooden fixture to hide the luminaires and provide indirect lighting to reduce facial shadows. The impressions of spacious and closure are created through the different scene controls.

In order to incorporate the new lighting designs, an electrical redesign of the control system and panelboards was completed. Also, a photovoltaic analysis was completed in order to determine the feasibility of installing a photovoltaic array. Additionally, a cost benefit analysis of increasing feeder sizes was performed in order to determine if increasing feeders was economically beneficial.

References

ASHRAE Standard 90.1 - 2010. Atlanta, GA: American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc., 2010

CMD Group. RSMeans Electrical Cost Data 2011. Kingston, MA: R.S. Means, 2011. Print.

DiLaura, Houser, Mistrick, and Stefy. The IESNA Lighting Handbook: Reference & Application. 10th ed. New York, NY: Illuminating Engineering Society of North America, 2011.

National Electric Code 2011, Quincy, MA: National Fire Protection Association, Inc., 2010

Software

3DStudioMAX, Adobe Photoshop CS5, AGI32, Autodesk AutoCAD 2012, Revit Architecture 2012, and DAYSIM 3.1

Acknowledgements

Thank you to all of my professors, friends, and family for all of your support and help through the last year, especially the following individuals without which I would not have completed my thesis:

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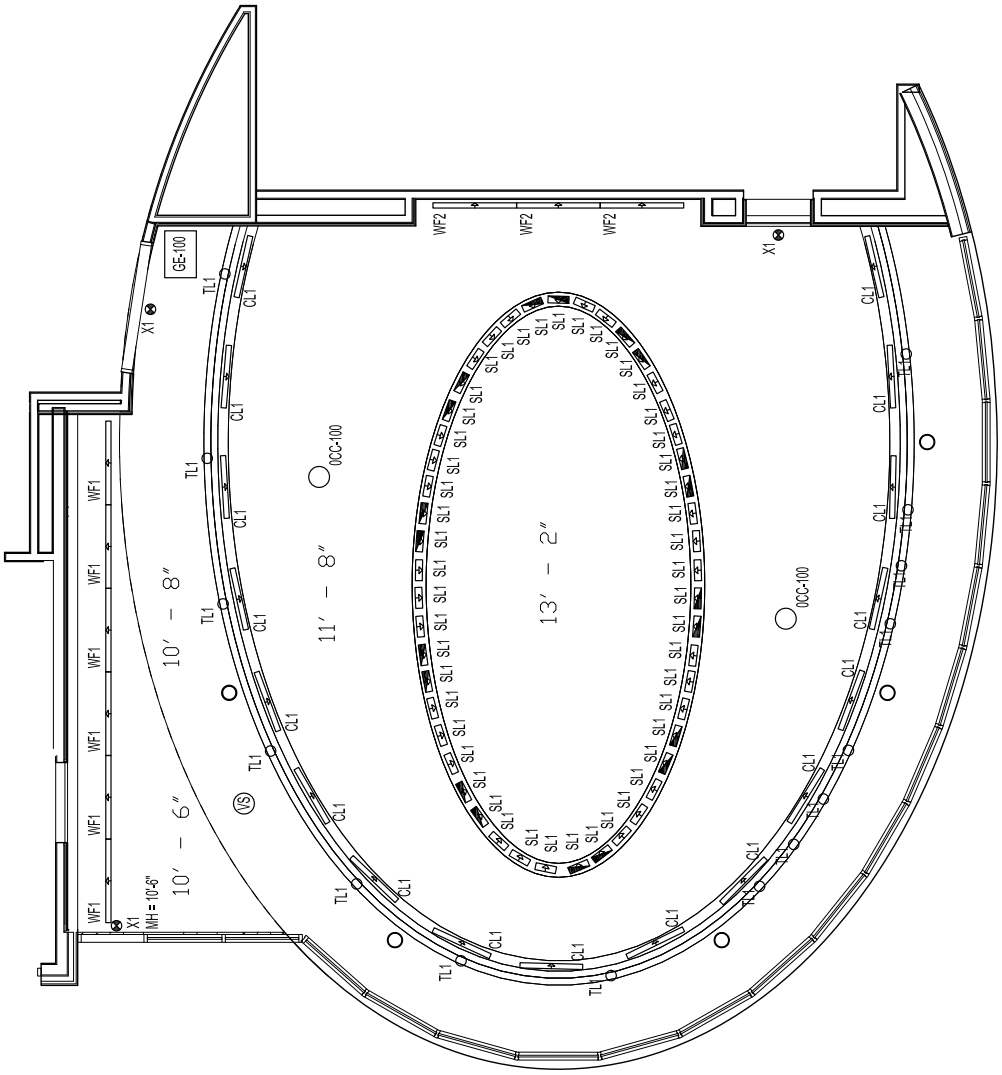
Dr Richard Mistrick
Professor Ted Dannerth
Professor Shawn Good
Professor Parfitt
Professor Holland

Grenald Waldron Associates, especially Sandra Stashik for her support and help.

And my family and friends, especially the lighting kids for the long nights together in 308 Sackett.

Appendix A | Lighting and Electrical Plans

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/16" = 1'	ISSUE DATE: 03/31/2012	DRAWN BY: SARAH WUJCIK	TITLE: BOARD ROOM LIGHTING PLAN	SHEET TITLE: L01



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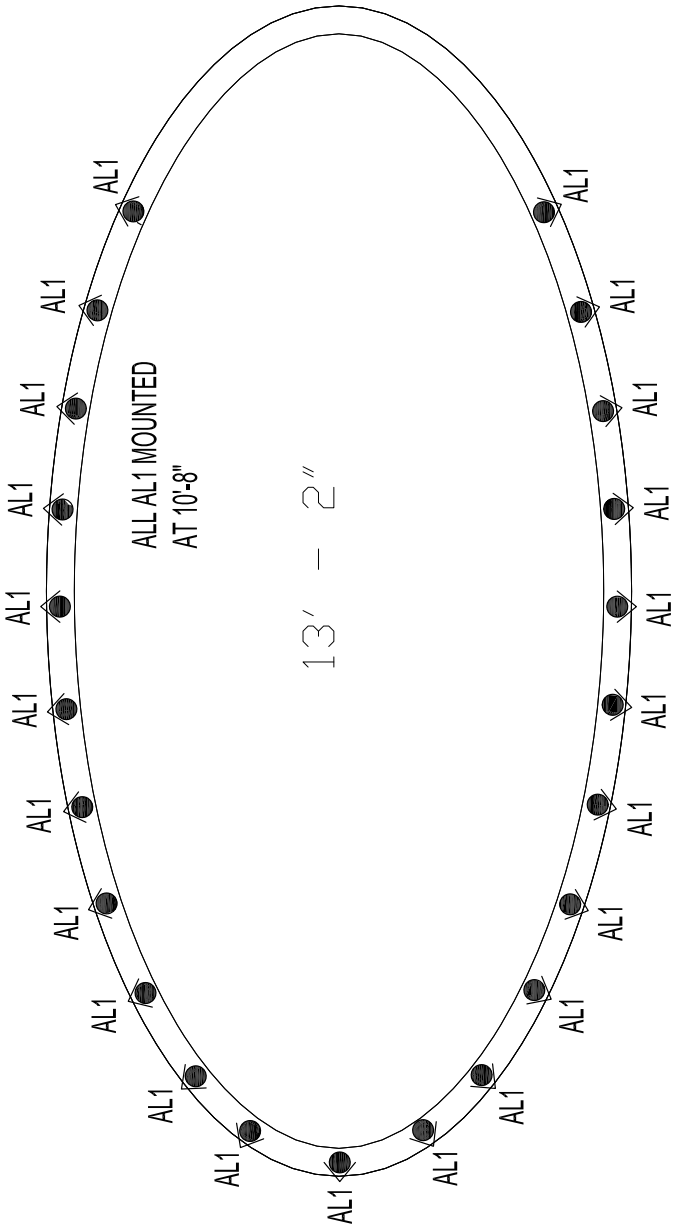

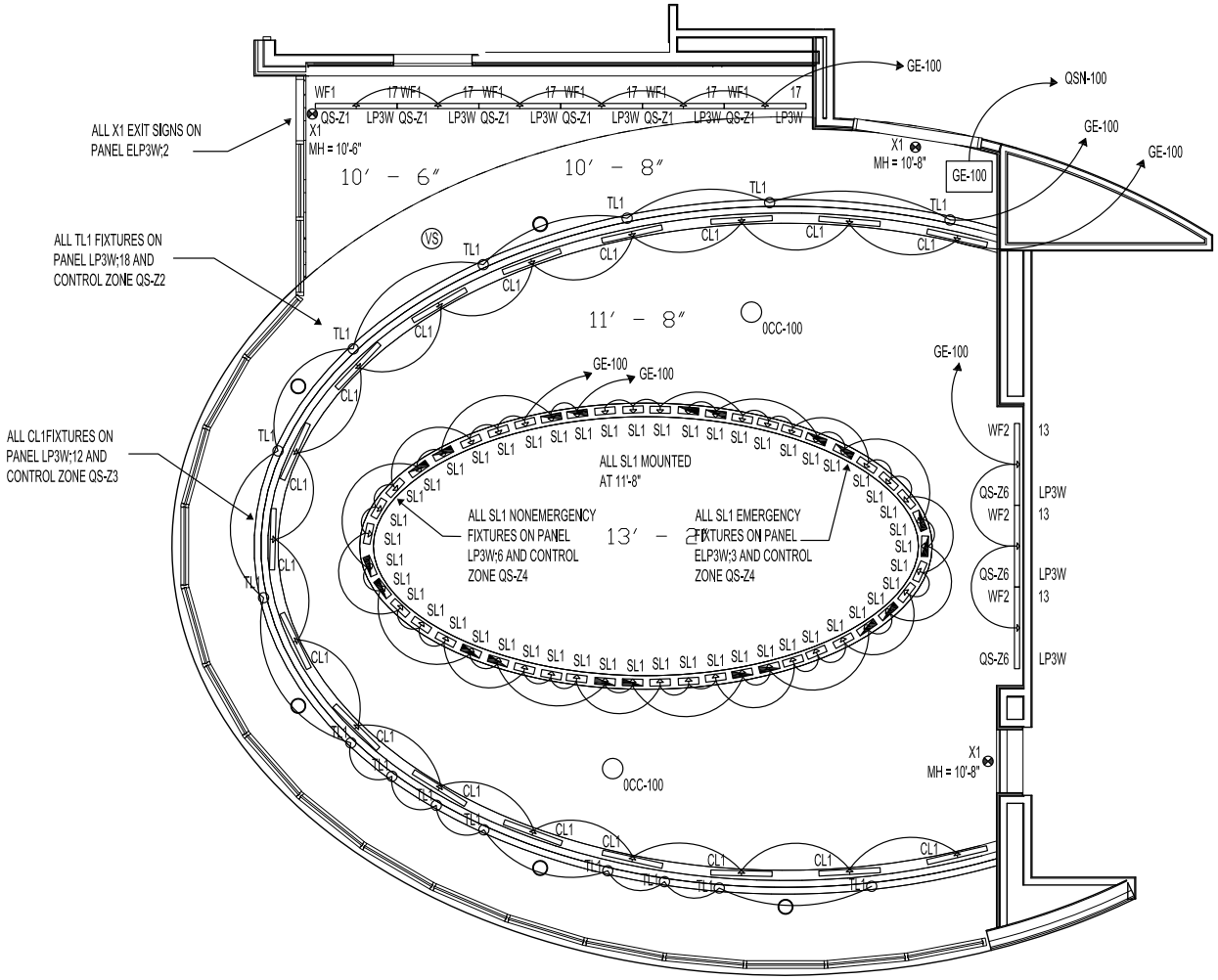

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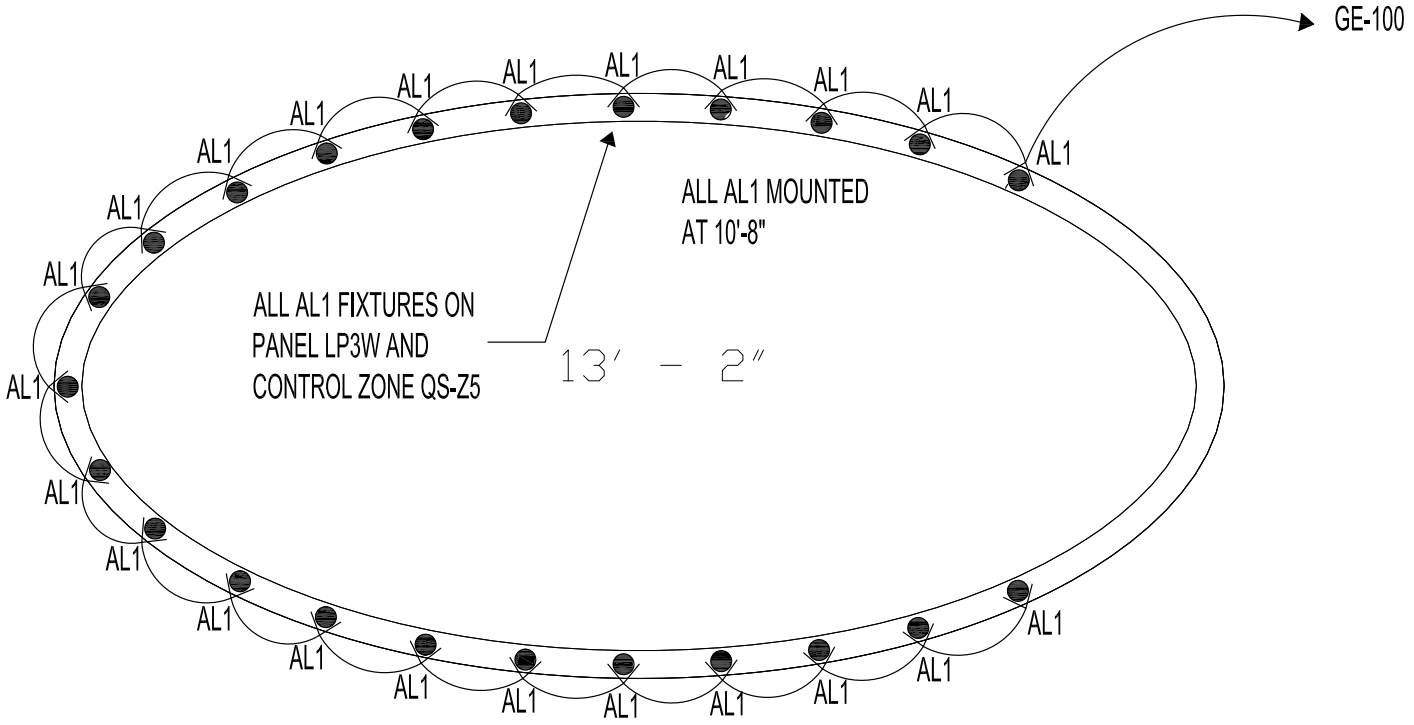
TITLE:
BOARD ROOM CIRCUITING DIAGRAM

SHEET TITLE:
E.01



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TITLE:
BOARD ROOM CIRCUITING DIAGRAM FOR CUSTOM FIXTURE

SHEET TITLE:
E.01.2

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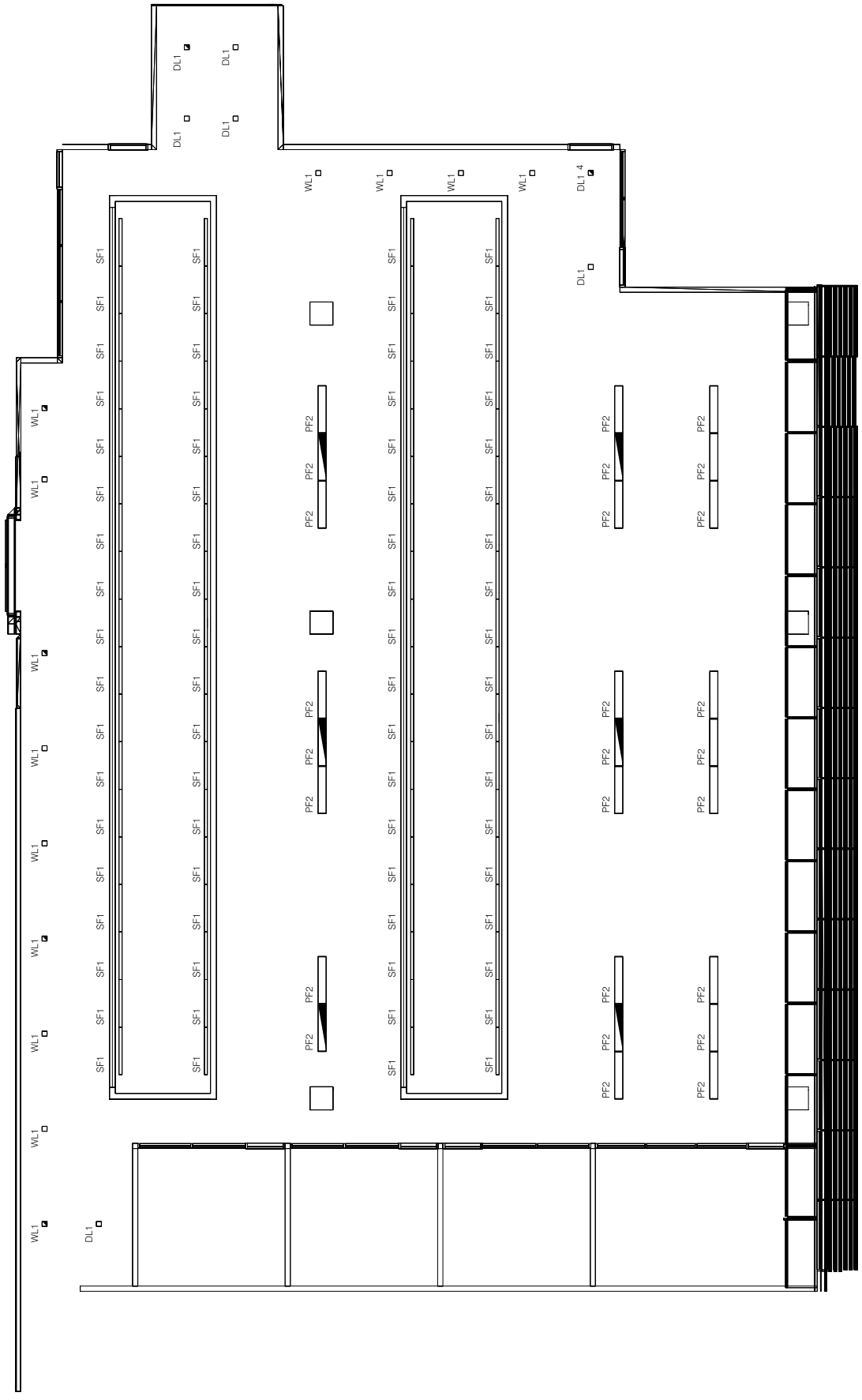

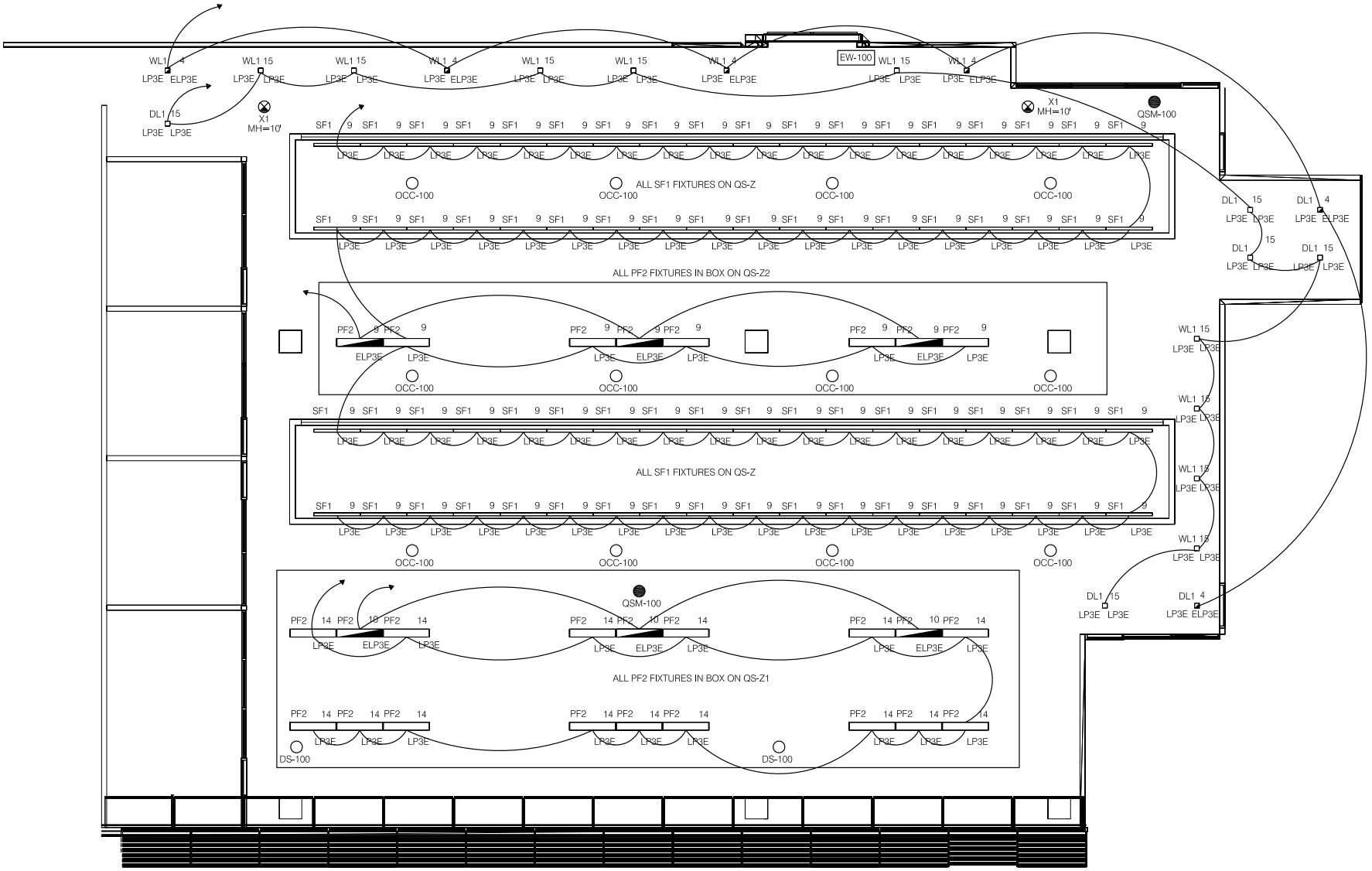

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SCALE:
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ISSUE DATE:
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DRAWN BY:
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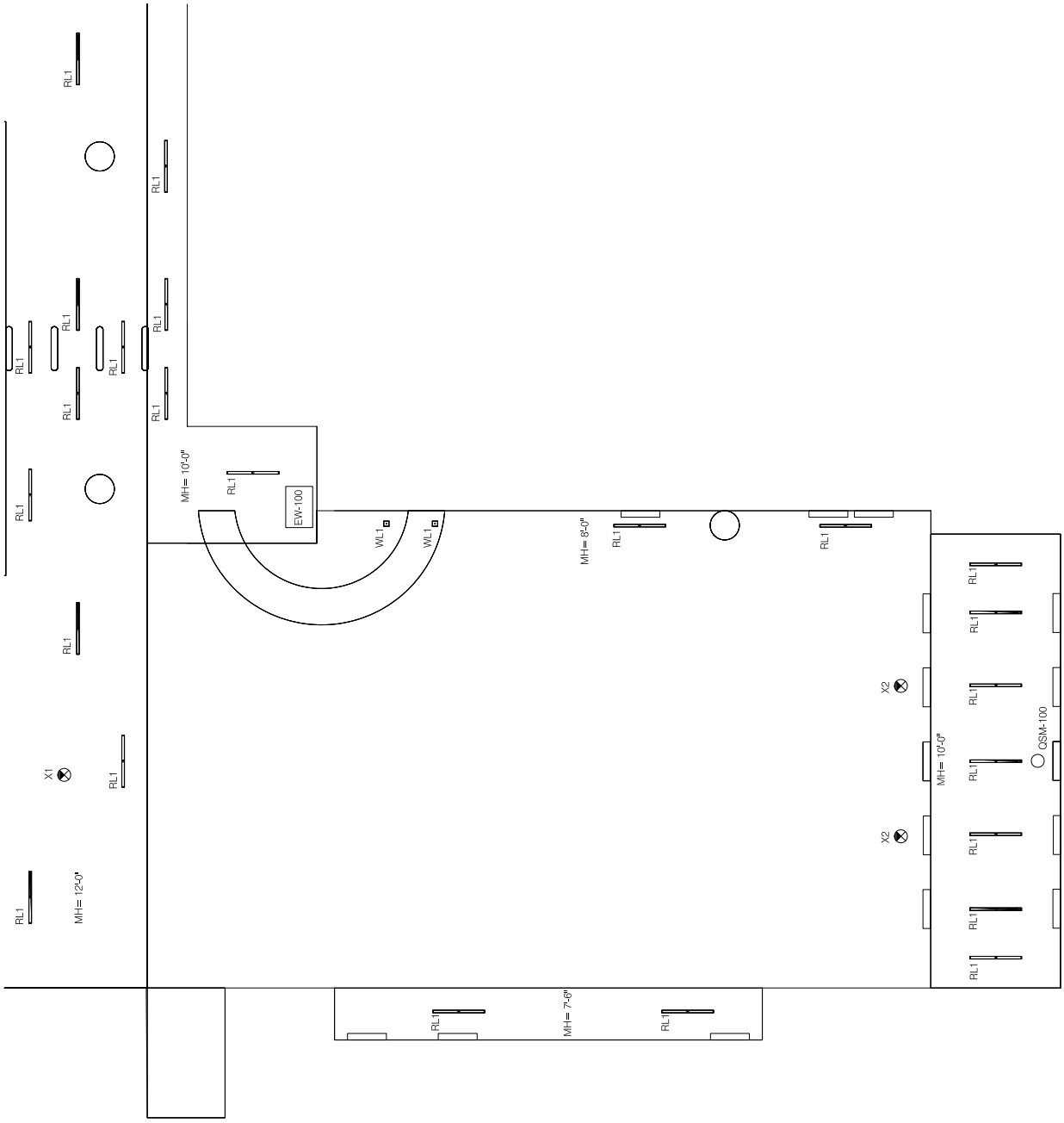
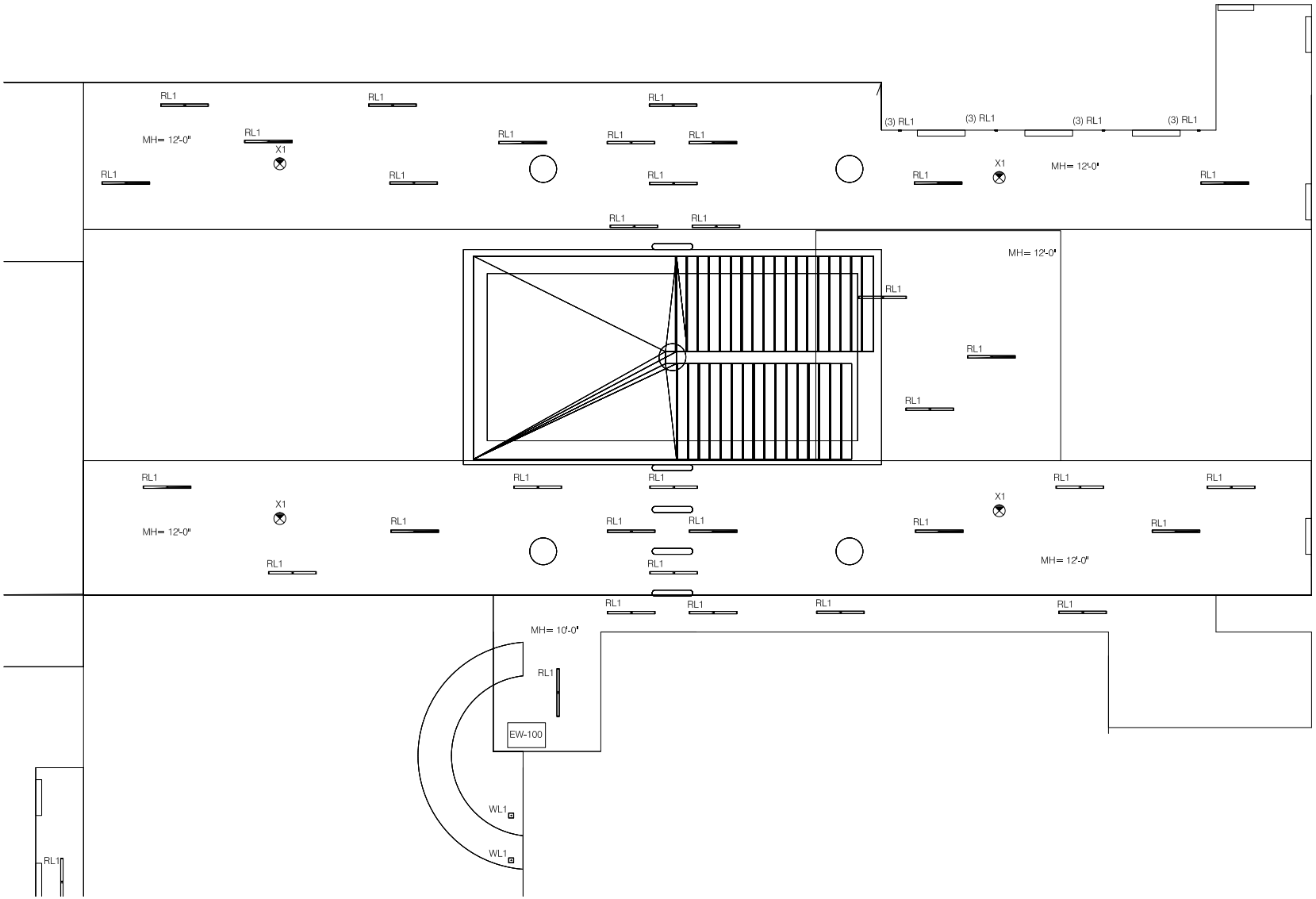
TITLE:
MARKETING OFFICE
CIRCUITING DIAGRAM

SHEET TITLE:
E.02

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS HARRISBURG, PA	SCALE: 1/8" = 1'	ISSUE DATE: 04/03/2012	DRAWN BY: SARAH WUJCIK	TITLE: FIRST FLOOR LOBBY LIGHTING PLAN	SHEET TITLE: L03





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ISSUE DATE:
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DRAWN BY:
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TITLE:
FIRST FLOOR
LOBBY LIGHTING PLAN

SHEET TITLE:
L.04

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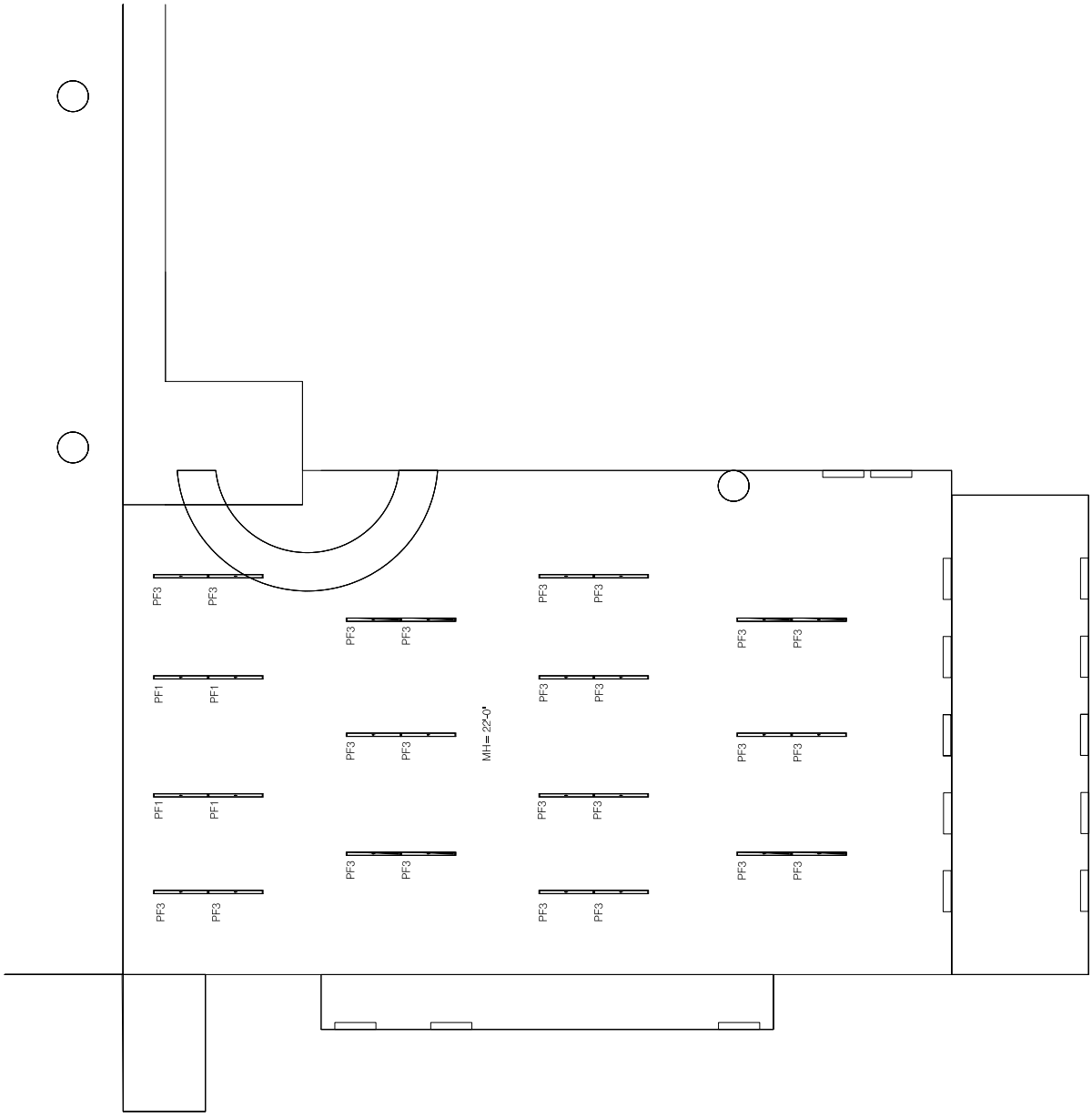

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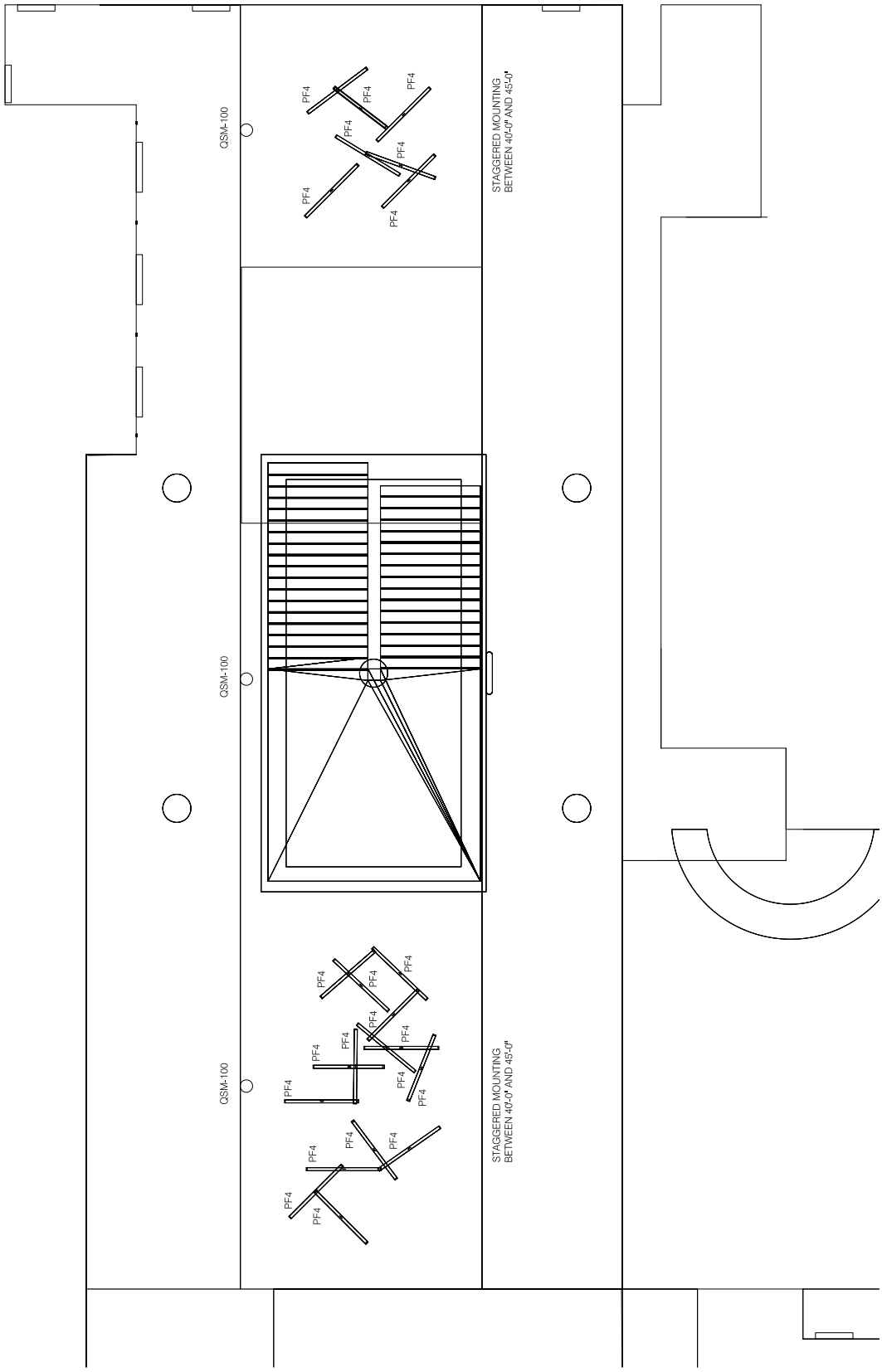

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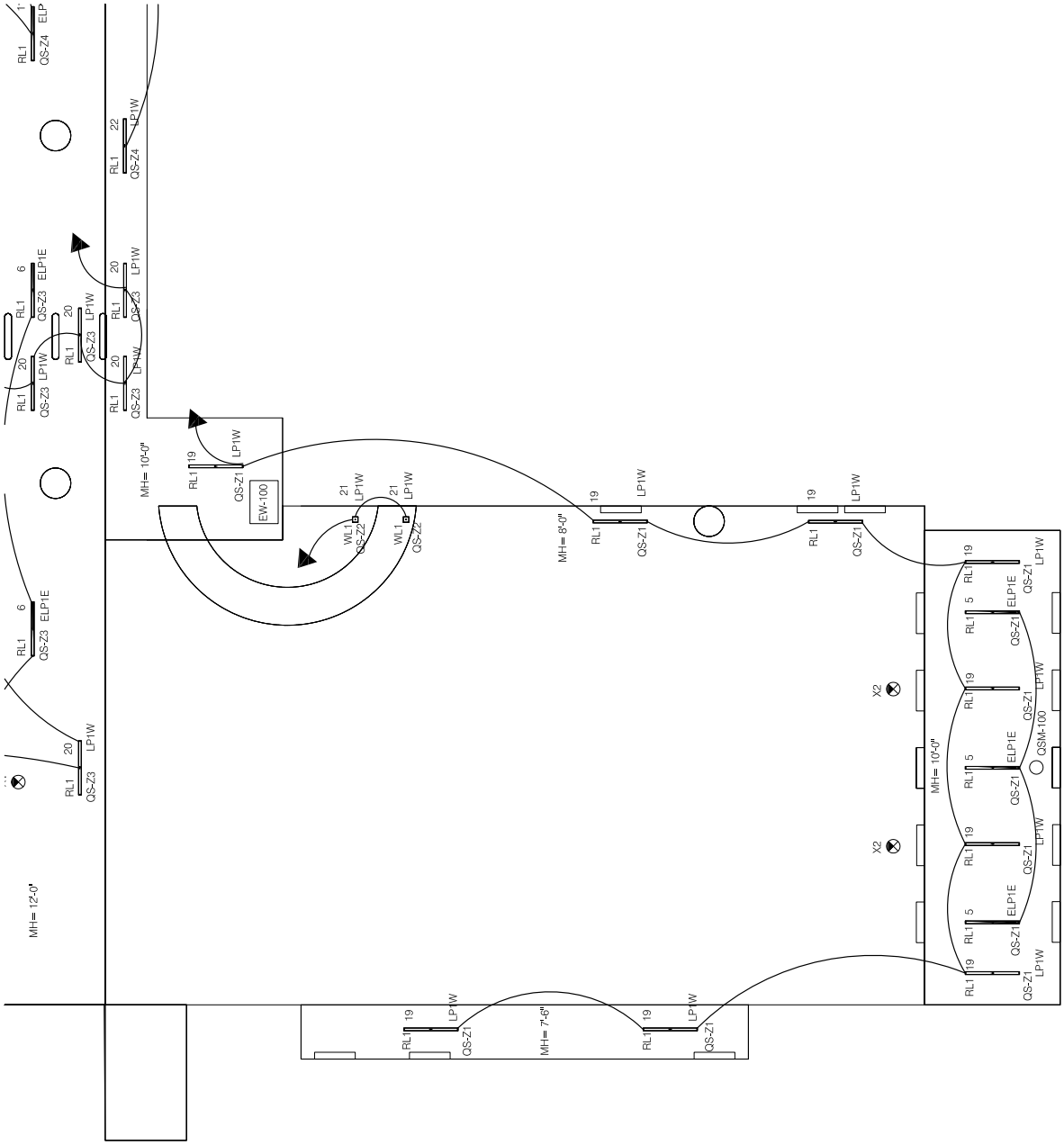

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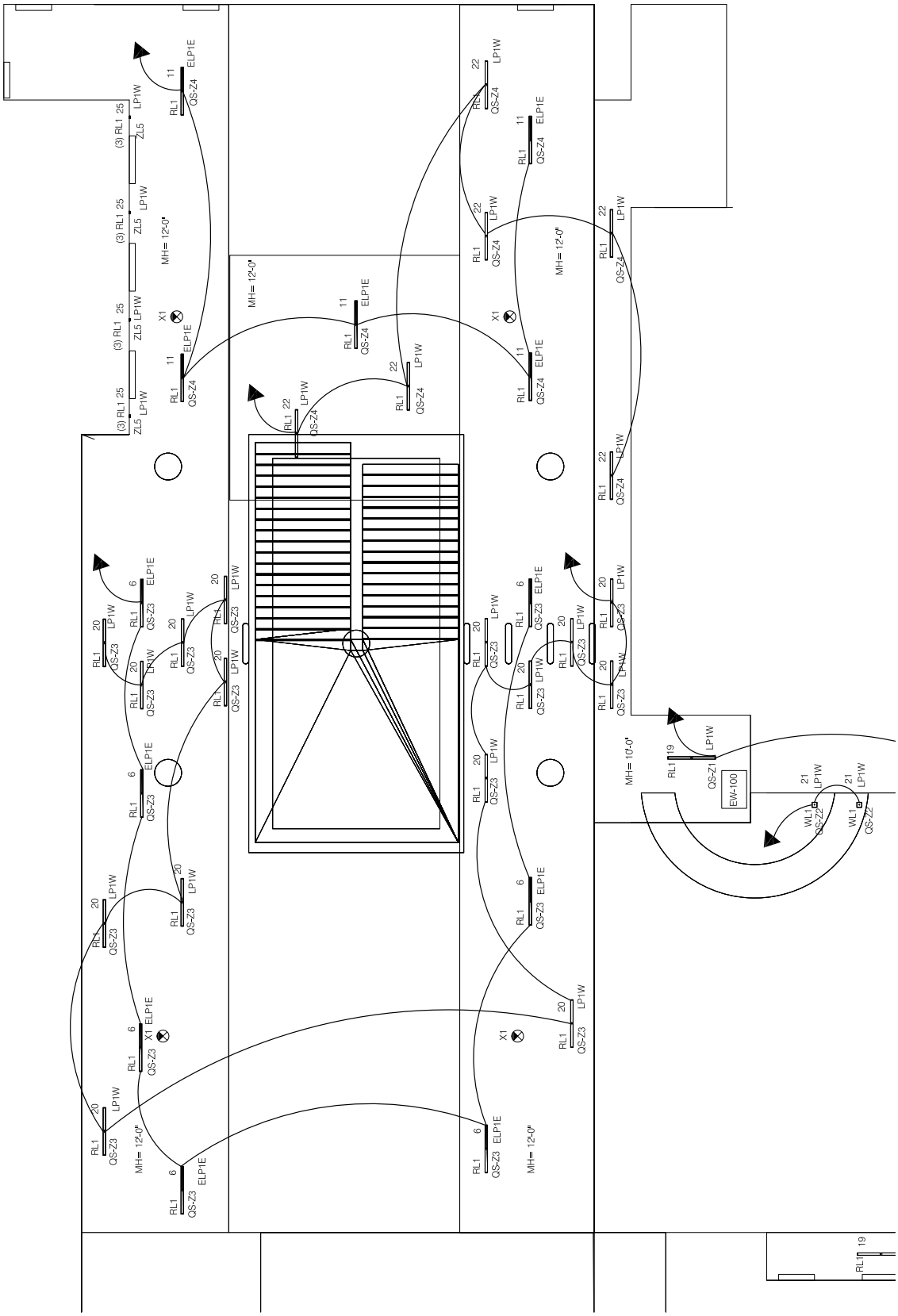

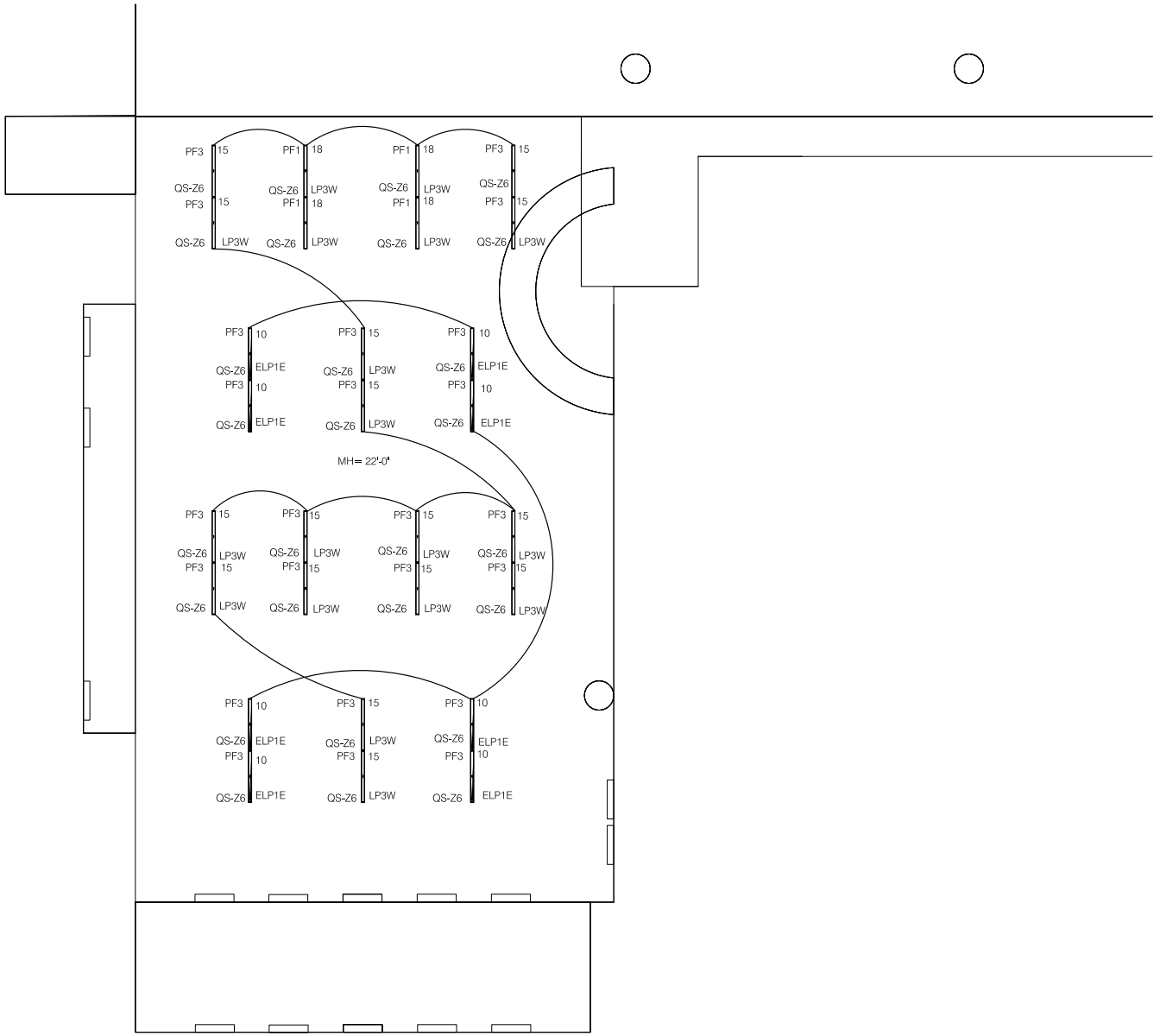

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DRAWN BY:
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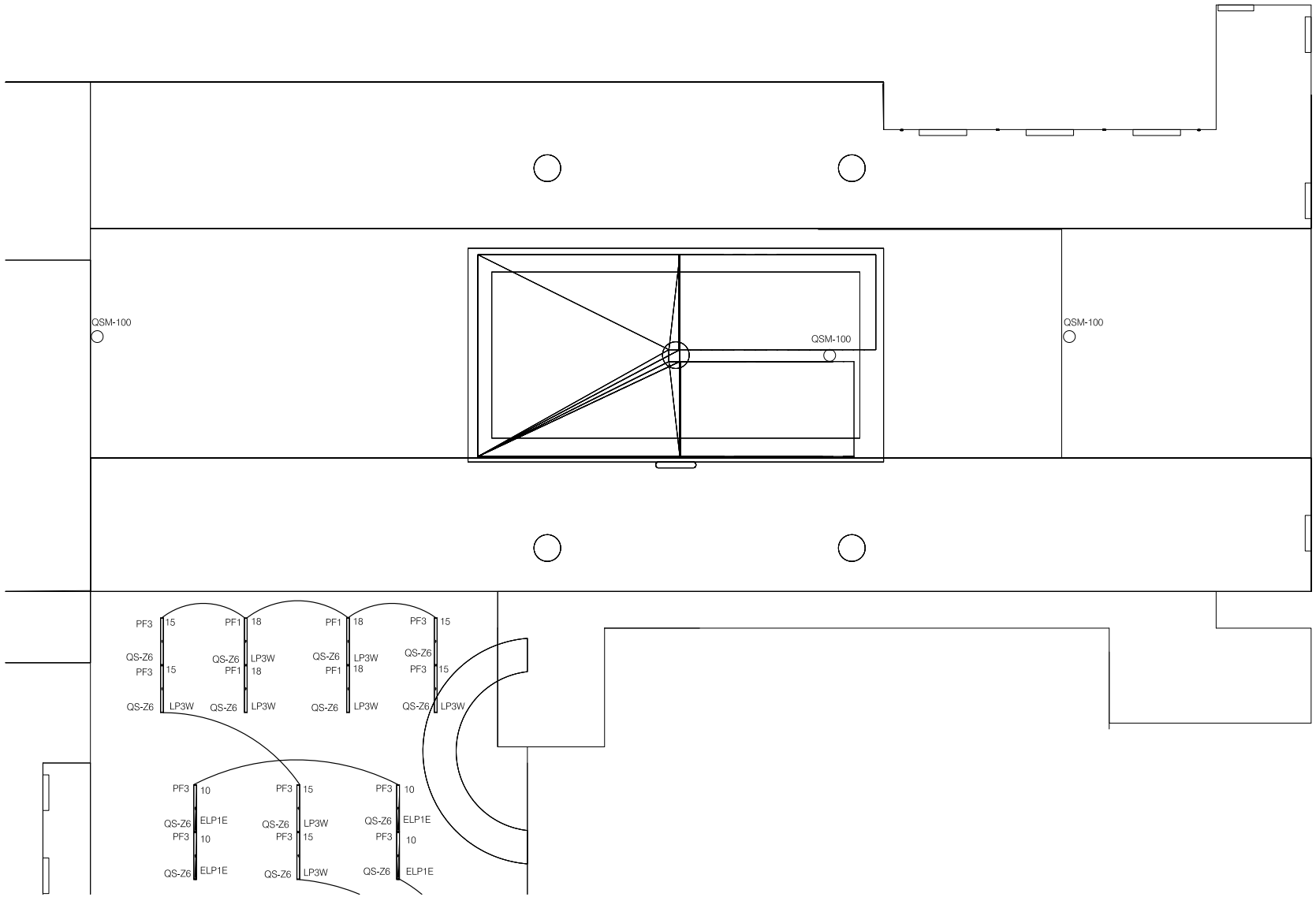
TITLE:
SECOND FLOOR
LOBBY CIRCUITING DIAGRAM

SHEET TITLE:
E.05



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SCALE:
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ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
SECOND FLOOR
LOBBY CIRCUITING DIAGRAM

SHEET TITLE:
E.06

THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
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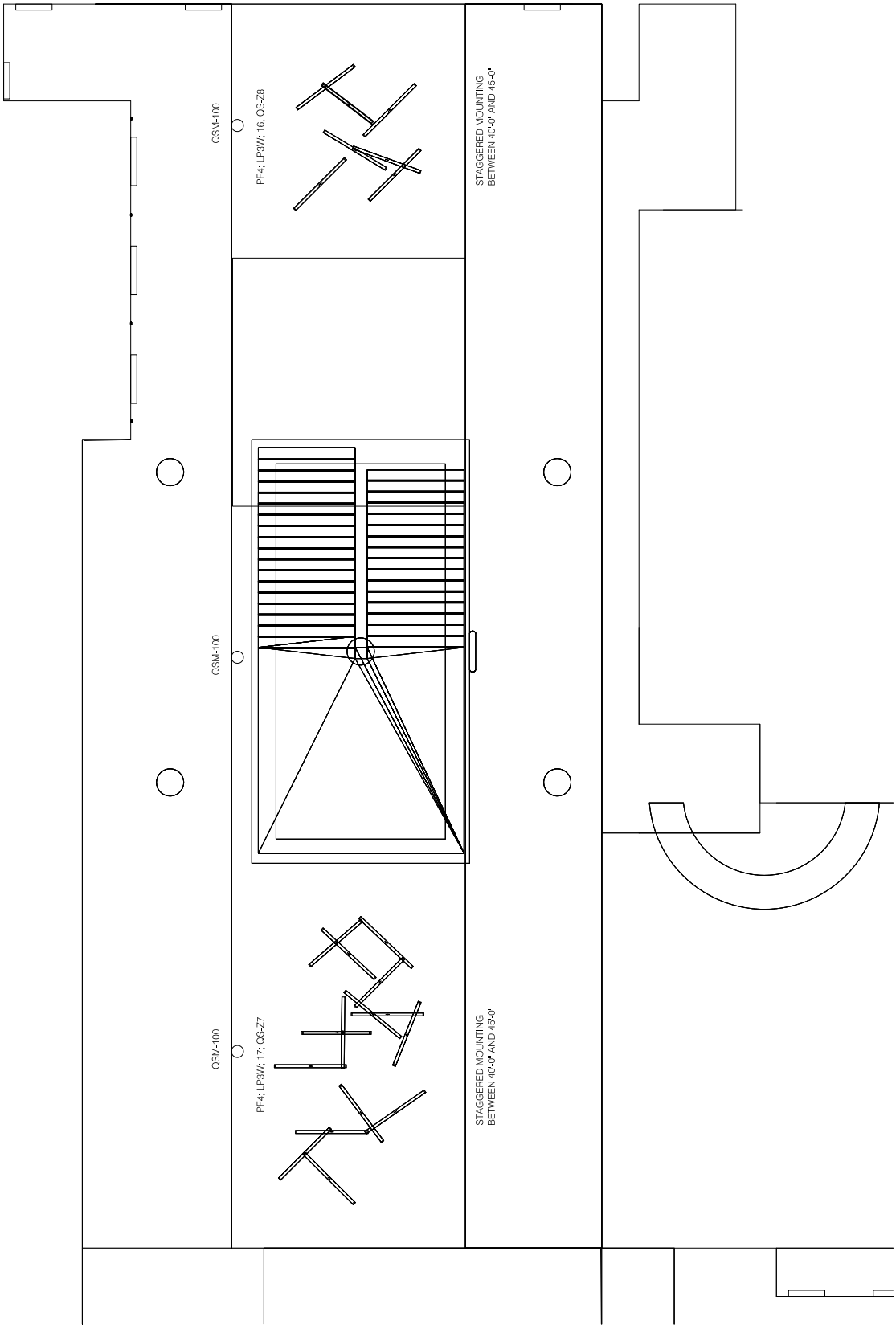
HARRISBURG, PA

SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
1/8" = 1'	04/03/2012	SARAH WUJCIK	THIRD FLOOR LOBBY CIRCUITING DIAGRAM	E.07



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SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
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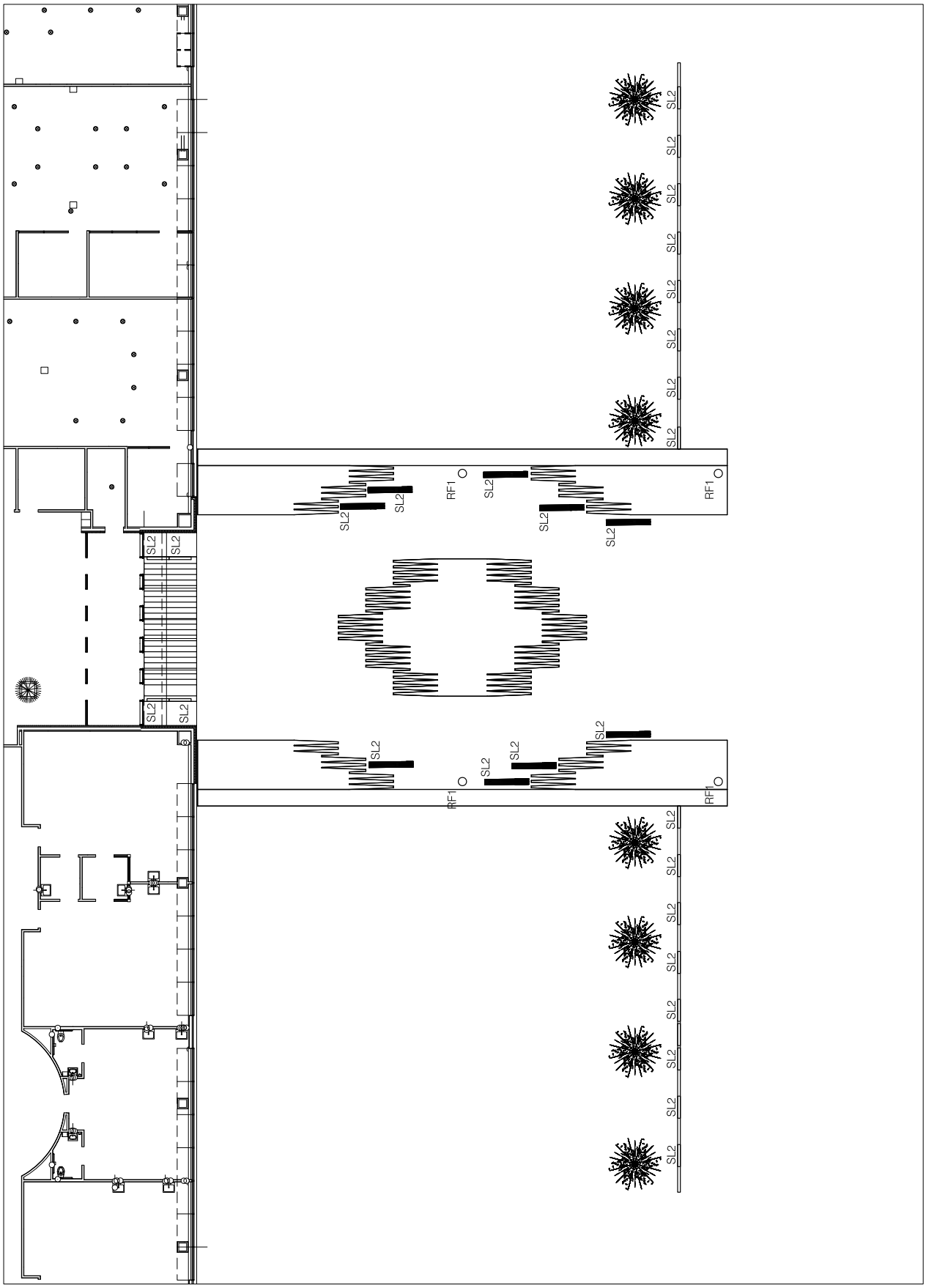

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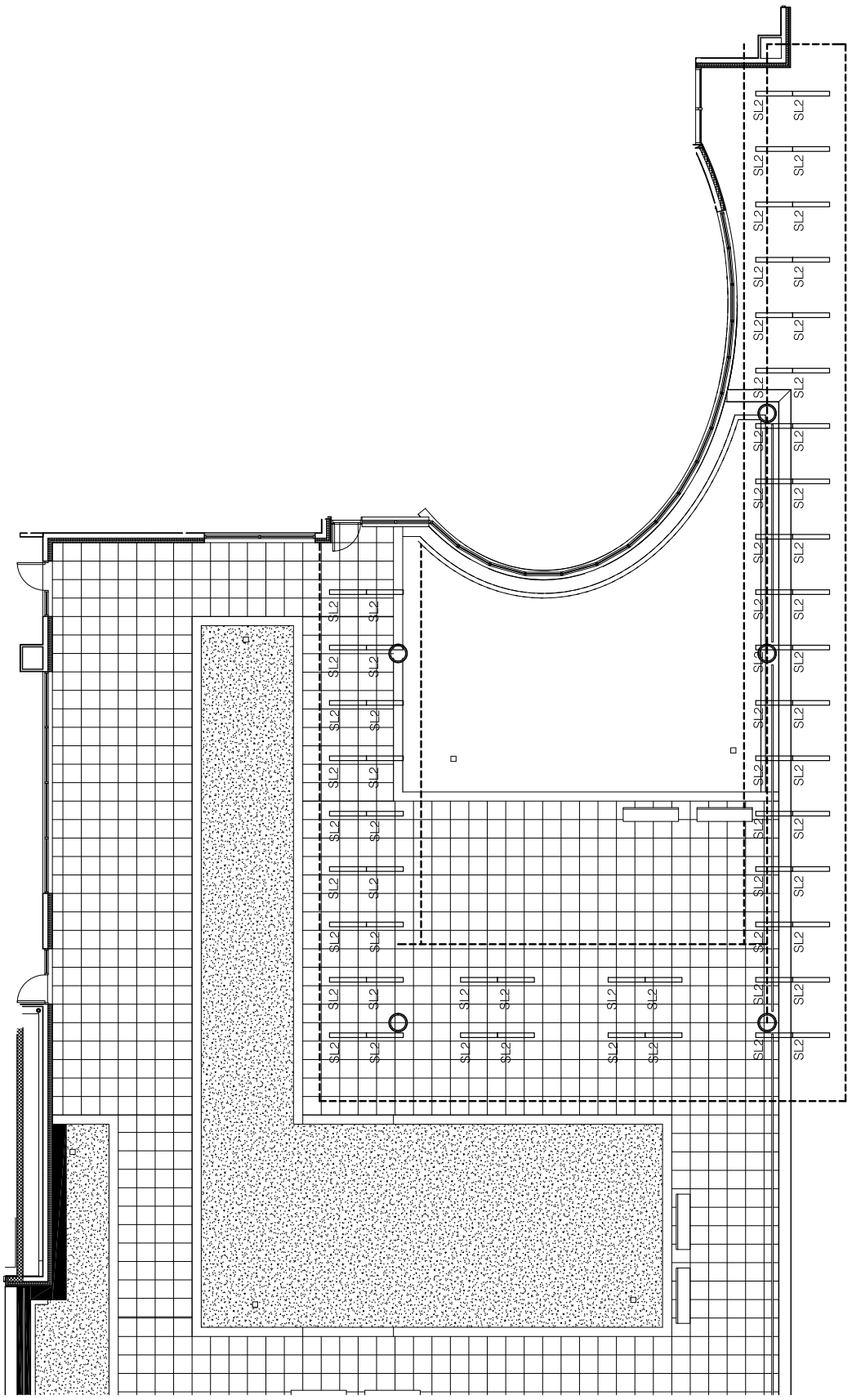

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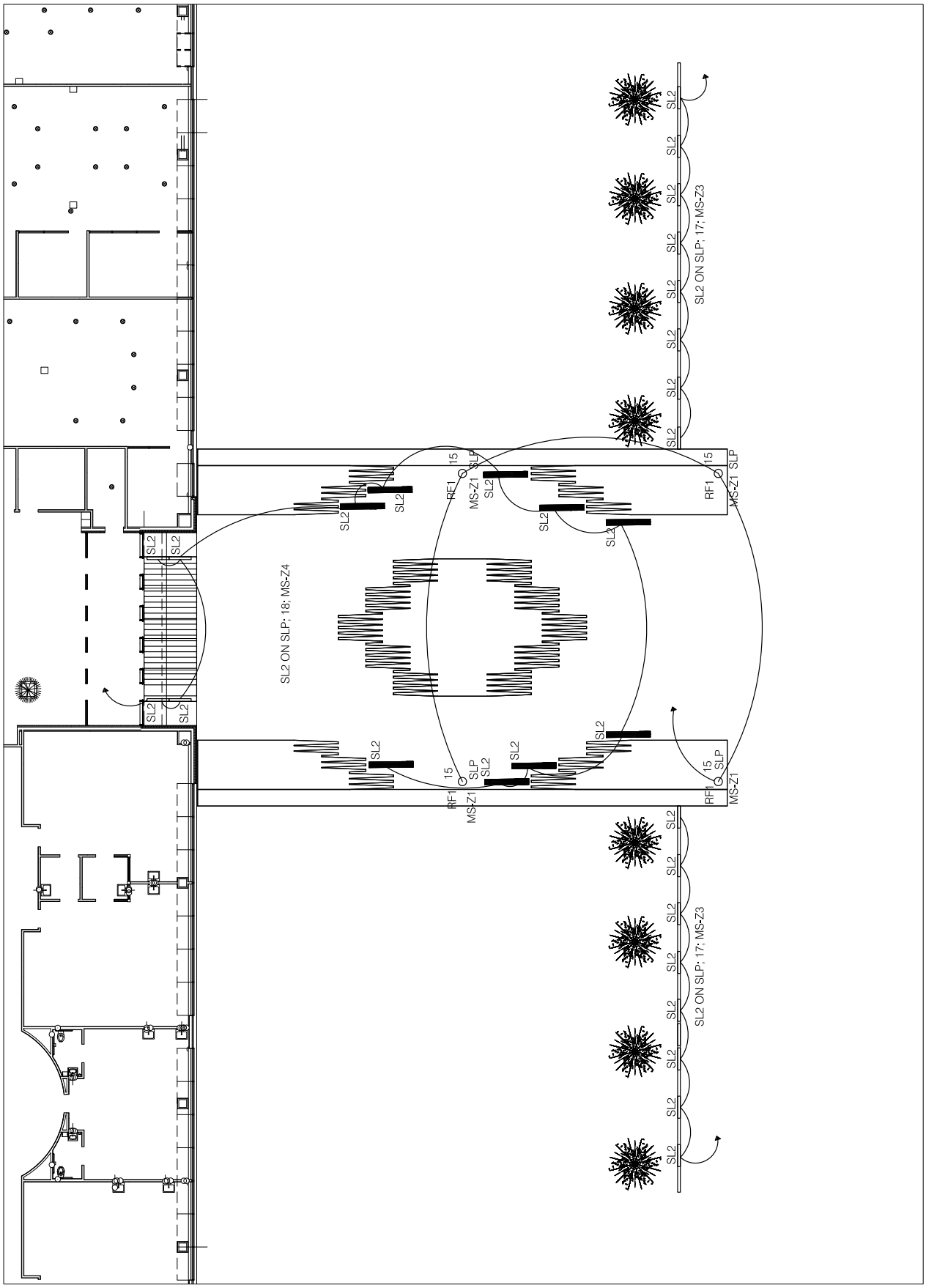
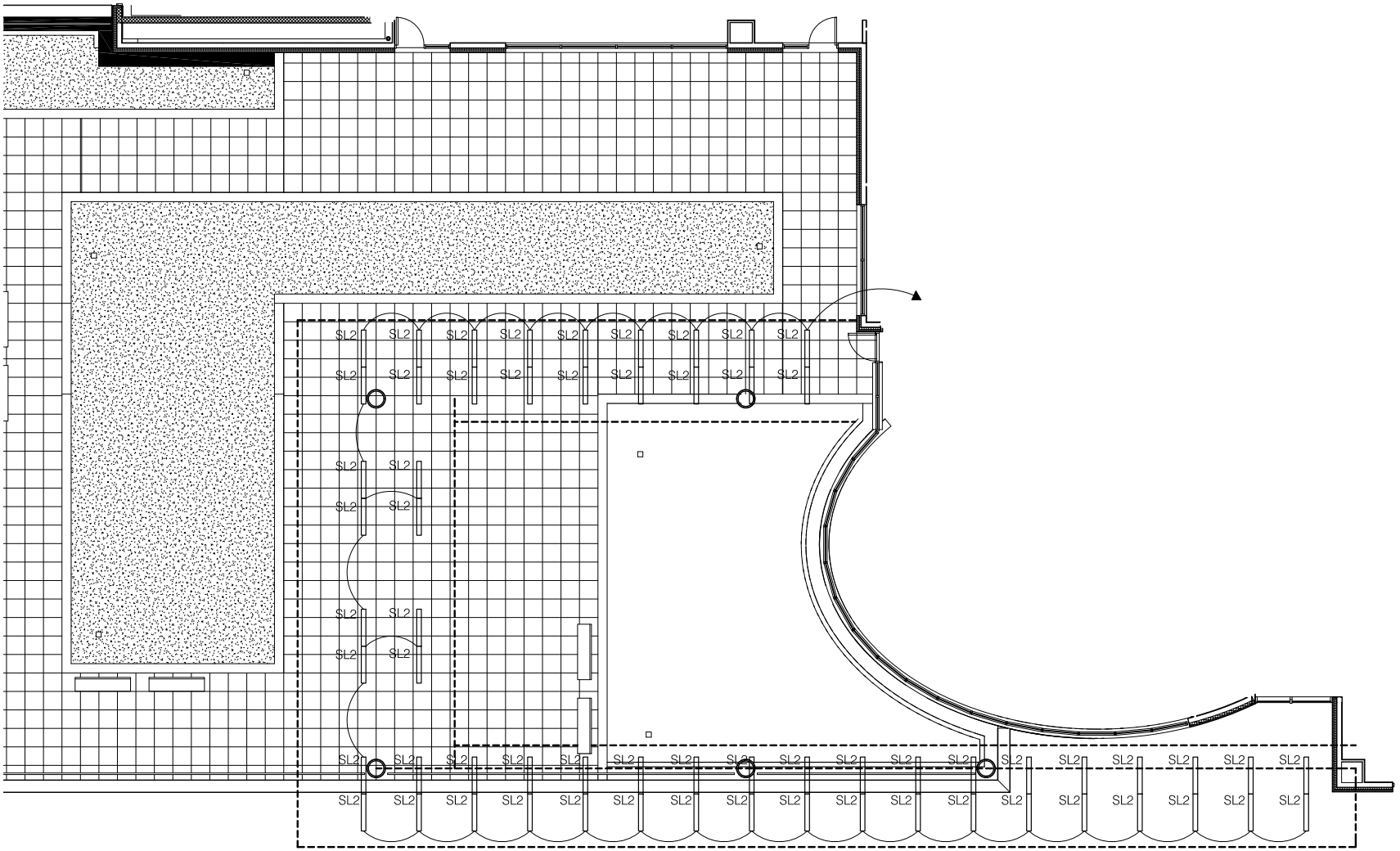
HARRISBURG, PA

SCALE:	ISSUE DATE:	DRAWN BY:	TITLE:	SHEET TITLE:
1/16" = 1'	04/03/2012	SARAH WUJCIK	ENTRY PLAZA CIRCUITING DIAGRAM	E.08





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CORPORATE HEADQUARTERS
HARRISBURG, PA

SCALE:
3/32" = 1'

ISSUE DATE:
04/03/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
ROOF GARDEN
CIRCUITING DIAGRAM

SHEET TITLE:
E.09

Appendix B | Lighting Equipment Schedule and Cut Sheets

Lighting Equipment Schedule

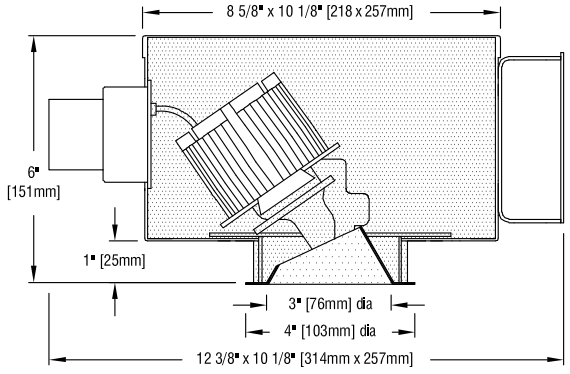
Type	Description	Manufacturer	Lamp
AL1	Recessed LED adjustable downlight with 3" aperture and 18 degree beam. Extruded aluminum finish	Edison Price Lighting	LED arrray with 800 lumen output, 3000K CCT, 85+ CRI
CL1	3' long x 6.5" wide LED asymmetric, surface mount, cove fixture with stainless steel finish	Winona Lighting	LED array, 44 watt, 1050 lumen output, 3000K CCT, 85+ CRI
DL1	Recessed LED downlight with 5" square aperture. Extruded aluminum housing. Dimmable to 10% output. 40 degree beam, 50,000 hour life.	Edison Price Lighting	LED array, 14 watt, 18 input watts, 800 lumen output, 3500K CCT, 85+ CRI
PF1	8 foot direct indirect fluorescent pendant with soft glow lens, extruded aluminum housing with aluminum finish, suspended 4 feet, 42% uplight. Integral ballast.	Litecontrol	(2) 54 watt T5HO, 85 CRI, 3500K CCT
PF2	4' long x 8" wide x 2" deep semi-indirect pendant mounted 8 ft A.F.F. with die cast aluminum housing and white paint finish.	Peerless	(1) 28 watt T5 fluorescent, 85 CRI, 3500K CCT, 32 input watts
PF3	8 foot direct indirect fluorescent pendant with soft glow lens, extruded aluminum housing with aluminum finish, suspended 4 feet, 42% uplight. Integral ballast.	Litecontrol	(2) 28 watt T5, 85 CRI, 3500K CCT
PF4	Suspended 2" wide x 6' long x 2" deep direct pendant mounted direct and indirect. Staggered mounting with extra diffuse lens and white finish. Integral ballast.	Architectural Lighting Works	(2) 21watt T5, 85 CRI, 3500K CCT
RF1	12 feet tall light column with die-cast aluminum housing, 8" diameter lens with refractor rings for anti-glare, 5" diameter pole with silver finish	Selux	(2) 32 watt T8, 3500K, 85 CRI
RL1	4 foot long x 2" wide LED linear recessed fixture with extruded aluminum housing and white enamel reflector. Integral electronic driver.	Amerlux LLC	21.6 watt LED array, 120 white LEDs, 73.6 lumens/ watt, 80+ CRI, 3500K CCT
SF1	4' long x 7" wide x 3" deep linear fluorescent wall mounted assymetric indirect fixture with extruded aluminum housing and white painted finish	Litecontrol	(1) 28 watt T5 fluorescent, 85 CRI, 3500K CCT, 32 input watts
SL1	1' LED adjustable surface mount fixture, 50 degree x 70 degree beam,	Philips Color Kinetics	LED array, 12.1 watt, 446 lumen output, 3000K CCT, 85+ CRI
SL2	4 foot long x 1" wide x 1" deep surface mount LED strip with clear anodized aluminum housing and soft focus lens	Lightwild	11.3 watts, 149 lumens/W, 80+ CRI, 3500K CCT
TL1	2" aperture LED cylinder, black die-cast aluminum finish, 26 degree beam, aluminum housing	Philips Lightoiler	LED array, 10 watt, 414 lumen output, 3000K CCT, 85+ CRI
WF1	4' recessed fluorescent direct-indirect wall wash fixture, 3" wide x 5" tall, integral dimming ballast, white powder finish	Cooper Lighting Neo-Ray	(1) 28 watt T5 lamp, 3000K CCT, 85 CRI
WF2	4' long x 6" wide recessed fluorescent grazer with open optics, steel housing, matte white housing, integral electronic dimming ballast	Focal Point	(1) 28 watt T5 lamp, 3000K CCT, 85 CRI
WL1	Recessed LED wall wash with 5" square aperture. Extruded aluminum housing. Dimmable to 10% output. 50,000 hour life.	Edison Price Lighting	LED array, 14 watt, 18 input watts, 800 lumen output, 3500K CCT, 85+ CRI

THREE LED CM AA

recessed LED accent light

AL1

FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE



Requires ceiling opening of 3 ¾" (95mm) for Overlap or Flush Detail.
Requires ceiling opening of 4" (102mm) for Trim Flush Detail.

FEATURES

Three LED CM AA is a 3" aperture LED accent light. Reflector design minimizes aperture brightness. Luminaire provides 365° horizontal rotation and 0 – 35° angular lamp adjustment. Once focused, adjustment can be locked in place by means of a lever and a wing nut. Conical reflector, cut at 25°, is designed for maximum angular adjustment. Optional reflectors cut at 0° and 15° are also available. Luminaire is 6" deep.

Luminaire is powered by Cree LED arrays of 700 or 900 lumen light output, with 2700K, 3000K, 3500K or 4000K white color, all with 80+ CRI and all with extraordinary color consistency (within 2-step MacAdam ellipse). See tables on the reverse for luminaire wattages and efficacies.

Luminaire includes an internal reflector to produce an 18° spot, 32° narrow flood or 52° wide flood beamspread. To allow beamspread to be changed in installed luminaires, internal reflectors are also available as accessories.

Luminaire with 900 lumen array and standard driver is dimmable to 10% with an electronic low voltage dimmer. Luminaires with 700 or 900 lumen arrays may be ordered with an optional driver dimmable to 1%.

Luminaire includes a holder to accept one of 14 available Optical Accessories including spread lenses and color filters.

LightPlate trim plate may be used instead of standard reflector.

Three LED CM AA includes a pair of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are also available.

APPLICATIONS

Luminaire is recommended for directional accent and display highlighting in stores, offices, museums, restaurants, showrooms, residences and hotels.

Luminaire is listed as an inherently protected luminaire and does not require a thermal protector. To maximize life of LED arrays luminaires equipped with 900-lumen arrays should be spaced at least 24" apart and 12" from walls, and should have ½" clearance above housing. Luminaire is listed for Damp Location, is RoHA compliant, is suitable for use in a fire rated ceiling and is approved for ten #12 wire 90° C branch circuit pull through wiring.

Removal of the reflector allows access to the LED array and junction box.

FULLY SUSTAINABLE

Three LED CM AA is fully sustainable. All critical components are replaceable and are available from Edison Price Lighting.

MODIFICATIONS AVAILABLE ▼ *See next page*

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit ..... THREE-LED-CM-AA

Light Output
- 700 lumens ..... – 700
- 900 lumens *note spacing requirements: see* Applications *text* ..... – 900

Beamspread
- 18° ..... – 18D
- 32° ..... – 32D
- 52° ..... – 52D

Light Engine Color *all with 80+ CRI*
- 2700K ..... – 2700
- 3000K ..... – 3000
- 3500K ..... – 3500
- 4000K ..... – 4000

Voltage: standard luminaire operates on either 120 or 277 service

Reflector Color and Detail	*Overlap*	*Flush*	*Trim Flush**
Slightly diffuse Clear	VOL	VFL	VTF
Fully diffuse Clear	ECOL	ECFL	ECTF
Champagne Gold	GOL	GFL	GTF
Black	BOL	BFL	BTF

Other reflector finishes available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

Trim Flush reflector trim requires the use of a **plaster ring Accessory (see below).*

LightPlates may be ordered instead of the standard reflectors above (see next page).

LightPlate **Downlight Spot**, white	DP3-OL	DP3-FL	DP3-TF
LightPlate **Accent Spot**, white	AP3-OL	AP3-FL	AP3-TF
LightPlate **Accent Slot**, white	AL3-OL	AL3-FL	AL3-TF

Custom painted trims for LightPlate are available on special order. Add –CC

OPTIONS *Specify by adding to the basic unit.*

Dimmable to 10% ..... standard 900-lumen unit dims to 10% with an electronic low voltage (ELV) dimmer

Dimmable to 1% with Lutron® driver, compatible with Lutron 3-wire fluorescent dimmer or EcoSystem Bus Control; available with either 700-lumen or 900-lumen units .....–DLU

Remote emergency battery pack including two components – battery and plate with test switch and light – to be mounted adjacent to luminaire .....–REMX

0° cut reflector *(standard reflector is 25°cut)* .....–0

15° cut reflector *(standard reflector is 25°cut)* .....–15

ACCESSORIES *Specify as a separate line item.*

Plaster ring allows use of Trim Flush (-TF) reflector in sheetrock ceiling; 4" (102mm) dia hole is required.....TF RING/3

18° spot internal reflector CM-REF18

32° narrow flood reflector CM-REF32

52° flood reflector..... CM-REF52

OPTICAL ACCESSORIES ▼ *See next page*

EDISON PRICE LIGHTING

41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

THREE LED CM AA

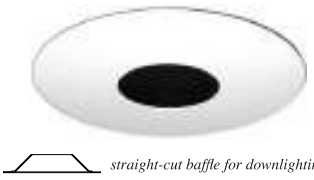
AL1

MODIFICATIONS AVAILABLE *Contact factory with quantity for pricing; orders may require shop drawing approval.*

+TR: luminaire prepared for top re-lamping; add +TR to Product Code.
+DOD: luminaire suitable for **high humidity** environments; add +DOD to Product Code.
+MAR: reflector suitable for **marine** environments; add +MAR to Product Code.

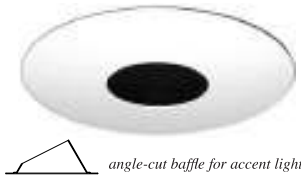
LIGHTPLATES *LightPlates may be used instead of standard reflectors.*

DOWNLIGHT SPOT



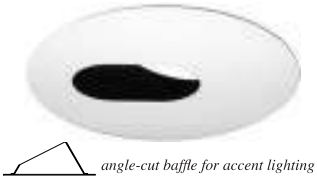
straight-cut baffle for downlighting

ACCENT SPOT



angle-cut baffle for accent lighting

ACCENT SLOT



angle-cut baffle for accent lighting

OPTICAL ACCESSORIES *Specify as separate line*

All are 2 3/8" (60mm) diameter. Lenses and filters are glass; screens are aluminum.

diffuse glass DGS/2.375
prismatic lens (Solite) PLS/2.375
55° spread lens LENS/2.375
40° x 70° spread lens LENS/2.375-4070
beam smoother CLR/2.375
33% light reduction screen SCR33/2.375
50% light reduction screen SCR50/2.375

color filters

surprise pink PNK/2.375
daylight blue DAY/2.375
amber AMB/2.375
blue BLU/2.375
green GRN/2.375
red RED/2.375

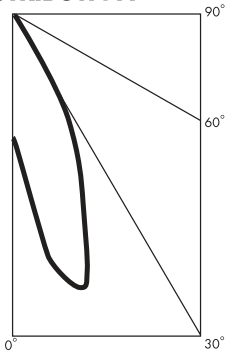
PHOTOMETRIC REPORT (tested per IESNA LM-79-2008)

LTL *Report No. 23087. Original Luminaire Testing Laboratories, Inc. (LTL) test reports furnished upon request.*

Luminaire ..... recessed LED accent light with slightly diffuse clear aluminum reflector, LED aimed at 15° above vertical
Light Source ..... one white LED with 18° beam spread integral reflector, 3000K CCT, 900 lumens.
Luminaire light output..... 450 lumens
Luminaire efficacy ..... 24 lumens per watt

LUMINAIRE STANDARD CANDLEPOWER DISTRIBUTION

Vertical Angle	*Horizontal Angle*				
	0	*45*	*90*	*135*	*180*
0	1042	1042	1042	1042	1042
5	1459	1269	956	714	582
15	2415	1260	390	83	8
25	1379	488	6	0	0
35	237	29	0	2	2
45	0	14	0	0	0
55	0	0	0	0	0
65	0	0	0	0	0
75	0	0	0	0	0
85	0	0	0	0	0
95	0	0	0	0	0



LUMINAIRE LIGHT OUTPUT AND EFFICACY

LED Light Output	*Luminaire Light Output*	*Luminaire Efficacy (lumens/watt)*	*System Wattage*
700 Lumens	370*	26*	14.5*
900 Lumens	450	24	19.0

**estimated values*

LIGHT OUTPUT MULTIPLIER

700 lumens light output	*900 lumens light output*
0.82 *(estimated)*	1.00

DRIVER INFORMATION *UL Class 2, dry and damp location*

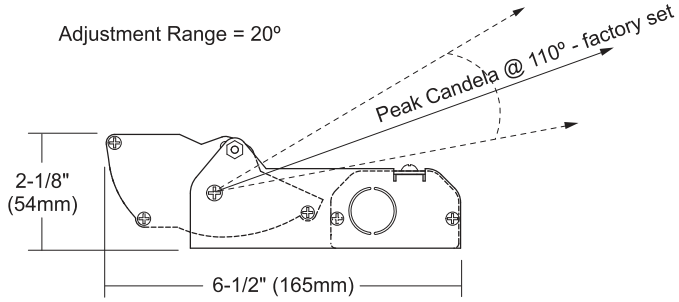
Line Voltage	*120*	*277*
Input Watts (700/900 lumens)	14.5/19.0	14.5/19.0
Input Current (A) (700/900 lumens)	0.12/0.16	0.05/0.07
Output Current (mA)	550/700	550/700
Output Voltage (Vdc)	23-25	23-25
Min. Power Factor (700/900 lumens)	>.9/>.99	>.9/>.99
Operating Temperature Range (F)	-13 to122	-13 to122

SCV1 SMALL ASYMMETRIC COVE • LED

Cove

SCV1 Asymmetric LED Cove
QUICK FIND #: QF-1130

MOUNTING DETAIL



Weight:

24" = 5 lbs	60" = 12 lbs
36" = 7 lbs	72" = 14 lbs
48" = 9 lbs	84" = 16 lbs
96" = 18 lbs	

MOUNTING- *Integral front wireway runs the length of the luminaire allowing for a continuous row mount without spaces betweens sections. Knock outs are located at each end of the housing to allow for through wiring. Individual aiming is achieved with the adjustable locking mechanism. See Mounting Detail above.*

TYPE- *Small profile linear luminaire. For indoor use only.*

COLOR AND LIGHT OUTPUT - *SCV1 Cove Series utilizes Nichia 183 white LEDs in five standard color temperatures. Model SCV1 features (12) LEDs/ft. Estimated LED lamp life is an industry standard 50,000 hours to 70% depreciation. A modular design has been incorporated that allows field replacement of the LED board/heat sink assembly for this product.*

Color	*Model SCV1*
ANSI-2700K White	*341 lm/ft*
ANSI-3000K White	*350 lm/ft*
ANSI-3500K White	*371 lm/ft*
ANSI-4000K White	*427 lm/ft*
non-ANSI-5000K White	*486 lm/ft*

PERFORMANCE- *High performance small profile linear luminaire incorporating an extruded reflector specifically designed for high output LED sources. The optical design allows for maximum beam projection across the target plane and even cove or slot illumination in tight setback applications. Has aimable and lockable optics, is ruggedly constructed and utilizes an extruded aluminum front wireway that allows low profile luminaires to be installed continuously, eliminating socket shadows.*

ELECTRICAL- *Power consumption is 15W/ft. (maximum run length 28 feet). Operates on 24VAC and can be dimmed with commonly available low voltage magnetic dimming equipment. A wide range of remote transformers are available in 120V and 277V primary (see technical section).*

PROFILE- P1 (basic): *Anodized, extruded high-purity aluminum specular reflector with solid aluminum end caps and wireway. Stainless steel hardware.*

OPERATING TEMPERATURE - *Minimum and Maximum ambient air temperatures around this luminaire shall not exceed -22°F to 113°F (-30°C to 45°C). Any application of this product should also take into consideration air flow and ventilation to ensure performance and reliability.*

FINISHES- *Bright anodized specular reflector with mill finish aluminum components and stainless steel hardware.*

• *Winona Lighting reserves the right to make design revisions without prior notice.*

3190865

Windirect SCV1 is ETL listed for dry location. This complies with UL Standard 2108.

RoHS COMPLIANT

PRODUCT SPECIFICATION

SCV1 – SLC – LED1 – ____ – ____ – ____ – P1 – RA – X – ____

MOUNTING
SCV1 - front wireway

TYPE
Indoor
dry label
SLC - small LED cove

LAMP CODE

Lamp Code	Description
LED1	(12) Nichia 183 high output / ft.

Modification:

RUN LENGTH CODE
Total Run Length in Feet - SCV1 offered in 12" increments starting at 24" ex. 60FT = 60 foot run
or
Preconfigured Run Length Code - see submittal at www.winonalighting.com (additional information see technical section)
or
To Be Determined - TBD when run length unknown

LED CODE
27K - 2700K ANSI-binned
30K - 3000K ANSI-binned
35K - 3500K ANSI-binned
40K - 4000K ANSI-binned
50K - 5000K non-ANSI-binned

VOLTAGE
ND24V - non-dimming 24 volt AC
DM24V - dimming 24 volt AC

PROFILE
P1 (basic)

FINISH
RA - raw anodized
anodized reflector with mill finish components

OPTIONS
X - no options

CLASS
STD - standard
MOD - modified

Nichia 183 LED
36" Luminaire
3000K
Report #15314
PHOTOMETRY
Visit the web for detailed photometry reports

Visit www.winonalighting.com for the most complete and current information.

LED SQUARE FTS DL/5

recessed LED downlight

DL1

FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE

FEATURES

LED Square FTS DL/5 is a 5" square downlight employing LED technology. Fixture is only 5 7/8" deep. Precise reflector design minimizes aperture brightness, virtually eliminates the inter-reflections inherent with square apertures and provides a shielding angle of 40°.

Luminaire is powered by a Philips Fortimo SLM LED module, dimmable to 10% with a 0-10 volt dimmer, with a CRI as high as 90 and a 5-year warranty. Luminaire may be specified with modules of 800, 1100 or 2000 lumen light output and with 2700K, 3000K, 3500K or 4000K color. Refer to the tables below for system wattages and luminaire efficacies.

Other features include:

- life: 50,000 hours at 70% of initial light output (IESNA LM80-2008)
- operational range: tolerates temperatures as low as -20° C (-4°F)

Luminaire reflectors are available with an optional glass shield or lens.

Luminaire reflectors are available in slightly diffuse clear natural aluminum or champagne gold Alzak®.

Luminaire includes a pair of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are also available.

APPLICATIONS

Luminaire is recommended for downlighting in commercial, retail and residential spaces.

Luminaire is listed for Damp Location. Luminaire is prewired with thermal protector, approved for ten #12 wire 90° branch circuit pull-through wiring and suitable for use in a fire rated ceiling. To maximize life of LED modules luminaires equipped with 2000-lumen modules should be spaced at least 30" apart and 15" from walls, and should have ½" clearance above housing. All luminaires are RoHS compliant. Removal of the reflector allows access to the junction box.

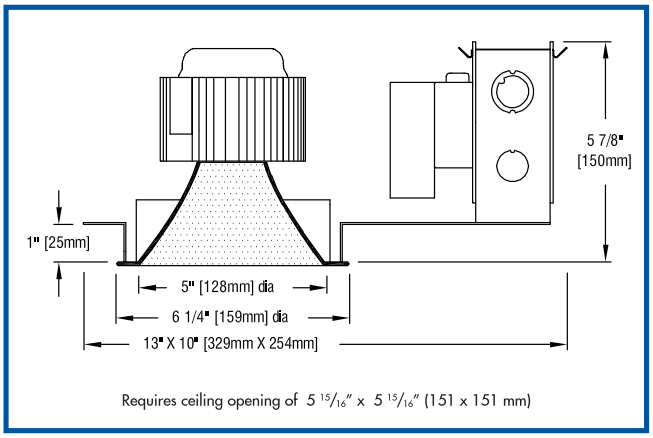
FULLY SUSTAINABLE

LED Square FTS DL/5 is fully sustainable. Both critical components – the LED module (diode array) and the driver (power conditioner) – can be replaced through the aperture with a screwdriver. Both components are, and will remain, available from Edison Price Lighting.

MODIFICATIONS AVAILABLE

Contact factory with quantity for pricing; orders may require shop drawing approval.

+DOD: luminaire suitable for **high humidity** environments; add +DOD to Product Code.
+MAR: reflector suitable for **marine** environments; add +MAR to Product Code.



Requires ceiling opening of 5 15/16" x 5 15/16" (151 x 151 mm)

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit LED-SQ-FTS-DL/5
NOTE: Standard driver is dimmable to 10% with a 0-10 volt dimmer.

Light Output
- 800 lumens 800
- 1100 lumens 1100
- 2000 lumens note spacing requirements: see Applications text. 2000

Light Engine Color
- 2700K (90 CRI) 2700
- 3000K (90 CRI) 3000
- 3500K (80 CRI) 3500
- 4000K (80 CRI) 4000

Voltage
- 120 volt service 120
- 277 volt service 277

Reflector Color and Detail

	Overlap
Slightly diffuse Clear	VOL
Champagne Gold	GOL

Other reflector finishes available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

OPTIONS

Specify by adding to the basic unit.

Dimmable ..standard driver is dimmable to 10% with a 0-10 volt dimmer.

Emergency battery pack operates luminaire in event of power outage. Includes a plate with ready light and test switch for adjacent installation by others ..... – REM

1/8" (3mm) thick **clear glass shield** ..... – GS
1/8" (3mm) thick **prismatic lens** ..... – WLS

EDISON PRICE LIGHTING

41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

U.S. Patent No. US 7,744,256 B2 (June 29, 2010)

LED SQUARE FTS DL/5

DL1

PHOTOMETRIC REPORT (tested per IESNA LM-79-2008)

LTL *Report No. 25254 and 25255. Original Luminaire Testing Laboratories, Inc. (LTL) test reports furnished upon request.*

Luminaire ..... recessed LED square downlight with aluminum reflector
Lamp ..... Philips LED Fortimo SLM 2000, 3000K CCT
Spacing Criteria 1.0
Luminaire light output..... 1575 lumens

LUMINAIRE LIGHT OUTPUT AND EFFICACY

Color	800 lumens light engine			1100 lumens light engine			2000 lumens light engine		
	Luminaire *Light Output*	Luminaire *Efficacy*	System *Wattage*	Luminaire *Light Output*	Luminaire *Efficacy*	System *Wattage*	Luminaire *Light Output*	Luminaire *Efficacy*	System *Wattage*
2700K	700*	37	19	963*	36	27	1575	38	42
3000K	700*	39	18	963*	39	25	1575	40	39
3500K	700*	50	14	963*	48	20	1575	53	30
4000K	700*	54	13	963*	51	19	1575	61	26

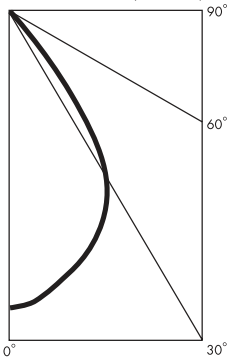
*estimated values

LIGHT OUTPUT MULTIPLIER

800 lumens light engine	0.44
1100 lumens light engine	0.61
2000 lumens light engine	1

CANDLEPOWER DISTRIBUTION *(Candela)*

Vertical Angle	Horizontal Angle 0
0	1566
5	1540
15	1392
25	1173
35	589
45	43
55	0
65	0
75	0
85	0
90	0



ZONAL LUMEN SUMMARY

Zone	Lumens	% Fixture
0 - 30°	1047	66.5
0 - 40°	1478	93.9
0 - 60°	1575	100.0
0 - 90°	1575	100.0
90 -180°	0	0.0
0 -180°	1575	100.0

LUMINANCE DATA *(Candela/m²)*

Vertical Angle	Horizontal Angles 0
45	3807
55	0
65	0
75	0
85	0

DRIVER INFORMATION UL Class 2, dry and damp location

Voltage	120	277
Input Watts *(800/1100/2000 lumens), 3000K*	18/25/39	18/25/39
Input Current (A) *(800/1100/2000 lumens)*	0.15/0.21/0.33	0.06/0.09/0.14
Output Current (mA)	200-700	200-700
Output Voltage (Vdc)	25–56	25–56
Min. Power Factor	>0.9	>0.9
Operating Temperature Range (F)	–4 to 131	–4 to 131

DIMMING INFORMATION

Dimming Method	Dimming Range (%)	Min. Output Power
0 - 10V	10% -100%	15

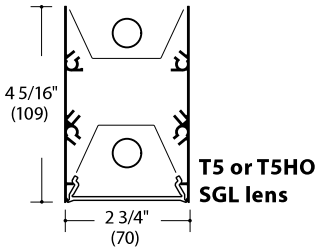
COMPATIBLE DIMMERS Please verify with vendors

CONTROL MANUFACTURER	WALLBOX DIMMER	POWER BOOSTER AVAILABLE
DOUGLAS LIGHTING CONTROLS	WPC-5721	
ENTERTAINMENT TECHNOLOGY	Tap Glide TG600FAM120(120V) Tap Glide Heatsink TGH1500FAM120 (120V) Oasis OA2000FAMU (120/277V)	
HONEYWELL, INC.	EL7315A1019 and EL7315A1009	EL7305A1010 (optional)
HUNT DIMMING	Preset slide: PS-010-IV-120V and PS-010-WH-120V Preset slide: PS-010-3W-IV-120V and PS-010-3W-WH-120V Preset slide: PS-010-IV-277V and PS-010-WH-277V Preset slide: PS-010-3W-IV–277V and PS-010-3W-WH-277V Preset slide, controls FD-010: PS-IFC-010-IV and PS-IFC-010-WH-120/277V Preset slide, controls FD-010: PS-IFC-010-3W-IV and PS-IFC-010-3W-WH-120/277V Remote mounted unit: FD-010-120V and FD-010-277V	
LEHIGH ELECTRIC PRODUCTS CO.	Solitarire	PBX
LEVITON LIGHTING CONTROLS DIV.	Leviton Centura Fluorescent Control System IllumaTech™ IP7 Series	CN100 PE300
LIGHTOLIER CONTROLS	Sunrise Preset slider ZP600FAM-120 (120V) Momentum Preset slider MP1500FAM-120 (120V) Vega Slider V2000FAMU (120-277V)	
LITHONIA CONTROLS	ISD BC SLD LPCS Digital Equinox (DEQ BC)	RDM FC
LUTRON ELECTRONICS CO., INC.	Visit **www.lutron.com/advance** for the latest control information and selection	
PDM ELECTRICAL PRODUCTS	WPC-5721	
STARFIELD CONTROLS	TR61 with DALI interface port	RT03 DALInet Routers
THE WATT STOPPER, INC.	LS-4 used with LCD-101 and LCD-103	

LITECONTROL

Fixture Type:
Project Name:

PF1



LCS™ Control Solutions available

Mod™

P-ID-0200

Pendant-Mounted Indirect/Direct

Product Description

Small-scale indirect/direct extruded aluminum luminaire with separate up and downlight chambers. UL Listed. Cradle to Cradle Certified.CM

Ordering Guide

Product, Lamping, & Length

P -	ID -	02	Upper Lamp: 2	Upper Lamp: 8	Upper Lamp: T5HO	Lower Lamp: 2	Lower Lamp: 8	Lower Lamp: T5HO
Mounting	Distribution	Series	Lamp Count	Nominal Length (ft)	Lamp Type	Lamp Count	Nominal Length (ft)	Lamp Type
P Pendant-mounted	**ID** Indirect/ Direct	**02**	**1 →**	**3**	**T5**	**1 →**	**3**	**T5**
			1 →	**4**	**T5HO**	**1 →**	**4**	**T5HO**
			2 →	**6**	**T8**	**2 →**	**6**	**T8**
			2 →	**8**		**2 →**	**8**	
			3 →	**12**		**3 →**	**12**	
			see **notes**			see **notes**		

Mounting
- add to end of catalog number
Aircraft cables
✓ **FAI/ACC** (field adjustable)
standard

Options

SGL-	TCWM-	LP/ELB-	--	1CWQ-	F-	120
Baffle or Diffuser	Finishes	Ballasts	Tandem Wiring	Pre-wiring	Other Options	Volts
BW **SGL** see **Baffle and Diffuser Options**	**CMA** (color machined aluminum) **TCWM** (textured matte white) are std. see **LiteColors™** for other finishes	**ELB10** is std. for T8 **LP/ELB** is std. for T5 & T5HO **DA/MK7** **DL/ECO** **DO/HEL** **LPD/CS/e** see **Ballast Options**	-- → TW →	**1CWQ** **2CWQ**	**F** **LP/EF** see **Other options**	**120** **277**

notes:
Lamp count = total number of lamps in the fixture
For ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications.

P-ID-0228T5HO/28T5HO-SGL-TCWM-LP/ELB-1CWQ-F-120-FAI/ACC is a typical catalog number for a 2-lamp indirect (1 lamp in cross-section) / 2-lamp direct (1 lamp in cross-section), 8-foot long high output T5 indirect/direct fixture with soft glow lens, textured matte white finish, with a low-profile electronic T5HO ballast, one-circuit branch wiring and quick-connects, fuse, 120 volt, mounted with field adjustable aircraft cables.

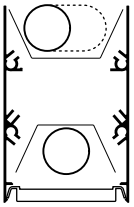
Cross-section lamping


1-T5 or T5HO


1-T8

Other Options

F Fuse. Slow or fast blow, determined by Litecontrol.
LP/EF Low-profile Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one lamp for 1 1/2 hours.


T8
BW baffle

Baffle and Diffuser Options

BW Blade Baffle, White. 5/16" high and 1/2" OC, aluminum, flush to bottom of fixture housing.
SGL Soft Glow Lens. Extruded, frosted acrylic, flush to bottom of fixture housing.

Finishes

TCWM Textured Matte White paint.
CMA Color Machined Aluminum. Specially formulated powdercoat paint that reliably and uniformly mimics the appearance of machined/sandblasted aluminum.
For *LiteColors* or other finish choices, consult the Product Guide or litecontrol.com.

Ballast Options LCSe

Specify in place of **ELB10** or **LP/ELB**, contact factory for availability:

DA/MK7 Advance Mark VII dimming ballast
DL/ECO Lutron ECO-10 dimming ballast
DO/HEL Osram Sylvania dimming ballast

To have the fixture enabled for Lutron EcoSystem compatibility:
LPD/CS/e EcoSystem low-profile dimming electronic ballasts installed at the factory, along with all required internal EcoSystem wiring. For other configurations of the Lutron EcoSystem components, including custom device connection feeds to enable connection to ceiling-mounted sensors and control devices, consult litecontrol.com/cs or contact the factory.

Tandem Wiring & Circuiting Options

1CWQ Fixture is wired with a single-circuit so that all lamps are switched together.
TW-2CWQ Fixtures wired with two circuits. The fixture is wired so that the indirect and direct lamps are switched separately.

Questions to Ask

1. Row information, including desired fixture lengths?
2. Lamp type? **3.** White baffle or soft glow lens? **4.** White, clear anodized, *LiteColor*, or special color?
5. Ballast options? **6.** Controls solutions? **7.** Other options? **8.** 120 or 277 volt?

revised 2/24/2011

Click on **Quick Find 02id**
litecontrol.com

Specifications

HOUSING. Two-piece extruded aluminum. Standard finishes include Textured Matte White (**TCWM**) paint or Color Machined Aluminum (**CMA**).
END CAPS. Required at each end of row and at both ends of an individual fixture. Either painted steel or Color Machined Aluminum (**CMA**) with no holes or knockouts, finished to match housing.
REFLECTOR. Die-formed steel with high-reflectance white finish.
LAMPING. Available in one-lamp T8, T5, or T5HO. T8 upper lamp is diagonally positioned along length to clear suspension hardware at fixture ends for "on-module" suspension, and provide symmetrical light distribution.
BALLAST. Electronic Ballast (**ELB10** for T8 lamping) or Low-profile Electronic Ballast (**LP/ELB** for T5 or T5HO lamping), high power factor, thermally protected Class P, Sound Rated A, manufactured by a UL-Listed manufacturer, as available, determined by Litecontrol. Ballasts with a voltage range of 120 to 277 will be used when fixture configuration and ballast availability allow. The minimum number of ballasts will be used.
CONTROLS. Available as an EcoSystem enabled fixture. See Ballast and Control options for details.
PRE-WIRING. Fixtures are supplied with #12 AWG type THHN wire for branch circuits. One end will have factory installed push-in quick-connects. The other end will be stripped back 1/2" for quick connection in field. For fixtures to accommodate special circuits such as night light and emergency, etc., in-field wiring will be required. See Pre-wiring Information online for details.
BALLAST DISCONNECT. Fixture supplied with a ballast disconnect device to enable compliance with the NEC.
ROW JOINING. Support points are centered above the midpoint of joint "on seam" for aligned, symmetrical appearance. Fixture end headers are threaded in one location to allow easy row joining without removing reflectors.
SUSPENSION Yoke with field adjustable aircraft cable attaches directly to the end header. Mounting points in rows are exactly "on module" at 36", 48", 72", 96", and 144", including at ends of rows.
CERTIFICATION. Fixture and electrical components shall be UL and/or CUL Listed and shall bear the I.B.E.W., A.F. of L. label. UL LISTED This fixture is Cradle to Cradle Certified^{CM} Silver by MBDC.

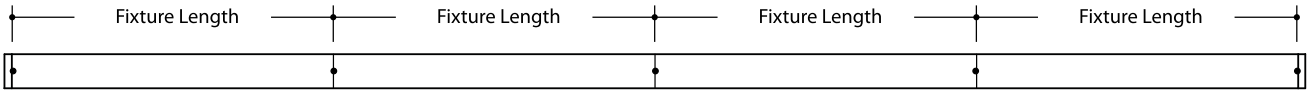
Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

Planning for installation

Suspension Assemblies
Provided with 3/64" diameter field adjustable aircraft cables (FAI/ACC) in 51" lengths (4' nominal). Longer length aircraft cables of 87" and 219" are available upon request. See Aircraft Cables sheets for further details.

Suspension mounting locations
Yoke with field adjustable aircraft cable attaches directly to end header. Mounting points in rows are exactly "on module" at 36", 48", 72", 96", and 144", including at ends of rows.

Row diagram

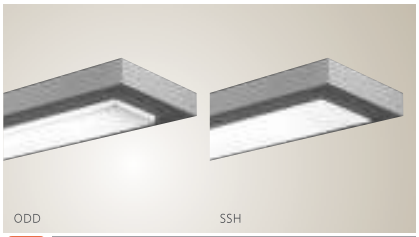


Fixture Lengths: 3', 4', 6', 8', and 12'
• Indicates pendant locations

LITECONTROL
employee owned | customer driven
100 Hawks Avenue Hanson, MA 02341
781 294 0100 f: 781 293 2849 litecontrol.com

PEERLESS®

PF2



Bruno

Diffuser / Softshine™ T5 / T5HO

Project:

SPECIFICATIONS Pendant Mount — Modular / 8" X 2" Rectangular BRM9

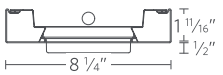
CATALOG NUMBER

FT

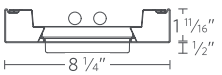
Examples: BRM9 2 28T5 SPR ODD 40FT R8 277 GEB10 DCT LP835 F1/18 C210 SCEP — BRM9 3 54T5HO SPR SSH R8 277 GEB10 1SE EL DCT LP835 F1/21 C110

AVAILABLE FIXTURES

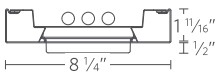
☐ **BRM9 - 1 - ODD**



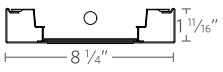
☐ **BRM9 - 2 - ODD**



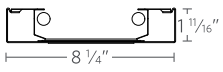
☐ **BRM9 - 3 - ODD**



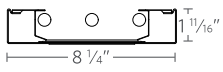
☐ **BRM9 - 1 - SSH**



☐ **BRM9 - 2 - SSH**



☐ **BRM9 - 3 - SSH**



SPECIFICATIONS

Construction
Housing is a nominal 8 1/4" x 1 11/16" rectangular channel formed from cold-rolled steel. 5/8" thick aluminum die cast end caps are standard, 4" sculpted die cast aluminum end caps are optional.

Reflectors
Die formed specular reflector with 95% reflectance.

Shielding
Die formed drop acrylic diffuser or flush Softshine™ high performance lens.

Finish
Fine textured white polyester powder paint is standard. Consult factory for special finish requirements.

Electrical
Specify 120V, 277V, or 347V. Pre-wired with 16AWG fixture wire. For special circuiting or wire gauge, consult factory. Plug-in electrical connectors included. UL and C-UL listed and labeled.

Fixture Length
4' 3/8", 8' and 12' lengths in a single section for nominal support spacing 4'-0", 8'-0", and 12'-0". For total fixture length, add 5/8" for each flat end cap and 4" for each sculpted end cap. Using internal joiners, 4', 8' and 12' sections can be joined to form longer rows.

ORDERING LOGIC

Use guide below to order complete fixture runs from four feet to one-hundred feet in increments of four.

Fixture	# of Lamps in Cross Section	Lamp Type	Reflector	Distribution[2,3]	Shielding	Nominal Row Length[4]	Maximum Section Length	Voltage	Ballast Type	# of Emergency Modules
BRM9	1 2 3	28T5 54T5HO	**SPR** Specular Reflector	**Blank** Standard; 70% Up; 30% Down **20/80** 20% Up; 80% Down **0/100**[8] 0% Up; 100% Down	**ODD** Opal Drop Diffuser **SSH** Softshine™ High Performance Lens	FT	**R4** **R8** **R12**	**120** **277** **347**	**GEB10** <10% THD ELECTRONIC **ADEZ**[1,5] Advance Mark 10 dimming **ECO10**[1] Lutron ECO-10 dimming **OSDIM**[1,5] Osram 0-10v dimming *Reference Ballast Chart on website or consult factory for other options.*	**Blank** No Emergency **1SE** 1 section **2SE** 2 sections **XSE** X sections

Emergency Type[6]	Switching	Lamp Color	Mounting Type /	Overall Suspension	Finish	Options
Blank No Emergency or Night Light **EL**[1] Emergency Battery Pack **EC** Emergency / Night Light Circuit **EN**[1] Emergency Battery Pack with Night Light Circuit	**SCT** Single Circuit **DCT** Dual Circuit	**L/LP** No Lamp **LP830** 3000K 80+ CRI **LP835** 3500K 80+ CRI **LP841** 4100K 80+ CRI **Available with T5 only:** **LP830** 3000K 80+ CRI Premier Lamp **LP835** 3500K 80+ CRI Premier Lamp **LP841** 4100K 80+ CRI Premier Lamp *Reference Lamp Chart on website or consult factory for other options.*	**F1** T-Bar Ceiling (Universal Mounting Bracket) **F1A** T-Bar Ceiling (UMB with Integrated J-Box) **F2** Hard Ceiling (Horizontal J-Box) **F3** Stem Mount **F4A** IDS Clip 15/16" Tee **F4B** IDS Clip 9/16" Tee **F4C** IDS Clip Screw Slot	**12** 12" overall suspension **15** 15" overall suspension **18** 18" overall suspension **21** 21" overall suspension **24** 24" overall suspension **XX** XX" overall suspension	**C210** Standard White White (fine-textured low gloss) **C110** Painted to match Aluminum Finish **C099** Custom Color	**ACG** Adjustable Cable Grippers **BLK** Black Cord, Cord Manager and Canopies **CP** Chicago Plenum **DL** Damp Location Label (not available with EL or EN) **DPC**[12] Daylight Photocell **DU**[7,8,9] Dust Cover **ELH** EM Through wire w/ Separate Feed **ELS** EM Through Wire w/ Single Feed **ELS2** Normal feed w/ EM Separate Neutral **GLR** Fusing (Fast blow) **GMF** Fusing (Slow Blow) **MCS** Matching Feed Canopy at Support **NYC** New York City Code **OJB** Offset Junction Box **SCEP** Sculptured End Cap **SLP**[10,11] Sloped Ceiling 10-45°

Notes:
1 Not available in 347 volt.
2 Nominal distribution. Refer to photometric reports for exact distribution.
3 Available with SSH (Softshine) only.
4 Must be in 4' increments.
5 Not available with 28T5 Lamp Type.
6 EL and EC are installed in last 4' of fixture sections and are not available concurrently. Separate feed required for each EL or EC unless ELS/ELH/ELS2 is specified.
7 Not available with 3 lamp.
8 Ambient conditions not to exceed 35° C for 2 or 3 Lamp 54T5HO.
9 Not available with 20/80 or 0/100 Distribution.
10 Available with F2 Mounting Type only.
11 Must order with OJB option.
12 Photocell installed approx. 4ft from the beginning of the row. DPC must be used w/ 0-10V dimming ballast.

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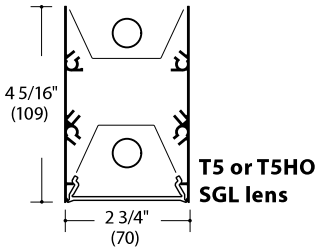
LITECONTROL

Fixture Type:
Project Name:

PF3



T5 or T5HO
SGL lens

LCS™ Control Solutions available

Mod™

P-ID-0200

Pendant-Mounted Indirect/Direct

Product Description

Small-scale indirect/direct extruded aluminum luminaire with separate up and downlight chambers. UL Listed. Cradle to Cradle Certified.CM

Ordering Guide

Product, Lamping, & Length

P -	ID -	02	Upper Lamp: 2	Upper Lamp: 8	Upper Lamp: T5HO	Lower Lamp: 2	Lower Lamp: 8	Lower Lamp: T5HO
Mounting	Distribution	Series	Lamp Count	Nominal Length (ft)	Lamp Type	Lamp Count	Nominal Length (ft)	Lamp Type
P Pendant-mounted	**ID** Indirect/ Direct	**02**	**1 →**	**3**	**T5**	**1 →**	**3**	**T5**
			1 →	**4**	**T5HO**	**1 →**	**4**	**T5HO**
			2 →	**6**	**T8**	**2 →**	**6**	**T8**
			2 →	**8**		**2 →**	**8**	
			3 →	**12**		**3 →**	**12**	
			see **notes**			see **notes**		

Mounting
- add to end of catalog number
Aircraft cables
✓ **FAI/ACC** (field adjustable)
standard

Options

SGL-	TCWM-	LP/ELB-	--	1CWQ-	F-	120
Baffle or Diffuser	Finishes	Ballasts	Tandem Wiring	Pre-wiring	Other Options	Volts
BW **SGL** see **Baffle and Diffuser Options**	**CMA** (color machined aluminum) **TCWM** (textured matte white) are std. see **LiteColors™** for other finishes	**ELB10** is std. for T8 **LP/ELB** is std. for T5 & T5HO **DA/MK7** **DL/ECO** **DO/HEL** **LPD/CS/e** see **Ballast Options**	**--** → **TW** →	**1CWQ** **2CWQ**	**F** **LP/EF** see **Other options**	**120** **277**

notes:
Lamp count = total number of lamps in the fixture
For ordering guide information in shaded areas, choose selection by reading ACROSS the shaded areas for correct specifications.

P-ID-0228T5HO/28T5HO-SGL-TCWM-LP/ELB-1CWQ-F-120-FAI/ACC is a typical catalog number for a 2-lamp indirect (1 lamp in cross-section) / 2-lamp direct (1 lamp in cross-section), 8-foot long high output T5 indirect/direct fixture with soft glow lens, textured matte white finish, with a low-profile electronic T5HO ballast, one-circuit branch wiring and quick-connects, fuse, 120 volt, mounted with field adjustable aircraft cables.

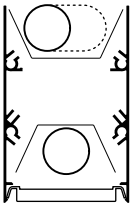
Cross-section lamping


1-T5 or T5HO


1-T8

Other Options

F Fuse. Slow or fast blow, determined by Litecontrol.
LP/EF Low-profile Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one lamp for 1 1/2 hours.


T8
BW baffle

Baffle and Diffuser Options

BW Blade Baffle, White. 5/16" high and 1/2" OC, aluminum, flush to bottom of fixture housing.
SGL Soft Glow Lens. Extruded, frosted acrylic, flush to bottom of fixture housing.

Finishes

TCWM Textured Matte White paint.
CMA Color Machined Aluminum. Specially formulated powdercoat paint that reliably and uniformly mimics the appearance of machined/sandblasted aluminum.
For *LiteColors* or other finish choices, consult the Product Guide or litecontrol.com.

Ballast Options LCSe

Specify in place of **ELB10** or **LP/ELB**, contact factory for availability:

DA/MK7 Advance Mark VII dimming ballast
DL/ECO Lutron ECO-10 dimming ballast
DO/HEL Osram Sylvania dimming ballast

To have the fixture enabled for Lutron EcoSystem compatibility:
LPD/CS/e EcoSystem low-profile dimming electronic ballasts installed at the factory, along with all required internal EcoSystem wiring. For other configurations of the Lutron EcoSystem components, including custom device connection feeds to enable connection to ceiling-mounted sensors and control devices, consult litecontrol.com/cs or contact the factory.

Tandem Wiring & Circuiting Options

1CWQ Fixture is wired with a single-circuit so that all lamps are switched together.
TW-2CWQ Fixtures wired with two circuits. The fixture is wired so that the indirect and direct lamps are switched separately.

Questions to Ask

1. Row information, including desired fixture lengths?
2. Lamp type? **3.** White baffle or soft glow lens? **4.** White, clear anodized, *LiteColor*, or special color?
5. Ballast options? **6.** Controls solutions? **7.** Other options? **8.** 120 or 277 volt?

revised 2/24/2011

Click on **Quick Find 02id**
litecontrol.com

Specifications

HOUSING. Two-piece extruded aluminum. Standard finishes include Textured Matte White (**TCWM**) paint or Color Machined Aluminum (**CMA**)
END CAPS. Required at each end of row and at both ends of an individual fixture. Either painted steel or Color Machined Aluminum (**CMA**) with no holes or knockouts, finished to match housing.
REFLECTOR. Die-formed steel with high-reflectance white finish.
LAMPING. Available in one-lamp T8, T5, or T5HO. T8 upper lamp is diagonally positioned along length to clear suspension hardware at fixture ends for "on-module" suspension, and provide symmetrical light distribution.
BALLAST. Electronic Ballast (**ELB10** for T8 lamping) or Low-profile Electronic Ballast (**LP/ELB** for T5 or T5HO lamping), high power factor, thermally protected Class P, Sound Rated A, manufactured by a UL-Listed manufacturer, as available, determined by Litecontrol. Ballasts with a voltage range of 120 to 277 will be used when fixture configuration and ballast availability allow. The minimum number of ballasts will be used.
CONTROLS. Available as an EcoSystem enabled fixture. See Ballast and Control options for details.
PRE-WIRING. Fixtures are supplied with #12 AWG type THHN wire for branch circuits. One end will have factory installed push-in quick-connects. The other end will be stripped back 1/2" for quick connection in field. For fixtures to accommodate special circuits such as night light and emergency, etc., in-field wiring will be required. See Pre-wiring Information online for details.
BALLAST DISCONNECT. Fixture supplied with a ballast disconnect device to enable compliance with the NEC.
ROW JOINING. Support points are centered above the midpoint of joint "on seam" for aligned, symmetrical appearance. Fixture end headers are threaded in one location to allow easy row joining without removing reflectors.
SUSPENSION Yoke with field adjustable aircraft cable attaches directly to the end header. Mounting points in rows are exactly "on module" at 36", 48", 72", 96", and 144", including at ends of rows.
CERTIFICATION. Fixture and electrical components shall be UL and/or CUL Listed and shall bear the I.B.E.W., A.F. of L. label. UL LISTED This fixture is Cradle to Cradle Certified[CM] Silver by MBDC.

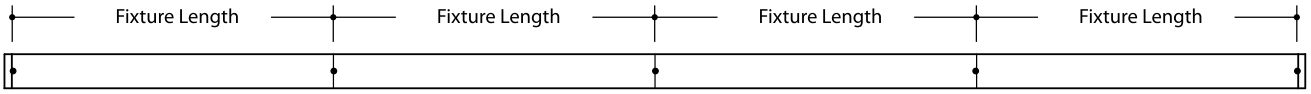
Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

Planning for installation

Suspension Assemblies
Provided with 3/64" diameter field adjustable aircraft cables (FAI/ACC) in 51" lengths (4' nominal). Longer length aircraft cables of 87" and 219" are available upon request. See Aircraft Cables sheets for further details.

Suspension mounting locations
Yoke with field adjustable aircraft cable attaches directly to end header. Mounting points in rows are exactly "on module" at 36", 48", 72", 96", and 144", including at ends of rows.

Row diagram



Fixture Lengths: 3', 4', 6', 8', and 12'
• Indicates pendant locations

LITECONTROL
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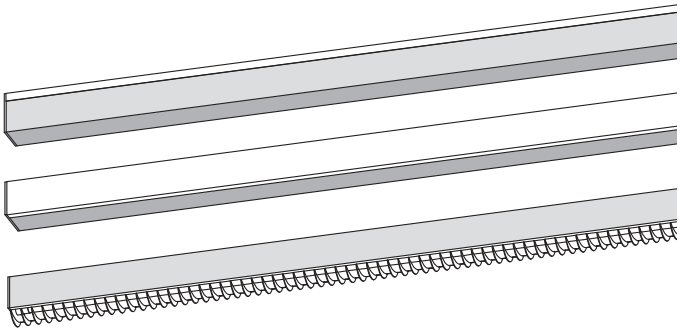
781 294 0100 f: 781 293 2849 litecontrol.com

LIGHTPLANE LINEAR - 2" Profile

ARCHITECTURAL LIGHTING WORKS

PF4

Specification and Ordering Information:



1. Style:

- ❑ LPLI - Suspended Indirect (LPLI)
- ❑ LPLD - Suspended Direct (LPLD)
- ❑ LPLSM - Ceiling/Surface Mount (LPLSM)
- ❑ WLPI - Wall Mount Indirect (WLPI)
- ❑ WLPD - Wall Mount Direct (WLPD)
- ❑ WLPIV - Wall Mount Vanity Style (WLPIV)
- ❑ WLPVERT - Wall Mount Vertical (WLPVERT)

2. Overall Run Length:

- ❑ Individual (2',3',4',5',6',7',8')
- ❑ Continuous (Enter total run length, i.e 20')

3. Lamping

- ❑ FSO - Fluorescent - Standard Output (FSO)
- ❑ FHO - Fluorescent - High Output (FHO)
- ❑ HP7- 80 LPW High Performance LED White 3500° 7W/LF (HP7)
- ❑ HP14- 80 LPW High Performance LED White 3500° 14W/LF (HP14)
- ❑ RGB - LED Color Changing (RGB)-Consult Factory for Control Interface Options
- ❑ LXHO - Seamlessline lamp (LXHO Feelux High Output)*
- ❑ LXHE - Seamlessline lamp (LXHE Feelux High Efficiency)*

*See Option 1A

4. Lamp Configuration:

- ❑ R - Regular (R)
- ❑ *S - Staggered (S)

*For Staggered lamping, it is recommended to use the EXT lens for maximum diffusion properties

5. Ballast Specification:

- ❑ LED - LED Power Supply, non-dim (LED)
- ❑ LED-DIM - LED Power Supply with 0-10V dimming (LEDDIM)
- ❑ STD - Standard Electronic, non-dim <10%THD (STD)
- ❑ * MK7 - Advance Mark 7® Dimming 0-10V (MK7)
- ❑ * MK10 - Advance Mark 10® Dimming (MK10)
- ❑ * HILUME - Lutron Hilume 3-D® (HILUME3D)
- ❑ * HSeries- Lutron H-SERIES® Dimming (HSERIES)
- ❑ * ECOSYS- Lutron ECOSYSTEM® Dimming (ECOSYS)
- ❑ * BALSTAR - Ballastar® Light level switching (BALSTAR)
- ❑ * USD - Superdim® Dimming (USD)
- ❑ * QUICK - Osram Quicktronic® Dimming (QUICK)

*Please consult ballast manufacturer for lamp/ballast compatability.

6. Voltage:

- ❑ 120 - 120 volt (120)
- ❑ 277 - 277 volt (277)
- ❑ UNV - Universal voltage (UNV) (Fluorescent Only)
- ❑ 347 - 347 volt (not available in dimming) (347)

7. Accessory options:

- ❑ WD - Lens (WD)
- ❑ *EXT - Extra Diffuse Lens (EXT)
- ❑ LV - Louver (LV)
- ❑ RO - Open, Reflector Only (RO)
- ❑ DG - Flush guard lens - Indirect only (DG)

*EXT is recommended for minimal lamp image

8. Finish:

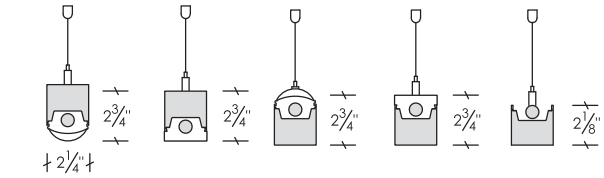
- ❑ * AL (Natural "Ultimatte" aluminum)
- ❑ BK (Black powdercoat)
- ❑ WH (White powdercoat)
- ❑ RAL (Specify RAL # of powdercoat of your choice)

* AL is standard on all Lightplane Linear product

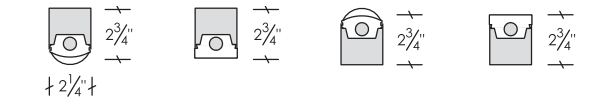
9. Additional Options:

- ❑ *OS - Occupancy Sensor
- ❑ *PH - Photocell - Consult Factory (OS)
- ❑ SB - Seismic Bracing- Consult Factory (SB)
- ❑ EM - Emergency Ballast (EM)
- ❑ EMC - Emergency Circuit (EMC)

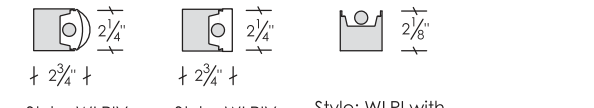
* Consult factory for options. Size limitations exist



Style: LPLD with LV (louver) | Style: LPLD with WD (lens) | Style: LPLI with LV (louver) | Style: LPLI with WD (lens) | Style: LPLI with RO (reflector only)



Style: WLPD with LV (louver) | Style: WLPD with WD (lens) | Style: WLPI with LV (louver) | Style: WLPI with WD (lens)



Style: WLPIV with LV (louver) | Style: WLPIV with WD (lens) | Style: WLPI with RO (reflector only)

*1A - Option: Seamlessline Lamp (SL) End to End Lamp Mounting

*Channel dimensions identical to standard T5 lamping. Luminous ends eliminate the need for staggered lamping. Consult factory for additional details.

8FT Suspension hardware standard (included)
Power canopy to cover 4-O Junction Box.

MTR Column

RF1

selux®

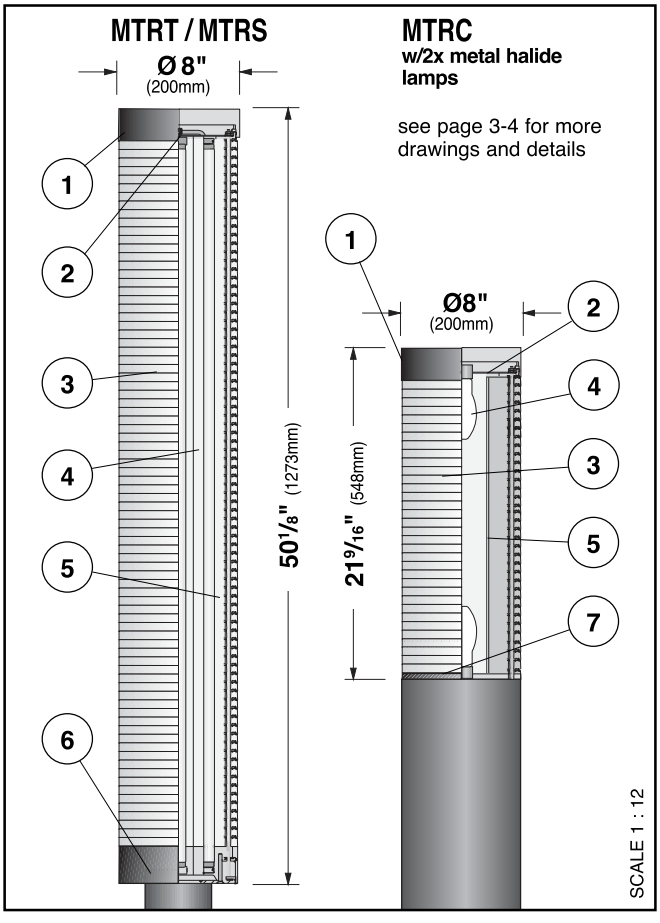
Project: _____

Type: _____ **Qty:** _____

Series	Height	Lamping	Finish	Voltage	Options

Series	Height	Lamping		Finish	Voltage	Options
MTRT MTR[1] Column Round Tapered Pole **MTRS** MTR[1] Column Round Straight Pole **MTRC** MTR[1] Column Round 8" Straight Pole	**12** 12 ft. **14** 14 ft. **16** 16 ft.	**Metal Halide** **2H050**[2] (2x)50w **2H070**[2] (2x)70w **2H100**[2] (2x)100w	**Fluorescent** **1T8** (1x)FO32T8 **2T8** (2x)FO32T8 **3T8** (3x)FO32T8 **4T8** (4x)FO32T8	**WH** White **BK** Black **BZ** Bronze **SV** Silver **SP** Specify Premium Color	**120** **277** **347**	**REC** GFCI Receptacle **CWB**[3] Cold Weather Ballast Consult factory for other heights and options

[1] US Patent No. 4,669,034 [2] Only available with MTRC (Round 8" Straight Pole) [3] Fluorescent Only.



1. Fixture Cover - Die-cast, alumi-num cover, with smooth crisp form to reflect and complement the column design. Thick-walled, alumi- num cover is painted white on the interior for maximum luminaire efficiency. Removes by loosening three vandal-resistant, stainless steel screws for easy access to lamp chamber.

2. Gasketing - Continuous gaskets provide weather-proofing, dust, and insect control at base of column, fixture cover, and between MTR rings.

3. Shielding - Consists of 8" (200mm) diameter injection-molded acrylic multi-prisms for total reflection (MTR). MTR rings have a wall thickness of .591" and are patterned after the light-bending characteristics of a prism (US Patent 4,669,034).

4. Lamping - One, two, three or four FO32T8 (32 watts each) fluorescent lamps on removable gear tray, mounted vertically; or two coated, medium base ED-17 metal halide up to 100w. Lamps provided by others.

5. Diffusing Cylinder - Satine acrylic cylinder between lamps and MTR rings to diffuse lamp image for maximum performance and visual comfort.

6. Pole Fitter - Self-leveling, die-cast aluminum, fitter base secured to pole with two, stainless steel, Allen head set screws. 31/2" (90mm) O.D. poles.

7. Column Fitter - Die-cast aluminum fitter, with built-in gasketing ridges, for smooth transition to column.

8. Ballast (not shown)- Electronic ESB, high power factor, class "P", type "A" sound rating. Minimum lamp starting temperature 0° F (-20° C). Cold Weather Ballast option (minimum lamp starting temp -20°F/ -29°C) available. Consult factory for more detailed ballast information.

9. Base Cover - (not shown - MTRT/MTRS only) Standard two-piece base cover is made from die-cast 356 alloy aluminum which is heat treated to produce a T6 temper, measuring 41/2" (115mm) height by 121/2" (316mm) diameter.

Exterior Luminaire Finish - SELUX utilizes a high quality Polyester Powder Coating. All SELUX luminaires and poles are finished in our Tiger Drylac certified facility and undergo a five stage intensive pretreatment process where product is thoroughly cleaned, phosphated and sealed. SELUX powder coated products provide excellent salt and humidity resistance as well as ultra violet resistance for color retention. All products are tested in accordance with test specifications for coatings from ASTM and PCI.

Standard exterior colors are White (WH), Black (BK), Bronze (BZ), and Silver (SV). Selux premium colors (SP) are available, please specify from your SELUX color selection guide. Hot Dip Galvanized finish (GV) on all steel parts also available.

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TEL (845) 691-7723
FAX (845) 691-6749
www.selux.com/usa
MTRC-1011-01 (ss-V2.7)

NRTL Listed (i.e. UL, CSA)

Union Made Affiliated with **IBEW** *Local 363*

MTR Column

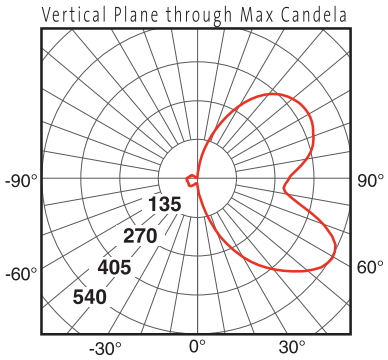
Photometry

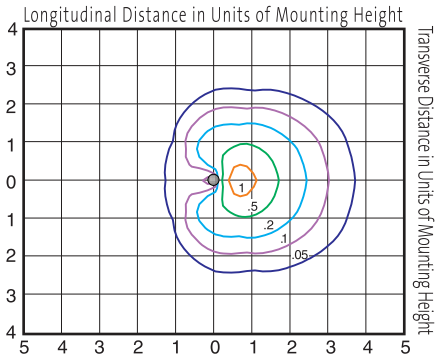
Round Tapered Pole / (1x)FO32T8

Catalog # MTRC-12-1T8
Report # SX-17021

- Round 8" Straight Pole
- Ideal for applications demanding max. spacing.
- Maximum candela of 540 at 60° from vertical.
- IES classification - Type IV Non-Cutoff.

DOWNLOAD IES FILE:
http://www.selux.com/web/files/exterior/MTRC-1T8.zip



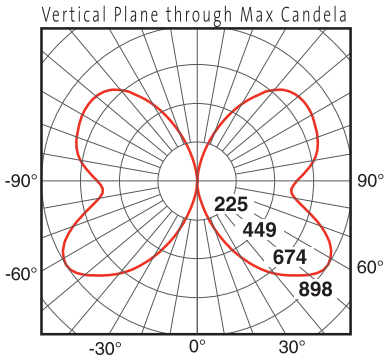


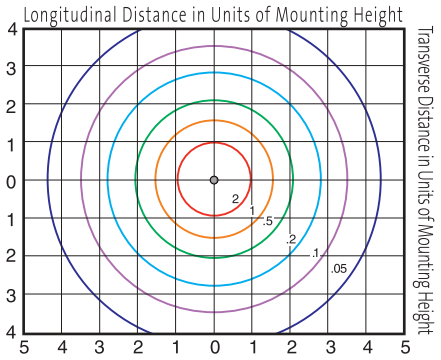
Round Tapered Pole / (4x)FO32T8

Catalog # MTRC-12-4T8
Report # SX-17020

- Round 8" Straight Pole
- Ideal for applications demanding max. spacing.
- Maximum candela of 898 at 58° from vertical.
- IES classification - Type V Non-Cutoff.

DOWNLOAD IES FILE:
http://www.selux.com/web/files/exterior/MTRC-4T8.zip

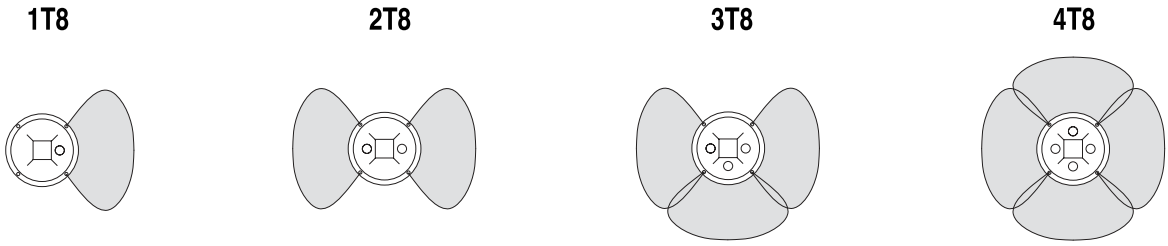




Conversion Chart
Values based on 14' (4.3m) mounting height.

Mounting Height	Multiply
12' (3.7m)	1.00
14' (4.3m)	0.93
16' (4.9m)	0.87

T8 Lamping Distribution Guide



GRÜV MINI EXTRUDED

2.5" RECESSED LINEAR LED, GYP BOARD

GRL **RL1**

APPLICATIONS:
Retail and commercial ambient lighting in wall to ceiling applications

CONSTRUCTION:
Extruded aluminum housing
Ceiling trim is high reflectance white finish

MOUNTING:
For use in sheet rock ceilings or walls only
Fixtures must be installed before finished ceiling or walls are installed

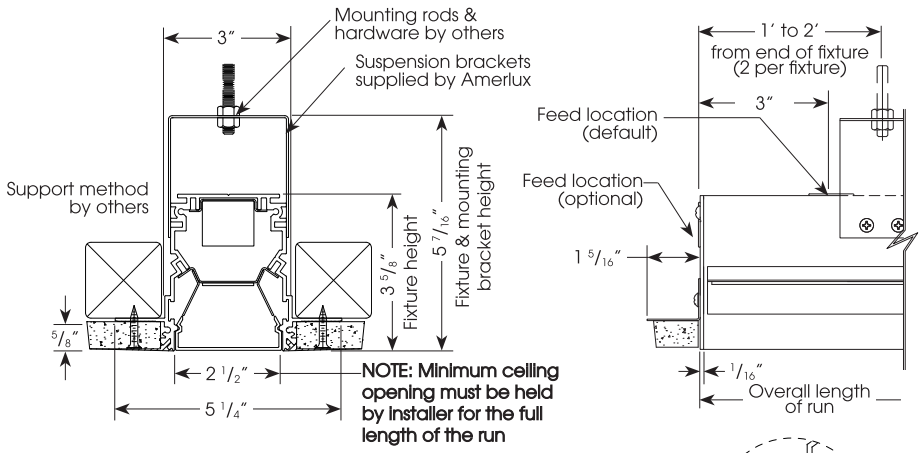
OPTICS:
5w/ft, 3500K LED's
Extruded white acrylic lens, snap-in, 8' maximum section
Amerlux exclusive white acrylic lens provides excellent transmission while effectively concealing lamp image

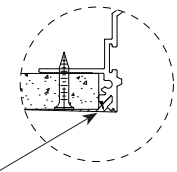
ELECTRICAL:
Electronic, multi-volt (120v-277v) constant current driver
Dimmable, 0-10v
This product complies with IEEE C62.41 for surge endurance up to 3KV. Amerlux recommends using additional surge protection with this unit (supplied by others), surge damage is not covered by warranty.
Emergency circuit via remote inverter or auxillary emergency power supply (by others)

LABELING:
c UL us

PROJECT:

TYPE:





Ceiling contractor to spackle, feather & sand at ceiling interface.

Electrostatic sensitive device, observe precautions for handling

ELECTRICAL

Driver	Wattage per foot	Lamping	4' Input watts	4' Amps	8' Input watts	8' Amps
Electronic	5	120v	22	.18	44	.37
		277v	20	.07	40	.14

10 year limited warranty AMERLUX LED

(see website for details)

ORDERING INFORMATION:

Model	Wattage Per Foot	Lamp Type	Ballast	Voltage	Length	Mounting	Color Temp
GRUVM-EX-GB	5	LED	E - electronic	120/277	4 - 4' 8 - 8' (other consult factory)	For Straight Runs IND - individual BOR - beginning of run MOR - middle of run EOR - end of run For Ceiling/Wall Corner BORWC - beginning of run, wall corner EORWC - end of run, wall corner BORCC - beginning of run, ceiling corner EORCC - end of run, ceiling corner	3500

Example: GRUVM-EX-GB-5-LED-E-120/277-8-IND-3500

Cat #:

Amerlux reserves the right to change details that do not affect overall function and performance.

Amerlux, LLC • 23 daniel road, fairfield NJ 07004 • p: 973.882.5010 f: 973-882.2605 • www.amerlux.com

amerlux

GRÜV MINI EXTRUDED

2.5" RECESSED LINEAR LED, GYP BOARD

GI **RL1** B

amerlux

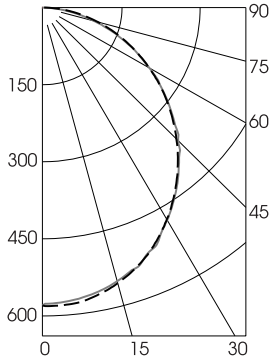
TYPE:

FIXTURE DATA:

Complete photometric data (.ies format) available upon request.

GRÜVM 5W LED
SOURCE: 120 WHITE LEDS LUMENS: 1592
RECESSED

LTL# 26361



ZONAL LUMEN SUMMARY

Zone	Lumens	%Lamp	%Fixt
0-30	446	NA	28.0
0-40	722	NA	45.4
0-60	1252	NA	78.7
0-90	1591	NA	100.0
90-180	0	0.1	0.0
0-180	1591	NA	100.0

Total Luminaire Efficacy = 73.6 lumens/watt

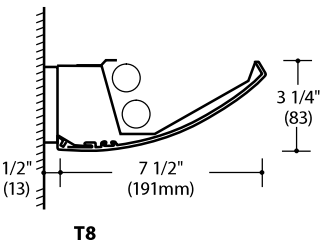
COEFFICIENTS OF UTILIZATION

RC	80			
RW	**70**	**50**	**30**	**10**
0	1895	1895	1895	1895
1	1728	1651	1582	1520
2	1572	1439	1329	1237
3	1433	1264	1133	1029
4	1312	1121	980	873
5	1207	1002	859	753
6	1116	903	760	658
7	1035	819	680	582
8	964	748	613	519
9	901	687	556	468
10	845	634	509	425

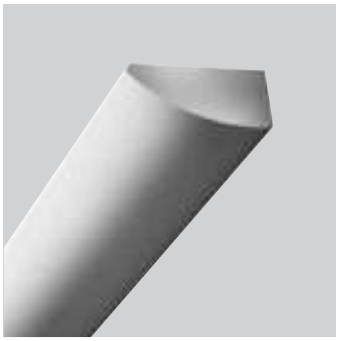
LITECONTROL

Fixture Type:
Project name:

SF1



T8



Wall Arcos™

W-AI-5600

Wall-Mounted Asymmetric Indirect

Product Description

Wall-mounted arcuate shaped extruded aluminum luminaire which complements Litecontrol's Arcos pendants. UL Listed. Cradle to Cradle Certified.CM

Ordering Guide

Product, lamping, & length

W -	AI -	56	2	4	T8-
Mounting	Distribution	Series	Lamp Count	Nominal Length (ft)	Lamp Type
W Wall-Mounted	**AI** Asymmetric Indirect	**56**	**1** →	**3** →	**T5HO** **T5**
			1 →	**4** →	
			2 →	**6** →	
			2 →	**8** →	
			3 →	**12** →	
			1, 2 →	**2** →	**T8**
			1, 2 →	**3** →	
			1, 2 →	**4** →	
			2, 4 →	**6** →	
			2, 4 →	**8** →	
			3, 6 →	**12** →	
			1 →	**2** →	**BX40** **BX50**
			2 →	**4** →	
			3 →	**6** →	
			4 →	**8** →	
			6 →	**12** →	
			2 →	**3** →	**BX39**
			see **notes**		

Options

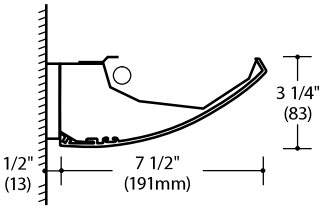
TCWM-	ELB10-	TW-	2CWQ-	F-	120
Finish	Ballast	Tandem Wiring	Pre-Wiring	Other Options	Volts
TCWM (textured matte white) is standard see **LiteColors**™ for other finishes	**ELB10** is std. for T8 or BX **LP/ELB** is std. for T5 or T5HO **DA/MK7*** **DL/ECO*** **DO/HEL*** **LPD/D10*** **LPD/ECO*** see **Ballast Options**	**--** → **1CWQ** **TW** → **2CWQ** see **notes**		**F** **EF** **LP/EF** see **Other Options**	**120** **277**

notes:
Lamp count = total number of lamps in the fixture
Tandem wiring not available for one-lamp cross-section fixtures
*Dimming ballasts not available for all lamp types and combinations. Contact factory for details.
For ordering guide information in shaded areas choose selection by reading ACROSS the shaded areas for correct specifications.

W-AI-5624T8-TCWM-ELB10-TW-2CWQ-F-120 is a typical catalog number for a 2-lamp (2 lamps in cross-section), 4-foot long, T8 fixture with textured matte white finish, electronic ballast, tandem-wired, pre-wired with two-circuit branch wiring and quick-connects, fuse, 120 volts.

Cross-section lamping

1-T5 or T5HO | **1-T8** | **2-T8** | **1-BX39, 40 or 50**



T5 or T5HO

Ballast Options

Specify in place of **ELB10** or **LP/ELB**, contact factory for availability:

DA/MK7 Advance Mark VII dimming ballast
DL/ECO Lutron ECO-10 dimming ballast
DO/HEL Osram Sylvania dimming ballast
LPD/D10 Low-profile dimming electronic ballast (T8, T5, 4' and 8' T5HO)
LPD/ECO Low-profile Lutron ECO-10 dimming electronic ballast

Tandem Wiring & Circuiting Options

1CWQ Fixture is wired with a single-circuit so that all lamps are switched together.
TW-2CWQ Fixtures wired with two circuits. 2-lamp in cross section fixtures, the fixture is wired such that the inline lamps are switched separately. 3-lamp in cross section fixtures, the fixture is wired such that the inline center lamps are switched separately from the inline outer lamps.

Other Options

F Fuse. Slow or fast blow, determined by Litecontrol.
EF Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one lamp for 1 1/2 hours.
LP/EF Low-profile Emergency Fluorescent Ballast. Battery-powered ballast from a UL Listed manufacturer will operate one lamp for 1 1/2 hours.

Questions to Ask

1. Row information, including desired fixture lengths?
2. Lamp type? **3.** Ballast options? **4.** White, *LiteColor*, or special color?
5. Controls solutions? **6.** Other options? **7.** 120 or 277 volt?

revised 7/12/2010

Click on **Quick Find 56**
litecontrol.com

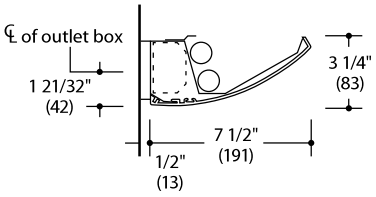
Specifications

HOUSING. Fixture body is one-piece extruded aluminum .100" thick attached to an 18-gauge steel back plate.
END CAPS. Steel, 14-gauge, with no holes or knockouts, finished to match housing.
REFLECTOR. Die-formed steel with high-reflectance white finish with additional areas of specular aluminum to enhance distribution and performance. Luminance Control Deflector™ (LCD) positioned above lamps provides uniform light distribution on wall to diminish any appearance of socket shadows.
LAMPING. Available in one- and two-lamp T8, one-lamp T5 or T5HO and one-lamp twin-tube compact fluorescent cross-sections.
BALLAST. Electronic Ballast (**ELB** - for T8 and BX lamping) or Low-profile Electronic Ballast (**LP/ELB** - for T5 or T5HO lamping), high power factor, thermally protected Class P, Sound Rated A, manufactured by a UL Listed manufacturer, as available, determined by Litecontrol. Ballasts with a voltage range of 120 to 277 will be used when fixture configuration and ballast availability allow. The minimum number of ballasts will be used.
TANDEM WIRING. When selected from Ordering guide below, fixtures wired to switch in-line lamps separately, providing two levels of light (2-lamp cross-section fixtures only).
BALLAST DISCONNECT. Fixture supplied with a ballast disconnect device to enable compliance with the NEC.
PRE-WIRING. Fixtures are supplied with #12 AWG type THHN wire for branch circuits. One end will have factory-installed push-in quick-connects. The other end will be stripped back 1/2" for quick connection in field. For fixtures to accommodate special circuits such as night light and emergency, etc., in-field wiring will be required. See Pre-Wiring Information for details.
MOUNTING. Provided with two wall-mounting brackets measuring 2 3/4" high x 7" wide x 1/2" deep. Finish is CWM (Matte White). **2' fixture:** provided with one wall-mounting bracket measuring 2 3/4" high x 22 1/2" wide x 1/2" deep. Finish is CWM (Matte White).
CERTIFICATION. Fixture and electrical components shall be UL and/or CUL Listed and shall bear the I.B.E.W., AF of L label. This fixture is Cradle to Cradle Certified™ Silver by MBDC.

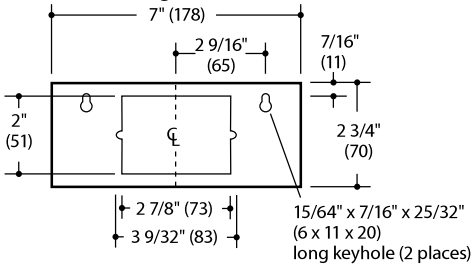
Note: Litecontrol reserves the right to change specifications without notice for product development and improvement.

Planning for installation

Cross-section

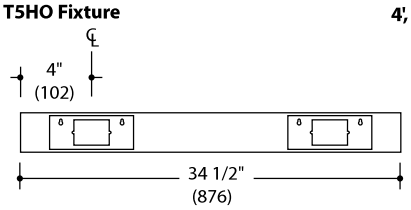


Wall-mounting bracket

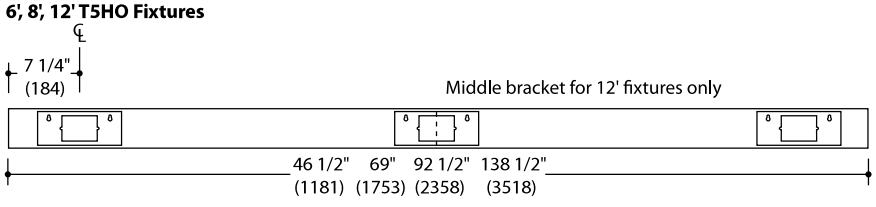


Mounts to and covers either a 2" x 4" single device box positioned horizontally or a standard outlet box with plaster ring ears positioned horizontally.

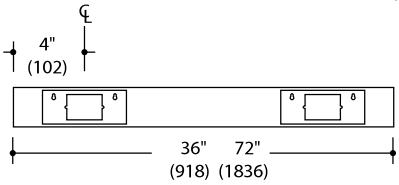
3' T5HO Fixture



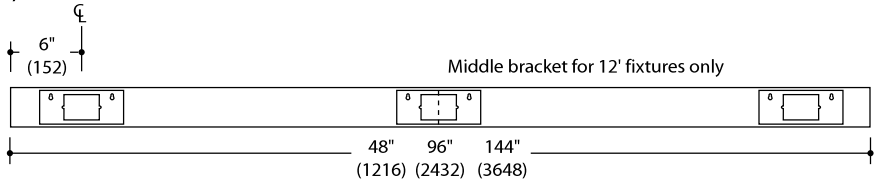
4', 6', 8', 12' T5HO Fixtures



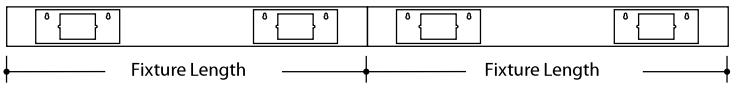
3' and 6' T8 & BX Fixtures



4', 8', 12' T8 & BX Fixtures



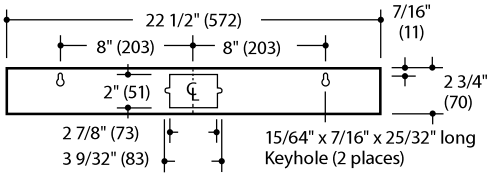
Row diagram



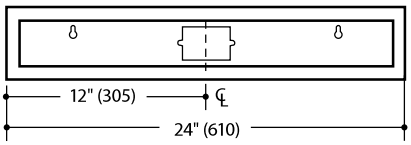
T5HO Fixture Lengths:
34 1/2", 46 1/2", 69", 92 1/2", 138 1/2"
T8 & BX Fixture Lengths:
24", 36," 48," 72", 96," and 144"

2' Fixture

Wall-mounting bracket



Back view of bracket and housing



LITECONTROL
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Cradle to Cradle CERTIFIED™ SILVER

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Specifications

SL1

Due to continuous improvements and innovations, specifications may change without notice.

Color Temperature	Beam Angle	Lumens†	Efficacy (lm / W)	CRI
2200 K*	Very wide (170° x 115°)	425	35.7	79
2700 K*	Wide (125° x 120°)	527	43.9	83
	Medium (50° x 70°)	384	34.9	83
3000 K*	Wide (125° x 120°)	534	45.3	84
	Medium (50° x 70°)	446	36.9	83
3500 K*	Wide (125° x 120°)	576	48.4	84
	Medium (50° x 70°)	476	40.0	84
4000 K*	Wide (125° x 120°)	632	53.1	81
	Medium (50° x 70°)	518	43.5	82

Item	Specification	Details
Output	Lumen Maintenance‡	50,000 hours L_{70} @ 25° C 37,000 hours L_{70} @ 50° C 90,000 hours L_{50} @ 25° C 80,000 hours L_{50} @ 50° C
Electrical	Input Voltage	100 – 277 VAC, auto-ranging, 50 / 60 Hz
	Power Consumption	12.5 W maximum at full output, steady state
	Power Factor	.99 @ 120 VAC
Control	Dimming	Compatible with selected commercially available reverse-phase ELV-type dimmers§
Physical	Dimensions *(Height x Width x Depth)*	2 x 12 x 1.5 in (51 x 305 x 38 mm) (very wide beam / wide beam) 1.64 x 12 x 1.5 in (42 x 305 x 38 mm) (medium beam)
	Weight	0.89 lbs (404 g) (very wide beam) 0.82 lbs (372 g) (wide beam) 1 lb (454 g) (medium beam)
	Housing	Die-cast aluminium, white powder-coated finish
	Lens	Polycarbonate / remote phosphor mix (very wide beam) Polycarbonate (wide beam / medium beam)
	Fixture Connections	Integral male / female connectors
	Temperature Ranges	-4° – 122° F (-20° – 50° C) Operating -4° – 122° F (-20° – 50° C) Startup -40° – 176° F (-40° – 80° C) Storage
	Humidity	0 – 95%, non-condensing
	Maximum Fixture Run Length‖	49 @ 100 VAC 59 @ 120 VAC 102 @ 208 VAC 108 @ 220 – 240 VAC 136 @ 277 VAC *Configuration: Fixtures installed end-to-end, 20 A circuit, standard 10 ft (3.1 m) Leader Cable*
Certification and Safety	Certification	UL / cUL, FCC, CE, CCC
	Environment	Dry / Damp Location, IP20
	Energy Efficiency	California Title 24 Compliant (wide beam angle only)

* Color temperatures conform to nominal CCTs as defined in ANSI Chromaticity Standard C78.377A.

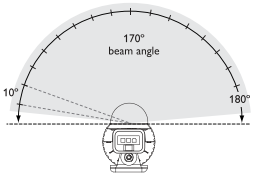
† Lumen measurement complies with IES LM-79-08 testing procedures.

‡ L_{70} = 70% lumen maintenance (when light output drops below 70% of initial output).
L_{50} = 50% lumen maintenance (when light output drops below 50% of initial output). Ambient luminaire temperatures specified. Lumen maintenance calculations are based on lifetime prediction graphs supplied by LED source manufacturers. Calculations for white-light LED fixtures are based on measurements that comply with IES LM-80-08 testing procedures. Refer to www.philipscolorkinetics.com/support/appnotes/lm-80-08.pdf for more information.

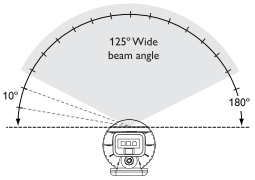
§ Refer to www.philipscolorkinetics.com/support/appnotes/ for specific details.

‖ These figures, provided as a guideline, are accurate for this configuration only. Changing the configuration can affect the fixture run lengths.

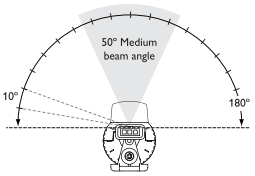
OPTIBIN® CK TECHNOLOGY | POWERCORE® CK TECHNOLOGY | DIMAND™ CK TECHNOLOGY



Very wide beam angle (170° x 115°)
2200 K only



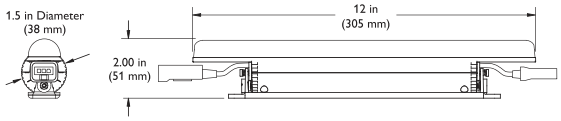
Wide beam angle (125° x 120°)



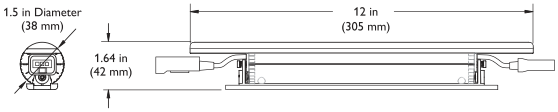
Medium beam angle (50° x 70°)

To calculate the number of fixtures your specific installation can support, download the Configuration Calculator from www.philipscolorkinetics.com/support/install_tool/

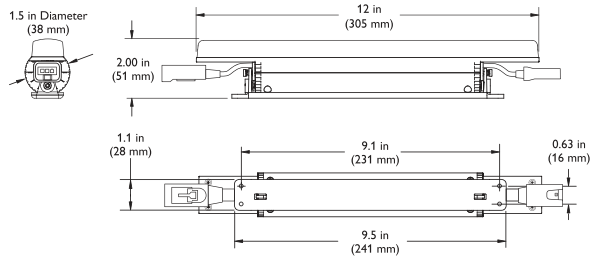
Very wide beam angle (2200 K)



Wide beam angle



Medium beam angle



LIGHTWILD

WIDE BEAM, WARM WHITE LUMENPOWER LITE 2.1 LINEAR

SL2

FIXTURE

▼ LENGTH
(ENTER THE LENGTH IN INCHES. EXAMPLE: ENTER 12 FOR A 12-INCH FIXTURE)

▼ LOCATION

▼ MOUNT

LW - LUMPWRLT - W - WW - _____ - _____ - _____

☐ 12 INS (300 mm) ☐ 24 INS (600 mm) ☐ 48 INS (1200 mm)

☐ INT = INTERIOR
☐ EXT = EXTERIOR

☐ FM = FIXED
☐ AM = ADJUSTABLE

* NOMINAL DIMENSIONS LISTED. SEE DRAWINGS BELOW FOR ACTUAL DIMENSIONS.

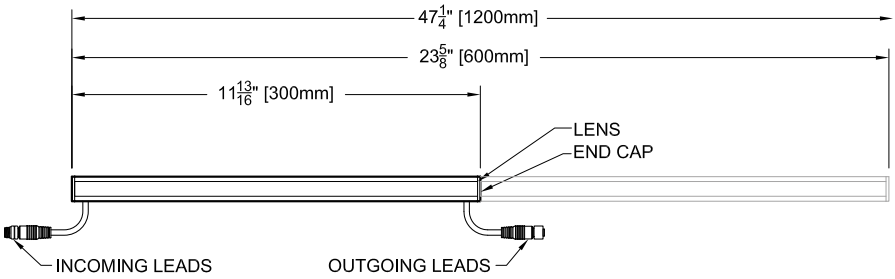
(EXTERIOR LOCATION MODEL PICTURED)

FEATURES

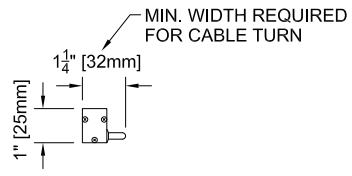
- **POWER REQUIREMENT:** 24VDC
- **LUMENS:** 149 lm/ft (489 lm/m)
- **BEAM ANGLE:** 120°
- **POWER CONSUMPTION:**
  - 12 IN., 2.8 WATTS PER FIXTURE
  - 24 IN., 5.6 WATTS PER FIXTURE
  - 48 IN., 11.3 WATTS PER FIXTURE
- **LISTINGS:** UL (2108)
- **ENVIRONMENTS**: MODELS AVAILABLE FOR DRY LOCATIONS OR WET LOCATIONS (IP65). NOT FOR USE AS A SUBMERSIBLE LIGHT SOURCE. PROPER DRAINAGE REQUIRED.
- **LENS:** COLORLESS SOFT FOCUSED GLASS
- **HOUSING:** CLEAR ANODIZED ALUMINUM (DRY LOCATION) OR BLACK ANODIZED ALUMINUM (WET LOCATION); DO NOT PAINT
- **CABLE ATTACHMENT:** CABLES EXIT ENDS OF FIXTURE ON SAME SIDE
- **CONNECTORS:** LOCKING, WATER-TIGHT (IP 65) CONNECTORS
- **MOUNTING:** SELECT FROM A FIXED MOUNT BRACKET OR ADJUSTABLE AND LOCKABLE 180-DEGREE HINGE
- **LED COLOR:** 2950K +/- 200K
- **TEMPERATURE RANGE:** -13° TO 158°F (-25° TO 70°C)
- **LUMEN MAINTENANCE (L70):** LED LIFETIMES ARE AFFECTED BY AMBIENT OPERATING TEMPERATURES AND OTHER FACTORS. CONSULT LIGHTWILD FOR DETAILS.

DIMENSIONS

(DOWNLOAD CAD-BASED DIMENSIONAL DRAWINGS AND PHOTOMETRIC DATA AT WWW.LIGHTWILD.COM)

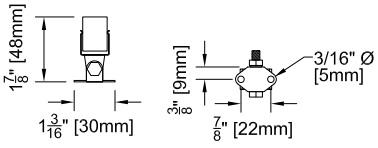


FIXTURE TOP VIEW

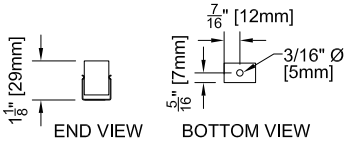


FIXTURE END VIEW

CONNECTOR DETAIL



ADJUSTABLE MOUNTING CLIP



FIXED MOUNTING CLIP

CONTROL

SERIES A CONTROL UNITS
- POWER ON/OFF CONTROL

SERIES B CONTROL UNITS
- POWER + DIMMING BY LIGHTWILD

OR • POWER + DIMMING BY OTHERS (0-10V OR DMX)

OR • DMX SHOW CONTROL BY OTHERS (LIGHTWILD CONTROL UNIT IS DMX READY)

SERIES C CONTROL UNITS
- INCLUDES ONE LIGHTWILD DMX DIRECTOR FOR SHOW CONTROL
- SHOW SELECTION OPTIONS:
  - LIGHTWILD SHOW SELECTOR WALL CONTROLLER

OR - THIRD PARTY SHOW SELECTOR VIA CONTACT CLOSURE INTERFACE

SERIES D CONTROL UNITS
- BUILT TO ORDER AND REQUIRES CONSULTATION WITH LIGHTWILD
- INDIVIDUALLY CONTROL LIGHTWILD FIXTURES

OR • CONTROL A LARGE NUMBER OF GROUPS OF LIGHTWILD FIXTURES

(SEE SEPARATE CONTROL UNIT SPECIFICATION SHEETS FOR MORE INFORMATION.)

PHOTOMETRIC VALUES AND DISTRIBUTION DATA ARE TYPICAL FOR THIS LUMINARE. LUMINAIRE PERFORMANCE WILL VARY DEPENDING ON LED AND POWER SUPPLY. LIGHTWILD MANUFACTURES THIS LUMINAIRE TO AN OVERALL PERFORMANCE TOLERANCE OF +/- 5%.

PROJECTS@LIGHTWILD.COM • (913) 851-3000 • WWW.LIGHTWILD.COM

031711-1

Photometrics · LightWild LumenPower Lite 2.1 · Warm White · Wide Beam Angle

▶ Zonal Lumen Summary

Tests performed on the 12-inch (300 mm) length of the LightWild LumenPower Lite Linear fixture.

	Lumens
Zone	**Warm White**
0-90	0.00
90-100	0.26
100-110	4.69
110-120	16.46
120-130	25.26
130-140	29.11
140-150	28.51
150-160	23.80
160-170	15.73
170-180	5.49
Total	**149.30**

▶ Luminaire Photo

Part No. LW-LUMPWRLT-W-WW

(EXTERIOR LOCATION MODEL PICTURED)

▶ Luminous Flux (Stabilized)

Color	Lumens (lm)	Power (Watts)	Efficacy (lm/W)
Warm White	149.3	2.8	53.3

Note: Efficacy figures are for the total luminaire.
Individual light sources are not represented.

▶ Luminaire Specifications

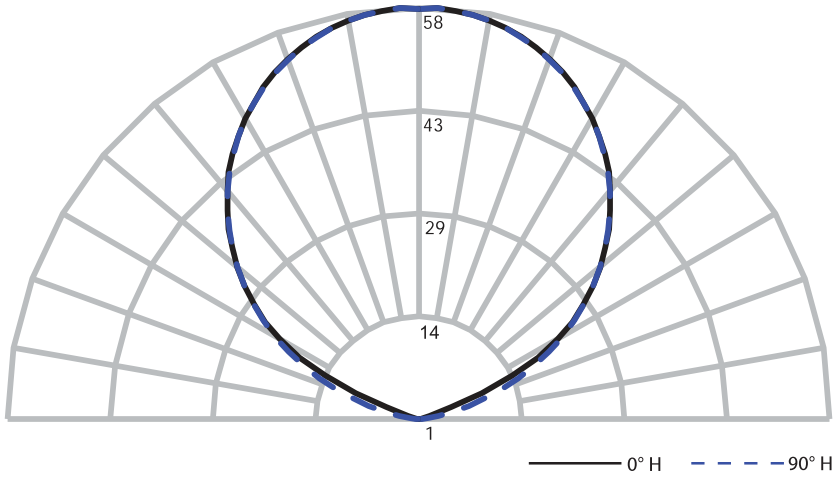
Source: 6 LEDs (Warm White) **CCT:** 2950K +/- 200K **Beam Angle:** 120° (50% Peak Intensity)

▶ Direct Illuminance Perpendicular to Luminaire

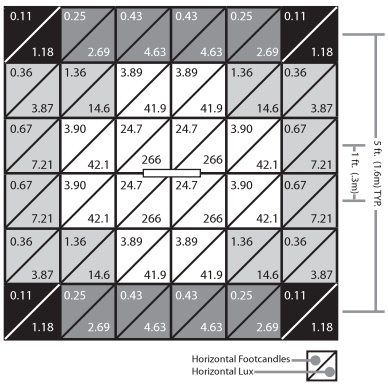
	Footcandles			
Color	**3 ft**	**6 ft**	**9 ft**	**12 ft**
Warm White	6.41	1.60	0.71	0.40

	Lux			
Color	**1 m**	**2 m**	**3 m**	**4 m**
Warm White	57.73	14.43	6.41	3.61

▶ Candela Plot



▶ Direct Illuminance Distribution



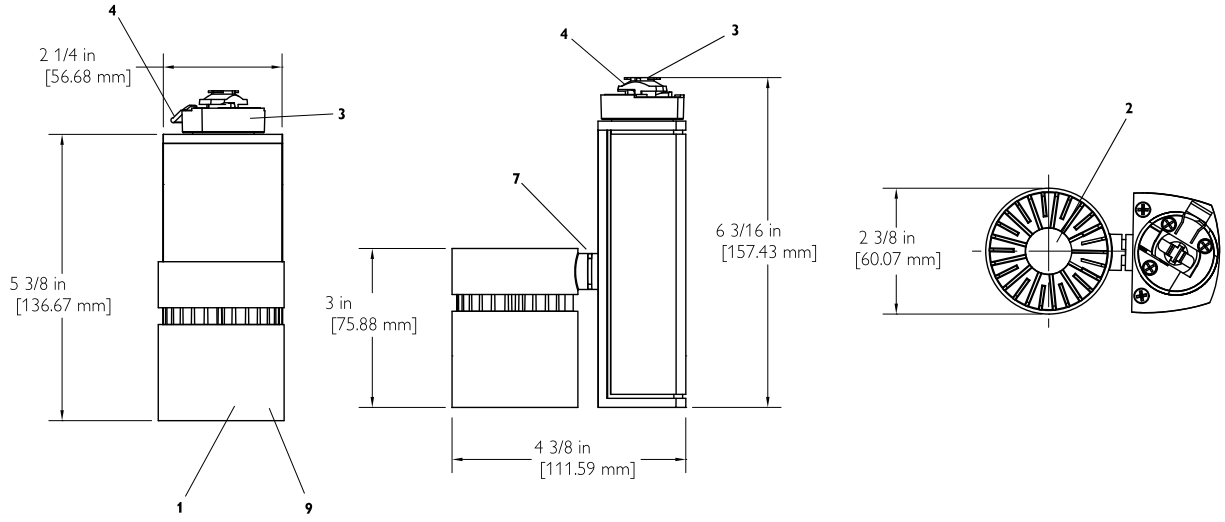
Luminaire centered 1 foot (.3 m) from and perpendicular to the surface.

Download electronic IES data at www.lightwild.com.

PHOTOMETRIC VALUES AND DISTRIBUTION DATA ARE TYPICAL FOR THIS LUMINARE. LUMINAIRE PERFORMANCE WILL VARY DEPENDING ON LED AND POWER SUPPLY. LIGHTWILD MANUFACTURES THIS LUMINAIRE TO AN OVERALL PERFORMANCE TOLERANCE OF +/- 5%.

LLA TL1

Lytespan Mini LED Micro Cylinder



Features

1. **LED board:** metal core board. 4 tightly packed high brightness white led's.
2. **Integrated housing heat sink:** die-cast aluminum maintains LED junction temperature for minimum 50,000 hr lifetime at 70% lumen maintenance.
3. **Track Attachment Fitting:** Molded polycarbonate. Integral color in gray, black or white. Rotates into track and locks into place with the use of push tabs.
4. **Push Tab:** Molded polycarbonate. Locks and detaches unit.
5. **Track Adaptor Housing:** Die-cast aluminum.

6 Movable Brass Contact: Brass extends for connection to second circuit (Advent track only).

7. **Pivot Mounts:** Allows for 350° horizontal and 320° vertical rotation.
8. **Driver Housing:** Extruded housing with die-cast aluminum covers.
9. **Interchangeable optics:** sold separately.

Finish

All painted finishes: Baked enamel.

Labels

CULus Listed, for dry locations only.

Ordering Information

Cat. No.	Finish	CCT	CRI
LLAV0030AL	Aluminum	3000K	85
LLAV0030BK	Black		
LLAV0030WH	White		
LLAV0027AL	Aluminum	2700K	83
LLAV0027BK	Black		
LLAV0027WH	White		

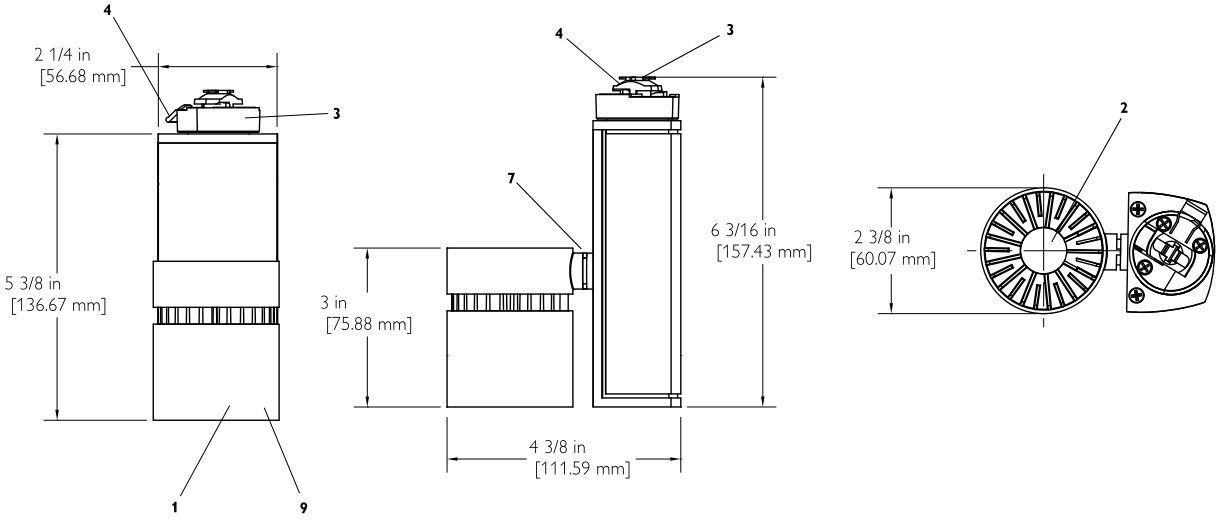
Job Information **Type:**

Job Name:

Cat. No.:

Notes:

PHILIPS LIGHTOLIER



Accessories

Accessory Holder

(When using two accessories must use holder)

LLA0V00AHBK	Accessory Holder Black

Snoot

22SR6WH	Snoot 2" dia. white
22SR6BK	Snoot 2" dia. black
22SR6AL	Snoot 2" dia. aluminum

Louver

AL2HC 2" Diam Hex Cell Louver

Diffusion or Color Filters

AF2, ADF2 Series

Mounting

All Monopoint, Multipoint, recessed track, suspension track, suspension stems, sloped ceiling adapter, Basic, Advent and Radius Track systems only. Ceiling and horizontal or vertical wall mounted. Not compatible with ProSpec track system.

Finish

All painted finishes are baked enamel.

Reflector Options (Sold Separately)

Ordered Separately. Field Changeable

LLAV00RS	Mini LED Micro Cylinder Spot Ref
LLAV00RNF	Mini LED Micro Cylinder, Narrow Flood Ref
LLAV00RF	Mini LED Micro Cylinder Flood Ref
LLAV00RSSOL	Mini LED Micro Cylinder, Spot Ref w/Solite
LLV00RNFSOL	Mini LED Micro Cylinder Narrow Flood Ref w/Solite
LLAV00RFSOL	Mini LED Micro Cylinder, Flood Ref w/Solite

Electrical

Electronic power supply input voltage: 120V, 60 Hz

Input power: 10W Efficacy: Approximately 44.8 LM/W

High power factor >0.9 ELV dimming available

Dimming

Lightolier Controls: ZP425QE

Lutron Skylark: SELV-300P-WH

Leviton Decora: IPE04-ILX

Labels

cULus listed. 5 year warranty,

Job Information	Type:

PHILIPS

LIGHTOLIER

NEO-RAY™

DESCRIPTION

23XR wall wash completes the Straight & Narrow family. Its precise optical reflector design provides wall illumination up to 10' in height with smooth gradiation from top to bottom of the wall. 23XR application is perfect for classrooms, conference rooms, corridor walls, arcades and galleries. 23XR features excellent photometrics and high efficiency while offering smooth wall wash free of striations and shadows. Runs are provided to the nearest foot and the light source is hidden from most viewing angles.

Catalog #		WF1
Project		
Comments		Date
Prepared by		03/13/07

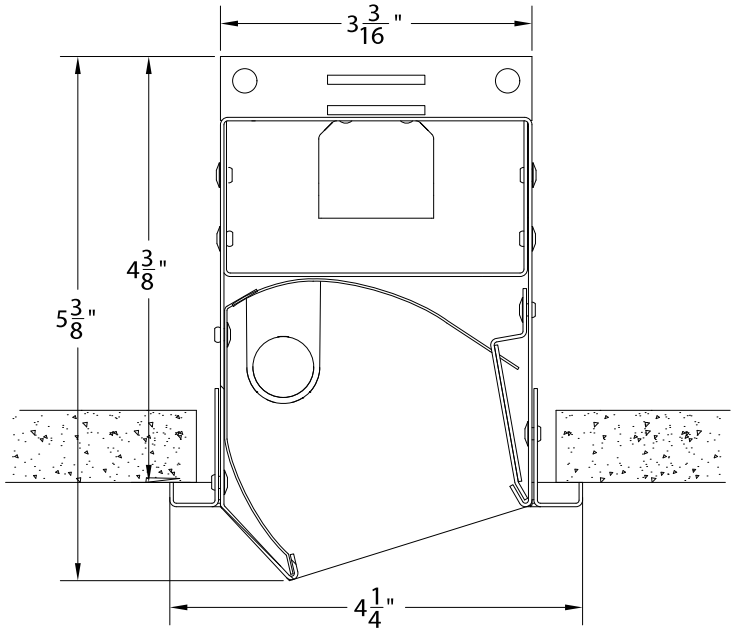
SPECIFICATION FEATURES

Construction
Housing is one-piece, die-formed, cold rolled steel. Standard 5', 4' and 3' fixture length.

Electrical
120, 277, 347 or Universal Voltage electronic ballast. Fixtures and electrical components certified to UL and CUL standards.

Finish
Durable, low gloss, white, powder coat acrylic. Optional custom finish.

Mounting
Recessed.



WALL WASH
23XR
Gen II

1T5
1T5HO

Wall Wash
Direct-Indirect

Light Distribution:
Indirect = 1%
Direct = 99%

ORDERING INFORMATION

SAMPLE NUMBER: S23XR-1T5-ETG4D-1EB-SI-EM-GLR-S90

23X	R	1								SI		

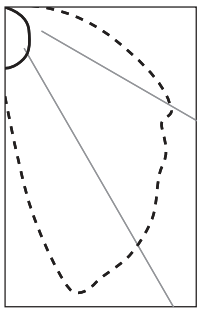
- Series: 23X =Straight & Narrow wall wash
- Mounting: R=Recessed
- Number of Lamps (not included): 1=1 Lamp
- Lamp Type: T5, T5HO
- Ceiling Type: ETG =15/16" Exposed T-grid; FTG =9/16" Exposed T-grid; STG =Screw Slot T-grid; SR =Sheet Rock; FSR = Flangeless Sheet Rock
- Length: 3 =3 ft; 4 =4 ft; 5 =5 ft
- Section [2]: D=Individual; I=Intermediate; B=Beginning of Run; E=End of Run
- Voltage: 1=120V; 2=277V; 3=347V; U=Universal
- Ballast [1]: EB =Electronic Ballast (standard); DB =Dimming Ballast
- Switching Options: SI =Single Switching
- Emergency: EM = Emergency Pack (consult factory) [1]
- Fusing: GLR; GMF

1 Requires voltage information.
- Runs available for sheet rock only.
- For some electronic, dimming and EM battery pack ballast combinations, fixture has space limitation (consult factory).
- Due to various constraints, some options may not be combined with others. Please consult your Cooper Lighting representative for availability.

2 Fixture end plates butted end-to-end for continuous runs

PHOTOMETRICS

WF1



23XR
1T5HO lamp
Efficiency 61.7%
Test#168P236

0 - - - - -
90 ——

Zonal Lumen Summary

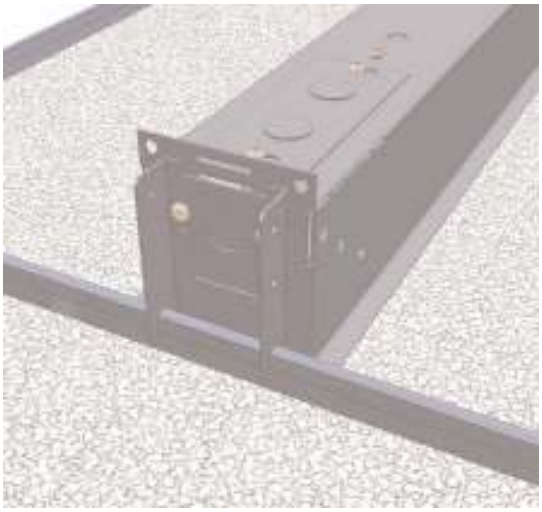
Zone	Lumens	%Lamp	%Fixture
0-30	650	13.0	21.1
0-40	1146	22.9	37.1
0-60	2174	43.5	70.4
0-90	3068	61.4	99.4
0-180	3086	61.7	100.0

Total Luminaire Efficiency = 61.7%

Candela

Angle	Along ∥	45°	Across ⊥
0	417	417	417
5	883	734	417
15	1999	1698	403
25	1912	1873	374
35	1768	1692	330
45	1530	1475	272
55	1344	1189	204
65	1143	968	132
75	746	661	63
85	419	310	9
90	222	144	2
95	46	6	2

MOUNTING INFORMATION

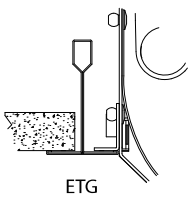


Patent pending adjustable ceiling mounting system. Adjust to various ceiling grid types and enables end installation precise fit for integrated ceiling appearance. Access plate and pre-wired assembly allows for easy wiring.

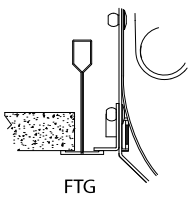
Recommended distance from fixture longitudinal axis and wall is 1' to 3'. Optimum performance distance is 2'. Fixture housing lengths are 3', 4' and 5' mounted individually in grid ceilings and in sheet rock can be mounted in continuous rows. Fixtures can be butted up against each other, end-to-end for continuous row mounting.

Ideal for vertical surfaces. The shape of the reflector was specially designed to produce uniform lighting on walls. The fitting's size is reduced. It uses high performance fluorescent lamps with low energy consumption. It is also quite easy to install.

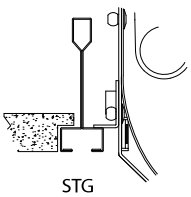
MOUNTING OPTIONS



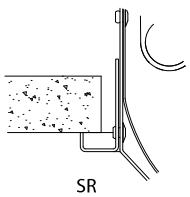
ETG
15/16" TEE GRID



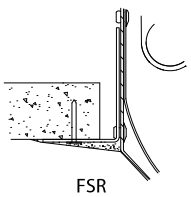
FTG
9/16" TEE GRID



STG
9/16" TEE GRID
(SLOTTED)



SR
SHEET ROCK



FSR
"FLANGELESS"
SHEET ROCK

WF2

FOCAL POINT®

mini-grazer™

features

High performance, T5 or T5HO Fluorescent Wall Grazer.

Nautilus optic designed to highlight textured walls and ceilings evenly from ceiling to floor.

Swing down lamp tray allows for easy lamp accessibility.

Housing creates 6" architectural slot.

Great energy solution that replaces multiple MR16 or PAR lamps commonly used for grazing applications.

Housing designed for drywall or grid ceilings.

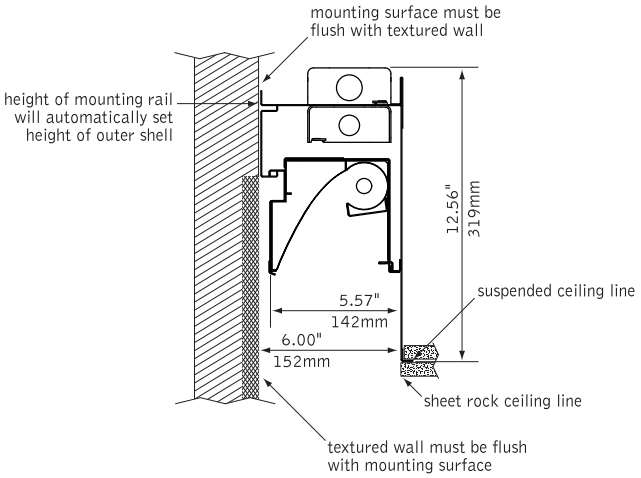
shielding options

open optic

baffle

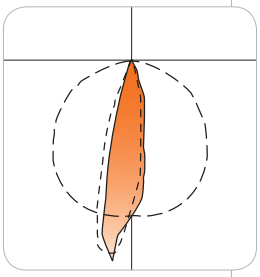
april 2009 A

dimensional data



performance

1-lamp T5HO
37% Efficiency
3734 cd @ 5°



Visit focalpointlights.com for complete photometric data.

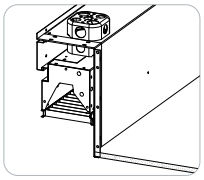
fixture:

project:

WF2

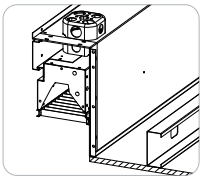
mounting information

Grid



Acoustical tile may rest on flange of luminaire.

Drywall

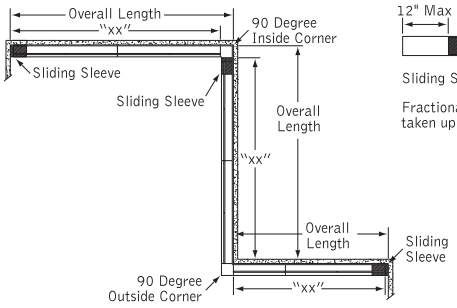


Mount drywall under luminaire and support to ceiling structure.

NOTE: Add drywall thickness to overall height of luminaire.

NOTE: Luminaire must be installed prior to ceiling.

typical run layout



Luminaires must be installed prior to ceiling.

Start run from corner with any standard luminaire.
Corner to corner runs end with a sliding sleeve.

sliding sleeves

Fractional Dimensions up to 12" are taken up by the use of a sliding sleeve.

specifications

construction

20 Ga. steel housing.

20 Ga. internal bulkheads.

20 Ga. steel rough–in housings are provided to create wall to wall slot.

20 Ga. steel sliding sleeve.

Optional baffle (.650"H x .800" frequency) provides 50° cutoff to lamp and held captive with torsion springs.

Luminaires are available in 3' and 4' lengths.

3' unit weight: 24 lbs
4' unit weight: 26 lbs

optic

CNC roll-formed specular .016" thick aluminum.

electrical

Electronic ballasts are thermally protected and have a Class "P" rating.

Consult factory for dimming specifications and availability.

UL and cUL listed.

finish

Polyester powder coat applied over a 5-stage pre–treatment.

ord

luminaire series		FMG
Mini-Grazer	FMG	
shielding		
No Shielding, Open Optic	NS	
Baffle, White	BB	
lamping		
One Lamp T5	1T5	
One Lamp T5HO	1T5HO	
circuits		1C
Single Circuit	1C	
voltage		
120 Volt	120	
277 Volt	277	
347 Volt	347	
ballast		
Electronic Dimming Ballast*	D	
Electronic Program Start <10% THD	S	
factory options		
Air Return	AR	
Chicago Plenum	CP	
Emergency Circuit*	EC	
Emergency Battery Pack*	EM	
HLR/GLR Fuse	FU	
Include 3000K Lamp	L830	
Include 3500K Lamp	L835	
Include 4100K Lamp	L841	
12" Sliding Sleeve	SS	
finish		WH
Matte White Housing	WH	
luminaire length		
Designate overall run length dimension (light modules provided in 3' & 4' lengths)	XX'	
corner options		
90–degree Inside Corner	FMG-IC90	
90–degree Outside Corner	FMG-OC90	

NOTE: Not intended for drywall surfaces unless a Level 5 finish is specified.

* for more information see Reference section.

Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | T: 773.247.9494 | F: 773.247.8484 | info@focalpointlights.com | www.focalpointlights.com.

LED SQUARE FTS WL/5

recessed lensed LED wallwasher

WL1

FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE – FULLY SUSTAINABLE

FEATURES

LED Square FTS WL/5 is a 5" square lensed wallwasher employing LED technology. Fixture is only 5 7/8" deep. Luminaire provides uniform illumination on vertical surfaces up to the ceiling line.

Luminaire is powered by a Philips Fortimo SLM LED module, dimmable to 10% with a 0-10 volt dimmer, with a CRI as high as 90 and a 5-year warranty. Fixture may be specified with modules of 800, 1100 or 2000 lumen light output and with 2700K, 3000K, 3500K or 4000K color. Refer to the tables below for system wattages and luminaire efficacies.

Other features include:

- life: 50,000 hours at 70% of initial light output (IESNA LM80-2008)
- operational range: tolerates temperatures as low as -20° C (-4°F)

A precisely designed reflector and spread lens distributes light to the top of the wall, minimizes aperture brightness and virtually eliminates the inter-reflections inherent with square apertures.

Reflectors are available in slightly diffuse clear natural aluminum or champagne gold Alzak®. Other reflector finishes are available on special order.

Luminaire includes a pair of mounting bars (¾" x 27" C channel). Specialty bars for wood joist and T-bar installations are also available.

APPLICATIONS

Luminaire is recommended for wallwashing in commercial, retail and residential spaces.

Luminaire is SP listed for Damp Location. Luminaire is prewired with thermal protector, approved for ten #12 wire 90° branch circuit pull-through wiring and suitable for use in a fire rated ceiling. To maximize life of LED modules luminaires equipped with 2000-lumen modules should be spaced at least 30" apart and 15" from walls, and should have ½" clearance above housing. All luminaires are RoHS compliant. Removal of the reflector allows access to the junction box.

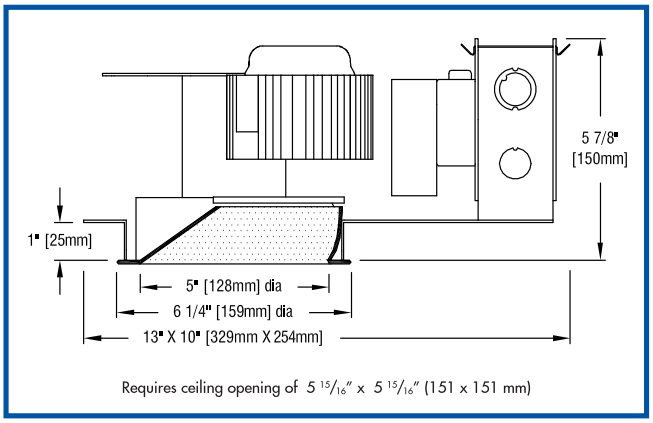
FULLY SUSTAINABLE

LED Square FTS WL/5 is fully sustainable. Both critical components – the LED module (diode array) and the driver (power conditioner) – can be replaced through the aperture with a screwdriver. Both components are, and will remain, available from Edison Price Lighting.

MODIFICATIONS AVAILABLE

Contact factory with quantity for pricing; orders may require shop drawing approval.

+DOD: luminaire suitable for **high humidity** environments; add +DOD to Product Code.
+MAR: reflector suitable for **marine** environments; add +MAR to Product Code.



Requires ceiling opening of 5 15/16" x 5 15/16" (151 x 151 mm)

PRODUCT CODE

For complete product code, list basic unit and select one item from each following box.

Basic Unit LED-SQ-FTS-WL/5
NOTE: Standard driver is dimmable to 10% with a 0-10 volt dimmer.

Light Output
- 800 lumens 800
- 1100 lumens 1100
- 2000 lumens *note spacing requirements: see* Applications *text.* 2000

Light Engine Color
- 2700K (90 CRI) 2700
- 3000K (90 CRI) 3000
- 3500K (80 CRI) 3500
- 4000K (80 CRI) 4000

Voltage
- 120 volt service 120
- 277 volt service 277

Reflector Color and Detail

	Overlap
Slightly diffuse Clear	VOL
Champagne Gold	GOL

Other reflector finishes available on special order.

Standard reflector flange continues reflector finish. White painted flanges and custom painted flanges are available on special order. Add WF (white flange) or CCF (custom color flange).

OPTIONS *Specify by adding to the basic unit.*

Dimmable ..standard driver is dimmable to 10% with a 0-10 volt dimmer.

Emergency battery pack operates luminaire in event of power outage. Includes a plate with ready light and test switch for adjacent installation by others ..... – REM

EDISON PRICE LIGHTING
41-50 22ND STREET, LIC NY 11101 TEL 718.685.0700 FAX 718.786.8530 www.epl.com

LED SQUARE FTS WL/5

WL1

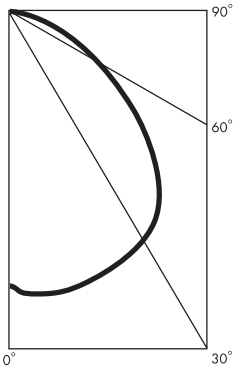
PHOTOMETRIC REPORT (tested per IESNA LM-79-2008)

LTL *Report No. 25257 and 25255.*
Original Luminaire Testing Laboratories, Inc. (LTL) test reports furnished upon request.

Luminaire ..... recessed LED square lensed wallwasher with aluminum reflector
Lamp ..... Philips LED Fortimo SLM 2000, 3000K CCT
Luminaire light output..... 990 lumens

CANDLEPOWER DISTRIBUTION

(Candela)



LUMINAIRE LIGHT OUTPUT AND EFFICACY

Color	*800 lumens light engine*			*1100 lumens light engine*			*2000 lumens light engine*		
	Luminaire Light Output	*Luminaire Efficacy*	*System Wattage*	*Luminaire Light Output*	*Luminaire Efficacy*	*System Wattage*	*Luminaire Light Output*	*Luminaire Efficacy*	*System Wattage*
2700K	438*	23	19	573*	21	27	990	24	42
3000K	438*	24	18	573*	23	25	990	25	39
3500K	438*	31	14	573*	29	20	990	33	30
4000K	438*	34	13	573*	30	19	990	38	26

**estimated values*

LIGHT OUTPUT MULTIPLIER

800 lumens light engine	0.44
1100 lumens light engine	0.58
2000 lumens light engine	1

WALLWASH INFORMATION

Distance From Ceiling (Feet)	*3'From Wall; 3'O.C.*		*3'6"From Wall; 3'O.C.*		*3'6"From Wall; 3'6" O.C.*	
	Below Fixture	*Between Fixtures*	*Below Fixture*	*Between Fixtures*	*Below Fixture*	*Between Fixtures*
1	14	10	9	8	8	6
2	26	25	18	19	17	15
3	29	29	24	25	21	21
4	26	26	25	24	21	21
5	21	21	21	21	18	18
6	16	16	17	17	15	15
7	13	13	14	14	12	12
8	11	11	12	12	10	10
9	9	9	10	10	8	8
10	7	7	8	8	7	7
11			7	7	6	6
12			6	6	5	5

All vertical footcandles are initial values with no contribution from ceiling or floor reflectances. Computation performed with a total of ten wallwashers.

DRIVER INFORMATION *UL Class 2, dry and damp location*

Voltage	*120*	*277*
Input Watts *(800/1100/2000 lumens), 3000K*	18/25/39	18/25/39
Input Current (A) *(800/1100/2000 lumens)*	0.15/0.21/0.33	0.06/0.09/0.14
Output Current (mA)	200-700	200-700
Output Voltage (Vdc)	25–56	25–56
Min. Power Factor	>0.9	>0.9
Operating Temperature Range (F)	–4 to 131	–4 to 131

DIMMING INFORMATION

Dimming Method	*Dimming Range (%)*	*Min. Output Power*
0 - 10V	10% -100%	15

COMPATIBLE DIMMERS *Please verify with vendors*

CONTROL MANUFACTURER	WALLBOX DIMMER	POWER BOOSTER AVAILABLE
DOUGLAS LIGHTING CONTROLS	WPC-5721	
ENTERTAINMENT TECHNOLOGY	Tap Glide TG600FAM120(120V) Tap Glide Heatsink TGH1500FAM120 (120V) Oasis OA2000FAMU (120/277V)	
HONEYWELL, INC.	EL7315A1019 and EL7315A1009	EL7305A1010 (optional)
HUNT DIMMING	Preset slide: PS-010-IV-120V and PS-010-WH-120V Preset slide: PS-010-3W-IV-120V and PS-010-3W-WH-120V Preset slide: PS-010-IV-277V and PS-010-WH-277V Preset slide: PS-010-3W-IV–277V and PS-010-3W-WH-277V Preset slide, controls FD-010: PS-IFC-010-IV and PS-IFC-010-WH-120/277V Preset slide, controls FD-010: PS-IFC-010-3W-IV and PS-IFC-010-3W-WH-120/277V Remote mounted unit: FD-010-120V and FD-010-277V	
LEHIGH ELECTRIC PRODUCTS CO.	Solitarire	PBX
LEVITON LIGHTING CONTROLS DIV.	Leviton Centura Fluorescent Control System IllumaTech™ IP7 Series	CN100 PE300
LIGHTOLIER CONTROLS	Sunrise Preset slider ZP600FAM-120 (120V) Momentum Preset slider MP1500FAM-120 (120V) Vega Slider V2000FAMU (120-277V)	
LITHONIA CONTROLS	ISD BC SLD LPCS Digital Equinox (DEQ BC)	 RDM FC
LUTRON ELECTRONICS CO., INC.	Visit **www.lutron.com/advance** for the latest control information and selection	
PDM ELECTRICAL PRODUCTS	WPC-5721	
STARFIELD CONTROLS	TR61 with DALI interface port	RT03 DALInet Routers
THE WATT STOPPER, INC.	LS-4 used with LCD-101 and LCD-103	

Appendix C | Lamp, Ballast, and Driver Cutsheets

T5 Standard

28W/835 Min Bipin T5 HE ALTO UNP

Philips T5 Fluorescent Lamps featuring ALTO® Lamp Technology offer increased energy savings and low toxicity in a slim profile.

Product data

- General Characteristics

System Description	High Efficiency
Base	Miniature Bipin
Base Information	Green [Green Base]
Bulb	T5 [16 mm]
Rated Avg. Life	24000 hr
Life to 10% fail	19000 hr
Preheat EL,3h	
LSF HF Preheat 20000h Rated,3h	85 %
LSF HF Preheat 16000h Rated,3h	94 %
LSF HF Preheat 12000h Rated,3h	95 %
LSF HF Preheat 8000h Rated,3h	97 %
LSF HF Preheat 6000h Rated,3h	98 %
LSF HF Preheat 4000h Rated,3h	98 %
LSF HF Preheat 2000h Rated,3h	99 %

- Light Technical Characteristics

Color Code	835 [CCT of 3500K]
Color Rendering Index	82 Ra8
Color Designation	White
Color Temperature	3500 K
Chromaticity Coordinate X	412 -
Chromaticity Coordinate Y	401 -
Initial Lumens	2900 Lm
Lum Efficacy Rated HF 25°C	94 Lm/W
Lum Efficacy Rated HF 35°C	104 Lm/W
LLMF HF 20000h Rated	88 %
LLMF HF 16000h Rated	90 %
LLMF HF 12000h Rated	91 %
LLMF HF 8000h Rated	93 %
LLMF HF 6000h Rated	94 %
LLMF HF 4000h Rated	95 %
LLMF HF 2000h Rated	96 %
Luminous Flux EL 25°C, Rated	2625 Lm
Luminous Flux EL 25°C, Nominal	2625 Lm
Design Temperature	35 C

- Electrical Characteristics

Watts	28 W
Lamp Voltage EL 25°C	166 V
Lamp Current EL 25°C	0.170 A
Dimmable	Yes
Lamp Wattage EL 35°C	27.8 W
Lamp Current EL 35°C	0.170 A
Lamp Voltage EL 35°C	167 V

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Lamp Wattage EL 25°C, Rated	27.9 W
Lamp Wattage EL 25°C, Nominal	28 W

- Environmental Characteristics

Energy Efficiency Label (EEL)	A
Mercury (Hg) Content	1.4 mg

- Measuring Conditions

Calibration Current	0.170 A
HF Generator Rated Voltage	329 V
Resistor	950 ohm

- Product Dimensions

Base Face to Base Face A	1149.0 (max) mm
Insertion Length B	1153.7 (min), 1156.1 (max) mm
Overall Length C	1163.2 (max) mm
Diameter D	17 (max) mm

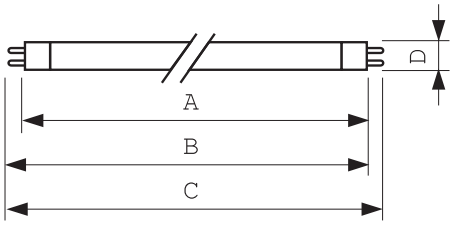
- Product Data

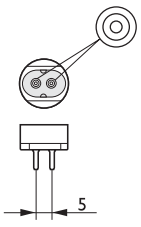
Product number	230854
Full product name	28W/835 Min Bipin T5 HE ALTO UNP
Short product name	28W/835 Min Bipin T5 HE ALTO UNP/40
Pieces per Sku	1
eop_pck_cfg	40
Skus/Case	40
Bar code on pack	46677230852
Bar code on case	50046677230857
Logistics code(s)	927990683522
tpd_ilcos_cd	FDH-28/35/1B-L/P-G5-16/1150
eop_net_weight_pp	104.500 gr

Dimensional drawing

G5, T5

Product	A (Max)	B (Min)	B (Max)	C (Max)	D (Max)
TL5 HE F28T5/835 HE Alto	1149.0	1153.7	1156.1	1163.2	17





G5

T8 Standard

F32T8/TL735 UNP

Philips T8 lamps offer high energy savings, superior lumen output, and long life in an environmentally responsible lamp.

Product data

• General Characteristics

Base	Medium Bi-Pin [Medium Bi-Pin Fluorescent]
Base Information	Green Base
Bulb	T8
Energy Saving	Energy Saving
Rated Avg Life [12-Hr Prog St]	36000 hr
Rated Avg Life [12-Hr Inst St]	30000 hr
Rated Avg Life [3-Hr Prog St]	30000 hr
Rated Avg Life [3-Hr Inst St]	24000 hr

• Light Technical Characteristics

Color Code	TL735 [CCT of 3500K]
Color Rendering Index	78 Ra8
Color Designation	TL735
Color Temperature	3500 K
Initial lumen	2600 Lm
Design Mean Lumens	2470 Lm

• Electrical Characteristics

Watts	32 W

• Environmental Characteristics

Mercury (Hg) Content	1.7 mg
Picogram per Lumen Hour	27 p/LuHr

• Product Dimensions

Nominal Length [inch]	48

• Footnotes

Footnotes Fluores-cent/CFL	920 [Circle E- The encircled E means this bulb meets Federal minimum efficiency standards.]

• Product Data

Product number	272591
Full product name	F32T8/TL735 UNP
Short product name	F32T8/TL735 UNP/1350
Pieces per Sku	1
eop_pck_cfg	1350
Skus/Case	1350
Bar code on pack	46677272593
Bar code on case	70046677272592
Logistics code(s)	927869773502
eop_net_weight_pp	0.001 kg

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Product Number: 21022

Order Abbreviation: FP54/850/HO/SL/ECO

General Description: 54W, T5, PENTRON High Output (HO) fluorescent lamp with Safeline coating. 5000K Color Temperature, rare earth phosphor, 85 CRI, ECO

Product Information	
Abbrev. With Packaging Info.	FP54850HOSLECO 40/CS 1/SKU
Actual Length (in)	45.795
Actual Length (mm)	1163.19
Average Rated Life (hr)	25000
Base	Miniature Bipin
Bulb	T5
Color Rendering Index (CRI)	85
Color Temperature/CCT (K)	5000
Diameter (in)	0.669
Diameter (mm)	17.00
Family Brand Name	PENTRON® SAFELINE®
Initial Lumens at 25C	4243
Initial Lumens at 35C	4753
Mean Lumens at 25C	3946
Mean Lumens at 35C	4420
Nominal Length (in)	48.000
Nominal Length (mm)	1219.20
Nominal Wattage (W)	54.00
Life at 3 hrs./start on PRS ballasts	30000
Life at 12 hrs./start on PRS ballasts	40000

ECOLOGIC ™

Footnotes

- ¿ Approximate initial lumens after 100 hours operation.
- ¿ The life ratings of fluorescent lamps are based on 3 hr. burning cycles under specified conditions and with ballast meeting ANSI specifications. If burning cycle is increased, there will be a corresponding increase in the average hours life.
- ¿ Minimum starting temperature is a function of the ballast; consult the ballast manufacturer.
- ¿ There is a NEMA supported, industry issue where T2, T4, and T5 fluorescent and compact fluorescent lamps operated on high frequency ballasts may experience an abnormal end-of-life phenomenon. This end-of-life phenomenon can resultin one or both of

the following: 1. Bulb wall cracking near the lamp base. 2. The lamp can overheat in the base area and possibly melt the base and socket. NEMA recommends that high frequency compact fluorescent ballasts have an end-of-life shutdown circuit which will safely and reliably shut down the system in the rare event of an abnormal end-of-life failure mode described above. The final requirements of this system are yet to be defined by ANSI. For additional information refer to NEMA papers on their WEBSITE at www.NEMA.org.

- ¿ SYLVANIA ECOLOGIC fluorescent lamps are designed to pass the Federal Toxic Characteristic Leaching Procedure (TCLP) criteria for classification as non-hazardous waste in most states. TCLP test results are available upon request. Lamp disposal regulations may vary, check your local & state regulations. For more information, please visit www.lamprecycle.org
- ¿ SAFELINE lamps satisfy the criteria of having a non-shattering covering for prevention of glass and other lamp components in your product by containment within the safety coating material. The covering must be intact or the lamp must be replaced to be in compliance. An onsite inspector will require correction if the lamps are installed improperly or not maintained properly.
- ¿ SAFELINE lamps are intended for indoor use only. Lamps must be used in ambient temperatures below 135 degrees F. For T8 and T12 lamps, the coating is designed to withstand constant operating temperatures up to 239 degrees F and has a melting point in excess of 500 degrees F. For T5 lamps, the coating is designed to withstand constant operating temperatures up to 500 degrees F and has a melting point in excess of 620 degrees F. Lamps must be used in open fixtures with sockets that provide adequate lamp pin to socket contact. Lamps must not be used with defective ballasts sockets, or fixtures with improper wiring.

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EcoSystem® H-Series Ballasts Overview

EcoSystem® H-Series digitally addressable ballasts provide a low-cost, flexible solution for any space in any application. Industry leading dimming to less than 1% meets the needs of the most demanding applications. Individual control with the EcoSystem® Digital Link eliminates the need to rewire, reduces design time, and provides a scalable solution from a small area to an entire building.

EcoSystem® H-Series, case type M

1.18 in (30 mm) W x 1.00 in (25 mm) H x 14.125 in (359 mm) L

EcoSystem® H-Series, case type G

2.38 in (60 mm) W x 1.0 in (25 mm) H x 9.5 in (241 mm) L

Features

- Continuous, flicker-free dimming from 100% to 1% or less for T8, and 1% for T5 and T5HO lamps.
- Compatible with Energi Savr Node™ with EcoSystem® unit, GRAFIK Eye® QS control unit, PowPak™ dimming module with EcoSystem® unit, and Quantum® software, allowing for integration into an existing or planned EcoSystem® lighting control solution.
- Programmed rapid start design preheats lamp cathodes before applying full arc voltage to ensure full-rated lamp life while dimming and cycling.
- 100% performance tested and burned in at factory.
- Lamps turn on to any dimmed level without going to full brightness.
- Low harmonic distortion throughout the entire dimming range maintains power quality.
- Frequency of operation ensures that ballast does not interfere with infrared devices operating between 38 kHz and 42 kHz.
- Ballasts maintain consistent light output for different lamp lengths, ensuring fixture-to-fixture uniformity
- Ultra-quiet operation.
- Ballast protected from miswires of any input power to control lead, or from lamp leads to each other and/or ground.
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life.
- Non-volatile memory restores all ballast settings after power failure.
- 100% compatible with all EcoSystem® digital controls.
- Custom ballast factors available for UL or CSA listed products. Design tool and specifications can be found at www.lutron.com/ballasttool

LUTRON® SPECIFICATION SUBMITTAL

Page 1

Job Name:	Model Numbers:	
Job Number:		

Specifications

Standards

- California Energy Commission Listed.
- UL Listed (evaluated to the requirements of UL935).
- CSA certified (evaluated to the requirements of C22.2 No. 74).
- Class P thermally protected.
- Meets ANSI C82.11 High Frequency Ballast Standard.
- Meets FCC Part 18 Non-Consumer requirements for EMI/RFI emissions.
- Meets ANSI C62.41 Category A surge protection standards up to and including 4 kV.
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20.
- Lutron® Quality Systems registered to ISO9001.2008.

Ballast Wiring & Mounting

- Ballast is grounded via a mounting screw to the fixture.
- Ballast mounts using two screws (or sheet metal feature and one screw) within a fluorescent fixture.
- Power and lamp wiring terminals accept one 18 to 16 AWG (0.75 to 1.5 mm^2) solid copper wire per terminal.

• Lamp Seasoning

Refer to the lamp manufacturer's requirements for lamp seasoning requirements prior to dimming.

Environment

- Minimum lamp starting temperature: 50 °F (10 °C)
- Relative humidity: less than 90% non-condensing
- Sound Rating: Class A
- Maximum ballast case temperature: 80 °C

Performance

- Dimming Range: 100% to 0.7% measured Relative Light Output (RLO) for T8, 100% to 1% RLO for T5 and T5HO.
- Lamp Starting: programmed rapid start
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output Variation: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer.
- Power Factor: greater than 0.95
- Total Harmonic Distortion (THD): less than 10% *
- Operating Voltage: Universal input 120 V~, 220/240 V~, 277 V~ at 50 or 60 Hz
- Frequency of Operation: greater than 42 kHz
- Ballast Factor (BF): 1.0/1.17 for T8 lamps and 1.0 for T5 and T5HO lamps
- Standby Power: less than 1 W

Dimming Range for T8 lamps:

BF	Dimming Range (Max/Min [BF])	Dimming Ratio
1.17	1.17 / 0.0085	138:1
1.0	1.00 / 0.0085	118:1

Dimming Range for T5 and T5HO lamps:

BF	Dimming Range (Max/Min [BF])	Dimming Ratio
1.0	1.00 / 0.01	100:1

Warranty

- 5-year limited warranty with Lutron® field service commissioning (3-year standard warranty) from date of purchase. For additional Warranty information, please visit www.lutron.com/ResourceLibrary/warranty/Limited%20Comm.pdf

* Models EHDT817MU110, EHDT514MU110, EHDT521MU110 and EHDT521MU210 have less than 15% (THD).

Job Name:	Model Numbers:	
Job Number:		

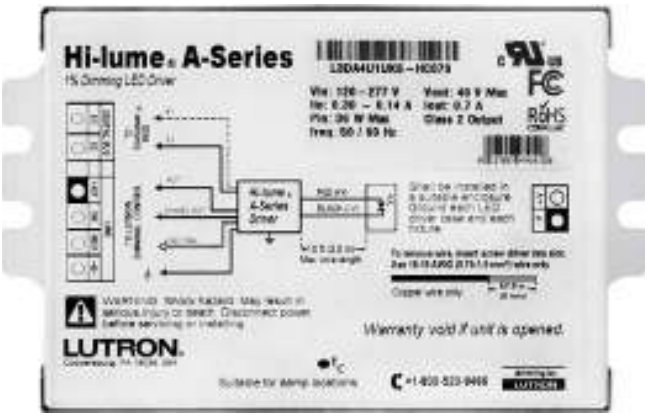
369-325 Rev. D 1 10.25.11

Hi-lume® A-Series Driver Overview EcoSystem® or 3-wire control

Hi-lume® A-Series Driver is a high-performance LED driver that provides smooth, continuous 1% dimming for virtually any LED fixture, whether it requires constant current or constant voltage. It is the most versatile LED driver offered today due to its compatibility with a wide variety of LED arrays, multiple form factors, and numerous control options.

Features

- Continuous, flicker-free dimming from 100% to 1%.
- Compatible with Energi Savr Node™ with EcoSystem® unit, GRAFIK Eye® QS control unit, PowPak™ dimming module with EcoSystem®, and Quantum® systems, allowing for integration into a planned or existing EcoSystem® lighting control solution. Please see chart at the end of this document or contact Lutron for details regarding compatible controls.
- Standard 3-wire line-voltage phase-control technology for consistent dimming performance and compatibility with all Lutron® 3-wire fluorescent controls.
- Protected from miswires of input power to EcoSystem® control inputs.
- 100% performance tested at factory.
- 100% burned in at factory.
- A rated lifetime of 50,000 hours @ t_C = 149 °F (65 °C).
- UL recognized for United States and Canada.
- FCC Part 15 compliant for commercial applications at 120 V~ or 277 V~.
- Pulse Width Modulation (PWM) or Constant Current Reduction (CCR) dimming methods available. See Application Note #360 for details.
- For more information please go to: www.lutron.com/HilumeLED



Hi-lume® A-Series, case type K

3.00 in (76 mm) W x 1.00 in (25 mm) H x 4.90 in (124 mm) L

Hi-lume® A-Series, case type M

1.18 in (30 mm) W x 1.00 in (25 mm) H x 14.25 in (362 mm) L

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Specifications

Performance

- Dimming Range: 100% to 1%
- Operating Voltage: 120-277 V~ at 50/60 Hz
- A rated lifetime of 50,000 hours @ t_C = 149 °F (65 °C). Contact Lutron for derating information.
- Patented thermal foldback protection
- LEDs turn on to any dimmed level without going to full brightness.
- Nonvolatile memory restores all driver settings after power failure.
- Power Factor: >0.90 at 40 W
- Standby Power Consumption: <1.0 W
- Total Harmonic Distortion (THD): <20% at 40 W
- Inrush Current: <2 A
- Inrush Current Limiting Circuitry: eliminates circuit breaker tripping, switch arcing and relay failure.
- Open circuit protected
- Short circuit protected
- Turn-on time: ≤1 second
- PWM Dimming Frequency: 550 Hz

Environmental

- Sound Rating: Class A.
- Relative Humidity: Maximum 90% non-condensing.
- Minimum operating ambient temperature t_a = 32 °F (0 °C).

Standards

- Meets ANSI C62.41 category A surge protection standards up to and including 4 kV.
- FCC Part 15 compliant for commercial applications at 120 V~ or 277 V~.
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20.
- Lutron® Quality Systems registered to ISO 9001.2008.
- UL 8750 recognized.
- Class 2 output available.
- Models available to meet LED Driver requirements for Energy Star 1.1.

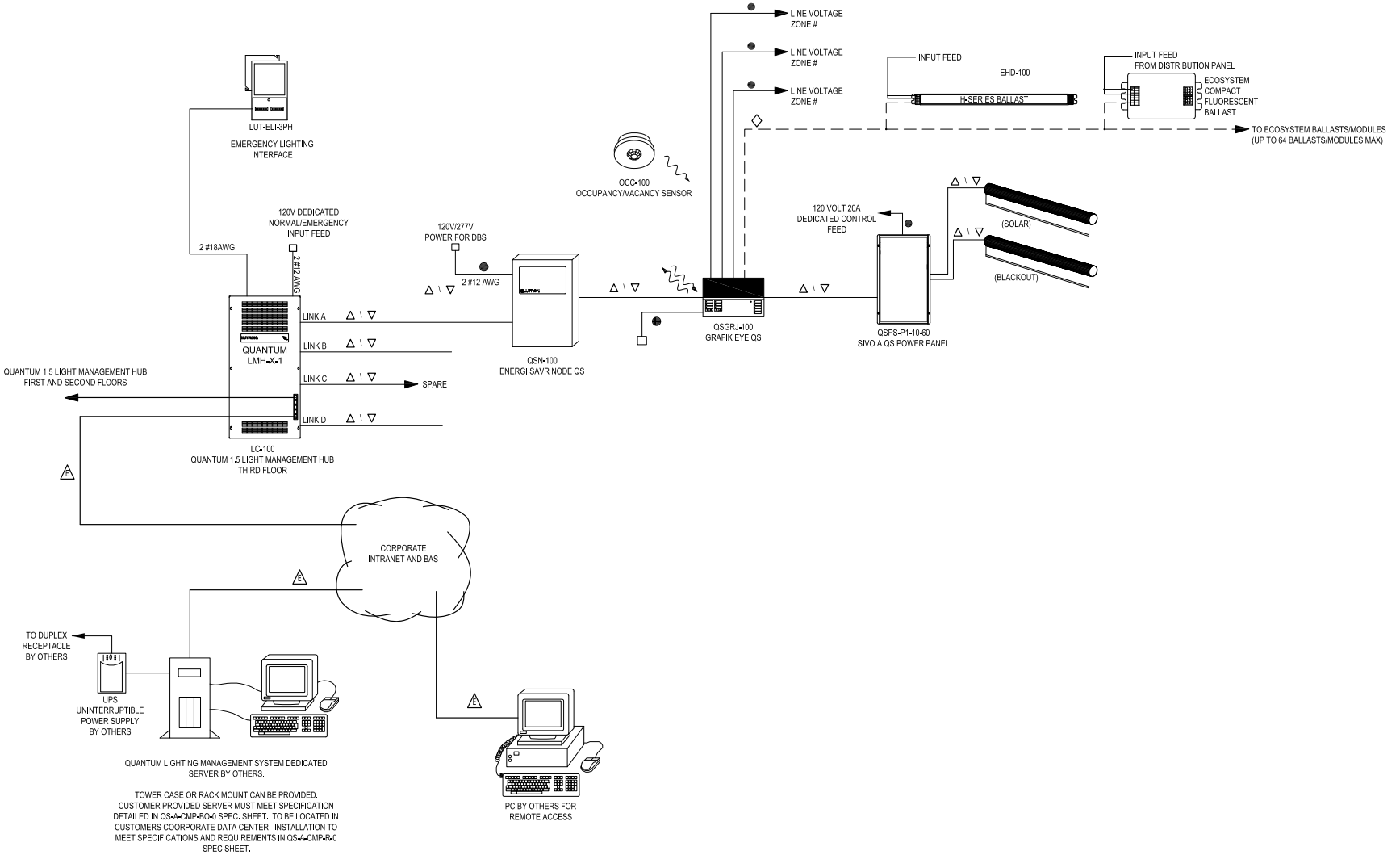
Driver Wiring & Mounting

- Driver is grounded by a mounting screw to the grounded fixture (or by terminal connection on the K case).
- Terminal blocks on the driver accept one solid wire per terminal from 18 to 16 AWG (0.75 to 1.5 mm^2).
- Fixture must be grounded in accordance with local and national electrical codes.
- Maximum driver–to–LED light engine wire length is 10 ft (3.0 m).

Job Name:	Model Numbers:	
Job Number:		

Appendix D | Control Schedule, Diagrams, and Cut Sheets

Lighting Control Equipment Schedule					
Type	**Manufacturer**	**Product Name**	**Catalog Number**	**Description**	**Location**
EHD-100	LUTRON	ECOSYSTEM H-SERIES BALLASTS	EHD T528 M U 1 10	Fluorescent Dimming Ballast with dimming capabilities to 1% output	EXTERIOR, LOBBY, OFFICE, BOARD ROOM
EW-100	LUTRON	ECOSYSTEM 4 BUTTON WALLSTATION	CC-4BRL-WH	Communicates with EcoSystem Ballasts and EnergiSavr Node. Up to three lighting scenes and on/off.	LOBBY, MARKETING OFFICE
DS-100	LUTRON	PHOTOSENSOR	LRFX-DCRB-WH	Wireless closed loop sliding setpoint daylight sensor that is compatible with up to 10 dimming and switching devices.	MARKETING OFFICE
GE-100	LUTRON	GRAFIK EYE QS	QSGRJ-16E	Contrls Board Room lighting with line voltage zones	BOARD ROOM
LC-100	LUTRON	QUANTUM LIGHT MANAGEMENT HUB	QP2-2P0CSE-120	Centralized connection for Lutron EcoSystem, supports up to 8 EcoSystem loops	DATA CENTER
LD-100	LUTRON	HI-LUME A-SERIES LED DRIVER	L3D 25 XXX A UNV 1	Dims continuously to 1% light levels, continuous flicker free dimming, line-voltage phase control	EXTERIOR, LOBBY, OFFICE, BOARD ROOM
MS-100	WATTSTOPPER	EW LOW VOLTAGE OUTDOOR MOTION SENSOR	EW-205-24-W	Motion sensor with capabilities to cover 270 degrees. Operates on 24 VDC and allows for high and low switching.	EXTERIOR
OCC-100	LUTRON	OCCUPANCY/VACANCY SNESOR	L2F2-OCRB-P-WH	Ceiling mounted occupancy sensor with up to 12' diameter coverage	LOBBY, OFFICE, BOARD ROOM
QSM-100	LUTRON	QUANTUM SENSOR MODULE	QSM2-4W-C	Quantum wireless sensor module that communicates with EcoSystem wallstation, occupancy sensors, and daylgiht sensors. Communicates with Grafik Eye QS	LOBBY, OFFICE
QSN-100	LUTRON	ENERGY SAVR NODE QS	QSN-2ECO-S	Controls occupancy sensors, daylight sensors, and EcoSystem Wallstations	DATA CENTER



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3/31/2012

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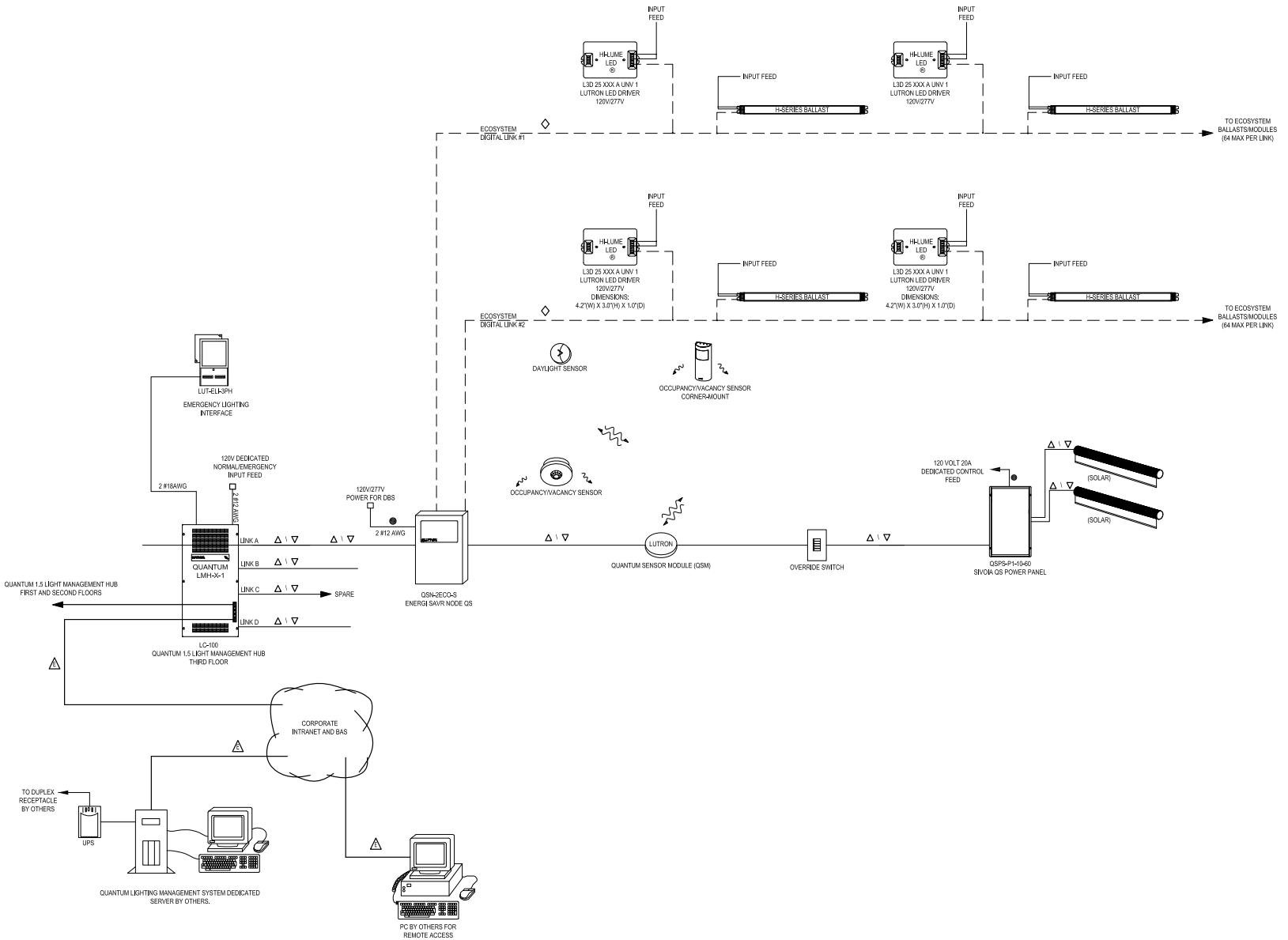
SARAH WUJCIK

TITLE:
BOARD ROOM CONTROL DIAGRAM

SHEET TITLE:
C.01



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TITLE:
MARKETING OPEN OFFICE CONTROL DIAGRAM

SHEET TITLE:
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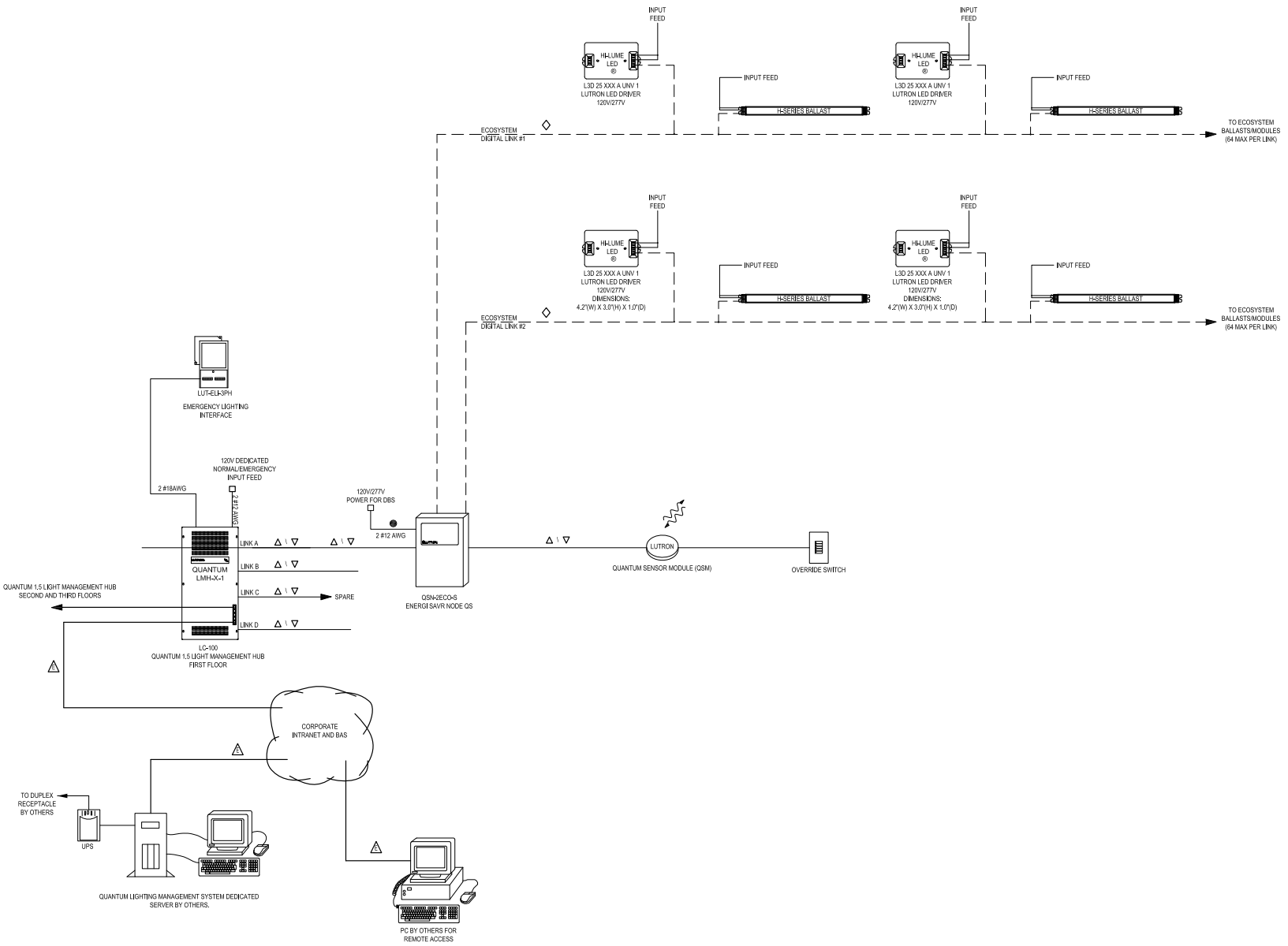

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TITLE:
LOBBY CONTROL DIAGRAM

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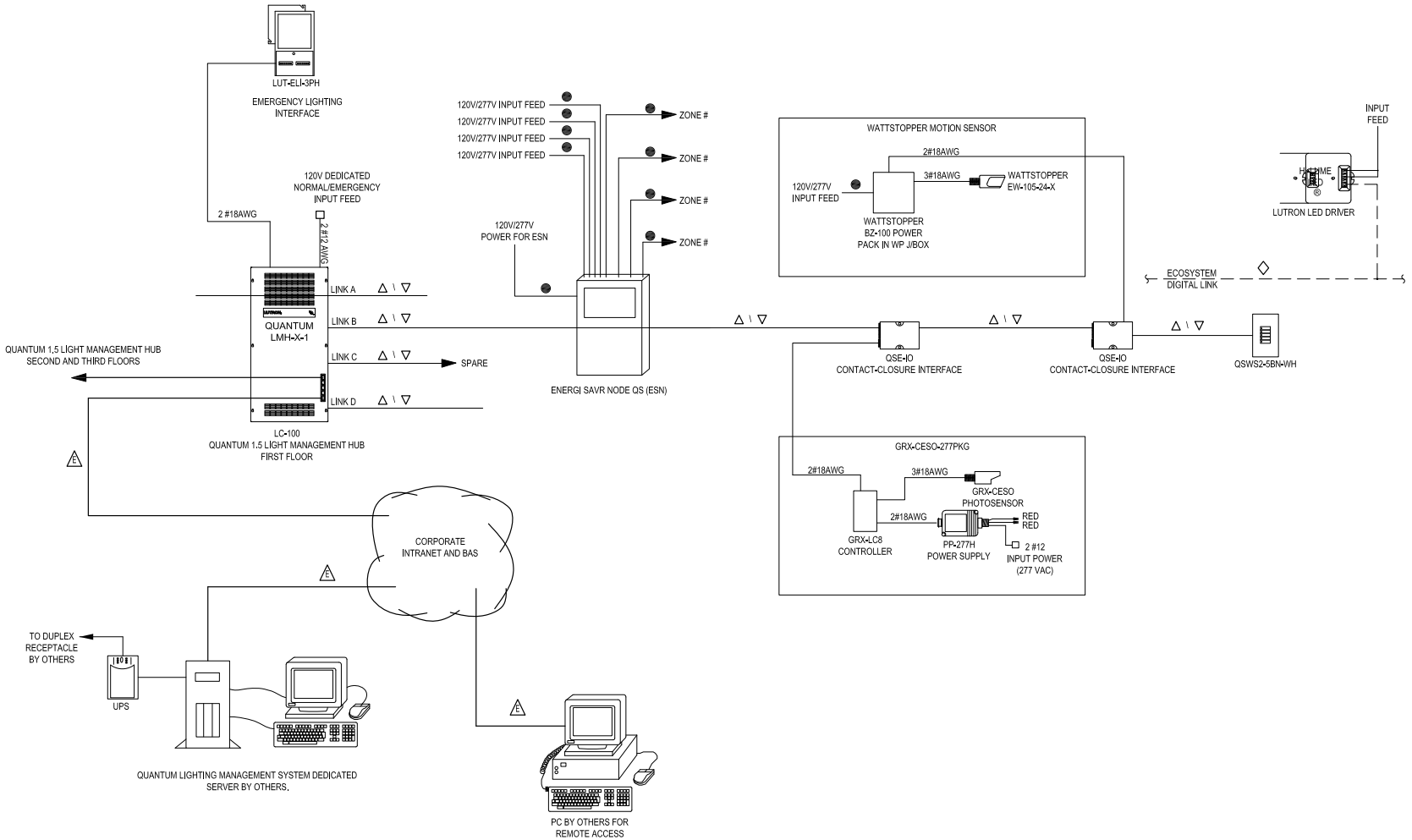

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04/04/2012

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SARAH WUJCIK

TITLE:
PARKING AREAS
CONTROL DIAGRAM

SHEET TITLE:
C.04

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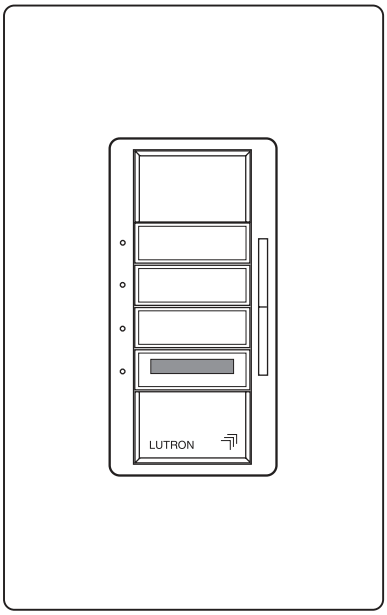
4-Button Wall Control with Raise/Lower

The 4-Button Wallstation recalls lighting presets for a group of EcoSystem® devices. The wallstation connects directly to the EcoSystem® ballast, ballast module, Energi Savr Node™, or QS Sensor Module (QSM) via low-voltage wiring.



Features

- Wires Class 2 / Low-Voltage
- Mounts easily in any single-gang wallbox
- 4 Presets as well as All On and All Off
- Raise/Lower rocker controls all assigned ballasts
- Built-in infrared receiver allows wallstation to be used as a programming point for EcoSystem® ballasts or ballast modules (traditional programming via PDA only)
- Infrared (IR) signals are received through the plastic button (maximum distance of 10 ft / 3 m)
- Programming of control groups can be performed at the wallstation
- Programming of scene levels can be performed at the wallstation when used only with EcoSystem® ballasts or ballast modules
- Multi-color LED to indicate button presses, programming mode, and reception of infrared signals
- Green LEDs shall be on at all times and operate as a “night light”
- Red LEDs shall indicate programming mode is active
- Fits any designer (Claro®) opening faceplates
- Faceplate not included
- Zone Control when used with Energi Savr Node™ or Quantum®

Notes

- Zone toggle and unaffected zone not supported in this model
- This product is designed to control a single ballast or group of ballasts or modules
- A second 4B control in the same group will perform the same function (recalls the same 4 scenes)

Job Name:	Model Numbers:	
Job Number:		

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Radio Powr Savr™ Wireless Daylight Sensor

Lutron's wireless daylight sensor is a battery-powered sensor that automatically controls lights via RF communication to compatible dimming or switching devices. This sensor mounts to the ceiling and measures light in the space. The sensor then wirelessly transmits the light level to the associated dimming or switching devices that automatically control the lights to balance light level in the space. The sensor combines both convenience and exceptional energy savings potential along with ease of installation.

Features

- Wireless daylight sensor has simple calibration.
- Daylight compensation through Lutron's reliable open loop control.
- Designed to give a linear response to changes in viewed light level.
- Light range 0–107,000 Lux (0–10,000 fc).
- Uses ClearConnect™ technology.
- Works seamlessly with Radio Powr Savr™ occupancy sensors and Pico® wireless controls.
- One sensor can be associated to up to 10 compatible RF dimming and switching devices allowing for switching, stepped dimming, and continuous dimming of multiple zones.
- Intuitive test mode provides instant system verification.
- Multiple ceiling mount methods available for different ceiling materials.
- Front accessible test buttons make setup easy.
- 10-year battery life.
- RoHS compliant.

Model Number

LRFX-DCRB-WH

- Color Code
- Frequency / Channel Code

Frequency / Channel Codes

2 = 431.0 – 437.0 MHz (US, Canada, Mexico, Brazil)
3 = 868.125 – 869.850 MHz (Europe and UAE)
4 = 868.125 – 868.475 MHz (China and Singapore)
5 = 865.5 – 866.5 MHz (India)
6 = 312.3 – 314.8 MHz (Japan)
7 = 433.05 – 434.79 MHz (Hong Kong)

Color Code

WH = White

Compatible RF Devices

- For use with Lutron® products only
- Communicates to various wireless Lutron® systems*

* *Contact Lutron® Customer Service at www.lutron.com for frequency/channel code compatibility with your particular geographic region, and for integrating with other Lutron® lighting and shading products.*

Job Name:	Model Numbers:	
Job Number:		

Specifications

Regulatory

Lutron® Quality Systems Registered to ISO 9001:2008

Standards

LRF2-

- FCC certified
- IC certified
- COFETEL
- ANATEL
- ASEP
- CRC
- SUBTEL
- SUPERTEL
- SUTEL
- Meets CA (U.S.A.) Energy Commission Title 24 requirements

LRF3-

- CE Marked (European Union)
- TRA Type Approved (United Arab Emirates)

LRF4-

- SRRC Type Approved (Mainland China)
- iDA Registered (Singapore)

LRF5-

- WPC Type Approved (India)

LRF6-

- 007YUUL0688

LRF7-

- FCC certified

Power / Performance

- Operating voltage: 3 V⎓
- Operating current: 7 µA
- Requires one CR 2450 lithium battery
- 10-year battery life
- Non-volatile memory (settings are stored during power loss)

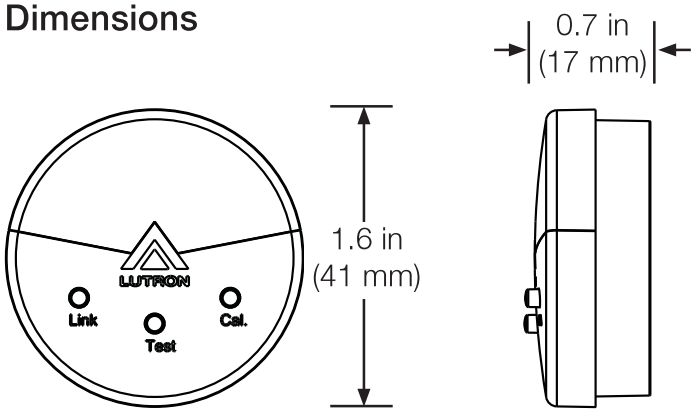
Enviroment

- Temperature: 32 °F to 104 °F (0 °C to 40 °C)
- For indoor use only
- Relative humidity: < 90% non-condensing

Range

- **LRF2, LRF3, LRF4, LRF5, LRF7**
  Local load controls must be located within 60 ft (18 m) line of sight, or 30 ft (9 m), through walls, of a sensor.
- **LRF6**
  Local load controls must be located within 23 ft (7 m), through walls, of a sensor.

Dimensions



Job Name:	Model Numbers:	
Job Number:		

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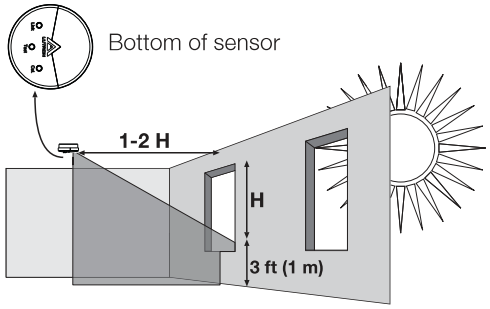
Mounting

Location for average size areas

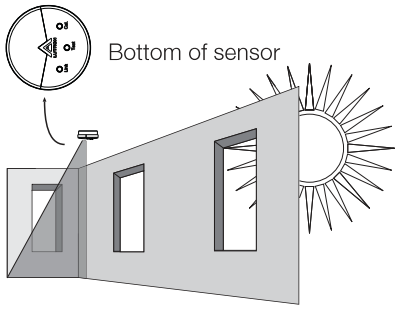
Arrow points towards the area viewed by the sensor (towards windows).



H = Effective Window Height

Location for narrow areas (corridors, private offices)

Arrow points towards the area viewed by the sensor (away from window)



Installation Overview

Determine the Daylight Sensor mounting location using the diagrams at left:

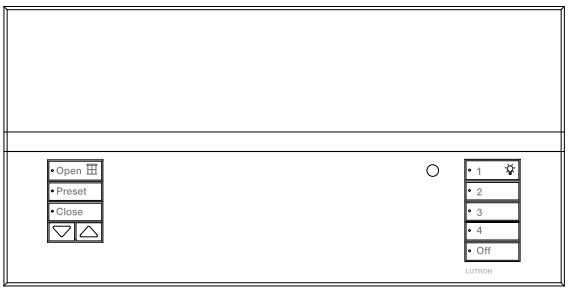
- The arrow on the daylight sensor points toward the area viewed by the sensor.
- Place the daylight sensor so its arrow is pointed at the nearest window at a distance from the window of one to two times the effective window height (H).
- The effective window height (H) starts at the window sill or 3 ft (1 m) up from the floor, whichever is higher, and ends at the top of the window.
- Ensure that the view of the daylight sensor is not obstructed (e.g. ceiling fans or pendant fixtures).
- Do not position the daylight sensor above an electric light that shines up at the ceiling or at the sensor.
- Do not position the daylight sensor in the well of a skylight or above indirect lighting fixtures.
- For narrow areas where the daylight sensor cannot be placed 1-2 (H) from windows, place sensor near windows facing into the space.
- Mount Sensor(s) away from large metal surfaces (e.g. light fixtures or metal-backed ceiling tiles). Metal objects will affect the Sensor's RF performance.

Daylight Sensor Communication

- A sensor can communicate with up to 10 local load devices.
- A local load device or zone can receive information from only one daylight sensor.

Job Name:	Model Numbers:	
Job Number:		

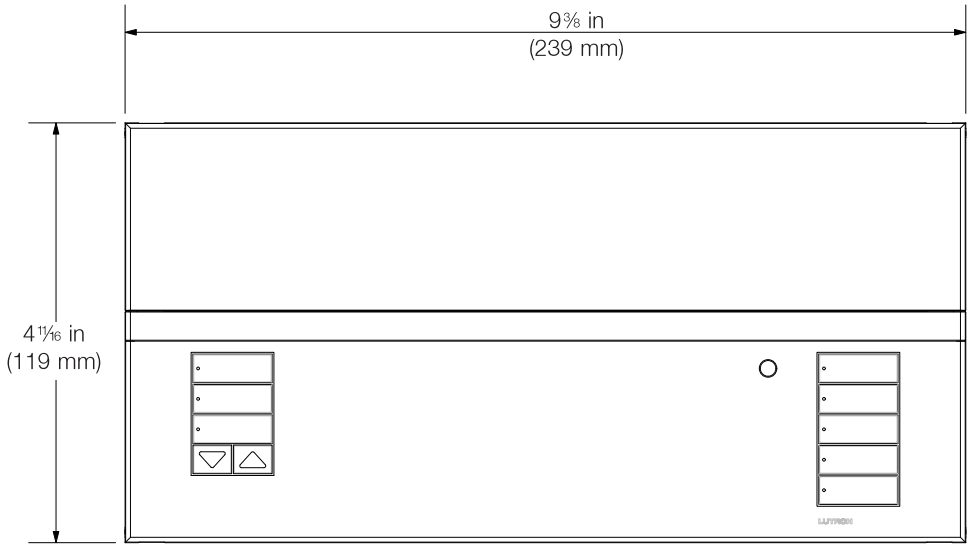
GRAFIK Eye® QS Wireless Control Unit with EcoSystem®



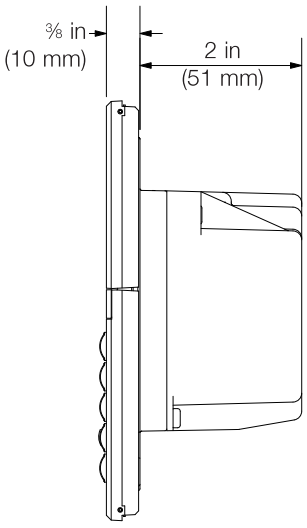
Description

GRAFIK Eye® QS Wireless with EcoSystem® is the premier energy-saving lighting and shade control. The GRAFIK Eye® QS control unit features an astronomic timeclock and intuitive lighting presets, which are seamlessly integrated with EcoSystem® fluorescent ballasts and LED drivers, and Lutron's QS components and systems. Now with wireless technology and an integral EcoSystem® bus supply, you can use the GRAFIK Eye® QS Wireless control unit with EcoSystem® to control ballasts and shades without interfaces, and integrate with a variety of Lutron wireless products and systems, including Radio Powr Savr™ occupancy, vacancy, and daylight sensors, Sivoia® QS wireless shades, Pico® wireless control, and other GRAFIK Eye® QS wireless control units. Additionally, the GRAFIK Eye® QS wireless control unit is compatible with all Lutron wired QS products and systems, including Quantum®.

Mechanical Dimensions



Front View



Side View

Fits into a 4-gang U.S. backbox, 3½ in (89 mm) deep; Lutron P/N 241-400

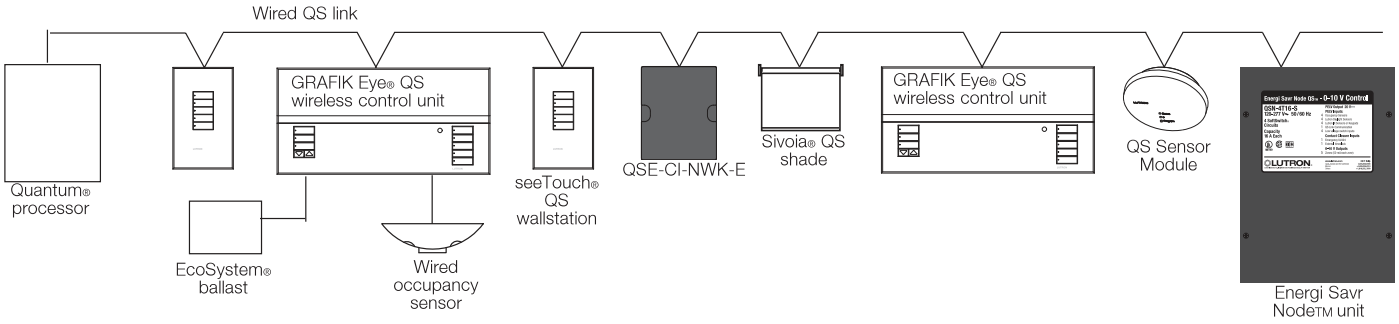
LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

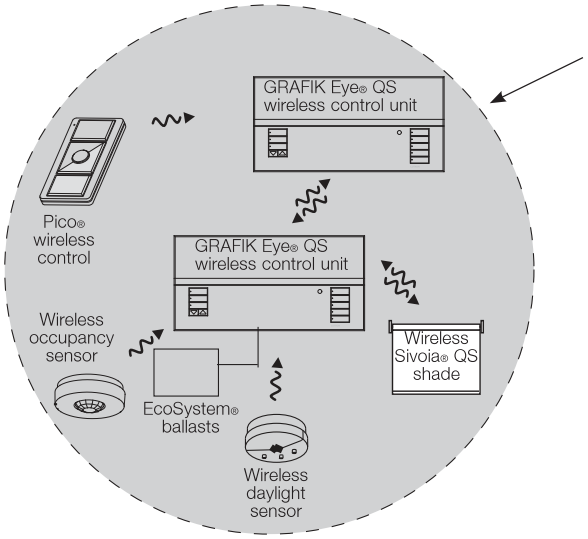
System Topologies

The GRAFIK Eye® QS Wireless control unit with EcoSystem® can be specified in three different system topologies. Examples of each are shown below.

Example of Wired System

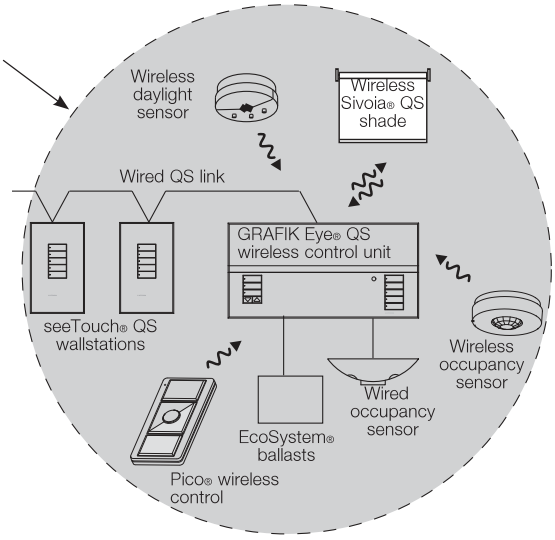


Example of GRAFIK Eye®-centric Wireless System



30 ft (10 m) wireless range; 60 ft (20 m) in open air

Example of Mixed GRAFIK Eye®-centric Wired/Wireless System



Job Name:	Model Numbers:	
Job Number:		

Application Suggestions and Differences between GRAFIK Eye® QS with EcoSystem® and Standard EcoSystem® Bus Supply

	GRAFIK Eye® QS with EcoSystem®	Energi Savr Node™ with EcoSystem®
Suggested/Recommended Applications	**Single rooms, partitioned spaces, e.g., conference room, classroom, ballroom, lobby**	**Open spaces, multiple enclosed rooms, e.g., open office, window offices**
Programming Method	Info Screen on the QS control unit	Via Energi Savr Node™ App for *iPod* mobile digital device
Integral Timeclock	Yes	No
Compatible with seeTouch® QS Keypads	Yes	Yes
Compatible with EcoSystem® Wall Controls	No	Yes
Compatible with EcoSystem® IR Sensors	No	Yes
Includes dry contact closure for integration to BMS or Security Systems	Yes	Yes
Input Voltage	120-127 or 220-240 V~ 50/60 Hz	120/240/277 V~ 50/60 Hz
Number of EcoSystem® Busses	1	1 or 2
Number of Zones	6, 8, or 16	Programmable
Number of Line-Voltage Outputs	3 (Zones 1-3 only)	--
Compatible with other QS Devices	Yes	Yes

iPod is a trademark of Apple Inc., registered in the United States and other countries.

Job Name:	Model Numbers:	
Job Number:		

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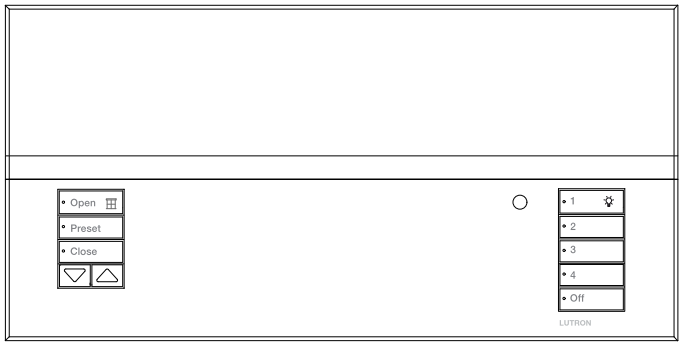
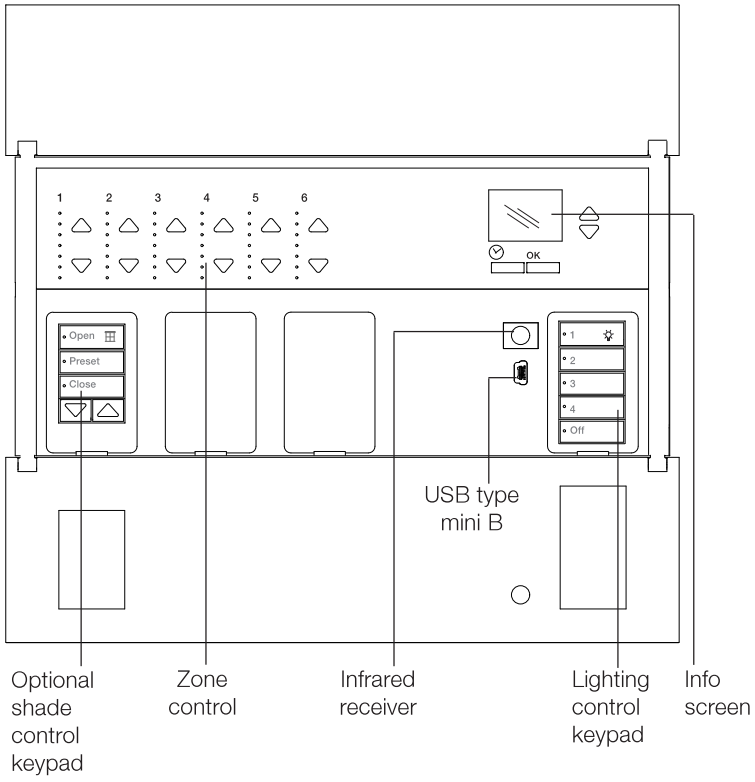


Note: General Engraving (-EGN) shown.



Features

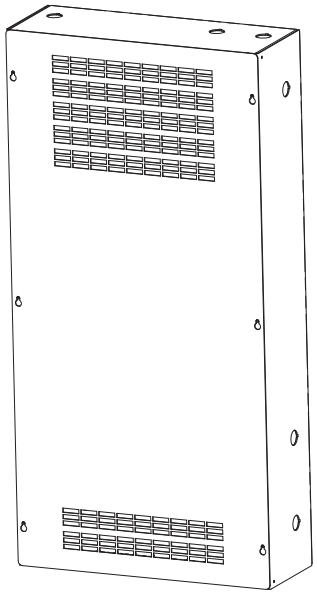
- Lutron's proprietary Clear Connect™ RF technology. Operates in the 434 MHz band.
- Pushbutton recall of four preset lighting scenes, plus Off.
- Twelve (12) additional scenes accessible through other QS devices, such as seeTouch® QS wallstations.
- Zones 1, 2, and 3 can control many light source types directly and others using power modules.
- Optional integrated shade control buttons, which can also be added to the unit after installation.
- Master override buttons to raise and lower all lights.
- Allows setup of lighting scenes and shade presets using buttons on the control unit.
- Built-in infrared (IR) receiver.
- External IR connection.
- Built-in astronomic timeclock.
- Info screen shows zone light level percentage, energy savings, zone labeling, programming, and EcoSystem® setup.
- Lockout option prevents accidental changes.
- One occupancy sensor input and 24 V⎓ power for occupancy sensor.
- QS communication link for seamless integration of lights, motorized window treatments, occupancy sensors, wallstations, and integration interfaces.
- Compatible with all Lutron QS system components.
- Wireless communication for seamless integration with a variety of Lutron wireless products and systems, including Radio Powr Savr™ occupancy, vacancy, and daylight sensors, Sivoia® QS wireless shades, Pico® wireless controls, and other GRAFIK Eye® QS Wireless control units.
- Control up to 6, 8, or 16 EcoSystem® zones from internal bus supply.
- Zones 1, 2, and 3 are integral line voltage dimming zones and can be optionally programmed as EcoSystem® zones.
- Up to 64 EcoSystem® or Hi-lume® 3D ballasts can be addressed and grouped to zones.
- Integral EcoSystem® setup and programming replaces the need for a handheld programmer (C-PDA-CLR does not communicate with the GRAFIK Eye® QS with EcoSystem® control unit)
- Backlit buttons with engraving make unit easy to locate and operate.
- Available in a variety of colors and finishes.

Job Name:	Model Numbers:	
Job Number:		

Light Management Hub

Description

The Quantum® light management hub provides a centralized connection point for Lutron® EcoSystem® digital ballast modules, *Lutron* power panels, GRAFIK Eye® QS, and Sivoia® QS shades.



Features

- Designed to control, manage, and monitor *EcoSystem* lighting, Energi Savr Node™ with *EcoSystem*, Lutron power panels, *GRAFIK Eye* QS, and *Sivoia* QS shade systems in a building or whole campus.
- Supports both astronomic and time-of-day events to automatically control the lights and shades in the system.
- Simple reconfiguration of a space without rewiring.
- Individually control, monitor, and adjust any light or shade in a space.
- QS control links and *EcoSystem* loops are topology-free.
- For *EcoSystem* loads, the light management hub accepts one normally closed (NC) emergency input per *Quantum* bus supply.
- *EcoSystem* bus may be wired NEC® Class 1 or PELV (Class 2: USA).

Panel Capabilities

- Each hub supports up to 8 *EcoSystem* loops, (4 *Quantum* bus supplies)
- Each loop can have a combination of 64 *EcoSystem* ballasts and ballast modules, plus a maximum of 16 daylight sensors, 32 occupancy sensors, and 64 infrared (IR) devices.
- Supports up to 2 *Quantum* processors with 2 links each that can be individually configured to communicate with:
  - *Quantum* bus supply (limited to one link per bus)
  - Lutron power panels
  - Lutron QS devices

Job Name:	Model Numbers:	
Job Number:		

Specifications

Power

- Input voltage: 120 V~, normal/emergency feed
  50 / 60 Hz 15 A
- Output: EcoSystem® - 18 V⎓ 250 mA per loop
  Processor - 24 V⎓ 1 A per link

Physical Design

- Enclosure: NEMA Type 1, IP-20 protection
  16 U.S. gauge steel
- Weight: 45 pounds (20.4 kg)

Mounting

- Surface mount only

Environment

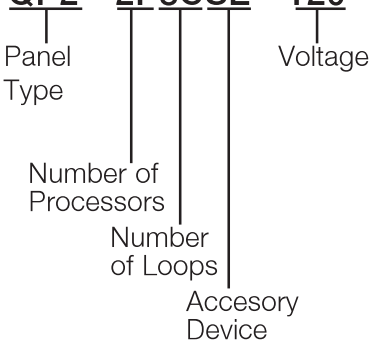
- For indoor use only
- 32 to 104 ºF (0 to 40 ºC)
- Relative humidity less than 90% non-condensing

Job Name:	Model Numbers:	
Job Number:		

How to Build a Model Number

Example

QP2 - 2P8CSE - 120



Available Model Numbers

Contact Lutron for options not listed below.

QP2-0P0CSE-120 (for rough-in use)
QP2-1P0CSE-120
QP2-1P2CSE-120
QP2-1P4CSE-120
QP2-1P6CSE-120
QP2-1P8CSE-120
QP2-2P0CSE-120
QP2-2P2CSE-120
QP2-2P4CSE-120
QP2-2P6CSE-120
QP2-2P8CSE-120

Panel Type
QP2 = Quantum® Light Management Hub

Number of Processors
0P = 0 *Quantum* processors
1P = 1 *Quantum* processor
2P = 2 *Quantum* processors

Number of Loops
0C = 0 EcoSystem® loops
2C = 2 *EcoSystem* loops
4C = 4 *EcoSystem* loops
6C = 6 *EcoSystem* loops
8C = 8 *EcoSystem* loops

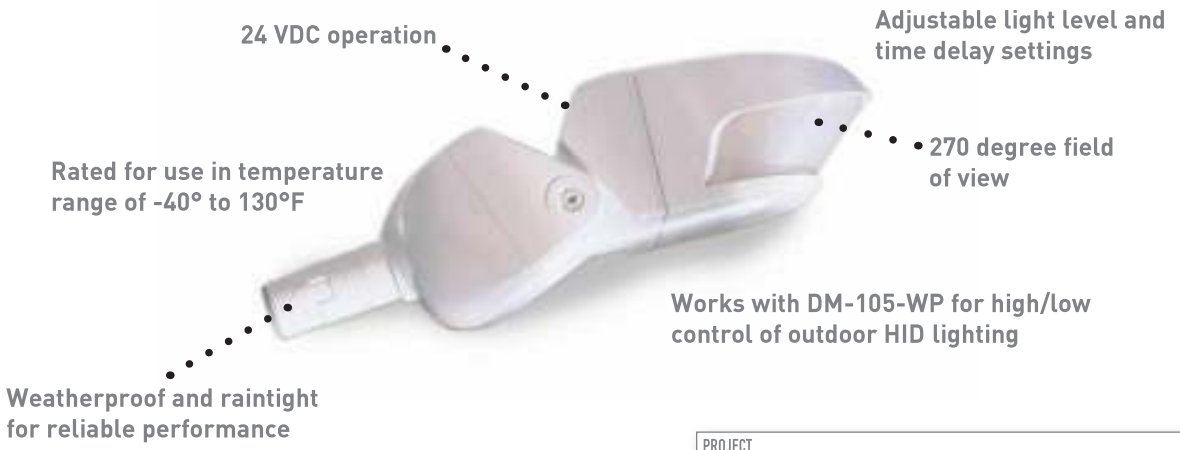
Accessory Device
SE = 5-port Unmanaged Ethernet Switch

Voltage
120 for 120 V~

Job Name:	Model Numbers:	
Job Number:		

COMMERCIAL OCCUPANCY SENSORS & CONTROLS

EW Low Voltage Outdoor Motion Sensor



PROJECT

LOCATION/TYPE

Product Overview

Description

WattStopper's EW outdoor motion sensors provide occupancy based control of outdoor lighting. Raintight and rated for -40°F to 130°F, EW sensors perform reliably in all weather conditions.

Operation

EW sensors operate at 24 VDC and are mounted onto a standard, outdoor junction box. Utilizing advanced passive infrared (PIR) technology, the sensors detect the difference between infrared energy in motion and the background space to turn lighting on when a person or vehicle enters the coverage area. After the area is vacated and the time delay elapses, lighting automatically turns off. The EW's dual PIR detectors and three level lens increase the detection density as well as the accuracy of motion detection.

Applications

The low voltage EW sensors are ideal to use in conjunction with WattStopper DM-105-WP outdoor HID control module. Here, the EW allows the outdoor HID lighting to switch between high and low based on motion detection. Applications include walkways, parking lots, dock lighting and warehouses. When used with a power pack, the low voltage EW also provides an outdoor lighting control solution for areas where line voltage is not available or where the load is too large for a single line voltage sensor to handle.

Features

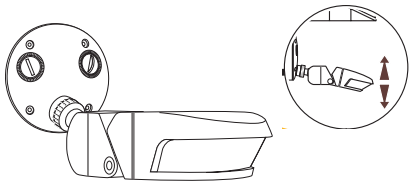
- Sensors can be mounted on walls, eaves, or ceilings for installation convenience
- 270° coverage pattern
- Front rotates for easy coverage adjustment
- Precision, double-shot tooling with internal silicon gaskets prevents water and dust contamination
- Optional override-ON to turn lights on remotely for the length of the time delay
- User-adjustable time delay from 12 seconds to 16 minutes
- Adjustable light level setting allows users to set the level at which lighting will turn on upon occupancy
- ASIC enhances reliability and helps to eliminate false triggers
- Pulse Count Processing eliminates false triggers and provide RFI and EMI immunity
- Includes hardware for mounting sensor to standard 4" round outdoor junction box

Specifications

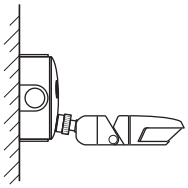
- Operating temperature range -40°F to +130°F
- UL 773A rated raintight
- 24 VDC operation
- 270° coverage
- Adjustable light level of 0.5 to 200 footcandles (5.4 - 2,152.8 lux)
- 1/2" threaded nipple fits standard NEMA weatherproof fixture fitting
- Sensor dimensions: 6.7" x 3.2" x 2.2" (170mm x 80mm x 55mm)
- Five year warranty

Wiring & Installation

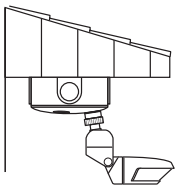
Installation & Positioning



Mounting Diagrams

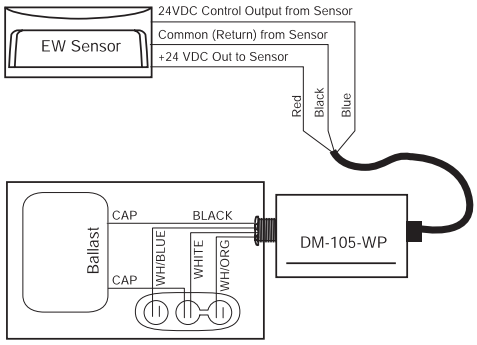


Wall or pole mounting

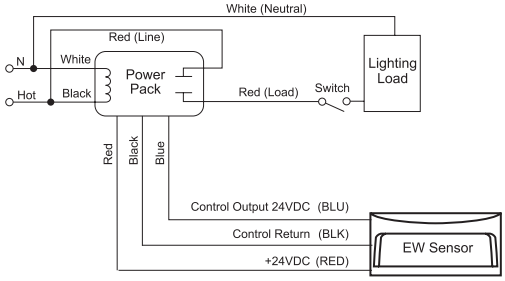


Ceiling/eave mounting

EW Wiring with DM-105-WP HID Control

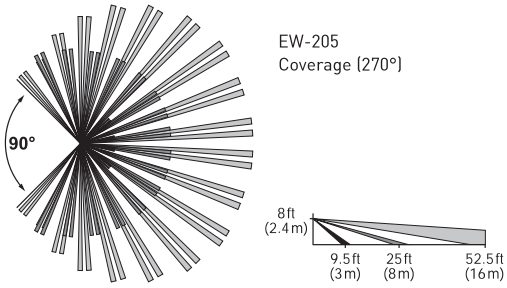


EW and Power Pack Wiring



Coverage

Coverage Pattern



Ordering Information

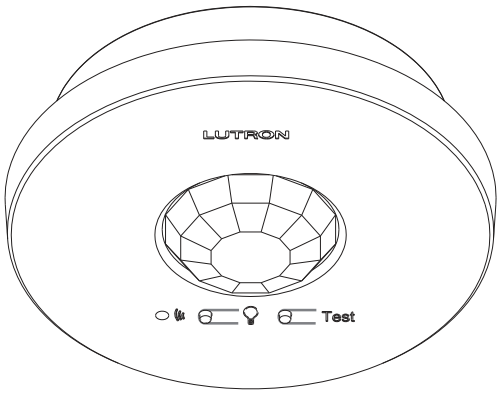
Catalog No.	Color	Voltage	Current	Coverage
☐ EW-205-24-W	Arctic white	24 VDC	7 mA	270°
☐ EW-205-24-G	Arch. grey	24 VDC	7 mA	270°

Pub. No. 17205 rev. 11/2011

369-480 Rev B 1 08.23.11

Wireless Ceiling Mount Sensor

Lutron's ceiling-mounted occupancy/vacancy sensors are wireless, battery-powered passive infrared (PIR) sensors that automatically control lights via RF communication to compatible dimming and switching devices. These sensors detect the heat from people (IR radiation of 9.5 µm) moving within an area to determine when the space is occupied. The sensors then wirelessly transmit the appropriate commands to the associated dimming and switching devices to turn the lights on or off automatically. They combine both convenience and exceptional energy savings potential along with ease of installation.



Features

- Wireless occupancy sensor has 3 settings available: Auto-On/Auto-Off, Auto-On Low-Light/Auto-Off, and Manual-On/Auto-Off
- Auto-On Low-Light feature will only turn lights on automatically if there is less than approximately 10 Lux (1 fc) of ambient light
- Vacancy only model available to meet California (U.S.A.) Title 24 requirements
- Uses Clear Connect™ technology
- Passive infrared motion detection with exclusive Lutron XCT™ Technology for fine motion detection
- 360˚ coverage ranges from 324 sq ft (98 sq m) to 676 sq ft (206 sq m), depending on mounting height
- Simple and intuitive adjustments available for Timeout, Auto-On, and Activity settings
- Supports advanced occupancy features, such as dependent occupancy groups and customizable occupied/unoccupied presets in some systems
- Multiple sensors can be added for extended coverage—refer to product specification submittal of receiving device to determine system limits
- Lens illuminates during test mode to verify ideal locations
- Multiple ceiling-mount methods available for different ceiling materials
- Front accessible test buttons make setup easy
- 10-year battery life design
- RoHS compliant

Models Available

- LRFX-OCR2B-P-WH
  - Color Code
  - Frequency / Channel Code
- LRF2-VCR2B-P-WH
  - *Vacancy Only Sensor*
  - Available for Channel Code 2 Only

Frequency/Channel Codes

2 = 431.0 – 437.0 MHz (US, Canada, Mexico, Brazil)
3 = 868.125 – 869.850 MHz (Europe and UAE)
4 = 868.125 – 868.475 MHz (China and Singapore)
5 = 865.5 – 866.5 MHz (India)
6 = 312.3 – 314.8 MHz (Japan)
7 = 433.05 – 434.79 MHz (Hong Kong)

Color Code

WH = White

Compatible RF Devices

- For use with Lutron® products only
- Communicates to various wireless Lutron® systems*

* *Contact Lutron® Customer Service at www.lutron.com for frequency/channel code compatibility with your particular geographic region, and for integrating with other Lutron® lighting and shading products.*

Job Name:	Model Numbers:	
Job Number:		

Specifications

Regulatory

- Lutron® Quality Systems Registered to ISO 9001:2008

Standards

LRF2-

- FCC certified
- IC certified
- COFETEL certified
- ANATEL certified
- SUTEL certified
- Meets CA (U.S.A.) Energy Commission Title 24 requirements

LRF3-

- CE Marked (European Union) [expected Q4 2011]
- TRA Type Approved (United Arab Emirates) [expected Q4 2011]

LRF4-

- SRRC Type Approved (Mainland China) [expected Q4 2011]
- iDA Registered (Singapore) [expected Q4 2011]

LRF5-

- WPC Type Approved (India)

LRF6-

- 007YUUL0689

LRF7-

- FCC certified

Power/Performance

- Operating voltage: 3 V ⎓
- Operating current: 14 µA nominal
- Requires one CR 123 lithium battery
- 10-year battery life design
- Non-volatile memory (saved changes are stored during power loss)

Environment

- Temperature: 32 ˚F to 104 ˚F (0 ˚C to 40 ˚C)
- For indoor use only

Range

- **LRF2, LRF3, LRF4, LRF5, LRF7**
  Local load controls must be located within 60 ft (18 m) line of sight, or 30 ft (9 m), through walls, of a sensor.
- **LRF6**
  Local load controls must be located within 40 ft (12.2 m) line of sight or 23 ft (7 m), through walls, of a sensor.

Sensor Coverage Test

- Front accessible test button
- Lens illuminates orange in response to motion during test mode and is visible from 60 ft (18 m)

Wireless Communication Test

- Front accessible test button
- Turn associated loads on and off

Timeout Options

- 1 minute *
- 5 minutes
- 15 minutes – default setting
- 30 minutes

Auto-On Options (Occupancy Versions Only)

- “Enabled” * – Sensor turns lights ON and OFF automatically – default setting.
- “Low Light” – Sensor turns lights ON automatically only in low ambient light conditions. Sensor turns lights OFF automatically.
- “Disabled” ** – Lights must be turned ON manually from dimming or switching device. Sensor turns lights OFF automatically.

Activity Options

- Low Activity – default setting
- Medium Activity
- High Activity

* Intended for use in high-activity, briefly occupied areas only

** There is a 15-second grace period that begins when the lights are automatically turned off, during which the lights will automatically turn back on in response to motion. This grace period is provided as a safety and convenience feature in the event the lights turn off while the room is still occupied, so that the user does not need to manually turn the lights back on. After 15 seconds, the grace period expires and the lights must be manually turned on.

Job Name:	Model Numbers:	
Job Number:		

369-242g 1 06.09.11

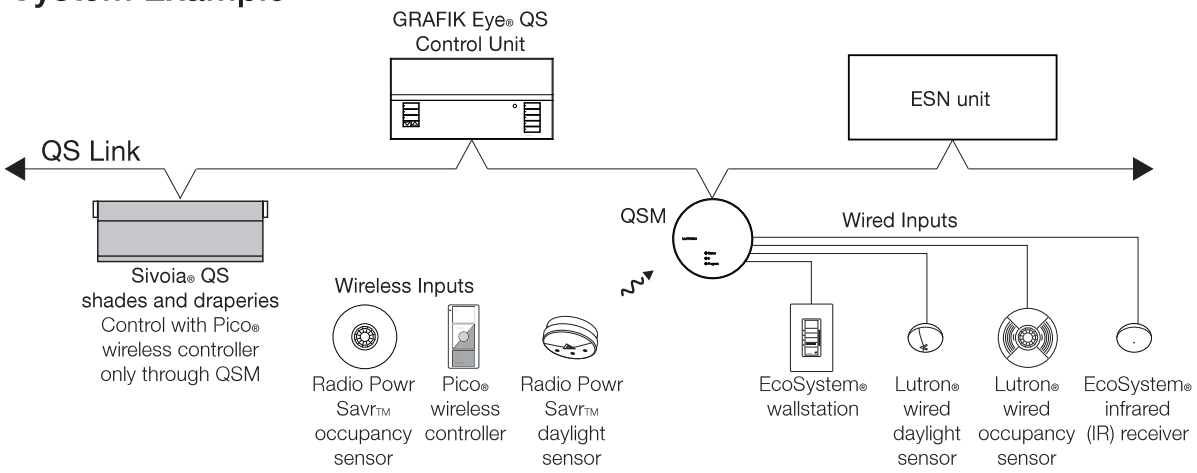
QS Sensor Module

The QS Sensor Module (QSM) is a ceiling-mounted device that integrates Lutron® wireless and wired sensors and controls through the QS communication link to Energi Savr Node™ (ESN) units, GRAFIK Eye® QS, Quantum®, and Sivoia® QS shades and draperies.

Features

- Uses Clear Connect™ RF Technology for communication with Radio Powr Savr™ occupancy sensors, Radio Powr Savr™ daylight sensors, and Pico® wireless controllers.
- QSM connects to four Lutron® wired sensors or controls—occupancy sensors, daylight sensors, EcoSystem® infrared (IR) receivers, or EcoSystem® wallstations. Does not apply to wireless only models.
- Powered by the QS link—no line voltage connections are required.
- Contact Lutron® for compatibility details with the Quantum® system.
- Compatible with the entire ESN product family:
  - — Allows Lutron® wired occupancy sensors, daylight sensors, EcoSystem® wall stations, EcoSystem® IR receivers, Pico® wireless controllers, Radio Powr Savr™ wireless occupancy sensors and daylight sensors to control ESN units.
- Compatible with GRAFIK Eye® QS control units.
  - — GRAFIK Eye® QS control unit models starting with QSGR.
  - — Allows Lutron® wired or Radio Powr Savr™ wireless occupancy sensors and daylight sensors linked to a QSM to control the GRAFIK Eye® QS control unit.
  - — Contact Lutron® for compatibility with Pico® wireless controllers, EcoSystem® wallstations, and EcoSystem® infrared (IR) receivers.
- Compatible with Sivoia® QS shades and draperies.
  - — Allows Pico® wireless controllers to control Sivoia® QS shades and draperies (QSM models with wireless inputs only).

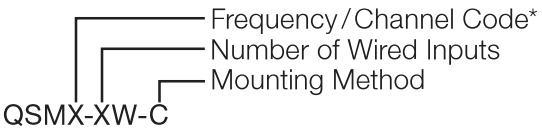
System Example



LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Models



Frequency/Channel Code*

2—431.5 - 436.6 MHz	U.S.A., Canada and Mexico
3—868.1 - 869.8 MHz	European Union and United Arab Emirates
4—868.1 - 868.5 MHz	Singapore and China
5—865.5 - 866.5 MHz	India
7—433.0 - 434.7 MHz	Hong Kong
X—No RF	

*Contact Lutron® for frequency/channel code compatibility with your particular geographic region if it is not indicated above.

Number of Wired Inputs
4—4
X—None

Mounting Method
C-Ceiling Mount
J-Junction Box Ceiling Mount

Availability/Compatibility

Refer to the chart below to determine QSM model availability and compatibility with different sensor models.

	Lutron® Radio Powr Savr™		
Models Available	Occupancy/Vacancy Sensors	Daylight Sensors	Lutron® Pico® Wireless Controllers
QSM2-4W-C QSM2-XW-C QSM2-4W-J QSM2-XW-J	LRF2-OCRB-P, LRF2-OHLB-P, LRF2-OKLB-P, LRF2-OWLB-P, LRF2-VHLB-P, LRF2-VKLB-P, LRF2-VWLB-P, LRF2-OCR2B-WH, LRF2-VCR2B-WH	LRF2-DCRB	MRF2-3BRL, MRF2-3B, MRF2-2BRL, MRF2-2B, QSR4P-3R
QSM3-4W-C QSM3-XW-C	LRF3-OCRB-P	LRF3-DCRB	QSRKP-2, QSRKP-2R, QSRKP-3R
QSM4-4W-C QSM4-XW-C	LRF4-OCRB-P	LRF4-DCRB	QSRMP-2, QSRMP-2R, QSRMP-3R
QSM5-XW-C	LRF5-OCRB-P	LRF5-DCRB	QSRNP-2, QSRNP-2R, QSRNP-3, QSRNP-3R
QSM7-4W-C QSM7-XW-C	LRF7-OCR2B-P	LRF7-DCRB	QSRQP-2, QSRQP-2R QSRQP-3, QSRQP-3R
QSMX-4W-C	N/A	N/A	N/A

Job Name:	Model Numbers:	
Job Number:		

Specifications

QS Sensor Module (QSM)

Power

- 24 V⎓
- Current draw:
  max 400 mA (models with wired input)
  max 100 mA (models without wired input)
- Power Draw Units: (PDU)
  Refer to the section titled "QS Link limits" as well as the QS Link Power Draw Units specification submittal (Lutron® P/N 369405) for information concerning PDUs on the QS Link. Use only Lutron® approved power sources.
- 10-year power failure memory: restores settings and programming after power interruption.

Regulatory

- Lutron® Quality Systems registered to ISO 9001.2008.

QSM2 –

- cUL US Listed (USA and Canada).
- FCC Compliant. Complies with the limits for a Class B digital device, persuant to Part 15 of the FCC Rules (USA).
- IC Certified. (Canada).
- SCT Certified (Mexico).

QSM3 –

- CE Marked (European Union).
- TRA Type Approved (United Arab Emirates).

QSM5 –

- WPC Type Approved (India).

QSM7 –

- FCC Compliant. Complies with the limits for a Class B digital device, persuant to Part 15 of the FCC Rules (USA).

Environment

- Ambient Temperature Operating Range: 32 ºF to 104 ºF (0 ºC to 40 ºC).
- Relative humidity: less than 90% non-condensing.
- For indoor use only.

Terminals

- Input wiring: 22 AWG to 12 AWG (0.5 mm^2 to 4.0 mm^2)
- QS link wiring: 22 AWG to 12 AWG (0.5 mm^2 to 4.0 mm^2)

Mounting

- QSM units should be mounted in the middle of non-metal ceiling tile or drywall, visible from inside the space.
- Installation near metal other than a Junction Box may reduce RF range.

Wireless Communication (models with wireless inputs only)

- RF Range: 60 ft (18 m) line of sight, or 30 ft (9 m) through typical construction materials.
- To ensure optimal wireless range, install the QSM in the ceiling in a visible position from inside the space.
- Lutron® Radio Powr Savr™ Occupancy sensor (up to 10)
- Lutron® Radio Powr Savr™ daylight sensor (up to 10)
- Lutron® Pico® wireless controllers (up to 10)

Wired Inputs

- There are 4 universal wired inputs. Each input can accept one of the following:
  - Lutron® EcoSystem® wallstations
  - Lutron® occupancy sensors (LOS- series)
  - Lutron® daylight sensors (EC-DIR- series)
  - Lutron® EcoSystem® infrared (IR) receivers (EC-IR, EC-DIR- series)
- Maximum wiring distance = 150 ft (46 m)

QS Link Limits

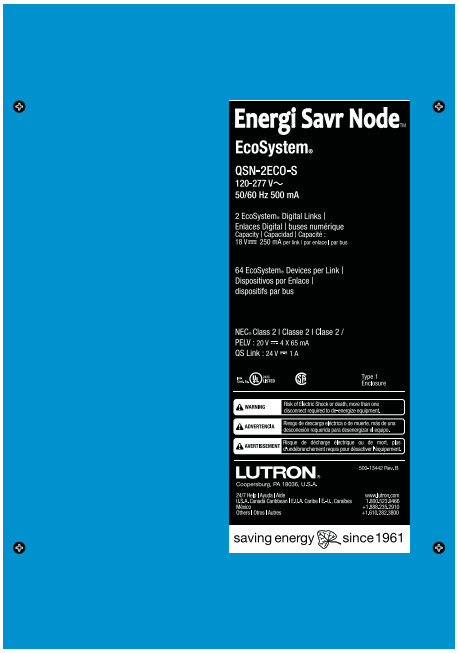
- The QS link can have up to 100 devices.
- Each QSM counts as 1 device towards the 100 device limit.
- Each QSM draws 3 Power Draw Units (PDUs) on the QS link.
- Wired sensors add to the PDU draw of a QSM. Refer to the QS Link Power Draw Units specification submittal (Lutron® P/N 369405) for information concerning PDUs.
- QS link maximum wire run length is 2000 ft (610 m).

Job Name:	Model Numbers:	
Job Number:		

Energi Savr Node™ with EcoSystem®

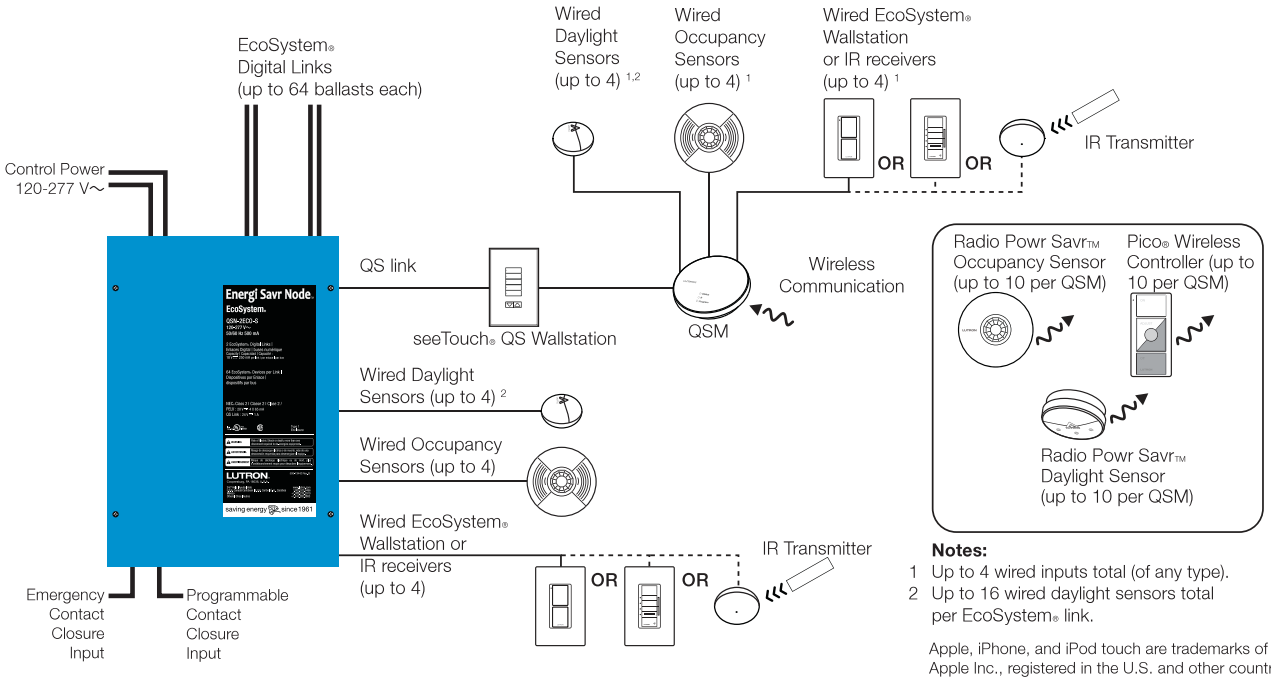
The Energi Savr Node™ family is a group of intelligent, modular products for the control of lighting loads. This document describes the Energi Savr Node™ with EcoSystem® unit, which can control all EcoSystem®-compatible products including EcoSystem® ballasts and modules, Hi-lume® 3D ballasts, EcoSystem® H-Series ballasts, and Hi-lume® LED and Hi-lume® A-Series LED drivers.

- Energi Savr Node™ with EcoSystem® unit with 1 EcoSystem® Digital Link (QSN-1ECO-S).
- Energi Savr Node™ with EcoSystem® unit with 2 EcoSystem® Digital Links (QSN-2ECO-S).



Features

- Powers up to 2 EcoSystem® Digital Links (QSN-2ECO-S).
- Easy system programming with an intuitive application for *Apple iPhone* or *iPod touch* mobile digital devices (required for non-Quantum® systems).
- Four occupancy sensor inputs for automated control of lights.
- Four daylight sensor inputs automatically adjust light levels based on the amount of natural light entering through the windows.
- Four IR receiver inputs for personal control.
- Includes QS control link for seamless integration of lights, control stations, and QS sensor modules.
- Expand the number of sensors and controls using the QS Sensor Module (QSM) or sensors connections on EcoSystem® ballasts and modules.
- Connect directly to other Energi Savr Node™ units, GRAFIK Eye® QS units, or Quantum® systems to expand functionality and control.



Notes:
1 Up to 4 wired inputs total (of any type).
2 Up to 16 wired daylight sensors total per EcoSystem® link.

LUTRON® SPECIFICATION SUBMITTAL Page 1

Job Name:	Model Numbers:	
Job Number:		

Specifications

Energi Savr Node™ with EcoSystem®

Power

- Control Power: 120-277 V~ 50/60 Hz.
- Lightning strike protection meets ANSI/IEEE standard 62.31-1980. Can withstand voltage surges of up to 6000 V~ and current surges of up to 3000 A.
- Current draw: 0.5 A.
- 10-year power failure memory: restores lighting to levels prior to power interruption.

Standards

- UL Listed
- CSA
- NOM Certified
- Lutron® Quality Systems registered to ISO 9001.2008

Environment

- Ambient Temperature Operating Range: 32 °F to 104 °F (0 °C to 40 °C).
- Relative humidity: less than 90% non-condensing.
- For indoor use only.
- Can be installed in accordance with National Electrical Code® (NEC®) Article 300.22(c) "Other spaces used for environmental air".

Terminals

- Control Power wiring: 14 AWG to 12 AWG (2.5 mm^2 to 4.0 mm^2)
- EcoSystem® Digital Link Wiring: 18 AWG to 12 AWG (1.0 mm^2 to 4.0 mm^2)
- Input Group Wiring: 22 AWG to 12 AWG (0.5 mm^2 to 4.0 mm^2)
- QS Link Wiring: 22 AWG to 12 AWG (0.5 mm^2 to 4.0 mm^2)

Physical Design

- NEMA Type 1, IP-20 protection.

Mounting

- Surface mount.

Programming Requirements

- An *Apple iPod touch* or *iPhone* mobile digital device with the Energi Savr app is required for programming Energi Savr Node™ with EcoSystem® systems.
- The Energi Savr app is available from the *Apple AppStore* online store.
- The Energi Savr app cannot be used to program the Energi Savr Node™ with EcoSystem® units when installed as part of a Quantum® system.
- The *Apple iPod touch* or *iPhone* communicates with the Energi Savr Node™ unit via a WiFi router (not included).
- See "Wiring: System Programming Connection" section for further information.

Input Default Associations

- Energi Savr Node™ with EcoSystem® units are pre-programmed from the factory to respond to inputs wired directly to the Energi Savr Node™ with EcoSystem® unit.
- Programmable CCI activates a scene using a normally open momentary closure by default.

EcoSystem®

- Control up to 64 EcoSystem®-compatible devices (ballast, modules, or LED drivers) per EcoSystem® Digital Link (up to 128 devices per Energi Savr Node™ with EcoSystem® unit):
  - — EcoSystem® ballasts and modules
  - — EcoSystem® H-Series ballasts
  - — Hi-lume® 3D ballasts
  - — Hi-lume® LED drivers
  - — Hi-lume® A-Series LED drivers
- Digitally define areas and zones.
- Configure wired or wireless sensors and controls to control devices on multiple EcoSystem® Digital Links and/or multiple Energi Savr Node™ units.
- Automatic replacement of a single failed ballast, module, or driver.
- Simple method of replacing multiple failed ballasts, modules, or drivers.
- EcoSystem® Digital Link can be wired as Class 1 or IEC PELV/NEC® Class 2 for maximum wiring flexibility.

Job Name:	Model Numbers:	
Job Number:		

Occupancy Sensors

- Use Lutron® LOS series of wired occupancy sensors in occupancy mode to control one or more areas.
- Use Lutron® occupancy sensors in vacancy mode to automatically turn the lights off in an area after it becomes vacant.
- Use Lutron® occupancy sensors to automatically turn the lights on in area when it becomes occupied and to automatically turn the lights off in an area after it becomes vacant.
- Each of the four occupancy inputs can power one Lutron® occupancy sensor.
- Each area's occupied light level and unoccupied light level can be programmed independently.
- Up to four additional Lutron® Wired Occupancy Sensors or ten additional Radio Powr Savr™ Occupancy/Vacancy Sensors can be assigned per QS Sensor Module (QSM) on the QS link.

seeTouch® QS Controls

- seeTouch® QS wallstations can be configured as a zone toggle or scene wallstation.
- In zone toggle mode, zone buttons are able to turn one or more zones on and off.
- In scene mode, buttons are able to recall scenes in one or more areas.
- All buttons on a wallstation will be in the same mode—zone toggle or scene.
- LED indicator displays zone or scene status.
- A single button can control lights or shades, but not both.

IR Wallstation or Receiver Input

- Four inputs for IR receivers or wallstations for control of lighting zones can be connected directly to the Energi Savr Node™ with EcoSystem® unit.
- Use Lutron® CC-4BRL-WH wallstations to control one or more zones.
- Use Lutron® EC-IR-WH or EC-DIR-WH ceiling mount sensors to control one or more zones.
- Up to four additional wired wallstations or IR receivers can be assigned per QS Sensor Module (QSM) on the QS link.

Daylight Sensors

- Lutron® daylight sensors allow daylight harvesting with programmable effect on light output.
- Four daylight sensors can be connected directly to the Energi Savr Node™ with EcoSystem® unit.
- Use Lutron® EC-DIR-WH sensors to control one or more daylight rows.
- Alternatively, up to four additional Lutron® Wired Daylight Sensors or ten additional Radio Powr Savr™ Daylight Sensors can be assigned per QS Sensor Module (QSM) on the QS link.
- Control 4 daylight rows per area with a maximum of 2 daylight sensors per area.

Contact Closure Input (CCI)

- Activate scenes using momentary or maintained closures from an external device like a timeclock.
- Start or stop Afterhours mode using a maintained closure.
- Enable or disable Load Shed mode to save energy during peak demand periods using a maintained closure.
- The attached device must provide a dry contact closure or solid-state output.
- Configurable for normally open (NO) or normally closed (NC) operation.
- Input is miswire-protected up to 36 V⎓.

Emergency Contact Closure Input

- By default, contact closure input from Lutron's Emergency Lighting Interface (LUT-ELI-3PH), security, or fire alarm systems turns all zones on to full output when emergency state is detected.
- Emergency contact closure input is normally closed (NC). The Energi Savr Node™ with EcoSystem® unit is shipped with a jumper pre-installed.
- Response of each zone is configurable.
- Attached devices, by default, will go to maximum output and ignore control inputs.
- No operations will be allowed until emergency signal is cleared.
- The attached device must provide a normally-closed (NC) dry contact closure or solid-state output.
- Input is miswire-protected up to 36 V⎓.
- Emergency CCI cannot control other Energi Savr Node™ units.
- See Application Note #140, "EcoSystem® Ballasts and Emergency Wiring" at www.lutron.com for more details.

Job Name:	Model Numbers:	
Job Number:		

Functionality with GRAFIK Eye® QS

- Energi Savr Node™ with EcoSystem® areas follow GRAFIK Eye® QS unit scene activations when associated with the GRAFIK Eye® QS unit.
- Energi Savr Node™ with EcoSystem® areas respond to commands initiated by the GRAFIK Eye® QS unit astronomic time clock when associated with the GRAFIK Eye® QS unit.
- Energi Savr Node™ with EcoSystem® areas operate in Afterhours mode when associated with a GRAFIK Eye® QS unit that is in Afterhours mode.
- Zones on Energi Savr Node™ units cannot be associated with zone controls on GRAFIK Eye® QS units.

Functionality with QSE-IO

- Energi Savr Node™ with EcoSystem® unit responds to scene commands initiated by the QSE-IO, if the QSE-IO DIP switches have been set to either Scene Selection mode, Zone Toggle mode, Partition mode, or Occupancy Sensor mode.

Functionality with QSE-CI-NWK-E

- Integrate the Energi Savr Node™ with EcoSystem® unit with touchscreens, PCs, A/V systems, or other digital systems and devices.
- Recall scenes and set/adjust zone levels.

QS Sensor Module (QSM)

- Use the QSM to integrate Radio Powr Savr™ Occupancy/Vacancy sensors, Radio Powr Savr™ Daylight sensors, and Pico® Wireless Controllers with an Energi Savr Node™ with EcoSystem® unit.
- Associate up to 99 QSMs per Energi Savr Node™ with EcoSystem® unit.
- Assign up to 10 Radio Powr Savr™ Occupancy sensors per QSM.
- Assign up to 10 Radio Powr Savr™ Daylight sensors per QSM.
- Assign up to 10 Pico® Wireless Controllers per QSM.
- Connect up to 100 wired or wireless sensors of each type per QS link.
- Wire and power up to 4 wired sensors per QSM:
  - — Daylight sensors
  - — Occupancy sensors
  - — Infrared (IR) receivers or wallstations
- The Radio Powr Savr™ sensors and Pico® Wireless Controllers associated with the QSM should be mounted within 60 ft (18 m) line of sight, or 30 ft (9 m) through walls, of the QSM.
- Refer to QSM Specification Submittal for more information.

EcoSystem Digital Link Limits

- Up to 64 EcoSystem®-compatible fluorescent ballasts and/or LED drivers per EcoSystem® digital link.
- Sensor and control communication limits:
  - — 16 daylight sensors
  - — 64 occupancy sensors
  - — 64 infrared (IR) receivers or wallstations

  A sensor or control counts as a device on the EcoSystem® digital link if it is wired to an EcoSystem® ballast on the same link, or is programmed to communicate with a fluorescent ballast or LED driver on the EcoSystem® digital link.
- EcoSystem®-compatible fluorescent ballasts and LED drivers on the EcoSystem® digital link do not count as QS devices.

QS Link Limits

- Each Energi Savr Node™ with EcoSystem® unit can provide up to 30 Power Draw Units for other QS devices. Refer to the QS Link Power Draw Units specification submittal (Lutron® P/N 369405) for more information concerning Power Draw Units.
- The QS Link can have up to 100 devices and 100 zones.
- Each Energi Savr Node™ with EcoSystem® unit counts as 1 device towards the 100 device limit.
- Each Energi Savr Node™ with EcoSystem® unit can count as 1 to 100 zones towards the 100 zone limit, depending on the number of zones created (up to 128 zones in a Quantum® system).
- A maximum of 8 EcoSystem® digital links may be connected to the QS link. Energi Savr Node™ with EcoSystem® unit counts as up to 64 or up to 128 ballasts.

Job Name:	Model Numbers:	
Job Number:		

Appendix E | Cost Benefit Analysis of Increasing Feeder Sizes Worksheets

The following are the tables used to compute the cost benefit analysis. Please refer to the cost benefit analysis of increasing feeder sizes electrical depth for further detail.

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	900	100	154302.4944	14967.34196	
5	MDP1	PPK	2	5	600	180	153	17478.51264	1695.415726	
6	MDP1	LP1E	1	5	400	120	88	6372.3744	618.1203168	
7	MDP1	PPM1E	1	5	100	30	96	1820.6784	176.6058048	
8	MDP1	LP2E	1	5	400	120	110	8010.98496	777.0655411	
9	MDP1	PPM2E	1	5	100	30	96	1820.6784	176.6058048	
10	MDP1	LP3E	1	5	400	120	130	9467.52768	918.350185	
11	MDP1	PPM3E	1	5	100	30	140	2639.98368	256.078417	
12	MDP1	ELEV #1	1	4	100	30	115	2184.81408	211.9269658	
13	MDP1	ELEV #2	1	4	100	30	115	2184.81408	211.9269658	
14	MDP1	CHILLER #1	3	4	1000	300	170	32772.2112	3178.904486	
15	MDP1	MAU-1	1	4	20	6	170	910.3392	88.3029024	
16	MDP1	EFR-10	1	4	20	6	140	746.478144	72.40837997	
17	MDP1	EFR-12	1	4	20	6	180	964.959552	93.60107654	
18	MDP1	P-10	1	4	60	18	150	1283.578272	124.5070924	
19	MDP1	SF1-1	1	4	20	6	230	1228.95792	119.2089182	
20	MDP1	AHU-6	1	4	70	21	190	2198.469168	213.2515093	
21	MDP1	AHU-7	1	4	100	30	100	1911.71232	185.436095	
22	MDP1	AHU-9	1	4	20	6	100	537.100128	52.09871242	
23	MDP1	AHU-10	1	4	150	45	100	2321.36496	225.1724011	
24	PPK	T-RPK	1	4	400	120	20	1456.54272	141.2846438	
25	LP1E	T-RP1E	1	4	150	45	10	136.55088	13.24543536	
26	LP1E	T-RP1MR	1	4	80	24	230	3495.702528	339.0831452	
27	LP1E	T-RP1WM	1	4	30	9	275	2143.848816	207.9533352	
28	PPM1E	T-RPM1E	1	4	60	18	20	245.791584	23.84178365	
29	LP2E	T-RPM2E	1	4	150	45	15	204.82632	19.86815304	
30	PPM2E	T-RPM2E	1	4	60	18	15	191.171232	18.5436095	
31	LP3E	T-PRP3E	1	4	150	45	15	204.82632	19.86815304	
32	PPM3E	T-RPM3E	1	4	80	24	15	218.481408	21.19269658	
33	T-RPK	RPK-11,12,13	2	5	800	240	20	2913.08544	282.5692877	
34	T-RP1E	RP1E1,2,3	1	5	250	75	10	341.3772	33.1135884	
35	T-RP1MR	RP1MR	1	5	175	52.5	15	238.96404	23.17951188	
36	T-RP1WM	RP1WM	1	5	60	18	15	191.171232	18.5436095	
37	T-RPM1E	RPM1E1,2	1	5	100	30	20	364.13568	35.32116096	
38	T-RPM2E	RP2E1,2,3	1	5	250	75	15	568.962	55.189314	
39	T-RPM2E	RPM2E	1	5	100	30	15	273.10176	26.49087072	
40	T-PRP3E	RP3E1,2,3	1	5	250	75	15	568.962	55.189314	
41	T-RPM3E	RPM3E1,2	1	5	175	52.5	15	398.2734	38.6325198	
42	MDP2	LP1W	2	5	400	120	255	16021.96992	1554.131082	
43	MDP2	PPM1W	1	5	100	30	240	3049.63632	295.814723	
44	MDP2	LP2W	2	5	400	120	240	15111.63072	1465.82818	
45	MDP2	PPM2W	1	5	100	30	250	3140.67024	304.6450133	
46	MDP2	LP3W	2	5	400	120	260	16386.1056	1589.452243	
47	MDP2	PPM3W	1	5	100	30	270	3413.772	331.135884	
48	MDP2	DWP	1	4	100	30	20	273.10176	26.49087072	
49	LP1W	T-RP1FC	1	4	60	18	20	245.791584	23.84178365	
50	LP1W	T-RP1W	1	4	150	45	25	546.20352	52.98174144	
51	PPM1W	T-RPM1W	1	4	60	18	15	191.171232	18.5436095	
52	LP2W	T-RP2W	1	4	150	45	15	341.3772	33.1135884	
53	PPM2W	T-RPM2W	1	4	60	18	15	191.171232	18.5436095	
54	LP3W	T-RP3W	1	4	150	45	15	341.3772	33.1135884	
55	PPM3W	T-RPM3W	1	4	60	18	15	191.171232	18.5436095	
56	T-RP1FC	RP1FC	1	5	125	37.5	15	227.5848	22.0757256	
57	T-RP1WM	RP1W1,2,3	1	5	250	75	15	568.962	55.189314	
58	T-RPM1W	RPM1W	1	5	100	30	15	273.10176	26.49087072	
59	T-RP2W	RP2W1,2	1	5	250	75	15	568.962	55.189314	
60	T-RPM2W	RPM2W	1	5	100	30	15	273.10176	26.49087072	

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	45	15	204.82632	19.86815304	
62	T-RPM3W	RPM3W	1	5	100	30	15	273.10176	26.49087072	
63	MDP2	SLP	1	5	100	30	20	364.13568	35.32116096	
64	MDP2	CH-2	2	4	800	240	170	24761.22624	2401.838945	
65	MDP2	ELEV-3	1	4	100	30	115	2184.81408	211.9269658	
66	MDP2	ELEV-4	1	4	100	30	115	2184.81408	211.9269658	
67	MDP2	ELEV-5	1	4	100	30	115	2184.81408	211.9269658	
101	MDP1	AHU-5	1	4	40	12	108.5	946.752768	91.8350185	
102	MDP1	AHU-15	1	4	40	12	63	564.410304	54.74779949	
103	MDP1	AHU-11	1	4	40	12	60	527.996736	51.21568339	
104	MDP1	B-3	1	4	40	12	170	1492.956288	144.8167599	
105	MDP1	UPS-WS	1	5	200	60	70	2093.78016	203.0966755	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	60	100	3004.11936	291.3995779	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	75	20	682.7544	66.2271768	
109	T-DPUPSWS	DPUPSWS	2	5	500	150	20	2048.2632	198.6815304	
110	DPUPSWS	RPUPS1	1	5	100	30	20	364.13568	35.32116096	
111	DPUPSWS	RPUPS2	1	5	300	90	20	819.30528	79.47261216	
112	DPUPSWS	RPUPS3	1	5	250	75	20	682.7544	66.2271768	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	60	100	3004.11936	291.3995779	
128	MDP2	EFR-22	1	4	30	9	172	1338.198624	129.8052665	
129	MDP2	EFR-13	1	4	30	9	360	2812.948128	272.8559684	
130	MDP2	EFR-16	1	4	30	9	130	1010.476512	98.01622166	
131	MDP2	P-11	1	4	70	21	150	1752.40296	169.9830871	
132	MDP2	EFR-15	1	4	20	6	140	746.478144	72.40837997	
133	MDP2	AHU-1	1	4	90	27	340	5202.588528	504.6510872	
134	MDP2	AHU-2	1	4	70	21	350	4046.457744	392.5064012	
135	MDP2	AHU-3	1	4	80	24	170.7	2585.363328	250.7802428	
136	MDP2	AHU-4	1	4	80	24	245	3714.183936	360.2758418	
137	MDP2	AHU-8	1	4	20	6	160	855.718848	83.00472826	
138	MDP2	AHU-13	1	4	60	18	350	4478.868864	434.4502798	
139	MDP2	P-9	1	4	20	6	150	801.098496	77.70655411	
140	MDP2	P-13	1	4	20	6	150	801.098496	77.70655411	
141	MDP2	P-2	1	4	150	45	150	3482.04744	337.7586017	
142	MDP2	SF1-2	1	4	30	9	20	150.205968	14.5699789	
143	MDP2	ELEV 3	1	4	100	30	113	6417.89136	622.5354619	
144	MDP2	ELEV 4	1	4	100	30	113	6417.89136	622.5354619	
145	MDP2	ELEV 5	1	4	100	30	113	6417.89136	622.5354619	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	900	100	132454.3536	12848.0723	
5	MDP1	PPK	2	5	600	180	153	15839.90208	1536.470502	
6	MDP1	LP1E	1	5	400	120	88	6372.3744	618.1203168	
7	MDP1	PPM1E	1	5	100	30	96	1502.05968	145.699789	
8	MDP1	LP2E	1	5	400	120	110	8010.98496	777.0655411	
9	MDP1	PPM2E	1	5	100	30	96	1502.05968	145.699789	
10	MDP1	LP3E	1	5	400	120	130	9467.52768	918.350185	
11	MDP1	PPM3E	1	5	100	30	140	2184.81408	211.9269658	
12	MDP1	ELEV #1	1	4	100	30	115	1820.6784	176.6058048	
13	MDP1	ELEV #2	1	4	100	30	115	1820.6784	176.6058048	
14	MDP1	CHILLER #1	3	4	1000	300	170	28675.6848	2781.541426	
15	MDP1	MAU-1	1	4	20	6	170	591.72048	57.39688656	
16	MDP1	EFR-10	1	4	20	6	140	482.479776	46.80053827	
17	MDP1	EFR-12	1	4	20	6	180	628.134048	60.92900266	
18	MDP1	P-10	1	4	60	18	150	1010.476512	98.01622166	
19	MDP1	SF1-1	1	4	20	6	230	801.098496	77.70655411	
20	MDP1	AHU-6	1	4	70	21	190	1752.40296	169.9830871	
21	MDP1	AHU-7	1	4	100	30	100	1593.0936	154.5300792	
22	MDP1	AHU-9	1	4	20	6	100	345.928896	33.55510291	
23	MDP1	AHU-10	1	4	150	45	100	1979.98776	192.0588127	
24	PPK	T-RPK	1	4	400	120	20	1456.54272	141.2846438	
25	LP1E	T-RP1E	1	4	150	45	10	204.82632	19.86815304	
26	LP1E	T-RP1MR	1	4	80	24	230	2767.431168	268.4408233	
27	LP1E	T-RP1WM	1	4	30	9	275	1365.5088	132.4543536	
28	PPM1E	T-RPM1E	1	4	60	18	20	163.861056	15.89452243	
29	LP2E	T-RPM2E	1	4	150	45	15	273.10176	26.49087072	
30	PPM2E	T-RPM2E	1	4	60	18	15	136.55088	13.24543536	
31	LP3E	T-PRP3E	1	4	150	45	15	273.10176	26.49087072	
32	PPM3E	T-RPM3E	1	4	80	24	15	182.06784	17.66058048	
33	T-RPK	RPK-11,12,13	2	5	800	240	20	2913.08544	282.5692877	
34	T-RP1E	RP1E1,2,3	1	5	250	75	10	341.3772	33.1135884	
35	T-RP1MR	RP1MR	1	5	175	52.5	15	318.61872	30.90601584	
36	T-RP1WM	RP1WM	1	5	60	18	15	136.55088	13.24543536	
37	T-RPM1E	RPM1E1,2	1	5	100	30	20	318.61872	30.90601584	
38	T-RPM2E	RP2E1,2,3	1	5	250	75	15	455.1696	44.1514512	
39	T-RPM2E	RPM2E	1	5	100	30	15	227.5848	22.0757256	
40	T-PRP3E	RP3E1,2,3	1	5	250	75	15	455.1696	44.1514512	
41	T-RPM3E	RPM3E1,2	1	5	175	52.5	15	318.61872	30.90601584	
42	MDP2	LP1W	2	5	400	120	255	14201.29152	1377.525277	
43	MDP2	PPM1W	1	5	100	30	240	2457.91584	238.4178365	
44	MDP2	LP2W	2	5	400	120	240	13290.95232	1289.222375	
45	MDP2	PPM2W	1	5	100	30	250	2548.94976	247.2481267	
46	MDP2	LP3W	2	5	400	120	260	14383.35936	1395.185858	
47	MDP2	PPM3W	1	5	100	30	270	2776.53456	269.3238523	
48	MDP2	DWP	1	4	100	30	20	227.5848	22.0757256	
49	LP1W	T-RP1FC	1	4	60	18	20	163.861056	15.89452243	
50	LP1W	T-RP1W	1	4	150	45	25	477.92808	46.35902376	
51	PPM1W	T-RPM1W	1	4	60	18	15	136.55088	13.24543536	
52	LP2W	T-RP2W	1	4	150	45	15	273.10176	26.49087072	
53	PPM2W	T-RPM2W	1	4	60	18	15	136.55088	13.24543536	
54	LP3W	T-RP3W	1	4	150	45	15	273.10176	26.49087072	
55	PPM3W	T-RPM3W	1	4	60	18	15	136.55088	13.24543536	
56	T-RP1FC	RP1FC	1	5	125	37.5	15	2048.2632	198.6815304	
57	T-RP1WM	RP1W1,2,3	1	5	250	75	15	455.1696	44.1514512	
58	T-RPM1W	RPM1W	1	5	100	30	15	227.5848	22.0757256	
59	T-RP2W	RP2W1,2	1	5	250	75	15	455.1696	44.1514512	
60	T-RPM2W	RPM2W	1	5	100	30	15	227.5848	22.0757256	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	45	15	273.10176	26.49087072	
62	T-RPM3W	RPM3W	1	5	110	33	15	300.411936	29.13995779	
63	MDP2	SLP	1	5	100	30	20	318.61872	30.90601584	
64	MDP2	CH-2	2	4	800	240	170	24761.22624	2401.838945	
65	MDP2	ELEV-3	1	4	100	30	115	1820.6784	176.6058048	
66	MDP2	ELEV-4	1	4	100	30	115	1820.6784	176.6058048	
67	MDP2	ELEV-5	1	4	100	30	115	1820.6784	176.6058048	
101	MDP1	AHU-5	1	4	40	12	108.5	619.030656	60.04597363	
102	MDP1	AHU-15	1	4	40	12	60	345.928896	33.55510291	
103	MDP1	AHU-11	1	4	40	12	60	345.928896	33.55510291	
104	MDP1	B-3	1	4	40	12	170	964.959552	93.60107654	
105	MDP1	UPS-WS	1	5	200	60	70	1729.64448	167.7755146	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	60	100	2548.94976	247.2481267	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	75	20	682.7544	66.2271768	
109	T-DPUPSWS	DPUPSWS	2	5	500	150	20	1820.6784	176.6058048	
110	DPUPSWS	RPUPS1	1	5	100	30	20	318.61872	30.90601584	
111	DPUPSWS	RPUPS2	1	5	300	90	20	819.30528	79.47261216	
112	DPUPSWS	RPUPS3	1	5	250	75	20	682.7544	66.2271768	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	60	100	1729.64448	167.7755146	
128	MDP2	EFR-22	1	4	30	9	172	860.270544	83.44624277	
129	MDP2	EFR-13	1	4	30	9	360	1788.816528	173.5152032	
130	MDP2	EFR-16	1	4	30	9	130	641.789136	62.25354619	
131	MDP2	P-11	1	4	70	21	150	1401.922368	135.9864697	
132	MDP2	EFR-15	1	4	20	6	140	482.479776	46.80053827	
133	MDP2	AHU-1	1	4	90	27	340	4342.317984	421.2048444	
134	MDP2	AHU-2	1	4	70	21	350	3249.910944	315.2413616	
135	MDP2	AHU-3	1	4	80	24	170	2075.573376	201.3306175	
136	MDP2	AHU-4	1	4	80	24	245	2949.499008	286.1014038	
137	MDP2	AHU-8	1	4	20	6	160	555.306912	53.86477046	
138	MDP2	AHU-13	1	4	60	18	350	2976.809184	288.7504908	
139	MDP2	P-9	1	4	20	6	150	518.893344	50.33265437	
140	MDP2	P-13	1	4	20	6	150	518.893344	50.33265437	
141	MDP2	P-2	1	4	150	45	150	2935.84392	284.7768602	
142	MDP2	SF1-2	1	4	30	9	20	95.585616	9.271804752	
143	MDP2	ELEV 3	1	4	100	30	113	1775.16144	172.1906597	
144	MDP2	ELEV 4	1	4	100	30	113	1775.16144	172.1906597	
145	MDP2	ELEV 5	1	4	100	30	113	1775.16144	172.1906597	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	4	40	3000	900	100	107875.1952	10463.89393	
5	MDP1	PPK	2	5	600	180	153	13655.088	1324.543536	
6	MDP1	LP1E	1	5	400	120	88	5826.17088	565.1385754	
7	MDP1	PPM1E	1	5	100	30	96	1274.47488	123.6240634	
8	MDP1	LP2E	1	5	400	120	110	7282.7136	706.4232192	
9	MDP1	PPM2E	1	5	100	30	96	1274.47488	123.6240634	
10	MDP1	LP3E	1	5	400	120	130	8557.18848	830.0472826	
11	MDP1	PPM3E	1	5	100	30	140	1775.16144	172.1906597	
12	MDP1	ELEV #1	1	4	100	30	115	1456.54272	141.2846438	
13	MDP1	ELEV #2	1	4	100	30	115	1456.54272	141.2846438	
14	MDP1	CHILLER #1	3	4	1000	300	170	25944.6672	2516.632718	
15	MDP1	MAU-1	1	4	20	6	170	373.239072	36.20418998	
16	MDP1	EFR-10	1	4	20	6	140	309.515328	30.02298682	
17	MDP1	EFR-12	1	4	20	6	180	400.549248	38.85327706	
18	MDP1	P-10	1	4	60	18	150	846.615456	82.12169923	
19	MDP1	SF1-1	1	4	20	6	230	509.789952	49.44962534	
20	MDP1	AHU-6	1	4	70	21	190	1465.646112	142.1676729	
21	MDP1	AHU-7	1	4	100	30	100	1274.47488	123.6240634	
22	MDP1	AHU-9	1	4	20	6	100	218.481408	21.19269658	
23	MDP1	AHU-10	1	4	150	45	100	1638.61056	158.9452243	
24	PPK	T-RPK	1	4	400	120	20	1274.47488	123.6240634	
25	LP1E	T-RP1E	1	4	150	45	10	341.3772	33.1135884	
26	LP1E	T-RP1MR	1	4	80	24	230	2330.468352	226.0554301	
27	LP1E	T-RP1WM	1	4	30	9	275	873.925632	84.7707863	
28	PPM1E	T-RPM1E	1	4	60	18	20	136.55088	13.24543536	
29	LP2E	T-RPM2E	1	4	150	45	15	341.3772	33.1135884	
30	PPM2E	T-RPM2E	1	4	60	18	15	136.55088	13.24543536	
31	LP3E	T-PRP3E	1	4	150	45	15	341.3772	33.1135884	
32	PPM3E	T-RPM3E	1	4	80	24	15	145.654272	14.12846438	
33	T-RPK	RPK-11,12,13	2	5	800	240	20	2548.94976	247.2481267	
34	T-RP1E	RP1E1,2,3	1	5	250	75	10	341.3772	33.1135884	
35	T-RP1MR	RP1MR	1	5	175	52.5	15	398.2734	38.6325198	
36	T-RP1WM	RP1WM	1	5	60	18	15	109.240704	10.59634829	
37	T-RPM1E	RPM1E1,2	1	5	100	30	20	273.10176	26.49087072	
38	T-RPM2E	RP2E1,2,3	1	5	250	75	15	568.962	55.189314	
39	T-RPM2E	RPM2E	1	5	100	30	15	182.06784	17.66058048	
40	T-PRP3E	RP3E1,2,3	1	5	250	75	15	568.962	55.189314	
41	T-RPM3E	RPM3E1,2	1	5	175	52.5	15	398.2734	38.6325198	
42	MDP2	LP1W	2	5	400	120	255	12926.81664	1253.901214	
43	MDP2	PPM1W	1	5	100	30	240	2093.78016	203.0966755	
44	MDP2	LP2W	2	5	400	120	240	12198.54528	1183.258892	
45	MDP2	PPM2W	1	5	100	30	250	2093.78016	203.0966755	
46	MDP2	LP3W	2	5	400	120	260	13108.88448	1271.561795	
47	MDP2	PPM3W	1	5	100	30	270	2321.36496	225.1724011	
48	MDP2	DWP	1	4	100	30	20	182.06784	17.66058048	
49	LP1W	T-RP1FC	1	4	60	18	20	136.55088	13.24543536	
50	LP1W	T-RP1W	1	4	150	45	25	409.65264	39.73630608	
51	PPM1W	T-RPM1W	1	4	60	18	15	136.55088	13.24543536	
52	LP2W	T-RP2W	1	4	150	45	15	341.3772	33.1135884	
53	PPM2W	T-RPM2W	1	4	60	18	15	136.55088	13.24543536	
54	LP3W	T-RP3W	1	4	150	45	15	341.3772	33.1135884	
55	PPM3W	T-RPM3W	1	4	60	18	15	136.55088	13.24543536	
56	T-RP1FC	RP1FC	1	5	125	37.5	15	170.6886	16.5567942	
57	T-RP1WM	RP1W1,2,3	1	5	250	75	15	568.962	55.189314	
58	T-RPM1W	RPM1W	1	5	100	30	15	182.06784	17.66058048	
59	T-RP2W	RP2W1,2	1	5	250	75	15	568.962	55.189314	
60	T-RPM2W	RPM2W	1	5	100	30	15	182.06784	17.66058048	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.3
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	45	15	341.3772	33.1135884	
62	T-RPM3W	RPM3W	1	5	110	33	15	200.274624	19.42663853	
63	MDP2	SLP	1	5	100	30	20	273.10176	26.49087072	
64	MDP2	CH-2	2	4	800	240	170	22212.27648	2154.590819	
65	MDP2	ELEV-3	1	4	100	30	115	1456.54272	141.2846438	
66	MDP2	ELEV-4	1	4	100	30	115	1456.54272	141.2846438	
67	MDP2	ELEV-5	1	4	100	30	115	1456.54272	141.2846438	
101	MDP1	AHU-5	1	4	40	12	110	418.756032	40.6193351	
102	MDP1	AHU-15	1	4	40	12	60	218.481408	21.19269658	
103	MDP1	AHU-11	1	4	40	12	60	218.481408	21.19269658	
104	MDP1	B-3	1	4	40	12	170	637.23744	61.81203168	
105	MDP1	UPS-WS	1	5	200	60	70	1638.61056	158.9452243	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	60	100	2275.848	220.757256	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	75	20	568.962	55.189314	
109	T-DPUPSWS	DPUPSWS	2	5	500	150	20	1593.0936	154.5300792	
110	DPUPSWS	RPUPS1	1	5	100	30	20	273.10176	26.49087072	
111	DPUPSWS	RPUPS2	1	5	300	90	20	682.7544	66.2271768	
112	DPUPSWS	RPUPS3	1	5	250	75	20	568.962	55.189314	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	60	100	2275.848	220.757256	
128	MDP2	EFR-22	1	4	30	9	172	573.513696	55.63082851	
129	MDP2	EFR-13	1	4	30	9	360	1147.027392	111.261657	
130	MDP2	EFR-16	1	4	30	9	130	409.65264	39.73630608	
131	MDP2	P-11	1	4	70	21	150	1147.027392	111.261657	
132	MDP2	EFR-15	1	4	20	6	140	309.515328	30.02298682	
133	MDP2	AHU-1	1	4	90	27	340	3482.04744	337.7586017	
134	MDP2	AHU-2	1	4	70	21	350	2708.25912	262.7011346	
135	MDP2	AHU-3	1	4	80	24	170	1711.437696	166.0094565	
136	MDP2	AHU-4	1	4	80	24	245	2476.122624	240.1838945	
137	MDP2	AHU-8	1	4	20	6	160	355.032288	34.43813194	
138	MDP2	AHU-13	1	4	60	18	350	2375.985312	230.4705753	
139	MDP2	P-9	1	4	20	6	150	327.722112	31.78904486	
140	MDP2	P-13	1	4	20	6	150	327.722112	31.78904486	
141	MDP2	P-2	1	4	150	45	150	2526.19128	245.0405542	
142	MDP2	SF1-2	1	4	30	9	20	68.27544	6.62271768	
143	MDP2	ELEV 3	1	4	100	30	110	1365.5088	132.4543536	
144	MDP2	ELEV 4	1	4	100	30	110	1365.5088	132.4543536	
145	MDP2	ELEV 5	1	4	100	30	110	1365.5088	132.4543536	

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	1500	100	257170.824	24945.56993	
5	MDP1	PPK	2	5	600	300	153	29130.8544	2825.692877	
6	MDP1	LP1E	1	5	400	200	88	10620.624	1030.200528	
7	MDP1	PPM1E	1	5	100	50	96	3034.464	294.343008	
8	MDP1	LP2E	1	5	400	200	110	13351.6416	1295.109235	
9	MDP1	PPM2E	1	5	100	50	96	3034.464	294.343008	
10	MDP1	LP3E	1	5	400	200	130	15779.2128	1530.583642	
11	MDP1	PPM3E	1	5	100	50	140	4399.9728	426.7973616	
12	MDP1	ELEV #1	1	4	100	50	115	3641.3568	353.2116096	
13	MDP1	ELEV #2	1	4	100	50	115	3641.3568	353.2116096	
14	MDP1	CHILLER #1	3	4	1000	500	170	54620.352	5298.174144	
15	MDP1	MAU-1	1	4	20	10	170	1517.232	147.171504	
16	MDP1	EFR-10	1	4	20	10	140	1244.13024	120.6806333	
17	MDP1	EFR-12	1	4	20	10	180	1608.26592	156.0017942	
18	MDP1	P-10	1	4	60	30	150	2139.29712	207.5118206	
19	MDP1	SF1-1	1	4	20	10	230	2048.2632	198.6815304	
20	MDP1	AHU-6	1	4	70	35	190	3664.11528	355.4191822	
21	MDP1	AHU-7	1	4	100	50	100	3186.1872	309.0601584	
22	MDP1	AHU-9	1	4	20	10	100	895.16688	86.83118736	
23	MDP1	AHU-10	1	4	150	75	100	3868.9416	375.2873352	
24	PPK	T-RPK	1	4	400	200	20	2427.5712	235.4744064	
25	LP1E	T-RP1E	1	4	150	75	10	227.5848	22.0757256	
26	LP1E	T-RP1MR	1	4	80	40	230	5826.17088	565.1385754	
27	LP1E	T-RP1WM	1	4	30	15	275	3573.08136	346.5888919	
28	PPM1E	T-RPM1E	1	4	60	30	20	409.65264	39.73630608	
29	LP2E	T-RPM2E	1	4	150	75	15	341.3772	33.1135884	
30	PPM2E	T-RPM2E	1	4	60	30	15	318.61872	30.90601584	
31	LP3E	T-PRP3E	1	4	150	75	15	341.3772	33.1135884	
32	PPM3E	T-RPM3E	1	4	80	40	15	364.13568	35.32116096	
33	T-RPK	RPK-11,12,13	2	5	800	400	20	4855.1424	470.9488128	
34	T-RP1E	RP1E1,2,3	1	5	250	125	10	568.962	55.189314	
35	T-RP1MR	RP1MR	1	5	175	87.5	15	398.2734	38.6325198	
36	T-RP1WM	RP1WM	1	5	60	30	15	318.61872	30.90601584	
37	T-RPM1E	RPM1E1,2	1	5	100	50	20	606.8928	58.8686016	
38	T-RPM2E	RP2E1,2,3	1	5	250	125	15	948.27	91.98219	
39	T-RPM2E	RPM2E	1	5	100	50	15	455.1696	44.1514512	
40	T-PRP3E	RP3E1,2,3	1	5	250	125	15	948.27	91.98219	
41	T-RPM3E	RPM3E1,2	1	5	175	87.5	15	663.789	64.387533	
42	MDP2	LP1W	2	5	400	200	255	26703.2832	2590.21847	
43	MDP2	PPM1W	1	5	100	50	240	5082.7272	493.0245384	
44	MDP2	LP2W	2	5	400	200	240	25186.0512	2443.046966	
45	MDP2	PPM2W	1	5	100	50	250	5234.4504	507.7416888	
46	MDP2	LP3W	2	5	400	200	260	27310.176	2649.087072	
47	MDP2	PPM3W	1	5	100	50	270	5689.62	551.89314	
48	MDP2	DWP	1	4	100	50	20	455.1696	44.1514512	
49	LP1W	T-RP1FC	1	4	60	30	20	409.65264	39.73630608	
50	LP1W	T-RP1W	1	4	150	75	25	910.3392	88.3029024	
51	PPM1W	T-RPM1W	1	4	60	30	15	318.61872	30.90601584	
52	LP2W	T-RP2W	1	4	150	75	15	568.962	55.189314	
53	PPM2W	T-RPM2W	1	4	60	30	15	318.61872	30.90601584	
54	LP3W	T-RP3W	1	4	150	75	15	568.962	55.189314	
55	PPM3W	T-RPM3W	1	4	60	30	15	318.61872	30.90601584	
56	T-RP1FC	RP1FC	1	5	125	62.5	15	379.308	36.792876	
57	T-RP1WM	RP1W1,2,3	1	5	250	125	15	948.27	91.98219	
58	T-RPM1W	RPM1W	1	5	100	50	15	455.1696	44.1514512	
59	T-RP2W	RP2W1,2	1	5	250	125	15	948.27	91.98219	
60	T-RPM2W	RPM2W	1	5	100	50	15	455.1696	44.1514512	

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	75	15	341.3772	33.1135884	
62	T-RPM3W	RPM3W	1	5	100	50	15	455.1696	44.1514512	
63	MDP2	SLP	1	5	100	50	20	606.8928	58.8686016	
64	MDP2	CH-2	2	4	800	400	170	41268.7104	4003.064909	
65	MDP2	ELEV-3	1	4	100	50	115	3641.3568	353.2116096	
66	MDP2	ELEV-4	1	4	100	50	115	3641.3568	353.2116096	
67	MDP2	ELEV-5	1	4	100	50	115	3641.3568	353.2116096	
101	MDP1	AHU-5	1	4	40	20	108.5	1577.92128	153.0583642	
102	MDP1	AHU-15	1	4	40	20	63	940.68384	91.24633248	
103	MDP1	AHU-11	1	4	40	20	60	879.99456	85.35947232	
104	MDP1	B-3	1	4	40	20	170	2488.26048	241.3612666	
105	MDP1	UPS-WS	1	5	200	100	70	3489.6336	338.4944592	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	100	100	5006.8656	485.6659632	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	125	20	1137.924	110.378628	
109	T-DPUPSWS	DPUPSWS	2	5	500	250	20	3413.772	331.135884	
110	DPUPSWS	RPUPS1	1	5	100	50	20	606.8928	58.8686016	
111	DPUPSWS	RPUPS2	1	5	300	150	20	1365.5088	132.4543536	
112	DPUPSWS	RPUPS3	1	5	250	125	20	1137.924	110.378628	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	100	100	5006.8656	485.6659632	
128	MDP2	EFR-22	1	4	30	15	172	2230.33104	216.3421109	
129	MDP2	EFR-13	1	4	30	15	360	4688.24688	454.7599474	
130	MDP2	EFR-16	1	4	30	15	130	1684.12752	163.3603694	
131	MDP2	P-11	1	4	70	35	150	2920.6716	283.3051452	
132	MDP2	EFR-15	1	4	20	10	140	1244.13024	120.6806333	
133	MDP2	AHU-1	1	4	90	45	340	8670.98088	841.0851454	
134	MDP2	AHU-2	1	4	70	35	350	6744.09624	654.1773353	
135	MDP2	AHU-3	1	4	80	40	170.7	4308.93888	417.9670714	
136	MDP2	AHU-4	1	4	80	40	245	6190.30656	600.4597363	
137	MDP2	AHU-8	1	4	20	10	160	1426.19808	138.3412138	
138	MDP2	AHU-13	1	4	60	30	350	7464.78144	724.0837997	
139	MDP2	P-9	1	4	20	10	150	1335.16416	129.5109235	
140	MDP2	P-13	1	4	20	10	150	1335.16416	129.5109235	
141	MDP2	P-2	1	4	150	75	150	5803.4124	562.9310028	
142	MDP2	SF1-2	1	4	30	15	20	250.34328	24.28329816	
143	MDP2	ELEV 3	1	4	100	50	113	10696.4856	1037.559103	
144	MDP2	ELEV 4	1	4	100	50	113	10696.4856	1037.559103	
145	MDP2	ELEV 5	1	4	100	50	113	10696.4856	1037.559103	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	1500	100	220757.256	21413.45383	
5	MDP1	PPK	2	5	600	300	153	26399.8368	2560.78417	
6	MDP1	LP1E	1	5	400	200	88	10620.624	1030.200528	
7	MDP1	PPM1E	1	5	100	50	96	2503.4328	242.8329816	
8	MDP1	LP2E	1	5	400	200	110	13351.6416	1295.109235	
9	MDP1	PPM2E	1	5	100	50	96	2503.4328	242.8329816	
10	MDP1	LP3E	1	5	400	200	130	15779.2128	1530.583642	
11	MDP1	PPM3E	1	5	100	50	140	3641.3568	353.2116096	
12	MDP1	ELEV #1	1	4	100	50	115	3034.464	294.343008	
13	MDP1	ELEV #2	1	4	100	50	115	3034.464	294.343008	
14	MDP1	CHILLER #1	3	4	1000	500	170	47792.808	4635.902376	
15	MDP1	MAU-1	1	4	20	10	170	986.2008	95.6614776	
16	MDP1	EFR-10	1	4	20	10	140	804.13296	78.00089712	
17	MDP1	EFR-12	1	4	20	10	180	1046.89008	101.5483378	
18	MDP1	P-10	1	4	60	30	150	1684.12752	163.3603694	
19	MDP1	SF1-1	1	4	20	10	230	1335.16416	129.5109235	
20	MDP1	AHU-6	1	4	70	35	190	2920.6716	283.3051452	
21	MDP1	AHU-7	1	4	100	50	100	2655.156	257.550132	
22	MDP1	AHU-9	1	4	20	10	100	576.54816	55.92517152	
23	MDP1	AHU-10	1	4	150	75	100	3299.9796	320.0980212	
24	PPK	T-RPK	1	4	400	200	20	2427.5712	235.4744064	
25	LP1E	T-RP1E	1	4	150	75	10	341.3772	33.1135884	
26	LP1E	T-RP1MR	1	4	80	40	230	4612.38528	447.4013722	
27	LP1E	T-RP1WM	1	4	30	15	275	2275.848	220.757256	
28	PPM1E	T-RPM1E	1	4	60	30	20	273.10176	26.49087072	
29	LP2E	T-RPM2E	1	4	150	75	15	455.1696	44.1514512	
30	PPM2E	T-RPM2E	1	4	60	30	15	227.5848	22.0757256	
31	LP3E	T-PRP3E	1	4	150	75	15	455.1696	44.1514512	
32	PPM3E	T-RPM3E	1	4	80	40	15	303.4464	29.4343008	
33	T-RPK	RPK-11,12,13	2	5	800	400	20	4855.1424	470.9488128	
34	T-RP1E	RP1E1,2,3	1	5	250	125	10	568.962	55.189314	
35	T-RP1MR	RP1MR	1	5	175	87.5	15	531.0312	51.5100264	
36	T-RP1WM	RP1WM	1	5	60	30	15	227.5848	22.0757256	
37	T-RPM1E	RPM1E1,2	1	5	100	50	20	531.0312	51.5100264	
38	T-RPM2E	RP2E1,2,3	1	5	250	125	15	758.616	73.585752	
39	T-RPM2E	RPM2E	1	5	100	50	15	379.308	36.792876	
40	T-PRP3E	RP3E1,2,3	1	5	250	125	15	758.616	73.585752	
41	T-RPM3E	RPM3E1,2	1	5	175	87.5	15	531.0312	51.5100264	
42	MDP2	LP1W	2	5	400	200	255	23668.8192	2295.875462	
43	MDP2	PPM1W	1	5	100	50	240	4096.5264	397.3630608	
44	MDP2	LP2W	2	5	400	200	240	22151.5872	2148.703958	
45	MDP2	PPM2W	1	5	100	50	250	4248.2496	412.0802112	
46	MDP2	LP3W	2	5	400	200	260	23972.2656	2325.309763	
47	MDP2	PPM3W	1	5	100	50	270	4627.5576	448.8730872	
48	MDP2	DWP	1	4	100	50	20	379.308	36.792876	
49	LP1W	T-RP1FC	1	4	60	30	20	273.10176	26.49087072	
50	LP1W	T-RP1W	1	4	150	75	25	796.5468	77.2650396	
51	PPM1W	T-RPM1W	1	4	60	30	15	227.5848	22.0757256	
52	LP2W	T-RP2W	1	4	150	75	15	455.1696	44.1514512	
53	PPM2W	T-RPM2W	1	4	60	30	15	227.5848	22.0757256	
54	LP3W	T-RP3W	1	4	150	75	15	455.1696	44.1514512	
55	PPM3W	T-RPM3W	1	4	60	30	15	227.5848	22.0757256	
56	T-RP1FC	RP1FC	1	5	125	62.5	15	3413.772	331.135884	
57	T-RP1WM	RP1W1,2,3	1	5	250	125	15	758.616	73.585752	
58	T-RPM1W	RPM1W	1	5	100	50	15	379.308	36.792876	
59	T-RP2W	RP2W1,2	1	5	250	125	15	758.616	73.585752	
60	T-RPM2W	RPM2W	1	5	100	50	15	379.308	36.792876	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	75	15	455.1696	44.1514512	
62	T-RPM3W	RPM3W	1	5	110	55	15	500.68656	48.56659632	
63	MDP2	SLP	1	5	100	50	20	531.0312	51.5100264	
64	MDP2	CH-2	2	4	800	400	170	41268.7104	4003.064909	
65	MDP2	ELEV-3	1	4	100	50	115	3034.464	294.343008	
66	MDP2	ELEV-4	1	4	100	50	115	3034.464	294.343008	
67	MDP2	ELEV-5	1	4	100	50	115	3034.464	294.343008	
101	MDP1	AHU-5	1	4	40	20	108.5	1031.71776	100.0766227	
102	MDP1	AHU-15	1	4	40	20	60	576.54816	55.92517152	
103	MDP1	AHU-11	1	4	40	20	60	576.54816	55.92517152	
104	MDP1	B-3	1	4	40	20	170	1608.26592	156.0017942	
105	MDP1	UPS-WS	1	5	200	100	70	2882.7408	279.6258576	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	100	100	4248.2496	412.0802112	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	125	20	1137.924	110.378628	
109	T-DPUPSWS	DPUPSWS	2	5	500	250	20	3034.464	294.343008	
110	DPUPSWS	RPUPS1	1	5	100	50	20	531.0312	51.5100264	
111	DPUPSWS	RPUPS2	1	5	300	150	20	1365.5088	132.4543536	
112	DPUPSWS	RPUPS3	1	5	250	125	20	1137.924	110.378628	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	100	100	2882.7408	279.6258576	
128	MDP2	EFR-22	1	4	30	15	172	1433.78424	139.0770713	
129	MDP2	EFR-13	1	4	30	15	360	2981.36088	289.1920054	
130	MDP2	EFR-16	1	4	30	15	130	1069.64856	103.7559103	
131	MDP2	P-11	1	4	70	35	150	2336.53728	226.6441162	
132	MDP2	EFR-15	1	4	20	10	140	804.13296	78.00089712	
133	MDP2	AHU-1	1	4	90	45	340	7237.19664	702.0080741	
134	MDP2	AHU-2	1	4	70	35	350	5416.51824	525.4022693	
135	MDP2	AHU-3	1	4	80	40	170	3459.28896	335.5510291	
136	MDP2	AHU-4	1	4	80	40	245	4915.83168	476.835673	
137	MDP2	AHU-8	1	4	20	10	160	925.51152	89.77461744	
138	MDP2	AHU-13	1	4	60	30	350	4961.34864	481.2508181	
139	MDP2	P-9	1	4	20	10	150	864.82224	83.88775728	
140	MDP2	P-13	1	4	20	10	150	864.82224	83.88775728	
141	MDP2	P-2	1	4	150	75	150	4893.0732	474.6281004	
142	MDP2	SF1-2	1	4	30	15	20	159.30936	15.45300792	
143	MDP2	ELEV 3	1	4	100	50	113	2958.6024	286.9844328	
144	MDP2	ELEV 4	1	4	100	50	113	2958.6024	286.9844328	
145	MDP2	ELEV 5	1	4	100	50	113	2958.6024	286.9844328	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	4	40	3000	1500	100	179791.992	17439.82322	
5	MDP1	PPK	2	5	600	300	153	22758.48	2207.57256	
6	MDP1	LP1E	1	5	400	200	88	9710.2848	941.8976256	
7	MDP1	PPM1E	1	5	100	50	96	2124.1248	206.0401056	
8	MDP1	LP2E	1	5	400	200	110	12137.856	1177.372032	
9	MDP1	PPM2E	1	5	100	50	96	2124.1248	206.0401056	
10	MDP1	LP3E	1	5	400	200	130	14261.9808	1383.412138	
11	MDP1	PPM3E	1	5	100	50	140	2958.6024	286.9844328	
12	MDP1	ELEV #1	1	4	100	50	115	2427.5712	235.4744064	
13	MDP1	ELEV #2	1	4	100	50	115	2427.5712	235.4744064	
14	MDP1	CHILLER #1	3	4	1000	500	170	43241.112	4194.387864	
15	MDP1	MAU-1	1	4	20	10	170	622.06512	60.34031664	
16	MDP1	EFR-10	1	4	20	10	140	515.85888	50.03831136	
17	MDP1	EFR-12	1	4	20	10	180	667.58208	64.75546176	
18	MDP1	P-10	1	4	60	30	150	1411.02576	136.8694987	
19	MDP1	SF1-1	1	4	20	10	230	849.64992	82.41604224	
20	MDP1	AHU-6	1	4	70	35	190	2442.74352	236.9461214	
21	MDP1	AHU-7	1	4	100	50	100	2124.1248	206.0401056	
22	MDP1	AHU-9	1	4	20	10	100	364.13568	35.32116096	
23	MDP1	AHU-10	1	4	150	75	100	2731.0176	264.9087072	
24	PPK	T-RPK	1	4	400	200	20	2124.1248	206.0401056	
25	LP1E	T-RP1E	1	4	150	75	10	568.962	55.189314	
26	LP1E	T-RP1MR	1	4	80	40	230	3884.11392	376.7590502	
27	LP1E	T-RP1WM	1	4	30	15	275	1456.54272	141.2846438	
28	PPM1E	T-RPM1E	1	4	60	30	20	227.5848	22.0757256	
29	LP2E	T-RPM2E	1	4	150	75	15	568.962	55.189314	
30	PPM2E	T-RPM2E	1	4	60	30	15	227.5848	22.0757256	
31	LP3E	T-PRP3E	1	4	150	75	15	568.962	55.189314	
32	PPM3E	T-RPM3E	1	4	80	40	15	242.75712	23.54744064	
33	T-RPK	RPK-11,12,13	2	5	800	400	20	4248.2496	412.0802112	
34	T-RP1E	RP1E1,2,3	1	5	250	125	10	568.962	55.189314	
35	T-RP1MR	RP1MR	1	5	175	87.5	15	663.789	64.387533	
36	T-RP1WM	RP1WM	1	5	60	30	15	182.06784	17.66058048	
37	T-RPM1E	RPM1E1,2	1	5	100	50	20	455.1696	44.1514512	
38	T-RPM2E	RP2E1,2,3	1	5	250	125	15	948.27	91.98219	
39	T-RPM2E	RPM2E	1	5	100	50	15	303.4464	29.4343008	
40	T-PRP3E	RP3E1,2,3	1	5	250	125	15	948.27	91.98219	
41	T-RPM3E	RPM3E1,2	1	5	175	87.5	15	663.789	64.387533	
42	MDP2	LP1W	2	5	400	200	255	21544.6944	2089.835357	
43	MDP2	PPM1W	1	5	100	50	240	3489.6336	338.4944592	
44	MDP2	LP2W	2	5	400	200	240	20330.9088	1972.098154	
45	MDP2	PPM2W	1	5	100	50	250	3489.6336	338.4944592	
46	MDP2	LP3W	2	5	400	200	260	21848.1408	2119.269658	
47	MDP2	PPM3W	1	5	100	50	270	3868.9416	375.2873352	
48	MDP2	DWP	1	4	100	50	20	303.4464	29.4343008	
49	LP1W	T-RP1FC	1	4	60	30	20	227.5848	22.0757256	
50	LP1W	T-RP1W	1	4	150	75	25	682.7544	66.2271768	
51	PPM1W	T-RPM1W	1	4	60	30	15	227.5848	22.0757256	
52	LP2W	T-RP2W	1	4	150	75	15	568.962	55.189314	
53	PPM2W	T-RPM2W	1	4	60	30	15	227.5848	22.0757256	
54	LP3W	T-RP3W	1	4	150	75	15	568.962	55.189314	
55	PPM3W	T-RPM3W	1	4	60	30	15	227.5848	22.0757256	
56	T-RP1FC	RP1FC	1	5	125	62.5	15	284.481	27.594657	
57	T-RP1WM	RP1W1,2,3	1	5	250	125	15	948.27	91.98219	
58	T-RPM1W	RPM1W	1	5	100	50	15	303.4464	29.4343008	
59	T-RP2W	RP2W1,2	1	5	250	125	15	948.27	91.98219	
60	T-RPM2W	RPM2W	1	5	100	50	15	303.4464	29.4343008	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	75	15	568.962	55.189314	
62	T-RPM3W	RPM3W	1	5	110	55	15	333.79104	32.37773088	
63	MDP2	SLP	1	5	100	50	20	455.1696	44.1514512	
64	MDP2	CH-2	2	4	800	400	170	37020.4608	3590.984698	
65	MDP2	ELEV-3	1	4	100	50	115	2427.5712	235.4744064	
66	MDP2	ELEV-4	1	4	100	50	115	2427.5712	235.4744064	
67	MDP2	ELEV-5	1	4	100	50	115	2427.5712	235.4744064	
101	MDP1	AHU-5	1	4	40	20	110	697.92672	67.69889184	
102	MDP1	AHU-15	1	4	40	20	60	364.13568	35.32116096	
103	MDP1	AHU-11	1	4	40	20	60	364.13568	35.32116096	
104	MDP1	B-3	1	4	40	20	170	1062.0624	103.0200528	
105	MDP1	UPS-WS	1	5	200	100	70	2731.0176	264.9087072	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	100	100	3793.08	367.92876	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	125	20	948.27	91.98219	
109	T-DPUPSWS	DPUPSWS	2	5	500	250	20	2655.156	257.550132	
110	DPUPSWS	RPUPS1	1	5	100	50	20	455.1696	44.1514512	
111	DPUPSWS	RPUPS2	1	5	300	150	20	1137.924	110.378628	
112	DPUPSWS	RPUPS3	1	5	250	125	20	948.27	91.98219	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	100	100	3793.08	367.92876	
128	MDP2	EFR-22	1	4	30	15	172	955.85616	92.71804752	
129	MDP2	EFR-13	1	4	30	15	360	1911.71232	185.436095	
130	MDP2	EFR-16	1	4	30	15	130	682.7544	66.2271768	
131	MDP2	P-11	1	4	70	35	150	1911.71232	185.436095	
132	MDP2	EFR-15	1	4	20	10	140	515.85888	50.03831136	
133	MDP2	AHU-1	1	4	90	45	340	5803.4124	562.9310028	
134	MDP2	AHU-2	1	4	70	35	350	4513.7652	437.8352244	
135	MDP2	AHU-3	1	4	80	40	170	2852.39616	276.6824275	
136	MDP2	AHU-4	1	4	80	40	245	4126.87104	400.3064909	
137	MDP2	AHU-8	1	4	20	10	160	591.72048	57.39688656	
138	MDP2	AHU-13	1	4	60	30	350	3959.97552	384.1176254	
139	MDP2	P-9	1	4	20	10	150	546.20352	52.98174144	
140	MDP2	P-13	1	4	20	10	150	546.20352	52.98174144	
141	MDP2	P-2	1	4	150	75	150	4210.3188	408.4009236	
142	MDP2	SF1-2	1	4	30	15	20	113.7924	11.0378628	
143	MDP2	ELEV 3	1	4	100	50	110	2275.848	220.757256	
144	MDP2	ELEV 4	1	4	100	50	110	2275.848	220.757256	
145	MDP2	ELEV 5	1	4	100	50	110	2275.848	220.757256	

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.7
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	2100	100	360039.1536	34923.7979	
5	MDP1	PPK	2	5	600	420	153	40783.19616	3955.970028	
6	MDP1	LP1E	1	5	400	280	88	14868.8736	1442.280739	
7	MDP1	PPM1E	1	5	100	70	96	4248.2496	412.0802112	
8	MDP1	LP2E	1	5	400	280	110	18692.29824	1813.152929	
9	MDP1	PPM2E	1	5	100	70	96	4248.2496	412.0802112	
10	MDP1	LP3E	1	5	400	280	130	22090.89792	2142.817098	
11	MDP1	PPM3E	1	5	100	70	140	6159.96192	597.5163062	
12	MDP1	ELEV #1	1	4	100	70	115	5097.89952	494.4962534	
13	MDP1	ELEV #2	1	4	100	70	115	5097.89952	494.4962534	
14	MDP1	CHILLER #1	3	4	1000	700	170	76468.4928	7417.443802	
15	MDP1	MAU-1	1	4	20	14	170	2124.1248	206.0401056	
16	MDP1	EFR-10	1	4	20	14	140	1741.782336	168.9528866	
17	MDP1	EFR-12	1	4	20	14	180	2251.572288	218.4025119	
18	MDP1	P-10	1	4	60	42	150	2995.015968	290.5165489	
19	MDP1	SF1-1	1	4	20	14	230	2867.56848	278.1541426	
20	MDP1	AHU-6	1	4	70	49	190	5129.761392	497.586855	
21	MDP1	AHU-7	1	4	100	70	100	4460.66208	432.6842218	
22	MDP1	AHU-9	1	4	20	14	100	1253.233632	121.5636623	
23	MDP1	AHU-10	1	4	150	105	100	5416.51824	525.4022693	
24	PPK	T-RPK	1	4	400	280	20	3398.59968	329.664169	
25	LP1E	T-RP1E	1	4	150	105	10	318.61872	30.90601584	
26	LP1E	T-RP1MR	1	4	80	56	230	8156.639232	791.1940055	
27	LP1E	T-RP1WM	1	4	30	21	275	5002.313904	485.2244487	
28	PPM1E	T-RPM1E	1	4	60	42	20	573.513696	55.63082851	
29	LP2E	T-RPM2E	1	4	150	105	15	477.92808	46.35902376	
30	PPM2E	T-RPM2E	1	4	60	42	15	446.066208	43.26842218	
31	LP3E	T-PRP3E	1	4	150	105	15	477.92808	46.35902376	
32	PPM3E	T-RPM3E	1	4	80	56	15	509.789952	49.44962534	
33	T-RPK	RPK-11,12,13	2	5	800	560	20	6797.19936	659.3283379	
34	T-RP1E	RP1E1,2,3	1	5	250	175	10	796.5468	77.2650396	
35	T-RP1MR	RP1MR	1	5	175	122.5	15	557.58276	54.08552772	
36	T-RP1WM	RP1WM	1	5	60	42	15	446.066208	43.26842218	
37	T-RPM1E	RPM1E1,2	1	5	100	70	20	849.64992	82.41604224	
38	T-RPM2E	RP2E1,2,3	1	5	250	175	15	1327.578	128.775066	
39	T-RPM2E	RPM2E	1	5	100	70	15	637.23744	61.81203168	
40	T-PRP3E	RP3E1,2,3	1	5	250	175	15	1327.578	128.775066	
41	T-RPM3E	RPM3E1,2	1	5	175	122.5	15	929.3046	90.1425462	
42	MDP2	LP1W	2	5	400	280	255	37384.59648	3626.305859	
43	MDP2	PPM1W	1	5	100	70	240	7115.81808	690.2343538	
44	MDP2	LP2W	2	5	400	280	240	35260.47168	3420.265753	
45	MDP2	PPM2W	1	5	100	70	250	7328.23056	710.8383643	
46	MDP2	LP3W	2	5	400	280	260	38234.2464	3708.721901	
47	MDP2	PPM3W	1	5	100	70	270	7965.468	772.650396	
48	MDP2	DWP	1	4	100	70	20	637.23744	61.81203168	
49	LP1W	T-RP1FC	1	4	60	42	20	573.513696	55.63082851	
50	LP1W	T-RP1W	1	4	150	105	25	1274.47488	123.6240634	
51	PPM1W	T-RPM1W	1	4	60	42	15	446.066208	43.26842218	
52	LP2W	T-RP2W	1	4	150	105	15	796.5468	77.2650396	
53	PPM2W	T-RPM2W	1	4	60	42	15	446.066208	43.26842218	
54	LP3W	T-RP3W	1	4	150	105	15	796.5468	77.2650396	
55	PPM3W	T-RPM3W	1	4	60	42	15	446.066208	43.26842218	
56	T-RP1FC	RP1FC	1	5	125	87.5	15	531.0312	51.5100264	
57	T-RP1WM	RP1W1,2,3	1	5	250	175	15	1327.578	128.775066	
58	T-RPM1W	RPM1W	1	5	100	70	15	637.23744	61.81203168	
59	T-RP2W	RP2W1,2	1	5	250	175	15	1327.578	128.775066	
60	T-RPM2W	RPM2W	1	5	100	70	15	637.23744	61.81203168	

FEEDER SCHEDULE FOR EXISTING FEEDERS

INPUTS	
DEMAND FACTOR	0.7
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	105	15	477.92808	46.35902376	
62	T-RPM3W	RPM3W	1	5	100	70	15	637.23744	61.81203168	
63	MDP2	SLP	1	5	100	70	20	849.64992	82.41604224	
64	MDP2	CH-2	2	4	800	560	170	57776.19456	5604.290872	
65	MDP2	ELEV-3	1	4	100	70	115	5097.89952	494.4962534	
66	MDP2	ELEV-4	1	4	100	70	115	5097.89952	494.4962534	
67	MDP2	ELEV-5	1	4	100	70	115	5097.89952	494.4962534	
101	MDP1	AHU-5	1	4	40	28	108.5	2209.089792	214.2817098	
102	MDP1	AHU-15	1	4	40	28	63	1316.957376	127.7448655	
103	MDP1	AHU-11	1	4	40	28	60	1231.992384	119.5032612	
104	MDP1	B-3	1	4	40	28	170	3483.564672	337.9057732	
105	MDP1	UPS-WS	1	5	200	140	70	4885.48704	473.8922429	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	140	100	7009.61184	679.9323485	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	175	20	1593.0936	154.5300792	
109	T-DPUPSWS	DPUPSWS	2	5	500	350	20	4779.2808	463.5902376	
110	DPUPSWS	RPUPS1	1	5	100	70	20	849.64992	82.41604224	
111	DPUPSWS	RPUPS2	1	5	300	210	20	1911.71232	185.436095	
112	DPUPSWS	RPUPS3	1	5	250	175	20	1593.0936	154.5300792	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	140	100	7009.61184	679.9323485	
128	MDP2	EFR-22	1	4	30	21	172	3122.463456	302.8789552	
129	MDP2	EFR-13	1	4	30	21	360	6563.545632	636.6639263	
130	MDP2	EFR-16	1	4	30	21	130	2357.778528	228.7045172	
131	MDP2	P-11	1	4	70	49	150	4088.94024	396.6272033	
132	MDP2	EFR-15	1	4	20	14	140	1741.782336	168.9528866	
133	MDP2	AHU-1	1	4	90	63	340	12139.37323	1177.519204	
134	MDP2	AHU-2	1	4	70	49	350	9441.734736	915.8482694	
135	MDP2	AHU-3	1	4	80	56	170.7	6032.514432	585.1538999	
136	MDP2	AHU-4	1	4	80	56	245	8666.429184	840.6436308	
137	MDP2	AHU-8	1	4	20	14	160	1996.677312	193.6776993	
138	MDP2	AHU-13	1	4	60	42	350	10450.69402	1013.71732	
139	MDP2	P-9	1	4	20	14	150	1869.229824	181.3152929	
140	MDP2	P-13	1	4	20	14	150	1869.229824	181.3152929	
141	MDP2	P-2	1	4	150	105	150	8124.77736	788.1034039	
142	MDP2	SF1-2	1	4	30	21	20	350.480592	33.99661742	
143	MDP2	ELEV 3	1	4	100	70	113	14975.07984	1452.582744	
144	MDP2	ELEV 4	1	4	100	70	113	14975.07984	1452.582744	
145	MDP2	ELEV 5	1	4	100	70	113	14975.07984	1452.582744	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.7
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	3	40	3000	2100	100	309060.1584	29978.83536	
5	MDP1	PPK	2	5	600	420	153	36959.77152	3585.097837	
6	MDP1	LP1E	1	5	400	280	88	14868.8736	1442.280739	
7	MDP1	PPM1E	1	5	100	70	96	3504.80592	339.9661742	
8	MDP1	LP2E	1	5	400	280	110	18692.29824	1813.152929	
9	MDP1	PPM2E	1	5	100	70	96	3504.80592	339.9661742	
10	MDP1	LP3E	1	5	400	280	130	22090.89792	2142.817098	
11	MDP1	PPM3E	1	5	100	70	140	5097.89952	494.4962534	
12	MDP1	ELEV #1	1	4	100	70	115	4248.2496	412.0802112	
13	MDP1	ELEV #2	1	4	100	70	115	4248.2496	412.0802112	
14	MDP1	CHILLER #1	3	4	1000	700	170	66909.9312	6490.263326	
15	MDP1	MAU-1	1	4	20	14	170	1380.68112	133.9260686	
16	MDP1	EFR-10	1	4	20	14	140	1125.786144	109.201256	
17	MDP1	EFR-12	1	4	20	14	180	1465.646112	142.1676729	
18	MDP1	P-10	1	4	60	42	150	2357.778528	228.7045172	
19	MDP1	SF1-1	1	4	20	14	230	1869.229824	181.3152929	
20	MDP1	AHU-6	1	4	70	49	190	4088.94024	396.6272033	
21	MDP1	AHU-7	1	4	100	70	100	3717.2184	360.5701848	
22	MDP1	AHU-9	1	4	20	14	100	807.167424	78.29524013	
23	MDP1	AHU-10	1	4	150	105	100	4619.97144	448.1372297	
24	PPK	T-RPK	1	4	400	280	20	3398.59968	329.664169	
25	LP1E	T-RP1E	1	4	150	105	10	477.92808	46.35902376	
26	LP1E	T-RP1MR	1	4	80	56	230	6457.339392	626.361921	
27	LP1E	T-RP1WM	1	4	30	21	275	3186.1872	309.0601584	
28	PPM1E	T-RPM1E	1	4	60	42	20	382.342464	37.08721901	
29	LP2E	T-RPM2E	1	4	150	105	15	637.23744	61.81203168	
30	PPM2E	T-RPM2E	1	4	60	42	15	318.61872	30.90601584	
31	LP3E	T-PRP3E	1	4	150	105	15	637.23744	61.81203168	
32	PPM3E	T-RPM3E	1	4	80	56	15	424.82496	41.20802112	
33	T-RPK	RPK-11,12,13	2	5	800	560	20	6797.19936	659.3283379	
34	T-RP1E	RP1E1,2,3	1	5	250	175	10	796.5468	77.2650396	
35	T-RP1MR	RP1MR	1	5	175	122.5	15	743.44368	72.11403696	
36	T-RP1WM	RP1WM	1	5	60	42	15	318.61872	30.90601584	
37	T-RPM1E	RPM1E1,2	1	5	100	70	20	743.44368	72.11403696	
38	T-RPM2E	RP2E1,2,3	1	5	250	175	15	1062.0624	103.0200528	
39	T-RPM2E	RPM2E	1	5	100	70	15	531.0312	51.5100264	
40	T-PRP3E	RP3E1,2,3	1	5	250	175	15	1062.0624	103.0200528	
41	T-RPM3E	RPM3E1,2	1	5	175	122.5	15	743.44368	72.11403696	
42	MDP2	LP1W	2	5	400	280	255	33136.34688	3214.225647	
43	MDP2	PPM1W	1	5	100	70	240	5735.13696	556.3082851	
44	MDP2	LP2W	2	5	400	280	240	31012.22208	3008.185542	
45	MDP2	PPM2W	1	5	100	70	250	5947.54944	576.9122957	
46	MDP2	LP3W	2	5	400	280	260	33561.17184	3255.433668	
47	MDP2	PPM3W	1	5	100	70	270	6478.58064	628.4223221	
48	MDP2	DWP	1	4	100	70	20	531.0312	51.5100264	
49	LP1W	T-RP1FC	1	4	60	42	20	382.342464	37.08721901	
50	LP1W	T-RP1W	1	4	150	105	25	1115.16552	108.1710554	
51	PPM1W	T-RPM1W	1	4	60	42	15	318.61872	30.90601584	
52	LP2W	T-RP2W	1	4	150	105	15	637.23744	61.81203168	
53	PPM2W	T-RPM2W	1	4	60	42	15	318.61872	30.90601584	
54	LP3W	T-RP3W	1	4	150	105	15	637.23744	61.81203168	
55	PPM3W	T-RPM3W	1	4	60	42	15	318.61872	30.90601584	
56	T-RP1FC	RP1FC	1	5	125	87.5	15	4779.2808	463.5902376	
57	T-RP1WM	RP1W1,2,3	1	5	250	175	15	1062.0624	103.0200528	
58	T-RPM1W	RPM1W	1	5	100	70	15	531.0312	51.5100264	
59	T-RP2W	RP2W1,2	1	5	250	175	15	1062.0624	103.0200528	
60	T-RPM2W	RPM2W	1	5	100	70	15	531.0312	51.5100264	

FEEDER SCHEDULE FOR ONE SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.7
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	105	15	637.23744	61.81203168	
62	T-RPM3W	RPM3W	1	5	110	77	15	700.961184	67.99323485	
63	MDP2	SLP	1	5	100	70	20	743.44368	72.11403696	
64	MDP2	CH-2	2	4	800	560	170	57776.19456	5604.290872	
65	MDP2	ELEV-3	1	4	100	70	115	4248.2496	412.0802112	
66	MDP2	ELEV-4	1	4	100	70	115	4248.2496	412.0802112	
67	MDP2	ELEV-5	1	4	100	70	115	4248.2496	412.0802112	
101	MDP1	AHU-5	1	4	40	28	108.5	1444.404864	140.1072718	
102	MDP1	AHU-15	1	4	40	28	60	807.167424	78.29524013	
103	MDP1	AHU-11	1	4	40	28	60	807.167424	78.29524013	
104	MDP1	B-3	1	4	40	28	170	2251.572288	218.4025119	
105	MDP1	UPS-WS	1	5	200	140	70	4035.83712	391.4762006	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	140	100	5947.54944	576.9122957	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	175	20	1593.0936	154.5300792	
109	T-DPUPSWS	DPUPSWS	2	5	500	350	20	4248.2496	412.0802112	
110	DPUPSWS	RPUPS1	1	5	100	70	20	743.44368	72.11403696	
111	DPUPSWS	RPUPS2	1	5	300	210	20	1911.71232	185.436095	
112	DPUPSWS	RPUPS3	1	5	250	175	20	1593.0936	154.5300792	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	140	100	4035.83712	391.4762006	
128	MDP2	EFR-22	1	4	30	21	172	2007.297936	194.7078998	
129	MDP2	EFR-13	1	4	30	21	360	4173.905232	404.8688075	
130	MDP2	EFR-16	1	4	30	21	130	1497.507984	145.2582744	
131	MDP2	P-11	1	4	70	49	150	3271.152192	317.3017626	
132	MDP2	EFR-15	1	4	20	14	140	1125.786144	109.201256	
133	MDP2	AHU-1	1	4	90	63	340	10132.0753	982.8113037	
134	MDP2	AHU-2	1	4	70	49	350	7583.125536	735.563177	
135	MDP2	AHU-3	1	4	80	56	170	4843.004544	469.7714408	
136	MDP2	AHU-4	1	4	80	56	245	6882.164352	667.5699421	
137	MDP2	AHU-8	1	4	20	14	160	1295.716128	125.6844644	
138	MDP2	AHU-13	1	4	60	42	350	6945.888096	673.7511453	
139	MDP2	P-9	1	4	20	14	150	1210.751136	117.4428602	
140	MDP2	P-13	1	4	20	14	150	1210.751136	117.4428602	
141	MDP2	P-2	1	4	150	105	150	6850.30248	664.4793406	
142	MDP2	SF1-2	1	4	30	21	20	223.033104	21.63421109	
143	MDP2	ELEV 3	1	4	100	70	113	4142.04336	401.7782059	
144	MDP2	ELEV 4	1	4	100	70	113	4142.04336	401.7782059	
145	MDP2	ELEV 5	1	4	100	70	113	4142.04336	401.7782059	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.7
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
1	UTILITY	MDP1	4	40	3000	2100	100	251708.7888	24415.75251	
5	MDP1	PPK	2	5	600	420	153	31861.872	3090.601584	
6	MDP1	LP1E	1	5	400	280	88	13594.39872	1318.656676	
7	MDP1	PPM1E	1	5	100	70	96	2973.77472	288.4561478	
8	MDP1	LP2E	1	5	400	280	110	16992.9984	1648.320845	
9	MDP1	PPM2E	1	5	100	70	96	2973.77472	288.4561478	
10	MDP1	LP3E	1	5	400	280	130	19966.77312	1936.776993	
11	MDP1	PPM3E	1	5	100	70	140	4142.04336	401.7782059	
12	MDP1	ELEV #1	1	4	100	70	115	3398.59968	329.664169	
13	MDP1	ELEV #2	1	4	100	70	115	3398.59968	329.664169	
14	MDP1	CHILLER #1	3	4	1000	700	170	60537.5568	5872.14301	
15	MDP1	MAU-1	1	4	20	14	170	870.891168	84.4764433	
16	MDP1	EFR-10	1	4	20	14	140	722.202432	70.0536359	
17	MDP1	EFR-12	1	4	20	14	180	934.614912	90.65764646	
18	MDP1	P-10	1	4	60	42	150	1975.436064	191.6172982	
19	MDP1	SF1-1	1	4	20	14	230	1189.509888	115.3824591	
20	MDP1	AHU-6	1	4	70	49	190	3419.840928	331.72457	
21	MDP1	AHU-7	1	4	100	70	100	2973.77472	288.4561478	
22	MDP1	AHU-9	1	4	20	14	100	509.789952	49.44962534	
23	MDP1	AHU-10	1	4	150	105	100	3823.42464	370.8721901	
24	PPK	T-RPK	1	4	400	280	20	2973.77472	288.4561478	
25	LP1E	T-RP1E	1	4	150	105	10	796.5468	77.2650396	
26	LP1E	T-RP1MR	1	4	80	56	230	5437.759488	527.4626703	
27	LP1E	T-RP1WM	1	4	30	21	275	2039.159808	197.7985014	
28	PPM1E	T-RPM1E	1	4	60	42	20	318.61872	30.90601584	
29	LP2E	T-RPM2E	1	4	150	105	15	796.5468	77.2650396	
30	PPM2E	T-RPM2E	1	4	60	42	15	318.61872	30.90601584	
31	LP3E	T-PRP3E	1	4	150	105	15	796.5468	77.2650396	
32	PPM3E	T-RPM3E	1	4	80	56	15	339.859968	32.9664169	
33	T-RPK	RPK-11,12,13	2	5	800	560	20	5947.54944	576.9122957	
34	T-RP1E	RP1E1,2,3	1	5	250	175	10	796.5468	77.2650396	
35	T-RP1MR	RP1MR	1	5	175	122.5	15	929.3046	90.1425462	
36	T-RP1WM	RP1WM	1	5	60	42	15	254.894976	24.72481267	
37	T-RPM1E	RPM1E1,2	1	5	100	70	20	637.23744	61.81203168	
38	T-RPM2E	RP2E1,2,3	1	5	250	175	15	1327.578	128.775066	
39	T-RPM2E	RPM2E	1	5	100	70	15	424.82496	41.20802112	
40	T-PRP3E	RP3E1,2,3	1	5	250	175	15	1327.578	128.775066	
41	T-RPM3E	RPM3E1,2	1	5	175	122.5	15	929.3046	90.1425462	
42	MDP2	LP1W	2	5	400	280	255	30162.57216	2925.7695	
43	MDP2	PPM1W	1	5	100	70	240	4885.48704	473.8922429	
44	MDP2	LP2W	2	5	400	280	240	28463.27232	2760.937415	
45	MDP2	PPM2W	1	5	100	70	250	4885.48704	473.8922429	
46	MDP2	LP3W	2	5	400	280	260	30587.39712	2966.977521	
47	MDP2	PPM3W	1	5	100	70	270	5416.51824	525.4022693	
48	MDP2	DWP	1	4	100	70	20	424.82496	41.20802112	
49	LP1W	T-RP1FC	1	4	60	42	20	318.61872	30.90601584	
50	LP1W	T-RP1W	1	4	150	105	25	955.85616	92.71804752	
51	PPM1W	T-RPM1W	1	4	60	42	15	318.61872	30.90601584	
52	LP2W	T-RP2W	1	4	150	105	15	796.5468	77.2650396	
53	PPM2W	T-RPM2W	1	4	60	42	15	318.61872	30.90601584	
54	LP3W	T-RP3W	1	4	150	105	15	796.5468	77.2650396	
55	PPM3W	T-RPM3W	1	4	60	42	15	318.61872	30.90601584	
56	T-RP1FC	RP1FC	1	5	125	87.5	15	398.2734	38.6325198	
57	T-RP1WM	RP1W1,2,3	1	5	250	175	15	1327.578	128.775066	
58	T-RPM1W	RPM1W	1	5	100	70	15	424.82496	41.20802112	
59	T-RP2W	RP2W1,2	1	5	250	175	15	1327.578	128.775066	
60	T-RPM2W	RPM2W	1	5	100	70	15	424.82496	41.20802112	

FEEDER SCHEDULE FOR TWO SIZE INCREASE

INPUTS	
DEMAND FACTOR	0.5
POWER FACTOR	0.85
VOLTAGE	480

TAG	FROM	TO	NO OF SETS	NO OF CONDUCTORS	SIZE OF OVERCURRENT PROTECTION (A)	LOAD	LENGTH OF FEEDER (ft)	kWh	Cost of energy loss	REMARKS
61	T-RP3W	RP3W1,2,3	1	5	150	75	15	568.962	55.189314	
62	T-RPM3W	RPM3W	1	5	110	55	15	333.79104	32.37773088	
63	MDP2	SLP	1	5	100	50	20	455.1696	44.1514512	
64	MDP2	CH-2	2	4	800	400	170	37020.4608	3590.984698	
65	MDP2	ELEV-3	1	4	100	50	115	2427.5712	235.4744064	
66	MDP2	ELEV-4	1	4	100	50	115	2427.5712	235.4744064	
67	MDP2	ELEV-5	1	4	100	50	115	2427.5712	235.4744064	
101	MDP1	AHU-5	1	4	40	20	110	697.92672	67.69889184	
102	MDP1	AHU-15	1	4	40	20	60	364.13568	35.32116096	
103	MDP1	AHU-11	1	4	40	20	60	364.13568	35.32116096	
104	MDP1	B-3	1	4	40	20	170	1062.0624	103.0200528	
105	MDP1	UPS-WS	1	5	200	100	70	2731.0176	264.9087072	
107	UPS-WS	MAINTENANCE BYPASS PANEL	1	5	200	100	100	3793.08	367.92876	
108	MAINTENANCE BYPASS PANEL	T-DPUPSWS	1	4	250	125	20	948.27	91.98219	
109	T-DPUPSWS	DPUPSWS	2	5	500	250	20	2655.156	257.550132	
110	DPUPSWS	RPUPS1	1	5	100	50	20	455.1696	44.1514512	
111	DPUPSWS	RPUPS2	1	5	300	150	20	1137.924	110.378628	
112	DPUPSWS	RPUPS3	1	5	250	125	20	948.27	91.98219	
113	MDP1	MAINTENANCE BYPASS PANEL	1	5	200	100	100	3793.08	367.92876	
128	MDP2	EFR-22	1	4	30	15	172	955.85616	92.71804752	
129	MDP2	EFR-13	1	4	30	15	360	1911.71232	185.436095	
130	MDP2	EFR-16	1	4	30	15	130	682.7544	66.2271768	
131	MDP2	P-11	1	4	70	35	150	1911.71232	185.436095	
132	MDP2	EFR-15	1	4	20	10	140	515.85888	50.03831136	
133	MDP2	AHU-1	1	4	90	45	340	5803.4124	562.9310028	
134	MDP2	AHU-2	1	4	70	35	350	4513.7652	437.8352244	
135	MDP2	AHU-3	1	4	80	40	170	2852.39616	276.6824275	
136	MDP2	AHU-4	1	4	80	40	245	4126.87104	400.3064909	
137	MDP2	AHU-8	1	4	20	10	160	591.72048	57.39688656	
138	MDP2	AHU-13	1	4	60	30	350	3959.97552	384.1176254	
139	MDP2	P-9	1	4	20	10	150	546.20352	52.98174144	
140	MDP2	P-13	1	4	20	10	150	546.20352	52.98174144	
141	MDP2	P-2	1	4	150	75	150	4210.3188	408.4009236	
142	MDP2	SF1-2	1	4	30	15	20	113.7924	11.0378628	
143	MDP2	ELEV 3	1	4	100	50	110	2275.848	220.757256	
144	MDP2	ELEV 4	1	4	100	50	110	2275.848	220.757256	
145	MDP2	ELEV 5	1	4	100	50	110	2275.848	220.757256	

Appendix F | Panelboard Cut Sheets

3

Type PRL1a Panelboard

Contents

Product Description

Eaton's EZ box and EZ trim represents the first significant change in panelboard box and trim designs in more than a half-century. The EZ box and EZ trim have been designed for faster, more secure and safer installations. The new EZ box and EZ trim are provided standard for Eaton's Pow-R-Line 1a and Pow-R-Line 2a lighting panelboards, as well as the Pow-R-Line 3a and Pow-R-Line 3E mid-range panelboard.

Flange Detail

Features

- Virtually eliminates sharp edges
- Trim installs in seconds rather than minutes
- Door-in-door is standard
- Ability to adjust flush box to wall irregularities
- Trim installs without the need for tools
- No exposed hardware (because there is none)

The EZ box flanges are bent and painted, which virtually eliminates the sharp edges associated with traditional boxes. Additionally, all steel panelboard chassis parts are painted. This significantly reduces potential injury for material handlers and installers. Each flange is adjustable outward up to 3/4-inch (19.1 mm). This feature allows the installer to adjust flush box applications to be level and flat with the finished wall after the wall material is installed to help correct wall irregularities. The new box flange also provides the means for attaching the EZ trim.

Standalone Trim and Bottom Flange Hanger with Notch

Corner Flange Detail

Fast Installation

The EZ trim incorporates a groundbreaking design that installs in seconds, rather than minutes. The standard trim features include door-in-door construction; no exposed hardware and no tools are required for installation.

Each EZ trim includes hangers attached on the right side. The bottom trim hanger has a notch in its base. To install, the bottom hanger is inserted into the bottom right side box flange opening, resting the notch on the flange.

Trim Hanger Inserted Into Box Flange

The balance of the hangers are aligned with the other flange openings and pushed in. When all hangers are in the box flange, the trim is lifted up slightly to clear the notch on the bottom hanger, and the trim in self-supported on the EZ box.

The installation is completed by swinging the trim to the closed position, then lifting and pushing slightly to the right. The trim will drop into place totally secured. The multi-point catches on the left side of the trim will lock into the left side box flange openings.

To prevent the trim from being removed by non-authorized persons, a unique sliding means automatically latches in place when the trim door is closed. Along with a new lock, the EZ trim offers a high degree of door security.

Trim Hanging on Surface Mounted Box

Standards and Certifications

When used with Eaton's panelboard chassis, EZ boxes and EZ trims meet the following applicable industry standards:

- UL 50 listed
- NEMA Standard PB1
- Federal specifications
- National Electrical Code

Listed

Product Selection

Boxes and Trims Only—Type 1

3

Types PRL1a, PRL2a and PRL3a (400A Maximum)

Box Dimensions—Inches (mm)	Height	YS Box Catalog Number	LT Trim Catalog Number	EZ Box ① Catalog Number	EZ Trim ① Catalog Number
20.00 W x 5.75 D (508.0 W x 146.1 D)	36.00 (914.4)	**YS2036**	**LT2036S or F**	**EZB2036R**	**EZT2036S or F**
	42.00 (1066.8)	**YS2042**	**LT2042S or F**	**EZB2042R**	**EZT2042S or F**
	48.00 (1219.2)	**YS2048**	**LT2048S or F**	**EZB2048R**	**EZT2048S or F**
	60.00 (1524.0)	**YS2060**	**LT2060S or F**	**EZB2060R**	**EZT2060S or F**
	72.00 (1828.8)	**YS2072**	**LT2072S or F**	**EZB2072R**	**EZT2072S or F**
	90.00 (2286.0)	**YS2090**	**LT2090S or F**	**EZB2090R**	**EZT2090S or F**

Type PRL3a (600A)

Box Dimensions—Inches (mm)	Height	YS Box Catalog Number	LT Trim Catalog Number	EZ Box ① Catalog Number	EZ Trim ① Catalog Number
20.00 W x 5.75 D (508.0 W x 146.1 D)	36.00 (914.4)	**YS2036**	**LTV2036S or F**	**EZB2036R**	**EZTV2036S or F**
	48.00 (1219.2)	**YS2048**	**LTV2048S or F**	**EZB2048R**	**EZTV2048S or F**
	60.00 (1524.0)	**YS2060**	**LTV2060S or F**	**EZB2060R**	**EZTV2060S or F**
	72.00 (1828.8)	**YS2072**	**LTV2072S or F**	**EZB2072R**	**EZTV2072S or F**
	90.00 (2286.0)	**YS2090**	**LTV2090S or F**	**EZB2090R**	**EZTV2090S or F**

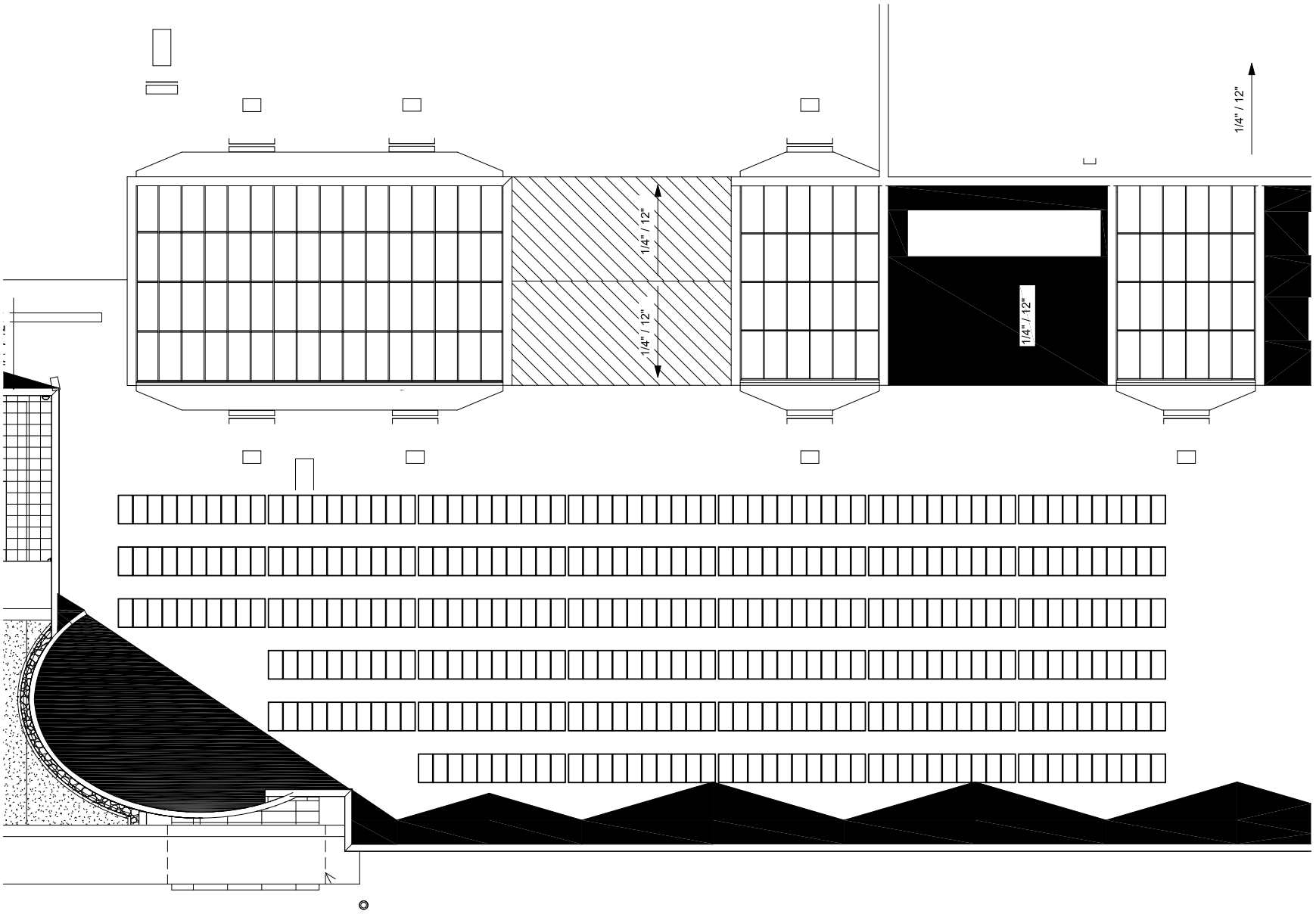
Type PRL3a (800A)

Box Dimensions—Inches (mm)	Height	YS Box Catalog Number	LT Trim Catalog Number
28.00 W x 5.75 D	36.00 (914.4)	**YS2836**	**LTV2836S or F**
	48.00 (1219.2)	**YS2848**	**LTV2848S or F**
	60.00 (1524.0)	**YS2860**	**LTV2860S or F**
	72.00 (1828.8)	**YS2872**	**LTV2872S or F**
	90.00 (2286.0)	**YS2890**	**LTV2890S or F**

Note

① EZ box must be used with EZ trim.

Appendix G | Photovoltaic Layout, Wiring Diagram, Single-line Diagram, and Cutsheets



THE PENNSYLVANIA STATE EMPLOYEES CREDIT UNION
CORPORATE HEADQUARTERS
HARRISBURG, PA

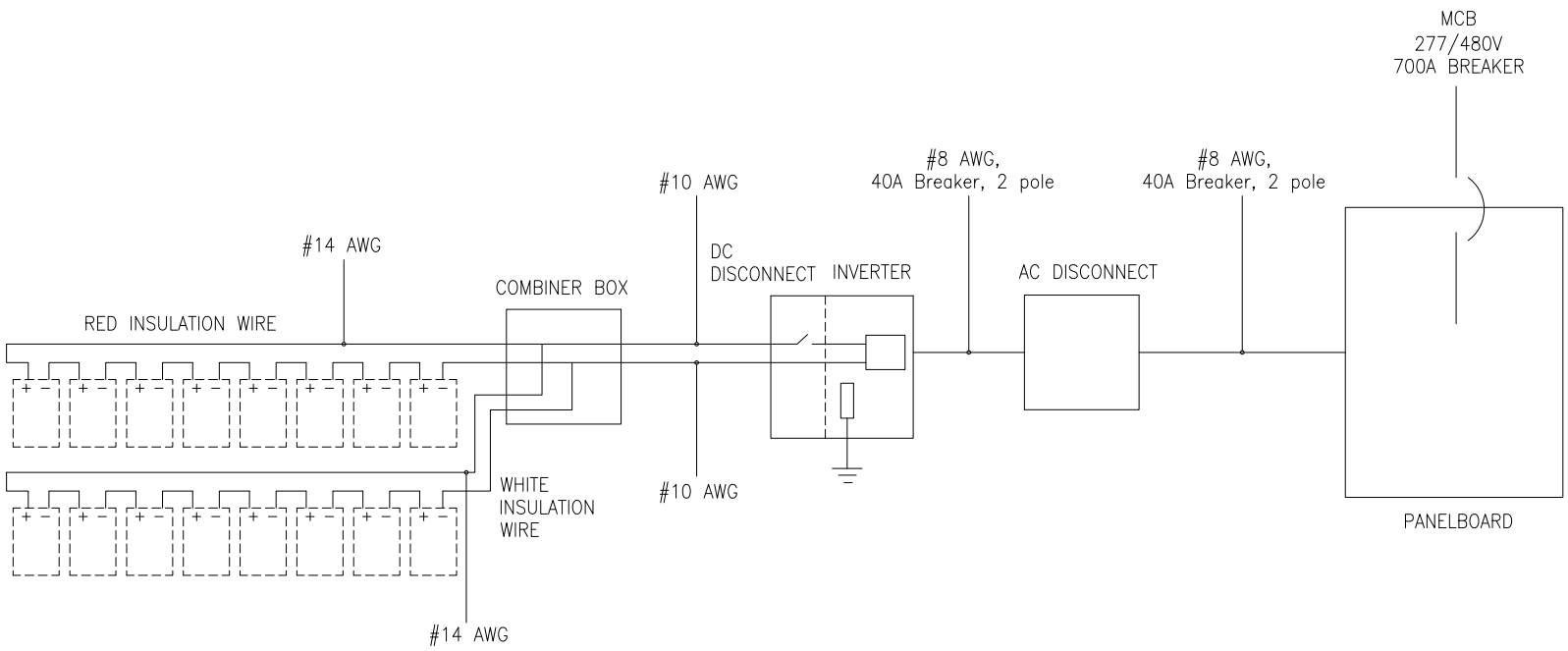
SCALE:
1/16" = 1'

ISSUE DATE:
04/04/2012

DRAWN BY:
SARAH WUJCIK

TITLE:
PHOTOVOLTAIC MODULE
ROOF PLAN LAYOUT

SHEET TITLE:



TYPICAL FOR 19 STRINGS IN PARALLEL

PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS

ADDRESS:
HARRISBURG, PA

SCALE:
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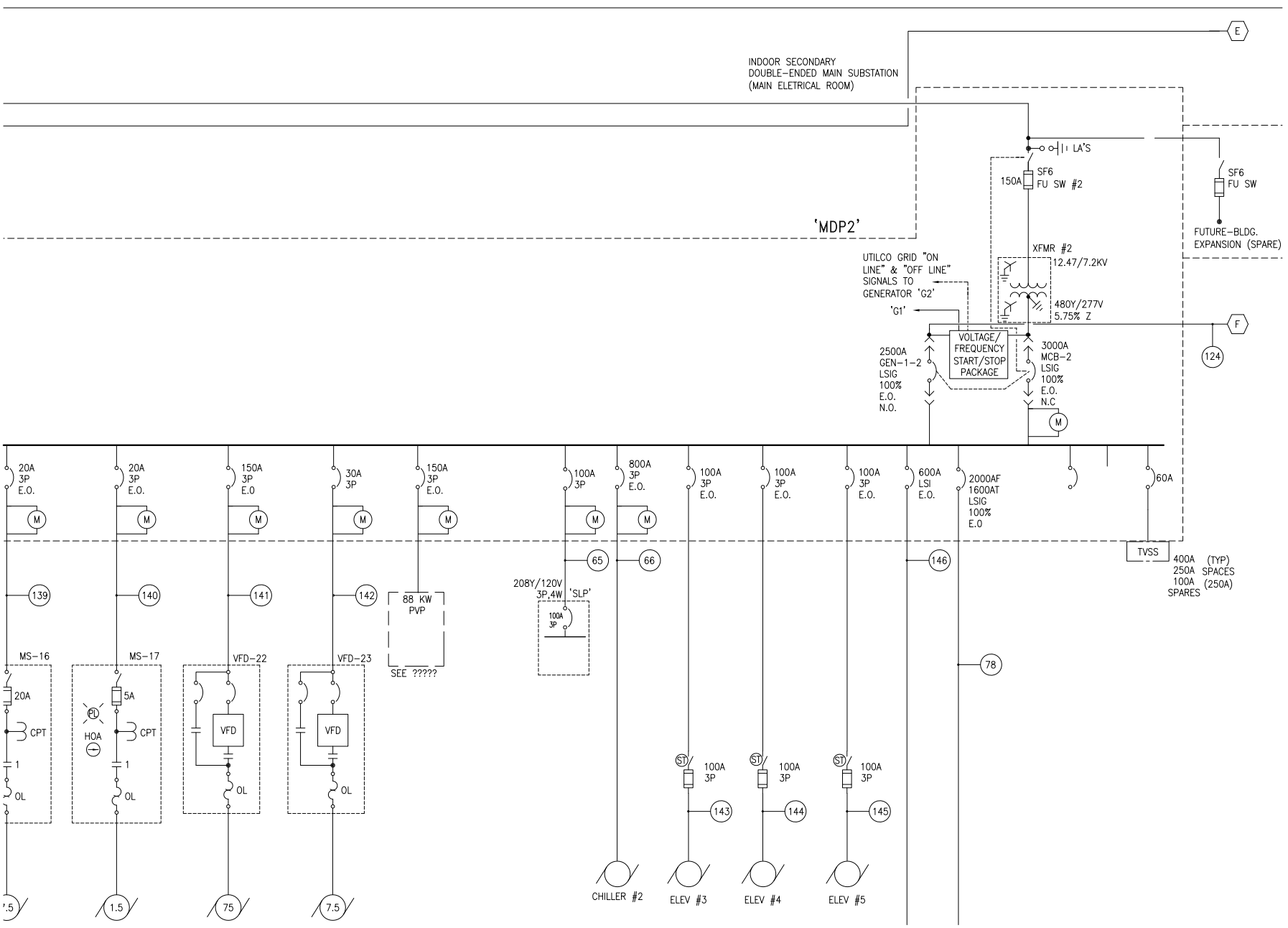
ISSUE:
03/26/2012

DRAWN BY:
SARAH WUJCIK

TYPICAL PHOTOVOLTAIC ARRAY LAYOUT

SHEET TITLE:



PENNSYLVANIA STATE EMPLOYEES CREDIT UNION CORPORATE HEADQUARTERS

ADDRESS:
HARRISBURG, PA

SCALE:
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ISSUE:
04/04/2012

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SARAH WUJCIK

PHOTOVOLTAIC PANELBOARD SINGLE-LINE

SHEET TITLE:

Fronius **IG Plus** PV Inverter

The first complete solution. Reliable. Proven. Smart.

An outstanding addition to the family: The next generation Fronius IG Plus inverter builds on a successful model with multiple enhancements, including maximum power harvest, a built-in six circuit string combiner, integrated, lockable DC Disconnect, significantly improved efficiency, and unbeatable reliability. New, larger power stages expand the proven Fronius IG family from 2 to 12 kW in a single inverter.

Fronius

POWERING YOUR FUTURE

INPUT DATA **Fronius IG Plus**		**3.0-1 UNI**	**3.8-1 UNI**	**5.0-1 UNI**	**6.0-1 UNI**	**7.5-1 UNI**	**10.0-1 UNI**	**11.4-1 UNI**	**11.4-3 Delta**	**12.0-3 WYE277**
Recommended PV-Power (Wp)		2500-3450	3200-4400	4250-5750	5100-6900	6350-8600	8500-11500	9700-13100	9700-13100	10200-13800
MPPT-Voltage Range						230 ... 500 V				
DC Startup Voltage						245 V				
Max. Input Voltage (at 1000 W/m² 14°F (-10°C) in open circuit operation)						600 V				
Nominal Input Current		8.3 A	10.5 A	13.8 A	16.6 A	20.7 A	27.6 A	31.4 A	31.4 A	33.1 A
Max. usable Input Current		14.0 A	17.8 A	23.4 A	28.1 A	35.1 A	46.7 A	53.3 A	53.3 A	56.1 A
Admissible conductor size (DC)						No. 14 - 6 AWG				
Number of DC Input Terminals						6				
Max. Current per DC Input Terminal					20 A; Bus bar available for higher input currents					

OUTPUT DATA **Fronius IG Plus**		**3.0-1 UNI**	**3.8-1 UNI**	**5.0-1 UNI**	**6.0-1 UNI**	**7.5-1 UNI**	**10.0-1 UNI**	**11.4-1 UNI**	**11.4-3 Delta**	**12.0-3 WYE277**
Nominal output power ($P_{AC\ nom}$)		3000 W	3800 W	5000 W	6000 W	7500 W	9995 W	11400 W	11400 W	12000 W
Max. continuous output power 104°F (40°C) 208 V / 240 V / 277 V		3000 W	3800 W	5000 W	6000 W	7500 W	9995 W	11400 W	11400 W	12000 W
Nominal AC output voltage					208 V / 240 V / 277 V				208 V / 240 V	277 V
Operating AC voltage range (default)	208 V				183 - 229 V (-12 / +10 %)					
	240 V				211 - 264 V (-12 / +10 %)					
	277 V				244 - 305 V (-12 / +10 %)					
Max. continuous output current	208 V	14.4 A	18.3 A	24.0 A	28.8 A	36.1 A	48.1 A	54.8 A	31.6 A*	n.a.
	240 V	12.5 A	15.8 A	20.8 A	25.0 A	31.3 A	41.7 A	47.5 A	27.4 A*	n.a.
	277 V	10.8 A	13.7 A	18.1 A	21.7 A	27.1 A	36.1 A	41.2 A	n.a.	14.4 A*
Admissible conductor size (AC)						No. 14 - 4 AWG				
Max. continuous utility back feed current						0 A				
Nominal output frequency						60 Hz				
Operating frequency range						59.3 - 60.5 Hz				
Total harmonic distortion						< 3 %				
Power factor						1				

GENERAL DATA **Fronius IG Plus**		**3.0-1 UNI**	**3.8-1 UNI**	**5.0-1 UNI**	**6.0-1 UNI**	**7.5-1 UNI**	**10.0-1 UNI**	**11.4-1 UNI**	**11.4-3 Delta**	**12.0-3 WYE277**
Max. Efficiency						96.2 %				
CEC Efficiency	208 V	95.0 %	95.0 %	95.5 %	95.5 %	95.0 %	95.0 %	95.5 %	95.0 %	n.a.
	240 V	95.5 %	95.5 %	95.5 %	96.0 %	95.5 %	95.5 %	96.0 %	95.5 %	n.a.
	277 V	95.5 %	95.5 %	96.0 %	96.0 %	96.0 %	96.0 %	96.0 %	n.a.	96.0 %
Consumption in standby (night)						< 1 W				
Consumption during operation		8 W			15 W		22 W			
Cooling					Controlled forced ventilation, variable fan speed					
Enclosure Type						NEMA 3R				
Unit Dimensions (W x H x D)		17.1 x 24.8 x 9.6 in.			17.1 x 36.4 x 9.6 in.			17.1 x 48.1 x 9.6 in.		
Power Stack Weight		31 lbs. (14 kg)			57 lbs. (26 kg)			82 lbs. (37 kg)		
Wiring Compartment Weight		24 lbs. (11 kg)			26 lbs. (12 kg)			26 lbs. (12 kg)		
Admissible ambient operating temperature					-4 ... 122°F (-20 ... +50°C)					
Compliance		UL 1741-2005, IEEE 1547-2003, IEEE 1547.1, ANSI/IEEE C62.41, FCC Part 15 A& B, NEC Article 690, C22. 2 No. 107.1-01 (Sept. 2001)								

PROTECTION DEVICES **Fronius IG Plus**	**3.0-1 UNI**	**3.8-1 UNI**	**5.0-1 UNI**	**6.0-1 UNI**	**7.5-1 UNI**	**10.0-1 UNI**	**11.4-1 UNI**	**11.4-3 Delta**	**12.0-3 WYE277**
Ground fault protection	Internal GFDI (Ground Fault Detector/Interrupter); in accordance with UL 1741-2005 and NEC Art. 690								
DC reverse polarity protection	Internal diode								
Islanding protection	Internal; in accordance with UL 1741-2005, IEEE 1547-2003 and NEC								
Over temperature	Output power derating / active cooling								

* per Phase

Fronius USA LLC Solar Electronic Division
10421 Citation Drive, Suite 1100, Brighton, Michigan, 48116
E-Mail: pv-us@fronius.com
www.fronius-usa.com

40,0006,2981,AE v01 2009 as02

SUNPOWER™

E18 / 230 SOLAR PANEL

EXCEPTIONAL EFFICIENCY AND PERFORMANCE

BENEFITS

Highest Efficiency
SunPower™ Solar Panels are the most efficient photovoltaic panels on the market today.

More Power
Our panels produce more power in the same amount of space—up to 50% more than conventional designs and 100% more than thin film solar panels.

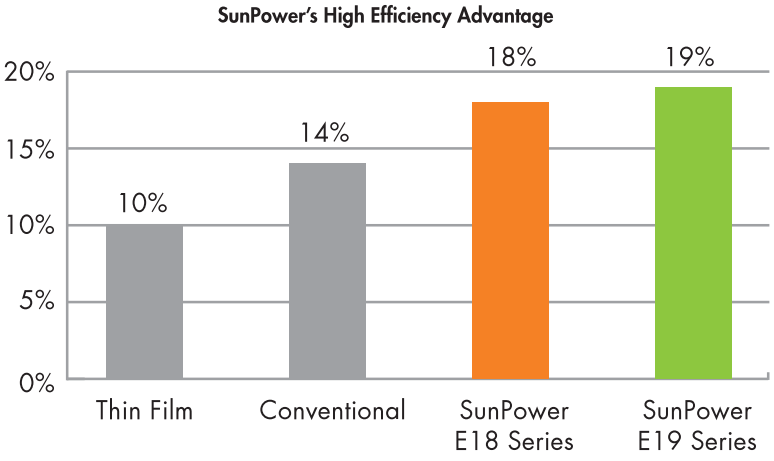
Reduced Installation Cost
More power per panel means fewer panels per install. This saves both time and money.

Reliable and Robust Design
Proven materials, tempered front glass, and a sturdy anodized frame allow panel to operate reliably in multiple mounting configurations.

SPR-230E-WHT-D

E18 SERIES

The SunPower™ 230 Solar Panel provides today's highest efficiency and performance. Utilizing 72 all back-contact solar cells, the SunPower 230 delivers a total panel conversion efficiency of 18.5%. The panel's reduced voltage-temperature coefficient and exceptional low-light performance attributes provide outstanding energy delivery per peak power watt.



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SUNPOWER™

E18 / 230 SOLAR PANEL

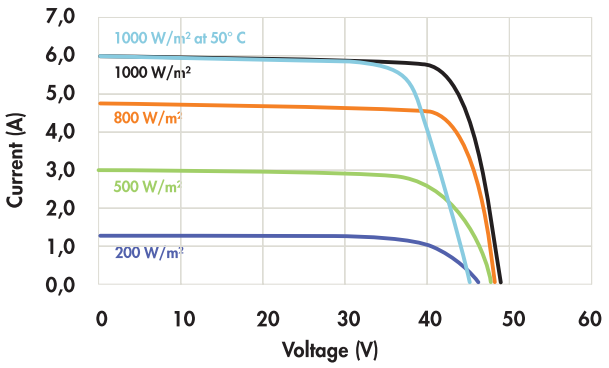
EXCEPTIONAL EFFICIENCY AND PERFORMANCE

Electrical Data

Measured at Standard Test Conditions (STC): irradiance of 1000W/m², AM 1.5, and cell temperature 25° C

Peak Power (+5/-3%)	P_{max}	230 W
Efficiency	η	18.5 %
Rated Voltage	V_{mpp}	40.5 V
Rated Current	I_{mpp}	5.68 A
Open Circuit Voltage	V_{oc}	48.2 V
Short Circuit Current	I_{sc}	6.05 A
Maximum System Voltage	UL	600 V
Temperature Coefficients	Power (P)	-0.38% / K
	Voltage (V_{oc})	-132.5mV / K
	Current (I_{sc})	3.5mA / K
NOCT		45° C +/-2° C
Series Fuse Rating		20 A

I-V Curve



Current/voltage characteristics with dependence on irradiance and module temperature.

Mechanical Data

Solar Cells	72 SunPower all-back contact monocrystalline
Front Glass	High transmission tempered glass
Junction Box	IP-65 rated with 3 bypass diodes
	Dimensions: 32 x 155 x 128 (mm)
Output Cables	1000mm length cables / MultiContact (MC4) connectors
Frame	Anodized aluminum alloy type 6063 (black)
Weight	33.1 lbs. (15.0 kg)

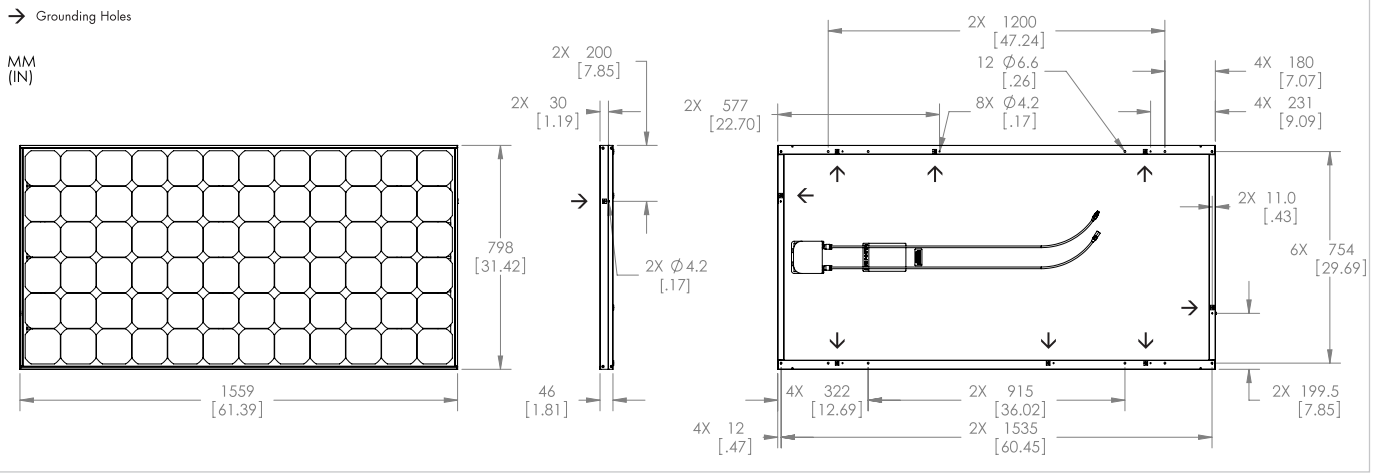
Tested Operating Conditions

Temperature	-40° F to +185° F (-40° C to + 85° C)
Max load	113 psf 550kg/m² (5400 Pa) front – e.g. snow; 50 psf 245kg/m² (2400 Pa) front and back – e.g. wind
Impact Resistance	Hail 1 in (25 mm) at 52mph (23 m/s)

Warranties and Certifications

Warranties	25 year limited power warranty
	10 year limited product warranty
Certifications	Tested to UL 1703. Class C Fire Rating

Dimensions



CAUTION: READ SAFETY AND INSTALLATION INSTRUCTIONS BEFORE USING THE PRODUCT.

Visit sunpowercorp.com for details

sunpowercorp.com

Document #001-60680 Rev** / LTR_EN

Appendix H | Mechanical Breadth Trace Results

Room Checksums

By ACADEMIC

Default

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 14
Outside Air: OADB/WB/HR: 91 / 74 / 102

	Space Sens. + Lat. Btu/h	Plenum Sens. + Lat Btu/h	Net Total Btu/h	Percent Of Total (%)
Envelope Loads				
Skylite Solar	0	0	0	0
Skylite Cond	0	0	0	0
Roof Cond	0	18,238	18,238	16
Glass Solar	24,074	0	24,074	21
Glass/Door Cond	3,386	0	3,386	3
Wall Cond	0	368	368	0
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	19,753		19,753	17
Sub Total ==>	47,212	18,605	65,817	58
Internal Loads				
Lights	17,827	0	17,827	16
People	10,000	0	10,000	9
Misc	3	0	3	0
Sub Total ==>	27,831	0	27,831	24
Ceiling Load	5,622	-5,622	0	0
Ventilation Load	0	0	24,080	21
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-3,468	-3,468	-3
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
***Grand Total* ==>**	80,665	9,515	114,260	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 14
OADB: 83

	Space Sensible Btu/h	Percent Of Total (%)
Envelope Loads		
Skylite Solar	0	0
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	44,545	56
Glass/Door Cond	1,586	2
Wall Cond	0	0
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	3,798	5
Sub Total ==>	49,928	63
Internal Loads		
Lights	17,827	22
People	10,000	13
Misc	3	0
Sub Total ==>	27,831	35
Ceiling Load	1,587	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Exhaust Heat	0	0
***Grand Total* ==>**	79,346	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 11

	Space Peak Space Sens Btu/h	Coil Peak Tot Sens Btu/h	Percent Of Total (%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	0	0.00
Roof Cond	0	-49,806	38.53
Glass Solar	0	0	0.00
Glass/Door Cond	-14,139	-14,139	10.94
Wall Cond	0	-331	0.26
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	-27,701	-27,701	21.43
Sub Total ==>	-41,840	-91,977	71.15
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-25,736	0	0.00
Ventilation Load	0	-33,769	26.12
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		15,877	-12.28
OA Preheat Diff.		0	0.00
RA Preheat Diff.		-663	0.51
Additional Reheat		-17,853	13.81
System Plenum Heat		-891	0.69
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
***Grand Total* ==>**	-67,576	-129,276	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	70.0
Ra Plenum	78.3	54.8
Return	78.3	54.8
Ret/OA	80.4	33.7
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	3,603	1,081
Terminal	3,603	1,081
Main Fan	3,603	1,081
Sec Fan	0	0
Nom Vent	520	520
AHU Vent	520	520
Infil	426	426
MinStop/Rh	1,081	1,081
Return	4,029	1,507
Exhaust	946	946
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	14.4	48.1
cfm/ft²	0.68	0.20
cfm/ton	378.41	
ft²/ton	559.78	
Btu/hr·ft²	21.44	-20.90
No. People	40	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	9.5	114.3	86.6	3,096	80.4	63.6	62.2	55.0	50.8	49.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	9.5	114.3								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	5,330		
Part	0		
Int Door	0		
ExFlr	0		
Roof	5,330	0	0
Wall	864	847	98
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-85.4	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-26.0	3,603	48.5	55.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-111.4			

Room Checksums

By ACADEMIC

Skylights

COOLING COIL PEAK

Peaked at Time: Mo/Hr: 7 / 14
Outside Air: OADB/WB/HR: 91 / 74 / 102

	Space Sens. + Lat.	Plenum Sens. + Lat	Net Total	Percent Of Total
	Btu/h	Btu/h	Btu/h	(%)
Envelope Loads				
Skylite Solar	3,919	0	3,919	3
Skylite Cond	0	1,209	1,209	1
Roof Cond	0	18,901	18,901	15
Glass Solar	24,074	0	24,074	19
Glass/Door Cond	3,386	0	3,386	3
Wall Cond	0	368	368	0
Partition/Door	0		0	0
Floor	0		0	0
Adjacent Floor	0	0	0	0
Infiltration	21,932		21,932	17
Sub Total ==>	53,311	20,477	73,788	59
Internal Loads				
Lights	19,794	0	19,794	16
People	10,000	0	10,000	8
Misc	3	0	3	0
Sub Total ==>	29,798	0	29,798	24
Ceiling Load	6,242	-6,242	0	0
Ventilation Load	0	0	25,714	20
Adj Air Trans Heat	0		0	0
Dehumid. Ov Sizing			0	0
Ov/Undr Sizing	0		0	0
Exhaust Heat		-3,770	-3,770	-3
Sup. Fan Heat			0	0
Ret. Fan Heat		0	0	0
Duct Heat Pkup		0	0	0
Underflr Sup Ht Pkup			0	0
Supply Air Leakage		0	0	0
Grand Total ==>	89,350	10,465	125,529	100.00

CLG SPACE PEAK

Mo/Hr: 9 / 14
OADB: 83

	Space Sensible	Percent Of Total
	Btu/h	(%)
Envelope Loads		
Skylite Solar	3,054	4
Skylite Cond	0	0
Roof Cond	0	0
Glass Solar	44,545	52
Glass/Door Cond	1,586	2
Wall Cond	0	0
Partition/Door	0	0
Floor	0	0
Adjacent Floor	0	0
Infiltration	4,217	5
Sub Total ==>	53,402	63
Internal Loads		
Lights	19,794	23
People	10,000	12
Misc	3	0
Sub Total ==>	29,798	35
Ceiling Load	1,762	2
Ventilation Load	0	0
Adj Air Trans Heat	0	0
Exhaust Heat	0	0
Grand Total ==>	84,961	100.00

HEATING COIL PEAK

Mo/Hr: Heating Design
OADB: 11

	Space Peak Space Sens	Coil Peak Tot Sens	Percent Of Total
	Btu/h	Btu/h	(%)
Envelope Loads			
Skylite Solar	0	0	0.00
Skylite Cond	0	-4,882	3.50
Roof Cond	0	-51,618	37.01
Glass Solar	0	0	0.00
Glass/Door Cond	-14,139	-14,139	10.14
Wall Cond	0	-331	0.24
Partition/Door	0	0	0.00
Floor	0	0	0.00
Adjacent Floor	0	0	0.00
Infiltration	-30,757	-30,757	22.05
Sub Total ==>	-44,896	-101,726	72.94
Internal Loads			
Lights	0	0	0.00
People	0	0	0.00
Misc	0	0	0.00
Sub Total ==>	0	0	0.00
Ceiling Load	-28,575	0	0.00
Ventilation Load	0	-36,061	25.86
Adj Air Trans Heat	0	0	0
Ov/Undr Sizing	0	0	0.00
Exhaust Heat		17,258	-12.37
OA Preheat Diff.		0	0.00
RA Preheat Diff.		-710	0.51
Additional Reheat		-19,116	13.71
System Plenum Heat		891	-0.64
Underflr Sup Ht Pkup		0	0.00
Supply Air Leakage		0	0.00
Grand Total ==>	-73,471	-139,465	100.00

TEMPERATURES

	Cooling	Heating
SADB	55.0	70.0
Ra Plenum	78.3	54.8
Return	78.3	54.8
Ret/OA	80.3	33.8
Fn MtrTD	0.0	0.0
Fn BldTD	0.0	0.0
Fn Frict	0.0	0.0

AIRFLOWS

	Cooling	Heating
Diffuser	3,858	1,157
Terminal	3,858	1,157
Main Fan	3,858	1,157
Sec Fan	0	0
Nom Vent	555	555
AHU Vent	555	555
Infil	473	473
MinStop/Rh	1,157	1,157
Return	4,331	1,631
Exhaust	1,029	1,029
Rm Exh	0	0
Auxiliary	0	0
Leakage Dwn	0	0
Leakage Ups	0	0

ENGINEERING CKS

	Cooling	Heating
% OA	14.4	48.0
cfm/ft²	0.65	0.20
cfm/ton	368.81	
ft²/ton	565.73	
Btu/hr·ft²	21.21	-20.34
No. People	40	

COOLING COIL SELECTION

	Total Capacity ton	Total Capacity MBh	Sens Cap. MBh	Coil Airflow cfm	Enter DB °F	Enter WB °F	Enter HR gr/lb	Leave DB °F	Leave WB °F	Leave HR gr/lb
Main Clg	10.5	125.5	95.4	3,428	80.3	63.5	61.9	55.0	50.8	49.3
Aux Clg	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Opt Vent	0.0	0.0	0.0	0	0.0	0.0	0.0	0.0	0.0	0.0
Total	10.5	125.5								

AREAS

	Gross Total ft²	Glass ft²	Glass (%)
Floor	5,918		
Part	0		
Int Door	0		
ExFlr	0		
Roof	5,918	394	7
Wall	864	847	98
Ext Door	0	0	0

HEATING COIL SELECTION

	Capacity MBh	Coil Airflow cfm	Ent °F	Lvg °F
Main Htg	-92.6	0	0.0	0.0
Aux Htg	0.0	0	0.0	0.0
Preheat	-27.8	3,858	48.5	55.0
Humidif	0.0	0	0.0	0.0
Opt Vent	0.0	0	0.0	0.0
Total	-120.4			