Holy Cross Hospital
North Addition

Silver Spring, MD

Philip Mackey
L/E Option
Dr. Mistrick – Adviser
Spring 2006

Holy Cross Hospital – North Addition

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Electrical/Lighting option

Project Name: Holy Cross Hospital – North Addition

Location: Silver Spring, MD

Size: 90,000 sq. ft. addition, 44,000 sq. ft. renovation

Cost: $21.9 million including $7.8 million MEP system and $3.1 million structural system

Date of Construction: April 2004 - August 2005

Owner: Holy Cross Hospital

Architect: Smithgroup

MEP Consultant: Leach Wallace Associates

Structural Engineer: McMullen & Associates

Civil Engineer: Drewberry & Davis

Construction Manager: Bovis Lend Lease

Lighting:

Public spaces are mainly lit with a combination of fluorescent downlights and decorative compact fluorescent and incandescent accent lighting. Exam rooms and patient areas are lit primarily with institutional linear fluorescent fixtures with task lighting where needed.

Electrical:

- 3-tiered emergency power distribution system in addition to normal service
- Two 750 kW generators with 5000 amp paralleling switchgear
- 3000 kVA substation with 14.4 kV supply

Structural:

- Structural steel skeleton
- Glass curtain walls on concourse/atrium level
- Efis cavity walls on upper floors
- Decorative glass knee walls in concourse

Mechanical:

- Dedicated custom modular AHU feeds critical/patient areas with additional AHU serving lobby and office
- New hot water heating plant installed on 2nd floor penthouse

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Executive Summary

The Holy Cross Hospital North Addition presents an interesting and unique mixture of spaces when discussing a typical hospital. Included among the usual exam rooms, nurses stations, and operating rooms are an assortment of unique spaces such as the conference center, concourse, lobby and surrounding spaces. In my lighting depth, my design focuses on two spaces: the out-patient registration area and the main entrance lobby. The following report includes an in-depth discussion of design concepts and criteria, equipment selections and characteristics, reflected ceiling plans, power densities, system performances, and conclusions on the designs' effectiveness. My goal for each space was to design a lighting system that both accentuated the architecture and functioned efficiently while remaining a minimal intrusion to the space. A portion of the main lobby space was also analyzed for the feasibility of implementing a dimming control system to utilize the available daylight within the space.

For the electrical depth, I proposed and investigated the feasibility of two separate alternatives. Alternative 1 discusses the feasibility of replacing the transformers feeding the 208Y/120V panels with a single transformer stepping down to a 208Y/120V distribution panel. Alternative 2 discusses the feasibility of reconfiguring the entire emergency generator system by including the normal power branch under an additional automatic transfer switch and supplying it with power from an isolated generator sized to feed only the North Addition portion of the hospital.

The Construction Management breadth analyzes the changes proposed in Alternate 2 and discusses the impact it will have on the cost, scheduling, and concerns that might arise in the construction phase of the project. The Mechanical breadth analyzes the impact Alternate 1 imposes upon the existing mechanical system. It discusses the redistribution of the sensible loads associated with the transformer changes and resizes the VAV boxes and associated ductwork.

Background

The Holy Cross Hospital – North Addition project is a 4-story, 80,000 square feet addition with 44,000 square feet of renovation work. Holy Cross Hospital is located north of Washington, D.C. adjacent to the Capitol Beltway. The addition consists of a main concourse, new main lobby, a gift shop, and a conference center wing on the 1st floor; a new obstetrician exam wing on the 2nd floor; a new gynecological exam wing on the 3rd floor; and unoccupied space on the 4th floor for future expansion. The new addition not only houses patient exam rooms, but is the main entrance to the hospital and is a major source of circulation on the 1st floor while connecting the North Addition with the new Emergency Department addition via the concourse.

Figure 1: Architects Rendering of North Addition

Site and Architecture

The North Addition to Holy Cross Hospital is part of a larger 260,000 square foot additions and alterations to the facility. The additions include the North Addition, Emergency Department addition, and a never Physician's Office Building (POB). Also included in the overall package is extensive renovation work in the ICU, NICU, Labor and Delivery, Ambulatory Services, MRI, Operating Room departments. In total, the hospital will be spending roughly $69 million expanding and improving the facility. Included in these renovations are some major infrastructure improvements. A new emergency generator plant will include two new 500-ton centrifugal chillers and a dual cell cooling tower, three new 750 KW generators and 5000 amp paralleling switchgear, and an additional 3000 KVA substation to support the additions.

Figure 2: Architects Rendering of Emergency Department/POB Addition

Introduction to Lighting Depth

The lighting redesign for the Holy Cross Hospital – North Addition focuses on 2 spaces: the out-patient registration area and the main lobby. As with any lighting design, each space should be aesthetically pleasing as well as function properly according to the space's intent. In doing so, one must design a lighting system that compliments the architecture of the space while efficiently and effectively delivering ample light levels to the task plane. Lastly, this proposed system must be desirable from a sustainability point of view by being easy to maintain and keep operational.

Registration – Lighting Space

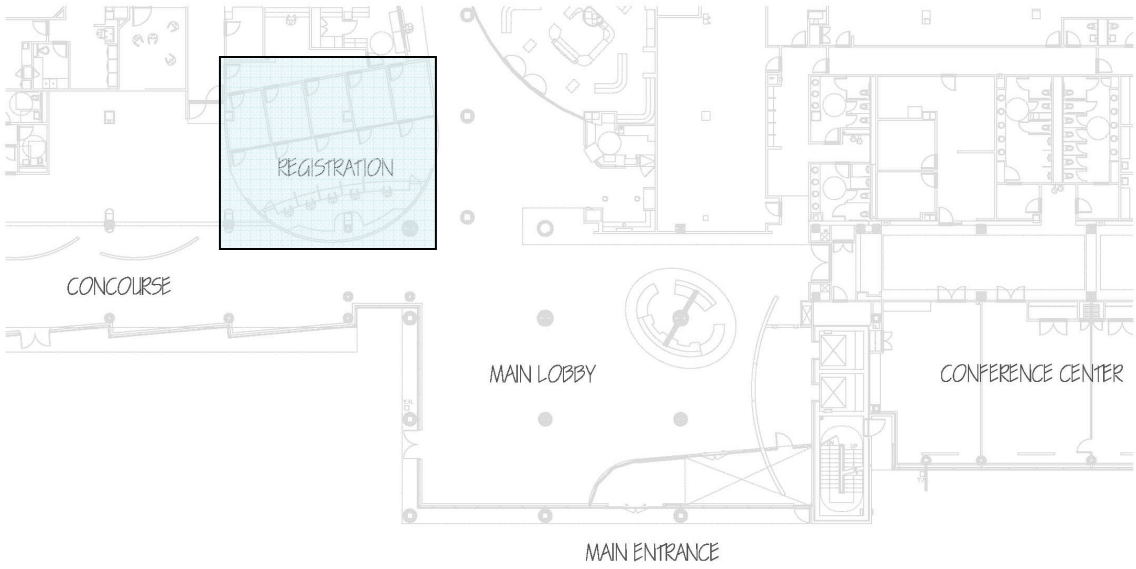


Figure 3: Registration space and relationship with surrounding spaces

Introduction

The registration space is located adjacent to the main entrance lobby and concourse for the North Addition to the hospital. Its purpose is to process and assist patients waiting for out-patient surgery. The space also functions as an intermediate corridor for some faculty and staff. The north wall consists of floor to ceiling glass with a frosted-striped finish separating several administration offices from the registration desks. The east façade is open to the patient waiting area and the west façade is open to the main lobby. On the south façade, a curved light wood-paneled partition wall is located behind the registration desks ending approximately 8’ a.f.f. with the top portion of the wall open to the main concourse. Metal partitions separate each work station. The floor is carpeted with a tan random patterned tile carpet.

Design Concepts

The design concept for the registration space was to accentuate the unique architectural features of the space with minimal fixture obtrusion while still provide adequate quality light to maintain productivity and accuracy of the crucial tasks. Because the space is so centrally located with respects to the main lobby and major thoroughfares of the building, I wanted to keep the same overall feeling to the space as the adjacent lobby. However, I wanted to provide enough variation to present the registration space as its own unique area with respective tasks due to the lack of clear boundaries between the space and the main lobby/concourse.

Figure 4: Existing condition of Registration space

To prevent potential problems with light spilling into the private offices, I chose a direct/indirect 2x2 fixture that will provide even, soft light to the pseudo-corridor separating the private offices and public registration desks and not disturb the private office patrons with a lot of direct light. Since the ceiling is rather low in this space (8'6"), I did not feel a pendant indirect would be best suited for the situation. To accentuate some of the architectural features, I ran strips of color changing LED's vertically on the front face of each desk partition. This should add some "pop" to the space and call attention to its main function. I highlighted the curved back wall with recessed fluorescent downlights to bring out the three-dimensionality of the wall as well as open up the rather cramped area behind the desks visually. For the ambient illumination of the desks, each station has a recessed downlight directly above the desk and receives some further light from the 2x2 basket fixtures in the pseudo-corridor. Additionally, each station has an adjustable-armed talk light that is controlled locally at the desk for further illumination of the workplane.

Design Criteria

- **Appearance of Space and Luminaires** – Being in a direct line of sight to several busy public spaces, the appearance of the space is critical. Continuity between the aesthetics of all the public spaces as the public enters the hospital helps form their opinion on the quality of care their loved ones will receive if treated there. Since the architecture of the entire addition sends a strong statement, the lighting fixtures should take more of a diminished roll and let the combination of light and architecture make the statement.
- **Color Appearance** – Color appearance is crucial to proper facial recognition as well as the proper highlighting of various surfaces in the space (wood-paneled wall, countertops).
- **Direct Glare** – Prevention of direct glare is essential to the operation of this space. Both registration personnel and patients need to use the same desk space from opposite sides of the desk to fill out paper work. Glare would hinder their ability to read things properly and may result in registration inaccuracies, which are important concerning healthcare procedures.
- **Light Distribution** – Light distribution on surfaces needs consideration since the majority of the tasks taking place in this area will be done on a desk or counter. Registration has young and old, healthy and sick people that need to use this space efficiently before they can be cared for. Therefore, the registration desks should be lit evenly and adequately.
- **Facial Modeling** - Modeling of faces/objects is important since human interaction is very prevalent in this space. People are constantly being registered and sit across from registration personnel while doing so. To ensure conversation is not distracted, proper facial modeling needs to be achieved.
- **Horizontal Illuminance** – 30 fc (reading), 10 fc (corridor)
- **Vertical Illuminance** – 3 fc
- **Maximum Power Density** – 1.3 W/ft^2
  (ASHRAE Standard 90.1)

Fixture Schedule:

Lighting Fixture Schedule						
Type	**Description**	**Manufacturer/Catalog No.**	**Lamps**	**CCT**	**Voltage**	**Notes**
A	2' X 2' DIRECT/INDIRECT RECESSED, MICRO-PERFORATED MESH DIFFUSER, CENTER BASKET, WHITE FINISH, GRID CEILING	DAYBRITE #2TOCG240-PMW-277-1/2-EB	(2) 40WTT5	3500K	277	
B1	4" OPEN DOWNLIGHT, VERTICAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AFV-13DTT-6AR-277	(1) CFL13Q	3500K	277	
B2	4" OPEN DOWNLIGHT, VERTICAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AFV-18TRT-6AR-277	(1) CFL18TRT	3500K	277	
D1	ADJUSTABLE TABLE LAMP, SILVER FINISH, BLUE GLASS REFLECTOR	BERENICE - MEDA & RIZZATTO 1985	(1) 35W GY6.35	3000K	12	
F3	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,4
NOTES:						
3. INTEGRAL STEP-DOWN TRANSFORMER INCLUDED WITH FIXTURES						
4. SEE INCLUDED DETAIL OF FIXTURE FOR MOUNTING SPECIFICS						

* All fixtures in this space (excluding D1) are switched by a single keyed switch located in an adjacent janitor's closet due to the extensive public access to the space.

Light Loss Factors:

Light Loss Factors											
Type	**Fixture**	**Lamp**	**Lamp Data**		**Ballast Data**			**LLF's**			
			Initial Lumens	**Mean Lumens**	**Input Watts**	**Ballast Factor**	**Dimming**	**LLD**	**LDD**	**RSDD**	**Total LLF**
A	2'x2' recessed direct/indirect	(2) F40BX	3150	2840	81	1.03	-	0.90	0.88	0.97	0.793
B1	4" gotham downlight	(1) CF13Q	900	755	16	1	-	0.84	0.88	0.97	0.716
B2	4" gotham downlight	(1) CF18TRT	1200	1010	20	1.05	-	0.84	0.88	0.97	0.754
D1	Task Light	(1) 35W 12V GY6.35	600	-	35	1	-	0.97	0.88	0.97	0.828
F1,F2,F3	LED Cove	-	45	-	6.9/l.f.	1	-	1.00	0.86	0.97	0.834

LED Mounting Detail:

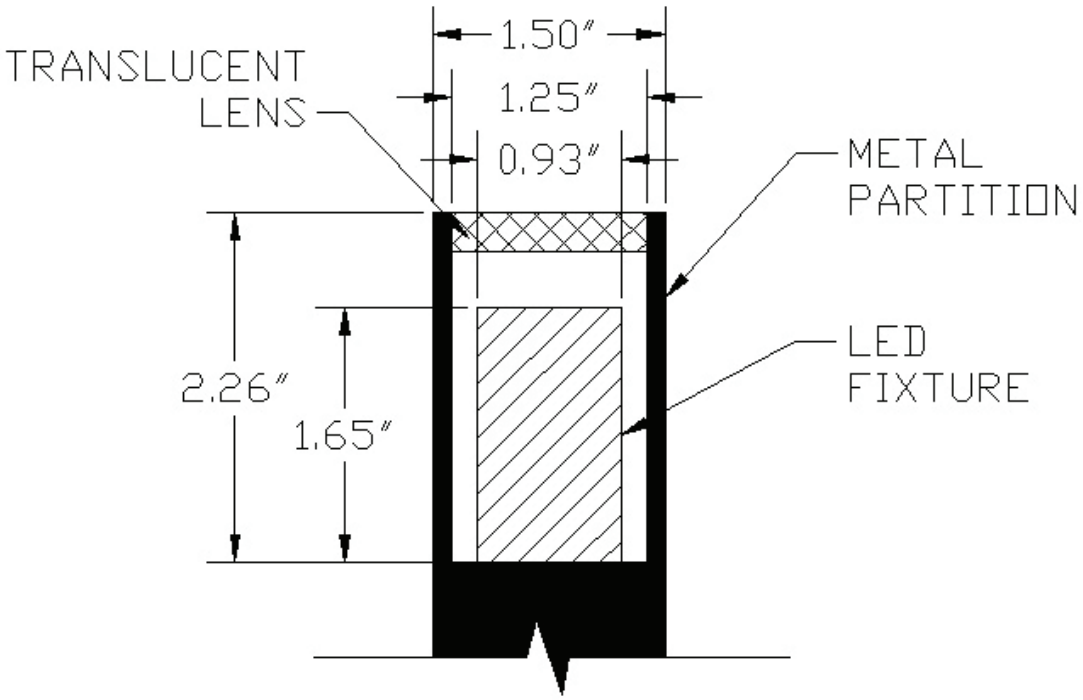


Figure 5: LED Partition Installation Detail

Lighting Plan

Power Density:

Power Density Calcs			
Fixture	**Ballast Watts/Fixture**	**Quantity**	**Total**
A	81	4	324
B1	16	12	192
B2	20	5	100
D1	35	5	175
F3	6.9	24	166
		Total Watts:	957
		Power Density (W/ft^2):	1.15

Calculation Grids:

Calc Grids Registration					
Description	**Plane Height (ft)**	**Average (fc)**	**Maximum (fc)**	**Minimum (fc)**	**Max/Min (fc)**
Pseudo-corridor	0	18	30	5	6.0
Desktops	2.5	36	*72	15	4.8
* Max value correlates to point under task lamp					

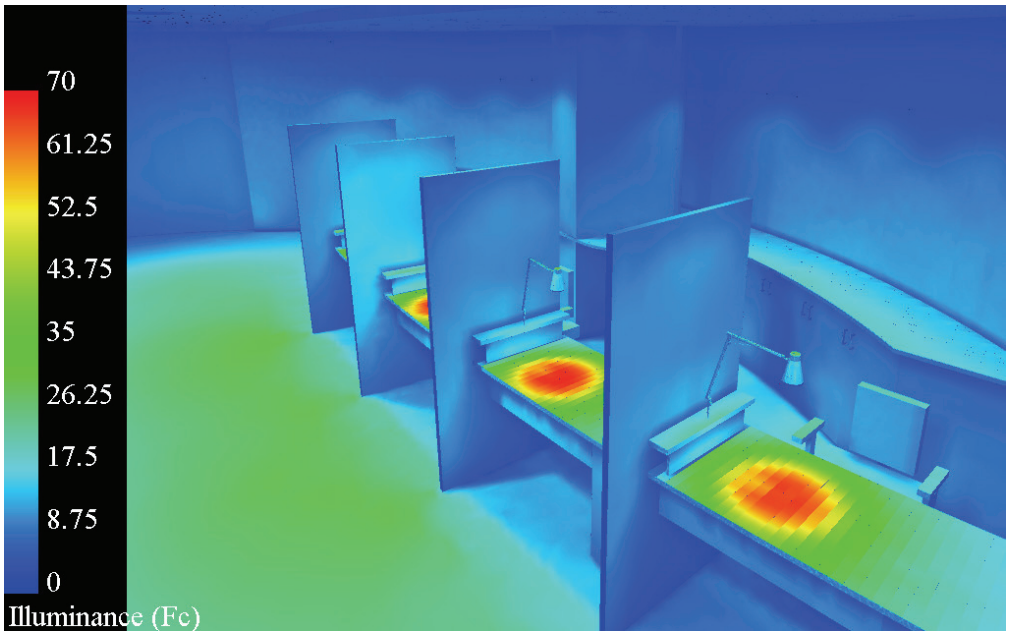


Figure 6: Registration Illuminance Pseudo-Rendering

Renderings:

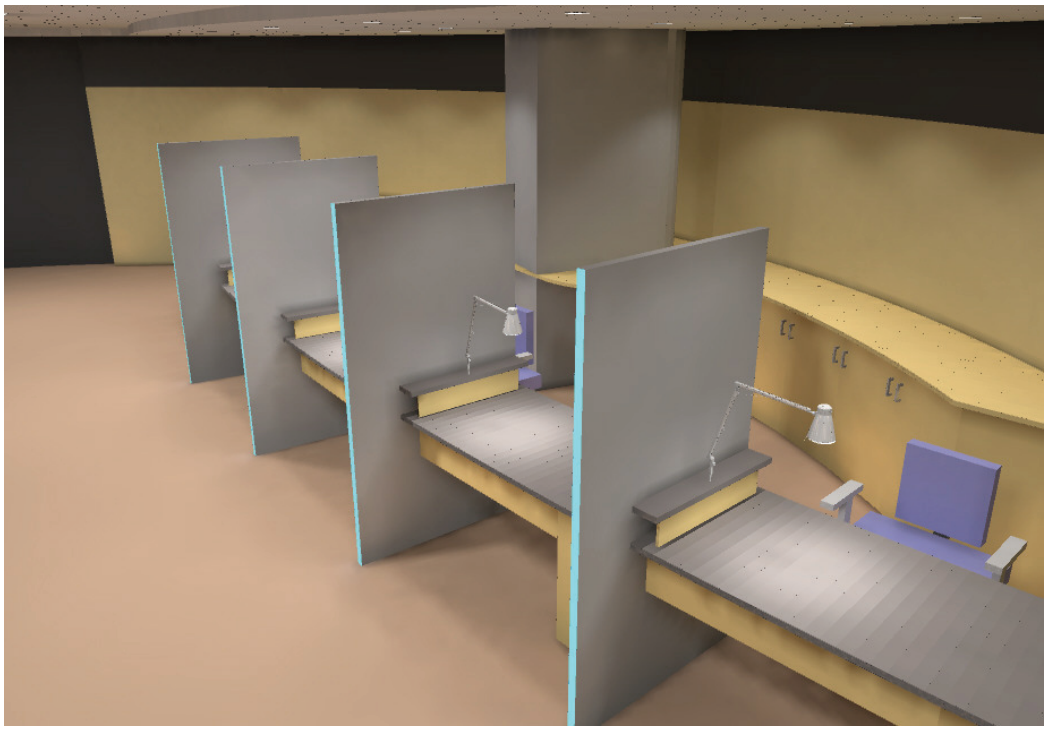


Figure 7: Registration Rendering

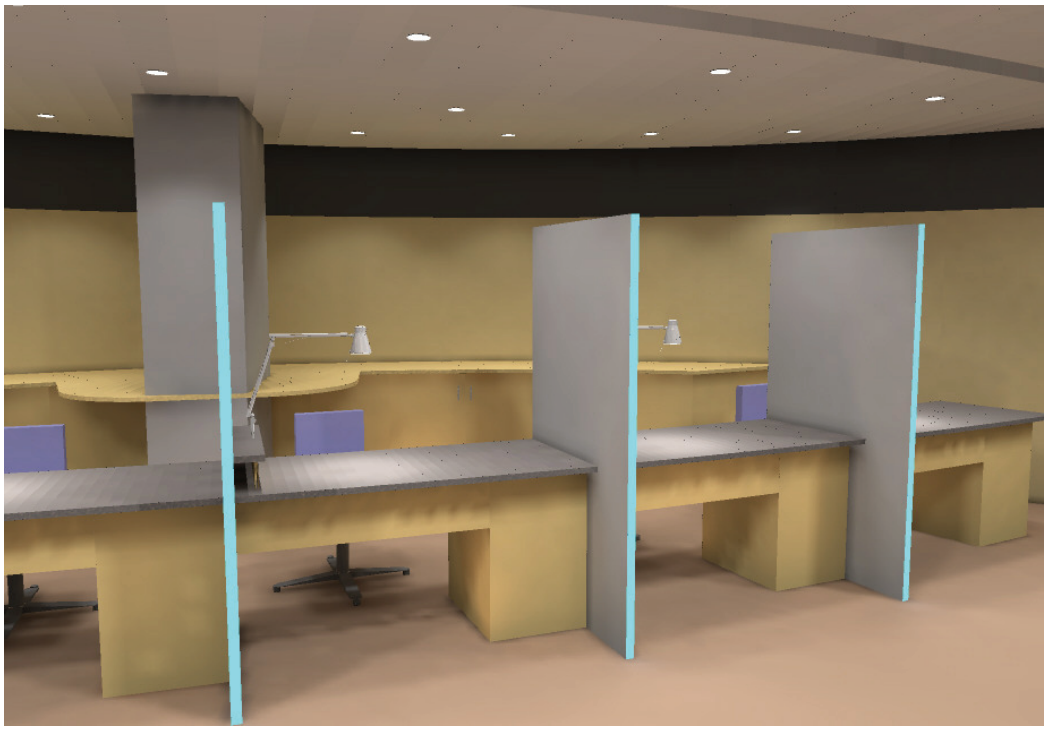


Figure 8: Registration Rendering

Figure 9: Registration Rendering

Figure 10: Registration Rendering

Conclusion

Overall, the proposed lighting design for this space successfully achieved my design goals. The direct/indirect basket fixtures both provided even, soft lighting for the corridor, as well as spread enough light laterally to provide some ambient light for the entire space without affecting the private offices on the north wall. The average illuminance for that corridor was also above the design value of 10 fc. The downlights grazing the curved back wall both accentuated the curvature and texture of the wall while providing workplane illuminance on the back countertops with an average of 22 fc. The combination of the 2x2 basket fixtures and the downlights centered over each workstation provided an ambient illuminance value of roughly 20 fc. With the addition of the adjustable task lamp, individuals had an average of 36 fc on the workplane with a cone average of approximately 65 fc underneath the desk lamp. Power density was below the ASHRAE 90.1 Standards and should contribute to energy conservation for the entire building.

Lobby – Lighting Space

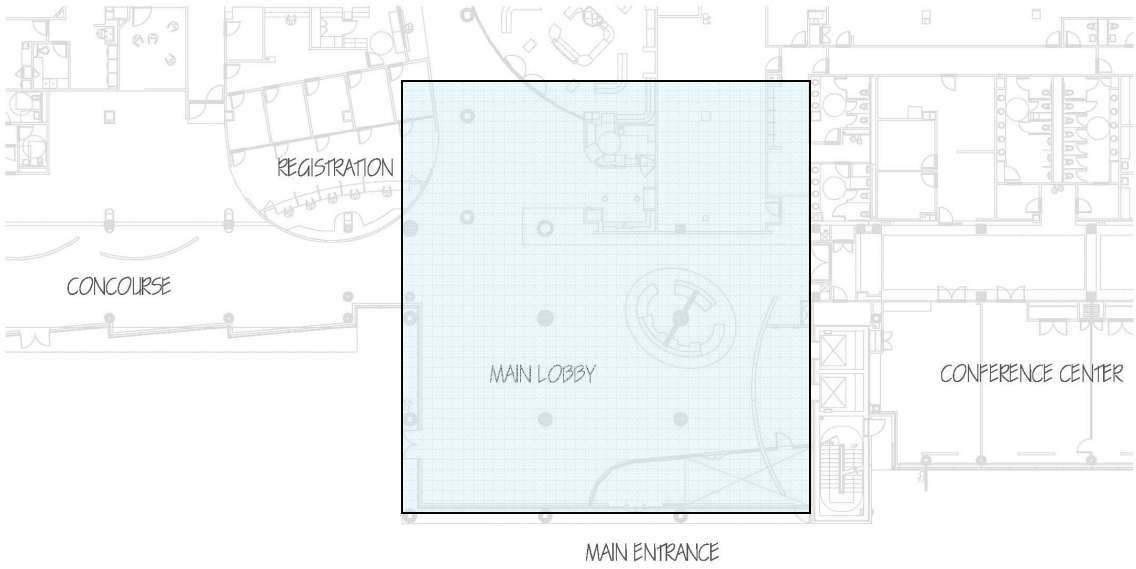


Figure 11: Main Lobby space and relationship with surrounding spaces

Introduction

The main lobby will serve as the primary entrance to the North Addition of the hospital. The lobby aims to funnel people into the building and distribute them throughout the facility via the adjacent concourses and elevator banks. Not only used for circulation, the space introduces visitors to the facility and needs to represent the function and principles of the hospital. Besides serving as the heart of the circulation system for the building, the main lobby also houses an information kiosk, meeting/reading area, and several pieces of artwork from local D.C. artists. The circulation portions of the space are light wood-tiled flooring and gypsum ceilings. The meeting/reading area has a darker brown tiled carpet and wood-paneled ceiling. The building north wall of the lobby consists of light wood panels and the building east wall is an arced blue mosaic tiled partition that separates the main lobby from one of the elevator banks. The information kiosk has an elliptical cove mimicking the shape of the kiosk desk with a column housed within the interior of the kiosk. All exterior walls are floor to ceiling glass allowing a nice exposure to the true north sky.

Design Concepts

Figure 12: Beach Inspiration

The design concept for the main lobby was to invite visitors into the hospital and present them with a pleasing, positive feel to their experience. Since many visitors are coming to visit sick loved ones, I wanted the main lobby to give the feeling of health and assurance that their loved ones will be taken care of by a state-of-the art facility. When taking into consideration the best means to portray health, I came across the picture of a tropical beach shown here. Before medical science had advanced to the level of care we receive now, ill patients were often times sent to tropical climates for both the physical and psychological benefits the tropics have to offer. By emulating this environment in the main lobby, I hope to ease some of the anxiety that is associated with visiting ill loved ones as well as create an overall positive feel to the facility.

When considering my global design for the space, I wanted to take advantage of the interesting architectural features and lines created by these features within the space. To do so, I wanted to keep the lighting fixture geometry's impact on the space as minimal as possible, essentially letting the combination of light and architecture "speak" for the space. For the ambient lighting in the circulation spaces, I provided recessed downlights creating an average of 10-15 fc on the floor. The use of recessed downlights minimized the fixture's impact on the space creating a "simple" feel to the ceiling and not intruding upon the space as a semi-recessed or surface-mounted fixture might appear. Over the meeting/reading area, I used a similar philosophy, using recessed downlight, as to not distract from the wood ceiling or the unique curved boundary created by the change of materials from the rest of the lobby to this area. I wanted to achieve 30 fc at the workplane because this seemed like a prime spot for people to sit and read the paper or a book while they wait for someone.

Since so much of the façade is directly related to the exterior environment through the floor to ceiling windows, I wanted to draw people into the space and give them a better sense of the depth of the space by washing the back wall with recessed linear fluorescent wallwash fixtures. Entering from the outside and adjusting to the drastic changes in light levels during the day can sometimes be confusing and disorienting. By lighting the back wall, one can more efficiently gain their bearings while decreasing the "cave effect" of such a deep space relative to its height. This lit back wall is similar to the bright horizon of a tropical beach assisting the beachgoer with their orientation. Also, I wanted to highlight the curved art wall since it is such a bold statement both artistically and geometrically with the main lobby. Again, I used recessed linear fluorescent wallwash fixtures to create an even wash of the mosaic wall.

For the information kiosk, I wanted to take advantage of the elliptical cove and column to call attention to the importance of the desk and its function. Using the light as a sign to potential visitors, the kiosk has more of a prominence in the space. To accentuate the desks, I used adjustable recessed downlights to provide 50 fc on the workplane since information and accuracy of communication is imperative to the operation and effectiveness of the desk. I also placed an LED cove within the inner elliptical raised ceiling. A translucent material was applied to the column, with an air gap behind it, to also give the appearance of the column "glowing". Metaphorically, this represents the palm tree on that tropical beach. The interest created by the lighting of the desk also helps to break up the depth of the room and create more interest in the center of the lobby, otherwise a rather plain portion of the space.

Design Criteria

- **Luminance of Room Surfaces –** Luminance of room surfaces is essential in a lobby with glass walls to the exterior. Walls need to be lit so the space does not seem dim and "cave-like" as the sun penetrates into the space. Also, whether night or day, illuminating the walls invites people into the space as well as make it look more spacious.
- **Appearance of Space and Luminaires** - Appearance of space and luminaires should be considered because the lobby is the first impression of a building. The lobby must invite people into the space and make them feel welcome. Improperly lit architectural features and ugly, obtrusive luminaires takes away from the initial impression of the facility. Visitors are probably there to see family and loved ones in the care of the hospital. If the lobby does not look like it is maintained properly, people may not think as highly of the facility that is caring for their loved ones.
- **Modeling of Faces/Objects** - Modeling of faces/objects is important since human interaction is very prevalent in this space. People meet and gather in the lobby throughout the day and need to properly recognize others.
- **Light Distribution on Surfaces** - Light distribution on surfaces needs consideration since the lobby is a very multi-functional space. The lobby has people entering/exiting the building, sitting and reading, engaging in conversation, and an information kiosk which all require differing light levels. Therefore, certain zones need to be considered for their specific tasks and should be lit accordingly.
- **Daylight Integration** - Daylight integration and control needs to be considered since the exterior wall is a glass curtain wall. Controls are important for power savings and proper transitional lighting levels to assist in the eye's need to adjust to different lighting conditions inside. Dimming and zonal controls can be a way to more accurately control the lighting environment to match the exterior conditions most effectively.

- **Color Appearance** - Color appearance is important for both proper facial recognition and for maintaining correct color characteristics on the numerous paintings, decorative wall finishes, and feature art wall.
- **Reflected Glare** – Especially in the meeting/reading area, reflected glare needs consideration because veiling reflections can occur on the reading task if the lighting system is improperly designed. The more directional light downward, typically the less reflected glare. However, geometry of fixtures also plays a roll. Avoiding severe hot spots on the ceiling from indirect lighting will decrease glare as well.
- **Horizontal Illuminance** – 10 fc (circulation), 30 fc (reading)
- **Vertical Illuminance** – 3 fc
- **Maximum Power Density** – 1.3 W/ft^2 (lobby), 1.2 W/ft^2 (reading) (ASHRAE Standard 90.1)

Fixture Schedule:

Lighting Fixture Schedule						
Type	**Description**	**Manufacturer/Catalog No.**	**Lamps**	**CCT**	**Voltage**	**Notes**
B3	6" OPEN DOWNLIGHT, HORIZONTAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AF-1/26TRT-6AR-277	(1) CFL26TRT	3500K	277	
B4	6" OPEN DOWNLIGHT, HORIZONTAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AF-1/42TRT-6AR-277	(1) CFL42TRT	3500K	277	1
C1	2' RECESSED LINEAR WALLWASH, 2" APERTURE, BLACK METAL DIFFUSER, GRID CEILING	PEERLESS #LWAR9-G-1-24T5HO-HOL-U2-277	(1) F24T5HO	3500K	277	
C2	4' RECESSED LINEAR WALLWASH, 2" APERTURE, BLACK METAL DIFFUSER, GRID CEILING	PEERLESS #LWAR9-G-1-28T5-HOL-U4-277	(1) F28T5	3500K	277	
D2	4" RECESSED ADJUSTABLE SPOT, BLACK POWDER-COAT FINISH, WHITE TRIM	ERCO #88111.000	(1) 50W GY6.35	3000K	12	
D3	ADJUSTABLE WALLWASH SPOT, TRACK/CEILING MOUNTED, WHITE FINISH, INTEGRATED ELECTRONIC TRANSFORMER	ERCO #72103.000	(1) 75W GY6.35	3000K	12	2
F1	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,5
F2	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,4
NOTES:						
1. PROVIDE DIMMING BALLAST AS SPEC'D WITH FIXTURE IN APPENDIX A						
2. FIXTURE COMES WITH 75W OPTION EVEN THOUGH SPEC SHEET DOES NOT REFLECT THAT						
3. INTEGRAL STEP-DOWN TRANSFORMER INCLUDED WITH FIXTURES						
4. SEE INCLUDED DETAIL OF FIXTURE FOR MOUNTING SPECIFICS						

* All fixtures in this space are switched by keyed switches (based upon their circuiting) located in an adjacent janitor's closet due to the extensive public access to the space.

Light Loss Factors:

Light Loss Factors											
Type	**Fixture**	**Lamp**	**Lamp Data**		**Ballast Data**			**LLF's**			
			Initial Lumens	**Mean Lumens**	**Input Watts**	**Ballast Factor**	**Dimming**	**LLD**	**LDD**	**RSDD**	**Total LLF**
B3	6" gotham downlight	(1) CF26TRT	1710	1440	29	1.1	-	0.84	0.88	0.97	0.791
B4	6" gotham downlight	(1) CF42TRT	3200	2690	45	0.95	x	0.84	0.88	0.97	0.682
C1	2' peerless wallwash	(1) F24T5HO	2000	1880	27	1.02	-	0.94	0.88	0.97	0.818
C2	4' peerless wallwash	(1) F28T5	2900	2726	*63	1.03	-	0.94	0.88	0.97	0.826
D2	Erco adjustable spot	(1) 50W 12V GY6.35	850	-	50	1	-	0.97	0.88	0.97	0.828
D3	Erco Parscan spot	(1) 50W 12V GY6.35	950	-	50	1	-	0.97	0.88	0.97	0.828
F1,F2,F3	LED Cove	-	45	-	6.9/l.f.	1	-	1.00	0.86	0.97	0.834
* Input watts reflects a 2-lamp ballast											

LED Column Installation Detail:

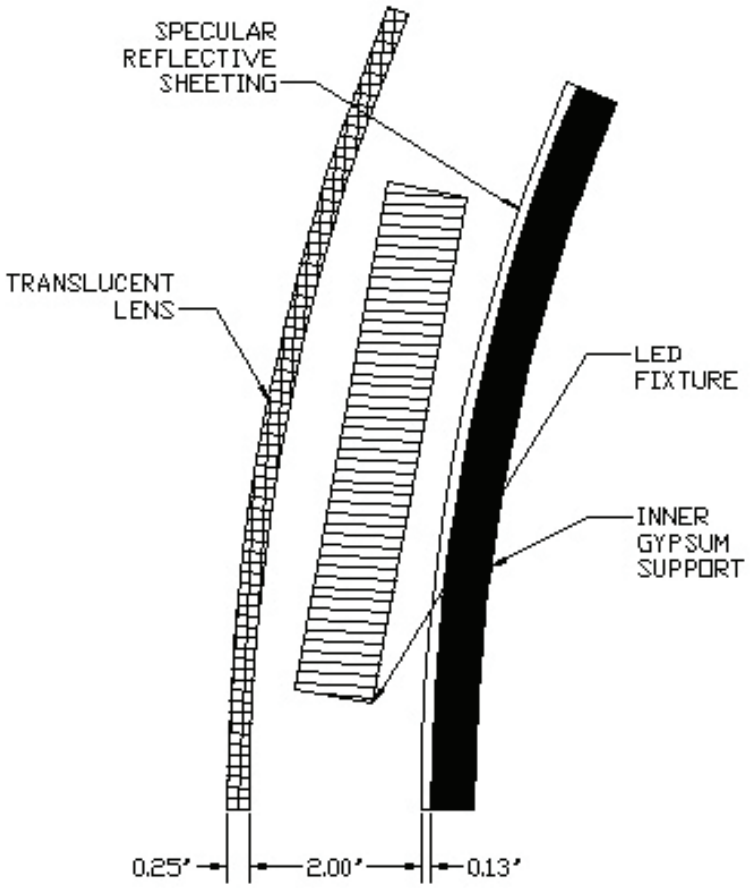
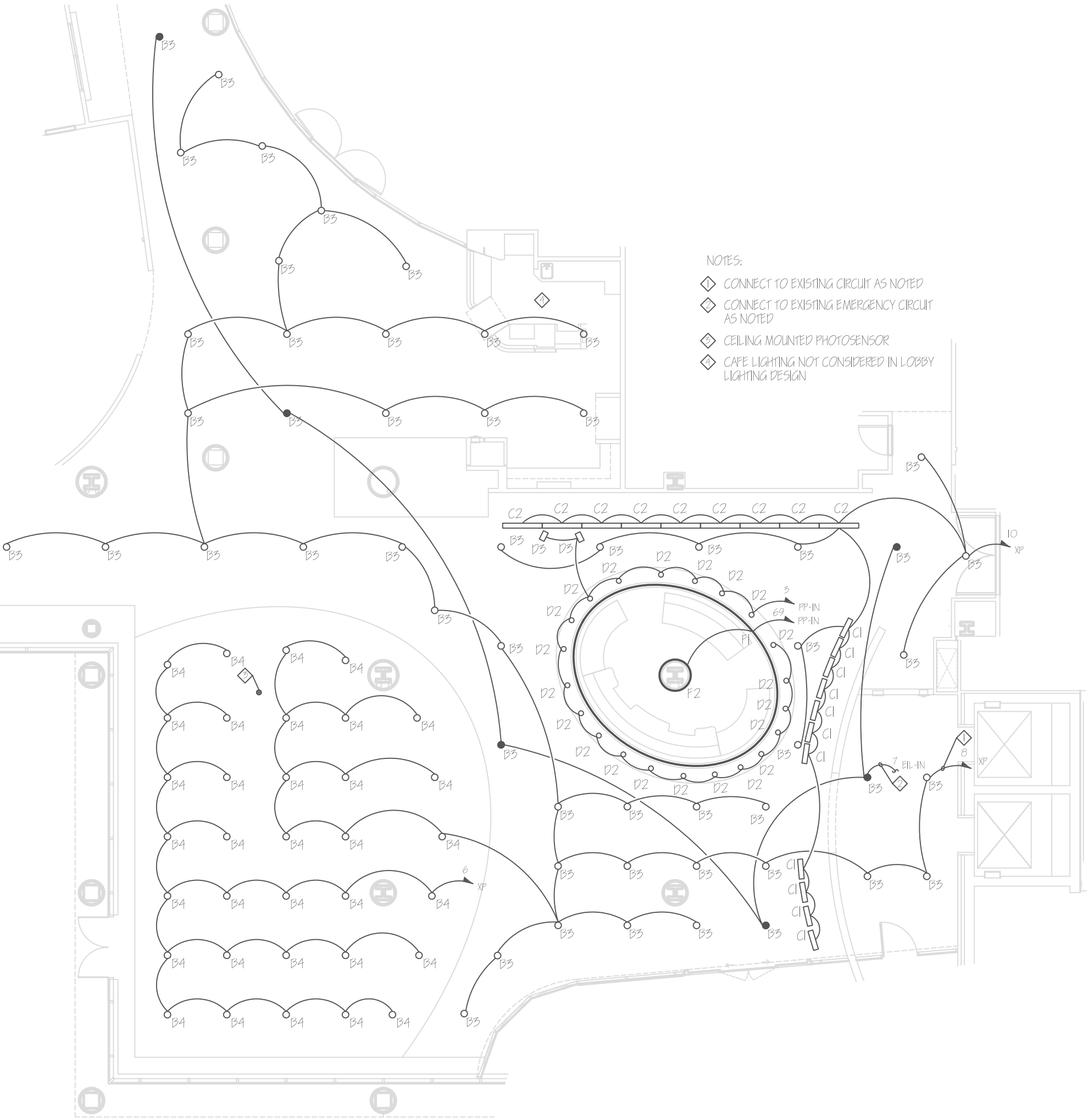


Figure 13: Column LED Installation Detail

Lighting Plan



MAIN LOBBY
SCALE: 3/32" = 1'-0"

Power Density:

Power Density Calcs Circulation Spaces			
Fixture	**Ballast Watts/Fixture**	**Quantity**	**Total**
B3	29	54	1566
C1	27	11	297
C2	63	9	567
D2	50	21	1050
D3	50	2	100
F1	6.9	52	359
F2	6.9	12	83
		Total Watts:	4022
		Power Density (W/ft^2):	0.84

Power Density Calcs Reading Space			
Fixture	**Ballast Watts/Fixture**	**Quantity**	**Total**
B4	45	34	1530
		Total Watts:	1530
		Power Density (W/ft^2):	0.97

Calculation Grids:

Calc Grids Main Lobby					
Description	**Plane Height (ft)**	**Average (fc)**	**Maximum (fc)**	**Minimum (fc)**	**Max/Min (fc)**
Circulation Floor	0	15	44	7.3	6.0
Reading Area	2.5	31	40	14	2.9
Kiosk Desktop	2.5	61	100	35	2.9
Art Wall (vertical)	-	34	64	8	8.0

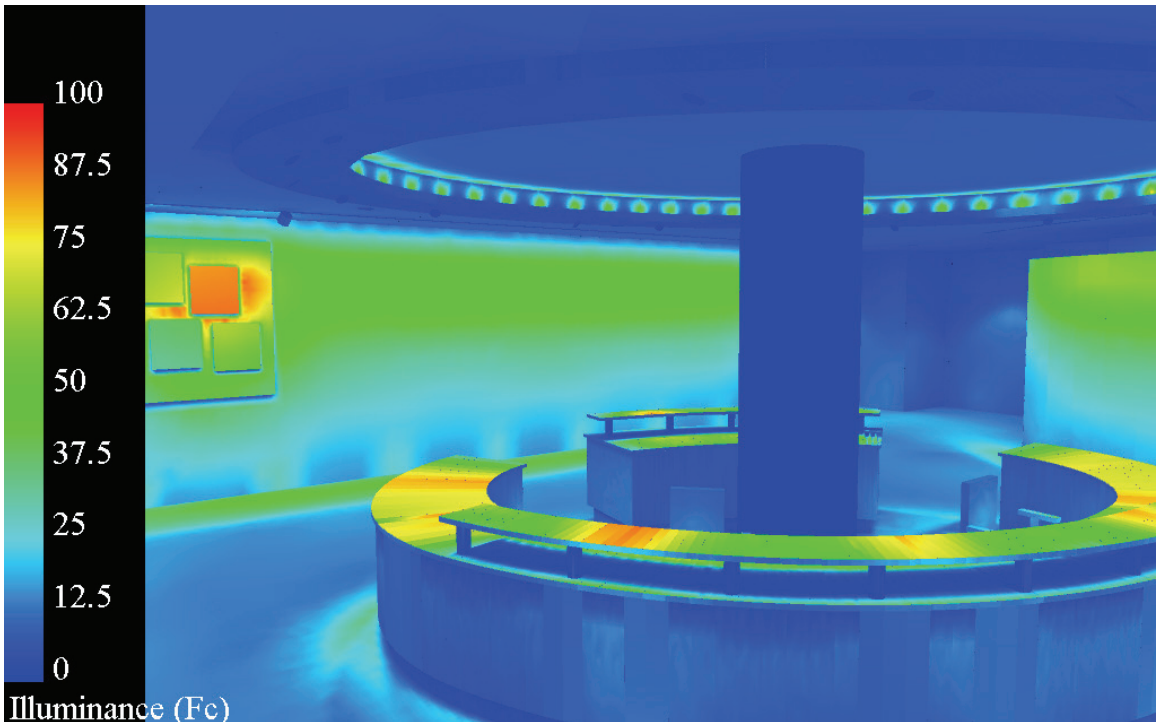


Figure 14: Main Lobby Illuminance Pseudo-Rendering

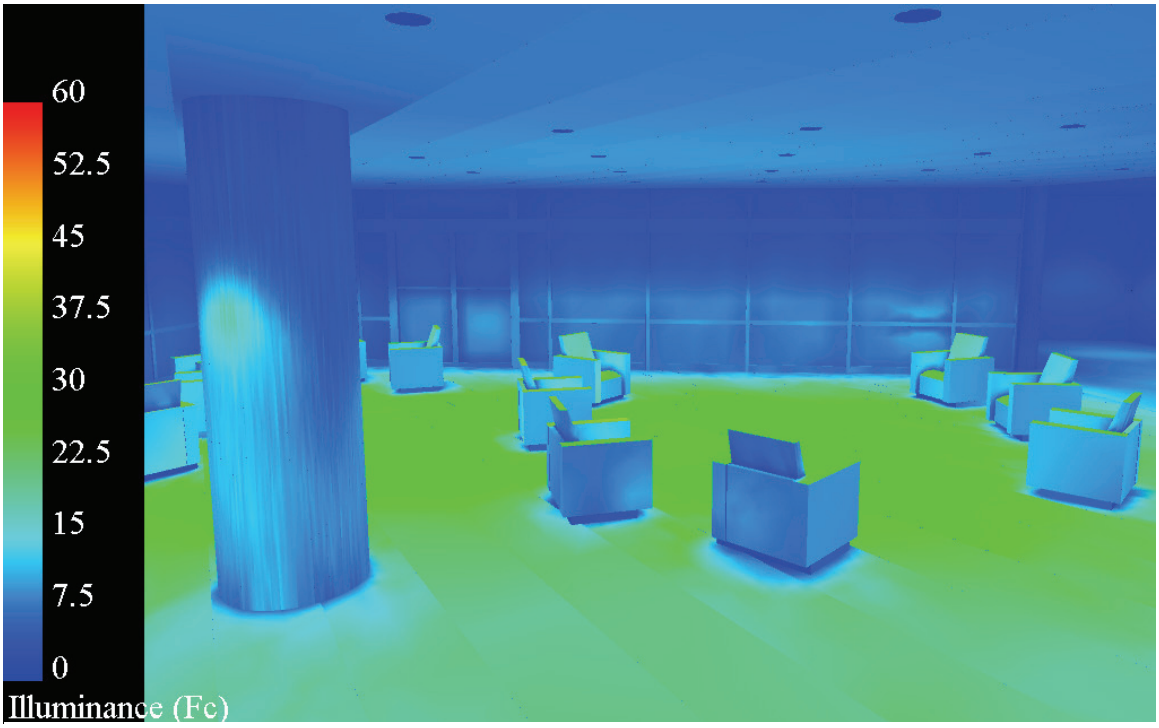


Figure 15: Main Lobby Illuminance Pseudo-Rendering

Renderings:

Figure 16: Main Lobby Rendering

Figure 17: Main Lobby Information Kiosk Rendering

Figure 18: Main Lobby Rendering

Figure 19: Main Lobby Meeting/Reading Area Rendering

Daylight Study

Goal

Determine whether or not dimming the reading area fixtures with daylight dimming controls would be beneficial to the hospital monetarily. Two options were considered: dimming all fixtures in the reading area, dimming a portion of them while leaving the furthest fixtures from the windows on continuously. Furthermore, the comparison was made between shutting off fixtures that went below BF = .05 or leaving them run after they have already dimmed to no light output. The following analysis and conclusion will detail this investigation.

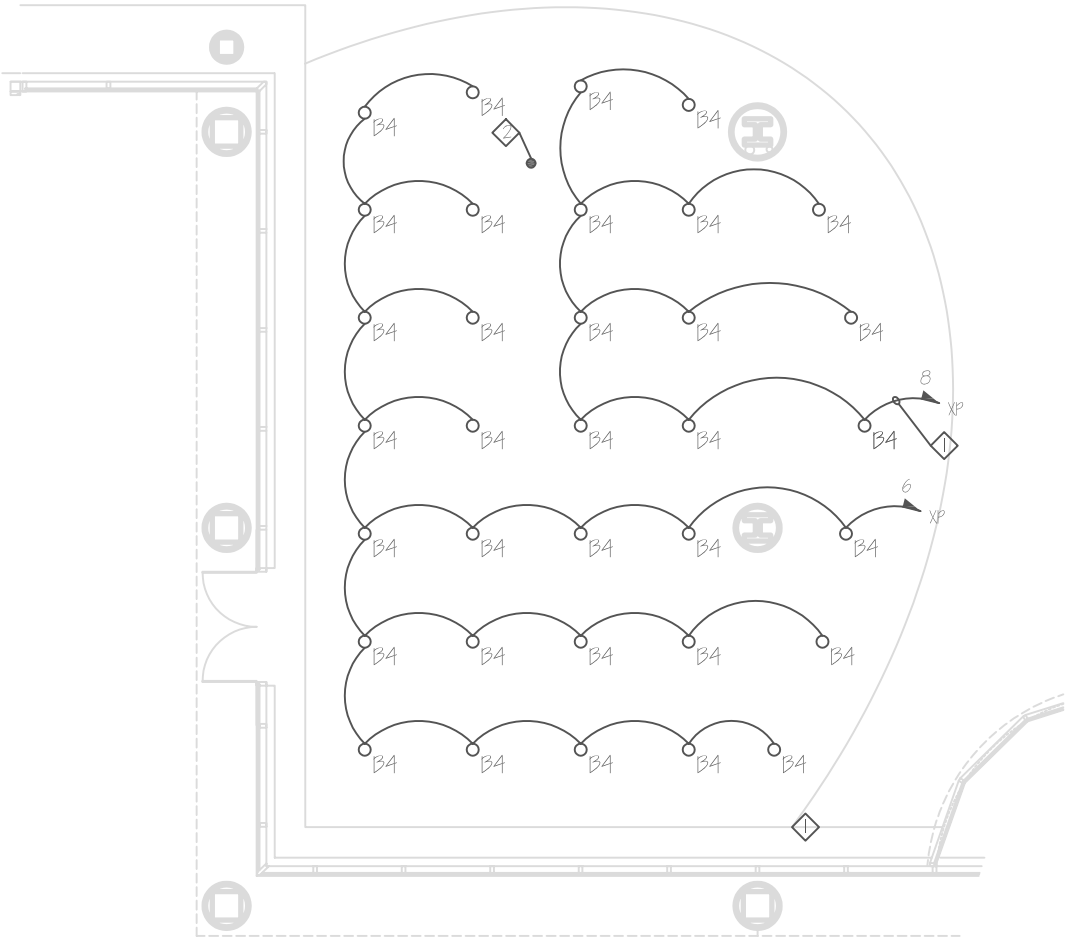
Assumptions/Notes

1) Difference between dimming ballast and standard electronic ballast is $60
2) One zone of control will be used
3) Weather data based upon Washington, D.C.
4) Building entrance faces magnetic north
5) AGI32 was used for daylight calculations in conjunction with Excel spreadsheet 'Daylighting Analysis.xls' located on enclosed CD-ROM

Lighting Plan

NOTES:

1. CONNECT TO EXISTING CIRCUIT AS NOTED
2. CEILING MOUNTED PHOTOSENSOR



MAIN LOBBY

SCALE: 3/32" = 1'-0"

Weather Data:

Washington, D.C. Weather Data			
	Overcast	Partly Cloudy	Clear
Oct. 22 - Feb. 21 (Jan 21 analysis date)	64	29	29
Feb. 22 - April 21 **Aug. 22 - Oct. 21** (Mar. 21 analysis date)	54	34	33
April 22 - Aug. 21 (May 21 analysis date)	50	43	29

Utility Rates:

Utility Rates		
	June-Oct	Nov-May
$/kWh:	0.08333	0.09602
* $/kW:	-	-

* Demand savings were ignored due to the negligible savings with respects to the entire hospital demand

Annual Energy Consumption:

Annual Energy Consumption - kW
no fixture shut-off

Month	Overcast			Partly Cloudy			Clear		
	No Controls	All Dim	Selective Dim	No Controls	All Dim	Selective Dim	No Controls	All Dim	Selective Dim
Oct. 22 - Feb. 21 (Jan 21 analysis	979.2	967.7	927.9	443.7	371.1	297.3	443.7	366.5	300.5
Feb. 22 - April 21 Aug. 22 - Oct. 21 (Mar. 21 analysis	991.4	939.8	868.0	624.2	456.0	356.0	605.9	460.7	348.6
April 22 - Aug. 21 (May 21 analysis	1071.0	963.0	885.0	921.1	552.4	477.7	621.2	389.9	326.5
Totals:	3041.6	2870.6	2680.9	1989.0	1379.5	1131.0	1670.8	1217.2	975.6

Annual Energy Consumption - kW
fixture shut-off below BF = .05

Month	Overcast			Partly Cloudy			Clear		
	No Controls	All Dim	Selective Dim	No Controls	All Dim	Selective Dim	No Controls	All Dim	Selective Dim
Oct. 22 - Feb. 21 (Jan 21 analysis	979.2	967.7	927.9	443.7	371.1	297.3	443.7	366.5	300.5
Feb. 22 - April 21 Aug. 22 - Oct. 21 (Mar. 21 analysis	991.4	939.8	868.0	624.2	456.0	301.3	605.9	460.7	333.4
April 22 - Aug. 21 (May 21 analysis	1071.0	963.0	885.0	921.1	552.4	378.8	621.2	370.2	279.8
Totals:	3041.6	2870.6	2680.9	1989.0	1379.5	977.4	1670.8	1197.5	913.7

Annual Energy Savings:

Annual Energy Savings no fixture shut-off						
.	No Controls		All Dim		Selective Dim	
	KWh	Cost	KWh	Cost	KWh	Cost
January	474.3	45.54	435.1	41.78	390.8	37.52
February 1-21	306.0	29.38	280.7	26.95	252.3	24.23
February 22-28	146.9	14.10	124.4	11.94	106.4	10.21
March	569.2	54.65	483.5	46.42	414.9	39.84
April 1-21	385.6	37.02	324.3	31.14	276.4	26.54
April 22-30	192.8	18.51	142.5	13.68	126.6	12.16
May	664.0	63.76	492.2	47.26	437.7	42.03
June	642.6	53.55	465.9	38.83	413.3	34.44
July	664.0	55.33	480.0	40.00	424.7	35.39
August 1-21	449.8	37.48	324.7	27.06	286.9	23.91
August 22-31	183.6	15.30	151.2	12.60	127.3	10.61
September	550.8	45.90	455.2	37.93	382.2	31.85
October 1-21	449.8	37.48	318.0	26.50	265.5	22.12
October 22-31	153.0	12.75	136.8	11.40	119.8	9.99
November	459.0	44.07	417.7	40.10	372.0	35.72
December	474.3	45.54	435.1	41.78	390.8	37.52
	Total Cost:	610.38		495.37		434.07
	Savings:			115.01		176.31

Annual Energy Savings fixture shut-off below BF=.05						
.	No Controls		All Dim		Selective Dim	
	KWh	Cost	KWh	Cost	KWh	Cost
January	474.3	45.54	435.1	41.78	390.8	37.52
February 1-21	306.0	29.38	280.7	26.95	252.3	24.23
February 22-28	146.9	14.10	124.4	11.94	102.2	9.82
March	569.2	54.65	483.5	46.42	398.8	38.29
April 1-21	385.6	37.02	324.3	31.14	264.4	25.39
April 22-30	192.8	18.51	142.5	13.68	116.5	11.19
May	664.0	63.76	492.2	47.26	403.4	38.74
June	642.6	53.55	465.9	38.83	376.0	31.33
July	664.0	55.33	480.0	40.00	386.5	32.21
August 1-21	449.8	37.48	324.7	27.06	261.2	21.76
August 22-31	183.6	15.30	151.2	12.60	119.9	10.00
September	550.8	45.90	455.2	37.93	363.6	30.30
October 1-21	449.8	37.48	318.0	26.50	253.7	21.14
October 22-31	153.0	12.75	136.8	11.40	119.8	9.99
November	459.0	44.07	417.7	40.10	372.0	35.72
December	474.3	45.54	435.1	41.78	390.8	37.52
	Total Cost:	610.38		495.37		415.14
	Savings:			115.01		195.24

Payback Period:

Payback Period		
Type	Number Dimming Ballasts	Payback Period (yrs)
All Dim (shut-off)	34	17.7
Selective Dim (shut-off)	23	7.8
All Dim (no shut-off)	34	17.7
Selective Dim (no shut-off)	23	7.1

Comments

Although the installation of a dimming system could save as much as $195/yr, the best payback period for any four of the system is still over seven years. With a payback period above five years, the savings become minimal and don't begin to accrue until a good distance into the future. For the reading area space in the main lobby, I would not recommend the installation of dimming controls in the space for two reasons: the payback period is too long for such a minimal savings and initial investment could probably be invested more effectively in some other component of the hospital. However, if the dimming system was added to the entire 1st floor public spaces (main lobby, corridors, concourse, conference rooms, etc.), the larger system's payback and investment characteristics may be substantial enough to overlook the higher payback period. In this specific case, I would not recommend installing a system of this magnitude in the main lobby.

Space Conclusion

Overall, the proposed lighting design for this space successfully achieved my design goals. The art wall stands out due to the wallwashers and becomes one of the prominent features of the space. The kiosk presents itself as a crucial function of the space due to the cove and backlit column while still having plenty of light on the workplane. Although the elliptical cove looks a little "spotty" with its distribution, I believe this can be attributed to computer program limitations more so than geometry of the cove setup. I believe the back wall is lit well enough to create a boundary to the "back" of the lobby when entering from the main entrance and nicely mirrors the pedestrian motion from the concourse to the conference center. The spotlights aimed at the artwork on the back wall also create another point of interest for those waiting or walking through the space. The meeting/reading area has a nice even distribution of light on the workplane without causing too much disruption in the wood-paneled ceiling.

Although the daylight study did not return favorable results, power density in both the circulation areas and meeting/reading area were well below the ASHRAE Standards. The efficiency of the design should contribute to energy conservation for the project.

Introduction to Electrical Depth

The electrical redesign for the Holy Cross Hospital – North Addition focuses on 2 separate alternatives and the effectiveness of their implementation in comparison to the existing electrical system. The first alternative will consider the cost impact of replacing six existing 480Y/277V to 208Y/277V step-down transformers located throughout the addition with a single 480Y/277V to 208Y/277V step-down transformer and all electrical system issues associated with that change. The second alternative will entail a much more in-depth look at the hospital's electrical system and emergency back-up. I will investigate the feasibility of provide an emergency back-up generator for the entire North Addition portion of the hospital (both emergency and normal branches) and will investigate the financial implications this change will have on the project.

Since hospitals have such a critical need for consistent uninterrupted power supply, the emergency system of a hospital is much more extensive and has more regulations governing its installation. When considering changes to this hospital, I must be very aware of these added regulations and make sure my redesign conforms to the code set forth by the NEC.

Electrical Depth

For my Electrical Depth, I quickly realized I would be performing a lot of load calculations due to the nature of my two alternates and the amount of redistribution I would be analyzing. To aid in the accuracy of my analysis, I created my own excel program that allows me to load a panel inputting each circuit's information as it would be documented on a set of drawings. However, I can also input the associated volt-amps into the proper load type column (with its respective demand factor) and the excel program will determine the connected, demand, and growth load for that panel. I felt the need to document the creation of the excel program before I began my alternates discussion because its assistance was imperative to the success and simplification of my calculation process. The following panel is a sample of the program at use and can be found in the entire panel schedule excel files on the enclosed CD-ROM:

Panel Schedule

Panel: LP-1N

Voltage: 480Y/277			Mains: MLO		Loads (VA)										Loc: 1ST FL ELEC RM			AIC: 25K
Amps: 200	Wires: 4		Phase: 3												Mounting: SURFACE			
Branch Circuit	**Amp**	**P**	**Description**	**Cir**	Ltg		Recept		Motor		Lg Motor		Equip		**Cir**	**Description**	**P**	**Amp**	**Branch Circuit**
1" C/3#4+1#8GRD	70	3	XFMR T-1	1	0	0	12600	5220	0	0	0	0	7236	12360	2	XFMR T-9	3	70	1" C/3#4+1#8GRD
-	-	-	-	3	1287	0	12780	5220	0	0	0	0	7200	13280	4	-	-	-	-
-	-	-	-	5	213	0	11520	5940	0	0	0	0	3636	13080	6	-	-	-	-
3/4" C/2#12+1#12GRD	20	1	LTG: PUBLIC TOILETS	7	170	1202									8	LTG: RM 375-377	1	20	3/4" C/2#12+1#12GRD
-	20	1	SPARE	9		2604									10	LTG: RM 326-334	1	20	3/4" C/2#12+1#12GRD
3/4" C/2#12+1#12GRD	20	1	LTG: COFFEE BAR	11	1163	2090									12	LTG: RM 335-342	1	20	3/4" C/2#12+1#12GRD
3/4" C/4#10+1#10GRD	30	3	PANEL DIM	13	6500	1953	0		0		0		0		14	LTG: GIFT SHOP	1	20	3/4" C/2#12+1#12GRD
-	-	-	-	15	5552	832	0		0		0		0		16	LTG: SHELL SPACES	1	20	3/4" C/2#12+1#12GRD
-	-	-	-	17	4056	1445	0		0		0		0		18	LTG: GIFT SHOP	1	20	3/4" C/2#12+1#12GRD
3/4" C/2#12+1#12GRD	20	1	LTG: GRD FLR STORAGE	19	2176										20	SPARE	1	20	-
3/4" C/2#12+1#12GRD	20	1	LTG: GRD FLR STORAGE	21	1924	768									22	LTG: RM 391, 393	1	20	3/4" C/2#12+1#12GRD
3/4" C/2#12+1#12GRD	20	1	LTG: GRD FLR CORRIDOR	23	1746										24	SPARE	1	20	-
1" C/4#6+1#10GRD	60	3	PANEL XP	25	13211	0	0	0	0	0	0	0	0	3696	26	XFMR T-11	3	100	1 1/2" C/3#1+1#8GRD
-	-	-	-	27	9095	0	0	180	0	0	0	0	0	5640	28	-	-	-	-
-	-	-	-	29	6220	0	0	180	0	0	0	0	0	6360	30	-	-	-	-
Connected Load Phase A: (A)			239.4		25211.5		17820		0		0		23292			Demand Load Phase A: (A)	248.1		
Connected Load Phase B: (A)			239.6		22061.7		18180		0		0		26120			Demand Load Phase B: (A)	244.7		
Connected Load Phase C: (A)			208.1		16932.62		17640		0		0		23076			Demand Load Phase C: (A)	209.6		
Total VA:	184565																		
Load: (A)	222.1																		
25% Growth: (A)	277.6																		

Alternate 1

Introduction

Alternate 1 will focus on consolidating the current normal power transformers, feeding all normal power 208Y/120V panels, to a single transformer fed from the 480Y/277V normal branch main distribution panel. From this system consolidation, I will determine whether or not this change will save the hospital money on installation of the system. Due to the characteristics of a hospital's emergency power system, it is not feasible to consolidate any of the emergency branch transformers due to the strict isolation requirements laid out by Article 517 of the NEC code. Thus, I will be focusing solely on the normal power transformers for this investigation.

Goal

I will determine the cost impact of the consolidation of normal power transformers into a single transformer feeding all 208Y/120V panels.

Design Criteria

All electrical sizing and calculations were completed using requirements and tables from the 2002 National Electric Code (NEC). Load calculations for existing conditions can be found on enclosed CD-ROM under the file name 'Master Panel Schedule.xls'. Alternate 1 load calculations can be found under the file name 'Alt 1 Panel Schedule.xls'.

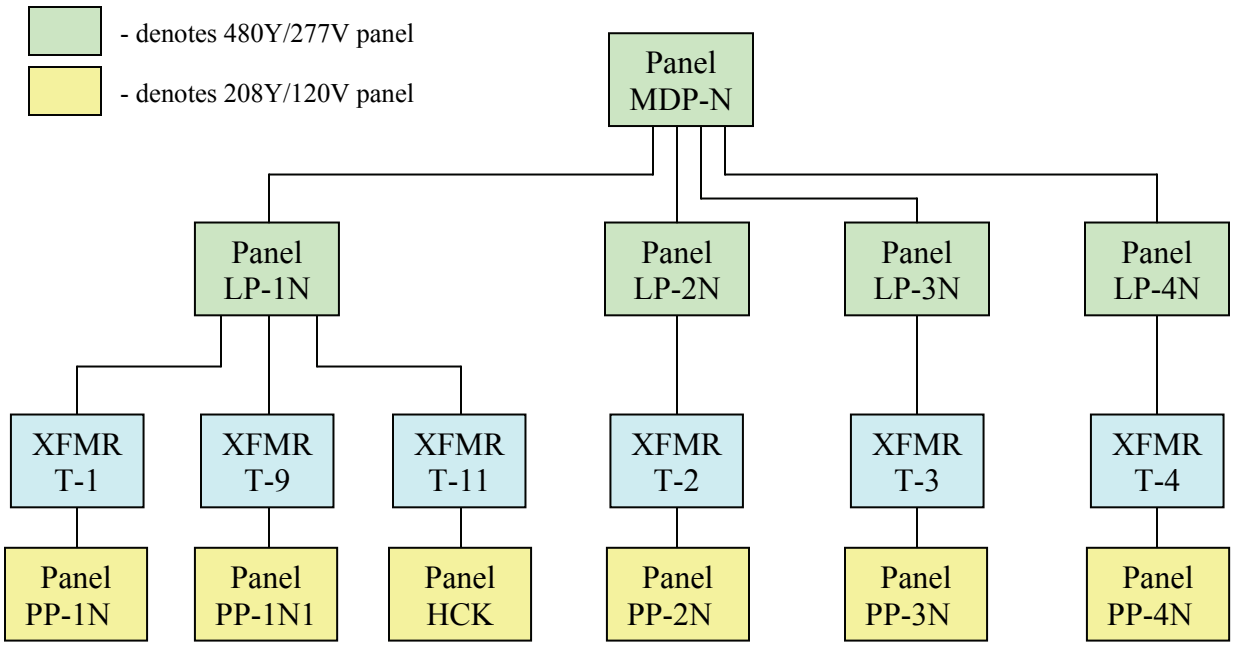
Assumptions

When sizing the existing loads for each Panelboard throughout the system, I had to make a lot of assumptions concerning the known equipment loads. With the assistance of the engineers at Leach Wallace, I assigned load values to these various amounts of equipment. From these assumptions, many of my panels were determined to be loaded past their rated capacity. With respects to the system components I was redesigning and resizing, I accounted for the calculated demand loads determined when surveying the existing system. For simplicity's sake however, I did not resize equipment previously designed and not being touched by my alternates. I am confident the original design was sized correctly and properly and the error was most likely in the many assumptions made concerning equipment loads. Therefore, seemingly undersized equipment as noted was not overlooked but considered and left intact.

I am aware a structural analysis should be performed to determine the structural impact of moving the transformers from floor to floor. Due to time considerations, the structural analysis was not performed, but is noted as an issue to be addressed.

Electrical Schematics

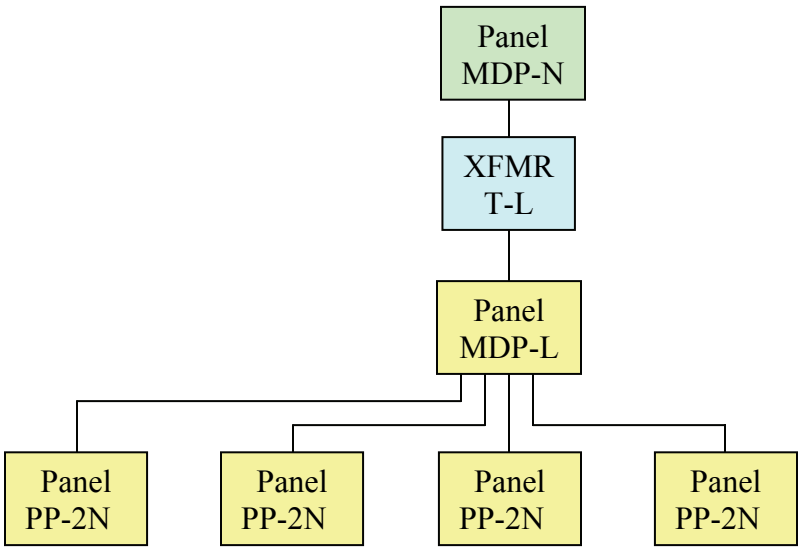
Existing Transformer Configuration:



Refer to one-line diagram inserts for details of existing and proposed changes to the entire system

Figure 20: Alternate 1 Existing Design Schematic

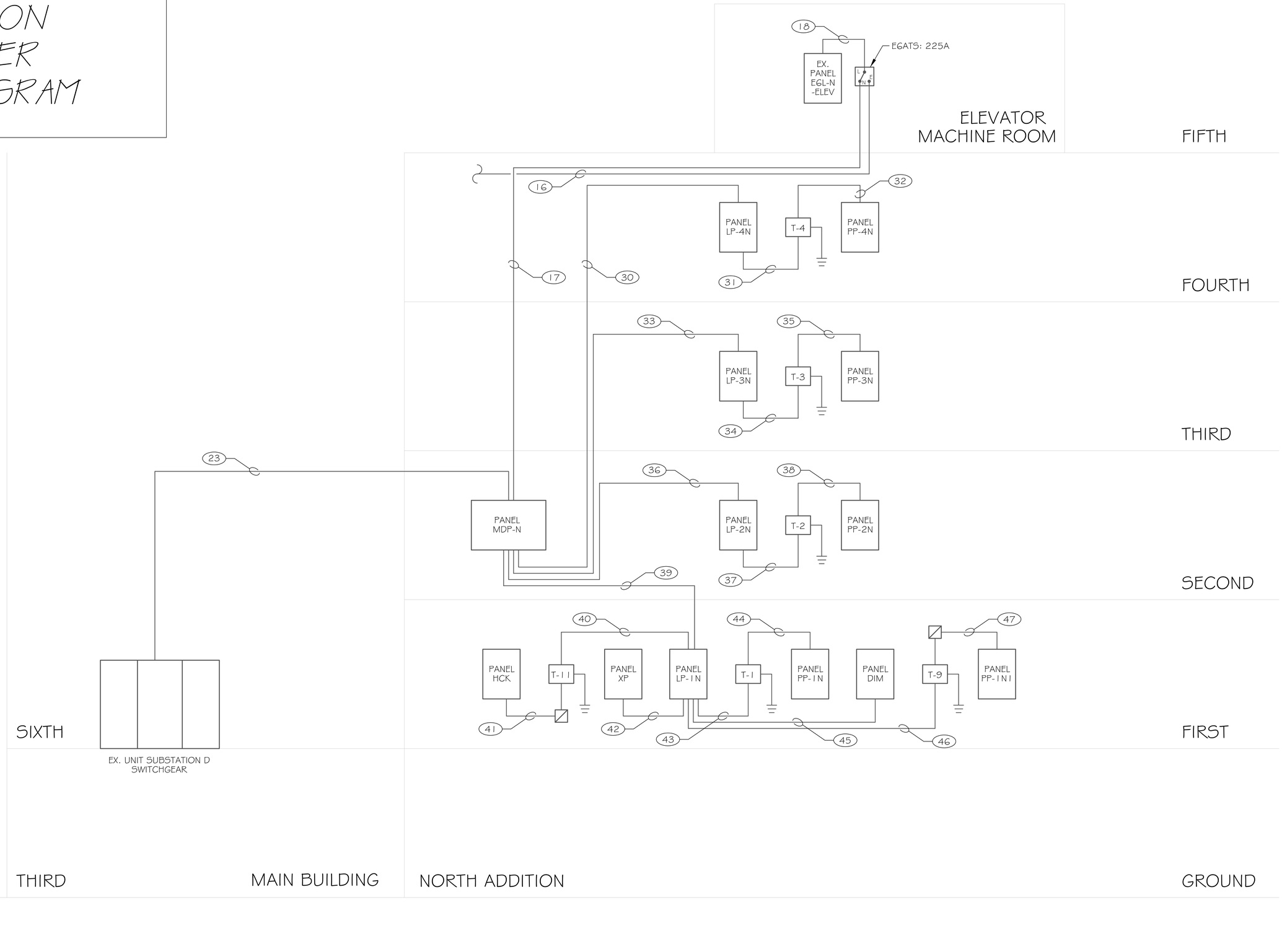
Proposed Transformer Configuration:



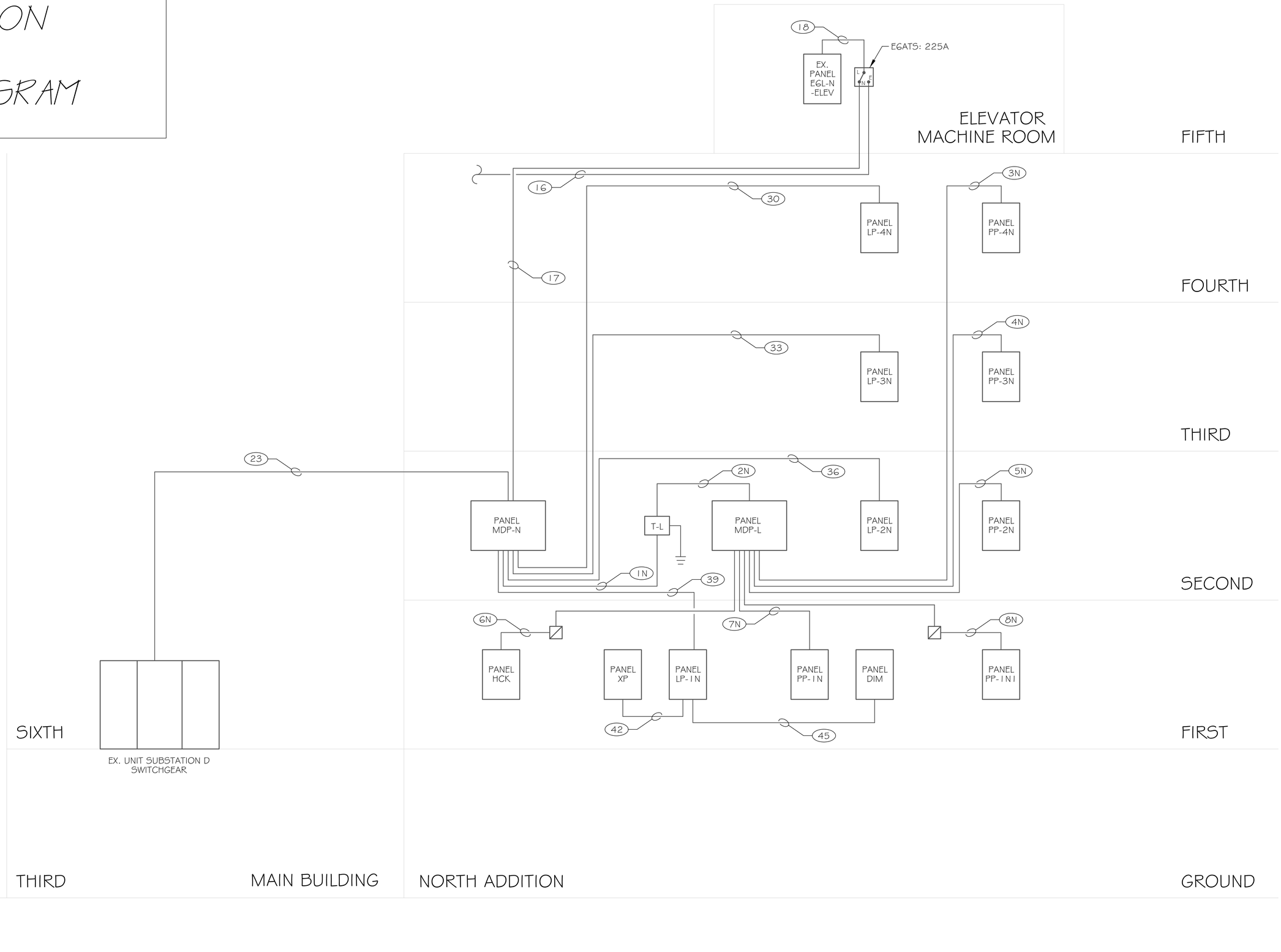
Refer to one-line diagram inserts for details of existing and proposed changes to the entire system

Figure 21: Alternate 1 Proposed Design Schematic

NORTH ADDITION NORMAL POWER ONE-LINE DIAGRAM



NORTH ADDITION
ALTERNATE 1
ONE-LINE DIAGRAM



Electrical Equipment Schedules

To determine the financial impact of the proposed change stated above, I first had to determine what components I would be deleting from the initial design to accommodate for the new changes. The following table summarizes these deletions:

Electrical Equipment - Deleted Normal System Components (Existing)

	Transformer					Circuit Breaker			
Equipment Type	Name	kVA	Primary Voltage	Secondary Voltage	Type	Feeding	Size (A)	Phase	Voltage
TRANSFORMER	T-1	45	480Δ	208Y/120	DRY				
TRANSFORMER	T-2	45	480Δ	208Y/120	DRY				
TRANSFORMER	T-3	45	480Δ	208Y/120	DRY				
TRANSFORMER	T-4	45	480Δ	208Y/120	DRY				
TRANSFORMER	T-9	45	480Δ	208Y/120	DRY				
TRANSFORMER	T-11	75	480Δ	208Y/120	DRY				
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
CIRCUIT BREAKER						PP-1N	70	3	208Y/120
CIRCUIT BREAKER						PP-1N1	70	3	208Y/120
CIRCUIT BREAKER						HCK	100	3	208Y/120
CIRCUIT BREAKER						PP-2N	70	3	208Y/120
CIRCUIT BREAKER						PP-3N	70	3	208Y/120
CIRCUIT BREAKER						PP-4N	70	3	208Y/120

Similarly, I needed to determine what components I would be adding to the current system. The following table summarizes those additions:

Electrical Equipment - Added Normal System Components (Proposed)

	Panelboard							Feeder					
Equipment Type	Name	Load Connected (A)	Rating (A)	# Poles	Spaces	Voltage	Protection (A)	Name	Size	Rating (A)	Ground	Conduit Size	Length (ft)
PANEL	MDP-L	644	800	3	24	208Y/120	800						
FEEDER								#1H	2 SETS (3) #1/0	300	#6	1 1/2"	16
FEEDER								#1L	3 SETS (4) #300	855	#2	2 1/2"	20
FEEDER								#1N	(4) #1/0	150	#6	1 1/2"	6
FEEDER								#1N1	(4) #1/0	150	#6	1 1/2"	152
FEEDER								#2N	(4) #1/0	150	#6	1 1/2"	12
FEEDER								#3N	(4) #1/0	150	#6	1 1/2"	24
FEEDER								#4N	(4) #1/0	150	#6	1 1/2"	36
FEEDER								#1HCK	(4) #4/0	230	#4	1 1/2"	88

Electrical Equipment - Cont'd (Proposed)									
	Transformer					Circuit Breaker			
Equipment Type	Name	kVA	Primary Voltage	Secondary Voltage	Type	Feeding	Size (A)	Phase	Voltage
TRANSFORMER	T-L	225	480?	208Y/120	DRY				
CIRCUIT BREAKER						T-L	300	3	480Y/277
CIRCUIT BREAKER						MDP-L	800	3	208Y/120
CIRCUIT BREAKER						PP-1N	150	3	208Y/120
CIRCUIT BREAKER						PP-1N1	150	3	208Y/120
CIRCUIT BREAKER						HCK	200	3	208Y/120
CIRCUIT BREAKER						PP-2N	150	3	208Y/120
CIRCUIT BREAKER						PP-3N	150	3	208Y/120
CIRCUIT BREAKER						PP-4N	150	3	208Y/120

Voltage Drop Calculations

Since my proposed redesign deals with some significantly long feeder runs, I had to make sure the voltage drop for the feeders did not exceed 2% as recommended by NEC Article 215.2 (A) (4). The following table summarizes the voltage drop calculations and what wires were resized to maintain a 2% drop or less:

Voltage Drop Calculations - Alt. 1							
Feeder	Size	V_{L-N}	Amperage	Length	Factor	V_{drop} Factor*	% Vd_{rop}
#1H	(2) #1/0	277	140	16	0.127	0.283	0.10
#1L	(3) #300 MCM	120	215	20	0.0545	0.234	0.20
#1N	#1/0	120	168	6	0.127	0.128	0.11
#1N1	#3/0	120	160	152	0.0865	2.104	1.75
#2N	#1/0	120	148	12	0.127	0.226	0.19
#3N	#1/0	120	160	24	0.127	0.488	0.41
#4N	#1/0	120	32	36	0.127	0.146	0.12
#1HCK	#4/0	120	56	88	0.0695	0.342	0.29

* Assumed a P.F. of 0.95

- denotes upsized feeder to shown size due to voltage drop

Pricing

With the help of a local electrical distributor, I priced the material and labor costs for both the credits and additional costs associated with the above changes to the current normal distribution system. The following table summarizes the credits associated with the deleted components:

System Component Pricing - Alt. 1 Credits

Equipment Type	Product Number	Quantity	Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
TRANSFORMER T-1	45T3H	1	$3,553.00	48.0	30.45	$1,461.60	$5,014.60
TRANSFORMER T-2	45T3H	1	$3,553.00	48.0	30.45	$1,461.60	$5,014.60
TRANSFORMER T-3	45T3H	1	$3,553.00	48.0	30.45	$1,461.60	$5,014.60
TRANSFORMER T-4	45T3H	1	$3,553.00	48.0	30.45	$1,461.60	$5,014.60
TRANSFORMER T-9	45T3H	1	$3,553.00	48.0	30.45	$1,461.60	$5,014.60
TRANSFORMER T-11	75TH3	1	$5,353.00	48.0	30.45	$1,461.60	$6,814.60
FEEDER (3 #4)	Electrical Contractor	14	$30.24	0.8	30.45	$25.58	$55.82
FEEDER (#8)	Electrical Contractor	14	$4.20	-	-	-	$4.20
EMT (1")	Electrical Contractor	14	$14.69	1.1	30.45	$34.10	$48.79
FEEDER (4 #1/0)	Electrical Contractor	10	$63.20	0.6	30.45	$18.27	$81.47
FEEDER (#6)	Electrical Contractor	10	$4.50	-	-	-	$4.50
EMT (1 1/2")	Electrical Contractor	10	$16.49	0.8	30.45	$24.36	$40.85
FEEDER (3 #4)	Electrical Contractor	15	$28.80	0.9	30.45	$27.41	$56.21
FEEDER (#8)	Electrical Contractor	15	$4.50	-	-	-	$4.50
EMT (1")	Electrical Contractor	15	$15.74	1.2	30.45	$36.54	$52.28
FEEDER (4 #1/0)	Electrical Contractor	12	$75.84	0.7	30.45	$21.92	$97.76
FEEDER (#6)	Electrical Contractor	12	$5.40	-	-	-	$5.40
EMT (1 1/2")	Electrical Contractor	12	$19.79	1.0	30.45	$29.23	$49.02
FEEDER (3 #4)	Electrical Contractor	22	$42.24	1.3	30.45	$40.19	$82.43
FEEDER (#8)	Electrical Contractor	22	$6.60	-	-	-	$6.60
EMT (1")	Electrical Contractor	22	$23.08	1.8	30.45	$53.59	$76.67
FEEDER (4 #1/0)	Electrical Contractor	12	$75.84	0.7	30.45	$21.92	$97.76
FEEDER (#6)	Electrical Contractor	12	$5.40	-	-	-	$5.40
EMT (1 1/2")	Electrical Contractor	12	$19.79	1.0	30.45	$29.23	$49.02
FEEDER (3 #4)	Electrical Contractor	15	$28.80	0.9	30.45	$27.41	$56.21
FEEDER (#8)	Electrical Contractor	15	$4.50	-	-	-	$4.50
EMT (1")	Electrical Contractor	15	$15.74	1.2	30.45	$36.54	$52.28
FEEDER (4 #1/0)	Electrical Contractor	12	$75.84	0.7	30.45	$21.92	$97.76
FEEDER (#6)	Electrical Contractor	12	$5.40	-	-	-	$5.40
EMT (1 1/2")	Electrical Contractor	12	$19.79	1.0	30.45	$29.23	$49.02
FEEDER (3 #4)	Electrical Contractor	20	$38.40	1.2	30.45	$36.54	$74.94
FEEDER (#8)	Electrical Contractor	20	$6.00	-	-	-	$6.00
EMT (1")	Electrical Contractor	20	$20.98	1.6	30.45	$48.72	$69.70
FEEDER (4 #1/0)	Electrical Contractor	152	$960.64	9.1	30.45	$277.70	$1,238.34
FEEDER (#6)	Electrical Contractor	152	$68.40	-	-	-	$68.40
EMT (1 1/2")	Electrical Contractor	152	$250.65	12.2	30.45	$370.27	$620.92
FEEDER (4 #4/0)	Electrical Contractor	88	$830.72	5.3	30.45	$160.78	$991.50
FEEDER (#4)	Electrical Contractor	88	$56.32	-	-	-	$56.32
EMT (1 1/2")	Electrical Contractor	88	$145.11	7.0	30.45	$214.37	$359.48
FEEDER (3 #1)	Electrical Contractor	16	$4.20	1.0	30.45	$29.23	$33.43
FEEDER (#8)	Electrical Contractor	16	$4.80	-	-	-	$4.80
EMT (1 1/2")	Electrical Contractor	16	$26.38	1.3	30.45	$38.98	$65.36
CIRCUIT BREAKER PP-1N	FAL34070	1	$616.00	1.0	30.45	$30.45	$646.45
CIRCUIT BREAKER PP-1N1	FAL34070	1	$616.00	1.0	30.45	$30.45	$646.45
CIRCUIT BREAKER HCK	FAL34100	1	$616.00	1.0	30.45	$30.45	$646.45
CIRCUIT BREAKER PP-2N	FAL34070	1	$616.00	1.0	30.45	$30.45	$646.45
CIRCUIT BREAKER PP-3N	FAL34070	1	$616.00	1.0	30.45	$30.45	$646.45
CIRCUIT BREAKER PP-4N	FAL34070	1	$616.00	1.0	30.45	$30.45	$646.45
						Total Credits:	$40,439.34

After I had determined the financial impact of my proposed deleted components, I determined the impact of my proposed additions to the system in the following table:

System Component Pricing - Alt. 1 Additions							
Equipment Type	**Product Number**	**Quantity**	**Material Cost**	**Labor Quantity**	**Labor Cost ($/hr)**	**Total Labor Cost**	**Total Cost**
TRANSFORMER T-L	225TH3	1	$12,406.00	80.0	$30.45	$2,436.00	$14,842.00
PANEL MDP-L	Eaton Elec. (pg. 27)	1	$12,164.00	2.0	$30.45	$60.90	$12,224.90
FEEDER (6 #1/0)	Electrical Contractor	16	$151.68	1.0	$30.45	$29.23	$180.91
FEEDER (2 #6)	Electrical Contractor	16	$14.40	-	-	-	$14.40
EMT (2 1 1/2")	Electrical Contractor	16	$48.22	1.3	$30.45	$38.98	$87.20
FEEDER (12 #300 MCM)	Electrical Contractor	20	$998.40	1.2	$30.45	$36.54	$1,034.94
FEEDER (3 #2)	Electrical Contractor	20	$66.00	-	-	-	$66.00
EMT (3 2 1/2")	Electrical Contractor	20	$180.84	1.6	$30.45	$48.72	$229.56
FEEDER (4 #1/0)	Electrical Contractor	6	$37.92	0.4	$30.45	$10.96	$48.88
FEEDER (#6)	Electrical Contractor	6	$2.70	-	-	-	$2.70
EMT (1 1/2")	LOWES	6	$9.89	0.5	$30.45	$14.62	$24.51
FEEDER (4 #3/0)	Electrical Contractor	152	$1,355.84	9.1	$30.45	$277.70	$1,633.54
FEEDER (#4)	Electrical Contractor	152	$97.28	-	-	-	$97.28
EMT (1 1/2")	LOWES	152	$250.65	12.2	$30.45	$370.27	$620.92
FEEDER (4 #1/0)	Electrical Contractor	12	$75.84	0.7	$30.45	$21.92	$97.76
FEEDER (#6)	Electrical Contractor	12	$5.40	-	-	-	$5.40
EMT (1 1/2")	LOWES	12	$19.79	1.0	$30.45	$29.23	$49.02
FEEDER (4 #1/0)	Electrical Contractor	24	$151.68	1.4	$30.45	$43.85	$195.53
FEEDER (#6)	Electrical Contractor	24	$10.80	-	-	-	$10.80
EMT (1 1/2")	LOWES	24	$39.58	1.9	$30.45	$58.46	$98.04
FEEDER (4 #1/0)	Electrical Contractor	36	$227.52	2.2	$30.45	$65.77	$293.29
FEEDER (#6)	Electrical Contractor	36	$16.20	-	-	-	$16.20
EMT (1 1/2")	LOWES	36	$59.36	2.9	$30.45	$87.70	$147.06
FEEDER (4 #4/0)	Electrical Contractor	88	$830.72	5.3	$30.45	$160.78	$991.50
FEEDER (#4)	Electrical Contractor	88	$56.32	-	-	-	$56.32
EMT (1 1/2")	LOWES	88	$145.11	7.0	$30.45	$214.37	$359.48
CIRCUIT BREAKER T-L	PL (pg. 8-33)	1	$7,700.00	1.0	$30.45	$30.45	$7,730.45
CIRCUIT BREAKER MDP-L	PL (pg. 8-33)	1	$11,110.00	1.0	$30.45	$30.45	$11,140.45
CIRCUIT BREAKER PP-1N	KCL34150	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
CIRCUIT BREAKER PP-1N1	KCL34150	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
CIRCUIT BREAKER HCK	KCL34200	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
CIRCUIT BREAKER PP-2N	KCL34150	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
CIRCUIT BREAKER PP-3N	KCL34150	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
CIRCUIT BREAKER PP-4N	KCL34150	1	$4,548.00	1.0	$30.45	$30.45	$4,578.45
						Total Costs:	$79,769.75

Notes:

1. Material prices were obtained from Hite Electric (Altoona, PA) and Lowe's of State College
2. Electrician Labor Cost was obtained for the Washington, D.C. area from Leach Wallace Assoc.
3. Labor productivity was quoted by Hite Electric (Altoona, PA) and consists of the following:
   - Lay 100' conduit: 1 person, 8 hrs
   - Pull 100' (3-phase) wire: 2 people, 3 hrs
   - Install small (<45 KVA) transformer: 2 people, 3 days (includes all connections)
   - Install large (>45 KVA) transformer: 2 people, 5 days (includes all connections)
   - 42 pole Panelboard: 1 person, 2 hours (not including connections)
   - Circuit Breaker/Circuit connections: 1 person, 1 hr each
   - No additional labor costs to install ground wires. This is included in the price for pulling the feeder.

Conclusions

From the results obtained above, I would not recommend changing the transformer configuration to the proposed change. Although it would simplify the transformer layout, it would cost the client an additional $39,000 and thus would not be ideal. Additionally, the failure of the single transformer in proposed change would constitute a failure of the entire 208Y/120V normal system. With the load distributed amongst six transformers as initially designed, I feel the system is more reliable and less likely to face a global catastrophic failure.

Alternate 2

Introduction

Alternate 2 will consider changing the existing emergency back-up system, which is connected to the main generator sets and paralleling switchgear, by isolating the North Addition emergency system from the rest of the hospital. Furthermore, the alternate will include the normal power branch as part of the emergency back-up system. To do so, I will be sizing an emergency generator to have enough capacity to supply ample power to all three emergency branches and the normal power. This investigation would be beneficial to the hospital if they were looking into the possibility of isolating the existing hospital power distribution system from the new addition. This could benefit them if they feel the facility is getting large enough that they would want to look into isolating some of the system incase a catastrophic emergency equipment failure took place. Thus, the entire hospital would not lose all power.

Goal

I will determine the cost impact of the resizing of equipment and addition of a separate generator to provide the North Addition with an alternative power supply. In addition, my Construction Management Breadth topic will detail this cost analysis as well as address other installation and sequencing concerns associated with the proposed changes.

Design Criteria

All electrical sizing and calculations were completed using requirements and tables from the 2002 National Electric Code (NEC). Load calculations for existing conditions can be found on enclosed CD-ROM under the file name 'Master Panel Schedule.xls'. Alternate 2 load calculations can be found under the file name 'Alt 2 Panel Schedule.xls'.

Article 517 of the NEC sets out specific emergency system requirements for healthcare facilities. Among these requirements, the article requires three separate emergency branches: life safety, critical, and equipment. Each branch must be fed by its own automatic transfer switch (assuming maximum demand <150 KVA) which in turn is supplied by both the primary and alternative power sources. The transfer switches must have the capability to shut-off its respective branch if the generator cannot handle the current demand of the entire system. Furthermore, the equipment branch must "shed" its

load before the critical branch and the critical branch must shed its load before the life safety. The requirements for each emergency branch and what types of loads are permitted are also outlined in Article 517 in detail. In brief, the life safety branch consists of emergency lighting, automatic doors, and any power required to egress people from the building. The critical branch consists of lighting, receptacle, and medical equipment loads essential in the care and well-being of patients where lives would be threatened if power was interrupted. The equipment branch consists of the mechanical equipment loads essential to the operation of critical care areas in the hospital.

Also outlined in Article 517, the addition of non-emergency loads (normal branch) are permitted to connect to the generator equipment if that branch is connected via an automatic transfer switch that will shed first in the priority order of transfer switches.

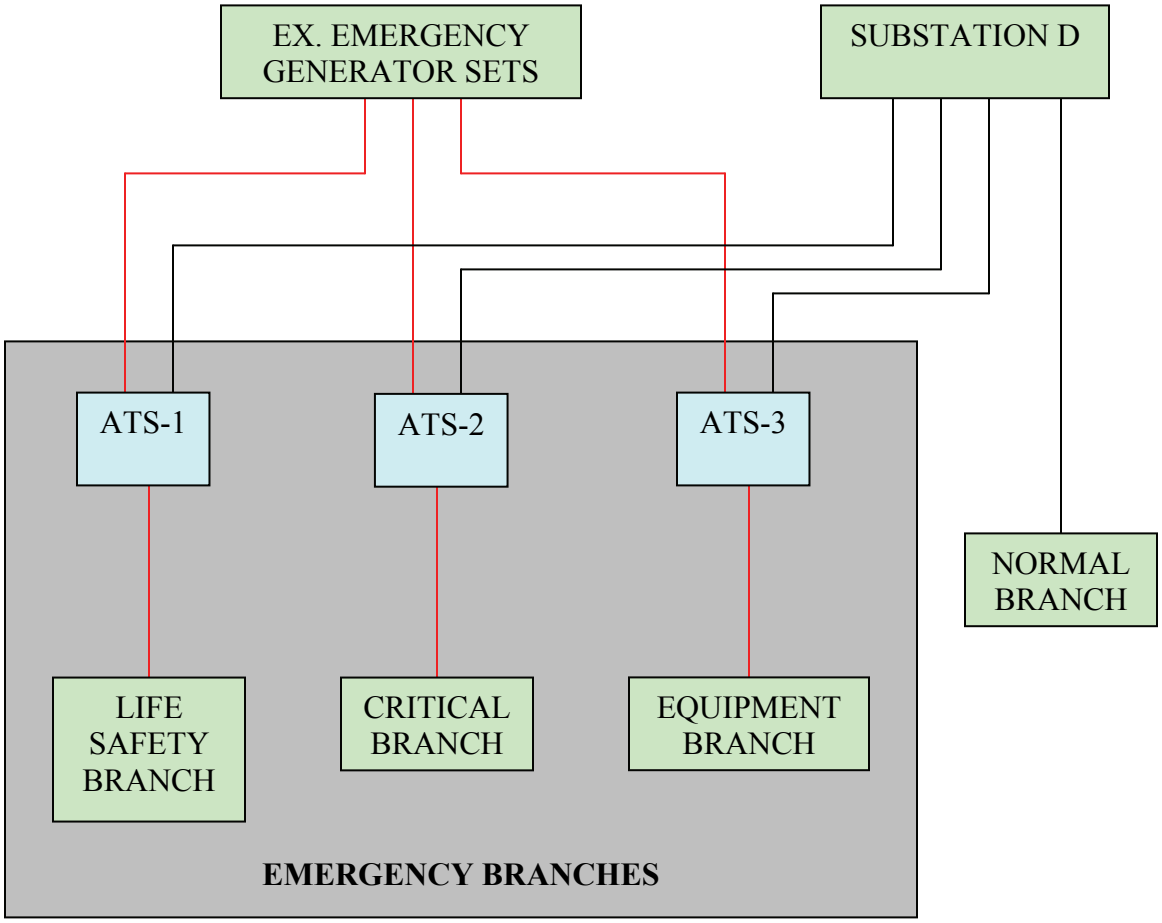
Assumptions

Again, when sizing the existing loads for each Panelboard throughout the system, I had to make a lot of assumptions concerning the known equipment loads. With the assistance of the engineers at Leach Wallace, I assigned load values to these various amounts of equipment. From these assumptions, many of my panels were determined to be loaded past their rated capacity. With respects to the system components I was redesigning and resizing, I accounted for the calculated demand loads determined when surveying the existing system. For simplicity's sake however, I did not resize equipment previously designed and not being touched by my alternates. I am confident the original design was sized correctly and properly and the error was most likely in the many assumptions made concerning equipment loads. Therefore, seemingly undersized equipment as noted was not overlooked but considered and left intact.

Since I am ultimately comparing the cost of the alternate compared with the original design, the direct analysis between the two systems will be hard to accurately portray. Since I do not have all the information for the various other additions and existing power demand, I will not be able to estimate the reduction in size of the initial redesign of the new generator set and associated paralleling switchgear. Therefore, I will not be able to incorporate the deletion or downsizing of any generator set equipment associated with the isolation of the North Addition demand.

Electrical Schematics

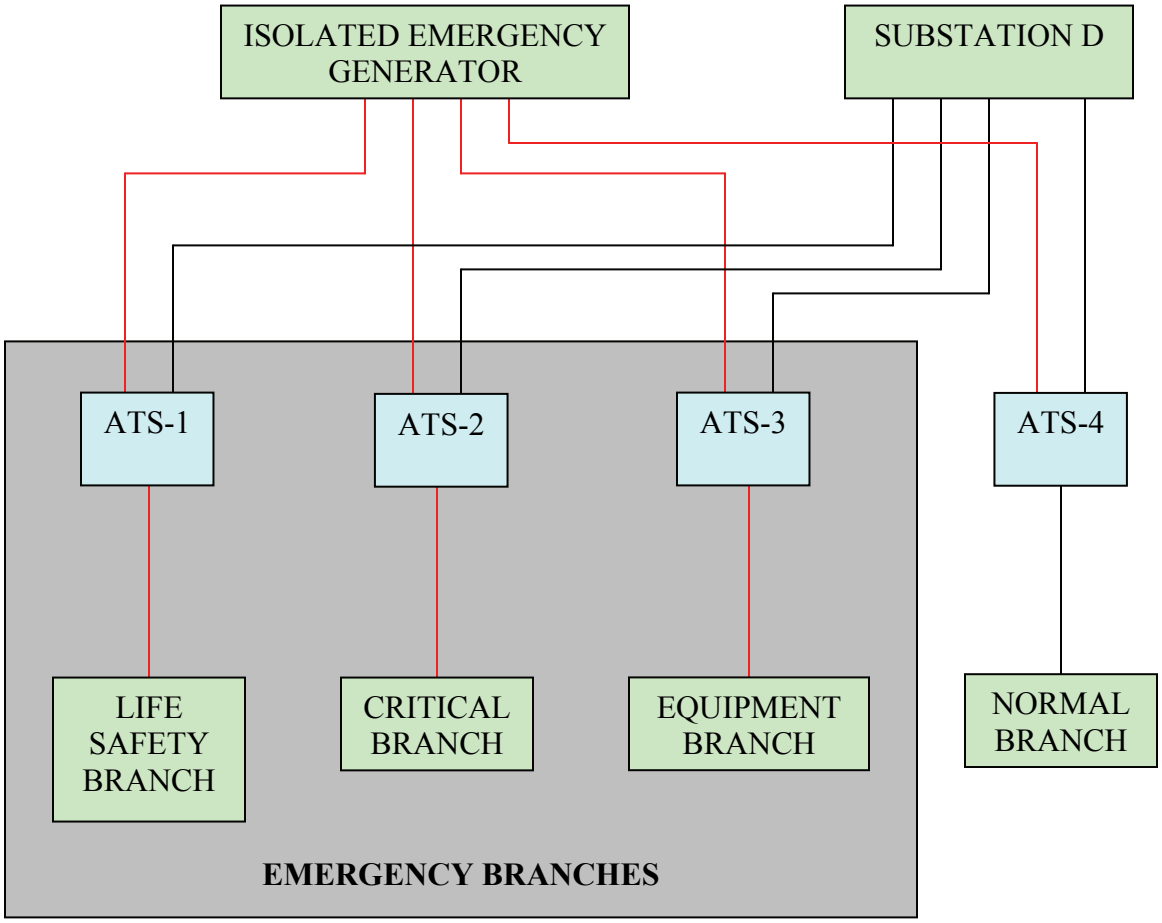
Existing Electrical Distribution Configuration:



Refer to one-line diagram inserts for details of existing and proposed changes to the entire system

Figure 22: Alternate 2 Existing Design Schematic

Proposed Electrical Distribution Configuration:



Refer to one-line diagram inserts for details of existing and proposed changes to the entire system

Figure 23: Alternate 2 Proposed Design Schematic

Feeder Schedules

Feeder Schedule - Existing								
Feeder Number	Serving	Served From	Conduit	Wire	Ground	Amperage	Wire Ampacity	Connected Load
1	PANEL ME1L-N	EX. PANEL ME1L-ED	2"	4#1/0	1#4	100 A	230 A	59.3 A
2	PANEL E2L-3N	EX. PANEL E2L-3A	1 1/4"	4#4	1#6	75 A	125 A	59.0 A
3	PANEL E1L-1N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	26.1 A
4	XFMR T-5	PANEL E1L-1N	3/4"	3#10	1#10	15 KVA	50 A	11.8 A
5	PANEL E1P-1N	XFMR T-5	3/4"	4#8	1#10	50 A	70 A	27.3 A
6	PANEL E1L-2N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	14.3 A
7	XFMR T-6	PANEL E2L-2N	3/4"	3#10	1#10	15 KVA	50 A	16.0 A
8	PANEL E2P-2N	XFMR T-6	3/4"	4#8	1#10	50 A	70 A	37.0 A
9	PANEL E1L-3N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	70 A	16.1 A
10	XFMR T-7	PANEL E1L-3N	3/4"	3#10	1#10	15 KVA	50 A	2.4 A
11	PANEL E1P-3N	XFMR T-7	3/4"	4#8	1#10	50 A	70 A	5.4 A
12	XFMR T-8	PANEL E2L-3N	3/4"	3#8	1#10	30 KVA	50 A	36.3 A
13	PANEL E2P-3N	XFMR T-8	1 1/4"	4#3	1#8	100 A	145 A	83.8 A
14	PANEL E1L-4N	PANEL ME1L-N	3/4"	4#8	1#10	50 A	50 A	12.9 A
15	PANEL E3L-N	EX. PANEL ME3L-ED	3"	4#350	1#1	250 A	505 A	205.3 A
16	E6ATS	EX. PANEL EMDP-ED	2"	3#2/0	1#6	110 A	265 A	21.9 A
17	E6ATS	PANEL MDP-N	2"	3#4/0	1#4	225 A	360 A	21.9 A
18	PANEL E6L-N-ELEV	E6ATS	2"	3#4/0	1#4	225 A	360 A	50.5 A
19	XFMR T-8	PANEL E3L-N	3/4"	3#6	1#8	30 KVA	95 A	37.0 A
20	PANEL E3P-N	XFMR T-8	1 1/4"	4#2	1#8	100 A	170 A	85.5 A
21	PANEL E2L-2N	PANEL E2L-3N	3/4"	4#8	1/#10	50 A	70 A	20.5 A
22	EX. PANEL EMDP-ED	EX. PARALLELING SWITCHGEAR	(3) 3"	3 SETS 4#500MCM	3#2/0	1000 A	1860 A	-
23	PANEL MDP-N	EX. SUBSTATION D	(3) 3 1/2"	3 SETS 4#400MCM	3#3/0	800 A	1635 A	-
24	EX. E1ATS	EX. SUBSTATION D	2 1/2"	4#4/0	1#4	225 A	360 A	-
25	EX. E1ATS	EX. PANEL EMDP-ED	2 1/2"	4#4/0	1#4	225 A	360 A	-
26	EX. PANEL ME1L-ED	EX. E1ATS	2 1/2"	4#4/0	1#4	225 A	360 A	-
27	EX. E3ATS	EX. SUBSTATION D	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	-
28	EX. E3ATS	EX. PANEL EMDP-ED	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	-
29	EX. PANEL ME3L-ED	EX. E3ATS	(2) 2 1/2"	2 SETS 4#350MCM	2#1	600 A	1010 A	-
30	LP-4N	MDP-N	1 1/2"	4#1/0	#6	150 A	150 A	26.0 A
31	XFMR T-4	LP-4N	1"	3#4	#8	45 KVA	85 A	13.9 A
32	PP-4N	XFMR T-4	1 1/2"	4#1/0	#6	150 A	150 A	32.2 A
33	LP-3N	MDP-N	1 1/2"	4#1/0	#6	150 A	150 A	80.6 A
34	XFMR T-3	LP-3N	1"	3#4	#8	45 KVA	85 A	65 A
35	PP-3N	XFMR T-3	1 1/2"	4#1/0	#6	150 A	150 A	150 A
36	LP-2N	MDP-N	1 1/2"	4#1/0	#6	150 A	150 A	84.7 A
37	XFMR T-2	LP-2N	1"	3#4	#8	45 KVA	85 A	64.2 A
38	PP-2N	XFMR T-2	1 1/2"	4#1/0	#6	150 A	150 A	148.2 A
39	LP-1N	MDP-N	2"	4#3/0	#6	200 A	230 A	277.6 A
40	XFMR T-11	LP-1N	1 1/2"	3#1	#8	75 KVA	150 A	24.2 A
41	HCK	XFMR T-11	2 1/2"	4#4/0	#4	200 A	200 A	55.8 A
42	XP	LP-1N	1"	4#6	#10	60 A	65 A	53.6 A
43	XFMR T-1	LP-1N	1"	3#4	#8	45 KVA	85 A	72.8 A
44	PP-1N	XFMR T-1	1 1/2"	4#1/0	#6	150 A	150 A	168 A
45	DIM	LP-1N	3/4"	4#10	#10	30 A	30 A	30 A
46	XFMR T-9	LP-1N	1"	3#4	#8	45 KVA	85 A	78.1 A
47	PP-1N1	XFMR T-9	1 1/2"	4#1/0	#6	150 A	150 A	180 A

Feeder Schedule - Alternates								
Feeder Number	Serving	Served From	Conduit	Wire	Ground	Amperage	Wire Ampacity	Connected Load
1N	XFMR T-L	MDP-N	(2) 1 1/2"	2 SETS 3#1/0	(2) #6	200 KVA	300 A	279 A
2N	MDP-L	XFMR T-L	(3) 2 1/2"	3 SETS 4#300MCM	(3) #2	800 A	855 A	644 A
3N	PP-4N	MDP-L	1 1/2"	4#1/0	#6	150 A	150 A	32.2 A
4N	PP-3N	MDP-L	1 1/2"	4#1/0	#6	150 A	150 A	150 A
5N	PP-2N	MDP-L	1 1/2"	4#1/0	#6	150 A	150 A	148.2 A
6N	HCK	MDP-L	2 1/2"	4#4/0	#2	200 A	230 A	55.8 A
7N	PP-1N	MDP-L	1 1/2"	4#1/0	#6	150 A	150 A	168 A
8N	PP-1N1	MDP-L	2"	4#3/0	#4	150 A	200 A	180 A
9N	EMDP	GENERATOR	(4) 3"	4 SETS 4#400	4#1/0	1200 A	1340 A	1035 A
10N	ATS-4	EMDP	(3) 2 1/2"	3 SETS 4#300MCM	3#2	800 A	855 A	723 A
11N	E6ATS	EMDP	2"	3#4/0	#4	225 A	230 A	50.5 A
12N	ATS-2	EMDP	1 1/4"	4#3	#8	100 A	100 A	52.5 A
13N	ATS-3	EMDP	2 1/2"	4#250MCM	#2	250 A	255 A	205.3 A
14N	ATS-1	EMDP	1 1/4"	4#3	#8	100 A	100 A	59.3 A
15N	MDP-N	ATS-4	(3) 2 1/2"	3 SETS 4#350MCM	3#2	800 A	930 A	723 A
16N	E2L-3N	ATS-2	1 1/4"	4#2	#8	100 A	130 A	52.5 A
17N	E3L-N	ATS-3	2 1/2"	4#300MCM	#2	250 A	285 A	205.3 A
18N	ME1L-N	ATS-1	1 1/2"	4#1	#6	100 A	130 A	59.3 A
19N	ATS-4	SUBSTAT. D	(3) 2 1/2"	3 SETS #350MCM	3#2	800 A	930 A	723 A
20N	ATS-3	SUBSTAT. D	2 1/2"	4#300MCM	#2	250 A	285 A	205.3 A
21N	E6ATS	SUBSTAT. D	2"	3#4/0	#4	225 A	230 A	50.5 A
22N	ATS-2	SUBSTAT. D	1 1/4"	4#2	#8	100 A	115 A	52.5 A
23N	ATS-1	SUBSTAT. D	1 1/2"	4#1	#6	100 A	130 A	59.3 A

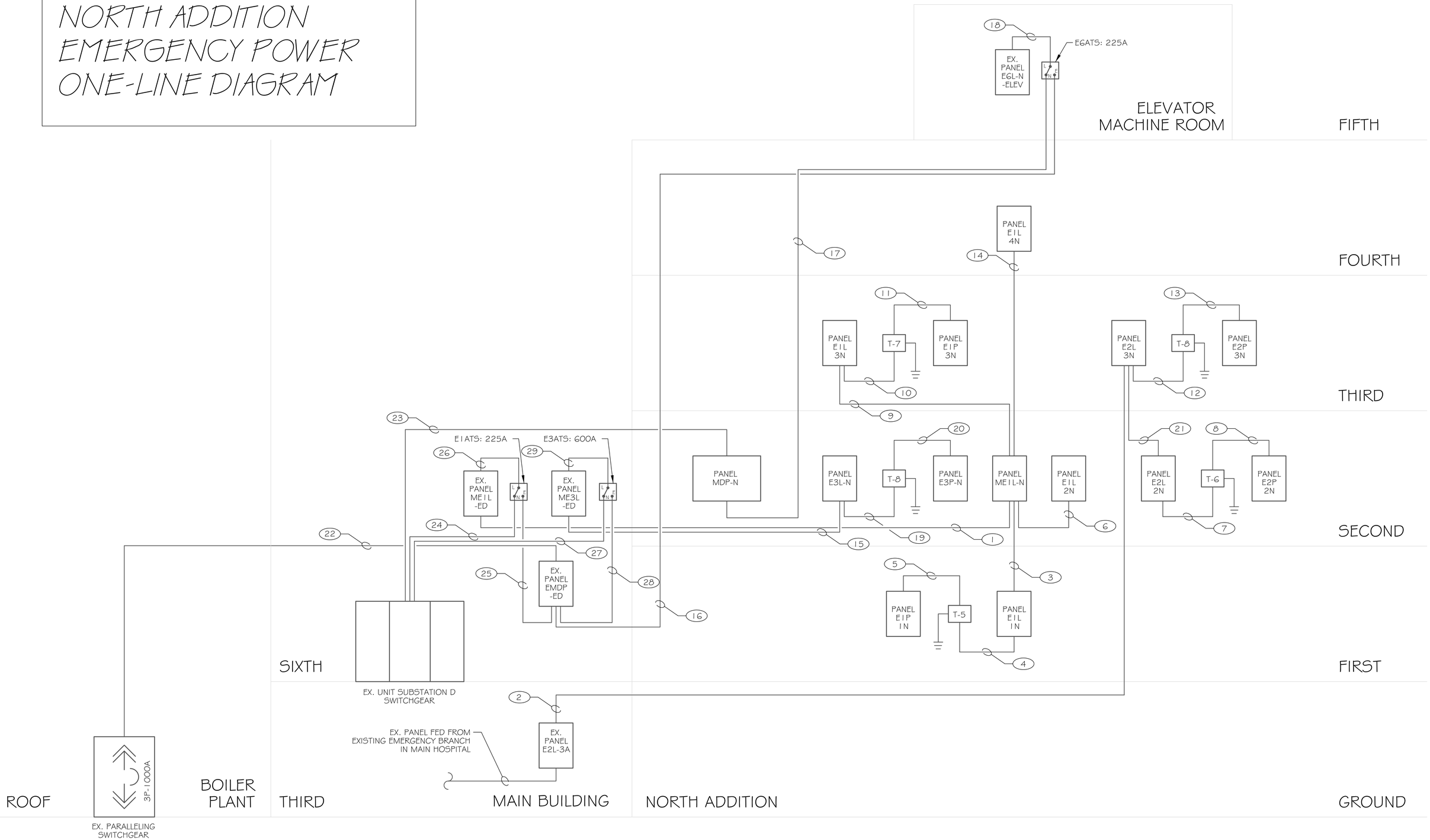
- denotes upsized feeder to shown size due to voltage drop

- denotes demand load larger than equipment rating (see “Assumptions” above)

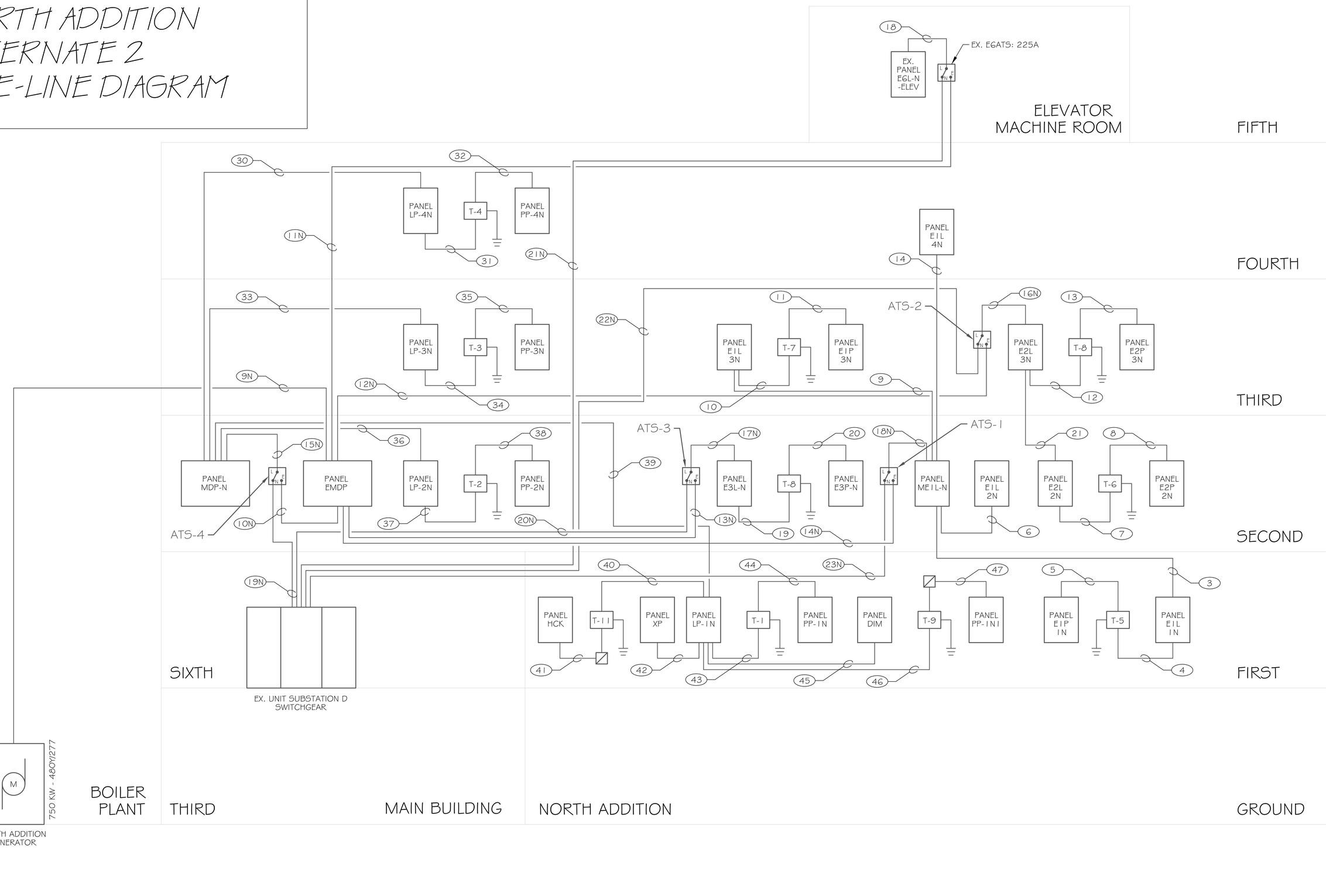
Generator Design

To determine the proper size generator needed for Alternate 2, I enlisted the help of Cummins Power Generation’s generator sizing program: Power Suite v. 4.0. To properly determine the size of generator needed, all loads have to be inputted into the software (based on load type and load demand) and assigned to a specific sequence determined by the operator. In this case, I used 4 steps to mirror each transfer switch being used. The software determined the running load to be 744.1 KW and the effective step KW to be 629.5 KW. These values correspond to a single 750 KW generator (Product #750DFGE) to be the best fit for this particular application. Therefore, I will be utilizing a single 480Y/277V 3-phase 750 KW generator to provide emergency power to the North Addition.

NORTH ADDITION EMERGENCY POWER ONE-LINE DIAGRAM



NORTH ADDITION
ALTERNATE 2
ONE-LINE DIAGRAM



Electrical Equipment Schedules

To determine the financial impact of the proposed change stated above, I first had to determine what components I would be deleting from the initial design to accommodate for the new changes. The following table summarizes these deletions:

Electrical Cost Analysis - Deleted System Components (Existing)

Equipment Type	Feeder					
	Name	Size	Rating (A)	Ground	Conduit Size	Length (ft)
FEEDER	#1	3 SETS (4) #400 MCM	1005	(3) #1/0	(3) 3 1/2"	500
FEEDER	#2	(4) #1/0	150	#4	2"	500
FEEDER	#3	(4) #4	85	#6	1 1/4"	500
FEEDER	#35	(4) #350 MCM	310	#1	3"	500
FEEDER	#36	(3) #2/0	175	#6	2"	40

Similarly, I needed to determine what components I would be adding to the current system. The following table summarizes those additions:

Electrical Cost Analysis - Added System Components (Proposed)

Equipment Type	Panelboard							Feeder					
	Name	Load Connected (A)	Rating (A)	# Poles	Spaces	Voltage	Protection (A)	Name	Size	Rating (A)	Ground	Conduit Size	Length (ft)
PANEL	EMDP	828	1200	3	24	480Y/277	1000						
FEEDER								ATS-1	(4) #1	130	#8	1 1/2"	500
FEEDER								ATS-2	(4) #2	115	#8	1 1/4"	500
FEEDER								ATS-3	(4) #300 MCM	285	#2	2 1/2"	500
FEEDER								ATS-4	3 SETS (4) #300 MCM	855	(3) #2	(3) 2 1/2"	500
FEEDER								EATS-1	(4) #3	100	#8	1 1/4"	20
FEEDER								EATS-2	(4) #3	100	#8	1 1/4"	35
FEEDER								EATS-3	(4) #250 MCM	255	#2	2 1/2"	20
FEEDER								EATS-4	3 SETS (4) #300 MCM	855	(3) #2	(3) 2 1/2"	20
FEEDER								EMDP	4 SETS (4) #400 MCM	1340	(3) #1/0	(3) 3 1/2"	500
FEEDER								E6ATS (E)	(3) #2/0	175	#6	2"	40
FEEDER								E6ATS (N)	(3) #2/0	175	#6	2"	40
CIRCUIT BREAKER													
CIRCUIT BREAKER													
CIRCUIT BREAKER													
CIRCUIT BREAKER													
PARALLELING SWITCHGEAR													

Electrical Cost Analysis - Added Cont'd (Proposed)									
Equipment Type	Automatic Transfer Switch					Circuit Breaker			
	Name	Rating (A)	Priority	Voltage	Phase	Feeding	Size (A)	Phase	Voltage
PANEL									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
FEEDER									
CIRCUIT BREAKER	ATS-1	100	1	480Y/277	3				
CIRCUIT BREAKER	ATS-2	100	2	480Y/277	3				
CIRCUIT BREAKER	ATS-3	250	3	480Y/277	3				
CIRCUIT BREAKER	ATS-4	800	4	480Y/277	3				
PARALLELING SWITCHGEAR						EMDP	1200	3	480Y/277

Voltage Drop Calculations

Since my proposed redesign deals with some significantly long feeder runs, I had to make sure the voltage drop for the feeders did not exceed 2% as recommended by NEC Article 215.2 (A) (4). The following table summarizes the voltage drop calculations and what wires were resized to maintain a 2% drop or less:

Voltage Drop Calculations - Alt. 2							
Feeder	**Size**	**V_{L-N}**	**Amperage**	**Length**	**Factor**	**V_{drop} Factor***	**% Vd_{rop}**
ATS-1	#1	277	59	500	0.156	4.602	1.66
ATS-2	#2	277	52.5	500	0.196	5.145	1.86
ATS-3	#300 MCM	277	205	500	0.0545	5.586	2.02
ATS-4	(3) #350 MCM	277	241	500	0.047	5.664	2.04
EATS-1	#3	277	59	20	0.2495	0.294	0.11
EATS-2	#3	277	52.5	35	0.2495	0.458	0.17
EATS-3	#250 MCM	277	205	20	0.062	0.254	0.09
EATS-4	(3) #300 MCM	277	241	20	0.0545	0.263	0.09
EMDP	(4) #400 MCM	277	259	500	0.043	5.563	2.01
E6ATS(E)	#2/0	277	50.5	40	0.104	0.210	0.08
E6ATS(N)	#2/0	277	50.5	40	0.104	0.210	0.08

* Assumed a P.F. of 0.95

- denotes upsized feeder to shown size due to voltage drop

Pricing

Since I will be discussing my detailed cost analysis in the following section (Construction Management Breadth), I will briefly summarize my results that can be investigated further in my breadth work.

Existing System Credits = $73,232
Proposed System Changes = $426,547
Total Increased Budget = $353,315

Conclusions

Since Alternate 2 is not as straight forward as Alternate 1, I cannot necessarily recommend the addition or declination of the alternate. Although it would cost the client approximately $353,000 more than the existing system, the net cost (including the credits given for an overall smaller generator set for the rest of the hospital) would be less. From the information I could gather, I was not able to determine all the cost savings in isolating the North Addition from the rest of the hospital because I was unable to determine the existing hospital demand and associated downsizing of the designed generator set. However, $353,000 would be a 15% increase in the entire project's electrical budget, assuming the electrical portion of the MEP Budget ($7.8 million) is 30% (as quoted by Leach Wallace). Therefore, the proposed changes to the alternative power supply can be considered a reasonable alternative for the client to consider, but would ultimately have to be their choice depending upon their degree of necessity for power isolation.

Construction Management Breadth

Introduction

With such a significant change to the electrical distribution system concerning Alternate 2, I wanted to further investigate the impact these changes would have on the construction end of the project. In doing so, I will address several different areas that might be affected by such a change to the overall system.

Goal

I will determine the cost impact, scheduling impact, and additional considerations that will aid in a smooth delivery and installation for Alternate 2. This should give the client a more accurate view of how the proposed change would impact the entire project.

Assumptions

- Space exists adjacent to the current boiler room (with pad already poured) for the addition of a new 750 KW generator. This boiler room expansion was previously finished on a recent infrastructure project.
- Feeders from the new generator to the main distribution panel in the North Addition are 500 ft.
- Feeders from the existing Substation D to the main distribution panel in the North Addition are 500 ft.
- Existing circuit breakers feeding panels in North Addition will be used in new distribution panel as needed.
- No additional labor costs to install ground wires. This is included in the price for pulling the feeder.

Pricing

With the help of a local electrical distributor, I priced the material and labor costs for both the credits and additional costs associated with the above changes to the current normal distribution system. The following table summarizes the credits associated with the deleted components:

System Component Pricing - Alt. 2 Credits

Equipment Type	Product Number	Quantity	Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
FEEDER (12 #400 MCM)	Electrical Contractor	500	$33,600.00	30	$30.45	$913.50	$34,513.50
FEEDER (3 #1/0)	Electrical Contractor	500	$2,370.00	-	-	-	$2,370.00
EMT (3 3 1/2")	Electrical Contractor	500	$8,449.50	40	$30.45	$1,218.00	$9,667.50
FEEDER (4 #1/0)	Electrical Contractor	500	$3,160.00	30	$30.45	$913.50	$4,073.50
FEEDER (#4)	Electrical Contractor	500	$320.00	-	-	-	$320.00
EMT (2")	Electrical Contractor	500	$1,725.00	40	$30.45	$1,218.00	$2,943.00
FEEDER (4 #4)	Electrical Contractor	500	$1,280.00	30	$30.45	$913.50	$2,193.50
FEEDER (#6)	Electrical Contractor	500	$225.00	-	-	-	$225.00
EMT (1 1/4")	Electrical Contractor	500	$674.50	40	$30.45	$1,218.00	$1,892.50
FEEDER (4 #350 MCM)	Electrical Contractor	500	$9,760.00	30	$30.45	$913.50	$10,673.50
FEEDER (#1)	Electrical Contractor	500	$700.00	-	-	-	$700.00
EMT (3")	Electrical Contractor	500	$1,892.50	40	$30.45	$1,218.00	$3,110.50
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
						Total Credits:	$73,232.22

After I had determined the financial impact of my proposed deleted components, I determined the impact of my proposed additions to the system in the following table:

System Component Pricing - Alt. 2 Additions

Equipment Type	Product Number	Quantity	Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
PANEL EMDP	Eaton Elec. (pg. 27)	1	$18,302.00	8	$30.45	$243.60	$18,545.60
FEEDER (4 #1)	Electrical Contractor	500	$2,800.00	30	$30.45	$913.50	$3,713.50
FEEDER (#6)	Electrical Contractor	500	$225.00	-	-	-	$225.00
EMT (1 1/2")	Electrical Contractor	500	$824.50	40	$30.45	$1,218.00	$2,042.50
FEEDER (4 #2)	Electrical Contractor	500	$2,200.00	30	$30.45	$913.50	$3,113.50
FEEDER (#8)	Electrical Contractor	500	$150.00	-	-	-	$150.00
EMT (1 1/4")	Electrical Contractor	500	$674.50	40	$30.45	$1,218.00	$1,892.50
FEEDER (4 #300 MCM)	Electrical Contractor	500	$8,320.00	30	$30.45	$913.50	$9,233.50
FEEDER (#2)	Electrical Contractor	500	$550.00	-	-	-	$550.00
EMT (2 1/2")	Electrical Contractor	500	$1,507.00	40	$30.45	$1,218.00	$2,725.00
FEEDER (12 #350 MCM)	Electrical Contractor	500	$29,280.00	30	$30.45	$913.50	$30,193.50
FEEDER (3 #2)	Electrical Contractor	500	$1,650.00	-	-	-	$1,650.00
EMT (3 2 1/2")	Electrical Contractor	500	$4,521.00	40	$30.45	$1,218.00	$5,739.00
FEEDER (4 #3)	Electrical Contractor	20	$57.60	1.2	$30.45	$36.54	$94.14
FEEDER (#8)	Electrical Contractor	20	$6.00	-	-	-	$6.00
EMT (1 1/4")	Electrical Contractor	20	$26.98	1.6	$30.45	$48.72	$75.70
FEEDER (4 #3)	Electrical Contractor	35	$100.80	2.1	$30.45	$63.95	$164.75
FEEDER (#8)	Electrical Contractor	35	$10.50	-	-	-	$10.50
EMT (1 1/4")	Electrical Contractor	35	$47.22	2.8	$30.45	$85.26	$132.48
FEEDER (4 #250 MCM)	Electrical Contractor	20	$280.00	1.2	$30.45	$36.54	$316.54
FEEDER (#2)	Electrical Contractor	20	$22.00	-	-	-	$22.00
EMT (2 1/2")	Electrical Contractor	20	$60.28	1.6	$30.45	$48.72	$109.00
FEEDER (12 #300 MCM)	Electrical Contractor	20	$998.40	1.2	$30.45	$36.54	$1,034.94
FEEDER (3 #2)	Electrical Contractor	20	$66.00	-	-	-	$66.00
EMT (3 2 1/2")	Electrical Contractor	20	$180.84	1.6	$30.45	$48.72	$229.56
FEEDER (16 #400 MCM)	Electrical Contractor	500	$44,800.00	30	$30.45	$913.50	$45,713.50
FEEDER (4 #1/0)	Electrical Contractor	500	$3,160.00	-	-	-	$3,160.00
EMT (3 3 1/2")	Electrical Contractor	500	$8,449.50	40	$30.45	$1,218.00	$9,667.50
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
ATS-1	Cummins	1	$9,000.00		$30.45	$0.00	$9,000.00
ATS-2	Cummins	1	$9,000.00		$30.45	$0.00	$9,000.00
ATS-3	Cummins	1	$14,000.00		$30.45	$0.00	$14,000.00
ATS-4	Cummins	1	$28,000.00		$30.45	$0.00	$28,000.00
GENERATOR (all inclusive)	Cummins	1	$220,000.00	160	$30.45	$4,872.00	$224,872.00
						Total Costs:	$426,547.64

Notes:

1. Material prices were obtained from Hite Electric (Altoona, PA) and Lowe's of State College
2. Electrician Labor Cost was obtained for the Washington, D.C. area from Leach Wallace Assoc.
3. Labor productivity was quoted by Hite Electric (Altoona, PA) and consists of the following:
   - Lay 100' conduit: 1 person, 8 hrs
   - Pull 100' (3-phase) wire: 2 people, 3 hrs
   - Install small (<45 KVA) transformer: 2 people, 3 days (includes all connections)
   - Install large (>45 KVA) transformer: 2 people, 5 days (includes all connections)
   - 42 pole Panelboard: 1 person, 2 hours (not including connections)
   - Circuit Breaker/Circuit connections: 1 person, 1 hr each
   - No additional labor costs to install ground wires. This is included in the price for pulling the feeder.

4. Generator was priced by Sebastian Theberge (Cummins Power Generation) and includes the following in the price:
   - Outdoor type 750 KW generator
   - 2500 gallon base tank
   - Generator enclosure
   - Fuel tank
   - Exhaust system
   - Outdoor rated circuit breaker

Scheduling

Although I do not have detailed information concerning the entire scheduling of the project, I wanted to know roughly how many man-hours I was adding to the overall project. Comparing the man-hours calculated above for the cost analysis, I determined approximately 260 additional man-hours would be needed for the proposed changes in Alternate 2. Assuming at least a 6 man electrical crew, that would equate to an additional 6 days of work on the project neglecting any lead-time for the generator or any other major equipment. Again, I am also assuming not all of the work is on the critical path. Even if the 6 days are on the critical path, this is in comparison to a 345 day schedule. Although extending the project completion a couple days is not the most favorable situation, 6 days is only a 1.7% increase in total scheduling, and that is the worst case scenario.

Additional Considerations

The following items should be considered and discussed in detail when preparing for the project start date as to not neglect key coordination issues:

- **Lead time for big equipment -** generator, automatic transfer switches, main distribution panel and main circuit breakers.
- **MEP Coordination in boiler plant** – extensive amounts of equipment get packed into boiler plants and sequencing work in this tightly packed area is critical to project efficiency.
- **Crane access** – a crane will be needed to lift and set the new generator and associated equipment. With such a packed site so close to the beltway, extra care must be taken in the placement and timing of the crane operation.
- **Location of generator** – Since the hospital is so close to residential surroundings, placement of the generator is critical as to not create too much noise for surrounding neighbors.
- **Below grade feeder installation –** Since multiple projects will be running so close to each other, coordination of running the feeders by the electrical contractors before the footers and slabs on grade are poured by the concrete subcontractors is crucial to the efficiency of the project.
- **Commissioning of system –** Since there are so many regulations governing the installation and implementation of hospital emergency power supply, proper commissioning of the emergency generator and all associated equipment must be ensured well before any patients visit the new wing.

Conclusions

As stated in the Electrical Depth portion of this report, the comparison of the existing system to the proposed change is not as simple as choosing the cheapest system. The proposed change would increase the budget by $353,000 (15% of the current electrical budget), a pretty sizeable amount. However, the change would also not increase the schedule significantly. Most importantly, the need of the client for isolation of the North Addition must be considered and weighed into the equation. The proposed changes to the alternative power supply can be considered a reasonable alternative for the client to consider. Ultimately, Alternate 2 would be presented as an alternative to the existing emergency system and the final decision would be up to the owner.

Mechanical Breadth

Introduction

Due to the addition and deletion of several transformers in each electrical room, I will be resizing the required cfm and all associated ductwork and VAV boxes. Although not detailed here, this should save the hospital money by decreasing the duct sizes and VAV boxes in most cases.

Goal

I will determine the impact Alternate 1 of the Electrical Depth has on the mechanical system in all four electrical rooms of the North Addition.

Assumptions

- 2% energy loss for all transformers
- Design for duct loss of 0.10 friction/100ft
- Use round duct 6" or below when possible
- Design temperature for room is 75° F
- Inlet temperature is 55° F
- All VAV boxes are DESV (digital control)
- Power Factor = 0.90

Calculations

Using the equation for sensible heat:

$$\mathbf{Q = 1.08*CFM*\Delta T}$$

I determined the sensible heat gain for each transformer as shown in the table below:

Heat Gain Calculations				
Room	Transformer			Heat Gain
	Designation	Size (KVA)	Gain (W)	(BTU-hr)
Elec. Rm - 1st Floor	T-1	45	810	2764
	T-5	15	270	921
	T-9	45	810	2764
	T-11	75	1350	4606
Elec. Rm - 2nd Floor	T-2	45	810	2764
	T-6	15	270	921
	T-L	225	4050	13819
Elec. Rm - 3rd Floor	T-3	45	810	2764
	T-7	15	270	921
	T-8	30	540	1843
Elec. Rm - 4th Floor	T-4	45	810	2764

- denotes deleted transformer

- denotes added transformer

From that information, I could determine the new CFM required in each room and compare the results to the designed CFM:

CFM Calculations				
Room	Initial		Corrected	
	Sensible Load (BTU-hr)	CFM	Sensible Load (BTU- hr)	CFM
Elec. Rm - 1st Floor	11055	215	921	45
Elec. Rm - 2nd Floor	3685	215	14740	650
Elec. Rm - 3rd Floor	5528	95	2764	145
Elec. Rm - 4th Floor	2764	145	0	*45

* Room will be designed for 45 CFM since anticipated growth will require an additional emergency transformer on that floor (it is currently a shell and not fit-out for its desired use at the present time).

From the Leach Wallace standards and Titus Catalog for VAV box design, the following size VAV boxes are typically specified with the characteristics shown:

Size 4 box: 0-100 CFM max
45 CFM min
Size 5 box: 100-300 CFM max
65 CFM min
Size 6 box: 300 – 650 CFM max
105 CFM min

VAV Box Sizing

Room	CFM	Box Size	Air Flow	
			Max	Min
Elec. Rm - 1st Floor	45	4	100	*0
Elec. Rm - 2nd Floor	650	6	650	*0
Elec. Rm - 3rd Floor	145	5	145	*0
Elec. Rm - 4th Floor	45	4	100	*0

* All VAV boxes are specified as 0 shut-off

To size the duct, I used TRANE Company Commercial Application "Ductulator". The Ductulator gave me an air flow rate and size of duct when friction loss (stated above in the assumptions) and max CFM are input. The following table summarizes the duct sizing:

Duct Sizing

Room	CFM	Duct Size	Air Speed* (ft/min)
Elec. Rm - 1st Floor	45	4" Φ	550
Elec. Rm - 2nd Floor	650	12"x10"	850
Elec. Rm - 3rd Floor	145	6" Φ	650
Elec. Rm - 4th Floor	45	4" Φ	550

* 500-900 ft/min is typically a safe range for air speed, but this value can vary depending on the size of the duct (the larger the duct, the faster tolerable air speed).

Conclusions

The mechanical redesign seems to be an overall success. Only one VAV box and associated ductwork needed to be upsized to accommodate for the addition of the 225 KVA transformer in the 2nd floor electrical room. The rest of the VAV boxes were downsized as well as their associated supply and return air ducts. However, I do not expect much of a savings with this change due to the shear magnitude of the project compared to this small analysis.

Report Conclusions

The goals set forth for the redesign of various lighting, electrical, and other architectural engineered systems was a success. I was able to create a lighting design that was both aesthetically pleasing and efficient. Both lighting spaces had improved performance, lowering power densities and increasing light levels where needed. Not only was the quantity of light increased, but the quality of light in each space was improved by the implementation of less obtrusive fixtures visually as well as the use of fixtures with better quality light distribution for the given space geometry. By researching the existing conditions and determining possible areas for further investigation, I was able to focus my design concepts on the critical aspects and functions of the space. Pairing these concepts with the design criteria set forth by the IESNA Handbook, I was able to most effectively design the space for the functions it must facilitate.

Since a hospital relies so heavily on consistent and effective power supply and distribution, I then investigated two alternate solutions to the existing electrical design to compare the feasibility of either to the existing design. Ultimately, I found the existing design was most advantageous for the client over the two proposed alternatives. However, I was able to present an alternate solution to the problem of emergency generator design and distribution if the client was interested in emergency power isolation from the rest of the hospital. As the hospital grows, the client may want to begin segmenting their emergency power back-up system and will have prior knowledge of the approximate cost and issues associated with such a project.

In this thesis project, I was able to provide stimulating lighting design that complemented the architectural features and did not compete with them. I also was able to investigate several alternative power designs and the effectiveness of the alternatives to the original design presenting valuable information to the client concerning such alternatives.

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Appendix

Fixture Cutsheets

Lighting Fixture Schedule

Type	Description	Manufacturer/Catalog No.	Lamps	CCT	Voltage	Notes
A	2' X 2' DIRECT/INDIRECT RECESSED, MICRO-PERFORATED MESH DIFFUSER, CENTER BASKET, WHITE FINISH, GRID CEILING	DAYBRITE #2TOCG240-PMW-277-1/2-EB	(2) 40WTT5	3500K	277	
B1	4" OPEN DOWNLIGHT, VERTICAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AFV-13DTT-6AR-277	(1) CFL13Q	3500K	277	
B2	4" OPEN DOWNLIGHT, VERTICAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AFV-18TRT-6AR-277	(1) CFL18TRT	3500K	277	
B3	6" OPEN DOWNLIGHT, HORIZONTAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AF-1/26TRT-6AR-277	(1) CFL26TRT	3500K	277	
B4	6" OPEN DOWNLIGHT, HORIZONTAL LAMP, ALUMINUM REFLECTOR AND SELF-FLANGED TRIM	GOTHAM #AF-1/42TRT-6AR-277	(1) CFL42TRT	3500K	277	1
C1	2' RECESSED LINEAR WALLWASH, 2" APERTURE, BLACK METAL DIFFUSER	PEERLESS #LWAR9-G-1-24T5HO-HOL-U2-277	(1) F24T5HO	3500K	277	
C2	4' RECESSED LINEAR WALLWASH, 2" APERTURE, BLACK METAL DIFFUSER	PEERLESS #LWAR9-G-1-28T5-HOL-U4-277	(1) F28T5	3500K	277	
D1	ADJUSTABLE TABLE LAMP, SILVER FINISH, BLUE GLASS REFLECTOR	BERENICE - MEDA & RIZZATTO 1985	(1) 35W GY6.35	3000K	12	
D2	4" RECESSED ADJUSTABLE SPOT, BLACK POWDER-COAT FINISH, WHITE TRIM	ERCO #88111.000	(1) 50W GY6.35	3000K	12	
D3	ADJUSTABLE WALLWASH SPOT, TRACK/CEILING MOUNTED, WHITE FINISH, INTEGRATED ELECTRONIC TRANSFORMER	ERCO #72103.000	(1) 75W GY6.35	3000K	12	2
F1	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,5
F2	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,4
F3	6" COLOR CHANGING LED COVE STRIP, COLOR ADJUSTING CAPABILITIES, VENTED PLASTIC HOUSING	COLOR KINETICS i-COLOR COVE NXT 6"	INCLUDED	1000-10000K	120	3,4

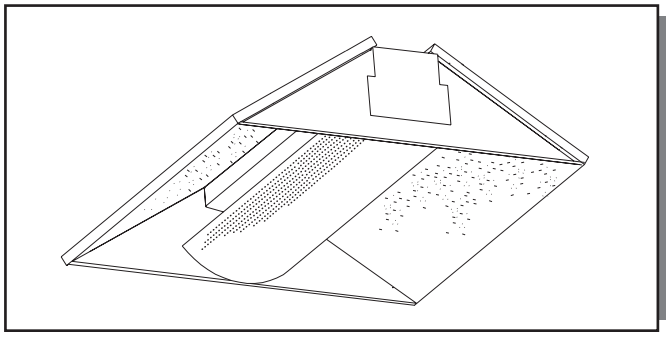
NOTES:

1. PROVIDE DIMMING BALLAST AS SPEC'D WITH FIXTURE IN APPENDIX A
2. FIXTURE COMES WITH 75W OPTION EVEN THOUGH SPEC SHEET DOES NOT REFLECT THAT
3. INTEGRAL STEP-DOWN TRANSFORMER INCLUDED WITH FIXTURES
4. SEE INCLUDED DETAIL OF FIXTURE FOR MOUNTING SPECIFICS
5. PROVIDE NUMBER OF FIXTURES NEEDED FOR LENGTH SHOWN ON DRAWING

Day-Brite® Lighting

Fixture A

Tenuto™



2' x 2'
1 or 2 Lamp
Center Basket
Recessed Direct/Indirect

APPLICATION

- Recessed direct/indirect luminaire for glare-free illumination.
- Fits standard 2' x 2' inverted T-grid (NEMA "G") opening.
- Fully recessed mounting, suitable for row mounting.
- Uses standard 2' x 2' ceiling tile (by others) cut in half as top cover/reflector.
- Ceiling tiles identical to surrounding ceiling can be used to provide a very integrated appearance.
- Different materials, patterns, or colors can be used to create accents or architectural features.
- Economical alternative to traditional recessed direct/indirect luminaires.

CONSTRUCTION/FINISH

- Delivered assembled with ballast channel, end panels, and one-piece perforated lamp cover. Ceiling tile to be supplied by others and installed on site.
- Ballast channel made of code gauge die formed steel.
- Multi-stage phospate treated for maximum corrosion resistance and finish coat is baked white enamel.
- Micro-perforated, center mounted lamp cover provides soft awareness to light source.
- Soft white overlay on inside of lamp cover conceals lamp image and balances between direct and reflected light.
- Easy ballast access through lamp compartment.
- Swing down lamp cover for easy relamping.

ELECTRICAL

- UL listed for damp locations.
- Class P, HPF ballasts comply with Ⓔ Federal Ballast Law (public law 100-357, 1988).
- Self contained emergency power pack can be incorporated. UL listed for dry locations.
- Power-Connect modular wiring option available for continuous row applications (see sheet 1604-OA).
- Electronic ballast standard for maximum efficiency.

CATALOG NUMBER

2	TO	C	G			–	PMW	–		–		–	

WIDTH
2'

FIXTURE FAMILY
TO– Tenuto

BASKET LOCATION
C – Center

CEILING TYPE
G - Grid

NO. OF LAMPS
(not included)
1
2

LAMP TYPE/WATTAGE
14 – 14wT5 (22")
17 – 17wT8 (24")
24HO – 24wT5HO (22")
CF40 – 40wTT5 (22-1/2")
CF50 – 50wTT5 (22-1/2")
CF55 – 55wTT5 (22-1/2")

SHIELDING
PMW – Perforated Metal with White Overlay

VOLTAGE
120
277
347 (consult factory for availability)
UNV - Universal voltage, 120-277 volt (T8 and 40wTT5 only)

BALLAST
Generic Electronic Ballasts
(Brand selected by Day-Brite)
Suffix Catalog # with
– **Ballast Quantity** – ___ / ___ -EB **Lamps Per Ballast.**

Example: –1/1-EB = One 1 Lamp Electronic Ballast.
Example: –1/2-EB = One 2 Lamp Electronic Ballast.

OPTIONS
CM – Canadian Market

JOB INFORMATION

360-AR

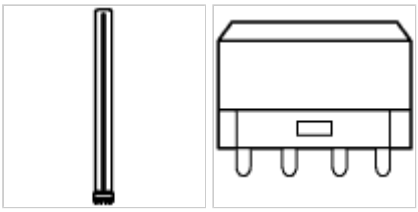
Fixture A Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

Plug-in 4-Pin High Lumen Biax®

Product Code: 16648
Description: F40/30BX/SPX35



Specification:
Firm Name :
Job Name :

General	
Product Code	16648
Description	F40/30BX/SPX35
Subcategory	Plug-in 4-Pin High Lumen Biax®
Physical	
Bulb Type	BiaxL (T5)
Base Type	2G11
Nominal Length (In.)	22.50
Nominal Length (mm)	572
Photometric	
Average Rated Life	20000
Lumens (Initial)	3150
Lumens (Mean)	2840
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Electrical	
Watts	40
Minimum Starting Temp (deg F)	50
Miscellaneous	
Additional Information	NEMA Generic Designation: FT40W/2G11/RS/835
Footnotes	Fluorescent lamp lumens decline during life.Based on 60Hz reference circuit.4-Pin lamp minimum starting temperature is a

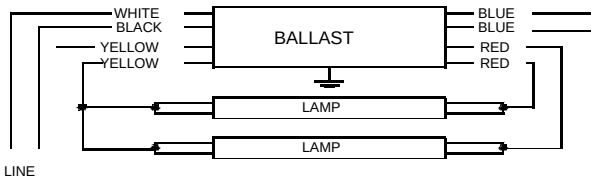
Fixture A Ballast

VOP-4P32-SC	
Brand Name	OPTANIUM
Ballast Type	Electronic
Starting Method	Instant Start
Lamp Connection	Parallel
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* F40T8	2	40	32/00	0.30	81	1.03	10	0.98	1.7	1.27
F40T8	3	40	32/00	0.38	108	0.93	10	0.98	1.7	0.86

Wiring Diagram



Diag. 71A

Insulate unused lead for 1000V

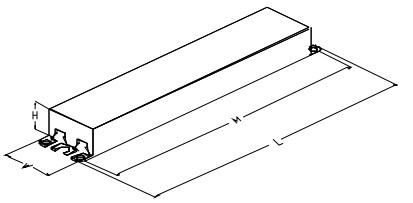
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	25L	63.5
White	25L	63.5
Blue	31R	78.7
Red	31R	78.7
Yellow	39L	99.1
Gray		0
Violet		0

	in.	cm.
Yellow/Blue		0
Blue/White		0
Brown		0
Orange		0
Orange/Black		0
Black/White		0
Red/White		0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
9.50 "	1.7 "	1.18 "	8.90 "
9 1/2	1 7/10	1 9/50	8 9/10
24.1 cm	4.3 cm	3 cm	22.6 cm

Revised 04/28/2005

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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FEATURES

Fixture B1

Type ..... Catalog number .....

OPTICAL

- Reflector – Self-flanged, specular clear or semi-diffuse reflector. Bounding Ray Optical Principle design provides lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish. White painted flange optional. (Vertisys optical system patented – US Patent #5,800,050)
- Baffle– Specular clear upper reflector. Microgroove baffle with white painted flange.

MECHANICAL

- 16-gauge galvanized steel mounting/plaster frame with friction support springs to retain optical system. Accommodates up to 7/8" thick ceiling standard. See Accessories for increased ceiling thickness capability.
- Mounting bars are 16-gauge galvanized steel with continuous 4" vertical adjustment, held in place with tool-less, cam-action locking system. Post installation adjustment possible without the use of tools from above or below the ceiling. Shipped pre-installed.
- Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination ½"-3/4" and three ½" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

ELECTRICAL SYSTEM

- Rugged aluminum lampholder housing designed for positive lamp positioning.
- Vertically mounted, positive-latch thermoplastic socket.
- Class P, thermally-protected, high power factor ballast mounted to the junction box.

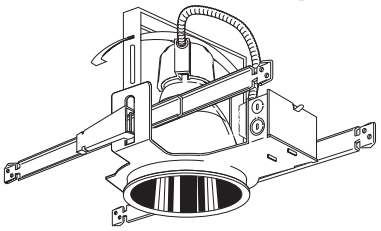
LISTING

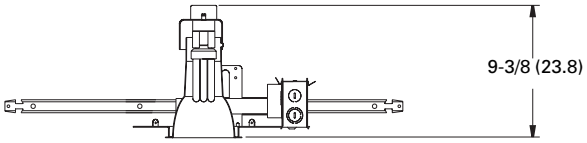
- Fixtures are UL Listed for thru-branch wiring, recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards (see Options).

Compact Fluorescent Lighting

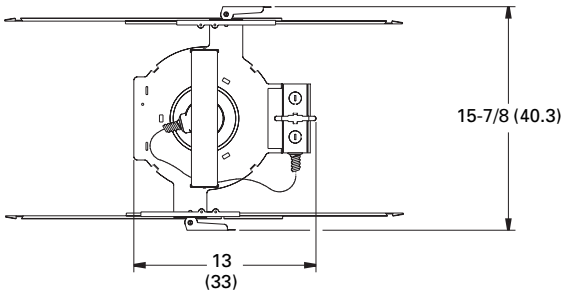
4" AFV

OPEN REFLECTOR
Vertical Lamp





Aperture: 4-5/16 (11)
Ceiling Opening: 5-1/8 (13)
Overlap Trim: 5-7/16 (13.8)



All dimensions are inches (centimeters).

ORDERING INFORMATION

Example: AFV 26TRT 4AR 120 GEB10 WLP

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.

AFV

Series	Wattage/Lamp	Reflector/ Color	Finish	Voltage	Ballast[6]	Options
AFV	13DTT[1] One 13W double twin-tube	4AR Clear	(blank) Specular low iridescent	MVOLT[5]	GEB10 Electronic ballast.	WLP With 35°K lamp (shipped separately).
	18TRT[2] One 18W triple-tube	4PR Pewter	LD Semi-diffuse low iridescent	120	EMB Electromagnetic ballast.	TRW White painted flange.
	26TRT[2] One 26W triple-tube	4UBR Umber		277	ADEZ Advance Mark X electronic dimming ballast. 120V or 277V, 26W only. Minimum dimming level 5%.	ELR Emergency battery pack. Access above ceiling required. Remote test switch provided (consult factory for dimensional changes).
		4WTR Wheat		347		GMF Single, slow-blow fuse (not available with MVOLT).
		4CR[3] Champagne Gold				RIF Radio Interference Filter.
		4GR[3] Gold				LRC[7] Provides compatibility with Lithonia Reloc System.
		4MB[4] Black Baffle				QDS[8] Quick Disconnect for easy ballast replacement.
		4WB[4] White Baffle				CSA Listed and labeled to comply with Canadian Standards.
		4BC[4] Black Cone				

NOTES:
1 Available with electromagnetic or electronic ballast.
2 Available with electronic ballast only.
3 Not recommended for use with compact fluorescent lamp; consult factory.
4 Not available with finishes.
5 Multi-volt electronic ballast capable of operating on any line voltage between 120- and 277-volt.
6 Refer to Options and Accessories tab for additional ballast types.
7 Refer to Options and Accessories tab for compatible Reloc systems.
8 Not available with ELR option.

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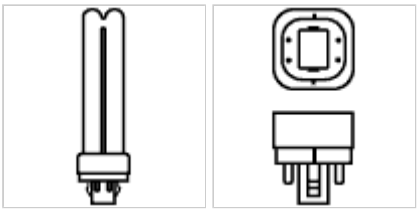
Fixture B1 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

Plug-in 4-Pin Double Biax®

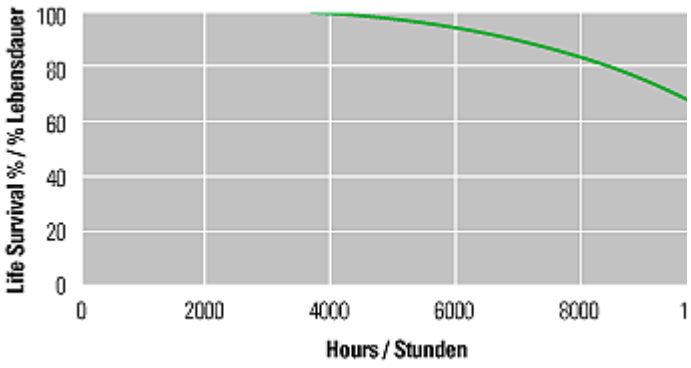
Product Code: 30037
Description: F13DBX/SPX35/835/4P



Specification:
Firm Name :
Job Name :

General	
Product Code	30037
Description	F13DBX/SPX35/4P
Subcategory	Plug-in 4-Pin Double Biax®
Physical	
Bulb Type	BiaxD (T4)
Base Type	G24q-1
Max Overall Length (In.)	4.9
Max Overall Length (mm)	125
Nominal Length (In.)	5.00
Nominal Length (mm)	127
Width of Lamp in inches	1.1
Depth of Lamp in inches	1.1
Base Face to Top of Lamp (In.)	4.4
Photometric	
Average Rated Life	12000
Lumens (Initial)	900
Lumens (Mean)	755
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Nominal Efficacy (Lumens/Watt)	69
Electrical	
Watts	13

Lamp Mortality



Radial Luminous Intensity Distribution

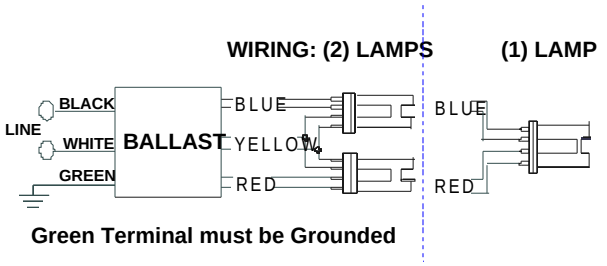
Fixture B1 Ballast

ICF-2S13-H1-LD@120	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	120-277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* CFQ13W/G24Q	1	13	0/-18	0.13	16	1.00	10	0.96	1.5	6.25
CFQ13W/G24q	2	13	0/-18	0.25	29	1.00	10	0.99	1.5	3.45
CFS10W/GR10q	1	10	0/-18	0.11	13	1.05	14	0.96	1.5	8.08
CFS10W/GR10q	2	10	0/-18	0.19	23	0.95	11	0.97	1.5	4.13
CFS16W/GR10q	1	16	0/-18	0.14	17	1.00	12	0.96	1.5	5.88
CFTR13W/GX24Q	1	13	0/-18	0.13	16	1.00	10	0.96	1.5	6.25
CFTR13W/GX24Q	2	13	0/-18	0.25	29	1.00	10	0.99	1.5	3.45

Wiring Diagram



Green Terminal must be Grounded

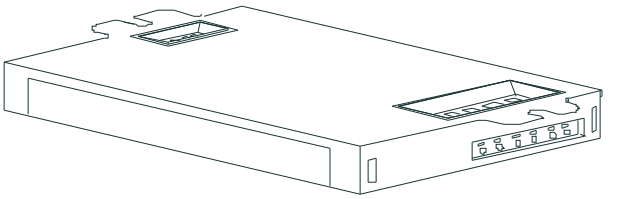
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0.0	
White	0.0	
Blue	0.0	
Red	0.0	
Yellow	0	
Gray		
Violet		

	in.	cm.
Yellow/Blue		
Blue/White		
Brown		
Orange		
Orange/Black		
Black/White		
Red/White		

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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FEATURES

Fixture B2

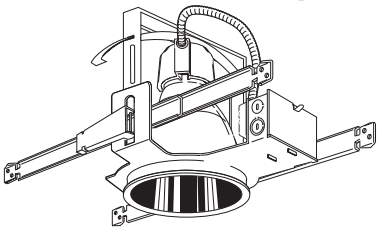
Type ..... Catalog number .....

.....

Compact Fluorescent Lighting

4" AFV

OPEN REFLECTOR
Vertical Lamp



OPTICAL

- Reflector – Self-flanged, specular clear or semi-diffuse reflector. Bounding Ray Optical Principle design provides lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish. White painted flange optional. (Vertisys optical system patented – US Patent #5,800,050)
- Baffle– Specular clear upper reflector. Microgroove baffle with white painted flange.

MECHANICAL

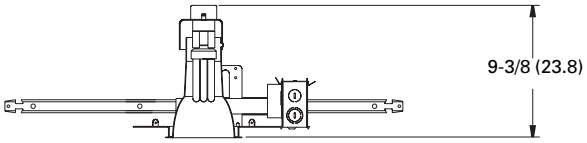
- 16-gauge galvanized steel mounting/plaster frame with friction support springs to retain optical system. Accommodates up to 7/8" thick ceiling standard. See Accessories for increased ceiling thickness capability.
- Mounting bars are 16-gauge galvanized steel with continuous 4" vertical adjustment, held in place with tool-less, cam-action locking system. Post installation adjustment possible without the use of tools from above or below the ceiling. Shipped pre-installed.
- Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination ½"-3/4" and three ½" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors rated for 90°C.

ELECTRICAL SYSTEM

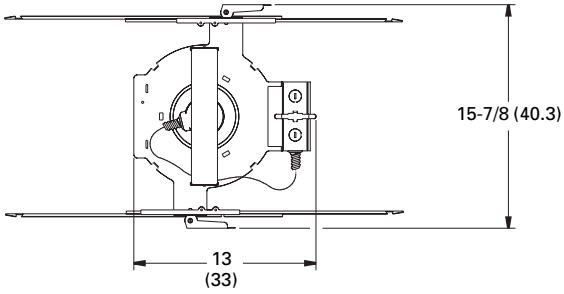
- Rugged aluminum lampholder housing designed for positive lamp positioning.
- Vertically mounted, positive-latch thermoplastic socket.
- Class P, thermally-protected, high power factor ballast mounted to the junction box.

LISTING

- Fixtures are UL Listed for thru-branch wiring, recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards (see Options).



Aperture: 4-5/16 (11)
Ceiling Opening: 5-1/8 (13)
Overlap Trim: 5-7/16 (13.8)



All dimensions are inches (centimeters).

ORDERING INFORMATION

Example: AFV 26TRT 4AR 120 GEB10 WLP

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line.

AFV

Series	Wattage/Lamp	Reflector/ Color	Finish	Voltage	Ballast[6]	Options
AFV	13DTT[1] One 13W double twin-tube	4AR Clear	(blank) Specular low iridescent	MVOLT[5]	GEB10 Electronic ballast.	WLP With 35°K lamp (shipped separately).
	18TRT[2] One 18W triple-tube	4PR Pewter	LD Semi-diffuse low iridescent	120	EMB Electromagnetic ballast.	TRW White painted flange.
	26TRT[2] One 26W triple-tube	4UBR Umber		277	ADEZ Advance Mark X electronic dimming ballast. 120V or 277V, 26W only. Minimum dimming level 5%.	ELR Emergency battery pack. Access above ceiling required. Remote test switch provided (consult factory for dimensional changes).
		4WTR Wheat		347		GMF Single, slow-blow fuse (not available with MVOLT).
		4CR[3] Champagne Gold				RIF Radio Interference Filter.
		4GR[3] Gold				LRC[7] Provides compatibility with Lithonia Reloc System.
		4MB[4] Black Baffle				QDS[8] Quick Disconnect for easy ballast replacement.
		4WB[4] White Baffle				CSA Listed and labeled to comply with Canadian Standards.
		4BC[4] Black Cone				

NOTES:
1 Available with electromagnetic or electronic ballast.
2 Available with electronic ballast only.
3 Not recommended for use with compact fluorescent lamp; consult factory.
4 Not available with finishes.
5 Multi-volt electronic ballast capable of operating on any line voltage between 120- and 277-volt.
6 Refer to Options and Accessories tab for additional ballast types.
7 Refer to Options and Accessories tab for compatible Reloc systems.
8 Not available with ELR option.

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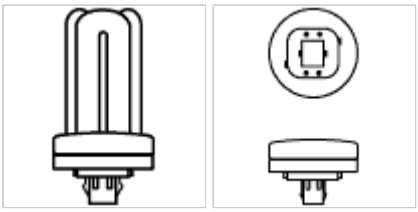
Fixture B2 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

Plug-in 4-Pin Triple Biax®

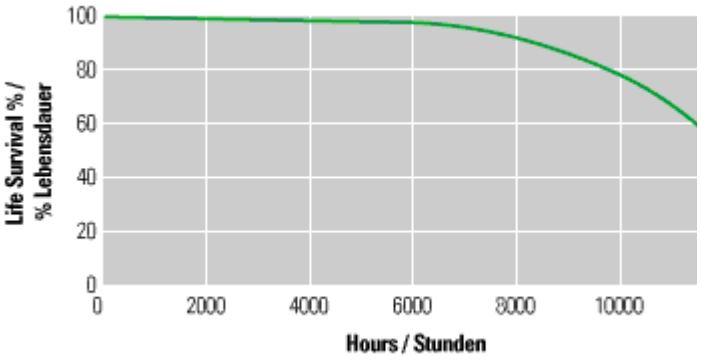
Product Code: 34405
Description: F18TBX/SPX35/835/A/4P



Specification:
Firm Name :
Job Name :

General	
Product Code	34405
Description	F18TBX/SPX35/A/4
Subcategory	Plug-in 4-Pin Triple Biax®
Physical	
Bulb Type	BiaxT (T4)
Base Type	GX24q-2
Max Overall Length (In.)	4.8
Max Overall Length (mm)	122
Nominal Length (In.)	4.80
Nominal Length (mm)	122
Width of Lamp in inches	1.7
Depth of Lamp in inches	1.7
Base Face to Top of Lamp (In.)	4.25
Photometric	
Average Rated Life	12000
Lumens (Initial)	1200
Lumens (Mean)	1010
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Nominal Efficacy (Lumens/Watt)	67
Electrical	
Watts	18

Lamp Mortality



Radial Luminous Intensity Distribution

Fixture B2 Ballast

C218UNV*xxx*

APPLICATION and PERFORMANCE SPECIFICATION

Description: Electronic compact fluorescent ballast(s) for (2/1) CFQ18W/G24q or (2/1) CFM18W/GX24q or (2/1) CFS21W/GR10q (2D) 4 pin lamps

- Line Voltage: 120vac or 277vac, ±10%, 50-60Hz
- High Power Factor
- Programmed Rapid Start
- Series Lamp Connection

Model	Line Volts	Lamp Type	Lamp #	Input Watts	Nominal Line Amps	Ballast Factor	Power Factor	THD	Crest Factor
C218UNV	120	CFQ18W	2	35	0.30	.95	> .98	< 10%	<1.5
	277	CFQ18W	2	35	0.13	.95	> .98	< 10%	<1.5
C218UNV	120	CFQ18W	1	19	0.16	1.00	> .98	< 10%	<1.5
	277	CFQ18W	1	19	0.07	1.00	> .95	< 15%	<1.5
C218UNV	120	CFM18W	2	38	0.32	1.05	> .95	< 15%	<1.5
	277	CFM18W	2	38	0.14	1.05	> .95	< 15%	<1.5
C218UNV	120	CFM18W	1	20	0.17	1.05	> .95	< 15%	<1.5
	277	CFM18W	1	20	0.07	1.05	> .95	< 15%	<1.5
C218UNV	120	CFS21W	2/1	43/24	.37/.18	.95/.98	> .98	< 10%	<1.7
	277	CFS21W	2/1	43/24	.16/.08	.95/.98	> .95	< 15%	<1.7

Application and Performance Specification Information Subject to Change without Notification

Performance:
- Meets ANSI Standard C82.11
- Meets FCC Part 18 (Non-Consumer), Limits for EMI/RFI
- Operating Frequency Range: 50-60 kHz
- **Auto-Reset Shutdown Circuit** per NEMA Recommendations
  - Both lamps should be replaced at end of life
  - Lamp relights upon insertion in socket
- Suitable for use in air handling spaces when NEC wiring guidelines are followed
- ME version: Input Terminals L N G intended for one supply connection only

Safety:
- No PCB's
- UL listed (Class P)
  Type 1 Outdoor, Type CC, Type HL
- CSA Certified

Application:
- Minimum Starting Temperature: 0° F, -18° C
- Maximum Case Temperature (@ t_c): 167° F, 75° C
- Sound Rated: A
- Lead configuration:
  - ***xxx* =** SE - Side Exit
  - *or* BE - Bottom Exit
  - *or* BES - Bottom Exit with Studs (2" on center)
  - *or* ME - Multi-Exit Replacement Kit for Distribution
- Remote Mounting 20 feet
- 18W applications also operate on 125VDC input (+)L (-)N

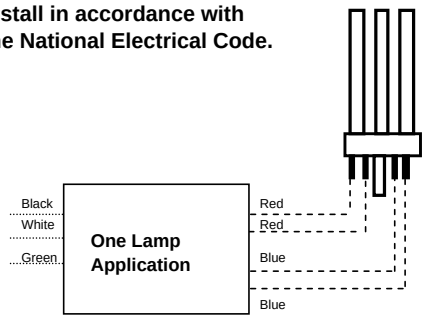
Physical Parameters

Overall Length:	4.94"
Width:	2.31"
Mounting:	4.61"
Height:	1.00"
Weight:	0.57 lbs
Qty/Carton:	20
Color:	SE-White BE/BES-Black ME-White
Can Material:	Metal

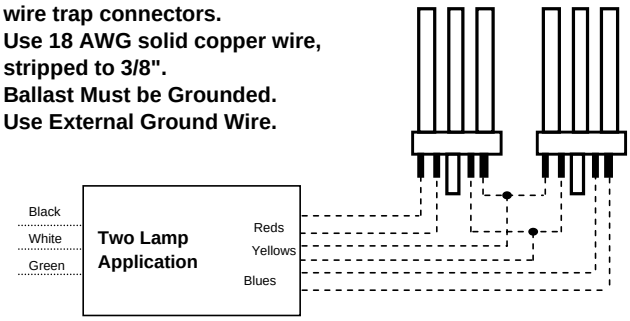
Warranty:
Universal Lighting Technologies warrants to the purchaser that each electronic ballast will be free from defects in material or workmanship for a period of 3 years from date of manufacture when properly installed and under normal conditions of use. Call **1-800-BALLASTx800** for technical assistance.

Manufactured in North America

Install in accordance with the National Electrical Code.



Ballast has plug in wire trap connectors.
Use 18 AWG solid copper wire, stripped to 3/8".
Ballast Must be Grounded.
Use External Ground Wire.



FEATURES

Fixture B3

Catalog number

OPTICAL SYSTEM

- Reflector - Self-flanged, specular clear or semi-diffuse reflector. Fluted vertical upper section works in conjunction with Bounding Ray Optical Principle to provide lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish. White painted flange optional.
- Baffle/cone - Specular clear upper reflector. Microgroove baffle with white painted flange or specular black cone with flange that matches cone finish.
- Hinged lampdoor seals upper trim for optimal fixture efficiency and the reduction of stray light in the plenum.

MECHANICAL

- 16-gauge galvanized steel mounting/plaster frame with integral yoke to retain optical system. Maximum 1-1/2" ceiling thickness.
- Mounting bars are 16-gauge galvanized steel with continuous 4" vertical adjustment, held in place with toolless, integral cam-action locking system. Post installation adjustment possible without the use of tools from above or below the ceiling. Shipped pre-installed.
- Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination 1/2"–3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors, rated for 90°C.

ELECTRICAL SYSTEM

- Horizontally-mounted, four-pin, positive-latch, thermoplastic socket.
- Class P, thermally-protected high power factor electronic ballast mounted to the junction box (CP and EL ballast mounted on ballast tray).

LISTING

- Fixtures are UL listed for thru-branch wiring, recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards (see Options).

ENERGY

LER.DOL	Annual Energy Cost	Lamps	Lamp Lumens	Ballast Factor	Input Watts
41	$5.83	1/26TRT	1800	0.98	27

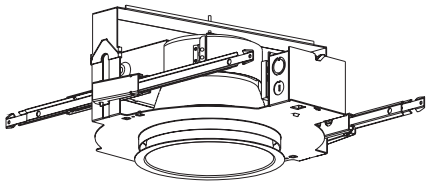
Calculated in accordance with NEMA standard LE-5.

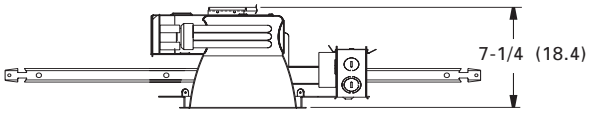
Compact Fluorescent Downlights

6" AF

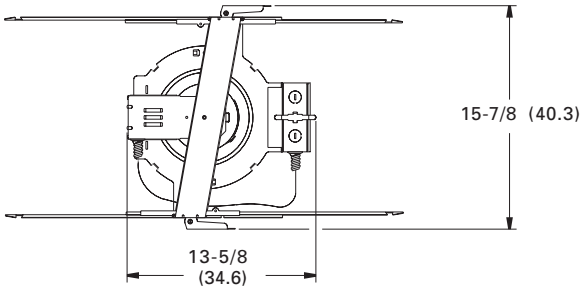
Open Reflector

Horizontal Lamp
Triple-Tube





Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap Trim: 7-1/2 (19.1)



All dimensions are inches (centimeters).

ORDERING INFORMATION

Example: AF 1/26TRT 6AR MVOLT

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number (shipped separately).

AF

Series	Wattage/Lamp	Reflector/Color	Finish	Voltage	Ballast	Options
AF	1/18TRT	6AR Clear	(blank) Specular low iridescent	MVOLT[4]	(blank) GEB10 standard. Electronic ballast.	WLP With 35°K lamp (shipped separately).
	1/26TRT	6PR Pewter	LD Semi-diffuse low iridescent	120	DMHL[5] Lutron Hi-Lume electronic dimming ballast	TRW White flange.
	1/32TRT	6UBR Umber		277	ADEZ[5] Advance Mark X electronic dimming ballast.	EL[6] Emergency battery pack. Integral test switch provided.
	1/42TRT	6WTR Wheat		347		ELR Emergency battery pack. Remote test switch provided.
		6CR Champagne Gold[1]				GMF Single, slow-blow fuse (not available with MVOLT).
		6GR Gold[1]				RIF Radio Interference Filter.
		6MB Black Baffle[2,3]				LRC Provides compatibility with Lithonia Reloc System. Reloc System can be installed less this option with connectors provided by others. Access above ceiling required. For compatible Reloc Systems, see options and accessories tab.
		6BC Black Cone[2]				QDS Quick Disconnect for easy ballast replacement. Not available with EL or ELR option.
						CP Chicago Plenum (consult factory).
						CSA CSA Certified.

NOTES:
1 Not recommended for use with compact fluorescent lamp. Consult factory.
2 Not available with finishes.
3 White flange standard.
4 Multi-volt electronic ballast capable of operating on any line voltage between 120-277 volt.
5 Consult factory for specific availability.
6 Not available with black cone.

Accessories

Order as separate catalog number.

SC6FL Sloped ceiling adaptor. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Ex: SC6FL 10D

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1400 Lester Road Conyers Georgia 30012
P 800 315 4982 F 770 860 3129
www.gothamlighting.com

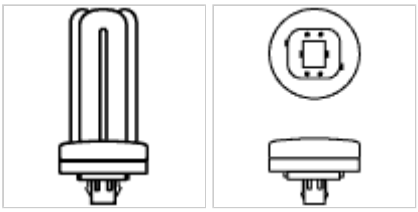
Fixture B3 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

Plug-in 4-Pin Triple Biax®

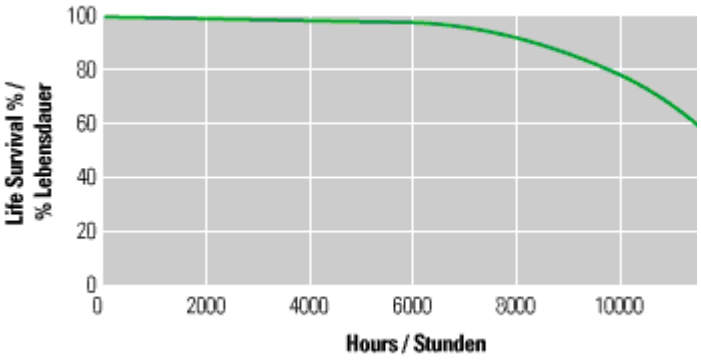
Product Code: 34406
Description: F26TBX/SPX35/835/A/4P



Specification:
Firm Name :
Job Name :

General	
Product Code	34406
Description	F26TBX/SPX35/A/4
Subcategory	Plug-in 4-Pin Triple Biax®
Physical	
Bulb Type	BiaxT (T4)
Base Type	GX24q-3
Max Overall Length (In.)	5.2
Max Overall Length (mm)	132
Nominal Length (In.)	5.20
Nominal Length (mm)	133
Width of Lamp in inches	1.7
Depth of Lamp in inches	1.7
Base Face to Top of Lamp (In.)	4.6
Photometric	
Average Rated Life	12000
Lumens (Initial)	1710
Lumens (Mean)	1440
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Nominal Efficacy (Lumens/Watt)	69
Electrical	
Watts	26

Lamp Mortality



Radial Luminous Intensity Distribution

ADVANCE™

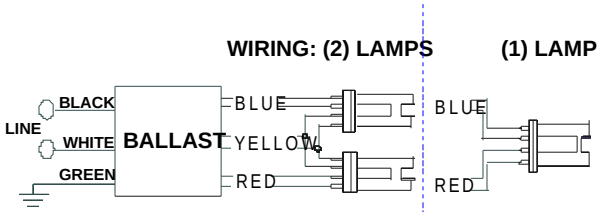
Fixture B3 Ballast

RCF-2S26-H1-LD-QS	
Brand Name	SMARTMATE
Ballast Type	Electronic
Starting Method	Rapid Start
Lamp Connection	Series
Input Voltage	120
Input Frequency	60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
CFQ26W/G24Q	1	26	0/-18	0.23	27	1.00	10	0.98	1.5	3.70
CFQ26W/G24Q	2	26	0/-18	0.43	51	1.00	10	0.99	1.5	1.96
* CFTR26W/GX24Q	1	26	0/-18	0.24	29	1.10	10	0.98	1.5	3.79
CFTR26W/GX24Q	2	26	0/-18	0.45	54	1.00	10	0.98	1.5	1.85
CFTR32W/GX24Q	1	32	0/-18	0.31	36	0.98	10	0.98	1.5	2.72
CFTR42W/GX24Q	1	42	0/-18	0.38	46	0.98	10	0.98	1.5	2.13
FC12T5	1	40	0/-18	0.32	38	0.95	10	0.98	1.5	2.50
FC9T5	1	22	0/-18	0.21	25	1.00	10	0.98	1.5	4.00

Wiring Diagram

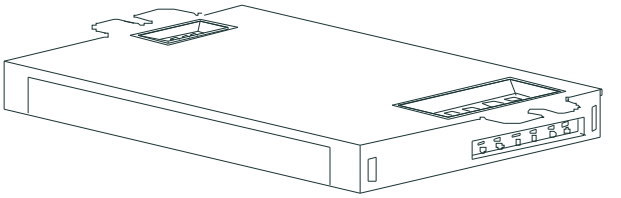


Green Terminal must be Grounded

The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
4.98 "	2.4 "	1.0 "	4.6 "
4 49/50	2 2/5	1	4 3/5
12.6 cm	6.1 cm	2.5 cm	11.7 cm

Revised 09/02/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE TRANSFORMER CO.
O'HARE INTERNATIONAL CENTER · 10275 WEST HIGGINS ROAD · ROSEMONT, IL 60018
Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

FEATURES

Fixture B4

Catalog number

OPTICAL SYSTEM

- Reflector - Self-flanged, specular clear or semi-diffuse reflector. Fluted vertical upper section works in conjunction with Bounding Ray Optical Principle to provide lamp before lamp image and smooth transition from top of reflector to bottom. Minimum flange matches reflector finish. White painted flange optional.
- Baffle/cone - Specular clear upper reflector. Microgroove baffle with white painted flange or specular black cone with flange that matches cone finish.
- Hinged lampdoor seals upper trim for optimal fixture efficiency and the reduction of stray light in the plenum.

MECHANICAL

- 16-gauge galvanized steel mounting/plaster frame with integral yoke to retain optical system. Maximum 1-1/2" ceiling thickness.
- Mounting bars are 16-gauge galvanized steel with continuous 4" vertical adjustment, held in place with toolless, integral cam-action locking system. Post installation adjustment possible without the use of tools from above or below the ceiling. Shipped pre-installed.
- Galvanized steel junction box with bottom-hinged access covers and spring latches. Two combination 1/2"–3/4" and three 1/2" knockouts for straight-through conduit runs. Capacity: 8 (4 in, 4 out) No. 12 AWG conductors, rated for 90°C.

ELECTRICAL SYSTEM

- Horizontally-mounted, four-pin, positive-latch, thermoplastic socket.
- Class P, thermally-protected high power factor electronic ballast mounted to the junction box (CP and EL ballast mounted on ballast tray).

LISTING

- Fixtures are UL listed for thru-branch wiring, recessed mounting and damp locations. Listed and labeled to comply with Canadian Standards (see Options).

ENERGY

LER.DOL	Annual Energy Cost	Lamps	Lamp Lumens	Ballast Factor	Input Watts
41	$5.83	1/26TRT	1800	0.98	27

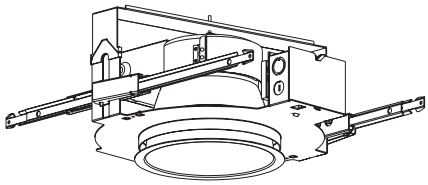
Calculated in accordance with NEMA standard LE-5.

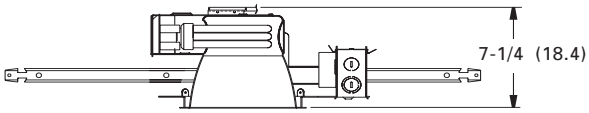
Compact Fluorescent Downlights

6" AF

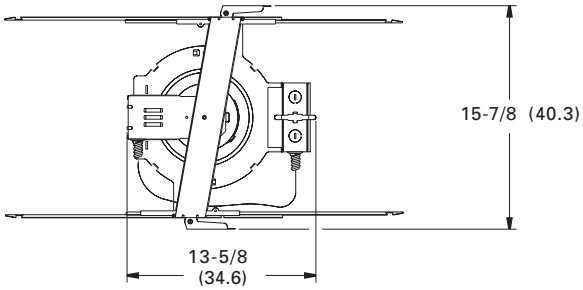
Open Reflector

Horizontal Lamp
Triple-Tube





Aperture: 6-1/4 (15.9)
Ceiling Opening: 7-1/8 (18.1)
Overlap Trim: 7-1/2 (19.1)



All dimensions are inches (centimeters).

ORDERING INFORMATION

Example: AF 1/26TRT 6AR MVOLT

Choose the boldface catalog nomenclature that best suits your needs and write it on the appropriate line. Order accessories as separate catalog number (shipped separately).

AF

Series	Wattage/Lamp	Reflector/Color	Finish	Voltage	Ballast	Options
AF	1/18TRT	6AR Clear	(blank) Specular low iridescent	MVOLT[4]	(blank) GEB10 standard. Electronic ballast.	WLP With 35°K lamp (shipped separately).
	1/26TRT	6PR Pewter	LD Semi-diffuse low iridescent	120	DMHL[5] Lutron Hi-Lume electronic dimming ballast	TRW White flange.
	1/32TRT	6UBR Umber		277	ADEZ[5] Advance Mark X electronic dimming ballast.	EL[6] Emergency battery pack. Integral test switch provided.
	1/42TRT	6WTR Wheat		347		ELR Emergency battery pack. Remote test switch provided.
		6CR Champagne Gold[1]				GMF Single, slow-blow fuse (not available with MVOLT).
		6GR Gold[1]				RIF Radio Interference Filter.
		6MB Black Baffle[2,3]				LRC Provides compatibility with Lithonia Reloc System. Reloc System can be installed less this option with connectors provided by others. Access above ceiling required. For compatible Reloc Systems, see options and accessories tab.
		6BC Black Cone[2]				QDS Quick Disconnect for easy ballast replacement. Not available with EL or ELR option.
						CP Chicago Plenum (consult factory).
						CSA CSA Certified.

NOTES:
1 Not recommended for use with compact fluorescent lamp. Consult factory.
2 Not available with finishes.
3 White flange standard.
4 Multi-volt electronic ballast capable of operating on any line voltage between 120-277 volt.
5 Consult factory for specific availability.
6 Not available with black cone.

Accessories

Order as separate catalog number.

SC6FL Sloped ceiling adaptor. Degree of slope must be specified (10D, 15D, 20D, 25D, 30D). Ex: SC6FL 10D

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www.gothamlighting.com

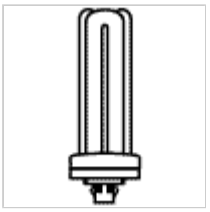
Fixture B4 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

Plug-in 4-Pin Triple Biax®

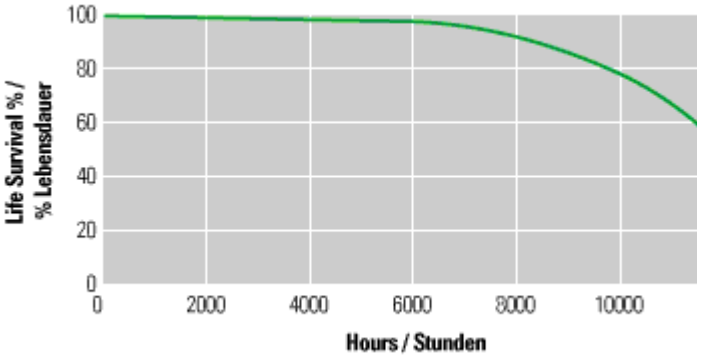
Product Code: 46314
Description: F42TBX835A4P/EOL



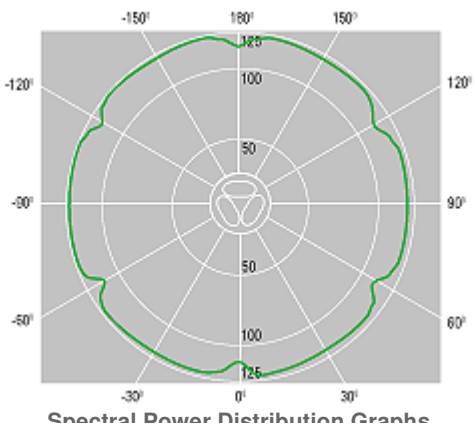
Specification:
Firm Name :
Job Name :

General	
Product Code	46314
Description	F42TBX835A4P/EOL
Subcategory	Plug-in 4-Pin Triple Biax®
Physical	
Bulb Type	BiaxT (T4)
Base Type	GX24-q4
Max Overall Length (In.)	6.4
Max Overall Length (mm)	163
Nominal Length (In.)	6.40
Nominal Length (mm)	163
Width of Lamp in inches	1.7
Depth of Lamp in inches	1.5
Base Face to Top of Lamp (In.)	5.77
Photometric	
Average Rated Life	12000
Lumens (Initial)	3200
Lumens (Mean)	2690
Color Temperature (K)	3500
Color Rendering Index (Ra) CRI	82
Nominal Efficacy (Lumens/Watt)	76
Electrical	
Watts	42
Minimum Starting Temp (deg F)	-.4
Nominal Lamp Operating Frequency (Hz)	20000
Cold Cathode Resistance (Rc)	2.7

Lamp Mortality



Radial Luminous Intensity Distribution



Spectral Power Distribution Graphs

Compact SE Overview

Fixture B4 Ballast

For designs requiring the energy savings and aesthetic appeal of dimmed T4 compact fluorescent or T5 twin-tube lamps, Compact SE dimming ballasts are your solution. The Compact SE product family includes ballasts for nearly every type of dimmable compact fluorescent lamp.

Compact SE, case type A
3.00"w (76mm) x 1.00"h (25mm) x 4.90"l (124mm)

Compact SE, case type B
3.00"w (76mm) x 1.00"h (25mm) x 6.75"l (171mm)

Compact SE, case type F
2.38"w (60mm) x 1.50"h (38mm) x 9.50"l (241mm)

Features

- Continuous, flicker-free dimming from 100% to 5%
- Standard 3-wire line-voltage phase-control technology for consistent fixture-to-fixture dimming performance
- Models for 4-pin T4 compact lamps and T5 twin-tube lamps
- Programmed rapid start design will preheat lamp cathodes before applying full arc voltage
- Lamps turn on to any dimmed level without flashing 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 and 42 kHz
- Inrush current limiting circuitry eliminate circuit breaker tripping, switch arcing, and relay failure
- End-of-lamp-life protection circuitry ensures safe operation throughout entire lamp life cycle
- Ultra quiet operation
- Protected from miswires of any input power to control lead, or lamp leads to each other or ground
- 100% compatible with all Lutron 3-wire fluorescent controls
- 100% performance tested at factory
- Designed and assembled in the USA
- 5-year limited warranty with Lutron field service commissioning (3-year standard warranty) from date of purchase
- Ballasts that dim T4 compact fluorescent lamps are intended for factory installation by OEM fixture manufacturer.

Specifications

Fixture B4 Ballast

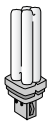
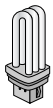
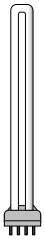
Performance

- Dimming Range: 100% to 5% measured relative light output (RLO)
- Lamp Starting: programmed rapid start
- Minimum Lamp Starting Temperature: 10°C (50°F)
- Ambient Temperature Operating Range: 10°C (50°F) to 60°C (140°F)
- Relative Humidity: maximum 90% non-condensing
- Operating Voltage: 120V or 277V at 60Hz
- Lamp Current Crest Factor: less than 1.7
- Lamp Flicker: none visible
- Light Output: constant ±2% light output for line voltage variations of ±10%
- Lamp Life: average lamp life meets or exceeds rating of lamp manufacturer
- Ballast Factor: greater than .95 for T4 quad or triple tube lamps, and greater than .85 for T5 twin-tube lamps
- Power Factor: greater than .95
- Total Harmonic Distortion (THD): less than 10%
- Maximum Inrush Current: 7 amps per ballast at 120V, 3 amps per ballast at 277V
- Sound Rating: Inaudible in a 27dBa ambient
- Maximum Ballast Case Temperature: 75°C (167°F)

Standards

- 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 for EMI/RFI emissions requirements
- T4 compact fluorescent ballasts are MIL Std. 461E compliant (meets the requirements of CE101, RE101 and RE102)
- Meets ANSI C62.41 Category A surge protection standards to 6kV
- Manufacturing facilities employ ESD reduction practices that comply with the requirements of ANSI/ESD S20.20
- Lutron Quality Systems registered to ISO 9001

Compact SE Ballast Models **Fixture B4 Ballast**

Lamp Type	Lamp Watts	Lamps per ballast	Case Type	120 VOLTS Ballast Current (amps)	120 VOLTS **Compact SE** Model Number [1]	277 VOLTS Ballast Current (amps)	277 VOLTS **Compact SE** Model Number [1]
T4 4-Pin Quad-Tube  1/2" diameter	18W	1	A	.20	FDB-T418-120-1-S	.08	FDB-T418-277-1-S
		2	B	.42	FDB-T418-120-2-S	.17	FDB-T418-277-2-S
	26W	1	A	.26	FDB-T426-120-1-S	.12	FDB-T426-277-1-S
		2	B	.50	FDB-T426-120-2-S	.21	FDB-T426-277-2-S
T4 4-Pin Triple-Tube  1/2" diameter	18W	1	A	.20	FDB-T418-120-1-S	.08	FDB-T418-277-1-S
		2	B	.42	FDB-T418-120-2-S	.17	FDB-T418-277-2-S
	26W	1	A	.26	FDB-T426-120-1-S	.12	FDB-T426-277-1-S
		2	B	.50	FDB-T426-120-2-S	.21	FDB-T426-277-2-S
	32W	1	A	.31	FDB-T432-120-1-S	.13	FDB-T432-277-1-S
		2	B	.59	FDB-T432-120-2-S	.24	FDB-T432-277-2-S
	42W	1	B	.36	FDB-T442-120-1-S	.16	FDB-T442-277-1-S
		2	B	.67	FDB-T442-120-2-S	.29	FDB-T442-277-2-S
T5 Twin-Tube  5/8" diameter	36/39W (16")	1	F	.33	FDB-1643-120-1	.14	FDB-1643-277-1
		2	F	.58	FDB-1643-120-2	.25	FDB-1643-277-2
		3	F	.85	FDB-1643-120-3	.35	FDB-1643-277-3
	40W (22")	1	F	.33	FDB-2227-120-1	.14	FDB-2227-277-1
		2	F	.61	FDB-2227-120-2	.25	FDB-2227-277-2
		3	F	.88	FDB-2227-120-3	.38	FDB-2227-277-3
	50W (22")	1	F	.38	FDB-2243-120-1	.17	FDB-2243-277-1
		2	F	.69	FDB-2243-120-2	.32	FDB-2243-277-2

[1] Mounting studs standard for T4 ballasts. Delete suffix -S in the model number if mounting studs not needed.

LIGHTLINE™ WALL WASH

Fixture C1

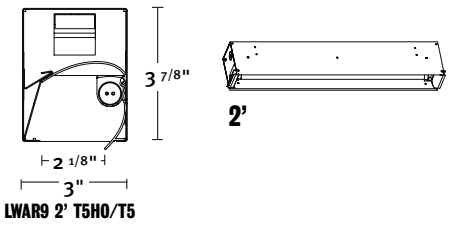
PEERLESS®

2” Aperture

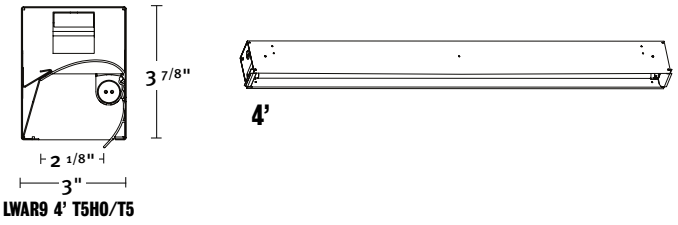
Recessed Mount Wall Wash

SPECIFICATIONS

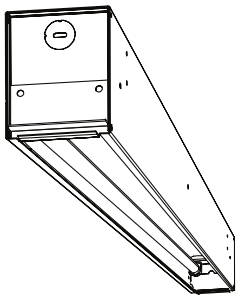
AVAILABLE FIXTURE



LWAR9 2’ T5HO/T5



LWAR9 4’ T5HO/T5



CONSTRUCTION

Housing is formed from painted cold-rolled steel. Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with high-gloss baked enamel.

REFLECTORS

Extruded aluminum, two component, specular asymetric vacuum metalized reflector system. Black metal diffuser with round holes. Lower extruded aluminum reflector.

ELECTRICAL

Specify 120 volt , 277 volt, or 347 volt. Non EL versions damp location labeled. UL and C-UL listed and labeled.
For special circuiting, consult factory.

FIXTURE SIZE

Nominal 2” aperture. 2’ and 4’ lengths available.

ORDERING LOGIC

Quantity	Fixture	Ceiling Type	# of Lamps in Cross Section	Lamp Type	Reflector/Shielding	Nominal Length	Voltage	Ballast Type	Emergency Options	Lamp Color	Options
	LWAR9		1								

- **LWAR9** – Asymetric recessed
- **G** – Lay in grid; **ST** – Screw Slot
- **24T5HO** – 24W 2’ T5HO; **54T5HO** – 54W 4’ T5HO; **28T5** – 28W 4’ T5; **14T5** – 14W 2’ T5
- **HOL** – Black Metal Diffuser with Round Holes
- **U2** – 2’; **U4** – 4’
- **120**; **277**; **347**
- **GEB10** – 10% THD Ballast (consult factory); **OSDIM** – Osram Dimming Ballast*
- **EL** – Emergency Battery Pack (390-700 lumens)**
- **L/LP** – No Lamp; **LP830** 3000k 80+ CRI; **LP835** 3500k 80+ CRI; **LP840** 4000k 80+ CRI
- **GMF** – Slow Blow Fuse; **LST** – Labor Saving Tandam[t]; **CP** – Chicago Plenum

Accessories (order separately)
DHSG2*** - Drywall housing 2’
DHSG4*** - Drywall housing 4’

* Only available with 54T5HO
** Only available with 28T5 & 54T5HO
*** Use with “G” trim type
t Option available on select models. Order fixtures in pairs. Factory will supply correct number of Master and Satellite units. 9’ cable standard.

EXAMPLE:

Qty	Fixture section
4	LWAR9 ST 1 54T5HO HOL U4 120 GEB10 L/LP
1	LWAR9 G 1 14T5 HOL U2 277 GEB10 LP835

Peerless Lighting reserves the right to change materials or modify the design of its product without notification as part of the company’s continuing product improvement program.

PEERLESS LIGHTING Box 2556, Berkeley, CA 94702-0556 510.845-2760 Fax 510.845-2776 www.peerless-lighting.com

LLWW-1

ITEM #: _____

Fixture C1 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

T5 Starcoat High Output

Product Code: 46700
Description: F24W/T5/835/ECO

Specification:
Firm Name :
Job Name :

General	
Product Code	46700
Description	F24W/T5/835/ECO
Subcategory	T5 Starcoat High Output
Physical	
Bulb Type	T5
Base Type	Miniature BiPin (G5)
Bulb Material	Soft Glass
Nominal Length (In.)	21.60
Nominal Length (mm)	550
Max Overall Length (In.)	22.173
Bulb Nominal Diameter in inches	.625
Max bulb diameter	.67
Max Face to End of Opposing Pin (B)	21.89
Min Face to End of Opposing Pin (B)	21.8
Photometric	
Lumens (Initial)	2000
Lumens (Mean)	1880
Color Temperature (K)	3500
Nominal Efficacy (Lumens/Watt)	83
Electrical	
Average Rated Life	20000
Watts	24
Nominal Lamp Volts	75
Nominal Lamp Operating Frequency (Hz)	20000
Minimum Starting Temp (deg F)	5
Min. Terminal to Terminal Starting Lamp Voltage (Vrms)- Instant Start at 15°C	350
Min. Terminal to Terminal	280

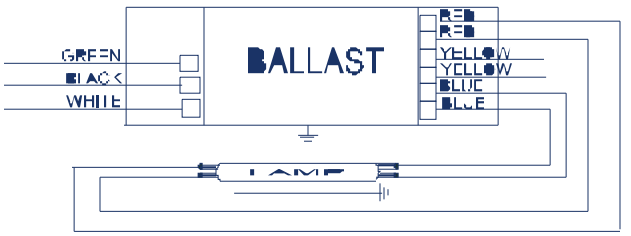
Fixture C1 Ballast

ICN-2S24@277V	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
* F24T5/HO	1	0	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
F24T5/HO	2	0	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
F39T5/HO	1	39	0/-18	0.15	40	0.90	10	0.98	1.7	2.25
FC12T5	1	40	0/-18	0.15	40	0.84	10	0.98	1.7	2.10
FC9T5	1	22	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
FC9T5	2	22	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
FT24W/2G11	1	24	0/-18	0.10	27	1.02	10	0.98	1.7	3.78
FT24W/2G11	2	24	0/-18	0.19	52	1.00	10	0.98	1.7	1.92
FT36W/2G11	1	36	0/-18	0.13	34	0.90	10	0.98	1.7	2.65
FT40W/2G11/RS	1	40	0/-18	0.17	47	1.00	10	0.98	1.7	2.13

Wiring Diagram



For 1 lamp operation, do not use yellow leads

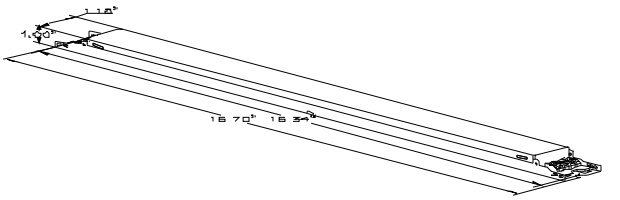
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray	0	0
Violet	0	0

	in.	cm.
Yellow/Blue	0	0
Blue/White	0	0
Brown	0	0
Orange	0	0
Orange/Black	0	0
Black/White	0	0
Red/White	0	0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
16.70 "	1.18 "	1.00 "	16.34 "
16 7/10	1 9/50	1	16 17/50
42.4 cm	3 cm	2.5 cm	41.5 cm

Revised 09/01/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

ADVANCE TRANSFORMER CO.
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Customer Support/Technical Service: Phone: 800-372-3331 · Fax: 630-307-3071
Corporate Offices: Phone: 800-322-2086

LIGHTLINE™ WALL WASH

Fixture C2

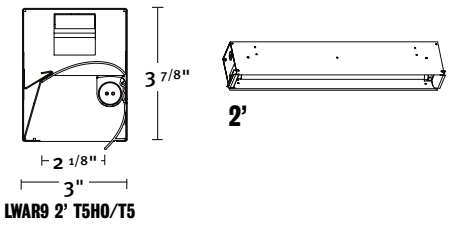
PEERLESS®

2” Aperture

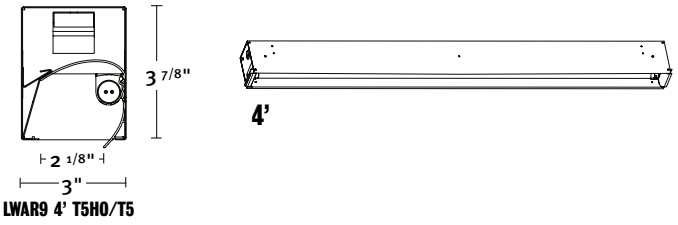
Recessed Mount Wall Wash

SPECIFICATIONS

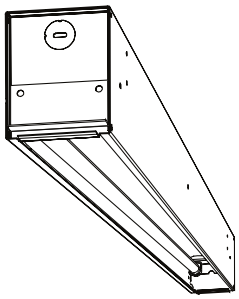
AVAILABLE FIXTURE



LWAR9 2’ T5HO/T5



LWAR9 4’ T5HO/T5



CONSTRUCTION

Housing is formed from painted cold-rolled steel. Five-stage iron-phosphate pretreatment ensures superior paint adhesion and rust resistance. Painted parts finished with high-gloss baked enamel.

REFLECTORS

Extruded aluminum, two component, specular asymetric vacuum metalized reflector system. Black metal diffuser with round holes. Lower extruded aluminum reflector.

ELECTRICAL

Specify 120 volt , 277 volt, or 347 volt. Non EL versions damp location labeled. UL and C-UL listed and labeled.
For special circuiting, consult factory.

FIXTURE SIZE

Nominal 2” aperture. 2’ and 4’ lengths available.

ORDERING LOGIC

Quantity	Fixture	Ceiling Type	# of Lamps in Cross Section	Lamp Type	Reflector/Shielding	Nominal Length	Voltage	Ballast Type	Emergency Options	Lamp Color	Options
			1								

- **Fixture:** LWAR9 – Asymetric recessed
- **Ceiling Type:** G – Lay in grid; ST – Screw Slot
- **Lamp Type:** 24T5HO – 24W 2’ T5HO; 54T5HO – 54W 4’ T5HO; 28T5 – 28W 4’ T5; 14T5 – 14W 2’ T5
- **Reflector/Shielding:** HOL – Black Metal Diffuser with Round Holes
- **Nominal Length:** U2 – 2’; U4 – 4’
- **Voltage:** 120; 277; 347
- **Ballast Type:** GEB10 – 10% THD Ballast (consult factory); OSDIM – Osram Dimming Ballast*
- **Emergency Options:** EL – Emergency Battery Pack (390-700 lumens)**
- **Lamp Color:** L/LP – No Lamp; LP830 3000k 80+ CRI; LP835 3500k 80+ CRI; LP840 4000k 80+ CRI
- **Options:** GMF – Slow Blow Fuse; LST – Labor Saving Tandam[t]; CP – Chicago Plenum

Accessories (order separately)
DHSG2*** - Drywall housing 2’
DHSG4*** - Drywall housing 4’

* Only available with 54T5HO
** Only available with 28T5 & 54T5HO
*** Use with “G” trim type
t Option available on select models. Order fixtures in pairs. Factory will supply correct number of Master and Satellite units. 9’ cable standard.

EXAMPLE:

Qty	Fixture section
4	LWAR9 ST 1 54T5HO HOL U4 120 GEB10 L/LP
1	LWAR9 G 1 14T5 HOL U2 277 GEB10 LP835

PEERLESS LIGHTING Box 2556, Berkeley, CA 94702-0556 510.845-2760 Fax 510.845-2776 www.peerless-lighting.com

ITEM #: _____

Fixture C2 Lamp

GE Consumer & Industrial Lighting

Lighting Specification Bulletin

T5 Starcoat High Efficiency

Product Code: 46705
Description: F28W/T5/835/ECO

Specification:
Firm Name :
Job Name :

General	
Product Code	46705
Description	F28W/T5/835/ECO
Subcategory	T5 Starcoat High Efficiency
Physical	
Bulb Type	T5
Base Type	Miniature BiPin (G5)
Bulb Material	Soft Glass
Nominal Length (In.)	45.20
Nominal Length (mm)	1150
Max Overall Length (In.)	45.795
Bulb Nominal Diameter in inches	.625
Max bulb diameter	.67
Max Face to End of Opposing Pin (B)	45.42
Min Face to End of Opposing Pin (B)	45.42
Photometric	
Lumens (Initial)	2900
Lumens (Mean)	2726
Color Temperature (K)	3500
Nominal Efficacy (Lumens/Watt)	104
Electrical	
Average Rated Life	20000
Watts	28
Nominal Lamp Volts	167
Nominal Lamp Operating Frequency (Hz)	20000
Minimum Starting Temp (deg F)	5
Min. Terminal to Terminal Starting Lamp Voltage (Vrms)- Instant Start at 15°C	530
Min. Terminal to Terminal	425

ADVANCE™

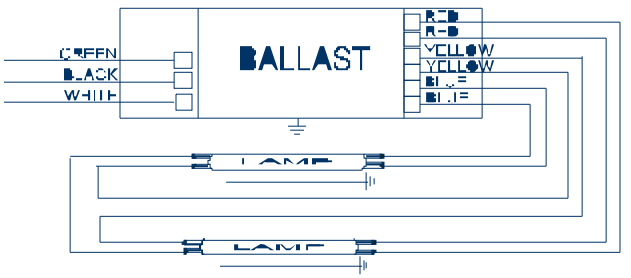
Fixture C2 Ballast

ICN-2S28@277	
Brand Name	CENTIUM T5
Ballast Type	Electronic
Starting Method	Programmed Start
Lamp Connection	Series
Input Voltage	277
Input Frequency	50/60 HZ
Status	Active

Electrical Specifications

Lamp Type	Num. of Lamps	Rated Lamp Watts	Min. Start Temp (°F/C)	Input Current (Amps)	Input Power (ANSI Watts)	Ballast Factor	MAX THD %	Power Factor	MAX Lamp Current Crest Factor	B.E.F.
F14T5	1	14	0/-18	0.07	19	1.07	20	0.90	1.7	5.63
F14T5	2	14	0/-18	0.13	34	1.06	10	0.98	1.7	3.12
F21T5	1	21	0/-18	0.10	26	1.03	15	0.95	1.7	3.96
F21T5	2	21	0/-18	0.17	48	1.02	10	0.98	1.7	2.13
F28T5	1	28	0/-18	0.12	33	1.04	10	0.98	1.7	3.15
* F28T5	2	28	0/-18	0.23	63	1.03	10	0.99	1.7	1.63
F35T5	1	35	0/-18	0.15	41	1.01	10	0.98	1.7	2.46
F35T5	2	35	0/-18	0.28	77	1.00	10	0.99	1.7	1.30

Wiring Diagram



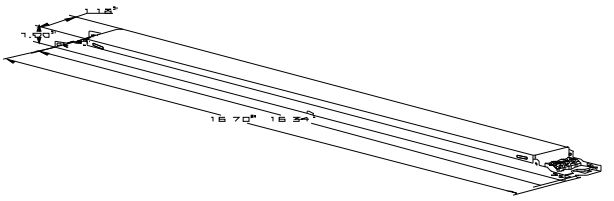
The wiring diagram that appears above is for the lamp type denoted by the asterisk (*)

Standard Lead Length (inches)

	in.	cm.
Black	0	0
White	0	0
Blue	0	0
Red	0	0
Yellow	0	0
Gray	0	0
Violet	0	0

	in.	cm.
Yellow/Blue	0	0
Blue/White	0	0
Brown	0	0
Orange	0	0
Orange/Black	0	0
Black/White	0	0
Red/White	0	0

Enclosure



Enclosure Dimensions

OverAll (L)	Width (W)	Height (H)	Mounting (M)
16.70 "	1.18 "	1.00 "	16.34 "
16 7/10	1 9/50	1	16 17/50
42.4 cm	3 cm	2.5 cm	41.5 cm

Revised 09/01/2004

Data is based upon tests performed by Advance Transformer in a controlled environment and representative of relative performance. Actual performance can vary depending on operating conditions. Specifications are subject to change without notice. All specifications are nominal unless otherwise noted.

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Corporate Offices: Phone: 800-322-2086

BERENICE

Alberto Meda, Paolo Rizzatto 1985

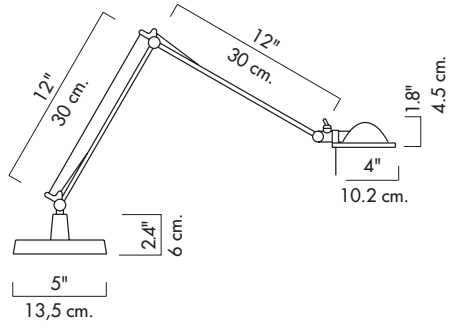
XIV Compasso d'Oro, ADI/Milano: Selection 1987

Fixture D1

TABLE

D12 pi.

Metal parts in die-cast aluminum.
Friction joints in stiffened nylon.
Rynite head.
Aluminum body finishes: silver or black.
Reflector in green or blue pressed glass with enamelled white interior, or in black or silver metal.
Anti-UV protection glass.



D12/4
D12/5

35W/12V
Halogen-frosted
Bi-Pin T3 GY6.35

Product Information Bulletin

SYLVANIA BI-PIN

Low Voltage Halogen Lamps

Fixture D1 Lamp

The SYLVANIA family of BI-PIN lamps represents an outstanding collection of compact, low voltage halogen light sources ideal for a wide range of applications.

Top of the line BI-PIN IR lamps have an infrared reflective coating on the outside of the capsule to conserve heat energy and create a more efficient source. With an axial filament for easy focusing and a 4000 hour life these lamps are suitable for either saving energy or increasing light output from existing fixtures without increasing energy costs.

High performance axial filament STARLITE lamps enable the design of efficient reflector systems that are easy to focus, resulting in better quality light on the target. These long life efficient lamps meet the needs of all residential, commercial and industrial bi-pin applications.

All SYLVANIA BI-PIN lamps utilize advanced UV-stop quartz that reduces UV-B and UV-C radiation by 90% compared to regular quartz. In addition, the IR coating on BI-PIB IR lamps further reduces this spectrum, effectively eliminating all UV-B and UV-C radiation from those capsules.

All 6V and 12V SYLVANIA BI-PIN lamps are low-pressure, low-voltage capsules. Because of this, these lamps are suitable for use without shielding.* The 24V SYLVANIA BI-PIN lamps are high-pressure capsules, and a suitable protective shield is required with these lamp types.

A complete family of BI-PIN halogen lamps to meet the various needs of designers and end users:

IR
- Axial filament
- 4000-hour average rated lamp life
- UV stop quartz capsule
- Low pressure
- Energy saving IR technology
- No UV-B or UV-C Light output
- Suitable for use without shielding*

STARLITE
- Axial filament
- 4000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- Suitable for use without shielding*

STANDARD
- Clear and frosted
- 2000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- 6V and 12V suitable for use without shielding*

Product Availability

Watts	STARLITE	STANDARD	IR
5	T3	T3, T3/F	
10	T3, T3 (6V)	T3, T3/F	
20	T3, T4	T3, T3/F, T3 (24V)	
35	T4		
37			BT4
50	T4	T4, T4/F, T4 (24V)	BT4
75	T4	T4	
90	T4		

*SYLVANIA does not require lamp containment shielding. Consult most recent UL standards for luminaire requirements.

Application Information

Applications

Small aperture down lighting
Residential, commercial and industrial applications
Accent strip lighting
Task lighting
Display lighting

Application Notes

- Axial filament orientation means light is smoothly distributed by reflector
- Do not touch lamp with bare hands
- Overall UV-emissions are reduced 95% for extra fade protection on light sensitive materials

Fixtures

Ardee/USA
Belfer
BK Lighting
CSL
Lucifer
Roberts
Tivoli

Sample Specification

STANDARD
Lamp(s) shall be (a) 12V or 24V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 2000-hour average rated life. Lamp(s) shall be frosted or clear with an axial or transverse filament.

STARLITE
Lamp(s) shall be (a) 12V STARLITE halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament and gold plated pins.

IR
Lamp(s) shall be (a) 12V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament, a constant and an infrared reflective coating on the lamp capsule.

24V BI-PIN Lamps must be operated in enclosed fixtures.

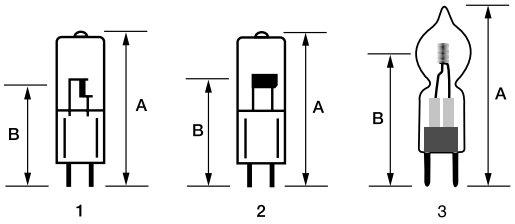
Fixture D1 Lamp

Lamp Comparison

Item No.	Lamp Type	Watts	Lumens	Av. Rated life
58676	50T4Q/CL/AX	50	930	4000
	Brand X Q50T4/CL/CD	50	950	2000
	Brand Y 50W/12V/Capsule	50	950	2000
	Incandescent 60A19/CL	50	890	1000

Dimensions

	(A) MOL	(B) LCL
Standard (2) 5W-20W	31mm	22mm
Standard (2) 50W-75W	44mm	30mm
Standard (1) 50W/100W (24V)	44mm	30mm
Starlite (2) 5W	31mm	22mm
Starlite (1) 10W-20W	31mm	22mm
Starlite (1) 35W-90W	44mm	30mm
IR (3) 37W & 50W	44mm	30mm



Ordering and Specification Information

BI-PIN IR

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58683	37BT4Q/IR	37	12	GY6.35	4000	900	3
58687	50BT4Q/IR	50	12	GY6.35	4000	1320	3

STARLITE

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58690	5T3Q/CL	5	12	G4	4000	60	2
58691	10T3Q/CL/AX	10	12	G4	4000	130	1
58692	10T3Q/CL/AX/6V	10	6	G4	4000	130	1
58694	20T3Q/CL/AX[1]	20	12	G4	4000	320	1
58663	20T4Q/CL/AX	20	12	GY6.35	4000	320	1
58672	35T4Q/CL/AX	35	12	GY6.35	4000	600	1
58676	50T4Q/CL/AX[1]	50	12	GY6.35	4000	930	1
58680	75T4Q/CL/AX[1]	75	12	GY6.35	4000	1450	1
58684	90T4Q/CL/AX	90	12	GY6.35	4000	1800	1

STANDARD

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58652	5T3Q/CL[1]	5	12	G4	2000	60	2
58658	10T3Q/CL[1]	10	12	G4	2000	140	2
58661	20T3Q/CL[1]	20	12	G4	2000	320	2
58675	50T4Q/CL[1]	50	12	GY6.35	2000	930	2
58662	20T3Q/CL/24V	20	24	G4	1000	350	2
58678	50T4Q/CL/AX/24V	50	24	GY6.35	2000	850	1

FROSTED

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58651	5T3Q/F	5	12	G4	2000	55	2
58656	10T3Q/F	10	12	G4	2000	130	2
58695	20T3Q/F	20	12	G4	2000	300	2
58698	50T4Q/F	50	12	GY6.35	2000	830	2

[1] Also available in bulk pack

Ordering Guide

50	T4	Q	/	CL	/	AX	/	24V
Wattage	Tubular Lamp T3= Diameter (3/8") T4= Diameter (4/8") BT4=Bulbous tube (4/8")	Quartz Glass		Finish CL = Clear F = Frosted IR = IR Conserving		AX= Axial Filament __= Transverse		Voltage __= 12V 24V 6V

OSRAM SYLVANIA
National Customer
Support Center
18725 N. Union Street
Westfield, IN 46074

Industrial & Commercial
Phone: 1-800-255-5042
Fax: 1-800-255-5043

National Accounts
Phone: 1-800-562-4671
Fax: 1-800-562-4674

Special Markets
Phone: 1-800-762-7191
Fax: 1-800-762-7192

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Fax: 1-800-667-6772

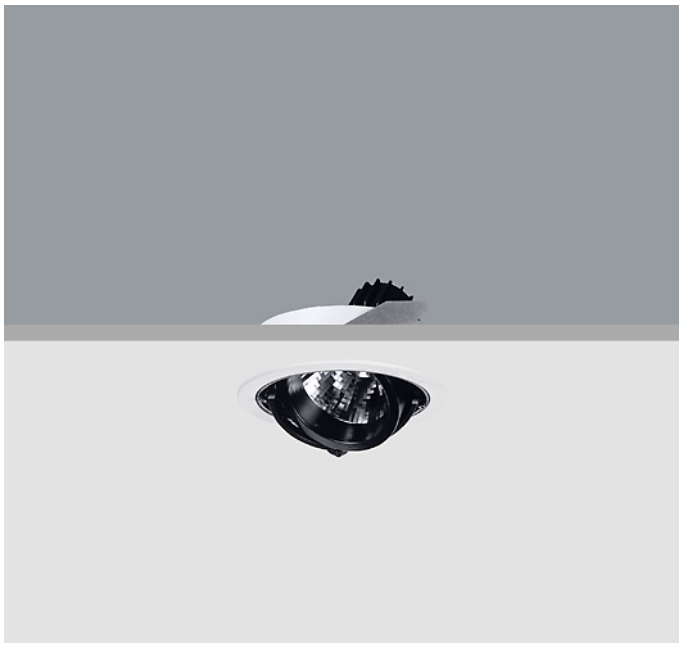
Visit our website: www.sylvania.com

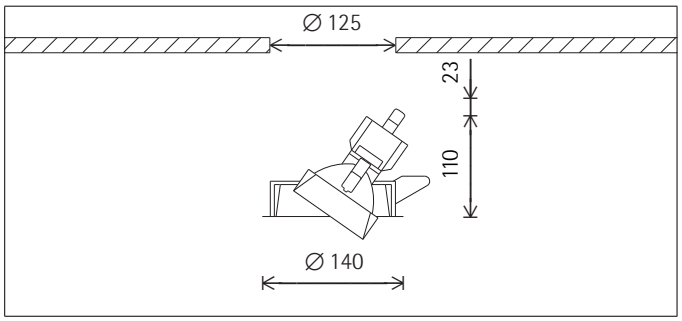
ERCO

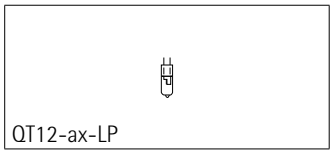
Gimbal Directional spotlight

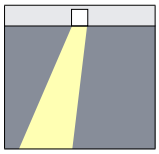
for low-voltage halogen lamps

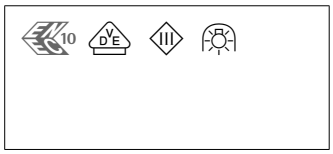
Fixture D2





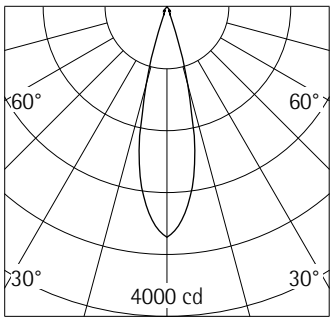






88111.000 Reflector silver
QT12-ax-LP 50W 12V GY6.35
950lm

Product description
Size 4
Luminaire: cast aluminium, black powder-coated. Heat sink: black. Mounting ring: plastic, white (RAL9002), with multigroove baffle, cast aluminium, black powder-coated. Fixing springs for ceiling thickness max. 25mm. Cardanic suspension of the luminaire in the mounting ring. 0°-40° tilt. Pivots are to be locked.
Cable, L 500mm.
Anti-dazzle ring: plastic, black.
Flood reflector: aluminium, anodised, mirror-finish.
Transformer according to EN 61558 or EN 61347 to be ordered separately.
Weight 0.45kg



QT12-ax-LP 50W 12V GY6.35
950lm

h(m)	E(lx)	D(m) 25°
1	2978	0.44
2	745	0.89
3	331	1.33
4	186	1.77
5	119	2.22

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Technical Region: 230V/50Hz
Edition: December 16, 2005
Please download the current version from
www.erco.com/88111.000

Product Information Bulletin

SYLVANIA BI-PIN

Low Voltage Halogen Lamps

Fixture D2 Lamp

The SYLVANIA family of BI-PIN lamps represents an outstanding collection of compact, low voltage halogen light sources ideal for a wide range of applications.

Top of the line BI-PIN IR lamps have an infrared reflective coating on the outside of the capsule to conserve heat energy and create a more efficient source. With an axial filament for easy focusing and a 4000 hour life these lamps are suitable for either saving energy or increasing light output from existing fixtures without increasing energy costs.

High performance axial filament STARLITE lamps enable the design of efficient reflector systems that are easy to focus, resulting in better quality light on the target. These long life efficient lamps meet the needs of all residential, commercial and industrial bi-pin applications.

All SYLVANIA BI-PIN lamps utilize advanced UV-stop quartz that reduces UV-B and UV-C radiation by 90% compared to regular quartz. In addition, the IR coating on BI-PIB IR lamps further reduces this spectrum, effectively eliminating all UV-B and UV-C radiation from those capsules.

All 6V and 12V SYLVANIA BI-PIN lamps are low-pressure, low-voltage capsules. Because of this, these lamps are suitable for use without shielding.* The 24V SYLVANIA BI-PIN lamps are high-pressure capsules, and a suitable protective shield is required with these lamp types.

A complete family of BI-PIN halogen lamps to meet the various needs of designers and end users:

IR
- Axial filament
- 4000-hour average rated lamp life
- UV stop quartz capsule
- Low pressure
- Energy saving IR technology
- No UV-B or UV-C Light output
- Suitable for use without shielding*

STARLITE
- Axial filament
- 4000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- Suitable for use without shielding*

STANDARD
- Clear and frosted
- 2000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- 6V and 12V suitable for use without shielding*

Product Availability

Watts	STARLITE	STANDARD	IR
5	T3	T3, T3/F	
10	T3, T3 (6V)	T3, T3/F	
20	T3, T4	T3, T3/F, T3 (24V)	
35	T4		
37			BT4
50	T4	T4, T4/F, T4 (24V)	BT4
75	T4	T4	
90	T4		

*SYLVANIA does not require lamp containment shielding. Consult most recent UL standards for luminaire requirements.

Application Information

Applications

Small aperture down lighting
Residential, commercial and industrial applications
Accent strip lighting
Task lighting
Display lighting

Application Notes

- Axial filament orientation means light is smoothly distributed by reflector
- Do not touch lamp with bare hands
- Overall UV-emissions are reduced 95% for extra fade protection on light sensitive materials

Fixtures

Ardee/USA
Belfer
BK Lighting
CSL
Lucifer
Roberts
Tivoli

Sample Specification

STANDARD
Lamp(s) shall be (a) 12V or 24V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 2000-hour average rated life. Lamp(s) shall be frosted or clear with an axial or transverse filament.

STARLITE
Lamp(s) shall be (a) 12V STARLITE halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament and gold plated pins.

IR
Lamp(s) shall be (a) 12V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament, a constant and an infrared reflective coating on the lamp capsule.

24V BI-PIN Lamps must be operated in enclosed fixtures.

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Special Markets
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Fax: 1-800-667-6772

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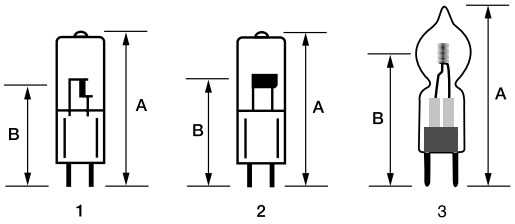
Fixture D2 Lamp

Lamp Comparison

Item No.	Lamp Type	Watts	Lumens	Av. Rated life
58676	50T4Q/CL/AX	50	930	4000
	Brand X Q50T4/CL/CD	50	950	2000
	Brand Y 50W/12V/Capsule	50	950	2000
	Incandescent 60A19/CL	50	890	1000

Dimensions

	(A) MOL	(B) LCL
Standard (2) 5W-20W	31mm	22mm
Standard (2) 50W-75W	44mm	30mm
Standard (1) 50W/100W (24V)	44mm	30mm
Starlite (2) 5W	31mm	22mm
Starlite (1) 10W-20W	31mm	22mm
Starlite (1) 35W-90W	44mm	30mm
IR (3) 37W & 50W	44mm	30mm



Ordering and Specification Information

BI-PIN IR

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58683	37BT4Q/IR	37	12	GY6.35	4000	900	3
58687	50BT4Q/IR	50	12	GY6.35	4000	1320	3

STARLITE

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58690	5T3Q/CL	5	12	G4	4000	60	2
58691	10T3Q/CL/AX	10	12	G4	4000	130	1
58692	10T3Q/CL/AX/6V	10	6	G4	4000	130	1
58694	20T3Q/CL/AX[1]	20	12	G4	4000	320	1
58663	20T4Q/CL/AX	20	12	GY6.35	4000	320	1
58672	35T4Q/CL/AX	35	12	GY6.35	4000	600	1
58676	50T4Q/CL/AX[1]	50	12	GY6.35	4000	930	1
58680	75T4Q/CL/AX[1]	75	12	GY6.35	4000	1450	1
58684	90T4Q/CL/AX	90	12	GY6.35	4000	1800	1

STANDARD

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58652	5T3Q/CL[1]	5	12	G4	2000	60	2
58658	10T3Q/CL[1]	10	12	G4	2000	140	2
58661	20T3Q/CL[1]	20	12	G4	2000	320	2
58675	50T4Q/CL[1]	50	12	GY6.35	2000	930	2
58662	20T3Q/CL/24V	20	24	G4	1000	350	2
58678	50T4Q/CL/AX/24V	50	24	GY6.35	2000	850	1

FROSTED

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58651	5T3Q/F	5	12	G4	2000	55	2
58656	10T3Q/F	10	12	G4	2000	130	2
58695	20T3Q/F	20	12	G4	2000	300	2
58698	50T4Q/F	50	12	GY6.35	2000	830	2

[1] Also available in bulk pack

Ordering Guide

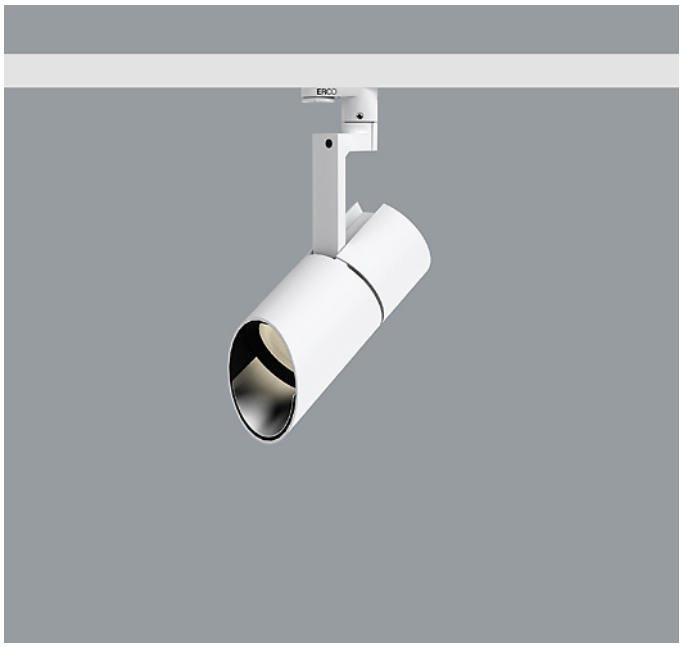
50	T4	Q	/	CL	/	AX	/	24V
Wattage	Tubular Lamp T3= Diameter (3/8") T4= Diameter (4/8") BT4=Bulbous tube (4/8")	Quartz Glass		Finish CL = Clear F = Frosted IR = IR Conserving		AX= Axial Filament __= Transverse		Voltage __= 12V 24V 6V

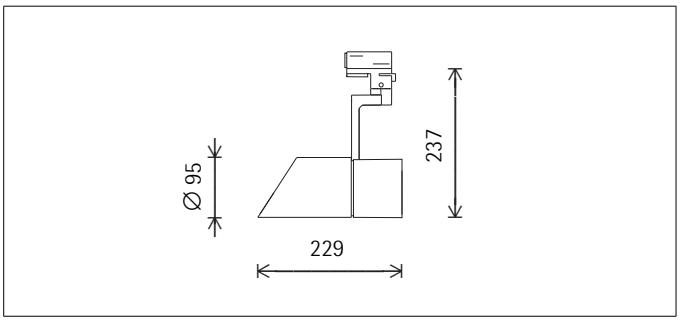
ERCO

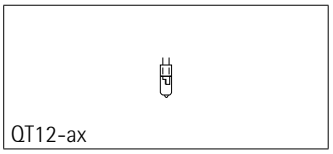
Parscan Wallwasher

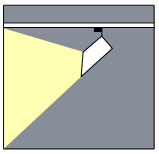
for low-voltage halogen lamps

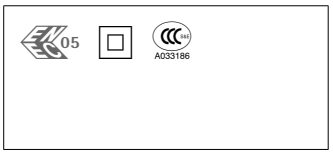
Fixture D3











72103.000 White (RAL9002)
QT12-ax 50W 12V GY6.35 950lm

Product description
Housing: two-piece cylinder, aluminium, powder-coated, removable for lamp replacement. 0°-90° tilt. Scale for identifying the lamp power used. Safety cord.
Bracket integrated in the cylinder: cast aluminium, powder-coated, rotatable on the 3-circuit adapter through 360°. Screw to set the angle of rotation and of tilt. Internal wiring.
Electronic transformer 230/12V, 20-50W.
ERCO 3-circuit adapter: plastic.
Spread lens with reflector: aluminium, silver anodised.
Use dimmers for electronic transformers (trailing edge).
Weight 1.50kg

Mounting
ERCO 3-circuit track
Hi-trac track
Monopoll track
1-circuit singlet

ERCO Leuchten GmbH
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58505 Lüdenscheid
Germany
Tel.:+49 2351 551-0
Fax.:+49 2351 551-300
info@erco.com

Technical Region: 230V/50Hz
Edition: December 16, 2005
Please download the current version from
www.erco.com/72103.000

Product Information Bulletin

SYLVANIA BI-PIN

Low Voltage Halogen Lamps

Fixture D3 Lamp

The SYLVANIA family of BI-PIN lamps represents an outstanding collection of compact, low voltage halogen light sources ideal for a wide range of applications.

Top of the line BI-PIN IR lamps have an infrared reflective coating on the outside of the capsule to conserve heat energy and create a more efficient source. With an axial filament for easy focusing and a 4000 hour life these lamps are suitable for either saving energy or increasing light output from existing fixtures without increasing energy costs.

High performance axial filament STARLITE lamps enable the design of efficient reflector systems that are easy to focus, resulting in better quality light on the target. These long life efficient lamps meet the needs of all residential, commercial and industrial bi-pin applications.

All SYLVANIA BI-PIN lamps utilize advanced UV-stop quartz that reduces UV-B and UV-C radiation by 90% compared to regular quartz. In addition, the IR coating on BI-PIB IR lamps further reduces this spectrum, effectively eliminating all UV-B and UV-C radiation from those capsules.

All 6V and 12V SYLVANIA BI-PIN lamps are low-pressure, low-voltage capsules. Because of this, these lamps are suitable for use without shielding.* The 24V SYLVANIA BI-PIN lamps are high-pressure capsules, and a suitable protective shield is required with these lamp types.

A complete family of BI-PIN halogen lamps to meet the various needs of designers and end users:

IR
- Axial filament
- 4000-hour average rated lamp life
- UV stop quartz capsule
- Low pressure
- Energy saving IR technology
- No UV-B or UV-C Light output
- Suitable for use without shielding*

STARLITE
- Axial filament
- 4000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- Suitable for use without shielding*

STANDARD
- Clear and frosted
- 2000-hour average rated lamp life
- UV-control quartz capsule
- Low pressure
- 6V and 12V suitable for use without shielding*

Product Availability

Watts	STARLITE	STANDARD	IR
5	T3	T3, T3/F	
10	T3, T3 (6V)	T3, T3/F	
20	T3, T4	T3, T3/F, T3 (24V)	
35	T4		
37			BT4
50	T4	T4, T4/F, T4 (24V)	BT4
75	T4	T4	
90	T4		

*SYLVANIA does not require lamp containment shielding. Consult most recent UL standards for luminaire requirements.

Application Information

Applications

Small aperture down lighting
Residential, commercial and industrial applications
Accent strip lighting
Task lighting
Display lighting

Application Notes

- Axial filament orientation means light is smoothly distributed by reflector
- Do not touch lamp with bare hands
- Overall UV-emissions are reduced 95% for extra fade protection on light sensitive materials

Fixtures

Ardee/USA
Belfer
BK Lighting
CSL
Lucifer
Roberts
Tivoli

Sample Specification

STANDARD
Lamp(s) shall be (a) 12V or 24V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 2000-hour average rated life. Lamp(s) shall be frosted or clear with an axial or transverse filament.

STARLITE
Lamp(s) shall be (a) 12V STARLITE halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament and gold plated pins.

IR
Lamp(s) shall be (a) 12V BI-PIN halogen lamp(s) with a UV-control quartz capsule and a 4000-hour average rated life. Lamp(s) shall be clear with an axial filament, a constant and an infrared reflective coating on the lamp capsule.

24V BI-PIN Lamps must be operated in enclosed fixtures.

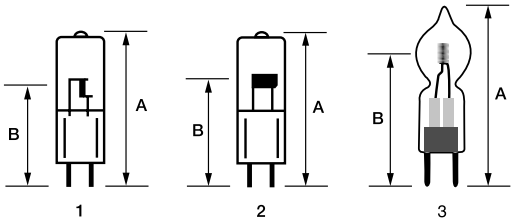
Lamp Comparison

Fixture D3 Lamp

Item No.	Lamp Type	Watts	Lumens	Av. Rated life
58676	50T4Q/CL/AX	50	930	4000
	Brand X Q50T4/CL/CD	50	950	2000
	Brand Y 50W/12V/Capsule	50	950	2000
	Incandescent 60A19/CL	50	890	1000

Dimensions

	(A) MOL	(B) LCL
Standard (2) 5W-20W	31mm	22mm
Standard (2) 50W-75W	44mm	30mm
Standard (1) 50W/100W (24V)	44mm	30mm
Starlite (2) 5W	31mm	22mm
Starlite (1) 10W-20W	31mm	22mm
Starlite (1) 35W-90W	44mm	30mm
IR (3) 37W & 50W	44mm	30mm



Ordering and Specification Information

BI-PIN IR

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58683	37BT4Q/IR	37	12	GY6.35	4000	900	3
58687	50BT4Q/IR	50	12	GY6.35	4000	1320	3

STARLITE

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58690	5T3Q/CL	5	12	G4	4000	60	2
58691	10T3Q/CL/AX	10	12	G4	4000	130	1
58692	10T3Q/CL/AX/6V	10	6	G4	4000	130	1
58694	20T3Q/CL/AX[1]	20	12	G4	4000	320	1
58663	20T4Q/CL/AX	20	12	GY6.35	4000	320	1
58672	35T4Q/CL/AX	35	12	GY6.35	4000	600	1
58676	50T4Q/CL/AX[1]	50	12	GY6.35	4000	930	1
58680	75T4Q/CL/AX[1]	75	12	GY6.35	4000	1450	1
58684	90T4Q/CL/AX	90	12	GY6.35	4000	1800	1

STANDARD

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58652	5T3Q/CL[1]	5	12	G4	2000	60	2
58658	10T3Q/CL[1]	10	12	G4	2000	140	2
58661	20T3Q/CL[1]	20	12	G4	2000	320	2
58675	50T4Q/CL[1]	50	12	GY6.35	2000	930	2
58662	20T3Q/CL/24V	20	24	G4	1000	350	2
58678	50T4Q/CL/AX/24V	50	24	GY6.35	2000	850	1

FROSTED

Item Number	Ordering Abbreviation	Watts	Volts	Base	Avg. Rated Life	Lumens (lm)	Figure
58651	5T3Q/F	5	12	G4	2000	55	2
58656	10T3Q/F	10	12	G4	2000	130	2
58695	20T3Q/F	20	12	G4	2000	300	2
58698	50T4Q/F	50	12	GY6.35	2000	830	2

[1] Also available in bulk pack

Ordering Guide

50	T4	Q	/	CL	/	AX	/	24V
Wattage	Tubular Lamp T3= Diameter (3/8") T4= Diameter (4/8") BT4=Bulbous tube (4/8")	Quartz Glass		Finish CL = Clear F = Frosted IR = IR Conserving		AX= Axial Filament __= Transverse		Voltage __= 12V 24V 6V

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Special Markets
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Fax: 1-800-667-6772

Visit our website: www.sylvania.com

Fixture F1,F2,F3

iCOLOR COVE NXT

Color Kinetics® iColor® Cove NXT brings digital color changing light and lighting effects to alcoves, task areas, accent areas, and other tight spaces without the drawbacks, expense, or constraints of conventional colored lighting methods. Providing a wide, symmetrical beam angle, iColor Cove NXT is ideal for backlighting applications.

iColor Cove NXT is modular in design, and projects a soft-edge strip of light at a 120° by 120° beam angle. Each length of iColor Cove NXT can be controlled by a Color Kinetics controller or a third-party DMX512 controller. Each fixture comes pre-addressed to light number one. With a Color Kinetics controller, simple effects such as fixed color and color wash require no additional addressing. For other effects across multiple lights, including Chasing Rainbow or Color Sweep, fixtures may be addressed using Serialized Addressing Software (SAS) or Zapi 1.5.

iColor Cove NXT is available in fixed lengths of six (6) and twelve (12) inches. Each fixture is cased in a low-profile, vented, molded plastic housing that snaps directly into a one-piece mounting bracket. The fixed position mounting brackets are indexed to lock iColor Cove NXT into place, allowing for the uniform alignment of multiple fixtures. Optional adjustable position brackets allow for easy rotation of fixtures.

To connect power and data, each fixture is equipped with a three-pin header that attaches to a master cable, making installations with curves or complicated geometries easy to install. Each master cable is designed to be hardwired to a PDS-150e or PDS-60 24V, which supplies power and data to all connected lights.

iCOLOR COVE SPECIFICATIONS

COLOR RANGE	16.7 million (24-bit) additive RGB colors; continuously variable intensity output range
SOURCE	High brightness surface mount colored LEDs
BEAM ANGLE	120° x 120°
HOUSING	Two-piece vented plastic
MOUNTING BRACKET	One-piece fixed position provided One-piece adjustable position, optional (Item#101-000007-00)
CONNECTORS	3-pin power and data connector for use with master cable (sold separately); master cable unterminated for use with PDS-150e or PDS-60 24V
LISTINGS	UL/cUL, CE

COMMUNICATION SPECIFICATIONS

DATA INTERFACE	Color Kinetics data interface system
CONTROL	Color Kinetics full line of controllers and DMX512 when using Color Kinetics power/data supply

ELECTRICAL SPECIFICATIONS

VOLTAGE REQUIREMENT	24VDC
POWER CONSUMPTION	Maximum: 4 Watts (6-inch) Maximum: 6.2 Watts (12-inch)
POWER SUPPLY	PDS-150e (ITEM# 109-000008-01) or PDS-60 24V (ITEM# 109-000017-00/01/02)
MASTER CABLE	Wire Harness for iColor Cove (ITEM# 108-000013-00)

ENVIRONMENTAL SPECIFICATIONS

TEMPERATURE RANGE	-4°F to 122°F (-20°C to 50°C)

SOURCE LIFE

Color Kinetics illumination products utilize high brightness LEDs as the illumination source. LED manufacturers predict LED life of up to 100,000 hours MTBF (mean time between failure), the standard used by conventional lamp manufacturers to measure source life. However, like all basic light sources, LEDs also experience lumen depreciation over time. So while LEDs can emit light for an extremely long period of time, MTBF is not the only consideration in determining useful life. LED lumen depreciation is affected by numerous environmental conditions such as ambient temperature, humidity and ventilation. Lumen depreciation is also affected by means of control, thermal management, current levels, and a host of other electrical design considerations.
Color Kinetics systems are expertly engineered to optimize LED life when used under normal operating conditions [ambient temperature: -4° F to 104° F (-20° C to 40° C), humidity: 0-95% non-condensing humidity, adequate ventilation and air volume] and when operated using typical color-changing effects. Long-term operation outside of these ranges or conditions, or at the upper limits of these ranges or conditions, may subject the product to further degradation of the LED source life, or in extreme cases, failure of internal components. Source life information is based on LED manufacturers' data, as well as other third party testing.

U.S. AND FOREIGN PATENTS AND PATENTS PENDING

CHROMACORE® BY COLOR KINETICS

OPTIBIN® BY COLOR KINETICS

DRY

CE c UL us LISTED 65CA

ITEM# 101-000015-00 (12-inch)
101-000015-01 (6-inch)

BRO114 Rev 05

Specifications subject to change without notice.

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Photosensor

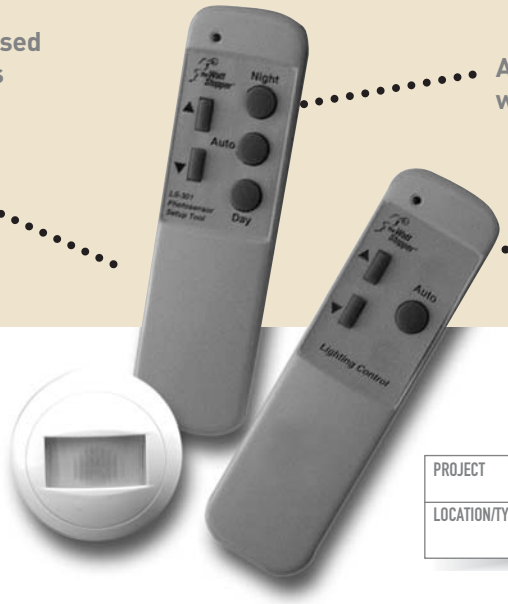
LS-301 Dimming Photosensor

Automatic dimming based on ambient light levels

All setup performed remotely with handheld

Controls standard 0-10 VDC electronic dimming ballasts

Optional occupant adjustment via handheld remote



Single zone control

Closed loop daylighting control

PROJECT

LOCATION/TYPE

Product Overview

Description

The LightSaver LS-301 is a ceiling mount, low voltage indoor photosensor that works with standard, 0-10 VDC electronic dimming ballasts to dim lighting as daylight increases.

Operation

The LS-301 mounts on a ceiling and utilizes a spectral filtering system to measure daylight and electric light levels. A closed loop daylighting system, the LS-301 measures the total light level from daylight and electric light in the controlled area to adjust electric lighting levels. As the daylight contribution increases, the lights dim down. The photosensor utilizes sliding setpoint control, which responds to the different spatial distribution qualities of electric light and daylight. The LS-301 calculates the required light level for current daylight contribution based on two setpoints. One represents the target level when no daylight is present (night setpoint) and the other when significant daylight is present (day setpoint).

Adjustment via Handheld Remote Control

All LS-301 adjustments are made with one of two handheld remotes. The LSR-301-S provides five buttons for initial set-up, which is easily completed by first raising or lowering electric light levels to desired levels, then programming this target level into the photosensor. The LSR-301-P provides three buttons for occupants to adjust light levels. With this optional tool, users can increase target light levels by up to 25% or reduce them to the lamp/ballast minimum level. Pressing the "Auto" button returns the control to programmed levels.

Applications

The LS-301 is designed to blend into its surroundings when installed in any environment. It provides one zone of daylighting control in a private office or classroom. In these applications, the LS-301 can be combined with an occupancy sensor. Often, it is possible for the LS-301 to share a single power pack with occupancy sensor(s).

Features

- Provides precise control of lighting to maintain desired light level
- Extremely linear photocell response with greater than 1% accuracy
- Designed to measure light as the human eye perceives it, eliminating "overreporting" illumination levels provided by daylight
- Separate handheld remote controls for setup and occupant adjustment to prevent tampering
- Boosts energy savings by reducing maximum lamp output, often resulting in a 20% reduction or more compared with lights at full output
- Achieves lumen maintenance by holding target light level as lamp output decreases over time

WattStopper
legrand
www.wattstopper.com
800.879.8585

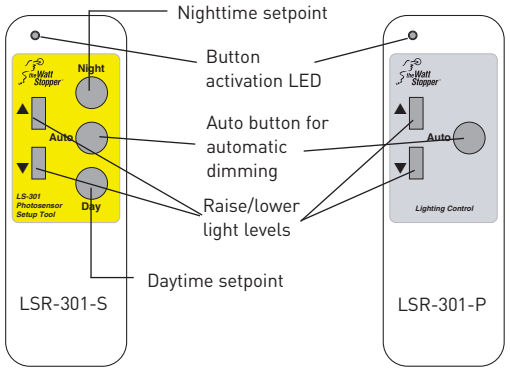
LS-301 Technical Information

Specifications

- Full range dimming: .2 VDC (minimum) to 10 VDC (100% lighting) output voltage
- Current consumption: 30 mA @ 24 VDC
- In typical applications, setpoints are adjustable from 20-60 footcandles (210-640 lux)
- Controls up to 50 standard dimming ballasts in one zone
- Sensor leads: gray and violet to ballast, red and black to 24 VDC
- Dimensions: 2.35" diam. x 0.875" depth (60mm x 22mm), threaded piece extends 1.25" (31.8mm) from back, fits .5" knockout
- 5 year warranty

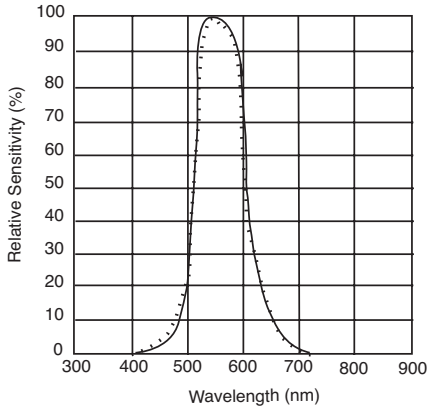
Product Controls

Remote Controls



Remote handheld (above left) enables easy set-up while optional occupant remote provides adjustability for individual lighting preferences.

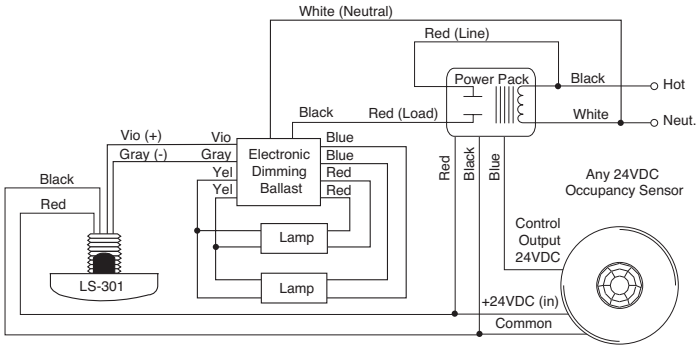
Spectral Response Curve



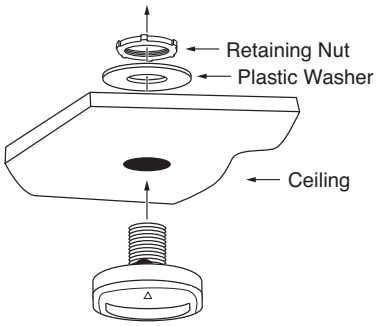
The spectral response of the LS-301 photocell closely matches the sensitivity of the human eye.

Wiring & Installation

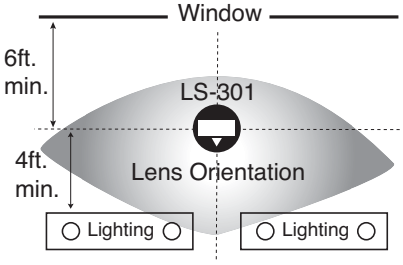
Wiring



Mounting and Installation



Coverage



Placement Guidelines

- Mount photocell between 6 and 12 feet (1.8m - 3.7m) from window.
- Do not mount directly above direct/indirect pendant fixtures. Mount at least 4 feet (1.2m) from pendant fixtures.

Ordering Information

Catalog No.	Description	Input Voltage
☐ LS-301	Dimming Photosensor	24 VDC
☐ LSR-301-S	Setup Remote Control (2 AAA batteries included)	
☐ LSR-301-P	Occupant Remote Control (2 AAA batteries included)	

LS-301 works with Watt Stopper power packs

Watt Stopper/Legrand®
Pub. No. 17504