

## Louie's Convenience Store

### Introduction

As you approach the main entrance of Redifer Commons, the first space you will see is Louie's. The interior is easily seen from outside through large windows which wrap around the entire front façade. Louie's is the convenience store of the commons where customers can buy food or drinks "on the go". You can get anything from chips, drinks, and frozen dinners to headache medicine.

Louie's has two very interesting features. First of all, during the day the space is completely filled with daylight coming through the large front windows and smaller windows around the top perimeter. There is enough light at most times of the year to allow for little or no electric light to be used during daylight hours. Second, the space has a high dome ceiling that reaches 24 feet at its highest point.

### Design Criteria

The following design criteria combines the suggested design criteria set forth by the IESNA Lighting Handbook Ninth Edition and the design criteria elements in which I felt were important to create the atmosphere appropriate for this space.

**Appearance and Themes:** This is a convenience store that should make you want to come in and buy something to snack on or drink. The appearance of this space is extremely critical and should be very bright, especially at eye level where the food is located. A very important architectural feature of this space is the high domed ceiling. This feature should be accentuated with the lighting design. Since the color scheme used in this space is not too exciting, the lighting should replace this lack of color. A cleanly look is also very essential here.

**Appearance of Luminaires:** The lighting should be designed to accentuate the existing architecture. The domed ceiling leaves much opportunity for a great deal of uplighting. Also, the fixtures should be simple in order to eliminate distractions and a cluttering effect in the ceiling.

**Light distribution on Surfaces:** The light should be fairly uniform across the length of the shelves.

**Low wall luminance:** This effect will help enhance the appearance of the products being sold in the space. If the luminances of the products are much greater they will be more noticeable and more appealing.

**Highlight and Sparkle:** These can be used in the dome to accentuate the architectural feature. Choosing the right light source will help enhance sparkle.

**Lamp Type:** The lamp should have a CRI greater than 80% and have a CCT of 3000K so the packaging is rendered the way the manufacturer intended.

**Direct Glare:** This is important since customers could be inclined to look up at the high ceiling. A glary fixture would produce an uncomfortable feeling to the person looking. Direct glare could also be an issue for the person working behind the cash register since the lights could be reflected in their screen.

**Daylight Integration and Control:** This space is filled with daylight during daytime hours. This means that daylight can be used as the primary light source during the day. Switching and/or dimming for electric light is very important, especially since it appears that is little or no electric light needs to be used for a majority of the day.

The addition of a skylight reflector system would also enhance the space and ensure that the entire space was filled with light.

**System Control and Flexibility:** Although this space is lit by daylight during the day, there are many cloudy, miserable days in State College. For days such as this there needs to be a way for only a select number of fixtures to be turned on. This flexibility will allow for the appropriate addition of electric light to light the space.

**Illuminance Levels:** The illuminance levels on the workplane suggested by IESNA to be 50fc horizontally and 10fc vertically.

**ASHRAE 90.1 2004 Allowable Power Density:** 1.7 W/SF for retail spaces

## Design Concept

Louie's is used as a purely functional space. Its purpose is to provide a place where students can buy items quickly. Therefore, the main task taking place is product analyzing. Good color rendering is very important for this task. The fixture used to light the products should be able to provide a punch at a long throw distance since the ceiling is very high. This leads to another area of importance which is highlighting the domed ceiling as an architectural feature. Finally, I would like to add a daylight system into the domed ceiling which will help draw more light into the center of the space. These two systems, daylight and electric light, should also be integrated using a control system that will allow for the addition of electric light for extremely cloudy days and dusk.

The image below shows how I applied my design concept to this space. This is a section of Louie's. Not shown on this section is the check out counter which is located on the left, and the freezers which are located on the right. The large source located at the top of the dome ceiling represents the large skylight. At night the light will be supplied by a large 3000K 250W metal halide fixture located centrally in the skylight. Surrounding the large skylight is a circle of downlights whose purpose is to light the areas around the perimeter in which the large metal halide source does not reach. The downlights will also be 3000K metal halide. Finally, a compact fluorescent uplight will be used to highlight the dome. This source will also be 3000K.



## Luminaire Schedule

Luminaire				Lamp							Ballast				
Symbol	Designation	Type	No. Lamps	Type	Wattage	CRI	CCT	Life (Hrs)	Initial Lumens	Design Lumens	Type	Voltage (V)	Operating Current (A)	Input Watts	No. Lamps
●	LA	Enclosed High Bay Downlight (Lithonia)	1	Metal Halide (Osram Sylvania)	250	94	3000	15,000	24,000	19,200	Super Constant Wattage Autotransformer (Lithonia)	120	2.50	288	1
⊕	LB	Directional Downlight (ERCO)	1	Metal Halide (Osram Sylvania)	70	87	3000	9000	6,700	5,360	Super Constant Wattage Autotransformer (Advance)	120	0.85	94	1
○	LC	Downlight (ERCO)	1	Metal Halide (Osram Sylvania)	39	82	3000	9,000	3,400	2,720	Super Constant Wattage Autotransformer (Advance)	120	0.50	55	1
□	LD	Uplight (ERCO)	1	Compact Fluorescent (Philips)	32	82	3000	10,000	2,400	2,040	Electronic Program Start (Advance)	120	0.31	36	1

Cut sheets for this equipment can be found following this report

## Light Loss Factors

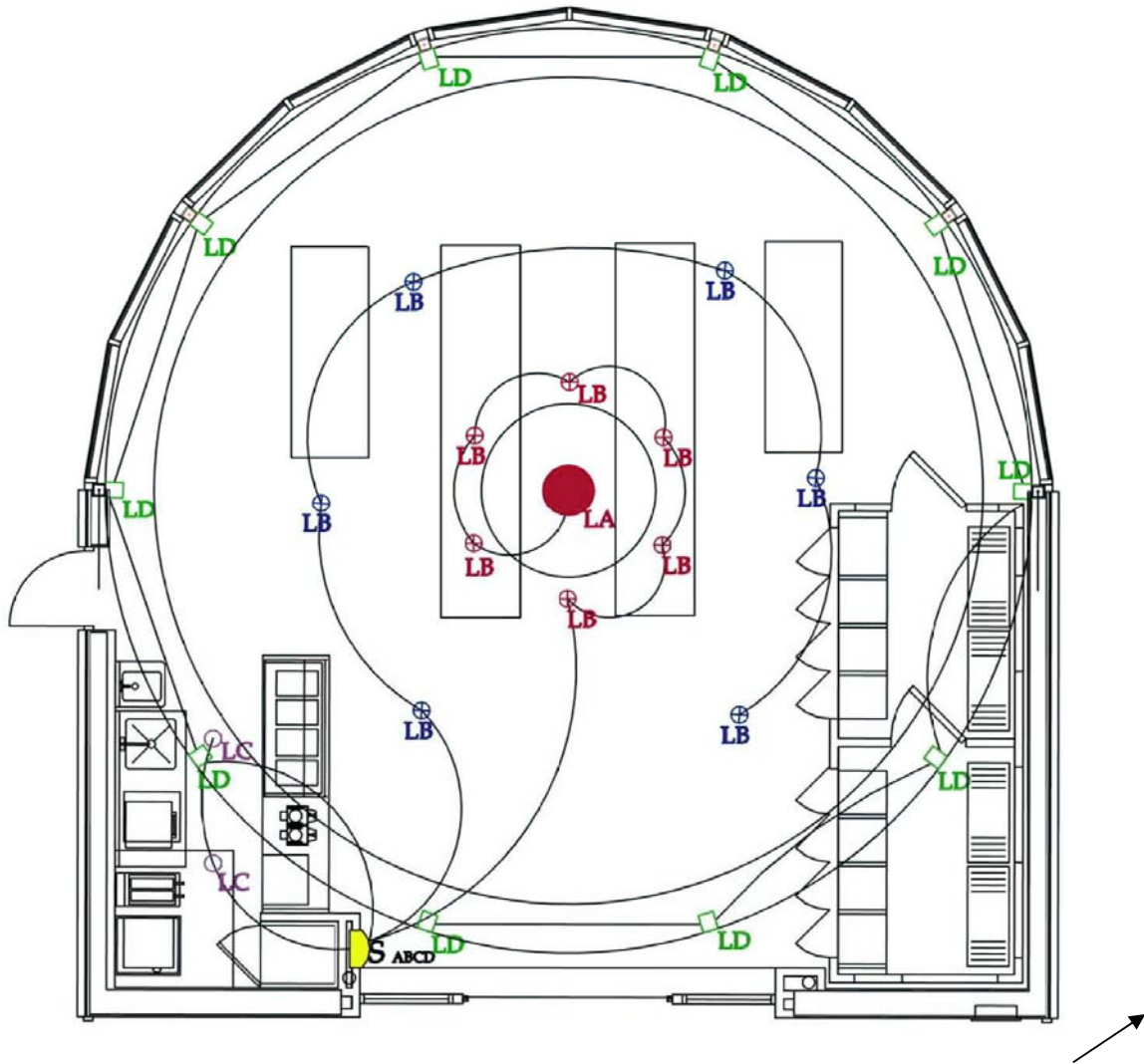
Luminaire Designation	Ballast Factor	Maintenance Category	Cleaning Interval	RCR	RSDD (Expected Dirt Depreciation= 4%)	LLD	LDD	Total LLF
LA	1.00	IV	Very Clean; Cleaned Every 6 months	7.6	0.98	0.80	0.96	0.75
LB	1.00	IV	Very Clean; Cleaned Every 6 months	7.6	0.98	0.80	0.96	0.75
LC	1.00	IV	Very Clean; Cleaned Every 6 months	7.6	0.98	0.80	0.96	0.75
LD	0.98	VI	Clean; Cleaned Every 18 months	7.6	0.92	0.85	0.82	0.63

## Control Equipment and Zones

Each zone will be controlled by individual switches A, B, C, and D which can be seen below in the lighting and switching plan.

## Lighting and Switching Plan

Fixture type and zones are represented on this plan. The wall switches will control these zones and will be located to the left of the entrance shown in yellow.



**Zone 1- downlights to be turned on at sunset**

**Zone 2- downlights to be turned on for daylight hours when little sunlight is entering the space and at sunset**

**Zone 3- uplights to be turned on at sunset**

**Zone 4- extra light behind cash register for whenever needed**

## Power Density Calculation

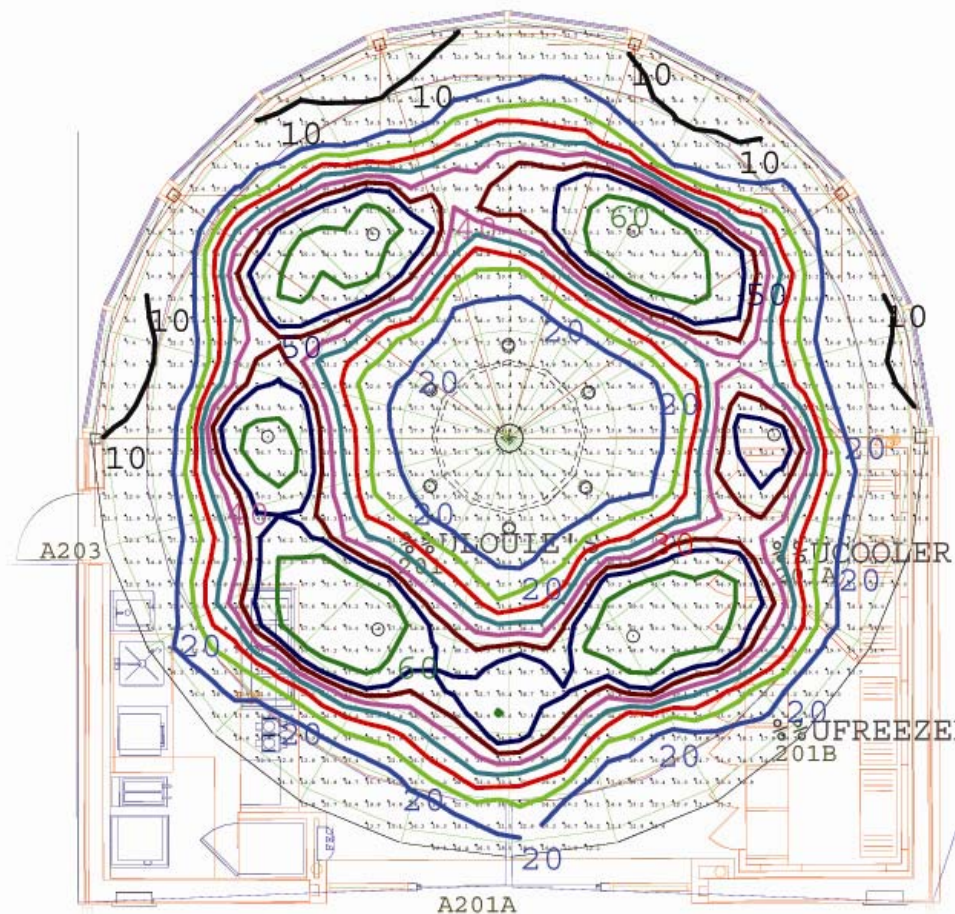
Luminaire Designation	Input Watts	Number Used	Watts per fixture Type
LA	288	1	288
LB	94	12	1128
LC	55	2	110
LD	36	10	360
Total Area (SF)	1270	Total	1886
			<b>Power Density</b>
			<b>1.49</b>

1.49 W/SF < 1.7 W/SF Allowable

## Calculation Results

**Electric Light:** Illuminance Levels on the Floor

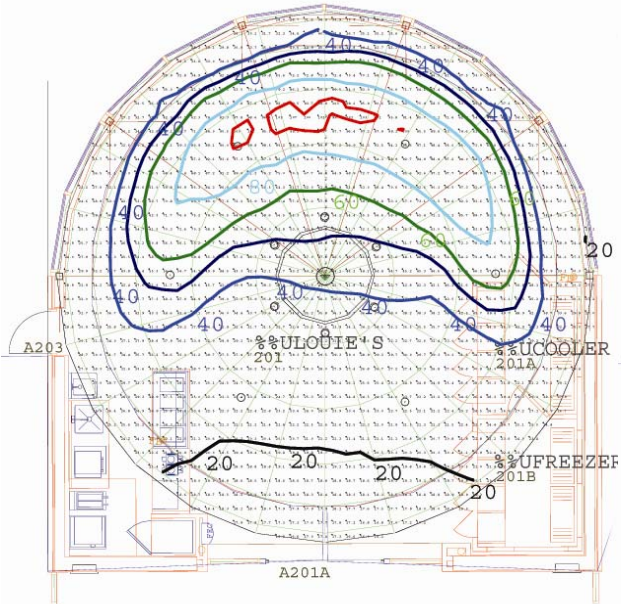
These contour lines show the light distribution when all luminaires in the ceiling are on. The average illuminance on the floor is 25.5 footcandles, which is sufficient for walking through the store. The average illuminance horizontally on the shelves ranged from 25 to 60 footcandles and vertically from 7 to 10 footcandles.



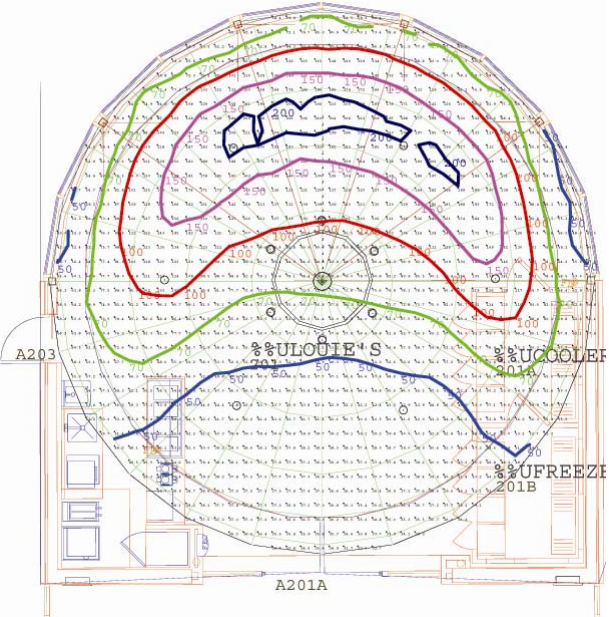
**Daylight:** Illuminance Values on the floor

Shown below are three samples of different times of the year at 9 am with an overcast sky. A study was done on these three days from about 9 am to 5 pm and can be found on the attached cd. The addition of skylight was also taken into consideration in these studies. The fourth set of contour lines shows the skylight's daylight contribution. The .ies file for this skylight was made assuming a sky luminance of 2000cd/m<sup>2</sup>. The intensity distribution, illuminance contours, and TracePro model for the skylight can also be found below. The skylight uses an anidolic parabolic reflector made of Miro 1, which is simply an extremely enlarged version of a parabolic reflector used in a simple downlight.

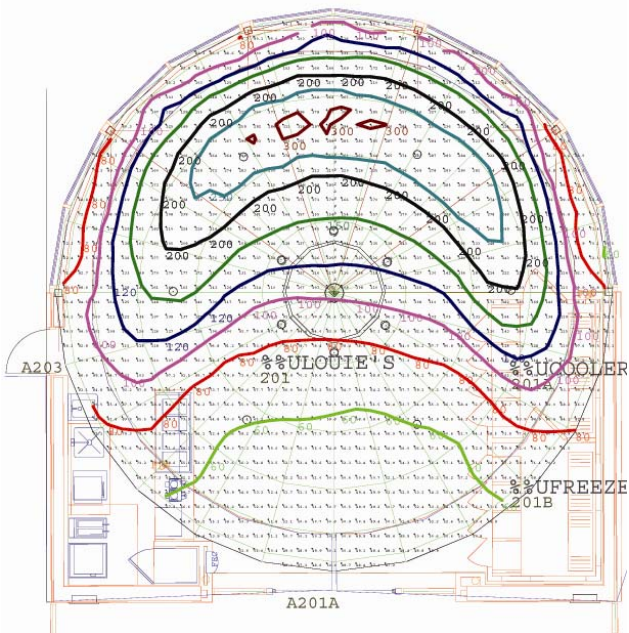
December 21, 2004



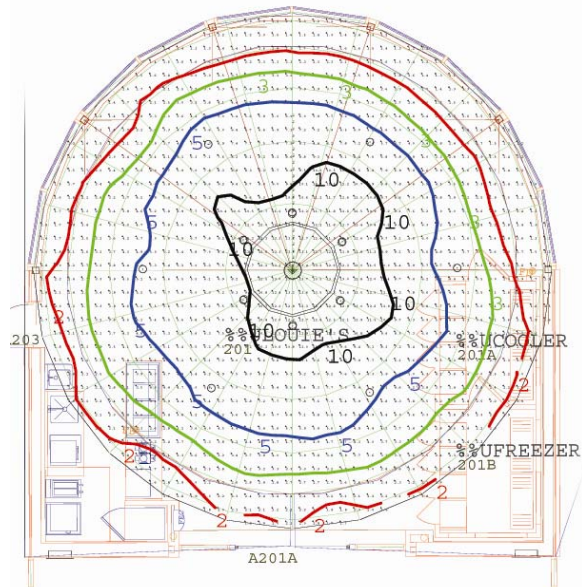
March 21, 2005



June 21, 2005

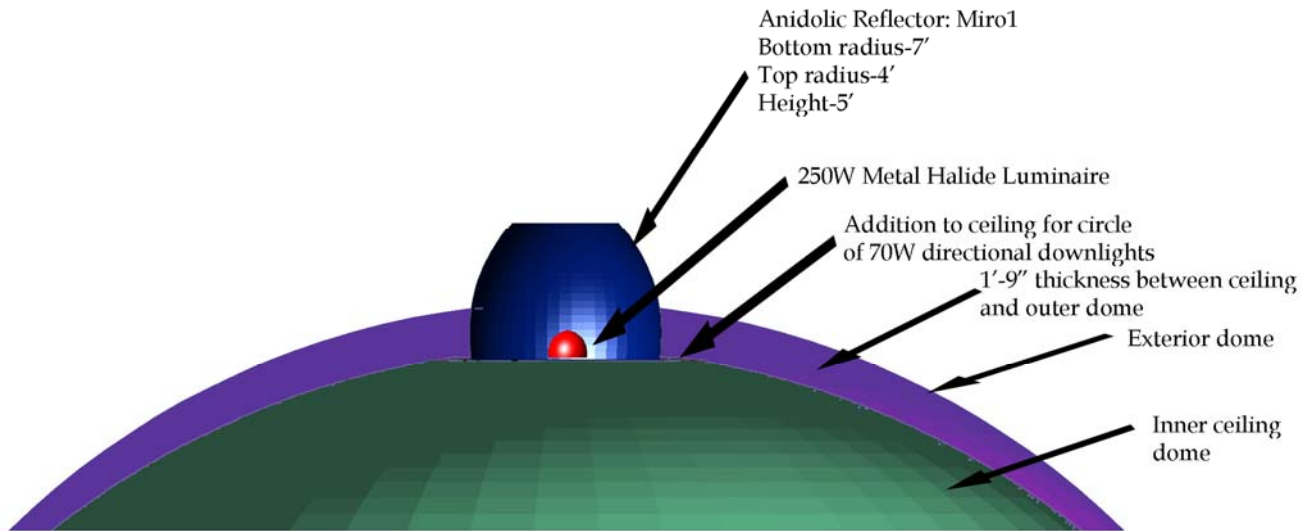


Skylight component

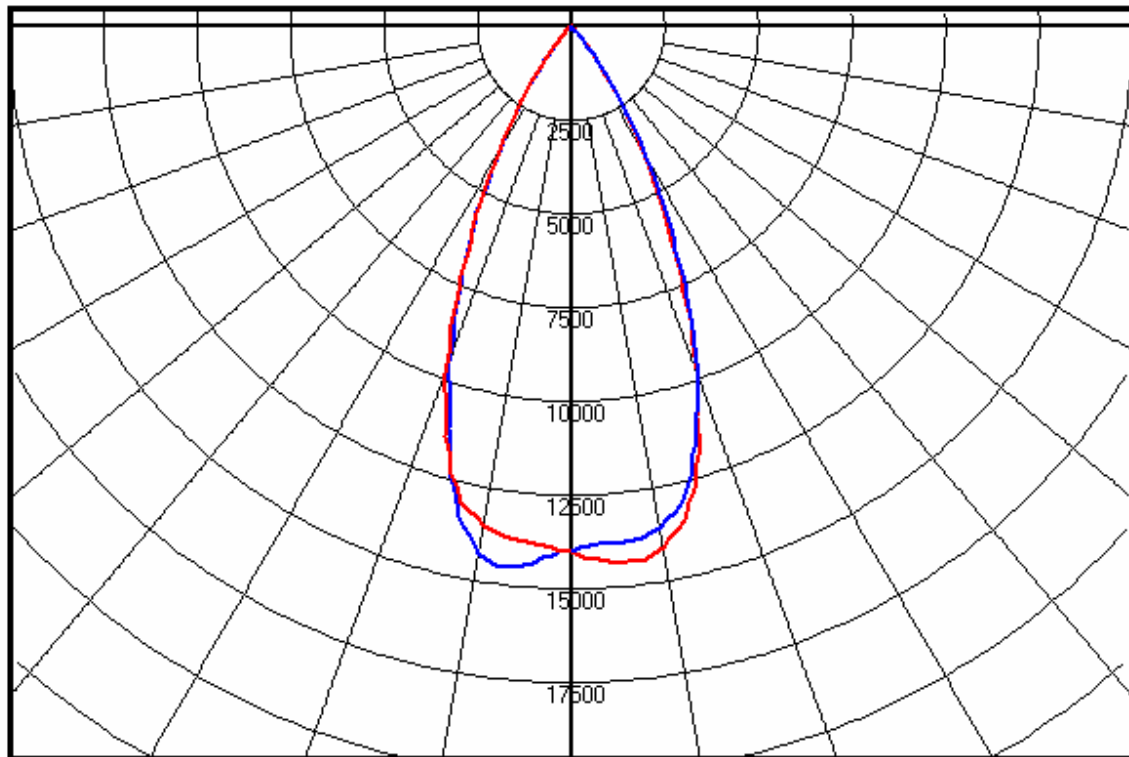


## Skylight Information

### Installation Detail

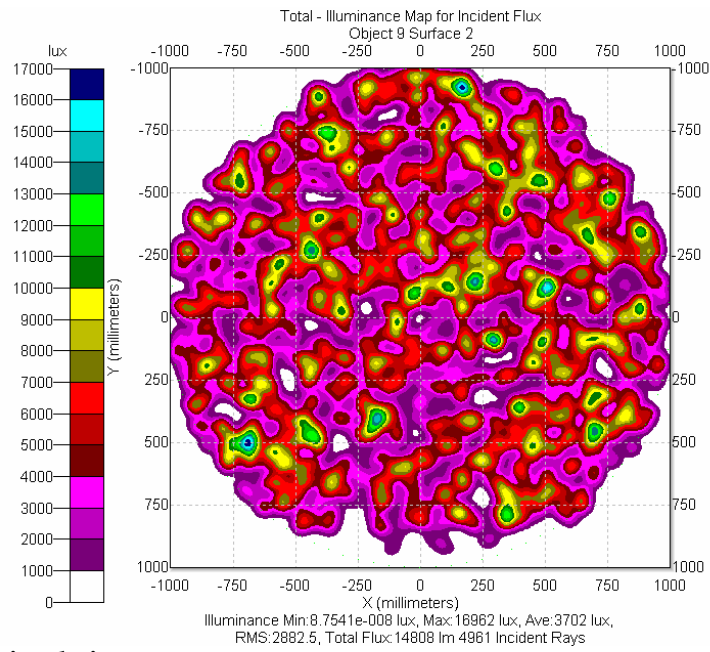


### Intensity Distribution

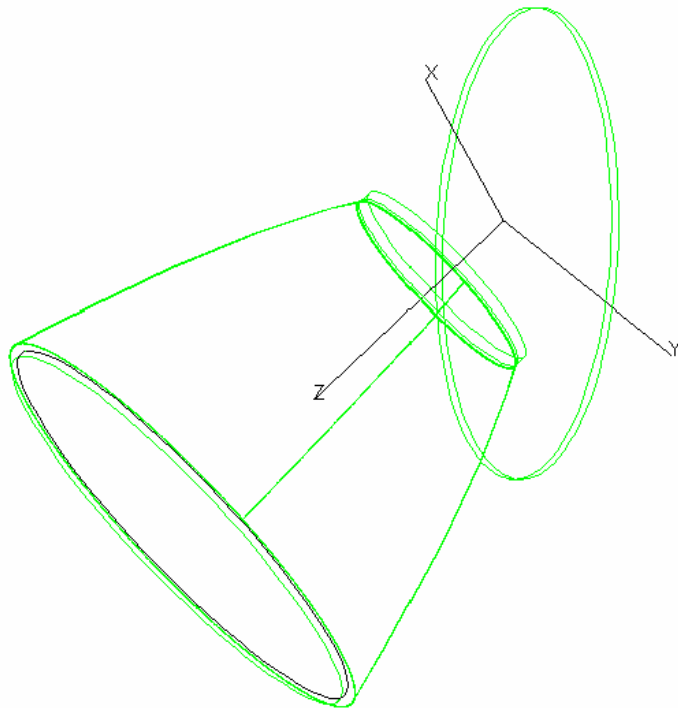


Totally Asymmetric 180-0 Degrees 270-90 Degrees

**Illuminance in lux entering the space at the base of the reflector**



**TracePro Model Used for simulation**





## Renderings

View as you enter Louie's



View of check out area



View of Freezers



View of domed ceiling



View from the back



## Conclusions

The most important part of the redesign of this space was to integrate daylight as a primary light source during the day. Using different zones allows the power consumption to be reduced dramatically. The connected load is almost 1.5 W/SF, which is less than the allowable 1.7 W/SF. During the winter months Louie's will obviously need more electric light, but this lighting scheme allows for this type of flexibility and will help to reduce the electricity being paid for by the University. The addition of the skylight also made a huge difference in the amount and quality of light entering the space during the day. Instead of light just pouring in through the exterior windows, light now has the opportunity to fall straight into the core of the space illuminating the entire space more evenly. The use of directional downlights in the ceiling also gives more flexibility to where the fixtures are aimed. The luminaires can now focus on the products more accurately instead of simply being directed straight down through the normal.