



# Confessions of an Old School Lighting Auditor

Document Accurately. Capture Efficiently.

March 20<sup>th</sup>, 2024

1:30pm ET

Frank Agraz, LC, IES

Eco Engineering

[leducation.org](https://www.leducation.org)

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.



## Learning Objectives

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At the end of this course, participants will be able to:

1. Learn how to prepare for an onsite lighting audit and how to maximize assessment accuracy.
2. Evaluate the anatomy of a successful lighting audit plan.
3. Understand how data management audit tools have evolved and what practitioners find effective today.
4. Discover veteran auditor tricks of trade including effective assessment methods, tool bag gadgets, and a helpful reference guide resource.

# Delivering Lighting Projects



Manufacturer  
Rep Agency  
Distributor



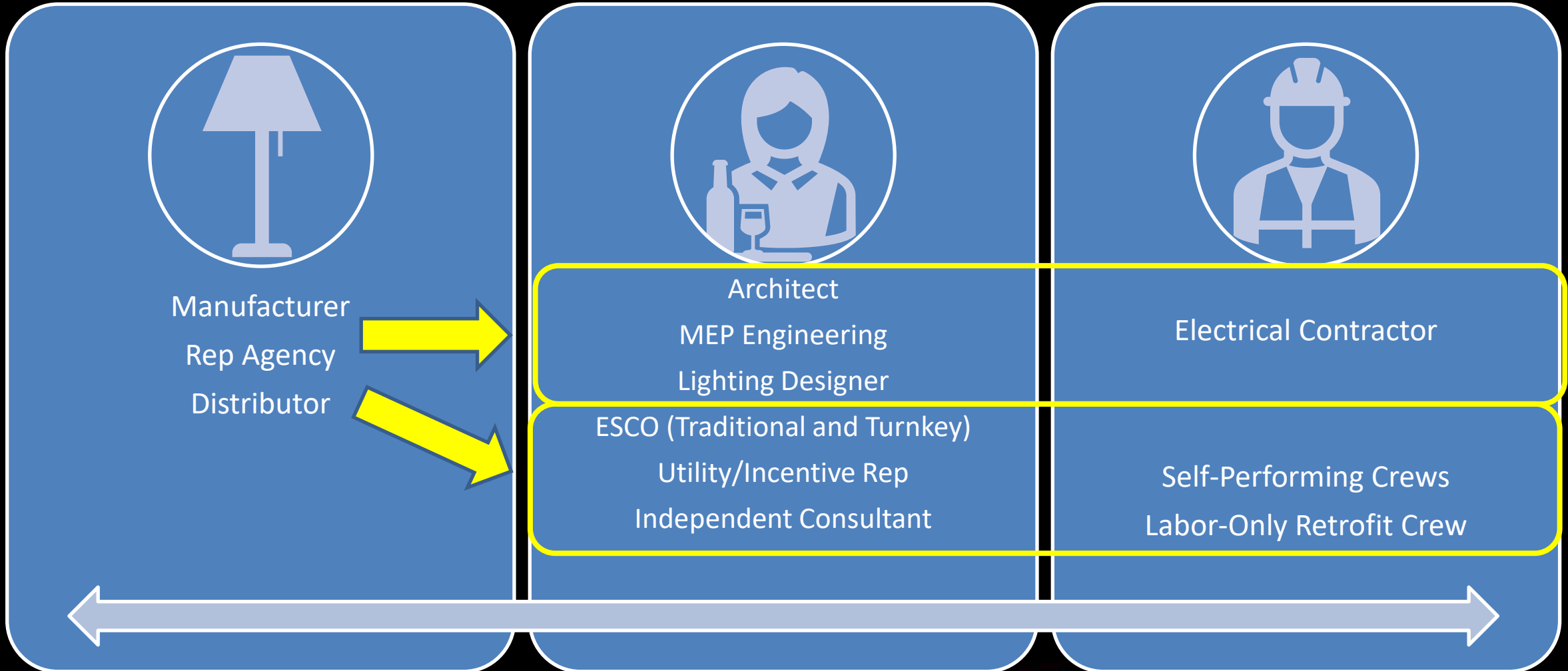
Architect  
MEP Engineering  
Lighting Designer  
ESCO (Traditional and Turnkey)  
Utility/Incentive Rep  
Independent Consultant



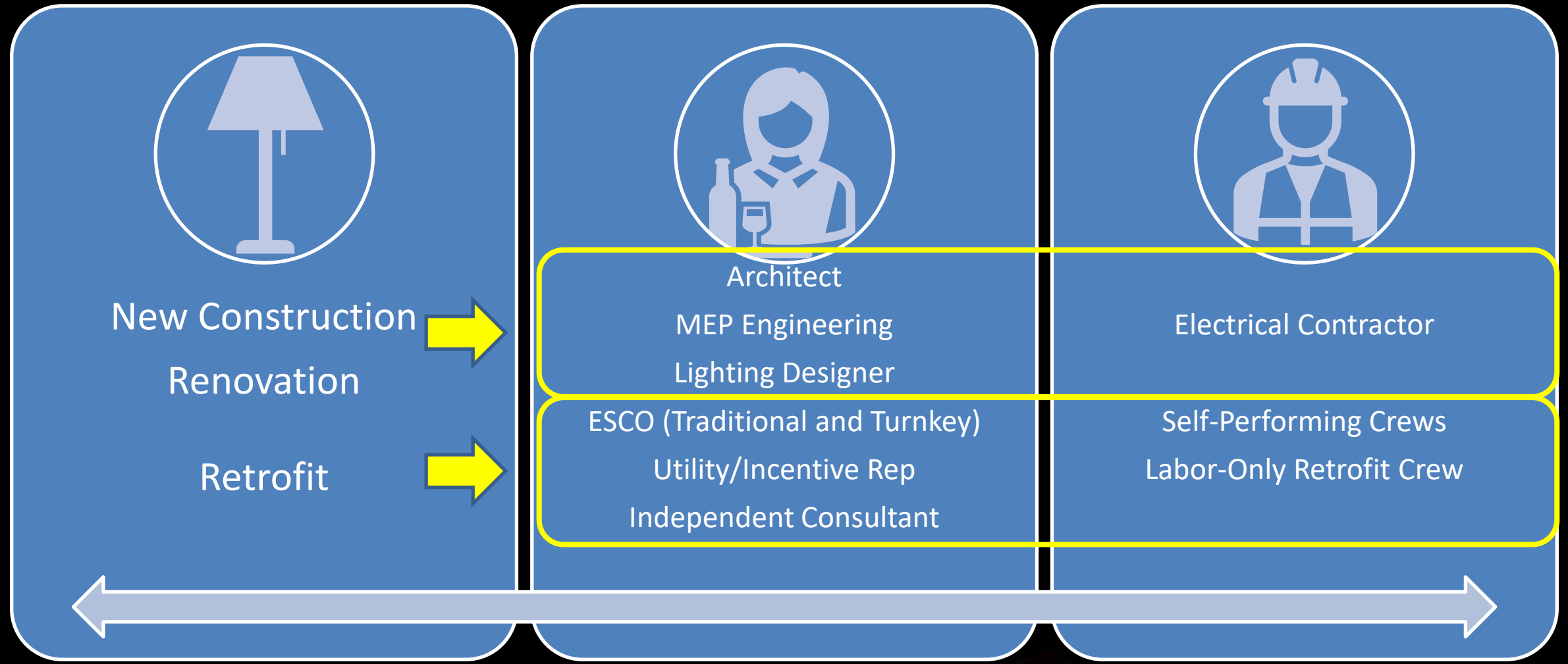
Electrical Contractor  
Self-Performing Crews  
Labor-Only Retrofit Crew



# Delivering Lighting Projects



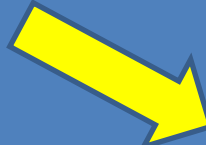
# Delivering Lighting Projects



# Delivering Lighting Projects



Manufacturer  
Rep Agency  
Distributor



Architect  
MEP Engineering  
Lighting Designer

**Turnkey ESCO**

Utility/Incentive Rep  
Independent Consultant

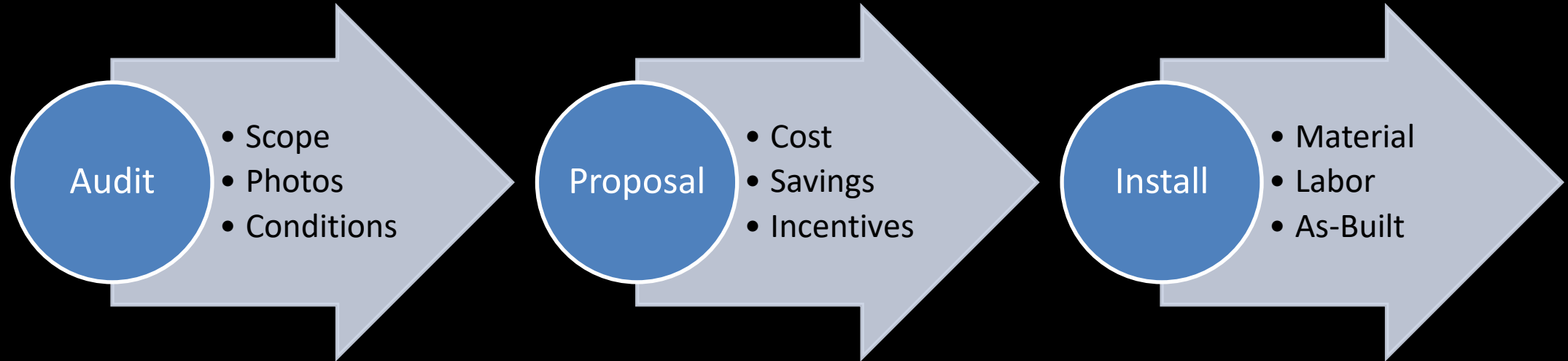


Electrical Contractor

Self-Performing Crews  
Labor-Only Retrofit Crew

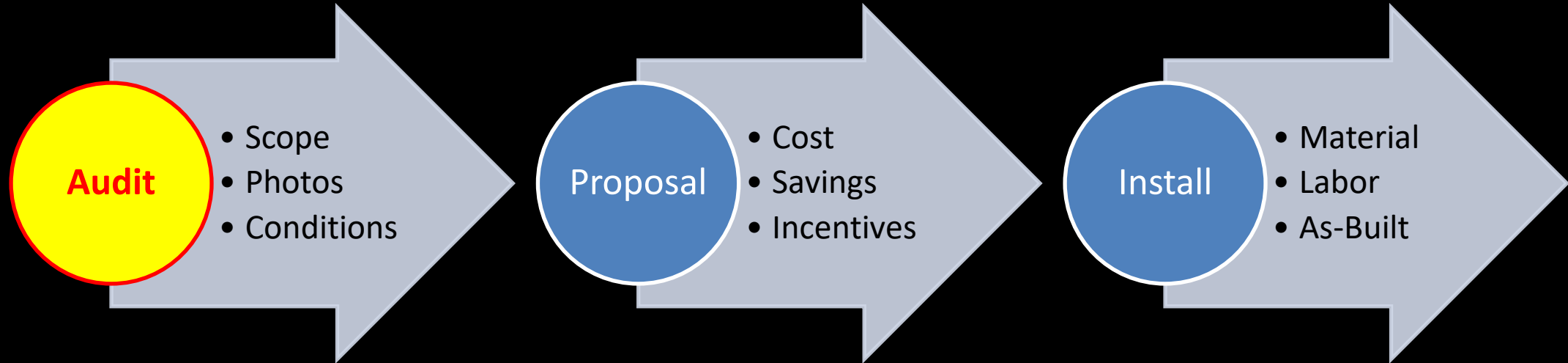


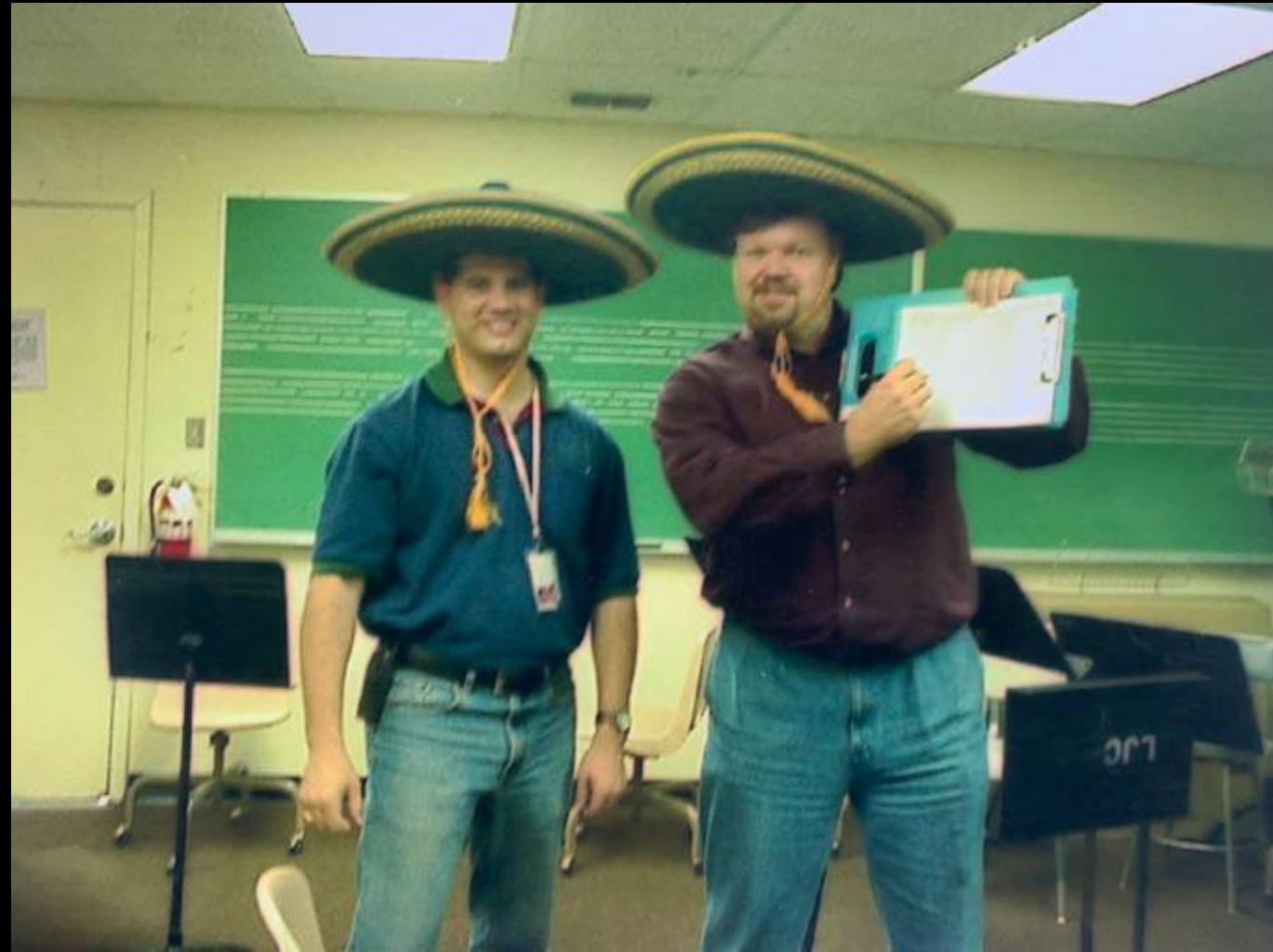
# Turnkey ESCO Retrofit Process





# Turnkey ESCO Retrofit Process







# Agenda

Deadline

- Preparation
- Anatomy
- Data
- Tools
- Tips
- Reference
-

## Preparation

Anatomy

Data

Tools

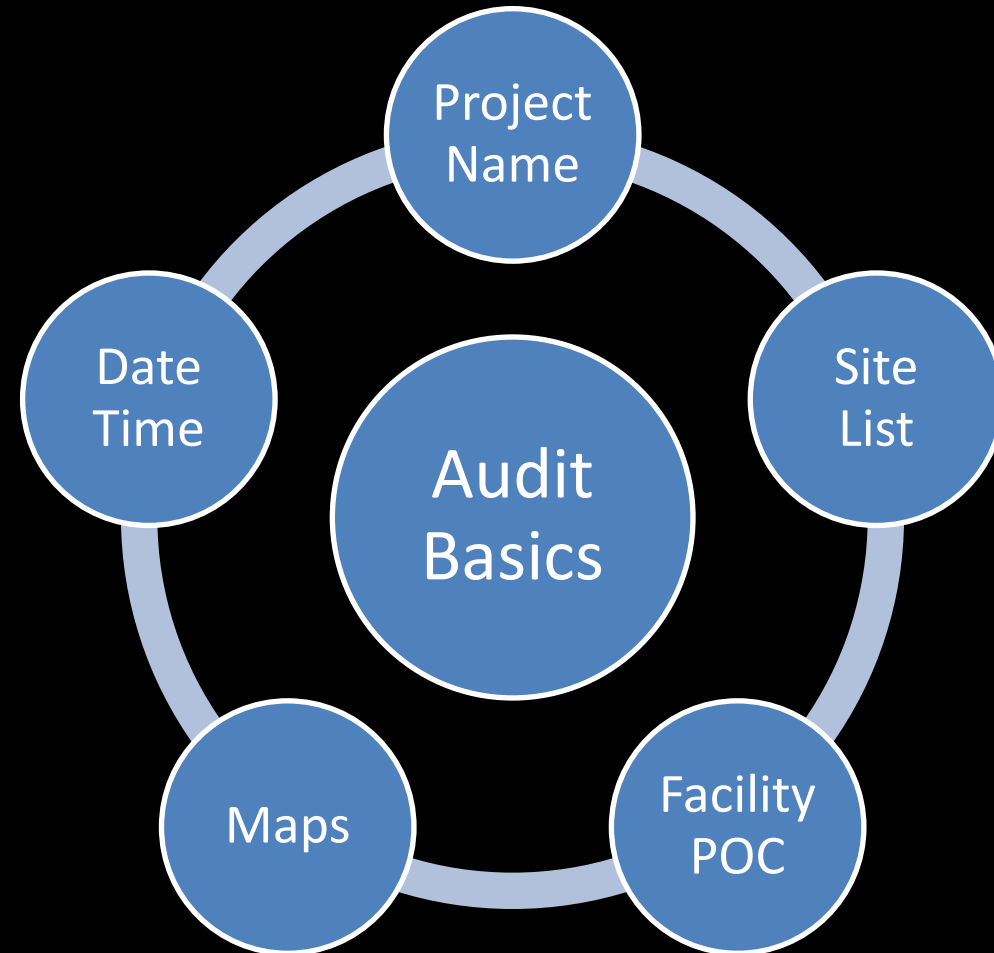
Tips

Reference



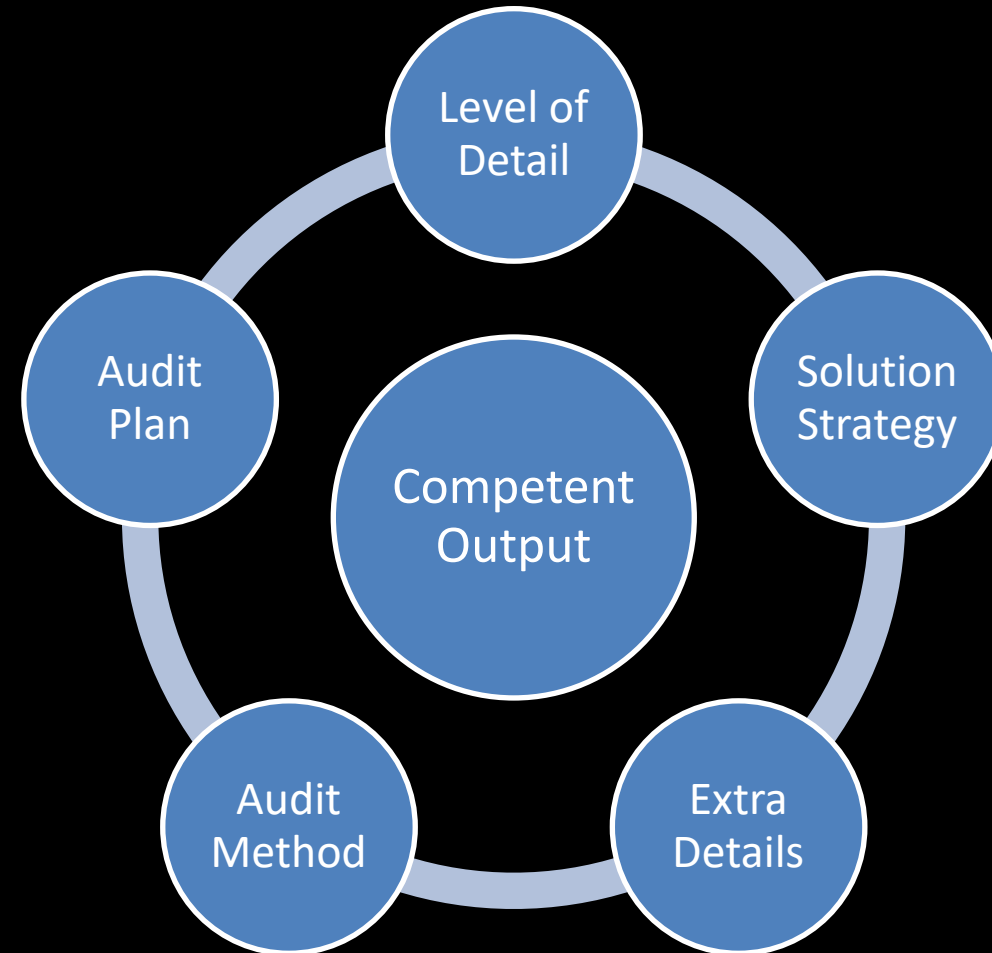
# Initial Details

- Document the Basics



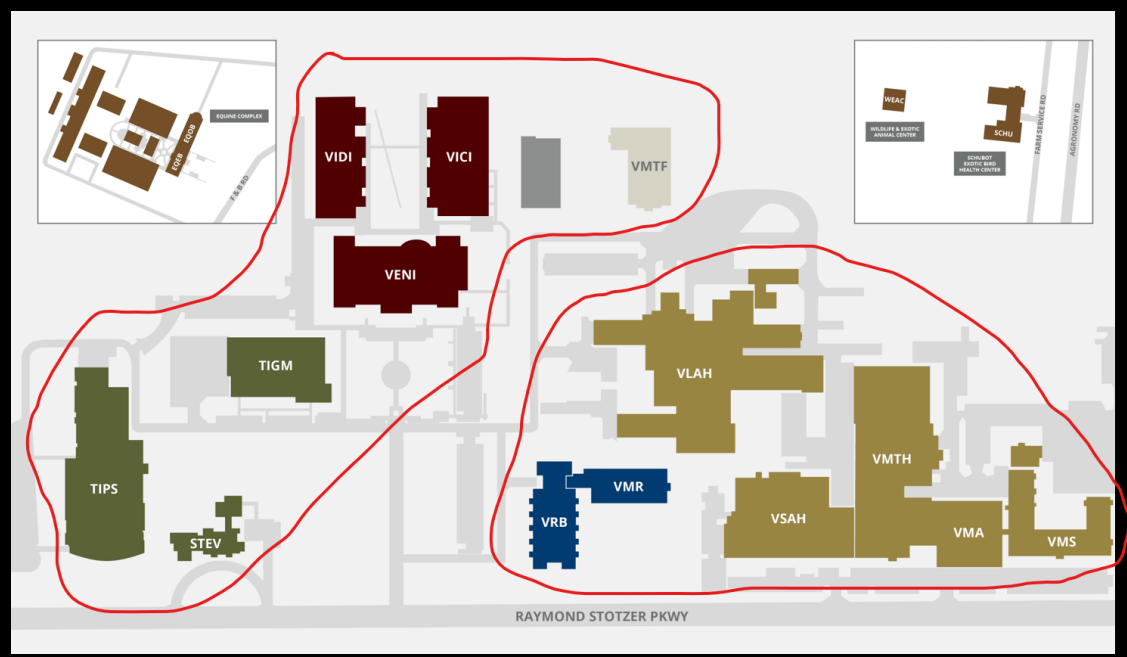
# Audit Data Quality

- Will our Audit Data properly capture what's needed to deliver an accurate proposal that maximizes the chances of winning?

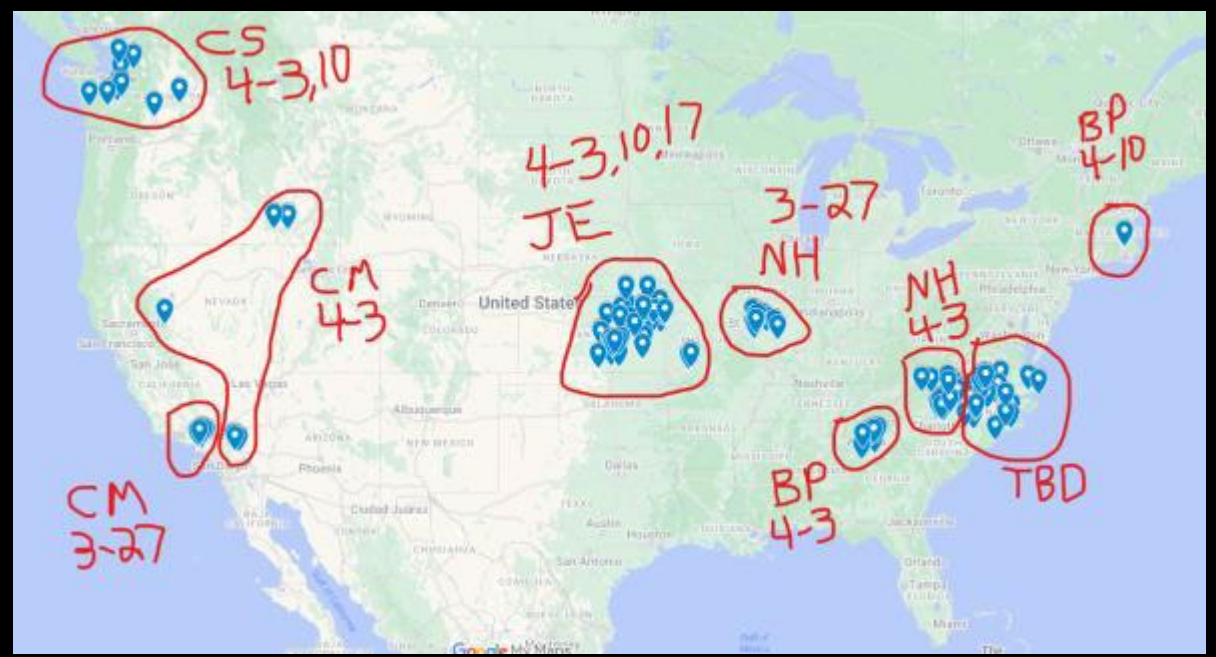


# Audit Logistics

One Campus  
Multiple Buildings



Multiple Cities  
Multiple Locations





# Audit Logistics

- Who are we sending?
- How long will it take?
- How much will it cost?



Preparation

**Anatomy**

Data

Tools

Tips

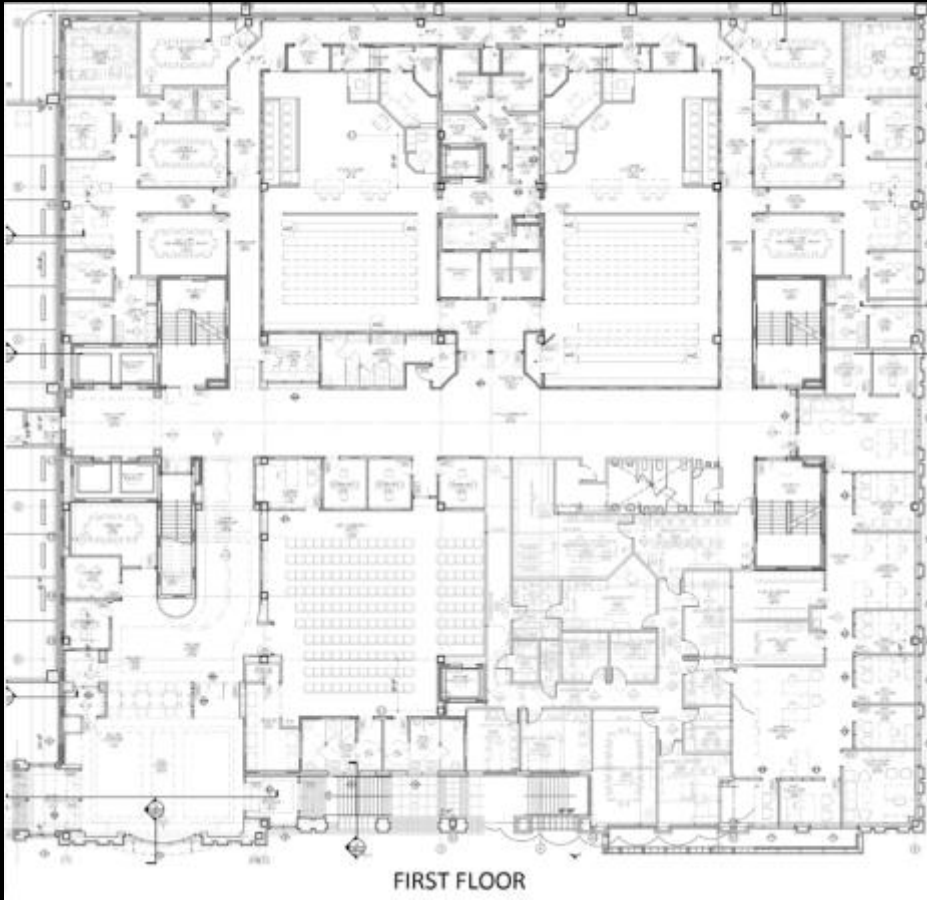
Reference



# The Lighting Assessment



# Map Review



# Map Review



# Pre-Audit Meeting

## Lighting Pre-Audit Meeting Questions

**Project Name:**

**Contact Name:**

**Address:**

**Phone:**

**City, ST, Zip:**

**Date:**

### Facility

1	SQ FT	Existing Controls: BMS, sensors, time clocks, etc.	
2	Owned vs. Leased? If Leased, Owners contact info.	Areas conditioned or refrigerated? % of year?	
3	Age, including additions.	Exterior lighting: any utility owned poles?	
4	Operating Hours,	Emergency lighting?: generator, BB %, bug-eye	
5	Voltage (any 480v)? Nearest interconnection point, 1 or 3 phase	Shattershield or colored tube guards required?	
6	CCT requirements (e.g. 4000K, 5000K)	Wet location or Wash down areas	
7	Asbestos or other known building issues?	Hazardous locations? Map?	
8	Bi-level switching, dimming, tandem-wiring	Extreme conditions? Temp / Dirt / Dust / Oil / Humidity	
9	How is Existing Lighting Maintained? Lift required?	Existing Recycling program or requirements?	

### Utility

10	Utility rate (blended KWH)		Utility Rep Contact	
11	Utility (Electricity provider)		Known Rebate Program? Previous submitted project?	

### During the Survey

12	Escort required? If, so what working hours?		Contractor Badge or Keys supplied?	
13	Any areas/buildings NOT included on maps? Tunnels/Basement?		site-specific safety procedures in addition to OSHA?	
14	Existing stock of lamps/ballasts on site?		PPE Requirements	

### Design Considerations

15	Light Level goals or standards?		Recent lighting retrofits or renovations?	
16	Areas where Sensors make sense? %Reduction		Any known lighting trouble spots or wish lists?	

### Installation

17	Ability to receive & store material		Crew working hours	
18	Dumpster/Recycling requirements		Preferred Labor contractor	
19	Labor requirements (union, DB, PW)		Areas accessible only during shutdown? Dates?	
20	Background checks required?		Permits, bonds, taxes	



# Dime Tour



# Data Collection: Details

The screenshot shows the Snapcount web application interface. At the top, there is a navigation bar with a home icon, the Snapcount logo (powered by Streamlink), and a 'RESOURCES' link with an information icon and a settings gear. Below the navigation bar, the page title is 'Agraz Test - test 3'. A secondary navigation bar contains tabs for 'LOCATION', 'BURN HOURS', 'AREAS', and 'ROOMS', with 'ROOMS' being the active tab. Below this, there is a search bar containing 'test 3 / Area' and two buttons: 'SET DEFAULTS' and '+ NEW ROOM'. A search icon is also present. Below the search bar, there are two tabs: 'DETAILS' (which is selected) and 'FLOORPLAN'. The main content area displays a table with the following data:

	Room	Fixture	Qty	Burn Hours	
* 1	Office 101	F-F32T8-3/Troffer-2X4-Prismatic-Recessed- Tile-4100-Emergency Battery-Master	1	Office Sensor30 - 2184	
* 2	Break Room	F-F32T8-2/Troffer-2X4-18 cell Parabolic Louver-Recessed- Tile-4100-*	1	Office - 3129	
* 3	Conference	CFL-PL4P26W-2/6-in Downlight Round-4-Pin PL-C Horizontal-Open-Recessed- Hard-4000-*	1	Office - 3129	

The screenshot shows the Snapcount web application interface, specifically the 'FLOORPLAN' tab. At the top, there is a navigation bar with a home icon, the Snapcount logo, and a 'RESOURCES' link. Below the navigation bar, the page title is 'test 3 / Area / Floor Plan'. A secondary navigation bar contains tabs for 'LOCATION', 'BURN HOURS', 'AREAS', and 'ROOMS', with 'ROOMS' being the active tab. Below this, there is a search bar containing 'test 3 / Area / Floor Plan' and two buttons: 'SET DEFAULTS' and '+ NEW ROOM'. A search icon is also present. Below the search bar, there are two tabs: 'DETAILS' and 'FLOORPLAN' (which is selected). Below the tabs, there is a toolbar with buttons for 'View', 'Add', 'Copy', 'Copy Multiple', 'Drag', 'Remove', and 'Markup'. The main content area displays an aerial satellite view of a building complex with a red location pin. The pin is labeled '7780 Peachtree Pike, Suite 101, PA, 19422'.





# Data Collection: Details

Area: Courthouse - Ground Floor Delete Room Add Room Copy Room Save Close

Room Name:

Position After:

Dimensions:  (len) X  (wid) =  (sqft)

Room Notes:

Room Type:

Inaccessible:

#591 #592 #593 + Element

**High Priority**

Fixture: F-F32T8-3/Troffer-2X4-Prismatic-Recessed-Tile-4100-\*

#Fix-GEN:

#Fix-PDAY:

#Fix-SDAY:

#Fix-SKY:

Qty:

Lamps Out:

Difficulty Factor:  10  20  30  40  50  60  70  80  90  100

Suggested Action:  Retrofit  Replace  Remove  Relamp  Delamp  Relocate  Install  Do Nothing  Exclude

Burn Hour Group: Audited: Office - 3120  
Quote Existing:  Add

Lighting Use:  Tandem 2 to 1  Tandem 3 to 1  Tandem 4 to 1

Switching:  On/Off single  On/Off 3-way  Inboard-Outboard  2 Zones  3 Zones  Dimming  Panel  24/7 Night circuit

Switch Qty:

Line #:

Map Ref #:

Area: Courthouse - Ground Floor Delete Room Add Room Copy Room Save Close

Room Name:

Position After:

Dimensions:  (len) X  (wid) =  (sqft)

Room Notes:

Room Type:

Inaccessible:

#591 #592 #593 + Element

**Room Navigation**  
Previous Next

**Controls**

Voltage:  12V  24V  120  208  240  277  347  480  Unknown

Existing Sensor:  Ceiling  Fixture  Switch  Wall  None

Effect of Controls (K):

New Sensor:

New Sensor Qty:

Control Notes:

**Misc**

Ceiling Type:  Concrete  Drop  Drywall  Metal  Open Truss  Other  Plaster  Spine  Wood

Ceiling Height:  7  8  9  10  11  12  13  14  15  16  18  20  22  24  25  26  28  30  32  35  40  45  50  70

Fixture Height:  0  1  2  3  6  7  8  9  10  11  12  13  14  15  16  18  20  22  24  25  26  28  30  32  35  40  45  50  70

Special Equipment:

Fixture/Lamp Notes:

**Fl Cande Readings**

FC1 Reading:

FC2 Reading:

FC3 Reading:



Energy: **F** - **F32T8** - **3**

Attributes: **Troffer- Air Handling** - **2X4** - **18 cell Parabolic Louver** - **Recessed-Tile** - **4100** - **Emergency Battery** - **Master**

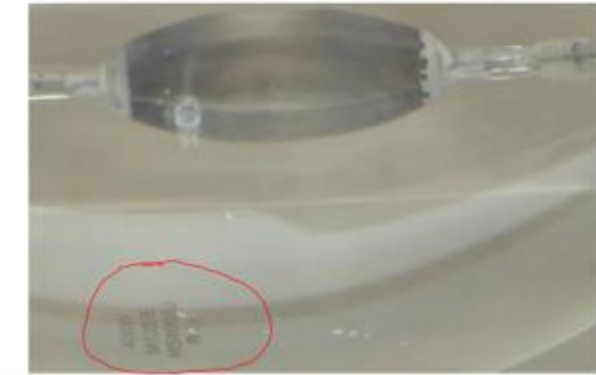
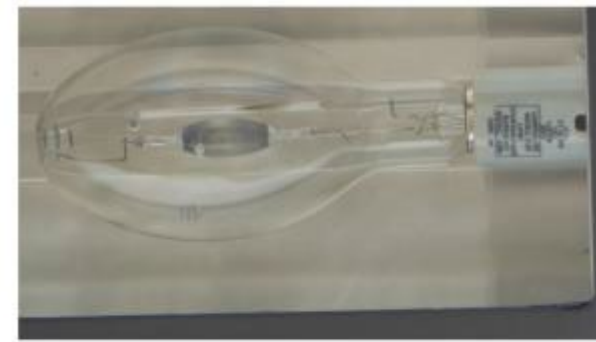


Energy:  -  -

Attributes:  -  -  -  -  -  -



# Data Collection: Photos



## AGI Lighting Layout Data Collection Form

Project Name: **Smith ISD Schools**  
 Address:  
 City, ST, ZIP:  
 Audit Date:  
 Auditor Name:  
 SnapCount Sales Project #:

**Dimensions (Feet)**

1 Room Length	50
2 Room Width	50
3 Room Height	20

**Fixture Spacing (Feet)**

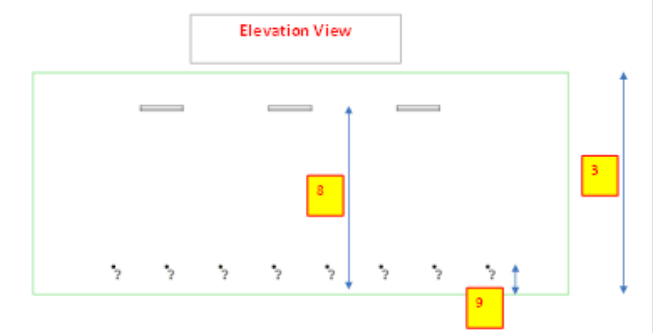
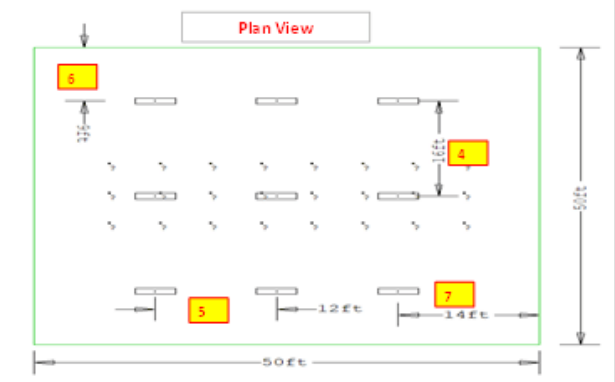
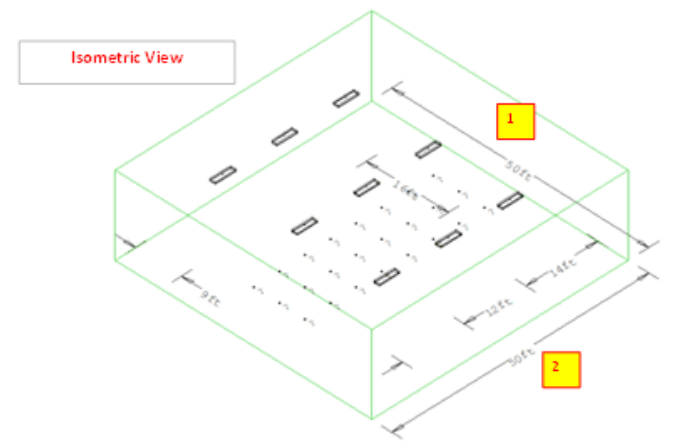
4 on-center Across	16
5 on-center Along	12
6 Wall to 1st Fixt. Across	9
7 Wall to 1st Fixt. Along	14
8 Mounting Height	17
9 Task Plane Height (Feet)	2.5

**Room Reflectance Values (%)**

Ceiling	80%
Walls	50%
Floor	20%

**Sketch Details to Include**

Luminaire Type, Qty  
 Room obstructions (partitions, racks, etc.)  
 Light Levels  
 Photos  
 Switching  
 Controls



- Lighting Layout Requirements
  - Dimensions
  - Fixture Spacing
  - Room Reflectances
  - Task Areas
  - Additional Light Levels

- Existing lighting system summary
  - Areas of Concern
  - Areas Excluded from Scope
  - Potential Solutions and Design Strategy
  - Questions on Specific Map #'s
  - Other Comments



Preparation

Anatomy

**Data**

Tools

Tips

Reference



# Analog vs Digital





# Old-School Digital Platforms

Macsteel-Houston, Texas																												
Savings Detail																												
OPTION B: Include Sensors in Warehouse																												
Space																												
#	Mac #	Fl.	SqFt	Area	Cat	Existing Lighting System						Proposed Solution																
						Components	Fixture Type	Qty	Watts	Hours	KWH	Components	Fixture Type	Qty	Watts	Hours	KWH											
1	A000	1	OFF	Office-Open	C	2 amp, 34 watt F40T12, 086 Magenta	CHP recessed Troffer Louver	108	133	2,887	21,147	65,020	1 amp, FC05000P, 060W LxR	Recessed, Recessed	108	65	2,887	10,331	29,020	13,812	30,960	\$4,836.68	1,248	3,071	\$657.02			
2	A000	1	OFF	Office-Open	D	2 amp, 34 watt F40T12, 086 Magenta	CHP recessed Troffer Louver	3	94	2,887	2,722	722	1 amp, FC05000P, 060W LxR	Recessed, Recessed	3	46	2,887	6,144	413	9,199	216	\$49.35	0,012	36	\$9.98			
3	A005	1	OFF	Office-Private (B)	E	2 amp, 34 watt F40T12, 086 Magenta	CHP recessed Troffer Louver	12	133	2,887	1,596	4,576	1 amp, FC05000P, 060W LxR	Recessed, Recessed	12	65	2,887	6,786	1,595	9,919	3,916	\$489.61	0,094	347	\$54.05	30%	on switch	0
4	A005	1	OFF	Office-Private (C)	E	2 amp, 34 watt F40T12, 086 Magenta	CHP recessed Troffer Louver	9	133	2,887	1,197	3,422	1 amp, FC05000P, 060W LxR	Recessed, Recessed	9	65	2,887	6,081	1,174	9,812	2,758	\$352.21	0,070	260	\$41.07	30%	on switch	3
5	A000	1	OFF	Office-Private (S)	C	2 amp, 34 watt F40T12, 086 Magenta	CHP recessed Troffer Louver	12	133	2,887	1,896	6,376	1 amp, FC05000P, 060W LxR	Recessed, Recessed	12	65	2,887	6,786	1,869	9,919	3,916	\$489.61	0,094	347	\$54.05	30%	on switch	3
6	A010	1	0900	Warehouse Bay 1 (A.S.)	A	1 amp, 1,000 watt Ballast, 086 Magenta	Pendant High Bay	68	1000	4,000	71,200	204,317	1 amp, FFS4500, 75 Watt, 086 Magenta	Industrial High Bay, 086 Magenta, 086 Bay	68	476	2,342	21,476	73,719	20,884	289,799	\$40,824.71	0,000	0	\$0.00	30%	on future	68
7	A010	1	0900	Warehouse Bay 1 (A.S. South)	A	1 amp, 1,000 watt Ballast, 086 Magenta	Pendant High Bay	64	1000	4,000	69,120	204,360	1 amp, FFS4500, 75 Watt, 086 Magenta	Industrial High Bay, 086 Magenta, 086 Bay	64	476	1,528	14,464	107,220	30,959	217,154	\$33,676.16	0,000	0	\$0.00	30%	on future	64
8	A010	1	0900	Warehouse Bay 1 (A.S. South)	A	1 amp, 1,000 watt Ballast, 086 Magenta	Pendant High Bay	68	1000	4,000	73,440	204,888	1 amp, FFS4500, 75 Watt, 086 Magenta	Industrial High Bay, 086 Magenta, 086 Bay	68	476	2,988	22,368	129,119	40,372	218,528	\$33,623.67	0,000	0	\$0.00	18%	on future	68
9	A010	1	0900	Warehouse	B	1 amp, ADD-F30708, 086 Magenta, 20 Watt	Industrial High Bay, 086 Magenta, 20 Watt	4	0	4,000	0,000	0	1 amp, FFS4500, 75 Watt, 086 Magenta	Industrial High Bay, 086 Magenta, 086 Bay	4	476	4,000	1,804	8,203	-1,804	-8,203	\$1,203.82	0,000	0	\$0.00	0	0	
10	A010	1	0900	Warehouse	B	2 amp, 34 watt F40T12, 086 Magenta	or Surface Industrial	2	64	4,000	6,168	780	1 amp, FC05000P, 060W LxR	Recessed, Recessed	2	44	4,000	6,080	413	9,399	376	\$68.57	0,000	0	\$0.00	0	0	



Link  
version 1.0



**Maneri-Agraz**  
energy efficient lighting professionals

**Main Menu**

Data    Utilities

Projects

Construction

Purchase Orders

Vendors


An Energy-Efficient  
Lighting Proposal to

## Macsteel


**Macsteel**  
Houston, Texas

Prepared for:  
Jeff Edgcomb

Prepared by:  
Frank J. Agraz, Jr.  
Maneri-Agraz, LLC



October 9, 2008  
Version #1


Clients    Manage Catalog    L

Back to client list

**884 Mokulua LLC**

Primary Contact: ESCO    No

Engineer:    Utility Co.

Sites:

**Vasco Industries**

Site

**Vasco Industries**

*Add Project*

**Industrial Park Exterior**

*View project | Delete*

Owner: 884 Mokulua LLC    Site: Vasco Industries    State: California

Description:

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# Current Digital Platforms

THE SOFTWARE ABOUT US INSIGHTS CONTACT US SUPPORT Training Calendar Schedule A Demo

## ECOINSIGHT COMBINES THE FLEXIBILITY AND MOBILITY OF TABLET-BASED LIGHTING AUDIT SOFTWARE WITH THE POWER AND SECURITY OF A COLLABORATIVE, CLOUD-BASED LIGHTING SPECIFICATION PLATFORM

Success at your fingertips

### INTERACTIVE FLOOR PLAN

Retrolux Home Features Solutions About

### Optimized Energy Audit

Conduct on-site lighting audits with an easy-to-use mobile tablet app.

### Elevated Solution Design

Create multiple solutions with manufacturer product catalogs.

SNAPCOUNT SNAPSOURCE RETROFIT SHOWCASE PROOF ABOUT US INSIGHTS CONTACT US

## The lighting retrofit software that changed everything.

With SnapCount® lighting retrofit software, retrofitters across North America audit, propose and implement up to 70% faster. Now it's your turn.

See How SnapCount Fits Your Business

Fast Cost Estimating Build professional project estimates with rebates, incentives, and services.

Winning Proposals Create stunning customized energy savings proposals & close deals faster.

Streamlined Installation Get project installation updates directly from the field while saving time & money.

Preparation

Anatomy

Data

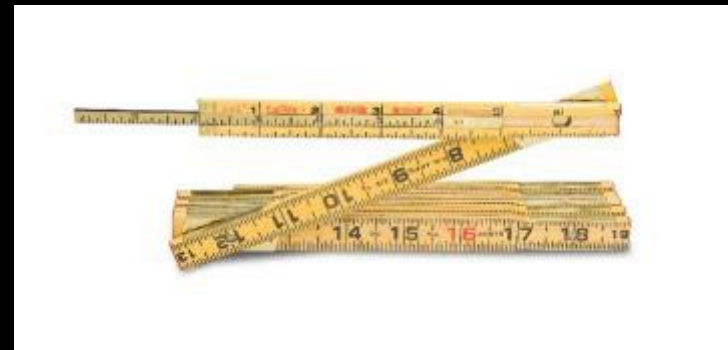
**Tools**

Tips

Reference



# Audit Tool Bag



# Personal Protective Equipment



Preparation

Anatomy

Data

Tools

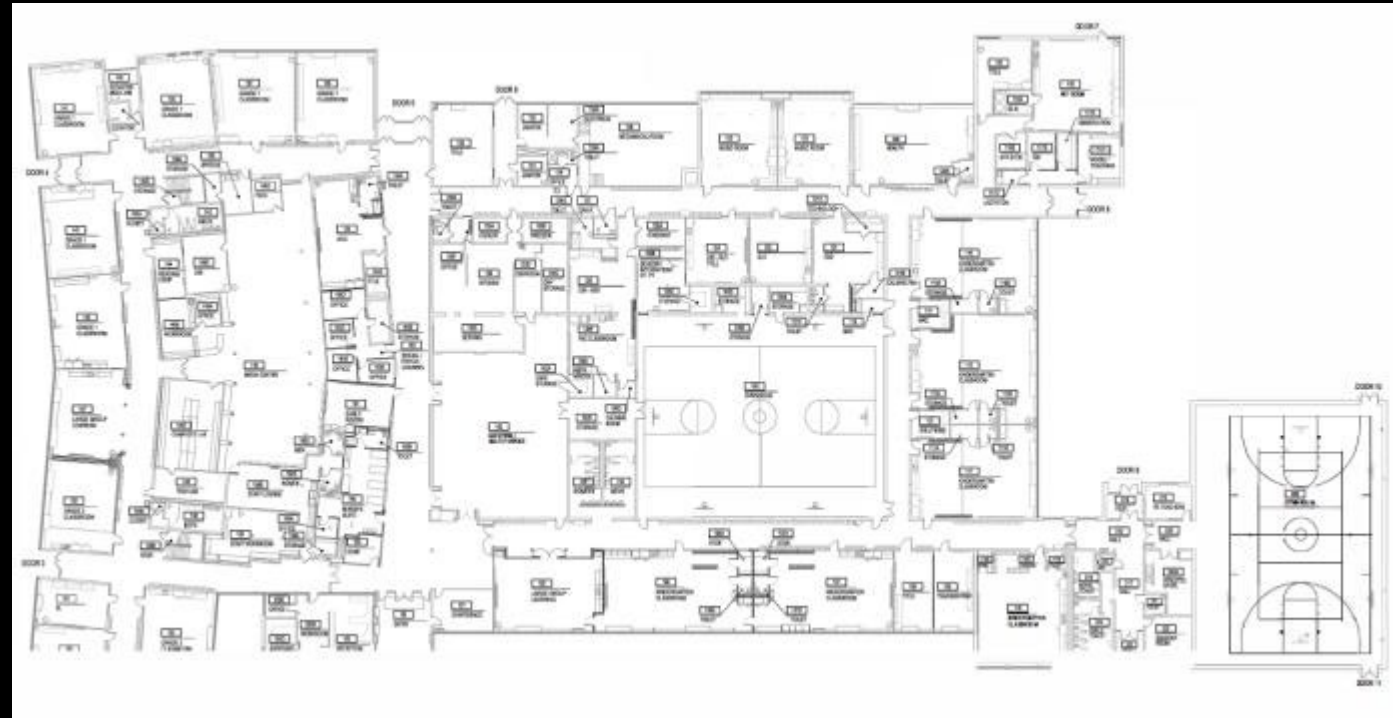
**Tips**

Reference



# Advice to Consider

- Consistency is your friend
  - Multiple Floors: Top-Down vs Bottom-Up
  - Per Floor: Pick a Corner
  - Direction: Clockwise vs CC
  - Hall/Wing: Same Side vs Criss-Cross



# Advice to Consider

- How to Count
  - Coves: Ceiling Tiles
  - High Bay: Columns
  - Troffers: one Row at a time
  - Complex: in Layers





# Advice to Consider

- Distance: Use known measurements
  - Ceiling Tiles: 2ft, 4ft.
  - Warehouse Rack section: ~ 4-5ft
  - Purlin Spacing: ~ 4-5ft
  - Cinder Blocks: 8in
  - Standard Door: 7ft
  - Dock Bay Door: ~10ft



# Advice to Consider

## How to Maximize Efficiency

- Arrival: Additional time- badging, training videos, safety training.
- Escorts: Schedule Audit Team to match available Escorts.
- Timing: Plan each day to maximize access.
- Occupancy: Audit with or without occupants present?
- Interruption: Always write down your count and note your position BEFORE you start talking.



# Factors to Consider

## Hospital, Food Preparation, Clean Room

- Hair Net
- Long Sleeves
- No buttons or denim
- Ear Plugs with Metal
- Medical gown, “bunny suit”



Preparation

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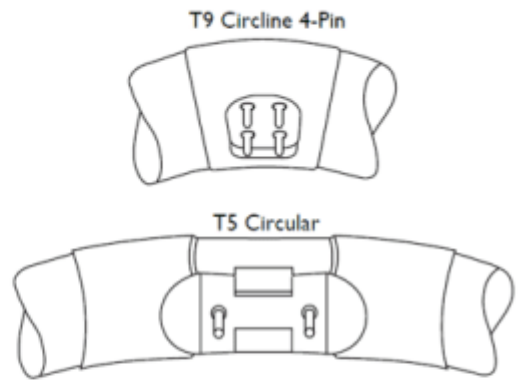
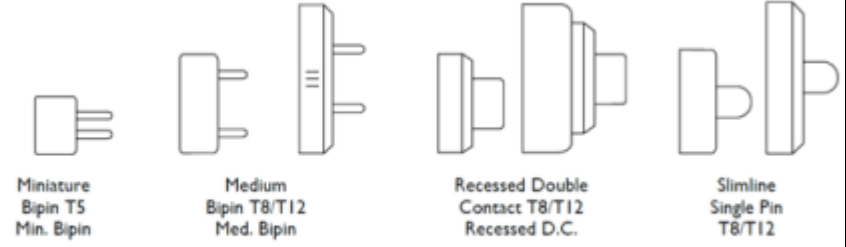
Tools

Tips

**Reference**



## Base Types- Fluorescent



## Fluorescent: Linear T12 8ft

Row	Catalog #	Nominal Length (in)	Lamp Watts	Lamp Version	Base	Ballast Start	Initial Lumens	Maintained Lumens
1	F96T12/CW/SS/ECO	96	<b>60</b>	Slimline (ES)	Single Pin	Instant	5,300	4,664
2	F96T12/D41/ECO	96	<b>75</b>	Slimline	Single Pin	Instant	6,420	5,906
3	F96T12/D41/HO/SS	96	<b>95</b>	High Output (ES)	Recessed Double Contact	Rapid	8,350	7,515
4	F96T12/D41/HO	96	<b>110</b>	High Output	Recessed Double Contact	Rapid	9,050	8,145
5	F96T12/CW/VHO/SS	96	<b>195</b>	Very High Output (ES)	Recessed Double Contact	Rapid	13,000	9,100
6	F96T12/CW/VHO	96	<b>215</b>	Very High Output	Recessed Double Contact	Rapid	14,000	9,800

## Fluorescent: Linear T8

F 32 T 8 8 41

### Technology

F- Fluorescent, linear

FO- Fluorescent Octron, linear (Sylvania only)

FB- Fluorescent, U-Bend

**Watts (Linear):** 25, 28, 30, 32 (4'), 17 (2'), 25 (3'), 40 (5')

**Watts (U-Bend):** 16, 24, 29, 31 (1 5/8"), 25, 30, 32 (6")

**Length (High Output):** 48, 60, 72, 96

### Bulb Shape

T- Tubular

**Diameter in 1/8"**

8- 8/8" = 1"

### Lamp Series

7- 700 Series (CRI in 70's)

8- 800 Series (CRI in 80's)

9- 900 Series (CRI in 90's)

### Correlated Color Temperature (CCT)

27- Warm White (2700K) 41- Cool White (4100K)

30- Warm White (3000K) 50- Daylight (5000K)

35- Neutral White (3500K) 65- Daylight (6500K)

F 32 T8 841

### Blue

**ADV-** Energy Advantage

**EW, XEW-** EconoWatt

**XLL-** Extra Long Life

**PLUS-** Improved Phosphor

**ALTO-** less mercury (green endcaps)

**25 WATT, 28 WATT, 30 WATT (4')**

### Orange

**XP-** Extended Performance (lumens & life)

**XPS-** Extended Performance Super (lumens & life)

**SS-** Super Saver (25, 28, 30 watt 4')

**ECO-** less mercury

### Black

**XL-** Extra Life

**SXL-** Super Long Life

**25W-** 4' 25 watt

**SP-** Specification Series (lumens & life)

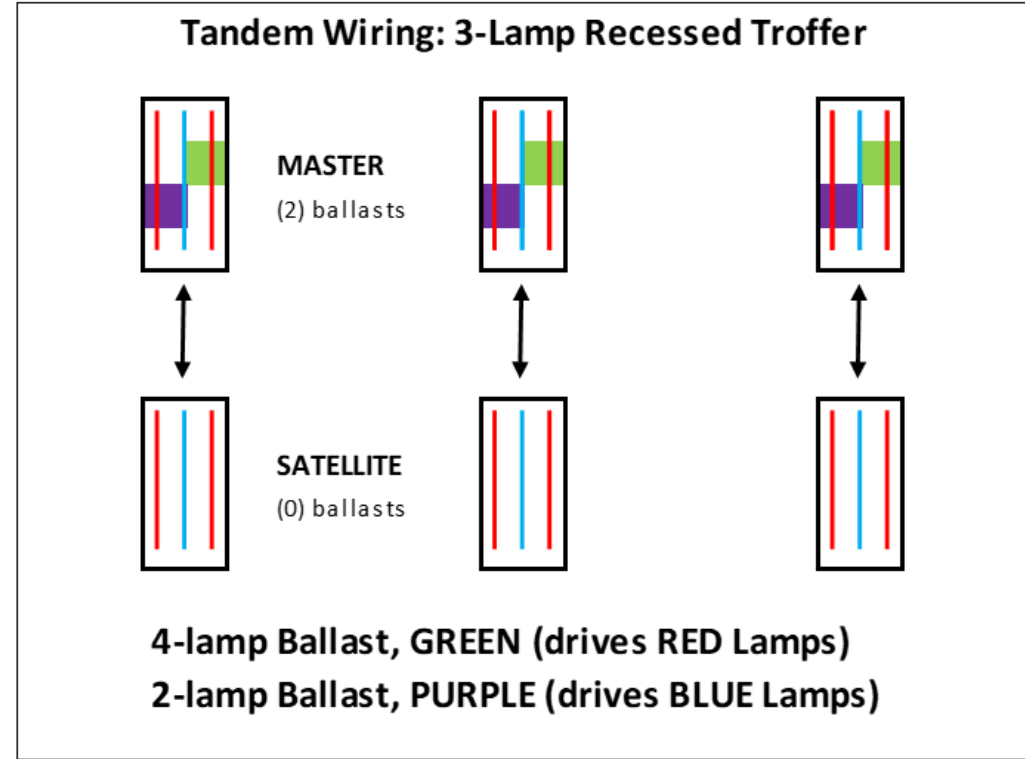
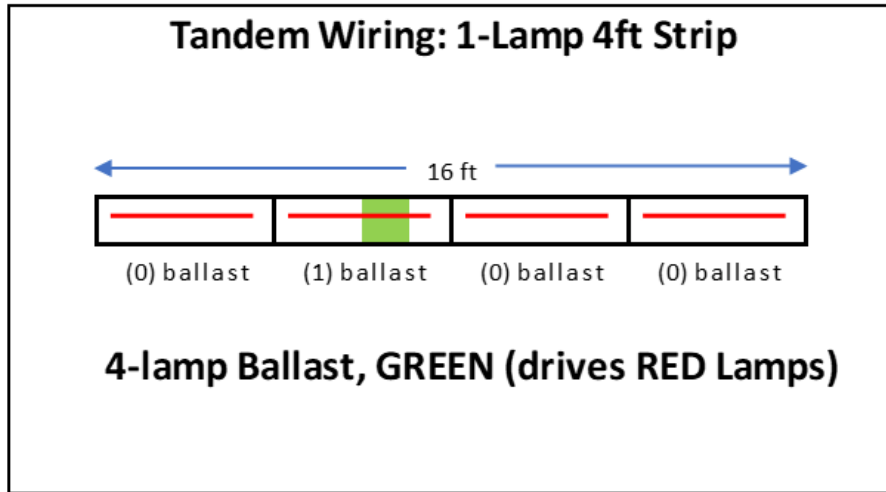
**SPX-** Specification Series (lumens & life)

**HL-** High Lumen

**WM-** Watt Miser

**ECO, ECO2-** less mercury

# Tandem Wiring





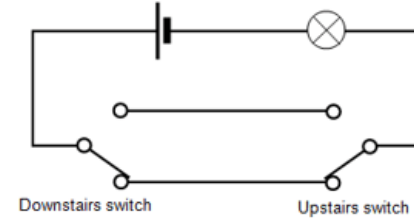
## Switching

- On/Off Single
- On/Off 3-Way
- Inboard-Outboard
- 2 Zones
- 3 Zones
- Dimming
- Panel
- 24/7 Night Circuit

On/Off Single



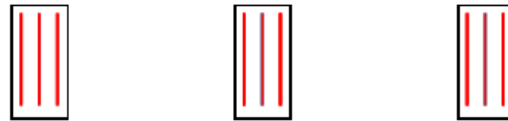
On/Off 3-Way



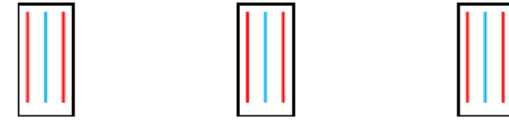
2-Zone Switching



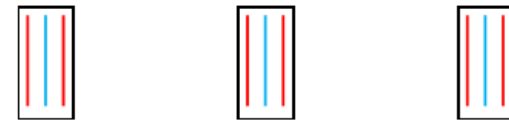
Switch 1: Zone 1, Yellow  
Switch 2: Zone 2, White



Inboard-Outboard Switching: 3-Lamp Recessed Troffer



Switch 1: Outside (2) Lamps, RED  
Switch 2: Inside (1) Lamp, BLUE



## Compact Fluorescent: Plug-In

	Plug-In		Plug-In			
Cat #	CF9DS/850/ECO	CF13DD/830/ECO	CF7DS/E/827	CF26DD/E/830/ECO	CF26DT/E/835/ECO	FT40DL/841/RS/ECO
Base	G23	GX23-2	2G7	G24q-3	GX24q-3	2G11
	2-Pin		4-Pin			
	PL-S (Short)	PL-C (Cluster)	PL-S (Short)	PL-C (Cluster)	PL-T (Triple)	PL-L (Long)
Watts	5, 7, 9, 13	9, 13, 18, 22, 26, 28	5, 7, 9, 13	10, 13, 18, 26	13, 18, 26, 32, 42	18, 24, 36, 40, 50, 55



## Bulb Size- HID

**Metal Halide:  
Probe-Start, Pulse-Start**

**High Pressure Sodium**



# Bulb Size- HID

Metal Halide: Ceramic



Lamp Watts



## Bulb Size- HID

### Mercury Vapor



100      100      250  
175      400      1000

### Low Pressure Sodium



55      180  
35      135  
18      90

Lamp Watts











## Confessions of an Old School Lighting Auditor



**Thank you for your time!  
Questions?**

Frank Agraz, LC, IES  
FAgraz@ecoengineering.com



This concludes The American Institute of Architects Continuing  
Education Systems Course

