A large rectangular area with a horizontal rainbow gradient background, transitioning from blue on the left to red on the right. The text is centered within this area.

**STATE OF THE ART
LIGHTING RETROFIT
OF THE HAWAII
CONVENTION CENTER**

**STAN WALERCZYK, LC
LIGHTING WIZARDS**

7/21/08

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BIO

- 19 years experience
 - Distribution, maintenance, installer, retrofit contractor, consultant, designer, researcher
- 500+ projects
- 30+ published articles
- 400+ seminars
- IESNA member
 - Effects of Lamp Spectral Distribution Committee
 - Served on Energy Management Committee
 - Past chair of Retrofit/Upgrade Subcommittee
- CLEP by AEE
- Lighting Certified by NCQLP
- Project manager for California Lighting Technology Center
- Assisted on DOE scotopically enhanced lighting research
- Consultant for PG&E on California Title 20
- Several IIDA Awards

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WHO ARE YOU?

- So everybody can hear
 - Name
 - Position
 - Company or institution (optional)
 - What you want to learn

HISTORY

- Convention Center had its grand opening in 1998
 - Considered state of the art lighting
- About 2 years ago...
 - Significant numbers of original dimming ballasts started to burn out
 - Replacements were very expensive
 - With increasing oil prices, electrical costs were getting out of hand
 - Convention Center was getting info mainly from sales people that wanted to sell their products
- At the PCEA in Maui last September Mike Polovcin from the Convention Center attended my seminar
 - Convention Center wanted an independent consultant
 - Contract was signed in November and I came out for 4 days

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PROCESS

- In the four areas specified by the Convention Center, inspected and evaluated...
 - Applications and people usage
 - Light quantity
 - Light quality
 - Lamps
 - Ballasts
 - Fixtures
 - Controls (or lack of)
- Prepared the accompanying feasibility study on a common fixture type, and went over pros and cons of each option, so Convention Center could decide on their optimal solution
 - With that feedback, I also knew what to do with other fixture types

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PROCESS

- After getting back to home, I started writing audit files on each of the four areas
 - Exhibit halls
 - Ballrooms
 - Administration, including
 - Offices
 - Kitchens
 - Halls
 - Mechanical rooms
 - Etc
 - Fire exits
 - Special stairs
 - Special halls

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ELECTRIC RATES

- When starting on the project, informed to use \$.21/KWH as a blended rate
- This summer informed to use \$.28/KWH
– 33% increase

EXHIBIT HALLS

- Originally thought this would be the easiest, because knew 800 400W MH hibays
 - Mainly in sets of 4 in a square
 - Each on its own circuit for 1/4, 1/2, 3/4 and full light in each set
 - For example, typically only need 1 or 2 hibays on in each set for set up and break down
 - Dimmable incandescent in the middle of set
- But Convention Center, chosen hibay manufacturer and I soon learned otherwise

EXHIBIT HALLS

- Originally wanted to replace set of four MH hibays & dimmable incandescent fixture with
 - 2 2x8 non-lensed hibays, each with
 - 12 F32T8 lamps
 - 10 driven by 1.15 BF ballasts
 - 2 driven by .71 BF ballasts
 - » These were intended to replace incandescent
 - » But since T8s looked much warmer with low than high BF ballasting, not dimmable, not aesthetically pleasing, Convention Center said no
 - 4 cords & plugs
 - Found out that UL no longer allows more than one cord & plug per fixture and getting a special approval would cost serious money, take a long time and the answer would still be no

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EXHIBIT HALLS

- Then we tried replacing each dimmable incandescent fixture with a 1x4 fixture that had 2 F32T8s and a dimmable ballast, that could work with existing incandescent dimmer
 - Certain key people did not like, so was canned

EXHIBIT HALLS

- Final solution...
 - Keep existing high wattage dimmable incandescents
 - Not used very much anyway
 - Replace each 400W MH hibay with 2x4 lensed hibay that has
 - Good thermal management for lamps and ballasts
 - 6 3100 lumen 5000K 32W F32T8 lamps
 - 2 parallel-wired program-start extra-efficient program-start ballasts
 - 6 high performance white specular reflectors
 - At least 4" wide for each lamp
 - Bottom of reflector is below bottom of lamp
 - 1 cord & plug
 - Twist lock lamp holders
 - Custom mounting so easily put 2 fixtures together on ground level and easily mount 2x8 fixture array to ceiling brackets

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EXHIBIT HALLS

- Projected financials
 - Wattage reduced from 458 to 218 and with instant-on and no-restrike time, also additional KWH savings
 - \$123,500 annual electrical savings, including reduced AC load
 - \$26,800 HECO rebate
 - 2.0 year payback, including AC and maintenance savings
 - \$1,922,000 15-year long term benefit, including AC and maintenance savings

GENERAL HIBAY NOTES

- Some parties push T5HO hibays, but for most applications, high performance T8 hibays provide the same or more light, while saving considerable wattage
- Avoid T8 hibays, which have any of these
 - Basic or mid grade lamps
 - Generic electronic ballasting
 - On/off instant start ballasts with occupancy sensors
 - 2 lamps in one reflector cavity
 - Reflectors less than 4” wide nominally for each lamp
 - Bottom of lamps below bottom of reflectors
 - No or insufficient thermal design for lamps and ballasts

HIGH PERFORMANCE MH, T5HO & T8 HIBAY COMPARISON

Following are some examples

lamp, ballast & dome/reflector type	lamp life at 10 hour cycles	CRI	initial total lamp lumens	BF	actual initial total lamp lumens	EOL lamp lumen maintenance	EOL total lamp lumens	luminaire efficiency	EOL lamp luminaire lumens	system watts	EOL lamp luminaire lumens per watt	Kelvin	S/P ratio	EOL lamp luminaire task modified lumens	EOL lamp luminaire task modified lumens per watt
320W quartz PS MH lamp, magnetic reactor ballast, high performance dome	20,000	65	32,000	0.97	31,040	65%	20,176	92%	18,562	345	54	4000	1.65	27,432	80
320W quartz PS MH lamp, electronic ballast, high performance dome	20,000+	65	32,000	0.97	31,040	75%	23,280	92%	21,418	335	64	4000	1.65	31,653	94
high Kelvin quartz 375W PS MH lamp, electronic ballast, high performance dome	20,000+	90+	28,000	0.97	27,160	75%	20,370	92%	18,740	391	48	5000	2.10	33,428	85
315W ceramic MH lamp, electronic ballast, high performance dome	20,000+	90	36,225	1.00	36,225	80%	28,980	92%	26,662	353	76	4200	1.80	42,170	119
320W ceramic MH lamp, electronic ballast, super high performance dome	20,000+	90	38,800	1.00	38,800	80%	31,040	94%	29,178	335	87	4200	1.80	46,149	138
4 F54T5HO 4100K lamps, electronic ballasts, enhanced aluminum reflector	33,000+	85	20,000	1.00	20,000	92%	18,400	92%	16,928	234	72	4100	1.65	25,017	107
4 GE 51W F54T5HO 4100K lamps, extra efficient electronic ballasts, enhanced aluminum reflector	33,000	85	20,000	1.00	20,000	92%	18,400	92%	16,928	216	78	4100	1.65	25,017	116
6 high lumen F32T8 4100K lamps, instant start electronic ballasts, enhanced aluminum reflector	28,000+	85	18,600	1.18	21,948	92%	20,192	91%	18,375	218	84	4100	1.65	27,156	125
6 high lumen F32T8 4100K lamps, program start electronic ballasts, enhanced aluminum reflector	34,000+	85	18,600	1.15	21,390	92%	19,679	91%	17,908	216	83	4100	1.65	26,465	123
6 high lumen F32T8 5000K lamps, 1.0 BF instant start electronic ballasts, enhanced aluminum reflector	28,000+	85	18,000	1.00	18,000	92%	16,560	91%	15,070	178	85	5000	1.95	25,370	143
6 Philips extra long life F32T8 5000K lamps, program start electronic ballasts, enhanced aluminum reflector	44,000	85	17,100	1.15	19,665	92%	18,092	91%	16,464	216	76	5000	1.95	27,717	128
6 F32T8 6500K lamps, 1.0 BF instant start electronic ballasts, enhanced aluminum reflector	28,000+	85	17,100	1.00	17,100	92%	15,732	91%	14,316	178	80	6500	2.25	26,948	151
6 Sylvania Skywhite F32T8XP 8000K lamps, 1.0 BF instant start electronic ballasts, enhanced aluminum reflector	28,000+	88	15,900	1.00	15,900	92%	14,628	91%	13,311	178	75	8000	2.50	27,203	153

Notes

BF stands for ballast factor and EOL stands for end of life. Not all electronic ballasts for MH start the lamps the same, use the same wattage, etc.

High performance domes include clear prismatic, metal faceted or glass lined metal faceted. 320W CMH data is preliminary.

Initial lumens for ceramic MH lamps with some electronic ballasting is at least 5% higher than catalog listing with magnetic ballasting.

IMPORTANT! Fluorescent lamp lumens are based on optimal temperatures & can be adjusted with lumen/temp tables provided by manufacturer.

Luminaire dirt depreciation could be included if you know it. All line voltages are considered to be 277.

End of life luminaire task modified lumens = end of life lamp luminaire lumens x (S/78)^{-0.78} [78 exponent]. Task modified lumens less for lower Kelvin.

Prepared by Stan Walczvck of Lighting Wizards, 6/3/08 version.

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BALLROOMS

- As mentioned before, Convention Center wanted to get rid of dimming ballasts
 - Dimming ballasts are not very efficient
 - Replacement ballasts are very expensive
 - Numerous lamps would flick on and off, which was very annoying
 - Lamp life was not very good
 - Somebody convinced Convention Center to buy 28W F32T8s
 - Which are not designed to work with dimming ballasts
- Access to and into the high mounted double lensed chandeliers very time consuming and has to be scheduled around events

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BALLROOMS

- Since there are 4 circuits in each chandelier, it was agreed to go to staged dimming for various levels of lighting and patterns
- Most fixtures were retrofitted lamp for lamp with
 - High lumen 5000K full wattage T8s
 - Extra-efficient parallel-wired program-start .71 BF ballasts
- Projected financials for chandeliers and other fixtures
 - \$6800 HECO rebate
 - \$8500 annual electrical savings, including reduced AC
 - 2.7 year payback, including reduced AC and maintenance savings
 - \$210,000 15-year long term benefit including AC and maintenance savings

GENERAL DIMMING BALLASTS NOTES

- Not only are dimming ballasts not that efficient at full light output, they get less efficient the more they are dimmed, because more energy has to go to heat lamp cathodes, so lamps do not flicker or turn off

BALLAST EFFICACY FACTOR TABLE - 2F32T8				
<i>general type</i>	<i>further description</i>	<i>ballast factor</i>	<i>system watts</i>	<i>BEF</i>
instant start	extra efficient	0.87	53	1.64
	basic grade	0.87	58	1.50
	extra efficient	0.77	48	1.60
	basic grade	0.77	51	1.51
	extra efficient	1.15	72	1.60
	basic grade	1.15	77	1.49
program start	extra efficient	0.88	55	1.60
	basic grade	0.88	62	1.42
	extra efficient	0.71	46	1.54
rapid/ program start dimming	extra efficient	0.99	66	1.50
	continous photocell	0.49	41	1.20
		0.18	18	1.00
	extra efficient	0.88	58	1.52
	continous	0.05	15	0.33
		0.88	64	1.38
	0-10V	0.05	14	0.36
		1.00	68	1.47
	powerline	0.05	15	0.33
		1.00	70	1.43
	continous DALI	0.54	45	1.20
		0.05	17	0.29
		0.88	62	1.42
	three stages	0.58	45	1.29
		0.27	28	0.96
notes: Wattages based mainly on 277V.				
Values will vary among specific ballasts.				
By Stan Walerczyk, Lighting Wizards, 10/30/06				

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GENERAL T8 NOTES

- If you have basic grade 700 series T8s, probably cost effective to replace them, but with what?
 - Highest lumen full wattage 3rd generation or 'Super' T8s
 - GE HL
 - Philips Advantage
 - Sylvania XPS
 - Mid lumen extra long life T8s
 - Philips XXL
 - Sylvania XP XL
 - 28W or 25W F32T8s
 - GE, Philips and Sylvania have these

GENERAL T8 NOTES

- Highest lumen full wattage 3rd generation or 'Super' T8s
 - I have always been able to provide a better total solution with these lamps than with reduced wattage lamps, because with more lumens easier to delamp or use lower BF ballasts
 - With fewer lamps, customers have lower lamp replacement and recycling costs
- Mid lumen extra long life T8s
 - Lumens fight against life, so cannot have best of both
 - These lamps have about 5% less lumens than highest lumen lamps, but 50% more rated life
 - These can be the best solution in high maintenance applications
- 28W or 25W F32T8s
 - I think that they are really better for the manufacturers and distributors than end customers, because relatively high margins and typically do not delamp, so maintain volume
 - I ask end-customers that have sales people who push these lamps without also providing other options, to find other sales people

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4' T8 LAMP LIFE, LUMENS, CRI & MERCURY

LAMP	WATTS	4100K		5000K		MAX MG OF MER- CURY	LAMP LIFE HOURS WITH VARIOUS BALLASTS & CYCLES					
		CATA-LOG LUMENS	CRI	CATA-LOG LUMENS	CRI		INSTANT START		RAPID START		PROGRAM START	
							3 HR	12 HR	3 HR	12 HR	3 HR	12 HR
1st GENERATION - GENERIC - LOW MERCURY	32	2800	75-78	2800	75-78	1.7 - <10	15,000 - 20,000	20,000 - 28,000	20000 - 25,000	24,000 - 28,000	20000 - 25,000	24,000 - 28,000
2nd GENERATION - GENERIC - LOW MERCURY	32	2950	81-85	2800 - 2950	80-85	1.7 - <10	15,000 - 20,000	20,000 - 28,000	20000 - 25,000	24,000 - 28,000	20000 - 25,000	24,000 - 28,000
GE HL	32	3100	82	3000	80	3.95	24,000	29,000	24,000	29,000	24000+	29000+
PHILIPS ADVANTAGE	32	3100	85	3100	85	1.7	24,000	30,000	30,000	36,000	30,000	36,000
PHILIPS PLUS	32	2950	85	2850	85	1.7	30,000	36,000	36,000	42,000	36,000	42,000
PHILIPS EXTRA LONG LIFE 32W	32	2950	85	2850	85	1.7	36,000	40,000	NA	NA	40,000	46,000
SYLVANIA XPS	32	3100	85	3000	85	3.5	24,000	36,000	36,000	42,000	36,000	42,000
SYLVANIA XP XL	32	2950	85	2900	85	3.5	36,000	40,000	40,000	46,000	40,000	46,000
GE WM	30	2850	81	2750	80	3.95	20,000	24,000	NA	NA	20000+	24000+
GE XL WM	30	2800	81	2700	80	3.95	24,000	29,000	NA	NA	24000+	29000+
PHILIPS ADV EW	30	2850	85	2850	85	3.5	24,000	30,000	NA	NA	30,000	36,000
SYLVANIA FO30 SS	30	2850	85	2800	85	3.5	24,000	36,000	36,000	42,000	36,000	42,000
SYLVANIA FO28 SS	28	2725	85	2650	80	3.5	24,000	36,000	36,000	42,000	36,000	42,000
GE F28T8/XL/SPX/ECO	28	2725	82	2625	80	3.95	24,000	30,000	NA	NA	36,000	42,000
PHILIPS ENERGY ADV 28W	28	2725	85	2650	85	1.7	24,000	30,000	NA	NA	30,000	36,000
GE F32T8/25W/SPX/ECO	25	2400	85	2350	80	3.95	36,000	40,000	40,000	46,000	40,000	46,000
PHILIPS ENERGY ADV 25W	25	2475	85	2400	85	1.7	24,000	30,000	NA	NA	30,000	36,000
PHILIPS EXTRA LONG LIFE 25W	25	2400	85	2300	85	1.7	36,000	40,000	NA	NA	40,000	46,000
SYLVANIA FO32/25W SS	25	2475	85	2350	85	3.5	24,000	36,000	36,000	42,000	36,000	42,000
F34T12CW	34	2650	60	NA	NA	4.4-10	NA	NA	20,000	27,000+	NA	NA
F28T5	26-28	2900+	85	2750+	85	1.4 - 5.0	*	*	*	*	20,000 - 30,000	25000 - 36,000
F54T5HO	51-54	5000	85	4800+	85	1.4 - 5.0	*	*	*	*	20,000 - 30,000	25000 - 36,000

Lamp manufacturers may alter rated lamp life and lumen specifications, so get updates from manufacturers.

Some manufacturers may have higher ratings for basic and mid grade T8s.

GE lamp life may be as good as equivalent lamps from Philips and Sylvania with program start ballasts, but GE is being conservative at this time.

Program start ballasts include fixed output and most dimming ballasts. All ballasts, except for T12, are electronic.

Even though listed as NA (not applicable/available) some rapid start & program start ballasts can operate some 25-30W lamps.

Prepared by Stan Walercyk of Lighting Wizards 7/1/08 version. www.lightingwizards.cc

4' LINEAR FLUORESCENT EFFICACY TABLE

4' lamp type	lamp lumens	lamp watts	lamp lumens per lamp watts	lamp quant	ballast type	standard ballast factor	system watts	initial system lumens	initial system lumens per watt	mean or 8000 hour lumen maintenance	mean or 8000 hour system lumens	mean or 8000 hour system lumens per watt
high performance F32T8	3100	32	96.9	2	EE IS	0.87	53	5394	101.8	95%	5124	96.7
	3100	32	96.9	2	EE IS	1.20	73	7440	101.9	95%	7068	96.8
	3100	32	96.9	2	EE IS	0.87	58	5394	93.0	95%	5124	88.4
extra long life 2950 lumen F32T8	2950	32	92.2	2	G IS	0.87	53	5133	96.8	95%	4876	92.0
	2950	32	92.2	2	G IS	0.87	58	5133	88.5	95%	4876	84.1
basic grade F32T8	2800	32	87.5	2	EE IS	0.87	53	4872	91.9	95%	4628	87.3
	2800	32	87.5	2	G IS	0.87	58	4872	84.0	95%	4628	79.8
30W F32T8	2850	30	95.0	2	EE IS	0.87	51	4959	97.2	95%	4711	92.4
	2850	30	95.0	2	G IS	0.87	55	4959	90.2	95%	4711	85.7
28W F32T8	2750	28	98.2	2	EE IS	0.87	48	4785	99.7	95%	4546	94.7
	2750	28	98.2	2	G IS	0.87	51	4785	93.8	95%	4546	89.1
25W F32T8	2440	25	97.6	2	EE IS	0.87	42	4246	101.1	95%	4033	96.0
	2440	25	97.6	2	G IS	0.87	47	4246	90.3	95%	4033	85.8
extra long life 25W F32T8	2400	25	96.0	2	EE IS	0.87	42	4176	99.4	95%	3967	94.5
	2400	25	96.0	2	G IS	0.87	47	4176	88.9	95%	3967	84.4
high lumen F28T5	3050	28	108.9	2	EE PS	0.95	58	5795	99.9	93%	5389	92.9
typical F28T5	2900	28	103.6	2	PS	1.00	64	5800	90.6	93%	5394	84.3
26W F28T5	2900	26	111.5	2	EE PS	0.95	55	5510	100.2	92%	5069	92.2
26W high lumen F28T5	3050	26	117.3	2	EE PS	1.15	67	7015	104.7	92%	6454	96.3
51W F54T5HO	5000	51	98.0	2	EE PS	1.00	108	10000	92.6	92%	9200	85.2
typical F54T5HO	5000	54	92.6	2	PS	1.00	117	10000	85.5	93%	9300	79.5
F34T12 800	3100	34	91.2	2	RS E	0.85	60	5270	87.8	93%	4901	81.7
F34T12 CW	2650	34	77.9	2	RS M	0.88	72	4664	64.8	87%	4058	56.4

notes: Lumens, lumen maintenance, ballast factors and wattages may vary among various manufacture
 In enclosed fixtures, since reduced wattage F32T8s consume less heat they can often operate closer to optimal 77 degree temperature, so may provide more light than this table shows compared to full wattage.
 Although efficacy can be improved with IS and RS ballasts with T5s and T5HOs, lamp life can be greatly reduced and lamp manufacturers may not warranty lamps.
 93% is used as an average EOL lumen maintenance for T5HOs. 90% - 94% range among manufacturers.
 All wattages based on 277V. EE IS is extra efficient instant start. G IS is generic instant start. EE PS is extra efficient program s PS is program start. RS E is rapis start electronic. RS M is rapid start magnetic.
 Extra long life is 36,000 hours with IS and 40,000 hours with PS ballasts at 3 hour cycles.
 Prepared by Stan Walerczyk of Lighting Wizards www.lightingwizards.com 12/1/07 versi

GENERAL SPECTRALLY ENHANCED LIGHTING NOTES

- Spectrally enhanced lighting is the new name for scotopically enhanced lighting
- It is based on research of Dr. Sam Berman and the federal Department of Energy, showing that light with more blue content is perceived brighter by the human eye and visual acuity is improved
- Much more info on this subject is available in my website, listed on last slide

S/P Benefits of 5000K 3000+ Lumen F32T8s

lamp	mean photopic (catalog) lumens	S/P ratio	brightness	paper	computer	
			P(S/P) ⁵	P(S/P) ⁷⁸	P(S/P) ^{1.0}	
F34T12 CW	2300	1.50	2817	3156	3450	
F34T12 WW	2350	1.00	2350	2350	2350	
F32T8 730	2650	1.19	2891	3035	3154	
F32T8 735	2650	1.30	3021	3252	3445	
F32T8 741	2650	1.56	3310	3749	4134	
F32T8 830 2nd	2800	1.29	3180	3415	3612	
F32T8 835 2nd	2800	1.41	3325	3661	3948	
F32T8 841 2nd	2800	1.62	3564	4079	4536	
F32T8 830 3rd	2950	1.29	3351	3598	3806	
F32T8 835 3rd	2950	1.41	3503	3857	4160	
F32T8 841 3rd	2950	1.62	3755	4298	4779	
F32T8 850 3rd	2860	1.95	3994	4815	5577	
Increase of energy efficiency of 3000+-initial-photopic-lumen 850 3rd generation F32T8s when considering full field of view compared to			CW	42%	53%	62%
			WW	70%	105%	137%
			730	38%	59%	77%
			735	32%	48%	62%
			741	21%	28%	35%
			830 2nd	26%	41%	54%
			835 2nd	20%	32%	41%
			841 2nd	12%	18%	23%
			830 3rd	19%	34%	47%
			835 3rd	14%	25%	34%
841 3rd	6%	12%	17%			

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notes : Lumens and S/P ratios can vary among lamps and manufacturers.

Prepared by Stan Walerczyk, www.lightingwizards.com, 4/9/06 versior.

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ADMIN AREAS

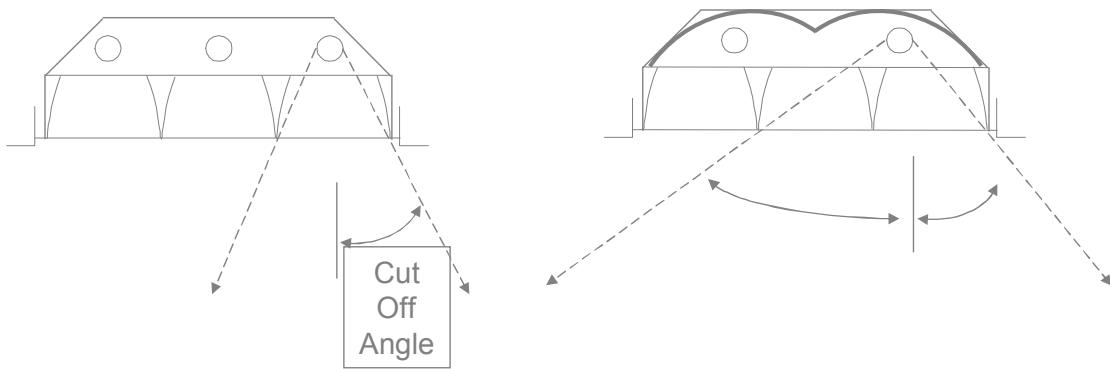
- Want to focus on 2x4 18 cell parabolic louver troffers
 - Although these were quite popular in late 80s through mid 90s, many qualified lighting professionals now understand the downsides
 - Overhead glare
 - Only about 75% fixture efficiency
 - Dreaded cave effect caused by dark ceilings and upper walls
 - Low vertical footcandles



18 CELL PARABOLIC LOUVER TROFFERS

- Many retrofitters like to delamp these fixtures with a reflector and repositioning the remaining lamps, which ruins proper cut-off angles, which can create a glare bomb

CUT OFF ANGLES



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18 CELL PARABOLIC LOUVER TROFFERS

- ALP's RDI AC HT kit is one good option, and the solution that the Convention Center selected

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QuickTime™ and a
TIFF (Uncompressed) decompressor
are needed to see this picture.

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RETROFIT, RELAMP, RELIGHT & REDESIGN OPTIONS FOR TYPICAL 12' x 12' INDIVIDUAL OFFICE WITH 2X4 18 CELL PARABOLIC 3F32T8-700 TROFFERS																	
\$0.15		blended KWH rate		3500		annual hours		\$0.05		utility or 3rd party incentive for first year KWH reduction		15		number of years for cumulative long term benefit			
18 options to consider (shorter paybacks do not always provide better long term benefits)																	
fixture type	quantity	total watts	watts / sq ft	annual elect'l cost	lamp life @ 3 hour cycles	#	4R	quantity	products	total watts	watts / sq ft	annual elect'l savings	incentive	appr. installed cost	simple payback in years	lamp life @ 3 hour cycles	long term benefit
2x4 18 cell parabolic troffers each with 3 F32T8 735s or 741 lamps and 3-lamp .88 BF generic instant start electronic ballast (originally inboard/outboard switching)	2	172	1.20	\$90.30	15,000 - 20,000	1A	retrofit	2	3 32W F32T8 850s & .6 BF EE PS ballast	114	0.79	\$33.50	\$10.15	\$120.00	3.3	30,000	\$415.08
						1B	retrofit	2	3 32W F32T8 850s & TW .6 BF PS ballasting	91	0.63	\$46.78	\$14.18	\$140.00	2.7	30,000	\$598.34
						2A	retrofit	2	3 32W F32T8s & .77 BF EE IS ballast	144	1.00	\$16.17	\$4.90	\$100.00	5.9	24,000	\$169.95
						2B	retrofit	2	3 32W F32T8s & TW .77 BF EE IS ballasting	115	0.80	\$32.92	\$9.98	\$120.00	3.3	24,000	\$406.24
						3A	retrofit	2	3 28W F32T8s & .87 EE IS ballast	142	0.99	\$17.33	\$5.25	\$100.00	5.5	18 - 24,000	\$165.13
						3B	retrofit	2	3 28W F32T8s & TW .87 BF EE IS ballasting	114	0.79	\$33.50	\$10.15	\$120.00	3.3	18 - 24,000	\$392.58
						4A	retrofit	2	3 25W F32T8 850s & .87 EE IS ballast	126	0.88	\$26.57	\$8.05	\$110.00	3.8	20 - 24,000	\$296.53
						4B	retrofit	2	3 25W F32T8 850s & TW .87 EE IS ballasting	101	0.70	\$41.00	\$12.43	\$130.00	2.9	20 - 24,000	\$497.46
						5A	retrofit	2	3 25W F32T8 835/841s & 1.0 BF EE IS ballast	144	1.00	\$16.17	\$4.90	\$110.00	6.5	20 - 24,000	\$137.45
						5B	retrofit	2	3 25W F32T8 835/841s & TW 1.0 BF EE IS ballasting	115	0.80	\$32.92	\$9.98	\$130.00	3.6	20 - 24,000	\$373.74
						6A	relamp	2	3 28W F32T8s & use existing ballast	155	1.08	\$9.82	\$2.98	\$25.00	2.2	20 - 24,000	\$105.24
						6B	relamp	2	3 25W F32T8 850s & use existing ballast	140	0.97	\$18.48	\$5.60	\$30.00	1.3	20 - 24,000	\$222.80
						7A	upscale retrofit	2	ALP RDI AC HT type of kit with 2 32W F32T8 850s & .77 BF EE IS ballast	96	0.67	\$43.89	\$13.30	\$250.00	5.4	24,000	\$1,216.65
						7B	upscale retrofit	2	ALP RDI AC HT kit with 2 32W F32T8 841s & .87 BF EE IS ballast	106	0.74	\$38.12	\$11.55	\$250.00	6.3	24,000	\$1,128.28
						7C	upscale retrofit	2	ALP RDI AC HT type of kit with 2 32W F32T8 835s & 1.0 BF EE IS ballast	130	0.90	\$24.26	\$7.35	\$250.00	10.0	24,000	\$916.18
						8A	relight	2	new high performance lensed troffer, such as Cooper Accord, with 2 32W F32T8 850s & .71 BF EE PS ballast	94	0.65	\$45.05	\$13.65	\$350.00	7.5	30,000	\$1,138.83
						8B	relight	2	new high performance lensed troffer, such as Cooper Accord, with 2 32W F32T8 841s & .77 BF EE IS ballast	96	0.67	\$43.89	\$13.30	\$350.00	7.7	24,000	\$1,121.15
						8C	relight	2	new high performance lensed troffer, such as Cooper Accord, with 2 32W F32T8 835s & .87 BF EE IS ballast	106	0.74	\$38.12	\$11.55	\$350.00	8.9	24,000	\$1,032.78
9A	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 2 32W F32T8 850s & 1.15 BF IS ballast	73	0.51	\$57.17	\$17.33	\$480.00	8.1	24,000	\$4,212.41						
9B	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 2 32W F32T8 841s & 1.32 BF EE IS ballast	85	0.59	\$50.24	\$15.23	\$480.00	9.3	24,000	\$4,106.36						
9C	redesign	1	new 8' suspended indirect fixture with good batwing distribution, 4 32W F32T8 835s & .77 BF IS ballast	96	0.67	\$43.89	\$13.30	\$480.00	10.6	24,000	\$4,009.15						

notes: Prepared by Stan Walerczyk, LC, Principal of Lighting Wizards, April 2, 2008 version

Delamping these parabolic troffers is not an option, because it ruins proper cut-off angles, which can greatly increase direct, indirect and overhead glare

Listed 32W F32T8s are high performance ones that are rated for 3100 catalog lumens, 82 - 86 CRI and 24,000 hour rating with IS ballasts at 3 hour cycles

25W F32T8s may not be recommended with occupancy sensors or other short cycle applications, especially with existing ballasts

EE = extra efficient, BF = ballast factor, IS = instant start, PS = program start, TW = tandem wiring using 1 2-lamp & 1 4-lamp per fixture pair to allow for board/outboard switching.

Wattages are based on 277V line voltage and may be higher with 120V. Lower wattages with higher Kelvin lamps are based on scotopically enhanced lighting

With some states' prevailing wages and union rates, can be considerably less labor costs to retrofit than replace fixtures.

In options, total watts is reduced 20% in options that inboard/outboard switching is re-introduced, because not all lamps will be on all of the time

Annual electrical savings include 10% for reduced air conditioning load. In some areas this would be higher, and in other areas this would be low

Although this table includes an incentive for 25W and 28W F32T8s with new EE ballasts, some programs do not include them, because long term savings cannot be guaranteed

long term benefit = (annual elect. savings x number of years) + incentive - initial installed cost. Small adder for 24,000 hour rated lamps and using fewer lamps. Because of increased productivity

\$50/year for baskets and \$150 - \$250/year added for suspended indirects. \$250 is 1/2 of 1% improvement on \$50,000 salary. 0.05% is not wasting 2.5 minutes/day

Regarding long term benefits, cost of money is considered to be offset by increases in electricity, majority of maintenance savings and increases in worker salaries

KWH rate, annual hours, incentive rate, and length of long term benefit can all be easily changed in colored/shaded boxes. Ballasts are typically rated for 15 years, fixtures much longer

ADMIN AREAS

- Projected Financials for all fixture types
 - \$22,000 HECO rebate
 - \$66,000 annual electrical savings, including reduced AC
 - 1.2 year payback, including reduced AC and maintenance savings
 - \$1,188,000 15-year long term benefit including AC and maintenance savings

FIRE EXITS

- Many of the stairwells and halls are mainly for emergencies and are hardly used
- Before the retrofit most of these lights were on 24/7/365
- Stairwells
 - White walls and ceilings, so light bounces around
 - A lot of 4' corridor wraps
 - Had 2 F32T8 735 lamps & generic electronic ballasts, which consumed 59W
 - Retrofit with the below to consume 37W, a 37% reduction
 - » 1 third generation 3000-3100 lumen 5000K 32W F32T8
 - » 1.0 BF extra-efficient program-start ballast
 - » And alternate fixtures with occupancy sensor

FIRE EXITS

- Projected Financials for all fixture types
 - \$5900 HECO rebate
 - \$31,000 annual electrical savings, including reduced AC
 - 0.6 year payback, including reduced AC and maintenance savings
 - \$578,000 15-year long term benefit including AC and maintenance savings

GENERAL STAIRWELL NOTES

- Numerous manufacturers that offer fixtures with occupancy sensors for stairwell applications
 - Some use dimming ballasts
 - Which are expensive and not very efficient
 - Some use 10,000 hour CFL as lamp always on
 - Which may not provide sufficient light and will have high maintenance
 - Some use 20,000 hour cold cathode as lamp always on
 - Which may not provide sufficient light and lamp life is still considerable less than good T8s
 - Some have no light always on
- Retrofitting existing is usually less expensive than getting new fixture
- When I need a new fixture, it often has 1 32W F32T8 driven by an extra-efficient program-start ballast and controlled by an occupancy sensor and 1 F17T8 driven by low-BF extra efficient ballast on all of the time

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**IF NOT FOR THESE AND OTHER
CURRENT STAFF MEMBERS OF
THE CONVENTION CENTER, THIS
PROJECT WOULD NOT HAVE SO
SUCCESSFUL**

- Mike Polovcin
- Richard Graham
- Fred Harper

ALSO THANKS TO

- Dragos Oprescu at HECO
- Glenn Gara & Greg Cooper at 1st Source Lighting
 - Manufacturer of hibays
- Brian Kealoha & Oliver Pohina at Energy Industries
 - Awarded contractor
- Dallas Buchanan at ALP
 - Manufacturer of kits for parabolic troffers
- Brian Friedel & Charles Knuffke at Watt Stopper
 - Manufacturer of occupancy sensors
- Glenn Sameshima at GE
- Sean Bakey at Sylvania
- Dexter Kumano at Illuminetix representing Philips

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**LET'S
TAKE
A
WALK**

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CONCERNS ABOUT PARTIAL RETROFIT

- Since Convention Center did not have sufficient funds and did want to do positive cash flow financing, still a bunch of 735 T8s, old generic electronic ballasts, etc.
- Like many other facilities, it will be a challenge so the correct replacement lamps and ballasts go in the correct fixtures and areas
 - Too often there becomes a mish-mash of different Kelvin lamps in the same rooms, which looks bad
- Hard to schedule group relampings
- Convention Center wants to retrofit remaining areas when funds become available

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**ANY
MORE
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THAT'S ALL FOLKS

- **Please fill out review forms**
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- **Moving to Maui**
- **Thanks for coming**

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