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Good to Great 2008

Lighting Control Solutions

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Square D
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Building a New Electric World

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Executive Order Tasks Federal Agencies with Reducing Environmental Impact

President George W. Bush issued an executive order calling on the head of each federal agency to reduce "energy intensity" (energy consumption per sq. ft. of building space) by 3% annually through the end of fiscal year 2015, or 30% by the end of fiscal year 2015.

EPAct

In accordance with the Federal Energy Policy Act, states must certify to the U.S. Department of Energy that their local building code meets or exceeds requirements of ANSI/ASHRAE/IESNA Standard 90.1-1999, or equivalent

Application of the Code

- ➔ New buildings
- ➔ Additions and alterations to existing buildings

  Addition - an extension or increase in floor area or height of a building outside of the existing building envelope.

  Alteration – a replacement or addition to a building or its systems and equipment.

ASHRAE 90.1

- Lighting in buildings larger than 5,000ft^2 shall be controlled with an automatic device to shut off building lighting in all spaces.
- Exceptions
  - Emergency lighting that is automatically off during normal building operation
  - Lighting within living units (low rise residential)
  - Lighting required for health, safety, ordinance, or regulation

Automatic Shut-off Control (9.2.1.1)

1. Time-of-Day Control
   - Drives lighting off at specific programmed times
   - Independent schedule for areas ≤ 25,000ft^2 or one floor

2. Occupancy Control
   - Drives lighting off within 30 minutes of an occupant leaving a space

3. Building Automation Control
   - Drives lighting off with signal from another control or alarm system indicating area is unoccupied

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Space Control (9.2.1.2)

- Each enclosed space shall have at least one control device operated manually or automatically (sensing an occupant) to independently control lighting within the space.

- Each control device shall:

1. control maximum areas of 2,500ft2 for $\leq$ 10,000ft2 spaces and maximum areas of 10,000ft2 for >10,000ft2 spaces,
2. be capable of overriding a shutoff command for no more than four hours, and
3. be readily accessible and located so occupant can see the controlled lighting.

Additional Strategies

- Daylight dimming employs sensors that detect ambient light levels and then allow ballasts to dim nearby lights.
- Bi-level switching uses two separate on-off controls, usually manual switches, to operate different lamps (bulbs) within a light fixture.
- Demand limiting refers to centralized control of lighting, usually by dimming or step switching, in order to reduce electrical demand at high-cost times (or at utility request).

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How to apply individual strategies:

- ➔ Occupancy Sensors - Areas with intermittent occupancy are well-suited to occupancy sensors.
- ➔ Scheduled Control - In large, open office areas with many occupants, scheduled switching is often an effective energy-saving strategy.
- ➔ Daylight Harvesting - In day-lit offices, properly adjusted light sensors with dimming ballasts make sense.
- ➔ Bi-Level Controls - Because some workers prefer lower lighting levels, bi-level manual switching is another option.
- ➔ Demand Cutback - Advanced lighting controls can be used for demand limiting to allow building managers to reduce lighting loads when electricity demand costs are high.

Application Considerations

- ➔ The ability to implement lighting controls in existing facilities with the least disruption to normal operation.
- ➔ The ability to control specific connected load.
  - Some types of lighting are not well suited to certain controls. For example, daylight harvesting and occupancy sensing are not generally appropriate for high intensity discharge (HID) lighting (which require a delayed re-start), whereas time scheduling is usually a good match for HID.

Hybrid Approach

- ➔ It is unlikely that a single approach alone will provide optimal results. You should evaluate each facility on a space by space basis. For example, an open office area might be best suited with schedule based controls, but if there is exterior light, you might also consider daylighting controls; if there are utility spaces on the same circuit, you should consider local occupancy sensors; perhaps you should also react to high demand periods.

- ➔ You may need to consider the changing use of some areas. If you anticipate remapping light to suit new requirements, you should consider a flexible system to accommodate change with the least disruption to your operation.

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Hybrid Approach

- The ability to integrate with other systems where desired, without loss of functionality.
- Finally, there are web-based technologies allowing access to information on all products to support facility management. Data on runtime, circuit conditions, ambient light levels, etc are available at a click of the mouse.

LEED Framework
Leadership in Energy & Environmental Design

- ➔ Develop data base of best practices
- ➔ Facilitate positive results for the environment, occupant health and financial return
- ➔ Promote integrated, whole-building design practices
- ➔ Define "green building" by establishing a common standard of measurement and prevent "greenwashing"
- ➔ Raise consumer awareness of green building benefits
- ➔ Stimulate green competition and recognize environmental leadership in the building industry
- ➔ Demonstrate commitment
- ➔ Transform the building market

Applying Lighting Control for LEED Credit

- Sustainable Sites
  - Light Pollution Reduction
- Water Efficiency
- Energy and Atmosphere
  - Fundamental Commissioning of the Building Energy Systems (pre-req)
  - Enhanced System Commissioning
  - Minimum Energy Performance (pre-req)
  - Optimum Energy Performance
  - Measurement and Verification
- Materials and Resources
- Indoor Environmental Quality
  - Controllability of Systems
- Innovation and Design Process
  - Innovation in Lighting Control
  - LEED Accredited Professional

Affecting Return on Investment

- Energy Priorities
  - Re-Lamping vs Control vs Combination
    - Occupancy Profile – Best Payback for space usage
- Control Objectives
  - Facility Management vs Occupant Convenience
    - Integration of various control strategies
- Granularity
  - Circuit (or multiple circuit) vs Sub Circuit control
    - Cost per control point
- Financing Options
  - Purchase vs ESCO
    - Funding (Energy Upgrade, Operations & Maintenance, etc)

Microsoft Excel - Savings Calculator.xls

File Edit View Insert Format Tools Data Window Help

Procurement made easy - POWERLINK is available on the GSA schedule

POWERLINK Savings Calculator

Instructions

Pentagon renovation project - one of many successful POWERLINK government applications

Lighting Power Consumption

Calculation Basis: Square Feet

Calculate — 42 kW

Hours Saved

Calculated Hours — ☑ Demand Curtailment at Peak

Calculate — 106 Hours per Month (total saved)

Luminaire & Facility

Cost per kWh:	$0.06
Peak Demand Cost per kW:	$ 10.00
Number of Luminaires	350

Calculate — Calculated

Lamps per Luminaire	3
Average Lamp Life (hours)	20,000
Cost to Replace Lamp (Labor and Material)	$ 10.00

System Cost

Quotation

Calculate — $ 12,000

Monthly Savings:	Money	Energy	
Lighting Energy:	$ 268	4,471	kWh
Demand Power:	$ 421	42	kW
Cooling:	$ 40	671	kWh
Relamping:	$ 56	5,142	kWh (total)
Total:	$ 785		

Annual $:	9,419
Payback (years):	1.3
IRR (5 year):	364%

Print

This spreadsheet is only a guide to be used in estimating potential savings. Your actual conditions will vary. While reasonable assumptions are made, no guarantee of results is offered or implied.

Ready

start | John Berry - All D... | Schneider Electric... | Microsoft PowerP... | Sales Aides | Microsoft Excel - ... | 99% | 2:34 PM

Additional Considerations (beyond straight payback)

Lifecycle costing promotes the design of buildings (materials, components, information systems) and instills management practices when placing buildings in service that anticipate and optimize the total cost of operation.

Typical Lifecycle cost of placing a building into service over 40 years;

25% Initial Construction and Financing

25% Upgrades

50% Daily Operation

Camp Pendleton:

Located between Los Angeles and San Diego, CA, U.S. Marine Corps Base Camp Joseph H. Pendleton is home to 1st Marine Expeditionary Force, 1st Marine Division, and hosts 60,000 military and civilian personnel each day.
6,000 buildings and 15.3 million square feet of office space.

Needs:

Meet requirements of Executive Order 13123, signed by President Bill Clinton in 1999.
1985 baseline energy consumption levels reduced 30% by 2005 and 35% by 2010
Nuisance tripping and shorts becoming a regular occurrence.

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Square D Solution:

- ➔ Comprehensive retrofit plan implemented to replace existing lighting with higher efficiency luminaries and incorporating Square D lighting controls to switch lights off during unoccupied periods.
- ➔ Lighting control system contoured to best meet occupant needs, provides flexibility.
- ➔ Square D® Powerlink® lighting control systems installed in order to achieve all goals. System flexibility achieved via 16 independently configurable time schedules and 64 lighting zones per controller included with each system.

Benefit to Camp Pendleton:

- As of mid-2006, base energy consumption reduced 31% from 1985 levels.
- Saving more than 500,000 kWh annually.
- Payback period better than originally expected.
- Improved productivity.

- *Jeff Allen, Base Energy Manager, states "Lighting control represents a straightforward way to reduce energy consumption. It reduces energy use, prolongs lamp life, reduces maintenance costs, contributes to our energy reduction goal and creates a pressure-free environment for personnel, because lights go off on their own."*

Oak Ridge National Labs

- "EPAct 2005 mandates strict requirements for all federal facilities to improve their energy efficiency every year against a particular baseline. This was a difficult challenge for us as we were still dealing with a campus that consisted of numerous older buildings, and limited capital funds available to update them."
- "With limited capital to use, we had to go back and develop out-of-the-box strategies to solve our problems. We couldn't just replace all the equipment, it required matching new technology with old to come up with unique solutions."
  - Greg Palko, Energy Efficiency Manager at Oak Ridge National Laboratories

Square D Solution:

- ORNL saw energy saving potential with building automation. They worked with Square D to put Powerlink® panels equipped with motor operated breakers to automatically drive lights off when not required. They then installed occupancy sensors as inputs to the Powerlink panels.
- Beyond occupancy sensors, there are plans to add sub-circuit lighting control to conference spaces in the newer buildings which would allow local manipulation such as lighting scenes for presentations. “We’re looking to add some Square D Clipsal® touchscreens in the future to give us the ability to control lighting patterns and scenes,” said Palko. “The tenants of these buildings like having control, and the more control they have the better the usage is going to be. They’re going to take a more aggressive posture than I can generically apply across the campus.”

Local Resume

Date	Site	Content	Network
2001	Pentagon - Wedge One	Approximately 80 Panels	Integrated system w/JCI
2002	Islip Federal Courthouse	Approximately 42 Panels	Turn-key Stand-alone system w/GUI
2003	Smithsonian Air & Space	Approximately 64 Panels	Stand-alone system w/GUI and Integrated w/SBT
2003	USPS Distribution Center	Approximately 36 Panels	Integrated system w/GE
2005	SSA MetroWest	Approximately 48 Panels	Integrated system w/JCI by ESCO
2005	VA Headquarters	Approximately 42 Panels	Turn-key Stand-alone system w/GUI
2006	Pentagon Ancillary Bldgs	Approximately 10 Panels	Integrated system w/JCI
2006	Smithsonian Portrait	Approximately 60 Panels	Stand-alone system w/GUI and Integrated w/SBT
2006	FDA CDER	Approximately 36 Panels	Stand-alone system
2006	US Embassies	Approximately 8 Panels	Local 3 Stand-alone system (two sites)
2006	Ft Detrich	Approximately 4 Panels	Stand-alone system
2006	Fannie Mae	Approximately 20 Panels	Stand-alone system and Integrated w/BAS
2006	USNA Greenhouse	Approximately 4 Panels	Stand-alone system
2007	New Executive Office Bldg	Approximately 44 Panels	Integrated system w/TAC
2007	NOAA	Approximately 12 Panels	Stand-alone system except w/Clipsal
2007	FDA CDRH	Approximately 36 Panels	Stand-alone system except w/Clipsal
2007	SSA Woodlawn	Approximately 32 Panels	Stand-alone system except w/Clipsal by ESCO
2007	National Archives	Approximately 4 Panels	Stand-alone system except w/Clipsal

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The U.S. General Services Administration took advantage of a floor-to-floor re-modeling already planned (for asbestos abatement) in San Francisco's Phillip Burton Federal Building. Various control combinations of daylighting, occupancy sensing, manual dimming, and time scheduling were installed and carefully monitored to allow GSA to learn how to make best use of lighting controls in the office spaces it manages nationwide. The original lighting design in this facility was typical of large leased-space office buildings. In "open-plan" areas, three-lamp parabolic troffers were evenly spaced on 8-ft. centers over the entire ceiling, without regard to furniture placement. In most private offices, two 3-lamp fixtures were spaced evenly in the ceiling. In the new design, daylight dimming is used in both private offices and open-plan perimeter areas with daylight access, with and without occupancy sensors. Manual dimming and bi-level switching were tested in private offices. In half of the open-plan interior (without daylighting) office areas, dimming ballasts allow adjustment of the light levels either manually, or through use of "closed-loop" light sensors to maintain a constant level of illumination. The dimming ballasts also permit reducing lighting loads at times of peak demand using the building energy management system. As shown below, savings were impressive. In private offices, the use of occupancy sensors alone reduced lighting energy by 25% on weekdays. Automatic daylight dimming saved an average of 27% of lighting energy, and the combination of both the sensors and dimming saved approximately 45%. In open daylit offices, savings from daylighting alone were also substantial, particularly in the first and second cubicle rows from windows (especially south-facing ones). Open interior offices with time scheduling or occupancy sensors saved about 10% over wall switches alone. In open areas close to windows, automatic daylighting saved more than a quarter of previous lighting energy, and more than a third when combined with either occupancy sensing or time scheduling.

- Proper installation and adjustment of lighting controls are essential to both occupant satisfaction and energy savings.
- Properly adusted occupancy sensors reliably save energy.
- In areas with available daylight, well-designed and adjusted automatic daylight dimming systems can save a substantial amount of energy.
- The choice between time-scheduling and occupancy sensing controls for a given open-plan space depends on several factors, including budget, variations in occupancy patterns, and the frequency of after-hours use. Timescheduled controls (with overrides for those working late) may be as effective in some cases, especially where the primary savings comes from assuring that lights are turned off after normal business hours.
- In private offices whose occupants travel a lot or who move from place to place within the building frequently, occupancy sensors tend to save more than daylighting, but in window offices where the occupants work most of the day at their desks automatic daylighting provides greater savings.
- Occupant preferences vary: Some occupants with bi-level switching choose partial light levels consistently, while others always choose full lighting.
- For new construction or major renovation, designing lighting circuits to be switched in smaller “zones” has many advantages, especially where these zones conform to similar usage patterns and similar levels of daylight availability. Small lighting zones with dimming controls can also allow individual workers to adjust lighting levels to their own preferences, and to switch on only a few lights when they work late.