FEMP Federal Energy Management Program

Fact Sheet

A product of the FEMP O&M Center of Excellence

Leading by example, saving energy and taxpayer dollars in federal facilities

O&M First!

Maintaining Effective and Efficient Lighting Can Help Save Energy and Reduce Costs

Over 20 percent of the nation's electricity is consumed by various lighting products and systems. This percentage can be even higher in some buildings, and opportunities to save a portion of this energy can be some of the easiest and most profitable to pursue.

The best opportunity to provide the most effective and efficient lighting system for a building is at the initial design and installation stage. However, there are many opportunities to keep the system operating at maximum efficiency and improve its operation long after it is first switched on.

It is always wise to develop long-term operations and maintenance (O&M) plans and schedules to ensure maximum operational efficiency. Some of the recommended options in this FEMP O&M fact sheet can become an integral part of such plans. Others may be applied immediately to harvest available energy savings.

Beyond upkeep and adjustment of the existing design there are additional opportunities to improve efficiency and the quality of the lighted space. These opportunities may involve lighting system redesigns or the use of advanced systems and should be considered along with maintenance activities.

Opportunity 1: Ensure correct operation of lighting controls

One of the best energy savings mechanisms of any lighting system is the control system that allows for lighting to be turned off when not needed. Depending on the type of control and its application, savings can vary from a few percent up to 75 percent of uncontrolled lighting energy. However, even the best designed lighting controls can become less effective over time due to lack of calibration, dirt accumulation, or the need for adjustment to new occupancy conditions. Controls may also have been installed improperly or never commissioned to operate correctly.

Ceiling occupancy sensor

Solution: Verify that controls are operating as designed and installed to ensure maximum savings. One of the most common and effective lighting controls is the occupancy sensor. These sensors should be periodically checked and calibrated to ensure they are operating correctly AND operating to the satisfaction of the occupant. Sensors that are not operating correctly or do not meet the needs of occupants will be unable to save energy and may even be be eliminated due to occupant

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complaints. Typical sensor problems that need to be addressed include the following:

- Occupancy sensors turn lights "on" when they are not needed – check triggering of sensor from motion in adjacent areas and adjust accordingly.
- Occupancy sensors turn lights "off" when occupants are still in the space – check unit sensitivity and/or timer to ensure it detects motion and remains activated long enough for the current occupant.

Other effective lighting controls include daylight sensing and control, manual and automatic dimmers, and astronomical time clocks for exterior lighting. Refer to the Lighting Controls Calibration and Troubleshooting section of the FEMP O&M best practices guide for guidance to initiate regular inspection and calibration of lighting controls.

Great daylight—but lights still on!

Opportunity 2: Incorporate lighting into centralized building control

Automatic group control of lighting can provide great energy savings and utility demand rate savings for larger facilities that operate with known schedules. However, retrofits to install this level of control for lighting alone can be costly.

Solution: Most medium-to-large facilities will have an existing Automated Building Management System (BMS) or Energy Management Control System (EMCS). that already controls HVAC, electrical, water, and fire systems. Check to see if an existing system has lighting control capability that can be enabled. Some control systems offer additional modules that can interface with building maintenance systems while providing data on lighting operation. These can provide simple energy savings as well as monitor and control lighting loads to reduce monthly demand costs. When considering this type of control be aware that centralized systems may not always be appropriate for some functions, such as specific task dimming controls and daylighting area control. Check with the manufacturer of the building control system to see what opportunities exist to add automatic lighting control.

Automatic whole building lighting controls can reduce after hours lighting waste!

Opportunity 3: System cleaning and repair

As lamps and luminaires age they accumulate dirt and dust that reduces light output. Lighting systems can accumulate dirt even faster than surrounding surfaces due to the static charge associated with the charged nature of the lamps. This avoidable reduction in light output can prompt calls for lamp or fixture replacement in advance of the actual need for replacement.

Solution: Cleaning lamps, luminaries, and room surfaces will help them retain their original designed light output. This action itself may not immediately save energy, but it does help the system avoid degraded light output, which can reduce occupant complaints and help defer equipment replacement or upgrade costs. A further benefit may be that fewer occupants will have a need for supplemental lighting such as task lights and desk lamps, which will save some energy.

Opportunity 4: Scheduled vs. on-demand re-lamping

Re-lamping does not by itself directly save energy. In fact, the standard joke is that lamp burn-outs are an energy savings measure! However, burned out lamps can sometimes cause damage to ballasts. Lamps also experience reduced light output over time which can reduce the quality of the lighting in a space. Changing burned-out lamps one at a time takes time and money. Scheduled or group re-lamping optimizes labor costs. While lamp material costs may increase slightly, labor cost can be significantly reduced, making group re-lamping a cost-effective investment.

Proactive Maintenance for Best Results

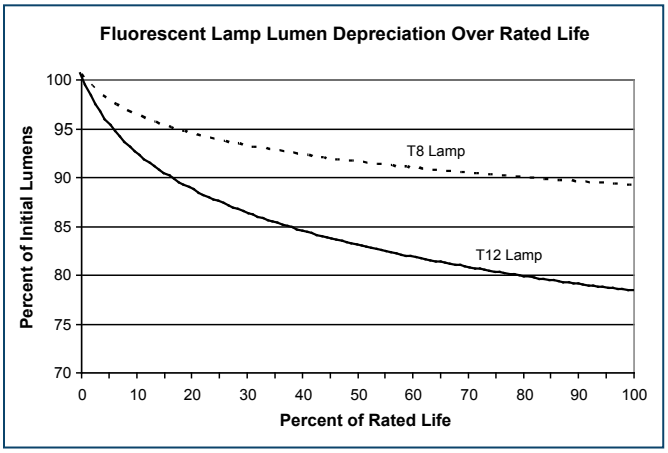
Reactive maintenance (i.e., replacing lamps when they fail) may not effectively keep illumination at the designed levels. A proactive maintenance program can be important to the success of any lighting system and can include:

- Regular cleaning of lamps and luminaries
- Scheduled group relamping of luminaires
- Regular inspection/repair of lighting equipment
- Inspection and re-calibration of lighting controls
- Re-evaluation of lighting system for upgrades

Solution: Depending on the type and size of the building, there may be cost benefits to initiating a group re-lamping maintenance schedule in place of an on-demand lamp replacement policy. The major element of savings associated with lamp replacement is in the maintenance labor cost. An important factor in determining the most efficient scheduled re-lamping plan is the rated life of a lamp provided by the manufacturer. This is the point where 50 percent of a group of lamps are expected to have burned out under normal office conditions. The most effective group re-lamping point is when lamps in an area start burning out on a regular basis. This is commonly at 70 to 80 percent of rated lamp life. When 10 to 15 percent of the lamps burn out, the optimum re-lamping period should be adjusted to actual operating conditions and occupant needs. Group re-lamping will also maintain improved ligh levels by replacing lamps before their lumen output degrades further.

Lamp Light Output Degradation

For even the best T12 fluorescent lamps, the light output can degrade to as low as 78 percent of initial output at end of life. Newer, high-performance T8 lamps retain closer to 90 percent of their lumen output over their life, while HID lamps generally retain only about 70 percent of their initial output.



Opportunity 5: Replace lamps with lower wattage options in overlit spaces

Many spaces can be overlit as a result of initial over-design or changes in the use of a space. The lighting may be relatively efficient but is an extra unneeded use of energy.

Solution: Reduce energy consumption by reducing light levels through replacement of existing lamps with lower wattage (and lower light output) options where appropriate. This option is effective when:

1) Spaces can be identified as overlit

2) A compatible lower wattage lamp is available

Identification of overlit spaces involves measuring light levels and comparing these measurements to recommended light levels. (Refer to the FEMP O&M best practices guide and the IESNA Handbook for guidance on taking lighting measurements as well as recommended light levels for typical space types.) For most common direct overhead lighting systems, a replacement lamp with the appropriate (lower) light output can be identified by applying the ratio of required to measured light levels to the lumen output of the existing lamp:

*(Recommended footcandles/Existing footcandles) *Existing lamp lumens = Replacement lamp lumens*

For complicated lighting designs involving indirect lighting, daylighting systems, or other advanced features, a test replacement should be done first to verify resulting light levels.

Replacing existing lamps with lower wattage options can be simple for most standard screw-in fixtures but requires matching of components for others.

Standard screw-in-type fixtures – These can be a simple replacement and provide a good opportunity to use much lower wattage CFL lamps with longer life. If a CFL is used, make sure that it will fit appropriately in the existing fixture (e.g., not protrude from the fixture). In cases where a standard CFL lamp is not appropriate, consider a spot CFL lamp (available in some sizes and wattages) or a lower wattage incandescent.

Linear fluorescent (2', 4', 8', U-tube) – Replacement of lower wattage fluorescent lamps is possible but the lamp MUST be matched with the ballast especially in T12 to T8 retrofits. Check the label on the ballast to see what lamp types it will accommodate. If the ballast is to be replaced as part of a regular maintenance task, consider a lower wattage lamp-ballast combination.

Plug-in fluorescent – Most plug-in lamps have dedicated ballasts sized specifically for that lamp. Therefore, replacement options will be limited. If the ballast is to be replaced as part of a regular maintenance task, consider a lower wattage lamp-ballast combination.

What About De-lamping to Save Energy?

De-lamping, or eliminating fixtures, is often used as an energy saving measure. If the existing lighting levels are higher than needed, this may be a workable option. However, this type of savings measure is often considered inappropriate because it can degrade the quality of the lighted space, cause dark areas, and create the appearance of a poorly maintained space. Also, if lamps are removed without removing the associated ballasts, some of the potential energy savings will be lost because of continued ballast losses. Light level reduction should be done uniformly to maintain the quality of the lighted space. Design assistance is important when considering this type of light reduction.

Fluorescent lamp change or retrofit?

While replacement of fluorescent lamps with lower wattage versions can be an easy method of reducing energy, it may not be the most effective. In many cases the retrofit of fixtures with more efficient lamps and ballast combinations provides the most effective results. This option may be beyond standard operations and maintenance activities but should be considered before deciding on a lamp only replacement.

Opportunity 6: Replace incandescent lamps with lower wattage CFLs

Many downlights, wall sconces, and individual small space fixtures use incandescent technology because of its low first cost. But incandescent lamps provide light at very low efficiency.

Solution: Replace incandescent lamps with compact fluorescent lamps (CFLs) whenever appropriate. This is the most common and one of the easiest methods to save energy when existing lighting levels need to be maintained. Reducing energy use is accomplished

by replacing existing incandescent lamps with CFLs. Because of their increased efficiency, CFL lamps can replace incandescent lamps to provide similar light output with less wattage. In many cases, this can mean a 60 percent (or more) reduction in energy. Check the manufacturer's rated lumen output of the replacement and existing lamp to ensure they will provide the same light output. To make this an effective change, also make sure that the replacement CFL lamp fits and does not detract from the design of the fixture (e.g., protrude from the fixture). [Note: In some applications, a standard CFL replacement may not be appropriate. Some downlights or aimed fixtures that are used to highlight merchandise, art, or other architectural features may need the focused light and punch not as easily provided by standard CFLs. In some of these cases, a special spot CFL lamp (available in some sizes and wattages) may be effective. See **www.pnl.gov/rlamps** for more information. Also note that dimmable fixtures will require a special dimmable CFL.]

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O&M First!—FEMP is pleased to present this series of fact sheets as a way to promote energy efficiency by first applying O&M best practices. It is our hope that the experiences shared will provide federal facility managers with strategies they can apply to their own facilities, as well as introduce the FEMP O&M program to federal site staff.

A copy of the FEMP O&M Best Practices Guide can be downloaded at www.eere.energy.gov/femp/operations_maintenance/om_best_practices_guidebook.cfm. This guide, which covers a full range of facilities O&M topics, provides the rationale for a proactive O&M program; identifies O&M management issues and their importance; explains the various O&M program approaches; introduces maintenance technologies; and explores O&M procedures for the predominant equipment found at most federal sites.

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Produced for the U.S. Department of Energy, Energy Efficiency and Renewable Energy, by the Pacific Northwest National Laboratory

August 2005

PNNL-SA-46067