Operating and Maintaining Lighting Systems

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Autumn is here, which means the days have officially begun to get shorter. There is, perhaps, no better time to think about the lighting in your facilities.

A lighting system should provide adequate light at a minimum cost. And that performance should continue over time. An effective lighting maintenance program can significantly increase lighting system efficiency; however, without such a program, a lighting system will deteriorate. Dirt, lamp depreciation, and burnouts that are not promptly replaced can combine to the point where your lighting system delivers as little as one-half the original light.

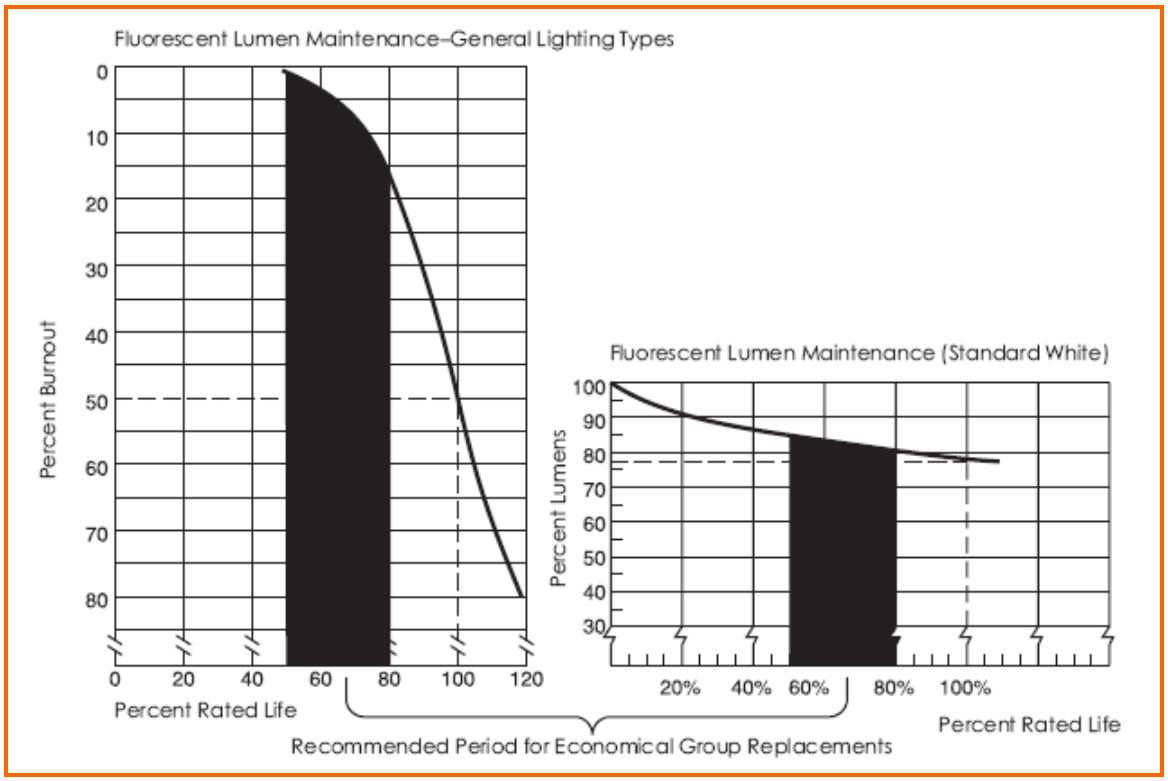
When lighting fixtures are cleaned and relamped regularly, light output can be increased by as much as 25 to 30 percent. When energy-reduction steps are taken that would otherwise lower light output, group relamping and cleaning often more than compensate for the planned reduction.

Relamping

Group relamping at planned intervals can reduce labor costs to between one-fifth and one-tenth of the cost per lamp for spot relamping. (Spot relamping is the replacement of individual lamps when they burn out.) The time needed for someone to replace a single lamp includes the time a maintenance worker spends determining which particular lamp is to be replaced, getting the new lamp, placing the ladder, opening the fixture, replacing the lamp (and hopefully cleaning the fixture), returning the ladder, and disposing of the old lamp. This time is much greater than the time involved for replacing each lamp in an organized replacement of all lamps at once. As relamping is often done at nights and on weekends, when higher hourly wages are paid, the ability to reduce the number of times each fixture must be serviced should be considered as part of the cost-savings equation.

In a group relamping plan, all lamps are replaced at a preplanned point in the life of the group of lamps. The most economical time to relamp can be predicted on the basis of the known rate of burnouts. Ordinarily, the most economical group-relamping period is at about 70 to 80 percent of rated life, when depreciation of lamp quality is appreciable.

The pattern of lamp burnouts illustrated below shows why group relamping should take place well before the end of lamp life. The curve of light depreciation indicates that group relamping removes lamps before they have dropped to their lowest efficiency.



Cleaning

We've already acknowledged that significant light losses will result from dirt accumulating on lamps, reflectors, and shielding materials if regular cleaning is not done. Even in very clean conditions, where there is little dirt in the environment and the air system is filtered, light output can drop by 5 percent per year. In dirtier environments, greater losses can occur. It is important to clean the lens, louvers, sockets, and even the fixture. If the troffer housing has become rusted or dirt is baked on, making the fixture too hard to clean, it should be replaced. Just cleaning the fixture, especially the reflector surfaces and the lens, will often increase existing light levels between 25 and 50 percent.

Cleaning is usually needed no more often than once a year, but no less often than once every three years. Since group relamping every three years is often the most economical frequency for an office building, relamping can coincide with cleaning and reduce labor costs.

Implementing a Lighting Maintenance Program

Either building personnel or a lighting maintenance contractor can implement a lighting maintenance program. Lighting maintenance contractors can also help develop a plan for a property’s lighting systems that will upgrade light output and appearance and eliminate any need for attention from building maintenance personnel.

If building personnel are to maintain the lighting, the plan should be based on the most economical period of group relamping for the types of lamps and fixtures used, as well as on the capabilities of personnel and equipment. With a small crew, a workable goal should be established, such as group relamping one area or one floor each night until the building is completed.

At the same time that they clean and relamp lighting fixtures, building personnel or contract workers can replace older, less efficient lamps with reduced-wattage versions. Greater lighting efficiency from group relamping, along with cleaner fixtures, will compensate for any reduced lamp output from reduced wattage.

Lighting Controls

Proper maintenance is almost always the front-line defense against unnecessary energy costs. But there are other proven methods for realizing cost reductions. When we're talking about lighting, controls are one solution.

In the past, lighting controls had been used mostly to provide lighting flexibility or dramatic lighting effects in office spaces. Today, their primary function is energy management. Simple controls such as photocells, time clocks, or motion sensors automatically turn lights on when they are needed and off when they are not needed. For larger facilities, control systems can be designed to integrate lighting into other building automation systems, such as those used to control heating and cooling. Many computer-controlled lighting systems also have reporting capabilities that allow property managers to allocate and bill energy use accurately among tenants.

The key to using controls effectively is not only selecting the appropriate control device, but also carefully planning how the control will be used. Efficient energy-saving lighting controls are designed to provide light only when and where light is needed. The savings from turning lights off when not needed can be significant. For example, if a commercial building has 1,000 fluorescent light fixtures and they are turned off one hour earlier each weekday, over $4,500 can be saved annually given typical energy costs.

Wall Switches and Motion Detectors

The simplest approach to saving energy is to turn out the lights when a room is not occupied. Workers can be educated to do this manually with a wall switch, or it may be automatic, activated by a motion detector mounted on the ceiling or on the wall to replace the wall switch. Various types of sensors are available; motion detectors may use infrared sensors, ultrasonic sensors, or both. Because a sensor must be able to “see” most of the room to be effective, placement of sensing devices is critical. Motion-detector-activated light switches should be considered in private offices, conference rooms, file rooms, restrooms, and some general office areas to turn off lighting automatically when these areas are not occupied.

Time Clocks and Programmable Lighting Circuits

Using time clocks or programmable computer-controlled lighting circuits is also a powerful energy-saving strategy. Studies indicate that building lights are often switched on by those workers who arrive early but are not switched off promptly at the end of the day. Installing time-switched circuits can result in energy savings of 25 to 50 percent. In addition, many energy management systems are zoned to activate only the areas in which the new arrivals work, with the emergency lighting circuits to be used as a pathway to their desks, again saving energy costs.

Daylight Sensors

Controls that have daylight sensors automatically lower the level of electric lighting as increased amounts of daylight enter the office. This energy-saving strategy is most effective on perimeter zones, dimming the row of luminaires closest to the windows. Potential energy savings vary widely; in square or rectangular buildings with perimeter offices, savings of 10 to 20 percent have been reported.

Dimmers

Replacing an existing local wall on/off switch with a wall box dimmer for fixtures with incandescent or tungsten-halogen/quartz lamps increases lamp life (dimming the lighting down 10 percent increases lamp life approximately four times) and proportionally saves energy. For example, if a 100-watt incandescent A-lamp, which has a rated lamp life of 750 hours, is dimmed by 10 percent, the lamp life would increase to 3,000 hours and consume 90 watts.

Light-Level Sensors

The initial light level from new lamps and clean fixtures is almost always much higher than the average light level of depreciated lamps and dirty fixtures. One approach to this problem is to set a light level below the light level of a new lamp and fixture. A light-level sensor attached to a fluorescent dimming-control system can reduce the initial light level of a new system to the level desired. The control system slowly increases power over the life of the lamp, compensating for lamp depreciation and dirt accumulation to maintain the same light level at all times. The most significant savings occur in the first few years when the lamps are new and the fixtures are clean. To achieve maximum savings with this method, the fixtures should be relamped and cleaned as a group at 60 to 70 percent of the rated lamp life to restore the lighting system to the light levels when new and to repeat the cycle of savings.

Payback Period on Lighting Control

The numbers you plug in will be different for just about every facility, but there is a simple equation to tell you whether installing controls, relamping, or other initiatives will be worthwhile. Simply divide the estimated cost of installation by the expected annual energy cost savings. This will give you the number of years before your investment pays for itself. There are more accurate and more useful calculations—5-year cash flows and ROIs, for example—but for a rough idea, the payback period will give you a serviceable number.

More Information

This article is adapted from BOMI International's ***The Design, Operation, and Maintenance of Building Systems, Part II.*** *More information regarding this is available by calling 1-800-235-2664, or by visiting www.bomi.org.* ***Visit BOMI International's Web site.***