A new four-year study reveals that building owners can save up to 10 percent of their lighting costs by scheduling regular maintenance.

CLEANER FIXTURES REDUCES LIGHTING COSTS

All lighting systems lose light as they operate, and all too often this common occurrence can mislead building owners and managers to over-light a space in compensation. A new four-year landmark building lighting study, conducted by the interNational Association of Lighting Management Companies (NALMCO), details how lighting costs for a building can be reduced by 10 percent or more simply by cleaning the fixtures on a regular maintenance schedule.

Known as the Luminaire Dirt Depreciation (LDD) study, the federally

Left: *Fixtures used in the study were cleaned at regular intervals and the output readings carefully tabulated.*

The Fluxometer is a specially designed instrument used to gather the lighting data throughout the four years of testing.

funded project involved taking scientific measurements of available light over four years from a test group sampling to determine the benefits – in terms of both improved lighting and reduced costs – of periodic cleaning of the lighting fixtures. The goal is to install fewer lighting fixtures without sacrificing quality of light output.

The U.S. Environmental Protection Agency (EPA) estimates the electricity needed to run commercial and industrial buildings to cost $90 billion per year. According to the EPA, lighting accounts for 30 to 40 percent of electricity use in commercial buildings – that translates to $27 to $36 billion spent on lighting annually.

Based on the study prediction of 10-percent savings using maintenance procedures, the EPA calculations indicate an annual savings of 10 percent of total commercial and industrial lighting costs nationwide, or $2.7 to $3.6 billion each year.

The study targeted office buildings, schools, health facilities, and retail stores. Preliminary results were released two years ago as the study was nearing completion. Final results, however, were significantly more definitive.

Originally funded for three years with two years of field measurements, the study was extended to four years to permit a full three years of field measurements to allow for more representative lamp failure figures.

Dirt accumulation reduces light levels

"For some 50 years, essentially ever since the fluorescent light fixture has been in common use in commercial buildings, the negative effect of light loss due to dirt accumulation on lamps and luminaire surfaces has resulted in reduced light levels," says Norma Frank, past president of NALMCO and chairman of the Illuminating Engineering Society of North America's (IESNA) Lighting Maintenance Committee, which has been looking into the problem.

"In addition, architects and lighting designers have been specifying and installing initial design levels of illumination above the required levels to compensate for accumulation of dirt, resulting in increased upfront costs and more electrical power wasted daily," she adds.

"We now expect this study to be used by industry leaders – working with the EPA – in the establishment of new design standards for lighting in the workplace that will have long-term benefits to both building owners and the environment. All from recommendations contained in this study that suggest building owners install fewer lighting fixtures than before and schedule regular professional cleaning of lighting fixtures, generally when maintenance crews are replacing lamps and ballasts anyway," Frank states.

She pointed out that while existing standards acknowledge that lighting systems must be maintained to assure the lighting quantity and quality intended, designers have been installing more fixtures than necessary for years. The results of this study, Frank comments, will enable designers to quantify – based on scientific data – the precise numbers of fixtures needed and the savings possible for specific applications and task requirements – all with varying operating hours, mounting heights, environments, and maintenance policies.

"The need to periodically clean luminaires has been recognized, but has not been a high priority with many users as maintenance budgets are reduced," she says, resulting in lighting system over-design.

Concrete data provides proof

The study offers factual maintenance data that can be used in the design of both new facilities and lighting retrofit projects as systems are updated. The extensive nationwide study, funded primarily by the EPA in a grant to NALMCO, is the most comprehensive and scientific study of its kind since the introduction of the fluorescent lighting fixture a half-century ago.

Dr. Robert Levin, corporate scientist for Osram Sylvania and a 40-year lighting industry veteran, calls the LDD project, "the first study ever on the subject to be completed in both a comprehensive and scientific manner. Data was informally collected in the 1950s on maintenance, but not as a controlled study," he comments.

Dr. Levin, who has served as the principal technical advisor to the project through his work with the IESNA Lighting Maintenance Committee, pointed out that the original 50-year-old study was conducted in the era before widespread air conditioning and during a time when many office and industrial tasks were different and produced different types of dirt in the workplace than is common today.

For example, smoking was common and office windows were frequently open; electronic machines were not in use, but early duplicators and lead pencils were commonplace. There were also different types of paints and building materials used 50 years ago. Not to mention that lighting fixtures themselves have changed over the past five decades.

"We know the dirt environment changed – the study was designed to quantitatively determine how much," Levin says. "If we have a loss of light over two or three years, you must either design to allow for that decrease or maintain the system. And there is the potential for the reduction of energy use for lighting of 10 percent or more," he adds.

"In the time frame of a two- to three-year cleaning cycle, the present lighting standards recommend allowing for on the order of 20-percent loss of light," Levin comments. "The new findings show we can recommend a 10-percent loss.

These are the allowances we make in terms of over-designing to make up for this loss due to dirt collecting on the light fixtures."

The impact of the study is far-reaching

By following the guidance of this new study, designers can cut the overage by half – and save 10 percent or more in lighting costs, operating costs, the cost of fixtures and wiring, service capacity, and the burden of air conditioning since a building with 10-percent fewer lighting fixtures will produce less heat and require less air conditioning.

"The final tabulations in this four-year study confirm our preliminary thoughts – you can have a very significant impact on lighting design practice and all energy codes and standards which incorporate good lighting design practice in their development," Levin says.

It is hoped that the final report for the four-year study will force new leading-edge design practices for a large fraction of the designed lighting environment that was targeted: lighting in office buildings, schools, health facilities, and retail stores. The study did not look at manufacturing facilities, foundries, storage facilities, and other types of lighted structures. Data produced by the study will be incorporated in lighting design practices prepared by the IESNA Lighting Maintenance Committee.

"All lighting systems lose light as they operate, fixtures get dirty, and lighting standards are provided to account for this," Levin notes. "So initially you provide for more light which means more expensive installation, more energy consumed, which also is more operating costs. With good, firm numbers on how much the light depreciates, the designer now will be able to cut back a bit on the amount he recommends daily."

Maintenance must be performed, not just "planned"

The study emphasized the need for regular maintenance once the cost-saving reductions are made. It is not enough for facilities managers to make these reductions, the lighting must be regularly maintained in order to ensure that only a minimal amount of excess light be allowed for reasonable light loss due to dirt. Then, the fixtures can be periodically cleaned on a schedule, typically during group relamping.

Another goal of the program is to save energy, reduce demand on power-generating facilities, and lower air pollution emissions through increased installation of efficient lighting and building technologies, according to Clark Reed, a program manager with the EPA's Energy Star Buildings and Green Lights Partnership.

Why this study, why now?

Norma Frank, a certified Lighting Management Consultant and co-owner of Colorado Lighting Inc. in Denver, initially identified the need for the LDD study and convinced NALMCO to make it an association priority. Frank explained that the results of the earlier, non-scientific study performed in the 1950s are still in use today in the "recommended practices" of the IESNA used by architects and developers everywhere.

"In effect for at least 25 years, we've been over-engineering to compensate for the lack of organized maintenance programs," Frank points out.

The first step was to include a cross-section of people on the Lighting Maintenance Committee, who were representative of the fixture, lamp, ballast, and maintenance industries. Next, the group identified the basic fixture types to be included in the study.

Then, the group created a specially designed instrument – a Fluxometer – to be used in gathering the lighting data throughout the four years of testing. The instrument is essentially a modified light meter that measures individual light fixtures while in place and is coupled to a hand-held computer used for calculating and recording results. Frank contacted Levin and Bill Brackett, then owner of Independent Testing Laboratories in Denver for their technical expertise. Levin and Brackett were primarily responsible for developing the Fluxometer.

Once the EPA funding was available, NALMCO went to work identifying 10 contractors – all NALMCO members – to send test crews out in the field in representative areas of the country to take light readings. Each contractor was issued a Fluxometer and each identified 20 sites, typically his own lighting maintenance customers. Eight lighting fixtures were identified at each site for use in providing test data throughout the term of the four-year study.

Actual testing got underway in March 1996. The eight units were tested initially, then cleaned and relamped and the initial output readings tabulated. At six months, two units were retested to secure valves when dirty, and after cleaning. At 12 months, the same test was repeated on the two other luminaires, and on different luminaires again at 18, 24, 30, and 36 months. Informational labels were left on the test fixtures instructing maintenance crews not to disturb the fixtures. In all, an estimated 200 test sites were evaluated over the four-year test period to provide a statistically representative sample.

NALMCO is a 47-year-old organization of lighting management and related companies committed to promoting professional lighting management techniques, the benefits of quality lighting, and the expansion of the lighting management industry.