NEW SOFTWARE PACKAGE FOR EVALUATING RETROFIT AND NEW LIGHTING DESIGNS

R. Arnold Tucker, P.E., C.E.M.
GTE Electrical Products

INTRODUCTION

Over the past decade, energy efficiency has been a major consideration in retrofitting existing lighting equipment and in new lighting system designs. High costs and shortages of available energy have made users more aware of the need to optimize lighting requirements. At the same time, state and local building codes are limiting the amounts of lighting energy that can be designed into new commercial and industrial buildings. The lighting industry has responded by providing a wide choice of products with a variety of benefits. In this age of heightened energy awareness, however, we must not lose sight of the fundamental criteria that should be considered in selecting the right lighting design. These include quality of light, initial investment, annual operating costs and environmental factors.

This paper reviews a new software package for evaluating various lighting system retrofits and the resulting implications for energy use and operating costs. Various lighting strategies can be examined by personal computer as well as their effect on the use of electricity for heating and cooling the same space. Using IBM compatible equipment and the DOS operating system, this software can be used by energy consultants and the lighting community to play "what if" scenarios with different lighting systems. For these firms the effort and expense that goes into using microcomputer software is paying off in productivity and is reducing costs for the labor intensive process of analyzing lighting strategies.

CAPABILITIES

The program will analyze a wide variety of lighting situations involving incandescent, tungsten halogen, fluorescent or high intensity discharge (HID) equipment. Preliminary design considerations can be considered with this model as well. With the previous accepted method of lighting the space as the existing system, the new lighting technology can be compared to it. All of the evaluation of the various lighting strategies will follow after the user inputs the numbers for the luminaires involved and the net cost per luminaire for each system proposed.

A user follows several steps to analyze a lighting system's operating costs. Utilizing common operating cost information such as annual burning hours, average cost of energy in $/KWH and average demand cost in $/KW, as many as two proposed lighting strategies can then be analyzed. Each separate lighting strategy can be evaluated as to its effect on various heating and air conditioning considerations. The cost effect of different types of fuel can be investigated as well as various operating times for heating and cooling. Thus making the model capable of evaluating the effect of a lighting retrofit or design on heating and cooling costs for any region in the country.

Various lighting retrofits can be economically evaluated using the wattage for lamp and magnetic (standard and energy saving) and electronic ballasts where fluorescent systems are involved. The lamp and ballast wattage for HID (mercury, metal halide or high pressure sodium) systems will be taken into account as well. This gives the software the capability of analyzing the latest "state of the art" technology.

CALCULATIONS

The following equations will give a user information on how the results are generated by the program:

RESULT FIELD		EQUATION
Lighting Load	=	Watts/Lamp X Number of Lamps / 1,000 Watts/KW
Load Reduction	=	Present Lighting Load - New Lighting Load
Annual Load Reduction	=	Load Reduction X Burning Hours per Year
Annual Savings	=	Annual Load Reduction X Cost per KWH
Demand Savings	=	Load Reduction X Monthly Demand Charge X 12
Reduced Air Conditioning Load per Year	=	Load Reduction X AC Hours X 3413 BTU/KWH / 100,000 BTU/Therm
Reduced Air Conditioning Capacity	=	Load Reduction X 3413 BTU/KWH / 12,000 BTU/H/Ton
Annual Air Conditioning Savings	=	Reduced AC Capacity X AC Hours per year X Cost per KWH Note: Assume 1 ton of AC = 1 KW
Heat Load Reduction	=	Load Reduction X 3413 BTU/KWH
Total Heat Load Reduction per Year	=	Heat Load Reduction X Burning Hours per Year / 100,000 BTU/Therm
Additional Fuel Required	=	(Heat Load Reduction X Heating Hours per year/Heating Content of Fuel) X 1.333
Annual Cost for Additional Fuel	=	Additional Fuel Required X Cost of Fuel
Annual Lighting Energy Savings	=	Annual Savings + Demand Savings
Total Energy Savings per Year	=	Annual Lighting Energy Savings + Annual Air Conditioning Savings - Additional Annual Heating Fuel Cost
Energy Savings over Lamp Life	=	Total Energy Savings X Rated Lamp Life / Burning Hours per Year
Total Investment New Lamps/System	=	Number of Luminaires X Net Cost per Luminaire
Net Return on Investment	=	Energy Savings over Lamp Life - Total Investment New Lamps/System
Annualized Net Return	=	Net Return on Investment / (Rated Lamp Life/Burning Hours per Year)
Return on Investment	=	Annualized Net Return / Total Investment New Lamps/System X 100
Pay Back Period of Proposal (Months)	=	Total Investment New Lamps/System / Total Energy Savings per Year X 12

BENEFITS

A user can view the database, but is not limited to its use only. The user can input information and perform the analysis or use the data of almost 400 lamps to perform the analysis.

This software is available to make comparisons of different lighting systems and to determine which is the most economical. It allows the user to quickly and accurately analyze lighting systems in the convenience of his/her office, at a job site or wherever the personal computer is located. The program is very "user friendly" and comes with easy-to-follow, system prompted instructions. Screen format has the look and feel of future IBM System Analysis Architecture (SAA).

Buildings can be modeled with the latest energy efficient lighting systems and performance and operating costs utilizing these systems calculated.

Now anyone who wants to maximize a lighting investment in terms of justifying, installing and operating the most efficient lighting system while achieving the required light levels has access to a software package what will help accomplish this goal. This software is a useful tool for decision making and optimizing this operating efficiency of any lighting system.