

*Customer Advanced Technology Program  
Technology Evaluation Report*

*Cyril Spinelli School  
Lighting Project*

*An Evaluation of Dimmable Fluorescent  
Lighting System Technology*



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## Introduction

SMUD's Customer Advanced Technologies (C.A.T.) program works with customers to encourage the use of and evaluate new or underutilized technologies. The program provides funding for customers in exchange for monitoring rights. Completed demonstration projects include lighting technologies, light emitting diodes (LEDs), residential building shell construction, geothermal heat pumps, indirect / direct evaporative cooling, non-chemical water treatment and a wide variety of other technologies.

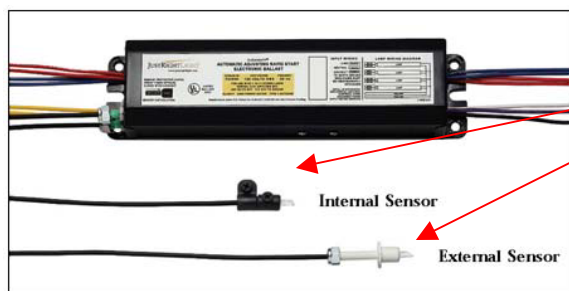
## Technology Description

Dimmable fluorescent lighting systems are nothing new: they have been available for at least two decades. These types of systems usually require special ballasts and lighting control systems and are available with various features. The potential energy savings from these types of systems has been well documented.

One company, however, has taken a new approach by offering *individually* adjustable ballasts. These ballasts enable the end user to adjust the lighting output of *each fixture* to meet the illumination requirements for the individual tasks being performed. Since conventional lighting system design is based upon the task with the highest illumination requirements and incorporates provisions for lumen depreciation, over lit spaces are quite common in schools and commercial buildings. Consequently, significant savings opportunities exist for this technology.

The lighting system featured in this profile is marketed under the name JustRightLight® (formerly Flexiwatt®) and is offered by Lincoln, Nebraska-based Precision Lighting Inc. The system consists of an electronic ballast that utilizes fiber optic sensors to measure and adjust lighting output. The system is available with or without a daylight harvesting option. Here is a brief look at how it works:

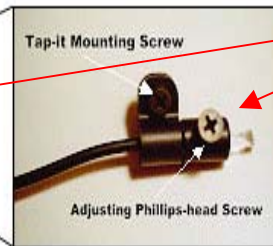
- **Standard system:** the existing ballast is replaced with the new ballast. The internal fiber optic sensor is located within the lighting fixture and measures the output of the lamps. The installer places a light meter on the task surface and uses a Phillips head screwdriver to adjust the output of the ballast until the desired illumination level is reached.



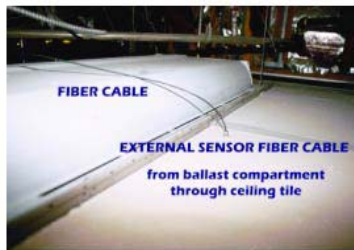
Photograph of a JustRightLight ballast. Note the internal and external sensors

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- **System with daylight harvesting option:** works the same as the standard option but incorporates an external sensor (mounted outside of the fixture) to measure the amount of available daylight. Once the internal sensor has been set to provide the desired illumination level, the external sensor will automatically adjust the lighting output depending on the amount of available daylight present in the space.



Note the Phillips head screw for adjusting lighting output and the location of the internal sensor



Note the location of the external sensor. This sensor is used when the daylight harvesting option is used

JustRightLight® ballasts are currently offered in two, three and four T8 lamp configurations for either 120 or 277 volt applications. For more information, please visit [www.JustRightLight.com](http://www.JustRightLight.com)

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## Showcase Project

**Project: Cyril Spinelli School**  
**3401 Scotland Drive, Antelope, CA 95843**  
**Rooms 34 & 35 (Portable Classrooms)**



### Basecase:

- ❑ Twenty-two, 4-lamp fluorescent fixtures with 34-watt T12 lamps and magnetic ballasts
- ❑ Measured electrical demand = 2.88 kW<sup>1</sup>
- ❑ Estimated hours of operation = 2,200 hours per year
- ❑ Estimated energy consumption = 6,332 kWh<sup>1</sup> per year
- ❑ Estimated electrical costs = \$670 per year
- ❑ Measured light levels = 75 to 90fc (foot-candles)

### New System:

- ❑ Twenty-two, 4-lamp fluorescent fixtures retrofitted with 32-watt T8 lamps and JustRightLight® ballasts (4-lamp ballasts with daylight harvesting option)
- ❑ Calculated maximum electrical demand = 2.1 kW
- ❑ Measured electrical demand = 1.16 kW<sup>1</sup>  
*Note: the ballasts were adjusted by the Customer to provide an illumination level of 35fc*
- ❑ Estimated hours of operation = 2,200 hours per year
- ❑ Estimated energy consumption = 2,541 kWh<sup>1</sup> per year
- ❑ Estimated electrical costs = \$269 per year
- ❑ Measured light levels = 35 fc (*the ballasts were adjusted by the Customer*)
- ❑ Project cost = \$2,204<sup>2</sup>

### Results:

- ❑ Electrical demand reduction = 1.72 kW
- ❑ Calculated annual energy savings = 3,791 kWh per year<sup>1,2</sup>
- ❑ Electrical cost savings = \$401 per year<sup>1,2</sup>
- ❑ **Savings of nearly 60% for all three categories**
- ❑ Simple payback = 5.5 years<sup>3</sup>

<sup>1</sup>Calculations are based on measurements obtained at the project site

<sup>2</sup>The amount of available daylight in these classrooms is somewhat limited due to the relatively small number and size of the windows. Consequently, no attempt was made to estimate any additional potential savings from the daylight harvesting option.

<sup>3</sup>Project cost and simple payback do not include the Customer Advanced Technologies program grant

### Comments:

- ❑ The Customer was very pleased with the results of this project. He especially appreciated the ability to set the lighting system to provide the desired illumination levels.

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## Observations

### Ballast Factor

In addition to energy savings, the main benefit of this technology is the ability to adjust the lighting output of each fixture to the requirements of the task. This is accomplished by changing the *ballast factor*. The ballast factor is a rating used to describe how hard a ballast will drive the lamps. The initial lumen output of a lighting system can be calculated as follows:

$$\text{Initial system lumens} = (\text{lumens / lamp}) \times (\text{number of lamps}) \times (\text{ballast factor})$$

*Example: two lamps rated at 3,000 lumens are connected to a ballast with a ballast factor of 0.90*

$$\text{Initial system lumens} = (3,000 \text{ lumens/lamp}) \times (2 \text{ lamps}) \times (0.90)$$

$$\text{Initial system lumens} = 5,400 \text{ lumens}$$

As mentioned earlier, the JustRightLight® is available for two, three or four lamp configurations. The manufacturer's table shown below lists the maximum and minimum ballast factors. As you can see, the ballasts for the two and three lamp systems offer a wide range of adjustability. These systems should provide the end user with a great deal of flexibility.

However, the maximum ballast factor for the four-lamp ballasts is only 0.65. Unfortunately, this low rating will undoubtedly limit the number of applications for the four-lamp system. If a lighting application only requires less than 65% of the existing system lumens, it may be more cost effective to simply reduce the number of lamps (de-lamp). Perhaps the best applications for the four-lamp system would be for fixtures that are difficult to de-lamp and are located in areas with plenty of available day lighting.

Ballast Factor (without Daylight Harvesting):

120V, 2 lamp	@max. light = 0.96	@min. light = 0.12
120V, 3 lamp	@max. light = 0.80	@min. light = 0.10
120V, 4 lamp	@max. light = 0.64	@min. light = 0.08
277V, 2 lamp	@max. light = 0.93	@min. light = 0.10
277V, 3 lamp	@max. light = 0.82	@min. light = 0.10
277V, 4 lamp	@max. light = 0.65	@min. light = 0.06

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## **Installation**

These ballasts are installed in the same manner as conventional ballasts-with the exception of the fiber optic sensors. One internal sensor and cable is included with each JustRightLight® ballast. However, if the daylight harvesting option is desired, one additional external sensor with fiber optic cable must be purchased. Since these sensors control the lighting output of the ballast, care must be taken to follow the manufacturer's guidelines for properly locating and installing the sensors.

**IMPORTANT MANUFACTURER'S NOTE: JustRightLight® units are rapid start type ballasts and must be wired as such. In the event a JustRightLight® unit is replacing an instant start ballast (which has only one, instead of two, independent wires connected to each lamp socket), the lamp sockets **must** be replaced with 2-wire rapid start sockets.**

## **Potential Benefits**

### **Energy Savings**

The power consumption of a fluorescent lighting system is directly related to the ballast factor. Generally speaking, the higher the ballast factor, the more energy the system will consume. Since this technology offers the ability to reduce the ballast factor, significant savings opportunities exist for spaces that are over lit. The Spinelli School project resulted in savings of nearly 60%. According to the manufacturer, other documented projects have resulted in savings ranging from 45 to 75%.

### **Precise Control of Illumination Levels**

One of the most common complaints following a T12 to T8 lamp conversion is that the new system is **too bright**-especially in areas where the occupants are using desktop computers. Since standard lighting design practice includes a significant allowance for lumen depreciation, many offices are over lit. Consider this example:

- If the desired *maintained* illumination level for an office application was 50fc (foot-candles), the *initial* lighting levels may be 60 fc or higher. Furthermore, since lighting designs are usually based upon *average* illumination levels; some areas would be higher than 50fc and other areas would be lower. The JustRightLight® system would enable the end user in this situation to adjust the initial illumination level to the desired 50 fc. Not just an average – but 50 fc for each individual workstation. In addition to saving a significant amount of energy, this would provide even illumination throughout the work areas. Furthermore, additional adjustments could easily be made for any specific work area. In the Spinelli School project, the Customer adjusted the illumination levels to 35fc using only a Phillips head screwdriver. With conventional ballast technology, the end user is usually limited to removing lamps or replacing ballasts to reduce illumination levels.

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## Lumen Maintenance

As fluorescent lamps age, their lumen output diminishes over time. The JustRightLight® ballasts are designed to automatically increase the power (if necessary) to the lamps in order to maintain the desired preset illumination level. This feature is commonly referred to as lumen maintenance.

## Lamp Life

The life of fluorescent lamps is affected by several factors including the ballast factor. Lamp manufacturers report that the life expectancy of fluorescent lamps will be reduced by 25% when they are connected to a system with a ballast factor of 1.25 or greater. Conversely, some studies suggest that ‘under driving’ the lamps may extend their useful life. Although the manufacturer of the JustRightLight® system does not appear to make this claim, it is theoretically possible. In any case, the effect of this technology upon lamp life is beyond the scope of this evaluation.

## Conclusion

### Market Potential and Barriers

This technology will work for virtually any commercial facility with fluorescent lighting. Consequently, the potential market is huge. Since many of these facilities are over lit and include large areas in which day lighting is available, significant energy savings potential exists. Furthermore, the ability to adjust the lighting output for individual fixtures and the lumen maintenance feature offers customers an unprecedented level of control. However, two significant market barriers may exist:

- 1) **Functionality:** Most customers install dimmable fluorescent lighting systems for applications that require immediate, *centralized* control over illumination and power consumption levels. For example
  - ❑ It is often necessary to temporarily lower the lighting levels in a classroom during video presentations
  - ❑ Many customers are participating in ‘demand responsive’ load shed programs. When asked by their local utility, these customers often reduce their power consumption by temporarily reducing lighting levels (via centralized lighting control systems).

Since the JustRightLight® system does not offer any options for centralized control, it is not a viable replacement option for these types of applications.

- ❑ **Cost:** Although the material cost of this system may be comparable or less than other types of daylight harvesting systems, it is *three times* more expensive than conventional electronic ballasts. Unfortunately, experience has shown that many commercial customers may not be willing to make the additional required investment, *unless* they are able to take full advantage of the additional benefits this system offers.

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## Recommendations

This technology may provide significant benefits to customers, but care must be taken to identify optimal applications. Desirable applications may include:

- ❑ Areas with abundant daylight
- ❑ Over lit spaces with lighting systems where permanent de-lamping is difficult or undesirable
- ❑ Areas where substantially different tasks are being performed
- ❑ Applications where lumen maintenance is important

## Technology Transfer

To date, only one Customer Advanced Technologies demonstration project for this technology has been completed. More projects will be necessary to sufficiently evaluate this technology. Applications for the two and three lamp systems with more available daylight would provide a more thorough basis for evaluation.

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