



## **PIER Lighting Research Program**



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### **Bathroom Smart Light Fixture Specifications**

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## Bathroom Smart Light Fixture Specifications

### Introduction

For Project 4.1: Hotel and Institutional Bathroom Lighting Project, the concepts are based on hotel lighting configurations utilizing LED and fluorescent fixtures with integrated controls. The basic approach philosophy uses the fluorescent lighting component to provide full task lighting function, while the LED component provides a low light level, energy saving night-light function. The controls for the fixture can be handled in different ways. The basic fixture configurations and control strategies are briefly described below.

### Fixtures

There are four basic physical fixture configurations under consideration.

- 1) Build-out box fixture - This fixture incorporates the fluorescent and LED portions of the fixture into a dedicated box unit that is designed specifically for hotel guestroom applications. This fixture is intended to replace a hotel bathroom “build-out” where a strip fixture is surrounded by a custom built wood frame and diffuser.
- 2) Lens covered wall mount – This fixture is similar to existing bathroom lighting fixtures that employ a fluorescent lamp covered by a diffusing lens. The LED portion will be integrated into the fixture and provide proper night light illumination.
- 3) Direct/indirect wall mount – This type of fixture uses a front plate to redirect the fluorescent lamp flux upwards and downwards. This provides a direct task light component and an indirect ambient component. The LED portion would be integrated into this fixture in such a way as to maximize both its utility as a night light and its aesthetic appeal.
- 4) Dual wall sconce – This fixture combo uses two wall sconces on either side of the mirror and, as such, is fundamentally different from the first three concepts. The two sconces provide horizontal illumination to the relevant task planes. LED units will be mounted in one or both of the sconces as necessary to provide proper night lighting function.

LBNL will work with the manufacturer(s) concerning the advantages and disadvantages of the four basic physical fixture configurations. For each configuration, customer appeal, cost of material, installation issues, and pricing will be considered.

### Controls

There are three basic control configurations for these fixtures. Each configuration includes a wall mount switch receptacle that is located just within the doorway for easy

user access. Each of these control features can be applied to each of the four fixture concepts described above for a total of 12 different fixture/control combinations.

The control options included in this switch, and in the light fixture itself, are as follows:

- 1) Switch only - This approach uses only a switch to toggle between the LED nightlight and the fluorescent light. No occupancy sensing is performed.
- 2) Wall based occupancy sensing – This approach integrates an occupancy sensor into the wall mount switch. The sensor controls the LED/fluorescent functions.
- 3) Fixture based occupancy sensing – This approach places the occupancy sensor into the fixture. The wall mount switch is used to manually turn off the fluorescent.

Option #1 skips the occupancy sensor, which would lessen the potential for daytime energy savings, though some energy savings may accrue at night if the room occupants use the LED instead of the fluorescent light for nightlights. Option #3 would be less expensive to install than option #2, and has the potential to provide the significant energy savings.

The next task is to identify the critical product attributes for the new bathroom fixture system(s) including technical, operational and product design product features.

## Fixture Designs

The designs developed to date were established in part based on initial feedback received from customers and hospitality industry representatives in response to the WN-100 occupancy sensor nightlight system developed in the earlier phase of this project. Additionally, design sessions and working groups with industrial partners and potential hospitality end users helped to identify specific product needs and potential product attributes. Design renderings are unavailable for review at this time. As discussions with the manufacturer(s) progress, information on the fixture design and the selected control configuration will become available.

## Prototype Specifications

The specifications will serve as the starting point for the next phase of the project in which researchers will work with the project's industrial partners to develop prototype systems. The following key specifications were developed for the hotel guestroom bathroom luminaire. These are essentially a "wish list" of potential features for the final product.

- Integrated occupancy sensor  
In order to capture the percent of energy savings that were verified during the WN-100 study, the luminaire must have an integrated occupancy sensor. This sensor should be integrated into the luminaire in a manner that allows for appropriate sensor coverage of the bathroom area for all potential application scenarios. The occupancy sensor should also be integrated into the luminaire in a manner that is transparent during installation (i.e., it should wire exactly like any other luminaire).

It is important to emphasize that the amount of energy savings from the bathroom smart light fixture may be less than were shown in the WN-100 (wall switch LED-based nightlight with occupancy sensor) study. The reason is the WN-100 is designed for use in retrofit applications, which include mostly inefficient incandescent lighting fixtures. The bathroom smart light fixture is designed for new construction applications and will use high efficient fluorescent lamps. However, the occupancy sensor should provide an equivalent percent of savings.

- Integrated nightlight

The LED nightlight will be integrated into the luminaire and function in a manner similar to the WN-100 unit. That is, the nightlight will be on whenever the general luminaire lighting is off and vice versa. The LEDs on the WN-100 draw approximately one Watt and it is felt that the WN-100 package provides an acceptable level of nighttime illumination; thus the LED package for the luminaire will likely be in the same range. Proper placement of the LEDs in the luminaire should yield a more uniform level of illumination than the illumination level provided by the WN-100.

- Easy installation

A key feature of the newly developed system is the need for its installation to be as easy or easier to install than current systems. Reducing the labor associated with the installation will make the system more desirable to hotel facility managers and help to justify the higher overall luminaire cost that the inclusion of the occupancy sensor and nightlight will require.

- Broadly applicable

The newly developed system needs to be broadly applicable to a wide variety of applications. The more flexible the luminaire is to both potential geometric and mounting constraints, as well as aesthetic considerations, the greater its potential appeal. It is conceivable that a universal “backbone” of a system can be developed that will fit in a wide cross-section of hotel and potentially dormitory bathroom applications. The universal backbone would allow for a large number of “faceplates” to be attached that would be appropriate to the specific geometric and aesthetic requirements of a wide variety of applications. Such an approach would have the additional potential benefit of allowing the hotel or dormitory to change the appearance of the luminaire relatively inexpensively during renovation by changing the faceplate while maintaining the backbone.

- Power outage lighting

Hospitality industry representatives revealed that it would be of great value to them if the luminaire had a function that operated the LEDs – either at their standard nightlight level or at an increased output level – during power outages. Typically hotels have emergency lighting in the hallways, but none in the guestrooms themselves. It was felt that this capability would be a safety feature they could tout when negotiating contracts with large customers, such as airlines.

- Compatible with any wall switch  
It would be desirable if the newly developed luminaire could be fully functional regardless of what type of wall switch operated it, rather than requiring a special switch also to be installed with the luminaire. This would allow the luminaire to be an all-in-one solution for hotel facility managers, reducing both the material costs and the installation cost of the system. This specification may affect the ability to select control option #1, which toggled between the LED and fluorescent lamp.
- Improved maintenance  
Due to the nature of their occupancy, hotels are unable to perform group relamping. In fact, when lamps fail, there is a critical need to perform an immediate spot replacement. This is an expensive, labor intensive process that also has obvious implications on guest comfort. It was determined that it would be desirable to have a luminaire that either significantly increased lamp life, or was still substantially functional after a lamp failed (for example, it switches to a “backup lamp” when the primary lamp fails) so it could be relamped during a convenient period of vacancy. A backup lamp and proper switching could be designed into the new product, though it would more than likely increase the overall cost.

## Conclusion

Over the next several months, designs and prototypes will be developed to meet these specifications. While meeting some of these specifications will be relatively straightforward (such as integrating the occupancy sensor and LEDs), others will be more complicated. In certain cases, the specifications might prove to be mutually exclusive, in which case a decision will have to be made on which specification is of greater value to the overall design. For example, it would not be possible to develop a system that has a power outage feature without including a specialized switch for the luminaire (otherwise the luminaire would not be able to tell the difference between when the power goes out and when it is simply turned off). Every attempt will be made to work with the industrial partner(s) to find economically feasible solutions in integrating these features into the ultimate prototype designs.

Finally, it may be important to note that many hotels in the East and Midwest design new hotels with incandescent bathroom lights. While the focus of this project is primarily California, the impact on the national picture is also a consideration. Many hotel chains may find the bathroom smart fixture desirable for future hotel projects across the nation.