

Leading by example, saving energy and taxpayer dollars in federal facilities

New and emerging lighting technologies, such as LEDs, can improve lightening quality while reducing energy and maintenance costs.

## LED Provides Effective and Efficient Lighting in Freezer Storage Room

New lighting technology improves illumination while reducing maintenance and energy costs

The Defense Commissary Agency operates a worldwide chain of commissaries providing groceries to military personnel, retirees and their families. Patrons save an average of more than 30 percent on their purchases compared to commercial prices, which is a valued part of military pay and benefits.

For these reasons, keeping costs low is paramount to the Defense Commissary Agency.

Commissaries, like most food stores, are some of the most energy intensive buildings. The largest energy consumer is usually the refrigeration system, which can account for half of the total annual energy consumption. The second largest energy consumer is usually the lighting system. Together, these two account for significant annual operating costs. Reducing these energy costs is a major concern to the Defense Commissary Agency.

Commissaries have extended customer business hours compared to most buildings. During the day, patrons keep the front of the building busy. Deliveries keep the back of the building busy as trucks continuously arrive; products are unloaded and placed in interim storage. After customer hours, the shelves are restocked with the products from storage. The Fort George G. Meade<sup>1</sup> commissary, considered one of the busiest commissaries, is no exception.

<sup>1</sup> Fort George G. Meade, located a few miles south of Baltimore, Maryland, is home to the fourth largest workforce of Army installations in the continental United States. Fort Meade's workforce has approximately 39,000 members, composed of military, civilian and contractor personnel. The local population is estimated to be 109,000 in addition to thousands of daily visitors.



LED globe lights in freezer storage room.

### Introduction

To support the high business volume, the Fort George G. Meade commissary has several large freezer storage rooms located in the rear of the commissary facility. The freezers are kept at different temperatures depending on the products stored; some are kept as low as -15°F. The storage rooms are very busy and very energy intensive. In addition to the refrigeration load, each room is illuminated.

Conventional lighting and refrigeration systems typically work against each other. Lighting systems generate heat, which the refrigeration system needs to remove. In addition, lower temperatures typically reduce the efficacy of lighting systems. Thus, more power is required to generate the desired illumination, which in turn, increases the load on the refrigeration system.

Investigating ways to reduce energy consumption and costs, the Defense Commissary Agency and the Fort George G Meade commissary sought to demonstrate a new lighting technology in one of



# Federal Energy Management Program

## Spotlight on Design

the large drive-in freezer storage rooms. The 35 by 47 ft freezer storage room is kept at -15°F and is designed to accommodate large pallets of frozen food, including ice cream products. The old lighting system consisted of 36, 100-watt gel-coated incandescent lamps in globe-type enclosed fixtures mounted on the ceiling, 13½ ft above the floor. While there is a light switch located outside the main door from the inner loading dock area, the freezer storage room has heavy traffic and the lights are rarely turned off.

### New Lighting System

The old incandescent lights were replaced with 36, 15-watt white LED (light-emitting diode) fixtures from Energy Focus, Inc.<sup>2</sup> The LED lights offer several advantages over the incandescent lamps.

- Lighting power is reduced to 540 watts from 3600 watts, a reduction of 85%.
- The new LEDs deliver a different color corrected temperature (CCT) compared to the old incandescent lamps; 6500K for the new LEDs compared to 2600K for the incandescent lamps. The scotopically-enhanced color from the new LEDs provides an improved perception of overall brightness.
- LEDs are inherently directional light sources. In this application, it means the lamp-fixture LED system is more effective at getting useful light to the task. To improve light distribution, the new LED globe enclosures are frosted. The new LED lighting system provides over 10 footcandles of illumination on the floor, an improvement over the incandescent lamps even when all the lamps were working.
- Normally, heat management is a design issue with LED fixtures. In this application, the cold storage environment actually improves the efficacy of the LED light source. Unlike conventional lamps, the light output of LEDs improves in cold climates. At -15°F, the light (lumen) output of the LED light is about 18% greater than at normal room temperatures.



New LED globe lights require 85% less power and will provide over 5 years of continuous service.

To see if the impact on the refrigeration system was measurable, the lights and refrigeration system were sub-metered for around 3 months as compressor power was too great compared to the lighting power reduction to see a statistically significant difference.

### Lighting Operations and Maintenance

The new LED lights are expected to provide over 5 years of useful service. This contrasts with the old incandescent lamps, which needed to be replaced more than 8 times each year. Significant labor is saved because the frozen foods do not need to be shifted to allow safe access to the overhead fixtures.

Because the commissary uses a maintenance contractor for lamp replacement, it means maintenance costs are saved resulting from the reduced labor requirement.

<sup>2</sup> Armada LED small globe, 15 watt, white, 6500K, 750 rated lumens by Energy Focus, Inc. ([www.energyfocusinc.com](http://www.energyfocusinc.com))



## Conclusions

The new LED lighting system for the freezer storage room at the Fort George G. Meade commissary is a notable improvement over the older technology. This application of an emerging lighting technology serves as an example to others.

Lighting power is reduced by 85%; overall illumination is improved, and maintenance costs are reduced.

The LED lighting system provides a good return on investment and allows the Defense Commissary Agency to reduce energy consumption and costs.



Previous incandescent globe lights had short lamp life.

Measurement	Before	After	Unit
Average total lighting power	3,600	540	Watts
Operating hours per day	24	24	hours
Energy consumed per year (lights only)	31,363	4,704	kWh
Energy saved per year (lights)		26,659	kWh
Energy saved per year (refrigeration)		Indeterminate	
Energy saved per year (total)		26,659	kWh
Energy cost reduction per year (total)†		\$4,561	
CO <sub>2</sub> reduced per year		21.1	tons
Installed cost		\$14,400	
Simple payback		3.2	years

† Assumes electricity cost = \$0.1711/kWh. (Reference: Fort Meade FY06 Energy Management Report)



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