Evaluation of NYSDOT LED Traffic Installation

Troy-Green Island Bridge, Troy, New York
New York State Energy Research and Development Authority

Project Profile

Agency:

New York State Department of Transportation

Location:

Troy-Green Island Bridge: Troy, NY

Description:

Replacement of Red and Green Signals with LEDs

Project Introduction

The New York State Department of Transportation (NYSDOT) is currently in the process of converting the red and green incandescent traffic signals in its 6,000 intersections to light-emitting diodes (LEDs).[1] The yellow signals have not been converted to LEDs, because no yellow LED signals meeting the luminous intensity specifications of the Institute of Transportation Engineers (ITE)[2] were available at the time of this evaluation. One intersection where the conversion of red and green signals has occurred is located at the eastern end of the Troy-Green Island Bridge in Troy, NY where it intersects State Route 4 *(Figure 1.)*. The bridge runs east to west across the Hudson River. Another NYSDOT-maintained intersection, at the western end of the bridge in Green Island, NY still contains all incandescent signals *(Figure 2.)*. All of the signals in these intersections are 300 millimeters in diameter.

This document describes an evaluation of the performance history and photometric characteristics of the signals at these intersections to provide information to decision-makers about the practical aspects of installing, maintaining, and using LED traffic signals.

Fast Facts

- **Installation of red and green LED signals at the Troy-Green Island Bridge has reduced energy use and maintenance requirements with no negative reports from the public**
- **Field "spot check" measurements can be made during the daytime with relatively inexpensive equipment**
- **The LED signals at this intersection currently exceed minimum luminous intensity specifications of the ITE and are brighter than incandescent signals located across the bridge**
- **All of the signals were of sufficient intensity to allow correct color identification during daytime conditions**

ITE specifications for incandescent signals[3] specify only *initial* minimum luminous intensities for each type of signal (color and size) that is to be met under specified test conditions. It is expected that under normal operating conditions, reductions in light output from the lamp and lens will occur as the system ages and becomes dirty, but not below a level of service deemed acceptable throughout the operating life of the system. ITE specifications for LED traffic signals, on the other hand, give minimum intensities that are to be *maintained* throughout the system's service life. The minimum intensities for each LED signal type are 15 percent lower than the initial values in the specification for incandescent signals. However, at present there is no widespread method for verifying whether LED signals do indeed meet ITE specifications in the field.

Figure 1. ***Photograph of Troy intersection, facing East.***

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Figure 2. ***Photograph of Green Island intersection, facing West.***

Also reported in this document are the results of a series of measurements of the signals at both intersections that were taken in the field during the daytime and without disrupting traffic operations.

Agency Experience

NYSDOT operates and maintains all of the signals at the intersections adjoining the Troy-Green Island bridge. NYSDOT purchased the LED signals in Troy using the contract it arranged through the NYS Office of General Services procurement division. The LED signals were installed in March and April 2001. The yellow signals in Troy still contain incandescent lamps, as do all three signal colors in Green Island.

There have been no complaints or reports of problems with the LEDs from the public, nor from the municipality. NYSDOT reports that when it first began to install LEDs at various locations throughout the state, the agency received occasional calls that the new signals looked different. Such calls have not occurred in recent years.

None of these signals at these intersections are metered for electrical use; the local utility charges a rate based upon the number and type (LED or incandescent) of signals at an intersection. Each pair of red and green LED signals installed reduces annual energy use by more than 1,000 kWh. NYSDOT also expects to realize maintenance cost savings, as the LEDs have virtually eliminated signal "burnouts" that require immediate replacement by signal crews.

Field Measurements

Field measurements were taken with a portable luminance meter in October 2001 during daytime conditions. For safety reasons, and to avoid interfering with traffic, the measurements were taken from locations on nearby sidewalks and traffic islands where the most direct view of the signals could be obtained practically *(Figures 3. & 4.)*. Measurements were made with each signal alternately switched on and off to eliminate the contribution of daylight to the signal's intensity.

The luminous intensities calculated from these measurements were compared to the relevant ITE specifications for traffic signals at the angle from which the measurements were taken. Thus, the measurements served as a "spot check" of signal performance at several different angles. The vertical angles ranged from 5° to 10° below horizontal, and the horizontal angles ranged from 0° (directly in front of the signal) to 20° toward the side of the signals.

In both intersections, two signals face each direction of travel. Three individual measurements were taken of each signal. One yellow signal in Troy facing northbound traffic was not operational during the time of measurement. One set of red, yellow, and green signals facing eastbound traffic and two sets facing westbound traffic in Troy could not be measured safely from any location offering a direct view of the signal.

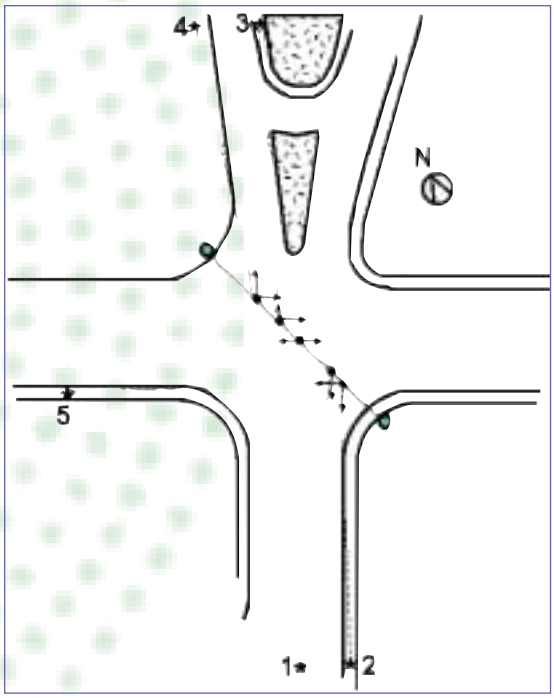

Figure 3. ***Sketch of Troy intersection layout, showing measurement locations.***

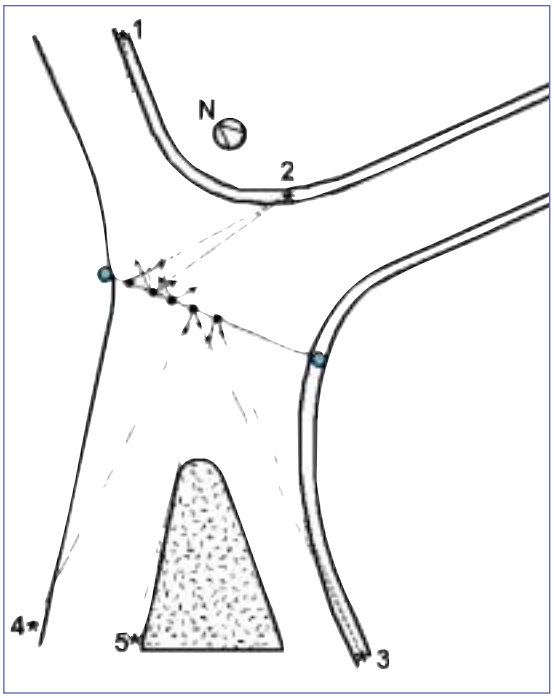

Figure 4. ***Sketch of Green Island intersection layout, showing measurement locations.***

Measurement Results

The measurements are listed in the table below; they illustrate two major trends. First, the red and green LED signals have luminous intensities well above the minimum levels specified by the ITE. Second, the red and green LED signals in Troy are brighter than their incandescent counterparts in Green Island. The yellow signals on each side of the bridge are relatively close to one another in terms of luminous intensity, which was expected since they both use incandescent lamps.

LED signal color (Troy side)	Average intensity relative to ITE LED specification	Average intensity relative to Green Island side
red	260%	680%
yellow (incandescent)	N/A (not LED)	83%
green	200%	270%

Evaluation

The measurement results illustrate that the LED signals in Troy are brighter than the incandescent signals in Green Island. All of the signals, including the incandescent signals, were of sufficient intensity to allow correct color identification during daytime conditions.[4] Except for the green LED signals, none of the signals in Troy or Green Island were bright enough to cause discomfort glare to observers during nighttime conditions.[5] The green LEDs might cause momentary discomfort to drivers, but these signals are not viewed by drivers for prolonged periods of time, nor has NYSDOT received any complaints about glare at this intersection.

All LEDs are highly durable devices that exhibit a slow but gradual reduction in light output over time. Based on the published rates of this reduction for red and green LEDs found in traffic signals,[6] the LED signals in Troy are likely to maintain the required minimum luminous intensities for at least five years, exceeding ITE requirements that they maintain these levels for three years.[2]

Overall, NYSDOT's experience with LED signals at this intersection, and at the more than 2,000 other intersections where red and green LEDs have been installed, is considered a success. Indeed, the red and green incandescent signals in Green Island are slated to be replaced with LEDs in 2002. Furthermore, the measurement techniques described above could be a practical means for determining whether LED signals meet the ITE's luminous intensity requirements after they have been installed.

For More Information

To learn more about how your municipality can take advantage of NYSOGS's procurement contract for LED traffic signals, visit the NYSOGS website at www.ogs.state.ny.us or contact the NYSOGS purchasing coordinator at (518) 474-6717 or customer.services@ogs.state.ny.us.

This case study was developed by the New York State Energy Research and Development Authority (NYSERDA) to inform municipalities of the energy saving opportunities offered by LEDs. NYSERDA has many programs available that can help your municipality identify energy saving improvements that will reduce your utility costs, including:

Technical Assistance Program: Offers cost-shared help from energy engineers and experts for technical assistance. Funds are available for Energy Feasibility Studies, Energy Operations Management, and Rate Analysis.

Standard Performance Contracting: Offers fixed-price incentives to energy service companies (ESCOs) that install cost-effective electric energy efficiency measures.

Smart Equipment Choices Program: Offers financial incentives to customers for energy-efficient lighting equipment.

To learn more about these programs and others, visit the NYSERDA website at *www.nyserda.org.*

Footnotes

1. New York State Energy Research and Development Authority. 2001. *New York State Department of Transportation: An Effective LED Traffic Signal Purchasing Strategy to Save Maintenance and Energy Costs*. Albany, NY: New York State Energy Research and Development Authority.
2. Institute of Transportation Engineers. 1998. *Vehicle Traffic Control Signal Heads — Part 2: Light Emitting Diode Traffic Control Signal Modules*. Washington, DC: Institute of Transportation Engineers.
3. Institute of Transportation Engineers. 1985. *Vehicle Traffic Control Signal Heads: A Standard of the Institute of Transportation Engineers*. Washington, DC: Institute of Transportation Engineers.
4. Bullough, J., P. Boyce, A. Bierman, K. Conway, K. Huang, C. O'Rourke, C. Hunter and A. Nakata. 2000. Response to simulated traffic signals using light-emitting diode and incandescent light sources. *Transportation Research Record* (1724): 39-46.
5. Bullough, J., P. Boyce, A. Bierman, C. Hunter, K. Conway, A. Nakata and M. Figueiro. 2001. Traffic signal luminance and visual discomfort at night. *Transportation Research Record* (1754): 42-47.
6. Rea, M. (editor). 2000. *IESNA Lighting Handbook*, 9th edition. New York, NY: Illuminating Engineering Society of North America.

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