NPSTC

Radio Frequency (RF) Interference from Energy-Efficient Lighting

FINAL REPORT

June 30, 2015

National Public Safety Telecommunications Council

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Background:

The Energy Independence and Security Act of 2007 required improvements in energy efficiency of lighting equipment.[1] These requirements have led to the gradual phase out of traditional incandescent lighting and helped spur the development of energy-efficient lighting technologies. As a result, homes, businesses, and local, state and Federal government facilities are transitioning to compact fluorescent lighting, LED lighting, electronic ballasts, and other forms of energy-efficient lighting products. Therefore, energy-efficient lighting is a fact of life in our current environment. While energy-efficient lighting products have many benefits, experience shows they can also cause radio frequency (RF) interference, impacting nearby communications equipment, including that of public safety entities.

NPSTC was approached by several individuals and organizations who reported interference to public safety radio networks from energy efficient lighting. In October, 2014 NPSTC issued an initial query to the public safety community through the NPSTC Participant's Listserv which resulted in dozens of responses. For example, Lake County, Florida reported interference to the public safety VHF band and Amateur bands after installing new tower lighting on its radio sites. Las Vegas, Nevada experienced extreme interference in the UHF band from a business using excited plasma lights. An incident management team operating at a fire in northern California in August 2012 had set up and tested all of its communications equipment. During the evening operational period all communications failed. The source was determined to be a string of overhead fluorescent lights. Quebec, Canada reported interference problems on its public safety VHF trunking system from LED lighting made by a variety of manufacturers, which created a strong interfering signal within 100 meters of the building.

NPSTC Questionnaire:

Based on the initial input from these agencies, NPSTC developed and compiled a more formal questionnaire which was distributed broadly throughout the public safety community on January 19, 2015. The online questionnaire was closed on February 13, 2015. NPSTC designed the questions to seek information on the frequency band(s) affected, how any interference manifested itself, whether the interference has been resolved, etc. Appendix A includes the full list of questions asked.

[1] PUBLIC LAW 110–140—DEC. 19, 2007, Subtitle B, Lighting Energy Efficiency

NPSTC Survey Results

Seventy-six (76) public safety agency representatives responded to the questionnaire. Fifty-five (55) of those responding said they had no interference with the remaining twenty-one (21) providing some details on the interference they had experienced.

The following chart summarizes the input from those 21 responses.

Survey Respondent	Interference Cause	Band(s) Affected	How Affected	Impact Area
Anonymous	Traffic Lights and associated ground-mounted light controllers and transformers	VHF; UHF	Noise in mobile or portable radios. Noise rises as traffic signals change or blink	100-200 feet of intersections
Linda Fire Protection District	Florescent light ballasts	VHF	Nuisance level of noise and garbled transmissions on portable radios and pagers	Inside the Fire station
New York State DOT	Multi-voltage ballasts for florescent lighting	VHF Lowband	Noise, Loss of coverage, garbled transmissions impacting portables, mobiles and base receivers.	Within 50 yards of facility
State of California	Indoor and outdoor lighting- When magnetic ballasts in florescent lights were changed to electronic ballasts; also worsened when LED lighting tried.	VHF Lowband	High noise on Low-band increased; loss of coverage. Impacts portables, mobiles and base receivers.	Station parking lots and garages
Oregon DOT	LED traffic lights; an LED flashlight next to portable radio	VHF	Loss of coverage to mobiles and portables; also to consumer FM car radios	Within 50-75 feet of LED traffic lights. Within about 14 inches of LED flashlight
Industry Canada	Electronic ballasts for florescent lights in nearby store	800 MHz cellular band	Broadband noise 20 MHz wide caused loss of coverage/dropped cellular calls	Within 2 km
P3 Communications	LED billboards. Have performed many interference investigations for cellular carriers	700 MHz cellular band	Increased noise for cellular base stations	Within a few hundred yards

Survey Respondent	Interference Cause	Band(s) Affected	How Affected	Impact Area
Government of Quebec, Canada	Found 15 locations in City with interference cause by lighting.	VHF	Loss of coverage, noise and garbled transmissions on portables and mobiles	Within 250 meters but distance varies
Tenafly Fire Dept. (New York)	High efficiency interior lighting; also some new FAA tower lighting	VHF Lowband; 700/800 MHz	20 dB increase in noise floor	Not specified
Consultant	LED Lighting inside Sheriff's Department Mobile Communications van	HF (1.8-30 MHz); VHF Lowband; VHF	Loss of coverage, noise and garbled transmissions on portables, mobiles and base stations.	Mostly inside mobile communications van
Sprint	Ballasts, jewelry store display window lighting, ceramic metal halide lights with integrated ballasts	800 MHz cellular uplinks	Loss of coverage, noise and garbled transmissions	Within ¼ mile
Warren County	LED blue lights on vehicle with internal switching power supply	VHF	Pulsing and buzzing noise in portable and mobile radios when LED lights flashing	10 foot radius around vehicle
Ontario, Canada Ministry of Health	Electronic ballasts installed at ambulance base facilities (400 such base facilities in the Province of Ontario)	VHF	Loss of coverage, noise and garbled transmissions on land mobile base receivers and paging base receivers	Within 75 feet; affects any ambulance parked at its base facility
Summit County, Ohio-Coventry Fire Station	High Efficiency Lighting ballasts installed in Fire station	800 MHz	Loss of coverage with portable radios	Within approx. 15 feet of each defective ballast
KITTCOM - Kittilas County, Washington 911	Installation of florescent fixture in fire station. Fixture, purchased from bigbox hardware store was imported and found not to be FCC certified.	VHF	Loss of coverage, noise and garbled transmissions on portables, mobiles and pagers	Within same room of same building
US Coast Guard Auxiliary	LED and Florescent lighting inside and outside building	VHF; UHF; 700/800 MHz	Locks up radio systems in scan or trunked mode; impact to portable, mobile and base stations.	Since it locks down system in scan or trunked mode, impact is to wide area.

Survey Respondent	Interference Cause	Band(s) Affected	How Affected	Impact Area
Washington Dept. of Natural Resources	LED overhead lighting in a mobile shop repair vehicle	VHF	Noise on channel impacted troubleshooting and repair	Within the mobile repair vehicle
Town of Bennington Rescue Squad	TBD if interference is caused by the LED emergency lights, interior Fluorescent lighting, or radio equipment issues from Narrowbanding	VHF	Loss of coverage, noise; garbled transmissions. Impact to portables, mobiles, base receivers an dispatch locations.	
Texas DOT	LED red lights on tower beacon when flashing	VHF	Loss of coverage, noise; garbled transmissions. Impact to portables, mobiles,	Within 20 feet from antenna tower
County of Westchester, NY	LED street lights	Below 30 MHz	Noise on mobile radios	Within 150 feet of LED lights. Lights are 20 feet overhead.
United Radio Communications, Inc.	Residential LED lamps	VHF Low band, HF amateur bands and FC broadcast band	Noise on portable radios	Within 15 feet

As shown, the interference cases reported span across multiple bands and situations, with the VHF and VHF Lowband most often mentioned. In some cases, questionnaire respondents provided additional information not shown in the chart above concerning the manufacturer of the interfering devices. That additional information shows that offending high efficiency lighting devices emanate from multiple manufacturers, i.e., no one manufacturer is at fault. The results of the questionnaire indicate that while not yet large in number, interference from high efficiency lighting appears to be a growing problem.

Recommendations

While cases of interference to communications from energy-efficient lighting is not yet at epidemic proportions, NPSTC believes additional attention should be paid to the issue. NPSTC expects the instances of interference to expand going forward as building codes and interests in saving energy further increase the pressure to deploy energy-efficient lighting. For example, section R404.1 of the 2012 International Energy Conservation Code (IECC) requires that "a minimum of 75 percent of the lamps in permanently installed lighting fixtures shall be high-efficacy lamps." The percentage has been raised from 50% in the 2009 code.[2]

The code defines a high-efficiency lamp as either:

- A compact fluorescent lamp (CFL);
- A T8 or smaller linear fluorescent lamp; or
- Any lamp meeting the following minimum efficiency requirements: 60 lumens per watt for lamps over 40 watts, 50 lumens per watt for lamps over 15 watts but no more than 40 watts, and 40 lumens per watt for lamps rated at 15 watts or less.

[2] See http://www.greenbuildingadvisor.com/blogs/dept/musings/overview-2012-energy-code

This definition excludes incandescent light bulbs. While LED lighting accounted for only about 2% of the commercial market share in 2011, it is expected to climb to 52% over the next ten years.[3] Energy-efficient lighting is an integral element of energy conservation programs with public benefits, however, steps need to be taken to minimize the risk of interference from such lighting devices and systems.

NPSTC notes that the FCC equipment certification standards were developed long before energy-efficient lighting equipment became popular. NPSTC understands there is some uncertainty in the industry whether new energy-efficient lighting equipment must meet the emission limits of Part 15 of the FCC rules or the limits in Part 18 of the rules. Further, given the interference from energy-efficient lighting is a relatively recent phenomena, there may be some confusion about the device limits required to prevent such interference.

There has been some regulatory activity regarding interference from high-efficiency lighting. For example, in 2013 and 2014, the FCC investigated interference to a Verizon 700 MHz network in Los Angeles. The source of the interference was found to be electronic ballasts in the florescent lighting at a nearby 41-story office tower.[4] Also, the FCC Office of Engineering and Technology Laboratory Division periodically issues "Knowledge Data Base (KDB)" publications which are aimed at clarifying issues for which there has been industry questions or confusion. In August 2014, the FCC Lab issued a draft publication which notes some instances of interference from electronic ballasts and LED lighting have occurred. That draft publication addresses testing procedures for those devices.[5] As of June 2015, this publication is still pending in draft form and has not yet been published in final.

Any FCC rulemaking action normally entails a multiyear process. Therefore, NPSTC recommends the FCC open a proceeding to address these and other issues surrounding energy-efficient lighting. NPSTC recommends that this issue be examined with the goal of preventing interference rather than having to resolve it after the fact once high efficiency lighting devices are deployed in the field.[6] That implies better adherence to FCC certification standards and/or more rigorous standards than those currently in the rules. Given some responses to the NPSTC questionnaire from Canada, similar attention by Industry Canada may also be needed.

In addition to design, certification and testing of energy-efficient lighting, installation techniques, especially in commercial and industrial lighting installations, may also impact the risk of interference. NPSTC notes the need for best practices for the procurement and installation of these systems.

[3] Executive Summary: Energy Efficient Lighting for Commercial Markets, Pike Research, Published 4Q 2011. http://www.navigantresearch.com/wp-content/uploads/2011/11/EEL-11-Executive-Summary.pdf

[4] LA Building's Lights Interfere with Cellular Network, FCC Says, PC World, February 7, 2014. http://www.pcworld.com/article/2095940/la-buildings-lights-interfere-with-cellular-network-fcc-says.html

[5] Federal Communications Commission, Office of Engineering and Technology, Draft Laboratory Division Publication: RF Lighting Products Must Meet All FCC Standards to Mitigate Potential Harmful Interference to Radio Services, Publication number 640677, August 27, 2014.

[6] NPSTC notes plans are underway to close some of the FCC's Enforcement Bureau Field Offices. At the time of this report, the extent of the closures appears to be less than originally planned, however, NPSTC believes it is still smart to take the necessary measures to help prevent interference at the outset.

Appendix A

NPSTC Questionnaire Re RF Interference from Energy-Efficient Lighting

1. Have you experienced any cases of interference to your public safety radio system caused by energy-efficient lighting?

( ) YES - please continue to the next question
( ) NO - there is no need for you to continue with the survey

2. Agency Name: _____

3. Name of person completing this survey: _____

4. Please provide your email address so we may contact you if we need further information:
_____

5. Please provide a general description of the problem. Tell us when you first noticed the interference and to what extent the interference impacted public safety operations.

COMMENT: _____

6. What type of interference did your agency receive?
( ) Loss of coverage (mobile or portable radio could not receive)
( ) Noise on channel (radios received interference signals)
( ) Garbled transmissions (user voices are mixed with interference noise)
( ) Other: _____

7. Did the interference cause problems for:
( ) Portable radios
( ) Mobile radios
( ) Base station Radios or Satellite Receivers?
( ) Dispatcher consoles

8. In which frequency bands did you notice the interference?

[Check all that apply]

( ) VHF Low Band
( ) VHF 147-174 MHz
( ) UHF 450-512 MHz
( ) 700/800 MHz
( ) Other: _____

9. How did you determine that energy-efficient lighting was the cause of the interference?

COMMENT: _____

10. What was the energy-efficient lighting source?

( ) External Building Lights
( ) Internal Building Lights
( ) Tower Lighting
( ) Other _____

11. How close in distance were the radios/equipment receiving interference to the energy-efficient light sources? (i.e., was the interference wide spread or localized to a single/individual first responder portable or mobile radio near the LED lighting source?)

COMMENT: _____

12. Please explain what steps were taken to resolve the interference?

COMMENT: _____

13. Did you successfully resolve the interference problem?
( ) Yes
( ) No

14. Please provide any information on the energy-efficient lighting equipment involved. (Please list manufacturer, model number, or other information that would help identify the device)

COMMENT: _____