

12 February 2010

VIA EMAIL

Kate Buck
ICF InternationalAlex Baker
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Office of Air and Radiation
United States Environmental Protection Agency
Washington, DC 201460

Re: Proposal for Amending the ENERGY STAR Program Requirements for Integral LED Lamps

Dear Ms. Buck:

This letter is in response to the letter of 22 January 2010 from the Office of Air and Radiation of the United States Environmental Protection Agency and, more specifically, the invitation for comments to the Proposal for Amending the ENERGY STAR Program Requirements for Integral LED Lamps to reduce the LED operating frequency from 150 Hz to 120 Hz (hereinafter “the proposed amendment”).

The current Energy Star requirement sets the minimum operating frequency for LED replacement lamps at 150 Hz. The proposed amendment would change this requirement to 120 Hz. The operating frequency results in a flicker of the light emitted by LEDs. LSG believes that the current 150 Hz requirement for LED replacement bulbs is a reasonably safe standard. The lower frequency ranges have not been sufficiently investigated with regard to adverse biologic response and thus the change could adversely affect human health and safety.

LSG is deeply concerned about the proposed amendment and that it is being considered (a) without due regard for the presently available scientific and medical evidence and (b) without due consideration and investigation. In addition to the potential adverse biological effects, encouraging the introduction of less than ideal products may serve to inhibit the adoption of what is otherwise important energy saving and environmentally safe products.

Biologic Concerns

A light flickering at 120 Hz is not generally noticeable to the human eye (Canadian Centre for Occupational Health and Safety). Nonetheless, this flickering is perceived by the brain, and could have

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negative effects on people who suffer from photosensitive diseases like epilepsy, amongst others. It is well established that people with certain medical conditions such as epilepsy have a heightened sensitivity to photopic stimuli that the average person does not (Canadian Centre for Occupational Health and Safety).

Sadly, epilepsy afflicts about 2.5 million Americans (Centers for Disease Control and Prevention) and epileptic seizures are a grave concern for nearly 50 million people in the world (World Health Organization). In a study of brain responses due to flickering of up to 150 Hz, brain activity prior to a seizure in epileptic patients showed “a fivefold increase in the 80-120 Hz portion of the spectrum” (Fisher et al). These frequency responses were distinctive because they were “localized to the region of the seizure focus” (Fisher et al). We believe that some headroom above the noticeable threshold for onset is required to ensure that ENERGY STAR LED integral lamps do not create a widely distributed public hazard.

Though consciously unrecognizable to the eye, certain frequencies will cause an epilepsy patient’s brain to fire abnormally, starting a seizure (Epilepsy Foundation). In fact, seizures can occur even if the patient has their eyes shut. Stimulation of the human brain showed amplitude enhancement at 10, 20, 40, and 80 Hz (Herrmann), indicating that neural oscillators respond more strongly at these resonant frequencies. This research only tested frequencies up to 100 Hz and therefore the frequency range above 100 Hz should be more fully explored.

There is also inconclusive, but suggestive evidence about how flicker frequencies in the 120 Hz range will affect other conditions. Humans suffering from medical conditions such as lupus, Meneire’s disease, Cogan’s syndrome, urticaria, and generalized eye strain may be adversely affected by flicker frequencies below 150 Hz. (Scientific Committee on Emerging and Newly Identified Health Risks, Gluth et al, New Zealand Dermatological Society Inc., Wilkins et al). Medical conditions such as eye strain (asthenopia) may exhibit further negative consequences, including migraines, vertigo, nausea, dizziness, and chronic fatigue syndrome (Mayo Clinic, Australian Government) when exposed to certain frequencies of light.

Taking into consideration the health and safety of the general population, until there are more conclusive studies establishing that 120 Hz is a safe alternative to higher operating frequency lighting, we believe that the proposed amendment is not prudent.

Technological Concerns

It has been our experience that high quality, cost effective, energy efficient LED integral lamps operating at 150 Hz or above are within the state of the art for LED lighting technology. We believe that the cost and design implications of maintaining the 150 Hz operating frequency standard for ENERGY STAR certification are not now, nor will they be, prohibitive to the adoption of LED technology for lighting, even in market segments as cost constrained as integral lamps. We presently consider operating and flicker frequencies below 150 Hz to represent an unnecessary technological compromise that results in a potentially inferior product. Setting the operating frequency requirement for ENERGY STAR below 150 Hz will encourage inferior products and discourage efforts to reach the full potential of solid state lighting.

Longevity is one of the major concerns for LED lighting products because the economics of adoption require the product to last at least 50,000 hours. The thermal time constant of many LED die/package combinations is on the order of 8 ms and therefore a 100% modulation of energy at 120 Hz could potentially decrease the lifetime of LEDs. In particular, strictly AC driven products have shown significant failure rates in the marketplace due to a lack of transient absorption capability as per IEEE

standard C62.41.1-2002. It should be noted that such decreased lifetime will be a complete loss of light, not merely a tolerable and expected reduction or depreciation of lumen output. Accelerated lifetime testing may not be exemplary of real world conditions and thus should not be relied on exclusively to establish product longevity. The failure of products to live up to their lifetime expectation will result in poor market response, one of the factors that has hindered and continues to hinder the adoption of CFL technology.

We believe that more work needs to be done to determine whether lower operating frequencies are suitable technically and we are committed to such work and have active research and development projects underway. However, the need and desirability for such further work should not influence a change to the standard for ENERGY STAR certification.

Conclusion

The possible exclusion of any given product from qualifying for ENERGY STAR certification should not be a principal concern of a standard. Further, the 150 Hz minimum operating frequency requirement was established after due consideration and comment and thus manufacturers interested in qualifying for ENERGY STAR certification had due notice of the requirement.

As innovators of LED lighting technology, safety and environmental sensitivity are top priorities for Lighting Science Group Corporation. The proposed amendment is, we believe, inconsistent with those priorities. The ENERGY STAR requirements should ensure that the qualifying products are of the highest standard and not merely a convenient standard.

Thank you for your attention to this matter and the opportunity to comment. Please do not hesitate to contact me if we can be of any assistance in this matter.

Respectfully submitted,

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Fred Maxik*
Chief Scientific Officer

*Fred Maxik is the founder of one of the predecessors to Lighting Science Group Corporation and is presently the Chief Scientific Officer of Lighting Science Group Corporation. Mr. Maxik has a BA in physics and philosophy and an honorary PhD in physics.

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