Medical Hypotheses 116 (2018) 33–39

Contents lists available at ScienceDirect

Medical Hypotheses

journal homepage: www.elsevier.com/locate/mehy

The electronics in fluorescent bulbs and light emitting diodes (LED), rather than ultraviolet radiation, cause increased malignant melanoma incidence in indoor office workers and tanning bed users

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ABSTRACT

The epidemiology of cutaneous malignant melanoma (CMM) has a number of facets that do not fit with sunlight and ultraviolet light as the primary etiologic agents. Indoor workers have higher incidence and mortality rates of CMM than outdoor workers; CMM occurs in body locations never exposed to sunlight; CMM incidence is increasing in spite of use of UV blocking agents and small changes in solar radiation.

Installation of two new fluorescent lights in the milking parlor holding area of a Minnesota dairy farm in 2015 caused an immediate drop in milk production. This lead to measurement of body amperage in humans exposed to modern non-incandescent lighting. People exposed to old and new fluorescent lights, light emitting diodes (LED) and compact fluorescent lights (CFL) had body amperage levels above those considered carcinogenic. We hypothesize that modern electric lighting is a significant health hazard, a carcinogen, and is causing increasing CMM incidence in indoor office workers and tanning bed users. These lights generate dirty electricity (high frequency voltage transients), radio frequency (RF) radiation, and increase body amperage, all of which have been shown to be carcinogenic. This could explain the failure of ultraviolet blockers to stem the malignant melanoma pandemic. Tanning beds and non-incandescent lighting could be made safe by incorporating a grounded Faraday cage which allows passage of ultraviolet and visible light frequencies and blocks other frequencies. Modern electric lighting should be fabricated to be electrically clean.

Background

In June 2015, recently deceased Prof. Martin Graham, emeritus professor of electrical engineering at University of California, Berkeley, discovered that an off-the-shelf Fluke 187 multi-meter, could measure amperage (current) in the body. He sent us meters and instructions on how to use them. Surprisingly, a review of the English body current literature indicated that this was the first direct measurement of human body amperage (I) which had been previously calculated from voltage (V) and resistance (R) using Ohm's law (V = I/R). The meter was used to measure contact current in a woman complaining of illness in her shower [1]. Studying the relationship between measured electromagnetic fields and body amperage in high electromagnetic field environments, showed that ground current and old and new non-incandescent lighting were major sources of elevated human body amperage [2].

In the 1970s, with increasing non-linear loads being added to the electric grid, the US electric utilities began using the earth as a primary neutral return to their substations, in spite of the fact that US National Electric Safety Code Rule 92 D prohibits this. The first to notice the effects of increasing ground current levels were dairy farmers. The effect of electric power quality and ground currents on health and milk production in dairy cattle has been studied by one of us [3]. After that study, some of the original twelve study farms continued to monitor power quality on a real time basis with an oscilloscope connected to two 16 inch square metallic plates which were grouted into the milking parlor floor 1.5 m apart during the original study. In July 2015, milk production dropped suddenly with deteriorating monitored power quality at one of the study farms. The problem was traced to two new recently installed four foot, six lamp, T 8 fluorescent lights. The new lights were different from the older lights in that they contained modern electronic ballasts. The lamps caused an increase in the voltage measured in the milking parlor floor, and an increase in dirty electricity (high frequency voltage transients) in barn wiring. Turning the lights off restored milk production. These lights were studied electrically on site and removed and replaced with two LED lights designed to be

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https://doi.org/10.1016/j.mehy.2018.04.013
Received 29 January 2018; Accepted 16 April 2018

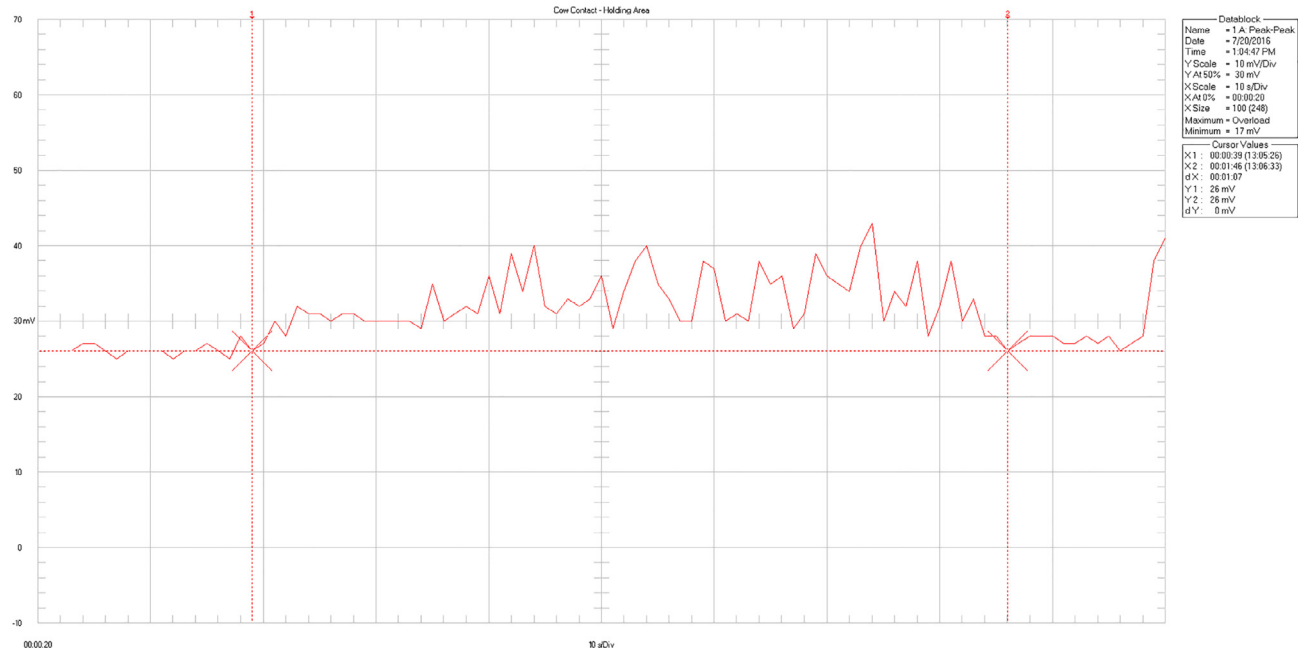

Fig. 1. The data plot was collected at the Terrance Pfaff farm near Harmony, MN using a Fluke 190–202 Scopemeter. Channel A was connected at cow contact, per MN Study. The area between cursors represents when two 4-foot, 6-lamp T8 fluorescent lights in the holding area were turned on.

electrically clean by adding tuned filters. Replacing the new fluorescent lights which caused the drop in milk production with two light emitting diode (LED) lamps fabricated to prevent radio frequency (RF) emission and dirty electricity, permanently restored milk production to levels seen before July 2015.

Hypothesis

The knowledge that new fluorescent lights caused a drop in milk production in dairy cattle, the preliminary finding that human body amperage was increased by exposure to non-incandescent lighting, the reports that indoor office workers [4] had higher malignant melanoma incidence rates than outdoor workers in spite of lower ultraviolet (UV) exposure, and that tanning bed users had increased malignant melanoma incidence [5], lead us to hypothesize that it was the bulb electronics not the UV and sunlight which caused malignant melanoma. As early as 1982 malignant melanoma was associated with exposure to fluorescent lighting at work in offices in Australia [6].

Methods

We studied the nature of the electrical exposure of dairy cattle causing the drop in milk production, and the nature of the electrical lighting exposure of tanning bed users, indoor workers and the general population.

A Fluke 190–202 two channel oscilloscope was used to record wave forms in wiring and air, a Graham Stetzer Microsurge meter was used to measure dirty electricity in electrical outlets, and a Fluke 187 true RMS (root mean square) multimeter was used to measure current flowing in the bodies of people near the lamp. The Fluke 187 probes were attached to an electrocardiograph patch over the sternum and an outlet ground to measure the current flowing between them. An Aaronia spectrum analyzer and the Fluke oscilloscope were used to determine the electromagnetic spectra of the lamps and an FW Bell tri-axial magnetic field meter was use to measure magnetic fields . An AM (amplitude modulation) portable radio tuned off station was used as an RF detector. This covers the frequency range 535–1605 kHz.

Daily milk production records from the dairy for the month of July 2015 were obtained and analyzed, and their milk production records for the afternoon milking on July 20, 21 and 22, 2016 were also obtained. On July 20, 2016 the problem lights were turned on for 15 min to study their electromagnetic field characteristics on site. The problem lights were also turned on during the July 21 afternoon (convenient for the dairy) milking to test their effect on milk production. One of the lights was removed and studied electrically at Stetzer Electric offices in Blair, Wisconsin and compared to a newly fabricated clean LED light. This LED light contained tuned filters which removed identified specific RF frequencies in the kilohertz range. The prototype LED lights were tested at the Stetzer Electric offices in Blair, Wisconsin and after installation at the dairy farm, replacing the two offending fluorescent lights.

To see whether lighting was impacting humans, a wide variety and large number of non-incandescent electric lights were tested, including compact fluorescent lights, ordinary tube type fluorescent lights, and light emitting diode lights. Lights were tested in Olympia, Washington lighting stores, in a barber shop, in tanning salons and in offices and homes, with a portable AM radio tuned off station to detect lamp RF and with a Fluke 187 to measure body current as above.

Results

Milk production was [31.9 Kg(kilograms)] (70.3 lb) per cow per day before the lights were installed on July 8, 2015 and dropped to 27.5 Kg (60.7 lb) per cow per day on July 9, 2015 after the lights were installed. Milk production during the afternoon milking on July 20, 2016 was 10.3 Kg (22.7 lb) per cow (cows are milked three times a day). On July 21, 2016 the suspect lights were turned on during the afternoon milking, and milk production dropped to 9.1 Kg (20.1 lb) per cow. On July 22, 2016 with the lights turned off, the cows produced 10.6 Kg (23.3 lb) of milk per cow. Averaging the milk production on July 20, 2016 and July 22, 2016 with the lights off [10.4 Kg (23.0 lb)] and comparing it to milk production on July 21, 2016 with the lights on [9.1 Kg (20.1 lb)] showed that the dairy lost 2,170 Kg (4,785 lb) of milk per day with the lights on: [1.3 Kg (2.9 lb) per cow × 3 milkings × 550 cows]. Since only 3 days elapsed in the 2016 testing, age and stage of lactation of the 550 cow herd were not important in milk production. Fig. 1 shows the change in the oscilloscope tracing in the milking parlor floor when the suspect lights were turned on briefly. The voltage

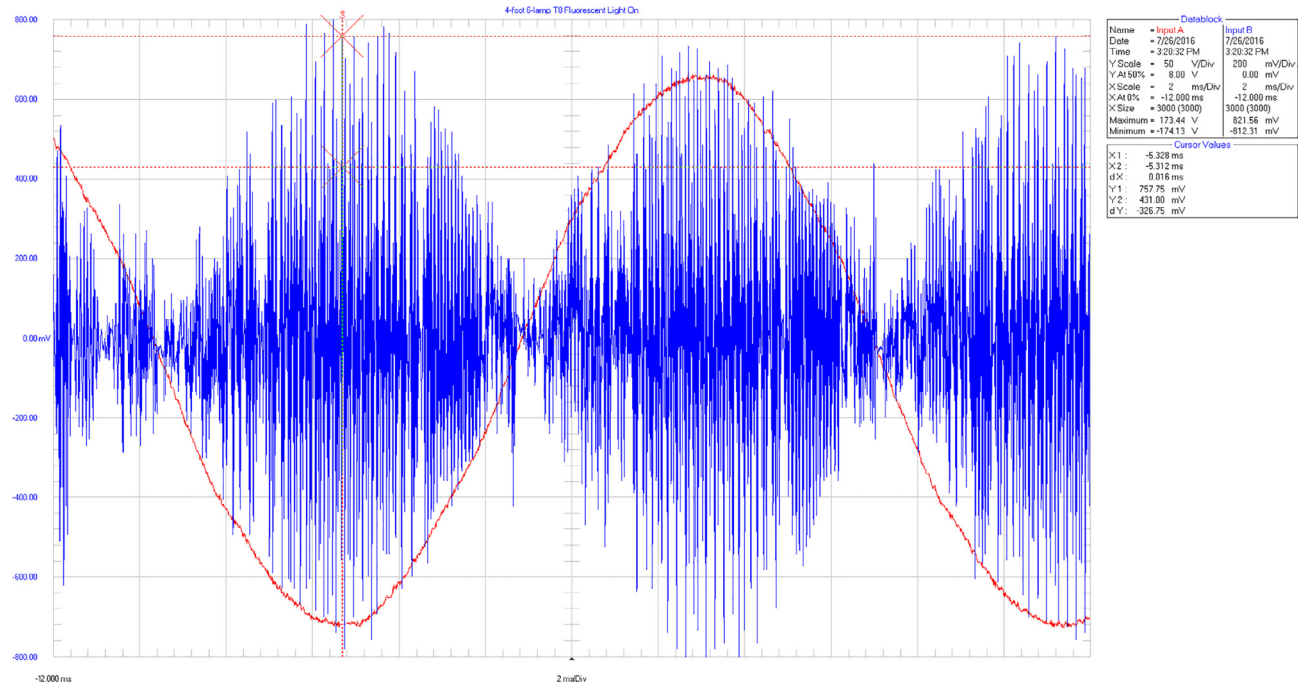

Fig. 2. The waveforms were collected at the Stetzer Electric Offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. Channel B was connected at the same potential, except through the Graham Ubiquitous Filter (removes the 60 cycle). A fluorescent light (from a Minnesota dairy farm) was in use at the time. The area between the cursors represents a frequency of 62.5 kHz.

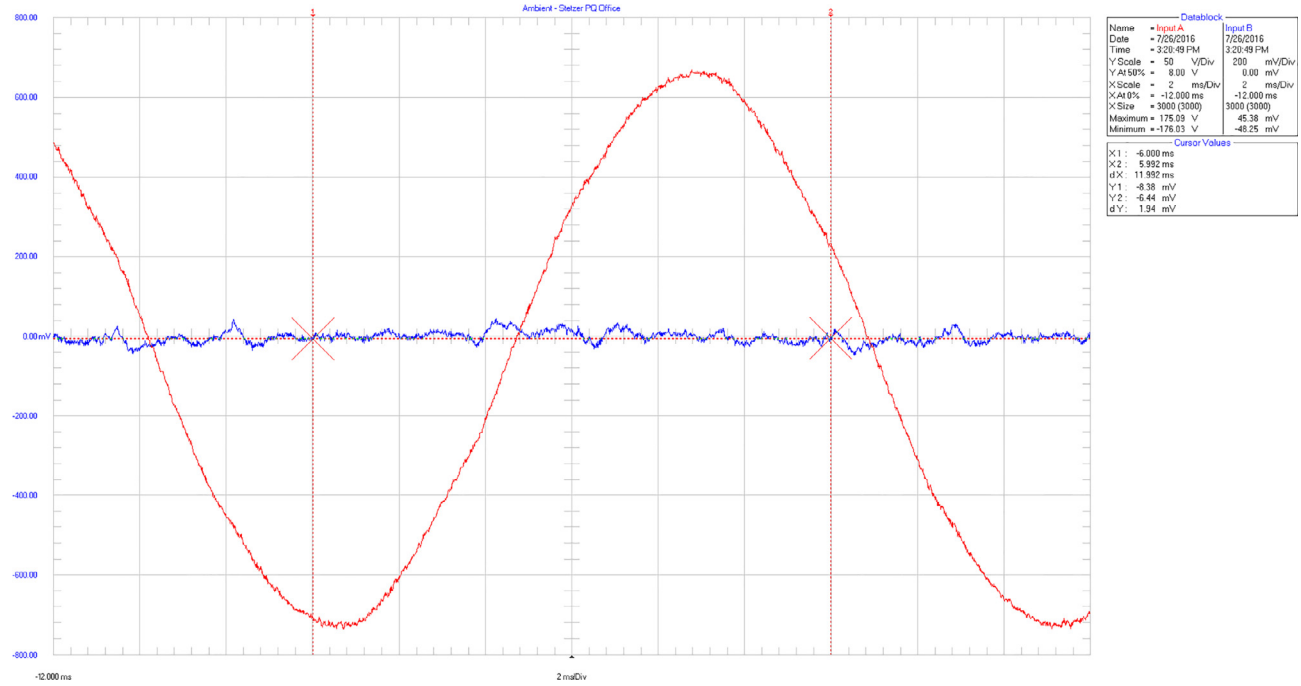

Fig. 3. The waveforms were collected at the Stetzer Electric Offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. Channel B was connected at the same potential, except through the Graham Ubiquitous Filter (removes the 60 cycle). The fluorescent light was turned off at the time.

increased from about 26 mV (millivolts) with the lights off to 42 mV when the lights were turned on. Figs. 2 and 3 show the dirty electricity in office wiring generated by the dairy fluorescent light in a bench test at the Stetzer Electric offices. Fig. 2 is with the light on and Fig. 3 is with the light off. With the light on in Fig. 2 there was 1633.8 mV (peak to peak) of dirty electricity in the outlet wiring. The predominant frequency was 62.5 kHz (kilohertz). In Fig. 3, there was 93.6 mV of dirty electricity with the light off. Figs. 4 and 5 show the dirty electricity in air at 6 feet from the barn lamp with the lamp on and off. The extensive dirty electricity in the oscilloscope tracing measured at 6 feet from the lamp seen in Fig. 4, disappears when the lamp is turned off in Fig. 5.

The newly fabricated LED lights with tuned filters (fabricated to cancel specified frequencies) which replaced the dairy fluorescent lights generated no additional dirty electricity in the wiring or in the air, and induced less than 1 μA (microamperes) (RMS) of current in the body of a person 2 feet from the lights. Before filtering , the dirty electricity was 158 units on a Microsurge meter in office wiring, and the lamp generated 40 μA of current in the body at 2 feet. Fig. 6 shows the dirty

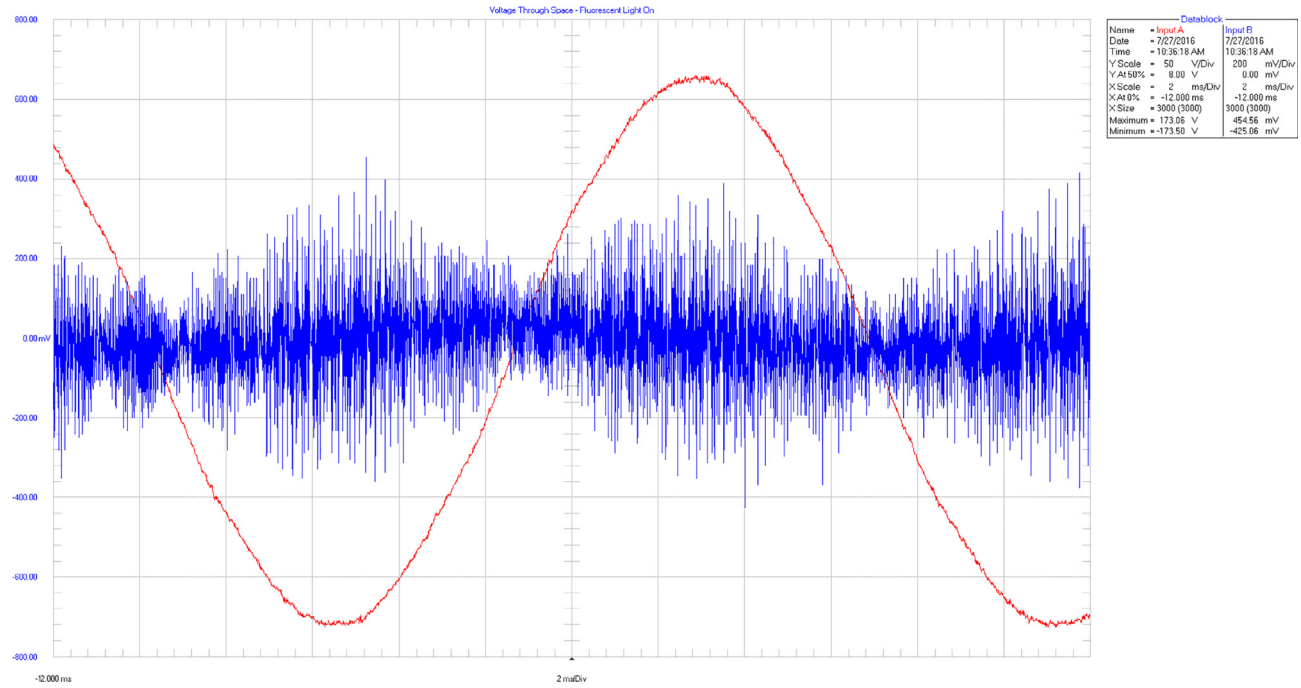

Fig. 4. The waveforms were collected at the Stetzer Electric offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. A collapsible antenna on B Channel was measuring voltage through the air. The 4-foot, 6-lamp T8 fluorescent light was on at the time. Measurements were taken with the scope placed approximately 6 feet from the fluorescent light.

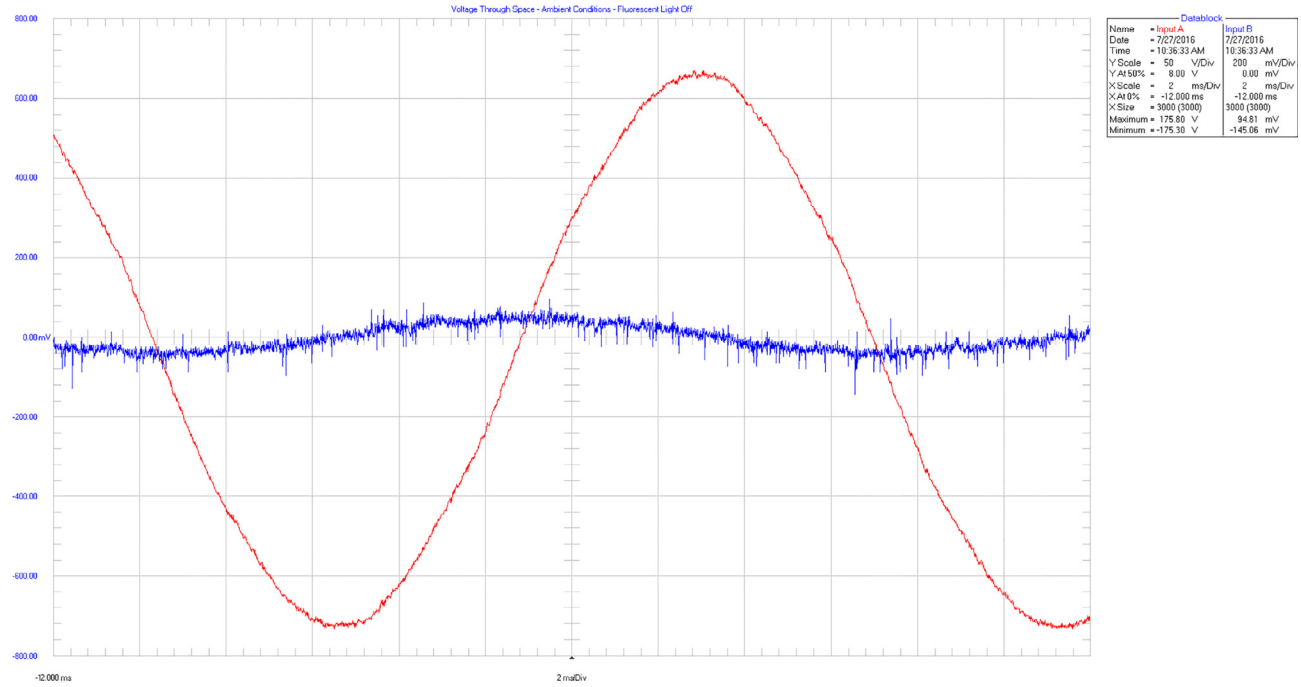

Fig. 5. The waveforms were collected at the Stetzer Electric offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. A collapsible antenna on B Channel was measuring voltage through the air. The 4-foot, 6-lamp T8 fluorescent light was off at the time. Measurements were taken with the scope placed in the same location as when the fluorescent light was turned on.

electricity generated by the new LED without tuned filters, and Fig. 7 shows that the tuned filters have removed the bursts of dirty electricity seen in Fig. 6.

In lighting stores, nearly all the non-incandescent lamps (fluorescent, CFL, and LED) generated significant body amperage. Most lamps generated 10–50 μA at about 5 feet, which was strongly inversely related to distance from the lamp. The desk lamps created the highest body amperage levels because of proximity to the user, and when they were touched for manual adjustment, the body amperage levels were often above 150 μA. A few tested LED lights caused no AM radio interference and generated no increase in body amperage, so there are a few safe modern non-incandescent lights currently available. Nearly all of the non-incandescent lights tested emitted radio frequency radiation, generated dirty electricity (high frequency voltage transients) in wiring and increased current (amperage) in the body of anyone close to the lights.

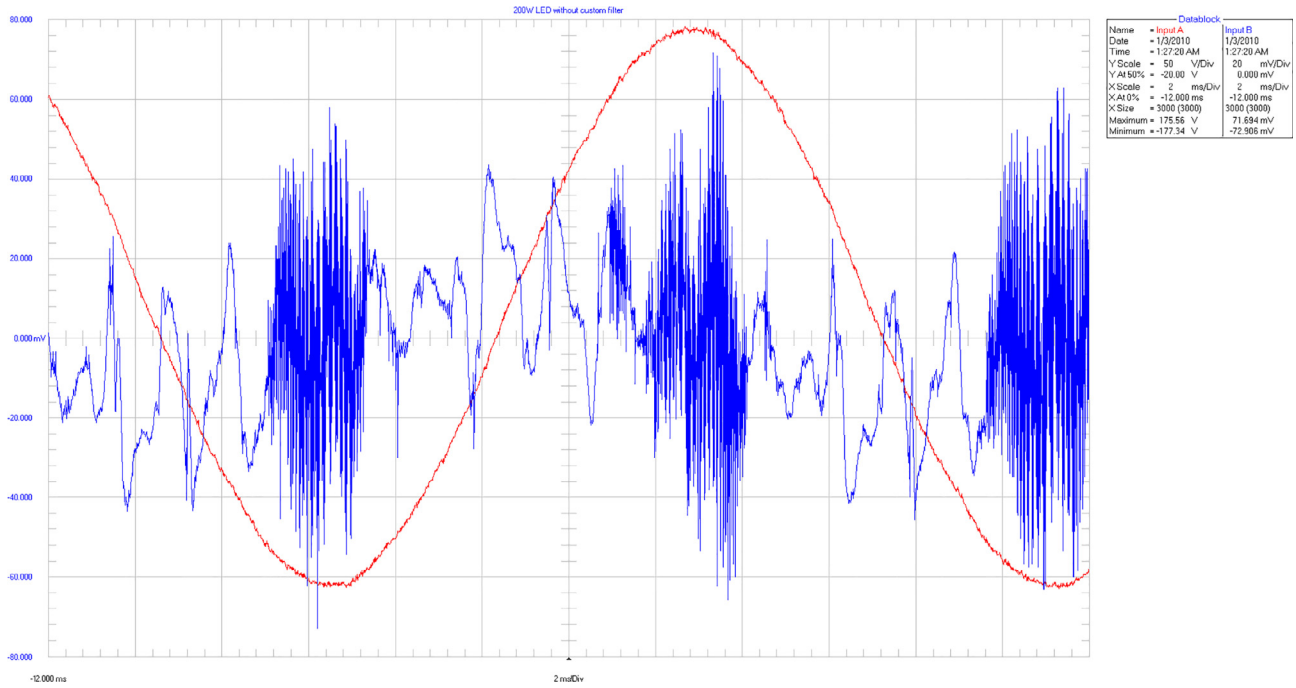

Fig. 6. The waveforms were collected at the Stetzer Electric offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. Channel B was connected at the same potential, except through the Graham Ubiquitous Filter (removes the 60 cycle). A 200 W LED light fixture without custom filter was in use at the time.

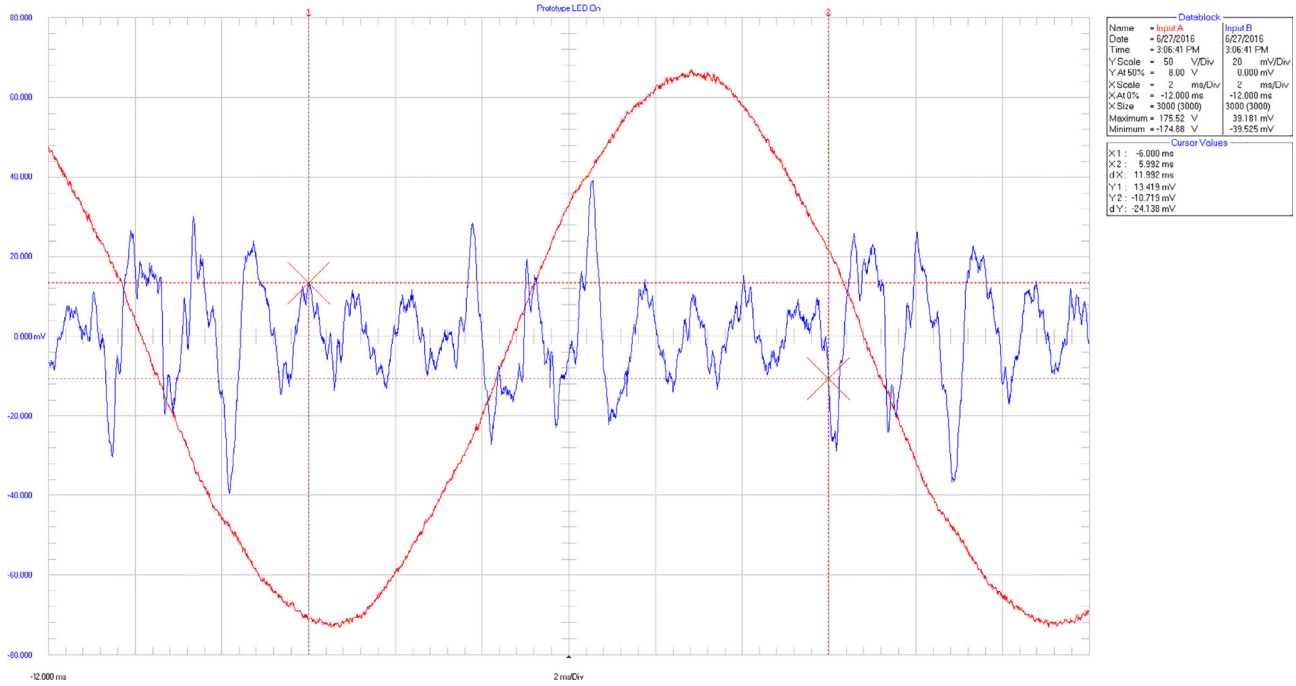

Fig. 7. The waveforms were collected at the Stetzer Electric offices in Blair, WI using a Fluke 190–202 Scopemeter. Channel A was connected to a 120 V receptacle. Channel B was connected at the same potential, except through the Graham Ubiquitous Filter (removes the 60 cycle). The prototype LED light was turned on at the time with the tuned filter. No changes were witnessed in the waveforms as compared to the ambient waveforms.

A clerk seated at the front desk of one of the tanning salons had a body amperage of 65 μA from overhead fluorescent lights about 10 feet away. With an arm raised, the amperage was 85 μA. This was almost as high as 130 μA measured in a in a tanning bed user. Magnetic fields on the tanning beds were about 100 mG (milligauss) at one salon and 230 mG at another salon with newer beds. The magnetic field readings varied across the bed surface, and was higher on the bottom bed surface than the top and higher at the head and fan end of the bed. The beds have fluorescent tubes generating ultraviolet light (UV A and B), cooling fans and motors and lamp electronics close to the users.

At the barbershop, a barber standing at a chair, had between 30 and 40 μA of current in the body with the fluorescent lights on and 1.62 μA with the lights off. One set of lights, which looked the same as the other eight sets induced between 80 and 100 μA.

In a residential bathroom, a 4 foot, 2 bulb fluorescent lamp above a mirror read 2 μA in with the lights off. With the lights on, the meter

read 15 μA while shaving, 25 μA while wiping the mirror and > 100 μA while touching the plastic lamp enclosure. The RF from the fluorescent light and the body amperage it caused could be blocked by a grounded wire screen.

Discussion

By 1951 more light was produced in the United States by fluorescent lamps than by incandescent lamps [7]. The original lamps had magnetic ballasts, which have been replaced by electronic ballasts in newer lamps. The electronic ballasts cause more electrical pollution than the old magnetic ballasts. Most LEDs have inverters or switch mode power supplies in them to convert the AC line voltage to DC. These lamps interrupt current flow and produce dirty electricity which flows into the grid as well as producing RF which travels from the bulb through space like visible light. The intensity of the amperage generated in the body decreases with distance from the lamp, similar to the decreasing intensity of light with distance from the source. The big box stores with lighting on high ceilings have low induced body amperage at floor level. Most offices, schools and stores with flat, low ceilings and fluorescent lighting, generate high body amperage in people in them. What is worrisome, is that the NIEHS (National Institute of Environmental Health Sciences) Working Group 1998, associates chronic exposure to contact currents of 18 μA and above (produces average electric fields in tissue along its path that exceed 1 mV/m) with the development of cancer [8]. This level is exceeded in most of the offices and homes with fluorescent lighting which we measured, In a study of self-reported electro-hypersensitives, headaches were reported far more frequently with exposure to both CFLs and tube type fluorescent lights than to incandescent lighting [9].

In 1973, photobiologist John Ott demonstrated that grounding the RF from fluorescent lights in a windowless Florida school could dramatically improve attention and behavior in students [10]. He essentially created a Faraday cage which grounded the RF from the lamps. The World Health Organization's IARC categorizes RF exposure as a class 2B carcinogen [11], and the National Toxicology Program has shown that cell phone RF radiation is an animal carcinogen [12]. Classroom dirty electricity exposure in teachers at a California school has been correlated with cancer incidence and with a high incidence of malignant melanoma [13].

This study may explain the high cancer and malignant melanoma rates in professors, school teachers and office workers and other indoor office workers who are exposed almost universally to fluorescent lights at work [14]. In fact, none of the 25 male occupations in Washington State (1950–2010) with a significant ($p < 0.05$) CMM mortality excess was primarily an outdoor occupation. None of the outdoor occupations like farmers, gardeners, fishermen or sailors had excess mortality due to CMM. This also explains the well documented increasing malignant melanoma incidence in tanning bed users, and the failure of sunscreens to stem the malignant melanoma pandemic. The concentration of malignant melanomas in the trunk area fits with the induced vertical currents in the body due to radio frequency electromagnetic fields [15]. Man-made electromagnetic fields have been associated with all the so called diseases of civilization including cancers [16] . It would be surprising if malignant melanoma was an exception. We recently reported a cluster (relative risk over 60) of ocular melanoma in young blond women centered at a North Carolina high school near a liquid natural gas storage and pumping station. We found oscilloscope voltage wave forms and spectra in the kilohertz frequencies measured in a transformer down ground wire near the high school were nearly identical to the ground voltage 2.3 miles away at the gas pipeline [17]. We think they originated from variable frequency drives on the compressor motors at the liquid natural gas plant.

Radio frequency exposure causes single and double strand DNA breaks [18], calcium ion efflux from cells [19] and permeability of the blood–brain barrier [20]. We believe that radio frequency radiation and other parts of the electromagnetic spectrum are generalized stressors of electrified populations and are responsible for much human morbidity and mortality [21]. We believe that our findings that bulb electronics, not UV and sunlight, cause malignant melanoma better explain the epidemiology of CMM than the "intermittent UV exposure hypothesis" for indoor workers and skin thickening in outdoor workers.

Tanning beds with fluorescent lights could be made safer by incorporating a grounded Faraday cage which allows passage of ultra violet tanning frequencies while blocking other frequencies, including those in the kilohertz range.

Evaluation of hypothesis

To test this hypothesis, tanning beds with and without grounded Faraday cages which allow passage of UV light and block other electromagnetic frequencies should be tested with a body amperage meter and with animal malignant melanoma models. Incandescent (no internal or external electronics) and fluorescent tanning bulbs of the same UV frequency (wavelength) and intensity should also be tested similarly. Modern non-incandescent lighting of all types should be tested and compared to incandescent lights and lights fabricated to be electrically clean. Case/control and cohort studies of CMM cases focused on lighting exposures should be undertaken.

Consequences of the hypothesis

Since many jurisdictions are outlawing incandescent lighting, a moratorium should be granted until electrically clean lighting is available. A massive retrofit or replacement of existing non-incandescent lighting will be needed to eliminate this problem. New lighting and tanning beds should be designed to be electrically clean.

Conflicts of interest

None.

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