

Environmental Assessment
From an
Electromagnetic (EMF)
Perspective

In a
NYC Taxi Cab

Performed for:
NYC Cab Drivers

Work performed on
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By
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Executive Summary

Individuals who drive NYC Cabs indicated that, due to recent changes in the fleet they lease from, they have been getting predictably recurring headaches and been unable to sleep. They suspected it had something to do with the wireless features. While this was part of the picture, other contributors were found.

Findings

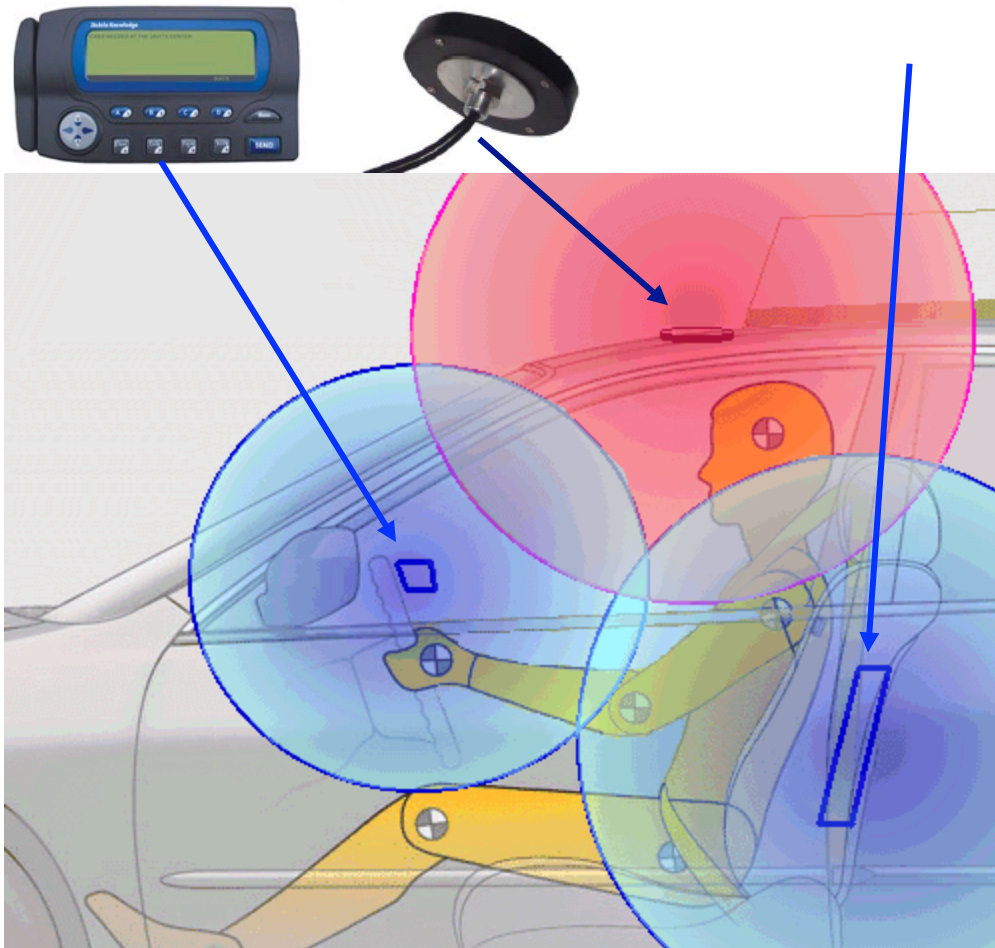
Three new items (*since 2007*) contribute to personal exposure within the cab, in addition to standard electrical systems and wiring.

Below is a perspective of their approximate range of influence and biological interest.

Passenger Information Monitor (PIM)



CMT's Driver Interactive Unit (DIU)



Discussion and Recommendations

With the intent to “*enhance the payment experience*”, so that “*Credit and debit card equipped taxicabs give passengers the same conveniences they already receive at the supermarket, gas pump, online and virtually everywhere.*”, and “*The Passenger Information Monitor (PIM) provides the passenger with real-time mapping to track their journey.*”, “*CMT has partnered with leaders in the media and entertainment industry to provide a unique blend of entertainment, news and advertising, via the PIM in the backseat of every FREEdom Solution taxicab.*” In addition “*CMT's FREEdom solution includes access to FleetNet, CMT's web portal, which allows vehicle or fleet owners to manage and track their vehicle operations. FleetNet also provides the ability for the TLC or the fleet manager to send text messages to driver's in-vehicle terminal.*” **The author contends that Creative Mobile Technologies (and imitators that may follow in their footsteps) outfitting cabs with these digital features is a bad idea.**

Conventionally any gasoline-powered auto produces an Alternating Magnetic Field, whose frequency varies with the speed of the vehicle, from the Alternator, which is a three-phase generator, conceptually just like every power company uses, but rectified to DC. Additional Pulsating Magnetic Fields are provided by DC Motors, when in use. Separately, **Wideband Emissions (many frequencies simultaneously) are produced by the High Voltage Ignition (HVI) System.** These aggregated may be bad enough. What have been added since about mid-2007, are a digital interactive display known as a Driver Interactive Unit and a digital interactive display known as a Passenger Information Monitor. Both are pictured in the previous page, and **both are Wideband Emission sources**, now brought within easy reach of the driver and passenger(s). The last item of interest is a **multi-band Antenna that uses GPS to determine its position, and Cellular/PCS communications to constantly update its position in a Fleet Management System**. The latter is located immediately above the driver's head on the exterior of the cab. While this was done for convenience of the installer, there are other serious considerations that make this specific location especially troublesome.

Radio Frequency (RF) transmitting antennas produce peculiar energetic behavior in their immediate proximity in order to force Electromagnetic (EM) energy to travel in free space. That is because the electronics' internal impedance (*characteristically around 50 Ohms*) is different that that of free space (377 Ohms). The impedance mismatch causes standing waves (*as in a small circular pond when a pebble is dropped in the middle*) immediately near the antenna for a distance of about three (3) wavelengths from the antenna. This is known as the Near Region. Within the Near Region complex interactions occur between the Electric and Magnetic fields, and measurement is nearly impossible due to the convective currents produced in anything metallic or conductive, associated with the measurement equipment, or the exposed structure under study, resulting in exposure to usually be a calculation estimate. These local echoes cause peaks and nulls that are not predictable, and change dynamically depending on the position of anything

conductive and mobile within this region of influence, be it a human or other conductive structure. While human skin is generally a good insulator to Electric fields, it is not to Magnetic fields, so within the Near Region the interaction is not just superficial or reliably predictable. A portion of the energy echoing back and forth escapes the Near Region and begins to travel freely in free space in the Far Region. For everyone on the planet the exposure is mostly in the Far Region. For those who use cellular or other transmitters near them there is the additional exposure in the Near Region. The regions are distinguished by the wavelength of the frequency in use. In the case of the CMT multi-band antenna, reception in the GPS frequencies occurs at 1575.42 ± 2 MHz and is not a Near Region exposure concern from this antenna as it is receive only. For Cellular / PCS it is at 806-960 / 1710-2170 MHz. The wavelength for 1 GHz (1000 MHz) is about 1 foot (12 inches, or about 30 cm). Three wavelength's radius would define a region within three feet or about one meter from the antenna as the Near Region. The wavelength for 2 GHz (2000 MHz) is about 6 inches (about 15 cm). Three wavelength's radius at this frequency would define a region within about 18 inches or about 50 cm from the antenna as the Near Region. **The present installation of the antenna is directly above the driver's head.** Although it is outside the cab, the window is transparent, placing the driver's head immediately within the Near Region. Realizing that the driver cannot be relocated, **this is the worst possible placement for the antenna. This may be compounded by RF leakage from the electronics near the operator controls.** A much better location would have been on the roof above the rear seat, on the passenger side. **Drivers have already complained of recurring headaches, indicating that negative, and possibly damaging, biological interaction has been going on for some time.** Their exposure is typically 8 to 12 hours a day.

Early stages of disease can manifest themselves as irritation that persists during exposure to an irritant. Moving away from the irritant, discomfort stops and the body is able to recover. If the body cannot recover during the time away, then additional and similar irritants may be at work, and /or a trigger mechanism may be established that can cause irreversible damage.

One of the functions of the central nervous system occurs with Electromagnetic (EM) messaging named "Action Potential". This is a pulse train that travels to and from organs and appendages for indication and control. Interference with this type of messaging can bring on discomfort or pain. **Wideband Emissions can** mimic these signals and **cause irritation that may be local or systemic, depending on the frequencies, the extent of exposure, and the strength of the emissions.** A casual sweep near the Passenger Information Monitor and the Driver Interactive Unit indicated them both to be wideband emitters. **These emissions have sharp rise and fall times, allowing them to easily penetrate the skin boundary and propagate through the central nervous system** using the same concept utilized in Transcutaneous Electrical Nerve Stimulation (TENS, *used by athletes and sports medicine doctors to alleviate pain*) and TASER units (*used by law enforcement units to inflict pain or immobilize individuals*). While a controlled use such

as in a TENS unit can alleviate pain, uncontrolled exposure such as that from the cabs' newest electronics fall within the description of TASER exposure.

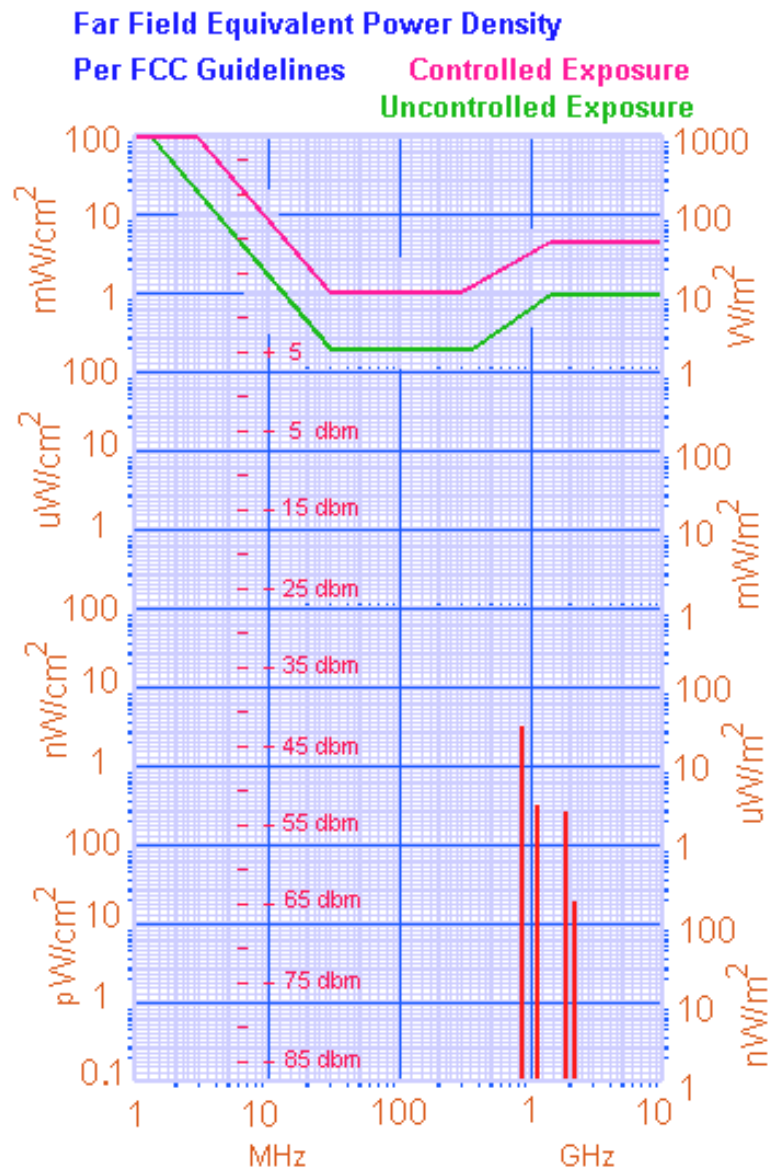
The exposure level of the RF emissions was below the Thermal guidelines used by the FCC, which “limits, and the NCRP and ANSI/IEEE limits on which they are based, are derived from exposure criteria quantified in terms of specific absorption rate (SAR). The basis for these limits is a whole-body averaged SAR threshold level of 4 watts per kilogram (4 W/kg), as averaged over the entire mass of the body, above which expert organizations have determined that potentially hazardous exposures may occur.” [oet65, p8]

“Another feature of the exposure guidelines is that exposures . . . may be averaged over . . . time with the average not to exceed the limit for continuous exposure.” [oet65, p10] **This implies that momentary exposure, as from digital emissions, can be substantially higher than the exposure guidelines, as long as the average is below them.**

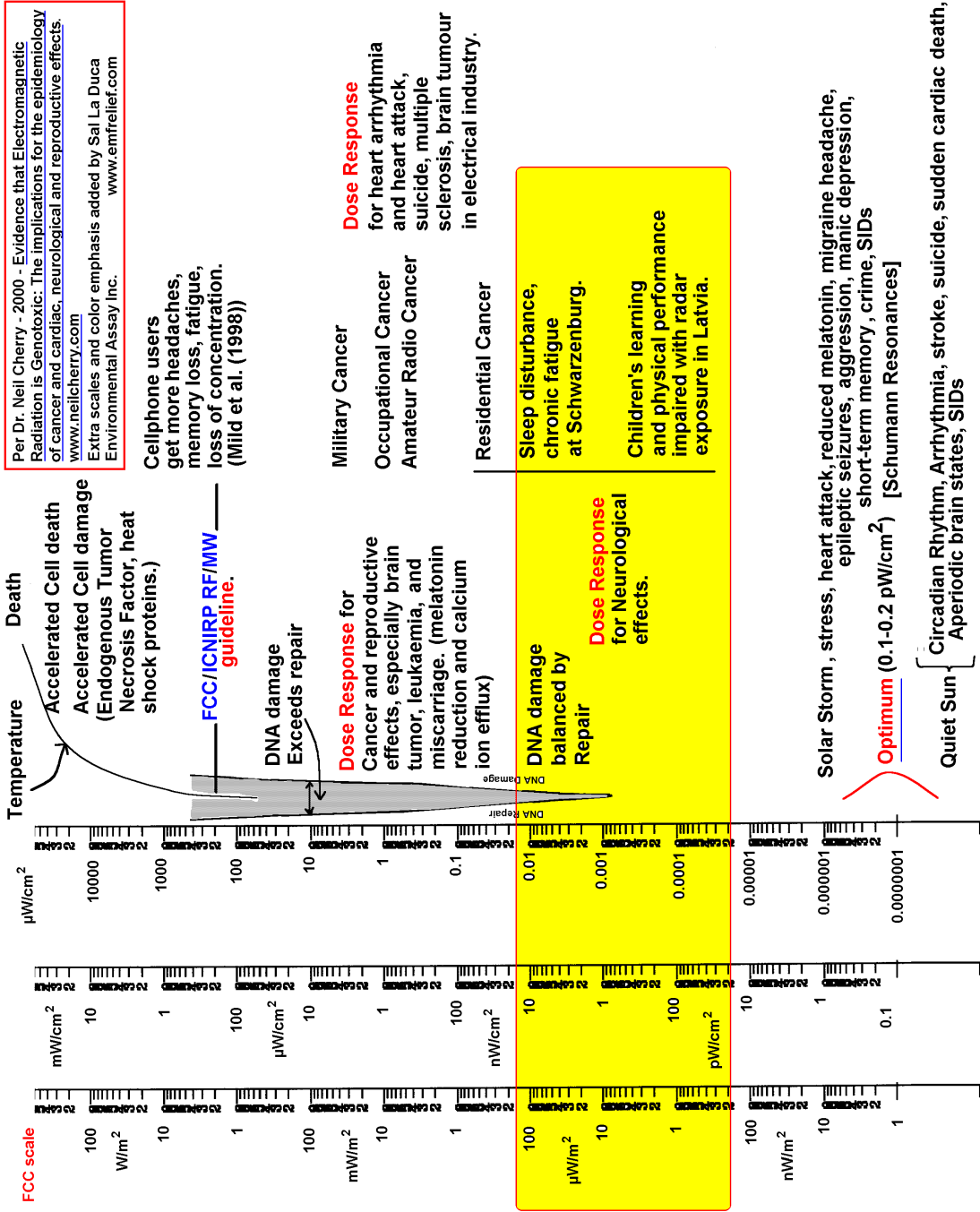
Both of the above criteria are based on short-term effects.

Shown to the right are the approximate Frequencies (horizontal axis) and intensities (vertical axis) detected, with different units on right and left for ease of conversion. They are well below the recommended exposure limits shown near the top of the graph. **There is a good chance of significant RF leakage from the operator controls, as measurement inside and outside the cab did not vary in intensity.**

Based on these recommendations there is no exposure concern, because flesh does not get warm beyond the body's ability to control temperature. Since it doesn't “cook”, everything's OK . . .



However, **behavioral responses occur below the Thermal guidelines**, although these are not technically defined as bad, nor actionable. Below is a sketch from “*Evidence that Electromagnetic Radiation is Genotoxic: The implications for the epidemiology of cancer and cardiac, neurological and reproductive effects – Dr Neil Cherry, June 2000*” with the general area of detected emissions highlighted in yellow.



The exposure concerns for wideband emissions are much more difficult to quantify. That is because most exposure criteria are based on emissions of single frequency, constant level / intensity, or both. Wideband emissions do not fit either category, and subsequently there are no exposure guidelines.

Wideband Emissions characteristically sweep through a portion of the frequency spectrum generating many discrete frequencies simultaneously. Lightning is a typical example. High Voltage Ignition Systems is another. Digital Displays are yet another. [The observed effects of radio-frequency electromagnetic radiation on biological systems seem to depend more on a differential rate of energy deposition than is the case with ionizing radiation where biological effects are related more to energy and integral (*time independent*) quantities, such as absorbed dose [NCRP report# 67, 3-1981 - intro, p2]. **The sharper the digital “edge”, the higher the differential rate of energy deposition (*this author’s comment*).** With a simple AM radio you can detect the crackle during lightning. If the AM radio could be made to listen to all frequencies simultaneously, then it could be noted that there are emissions at most frequencies throughout the portion of the spectrum that the unit can detect. **Digital displays of any type will emit energies at many frequencies simultaneously** similar to Lightning or HVI systems, but on a much smaller scale. The exposure then depends on the size of the display, the vintage of the associated electronics, and the proximity of the display to the user. A typical digital display as used for a computer is typically two feet (60 cm) distant from the user. **The digital displays as used in the NYC cabs are within 6 inches of the user, 8 to 12 hours a day.** If there is central nervous system irritation, as the cabbies affirm, then the extended length of exposure is bound to cause effects that may linger for some time after exposure stops. The cab drivers testified to this, having noted their trouble sleeping.

These two exposures (*RF and Wideband*) work in tandem to provide the perceived effects, so it is difficult to say with certainty that the RF is the problem, or the Wideband Emissions are the problem, but what is certain is that their combined presence shortly after their mid-2007 installation has provided irritating biological effects. If this irritation transitions to illness, then the claimed “improvement in services to the passengers” is a hollow improvement at the cost of the cab drivers’ health.

Indubitably CMT will deny any responsibility. Guiding agencies will deny any cause and effect. Meanwhile cab drivers’ health will be affected negatively, and it will be up to them to bypass the “junk science” that the guiding agencies rely on, and either change jobs, or use their collective bargaining efforts through unions or otherwise to demand that the devices be removed from the cabs. Granted, progress may be inevitable. However, when that progress is at the cost of the health of those involved, the progress is not forward, but backwards.

The “improvements” have already been installed in many of New York City, Chicago, and Boston’s cabs. Others may very well follow, unless the cabbies unite, and through their collective efforts take measures to protect their health.

Limited Glossary

Electron – The fundamental unit of charge. It causes an Electric Field.

Voltage – Electrical difference between two points, or surfaces, because of differing concentration of electrons.

Current – Flow of charge past a given point over a unit of time. It will cause a Magnetic Field.

Watt – Unit of power caused by an interaction of a certain amount of Voltage and a certain amount of Current.

Alternating – Periodically changing polarity and strength.

Impedance – The electrical resistance that a structure offers to an Alternating signal.

Frequency – number of Alternations per unit time, such as Cycles per Second (a.k.a. Hertz (Hz)).

Electromagnetic Field (EMF) – Energy field that is propagated through conductive material such as wires, or free space, caused by interaction of Voltage and Current.

Radio Frequency (RF) – Electromagnetic energy faster than about 30 million Cycles per Second (Hertz) or 30 MHz.

Near Region – The region nearest an EM source where there are unusual electric and magnetic field interactions due to impedance mismatch between the antenna and free space.

Far Region – The region in space where the EM wave has adjusted to the impedance of free space and travels unobstructed until it encounters something partially or fully conductive.

Inverse Square law – Reduction relationship where the field strength at a point twice as far as another point from an antenna is $\frac{1}{4}$ that of the other. Most sources display this relationship in the Far Region.

Specific Absorption Ratio (SAR) – The Rate at which Electromagnetic energy is deposited onto a solid surface. It is equal to the product of Voltage times Current and is divided by the surface area the energy is spread out over.

Attenuation – Reduction in strength due to either shielding (*fully or partially conductive material*) or distance (*such that the emitted energy gets substantially spread out*). Depending on the electrical conductivity, some shielding requires grounding.

Resources

Bioinitiative Report - A Rationale for a Biologically-based Public Exposure Standard for Electromagnetic Fields (ELF and RF) – August 31, 2007

Electrosmog in the environment Swiss Agency for the Environment, Forests and Landscape - SAEFL – June 2005

Evidence that Electromagnetic fields from high voltage powerlines and in buildings, are hazardous to human health, especially to young children – Dr. Neil Cherry - 2001

Evidence that Electromagnetic Radiation is Genotoxic: The implications for the epidemiology of cancer and cardiac, neurological and reproductive effects – Dr Neil Cherry, June 2000

OET Bulletin 65 - Edition 97-01 - Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields – August 1997

Radio Frequency Electromagnetic Fields - Properties, Quantities and Units, Biophysical Interaction, and Measurements - National Council on Radiation Protection and Measurements – NCRP report# 67, March 1981

While links to all of the above documents could be provided here, their volatility within the Internet would eventually render the links useless. A simple cut-and-paste of part of any of these titles onto a search engine will locate the document for download or online browsing.

Some residential exposures may prolong the perceptions described. Their descriptions can be found at <http://www.emfrelief.com/emf.html>

ENERGY MEDICINE: The Scientific Basis - James L. Oschman, Candace Pert – Publisher: Churchill Livingstone, Inc., - 2000, ISBN: 0-443-06261-7

CROSS CURRENTS, The Perils of Electropollution, The Promise of Electromedicine - Robert O. Becker M.D., – Publisher: James P. Tarcher Inc. 1990, ISBN 0-87477-609-0