

To

Dr. Paul Demers

Chair of the Royal Society of Canada's Expert Panel Reviewing Safety Code 6  
c/o Russel MacDonald at [admin-assistant@rsc-src.ca](mailto:admin-assistant@rsc-src.ca)

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## **Submission regarding the Review of Safety Code 6**

Dear Dr. Demers,

As you and your colleagues review the scope, accuracy, and protection effectiveness of Health Canada's Safety Code 6, I would like to draw your attention to EMF/RF radiation exposure scenarios in the real world and how they can impact a person's life at much lower levels than assumed possible by Health Canada. As a Building Biology Environmental Consultant IBN with a Certificate in Environmental and Occupational Health from the University of Victoria (BC), I measure EMF/RF exposure levels from 5 Hz to 6 GHz in residential homes and at computer workstations on a regular basis.

### **Frequency range of Safety Code 6 only ranges from 3 kHz to 300 GHz and does not include power-frequency electromagnetic fields.**

To my knowledge, there is no safety code in Canada that covers power-frequency electric and magnetic fields including harmonics to protect public health though ELF magnetic fields have been classified as possibly carcinogenic (Group 2B) by the IARC since 2002.<sup>1</sup> Magnetic fields even made the CAREX "Preliminary Priority List" in 2008.<sup>2</sup> According to a compilation by John Swanson<sup>3</sup> from National Grid, a UK utility company that hosts an EMF info site, out of 59 developed countries only Canada, New Zealand, Peru, Spain, and Turkey do not issue guidelines to protect the public from ELF electric and magnetic fields.

*As a developed country that makes extensive use of electricity, Canada should issue a safety code that covers the range from 0 Hz to 300 GHz, especially when considering that Canadian research by Miller<sup>4</sup> and Villeneuve<sup>5</sup> from over 10 years ago indicated that ELF electric fields are*

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<sup>1</sup> IARC (2002): Non-Ionizing Radiation, Part 1: Static and Extremely Low-Frequency (ELF) Electric and Magnetic Fields monograph. Volume 80. <http://monographs.iarc.fr/ENG/Monographs/vol80/>

<sup>2</sup> Demers et al. (2008): Priority environmental carcinogens for surveillance in Canada: preliminary priority list. [http://www.carexcanada.ca/en/classifying\\_carcinogens/](http://www.carexcanada.ca/en/classifying_carcinogens/)

<sup>3</sup> Swanson J (2013): Power-frequency EMF exposure standards applicable in Europe and elsewhere. <http://www.emfs.info/Related+Issues/limits/world/other/>

<sup>4</sup> Miller AB et al. (1996): Leukemia following occupational exposure to 60-Hz electric and magnetic fields among Ontario electric utility workers. <http://www.ncbi.nlm.nih.gov/pubmed/8678046?dopt=Abstract>

<sup>5</sup> Villeneuve et al. (2000): Leukemia in electric utility workers: the evaluation of alternative indices of exposure to 60 Hz electric and magnetic fields. <http://www.ncbi.nlm.nih.gov/pubmed/10797504>

*also possibly carcinogenic.* (That this line of research has not been pursued any further has nothing to do with a lack of evidence but everything with the politics of EMF research funding.<sup>6</sup>)

And with regard to ELF magnetic fields, latest research findings<sup>7</sup> are rather disturbing because low-level magnetic field exposures are capable of modulating the antiproliferative effect of melatonin and tamoxifen. To make matters worse, it is not a linear dose-response relationship, but the highest biological activity was registered at **1200 nT** (12 mG), which is commonly found in miswired residences, close to electrical appliances and high-tension transmission lines, and a lower activity at **100,000 nT** (1000 mG), which is the ICNIRP exposure limit for the general public for acute effects.

### **Radio-frequency radiation as an IARC Group 2B carcinogen is not listed in the CAREX database.**

I understand that the list of carcinogens—possible, probable, and verified—is rather long and scientific documentation does take its time. However, what I do not understand is that a physical agent, namely radio-frequency radiation, to which almost everybody in this country is exposed to in increasing amounts on a daily—and nightly—basis is not featured with a profile and exposure estimate yet. And now it is not only adults anymore, but more and more children at an ever younger age use RF transmitters close to their body.

*I urge you to include radio-frequency radiation in the CAREX database. And do not make the mistake of only focusing on cell phone radiation in the exposure estimates but also include at least Wi-Fi radiation and cordless phone radiation.* The latest cell phone study by Hardell<sup>8</sup> and his team demonstrated again, for example, that the RF exposure to cordless phones carries a similar brain tumor risk. The odds ratio increases with increasing exposure duration. Based on the classic Hill criteria, he even goes so far as to classify RF radiation from wireless phones as a Group 1 carcinogen.<sup>9</sup>

### **Exposure limits from other countries**

In the current Safety Code 6<sup>10</sup>, Health Canada claims on page 7 that any RF exposure limits that

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<sup>6</sup> Microwave News (2009): The real junk science of EMFs: stop electric field cancer research, say industry scientists. <http://microwavenews.com/junkscience.html>

<sup>7</sup> Girkert R, Hanf V (2009): Verifizierung des veränderten Wachstumsverhaltens von verschiedenen Brustkrebszelltypen in vitro unter Magnetfeldeinfluss mit verschiedenen Onkostatika [Verification of changes in growth behavior of different breast cancer cell types in vitro when exposed to magnetic fields with different oncostatic agents]. [http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-2009042374/1/BfS\\_2009\\_BfS-RESFOR-13-09.pdf](http://doris.bfs.de/jspui/bitstream/urn:nbn:de:0221-2009042374/1/BfS_2009_BfS-RESFOR-13-09.pdf)

Microwave News (2005): When enough is never enough: a reproducible EMF effect at 12 mG.

[http://microwavenews.com/nc\\_nov2005.html](http://microwavenews.com/nc_nov2005.html)

<sup>8</sup> Hardell et al. (2013): Case-control study of the association between malignant brain tumors diagnosed between 2007 and 2009 and mobile and cordless phone use. <http://www.ncbi.nlm.nih.gov/pubmed/24064953>

<sup>9</sup> Hardell L, Carlberg M (2013): Using the Hill viewpoints from 1965 for evaluating strengths of evidence of the risk for brain tumors associated with use of mobile and cordless phones. Rev Environ Health 2013-0006. De Gruyter; DOI 10.1515

<sup>10</sup> Health Canada: Safety Code 6. [http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio\\_guide-lignes\\_direct-eng.php](http://www.hc-sc.gc.ca/ewh-semt/pubs/radiation/radio_guide-lignes_direct-eng.php)

are lower than the Canadian ones “are based on socio-political considerations” and not on “scientifically established health hazards.” I sure hope that the RSC expert panel subscribes to a higher level of scientific accuracy.

Since Russia, the Ukraine, and China also have carried out their own RF research, it is safe to assume that their guidelines are not “socio-political considerations” but their interpretation of the scientific literature that happens to differ from Health Canada’s evaluation of possible nonthermal effects.<sup>11</sup> I think there is a need for translators to provide an urgently needed knowledge transfer. The Ukrainian Health & Safety Guideline regarding RF radiation from 1996<sup>12</sup>, for example, does not exist in English. However, to my knowledge, it is the lowest exposure limit—**3 V/m or 24,000 μW/m<sup>2</sup>**—issued by a national Ministry of Health. It even has a specific section on radar radiation. One of the latest studies from the Ukraine observes an increase in free radical species in Japanese quail eggs due to low-level RF radiation exposure from a real GSM 900 MHz cell phone at 3 cm, not a signal generator (**ca. 3 μW/kg or ca. 2500 μW/m<sup>2</sup>**).<sup>13</sup> Yakymenko from the Kavetsky Institute of Experimental Pathology, Oncology and Radiobiology of the National Academy of Sciences of the Ukraine explains the strict safety limits of his country by “long long-term national research traditions in a field of electromagnetic biology, and on experience in studying the non-thermal biological effects of this kind of radiation.”<sup>14</sup> *In the same paper, he goes on to say that “recently obtained data”—not socio-political considerations—require a reevaluation of current safety limits, and that RF radiation “should be regulated based on precautionary principles which imply maximum restriction of excessive exposure.”<sup>15</sup>*

According to Yuri Grigoriev, chair of the Russian National Committee on Non-ionizing Radiation Protection, the official Russian RF exposure limit of **100,000 μW/m<sup>2</sup>** for the general public is not a 6-minute average threshold level like in Safety Code 6, but a peak threshold level for long-term exposure.<sup>16</sup> Not “socio-political considerations” but actual Russian research studies are the basis of these stricter guidelines.<sup>17</sup>

In China, the RF exposure limits for the general public distinguish between an exposure limit of **100,000 μW/m<sup>2</sup>** for permanent exposure (e.g. residences schools, hospitals) and **400,000**

<sup>11</sup> Katharina Gustavs (2013): A compilation of RF exposure limits and precautionary guidelines including links to the source documents. [http://buildingbiology.ca/media/pdf/rf\\_exposure\\_limits\\_cell\\_antennas.pdf](http://buildingbiology.ca/media/pdf/rf_exposure_limits_cell_antennas.pdf)

<sup>12</sup> Ukraine Ministry of Health (1996): <http://zakon4.rada.gov.ua/laws/show/z0488-96/page>

<sup>13</sup> Burlaka et al. (2013): Overproduction of free radical species in embryonal cells exposed to low intensity radiofrequency radiation. <http://exp-oncology.com.ua/article/6079/overproduction-of-free-radical-species-in-embryonal-cells-exposed-to-low-intensity-radiofrequency-radiation>

<sup>14</sup> Yakymenko et al. (2011): Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems, p. 64. <http://www.ncbi.nlm.nih.gov/pubmed/21716201>

<sup>15</sup> Yakymenko et al. (2011): Long-term exposure to microwave radiation provokes cancer growth: evidences from radars and mobile communication systems, p. 62. <http://www.ncbi.nlm.nih.gov/pubmed/21716201>

<sup>16</sup> Personal e-mail communication with Yuri Grigoriev.

<sup>17</sup> Center for Electromagnetic Safety (Moscow) on Russian exposure limits:  
<http://www.tesla.ru/english/protection/standards.html>

$\mu\text{W}/\text{m}^2$  for temporary exposure (e.g. factories, parks).<sup>18</sup> According to Huai Chian<sup>19</sup> from the Microwave Lab at Zhejiang University, Chinese exposure limits are based on “medical examination and epidemiological analyses of personnel exposed to EMFs,” not on “socio-political considerations.” He points out that “chronic exposures to EMFs are associated with a variety of nonspecific symptoms.”

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### **Precautionary EMF/RF guidelines and recommendations**

In my experience, even the above science-based exposure limits from Russia, the Ukraine, and China will not guarantee long-term public health.

The concept of precaution does not seem to be included in Safety Code 6 so far, but in face of the complexity of these very many different frequencies, modulations, and power densities and our uncertainty about their interactions, it is sorely needed. A review paper of cell tower studies at the Center for Public Health of the Medical University of Vienna from 2009 suggested that “power densities around  $0.5\text{--}1 \mu\text{W}/\text{m}^2$  [ $500\text{--}1,000 \mu\text{W}/\text{m}^2$ ] must be exceeded in order to observe an effect,”<sup>20</sup> including cardiac symptoms, sleep disorders, and headaches. In 2010 another review by Khurana, a neurosurgeon at the Australian National University Medical School, “reported an increased prevalence of adverse neurobehavioral symptoms or cancer in populations living at distances <500 meters from base stations.”<sup>21</sup> Most precautionary RF threshold levels tend to be set at or below  $1000 \mu\text{W}/\text{m}^2$ .

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<sup>18</sup> [http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Asia/China\\_files/table\\_ch.htm](http://www.who.int/docstore/peh-emf/EMFStandards/who-0102/Asia/China_files/table_ch.htm)

<sup>19</sup> Chiang H (2000): Rationale for setting EMF exposure standards.

[http://www.salzburg.gv.at/Proceedings %2820%29\\_Chang.pdf](http://www.salzburg.gv.at/Proceedings %2820%29_Chang.pdf)

<sup>20</sup> Kundi M, Hutter HP (2009): Mobile phone base stations—Effects on wellbeing and health.

[http://www.mreengenaria.com.br/pathfisiologia/Pathophysiology\\_2009\\_Kundi.pdf](http://www.mreengenaria.com.br/pathfisiologia/Pathophysiology_2009_Kundi.pdf)

<sup>21</sup> Khurana et al. (2010): Epidemiological evidence for a health risk from mobile phone base stations.

[http://www.brain-surgery.us/Khurana\\_et\\_al\\_IJOEH-Base\\_Station\\_RV.pdf](http://www.brain-surgery.us/Khurana_et_al_IJOEH-Base_Station_RV.pdf)

Year	Agency/Organization	Classification / Area of application	Maximum threshold level in $\mu\text{W}/\text{m}^2$
2012	<a href="#"><u>Multistakeholder Austrian Antenna System Siting Guideline</u></a>	Sum total of RF radiation peak level in indoor and outdoor environments	1000
2011	<a href="#"><u>Parliamentary Assembly of the Council of Europe</u></a>	Immediately: Sum total of RF radiation in all indoor environments	1000
2011	<a href="#"><u>Parliamentary Assembly of the Council of Europe</u></a>	In the medium term: Sum total of RF radiation in all indoor environments	100
2012	<a href="#"><u>EMF Working Group of the Austrian Medical Association</u></a>	Within normal limits	1
2008	<a href="#"><u>Building Biology Evaluation Guidelines</u></a>	"No concern range" Individual RF source	<0.1

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In my testing experience, peak exposure levels as low as 100  $\mu\text{W}/\text{m}^2$ —not 6-minute averages—from Wi-Fi routers and cordless phones have the potential to interfere with healthy sleep and proper immune function, especially in children and sensitive or chronically ill persons. In most cases, there is a combination of different frequencies at elevated exposure levels present, including ELF electric and magnetic fields.

### Near-field exposures and SAR values

These days the majority of people keep RF transmitters intimately close to their body. Thus personal wireless devices are responsible for the exponential increase in RF radiation exposure. According to the European Health Risk Assessment Network on Electromagnetic Fields Exposure (EFHRAN),<sup>22</sup> indoor RF exposures are increasing faster than outdoor exposures and cell phones and cordless phones are the dominant sources. When a cell phone is placed in a pant pocket, this may have a devastating impact on male reproductive health.<sup>23</sup> When a cell phone is placed in a bra, the user may develop multifocal breast cancer at a frighteningly early age.<sup>24</sup>

<sup>22</sup> EFHRAN (2010): Report on the level of exposure (frequency, patterns and modulation) in the European Union. Part 1: Radiofrequency (RF) radiation, page 23.

[http://efhran.polimi.it/docs/D4\\_Report%20on%20the%20level%20of%20exposure%20in%20the%20European%20Union\\_Oct2010.pdf](http://efhran.polimi.it/docs/D4_Report%20on%20the%20level%20of%20exposure%20in%20the%20European%20Union_Oct2010.pdf)

<sup>23</sup> Desai et al. (2009): Pathophysiology of cell phone radiation: oxidative stress and carcinogenesis with focus on male reproductive system. <http://www.rbej.com/content/7/1/114>

<sup>24</sup> West et al. (2013): Multifocal breast cancer in young women with prolonged contact between their breasts and their cellular phones. <http://www.hindawi.com/crim/medicine/2013/354682/>

And what about school children who are forced to use Wi-Fi-enabled tablets, which they often place in their lap? In the case of iPads, children would also have to install a Wi-Fi router at home to do their homework because these tablets do not support wired Ethernet networks. This is an exponential increase in RF radiation exposure for children in addition to the cell phone or smartphone they may already be using.

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On the one hand, Health Canada issued a Health Alert in October 2011 in which parents are encouraged “to reduce their children’s RF exposure”<sup>25</sup> from cell phones. (For reasons unknown to me, the original Health Alert seems to have been removed from the Health Canada server this spring. Now there is only a single reference to children in their fact sheet on cell phone and cell tower radiation safety.) On the other hand, at the exact same time, Health Canada states that with regard to Wi-Fi devices “no precautionary measures are needed” because supposedly “RF energy from Wi-Fi devices is typically transmitted at a much greater distance from the human body.”<sup>26</sup> I hope that the members of the RSC expert panel have a better grasp of reality. Wi-Fi-enabled tablets and iPods are used just as close to the body as cell phones and smartphones. A look inside Apple’s “Important Product Information Guide”<sup>27</sup> for the iPad WiFi + 3G, for example, lists the highest SAR value for the WiFi 2.4 GHz with **1.19 W/kg** and for the 1800/1900 MHz cell phone network with **1.18 W/kg**. I fail to see any difference in exposure level here. Also, smartphones emit not only cell phone radiation anymore but also Wi-Fi radiation among several other wireless radiation sources.

How does the SAR threshold level of **1.6 W/kg** recommended by Safety Code 6 for head, neck, and trunk apply to devices with multiple wireless transmitters? I thought that this SAR value would apply to the sum total of the SAR values of all antennas fitted into a single device at any given time. However, manufacturers of wireless devices list the various wireless transmitters of a single device separately and compare the SAR value of each single frequency to the SAR value of Safety Code 6. When two or any number of transmitters emit at the same time, the SAR value would be easily exceeded. Also, how do compliance SAR measurements for cell phones, performed on a standardized phantom head with all its limitations, apply to tablets that are primarily used in the lap or on the thighs that do not have a protective shell like the skull? And Safety Code 6 does not even mention the greater vulnerability of children to radio-frequency radiation. I hope your expert panel can remedy this situation.

*In order to prevent a public health disaster in the long term, all personal wireless devices such as smartphones, cell phones, cordless phones, Wi-Fi routers, computers, laptops, tablets, iPods, baby monitors, etc. should come with a clear warning label right on the device, not hidden in the fine print, including the SAR value, as suggested by the French*

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<sup>25</sup> Health Canada (October 2011): Safety of cell phones and cell phone towers. <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/cell-eng.php>

<sup>26</sup> Health Canada (October 2011): Safety of Wi-Fi equipment. <http://www.hc-sc.gc.ca/hl-vs/iyh-vsv/prod/wifi-eng.php>

<sup>27</sup> Important Product Information Guide (2010).

[http://manuals.info.apple.com/en\\_US/iPad\\_Important\\_Product\\_Information\\_Guide.pdf](http://manuals.info.apple.com/en_US/iPad_Important_Product_Information_Guide.pdf)

*Agency for Food, Environmental and Occupational Health this fall.<sup>28</sup> Clear instructions on how to turn off the various wireless transmitters when not in use would not only go a long way to minimize RF radiation exposure but would also save energy.*

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### **Best practices for a safer use of wireless devices**

The large portion of RF exposures is completely unnecessary and could be easily avoided. In addition, smart network designs could easily reduce background RF radiation exposure levels of the general public. It would be very helpful if safety codes could provide incentives to manufacturers of wireless devices and networks for low-emission designs.

French Agency for Food, Environmental and Occupational Health (ANSES) (October 2013):  
[Update of the “Radiofrequencies and health” expert appraisal](#)

“ANSES recommends:

- reducing the exposure of children by encouraging only moderate use of mobile phones, ideally with hands-free kits and mobile terminals with the lowest SAR values;
- carrying out an in-depth study of the consequences of possibly multiplying the number of relay antennas in order to reduce levels of personal environmental exposure to radiofrequencies emitted by mobile phones;
- that the development of new network infrastructures be subject to prior studies concerning the characterisation of exposures, taking into account the accumulation of existing levels with those that would be generated by new installations, in order to favour concerted discussion regarding new installations or modifications of transmitters;
- documenting the conditions pertaining at those existing installations causing the highest exposure of the public and investigating in what measure these exposures can be reduced by technical means.”

“ANSES recommends, without prejudice to the need to respect reference values in force concerning electromagnetic compatibility, that:

- current regulations concerning exposure of the general population to electromagnetic fields emitted by equipment used in telecommunications networks or by radioelectric installations (Decree No. 2002-775 of 3 May 2002) be extended to cover other artificial sources of emissions of radiofrequency radiation for which compliance with exposure limit values cannot be established *a priori*;
- devices emitting electromagnetic fields intended for use near the body (DECT telephones, tablet computers, baby monitors, etc.) display the maximum level of exposure generated (SAR, for example), as is already the case for mobile phones. ”

German Federal Office for Radiation Protection (BfS) (2006) : [Cordless phones with low EMF radiation levels](#)

“Aiming at a precautionary reduction in exposure, the Federal Office for Radiation in 2006 issued the following criteria for cordless phones with low EMF radiation levels:

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<sup>28</sup> ANSES (October 2013): Update of the „Radiofrequencies and health“ expert appraisal.  
[www.anses.fr/en/documents/PRES2013CPA18EN.pdf](http://www.anses.fr/en/documents/PRES2013CPA18EN.pdf)

- automatic switch-off or a minimum 100,000-fold reduction of the control signal in stand-by mode - regardless of the number of handsets involved, e.g., the handset does not need to be returned to the base station;
- demand-driven graded regulation of handset transmitting power (more than 2 stages) when telephoning – similar to mobile phones;
- demand-driven graded regulation of base station transmitting power (more than 2 stages) when making a phone call;
- possibility of attaching a headset to the handset;
- possibility of setting / limiting the maximum distance”

Katharina Gustavs (2013): [Wi-Fi networks—Best practice guidelines for saving energy and minimizing RF radiation exposure](#)

It is high time that the ubiquitous exposure of the general public to low-level EMF/RF electromagnetic fields below 10,000,000  $\mu\text{W}/\text{m}^2$  (RF), below 83,000 nT (ELF), and below 4200 V/m (ELF) are taken seriously. I hope the members of the RSC expert panel are up to the task.

Sincerely,

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