

Seven Repeatedly Documented Findings Each Show that EMF Safety Guidelines Do Not Predict  
Biological Effects and Are, Therefore Fraudulent.  
The Consequences for Both Microwave Frequency Exposures and Also 5G

Martin L. Pall, PhD, Professor Emeritus of Biochemistry and Basic Medical Sciences,  
Washington State University, martin\_pall@wsu.edu

I am responding to a request to discuss the scientific concerns regarding 5G, including possible concerns with the statement copied below that were obtained from Europe Direct.

"As 5G is expected to use smaller cells with lower power levels, the overall EMF exposure would be distributed more evenly and, therefore, is likely to even decrease in areas where 5G is deployed."

That statement is completely undocumented and cannot be shown, therefore, to have any scientific merit. It is also clear from the statement that it is false. 5G is to be deployed *in addition* to the exposures we already have and therefore any suggestion that it can decrease exposures is false. I have seen many statements that 5G power levels will be very high because of the problems of penetration. Rather than focusing on this false statement, let us consider what the flaws are in the whole rush to rollout 5G and why we should be profoundly concerned about the flaws and the rush. Some of those flaws are identical to the flaws in the "safety guideline" regulatory scheme that is supposed to protect us from EMF effects and some of those flaws are specific to 5G. Let's consider the regulatory flaws first and then return to 5G.

All of the regulatory schemes involve only looking at average intensities so let's examine the specific structure of the EU safety guidelines. EU safety guidelines use Average SAR (specific absorption rate) values measured over a 6 minute interval. Because SAR values only estimate thermal effects and when averaged over 6 minutes, we are only looking at an averaged thermal effect. It follows from this that any effect that is produced by non-thermal mechanisms or where the EMF impact is not predicted by SAR values or that occurs in much shorter times than 6 minutes are not at all predicted by the structure of the EU "safety guidelines." Each of these turn out to be very important. These concerns were central to the 41 statements written by scientists and physicians (see attached) decrying that the safety guidelines are inadequate because they do not take into consideration non-thermal effects. Let's look at specific findings that show that the EU safety guidelines do not predict biological effects.

1. Chapter 1 of my 90 page document contains 8 different EMF non-thermal each of which is *very extensively documented* in from 12 to 35 different review articles, each of which provides a substantial body of evidence showing that one of these effects do occur following non-thermal EMF exposures (see attached). These each occur at levels well below those allowed by the EU safety guidelines and show, therefore that EU safety guidelines do not predict biological safety. These effects are as follows:

- 1) **Lowered fertility, including tissue remodeling changes in the testis, lowered sperm count and lowered motility and other measures of lowered sperm quality, lowered female fertility including ovarian remodeling, oocyte (follicle) loss, lowered estrogen, progesterone and testosterone levels (that is sex hormone levels), increased spontaneous abortion incidence, lowered libido (18 reviews).**
- 2) **Neurological/neuropsychiatric effects including sleep disturbance/insomnia; fatigue/tiredness; headache; depression/depressive symptoms; lack of**

- concentration/attention/cognitive dysfunction; dizziness/vertigo; memory changes; restlessness/tension/anxiety/stress/agitation; irritability** (25 reviews).
- 3) **Effects on cellular DNA including single strand and double strand breaks in cellular DNA and on oxidized bases in cellular DNA; also evidence for chromosomal mutations produced by double strand DNA breaks. These produce all of the important type of mutations, as described at the DNA level that have roles in cancer causation and in human whole organism mutation** (21 reviews).
  - 4) **Apoptosis/cell death (an important process in production of neurodegenerative diseases that is also important in producing infertility responses)** (13 reviews).
  - 5) **Oxidative stress/free radical damage** (important mechanisms involved in almost all chronic diseases; direct cause of cellular DNA damage) (19 reviews).
  - 6) **Endocrine, that is hormonal effects; Includes changes in non-steroid and also steroid hormones** (12 reviews).
  - 7) **Increased intracellular calcium levels, thought to be the cause in all other effects** (15 different reviews).
  - 8) **Cancer including initiation, promotion and progression, further including tumor progression, tissue invasion and metastasis** (35 reviews).

We have here, a total of 158 bodies of evidence each showing that non-thermal exposures well below EU or other “safety guidelines” cause an important health-related effect. These 8 different non-thermal effects are not the only effects being produced. Because many of these reviews provide bodies of evidence on the occurrence of more than one health-related effect, there are fewer than 90 actual review articles listed. These 158 bodies of evidence *individually* provide strong evidence against any claims that can be made on the basis of the EU safety guidelines.

2. There were also 13 reviews cited in Chapter 1 of my 90 page document, each of which showed that pulsed EMFs are, in most cases, much more biologically active than are non-pulsed (also known as continuous wave) EMFs of the same average intensity. Because average intensities, averaged over a 6 minute period, are the basis of the EU, SCENIHR, Canadian and US FCC guidelines and ICNIRP is even worse, averaging over a 30 minute period, this is a fatal flaw in the structure of those safety guidelines. Average intensities are *not* predictive of biological effects and therefore cannot be used as the basis of any useful regulatory scheme. Pulsation is also of great importance, because all wireless communication devices, communicate at least in part, via pulsation and the smarter they are, the more they pulse. Consequently, the role of pulsation is stunningly important with regard to the EMFs we are most exposed to.

3. There is a large literature on nanosecond pulses producing biological effects. If you search under nanosecond pulse in the EMF-Portal database, you will find 206 hits where over 170 are genuine nanosecond pulse studies that produced non-thermal effects. These do produce effects at levels that fall far short of those needed to produce electroporation, so electroporation is not the primary mechanism here. If you take a typical pulse that may last for about 10 nanoseconds and average it over a 6 minute period (about  $10^{10}$  times longer), as the EU and most other safety

guidelines do, the average intensity (and average SAR value) is so low that, of course the safety guidelines predict there cannot be effects. ***But there are repeatedly found effects.*** So here again the EU safety guidelines are not predictive of biological effects and average intensities tell us nothing about biological effects. It makes no sense to average intensities over approximately  $10^{10}$  times longer than it takes to produce an effect. The logic here is the same as if the following were to occur: Let's assume that you are concerned about someone shooting you with a high power rifle bullet traveling at about 700 meters per second. The bullet takes about 50 microseconds to tear your body apart. If someone from a regulatory authority tells you that you don't need to worry about that, if you average the force of the rifle bullet over a 21 day period (about  $10^{10}$  times longer than 50 microseconds), the average intensity is so low, you don't need to worry about it. If someone were to tell you that, you would laugh in their face and state that they are either completely incompetent or completely corrupt. That is exactly the correct response in dealing with the EMF safety guidelines of the EU and other regulatory authorities.

4. There is also a large literature on the existence of exposure intensity windows where certain specific ranges of intensity of a particular EMF, ***produce maximum biological effects and where ranges either lower or higher produce much lower effects.*** The consequences of these findings is that dose response curves are non-linear and are also non-monotone, that is they do not always increase with increasing exposure nor do they always decrease with decreasing exposure. Therefore, the EU safety guidelines are fatally flawed for still an additional reason. I am listing here a series of studies that have reviewed studies of this type. Some of these are genuine review articles and some are primary literature articles that have reviewed substantial amounts of earlier literature. One of the things that is striking here, is that many of these studies have found exposure windows that occur at levels 3, 4 or 5 or more orders of magnitude below the safety guideline cutoffs. So again, the safety guidelines give us absolutely no assurance of safety.

- a. Pall, M. L. 2015 Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. Rev. Environ. Health 3, 99-116. doi: 10.1515/reveh-2015-0001.
- b. Belyaev, I., 2005. Non-thermal biological effects of microwaves. Microwave Rev. 11, 13-29.
- c. Belyaev, I., 2015. Biophysical mechanisms for nonthermal microwave effects. In: Markov M.S. (Ed), Electromagnetic Fields in Biology and Medicine, CRC Press, New York, pp 49-67.
- d. Adey WR. 1980 Frequency and power windowing in tissue interactions with weak electromagnetic fields. Proc IEEE 68, 119-125.
- e. Blackman CF, Kinney LS, House DE, Joines WT. 1989 Multiple power density windows and their possible origin. Bioelectromagnetics 10:115-128.
- f. Panagopoulos DJ, Margaritis LH. 2009 Biological health effects of mobile telephone radiations. Int J Med Biol Front 15:33-76.
- g. Persson BRR, Eberhardt J, Malmgren L, Persson MB, Brun A, Salford LG. 2005 Effects of microwaves from GSM mobile phones on blood-brain barrier and neurons in rat brain. PIERS Online 1:638-641.
- h. Wei Q, Cao ZJ, Bai XT. 2005 [Effect of 900 MHz electromagnetic fields on the expression of the GABA receptor of cerebral cortex cortical neurons in postnatal rats] Wei Sheng Yan Jiu 34: 546-548.
- i. Markov MS. 2004 Myosin light chain modification depending on magnetic fields II. Electromagn Biol Med 23:125-140.
- j. Thompson CJ, Yang YS, Anderson V, Wood AW. 2000 A cooperative model for  $Ca^{++}$  efflux windowing from cell membranes exposed to electromagnetic radiation. Bioelectromagnetics 21:455-464.

5. Another important factor in determining EMF responses is the type of cell being studied. The relevant studies documenting the importance of cell type are studies where different cell types were studied by the same research group using identical methodologies and where the different cell types repeatedly responded differently to the same EMF exposures. I reviewed several studies where such findings were obtained in my 2013 study where single strand breaks in cellular DNA were being measured (Pall ML 2013 Electromagnetic fields act via activation of voltage-gated calcium channels to produce beneficial or adverse effects. *J Cell Mol Med* 17:958-965. doi: 10.1111/jcmm.12088). I also reviewed several studies of this type when reviewing various genotoxicity studies in my 2015 study (Pall, M. L. 2015 Scientific evidence contradicts findings and assumptions of Canadian Safety Panel 6: microwaves act through voltage-gated calcium channel activation to induce biological impacts at non-thermal levels, supporting a paradigm shift for microwave/lower frequency electromagnetic field action. *Rev. Environ. Health* 3, 99-116. doi: 10.1515/reveh-2015- 0001). Belyaev IY (2010 Dependence of non-thermal effects of microwaves on physical and biological parameters. *Eur J Oncol Library* 5: 187-217) also reviewed a number of studies, on pp.202 & 203, showing that non-thermal EMF effects were cell type specific. It has repeatedly been found in such studies that stem cells are unusually sensitive to EMF exposures, producing effects where most other cell types do not. Some of these studies have been reviewed by Dr. Belyaev and his colleagues (Belyaev IY, Markovà E, Hillert L, Malmgren LO, Persson BR. 2009 Microwaves from UMTS/GSM mobile phones induce long-lasting inhibition of 53BP1/gamma-H2AX DNA repair foci in human lymphocytes. *Bioelectromagnetics* 30:129-141. doi: 10.1002/bem.20445; Markovà E, Malmgren LO, Belyaev IY. 2010 Microwaves from Mobile Phones Inhibit 53BP1 Focus Formation in Human Stem Cells More Strongly Than in Differentiated Cells: Possible Mechanistic Link to Cancer Risk. *Environ Health Perspect* 118:394-399. doi: 10.1289/ehp.0900781). These cell-type specific findings clearly show that that effects are produced via cell type specific biological processes and consequently all claims that are made that one can predict effects just from the physical properties of the EMFs, ***as the EU, FCC, Canadian and other safety guidelines do, are fraudulent.***

6. The following comes from (Pall ML. 2018 Wi-Fi is an important threat to human health. *Environ Res.* 2018 Jul;164:405-416; full citations can be obtained from that paper; information inserted into that text is italicized to identify it). How are the non-thermal EMF effects produced? The author found the answer to this question in the already published scientific literature (Pall, 2013). That study showed that in 24 different studies [there are now a total of 26 Pall, (2015b)], effects of low-intensity EMFs, including microwave frequency and also extremely low frequency EMFs, static electrical fields and static magnetic fields could be blocked by calcium channel blockers, drugs that are specific for blocking voltage-gated calcium channels (VGCCs). There were 5 different types of calcium channel blockers used in these studies, each thought to be highly specific, each structurally distinct and each binding to a different site on the VGCCs. In studies where multiple effects were studied, all studied effects were blocked or greatly lowered by calcium channel blockers. These studies show that EMFs produce diverse non-thermal effects via VGCC activation Pall 2013; 2014; 2015a & b; 2016a & b) in many human and animal cells. In plant cells, EMFs activate somewhat similar calcium channels and produce somewhat similar effects on oxidative stress, cellular DNA damage and calcium signaling (Pall, 2016a). Furthermore, many different effects shown to be produced in repeated studies by EMF exposures, including the effects discussed above, can be produced by downstream effects of VGCC activation, via increased  $[Ca^{2+}]_i$ , as discussed in detail below.

Before leaving this issue, it is important to discuss why the VGCCs are so sensitive to activation by these low-intensity EMFs. The VGCCs each have a voltage sensor which is made up of 4 alpha helices in the plasma membrane, with each such helix having 5 positive charges on it, for a

total of 20 positive charges (Pall, 2015b). These voltage sensor helices are each called S4 helices because each is the fourth helix in a distinct multi-helix domain. Each of these voltage sensor charges is within the lipid bilayer part of the plasma membrane. The electrical forces on the voltage sensor are very high for three distinct reasons (Pall 2015b; 2015a; 2016a). 1. The 20 charges on the voltage sensor make the forces on voltage sensor 20 times higher than the forces on a single charge. 2. Because these charges are within the lipid bilayer section of the membrane where the dielectric constant is about 1/120th of the dielectric constant of the aqueous parts of the cell, the law of physics called Coulomb's law, predicts that the forces on those charges will be approximately 120 times higher than the forces on charges in the aqueous parts of the cell. 3. Because the plasma membrane has a high electrical resistance whereas the aqueous parts of the cell are highly conductive, the electrical gradient across the plasma membrane is estimated to be concentrated about 3000-fold, as shown by Ohm's law. The combination of these effects means that comparing the forces on the voltage sensor with the forces on singly charged groups in the aqueous parts of the cell, the forces on the voltage sensor are approximately  $20 \times 120 \times 3000 = 7.2$  million times higher (Pall, 2015b). The physics predicts, therefore, extraordinarily strong forces activating the VGCCs via the voltage sensor. It follows that the biology tells us that the VGCCs are the main target of the EMFs and the physics tells us why they are the main target. Thus the physics and biology are pointing in the same direction.

There are also additional findings pointing to the voltage sensor as the direct target of the EMFs. In addition to the VGCCs, there are also voltage-gated sodium, potassium and chloride channels, with each of these having a voltage sensor similar to those found in the VGCCs. Lu et al (2015) reported that voltage gated sodium channels, in addition to the VGCCs were activated by EMFs. Tabor et al (2014) found that Mauthner cells, specialized neurons with special roles in triggering rapid escape mechanisms in fish, were almost instantaneously activated by electrical pulses, which acted via voltage-gated sodium channel activation to subsequently produce large  $[Ca^{2+}]_i$  increases. Zhang et al (2016) reported that in addition to the VGCCs, potassium and chloride channels were each activated by EMFs, although these other voltage-gated ion channels had relatively modest roles compared with the VGCCs in producing biological effects. Each of these three studies, the Lu et al (2015) study, the Tabor et al (2014) study and the Zhang et al (2016) study used specific blockers for these other voltage-gated ion channels to determine their roles. The Tabor et al (2014) study also used genetic probing to determine the role of the voltage-gated sodium channels. Lu et al (2015) also used whole cell patch clamp measurements to measure the rapid influx of both sodium and calcium into the cell via the voltage-gated channels following EMF exposure. *One important finding that is not in the Wi-Fi paper is that Tekieh et al, in a 2016 paper (Effects of electromagnetic field exposure on conduction and concentration of voltage gated calcium channels: A Brownian dynamics study. Brain Res. 2016 Sep 1;1646:560-569), showed that VGCCs in isolated plasma membranes, were activated by three different frequencies of microwave radiation. That shows that EMF activation of the VGCCs is directly produced by EMF impact on the VGCC protein.* Sodium influx, particularly in electrically active cells, act in the normal physiology to depolarize the plasma membrane, leading to VGCC activation such that the voltage-gated sodium channels may act primarily via indirect activation of the VGCCs. In summary then, we have evidence that in animal including human cells, seven distinct classes of voltage-gated ion channels are each activated by EMF exposures: From the Pall, 2013 review, four classes of voltage-gated ion channels were shown from calcium channel blocker studies, to be activated by EMFs, L-type, T-type, N-type and P/Q -type VGCCs. In this paragraph we have evidence that three other channels are also activated, voltage-gated sodium channels, voltage-gated potassium channels and voltage-gated chloride channels. Furthermore the plant studies strongly suggest that the so called TPC channels, which contain a similar voltage sensor, are activated in plants allowing calcium influx into plants to produce similar EMF-induced responses (Pall 2016a). One can put those observations together with the powerful findings from the

physics, that the electrical forces on the voltage-sensor are stunningly strong, something like 7.2 million times stronger than the forces on the singly charged groups in the aqueous phases of the cell. Now you have a stunningly powerful argument that the voltage sensor is the predominant direct target of the EMFs. *Because heating is produced predominantly by the EMF forces on singly electrically charged groups in aqueous solution, the 7.2 million figure suggests that safety guidelines allow us to be exposed to EMFs that are approximately 7.2 million times too high.*

There is one additional finding that should be discussed here. In a study published by Pilla (2012), it was found that pulsed EMFs produced an “instantaneous” increase in calcium/calmodulin-dependent nitric oxide synthesis in cells in culture. What Pilla (2012) showed was that following EMF exposure, the cells in culture, must have produced a large increase in  $[Ca^{2+}]_i$ , this in turn produced a large increase in nitric oxide synthesis, the nitric oxide diffused out of the cells and out of the aqueous medium above the cells into the gas phase, where the nitric oxide was detected by a nitric oxide electrode. This entire sequence occurred in less than 5 seconds. This eliminates almost any conceivable indirect effect, except possibly via plasma membrane depolarization. Therefore that the pulsed EMFs are acting directly on the voltage sensors of the VGCCs and possibly the voltage-gated sodium channels, to produce the  $[Ca^{2+}]_i$  increase.

Why is it that the VGCCs, acting via calcium influx, seem to be much more important in producing EMF effects than are the other voltage-gated ion channels? Probably for three reasons: 1.  $Ca^{2+}$  ions under resting conditions in cells have about a 10,000-fold concentration gradient driving them into the cell, and over a million-fold electrochemical gradient also driving them into the cell. Because of this, one can have huge calcium influxes upon channel activation. 2.  $[Ca^{2+}]_i$  produces many important regulatory effects, such that over activation of those effects can have very large pathophysiological consequences. 3. Sustained elevation of  $[Ca^{2+}]_i$  produces major cell damage.

*This section of the Wi-Fi paper was followed by an additional section showing how VGCC activation acting via elevated  $[Ca^{2+}]_i$ , can produce each of the non-thermal effects documented above and elsewhere in the scientific literature.*

7. The last of these are findings that there are very specific EMF frequencies which produce vastly larger EMF effects than do other slightly different frequencies. These have been interpreted as being due to resonance interactions, where the specific frequency produces a resonance response in the target involved and therefore produces vastly larger responses. These findings have been reviewed four times, to my knowledge:

- a. Belyaev, I., 2005. Non-thermal biological effects of microwaves. *Microwave Rev.* 11, 13-29.
- b. Belyaev IY. 2010 Dependence of non-thermal effects of microwaves on physical and biological parameters. *Eur J Oncol Library* 5: 187-217.
- b. Belyaev, I., 2015. Biophysical mechanisms for nonthermal microwave effects. In: Markov M.S. (Ed), *Electromagnetic Fields in Biology and Medicine*, CRC Press, New York, pp 49-67.
- c. Adey, WR. 1980 Frequency and power windowing in tissue interactions with weak electromagnetic fields. *Proc IEEE* 68, 119-125.

I would suggest that in animals and plants, the most likely target of such a resonance interaction would be the voltage sensors. We have no evidence as to whether this is correct or not. Interestingly the only such evidence occurs in the bacterium *Escherichia coli* (reviewed in the second review above) where the target appears to be the DNA of the cell and where the resonance interaction is influenced by the supercoiling of the DNA.

Summary of these seven distinct types of findings:

Each of these seven distinct types of findings shows that the ***EU safety guidelines are fraudulent because they do not predict biological effects***. While this document is aimed at the EU safety guidelines, the similar safety guidelines produced by ICNIRP, Canada safety code 6, the US FCC, and Australia's ARPANSA are similarly fraudulent for each of those same seven reasons. ***All guarantees of safety given by these organizations or by industry organizations, which are based on these or similar safety guidelines, are similarly fraudulent***. The fraudulence is caused, in part, by the series of false assumption underlying these safety guidelines: Assumptions that average intensities or average SARs can be used to assess safety are false. Assumptions that one can ignore pulsations including very short spikes are false. Assumptions that you one ignore biological heterogeneity and assess effects simply based on physics are false. Assumptions that dose-response curves are linear or at least monotone are false. Assumptions that there are no mechanisms that can explain the existence of non-thermal effects are false. Assumptions that electrical forces produced by low intensity EMFs are too weak to do anything are false. The consequences of all this, is that we have a multi-trillion dollar (or multi-trillion euro) set of industries, the telecommunication industries that are based entirely on massive fraud.

### What About 5G?

5G will entail using millimeter wave EMFs with sufficient band width and extraordinary levels of pulsation to communicate many orders of magnitude greater amounts of information. This is clearly stated in the paper that I think of as a propoganda document which, then, fails to take into account any of the established findings previously discussed in this document (Wu T, Rapaport TS, Collins CM. 2015 Safe for generations to come. IEEE Microw Mag. 2015 March ; 16(2): 65–84.) The extraordinary 5G health problems are created by the extraordinary pulsation levels. They are also created in two ways, by the millimeter wave frequencies. The electrical parts of millimeter waves are highly absorbed by materials including the materials in our buildings and the materials in our bodies. Such absorption means that the 5G plans have entailed putting out tens of millions of antennae in close proximity to our homes and other buildings, putting out very high power EMFs, such that the electrical parts can penetrate into our homes and other buildings such that electrical devices can communicate with the 5G antennae. The high absorption argues that these millimeter waves will be particularly active in activating the VGCCs because the mechanism of such absorption involves interacting with electrically charged groups, including the electrically charged groups of the voltage sensor. That is one very large problem, very high level VGCC activation. The second large problem is the high numbers and high power of the so called small cell antennae which means that it will be essentially impossible to avoid the EMFs, especially when we are outside and have no shielding between our bodies and the antennae. I predict, therefore that 5G will inevitably create not only human but also ecological disasters of unparalleled proportions. Small mammals and birds and insects will be heavily impacted because of their large surface to volume ratios. The same thing will be true of plants where even large trees have their leaves and reproductive organs highly exposed. One of the consequences that I predict is that we will have huge conflagrations because EMFs make plants vastly more flammable. That may make fires much worse than the recent California fires commonplace. I am therefore, profoundly concerned about both the human effects and the ecological effects.

One of the claims that the industry makes is that millimeter wave frequencies to be used in 5G will be absorbed in the out 1 mm of the body and that therefore, 5G will have no effects in underlying tissues. I showed in Chapter 7 of my 90 page document what the industry claims about microwaves were false and that microwaves act much more deeply in the body than the industry claims is possible. I predicted therefore that millimeter waves will act deeply as well. Now we have evidence from two CIA translated documents that millimeter waves act at least 20 times more deeply in the body than the industry claims is possible (Zalyobokskaya NP, 1977.

Biological effect of millimeter radiowaves. Vrachebnoye Delo 3: 116-119. Declassified and Approved for release 2012/05/10: CIA-RDP88B01125R000300120005-6; Levedeva NN, Reactions of the central nervous system to peripheral effects of low-intensity EHF emissions. Approved for release 2000/08/10: CIA-RDP96-00792R000100070001-9).

The first of these documents shows that internal organs of rodents including heart, kidney, liver spleen and bone marrow can be heavily impacted by low intensity continuous millimeter wave radiation. There are even more severe effects on the skin, as may be expected. These studies show that these millimeter wave EMFs produce effects at least 20 times deeper than the industry claims is possible. The effects seen start out as modest effects that can be reversible with cessation of exposure but become much more severe with increasing times of exposure. The human study (second paper) was an EEG study where electrical activity in the brain was being monitored. Here for the low intensity millimeter continuous wave EMF exposure to have effects, it must penetrate the hair, skin, skull and meninges surrounding the brain. Again, in humans effects are found at least 20 times deeper than the industry claims is possible.

How then are these highly penetrating effects produced? Although the electrical parts of the EMFs may be absorbed readily, the magnetic parts are very highly penetrating. These can then put forces on dissolved ions in the aqueous phases of our cells and tissues, moving them a regenerating the electrical parts of the EMFs, with the same frequency and same pulsations, just with much lower intensity. However with the voltage sensor of the VGCCs so stunningly sensitive to the electrical forces, this can produce effect very deeply within the body.

These deep effects produced by the millimeter wave EMFs in these two CIA documents, no doubt deeply underestimate that genuine 5G radiation will produce, given its extraordinarily high level of pulsations. What effects do I predict for genuine 5G? I predict that similar but much more severe effects will be produced by 5G as are produced by microwave frequency EMFs. I also predict because of the roles of aqueous dissolved ions in producing these deep effects, that regions of the body with large such internal "bodies of water" may be expected to produce particularly severe problems. These may include:

- a) Various types of birth defects because of the role of the amniotic fluids and the increased water content in the tissues of the fetus.
- b) Massive epidemics of blindness due to the role of the aqueous and vitreous humors of the eye.
- c) Massive epidemics of kidney failures due to the water in the kidney.
- d) Larger epidemics of life threatening cardiac changes in the electrical control of the heart, because of the large blood fluids.
- e) Large epidemics of circulatory problems, possibly including aortic and other arterial aneurisms.

The only way to test for these and other health impacts is to do biological testing with genuine 5G radiation with all of the pulsations that will be involved once it is connected to the internet of things, with all of the pulsations that that will involved. That is exactly what the regulatory agencies and the industry are avoiding doing.