

## **Voltage transients and possible effects on health through cell membrane functionality disturbance**

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Generally, the 50 Hz magnetic field is not considered as a health risk except in the case of childhood leukaemia (Greenland *et al.* 2000; Ahlbom *et al.*, 2000). Recently, there have been some indicators that electric fields (Miller *et al.* 1996; Guenel *et al.* 1996; Villeneuve *et al.* 2000) and voltage transients (Armstrong *et al.* 1994; Milham and Morgan, 2008) may be more active in causing health problems. Our research tries to find what impact voltage transients have on human health and what happens when voltage transients are reduced.

Voltage transients are defined as voltages and currents of short duration, typically less than one-half a cycle and possibly of larger amplitude than that of the normal steady state (Dranetz, 1997). In a review article of voltage transients De Vocht (2010) pointed out: “Environmental exposure to high-frequency voltage transients is an interesting electromagnetic fields (EMF) exposure metric, which might explain the spurious results from epidemiological studies using standard' ELF (Extremely Low Frequency) and RF (Radio Frequency) exposure metrics”.

According to Vignati & Giuliani (1997) electric current at 100 kHz can penetrate much more deeply through the plasmatic membrane than current at 50/60 Hz. Similarly, Ozen's (2008) results indicated that the transient electric and magnetic fields induce higher current density in the body than power frequency fields with similar field strength. In their classical experiment Bawin and Adey (1976) showed that a 56 V/m ELF field (in 50 Hz) induces a tissue gradient of  $10^{-7}$  V/cm, whereas a 56 V/m 147 MHz signal induces a tissue gradient of  $10^{-1}$  V/cm, a million times higher. Li *et al.* (1999) demonstrated how EMFs alter gap junction flow. This is interesting, since gap junction opening is regulated by calcium ions and pH (Alberts *et al.*, 1994). Blank and Goodman (2009) see that while low energy EMF interacts with DNA to induce the stress response, increasing EMF energy in the RF range can lead to breaks in DNA strands. What kind of symptoms are relieved when transient are minimised? There is very little research on this topic. Havas (2008) found that type 1 diabetics require less insulin and type 2 diabetics have lower levels of plasma glucose. Less tremors and better movability were observed in some multiple sclerosis patients (NFAM, 2008). Certain asthma patients were able to leave inhalators aside when transients were reduced (Havas and Oldstad, 2008).

We have conducted a small pilot. In a Finnish high school teachers and students have had many health problems and complaints. Minimal amount of mould was found and removed. Ventilation was improved in the school. Still, problems remained. We had heard from our Russian researcher colleagues (Trushina *et al.*, 2009) about similar schools, so, we measured first transients in every class room. Thereafter we checked if symptoms and transient readings match. Interestingly, there was a match, the 2 teachers who had the most long-lasting health problems (asthma, skin problems, watery eyes, continuous coughing) worked in those 2 class rooms with highest transient readings. Next we installed filters that drop the HF-transients in the electrical circuit. Preliminary results indicate that by removing transients the symptoms of teacher were reduced. We are also trying to find out, what is the exposure at home of these teachers and what other confounding factors (chemicals etc) can explain symptoms / illnesses. Thereafter we will focus on students. Additionally, we have another pilot with the local hospital and its business centre. Currently we are preparing a joint research project with the Moscow and Kazan State universities. Conclusions: Voltage transient should be measurement when health effects of EMFs are inspected. We have acquired information how to design more sustainable devices and power transmission systems.

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