

## NTP analysis – Part II: design flaws and conclusions

As I have shown in [Part I](#) of my analysis, the National Toxicology Program cell phone studies ([rat study](#) and [mouse study](#)) produced large numbers of tumors in both species. The mice had fewer tumors than the rats. However, within each species, the numbers of both benign and malignant tumors were enormous and essentially the same for every level of exposure, including “unexposed.”

In Part II, I point out some serious design flaws in these studies and reach some conclusions about the meaning of the results that are much different than the conclusions reached by others.

### 1. Exposure levels were poorly controlled.

For the rat study, the SAR levels were stated to be 0, 1.5, 3, and 6 W/kg.

For the mouse study, the SAR levels were stated to be 0, 2.5, 5, and 10 W/kg.

Those were the *target* SAR levels. The *actual* SAR levels were all over the place. The “medium” exposure animals were often exposed to more radiation than the “high” exposure animals. Even the “low” exposure animals were sometimes exposed to more radiation than the “high” exposure animals. For example, these were the minimum and maximum exposure levels recorded during the two years for mice exposed to GSM radiation:

	<u>Minimum</u>	<u>Maximum</u>
“high”	3.290 W/kg	23.576 W/kg
“medium”	2.105 W/kg	11.918 W/kg
“low”	0.472 W/kg	4.060 W/kg

Instead of 10 W/kg, the “high” exposure mice were sometimes exposed to 23 W/kg. Instead of 5 W/kg, the “medium” exposure mice were sometimes exposed to almost 12 W/kg.

The range of exposures for the rats was even more scattered. These were the minimum and maximum levels recorded for male rats exposed to GSM radiation:

	<u>Minimum</u>	<u>Maximum</u>
“high”	0.734 W/kg	25.815 W/kg
“medium”	0.391 W/kg	10.692 W/kg
“low”	0.292 W/kg	5.732 W/kg

Instead of 6 W/kg, the “high” exposure rats were sometimes exposed to 25 W/kg. Instead of 3 W/kg, the “medium” exposure rats were sometimes exposed to 10 W/kg. The “low” exposure rats were sometimes exposed to almost 6 W/kg, which was the target level for the “high” exposure rats. This variation of exposure with time was a direct result of the constantly moving stirrers (see below), which rotated at a speed of between 1 and 50 revolutions per second, so that

the exposure level at any point in the chamber could change dramatically up to 50 times per second.

The purpose of the stirrers was to make sure that the radiation levels were uniform in space. This, however, was not achieved either. The cages at the top of the chamber were exposed to three to four times as much radiation as the cages at the bottom of the chamber. In an attempt to equalize the exposures, the researchers continually rotated the cages.

Despite the significant spatial variations and the enormous temporal variations, the NTP reports claim that the exposure levels were within the target range almost 100% of the time. How could that be? The answer is hidden in the definition of “target.” For example, the rat study defined the “high” target level of 6 W/kg to be met as long as the actual level was anywhere from 3.79 W/kg to 9.51 W/kg. The “medium” target was met if the actual level was anywhere from 1.89 to 4.75 W/kg. The “low” target was met if the actual level was anywhere from 0.95 to 2.38 W/kg.

In other words, the exposure levels were poorly controlled and there was no clear difference between “low,” “medium,” and “high.”

## **2. The “unexposed” chambers were not unexposed.**

Although the chambers were described as “fully shielded,” the shielding was stainless steel, which is not best, and the degree of shielding was either not measured or not reported.

In addition to the unknown degree of shielding, the different exposure chambers, as I noted in Part I, were not isolated from one another. There were multiple conductive pathways from the “exposed” chambers into the “unexposed” chambers: wiring, heating and air conditioning systems, exhaust ducts, coaxial cables, plumbing (an automated watering system supplied water to each cage via stainless steel tubes) and “other interconnections.” The microwave transmitters were connected to the common wiring. Radiation was conducted over multiple paths into all the chambers, resulting in both cell phone radiation and “dirty electricity” everywhere, including the “unexposed” chambers. In these reverberation chambers, the frequencies were amplified tremendously.

Although RF radiation between 40 MHz and 6 GHz was monitored every 20 seconds, lower frequencies were not monitored. Wired connections were filtered for microwave frequencies, but the degree of attenuation is not stated. Other conductive pathways were not filtered, and lower frequencies were not filtered.

The sources of radiation into the “unexposed” chambers were multiple:

**(a) Cell phone radiation: 900 MHz and 1900 MHz.** Cell phone radiation levels were monitored in every chamber every 20 seconds. However, the electric field sensors that were used (ER3DV6 E-field probes) were only capable of measuring down to 2 V/m, so the reported “0.0” values in all the “unexposed” chambers only means the radiation levels were less than 2 V/m. That is the same as  $1 \mu\text{W}/\text{cm}^2$ , and is a high level of exposure.

**(b) Switch-mode power supplies.** Each of the 18 RF antennas (one in each exposure chamber) was powered by a switch-mode power supply that converted the AC wall current to DC. Switch-mode power supplies are a notorious source of dirty electricity.

**(c) Variable frequency drives.** Each of the 21 chambers, including the 3 “unexposed” chambers, contained two motor-controlled “stirrers” with adjustable speed control. Variable frequency drives are another notorious source of dirty electricity.

**(d) Wireless microphones.** It is hard to believe, but the NTP reports state that the microphones, located in the air exhaust ducts, that monitored noise levels in each chamber, had a “design based on WL-93 microphone; Shure Brothers, Inc., Evanston, IL.” The WL-93 model is a wireless microphone.

**(e) Modulation frequencies from the cell phone transmitters.** Since the transmitters were powered by DC current, the cell phone modulation frequencies would have traveled through the building’s wiring and along the multiple other connections into the “unexposed” chambers.

**(f) Modulation frequencies from the stirrers.** The antenna in each of the 18 exposure rooms was directed toward one of the two “stirrers.” The stirrers were metallic, reflective contraptions that rotated at a variable speed between 1 and 50 rpm. Their purpose was to “mix” the radiation in the chamber so as to produce a uniform power level. First of all this did not work (see above: actual radiation levels in individual chambers varied spatially up to 4-fold and temporally up to 35-fold). Secondly, this modulated the radiation at additional frequencies of 1 to 50 Hz, which further confounded the results in the “exposed” chambers and leaked via multiple paths into the “unexposed” chambers.

### **3. The hematology and blood chemistry results were averaged and outlying values were eliminated.**

At 14 weeks into the studies, blood from some of the animals was drawn and analyzed, and then the results were all averaged together. The researchers virtually admitted that the results were abnormal. Hematology and clinical chemistry, they wrote, “have typically skewed distributions.” Further, they wrote, “implausible values were eliminated from the analysis.” One way to hide abnormal data is by throwing out the most extreme values and then averaging the rest.

As of today, the NIH has not released the individual hematology and clinical chemistry results for any animals.

### **4. The animals were fed irradiated food and had irradiated bedding.**

The safety of irradiated food has long been controversial. Reported effects of irradiated food include premature death, genetic damage, reproductive problems, residual radioactivity, immune system dysfunction, internal bleeding, organ damage, tumors, blood disorders, nutritional deficiencies and stunted growth. (Public Citizen, “Questioning Food Irradiation: A History of Research into the Safety of Irradiated Foods,” Washington, DC, April 2003). This was another completely unnecessary confounding factor that confused the interpretation of the results.

## 5. The authors cherry-picked the data

There were no significant differences between the total number of cancers in the highest-exposed animals and the total number of cancers in the supposedly unexposed animals. Therefore the authors tried to see if there was any particular kind of cancer that was significantly more frequent in the exposed than in the unexposed animals, and they found one. Supposedly. In the CDMA-exposed male rats, they found 6 schwannomas of the heart in the most highly exposed animals, versus none in the unexposed animals. In the GSM-exposed male rats, they found 5 schwannomas of the heart in the most highly exposed animals, versus none in the unexposed animals. The statistical significance of those findings was called “marginal.” And schwannomas in general were not significantly higher in the exposed animals. Only shwannomas of the heart. And only in male rats. Not in female rats and not in mice. In fact, the mice in the experiments developed no schwannomas of any kind in any of their organs.

### Total number of schwannomas

	Male rats CDMA	Male rats GSM	Female rats CDMA	Female rats GSM	All mice	
6 W/kg	12	8	4	2	0 W/kg	0
3 W/kg	6	12	2	8	2.5 W/kg	0
1.5 W/kg	12	5	2	5	5 W/kg	0
0 W/kg	7	7	6	6	10 W/kg	0

## 6. Conflicts of interest: The test facility was designed, maintained and monitored by the telecommunications industry.

The IT’IS Foundation designed, built, maintained, measured, and monitored the chambers and the exposure system throughout the studies. It installed all system hardware and software. The IT’IS Foundation is funded in large part by telecommunications companies, including the CTIA, the GSM Association, AT&T, Deutsche Telecom, Nokia, Qualcomm, Samsung, Motorola, Mitsubishi, Ericsson, Vodafone, DoCoMo, Intel, TCT Mobile (Alcatel and Blackberry), Sunrise Communications, Panasonic, SONY, Safran (French aerospace and defense company), Phonak Communications, LG Electronics, Cisco Systems, the Association of Radio Industries and Businesses, and the Foundation on Mobile Communications (Switzerland). The full lists of sponsors and partners are here: <https://www.itis.ethz.ch/who-we-are/funding/> and <https://www.itis.ethz.ch/who-we-are/partners/>.

The technical aspects of the exposure system are not in the open literature and are not available from the NIH. They were published in *IEEE Transactions on Electromagnetic Compatibility*, Vol. 49, No. 4, August 2017, pp. 1041-1052, and I had to purchase the article in order to read it. The title is “A Radio Frequency Radiation Exposure System for Rodents Based on Reverberation Chambers.” Of the 11 authors, 4 work for the IT’IS Foundation, 1 used to work for the IT’IS Foundation, one works for Siemens Mobility, one has worked for Motorola, and one has worked for the Mobile Telecommunications and Health Research Programme of the U.K.

## Conclusions

These were poorly designed, poorly controlled studies conducted by scientists with blatant conflicts of interest.

There were no unexposed groups of animals. There were huge numbers of tumors at every exposure level: 1  $\mu\text{W}/\text{cm}^2$ , 5  $\text{mW}/\text{cm}^2$ , 10  $\text{mW}/\text{cm}^2$ , and 20  $\text{mW}/\text{cm}^2$  (rats); 1  $\mu\text{W}/\text{cm}^2$ , 4  $\text{mW}/\text{cm}^2$ , 8  $\text{mW}/\text{cm}^2$ , and 16  $\text{mW}/\text{cm}^2$  (mice).

In the Chou et al. (1992) study the malignant tumor incidence in unirradiated male rats was 5%, and in irradiated rats was 18%. In the NTP study it was 36%.

In the Chou et al. study there were 76 tumors among 100 unirradiated male rats, and 116 tumors among 100 irradiated male rats. In the NTP study there were 228 tumors per 100 male rats.

Chou et al. found that RF radiation at an SAR of 0.4 W/kg causes cancer. The NTP study found that RF radiation, both at much higher and much lower SARs, causes cancer.

The NTP study reported that a tiny number of schwannomas of the heart were more frequent in the exposed than in the unexposed animals. This was of marginal significance and was only found in male rats—not in female rats and not in mice. There were no schwannomas at all in any of the mice. There was no difference in the total number of schwannomas of all organs between the exposed and unexposed rats, male or female.

Despite this being a poorly designed study it is evidence that RF radiation, at all exposure levels, causes cancer. Not just a tiny number of schwannomas of the heart, but large numbers of all types of cancer. There is no basis on which to conclude that the schwannomas were caused by RF radiation but the other tumors were not. The most significant difference between the NTP (2018) study and the Chou et al. (1992) study is the multitude of other sources, types, and frequencies of radiation that the NTP animals were exposed to. There were no stirrers, reverberation chambers, switch-mode power supplies, variable frequency drives, wireless microphones, cell phone modulation frequencies, irradiated food, or irradiated bedding in the 1992 study, just a single pulsed 2,450 MHz signal. It caused less cancer because it exposed the animals to less radiation. By less radiation I don't mean less power.

It is not the power level that does the harm. It is the degree of coherence, type and depth of modulation, wavelength, number of frequencies, number of signals, bandwidth, shape of the waves, pulse height, pulse width, rise and fall time, and other properties of the radiation. The unimportance of power levels for effects other than heat has been shown many times. In Salford's studies<sup>1</sup> the lowest power levels caused the most leakage in the blood-brain barrier. Blackman,<sup>2</sup> Bawin,<sup>3</sup> Dutta,<sup>4</sup> Schwartz,<sup>5</sup> and Kunjilwar,<sup>6</sup> all in different laboratories, found that calcium efflux from neural and cardiac cells occurred at specific frequencies and exposure levels and did not increase with power. In Dutta's study a 3,000-fold decrease in power caused a 4-fold *increase* in calcium efflux. Sadchikova<sup>7,8</sup> and her Soviet colleagues found that workers exposed

to the lowest power levels suffered more often from radio wave sickness. Belyaev<sup>9</sup> found that genetic effects occurred at specific frequencies and the magnitude of the effect did not change with power level over 16 orders of magnitude.

My conclusion from the NTP studies is that RF radiation causes a lot of both malignant and benign tumors at every exposure level. The assumption that there is a dose response, i.e. higher power levels cause more cancer, is proven wrong.

The assumption that wireless technology can be made safe by reducing the power is proven wrong.

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<sup>1</sup> Persson, B. R. R., Salford, L. G., Brun, A. (1997). Blood-brain barrier permeability in rats exposed to electromagnetic fields used in wireless communications. *Wireless Networks* 3:455-461.

<sup>2</sup> Blackman, C. F. et al. (1980). Induction of calcium-ion efflux from brain tissue by radiofrequency radiation. *Bioelectromagnetics* 1:35-43.

<sup>3</sup> Bawin, S. M., Kaczmarek, L. K. and Adey, W. R. (1970). Effects of modulated VHF fields on the central nervous system. *Annals of the New York Academy of Sciences* 247:74-80.

<sup>4</sup> Dutta, S. et al. (1986). Microwave radiation-induced calcium ion flux from human neuroblastoma cells: dependence on depth of amplitude modulation and exposure time. In *Biological Effects of Electropollution*, S. Dutta and R. Millis, eds. Information Ventures, Phila., pp. 63-69.

<sup>5</sup> Schwartz, J.-L. et al. (1990). Exposure of frog hearts to CW or amplitude-modulated VHF fields: selective efflux of calcium ions at 16 Hz. *Bioelectromagnetics* 11: 349-358.

<sup>6</sup> Kunjilwar, K. K. and Behari, J. (1993). Effect of amplitude-modulated RF radiation on cholinergic system of developing rats. *Brain Research* 601:321-324.

<sup>7</sup> Sadchikova, M. N. (1960). State of the nervous system under the influence of UHF. In *Biological Action of Ultrahigh Frequencies*, A. A. Letavet and Z. V. Gordon, eds., Academy of Medical Sciences, Moscow, pp. 25-29.

<sup>8</sup> Sadchikova, M. N. (1973). Clinical manifestations of reactions to microwave irradiation in various occupational groups. In *Biologic Effects and Health Hazards of Microwave Radiation: Proceedings of an International Symposium*, Warsaw, 15-18 Oct., 1973, P. Czerski et al., eds., Polish Medical Publishers, Warsaw, pp. 261-267.

<sup>9</sup> Belyaev, I. Y. et al. (1996). Resonance effect of millimeter waves in the power range from  $10^{-19}$  to  $3 \times 10^{-3}$  W/cm<sup>2</sup> on *Escherichia coli* cells at different concentrations. *Bioelectromagnetics* 17: 312-321.