Nicholas H. Steneck, Ed., *Risk/Benefit Analysis: The Microwave Case*

Glaser

COMMENTS ON OCCUPATIONAL SAFETY AND HEALTH PRACTICES IN THE USSR AND SOME EAST EUROPEAN COUNTRIES: A POSSIBLE DILEMMA IN RISK ASSESSMENT OF RF AND MICROWAVE RADIATION BIOEFFECTS

Zorach (Zory) R. Glaser and Christopher H. Dodge

This presentation is an outgrowth of informal discussions that took place at the International Union of Radio Science (URSI) Meeting (on RF/microwave radiation bioeffects), held in 1977 at Airlie House, Va., and at subsequent international gatherings, with concerned scientific officials from the USSR, Poland, Czechoslovakia, East Germany, and others. The discussions concerned occupational safety and health doctrine as it pertains to the setting of RF/microwave radiation standards in those countries. The conclusions arrived at following the discussions help to explain why one so often reads in the Soviet and some East European literature (in contrast to the U.S. literature) references to so many subjective and reversible symptoms (such as neurasthenia), which are attributed to very low exposure to RF energy. It is thought that the conclusions, or at least some of the reasons for the apparent differences, are relevant to the issue of applying cost/benefit analysis to the resolution of the microwave bioeffects "problem."

This paper is not necessarily a contrast between the East and the West, but rather a discussion of general protection philosophy (and differences in that philosophy) at present in use in various locations in the world. Many of the comments would also be valid for Scandinavian countries (particularly Sweden) and West Germany, where the occupational health and safety law, and worker involvement in the development and application of such law, is strong and progressive. It also appears that some of the comments are applicable, but perhaps to a somewhat lesser degree, to Britain and Canada.

It is obvious that there are vast differences in doctrine and philosophy between the USA on one hand and the USSR and most East European countries on the other hand when it comes to human exposure standards for RF and microwave radiation.

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*The opinions or assertions expressed in this paper are the authors' only, and are not to be construed to represent the views of the Bureau of Radiological Health, FDA, or the Library of Congress.

These differences continue to present sources of confusion and frustration for those who, for many years, have been reviewing the RF bioeffects literature. Soviet and East European clinical surveys of workers exposed to RF and microwave fields contrast sharply with the as yet few studies of this type conducted in the West. The Soviet and East European surveys are numerous and apparently comprehensive in their scope, but the findings reported in these studies have in general not been corroborated in the West.

Soviet and East European studies regularly report a vast array of subjective symptoms of a reversible nature in workers apparently exposed to very low level RF fields (intensities far less than 10 mW/cm^2). As an example, the "radiowave illness" or "microwave disease" is a classical diagnostic entity often mentioned in the Soviet literature. The disease is characterized by Sadchikova (1960) and Sadchikova and Nikonova (1971) as a complex of autonomic, vascular disturbances with crises of cerebral and coronary-vascular insufficiency. Asthenic symptoms are characteristic. The asthenic syndrome (i.e., weakness, lethargy, and insomnia) is said to appear in isolation early in the development of "microwave disease." Vascular hypertonia is typical in the moderately advanced stage. Hypothalamic autonomically associated deficits of vascular function are said to be typical for the well-advanced stage.

More often than not it is virtually impossible for the Western reviewer to ascertain from the data presented even the approximate parameters of the incident RF radiation, the RF source, or the exposure conditions in order to establish a credible correlate between the incident RF fields, the dose (i.e., the quantity of RF energy absorbed by the body), and the clinical symptoms reported. As a result, many Soviet and East European studies have been held in low repute in the West. Opinions of these studies range from sarcastic disbelief to mild skepticism.

Discussions with Soviet and East European Scientists

We addressed the discrepancy between the Eastern and Western approaches to RF radiation safety standards and research at an international meeting sponsored by URSI (International Union of Radio Science) on the biological effects and mechanisms of RF/microwave radiation, held in 1977 at Airlie House in Virginia. At a special evening session on occupational aspects of microwave radiation exposure, the following series of questions were posed to colleagues from the USSR, Czechoslovakia, Poland, and East Germany who had traveled to the USA to discuss differences and compare notes. We queried:

As you know, studies of this nature (i.e., occupational surveys), particularly the results, appear to differ substantially depending on where they are conducted. Reports of subjective symptoms of RF electromagnetic (EM) radiation exposure are nearly never reported in the West, but they are reported frequently in the USSR, Czechoslovakia, and Poland. Can you please explain for us why that is so? Could not many of the symptoms reported in these studies be attributable to other physical, health, or emotional factors (e.g., noise, chemicals, vibration, job stress, general health, personal problems, etc.)? Why does there appear to us to be more willingness in your countries to attribute the many human malfunctions reported as responses to weak EM fields? If there is such a strong feeling in your countries that EM fields are responsible for so many human malfunctions of a reversible nature, what is being done to change exposure standards or to improve the definitions of exposure conditions in order to establish a stronger correlate between exposure to EM fields and the many symptoms you report?

Although there was some apprehension that these questions might antagonize the visiting scientists, it came as a pleasant surprise that responses were immediate, spontaneous, and positive. One East German scientist* explained his country's philosophy on occupational standards by stating that it is better to have stringent standards than to risk injury to the worker. (For a discussion of East German and other East European exposure standards, see the paper by P. Czerski in this volume.) The East German scientist stated that the Soviet standard of 0.01 mW/cm^2 for an 8hr exposure might be unrealistically low, and hence felt that East Germany might move toward the slightly more lenient Polish standard of 0.1 mW/cm^2 for an 8hr exposure. What that means is that the present East German standard is an order of magnitude (i.e., 10 times) lower than the Polish standard, and approximately three orders of magnitude below the U.S. standard (Table 1).

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*This paper is the result of private, informal discussions, held over a period of years with many international experts. We had no opportunity to submit this paper to the sources of our information for their authorization to cite their names. Their statements were *not* public policy pronouncements. In view of that, we chose to omit most names so as to avoid any breach of confidence. The authors assume full responsibility for the text.

TABLE 1.--Comparative table of international occupational RF exposure standards/guidelines.

Frequency Range	Country or Agency	Specifications
Maximum permissible power density, 10 mW/cm^2 or above		
0.06-1.5 MHz	BULGARIA(s),USSR(s)	(5 A/m permitted)
10 MHz-100 GHz	USA: OSHA(s)	10 mW/cm^2
10 MHz-100 GHz	ANSI(g)'74	200 V/m, 0.5 A/m 40 000 V^2/m^2, 0.25 A^2/m^2
0.3-10 MHz	ANSI(p,g)'81	(up to 100 mW/cm^2 (400 000 V^2/m^2, 2.5 A^2/m^2) below 3 MHz
300 MHz-300 GHz	ACGIH(g)	10-25 mW/cm^2, 10 min/hr
0.01-10 MHz 1-300 GHz	ACGIH(p,g)'81	10 mW/cm^2 TLV†, 25 mW/cm^2 ceiling (up to 100 mW/cm^2)* 10 mW/cm^2
Maximum permissible power density, 1-10 mW/cm^2		
10-17 MHz	AUSTRALIA(p)	(up to 2.4 mW/cm^2)*
1.3-3 GHz		(up to 1.5 mW/cm^2)*
3-300 GHz		1.5 mW/cm^2
30-50 MHz	BULGARIA(s),USSR(s)	(0.3 A/m permitted, 3.3 mW/cm^2)
10 MHz-1 GHz	CANADA(s)	1 mW/cm^2, 60 V/m, 0.16 A/m
1-300 GHz		5 mW/cm^2, 140 V/m, 0.36 A/m
0.1-10 MHz	POLAND(s)	(70 V/m, 1.3 mW/cm^2) IZ**
10-300 MHz	SWEDEN(s)'76	5 mW/cm^2
300 MHz-300 GHz		1 mW/cm^2
10 MHz-300 GHz	USA: ANSI(p,g)'81	(up to 10 mW/cm^2)**, 10-30 MHz 1 mW/cm^2 (60V/m, .16A/m), 30-300 MHz (up to 5 mW/cm^2)**, 300-1500 MHz 5 mW/cm^2, 1500 MHz-100 GHz
Maximum permissible power density, 0.1-1 mW/cm^2		
17-30 MHz	AUSTRALIA(p)	(1.0-0.2 mW/cm^2)*
30-1300 MHz		(0.2-1.0 mW/cm^2)*
0.06-3 MHz	BULGARIA(s),USSR(s), GERMAN DEM. REP.(s)	(50 V/m, 0.65 mW/cm^2)
3-30 MHz		(20 V/m, 0.1 mW/cm^2)
0.03-30 MHz	CZECHOSLOVAKIA(s)	(50 V/m, 0.65 mW/cm^2)
Maximum permissible power density, 0.025-0.1 mW/cm^2		
30-50 MHz	BULGARIA(s),USSR(s), GERMAN DEM. REP.(s)	10 V/m, (0.025 mW/cm^2)
300 MHz-300 GHz	USSR(s),rot. antenna	(up to 0.1 mW/cm^2)
30-300 MHz	CZECHOSLOVAKIA(s)	10 V/m, (0.025 mW/cm^2)
0.1-10 MHz	POLAND(s)	<20 V/m "Safe Zone"
300 MHz-300 GHz	(stationary antenna)	(0.01-0.2 mW/cm) IZ**

KEY: p = proposal
s = standard
g = guideline (or voluntary standard)
* depending on frequency
** IZ = intermediate zone
† threshold limit value (revision proposed)

(Table cont'd)

Table 1 (Cont'd)

Maximum permissible power density, 0.01-0.025 mW/cm^2		
300 MHz-300 GHz	BULGARIA(s)	(up to 0.01 mW/cm^2)
300 MHZ-300 GHz	CZECHOSLOVAKIA(s)	(25 μW/cm^2 CW, 10 μW/cm^2 pulsed)
50-300 MHz	GERMAN DEM. REP.(s)	5 V/m (< 0.01 mW/cm^2)
300 MHz-300 GHz	(stationary)	10 μW/cm
	(rotating)	(for comparison, 100 μW/cm^2)
10-300 MHz	POLAND(s)	7-20 V/m (0.013-0.1 mW/cm^2) IZ**
300 MHz-300 GHz		0.01-0.02 mW/cm^2 IZ**
50-300 MHz	USSR(s)	5 V/m (< 0.01 mW/cm^2)
300 MHz-300 GHz	(stationary)	(up to 0.01 mW/cm^2)

KEY: s = standard
** IZ = intermediate zone

Also see Fig. 1 at end of chapter.

One of the Czechoslovakian scientists has for many years reported a wide range of subjective symptoms that are attributed to RF exposure. Moreover, it is maintained that the Czech scientist did take other factors into account (e.g., job stress, lighting, air pollution, etc.) as possible causative agents in the studies. (However, the consideration of these and/or other factors has not been implicit in Czechoslovakian and most other selected East European and Soviet clinical surveys, which strongly implicate RF energy as the causative factor). True to this belief, the Czech representatives at the Airlie House meeting strongly defended their country's occupational survey practices; they stated that their survey methods are comprehensive and take into consideration such factors as physical health, mental health, and physical surroundings (in the workplace and in the home). Occupational personnel in Poland, Czechoslovakia, and the USSR are allegedly subjected to a far more comprehensive array of clinical tests than are occupational personnel in the USA. A Czech scientist suggested that the comprehensiveness of clinical survey methods in East European countries might explain differences in the effects reported from those countries and from the USA.

Most of the RF/microwave radiation human studies conducted in the East are based (it is claimed) on actual examinations of the workers involved, usually by a team of medical specialists. The examination generally includes the completion by the examinee of a detailed questionnaire, which allows the examinee to describe any complaints or "symptoms." The team of medical specialists conducting the examination often includes an internist (or a physician specializing in occupational medicine), and a neurologist;

an ophthalmologist is also often involved, it is reported.

In early RF/microwave radiation studies conducted in the Soviet Union and in Poland (and probably also in Czechoslovakia), there existed teams of physicians and special clinics (for the study of occupational diseases) which were involved in the physical exam processes. In many instances, particularly in the military medical community, the individuals were brought into a hospital for several days so as to conduct the complete examination. On the other hand, most studies conducted in the West were based on questionnaires, and *not* on actual examination of the "patients."

As concerns exposure conditions in the human epidemiologic studies, there are almost no studies that provide information on the conditions of exposure, or dose received. Since personal dosimetry did not exist at the time most of the studies were conducted, and since personal dosimetry still essentially does not exist, the human studies (such as case reports of accidental RF overexposure), and particularly the epidemiologic assessments, do not include much information regarding the exposure or the dose of RF energy received by the subject. However, attempts to characterize the exposure *were* made in a small number of studies, for example, Czerski et al. (1974), Barański and Czerski (1976), Gordon et al. (1974), and Gordon (1964). In the first example, exposure was classified into "low," "medium," or "high" exposure. The criticism relating to the lack of exposure and absorption data is generally true of the Eastern studies as well as the Western studies. Also, most of the epidemiologic and/or human studies have been conducted on military personnel or in a military environment.

The corollary to the Eastern view, from the Western viewpoint, is that if one is trying diligently to find something wrong with a person, the person being examined might be inclined to comply by reporting symptoms just to satisfy the examiner. Indeed, in such an environment, it would not be surprising to encounter a certain degree of hypochrondria in a working population that is sensitive to the occupational health scrutiny being accorded to it.

For example, an interesting point was recently made by Pazderová-Vejlupková (1981) cautioning that one must not "overestimate the hygienic significance of subjective complaints of some East European workers who receive additional wages [i.e., hazardous-duty pay] for working in environments where microwaves, short waves, and other radio waves are found." She suggests that "some workers will exaggerate in discussing their problems out of fear they will lose their extra pay," and cautions those evaluating the bioeffects of RF energy and those involved in standards setting to adhere

"to the principle of objectivity." It has also recently come to our attention that in some East European countries, workers involved with RF/microwave radiation are rewarded by a shorter work week.

In any event, a Czech scientist at the 1977 Airlie House meeting in general defended the reported epidemiological studies by arguing that the *comprehensive nature* of Soviet and East European epidemiologic studies might explain the large number of symptoms reported in workers exposed to RF energy. The message somehow came across that if workers in the West were examined as carefully as workers in the East, the same types of symptoms might be observed. This is a point worth returning to later because it is troublesome, and relates directly to the purpose of this paper, i.e., risk/benefit analysis.

One Soviet speaker pointed out that there have traditionally been differences between methods used in the East and West to survey the health of occupationally exposed personnel. Like the Czech speakers, he defended the comprehensive nature of Soviet human health survey methodology, pointing out that their studies take into account many physical factors in the environment, as well as the worker's physical and mental health background. (This point is generally not evident in their published reports.) He vigorously denied that the many symptoms related to RF/microwave exposure in the Soviet literature ignored the possibility of other causalities, and maintained that other factors, such as environmental temperature and other environmental factors, job stress, and personal habits, were indeed taken into consideration. (As noted earlier regarding the Czech literature, that point is seldom articulated in Soviet occupational literature concerned with RF exposure. To the Western reviewer of much of the Soviet RF bioeffects literature, the correlation between symptoms and RF exposure always emerges as very strong.) He acknowledged that there was skepticism in the West about Soviet and some East European clinical findings, as well as about reports on low-level biological effects allegedly resulting from exposure to other physical and environmental factors. But he was quick to point out that such skepticism was being eroded by recent Western findings of low-level RF/microwave radiation bioeffects. Differences between clinical findings in the East and West were attributed (in part) to the conduct of more comprehensive health (i.e., physical/medical) examinations given to workers in the East, particularly those exposed to RF/microwave radiation, compared with the type of physical examination/health screening performed in the West. Some of our East European colleagues believe that physicians

in the East are more sensitive to occupational-health issues than physicians in the West. This, in their view, may explain why so many "symptoms" of exposure to RF/microwave radiation and other stresses are reported in the East, as contrasted with the apparent lack of such symptoms (at least those being reported) in the West.

The Soviet scientist expressed optimism that remaining differences in the occupational arena might better be resolved as a result of existing and future USSR/selected East European/U.S. scientific exchanges, most notably the USA/USSR Working Group on Physical Factors in the Environment.* In general he, like his Czechoslovakian co-worker, strongly (and comprehensively) defended Soviet occupational findings and methods. His main message, which was reiterated later by Polish scientists, was that Soviet occupational assessments of safety and health are more comprehensive and more personalized than in the West, and therefore more beneficial to the worker.

Occasionally, these optimistic assessments of the East European work were not borne out in fact. A paper from Czechoslovakia formally presented during the 1977 Airlie House meeting contained information implicating microwaves in a number of human developmental dysfunctions. However, when questioned, the author was unable to confirm that cases of encephalopathy, "psychic damage," and "neurotic" syndromes observed in children or their children could be linked directly to microwave exposure; nor was the author able to report any microwave exposure parameters (such as duration of exposure, field intensity, availability of shielding, etc.). So the contrasts and the dilemma remained, and have remained to this day, a major issue for questioning and debate.

In an attempt to conduct an *economic analysis* to aid in the risk/benefit evaluation, the following information is provided, based on discussions with the Soviet and East European scientists. In most East European countries and the USSR, where the state is the employer, health care is provided by the state, and thus is "free" to the worker.

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*The Biological Effects of Microwave/RF Radiation portion of the USA/USSR scientific exchange program, which has been going on for a number of years, has been of considerable value toward a better understanding of the general philosophy of the industrial hygiene/occupational medicine and epidemiological studies, the interpretation of the laboratory animal studies, and of the protective guides/exposure standards published by the Soviet Union and East European countries.

The absence of a worker from his or her job or decreased output from the worker is considered as a production loss (in terms of cost). To this "cost" is added the salary of the worker while he is on sick leave; any other costs incurred with his health care (including laboratory tests, treatment, diagnosis, etc.) are added to the cost. The sum of these costs is termed cost A. This calculation is probably easy to perform in a state-run enterprise.

Expenses involved in enforcing the standard are termed cost B. Such a calculation is probably not an easy one to make. If cost B is less than cost A, the outcome of the cost/benefit ratio (A/B) is "positive." This example is provided form the East European literature, and is outlined in a Soviet book entitled *Nonionizing Radiation Protection*, by Krylov and Yuchenkova (1972). The calculation appears simple in its description. While it is somewhat different from the procedure used in many Western countries, it does not differ entirely from our present concept.

Regarding worker compensation, if a worker is unable to continue in his occupation because of injury or occupational disease, the employer has an obligation to provide for the retaining of the worker; and during the period of training, the employer pays the worker's usual salary. Obviously, this factor must be considered in the calculation of the cost of the standard (or the lack of a standard).

General Philosophy

All scientists, East and West, lack an indepth understanding of the mechanisms through which humans respond to RF energy. Our knowledge certainly is not by any means thorough. It is not even partial, especially for low-level effects. Most of our "knowledge" about RF/microwave effects comes from *animal* experiments, and the applicability of these studies to approximate the *human* responses to RF energy have been challenged. Given the lack of information, the philosophies that stand behind standard-setting processes become vitally important.

There is some disagreement between East and West regarding the interpretation of the "effects" of RF energy, their reversibility, and even which acknowledged "effects" represent "hazards" to man. The question also arises, when is a biological change of significance in the disease process? These questions and factors must be considered in the setting of exposure standards for RF/ microwave energy.

Soviet and some East European policy makers (e.g., Petrov 1970) believe in general that *any* effect of an e-m field must be taken into consideration, from a policy-making point of

view, if it affects the "comfort zone" of the individual. This presumptive philosophy is imbedded in the basic scientific philosophies of those countries, and dictates that any physical factor that affects physiological or behavioral homeostasis must be considered to be outside the "zone of comfort" and therefore a potential risk to the health of the individual. On the other hand, we understand (Glaser and Dodge 1976) that exemptions are reportedly granted to some segments of the user community (in Soviet and some East European countries) from their very low exposure "standards." This point has recently been disputed (at least for Poland) by a respected Polish microwave scientist.

Juxtaposed against this conservative philosophy is the Western belief that if no statistically reliable change in physiological or behavioral homeostasis as a result of exposure to RF/microwave energy can be measured, and if such exposure cannot be demonstrated to cause measurable heating in tissues, then it cannot be considered to present a hazard to health. In other words, Western policy makers look for demonstrable evidence of harm before proceeding to set standards; Eastern policy makers look instead for the existence of deviations from normalcy.

Definitions of Safety and Risk

The differences between Eastern and Western standard-setting policies do not further reduce to conceptions of "safety." For the Soviet and many East European countries, "safety" apparently is simply defined as the prevention or elimination of irreversible injury or accidents in the workplace. Obvious or acute effects of a physical stress, such as the irreversible damage produced by some "thermalizing" doses of RF/microwave radiation, are in this category in both the East and West. Thus, there is little difference between the Eastern and Western definitions of "safety." Such is not true for the definition of "risk," however.

In some East European countries, "risk" is taken to encompass conditions covered under the term "hygiene," defined as the prevention of subtle or reversible injury from physical or chemical agents or industrial processes, especially in areas for which risk factors (in the generally accepted Western meaning) are poorly defined or understood. In other words, in those countries, "safety" involves pure practice, whereas "risk" or "hygiene" is slightly more empirical than theoretical in the sense that legal mechanisms for implementing policies for compensation of officially acknowledged injuries appear to us to be stronger in the East than in the West.

The reported basic philosophy in occupational hygiene

and medicine, and in public health in the East, attempts to take the path that leads to the least damage to the human body, especially when knowledge about potential risk factors is limited. Nonthermal (or athermal) effects of RF/microwave radiation appear to be included in this category. If it doesn't burn you, and doesn't make you feel bad, it's OK. If it doesn't burn you, but *does* make you feel bad, it's a problem. That is how the Soviets and most other East Europeans appear to have approached the RF bioeffects problem.

One of our scientific associates from Poland characterized practical medicine as being a clearcut discipline in occupational "safety," whereas "hygiene" was defined as an inexact combination of sciences in a primitive stage of development. "Hygiene," be suggested, consists of approximately 40% medicine, 30% economics, and 30% "technique development" (or engineering practices). In other words, hygienic practices in the East are closely associated with economics (e.g., "costs"). The setting of occupational standards for physical hazards is based on the results of risk/benefit analyses that have taken into account (1) the magnitude of the potential risk to the worker's health, based on available bioeffects data; (2) the cost to the economy (calculated, as noted earlier) of the proposed standard; and (3) the assumed benefits to be derived from the proposed standard, to both the worker and the economy. This view of "hygiene/risk" helps explain the greater attention given to occupational surveys in the East.

The basic philosophy apparently prevailing in the East with regard to occupational hazards is that any manmade factor in the environment may be considered as a potential hazard. Therefore, "hygiene" in the East is designed to preserve (to the extent practical) the natural homeostasis of the human body. One of our East European associates strongly believes that the clinical information on RF/microwave effects, although difficult to explain in many cases, is too compelling to ignore. Therefore, even weak microwave fields are regarded in practice as potential hazards. This philosophy, which is embraced in the USSR and other East and certain Western European countries, may provide a partial explanation for the lower microwave exposure standards in those countries. Neither the data from animal nor human studies provide a very compelling explanation for the many low-level symptoms reported in the literature, unless, of course, one looks at the preponderance of "hygienic surveys" conducted by those countries as far back as 1948, and continuing to this day, involving literally thousands of people, many of whom are reported to be suffering from various symptoms of exposure to low-level RF/microwave fields (Dodge 1970).

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To accentuate and reiterate the perplexing nature of symptomatology reported in response to microwaves, one of our Polish colleagues at Airlie House in 1977 cited several examples of worker health surveys in which he was personally involved. He noted altered menstrual cycles in women workers chronically exposed to RF radiation from RF dielectric heating and sealing devices; male workers in one factory who could "sense [and almost quantitate] the presence of microwave energy" at the power levels actually measured, but could not explain how or why they could do it; and curious episodes of mental illness and aberrant behavior in 10% of a male workforce (that had been noted previously for its high morale and productivity), after alleged exposure to microwaves over a three-year period. He acknowledged that these cases were difficult to evaluate in terms of the correlation of the reported symptoms with microwave exposure, but in the absence of any other explanations for the findings, he was forced to implicate the microwave radiation exposure.

Conclusions

To summarize these perceptions, it would seem that there are significant and fundamental differences between Eastern and Western approaches to the treatment of occupational health data on RF/microwave radiation workers, insofar as the establishment of exposure standards are concerned. In Soviet and some East European countries, workers are apparently subjected to comprehensive, multifaceted, and periodic physical and mental (i.e., psychological) examinations. In the West, workers often receive only a general physical examination, if any at all, and follow-up examinations are generally not required. The field of occupational hygiene in the East differs from its Western counterpart in philosophy, definition, and approach. These fundamental differences may help to explain (a) why Soviet and most East European reports of clinical findings of workers occupationally exposed to RF/microwaves are more numerous than in the West, (b) why many symptoms of microwave exposure reported in the East are not reported in the West, and (c) why occupational exposure standards are lower in the East than in the West.

It is also interesting to note the lack of most adverse clinical findings in Western workers who are "protected" by a recommended standard, endorsed by OSHA, of 10 mW/cm^2 for an 8-hour day, which is many times higher than either the Soviet, Czechoslovak, or Polish standard. At the same time, a certain amount of agreement (or at least awareness) about low-level microwave bioeffects is being established, as

evidenced by the many papers presented at recent scientific symposia on the subject.

What are the benefits of these lower RF/microwave radiation exposure standards for the population in these countries? What is the impact on risk/cost/benefit analysis? Before one can formulate answers to such questions, one has to define clearly such terms as "risk," "hazard," "benefit," and "analysis." The East and the West use different definitions for some of these terms, and the different definitions result in different "costs." For example, the Soviets and most East Europeans are willing to work within so called "comfort" limits, whereas Western philosophy establishes an allowed exposure below a so called "hazard" level (modified by a predetermined safety factor).

Does acceptance of the Eastern philosophy (for establishment of RF/microwave radiation exposure standards) imply that we must accept their bioeffects data? Obviously, much of their data does not fit our standard-setting philosophy. Can we afford to dismiss their bioeffects data? The dilemma arises: many of the RF/microwave bioeffects scientists in the West have tended to deride and dismiss most of the early reports of low-level effects, most of which came from Soviet and East European laboratories. Now we are tending to accept *some* of the reports of low-level effects as valid, especially since some of the recent studies showing effects at low exposure levels come from respected Western scientists.

In the absence of quantitative indicators of productivity in the East against which to compare like indicators in the West, it is difficult to state unequivocally that the conservative approach to protection of the worker (from RF/microwave radiation) in the East is more beneficial than the less conservative Western approach. It can be speculated that the costs of implementing conservative safety doctrines in the East are greater than those incurred in the West. Therefore, one can also speculate that costs (in terms of decreased productivity) of more restrictive safety standards for RF/microwave radiation exposure in the East are higher than those costs in the West, particularly when one considers the increased awareness of the occupational and general populations to RF/microwave radiation exposure and possible hazards in those countries. The speculation that the costs are high to society and to the economies of Eastern countries is also supported by the many reports from these countries that continue to report a multitude of reversible symptoms as a result of chronic occupational exposure to even very weak RF/microwave fields. What are the benefits of these lower occupational exposure standards to

the populations in those countries? We have no answer. In view of possibly more restrictive RF exposure standards being considered in the West, it is hoped that this issue will be discussed in more detail at future international conferences and technical exchanges on RF/microwave biological effects and standards.

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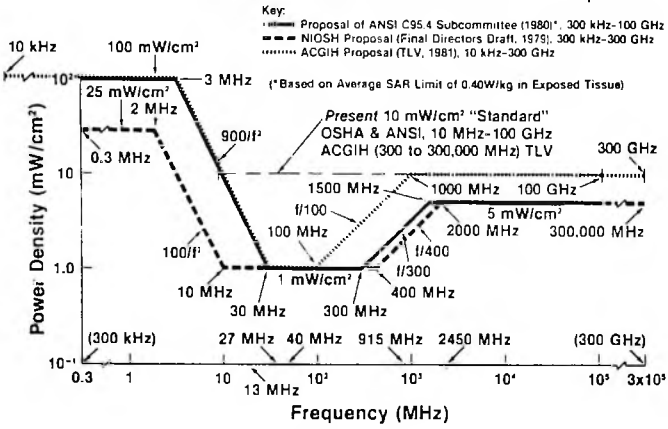

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