

Glaser

Health Surveillance of Microwave Hazards

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⊗ Since the early 1940's, industrial use of electronic equipment that emits electromagnetic energy in the microwave region has increased. Concurrent with this growth has been the development of data on the biological effects of this form of radiant energy and the establishment of exposure criteria. Of equal importance in protecting the health of exposed persons is the evaluation, by qualified occupational health personnel, of the electronic equipment as it is used in the workplace by reliable and accepted environmental health techniques.

Various local, state, and federal health programs and survey techniques and instrumentation are reviewed. Standardization of survey techniques is suggested, and recommendations are presented regarding future activities in establishments where persons may be potentially exposed to microwaves from ovens and other commercial and industrial sources of energy.

Introduction

THE USE OF ELECTRONIC equipment which emits electromagnetic energy in the microwave region of the electromagnetic spectra is rapidly expanding as newer applications are developed. As a result, an increasing number of industrial workers and consumers are being exposed to potential health hazards associated with the use of these devices.

As with many rapidly developing industrial processes and consumer applications, expanding use of such equipment may be accompanied by lack of knowledge or neglect on the part of the user of the potential hazards associated with its operation and the basic principles of health protection practices involved in its safe use. To assure the manufacturer, distributor, and consumer that he has the best and latest information on health-protective techniques for controlling potential health hazards, exposure criteria acceptable to local, state, and federal governmental organizations, as well as to the industry and the consumer, must be developed. These exposure criteria and standards must be based

on adequate data on the biologic effect of the physical and chemical agents produced from operation of the devices and standardization of survey techniques and instrumentation.

The exposure of an increasingly larger segment of the industrial and general population to microwave energy is of growing concern.

This report summarizes criteria and presents survey techniques utilized in state and local governments. Methods for further refinement of these techniques are suggested.

Present Practices

In all states and in the Commonwealth of Puerto Rico and the District of Columbia, departments of health or other appropriate agencies at the state, county, or municipal level of government were contacted concerning their present activities relating to potential health hazards from microwave energies. Also considered was the use of criteria within their jurisdictions, legal authority to require compliance, and techniques employed for calibration of equipment and survey techniques.

In those states where it could be determined that both the occupational health and

radiological health activities were concerned with the problem, both agencies were queried. A total of 111 organizations, including several universities, were included in the survey.

Forty of the fifty-two state governments (including Puerto Rico and Washington, D. C.) replied to the questionnaire; two of these were too late to be included in the data presented. The governmental organizations included in the survey represent 82% of the working population of the United States.

Twenty-seven states indicated that they had some legal authority to require compliance with their recommendations for control of microwave hazards. This authority was almost without exception based on general public health or labor laws. Only one state indicated that it had legal authority to require compliance with recommendations for control of microwave hazards only if an employee was subjected to these hazards by an employer.

Several states indicated that enabling legislation has been or will be proposed to the state legislature for the control of hazards from lasers and other nonionizing radiations, which may or may not include microwave energy.

State governmental organizations indicated that a total of 270 requests had been received to evaluate microwave exposure conditions, or to obtain information during the three-year period between October 1965 and November 1968. Over half had been received by one state government representing approximately 10% of the nation's working population.

A number of states, 9 out of the 38 reporting, indicated that microwave criteria were utilized by their organization for the purposes of making recommendations for control of possible health hazards from microwave energy. In fact, one state with several official organizations interested in the health hazards from microwave devices reported that three different criteria were used. One of the state organizations reported that it used two different criteria; another criterion was used by a different official agency, and the last official agency reporting from that state indicated that they did not use any criteria. One other

state indicated the use of two different criteria.

Seven states indicated that they used 10 mW/cm² for making recommendations for control of possible health hazards. Three states use levels of exposure proposed by Bell Laboratories.¹ These criteria are:

1. Power levels in excess of 10 mW/cm² are potentially hazardous, and personnel must not be permitted to enter areas where major parts of the body may be exposed to such levels.

2. Power levels between 1 and 10 mW/cm² are considered safe only for incidental, occasional, or casual exposure, but are not permissible for extended exposure.

3. Power levels under 1 mW/cm² are safe for indefinitely prolonged exposure.

Two states indicated the use of 10 mW/cm² for continuous exposure; for pulsed microwave systems the time-on, time-off could be averaged if the power density did not exceed 100 mW/cm².

The 38 states reported that 129 microwave surveys were made between October 1965 and November 1968. Additionally, 82 surveys made in one state included lasers grouped with microwave devices, and New York reported the results of their survey between 1959 and 1964, which included 181 microwave devices.

The total from 38 states for the three-year period was 211 surveys. This figure must be compared with the 56 surveys completed during the same time period by Pinellas County, Florida Health Department. Pinellas County represents approximately 0.2% of the working population of the nation as reported by U. S. County Business Patterns.²

A realistic estimate of the number of workers and general public potentially exposed to microwave energy cannot be made on the bases of data collected in this survey; however, it should be noted of 268 surveys reported in this paper (including the 1959 to 1964 data from New York State) that 4650 workers and 8000 consumers were potentially exposed to microwave energies according to the reporting agencies. In another state representing about 5% of the nation's working population,² it was estimated that a substan-

tial number of microwave ovens were in use, numbering at least several thousand.

Only 7 states reported that equipment was available in their organization to make microwave surveys. In several states equipment was used on a loan basis from the Bureau of Occupational Safety and Health (U. S. Public Health Service) or other federal agencies. One state reported the use of fluorescent tubes for checking the presence of leaks around oven doors and indicated that the lack of properly calibrated test equipment was the reason for not attempting surveys of a more sophisticated nature.

None of the states indicated that they used a standardized survey form, which in turn would indicate that the technique employed in a survey was left to the discretion of the surveyor. The Pinellas County Health Department returned a survey form for microwave evaluations which would provide some uniformity and comparability from one survey to the next. In surveys of microwave ovens, all states that reported conducting such surveys indicated that they surveyed the door seals for leaks. At this point, however, any similarity between survey techniques quickly ends.

None of the states reported having the capability for calibration of instruments for the evaluation of microwave exposures.

In very few surveys were any attempts made to determine if the oven could be operated with the door interlocks defeated. None of the survey techniques included survey measurements with the oven cabinet removed, a situation which might be encountered in a repair operation; the hazards of this situation have previously been reported by the authors.³

Discussion and Recommendations

The results of this survey indicate an apparent awareness, on the part of the public health officials of this country, of the potential health hazards associated with microwave radiant energy. Along with such an awareness, however, there appears to be a lack of activity on the part of most state and local health groups in conducting surveys to evaluate the magnitude of the prob-

lems. This lack of activity appears to stem from several reasons, the most significant of which appear to be: (1) the lack of reliable field survey equipment at the state and local level with which to conduct surveys; (2) if equipment is available, the lack of reliable procedures for calibrating such equipment, short of returning it to the manufacturer at periodic intervals; (3) a considerable amount of confusion with regard to the appropriate standard(s) to be applied in a given situation; and (4) the absence of a standardized technique for conducting surveys.

The recommendations to be made as a result of this survey are designed to eliminate the above-mentioned problems, which in turn should eliminate most of the road blocks which have delayed an assessment of the significance of the microwave exposure problem. The following recommendations are made: (1) Studies should be conducted by a disinterested group to evaluate the reliability and accuracy of the presently available equipment for the measurement of microwave energy. (2) Such studies should also evaluate presently available methods for calibrating microwave equipment and determine whether the centralized laboratories should be established to provide microwave calibrating services, or whether such calibration should indeed be accomplished by the using organizations (3) Although many groups and organizations in the United States have recommended microwave exposure standards,^{1, 4-6} no two are completely in agreement, and almost without exception such standards are designed for occupational exposure. Further experimental work in this field is required, especially as it pertains to safe exposure levels for the general population. (4) It is imperative that standardized survey techniques be developed and subsequently be put into use by the various official health and safety agencies which have the responsibility for evaluating exposures to microwave energy.

The standardization of equipment, calibration techniques, and survey formats will contribute significantly in assessing the problem of man's exposure to microwave energy in his home, his workplace, or his general environment.

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