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LASER AND MICROWAVE PROBLEMS

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DR. MILLER: Let us go on with the program right now and take a look at the laser and microwave problem. To introduce this subject is Mr. Jack Nelson, Director, Electronic Products Division.

MR. NELSON: Now, since this is going to be a technical discussion primarily, I am going to turn this discussion of laser and microwaves over to one of the people on the staff of the Electronic Products Division who knows a great deal about them. We would like to let you hear about some of the problems we are trying to solve in the electronic products area in terms of the entire electromagnetic spectrum. I hope tomorrow, and perhaps this afternoon, I can try to answer your questions as to where we think the best direction is to go with respect to this whole new area. We have certain problems of units and standards and are learning a whole new vocabulary, as are many others.

It is a real pleasure to see a great many of you who have been in ionizing radiation for 20 years. I know we are all going to have the same difficulty in learning the new language and applying it to new techniques. The other elements of the electromagnetic spectrum are not going to be quite as susceptible to the same techniques, in terms of control, as X-rays and radium. There are some new elements, new problems, and some new twists; and I will let Mr. Duane Solem give you an outline of where we believe and where the industry believes the laser and microwave sources are going and where we are in setting standards.

MR. SOLEM: I am going to try to be very, very brief. The problems as I see them with respect to lasers and microwaves are:

(1) the number of lasers and microwave sources that we have now and are going to have in the future,

(2) the variations in exposure limits,

(3) the occupational exposures from these sources and the potential exposure from the sources which we now have, and

(4) the lack of data on current public exposure.

In general, we know that practically every industrial field is using lasers. About 10 years ago use of the laser was established, and right now it is about a $100 million market. By 1977, it should reach $200 million.

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Eight years from now the greatest gain in laser usage will be made in advanced technology. Of course, research will show some increase, and military usage will increase substantially. All communication facilities have advanced very much in laser usage, as have drilling, metal work, chemistry and physics. The greatest gain will be in advanced technology where there will be an increase of about 60 times. By 1967, there were about 30,000 continuous wave (CW) lasers that were used for surveying and similar applications. About a hundred thousand units per year were sold in 1967 and 1968, and perhaps three hundred thousand units per year now.

As far as I know, there are no exposure limits for the general public. Occupational exposure limits require a little bit of explanation. The exposure limits which exist in industry and in government--I have looked through about 8 or 10 different exposure limits--are rated in different ways. They depend upon whether the exposure is at the retina of the eye, whether it is at the cornea, whether it is a brightly lit room and the pupil is very small, or very large, so that there is no one technique which you can use to compare all the standards. It requires a lot of interpretation and playing around with formulas and numbers.

I have chosen representative means of evaluating exposure limits. One is at the retina, one at the cornea. A number of exposure limits have been set by various agencies or industries. You can see that for retina exposure some people will say, "Well, this is safe," and other people will say, "Well, no, this is safe." The worst discrepancy comes from exposure at the cornea, like we get from a small laser. The lowest tolerance rate exists with the CW laser.

In 1967, a State survey estimated about 30,000 persons were occupationally exposed to laser radiation. Perhaps the number has increased to 90,000 or 120,000 now.

There are four general areas where microwave sources are now being used--in industrial processing, in food vending establishments where prepacked food is heated, in home use of microwave ovens, and other areas.

Within industry, there are probably five or six thousand industrial microwave heaters. There are between 20,000 and 30,000 microwave ovens in food vending establishments.

Now, in terms of home microwave ovens; right now there are about 20,000 home microwave ovens sold per year. If the oven would sell for $350, the sales could double. In 1962, practically none were sold and in 1969, about 40,000 will be sold. The increase will be due in part to microwave ovens imported into this country from Japan. The sales price in Japan is $150 per oven. I don't know what the sales price would be here, but the Japanese ovens could double the present sales rate if they do indeed hit the market. They have already been submitted to the FCC for approval.

There are many thousands of other radar and microwave sources in existence.

In regard to industrial exposure limits, there is about 1,000-fold difference between the United States and Soviet Union values. The current United States limit is 10 milliwatts per square centimeter, while the Soviet Union value is only 0.01 milliwatt per square centimeter.

We have no idea how many persons are exposed to microwave devices. The microwave industry employs about a half million people; how many of these are exposed we don't know. We know in a general way the public is exposed, but we don't know the significant exposure level.

For about $100, that little 15-year old electronics expert in the neighborhood, of whom there seem to be more and more lately, can build a pulsed ruby laser which will fry your eyes to a crisp. Also, for $100, you can put together an S-band source microwave oven, and this can give all of the neighbors' friends cataracts. So for $100 you can do a lot. As I see it, there is a very big problem.