Application of these techniques to the radiology clinic should provide information on both quantity and quality of radiation exposure to patients.

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A Proposal for a Microwave Radiation Warning Sign

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Introduction

The number and power of microwave devices are increasing every year. More and more workers, the population at large and special groups such as pacemaker wearers are being exposed to microwave radiation. Consequently, government agencies and the industrial and private sectors of society, all have expressed concern over exposure to microwave radiation. One way to reduce exposure is to indicate which devices emit radiation and where the radiation intensities are high. Thus, it seems appropriate that a warning sign specific to microwave radiation hazards be available for display on devices at work stations or in areas where hazards exist.

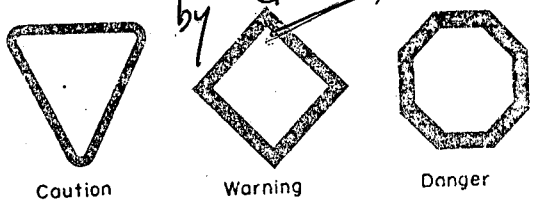

Fig. 1. Shape indicates degree of hazard.

Ideally, a sign should indicate the hazard both qualitatively and quantitatively. The presently accepted sign warning against possible ionizing radiation hazards is the well-known trefoil design. This sign serves admirably well in designating the quality or type of hazard to be expected where it is displayed, but it fails to indicate the quantity or degree of hazard. Thus, a source barely stronger than 5 μCi and a spent fuel rod fresh from a nuclear reactor core would bear the same warning sign. This, of course, is a rather exaggerated example, but correct in principle. The question is how can we indicate the quantity or degree of hazard as well as the quality or type.

Recognizing the already widely known, distributed and standardized system of traffic control signs in North America, the Department of Consumer and Corporate Affairs, Canada proposed the three shapes shown in Fig. 1 to indicate the degree of hazard.[1] The erect triangle used for YIELD signs in traffic indicates CAUTION; minor injuries could result from misuse. The diamond used for SLOW signs in traffic indicates WARNING; major injuries could result from misuse. The octagon used for STOP signs in traffic indicates DANGER; death could result from misuse. The colours to be used are not specified although the usual yellow, orange and red serve to reinforce the message conveyed by the shape. The three shapes are used in all possible combinations with four symbols which indicate the kinds of hazards encountered in various commercial products containing poisonous, flammable, explosive and corrosive materials. This system of symbols has been widely publicized in Canada, and is appearing on many products available to the Canadian consumer. It is being implemented gradually to allow manufacturers time to make the required adjustments in their packaging containers.

This proposal for a microwave warning sign closely follows the concept used by the Department

of Consumer and Corporate Affairs, Canada in specifying signs which embody both the qualitative and quantitative aspects.

Microwave Exposure Standards

Historically, most microwave exposure standards have recognized three degrees of hazard delimited by two threshold values.[2] The lower value was such that exposures below it would have no observable effect of any sort, latent or immediate. The upper value was such that exposures in excess of it on a continuous basis would give rise to a specific observable effect or range of effects, potentially lethal. The intermediate region has been considered permissible for limited periods of time.

Until recently, the standard commonly used in North America allowed continuous exposure in fields of 10 mW/cm^2 or less. Levels above 10 but below 100 mW/cm^2 were permissible for a fraction of an hour related to the actual level and exposures to fields in excess of 100 mW/cm^2 were not allowed at all. Another standard commonly used is based on the energy incident in the exposure field. Exposure is limited to 1 mW . hr/cm^2 in any 1-hr period. Exposure to fields in excess of 25 mW/cm^2 is not permitted. This latter is actually a practical limit since based on the 1 mW . hr/cm^2 standard, the exposure to a 25 mW/cm^2 field would have to be limited to 1/25 of an hour (i.e. 2 min, 24 sec) in any 1-hr period. A time period shorter than this, as would be required in a higher exposure field, would be too short for any practical task to be accomplished. There has been a distinct difference between Soviet bloc and Western bloc countries in the effect or range of effects considered significant in assessing the hazards of microwave exposure. However, the assignment of the degree of hazard into three categories remains valid for both; only the exposure limits are different.

Microwave Warning Sign

The symbol proposed to indicate microwave hazards is shown in Fig. 2. When combined with the outlines shown in Fig. 1, the three signs shown in Fig. 3 result, just as in the CCAC labelling scheme. These three signs would allow the demarcation of three regions in establishments where microwave

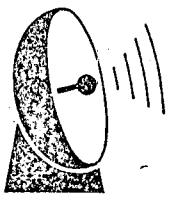

FIG. 2. Symbol to indicate microwaves.

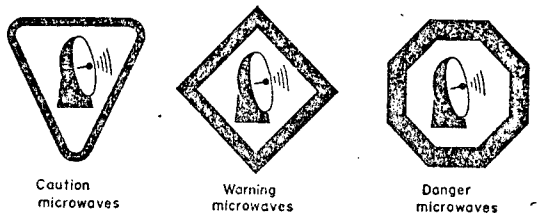

FIG. 3. Three signs to indicate microwave hazards.

energy is used. Based on the 1 mW . hr/cm^2 exposure standard outlined above, the zone boundaries would be the entrance of the establishment, 1 and 25 mW/cm^2. The triangular sign indicating CAUTION MICROWAVES would appear at the entrance and at various locations deemed appropriate according to circumstances where microwave fields are present but are sufficiently low (less than 1 mW/cm^2) to allow UNLIMITED OCCUPANCY under normal conditions. It would indicate that the enclosed area had been surveyed and cleared for unlimited occupancy unless otherwise posted. The diamond-shaped sign indicating WARNING MICROWAVES, would appear at the outer boundary of areas where the power density exceeds 1 mW/cm^2 and within which LIMITED OCCUPANCY (for example, calculated according to the 1 mW . hr/cm^2 standard) is allowed. The octagonal sign indicating DANGER MICROWAVES would appear at the outer boundary of areas where the power density exceeds 25 mW/cm^2 and thus demarcate DENIED OCCUPANCY zones. Work within DENIED OCCUPANCY zones or LIMITED OCCUPANCY zones for times in excess of the limits imposed by the standard could be carried out if appropriate shields and garments were used.

It might be argued that the triangular CAUTION sign is redundant since it would appear before the 1 mW/cm^2 zone is reached. However, it has been observed in this laboratory that fields less than 1 mW/cm^2 can have undesirable effects on cardiac pacemakers and on other sensitive electronic devices. This sign would thus provide information indicating a possible hazard to certain individuals or types of devices.

It is expected the signs as applicable would be used in kitchens, cafeterias and self-serve vending establishments where microwave ovens are used, in industrial complexes where large heating devices using microwave energy are applied to various production processes, scientific laboratories where microwave devices are in use or under development. In military or commercial radar and communications facilities, the use of the signs could be helpful in

demarcating work areas into various controlled zones.

Conclusion

In summary then, it is proposed that the signs shown in Fig. 3 be used as warning signs on microwave devices or where microwave energy is present The three signs serve to indicate different degrees of hazard. For area demarcation, the triangular sign indicates the beginning of a surveyed area where microwave energy is present, indicates UNLIMITED OCCUPANCY is allowed unless otherwise posted, and serves as a warning to any susceptible individuals or devices. The diamond-shaped sign indicates the beginning of a LIMITED OCCUPANCY area where occupancy times are determined to some agreed standard. The octagonal sign indicates the beginning of a DENIED OCCUPANCY area, one in which lethal or extremely dangerous densities may exist.

For microwave devices, the triangular CAUTION sign indicates a device whose normal use requires care and serves as a warning to susceptible individuals or devices. The diamond-shaped WARNING sign indicates devices which could cause injury. The octagonal DANGER sign indicates devices which could cause death.

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Health Physics Salaries*

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Since there is a very limited number of health physicists, it is difficult to find information on their salaries. We have recently made a study on a limited group, i.e. employees of state regulatory agencies. Also included were New York City, Los Angeles County and the District of Columbia. This is a limited sample but it has advantages in that in almost all cases the requirements and salary structures are well specified and are public knowledge.

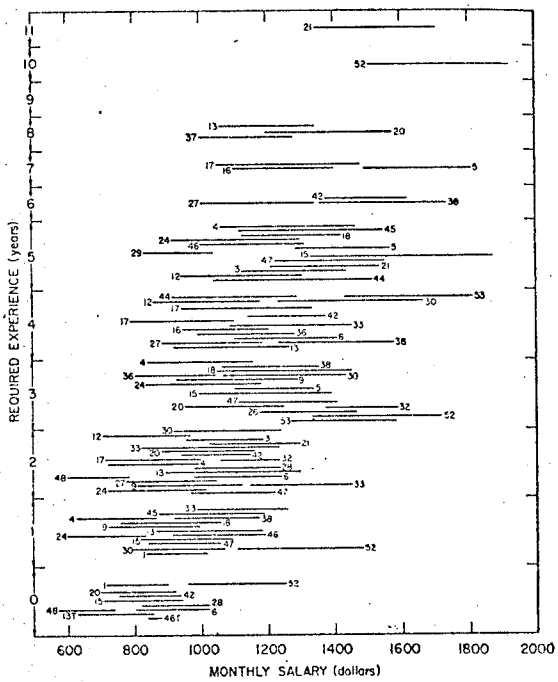

Fig. 1.

Letters were sent to the heads of the 53 agencies

Table 1.

1. Alabama	28. Nevada
3. Arizona	29. New Hampshire
4. Arkansas	30. New Jersey
5. California	32. New York
6. Colorado	33. North Carolina
9. Florida	36. Oklahoma
12. Idaho	37. Oregon
13. Illinois	38. Pennsylvania
15. Iowa	42. Tennessee
16. Kansas	44. Utah
17. Kentucky	45. Vermont
18. Louisiana	46. Virginia
20. Maryland	47. Washington
21. Massachusetts	48. West Virginia
24. Mississippi	52. New York City
26. Montana	53. Los Angeles County
27. Nebraska	

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