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For discussion only
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FEDERAL RADIATION REGULATIONS

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MEMORANDUM FOR THE PRESIDENT

SUBJECT: Radiation Protection Guidelines for Federal Agencies

Pursuant to Executive Order 11659 from August 1964, the Federal Radiation Council has made a study of the hazards and use of radiation. We herewith transmit our first report to you concerning our findings and our recommendations for the guidance of Federal agencies in the conduct of their radiation protection activities.

It is the statutory responsibility of the President, as the President with respect to radiation matters directly or indirectly affecting health, including guidance to all Federal agencies in the formulation of radiation standards and in establishing systems of programs of cooperation with States.

Fundamentally, setting basic radiation protection standards involves passing judgment on the extent of the health hazard which is willing to accept in order to realize the known benefits of radiation. It involves inevitably a balancing between the known benefits which might require foregoing any additional increase in radiation, and the vigorous pursuit of the use of nuclear energy in order to achieve a peaceful world.

The Federal Radiation Council has considered carefully the

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radiation effects and consulted with scientists within and outside the Government. Each member has also examined the guidance which is recorded in this memorandum in light of his statutory responsibilities. Although the guidance does not cover all phases of radiation protection, such as internal emitters, we find that the guidance which we recommend that you provide for the use of Federal agencies gives appropriate consideration to the requirements of health protection and the beneficial uses of radiation and atomic energy. Some of the findings and recommendations follow.

Discussion

The fundamental problem in establishing radiation protection guidelines is to allow as much of the beneficial uses of ionizing radiation as possible while ~~insuring~~^{assuming} that man is not exposed to undue hazards. To get a true insight into the scope of the problem and the impact of the decisions involved, a review of the benefits and the hazards of ionizing

It is important in considering both the benefits and hazards of radiation to appreciate that man has existed throughout his history in a bath of natural radiation. This background radiation, which comes over the earth, provides a partial basis for understanding the effects of radiation on man and serves as an indicator of the range of ionizing exposures within which the human population has developed and thrived.

The Benefits of Ionizing Radiation

is a boon to mankind. It has been of inestimable value in the diagnosis and treatment of disease. It can provide sources of energy greater than any the world has yet had available. In industry, it is used as a tool to measure thickness, quantity or quality, to discover hidden flaws, to trace liquid flow, and for other purposes. So many research uses for ionizing radiation have been found that scientists in many diverse fields now rank radiation with the microscope as a working tool.

The Hazards of Ionizing Radiation

Ionizing radiation involves health hazards just as do many other useful tools. Scientific findings concerning the biological effects of radiation of most immediate interest to the establishment of protective protection standards are the following:

1. Acute doses of radiation may produce immediate or delayed effects, or both.
2. As acute whole body doses in rads above approximately 25 rads (a unit of radiation dose), immediate observable effects increase in severity with dose, beginning with barely detectable changes, such as redness of skin, to severe damage, to death at levels of a few hundred rads.

3. Delayed effects produced by acute irradiation and chronic irradiation are similar in kind, but the ability of the body to repair radiation damage is usually more effective in the case of chronic than acute irradiation.
4. The delayed effects from radiation are in general indistinguishable from familiar pathological conditions usually present in the population.
5. Delayed effects include genetic effects (effects transmitted to succeeding generations), increased incidence of cancer, life span shortening, and growth and development delay.
6. The child, the infant, and the unborn infant appear to be more sensitive to radiation than the adult.
7. The various organs of the body differ in their sensitivity to radiation.
8. Although ionizing radiation can induce genetic and somatic effects (effects on the individual during his lifetime) other than genetic effects, the evidence at the present time is insufficient to justify precise predictions of the nature of the dose-effect relationship for these diseases and their occurrence. Moreover, the evidence is insufficient to prove or disprove the hypothesis of a "damage threshold" (a point below which no damage occurs) or the hypothesis of the threshold hypothesis at low doses.

9. If one assumes a direct linear relation between biological effect and the amount of dose, it then becomes possible to relate very low dose to an assumed biological effect, even though it is not detectable. It is generally agreed that the effect that may actually occur will not exceed that predicted by this assumption.

Basic Biological Assumptions

Because there are insufficient data to provide a firm basis for evaluating radiation effects for various types and levels of irradiation, and especially because there is great uncertainty on the biological effects at very low doses and low dose-rates, it is prudent to use the following conservative assumptions in providing radiation protection guidance:

1. There is no point below which exposure to radiation will not have a biological effect.
2. There is a linear relation between biological effect and the amount of radiation dose extending down to zero.

These assumptions are indeed conservative and somewhat arbitrary. It is important that additional research be undertaken and developed to provide a firmer basis for evaluating biological effects. Appropriate member agencies of the Federal Radiation Council should be sponsoring and encouraging research in these areas.

| <u>Type of Exposure</u> | <u>Condition</u> | <u>Dose (rem)</u> |
|--|------------------------------|---|
| Radiation Worker | | |
| a) Whole body, head and trunk, active blood forming organs, gonads, or lens of eye | Accumulated dose 10 weeks | 5 times the number of years beyond age 18 |
| b) Skin of whole body and thyroid | year 10 weeks | 50 50 |
| c) Hands and forearms, feet and ankles | year 10 weeks | 50 50 |
| d) Bone | 100 microgram | 50 microgram of radium-226 or its biological equivalent |
| e) Other organs | year 10 weeks | 50 50 |

Population

| | | |
|---------------|----------|-----------------|
| a) Individual | year | 50 (400-500) |
| b) Average | 10 years | 50 (400-500) |

The following points are made in relation to the distribution of the Guides herein provided:

Guides herein provided:

- (1) For the individual in the population, the basic Guide for annual ^{WHOLE BODY DOSE} ~~exposure~~ is 0.5 rem. ^{THIS} ~~The latter~~ Guide applies when the individual ^{WHOLE BODY DOSES} ~~exposures~~ are known. ~~General agencies should use this Guide to insure that there is no reasonable probability that this Guide is exceeded.~~ As an operational technique where the individual ^{WHOLE BODY DOSES} ~~exposures~~ are not known, a suitable sample of the exposed population should be developed whose ^{FOR ANNUAL WHOLE BODY DOSE} protection guide will be 0.5 rem per capita per year. It is emphasized that this is an operational technique which should be modified to meet special situations.
- (2) Considerations of population genetics impose a per capita ^{FOR THE GOVARS} dose limitation of 5 rem in 30 years. The operational ^{WHOLE BODY} mechanism described above for the annual individual dose of 0.5 rem is likely in the immediate future to insure that the gonadal exposure Guide (5 rem in 30 years) is not exceeded.
- (3) These Guides do not differ substantially from certain other recommendations such as those made by the National Committee on Radiation Protection, ^{AND MEASUREMENTS, THE} National Academy of Sciences, and ^{THE} International Commission on Radiological Protection ^{FOR} Measurements.

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- (4) The term "maximum permissible level" is used by the National Committee on Radiation Protection (NCRP) and the International Commission on Radiological Protection (ICRP). However, this term is often misunderstood. The words "maximum" and "permissible" both have unfortunate connotations not intended by either the NCRP or the ICRP.
- (5) There can be no single permissible or acceptable level of exposure without regard to the reason for permitting the exposure. It should be general practice to reduce exposure to radiation, and positive effort should be carried out to fulfill the sense of these recommendations. It is basic that exposure to radiation should result from a real determination of its necessity.
- (6) There can be different Radiation Protection Guides with different numerical values, depending upon the circumstances. The Guides herein recommended are applicable for normal peacetime operations.
- (7) These Guides are not intended to apply to radiation exposure resulting from natural background or the planned exposure of patients by medical means or the planned exposure of patients by peaceful means of the atomic energy.

(8) It is recognized that our present scientific knowledge does not provide a firm foundation within a factor of ten or higher for selection of any particular numerical value in preference to another value. It should be recognized that the Radiation Protection Guides recommended in this paper are well below the level where biological damage has been observed in humans.

It is recommended that:

4. Current protection guides used by the agencies be continued on an interim basis for organs dose to the population.

Recommendations are not made concerning the Radiation Protection Guides for individual organs dose to the population other than the gonads. Unfortunately, the complexities of establishing guides applicable to radiation exposure of all body organs preclude the Council from making recommendations concerning them at this time. However, current protection guides used by the agencies appear appropriate on an interim basis.

It is recommended that:

5. The term "Radioactivity Concentration Guide" be adopted for Federal use. This term is defined as the concentration of radioactivity in the environment which is determined to result in whole body or organ dose equal to the Radiation Protection Guide.

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Within this definition, Radioactivity Concentration Guides can be determined after the Radiation Protection Guides are decided upon. Any given Radioactivity Concentration Guide is applicable only for the circumstances under which use of its corresponding Radiation Protection Guide is appropriate.

It is recommended that:

6. The Federal agencies, as an interim measure, use radioactivity concentration guides which are consistent with the recommended Radiation Protection Guides. Where no Radiation Protection Guides are provided, Federal agencies continue present practices.

No specific numerical recommendations for Radioactivity Concentration Guides are provided at this time. However, concentration guides now used by the agencies appear appropriate on an interim basis. Where appropriate radioactivity concentration guides are available, and where Radiation Protection Guides for specific radionuclides are provided herein, the latter Guides can be used by the Federal agencies as a starting point for the derivation of Radioactivity Concentration Guides applicable to their particular problems. The Federal Radiation Council has also initiated action directed toward the development of additional guides for radiation protection.

It is recommended that:

7. The Federal agencies apply these Radiation Protection Guides with judgment and discretion, to insure that reasonable public health protection is achieved in the attainment of the desired goal of protecting man from the undesirable effects of radiation. The Guides may be exceeded only after the Federal agency having jurisdiction over the matter has carefully considered the reason for doing so in light of the recommendations in this paper.

The Radiation Protection Guides provide a general framework for the radiation protection requirements. It is expected that each Federal agency, by virtue of its ^{ITS} immediate knowledge of its operating problems, will use these Guides as a basis upon which to develop detailed standards tailored to meet its particular requirements. The Council will follow the activities of the Federal agencies in this regard and will promote the necessary coordination to achieve an effective Federal program.

If the foregoing recommendations are approved by you, under the guidance of Federal agencies in the conduct of their ^{RADIATION} radiological protection activities, it is further recommended that this memorandum be published in the Federal Register.

~~Secretary, Health, Education and Welfare~~
~~CHAIRMAN, FEDERAL RADIATION COUNCIL~~

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The recommendations numbered 1 through 10 contained in the above memorandum are approved for the guidance of Federal agencies, and the memorandum should be published in the Federal Register.

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