REPORT TO THE

SURGEON GENERAL

U.S. PUBLIC HEALTH SERVICE

on

THE CONTROL OF RADIATION HAZARDS IN THE UNITED STATES

Prepared by

The National Advisory Committee on Radiation

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REPORT

OF

THE CONTROL OF

PROCEDURES

THE NATIONAL

MARCH

NATIONAL ADVISORY [illegible]

[illegible]

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I. FOREWORD

The National Ad[illegible] by the Surgeon General of th[illegible] guidance in matters pertaining to the control of radiation hazards in the United States. Among the many assignments [illegible] since its inception, one has been the task of evaluating the present state of study followed in this country [illegible] the hazards of ionizing radiation. This report presents the conclusions reached by the Committee after its study of this important subject.

II. RADIATION HAZARD, A [illegible]

During the past several years, [illegible] including the National Academy of Sciences of the United States[1], the United Nations Scientific Committee on the Effects of Atomic Radiation[2], [illegible] reported extensively on the [illegible] From these reports it is evident that [illegible] undue radiation exposure and that [illegible] limit such exposure both to the [illegible]

The principal [illegible] or developed by man include [illegible] isotopic byproducts, [illegible] concentrated forms of [illegible] fallout constituents [illegible] reactors, their fuels, [illegible] wastes have been placed under [illegible] their influence on health and [illegible]

extensive studies have revealed that [illegible] by the population today, other than [illegible] from the x-ray machines employed [illegible] effort is now being applied [illegible] the exposure of individuals under [illegible] so, the absence of a comprehensive [illegible] of all sources of ionizing radiation [illegible] to this Committee to be an important [illegible] radiation safety.

A comprehensive program of radiation [illegible] important at this time because of the increasing [illegible] wherein ionizing radiation is applied [illegible] now used extensively in industry as well as in the [illegible] isotopes are finding applications [illegible] plants, universities, hospitals, [illegible] And nuclear reactors are being [illegible] pace. Few areas [illegible] do not find some practical application.

Since the discovery [illegible] population has been gradually [illegible] annual whole-body [illegible] individual of the United States [illegible] for the period from [illegible] included in the report of the [illegible]

calculations based on estimates of the [illegible] during this time period [illegible]. The reading obtained by the x-ray data suggests the [illegible] from x-ray apparatus may [illegible] control measures are [illegible].

TABLE I. Estimated Annual [illegible] Exposure Received Externally from [illegible]

YEAR	NATURAL SOURCES	MAN-MADE SOURCES
1925	100	1
1935	100	20
1945	100	35
195[illegible]	100	15[illegible]

The radiation exposure received from [illegible] likely to increase with the passage of time, [illegible] table II, where the natural growth [illegible] the years 1965 to 1985 [illegible] accumulated volume of radioactive [illegible] from this nuclear power [illegible].

TABLE II. Predicted Power Capacity and Associated Volume of Solid Radioactive Waste Resulting from Thermal Nuclear Power Stations

Year	Power Capacity (megawatts)	Solid Radioactive Waste Produced (cubic feet)
1965	[illegible] $\times 10^6$	[illegible] $\times 10^5$
1975	[illegible] $\times 10^6$	[illegible] $\times 10^6$
1985	[illegible] $\times 10^6$	[illegible] $\times 10^6$
1995	[illegible] $\times 10^6$	[illegible] $\times 10^7$

Another measure of the growth to be anticipated in the future of atomic energy may be made from a consideration of the rapid growth that has taken place during the last few years in the use of radioisotopes in the United States. This is shown in Table III, where the quantity of various isotopes shipped from the Oak Ridge National Laboratory from 1952 to 1958 and the number of medical users of radioisotopes in the United States in a similar period are tabulated[16, 17].

Table III. Curies of Radioisotopes Shipped by Oak Ridge National Laboratory and Number of Medical Users of Radioisotopes in the United States

YEAR	Curies	Number of Users
1952	12,000	200
1954	30,000	920
1956	180,000	1820
1958	230,000	3500

In addition to the rapid growth in the use of radioisotopes and products that produce ionizing radiation, there is another factor which urgently points to the national need for comprehensive research on the public health aspects of these activities. This is the successive reduction given by scientists to radiation exposures considered safe by the Federal Government. The most recent downward revision made over the past few years is the one recommended by the International Commission on Radiological Protection (ICRP) in September 1958[18]. The ICRP's recommended levels of ionizing radiation are summarized by the U. S. Federal Radiation Protection Guidance for Exposure of the Population of the United States[19] (Table IV).

Each downward revision increases the responsibility of [illegible] the problems of radiation protection.

Table IV. Recommended Annual Maximum Dose Equivalent for Workers Occupationally Exposed to Ionizing Radiation

Period	Maximum Permissible Dose Equivalent (rem/yr)
1931-1936	50
1936-1948	30
1948-1958	15
1958-present	5

III. THE ELEMENTS OF A RADIATION PROTECTION PROGRAM

A comprehensive program for the control of exposure to [illegible] includes many elements, two of which are:

(a) the formulation of [illegible] standards, and

(b) the endorsement of practical [illegible] procedures for meeting these standards.

In general, the responsibility for applying [illegible] protection standards employed in a country rests with (1) the [illegible] pertinent scientific data, development of [illegible] evaluation of these data in order to [illegible] them to the task, and (3) the [illegible] evaluation, after due consideration of [illegible] standards may create. Ideally, the [illegible] an organization independent of the [illegible] group.

The enforcement of health [illegible] involves the adoption of specific [illegible] agency's standards are [illegible]. Such forms of [illegible] procedures include, among others, the [illegible] registration of radiation sources, the [illegible] and the periodic inspection of [illegible].

It may be worthwhile [illegible] currently used in the United States [illegible] protection. In regard to scientific data, [illegible] biology, chemistry and physics [illegible] knowledge needed to [illegible] by the Division of Biology and [illegible] the National Institutes of Health of the [illegible] other governmental and non-governmental [illegible] this research is substantial, a review of [illegible] quantitatively relate radiation [illegible] gaps exist with [illegible] establishment of [illegible] basis. Since standards of radiation protection [illegible] to programs of radiation control, [illegible] greater emphasis should be placed [illegible] is particularly [illegible] of data for standards [illegible] important components of the [illegible] development by the Public Health Service.

Much of the responsibility for the evaluation of [illegible] and the subsequent preparation of [illegible] by regulatory agencies in the development of [illegible] standards, has been borne by the [illegible] by the National Council on Radiation Protection, a private [illegible] group of [illegible] American and Canadian scientists [illegible] by the Department of Commerce. [illegible] the untiring effort it has given [illegible]

From time to time, [illegible] suggested that the NCRP should be [illegible] mental agency. They believe that [illegible] would gain stature and its [illegible] official status given them. The National Advisory Committee, however, believes that there is [illegible] the NCRP enjoys. In such a [illegible] singularly forthright and [illegible] if these characteristics were changed.

IV. STATE VS. FEDERAL [illegible]

The enforcement of [illegible] subject of considerable [illegible] believe that the dangers of [illegible] radiation hazards [illegible] lie at the federal level. Others have [illegible]

best executed at the state or local level, while [illegible] controversy in an effort to resolve the difficult issues.

The Federal Government, under authority granted by the Atomic Energy Act of 1954[1-3], occupies a preeminent position in the field of nuclear energy. Through its control of access to special nuclear materials, source materials, facilities, facility operators, by-product materials, and technical information, the Federal Government through the Atomic Energy Commission, exercises a profound influence over the development of nuclear science and industry. Moreover, the Federal Government shares with the states social responsibility for the protection of the public health and safety. In addition to its responsibility for the promotion of the development of atomic energy, the Atomic Energy Commission has been given authority to regulate its operations in such a manner that the risks to the public health and safety and to the common defense and security will be maintained.

The [illegible] by development of nuclear energy is largely concentrated in the control of the radioactive effluents released during the operation processes. The extensive [illegible] production facilities, the widespread use of radioactive materials from nuclear reactors in research, industry, and the practice of medicine throughout this country, and the [illegible] protection. Furthermore, the [illegible] magnitude which must be controlled to [illegible] developed processes [illegible]

are sufficiently far from a s[illegible] the period [illegible] may be expected to elapse before the [illegible] is [illegible].

The dual role of the [illegible] government in the promotion and development of atomic energy, on the one hand, and the regulation of its use for safety on the other is an interesting [illegible]. Generally, [illegible] is unwise and may be expected [illegible]. For example, during the lifetime, the Atomic Energy [illegible] of criticism [illegible] criticized for seemingly subordinating [illegible] to the interests of economy when several of its [illegible] have been [illegible]. Also, a number of individuals and [illegible] establishment of large reactors [illegible] these criticisms have been [illegible] responsibility of the Commission [illegible] misunderstanding and this may [illegible] as more and more participate [illegible] place.

The question may be raised [illegible] of promotion and regulation of [illegible] governmental agency when the short [illegible]. The reasons for this may be found [illegible] ment. Nuclear science began [illegible] only at the time of World War II. [illegible] directed toward the develop[illegible] effort wholly concerned with [illegible]

Progress toward the production of practical atomic weapons was affected by the need for the rapid development of them, [illegible] safety and, because of secrecy, [illegible] in a regulatory body wholly independent of the production groups. Hence the functions of weapons development and production, [illegible] by a single agency, the Manhattan Engineer District.

After the completion of World War II, the Atomic Energy Commission was established by the Atomic Energy Act of 1946[1], with location of the Commission, initially, [illegible] relatively minor private [illegible] contemplated. In this [illegible] Engineering District were transferred to the new Atomic Energy Commission and the dual responsibilities of promoting and regulation were [illegible] essentially unchanged in the new organization.

When the Atomic Energy Act of 1946 was written, regulation of radiation protection was considered a [illegible] in the atomic energy field. However, [illegible] more complex and difficult [illegible] a vigorous role in the development of [illegible].

The creation of the Atomic Energy Commission [illegible] regulatory functions [illegible] groups which believed that such [illegible] agencies, rather than [illegible] incidentally, [illegible]

regulatory power has prevented [illegible] national interest was at stake[11].

It is not difficult to [illegible] not be well served if regulation of [illegible] energy were delegated entirely to [illegible] frequently occur where radiation [illegible] boundaries and serious dang[illegible] not provided. Furthermore, [illegible] radiation protection codes [illegible] development of atomic [illegible] interest might well be severely [illegible] has been achieved by scientists [illegible] Atomic Energy Commission [illegible] necessary for the execution [illegible] substantial. Indeed, the performance [illegible] record of which the AEC may be justly proud. All the [illegible] on the other hand, such comparatively [illegible]

In spite of the foregoing [illegible] regulation of radiation safety [illegible] competence in radiation safety [illegible] local health departments and [illegible] problems, intensive efforts [illegible] Evidence of this may be found [illegible] by the Public Health Service [illegible]

and technical assistants are currently employed in the field of radiological health in the health departments of the several States. Many persons give strong support to the concept that where regulatory controls are provided for the safety of a community, these controls may be best administered where the authority for control is not far removed from the people immediately concerned. This concept is likely to prove equally valid in the field of radiation protection. As many radioactive materials used in industry, medicine, and research become regulated, eventually be one element of environmental radiation surveillance necessity must be evaluated at the point of highest exposure in a program of health assessment. Finally, many State and local governments have demonstrated over long periods of time their ability to operate effective control programs in general areas of environmental hygiene, and the record of public health effectiveness in these fields is outstanding.

After careful consideration of the problem of effective control of radiation safety, the Committee believes that the discharge of the regulatory enforcement functions of the proposed program can be discharged effectively by State agencies. Also, the Committee believes it wise to continue the present relationship over the public health aspects of the use of radioactive materials as a prime interest of the people of the States. The Committee is not unaware of the responsibilities of the Atomic Energy Commission. Primarily, these responsibilities pertain to matters which are fundamentally sound. Furthermore, the Committee does not feel that the

that the AEC should not control [illegible] for the control of hazards to [illegible] and licensees. In any case, the Commission is willing [illegible] do so. In this respect, the [illegible] many of our nation's industrial [illegible] a broad range of safety [illegible] primary authority over the [illegible] where the ultimate responsibility [illegible] involving the protection of the public [illegible] Committee be given the opportunity [illegible] and preferably [illegible] U. S. Public Health Service.

V. RADIATION SAFETY PERSONNEL

The [illegible] protection [illegible] there be available [illegible] radiation control [illegible] agencies may [illegible] are needed [illegible]

(a) [illegible]

(b) [illegible]

* These individuals [illegible] employed principally [illegible] protection operations [illegible]

By the term, radiation health specialist, is meant a person trained to the level of a master's degree in one of the specialties of health protection and capable of assuming full responsibility for a radiation control program. The field specialties are those of health physics and the allied basic sciences, principally biophysics, biochemistry, genetics, radiobiology, and medicine and public health. Experience in solving laboratory and field problems, by the time a candidate is selected, is required of an individual trained to operate independently or to supervise the technical work under the supervision of a radiation health specialist.

At this time, the need for radiation health specialists appears to be most critical. Full implementation of basic radiation control programs in radiation control agencies is dependent upon the availability of adequate numbers of such specialists. Inadequately trained technicians will not be able to make the necessary judgments nor perform the complex technical work required of them.

Four studies made by the Committee, which are described in the following sections, indicate the general nature of the radiation health specialist needs for radiation control through the year 1970:

(a) Radiation health specialists	1,200
(b) Radiological technologists	4,000

These estimates are considered to be the minimum number required for three to four times the present level of radiation control activity. The nominal control program and the approximate number of radiation health specialist will be necessary for each 1,000,000 of population in the United

energy industry approaches [illegible] alter these values.

It is anticipated that [illegible] increase progressively as [illegible] present time the Public Health Service and [illegible] need for 150 specialists who [illegible] radiation protection. By the end of [illegible] have expanded to the point [illegible] by 1970, it is estimated that 1,200 will be required. These figures are over and above those currently employed by the nation's energy [illegible] conduct of its safety program.

VI. COMMENT AND RECOMMENDATIONS

It is evident from the [illegible] radiation hazards constitute a [illegible] more, it is more than likely that [illegible] the next few years.

A great deal of progress [illegible] the development of regulatory programs for the control of radiation hazards. However, even today, a number of serious [illegible] programs, as previous examples have indicated, [illegible] the absence of uniform regulations [illegible] an insufficient quantity of scientific [illegible] protection standards, the dual responsibility for promotion and [illegible] atomic energy sources currently [illegible] and the shortage of trained personnel [illegible]

programs may be carried out [illegible] more important, to improve the [illegible] of the [illegible] of the United States, the Committee [illegible] Surgeon General or review and [illegible]. Specifically, the Committee recommends that:

1. Primary responsibility for the [illegible] radiation hazards be established in a [illegible] agency of the Public Health Service. The Committee believes that this agency should [illegible] Health Service, Department of [illegible] immediate legislation to achieve this objective.

2. The agency be given [illegible] of radiation control. Such planning should [illegible] and local regulatory programs with the [illegible] groups in a manner which will provide [illegible] with the control of radiation hazards.

3. This agency be given authority to develop a comprehensive program of control for all sources of radiation. In this connection, the Committee wishes to call attention to the following principles and specific recommendations:

(a) Radiation protection standards should be [illegible] broad [illegible] control [illegible] and [illegible] foundation for [illegible] ration. Also, the full development of [illegible]

[illegible]

(b) [illegible]

within state and local governments in the field of
radiation protection. However, in order that the
agency may be assured of adequate control
bilities to the national society, the Committee
recommends that the agency be granted
authority in those areas of radiation protection
regulation seems most appropriate. It is recommended
that this authority apply only those circumstances
where a state or local government does not undertake
to meet its obligations.

Finally, in order that state and local governments
may discharge their responsibilities in the most
effectiveness, the Committee recommends that the
agency be granted authority to provide financial
financial assistance to state and local governments
public health programs.

(c) The training of professional and technical personnel
which to meet federal, state and local requirements
over the years, is a matter of serious concern.
Hence, the Committee recommends that the agency
be granted authority to conduct a broad range of
training programs which will assist the federal,
state and local governments in radiation
protection will be satisfactorily met.

VII. PROGRAM BUDGET

It is anticipated that the [illegible] control which includes the [illegible] will reach a level of approximately $[illegible] The Committee recommends, however, that the [illegible] perhaps at a level of approximately $[illegible] increasing in magnitude until [illegible] such progressive staging, [illegible] substantial one. However, [illegible] before the Committee in its [illegible] situation calls for bold action. Within [illegible] principle, the Committee believes that [illegible] with all deliberate speed.

[illegible]

[illegible]

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