REPORT TO THE

SURGEON GENERAL

U.S. PUBLIC HEALTH SERVICE

R

on

THE CONTROL OF RADIATION HAZARDS IN THE UNITED STATES

Prepared by

The National Advisory Committee on Radiation

March, 1959

REPORT TO [illegible]

[illegible]

OF

THE CONTROL OF R[illegible]

PREPARED BY

THE NATIONAL ADV[illegible]

MARCH, [illegible]

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I. FOREWORD

The National Advisory Committee on Radiation [illegible] by the Surgeon General of the [illegible] Public Health Service [illegible] guidance in matters pertaining to the [illegible] of radiation [illegible] United States. Among the many assignments [illegible] since its inception, one has been the [illegible] of [illegible] followed in this country [illegible] the hazards of ionizing radiation. [illegible] by the Committee after its study of [illegible].

II. RADIATION HAZARD, A [illegible]

During the past [illegible] including the National Academy of [illegible] of the United States[1], [illegible] Nations Scientific Committee on the [illegible] reported extensively on the [illegible] From these reports it is evident [illegible] undue radiation exposure and [illegible] limit such exposure both [illegible]

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

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

A comprehensive program of radiation control [illegible] important at this time in view of the [illegible] wherein ionizing radiation is a significant [illegible] now used extensively in industry [illegible] isotopes are finding applications [illegible] plants, universities, laboratories, hospitals [illegible] And nuclear reactors are being [illegible] pace. Few areas of human activity [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 United Nations Scientific Committee [illegible]

calculations based on estimates of the [illegible] of the [illegible] during this time period[3, 4]. The [illegible] exhibited by the x-ray data suggests the [illegible] of the population from x-ray apparatus may [illegible] control measures are systematically [illegible].

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

YEAR	NATURAL SOURCES	X-RAY SOURCES
1925	100	[illegible]
1935	100	60
1945	100	[illegible]
195[illegible]	100	[illegible]

The radiation exposure [illegible] likely to increase with the passage of [illegible] table II, where the natural growth [illegible] the years 1965 through [illegible]. [illegible] accumulated volume of radioactive [illegible] from this nuclear power development[5].

TABLE II. Predicted Power Capacity [illegible] Waste Resulting from [illegible]

Year	Power Capacity (megawatts)	[illegible] Waste Product ([illegible])
1965	[illegible]	[illegible]
1975	[illegible]	[illegible]
1985	[illegible]	[illegible]
1995	[illegible]	[illegible]

Another measure of the growth to be anticipated in the field of atomic energy may be made from an examination of the [illegible] 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 radioisotopes shipped from the Oak Ridge National Laboratory from 1952 to 1958 and the number of medical users of radioisotopes in the United States in the similar period are tabulated[6, 7].

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	[illegible]	[illegible]
1954	[illegible]	[illegible]
1956	[illegible]	[illegible]
1958	[illegible]	[illegible]

In addition to the rapid, anticipated growth in the use of devices and products which produce ionizing radiation, there is another factor which urgently points to the nation's need for a comprehensive program governing the public health aspects of this radiation. Like in the [illegible] given by scientists to radiation exposure to [illegible] by the [illegible] ward revision made over the [illegible] levels of ionizing radiation recommended by the National Committee on Radiation Protection and other authoritative groups (Table IV)[8, 9, 10, 11, 12]

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

Table IV. Recommended Annual [illegible] for Workers Occupation [illegible]

Period	[illegible]
1931-1936	[illegible]
1936-1948	[illegible]
1948-1958	[illegible]
1958-present	[illegible]

III. THE ELEMENTS OF A RADIATION [illegible]

A comprehensive program [illegible] includes many elements, two are [illegible] worthy of attention:

(a) the formulation of [illegible]

(b) the enforcement of public health regulations [illegible] these standards.

In general, the process by which a regulating agency [illegible] the protection standards employed [illegible] (1) the [illegible] pertinent scientific data, developed [illegible] (2) [illegible] evaluation of these data [illegible] them to the task, and (3) the preparation [illegible] evaluation, after [illegible] standards may create. [illegible] an organization independent of the regulatory agency.

The enforcement of health regulations by a controlling agency involves the adoption of specific procedures designed to ensure that the agency's standards are honored. In the front of radiation control, these procedures include, among others, the establishment of recommendations for the registration of radiation sources, the approval of operators and of the [illegible] and the periodic inspection of these facilities.

It may be worthwhile at this time to examine briefly the method currently used in the United States in the formulation of standards of radiation protection. In regard to scientific data, considerable research in radiation biology, chemistry and physics is contributing to the [illegible] knowledge needed for standards development. This research is being supported by the Division of Biology and Medicine of the Atomic Energy Commission and the National Institutes of Health of the [illegible] Health Service [illegible] by other governmental and non-governmental [illegible]. Although the [illegible] of this research is substantial, a review of [illegible] scientific data, which quantitatively relate radiation dose to biological effect, indicates that many gaps exist within these data [illegible] difficulty in the establishment of many radiation protection [illegible] basis. Since standards of radiation protection are of fundamental [illegible] to programs of radiation control, it appears to this Committee that [illegible] greater emphasis must be placed on radiation research in the future. This is particularly [illegible] scientific studies [illegible] of data for standards development. [illegible] important component of the radiation control program now in the process of development by the Public Health Service.

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

From time to time, a number of individuals have suggested that the NCRP should be [illegible] mental agency. They believe that, under [illegible] would gain stature and its recommendations would be [illegible] official status given them. The National Advisory Committee, however, believes that there is no [illegible] the NCRP enjoys. In such a climate, the actions of the NCRP are singularly forthright and decisive [illegible] if these characteristics were changed.

IV. STATE VS. FEDERAL [illegible]

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

best executed at the state or local level. The following discussion reviews the controversy in an effort to remove this difficult problem.

The Federal Government, under authority granted by the Atomic Energy Act of 1954[23], occupies a dominant position in the field of atomic energy. Through its control of atomic energy production facilities, [illegible] facilities, facility operators, by [illegible], classified data and [illegible], the Federal Government through its operating agency, the Atomic Energy Commission, exercises a profound influence over the development of atomic science in industry, medicine, [illegible] social structure. In addition to its responsibility for the [illegible] development of atomic energy, the Atomic Energy Commission has been given authority to regulate its operations [illegible] manner that the safety of the population both individually and collectively may be maintained.

The real and potential problems [illegible] by developments in atomic energy are principally more [illegible] control of the radiation, electromagnetic and particulate [illegible] processes. The extent of these problems [illegible] production facilities. The widespread use of [illegible] nuclear reactors [illegible] out this country [illegible] protection. Furthermore, the [illegible] magnitude which may be [illegible] developed [illegible]

are sufficiently far from a [illegible] expected to elapse before the [illegible].

The dual role of [illegible] development of atomic energy [illegible] safety on the other is an interesting [illegible] unwise and may be expected [illegible] lifetime, the Atomic Energy [illegible] criticized for seemingly subordinating [illegible] economy when several of its [illegible] also, a number of individuals [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 participation [illegible] place.

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

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Progress toward the production of practical atomic weapons was attended by the need for the rapid development of competence in the field of radiation safety and, because of secrecy, it was [illegible] to develop such competence in a regulatory body wholly independent of the production group. Hence, the functions of weapons development and protection regulation were [illegible] by a single agency, the Manhattan Engineering District.

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

When the Atomic Energy Act of 1954 was writing, [illegible] radiation protection was continued [illegible] responsibility of the Commission in the atomic energy field. However, such regulation [illegible] more complex and difficult because [illegible] a vigorous role in the development of [illegible].

The propriety of the Atomic Energy Commission to [illegible] regulatory function in radiation safety was [illegible] by a number of groups which believed that such [illegible] agencies, rather than [illegible] incidentally, is [illegible]

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regulatory power has pre-em[illegible] national interest was at stake[16].

It is not difficult [illegible] not be well served if regulation [illegible] energy were delegated entirely [illegible] frequently occur where radiation [illegible] boundaries and serious dang[illegible] not provided. Furthermore, [illegible] radiation protection codes [illegible] development of atomic machinery [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 per[illegible] record of which the AEC may be [illegible] on the other hand, such competence [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]

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and technical assistants are currently [illegible] in the health departments of the [illegible]. Also, [illegible] to the concept that where regulatory [illegible] community, these controls may [illegible] for control is not far removed [illegible] concept is likely to prove equally [illegible] many radioactive materials use [illegible] regulated, eventually [illegible] necessity must be evaluated [illegible] health assessment program. [illegible] demonstrated over long periods [illegible] effective control programs [illegible] the record of public health [illegible] sanitation.

After careful consideration [illegible] control of radiation safety, the Committee believes that [illegible] regulatory enforcement functions [illegible] discharged effectively by state [illegible]. Also, the Committee believes it wise to [illegible] over the public health aspects [illegible] a prime interest in the protection [illegible] the Committee [illegible] Commission. [illegible] be fundamentally sound. [illegible]

that the AEC should not continue to pursue [illegible] for the control of hazards in its own installations and in those of its contractors and licensees. Indeed, on the contrary, the Commission has a [illegible] to do so. In this respect, the position of the Commission is [illegible] many of our nation's industries [illegible] a broad range of safety [illegible] primary authority over the [illegible] where the ultimate authority should [illegible] involving the protection of the public [illegible] Committee believes this authority should be placed in an independent agency and preferably in one [illegible] U. S. Public Health Service.

V. RADIATION SAFETY PERSONNEL

The increasing urgency for [illegible] protection in the United States [illegible] there be available an ever increasing number of individuals [illegible] radiation control methods [illegible] agencies may conduct their regulatory functions. The types of individuals who are needed fall into two general categories:

(a) radiation health specialists* and

(b) radiological technicians.

* These individuals are not [illegible] employed principally [illegible] protection operations of the [illegible]

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By the term, radiation health specialists [illegible] to the level of a master's or doctor's degree on the [illegible] protection and capable of assuming a high order of responsibility for radiation control program. This training should include [illegible] physics and the allied basic sciences, [illegible] biological subjects [illegible] genetics, radiobiology, and [illegible] laboratory and field problems. By the [illegible] an individual trained to operate [illegible] technical work under the supervision of a radiation health specialist.

At this time, the need for radiation health specialists [illegible] be most critical. Until such [illegible] programs in radiation control cannot become fully effective at any [illegible] level. Inadequately trained individuals will not be able to [illegible] judgments nor perform the [illegible] of them.

From studies made by this Committee, it appears that the following constitute the personnel needs of the [illegible] radiation control through the year 1970:

(a) radiation health specialists [illegible]

(b) radiological technicians [illegible] 6,000

These estimates are based upon the belief that approximately three to four [illegible] nominal control program and that approximately one radiation health specialist will be needed for [illegible] of [illegible]

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energy industry approaches [illegible] alter these values.

It is anticipated that [illegible] increase progressively as [illegible] present time the Public Health Service [illegible] need for 150 specialists who have [illegible] radiation protection. By the [illegible] have expanded to the point where [illegible] by 1970, it is estimated that [illegible] and above those currently [illegible] conduct of its safety programs.

VI. COMMENT AND RECOMMENDATIONS

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

A great deal of progress [illegible] the development of regulatory [illegible] However, even today, a number of [illegible] programs, as previous comments have [illegible] the absence of uniform regulatory [illegible] an insufficient quantity of [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 for review and [illegible]. Specifically, the Committee recommends that:

1. Primary responsibility for the [illegible] radiation hazards be established in a [illegible] agency of the [illegible]. The Committee believes that the agency should logically be the [illegible] Health Service, Department of Health, Education and Welfare. [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 [illegible] with the control of radiation hazards.

3. This agency be given [illegible] program of control for all sources of [illegible]. In this connection, the Committee wishes to call attention to the following principles [illegible] recommendations:

(a) Radiation protection [illegible] broad [illegible] control [illegible] boundaries [illegible] ration. Also, the [illegible]

in [illegible] development [illegible] apply [illegible] of the country.

Therefore, [illegible] agency be [illegible] promulgating [illegible] protection [illegible] agency should [illegible] provided by the [illegible] Protection and by other [illegible] that the agency [illegible] intensive [illegible] provision [illegible] improved [illegible] protection.

(b) The [illegible] and well-[illegible] the responsibility [illegible] agency [illegible] reason [illegible] responsibility [illegible] associated [illegible] responsibility.

The [illegible] much [illegible] responsibility [illegible]

within state and local governments in the field of radiation protection. However, in order that the agency may be assured of discharging its responsibilities to the nation as a whole, the Committee recommends that the agency be granted supervisory authority in those areas of enforcement where federal regulation seems more appropriate. It also recommends that this authority apply under those circumstances where a state or local government finds itself unable to meet its obligations.

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

(c) The training of professional and technical personnel with which to meet federal, state and local requirements in over the years, is a problem of national importance. Hence, the Committee recommends that the agency be granted authority to [illegible] a broad range of training programs which will assure that the [illegible] state and local needs for personnel trained in radiation protection will be satisfactorily met.

VII. PROGRAM BUDGET

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

[illegible]

[illegible]

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