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

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REPORT

U. S. PUBLIC HEALTH SERVICE

ON

THE CONTROL OF RADIATION HAZARDS IN THE INDUSTRIAL USE

PRELIMINARY

THE NATIONAL ADVISORY COMMITTEE ON RADIATION

MARCH, 1956

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I. FOREWORD

The National Advisory Committee on Radiation was established in 1958 by the Surgeon General of the [illegible] to provide guidance in matters pertaining to the field of radiation and its effects on the United States. Among the many assignments [illegible] since its inception, one has been that of assessing the [illegible] followed in this country to protect the population and [illegible] the hazards of ionizing radiation. This report presents the recommendations developed by the Committee after its study of the [illegible] problem.

II. RADIATION HAZARD, A [illegible]

During the past several years, [illegible] including the National Academy of Sciences of the United States, the United Nations Scientific Committee on the Effects of Atomic Radiation, [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 [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 most of the [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 in view of the increasing [illegible] wherein ionizing radiation is a significant [illegible] now used extensively in industry, in medicine [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 1928 to 1958, [illegible] included in the report of the [illegible]

YEAR	[illegible]
1928	[illegible]
1934	[illegible]
1945	[illegible]
1953	[illegible]
1954	[illegible]
1955	[illegible]
1956	[illegible]
1957	[illegible]
1958	[illegible]
1959	[illegible]
1960	[illegible]
1961	[illegible]
1962	[illegible]
1963	[illegible]
1964	[illegible]

calculations based on estimates of the [illegible] of the [illegible]

during this time period[5, 6]. [illegible] x-ray data suggests [illegible] from x-ray apparatus [illegible] control measures are [illegible]

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

YEAR	NATURAL Sources	MAN-Related
1925	100	1
1935	100	20
1945	100	75
195[illegible]	100	125

The radiation exposure [illegible] likely to increase with [illegible] table II, where the [illegible] the years 1965 to [illegible] accumulated volume [illegible] from this nuclear [illegible][5]

TABLE II. Predicted Power Capacity [illegible] Waste Results [illegible]

Year	Power Capacity (megawatts)	[illegible] (curies)
196[illegible]	[illegible]	[illegible]
197[illegible]	[illegible]	[illegible]
198[illegible]	[illegible]	[illegible]
199[illegible]	[illegible]	[illegible]

Another measure of the growth to be anticipated in the future of atomic energy may be made from a consideration of the rapid progress which 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 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	32,000	670
1954	80,000	920
1956	180,000	1520
1958	230,000	1950

In addition to the rapid growth in the use of radioisotopes and products and processes involving radiation, there is another factor which urgently points to the national need for a comprehensive program to study the public health aspects of these activities. This is the new emphasis given by scientists to radiation exposure as the result of the recent upward revision made over the past few years in the maximum permissible levels of ionizing radiation recommended by the International Commission on Radiation Protection and other authoritative groups [(ICRP, 1954, 1958)

Each downward revision increased the acceptability of [illegible] the problems of radiation protection.

Table IV. Recommended Annual [illegible] for Workers Occupationally Exposed to Ionizing Radiation

Period	[illegible] (rem)
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 are particularly worthy of discussion:

(a) the formulation of [illegible] and

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

In general, the [illegible] protection standards employed [illegible] (1) the [illegible] pertinent scientific data, developed through research, (2) [illegible] evaluation of these data in [illegible] them to the task, and (3) [illegible] evaluation, after [illegible] standards may create. [illegible] an organization independent of the [illegible].

The enforcement of health protection [illegible] involves the adoption of specific [illegible] agency's standards are [illegible]. In addition, these procedures include, among others, the establishment of procedures for the registration of radiation sources, the issuance of specific radiation licenses and the periodic inspection of these facilities.

It may be worthwhile at this time to briefly review the [illegible] currently used in the United States for the formulation of standards of radiation protection. In regard to scientific data [illegible] biology, chemistry and physics contributing to the effects of ionizing knowledge needed to [illegible] by the Division of Biology and Medicine of the Atomic Energy Commission and the National Institutes of Health of the [illegible] other governmental and non-governmental [illegible]. Although the magnitude of this research is substantial, a number of critical scientific gaps exist which quantitatively relate radiation [illegible] establishment of more realistic [illegible] basis. Since standards of radiation protection [illegible] to programs of radiation control, [illegible] greater emphasis must be placed on [illegible] is particularly true of scientific [illegible] of data for standards development, [illegible] important component of the radiation control [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 leading 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 [illegible] suggested that the NCRP should be [illegible] mental agencies. They believe that [illegible] would gain stature and its recommendations would be [illegible] official status given them. The National Advisory Committee, however, believes that there is [illegible] the privileged status which the NCRP enjoys. In such a [illegible] singularly forthright and [illegible] if these characteristics were changed.

IV. STATE VS. FEDERAL R[illegible]

The enforcement of radiation standards [illegible] subject of considerable controversy between [illegible] believe that the dangers of [illegible] radiation hazards are so complex that regulatory responsibility should [illegible] lie at the federal level. Others [illegible]

best executed at the state or local level, [illegible] controversy in an effort to reduce the [illegible]

The Federal Government, under authority provided by the Atomic Energy Act of 1954[2,3], occupies a predominant position in the field of nuclear energy. Through its control of [illegible] facilities, facility operators, by [illegible], the Federal Government through its [illegible] Commission, exercises a great influence over the development of [illegible] 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 [illegible] authority to regulate its operations in such a manner that the [illegible] be maintained.

The [illegible] by developments in atomic energy is [illegible] control of the reactions, [illegible] processes. The extent [illegible] production facilities, the widespread use of [illegible] nuclear reactors [illegible] out this country [illegible] protection. Furthermore, the [illegible] magnitude which [illegible] developed processes [illegible]

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

The dual role of the Atomic Energy Commission with respect to the promotion and development of atomic energy on the one hand and the regulation of activities affecting safety on the other is an interesting one. Generally, such a mixture of responsibilities is unwise and may be expected to [illegible]. For the [illegible] lifetime, the Atomic Energy Commission has been subject to [illegible] criticized for seemingly subordinating [illegible] safety to the interests of economy when several of its [illegible] have been [illegible]. Also, a number of individuals and [illegible] have expressed concern [illegible] establishment of large reactors [illegible]. Some of these criticisms have been [illegible] but the [illegible] responsibility of the Commission has been [illegible] to some degree by misunderstanding and this may [illegible] as more and more participants [illegible] place.

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

Progress toward the production of practical atomic weapons was hindered only 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. Because all functions of weapons development and production were vested 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[1-3], with the function of the Commission, initially, was almost entirely promotional in nature. relatively minor private uses of fissionable materials were contemplated. In effect, the operating responsibilities of the Manhattan Engineering District were transferred to the new Atomic Energy Commission and the dual responsibilities of production and regulation were retained essentially unchanged in the new organization.

When the Atomic Energy Act of 1946 was written, regulation of radiation protection was considered a proper responsibility of the Commission in the atomic energy field. However, the application of the Act, as modified by more complex and difficult issues which arose, soon led to the Commission a vigorous role in the development of safety regulations.

The necessity of the Atomic Energy Commission to perform both regulatory functions was questioned, and was considered by several study groups which both supported such a combination of functions in one of the agencies, rather than split the responsibility[4-12]. This, incidentally, is now [illegible]

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

It is not difficult to suggest examples where the public would 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, the [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 commercial [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, which [illegible]

and technical assistants are currently employed in the field of radiological health in the health departments of the states. This personnel gives strong support to the concept that where regulatory controls are needed for the safety of a community, these controls may be best administered close to the activity or source for control is not far removed from the program personnel and the public. This concept is likely to prove equally valid in the field of radiation protection as many radioactive materials used in medicine and industry are brought under regulated, eventually become a part of routine municipal responsibility. The necessity must be evaluated at the point of local responsibility in terms of the total health assessment program. Finally, only state and local governments have demonstrated over long periods of time the ability to provide the broad, effective control programs in a great diversity of health activities, upon the record of public health effort is based for the most part the basic sanitation.

After careful consideration of the problem of state participation in control of radiation safety, the Committee believes that adequate discharge of the regulatory enforcement functions of the control program can be discharged effectively by state agencies presently operating. Also, the Committee believes it unwise to continue the present administrative practice over the public health aspects of the use of radioactive materials when a prime interest in the protection of the public by the Committee is not subject to study and control of the Atomic Energy Commission. A merely wise administrative practice which is subject to be fundamentally sound. Furthermore, the Committee does not feel that the

that the AEC should not continue to participate [illegible] for the control of hazards to [illegible] and licensees. Indeed, in the [illegible] do so. In this respect, the [illegible] many of our nation's [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 be [illegible] and preferably [illegible] U. S. Public Health Service.

V. RADIATION SAFETY PERSONNEL

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

(1) [illegible]*; and

(2) [illegible]

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

By the term, radiation health specialist, is meant a person trained to the level of a master's degree in the conduct of health physics protection and capable of assuming high levels of responsibility for radiation control programs. Specific specialties recognized are physics and the allied basic sciences, medical biological subjects such as genetics, radiobiology, and medicine, and specific engineering specialties laboratory and field problems. By the term, health technologist is meant an individual trained to operate radiation monitoring equipment and technical work under the supervision of a health specialist.

At this time, the need for radiation health specialists appears to be most critical. Until such personnel are available in adequate numbers, programs in radiation control cannot be carried out at the desired level. Inadequately trained individuals will not be able to make the necessary judgments nor perform the complex technical operations which are involved of them.

A study made by this Committee, reported in March 1956, of the following requirements of the Federal Government for radiation control through the year 1960:

(a) radiation health specialists 1,200

(b) radiological technologists 4,000

These estimates are based upon the need for only three to four technologists to support each health specialist in nominal control programs and the specialist will be needed for 1,200 additional health specialists in the

energy industry approaches [illegible] alter these values.

It is anticipated that [illegible] increase progressively as [illegible] present time the Public Health Service and state radiological health agencies have a need for 150 specialists who have completed [illegible] radiation protection. By the end of 1970, it is estimated that [illegible] have expanded to the point where [illegible] by 1970, it is estimated that 1,200 will be required. These figures are based and above those currently employed by the Atomic Energy Commission for the conduct of its safety programs.

VI. COMMENT AND RECOMMENDATIONS

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

A great deal of progress has been made [illegible] the development of regulatory programs for the control of specific radiation However, even today, a number of States are [illegible] programs, as previously mentioned, have been [illegible] the absence of uniform regulations [illegible] an insufficient quantity of [illegible] protection standards. The dual responsibility for protection [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 [illegible]. The Committee believes that the agency should logically be the [illegible] Health Service, Department of [illegible], and that [illegible] immediate legislation to achieve this objective.

2. The agency be given authority to [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 established on the basis of [illegible] control [illegible] and [illegible] should serve as [illegible] for [illegible] ration. Also, the [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 abilities to the authorities which the Committee recommends that the agency be given such authority in those areas of radiation control where regulation seems most appropriate. It is expected that this authority would be used only in those cases 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 financial assistance to state and local governments for radiation public health programs.

(c) The training of professional and technical personnel 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 conduct or support a broad range of training programs which will assure that federal, state and local needs for personnel trained in radiation protection will be adequately met.

VII. PROGRAM BUDGET

It is anticipated that the cost of energy research, development and pollution control which includes the activities set forth in the foregoing recommendations will reach a level of approximately $5 billion dollars a year within five years. The Committee recommends, however, that the program be undertaken gradually, perhaps at a level of approximately $2,000,000,000 in the first year, 1970-71, and increasing in magnitude until the five-year goal is reached. Although such progressive staging of the program is desirable, the total program is a substantial one. However, this is the type of problem that must be resolved before the Committee in its deliberations. While the Committee is fully aware that the situation calls for bold action, it believes, however, that adherence to the principle, the Committee believes that the Federal Government should proceed with all deliberate speed.

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