File with Waste Disposal

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EXCERPTS FROM THE

REPORT

OF

THE SAFETY AND

INDUSTRIAL HEALTH

ADVISORY BOARD

(The parts of this report which are of interest to Health Physicists have been copies herein.)

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[redacted] CONFIDENTIAL

NATIONAL SAFETY COUNCIL

20 North Wacker Drive
Chicago 6, Illinois

April 2, 1948

Atomic Energy Commission
Washington, D. C.

Gentlemen:

The attached report is respectfully submitted by your Safety and Industrial Health Advisory Board composed of the following:

Sidney J. Williams (Chairman), Assistant to the President, National Safety Council, Chicago, Illinois
Horatio Bond, Chief Engineer, National Fire Protection, Association, Boston, Mass.
Dr. Philip Drinker, Harvard School of Public Health, Boston, Mass.
Robert H. Albisser, Safety Director, Merck and Company, Inc., Rahway, New Jersey
Wm. F. Brown, Safety Director, Consolidated Edison Company of New York, New York City
Bernard R. Caldwell, Deputy Chief of Police, Los Angeles, Calif.
Dr. Abel Wolman, Head, Department of Sanitary Engineering, Johns Hopkins University, Baltimore, Maryland
Arthur E. Gorman, Sanitary Engineer, Office of the Housing Expeditor, Washington, D. C.
Herbert M. Parker, Assistant Superintendent, Medical Department, General Electric Company, Hanford, Wash.
Dr. Hymer L. Friedell, Director, Department of Radiology, University Hospitals of Cleveland, Cleveland, Ohio
Richard Fondiller, President, Woodward & Fondiller, New York, N. Y.

Jack J. Smick, Associate Actuary, Woodward & Fondiller, New York, N. Y.

We feel it a privilege to have been invited to serve you and we earnestly hope that our report will prove of value. Our work was greatly aided by the courtesy and cooperation shown by all your representatives in Washington and in the field, and by the contractors' representatives, and especially by Messrs. J. R. Maddy and Humphrey Gilbert who accompanied us on our field trip.

Very truly yours,

/s/ Sidney J. Williams

Sidney J. Williams
Chairman

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SAFETY AND HEALTH IN AEC OPERATIONS

SUMMARY - Principal Recommendations

5. Promptly study and correct radiation and other hazards to public health, both immediate and long-range. Make greater use of the cooperation of public health authorities, and of outside consultants generally.

Interchange of Information

Essential health physics data known at the Clinton Laboratories were not available to K-25 and Y-12.

Fire

On some projects we found excellent arrangements between Health Physics and the Fire Department - but not on all.

Employee Hygiene and Health

Further study and discussion may also lead to reduction of expenditures in some places without impairing needed protection. Further use may well be made of the safety inspectors and other professional workers, after training and in close liaison with Health Physics.

Medical men and health physicists need the help of industrial hygienists and sanitary engineers.

Public Health

Physicians, health physicists or managers should not attempt, or be required, to make decisions of vital long-range importance without the advice of such other specialists as sanitary engineers, epidemiologists, meteorologists, hydrologists, geologists and the like.

The correction of any continuing basis of the deficiencies noted in this and the preceding section lies primarily in the creation of a unit in the AEC of top level policy responsibility. Our original proposal for the creation of a health protection unit in AEC was intended to meet this contingency. Its details are presented in the Wolman-Gorman appendix and were submitted to AEC on September 27, 1947 in a memorandum by Wolman, Drinker, Friedell and Parker approved by the entire Board. We re-emphasize the necessity of the early creation of this unit. Where it should now be placed, in view of the AEC action with respect to the Biological and Medical Division while this Board was in the process of deliberation, is not so clear. It could be made a major sub-division of the Biological and Medical Division. If this is done, this Board feels that the usefulness of the new unit would be guaranteed if the Medical Advisory Board were enlarged so as to include adequate representation of professional workers in fields other than biological or medical research. Without such emphasis on specialized functions, we fear the unit will fail of its primary purpose.

This section has touched lightly on a few of the major aspects of an adequate long-range public health program. Reference should be made to the appended reports of Dr. Wolman and Mr. Gorman, of Dr. Drinker, of Mr. Parker and of Dr. Friedell.

AEC Organization and Program

Central Safety and Health Committee. We suggest, at AEC headquarters, a top committee for coordination of ideas and effort, consideration of safety and health aspects of new projects and (subject to approval by the General Manager) a determination of policy on all these matters. This committee, headed by a top management or production executive, should include the men in charge of such functions as production, engineering, research, health, safety, personnel and perhaps others - the fewer the better, consistent with full coverage. The committee should meet regularly, perhaps monthly.

Many industrial corporations have found a committee of this kind the most practical means of securing coordination among the various staff divisions and with line management. It is essential to success, however, that representation on the committee be kept at the top level and not delegated to subordinates who cannot speak with authority. This is not difficult if the meetings are short, with agenda limited to matters of major importance.

A similar committee is suggested in each Office of Directed Operations, tailor-made to fit local conditions and perhaps including contractor representation.

HYGIENE AND HEALTH by Philip Drinker.

Health Physics

The industrial applications of this science are new, but use of H-P in miscellaneous hospital work, in x-ray departments, Ra therapy, and the like, are well established. As the industrial and public health applications of AEC's future operations will be increasingly a public and not a secret matter, the sooner the present clumsy secrecy of H-P technics is modified the better. To observers like ourselves, with inadequate backgrounds in nuclear physics, the profound injunctions on comparing data put upon these groups, or even fostered by themselves, seems an absurd handicap. Meetings, visits, and exchange of technical data should be obligatory.

Records and summary reports of well-established laboratories, as at Clinton and Hanford, should be required of all and could profitably be circulated among selected personnel at other laboratories.

Due to the extraordinary record established by the H-P group, cumulative poisoning by radioactive materials has not yet been observed. Two accidental deaths are reported -- both of top-grade scientists - but any recurrence

is a remote possibility. In most though not all places the risks now are well understood, discipline is extremely good, and the caliber of craftsmen and laborers is far better than the industrial average. The danger has, therefore, become that of accidents rather than of chronic exposure as in poisoning from lead, benzol, or the like. That this state of affairs prevails is the best possible tribute to AEC. Granted that this argument is sound, it is the obvious job of the H-P men themselves to clean up their financial house, budget themselves, and work under their respective operations departments exactly as they would if they were part of an ordinary manufacturing enterprise.

We do not believe the differences in permissible radiation levels in the different areas are of much importance even though they be tenfold. All favor a figure allowing a large factor of safety. None are sure of the ultimate effects of exposures and there is no way they can be sure until an unknown time has elapsed. We are not competent to contribute a solution of these vexing questions and do not presume to make the attempt. But we insist that these men -- a selected few -- should circulate throughout the AEC areas, meet with their colleagues, swap information, and continually examine and improve their procedures.

Sins of Emission

Smyth states that Hanford's stack emissions of radioactive iodine and xenon are insignificant and that there is probably no danger of pollution of the Columbia. We question that statement as fact and we saw little evidence that AEC has profited from the vast experience of industry (particularly the smelting industry) in coping with stack pollution problems. Stratification of nitrous fumes from stack emissions at Hanford was evidence on one of the two days we happened to visit the plants. Stack heights, industrially speaking, are low in all AEC areas, and no stack heaters are used.

Multiplicity of hood discharges in the Tech Area of Los Alamos were a wonder to behold and nothing short of an engineering atrocity.

ENVIRONMENTAL SANITATION by Abel Wolman and Arthur E. Gorman

Technological Issues

1. Tolerance Limits for Radioactive and Toxic Materials. The maximum allowable amounts of radiation and of toxicity were established during the war period. Some of these limits were determined in consultation with medical officers of various specialties. There is little indication that these limits were reviewed, even during the war period, by public health officers normally concerned with and responsible for such problems in civilian life.

The limits used from area to area are not uniform. Some of this lack of uniformity apparently reflects disagreements in philosophy regarding the protections which should be afforded to the individuals exposed.

In some instances the factors of safety are low. In others the benefit of doubt was not always given to the individual, but rather to the exigencies of the process. When we are dealing, as in these instances, with potential and long range effects upon human beings, at best still under study, maximum factors of safety are ordinarily provided in more familiar industrial processes.

All of these tolerance limits should be reviewed by authoritative professional workers such as the medical officer of health, the sanitary engineer, the meteorologist, etc., in consultation with the highly expert workers in health physics.

2. Water Supply.

At Oak Ridge one of the major water supply intakes is below the discharges of radioactive and chemically toxic materials from the Clinton Laboratories' operations. Virtually no continuing observations or records are available at K-25 on these two important characteristics of the water supply. Past records do not disclose what the situations are at the point of water intake. It is generally assumed that the quality of water is good. In this, as in other situations, assumption is an unsatisfactory substitute for measurement and record.

The effects of various discharges on the Clinch River and in turn on the Tennessee River are accepted as without hazard, but only two isolated samplings were available of the Clinch River during some three years. One of these shows in excess of the tolerance limits for radioactive and toxic materials. The record is completely inadequate for the purposes of protecting public safety both within and without the government reservations.

3. Liquid and Solid Wastes. This particular field of operations has been developed without full consideration of the hazards involved. In the choice of procedures, professional advice, outside of the discipline of health physics, has been at a minimum. In some areas, such as Hanford, this omission is less exaggerated, since substantial beginnings have been made on bringing into the discussions professional judgments in waste disposal, biology, geology, and meteorology.

At Oak Ridge, liquid wastes of varying degrees of radioactivity and of toxicity have been disposed of either by direct discharge into the tributaries of the Clinch River or into temporary holding tanks. Some of these holding tanks were overflowing and were obviously insufficient either for the volume or for the character of the wastes held. At Los Alamos, laundry wastes carrying radioactive materials were being disposed of in sumps insufficient and unsatisfactory for the purposes for which they were being used.

At Hanford, a pipe line carrying certain radioactive wastes developed a leak which was undetected for a number of days. The effects of such leakage upon the surrounding subsoil still remain to be determined. Earlier disposal of liquid wastes into a well was at a depth dangerously near the ground water

table. At this same installation hundreds of thousands of dollars have been spent and are currently being spent for providing holding tanks for so-called "hot" wastes, for which no other method of disposal has yet been developed.

This procedure, in use at almost all the installations for this character of wastes, certainly provides no solution to a continuing and overwhelming problem. The business of constructing more and more containers for more and more objectionable material has already reached the point both of extravagance and of concern in most of the areas.

At Oak Ridge, as well as at most of the other areas, partially decontaminated major equipment of industrial and laboratory origin is being so disposed of as to create major responsibilities in the immediate future. Surface burial pits for such materials, frequently at sites more unfavorable for the purpose, are giving great concern to the contractors, both on account of unavailability of space and because of possible contamination of surrounding waters and air.

The disposal of radioactive wastes from the operations at Berkeley by dumping at sea raises important questions, even though these wastes are now enclosed in concrete while earlier dumping at sea was not so protected.

4. Air. The control of the disposal of radioactive and toxic materials into the atmosphere in all of the areas visited is subject to criticism in varying degrees. We cannot recall a single stack in any of the areas of such height or design as would meet modern requirements of industrial plant or laboratory operations.

Although we are aware of the difficulties attached to all measurements of radioactivity and of toxicity, carefully planned observations running over years should be instituted. The absence of any such data will undoubtedly raise many issues of a moral and of a legal character.

7. Transportation of Radioactive Materials. This monitoring of shipments of radioactive materials to and from all areas requires strengthening. We obtained conflicting reports on the intensity and desirability of such monitoring. Since the Commission is embarking on a world-wide distribution of such materials, a great deal of tightening of the controls is desirable.

The recent ICC proposals for transportation control leave some areas untouched, as, for example, the protection of watersheds and populated areas against potential accidents in transporting radioactive materials. Here, again, a much more intensive study of this specific problem should be undertaken by competent professionals. Our time was far too limited to explore the problem satisfactorily. The very hurried review of the situation disclosed inconsistencies in regulatory procedures and follow-up.

Organizational Problems (Wolman and Gorman, con't)

In all of the nuclear fission operations the establishment of maximum tolerance allowances has been primarily by the producer, and not by the guardians of the public health. Even assuming that in such a process maximum concern for the public has prevailed, it is an unusual deviation from the procedures by which the public in the past has insisted that its life and property should be protected.

Insulation between area and area, between industry operation and industry operation in the same area and between laboratory and laboratory has been so highly developed for security reasons that interchange of opinion, of ideas, or specifications, is virtually unknown.

At Oak Ridge, for example, one thoroughgoing set of controls is practiced in one area while in an adjacent area 10 miles ride away, virtually none of the controls are in force. Tolerance limits in one region are either unknown or unacceptable to another region.

Problems Demanding Immediate Investigation. (Wolman and Gorman, Con't)

1. The whole problem of the disposal of radioactive and toxic wastes needs immediate laboratory and field study. A tiny fraction of the money now spent for inadequate and purely temporary solutions to this problem, would provide more than enough funds for these purposes. This is one of the areas of research which cannot be indefinitely postponed.

2. Considerations of health and safety in many of the University laboratories and their surroundings require immediate attention. Their order of control is lower than in most of the industrial areas.

3. Determination of the extent to which radicactive and toxic wastes by past disposal in wells, cribs and pits have traveled from the point of disposal toward underground water courses; and the degree to which radioactivity or toxicity has been reduced.

4. Determination of the extent to which such wastes have traveled in surface water courses and become deposited on the banks or beds of waterways.

5. Determination of the air travel of such wastes from vents or stacks and their effect on plant and animal life in the area affected.

6. Effectiveness of various decontaminants and adsorbents and their characteristics after disposal by existing methods.

7. The extent to which existing containers used for transmission and storage of radioactive and toxic wastes have deteriorated since use. Exposed storage should be compared with housed storage and underground storage with above-ground storage.

8. Development of equipment and sampling techniques capable of maintaining and recording tests in air, soil, water and exposed surfaces with a minimum of labor and time.

9. Study of the biology, geology, meteorology and hydrology of areas within and surrounding present and proposed Atomic Energy Commission operations.

10. Study of the effect of wastes on the biological processes common to sewage treatments and disposal and the self-purification of streams.

11. Study of the concentration of toxicity and radioactivity of domestic sewage from communities where production plant and research workers live, with a view to establishing tolerances for sewage treatment processes.

Recommendations (Wolman and Gorman, Con't)

1. The permanent control of all hazards to health, whether of radioactive, toxic, contagious or other origins, might be best developed by the establishment at top level of AEC of a separate division responsible for health protection. It should be coordinate with the divisions of production engineering, research, etc. Its function should be diagnostic on a continuing full time basis and regulatory where the exigencies would require. Its size should be small and its staff of high professional competency. Its operations will penetrate most effectively to contractor levels by education, suggestion and intercommunication of ideas, although its ultimate responsibility for standards and their general application cannot be avoided.

Such a health protection division should be directed preferably by a medical officer of health. Key divisions should include at least initially the diciplines of biometrics, medical care and hospitalization, health physics, environmental sanitation coupled with industrial hygiene, and a unit for investigations of an applied operational type. The structure proposed simulates in essentials the familiar state health department organization.

The unit should be advisory to the General Manager, to the staff and to the contractors. Its functions should include, among others, current review of preventive health practices, of tolerance limits, of health hazards, of protective measures, of selection of new sites, of problems of transport of raw and finished products and of medical care and hospitalization. The serious problems of follow-up of workers after release should be an immediate concern. Investigation of waste disposal problems peculiar to nuclear fission projects presents another immediate issue.

Since the development of this proposed unit will take time, the early assignment of a sanitary engineer to the Engineering Division is recommended. His status in the permanent organization can be determined more definitely at a later time. Urgent decisions however require his attention now.

The skeleton structure proposed is illustrated below.

Director
Division of Health Protection

Biometrics	Health Physics	Environmental Sanitation & Industrial Hygiene	Investigations of applied operational character	Medical care and Hospitalization

2. Coupled with this addition to the organization is the necessity for the immediate initiation of a thoroughgoing investigation of disposal methods, of decontamination processes, of effects of radioactive and other toxic materials on current water and sewage treatment processes.

3. The training of doctors, sanitary engineers, hygienists, etc., in the techniques of measurement and in the interpretation of nuclear fission phenomena is a necessary concomitant of the preceding programs.

4. None of these steps are suggested for the dim future. They are essential undertakings for the present critical periods of transition and policy decisions.

RADIATION PROTECTION by H. M. Parker

The writer of this report is connected with the existing contractor's Health-Physics organization at the Hanford Works, and was previously connected with those at the Argonne National Laboratory, Chicago, and at the Clinton Laboratories, Oak Ridge. An entirely unbiased report is, therefore, unlikely to be presented, and the opinions submitted will also be colored by past experience and not solely the new exposure to the Project activities which was enjoyed by most of the members of the Advisory Board. The proposed review is far from comprehensive. It is not a safety inspection report, but will use certain incidents or conditions noted on the trip for illustrative purposes.

Clinton Laboratories, Oak Ridge

The Health Physics organization, under Dr. K. Z. Morgan, is potentially one of the strongest in the field. The rules for good protection procedure have been made available in all parts of the laboratories, but there appears at the present time to be rather indifferent acceptance of the rules in detail. The writer has been privileged to visit this location at intervals of six months for several years, and believes that adherence to the routine protection program has either marked time or retrogressed in the past year. This is appreciated by Dr. Morgan, who ascribes it to the length of time that he and his senior assistants have "had to spend" on national committees and other outside advisory boards. Although the Commission would do well to encourage the participation of the leading health physicists of its prime contractors in such activities, limitations should be set which prevent inadequate handling of the basic responsibilities of the contractor's Health Physics or-

Dr. Wolman and the writer discussed with Dr. Morgan at some length the waste disposal practices of the laboratories. It appeared that considerable care and attention had been given to the prevention of radiation injury to human, animal, and plant life, both within the Government Reservation and in the public domain. Similar attention to the hazards arising from release of chemically toxic wastes, essentially free from radiation, was not found. This same feature recurred at virtually all project locations, and appeared to be due to the split in organization between responsibility for radiation hazard control under Health Physics, and chemical toxicity control, which might fall under Industrial Medicine or Safety, or both.

Carbide and Carbon Chemical Co., Gaseous Diffusion Plant (H. M. Parker, con't)

This plant had apparently proceeded on the basis that there was no radiation hazard from the materials handled, provided that the accumulation of nearly chain-reacting masses was prevented. Control of this feature had been established early and properly maintained. The process gas used at this location is considered to have high chemical toxicity, but the work program is such that there is no possibility of hazard through the major part of the production process. However, there were locations at each end of the production line under which the process gas, under pressure, could have escaped into the atmosphere. No provision was made for routine monitoring for detection of such hazards.

Attention to waste disposal was entirely inadequate. Samples of the effluent water returned to Poplar Creek has been made only twice in the operating period. Of the first batch of 8 samples recorded, one showed significant concentrations of a process element. There was absolutely no follow-up of this occurrence.

Within the past few months, the Special Hazards organization has been alerted to the hazards of alpha-particle contamination and other potential hazards at the site, largely through contact with Dr. Morgan's group at Clinton Laboratories. This observer formed the opinion that the local group had a genuine interest in the full protection of employees and outside personnel. Any apparent lack of protection was due to lack of knowledge, much of which could have been obtained by liaison between the health groups of the Commission's own several installations.

Electromagnetic Separation Plant (H. M. Parker, Con't)

The health organization here seemed to function along similar lines to those reported at the Gaseous Diffusion Plant, now operated by the same contractor. The working staff in this Plant showed considerable disregard for the possible radiation hazards arising from handling of the process materials.* As at the Gaseous Diffusion Plant, the housekeeping was of high caliber, and this is a main factor in the hazard control mechanism of the material used. It would

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* With the exception of the excellent defense against accumulation of a chain-reacting mass.

follow that failure to maintain excellent control, if there is such failure, could be eliminated by additional outside discussion on the particular hazards of the operation.

Argonne National Laboratory (H. M. Parker, con't)

Dr. J. E. Rose, in charge of Health Physics here, is one of the recognized leaders of the specialty. The radiation hazard control of some parts of this organization is of extremely high caliber. The Physics Laboratory at Site A is typical of this. Even at this site, however, members of our Board were permitted to stand in a possibly dangerous exit beam from an operating unit, which indicates a class of control less rigid than that obtained under typical industrial management.

In contrast with Site A, radiation hazard conditions in the West Stands location cannot be described as better than deplorable. It is understood that work in this location has now been halted pending improvement. Conditions in the New Chemistry Building were very little better.

It was quite striking to observe these differences between the various subdivisions of the same National Laboratory. Much of the failure to achieve adequate safety conditions in the chemical laboratories presumably has to be ascribed to the attitude of the laboratory leaders. The Board was told that "It is necessary to take exposure to penetrating radiation when doing "research." The writer appreciates that there is an essential difference between industrial laboratories and research laboratories, but from the point of view of radiation hazard control this difference has been greatly over-rated by the majority of the research organizations. Correction of the situation has very little to do with Health Physics as such. It depends first on the persuasion of research laboratory staff that safety precautions now considered normal and elementary in any industrial laboratory have an equal place in the research laboratory. The particular phase of safety which is concerned with radiation would improve in direct proportion to this general improvement. The Commission cannot be encouraged too strongly to follow an educational program along these lines.

Hazard control at the Site B location was intermediate between that of Site A and the Chemical divisions. The laboratory already realizes that overcrowding and inadequate working conditions are largely responsible for the present sub-standard conditions.

The Argonne National Laboratory authorities are approaching their new responsibilities at the proposed DuPage County site with the best possible attitude. Outstanding radiation control will probably prevail when this consolidated site is in operation.

Los Alamos (H. M. Parker, con't)

The radiation protection program at Los Alamos is characterized by complete incoherence between its several parts. The original health group has had much greater interest in potential research problems than in the establishment of good routines of laboratory safety. Partly as a result of this, subsidiary organizations have each set up their own radiation hazard control. Although there is no fundamental objection to this procedure (in fact, it is in theory an ideal way to approach a safety problem), the usual result is to find that most of the independent organizations are of inferior quality, and this is certainly the case at Los Alamos. The C.M.R. Division puts considerable effort into operating its own Health Instrument Department, and there need not be much criticism of their efforts.

On this visit, the writer particularly studied the hazard management in the Physics organizations. Within this group, five sub-divisions were studied closely, and a wide disparity in safety performance noted. Some of the groups operating nuclear machines had paid considerable attention to basic safety planning and follow-up; in others, there was still an indifference to the potential hazards. A statement from supposedly "first-class" physicists that "they know much more about the biological hazards concerned than do the specially selected Health personnel on the site" was indicative of the breakdown of proper confidence in the Health Physics organization. Although the wearing of pocket meters and film badges is recommended in some locations, there is apparently no attempt to establish a working system. Typical of this was a record chart for seven people from May 1st until the date of this investigation which recorded only four pocket meter readings.

The Project leaders of this location freely admit that their safety and protection during the war period were inadequate. They state that in effect they worked on a "front-line" basis justified by the potential gains. One points out, however, that the Los Alamos record has been marred by the only two radiation deaths on the Project, and that both these occurred after the termination of the war. The apparatus for conducting the admittedly dangerous experiments in which these fatalities occurred has been redesigned to eliminate the hazards. Necessary security restrictions prohibited your Board from inspecting the new equipment, but permitted discussion revealed obvious loop-holes in the precautions taken. In comparison with the steps that would have been taken in an industrial analysis of this problem, the safety measures for routine operation, and especially the emergency procedures after another accident, were inadequate. The war emergency reason may have some connection with the poor protection standards, but the normal indifference of a University organization to safety measures can hardly be excluded as a contributory cause.

The waste disposal of both liquid and gaseous effluents at this site had not been followed with the completeness that might be desirable for the protection of public health or for the protection of the Commission against improper claims.

Radiation Laboratory, Berkeley (H. M. Parker, con't)

The most interesting feature of the radiation protection program at the Radiation Laboratory is the entire change of attitude during the past year. Previous visits to this location by the writer have led to the opinion that the majority of the scientists involved in the program were not personally convinced of the magnitude of the hazards involved; they felt that many of the safety requirements alleged to be necessary by the health physicist were unnecessary, and succeeded only in delaying a vital research effort. At the present time, it is evident that in the Physics divisions, and to a somewhat lesser extent in the Chemistry divisions, there is a desire to establish and follow necessary and sufficient protection practices. That the present status of hazard control is less effective than that found at some locations is less important than the recent development of this excellent cooperative spirit.

One circumstance of fundamental importance to the Commission was noticed in the inspection of the Berkeley facilities. Apparently a group of men operating the 60-inch cyclotron in the Crocker Laboratory spend part of their time on radiation problems under contract to the Commission, and part as free agents of the University. Records indicated that some of these men were routinely receiving more radiation than would be considered tolerable under Commission control. It appears to this reporter to be extremely unwise to permit divided responsibility for radiation exposure. It is a problem which should be brought to the attention of the Commission's legal advisors.

Hanford Works, Richland (H. M. Parker, con't)

The routine features of radiation control at the Hanford Works are commonly supposed to be handled better than at the other Project locations. This is due in large part to the excellent safety indoctrination of all members of the staff when the Hanford Works was operated by the DuPont Company. As emphasized elsewhere in this report, a solid foundation of general safe practice is necessary before the particular features of radiation safety can be effectively applied. At Hanford, there are difficult problems of waste disposal and responsibilities for prevention of significant contamination of the public domain. Neither the general public nor its responsible agencies have been given an opportunity to discuss their own safety with respect to effluents. Commission policy makers should evaluate the advantages of public reassurance against security requirements, now that the Hanford Works has a long term future.

General (H. M. Parker, con't)

If, following the lead of the Chairman of the Advisory Board, one states that "Safety First" is not the operating motto, then there is no such thing as an absolute safety program. In assessing ordinary safety programs, one establishes relative values in terms of cost of safety versus reduction in accidents, with its attendant financial gains and improved morale of the employees; one also makes statistics which evaluate the safety performance relative to similar industries. Most of these values are distorted in considering the special radiation hazards safety of the Atomic Energy Commission's operation. The insidious danger of radiation damage receives a spotlight in the popular and technical

press, which is out of proportion to the hazard in comparison with injury risk in many other industries (for example, the chemical industry in general where there are many late injuries as painful and damaging to the victim as those due to radiation). Nevertheless, the focus of public attention on the radiation hazards commits the Atomic Energy Commission to the very greatest care in the control of these hazards within its Plants and Laboratories, and especially in the release of noxious material outside these locations. The present inspection reveals that in general the Commission's contractors have been well aware of this responsibility, and have spared neither time nor effort in setting up organizations proper for hazard control. Within these plants and laboratories, the result has been a radiation safety record which is better than that enjoyed by any other organization.

In terms of cost, the radiation protection programs are consuming about 3% of the contractor's operating costs, as measured by employment figures. This is a modest outlay for the results obtained.

The Project record of two radiation deaths and virtually no established injuries should be compared with the performance of the radioactive luminous compound industry, and with the handling of radiation in hospitals and similar locations. These occupations have a continuing record of radiation injury and death. (See a review in MDDC 783.) Relative to these nearest analogues, the Commission's radiation safety record is phenomenally good. Criticisms of the program should consequently be accepted in the light of an over-all recognition that by the normal comparisons of cost and injury statistics the present record is sound.

One of the Commission's most pressing safety problems is concerned with the safe disposal of radioactive wastes in solid, liquid, or gaseous form. None of the locations visited is entirely satisfied with the disposal methods currently in use. A major unresolved question is the length of time for which a proposed disposal system should offer protection to the public. Times as varied as ten, one hundred, and several hundred thousand years have been mentioned.

In connection with waste disposal, several members of the Board have expressed surprise that outside organizations, such as the U. S. Public Health Service, State and County Public Health Services, and to some extent Geological and Agricultural Services, have not been freely consulted. It should be pointed out here that almost all the Project's health protection organizations have welcomed outside guidance whenever it has been possible to obtain it.* Most

* For example, the Hanford organization has the following consultants:

1. Radiotherapist - Dr. S. T. Cantril
2. Radiobiologist - Dr. R. E. Zirkle
3. Ichthyologist - Dr. L. R. Donaldson
4. Meteorologist and Oceanographer - Dr. P. E. Church
5. Geologist - U. S. Geological Survey

Also, waste disposal to the Columbia River has been reviewed by selected representatives of the State of Washington Fisheries Dept., State of Washington Game Dept., Oregon Fish Commission, Oregon Game Commission, and U. S. Fish and Wildlife Service.

of these same organizations are, however, opposed to any large scale transfer of responsibility to these public agencies.

The reasons for this are two-fold:

(1) In matters governing ordinary industrial pollution of streams, or the air, where there is no security reason for a breakdown of liaison between public agency and industrial operator, there is an obvious record of injury produced by improper effluent practice. The Health-Physics organizations believe that their own practices have been more thorough than is usual in industry.

(2) The "know how" on measurement of dangerous radioactive effluents is very largely concentrated within the project, and there is a natural fear that, if testing responsibility were given too rapidly to outside agencies, a lower standard of work would result.

Nevertheless, proper liaison in this field would inevitably strengthen the Commission's position. Ways and means of effecting this should be considered.

Two general criticisms of the Health Physicists are in order:

(1) The nature of their work exposes them to chemistry, physics, medicine, biology, electronics, engineering, industrial hygiene, and other technical specialties. Although the health physicists have developed considerable versatility, there is grave danger that they may consider themselves <u>experts</u> in all these fields. Some rather dogmatic statements on biology have been made by self-styled health physicists who have no formal training or even practical experience outside the field of physics. Such expertness leads a health physicist to assume a broad knowledge of sanitary engineering, for example, because he can measure trace amounts of active materials in the laboratory effluents.

(2) A faith method of operation, indigenous to Tennessee, was detected in many hazard problems. When questioned about certain hazard procedures, the answer was "I <u>believe</u> that this is safe." This answer was given in cases which other observers currently consider hazardous, and in other cases where experimental verification was possible but never attempted. We deduce that this is an intellectual version of the less hazardous rattlesnake-handling cult also indigenous to the region. It has already spread to other locations, especially in disposal problems, and is a very dangerous philosophy.

One item of general concern through the Project was the current system governing life insurance rates of Project employees. Unless the mode of operation of this system is misunderstood, it appears that radiation workers are being required to pay additional premiums on account of their possible exposure to radiation. The health physicists take the position that a chemical engineer within the Project has no risk beyond that normal to a chemical engineer in a non-radiation field, and similarly for each profession. The argument for

additional premium must either depend on a demonstrated high radiation accident rate, or on a fear on the part of an insuring agency that Project personnel may suffer shortening of life. Additional premium on the accident basis is entirely out of line as demonstrated by the already statistically adequate experience. As for the shortening of life, the probability of this at the extremely low exposure levels to which Project personnel are exposed should be determined by a competent body of Medical, Biological, and Health-Physics experts, in collaboration with actuarial skills. The genetic problem, which Professor H. J. Mueller succeeds in keeping before the public, cannot be so lightly dismissed, but it is not one which affects in any way the life insurance risks of the Commission's present employees. The whole question of life insurance rates is closely related to the morale of the Commission's employees, and it is recommended that the subject be very carefully considered by the Commission.

Training (H. M. Parker, con't)

Future improvement of the radiation protection program in the Commission's activities will be limited by the available trained force. It is important to realize that the Health-Physics organizations have become working medico-technical groups. A preponderance of the requisite skills is confined to the original Plutonium Project locations,* because these had the greatest magnitude and diversity of hazards. Future expansion at these and other locations is dependent on an additional supply of junior health physicists. It takes at least one year to convert a beginner into a useful member of the force; the five-day indoctrination courses that are springing up in some organizations are to be looked on with suspicion.

There is considerable competition for the location of training schools. Effective facilities are available at several sites. In sponsoring such programs, the Commission should not under-estimate the part that the larger production centers can play. Also a training that includes periods at two or three Project sites may be an ideal approach.

Summary and Conclusions (H. M. Parker, con't)

1. Radiation safety performance at project locations is good relative to previous radiation occupation experience, and current expenditures on protection are reasonable.

2. Security has stultified proper development of good practice in some cases. The radiation protection organizations require close liaison among themselves and with some outside protection groups.

3. The opposite danger of health physicists spending too much time on National or other committees is already apparent.

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* Metallurgical Laboratory becoming the Argonne National Laboratory; Clinton Laboratories, and Hanford Works.

4. Radiation safety is nowhere excellent unless there is also an excellent general safety response.

5. In research laboratories, there is an urgent need for such general safety indoctrination.

6. Almost without exception there is an increasing awareness of the value of sound radiation hazard control.

7. Waste disposal practices need broad Commission study and policy definition.

8. More field manpower is needed to amplify existing public health protection practices, and to conduct development.

9. Undue expertness and "faith" decisions should be reduced by the encouragement of broad development programs and contacts with recognized outside experts.

10. The legal aspects of part-time radiation work for two independent agencies should be analyzed.

11. A review of extra-hazard premiums for life insurance in view of the present safety record is in order.

12. Training of new men for radiation protection duties should be systematized by the Commission.

HEALTH PROTECTION by H. L. Friedell, M.D.

An over-all review indicates, in practically all aspects of health and safety, that the activities of the Manhattan Project were conducted with a very impressive record as to safety and health protection. Although this record has been excellent in the past and apparently superior to other industrial activities, many changes need to be instituted to maintain such a level. These excellent results, with respect to radiation hazards at least, have not been fortuitous since these hazards were continually reviewed. However, even on cursory inspection a great many changes immediately suggest themselves.

Organization and Policy (H. L. Friedell, Con't)

There are definite indications that many individuals who seek information or who have information to provide, do not have a definite procedure for transmitting the material or for making requests for information and data. I think the reason for this is quite clearly the lack of a division in the Atomic Energy Commission which could serve as a focal point for such activities. At the present time, health reports are combined with research reports and are transmitted almost indiscriminately to various people who the originator feels may have some interest in these problems. This individual is often in no position to properly distribute the reports or to see to it that they are devoid of non-pertinent information.

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As indicated in the Sub-Committee report submitted by Dr. Wolman, Dr. Drinker, Dr. Parker, and myself, a medical officer should be designated as director of the Health Protection Division. Other backgrounds were considered, such as that of sanitary engineer, and so forth, but it has been the previous experience that a medical man obtains the most effective cooperation with other health agencies and authorities. Since most of the activities of the organization concern matters of health, the indications that this individual should be a doctor of medicine are rather strong.

In the report it was indicated that the Health Protection Division should be a separate organization quite apart from any organization for medical and biological research. Although I agree that an organization to concern itself with (1) industrial health, (2) biometrics, (3) medical and hospital care, (4) health physics, and (5) special problems (see Sub-Committee report) may properly be a separate division, I do not feel that it precludes the possibility of combining this unit with the division for medical and biological investigations. In fact, there is some reason to believe that the problems facing the Atomic Energy Commission may be increased by having the organizations separate rather than combining the two under one head. Since there is extensive medical and biological research involved in the industrial health aspects of the Atomic Energy Commission activities it is obvious that close coordination and close cooperation will be essential. Various safe levels for radiation will have to be set on the basis of research conducted at various laboratories. Conversely, the character of part of the research will be determined by the kind of information that could be useful for health protection purposes. This is one very important reason why research and health protection might be combined. If established as separate divisions, close liaison must be maintained between them.

Somewhere in this organization, perhaps in an advisory capacity, a competent radiologist or group of radiologists should be available to consult with the Director of the Health Protection Division and in this way bring various health and safety measures under the scrutiny of a physician or physicians particularly interested in radiation.

The function of this Division of Health Protection should be supervisory without being regulatory. This means the accumulation of facts and data for constant review and the spreading of pertinent information throughout the Project.

I should like to add a note on the role of Health Physics. Considerable concern has been expressed in various quarters as to the position of Health Physics in the field of Health and Industrial Safety. The experiences of the Manhattan Project have clearly indicated that the Health Physicist provides a highly important and necessary function and therefore deserves full recognition and wide responsibilities within its domain. But I believe also, that the activities of the Health Physicist must be fully integrated with other aspects of health protection and that ultimate responsibility must rest with a properly qualified coordinator or medical director who will combine the various health features into the best possible fabric.

Radiation Hazards (H. L. Friedell, con't)

In reviewing very broadly the singular hazards which the Atomic Energy Commission will face, the problems of the hazards of radiation immediately come to the fore and are arresting in their magnitude. As has been indicated by the record of the Manhattan Project, these hazards have been very well handled and in fact, have received attention perhaps greater than other more common hazards which have actually produced injuries and deaths. The problem continues to be a vexing one and will require the closest scrutiny and attention. Since the effects of radiation are often insidious and are probably cumulative even at low levels, it is obvious that standards for permissible levels will be required at a very early date.

At the present time, various radiation levels are used in different portions of the Project. This is not serious in itself since they are all low and have varying margins of safety. However, some effort should be given to making these standards as uniform as possible. I believe, from a medico-legal point of view, it is unsatisfactory practice to have one group working at a higher level than another. There is a tendency to attribute every health disturbance to radioactivity in that section of the Project which operates under the higher levels. It is my personal feeling that the levels that have been used have been safe during wartime, but now that the operations embark upon a peacetime era, the levels should be reduced as low as is practicable. I do not wish to discuss these levels here since this particular aspect of the health problem will be a continuing one - the levels will undoubtedly undergo constant revision, and will need repeated review by special groups. It is recommended, however, that an Advisory Board or Committee be set up for this purpose, and wherever possible, liaison with official groups that have been concerned with problems of radiation in the past (Bureau of Standards, U. S. Public Health Service, etc.) be established.

Radioactive Waste Disposal (H. L. Friedell, con't)

One of the difficult problems involved is the disposal of radioactive wastes. Up to the present, in general the disposal of wastes has been reasonably satisfactory - that is, without important incident and without undue hazard - but it is certain that the entire problem will need review. Although much deliberation about, and consideration of, disposal of radioactivities has occurred, no concrete program exists at present for waste disposal. As the operations continue at the present level, this problem will become more pressing and should be tackled at the earliest opportunity. I personally attended several Project-wide meetings which were inconclusive. It was the consensus of opinion that this problem required continued long study and a variety of consultants for any long range plans. The radiologist and the health physicist should not alone bear the responsibility of determining the disposal of wastes even though the essential information with regard to toxicity levels of radiation will probably be within their domain. Critical information is required in other fields, including sanitary engineering, meteorology, etc. The Atomic Energy Commission should consider consultation with representative agencies of various municipal and state governments so that responsibility in part be shared by those who may be affected.

Cost of Radiation and Health Protection (H. L. Friedell, con't)

It would be quite impossible to determine the cost of health protection under the present circumstances. I am sure that it is extremely high (not that these costs cannot be justified). I have held to the opinion that during the war, risks with regard to hazards from radiation should not be maintained lower than risks occurring in other wartime civilian activities directed for the war effort; that is, no additional man power, time, or funds, should be expended to give extreme safeguards. With the beginning of peacetime operations, I believe this policy can be discarded and that the risks now can be reduced to the lowest practicable level. It is my opinion that careful study can reduce the cost of health protection. In any event, certain economies could be effected. Before any such economies can be put into effect, however, an adequate cost accounting system to establish the costs of health protection must be instituted. This will provide indications for the type of remedial measures.

In closing I would like to summarize the pertinent points high-lighted by the recent survey and meetings of the Safety and Industrial Health Advisory Board.

1. The speedy establishment of a Division within the organization of the Atomic Energy Commission to deal with matters of health and safety is of paramount importance and transcends all other specific measures.

   a. The organization should preferably be headed by a medical man, since health matters will be a primary concern of this Division and since it will need contact with medical officers both within and outside the Project.

   b. I have outlined in the body of this report the possibility of combining this with medical and biological research. Both could exist as distinct sub-divisions.

   c. The function of the organization should be fact-finding and advisory, rather than regulatory.

2. The singular hazard of radiation will require careful review, probably by a separate Committee with regard to the establishment of standards for permissible working levels. These standards should be made as uniform as possible, especially for medico-legal reasons.

3. The problem of waste disposal is pressing. I believe it has been satisfactory to the present, but a definite program needs to be instituted at once which can be applied Project-wide. The problem is not limited to the radiologist and the Health Physicist, but involves experts in other pertinent fields.

4. The cost of health protection has been high, but it may be possible to effect certain economies. This can be done only after institution of an adequate cost accounting system.

RECORDS AND COST by Richard Fondiller and Jack J. Smick

4. Liability for Suits

Radioactivity and toxicity are hazards to which many employees and an unknown number of the general public have been and will be exposed. It is our opinion that the AEC is both legally and morally obligated to reduce the possibility of injury and disease to a minimum, as well as to compensate for them regardless of the strict letter of the law. If claimants find they have no legal remedy, it will only be a matter of time until the legislatures and the courts will create the remedy and the liability.

It is obvious that the AEC faces a potential liability of substantial amount, which may be recovered by damage suits. Instead of dealing with these settlements on a year to year appropriation basis, we suggest that a fixed amount (or an amount proportioned to the operations) be set up annually to constitute an insurance fund.

5. Insurance Coverages, Costs and Records (Fondiller and Smick, con't)

No register is maintained in which reports of claims or of injuries are entered. These reports would comprise claims arising out of radiation as well as occupational injuries. In the absence of a register, we did not make any estimate as to the reserve liability.

We were permitted to examine the files at Hanford Works on employee cases of possible over-exposure to radiation on the basis of standards of tolerance prevailing there. Such cases were few in number, nearly all appeared to be attributable to accidental over-exposure, and none of the files showed medical evidence of injury.

Recommendations and Comments on Insurance Program (Fondiller and Smick, con't)

The records of exposure, division by insurance classifications, payrolls and loss costs are not now maintained in a manner suitable for insurance rate making. If they were, the results undoubtedly would justify re-negotiation of rates for insurance coverage, with a substantial saving to the Government. The rate-making methods now in use for AEC projects are based largely on judgment and, if continued, will result in redundant premium charges to the Government.

Recognition that certain of the operations present unusual hazards, which prevent employees from obtaining the type of personal insurance coverage at the usual rates available to the public at large. The secrecy surrounding much of the work and hazards is mainly responsible for this condition.

The unique hazards of the operations of AEC and of its operating contractors are not adequately compensated by any of the workmen's compensation laws. The need to supplement the gaps in insurance coverage exists by reason of disparity in benefits under workmen's compensation acts, non-recognition of occupational diseases endemic to AEC operations, and difficulty, because of security reasons, of openly defending claims in court.

6. Insurance Purchased by the Individual (Fondiller and Smick, con't)

The coded classification established by the Home Office Life Underwriters Association now permit employees to secure insurance, with extra premiums proportionate to the degree of hazard. While these extra premiums appear to many as substantial, nevertheless at this date the degree of hazard is unknown. We suggest that the Committee on Mortality of the Actuarial Society of America and the Association of Life Insurance Medical Directors be requested to establish a code, through which the mortality and morbidity experience can be determined in future years. We recommend that a periodic revaluation of the hazard be made, preferably by the same men who made the previous investigation, and who would consequently be able to evaluate changes in conditions.

7. Problems in Connection with Injuries from Exposure to Radiation (Fondiller and Smick, con't)

In addition to the protective and medical aspects involved in connection with this major problem, are the following:

(a) The maintenance of accurate records of actual cases of injury by over-exposure and of claims for alleged injury. This is needed to measure the extent of the problem and to allay public apprehension.

(b) The maintenance of personnel metering and monitoring records to allow for the determination (either on the basis of present or future standards) as to whether there has been over-exposure. This is necessary for the following reasons:

(1) It will allow for a determination, in case the effects are not evident until many years later, whether the injury can in fact be attributed to the employment. It will thus provide a record of inestimable value, in defending AEC from alleged claims and suits.

(2) It will constitute a record of each individual's exposure, and may enable the radiologists and other technicians (when the effects of exposure are better known) to determine whether any individual should be allowed to expose himself further. Too little is known at the present time about the long range effects to depend upon present day tolerance standards.

DETAILED ANALYSIS OF SEVERAL PLANTS (Fondiller and Smick, con't)

Monsanto Chemical Company - X-10

It will be seen that $6 was spent monthly for safety and fire protection. We were unable to secure the figures for safety expenditures separately from fire protection.

The medical total shows an average monthly expenditure of $6. The Medical Department maintains statistical studies to assist them in administering the Department. These statistical records are also interpreted so as to be of practical use in the operation of the plant.

The control of special hazards, to personnel and to equipment, is administered by the Health Physics Section. We find that a complete set of records is maintained for every employee who enters a restricted area. These records are entered daily and are accumulated at weekly intervals in the personnel folder of each employee. Since the cost for personnel (apart from equipment) is not available separately, we have used the total cost and divided by the total number of employees, to secure an average monthly cost of $13 per employee. This amount we recognize requires to be modified by the cost of inspection of equipment and by the fact that many employees are not exposed to these special hazards. To summarize, the total cost of all the services is shown by the following table to be $25 per month per employee.

Monsanto Chemical Company - X-10

Cost Figures - Year Ending June 30, 1947

Description	Amount	Amount	Monthly Average per employee
Safety and Fire Protection Total		$143,040	$6
General Medical	$142,604		
Urinalysis Laboratory	8,449		
Medical Total		$151,053	$6
General Health Physics	$ 30,233		
Development of Detection Devices	98,909		
Personnel Monitoring	86,305		
Radiation Survey	107,914		
Health Physics Total		$323,361	$13
GRAND TOTAL		$617,454	$25

Carbide and Carbon Chemical Corporation - Y-12 (Fondiller and Smick, con't)

As respects health physics, we were given an estimate that only 5% of the total or about 100 employees, are exposed to radiation hazard, and even in respect to these employees surveys are made only on request. No separate cost figures were available.

Hanford Works (Fondiller and Smick, con't)

A rather comprehensive general medical, hospital and health physics program is maintained by the General Electric. Inclusive of the cost of those services which are not directly paid for by employees and by residents of Richland, the average cost per month per employee of this program is $25. This does not include safety protection nor capital expenditures for plant and equipment nor administrative overhead.