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MANHATTAN DISTRICT HISTORY

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MANHATTAN DISTRICT HISTORY

BOOK I - GENERAL

VOLUME 4 - AUXILIARY ACTIVITIES
CHAPTER 2 - FOUNDATION OF THE NATIONAL LABORATORIES

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MANHATTAN DISTRICT HISTORY
Book I, General
Volume 4 - Auxiliary Activities

Chapter 2 - Foundation of the National Laboratories

1. General. - With its military mission completed, at the end of hostilities, the Manhattan District found itself faced with the problem of providing some effective arrangement for continuation of Government-supported research and development programs in nuclear science, during the interim period before a peacetime civilian agency could be established to sponsor and control such activities. During the war, research on separation methods for uranium isotopes had been conducted chiefly by academic or industrial contractors at private facilities. In the case of the Plutonium Project, however, the District established and supported a comprehensive research program at Chicago, known as the Metallurgical Project, supervised by the University of Chicago as operating contractor, which involved the construction and maintenance of various District laboratories and other facilities. Among these, for instance, were the pile in the Argonne Forest Preserve and other facilities constructed on University of Chicago property on the South Side, all of which possessed important potential peacetime uses for nuclear science research.

In order to reorganize, consolidate and redirect these various Chicago projects toward permanent peacetime research in nuclear science, it was desirable that the activities in the area be transferred eventually from the University of Chicago campus to one main site, where they could be established as essential branches of a centralized research institution. Such an undertaking, it was realized, required the prepara-

tion of a comprehensive and well-integrated research program, the design, construction and operation of adequate facilities, and the organization of a permanent scientific staff. The District felt strongly that any such Government-sponsored activity should be participated in by the many universities and scientific institutions in the surrounding area; moreover, the short-term loan of key technical personnel from such agencies to the new laboratory, on a rotating basis, would assist in assembling a competent scientific staff and also serve to train scientists in the new techniques of nuclear chemistry, physics, and engineering. Finally, it was desirable that the installation of elaborate scientific equipment and the formulation of research programs at the proposed Government-supported institutions be integrated with the scientific resources and activities of the neighboring universities.

Shortly after plans were promulgated for establishing the new District laboratory in the Chicago area, a number of universities in the northeast which had contributed in an important way to Manhattan Project research activities approached the District regarding the establishment of a similar Government-supported nuclear science laboratory in the New York metropolitan region, to implement the nuclear science activities at Harvard, M.I.T., Yale, Princeton, Columbia and other nearby universities, much as the proposed Chicago laboratory was intended to serve academic and private laboratories in the northcentral United States. This second proposal came as a direct consequence of the District's earlier decision to establish a peacetime laboratory in or near Chicago.

The general problem of supporting national laboratories, and

specifically the establishment of the two in northcentral and northeastern United States, was presented to the District's Advisory Committee on Research and Development in March, 1946.

This Committee had been appointed at a meeting of scientists and Army personnel in the Madison Square Area offices of the Manhattan District on 9 February 1946. Those present at this meeting included General K. D. Nichols, Col. K. E. Fields, Lt. Col. J. R. Ruhoff and Col. A. V. Peterson. The following were the members of this Advisory Committee: Dr. R. F. Bacher, Dr. A. H. Compton, Dr. W. K. Lewis, Dr. C. A. Thomas, Dr. R. C. Tolman and Dr. J. A. Wheeler.

At the meeting in March 1946, it was generally agreed that the District should undertake the establishment of national laboratories in various desirable regions of the United States, to supplement District-supported research and development work being undertaken under contract by universities and private laboratories. Further, the latter agencies should be permitted to participate in the national laboratories' programs, in cooperation with all such scientific institutions in the area. Specifically, the proposed plans for establishing the Argonne and the Northeastern (later Brookhaven) National Laboratories were approved.

Ultimately, it was intended that all national laboratories should be operated in the same manner. Representatives of the various participating universities of the region would form a formal mutual association, with a Board of Directors, which would be prepared to plan and operate the facility for the Government, subject to its approval, as a contractor. In the case of Argonne National Laboratory, however, this

arrangement was not possible during 1946. The new proposed Laboratory was to replace the old Metallurgical Project, which had been successfully operated by the University of Chicago. During the transition from the old organization to the establishment and effective functioning of the new mutually-cooperative Argonne arrangement, it was imperative that current and contemplated District research programs be continued without interruption. Inasmuch as the whole matter of outside university participation, with its resulting security and related problems, was still experimental, it was decided to continue the University of Chicago for the time being as the prime operating contractor for Argonne. A second reason for this action was the fact that, except for the pile facilities at Argonne, most other buildings on the project belonged to the University of Chicago, or were located on campus property. However, despite the University's primary responsibility as contractor, the Council of Participating Universities for Operation of Argonne, composed of 25 universities in the northcentral area, has served an important function in advising the District regarding the planning and staffing of Argonne National Laboratory since it came into existence on 1 July 1946.

Meanwhile, the organization of Brookhaven National Laboratory, in the northeast, followed a somewhat different history. Here, the establishment of a new research facility involved no continuation of previous District activities. It was possible to "start from scratch", and the ultimate objective was reached in a more direct fashion. Representatives of nine of the interested universities formally organized Associated Universities, Inc., a corporation prepared to undertake the

contract for planning, establishment and operation of the District's Brookhaven National Laboratory on the site of Camp Upton, Long Island. Subsequent to its incorporation in July, 1946, this concern prepared a program for the organization and operation of the new facility, in conjunction with the District, and negotiated a contract. By the end of 1946, and the close of this history, negotiations for approval of the proposed contract, and formulation of the research program to be pursued under it, were essentially complete, although formal approval was being withheld pending assumption of Manhattan District activities by the new Atomic Energy Commission.

At the Advisory Committee meeting in March, 1946, it had been agreed in the most general terms that establishment of national laboratories in other regions of the United States should be encouraged, but that no definite action should be taken by the District until a definite joint proposal had been made by the institutions which were interested in participating. At the close of this history, 31 December 1946, three universities in Southern California had presented a very general and preliminary proposal for establishing a government-supported nuclear science laboratory in their neighborhood, but there had not been sufficient time for detailed consideration of the proposal by the District.

2. Argonne National Laboratory.

a. Status of Metallurgical Project after V-J Day. - At the end of hostilities, in the summer of 1945, the physical organization of the Metallurgical Project at Chicago was that generally described in Chapters 6, 7 and 8 of the Smyth Report. Within the confines of the

Project itself, headed by Dr. A. H. Compton, were the Metallurgical Laboratory, under Dr. Farrington Daniels, the Argonne Laboratory, under Dr. W. H. Zinn, and various other technical divisions and auxiliary administrative sections. The contract under which the Project was being operated for the current fiscal year 1946 was written to terminate on 30 June 1946, and it was considered desirable by both the District and University of Chicago, the operating contractor, that a definite plan be formulated before this date for continuation of Government-supported research and development activities in nuclear science in Manhattan District facilities at Chicago on a permanent peacetime basis. Included among the various factors pressing for early resolution of the problem were:

(1) The University of Chicago's desire to recover its classrooms, laboratories and other regular facilities, and its teaching staff, being used for Project work.

(2) The fact that Dr. Compton, Project Director, was to leave shortly to assume his new duties as Chancellor of Washington University, St. Louis.

(3) The necessity for formulating some definite plans for the future in order to maintain the highly-trained scientific and technical personnel collected at Chicago, which was being lured away by offers of positions in teaching and industry.

b. Plans for Reorganization of the Metallurgical Project. - At a meeting of Major General L. R. Groves with Dr. Farrington Daniels and various other Metallurgical Project officials in Washington on 20 September 1945, it was decided to effect the following reorganization

of the Project following Dr. Compton's departure on 1 October 1945:

(1) The Metallurgical Laboratory would replace the Metallurgical Project in the administration of District research activities until termination of the 1946 fiscal year on 30 June 1946.

(2) Dr. Daniels would continue as Director of the Metallurgical Laboratory, with increased responsibilities as a result of the assimilation of Project activities by the Laboratory, and would report directly to the District's Chicago Area Engineer (Reference 1).

(3) The Argonne Laboratory would be made, for administrative purposes, a division of the Metallurgical Laboratory.

e. Initial Interest of Neighboring Universities.

(1) Non-District Sponsored. - Meanwhile, on 28 September 1945, Chancellor Robert M. Hutchins of the University of Chicago independently called a conference of eight north-central colleges to discuss possible cooperation by the neighboring universities in the joint utilization of the Argonne pile and other related facilities operated by the University of Chicago. The representatives attending the meeting all were or had been former Manhattan District scientists. General problems involved in academic participation in the nuclear science program at the University of Chicago were explored, and the difficulties of security restrictions were discussed at length. (Reference 2.)

(2) District Sponsored. - Shortly afterwards, the District took an active part in establishing a plan whereby neighboring northcentral universities might participate in Government-supported nuclear science activities at Chicago. Following informal discussions

between Dr. A. H. Compton and Colonel K. D. Nichols, the latter appointed Dr. Compton chairman of a committee of representatives of several leading north-central universities to investigate the general question of mutual participation in the Metallurgical Laboratory program to the extent permitted by security and other national interests. The immediate purposes of the committee, as indicated in Colonel Nichols' letter to Dr. Compton of 19 November 1945, were, generally, to recommend a plan for continued operation of the District's research facilities at Argonne by means of a cooperative arrangement between the Government and various neighboring north-central universities, and to achieve the following specific objectives:

(a) Initiation of new programs and continuation of current research and development activities in nuclear science at the District's permanent facilities in Chicago.

(b) Establishment of programs designed to train scientific personnel in the techniques, theory and application of nuclear science.

(c) Making the unique equipment and facilities at Argonne available on a widespread basis to qualified outside institutions interested in pursuing research programs related to this field.

(d) Staffing the laboratory with competent academic personnel from these outside institutions on a rotating basis.

Committee members appointed by Colonel Nichols, in addition to Dr. Compton, were: Dr. R. A. Gustavson, Vice President of the University of Chicago; Dr. F. H. Spedding, Iowa State College; Dr. Farrington

Daniels, University of Wisconsin; Dr. F. W. Loomis, University of Illinois; Dr. John T. Tate, University of Minnesota; Dr. O. H. Eshbach, Northwestern University; and Major E. J. Bloch, U. S. Corps of Engineers, Committee Secretary and non-voting member.

d. Establishment of Advisory Committee on Argonne. - This group, officially designated as the Advisory Committee on Operation of Argonne Laboratory, met at the University of Chicago on 2 December 1945. It was recommended at that time that the laboratory be continued as a regional Government-supported facility, designed primarily to serve research institutions in the northcentral United States and to undertake a research program of fundamental and applied nuclear science designed to supplement related programs at associated institutions in that area. The immediate operation of Argonne, it was felt, should be continued for the time being under the current contractual arrangement between the Manhattan District and the University of Chicago. However, a regional advisory council should be established to review the Laboratory's operation, and the ultimate objective should be the formation of an operating corporation, consisting of representatives from leading northcentral research institutions, to supervise administration of the Argonne National Laboratory for the Government. To effect this end it was recommended that an advisory council be immediately organized of representatives of 24 neighboring northcentral universities to operate Argonne in conjunction with the present contractor, the University of Chicago. This regional advisory council should then elect an executive board of seven members to act for the council and eventually to serve as a board of directors of the

corporate entity which would eventually assume full responsibility for operation of Argonne Laboratory. Finally, it was recommended that activities at Argonne should include both classified and unclassified nuclear research, that no scientific compartmentalization of information or of work should exist, and that participation in all laboratory activities would be on a voluntary basis and subject at all times to proper security regulations (Reference 3). It was proposed under this plan that all present Metallurgical Laboratory activities should be eventually removed from the University of Chicago campus and consolidated at the Argonne Laboratory site some twenty miles southeast of the city.

e. District Authorization for the New Laboratory. - A plan was subsequently submitted to the District Engineer by Dr. Daniels, on 21 February 1946, which outlined the specific procedure for transfer of Metallurgical Laboratory activities to the proposed new Argonne National Laboratory, in accordance with the broad objectives recommended by the Advisory Council (Reference 4). Under the proposed Daniels plan, Metallurgical Laboratory activities would terminate with the current 1946 contract on 30 June 1946 and the assets and facilities would be transferred to the new laboratory proposed by the Advisory Committee. In the meantime it was also suggested that research activities, necessarily confined to buildings on the University of Chicago campus at present, should be gradually transferred to the new institution during the next several years as fast as conveniently possible. Specific proposals for expansion and continuation at Argonne of the Metallurgical Laboratory's current research activities were also outlined in Dr. Daniels' proposal. A few days

later the District approved development of a definite program for establishment of a northcentral national laboratory at Argonne along the lines recommended by the Advisory Committee and according to the procedure suggested by Dr. Daniels. (Reference 5.) At the 8-9 March meeting of the Manhattan Project's Advisory Committee on Research and Development, the proposed District program with respect to the establishment of the new national laboratory was approved. In general, the Project's Advisory Committee felt strongly that plans for establishing national regional laboratories for research in nuclear science should be supported by the Government, in cooperation with the various neighboring universities and research institutions in particular regions. The broad outlines of organization should follow those proposed in the case of Argonne, with a board of directors chosen from the participating institutions in each area, to cooperate with the Manhattan District in determining the programs to be undertaken by the various regional laboratories. Each laboratory should be administered by a financially responsible agency acceptable to both the District and the participating institutions. In the case of the new Argonne Laboratory, specific approval was given to the District's general plans and the proposed organization.

f. Establishment of the Council of Participating Universities. - Shortly afterwards, Colonel Nichols invited the 25 northcentral institutions recommended by the Advisory Council, on 5 December 1945, to send representatives to the initial meeting of the Council of Participating Universities for Operation of Argonne, scheduled for 5 and 6 April 1946. At this conference, the cooperating institutions elected a board of

governors of seven scientists, comprising those originally appointed by Colonel Nichols in November, to effect the establishment of Argonne National Laboratory. This group met the following day to outline specific programs for the organization of Argonne for the approval of the District. It was agreed to recommend continuation of the University of Chicago as contractor for the fiscal year 1947. In general it was felt that research which could be done effectively at the laboratories of the associated institutions should not be undertaken at Argonne. The latter's efforts should be chiefly devoted to full scale projects in nuclear science for which the associated universities were not equipped. (See Reference 6.)

The 25 original participating institutions were the following:

Battelle Memorial Institute

Carnegie Institute of Technology

Case School of Applied Science

Illinois Institute of Technology

Indiana University

Iowa State College

Mayo Foundation

Michigan State College

Northwestern University

Notre Dame University

Ohio State University

Purdue University

St. Louis University

Washington University

Western Reserve University

University of Chicago

University of Cincinnati

University of Illinois

University of Iowa

University of Michigan

University of Minnesota

University of Missouri

University of Nebraska

University of Pittsburgh

University of Wisconsin

(Note: The name of the University of Nebraska was inadvertently omitted from the list of institutions in the duplicated copies of the Plan of Organization - Reference 7.)

g. Board of Governors. - The executive activities of the Council of Participating Universities have been carried on by the Board of Governors, which met at appropriate intervals after its establishment to effect the final mechanism for transfer of Metallurgical Laboratory activities to the new Argonne National Laboratory (Reference 9). At separate meetings on 6 May, 5 June and 7 October, it considered specifically:

(1) Selection of a laboratory director to replace Dr. Farrington Daniels, who planned to leave the Chicago Area when the Metallurgical Laboratory expired on 30 June.

(2) Preparation of a formal plan of organization and

statement of operating policy agreeable to the Council, the University of Chicago, and the District.

(3) Formal approval of the Argonne research program and budget for fiscal year 1947.

(4) Determination of the role of the University of Chicago as the operating contractor.

(5) Selection of a permanent site.

h. Selection of a Director. - Dr. W. H. Zinn, Director of Activities at the Argonne Laboratory under the Metallurgical Project, was selected on 6 May 1946 to head the new national laboratory upon its establishment on 1 July, and continued in this role through 31 December 1946.

i. Preparation of a Plan of Organization. - Instead of indicating the functions of the participating university group by a series of by-laws, it was decided to specify the responsibilities in a formal plan of organization and statement of operating policy, indicating the interrelated functions of the associated universities, the Laboratory, the operating contractor and the Manhattan District. Such a plan was prepared by the University of Chicago's legal counsel, based on principles outlined by the Board of Governors, and including revisions recommended by the District. At the Board's 5 June meeting the plan was unanimously approved and met with the consent of the full council. (Reference 7.) To achieve the objectives of the plan, the full Council of Participating Universities held an official organization meeting on 6 June and elected a new Board of Governors to function for the current year. Dr. John Tate was elected chairman of the Council, and Dr. Norman Hilberry, Secretary.

The new Governors themselves elected Dr. Daniels as their Chairman, Dr. John Tate as Vice Chairman, and Dr. Norman Hilberry, as Secretary, pro tem. On 1 July 1946 the Argonne National Laboratory officially came into being, upon termination of the Metallurgical Laboratory, and under the terms of the approved plan of organization and statement of policy which governed its activities through 31 December 1946 and the close of this history.

j. Argonne Research Program and Budget. - The Research program and proposed budget for operation of Argonne National Laboratory during the fiscal year 1947 was approved by the Board of Governors at its June meeting and it was agreed at that time to continue the plans originally intended for 1947 research under the old Metallurgical Laboratory, with a budget of $7,600,000. In general, the broad research objectives of the participating university group, as stated and approved by the Board of Governors, are to pursue research and development in nuclear science to the extent warranted by available manpower and in accordance with the Government's overall program of nuclear science research. Continued research in both reactor piles and the acceleration of nuclear particles has been emphasized. In connection with this latter field of research, the Board of Governors recommended approval of the Laboratory's request for construction of a high potential Van de Graaff generator. The District subsequently referred this request to the Advisory Committee on Research and Development, and authorized construction and installation of the equipment following the latter's approval. At the Board of Governors most recent meeting on 7 October 1946, a review of the extent

to which members of the staffs of the participating institutions had taken an active part in Argonne research programs since its formal establishment on 1 July showed that the original objectives were being gradually obtained. The "Summary Report on the Progress of the Program of Cooperation to Argonne and Participating Institutions since June 1946", presented at this time, indicated some twenty scientists and consultants from the cooperating universities had already contributed to research work currently under investigation (Reference 10). At this meeting Dr. Zinn also presented a list of research problems currently being investigated at Argonne, together with a program for the scientific and technical projects contemplated for the rest of fiscal year 1947. A more comprehensive and detailed account of the work of this installation will be found in the appropriate volumes of the District History devoted to Argonne National Laboratory research.

k. Role of the University of Chicago as Operating Contractor. An important phase in the development of the Argonne National Laboratory was the crystallization of the University of Chicago's legal and administrative position as operating contractor for the joint association of the District and its advisory group of participating universities. As operator of the Metallurgical Project, and the Metallurgical Laboratory which subsequently replaced it, the University's responsibilities had been solely to the District. Although it is intended ultimately that Argonne shall be operated directly by an agency representing the participating universities, it was felt that, until what was essentially a new and experimental effort in establishing a Government laboratory had been achieved, the University of Chicago should continue as the responsible operating

contractor. Under this arrangement both the choice of an operator and the proposed program of research would be subject to the approval of the participating university group. However, final approval of the Laboratory's program and budget, and of the performance of the operating agency, would lie in the hands of the Manhattan District. In order to clarify the University of Chicago's contractual status under this arrangement various conferences were held between the University and the District. The terms of the agreement reached at these conferences and concurred in by the Board of Governors were, briefly, that while the University would maintain close working relations with representatives of the Government and the participating institutions, it would also, as operating contractor, assume full responsibility for determining the business policies under which the Laboratory was to operate. The formulation of the research program would be prepared by the Laboratory staff in conjunction with the staffs of the participating universities, subject to District approval. The University, however, assumed full responsibility and authority for seeing that its objectives were properly implemented. In this connection it was agreed by all parties concerned that the University of Chicago's academic staff would not be preferred over the other cooperating universities in the mutual use of Argonne facilities. (Reference 8.)

1. Permanent Site for Argonne.

(1) Negotiations with Cook County Forest Preserve. - During the war, in 1942, the Cook County Forest Preserve leased to the District approximately 1000 acres of its holdings in the Palos Hills Section, some twenty miles south of Chicago, for construction of the Argonne

research facilities, including experimental piles. In the autumn of 1945 when plans were being formulated to transfer all District research activities of the University of Chicago to Argonne and to integrate them under the proposed national laboratory, negotiations were opened with the Forest Preserve authorities for permanent acquisition of the Argonne acreage. In conversation with the University of Chicago the District concluded that at least 45 acres of the Preserve property, comprising the land presently used together with sufficient added acreage for expansion purposes, should be acquired by purchase or long-term lease. Subsequent discussion with Forest Preserve officials, however, disclosed that the land would only be made available to the District on a 10-year lease, at the very longest, and that no permanent acquisition or loan of the property was possible. At the Board of Governors meeting on 5-6 April 1946 it was unanimously agreed that every effort should be made to continue operations at the proposed laboratory at the Argonne site as long as possible, particularly in view of its convenient location to metropolitan Chicago. By June, despite further negotiations with the Forest Preserve officials, it seemed apparent that permanent tenure of the Argonne property was unlikely and that other alternatives must be seriously considered. The District Engineer reported at this time that the War Department and Congress desired that surplus Government-owned property be used for the new site unless there were imperative reasons established to the contrary. A subcommittee, consisting of Dr. Daniels, Dr. Eshbach and Dr. Gustavson, was appointed to survey all Government-owned surplus property within a 150-mile radius of Chicago. Meanwhile

the District resumed its efforts to acquire a portion of the Forest Preserve for permanent use, this time at a higher level. These negotiations culminated in an exchange of letters between the Secretary of War and Cook County Forest Preserve officials which definitely precluded the possibility of using the property for a permanent site. A 10-year lease was subsequently arranged between the District and the park board, during the summer of 1946, for the 45-acre area presently occupied by Argonne facilities. Meanwhile, attention was turned toward acquisition of other land for a permanent location.

(2) Selection of a New Site. - It was essential for continued effective operation of Argonne and permanent retention of its highly trained technical personnel that a permanent site be obtained and new facilities constructed as soon as possible. Early plans for the establishment of the new laboratory called for construction of numerous additional structures of a permanent nature to provide space for the proposed nuclear research projects contemplated by the District. Dr. Farrington Daniels' "Proposed Program for the National Nucleonics Laboratory at Argonne," of 21 February 1946, and the Chicago Area Engineer's "Report on Availability of Utilities and Services Required for Expansion of the Argonne Project," of 1 May 1946, described the general preliminary considerations necessary for initiation of the proposed Argonne building program. With these in mind the Gustavson-Eshbach-Daniels subcommittee surveyed all Government-owned war surplus plants within a 150-mile radius of Chicago during the summer months and reported at the 7 October 1946 Board of Governors meeting that nothing of a satisfactory nature had been

found. After further discussion the Board of Governors unanimously agreed that the new permanent site should be located in the Chicago area within a few minutes drive of the present laboratory. Dr. W. H. Zinn then proposed a site highly recommended by his laboratory staff, which was located on the Des Plaines River near the present facilities and comprised some 4000 acres. After a tour of inspection the Board of Governors unanimously recommended that the War Department obtain this area as the permanent location for the Argonne National Laboratory. District approval of the proposed site was still pending on 31 December 1946.

3. Brookhaven National Laboratory.

a. Initiation of Program. - Following the end of the war a number of educational, scientific, medical and engineering institutions in the New York region, which had been interested in wartime developments in nuclear science, became concerned with the need in the northeastern area of the United States for certain of the large and expensive equipment necessary for further research in this field, such as chain reacting piles, and betatrons, cyclotrons, and other high energy accelerators. Specifically, it was felt that the Government should support a nuclear science research laboratory in the area, in which the various institutions could participate, similar to the proposed Argonne National Laboratory in the northcentral region.

On the 14th of January, 1946, Dean George B. Pegram of Columbia University took the initiative in inviting the heads of 17 institutions interested in research laboratories, in the general

Philadelphia to New Haven region centering in New York, to meet at Columbia on 16 January, to explore the situation in greater detail. (Reference 11.)

At the very time that this meeting was being arranged, Dean H. S. Taylor and Professor H. D. Smyth of Princeton University were formulating plans for a similar gathering to be held at their own university. The two separate efforts were consolidated at the Columbia meeting on 16 January 1946, at which 35 representatives from 18 institutions (including Columbia University) were present.

It was decided at this meeting to request the establishment of a nuclear science research laboratory by the District in the northeast area, and Dean Pegram advised General Groves of this decision in a letter dated 19 January 1946, which he was authorized to sign on behalf of each of the following participating institutions (Reference 13):

Bartol Research Foundation, Swarthmore, Pa.

Bell Telephone Laboratories, N.Y.C.

Board of Higher Education, New York City
(for The City College, Hunter College, Brooklyn College and Queens College)

Department of Genetics, Cold Spring Harbor, N.Y.
(Carnegie Institution of Washington)

Columbia University, N.Y.C.

Cornell University Medical College, N.Y.C.

Fordham University, N.Y.C.

Institute for Advanced Study, Princeton, N.J.

Long Island College of Medicine, N.Y.C.

Memorial Hospital, N.Y.C.

New York University, N.Y.C.

Polytechnic Institute of Brooklyn, N.Y.C.

Princeton University, Princeton, N.J.

Research Corporation, N.Y.C.

Rockefeller Institute for Medical Research, N.Y.C.

Rutgers University, New Brunswick, N. J.

Standard Oil Development Company, N.Y.C.

Stevens Institute of Technology, Hoboken, N. J.

University of Pennsylvania, Philadelphia, Pa.

Yale University, New Haven, Conn.

In reply to this letter General Groves designated Colonel K. D. Nichols (then Brigadier General) to meet with members of the group on 8 February to discuss the plan more extensively. At this conference three main points were brought out:

(1) The District was seriously considering the proposal.

(2) The laboratory should not be a "regional" one but "national". However, it was agreed that the preeminent resources of the New York region, in scientific personnel and other respects, made that area a particularly advantageous location.

(3) The whole case would be much strengthened if it were backed by Universities from Baltimore to Cambridge rather than those concentrated merely in the New York area. This was particularly true since M.I.T. had already approached the District for support of a laboratory to be set up in the vicinity of Cambridge.

Following this conference Dean Pegram conferred with President Compton at M.I.T., who said that his institution was quite ready to join with the other universities of the northeast region in cooperative efforts for a central laboratory. Similarly, the support of Harvard and Johns Hopkins for the broader plan was obtained. With this wider range of cooperation established, it appeared that the interest of the Manhattan District in establishing a laboratory in the northeastern region of the country was assured and the problem of how such a laboratory might be operated came to the fore.

A group of scientists from nine more or less similar universities of the entire participating body of instituions, namely, Columbia, Cornell, Harvard, Johns Hopkins, Massachusetts Institute of Technology, Pennsylvania, Princeton, Rochester, and Yale, met on 2 March. and decided to transmit a second letter to General Groves reemphasizing the proposal and indicating the broadened support it had received from a more widely distributed number of northeastern universities. The other institutions which had originally supported the proposal were informed of the combined action of the nine initiatory universities in a memorandum circularized to all parties concerned on 5 March, which summarized the developments to date. It was felt both by the District and by the nine university representatives that for practical efficiency the initial planning arrangements for the venture could better be concentrated in the hands of a few institutions rather than spread among the many which had first met informally (Reference 14). Consequently, further planning was carried on by the representatives of the nine institutions for which Dean Pegram had written the 3 March letter to General Groves. It was

thoroughly understood, however, that, while only the nine universities were to be associated with the management of the project, other universities and other research laboratories would be accorded similar appropriate privileges with respect to scientific cooperation with the proposed laboratory. (Reference 11.)

b. District Approval. - At the first meeting in Washington of the Project's Advisory Committee on Research and Development on 8-9 March 1946, the general proposals contained in Dean Pegram's 3 March letter were reviewed. Professor H. D. Smyth was chosen by the Initiatory Group to represent it at this conference and Professor Zacharias of M.I.T. and Dean Pegram also participated in the discussion. It was agreed by the Advisory Committee and General Nichols that the establishment of a northeastern laboratory should be a part of the District's broad program for support of nation-wide nuclear research and development activities. More specifically, it was agreed that the nine cooperating universities, with the assistance of the District, should be authorized to proceed with preliminary plans and organization of the northeastern laboratory, in accordance with the general objectives outlined in Dean Pegram's proposal (Reference 16).

c. The Initiatory Universities' Planning Committee. - Following Advisory Committee approval of plans for establishing a northeastern national laboratory, the District requested the "Initiatory Group" to (1) submit a detailed proposal for establishing and operating the project and (2) organize a legally responsible corporation or other representative and mutual association of the universities which would be prepared to undertake the operation. Since the previous conferences of

interested institutions had been entirely informal in nature, Dean Pegram, in a letter of 19 March, formally requested the presidents of the nine participating universities to designate two representatives, preferably one scientist and one administrative official, to represent each of the respective institutions at a formal organizational conference on 23 March (Reference 17). On this date the representatives met in New York and set up the "Initiatory University Group" to cooperate with the District in planning the project. At this meeting a Planning Committee was appointed consisting of one representative from each of the nine universities. This body served as the executive committee guiding the Group's activities during the interim period prior to formal incorporation as Associated Universities, Inc., in July, 1946. It met frequently with District representatives during the next several months, and reported its actions at the less frequent gatherings of the larger general Group. The Planning Committee was composed entirely of scientists, while the larger Group comprised both scientists and responsible officers and business managers of the universities. Dr. L. A. DuBridge, Rochester, headed the Planning Committee from its inception until 18 May 1946, at which time he was replaced by Dr. R. F. Bacher, Cornell. During the four-month period from March, 1946, to final incorporation of the Group in July, the Planning Committee met with District representatives on eight different occasions. The larger general Group of university representatives, however, met only twice, on 16 April and 1 June, to review and approve Planning Committee actions. Following incorporation, the responsibilities of the corporation were legally assumed by a Board of Trustees and by the latter's duly elected officers and executive committee. One of the

first acts of the new Corporate Trustees, however, was to confirm and continue the responsibilities of the Planning Committee and its various operating subcommittees on site, contract, nuclear machines, etc. During the rest of 1946 these groups continued to meet and prepare plans for establishing, organizing and operating the north-eastern laboratory (References 18 to 24, inclusive).

In the subsequent numerous conferences between the Manhattan District and the cooperating universities, leading to the establishment of the Northeastern (later Brookhaven) National Laboratory, the District was represented in all actions, except final decisions of important policy, by the Madison Square Area Engineer, Colonel G. W. Beeler, or by authorized members of his staff.

d. Planning Committee Objectives. - At its first meeting on 30 March 1946, the Planning Committee outlined the major preliminary objectives which were to be attained, with District approval, before the new laboratory could begin functioning effectively. These objectives were (1) establishment of a responsible corporate organization prepared to operate the new laboratory as the District's approved contracting agent, (2) negotiation of a mutually agreeable contract, (3) selection of a satisfactory site adequate to the laboratory's needs, (4) formulation of an approved program of scientific research and development, and (5) acquisition of a technical and administrative organization prepared to carry out the actual proposed research work. To effect each of these broad aims, various subcommittees were appointed to make recommendations on site location, form of contract, personnel policies, and installation of electronuclear machines and "pile" reactors, etc.

e. Formation of the Corporation. - In Dean Pegram's original proposal of 3 March 1946, the need had been emphasized for delegation of the operating responsibilities of the new northeastern United States laboratory to a strong contracting agency prepared to organize and support a permanent and qualified organization of scientific and administrative personnel. In view of (1) the desire of the various northeastern universities to support the program effectively, (2) the established corporate position of the institutions themselves, and (3) the practical and successful experience of both officers and scientists of the respective universities in undertaking numerous research war contracts, the District had a strong incentive for delegating operation of the proposed laboratory to the associated group.

f. Choice of Form of Organization. - At the 30 March Planning Committee meeting, Professor H. D. Smyth of Princeton was chosen Chairman of the Subcommittee on Contracts, and his group was requested to consider the various possibilities for organization of a contracting body; namely, (1) operation of the laboratory by a single university as at the Argonne National Laboratory, (2) formation of a mutual non-profit association, or (3) formation of a new corporation representing the nine associated universities (Reference 18). At the group meeting of the Initiatory Universities on 15 and 16 April 1946, it was decided that organization of a special corporation to serve as the responsible operating contractor would provide the most suitable arrangement. Provisions in the by-laws of the corporate charter would maintain the body as the cooperative association engaged in a mutual venture, an identity, which the various

universities desired to retain. It was originally planned that each university, individually, would serve as one of the incorporators, underwriting the program by an amount ranging from about $25,000 to $100,000. To effect these general objectives and prepare articles of incorporation, the New York legal firm of Milbank, Tweed, Hope, Hadley and McCloy was retained as the Group's legal counsel.

g. Incorporation of Associated Universities. - As the result of extended conferences between District representatives and the Planning Committee, the final articles of incorporation provided that: (1) individual representatives of the universities, including faculty members or officers, would serve as the individual incorporating members of the corporation, rather than the various university corporations, and (2) each of the associated universities would underwrite the corporation by $25,000. Since a definite site had not been decided upon at the date of incorporation, Associated Universities, Inc., was first incorporated under the laws of the State of New Jersey on 8 July 1946, with Princeton, New Jersey, as its official place of business (References 21, 22 and 25). About this time, however, Camp Upton, Long Island, was selected as the location of the new laboratory, and it was therefore considered advisable to have the Group incorporated under the laws of the state in which it would transact its business. Accordingly, incorporation of Associated Universities, Inc., under the Education Law of the State of New York was completed on 18 July 1946 through the granting of a permanent charter by the Regents of the University of the State of New York. (Reference 26.) It was provided that there should be eighteen trustees, two elected, for three year terms, from nominees proposed by each of the nine associated universities respectively. The incorporating trustees elected the necessary

additional trustees. An executive committee and officers were also elected, with Edward Reynolds, Vice President of Harvard, as Corporation President, Joseph Campbell, Columbia University, as Treasurer, and T. I. Parkinson, Jr., an associate of the firm of legal counsel, as Secretary (References 23 and 24). One of the important decisions at the first meeting of the corporation's Executive Committee, 9 September 1946, was to adopt the name "Brookhaven National Laboratory" for the corporation's research project to be established at the Camp Upton site, Brookhaven Township, Suffolk County, Long Island, New York.

h. Interim Financing of Associated Universities Prior to Formal Contractual Agreement. - Inasmuch as no formal contract had been arranged between the Manhattan District and the Associated University Group by 31 December 1946, reimbursement for interim expenditures up to that date was arranged through Letter Contract W-31-109-eng-15, negotiated between the District and Columbia University, and separate in form and intent from the District's two other current contracts with Columbia for specific research and development programs in the field of nuclear science. On 28 June 1946, the Madison Square Area Engineer, as Contracting Officer for the District, entered into this letter contract with Columbia, authorizing the latter to furnish all necessary services for planning the proposed national laboratory. The contract was written for an estimated expenditure of $50,000, over a period of two months, ending 1 September, in anticipation of a formal contract to be instituted shortly thereafter. Since no formal agreement was subsequently reached, it became necessary to extend the period of the agreement, and to raise the

ceiling of authorized expenditure. Five successive supplements, written between 17 July 1946 and 31 December 1946, have extended the period covered through 31 January 1947, and have raised the limit of reimbursable expenditures to $200,000 for planning Brookhaven under terms of the letter contract. (Reference 27).

i. Contract Negotiations Prior to Incorporation of Associated Universities, Inc. - Prior to incorporation, the District explored the question of a proposed contract with the Planning Committee, and the Madison Square Area submitted the initial draft of a suggested agreement, on 1 June 1946, for review and discussion at the 10 June 1946 Planning Committee meeting. It was agreed at that time that further contract negotiations should be withheld pending organization of the formal corporation, since the general form and legal powers of the latter undertaking would be deciding factors in determining the nature of any contract entered into by the District.

j. Negotiation of a Contract Subsequent to Incorporation of the Associated Universities. - By the articles of incorporation under both the New Jersey and New York laws, Associated Universities, Inc., was authorized to enter into contracts with agencies of the Government of the United States, or others, for establishment, support and operation of laboratories and other facilities for research in the physical and biological sciences, including all aspects of nuclear science and its applications in engineering and other fields. Subsequently, various drafts of proposed contractual agreements were drawn to serve as the basis for extended negotiations between the District and the officers and Executive Committee of Associated Universities, Inc. A final contract agreeable in

most particulars to both the District and the Corporation was drawn up for the calendar year 1947, at $7,900,000, and was submitted to the District for final approval on 17 December 1947 (Reference 28). After approval of the contract by the District Engineer, Major General L. R. Groves, on 27 December 1946, asked for the approval of Mr. David Lilienthal, who had been appointed Chairman of the Atomic Energy Commission by President H. S. Truman. However, since the Commission had not yet taken over and had not had sufficient time to consider the proposed agreement, and since he felt such review obligatory, Mr. Lilienthal decided to withhold Commission approval pending further consideration. Mr. Lilienthal, however, advised the Corporation on 27 December 1946 through its President, Mr. Reynolds, that it was the Commission's intent that the Laboratory should press ahead with its program, and that meanwhile interim arrangements would be made to permit all the necessary work to proceed pending formal signing of a contract between the two parties.

k. Site Requirements. - The general features desired by the university group in location of the proposed laboratory had been briefly indicated in Dean Pegram's letter to General Groves of 3 March 1946 (Reference 15): "It does seem entirely possible, however, to find a site so located that a man could leave his university after work one day, travel either in the evening or at night, spend the next day at the nuclear laboratory, and return to his own university the next evening or night; for instance, a site within a relatively short automobile ride of one of the stops of the Pennsylvania or New Haven Railroads between Washington and Boston." These general requirements were narrowed down by

the Planning Committee at its March 30 meeting to a location "as near as possible to New York City," not exceeding two hours commuting distance from Pennsylvania Station or Grand Central, and within easy range of a desirable residential area. Other considerations were adequate size, (at least a square mile) and satisfactory solution of problems of drainage and radiation from stack gases.

1. Inspection of Possible Sites.

(1) Developed Areas. - The Subcommittee on Site reported to the Planning Committee during the next several months its recommendations regarding the acceptability of a number of developed site areas which it had surveyed in the metropolitan region surrounding New York City. In view of the War Department's desire to utilize surplus war property where possible, the Manhattan District insisted that all surplus developed Army property be given full consideration in the discussions. This was agreeable, for developed acreage would allow a shorter interim construction period before the laboratory was in operating condition, because the installation of many utilities and conveniences would have already been completed. With this consideration in mind, and stimulated by District enthusiasm, the general interest of the Site Subcommittee shifted from undeveloped areas to several desirable War Department surplus property sites, including Fort Slocum, Fort Hancock, and Camp Upton in the adjacent New York area, and Fort Devens in Massachusetts. At the further suggestion of the District, it was agreed to have the Stone & Webster Engineering Corporation undertake feasibility surveys of several developed and undeveloped sites (References 29 and 31). At the request of the

Madison Square Area Engineer, the Initiatory University Group prepared and submitted an estimate of population, facilities, services, power, water and other factors which served as the basis for the Stone & Webster surveys. The New York District, Corps of Engineers, at the request of the Madison Square Area Engineer, also inspected the shore at Fort Hancock, New Jersey, to determine the need for shore protection and the type of protection required at this particular location (Reference 32).

(2) Undeveloped Areas. - Among the more important undeveloped sites considered were plots near Untermeyer Lake, Bear Lake in the Jersey Ramapo Mountains, the Lake Zoar area north of New York City, and the Millstone-Raritan area west of New Brunswick, New Jersey, but developed locations were favored instead because they were potentially more suitable for immediate utilization.

m. Selection of Camp Upton. - By the 17 June 1946 meeting, it was evident that Camp Upton was probably the most desirable site available in the region from War Department surplus, and the Planning Committee conducted an extensive inspection tour of the property on 27 June. At the 6 July 1946 meeting the Committee voted to accept the Camp Upton area and unanimously agreed to recommend it to the Corporation as the most suitable site for the new laboratory, in the belief that the advantages of a developed site more than outweighed the desirability of an undeveloped site, even though the latter might be more accessible or possess other incidental attractions. Of the various virgin areas considered, the Millstone, New Jersey, region along the Raritan River near New Brunswick was voted the most desirable. A few days later, at the first

meeting of the Trustees of Associated Universities, Inc. (A New Jersey corporation) the Planning Committee's recommendation that Camp Upton be acquired for the new laboratory was approved. The trustees of the New York Corporation approved this choice at their first meeting on 30 July 1946. Following this action, the Madison Square Area Engineer directed a request to the Secretary of War for assignment to the Manhattan District of the southern portion of Camp Upton, comprising 3725 acres of the Camp area, together with buildings and facilities; assignment was made to the District on 21 August 1946. The Planning Committee had also originally requested a right-of-way through the unassigned north portion of the Camp, comprising the target range, for construction of a pipe line necessary for contemplated chemical processing operations. The desired easement was refused by the War Department at the time the southern portion was transferred. A formal request for transfer to the District of the remaining 2434 acres of the reservation, including the target range, was made to the War Department by the Madison Square Area Engineer at the request of the Planning Committee, and transfer of this remaining area to the District was subsequently authorized by the Secretary of War.

n. Preparation of a Program. - One of the first acts of the Initiatory University Planning Committee had been formation of the various subcommittees to consider the many problems involved in establishing the proposed laboratory. The recommendations of these groups were incorporated into a "Proposed Program for the New National Laboratory of Nuclear Science," approved by the Initiatory University Group meeting of 1 June 1946, and transmitted to the District for approval (Reference 33).

Shortly afterwards, the District presented the proposed program to the General Advisory Committee on Research and Development for review at its 15 June 1946 session in New York. It was recommended at that time that the tentative 1947 minimum budget for $12,400,000 be cut in half and the general program be cut down to a more realistic basis. The remaining months of 1946 were devoted to effecting a functioning organization prepared to formulate and submit to the District a more realistic program in the light of available facilities, personnel and other determining factors. Once the preliminary steps of effecting a corporation, negotiating a contract and choosing a satisfactory site had been completed, the physical organization of an operating group and the preparation of its proposed program could be pursued with increased emphasis. Efforts in this respect had proceeded sufficiently far by 30 October 1946 for the Laboratory staff to submit a tentative outline of proposed Brookhaven plans, and to request approval of various modifications in administration buildings and of other matters which would improve the facilities from an administrative point of view. By 31 December 1946 preparation of the official program describing proposed Brookhaven research activities was substantially complete, although official District approval had not yet been indicated.

o. Selection of Director and Staff. - From its first meeting, the Planning Committee had given careful and detailed attention to the selection of a competent Director for the new Laboratory. After considerable discussion and review of numerous potential candidates, Dr. P. M. Morse, of Massachusetts Institute of Technology, was selected by the

Planning Committee early in July, 1946, and approved by the Corporation at its 10 July meeting. District approval of Professor Morse as Director of Brookhaven Laboratory was directly forthcoming. Prior to his war activities, Dr. Morse had received his doctorate at Princeton and taught physics at MIT for 16 years, 12 of which were as a full professor. In the late summer of 1946, the new Director began activating the major Brookhaven Laboratory departments, and by the end of October the skeleton staff included Professor Norman Ramsey of Columbia as acting head of the Physics Department, Dr. L. H. Borst, on leave from MIT, as head of the Pile Project, Professor M. S. Livingston, on leave from MIT, as head of the Cyclotron Project, and Professor J. G. Peter, on leave from Harvard University, as head of Architectural Planning and Plant Maintenance. Personnel, technical services, accounting and other administrative and service offices had also been organized by this date (Reference 34). Initial plans, reported by the Planning Committee's Subcommittee on Personnel, estimated a final Laboratory organization of approximately 1,000 (including around 400 members on the scientific staff) operating under a proposed annual budget of about $10,000,000. The technical personnel would consist of three broad categories: a permanent staff, a rotating group on leave from neighboring universities, of approximately one-to-three year tenure, and a floating group which would consist chiefly of summer workers and other short-term "visitors."

p. Proposed Research Activities. - A major purpose for establishing Brookhaven National Laboratory in the northeastern region was to provide central facilities available to the neighboring scientific

institutions for an intensive program in nuclear science research. Here, it was planned, would be centralized and established the elaborate, expensive and intricate scientific equipment and facilities necessary for such activities, including piles, cyclotrons and various other items peculiar to the study of nuclear particles and fissionable materials. In general terms, such equipment may be divided into two general classifications: (1) piles or "reactors," and (2) electro-nuclear machines, including cyclotrons, synchrotrons and other electrically-powered scientific equipment intended to accelerate bombarding nuclear particles. One of the first acts of the original Planning Committee, at its 30 March meeting, had been to appoint separate sub-committees to review and recommend action on each of these two subjects. Professor R. F. Bacher of Cornell headed the Subcommittee on Reactors, and Professor J. R. Zacharias, Columbia, headed the group on electro-nuclear machines (References 33 and 36). It was essential, of course, that plans for the construction of such expensive and complex equipment at Brookhaven be closely integrated with other existing or planned facilities at the various other District research laboratories. During the organizational meetings of the Planning Committee in the spring and summer of 1946, the District Research Division arranged for conferences between representatives of the initiatory group and various District research scientists, for visits to District sites, and for exchange of information. The 4 May 1946 meeting of the Planning Committee was held at Oak Ridge, where members of the group inspected Clinton Laboratories and discussed problems of mutual interest with the local staff. On June 17-19 members of the Committee met in

Chicago, where they inspected the Argonne National Laboratory and attended the Project General Information Meeting and Laboratory Directors' Meetings currently being held at the University. During the subsequent months, Dr. W. H. Zinn, Director of Argonne, Dr. E. P. Wigner, Director of Clinton Laboratories, and various other Project scientific personnel provided information and suggestions leading to the preparation of a realistic research program, including piles and electro-nuclear machines, which would supplement existing District equipment and facilities, and would make possible new programs of research in nuclear science. As was indicated in the most recent review of Brookhaven plans, on 30 October 1946, major Laboratory efforts during the remainder of the year were directed toward preparatory data preliminary to design and construction of such facilities, and toward preparing the elaborate and detailed program on the basis of which the District could authorize the future contractor to initiate the steps necessary to establish the new laboratory as an active Government-supported research facility (Reference 34).

4. Proposed West Coast Laboratory.

a. General. - In view of the Manhattan District's association with Pacific coast universities and scientific institutions during the War, it was inevitable that considerable interest would be shown in the establishment of a national laboratory in the West to supplement those planned for northcentral and northeastern United States. The District had not only constructed research facilities at the University of California's Berkeley Radiation Laboratory but included financial support for the new 184" cyclotron and construction of additional District

research facilities on the University campus. As a general policy governing the establishment of additional new national laboratories, especially on the west coast, the Advisory Committee on Research and Development agreed at its 8-9 March 1946 meeting that development of a plan for such project should be definitely encouraged, but that no District action should be taken until a definite joint proposal had been received from the institutions interested in participating.

b. Preparation of a Proposal. - Actual initiation of such a proposal did not begin until the arrival of Dr. L. A. DuBridge on the west coast as the new President of California Institute of Technology. It will be remembered that Professor DuBridge had served until 18 May as the Chairman of the Initiatory University Group for Brookhaven, at which time his imminent departure for California resulted in his being replaced in that role by Professor Bacher of Cornell. In November, 1946, the District forwarded to Dr. DuBridge detailed information on the procedure for organizing Argonne, to supplement his own personal experience with initial establishment of Brookhaven. On 30 December the heads of the University of Southern California and U.C.L.A. met with President DuBridge and agreed to cooperate in carrying through plans for establishing a national nuclear science laboratory in the Southern California area. At this time a contract was proposed for $18,000 to cover further preliminary planning and engineering studies for the new laboratory. The plan was submitted to the District at the year's end, 31 December 1946, and further action was withheld pending consideration by the new Commission. (Reference 37).

APPENDIX TO CHAPTER 2

REFERENCES

Number	Title	Location
1.	Letter from Drs. R. G. Gustavson and Farrington Daniels to Major General L. R. Groves, 29 September 1945, and reply from Groves to Gustavson, 23 October 1945	Research Div. Files
2.	Teletype from Chicago Area Engineer to District Engineer, 8 November 1945.	" " "
3.	"Plan for Continued Operation of Argonne Laboratory" submitted by the Advisory Council to Colonel Nichols, 5 December 1945.	" " "
4.	Plan for continued operation of Argonne Laboratory submitted by F. Daniels through the Chicago Area Engineer to the District Engineer, by teletype, 21 February 1946.	" " "
5.	Memo from Colonel Nichols to General Groves, 21 February 1946.	" " "
6.	Minutes of meetings of Advisory Council and Board of Governors, participating universities, 5 and 6 April 1946.	" " "
7.	"Plan of Organization and Statement of Operating Policy," appended to 5 June Minutes of Board of Governors' Meeting. (See 9 below.)	" " "
8.	Letter from Mr. W. B. Harrell, University of Chicago, to Colonel K. D. Nichols, 7 March 1946, and subsequent statements included in minutes referred to in (6) above.	" " "
9.	Minutes of Meetings of Board of Governors, 6 May 1946, 5 June 1946, 7 October 1946, and of Council 6 June 1946.	" " "
10.	"The Summary Report on the Progress of the Program of Cooperation to Argonne and Participating Institutions since June 1946", appended to 7 October 1946 minutes.	" " "

Number	Title	Location
11.	Letter from Dean G. B. Pegram to President J. C. Hinsey, Cornell Medical College, and others, dated 14 January 1946.	Research Div. Files
12.	Minutes of meeting of representatives of the New York Area, 16 January 1946.	" " "
13.	Letter from Dean G. B. Pegram to Major General L. R. Groves, 19 January 1946.	" " "
14.	Memorandum from Dean Pegram to fifteen northeastern institutions, dated 5 March 1946.	" " "
15.	Letter dated 3 March 1946, from Dean G. B. Pegram to Major General L. R. Groves.	" " "
16.	Minutes of the 8-9 March 1946 meeting of the General Advisory Committee on Research and Development.	" " "
17.	Letter from Dean G. B. Pegram to the presidents of the nine universities, dated 19 March 1946.	" " "
18.	Minutes of Planning Committee Meetings on the Initiatory University Group, dated:	" " "
	30 March 1946 - New York 15-16 April 1946 - New York 3 May 1946 - New York 4 May 1946 - Oak Ridge 18 May 1946 - New York 31 May 1946 - New York 17-19 June 1946 - Chicago 6 July 1946 - New York	
19.	Minutes of the Planning Committee of Associated Universities, Inc., dated 3 August 1946 - New York	" " "
20.	Minutes of the Initiatory University Group, dated 16 April 1946 and 1 June 1946, New York	" " "
21.	Minutes of meeting of incorporating members of Associated Universities, Inc. (a New Jersey Corporation) dated 10 July 1946 (New York).	" " "

Number	Title	Location
22.	Minutes of meeting of Board of Trustees of Associated Universities, Inc. (a New Jersey Corporation) dated 10 July 1946 (New York).	Research Div. Files
23.	Minutes of meeting of incorporating Trustees of Associated Universities, Inc., (a New York corporation) dated 30 July 1946 (New York).	" " "
24.	Minutes of meeting of Executive Committee of Associated Universities, Inc., (a New York corporation) dated 9 September 1946 (New York).	" " "
25.	By-laws and Certificate of Incorporation of Associated Universities, Inc. (a New Jersey corporation).	" " "
26.	Petition for Incorporation, supporting affidavit, and By-Laws of Associated Universities, Inc. (a New York corporation).	" " "
27.	Letter Contract No. W-31-109-eng-15 to Columbia University, dated June 25, 1946, and supplement Nos. 1-5, inclusive, dated 17 July 1946, 27 August 1946, 17 September 1946, 17 October 1946, and 17 December 1946, respectively.	" " "
28.	Proposed Contract No. W-42-069-eng-16, undated.	" " "
29.	Letter of A. C. Klein, Stone & Webster Engineering Corp., to the Madison Square Area Engineer, dated 9 July 1946.	" " "
30.	Omitted.	
31.	Report of the Stone & Webster Engineering Corp. on Fort Hancock, Camp Upton and the Untemyer Lake Area, dated 3 July 1946.	" " "
32.	Letter from Colonel W. J. Ely, CE, Resident Member, Beach Erosion Board, Office of the Chief of Engineers, to the Madison Square Area Engineer, dated 8 July 1946, subject: "Shore Protection at Proposed Installation, Fort Hancock, New Jersey."	" " "
33.	"Proposed Program for the New National Laboratory of Nuclear Science," dated 31 March 1946, with (5) appendices entitled "Reactor Designs", Regional Laboratory Pile", "Electronuclear Machines," "Synchro-Cyclotron", "Tentative Budget."	" " "

Number	Title	Location
34.	Memorandum from Dr. P. M. Morse to Colonel G. W. Beeler, dated 30 October 1946, "Preliminary Comments on Program for Brookhaven National Laboratory", with organization chart appended.	Research Division Files
35.	Omitted.	
36.	Minutes of Meeting of Subcommittee on Electronuclear Machines, 4 April 1946.	" " "
37.	Letter of 31 December 1946 from Dr. L. A. DuBridge to the District, inclosing a document entitled "Preliminary Planning and Engineering Studies for a Proposed Nuclear Science Laboratory in Southern California".	" " "

CHAPTER 3

~~SECRET~~

MANHATTAN DISTRICT HISTORY

BOOK I, GENERAL - VOLUME 4, AUXILIARY ACTIVITIES

CHAPTER 3, PROGRAM FOR PRODUCTION AND DISTRIBUTION OF RADIOISOTOPES.

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MANHATTAN DISTRICT HISTORY

BOOK I, GENERAL - VOLUME 4, AUXILIARY ACTIVITIES
CHAPTER 3, PROGRAM FOR PRODUCTION AND DISTRIBUTION OF RADIOISOTOPES.

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MANHATTAN DISTRICT HISTORY

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Chapter 3
Program for Production and Distribution of Radioisotopes

SECTION 1 - VALUE TO SCIENCES AND MEDICINE

1-1. Availability. - The potentialities of the uranium chain-reacting pile in providing radioactive atoms for research and other applications had been appreciated since the inception of the pile. During the war, however, the piles had other objectives. With the end of the war much of the work of Manhattan Project scientists and technicians became directed toward developing the peacetime uses of the pile. Radioactive isotopes, or, as they are now termed, radioisotopes, for example, could be made available on a greatly increased scale as new invaluable tools for research in the fundamental and applied sciences, particularly in biology and medicine.

Many radioisotopes were available from cyclotrons before the war, but in limited quantities and at high cost. Cyclotrons can use many nuclear projectiles, while a pile can only bombard with neutrons; therefore, cyclotrons can produce more varieties of radioisotopes than a pile. A pile, however, can far outdistance a cyclotron in quantity production of certain isotopes, at much less cost. For some of these, like Carbon 14, the pile can be made equivalent in production to hundreds of cyclotrons.

The small quantities of isotopes available ~~were~~ under the cyclotron processes before the war limited the scope of research and the number of

persons using radioisotopes. Nevertheless, many important results, particularly in biology and medicine, came from the use of the isotopes which were available. Now, with radioisotopes being made available on a large scale, even more important advances are expected in all sciences.

1-2. Uses. - The unique value of radioisotopes arises from the fact that they can be detected by electronic and photographic means. In "tracer" studies their paths can readily be followed in chemical, biological and technical processes. Several isotopes had been found valuable also for applying radiation as therapeutic agents in the treatment of certain special diseases. It appeared quite probable that by further extensive investigation a considerable number of medical applications of proved therapeutic value would develop.

For example, the isotope Carbon 14 was expected to give great impetus to the study of all organic processes, including the mechanism and growth of normal and abnormal tissues and all plant and animal functions; Phosphorous 32 was also expected to help in revealing many biological secrets in experimental use; Sulphur 35 could be used in tracing reactions of sulpha drugs; and Radioiodine, or Iodine 131, could be of value in studying the functions of the thyroid gland. All these isotopes might, in addition, be useful as tracers in industrial chemistry and metallurgy.

1-3. Release. - The release of these materials for research and application was indicated as one of the most significant peacetime results of the nation's great investment in nuclear fission. It was clearly in the public interest that the Manhattan Project find the means to provide scientists everywhere with these new tools.

SECTION 2 - PRODUCTION OF RADIOISOTOPES IN THE PILE.

2-1. General. - A radioisotope is made in the uranium chain-reacting pile by placing in the pile a stable element, which may be in the form of a metal or a salt - or a liquid or a gas - and leaving it there for a given length of time. This is the basic process and it applies regardless of whether the material inserted is a fissionable material, such as uranium, a common salt such as sodium chloride, or an ordinary metal such as iron. The method is known as the pile irradiation of the material. The irradiation process is not so simple, however, as it would seem to be from the above brief description.

a. Protection. - The material put into the pile must be protected from the temperatures which it will meet (for this reason liquids and gases are usually not used), and from the action of air and water vapor in the air, etc. It must be inclosed in a container not only for the above reasons but also so that it may be easily handled. This requirement means that a standard size and shape of container is desirable. The form and purity of the material exposed in the pile, as well as the material of which the container is made, must be such as to minimize neutron loss - that is, the drain on the power of the pile must be kept to a minimum. These conditions are usually met by carefully selecting the form of the element to be exposed and using aluminum for the can in which it is inclosed.

b. Separation. - A second major consideration is the subsequent separation of the newly created radioactive species from its

"parent", the latter being the element or compound put into the pile. Such separation may be exceedingly complicated, as in the case of the extraction of the individual fission products from the parent uranium; it may be relatively simple, as in the extraction of radioactive iodine from the parent tellurium; or it may be omitted altogether, as in the case of radioactive phosphorous, produced by the exposure of phosphorus itself. In the last named case, the radioactive phosphorus cannot be separated from the stable phosphorus parent, and the material can be shipped and used as soon as it is taken out of the pile. (The stable phosphorus is called a "carrier" for the tiny amount of radio-phosphorus.)

2-2. The Canning Operation. - Two types of aluminum cans are used to inclose the material for isotope production in the pile. One is a welded tight-fitting cylindrical aluminum jacket. This is used for the uranium (which maintains the chain-reaction and in which fission products are created) and for the calcium nitrate salt, which is irradiated for the creation of the Carbon 14 isotope. The uranium-type can is used for the nitrate salt because it has been found advantageous to load this salt into the pile in the same manner as the uranium itself is loaded. The parent materials for other radioisotopes produced in the pile are placed in small cylindrical aluminum cans about the size of a man's index finger. The amounts of material which are put into these small exposure cans vary from a few milligrams (a milligram is about 1/454,000th of a pound) to an ounce or two, depending upon the relative affinity, or "cross-section", of the exposed material for neutrons, and upon the amount of the radio-isotope to be produced.

2-3. Loading, Irradiation and Unloading. - As the production process is carried out at the Clinton Laboratories pile, the small cans are set into holes in a graphite block, running into the center of the pile. When the graphite block containing a number of such cans is loaded, it is pushed into the pile and left there during the period of irradiation.

While the pile is being loaded or unloaded, it is shut down - the control rods which stop the chain-reaction are in place. This prevents a dangerous beam of neutrons from emerging through the hole which is being loaded, but, even with the pile not operating, personnel must stand clear of the hole in order to avoid the residual gamma rays emerging from it.

After loading, the open hole is blocked so that neutrons cannot escape and the pile is started up. Usually the material is left in the pile for a period of one to several weeks. The time of exposure depends upon the half-life of the desired radioisotope (the shorter the half-life, the shorter the exposure time), as well as upon the amount desired and the cross-section of the exposed material.

When it is time to remove a batch of samples, the pile is shut down and left for a long enough period to permit the gamma radiation, which will come from the open hole, to die off to a relatively low value. Then the hole is opened and the graphite block is pulled out into a lead "coffin", for protection against the radiations emitted by the exposed material and its can. Technicians stand by with radiation-measuring instruments to insure that no one exposes himself to a hazardous amount of radiation. The samples are removed one by one from the block by means of long tongs,

examined with the instruments and then placed in a lead "safe" for temporary storage. Even those samples which emit very little radiation are not picked up with the bare hand. Gloves are always used because of the danger of picking up harmful amounts of radioactive material from the surface of anything which has once been inside the pile.

2-4. Chemical Processing - Separation of Radioisotopes from Parent and Impurities. Many of the cans when removed from the pile are ready for shipment as they are, requiring only to be placed in a container with lead walls of sufficient thickness to stop harmful radiation. Radioisotopes thus shipped, without subsequent chemical processing, are referred to as "non-processed irradiations". By and large, those radioisotopes which do not involve a transmutation are included in this group - for example: Phosphorus 32, produced from Phosphorus 31; Sulfur 35 produced from Sulfur 34; etc. An example of transmutation is Carbon 14, whose parent is Nitrogen 14 and not carbon; in this case, the chemical difference permits the chemist to separate the new radioactive species, C14, from the parent, stable nitrogen. In the case of the fission products, whose parent is uranium and of which there are many individual species (such as barium, iodine, cerium, etc.), the chemical separation must not only remove the radioactive species from the parent uranium but must also separate each radioactive element from all the others.

The chemical extraction of radioactive species is carried out in a so-called "hot" laboratory, with equipment and personnel experienced in dealing with potentially dangerous material. Because the amounts of

radioactive material involved are very small (in some cases, entirely invisible), even though they may emit large quantities of radiation, and because small equipment and small volumes of solutions, etc., must be used, the chemist must be close to his material while performing his operations, in order to be able to see what he is doing. The requirements have been met by the use of heavy shields of lead or concrete which permit closeness, and periscopes, which allow the operator to see the material around the shielding.

For many operations in which low levels of radiation are encountered, the operator may use distance, perhaps one or two feet, in lieu of shielding, while working with tongs and similar devices. For the separation of large quantities of fission products, however, a small room, or "cell", about 4'x6'x8', entirely inclosed by two feet of concrete, is used. The apparatus for the extraction process is placed inside this room, with all controls on the outside, where the operator and the eye-pieces of the periscopes are located. By means of air pressure, vacuum processes, electrical apparatus, rods and grappling devices, the operator is able to put the radioactive material through the required chemical and physical steps without entering the cell or removing the "hot" material from it.

2-5. Instrumentation. - A large variety of instruments is used in the "hot" laboratory for the detection and measurement of radiation from many sources. There are instruments for measuring, for example:

a. the general radiation level in the working area;

b. the radioactivity carried on dust particles which may be inhaled;

c. the extent of contamination on bench tops and other surfaces;

d. the amount of either soft or penetrating radiation received by any portion of the operator's anatomy;

e. possible radioactive contamination on shoes, clothes, etc.

Instruments are required not only for protection but also for assistance in operation, and electronic radiation-measuring instruments are built into certain parts of the apparatus to show how much of a radioactive material there may be at a given point.

2-6. Preparation for Shipment. - The final product from a radiochemical separation of the kind described above usually consists of an ounce or so of a water or acid solution containing a "weightless" amount of the radioactive species desired. Since fractions of the radioactive material cannot be weighed out, fractions of the solution are taken instead, and such separated "carrier-free" radioactive materials are shipped as solutions in small glass bottles. In order to guard against the dangers of accidental breakage in transit, the bottle is inclosed in a stainless-steel, tightly-closed, container, which is then placed inside a lead case with wall of sufficient thickness to permit handling en route to the recipient. The shipping container for separated radioactive materials thus differs from that used for the non-processed materials. The latter, when they emerge from the pile, are solids inclosed in closed aluminum cans, and therefore do not require extensive precautions against leakage of the material. Although most radioactive species

require lead containers for shipment or handling, others (such as Carbon 14 and Sulfur 35) emit such weak radiation that the thin aluminum can, or a glass bottle, or a wooden box, is all that is required to stop the radiation. All radioactive materials packed for shipment are measured with the appropriate instruments, to be sure that the radiation from the sample is prevented from escaping to the outside and to guard against possible surface contamination of the shipping box with radioactive materials which could be rubbed off in transit.

SECTION 3 - ESTABLISHING THE PROGRAM

3-1. First Proposal. - On 3 January 1946 the first complete, specific proposal for the national distribution of radioisotopes produced in the pile was presented by the Radioisotope Committee of Clinton Laboratories. This Committee was appointed by Dr. M. D. Whitaker, in December 1945, on the recommendation of the Committee on Growth of the Clinton Laboratories, to study the possibilities of distributing radioisotopes for general and cancer research. The members of the Radioisotope Committee were Drs. Waldo Cohn, J. R. Coe, C. D. Coryell and Arthur H. Snell. After completing their study the Committee made a report recommending the distribution of radioisotopes to research institutions and setting up a price schedule. The step-by-step plan of this Committee recognized the technical and administrative problems involved in the transition to peacetime operations and included recommendations on policy, organization, operation and personnel. The report was submitted to Colonel Stafford L. Warren, Director, Medical Division, Manhattan Engineer District, after which the Committee was disbanded.

3-2. The Isotopes Branch. - The job of putting the plan in operation was assigned to the Director of the Research Division. It was decided that a separate operating unit would be necessary to administer effectively a radioisotope distribution program. Tracer and therapeutic isotopes for research would be in great demand for scientific, medical and technological application. Through the cooperation of the University of California, Dr. Paul C. Aebersold was given leave to accept the assignment as chief of the "Isotopes Branch," Research Division, at Oak

Ridge. Dr. Aebersold was a pioneer in the field of the applications of nuclear physics to biology and medicine, and was associated with early cyclotron work on the production and use of radioisotopes. His responsibility was to establish an effective organization for the off-project distribution of radioisotopes. In February, one month after the initial proposal was presented, the Isotopes Branch was officially in operation.

3-3. Initial Problems. - Five months of intensive work by the Isotopes Branch were required to arrange details of the program. Initial problems to be met included (a) arrangements for production of the various types of materials, (b) formulation of policies by advisory committees on distribution and health protection, (c) shipment procedures, (d) handling of legal responsibilities, (e) determination of prices, (f) declassification of essential items, and (g) establishment of request-handling procedures. All arrangements were made by coordination and cooperation of off-project scientific advisers, project scientists, Monsanto Chemical Company management and Manhattan District authorities. Project scientists at Clinton Laboratories, at the Universities of California and Chicago, and at Iowa State College, all cooperated in developing methods and arranging for production.

3-4. Public Announcement. - Formal inauguration of the distribution program was made by the announcement from Headquarters, Manhattan Project, "Availability of Radioactive Isotopes", which appeared 14 June 1946 in Science, Vol. 103, pages 697-705. This statement listed the available isotopes (a total of about 100) and explained details concerned with pile production of radioisotopes. Also included were the principles for allocation and distribution and the details of procurement.

3-5. Operation of the Program. - Research and development required for expansion of Clinton pile operations to produce radioisotopes in forms suitable for general distribution were under the supervision of the Director of Clinton Laboratories, with the special duties of coordinator assigned to Dr. W. E. Cohn. Radioisotopes Committee, appointed by the Director of Clinton Laboratories, recommended the amounts and forms of radiomaterials to be made available and determined what materials could be irradiated in the pile. Although the radioisotopes for distribution purposes were to be prepared largely at Clinton Laboratories operated by the Monsanto Chemical Company, bombardment facilities of the Hanford Engineer Works near Pasco, Washington, operated by the du Pont Company and later by the General Electric Company, would also be used insofar as the flexibility of that operation allowed. Argonne National Laboratories at Chicago, operated by the University of Chicago in cooperation with a group of Midwestern universities, aided materially in pertinent preparations and research. It was determined that distribution should be limited to isotopes of elements of atomic number 3 to 83, inclusive. Some of the most important of these isotopes have already been mentioned: Carbon 14, Sulphur 35, Phosphorus 32 and Iodine 131 (these numbers refer to the mass of the isotope, the total of the protons plus neutrons in the nucleus).

3-6. Advisory Committee on Distribution Policy. - The established policy of the Manhattan Project was to seek qualified off-project advice and assistance in scientific matters of concern to the public welfare. Accordingly, Major General L. R. Groves, on 26 February 1946, had asked Dr. Frank B. Jewett, President, National Academy of Sciences, for representative nominations to an "Interim Advisory Committee on Isotope Distribution Policy". This off-project Committee would advise Headquarters,

Manhattan Project, Washington, D. C., on a nationally desirable policy concerning the distribution and production of radioisotopes during the period remaining until the Atomic Energy Commission assumed control of the Project. Dr. Jewett accepted this responsibility and on 6 March 1946 nominated twenty-seven scientists qualified to advise on isotope distribution policies. It was agreed that the committee finally chosen would be limited to ten individuals, two each from the following areas of science: Physics, Chemistry, Biology, Medicine and Applied Science. The Policy Committee appointed by General Groves from the nominations of the National Academy of Sciences is composed of two representatives from each of the major fields of isotope applications: Physics--Lee A. Du Bridge (Chairman) and Merle A. Tuve; Chemistry--Linus Pauling and Vincent du Vigneaud; Medicine--Cornelius P. Rhoads and Cecil J. Watson; Biology--Raymond E. Zirkle and A. Baird Hastings; Applied Science--Zay Jeffries and L. F. Curtiss; Secretary--Paul C. Aebersold (non-voting).

3-7. Committee Recommendations. - The Interim Advisory Committee on Isotope Distribution Policy met in Washington, D. C., 20 April 1946. The recommendations of the Committee were set forth in a letter dated 1 May 1946 to General Groves from Dr. Du Bridge, chairman. The Committee urged the District to (a) undertake as promptly as possible a major program of production and distribution of isotopes for use in research in pure and applied science, including medical science; (b) make a reasonable charge, for all isotopes, not greater than "out-of-pocket" costs to the District; (c) refer each request to a Subcommittee on Allocation and Distribution, to advise on the scientific value of the application and the qualifications of the requester, and further, refer each request for material for application in a human being to a Subcommittee on Human

Application which would have final veto power on any distribution suggested for human use; (d) make isotopes available to individuals only through qualified institutions and under priorities established according to intended use of the material, as follows: (1) publishable researches in the fundamental sciences, including human tracer applications, requiring relatively small samples; (2) therapeutic applications in humans or publishable researches in the fundamental sciences, but requiring larger samples; (3) educational and training purposes; (4) publishable researches in the applied sciences; (5) all others.

3-8. Authorization of Clinton Laboratories Program. - The suggested policy appeared to be a sound approach to the problem and General Groves issued instructions to his staff on 22 May 1946, to follow the above recommendations. Pursuant to General Groves' request, Brigadier General K. D. Nichols, District Engineer, authorized the Monsanto Chemical Company, through a letter dated 24 May 1946 addressed to Dr. C. A. Thomas, to set up an organization and facilities at Clinton Laboratories to effectuate this program. It was requested that Monsanto estimate costs of production and distribution, exclusive of pile costs, plant rentals, or costs of existing laboratories. Monsanto agreed to do everything possible to process, handle and ship radioactive materials without interruption to higher priority work at Clinton Laboratories. Actually, much of the groundwork had been done prior to Dr. Thomas' formal agreement on 4 June 1946 to proceed with arrangements necessary to distribute radioisotopes to nonproject users.

3-9. Costs and Prices. - Under the direction of Mr. Prescott

Sandidge of the Monsanto Company, a cost estimate was prepared and submitted on 22 June 1946. It was recognized at the time that actual cost estimates were based necessarily on future operations, and that they were subject to many variations as production experience advanced. The June estimates presented the total costs, excluding depreciation and amortization of research and development expense, computed according to standard business procedures within the limits of accuracy of the basic technical data supplied for this purpose. A price list compiled by the Isotopes Branch from Monsanto's cost estimates was approved 28 June 1946 by Colonel E. E. Kirkpatrick, Deputy District Engineer. This price list is shown in the Appendix to this chapter. Some of the prices quoted therein are as follows: Carbon 14, $367.00 per millicurie; Sulfur 35, $36.56 per millicurie; Phosphorus 32, $1.09 per millicurie; Iodine 131, $1.69 per millicurie. It was provided that a general review of all costs would be made within six months and prices would be adjusted (up or down) in the light of actual experience and obvious inequities.

3-10. Subcommittees.

a. General. - The subcommittees recommended by the Advisory Committee had also been appointed by General Groves from nominations by the Academy of Sciences and had completed organization by 28 June 1946.

b. Subcommittee on Allocation and Distribution. - The initial meeting of the Advisory Subcommittee on Allocation and Distribution was held 18 June 1946 in Chicago, Illinois. The members of this subcommittee are K. T. Bainbridge (chairman), J. W. Kennedy, J. G. Hamilton and P. C. Aebersold (secretary). The subcommittee discussed the

relationship of the available isotopes with the expected demand and approved the production arrangements presented by Clinton Laboratories as a good starting basis for "testing the market". The Policy Committee had approved an order of priority by main types of uses; it was now the responsibility of the subcommittee to adopt a uniform grading system to provide a basis for assigning priorities within each usage group. It was determined that requests for radioisotopes other than for therapy and diagnosis in humans would be noted according to the following scoring system:

1. Problem — 0 to 10
2. Facilities — 0 to 10
3. Quantity — $\frac{P}{R}$ = P = amount available, R = amount requested
4. Class
   a. Fundamental science 10
   b. Educational 3
   c. Applied science 2
   d. Others not commercial 1
   e. Routine commercial 0

Details were worked out for the mechanism of routing and handling requests referred to the subcommittee for an evaluation of allocation priority. All requests for human applications were to be passed upon by the Subcommittee on Human Applications before allocation could be effected. Committee members were to serve without compensation, and other expenses incurred by subcommittee work were to be reimbursed by the Government.

c. Subcommittee on Human Applications. - Members of the Subcommittee on Human Applications, A. H. Dowdy, (chairman), C. Failla, H. L. Friedell, and P. C. Aebersold (secretary), held their initial meeting in Oak Ridge, 28 June 1946. The functions of the subcommittee were determined to be: (a) to exercise a veto power on allocations for human application; (b) to recommend, for Advisory Committee action, the relative production efforts to be allotted to isotopes destined for therapeutic and diagnostic application; (c) to recommend, for Isotopes Branch action, the allocation of available materials for therapeutic and diagnostic applications. The isotopes considered most significant for therapeutic and diagnostic uses during 1946 were: Iodine 131, Phosphorus 32, Strontium 89, 90, Cobalt 60 and Sodium 24, with emphasis on Iodine 131 and Phosphorus 32. The subcommittee unanimously endorsed the following recommendations as the basis for radioisotope distribution for human applications: (a) the committee should initially select a group of accredited medical schools, hospitals and clinics which may be eligible to receive radioisotopes; (b) each selected hospital, medical school and clinic should be invited to appoint a local committee, composed of a chairman and whatever member or members they should see fit, to pass upon all requests originating from their institution; (c) all isotope requests to the Isotopes Branch of the research Division of the Manhattan District for human use for their particular institution should be initiated by the local chairman; (d) the committee should recommend to the selected institutions that the membership of the local committee include (1) a physician well versed in the physiology and pathology of the

blood forming organs, (2) a physician well versed in metabolism and metabolistic disorders, (3) a competent biophysicist, radiologist or radiation physiologist qualified in the techniques of radioisotopes.

3-11. Federal Food, Drug and Cosmetic Act. - The Federal Food, Drug and Cosmetic Act places definite restrictions on the use of any material for investigations involving humans or animals. Such uses define a material as a "new drug". The procedures set up by the Isotopes Branch for controlling the use of radioactive materials in the therapy, diagnosis and study of disease were submitted to Dr. Ernest Q. King, acting Medical Director, Food and Drug Commission, on 3 June 1946. Several suggestions were made to insure compliance with the Act and on 2 August 1946, P. B. Dunbar, Commissioner of Food and Drugs, gave final approval of forms and affidavits proposed by the Isotopes Branch for permitting the use of radio-elements in tracer studies in fundamental physiology, tracer studies of the causes of abnormal conditions in human beings and tracer studies in fundamental biology or similar investigations in animals and human beings.

3-12. Transportation. - Until the official announcement on 14 June of the availability of radioactive isotopes for national distribution it was not definitely understood how such materials could be shipped in interstate commerce. Even afterwards, questions continued to arise almost daily because of the lack of specific rules and regulations. Shipments were only possible through the cooperation of national and local express company and air line officials. The transportation of induced radioactive materials was a new problem for the carriers, who were

generally unacquainted with the properties of the materials. The Railway Express Company, however, had rules in effect since 1 May 1939, covering the transportation of radium. Mr. H. A. Campbell, Chief Inspector, Bureau of Explosives, Association of American Railroads, advised the Isotopes Branch on 14 June that in his opinion the labels, marking and packing as prescribed for radium should apply to the transportation of radioactive material. On the basis of this opinion arrangements were made for the acceptance of shipments from Clinton Laboratories. The airlines, through the Civil Aeronautics Board, quickly established emergency rules, effective 6 June 1946, to allow air transportation of radioactive materials until such time as more complete rules could be promulgated. Not all airlines consented to accept shipments. All lines serving Knoxville, however, agreed to carry such materials when consigned by Clinton Laboratories. As of 31 December 1946, tariffs were still inadequate and Mr. Campbell, at the request of the Interstate Commerce Commission, was endeavoring to write regulations to govern the transportation of all radioactive materials by rail. Mr. Homer S. Youngs of the Air Transport Association, Washington, D. C. was preparing a similar proposal for approval of the Civil Aeronautics Board to regulate shipment by air.

SECTION 4 - OPERATION OF THE PROGRAM

4-1. First Sale of Radioisotopes. - All was now in readiness for delivery of the first radioactive isotopes to the nation's research institutions. On 2 August 1946, Dr. F. V. Cowdry and Dr. William L. Simpson, research director and associate research director of the Barnard Free Skin and Cancer Hospital, St. Louis, Missouri, received the first peacetime product of the huge atomic energy facilities. At appropriate formalities in front of the Clinton pile, Col. E. E. Kirkpatrick delivered a pea-sized unit of Carbon 14 to Dr, Cowdry. The St. Louis institution wanted the radioactive carbon to "tag" component parts of cancer producing molecules and then, through radiation measuring instruments, seek an answer to this question: "Why does this particular molecule produce cancer?"

4-2. Number of Requests. - Since that date and to 31 December 1946, 306 requests for radioisotopes were received, representing 45 different elements. Of the total orders received, shipments had been completed on 125 with a sales value of $29,797.47. The volume of requests received was not so large as originally predicted but had been increasing gradually and steadily. A survey of research institutions showed that three main reasons were responsible for the slow start: (a) lack of trained personnel, (b) lack of electronic detection instruments, and (c) the speed with which radioisotopes were made available found researchers with plans incompleted for their utilization. All these obstacles were being overcome.

4-3. Price Revision. - In accordance with Col. Kirkpatrick's recommendations Clinton Laboratories reviewed the costs of the program after approximately six months' operations. A new cost estimate was prepared and presented to the Research Division 15 November 1946. It was found that costs were not being entirely recovered on the basis of the prices approved 28 June 1946. Decision on any change in the price structure was deferred for decision by the Atomic Energy Commission. The Atomic Energy Act of 1946 clearly provided that radioactive by-products could be distributed with or without charge. The determination of continuing a policy of partial subsidy was clearly a matter for the Atomic Energy Commission to decide.

4-4. New Products. - At the end of the year, proposals for releasing other isotopes, both radioactive and stable (tritium, Boron 10, Heavy Water, concentrated stable isotopes processed in the electromagnetic separation plant, etc.), were essentially complete. Final consideration however was being withheld pending transfer of Manhattan Project functions to the Atomic Energy Commission.

MANHATTAN DISTRICT HISTORY

Book I, General - Volume 4, Auxiliary Activities
Chapter 3, Program for Production and Distribution of Radioisotopes.

APPENDIX

Price List (as approved 28 June 1946 - Issued by Isotopes Branch, Research Division, Manhattan District.)

Notes: Table numbers in the list are the same as those in the article, "Availability of Radioactive Isotopes", published in Science, 14 June 1946, Vol. 103, No. 268, pages 697-705.

For each request a handling and administrative charge of $25.00 should be added.

A deposit will be required on returnable shipping containers used for transportation of gamma ray emitters. A demurrage charge may be made for containers retained longer than the period provided for in the "Agreement and Conditions for Order and Receipt of Radioactive Materials".

All transportation costs, including return of container, will be paid by requester.

The units (as shown in the headings of tables) are: 1 microcurie; 1 millicurie; or, 1 sample (irradiation unit). The curie is defined for purposes of this list as 3.7×10^{10} disintegrations/ sec. occurring in the active element. All methods by which a given isotope disintegrates are included.

Prices listed in Table 4 are for chemically unprocessed irradiation units. An irradiation unit is one metal can in one of three sizes (5 cc, 10cc, or 40cc) dependent upon quantity of target material required per sample.

Table 1.

Fission Products

Group	Radioisotope	Unit Price (per Millicurie)	Unit Price (per Microcurie)
I	(Zr 95)* (Cb 95)	$ .67	
II	Y91	1.15	
III	(Ce 141)* (Ce 144)	1.35	
IV	Ba 140	1.35	
V	(Sr 89)* (Sr 90)	1.35	
VI	(Pr 143)* (Nd 147) (61 147) (Eu 156) (Eu 155)	12.51	
VII	Cs 137	134.70	
VIII	(Ru 103)* (Ru 106) (Te 127) (Te 129)	6.74	

Table 2.

Fission Products (Derived from Table 1)

I	Cb 95	23.09	
II	(Ru 103)* (Ru 106)	23.09	
VIII	(Te 127)* (Te 129)	23.09	
VI	Pr 143	72.16	
VI	Nd 147	72.16	
VI	61 147		$14.43

* Mixtures

Table 3.

See Price Lists of other Tables

Table 4.

Radioactive Isotopes producible in pile by (n,γ) reactions

Isotope	Estimated Quantity which may be in sample**		Cost per Irradiation Unit (1 can)
Na 24	100	Millicuries	$ 7.36
P 32	500	"	21.65
S 35***	10	"	13.13
Cl 36	10	Microcuries	84.84
K 42	250	Millicuries	8.89
Ce 41)*	(100	")	38.51
Ca 45)	(5	")	
Sc 46	1	"	9.73
Ti 51	1	"	29.33
Cr 51	100	"	13.42
Fe 55)*	(500	Microcuries)	21.30
Fe 59)	(1	Millicurie)	
Co 60	100	Millicuries	31.03
Ni 59	10	Microcuries	9.73
Cu 64	100	Millicuries	7.36
Zn 65)*	(100	")	20.47
Zn 69)	(300	")	
Ge 72	100	"	23.38
Ge 71)*	(10	")	39.03
Ge 77)	(1	")	
As 76	100	"	7.36
Se 75	100	"	96.76
Br 82	100	"	7.51
Rb 86	100	"	20.73
Mo 99	100	"	11.08
Ru 103	10	"	25.32
Ag 108, 11C	100	"	121.30
Cd 115 (2.8d)(See Footnote 1)	20	" short bombardment	26.93
Cd 115 (43d)(See Footnote 2)	1	" long bombardment	91.65
In 114	10	"	29.73
Sn 113	1	"	10.25
Sb 122 (See Footnote 3)	100	" short bombardment	7.36
Sb 124 (See Footnote 4)	8	" long bombardment	10.07
Te 127)*(See Footnote 5)	10	"	44.05
Te 129)			

Isotope	Estimated Quantity which may be in sample**			Cost per Irradiation Unit (1 can)
Cs 134	100	Millicuries		$ 19.75
Ba 131	10	"		16.19
La 140	100	"		7.36
Ce 141)*	(100	"	)	11.26
Ce 143)	(25	"		
Pr 142	100	"		7.36
Eu 154	100	"		84.35
Ta 182	100	"		10.77
W 185	100	"		28.46
Os 191)*	(44	"	)	29.13
Os 193)	(100	"	)	
Ir 192, 194	100	"		39.69
Au 198	100	"		7.36
Hg 197 (See Footnote 6)	70	"	short bombardment	32.04
Hg 203, 205 (See Footnote 7)	100	"	long bombardment	100.17
Tl 206	10	"		13.97
Bi 210	10	"		7.36

Footnotes: * Mixtures

** Unit quantity may have been revised from publishedtable

*** This irradiation unit will also contain approximately 2.5 mc of carrier free P32 from transmutation.

1. Will include about 0.25 mc of 43d Cd 115
2. Will include about 20 mc of 2.8d Cd 115
3. Will include about 2 mc Sb 124
4. Will include 100 mc Sb 122
5. Will include Te131 (30hr.) and I131 (8day)
6. Will include about 25 mc of Hg 203, 205
7. Will include about 70 mc of Hg 197

Table 5.

Radioactive Isotopes from Transmutation Reactions

	SEPARATED		UNSEPARATED	
	UNIT PRICE			
Isotope	Per Millicurie	Per Microcurie	Estimated Quantity which may be in Sample	Price per Irradiation Unit (1 can)
C 14	$ 367.00			

Isotope	SEPARATED UNIT PRICE Per Millicurie	Per Microcurie	UNSEPARATED Estimated Quantity which may be in Sample	Price per Irradiation Unit (1 Can)
P 32	$ 1.09		500 Millicuries	$ 255.85*
S 35	36.56		6 "	26.93
Ca 45		$ 4.01		

*This unit is a special large can containing 5 lbs. of S.

Table 6.

Radioactive Isotopes from (n,γ) - produced chains

Isotope	SEPARATED Unit Price Per Millicurie	Estimated Quantity which may be in Sample	Price Per Irradiation Unit (1 Can)
As 77		0.7 Millicuries	$ 34.44
Rh 105		10 "	21.39
Ag 111		10 "	10.97
I 131	$ 1.69	80 "	44.02
Cs 131		10 "	16.02
Pr 143		10 "	11.26
Au 199		10 "	7.36

CHAPTER 4

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MANHATTAN DISTRICT HISTORY

BOOK I, GENERAL - VOLUME 4, AUXILIARY ACTIVITIES
Chapter 4, Research and Development of Atomic Energy for Power

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MANHATTAN DISTRICT HISTORY

BOOK I, GENERAL - VOLUME 4, AUXILIARY ACTIVITIES
CHAPTER 4, RESEARCH AND DEVELOPMENT OF ATOMIC ENERGY FOR POWER

1. Introduction. - From the time of the announcement by the President of the United States of the atomic bombing of Japan, on 6 August 1945, the Manhattan District concerned itself more and more with the possibilities existing in harnessing the tremendous power that is loosed by atomic fission; and many months before that date, scientists in the District's laboratories had already begun to give serious thought to these possibilities. As of the closing date of this history efforts were being made to construct an atomic plant for the production of power. Emphasis has been placed on the early achievement of practicable results, rather than the attainment of the best possible plant that could be built. It was believed (Reference 13) that an early application of atomic energy for peacetime use was necessary in order to channel the world toward thinking of it as a constructive agent rather than as a destructive one. The construction materials required involve elements of which relatively little is known from the standpoint of chemical and nuclear properties, methods of production or available sources. Therefore, extensive explorations for source materials have been necessary as well as the many special research investigations referred to in this section.

2. War Time History of Power Pile Research. - Immediately following the successful operation of the first chain reacting pile (2 December 1942) the Manhattan District's interest in this new scientific

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tool was necessarily restricted to chain reacting piles and auxiliary equipment for the production of fissionable materials for military purposes. Because of the urgency of this mission and the number of problems involved in achieving it, little effort could be spared for the investigation of peacetime applications of atomic energy. In the early part of 1944 a small group of scientists at the University of Chicago's Metallurgical Laboratory began to hold frequent informal meetings to discuss the application of nuclear energy for other uses. Of particular interest was the utilization of atomic energy for the generation of power. The group included Drs. S. K. Allison, E. P. Wigner, Leo S. Szilard, H. C. Vernon, Frederick Seitz, P. Morrison, Gale Young, E. C. Creutz, J. Franck, William W. Watson, Charles M. Cooper, Thorfin R. Hogness, Albert Weinberg, L. A. Ohlinger, Enrico Fermi and others who came in from time to time to express their ideas. Numerous proposals and suggestions were considered regarding the utilization of atomic energy in power piles. A record of these meetings may be found elsewhere (References 1,2). In September 1944 Dr. Farrington Daniels came to the Chicago Metallurgical Laboratory from the University of Wisconsin. He had conceived the idea of a high temperature pile using beryllium oxide as a moderating material. After detailed discussions of his idea by the group, it was concluded to be the most feasible project that had been considered up to that time. During the remainder of the fall of 1944 and the early part of 1945 frequent conferences were held between Dr. Daniels and Drs. Wigner, Hogness, and Compton of the Chicago Project. Other representatives of the Manhattan District talked with

Dr. Daniels and encouraged the idea of developing the power pile.

3. Authority for Research. - In April 1945 the District's budget for research and development at the University of Chicago's Metallurgical Laboratory included a provision for the expenditure of approximately $20,000 in the Chemistry Division for power pile research work (Reference 3). The Metallurgical Laboratory Power group, as yet, unorganized, continued its studies and discussions until July 1945. At that time a "Power Pile" section under the Chemistry Division was organized and the first actual experimental work was begun on problems relating to the construction of a chain reacting pile to be operated at a high temperature. Dr. J. E. Willard, then at Hanford Engineer Works, was brought to Chicago to take charge of this section. Information that had been gained from the operation of chain reacting piles over the previous two years had meanwhile modified many of the old problems that originally confronted the group, yet many new problems had also been introduced.

4. The Daniels Pile. - During the fall of 1945 several conferences were held between Major General L. R. Groves, Colonel K. D. Nichols, and Dr. Daniels (who at that time was Director of the Chicago Metallurgical Laboratory) as to the scope of the problems that were being encountered in the proposed high temperature pile. It was felt that the problem was getting too big for the Metallurgical Laboratory and that, since the pile was intended primarily for power purposes, its development should be the responsibility of an industrial organization rather than a research group. At the same time the Manhattan District was opposed to having the Metallurgical Laboratory negotiate additional

subcontracts. It was believed that a power pile should be built as soon as possible but that it should be built at Oak Ridge. It was decided that Monsanto Chemical Company (operators of Clinton Laboratories at Oak Ridge) should be approached regarding the undertaking of a contract for the design and development of the power pile program. In January 1946 Monsanto Chemical Company sent four representatives to the Chicago Metallurgical Laboratory to confer with Dr. Daniels. After a careful study of the plans, Dr. C. A. Thomas, Vice President of Monsanto Chemical Company, agreed to have the company undertake the job.

5. Advisory Committee Review. - Before final authorization by the District for construction of the Daniels pile, the whole problem was reviewed in detail by a District Advisory Committee, appointed by the District Engineer, comprised of Dr. R. C. Tolman, Dr. John Wheeler, Dr. A. H. Compton and Dr. W. K. Lewis. At the Committee's meeting in Washington in March 1946 it was agreed to undertake construction of the Daniels pile at Oak Ridge, but construction had not yet been authorized at the end of 1946.

It was further agreed that inasmuch as the purpose of the unit was primarily power generation, appropriate industrial concerns in the field of power generation should be brought into the program on a cooperative basis to assist the Monsanto Chemical Company. At this same time the committee reviewed a new and different type of pile known as the Zinn pile (See Par. 9), designed by Dr. W. H. Zinn at the Argonne National Laboratory. It was agreed that if and when authorized, construction of the new Zinn pile should be undertaken at Chicago and that it should be restricted to size which would permit its construction there. Despite this decision the transfer of the site of the Daniels pile from Chicago to Oak Ridge came as a definite

disappointment to the Argonne National Laboratory staff. Work on the Daniels pile was initiated by the District shortly afterwards and preliminary detailed design and planning activity began in the spring of 1946.

6. Organization of the Oak Ridge Power Pile Program. - On 11 April 1946 a meeting was attended in New York by Dr. Daniels, Dr. J. H. Lum, and Dr. C. R. McCullough, (the latter had been appointed Director of the Power Pile Division that was to be located at Oak Ridge) and various industrial executives and engineers from the General Electric Company, Westinghouse Electric Company and the Allis-Chalmers Manufacturing Company, and representatives of the Army and Navy (Reference 4). At this meeting the respective organizations agreed to a cooperative program which was to get underway at Oak Ridge as soon as possible. Monsanto Chemical Company formally accepted responsibility for the design, construction and operation of a high temperature pile. In May 1946 Dr. McCullough began to negotiate with the various companies for the loan of engineers and scientists, on a "leave of absence" basis, for the design work on the proposed pile (Reference 13). A few weeks later special courses in nuclear physics and mathematics were initiated at Clinton Laboratories for some of these men. Particular emphasis was given to the calculations involved in power pile design. Meanwhile, experimental work was being continued at the University of Chicago under Dr. O. C. Simpson. Dr. Daniels joined the group at Oak Ridge in July 1946 as a consultant. At the beginning of the school year (in the autumn of 1946) he began dividing his time equally between Oak Ridge and

the University of Wisconsin, spending alternate weeks at each place.

7. Scope of the Daniels Pile Project.

a. General. - The scope of the work involved in the design of a high temperature pile may be envisioned only by acquaintence with each major phase of the Project. The problems that presented themselves were approached from every possible angle. The advantages offered by the best solution for one problem often placed another at a disadvantage. Therefore, all aspects had to be carefully weighed and considered from an overall perspective before final acceptance of a solution for any individual problem could be given. Fundamental studies of the chemical characteristics and nuclear physical properties of all the materials involved in the construction and operation of a high temperature pile were required. During 1946 practically every District research contractor was engaged, at least in part, on some fundamental metallurgical, chemical or physical research problem in this field.

b. Preliminary Design Proposal. - By November 1946 plans and experimental work were far enough advanced so that a formal preliminary report could be prepared covering all phases of the design, construction and operation of the Daniels high temperature pile (Reference 5). At the time this preliminary report was written the main features of the power pile consisted of the following: The coolant was to be helium gas circulated through the pile. The inlet temperature of the gas was to be 500°F, the outlet temperature 1400°F. A pressure of 150 psi absolute was to be maintained throughout the coolant system. With the above temperature differential a gas flow rate equivalent to

40,000 kw heat output when operating at peak capacity was to be obtained. The moderator was to be beryllium oxide. The fuel units were to be 2 per cent by weight of 55 per cent enriched U-235 (in the form of UO_2) mixed with beryllium oxide. This mixture was to be fabricated into a tube approximately 1½" o.d. X 4½" long with a 1" i.d. Approximately 2300 of these tubes would be required to supply the fuel necessary to fire the pile at rated capacity. The reactor assembly was cylindrical in shape with the major axis in a vertical position. The reactor was to be approximately 6 ft. in diameter by 5½ ft. high containing 504 vertical channels, 250 of which would be fuel channels, the remainder being reflector channels. The heat generated within the pile would be absorbed by the flow of helium gas through the inside of the fuel tubes. A water tube boiler placed adjacent to the pile and acting as a heat exchanger between the helium and the water would generate steam at 450 psi for the operation of a steam turbine-generator. Spent steam from the turbine would be condensed and returned to the boiler. It is by no means believed that the decisions acceptable at that time were the best which could be had, for the multiplicity of problems involved will require many years of operating experience before it will be possible to develop an economical pile unit embodying competitive economic characteristics. (A diagram at the end of this chapter illustrates the "Engineering Principle of the Proposed Daniels Power Pile".)

c. Experimental. - Each of the following major phases of the Project required considerable experimental work. The Research Division of the Manhattan District coordinated the research program for this

work with the exception of the "Power Generation System". Special problems were assigned to those research contractors which had the manpower and equipment best suited to handle particular parts of the overall program. For instance, analytical problems were assigned to the National Bureau of Standards; metallurgical problems were assigned to Battelle Memorial Institute, Massachusetts Institute of Technology and others; methods of material purification and production were assigned to Iowa State College, University of Chicago and others. Each contractor submitted a monthly progress report on the program which was being conducted at its installation. At the conclusion of any particular phase a technical report was written to cover the experimental work.

8. Factors Concerning Power Pile Development.

a. General. - The size, shape and overall consideration of a power pile were approached mainly from the theoretical standpoint; however, experiences that had been gained from the operation of chain reacting piles were of considerable aid to the group connected with these particular factors. This portion of the program has been carried on for the most part at the Argonne National Laboratory.

b. Fuel. - The consideration of the type of fuel for operation of the power pile was a factor of particular importance. Under the present limitations the fuel must be U-235. How the U-235 was to appear in the pile has required much research. Rather than using the customary normal uranium as fuel, it appeared to be better to utilize enriched U-235, either alloyed or dispersed, in one of a number of possibly suitable materials. The size, shape, metallurgical composition, physical

and chemical characteristics of the fuel components were all vitally important factors. This problem has been a closely coordinated, cooperative investigation between the Argonne National Laboratory, Battelle Memorial Institute, Massachusetts Institute of Technology, the Norton Company and the National Carbon Company.

c. Moderators and Reflectors. - Moderators and reflectors are materials which prevent neutron escape and condition them for a specific job. These components will probably determine the final size, operating characteristics and efficiency of the power pile more than any other factor. The moderators and reflectors first considered were normal water, heavy water, beryllium oxide, beryllium metal and carbon. Because of the physical and chemical characteristics of all the moderators considered, the first two have been ruled out. The final choice will probably lie between the last three mentioned materials. The research program on this phase of the work at the close of this history was being conducted at Iowa State College, Hanford Engineer Works, Argonne National Laboratory, Massachusetts Institute of Technology, Brush Beryllium Corporation, Clifton Products Company, Beryllium Corporation, A. C. Sparkplug Company and the Norton Company.

d. Shielding. - Radiations given off from a chain reacting pile require the use of strong impervious shielding to safeguard the health of the operators. Very little progress was made in methods of shielding during the existence of the Manhattan District. It has been known that metallic lead and ordinary aggregate concrete of required thicknesses are adequate. Battelle Memorial Institute had embarked

upon a research program for concrete which has incorporated into it a high percentage of finely divided metallic iron. First results indicated some promise for this material as a superior shielding, but work along this line was not far enough advanced by December 1946 for any definite conclusions to be made.

e. Coolant. - The problem of a primary coolant to remove the heat generated in the high temperature pile was not too difficult a solution since the relative advantages of several suitable primary coolants have been known for some time. With the specific operating conditions of the Daniels pile in mind and with the existing knowledge of all materials that were suitable for this purpose it was not too difficult to select the most desirable. Helium has been chosen as the primary coolant for the pile.

f. Power Generation Components. - Development of this phase of the program was not under the primary jurisdiction of the Manhattan District. The overall program was approved by the District for execution by the Monsanto Chemical Company, but it was felt that the cooperating industrial concerns were the best suited and the most capable for selecting the best designed components for this system. The conditions under which the system was to operate were given to the cooperating industrial group and several designs for various pieces of equipment were subsequently submitted by the following companies to serve as the basis for further design evaluations:

(1) Boiler designs were submitted by Babcock and Wilcox, Foster-Wheeler Corporation and Combustion Engineering Corporation.

(2) Designs for a number of pieces of auxiliary equipment which are required were submitted by the following companies: Frederick Flader Incorporated, American Blower Company, Allis-Chalmers Manufacturing Company, Buffalo Forge Company, DeLaval Steam Turbine Company, Westinghouse Electric Company, and Spencer Turbine Company.

The steam turbine-generator set will probably be supplied by the Navy.

g. Chemical Processing. - A major factor in the continued operation of a power pile will consist of the chemical processing of the fuel after it has been discharged from the pile. The normal process for maintaining fuel in the pile is to charge fresh fuel into one face of the pile, at the same time discharging spent fuel from the opposite face. A period of radioactive decay, under water, is required before chemical processing of the isotopes and fission products from the spent fuel can be accomplished. Final designs for chemical processing are based on recent investigations concluded at the Argonne National Laboratory, California Radiation Laboratory, Hanford Engineer Works and Clinton Laboratories.

9. Other Stationary Piles.

a. The Zinn Pile. - Designed to operate at 1000 kilowatts, this pile is primarily a breeder pile (References 6, 7 & 8) and at the present time there is no indication that the power generated will be put to useful purposes. The term "breeder pile" refers to the ability of a chain-reacting pile to reproduce fissile material. In the case of a normal uranium pile, for every pound of U-235 that is burned a definite

quantity of plutonium is formed. By experimenting with various operating conditions and procedures it is hoped to increase the quantity of fissile material formed per pound of U-235 consumed.

On 30 June 1946 the District contract with the Chicago Metallurgical Laboratory was terminated. The responsibilities and activities of that Laboratory were taken over by the Argonne National Laboratory on 1 July 1946, with Dr. W. H. Zinn as Director. Dr. Daniels had declined the Directorship of the Argonne National Laboratory in order to devote more of his time as consultant to the Power Pile Division, which was to be located at Oak Ridge. It has been mentioned before that Dr. Zinn had proposed a fast neutron pile which was acceptable to the Advisory Committee that was appointed to study both the Daniels and the Zinn pile.

The main differences of the Zinn Pile compared to existing piles are:

(1) It is to have a liquid metal coolant.

(2) No moderator will be used.

(3) The neutron flux is to be considerably higher.

(4) The energy of the neutrons will be approximately 400,000 ev. (This neutron energy is much higher than that of any other proposed pile).

The fuel elements are to be of high 14 per cent enriched U-235 metal, fabricated into rods approximately 1/2" dia. X 8" long. These fuel rods will be incased midway in a steel tube approximately 5½ ft. long. The upper and lower portions of the steel tube will be filled with reflector material. There will be 169 fuel rods contained in the reactor

unit. The reactor assembly will be only 7" dia. X 8" high, the highly enriched U-235 fuel making possible its small size. The assembly will be encompassed in a blanket of normal Uranium or Thorium metal.

Many of the problems that confronted the Daniels group were directly related to the design of the Zinn pile. Consequently, many major cooperative research programs devoted to problems of pile design have been made broad enough to cover the Daniels pile, the Zinn pile and various other piles. The design and development work has continued on the Zinn pile at Chicago. The Argonne National Laboratory has made experimental tests in a special heat exchanger using a liquid sodium-potassium alloy (equal parts by weight) as the heat exchange medium.

b. Heterogeneous Pile. - This pile is an experimental tool designed primarily as a converter pile, i.e., to convert an element into other elements or isotopes by neutron capture. The unit is designed for a maximum heat output of 30,000 kilowatts, to be water cooled with the heat dissipated from the water in cooling towers. Here again it is not proposed at present to recover the generated heat, but a conversion may be made in the future. The heterogeneous reactor will be fired by 18 per cent highly enriched U-235 alloyed with aluminum metal. This alloy will be rolled into thin sheets and clad with pure aluminum sheet. These fuel plates will be assembled into tiers with the necessary spacing to permit cooling water to flow between them. In the fall of 1945 Clinton Laboratories began design work on this high-neutron flux pile to provide a research facility for investigation which could not be performed by the thermal pile presently located at their installation. Plans were far enough advanced by May 1946 that the design proposal for

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the pile could be presented to the Manhattan District for construction authorization. The District Engineer appointed W. K. Lewis, Jay Jefferies, John Wheeler, Hood Worthington and W. H. Zinn to serve as an advisory committee to study the proposed pile and to make recommendations regarding its feasibility. The committee met with representatives of Clinton Laboratories and the Manhattan District at Clinton Laboratories on 27 May 1946. In addition to the committee, those present were M. D. Whittaker, M. C. Leverett, L. W. Nordheim, J. W. Huffman, H. W. Newson, General K. D. Nichols and A. V. Peterson. In general, there are normally three stages of authorization for major construction, namely: (1) Estimating and planning, (2) Engineering, design and (3) Construction. The heterogeneous pile was in the second category at the end of the year 1946. The committee agreed that the proposed pile was technically feasible and advised that its construction be authorized at once (Reference 9).

10. Nuclear Energy for the Propulsion of Aircraft (NEPA). - Soon after the cessation of hostilities a number of airplane manufacturers requested the Air Forces to intiate a research program directed toward the utilization of nuclear energy for the propulsion of aircraft. The Air Forces contracted with the Fairchild Engine and Airplane Corporation, to form an operating organization to investigate this field. This organization, known as NEPA, a Division of the Fairchild Corporation and acting as an industrial cooperating agency, has, within its group, personnel from the National Advisory Committee on Aeronautics, Northrop Aircraft Incorporated, Frederick Flader Incorporated, Allison Division -

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General Motors Corporation, Continental Aviation Engine Corporation, General Electric Company, The Aviation Corporation, Kenasco Manufacturing Company, United Aircraft Corporation, Wright Aeronautical Corporation and Westinghouse Electric Company. Since certain facilities and information required for this program were at Oak Ridge, the Army Air Forces presented the Manhattan District with a program for cooperative research work. The District felt that the problems involved in this undertaking would be of direct interest to the Government and a cooperative agreement was reached in the summer of 1946 (References 10, 11). By 31 December 1946 the Air Forces and each of the various participating companies had stationed one or more representatives at Oak Ridge to follow the program. Active research had just begun on the project at the Massachusetts Institute of Technology, the Frederick Flader Company's plant at Tonawanda, New York; Oak Ridge, Tennessee; and at the Cleveland Laboratory of the National Advisory Committee on Aeronautics. This program is a far reaching and long range investigation in the field of atomic power.

11. Nuclear Energy for Ship Propulsion. - The power possibilities of nuclear energy had greatly interested the Navy Department during the war as a new method for ship propulsion. Notwithstanding the fact that the Navy had cooperated extensively with the Manhattan District throughout the Atomic Project, a specific program for Naval purposes was not started prior to the end of hostilities.

Prior to August 1946 the Navy had contacted the General Electric Company regarding a research program on atomic energy for ship propulsion.

General Electric expressed interest in such a program but before a Navy contract could be negotiated they were awarded a contract by the Manhattan District for the operation of the Hanford Engineer Works and for undertaking a broad research program at Schenectady, New York. The terms of this contract prompted the Navy to propose a cooperative program with both the General Electric Company and the Manhattan District. On 14 August 1946 the Acting Chief of the Bureau of Ships wrote to General Groves stating the general terms of the proposal. General Groves felt that the program was warranted and that it could be conducted at Schenectady under the Hanford contract. The proposed cooperative program was approved on 20 August 1946 (Reference 12). The Navy also requested that several Naval officers and civilian engineers of the Navy Department be assigned to Oak Ridge to acquire certain information which was necessary for the furtherance of the program. This request was also approved and a part of the group had been assigned to Oak Ridge by December 1946. A proposed design for a marine nucleonics power plant was well in the advanced stages at Schenectady on the closing date of this history.

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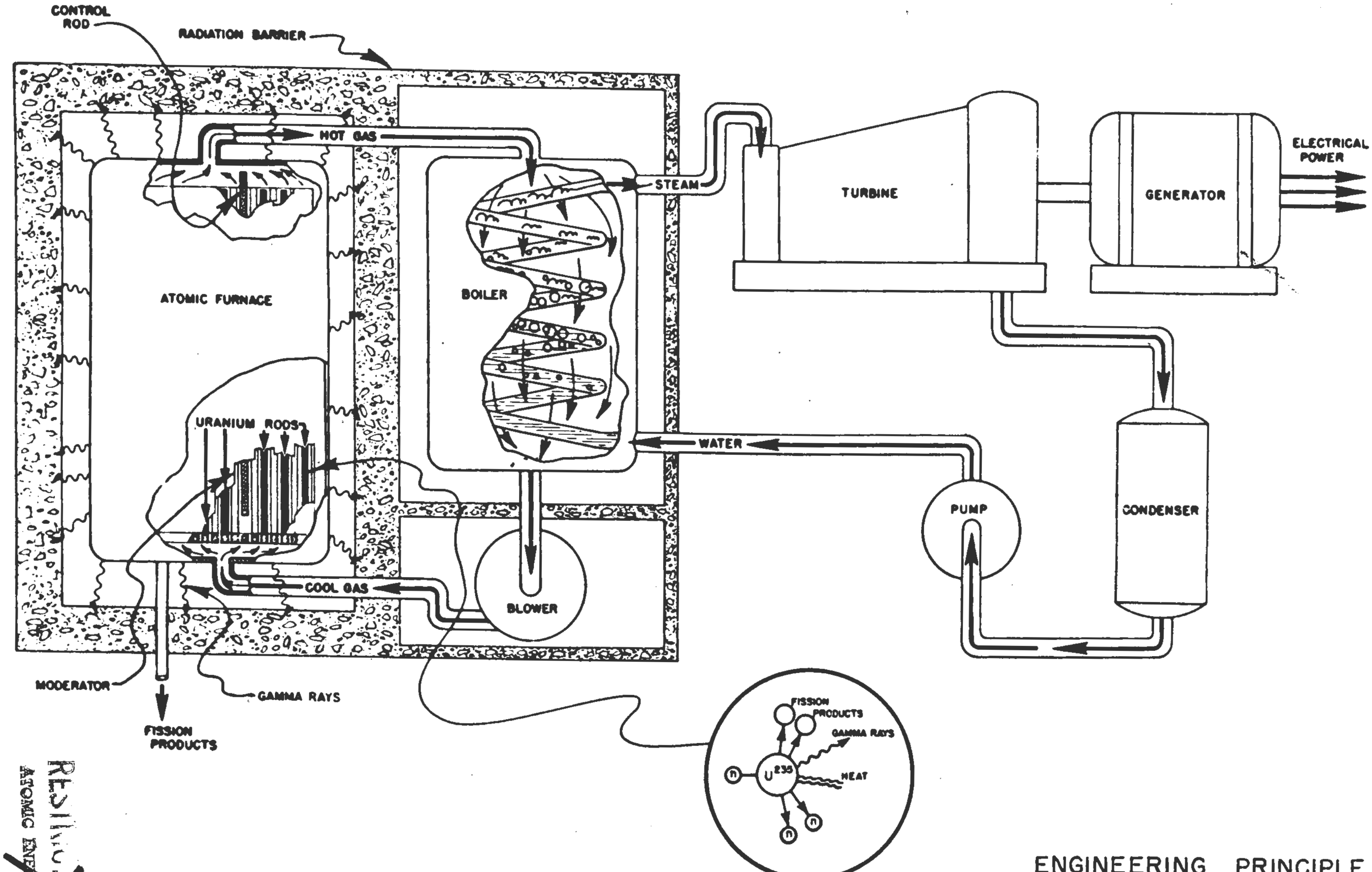
APPENDIX

REFERENCES

Number	Title	Location
1.	Chicago Report Number M-1729	Oak Ridge Research Div. Files.
2.	Chicago Report Number M-1569	Oak Ridge Research Div. Files.
3.	1946 Fiscal Year Budget of Manhattan District	Washington Office Files.
4.	Press release of 13 April 1946 signed by Colonel Nichols	Oak Ridge Research Div. Files.
5.	Preliminary Design Proposal-Daniels Experimental Power Pile Mon M-188, November 1, 1946	" " " "
6.	Chicago Report CF-3403	" " " "
7.	Chicago Report CF-3414	" " " "
8.	Chicago Report CF-3532	" " " "
9.	A letter to General Nichols signed by Committee members dated May 28, 1946	" " " "
10.	Letter from Colonel Nichols to Major Gen. Curtis E. LeMay, Deputy Chief of Air Staff for Research & Development, dated 7 August 1946, Subject: Facilities at Oak Ridge for the Army Air Forces, NEPA program.	" " " "
11.	Letter from the District Engineer to the Deputy District Engineer dated 27 Sept. 1946, subject: "Establishment of Security Channels for the Transmission of Classified Information Relative to the Use of Atomic Energy for Power Purposes".	" " " "
12.	Letter to Deputy and Acting Chief of Bureau of Ships from General Groves	" " " "
13.	Letter to Dr. C. A. Thomas from Col. K. D. Nichols dated May 13, 1946.	" " " "



ENGINEERING PRINCIPLE OF
THE PROPOSED DANIELS POWER PILE

CHAPTER 5

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This document consists of 33 pages
Copy No. 3 of 4 Series A

MANHATTAN DISTRICT HISTORY
Book I, General - Volume 4, Auxiliary Activities
Chapter 5, Declassification and Distribution of Project Information

Note: The section numbers and main paragraph numbers in this chapter, and their titles, correspond to those in a volume in the Manhattan District History files entitled: "History of the Declassification and Publication Program"; further details on the subject of any section or paragraph may readily be found by reference to the corresponding part of that volume. Occasional references to Appendices to that volume have also been included.

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Section IV. The Program for Publication of Classified and Declassified Project Information.

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MANHATTAN DISTRICT HISTORY
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Chapter 5, Declassification and Distribution of Project Information.

SECTION 1 - REASONS FOR ESTABLISHING THE DECLASSIFICATION SYSTEM.

1-1. Introduction - Before the atomic bomb was dropped on Hiroshima on 6 August 1945, the organization, aims and objectives of the Manhattan District were secret, and a highly complex security system had been evolved and enforced, to insure that the Manhattan Project activities should remain secret as long as might be necessary in the interests of national security. With the announcement by President Truman of the dropping of the first combat bomb, the greatest secret of all time was partially revealed, and it was then clearly evident that a major change in security policy was both necessary and desirable.

The necessity for this change in policy was foreseen before Hiroshima, and a memorandum from Major General L. R. Groves, dated 28 July 1945 (Reference: App. A-1), laid the basis for institution of such modifications of the security system as the public announcement of the existence and purpose of the Manhattan District would make necessary or desirable. The basic policy developed at that time by General Groves, which culminated in the release of the Smyth Report, the appointment of the so-called Tolman Committee and the establishment of the declassification program, embodied this principle: that the national safety, or national security, must be guarded above all else, without compromise or deviation, and that the dissemination of scientific and technical

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information, which is essential to scientific progress, must be encouraged insofar as possible consistent therein. This policy was later, in general, embodied in the provisions of the Atomic Energy Act of 1946, approved 1 August 1946.

During the winter of 1945-1946, certain groups of scientists and others became particularly active in exerting pressure for the adoption of a policy along these lines, the preliminary steps of which were then already in process of being carried out. It is somewhat ironical that these groups should have regarded General Groves as their chief opponent and should have directed their principal attacks against him personally, whereas he had actually started months before to develop the very policy they were advocating.

The change in policy necessitated by the disclosure of a major part of the secret of the Manhattan District on 6 August 1945 complicated the problems of administration of security enormously. This was inevitable, since there is a world of difference between releasing no information whatever and releasing some, selected, information and no more. A ban on the release of all information can be clearly and unequivocally understood by everyone, but no amount of words can draw a clear line of distinction, which cannot be interpreted differently by different people, between harmless information and harmful information. A major purpose of the declassification program has been to solve this problem and to simplify administration to the greatest possible extent.

In order to release information regarding the Manhattan Project which was not vital in nature, and could be revealed safely without

disclosing any essential secrets concerning the bomb, an interim declassification system was established. The purpose of this system was to safeguard the vital phases of the project without placing prohibitive restrictions on the release of other information such as that which might be useful to American industry or for the prosecution of further advanced scientific research. This temporary program extended over the period from August 1945 to 30 March 1946, and during its existence authority for declassification, within certain limits, was given to local public relations and security officers. Scientific and technical releases, however, were made by General Groves' office only.

1-2. Release of Project Information. - The first application of the new policy was the release of the Smyth Report, in August 1945, shortly after the announcement of the bombing of Hiroshima. In this report a general survey of the major fundamental developments was presented, to American scientists and engineers and to the general public, while detailed information which concerns national security was retained.

Other notable revelations of information were made during the period of the interim declassification system and those of a scientific nature included a lecture by Dr. Glenn Seaborg, of the Metallurgical Laboratory of the University of Chicago, on trans-uranium elements and one by Dr. C. D. Coryell, of Clinton Laboratories, on the chemistry of the fission products.

1-3. Appointment of Tolman Committee - Continuing the fundamental policy outlined above, General Groves, at the end of October 1945, appointed a Committee on Declassification (Reference: App. B-16) composed

of high-ranking scientists. Dr. Richard C. Tolman, Dean of the Graduate School, California Institute of Technology, scientific adviser to General Groves during the major stages of the Manhattan Project, and in 1946 Chief Scientific Adviser to the U. S. Representative, United Nations Atomic Energy Commission, was appointed chairman. Lt. Col. John R. Ruhoff of the Manhattan District was the non-voting secretary. Dr. R. F. Bacher, Dr. A. H. Compton, Dr. E. O. Lawrence, Dr. J. R. Oppenheimer, Dr. F. H. Spedding, and Dr. H. C. Urey formed the rest of the Committee. The purpose of this committee, as described in some detail by General Groves in a letter to Dr. Tolman dated 2 November 1945 (Reference: App. B-16), was to recommend a detailed program to accomplish the release of scientific information without danger to national security.

1-4. Tolman Committee Report - The first report of this Committee was submitted during the latter part of 1945. It was reviewed by General Groves and finally approved by the highest Governmental authority in March 1946 (Reference: App. A-2).

On the basis of the approval of the first Tolman Committee Report, a Declassification Guide was prepared which showed what information might, and what information might not, be declassifiable. A special organization was set up during February and March 1946 under the direction of Lt. Col. J. R. Ruhoff and later under the direction of Lt. Col. W. S. Hutchinson, Jr. This organization began operating 1 April 1946, and was incorporated as a branch of the Research Division on 1 May 1946. A specific procedure was worked out for accomplishing declassification and release of information, and, in the Manual for Declassification of Scientific and Technical

Matters dated 1 May 1946 (References App. B-2 and B-13), the new procedures were integrated with the current security provisions of the Manhattan District.

The statement of recommendations by the Tolman Committee (Reference: App. B-2), contained philosophical opinions from which the following pertinent quotations are made:

"Our fundamental belief is that the release of basic scientific and technical information obtained during the development of the bomb would, over a sufficiently long term, not only enhance our national welfare but actually conduce to our national safety ... we believe that nearly everyone will agree that there is much that can be disclosed at the present time without danger to our military security. We are convinced that practicable and sound principles can be formulated which will make it appropriate to release such information at once provided the release is carried out with circumspection and discernment under competent and informed guidance. The needless withholding of new developments is bound to delay progress in technical fields, and hence to have serious consequences for our national welfare and security, while disclosures of a great store of new and useful information will stimulate the growth and development of science and industry ..."

And on the subject of the Smyth Report the Committee agreed with all those who had approved its publication, in the following words (in part):

"We regard the release of the Smyth Report by the Manhattan District last August as the first step in the establishment of a desirable and national policy for the release of information and we wish to express

our approval of its publication. Although the report was written before the principles outlined above had been formulated by this Committee it was nevertheless prepared in accordance with a carefully thought-out and conservative set of rules, devised for the purpose of presenting a general picture of the development of the atomic bomb rather than for the purpose of releasing useful scientific and technical information ..."

1-5. General Considerations in Development of a Declassification Program. - The problem of declassification as applied to atomic energy in the United States was conditioned by two major considerations which were later to be specifically written into the Atomic Energy Act of 1946, and the subsequent enactment of the Act did not appear in any way to affect the already established declassification program as of 31 December 1946. The two considerations were:

a. Restriction of information to protect national security.

b. Free exchange of information in order to promote scientific research.

The problem was difficult because of the contradictions involved in these considerations. First of all, they were (and continued to be) mutually exclusive so that if one objective were to be completely attained, the other could not. Secondly, complete restriction of information would slow down the rate of our own technical progress so that foreign scientists working under no such restrictions would eventually attain and finally surpass our own state of technical development. Thirdly, a completely free exchange of information would permit a maximum rate of technical progress for ourselves, but would also permit the same thing for

foreign scientists.

Another important consideration was the practical difficulty in restricting the flow of information. Military security is ordinarily a matter of relatively short periods of time and normally is concerned with operations which will take place in the relatively near future. There is always, in any security operation, some leakage of information even though the rate of leakage is very small. Project security measures were, therefore, designed so that this leakage rate would be so small that the existence of the proposed operation would not be revealed before the operation had taken place. In the case of atomic information the strictest security had been maintained because the condition for release was a matter of international agreement, the date of which appears indefinite at the present time.

This meant that the rate of leakage of project information during the war had to be controlled exceedingly closely, and for an indefinite period of time.

In order to set up a control of information, project data were first compartmentalized as scientific and technical information or non-scientific and non-technical, the former to be handled by the declassification organization, and the latter by the public relations organization. Information in either category might or might not be important to the security of the United States.

Information important to the security of the United States was handled in accordance with the Manhattan District Security Manual and Army Regulation AR 380-5 (which is the basis of the Security Manual).

An important distinction between atomic project security and ordinary military security was the fact that most of the information important to national defense was in civilian hands. Consequently, in order to control the information, the actions of civilians rather than military had to be closely supervised. This led to many unprecedented problems, the solution of which required great ingenuity on the part of the Manhattan District. An adequate detailed description of their complexity is contained appropriately in the Security and Intelligence volume of this history (Book I, Vol. 14). A second important difference between atomic security and ordinary military security was the tremendous scope of the atomic bomb project.

SECTION 2 - DECLASSIFICATION PROCEDURE AND ORGANIZATION.

2-1. General. - On 1 April 1946, the Manhattan District established a new declassification procedure, whereby classified scientific and technical matters could be declassified and released for publication or other use. This procedure was in general accord with the recommendations of Dr. Tolman's Committee on Declassification.

2-2. Definition of Scope of Work. - The following prerequisites were established for material to be considered for declassification:

a. Declassification must be effected by document (Reference: App. B-3). The Tolman Committee had recommended the policy of declassification by document rather than declassification by fields. Materials or instruments must be adequately described in a document; that document, accompanied by a statement that the intention was to declassify the instrument or material described therein, could then be processed through the declassification system.

b. The document must have been classified. This included, for example, the requirement that a material described (for declassification) must have been classified for more than administrative reasons. Documents, instruments or materials which had been classified for administrative reasons could be "administratively" declassified, without being processed through the declassification system, if no technical information was thereby revealed.

c. The document must contain scientific and technical information. The release of any document not containing such information became purely a public relations matter. The Declassification Guide and

declassification policy were established solely for the declassification of scientific and technical information.

d. The information in the document must have been obtained for the project. This included information developed under the OSRD or other Government agencies prior to the assumption of authority by the Manhattan District.

2-3. Off-Project Release of Information. - Although the declassification organization had no authority to control the release of information developed off the project, some papers related to project work were submitted by outside authors to the Declassification Office for opinion as to whether their publication would be in the national interest. These were referred to as "opinion" papers, and it is interesting to note that where deletions in these papers were recommended, they have been always accepted by the authors.

2-4. Declassification Policy. - The declassification of a document was effected in three steps. The document was examined first by a Coordinating Organization Director, who determined whether it conformed with the Declassification Guide; if so, the document was forwarded to a second reviewer, known as a Responsible Reviewer, who also examined it; if the latter concurred, he forwarded the document to the Declassification Officer at Oak Ridge, where, after certain other appropriate checks were made, the actual declassification was effected.

Manhattan District policy prevented the declassification of documents containing scientific and technical information merely for convenience of filing routine. If a newly prepared document contained

scientific or technical information obtained from classified documents - or from new work in a field which was classified in accordance with the Security Manual - the new document itself must have been classified; but if the document contained only information obtained from unclassified, or previously declassified, documents, it need not be classified.

Examples of types of subjects for which declassification has been requested are:

a. Scientific and technical papers

b. Contracts

c. Speeches

d. Photographs

e. Advertising material

f. Equipment, instruments, and material

g. Plants; certain types of plants could be declassified, but, in general, operating plants for the production of classified substances could not be declassified. Documentary description of a plant was required, as in the case of instruments and materials.

2-5. Declassification Procedure. - The prime contractor was the one who determined who in his organization could originate a request for declassification; such a request had to be approved by the head of the contractor's organization and had to be forwarded by him to the appropriate Coordinating Organization Director.

Requests from subcontractors and vendors were handled through the prime contractor, in a similar manner.

Requests initiated by Manhattan District personnel were forwarded

directly to the appropriate Coordinating Organization Director. Certain Manhattan District personnel were designated as COD's by the District Engineer, to handle documents prepared directly by Government personnel.

A copy of the document for which declassification was requested was forwarded by the COD to the Patent Advisor or his local representative for review and comment, and, where patent considerations were involved, it was required that final patents release be obtained by the Declassification Officer directly from the Office of the Patent Advisor.

Another copy of the document was, as previously described, first reviewed by the COD and then by a Responsible Reviewer, who forwarded it to the Declassification Officer for final action. The Declassification Officer, subject to the approval, either with or without deletions, of the COD and of the Responsible Reviewer, and subject also to the approval of the Patent Advisor, would perform the actual declassification.

This processing usually required a period of about two weeks, after the document had reached the hands of the COD. After declassification, a copy of the document was returned to the source of the original request and other copies were filed in the Permanent Declassification File and in the Information Branch Files of the District's Research Division at Oak Ridge; when appropriate, a copy was forwarded by the Publication Officer to the Department of Commerce. (As explained hereinafter, in par. 4-4, the Office of Technical Services of the Department of Commerce has been designated as the official repository of basic scientific information.)

2-6. Declassification Guides. - Several types of Declassification Guides were prepared by the Declassification Office, with the approval

of General Groves, for use beginning 1 April 1946, to help the Coordinating Organization Directors and the Responsible Reviewers to determine what information could or could not be declassified. These were: a. for General Use; b. for the Electromagnetic Process; c. for the Diffusion Process; d. for the Plutonium Project; e. for the Military Utilization Project; f. for Responsible Reviewers (Reference: App. B-10).

The Declassification Guide was basically a rule book, and, in the beginning, if it was not stated specifically that the information under consideration was declassifiable, by a strict reading of the Guide, it was deemed inadvisable to release the information. This was modified somewhat with the establishment of the Committee of Senior Responsible Reviewers, described in a later section of this chapter.

The Declassification Guide for Responsible Reviewers (Reference: App. B-10) contains the following descriptions of material which can be declassified:

"1-905. Information within the scope of publications, 'Atomic Energy for Military Purposes' by Dr. H. D. Smyth, and other accredited releases concerned with project information.

"1-910. Information already published in scientific or technical literature which was developed outside the Manhattan Project."

To these descriptions the following footnote is appended, indicating some of the problems and difficulties of interpretation:

"It must be fully understood that the mention of particular subject matter in the Smyth Report or in the scientific or technical literature does not make it proper to release information beyond that which is actually disclosed in the publication concerned. Furthermore, unaccredited

publication of classified Project scientific or technical information does not constitute authority for declassification or for repeated publication of that information."

2-7. Coordinating Organization Directors. - The Coordinating Organization Directors were provided for in the original Tolman Committee recommendations of 17 November 1945. They were usually appointed as men in active charge of project installations or administrators of project contracts. Briefly, their duties were to determine whether or not a document was declassifiable in accordance with rules laid down in the Declassification Guide, and, if so, to initiate the necessary administrative actions. (Reference: App. B-5b, for a detailed account of the duties of a COD.)

2-8. Responsible Reviewers. - The principle of having two reviewers for every document was also included in the original Tolman Committee recommendations. The second in each case was one of the Responsible Reviewers. These were scientists who were recognized experts in their respective fields, appointed by the District Engineer, on the recommendation of the COD's, the Committee on Declassification, and others concerned.

The duty of a Responsible Reviewer was essentially to determine whether papers which were routed to him for review actually fulfilled the prerequisites for declassification based upon the rules set forth in the Declassification Guide. (Reference: App. B-9.)

2-9. Senior Responsible Reviewers. - Senior Responsible Reviewers were appointed by the District Engineer for each major phase of the Manhattan Project. They were leading scientists in their fields, as follows:

Dr. Warren C. Johnson, for the Plutonium Project

Dr. W. F. Libby, for the Gaseous Diffusion Project

Dr. John H. Manley, for the Military Utilization Project

Dr. Robert L. Thornton, for the Electromagnetic Project.

These men comprised the Committee of Senior Responsible Reviewers, with Mr. H. A. Fidler, Deputy Chief of the Declassification and Publication Branch, serving as the non-voting secretary. Their duties and responsibilities were defined in a letter from General Groves dated 31 July 1946. The Senior Responsible Reviewers were authorized to reconcile differences of opinion and to render final decisions on interpretations, in case of disagreement between the various CGD's and Responsible Reviewers, and to recommend changes in Declassification Guides and policies.

The Committee held three meetings: on 12, 13 and 14 August 1946; on 12 October 1946; and on 6 and 7 December 1946. (Reference: App. B-5d.)

2-10. Manhattan District Declassification Officer. - The Manhattan District Declassification Officer was appointed by the District Engineer in February 1946, and his office began functioning on 1 April 1946. His duties were set forth in general terms by the Tolman Committee's recommendations and, briefly, they were to effect the actual declassification of documents and to coordinate and supervise the day-to-day mechanics of the declassification system. (Reference: App. B-5e.) Major A. P. Donnell served as Declassification Officer from February until October 1946, when he was succeeded by Major R. T. Batson.

SECTION 3 - OPERATION OF DECLASSIFICATION PROGRAM.

3-1. Security Problems. - Deletion of all code terms and substitution of the proper terms therefor were required in all documents submitted for declassification. This requirement avoided the possibility of compromising security which the release of documents containing code words might have entailed. Declassification of the code terms was considered to be purely a security matter.

A special security problem arose in connection with declassification of papers relating to "Postum". The technology for the manufacture of this isotope, and even the facts that the project was interested in the substance and had available relatively large amounts of it, were secret. Also, no reports of work by the research personnel at the production plant were published during 1946, since the product of this relatively large plant would have been thereby divulged. Yet it was possible, in accordance with the Guide, to release useful information regarding postum which had been gathered in the course of research at other installations. No solution for this rather unfair situation had been reached as of 31 December 1946.

3-2. Patent Considerations. - As originally recommended by the Tolman Committee, the procedure required, in effect, that an authorization should be procured from the Office of the Patent Advisor for the release of each document processed, in order to insure that the Government's interest in any patentable features were adequately protected - or could be protected within the statutory time limit. This caused considerable delay in the release of material, and was particularly aggravating in

cases in which the requesting contractor believed that the information involved had no security value but was of considerable interest to other laboratories. A compromise procedure was finally worked out with the Patent Advisor, whereby information could be released under "Restricted" classification, and could be made available to other Government agencies or Government contractors on that basis, before completion of the examination as to patentability and before completion of the preparation of patent applications, if such applications were to be made.

3-3. Guide Inconsistencies. - As the declassification system became organized and a large number of documents came in for processing, in April 1946, some inconsistencies in the Declassification Guides became apparent. The problems which resulted were solved mainly through discussion, by the Committee of Senior Responsible Reviewers (also called the Senior Responsible Reviewers' Sub-Committee of the Tolman Committee) and by groups of Responsible Reviewers. (References: App. B-6 and A-4.)

3-4. Speed of Operations. - Many factors contributed to the length of time required to process a document through the declassification system, including: routine handling and transmission; orientation of the COD's regarding processing; securing required background information for the request form; the two independent reviews by the COD and the Responsible Reviewer; and the certification by the Patent Advisor that release of the information would not compromise the patent position of the Government. A period of two weeks was tentatively established as the minimum time required for declassification of a document, but the time might be much longer than this, particularly if the authors failed to file the necessary data.

3-5. Records. - The records kept, for each document submitted, included a copy of the document, with all certifications, etc., and all pertinent correspondence, and a "log", containing a summary of action taken and required. Separate convenient records were kept listing all instruments and materials which themselves had been specifically declassified by the declassification of the documents describing them.

3-6. Uniformity. - To help further in assuring uniform treatment of material submitted for declassification, there was established the Technical Sub-Section of the Declassification and Publication Branch; their duty was "to ascertain whether the mechanism of declassification was proceeding in accordance with the rules laid down in the Declassification Guide", which was the responsibility of the Declassification Officer, as prescribed by the Tolman Committee. This subsection performed a useful check by reviewing all documents processed, a task which the Senior Responsible Reviewers did not have time to accomplish; and this became in effect a third review. Still further assistance toward the attainment of uniformity was provided by circulating to the Responsible Reviewers documents which illustrated the usual interpretation of the Guide topics.

3-7. Declassification of Instruments. - Everything concerning instrumentation except its project applications and the motivation for its development could be declassified. This led some personnel to conclude that there was no need in classifying reports issued concerning instruments. Many of the instruments were inventions, however, and protection of the patent rights of the Government was required. Therefore, all

personnel concerned were advised that each new instrument had to be classified and that an improvement made on a declassified instrument had to be declassified as well, in the regular manner.

Some complications arose on account of the difficulty of determining whether certain plant instrumentation was pre-project information or was developed for the project. Declassification was denied on those instruments not specifically covered by Guide Topics as declassifiable unless they could be shown to have been pre-project.

3-8. Relationship between Classification and Declassification. - Misunderstandings of the relationship between classification and declassification have frequently occurred during the program. Many have felt that because certain types of scientific information were declassifiable, reports on new work in these fields should not be classified. One of the recommendations of the Tolman Committee tended to support this contention, - a recommendation that as declassification progressed, surveys should be made of information declassified and whole fields should be declassified. No change in policy along these lines had been made, however, when the direction of declassification was relinquished by the Manhattan District.

3-9. Variations in the Declassification Request Form. - To help reduce the clerical work required, variations of the standard request form, which eliminate alternative paragraphs which the Coordinating Organization Director knows will not be needed, have been authorized. A special form for the Military Utilization Project has also been created, and another special form, for Clinton Laboratories, - a combined Declassification Request and Publication Request Form - was in process of

design on 31 December 1946.

3-10. Contracts. - The responsibility for initiating action and for performing the first technical review of documents originating in contractors' organizations rested upon the Coordinating Organization Directors, as previously explained. In appointing these directors, the Declassification Office attempted to obtain individuals holding the highest positions in companies or laboratories, in order to enhance their authority. Every effort was made also to reduce the number of COD's required to the minimum, in order to obtain the most efficient and the most uniform operation, and it was determined that the maximum number should be about seventy-five. By eliminating from the contract list all subcontracts and all unclassified contracts, a composite list of some 800 to 900 prime classified contracts was drawn up by the Declassification Office for processing and further consolidation. These were in turn broken down into groups corresponding to the Area Engineer Offices supervising the contracts, and in general each Area group was broken down into three sections: Section I included those prime contractors who had their own COD's; Section II included those contractors whose work for the project was generally of less importance than that of contractors in Section I, who were, nevertheless, expected to possess considerable information suitable for declassification; Section III included contractors whose contracts were administratively classified and also contractors whose work was of such a highly classified nature that its declassification was impossible under present or contemplated declassification regulations. Contractors in Section II were to channel documents through an appropriate Coordinating Organization Director, subject to the

agreement of the individual. Section III was composed of contractors whose work was expected to produce either no classified scientific or technical information, or else information which could not be declassified; contractors in this section were therefore omitted from consideration and were not even notified of the program.

Acceptance of appointment as Coordinating Organization Directors was entirely voluntary and splendid cooperation was received from the appointees, in handling not only the declassification problems of their own organizations but also those of other contractors (when necessary, for contractors in Section II, as described above).

For some specialized contracts, administered by the Madison Square Area Engineer, the Research Division, and the Medical Division, it was necessary to appoint COD's from Area Offices or from Divisions of the Manhattan District.

An agreement was reached between General Groves and Dr. Vannevar Bush whereby contractors of the Office of Scientific Research and Development were authorized and instructed (by OSRD Administrative Circular No. 2.03, Suppl. 1, dated 28 June 1946; Reference: App. B-23) to utilize the Manhattan District Declassification system for declassifying scientific and technical information originating from work done under contracts related to the atomic bomb project. Procedures similar to those described above were followed with respect to all these OSRD S-1 contracts.

A master list of all prime classified contracts, including OSRD S-1 contracts, showing declassification channels for each, was maintained in the Declassification Office.

As of 31 December 1946, there were 37 active and 10 "inactive"

Coordinating Organisation Directors. The so-called inactive directors were those appointed to handle classified data which had been called in from contractors who were no longer associated with the Manhattan Project, or no longer had suitable arrangements for retention of that data by "cleared" individuals. These inactive directors have little or no processing to do but they are available in case of need. All declassification channels had been established by the end of the year 1946 except for a few OSRD contractors.

3-11. Cataloging Published Information. - In order to determine what had and what had not been previously published on atomic energy and nuclear physics and chemistry, it became necessary to catalog all information on these subjects which had been published or released for declassification purposes. The work of searching the literature, abstracting material, and preparing index cards was handled by the Literature Survey Unit, under the direction of the Declassification Officer. This unit has assisted the office of the U. S. member of the United Nations Atomic Energy Commission, during the summer of 1946, by furnishing the results of some of its cataloged information. The unit has also been called upon to assist in providing information for use in checking security violations.

On 27 November 1946 (by memorandum from Capt. Batson to Lt. Col. W. S. Hutchinson, Jr.) a declassification policy on legal claims was set up and all work connected with legal proceedings was delegated to the Literature Survey Unit. Previously a Legal Review Board had been set up to discuss cases on which trial was felt to be necessary and a representative

of the Declassification Section was appointed to this Board in November 1946. The principal problem was to find some way in which the requirements of national security could be reconciled with the rights of an individual complainant who brought suit in court against an operating concern of the Manhattan District. Up to the closing date of this History no method had yet been found whereby a person could describe in court his exact duties and what materials he had to handle without disclosing some secret information. Although a number of legal suits had been filed, no cases had yet been tried, and it seemed evident that, if public trials were to be held, a compromise between declassification principles, constitutional rights of the individual, and national security would be necessary.

3-12. Atomic Energy Act. - As previously stated in Section I above, the provisions of the Atomic Energy Act of 1946 confirmed in general the basic policy which had been developed by the Manhattan District, culminating in the release of the Smyth Report and the establishment of the declassification program. The Act provided that the Atomic Energy Commission should control the dissemination of classified data and that "the dissemination of scientific and technical information relating to atomic energy should be permitted and encouraged so as to provide that free interchange of ideas and criticisms which is essential to scientific progress". The Act also prohibited the exchange of information on atomic energy with other nations until Congress should declare that effective and enforceable international safeguards against its use for destructive purposes had been established. (Atomic Energy Act of 1946, Section 10(a))

3-13. International Aspects. - Until 1939, scientific knowledge obtained by one nation was in general available to all, but during the War such information was shared for mutual use by the United Nations only, principally the United States, the United Kingdom and Canada. At the end of hostilities, however, this situation raised many problems and questions. The British and the Canadians have declassification systems similar to those in the United States, and the U. S. Declassification Guide is used by them as a basis for their releases. Uniformity of interpretation is not so complete as might be desired, but the dangers involved have been lessened by mutual criticisms and by the fact that the work of the British and the Canadians is, as a whole, of a more restricted nature than a considerable part of the work in the United States.

SECRET

SECTION 4 - THE PROGRAM FOR PUBLICATION OF DECLASSIFIED AND CLASSIFIED PROJECT INFORMATION.

4-1. Reasons for Establishment. - Subsequent to the release of the Smyth Report it was decided that a coordinated system should be established for the release of basic scientific information as rapidly and as widely as possible consistent with national security. Under normal circumstances a large share of scientific information is released for publication through the numerous technical and semi-technical journals. During the period 1940 to 1945 it was necessary to impose restrictions on the release of such information for security reasons, and, as a consequence, the Manhattan District was placed in the position of having a tremendous backlog of scientific information at the close of hostilities.

When it became apparent that disclosures of scientific results could begin, it was realized that the normal channels of dissemination of information could, within a reasonable time, handle only a fraction of the information that could be released. On the other hand, an equitable credit policy required that the work should be described as nearly simultaneously as possible. Accordingly, it was decided that scientific records of the various Manhattan Project research activities should be written up for publication as an integrated series of books, primarily for a documentary record of the technical research and development of each activity. In the writing of the research activity records, emphasis was placed on the allocation of proper scientific credit and authenticity. Many of the scientists on the project were young and comparatively unknown, and since there had been no release of information, they had not attained the

scientific stature which would have been theirs under more normal conditions.

4-2. Publication Section. - The Publication Section of the Declassification and Publication Branch (of the District's Research Division) was established late in 1945, with Dr. A. F. Thompson as the Section Chief. It was closely integrated with the Declassification Section and its duties were:

a. To arrange for the collection of information for publication of the Manhattan Project Technical Series (MPTS);

b. To arrange for the orderly release of basic scientific information by means of letters to the editor, publication in a scientific journal, and disposition as required by research and development, prior to its formal publication in the MPTS, in such quantities as would not hamper research nor penalize the scientists contributing to the MPTS.

4-3. Manhattan Project Technical Series (MPTS). - The MPTS was conceived to furnish a documentary record of the research conducted on the project as a whole; it incorporated records of various contractors and project activities which pre-dated the MPTS itself.

Some activities in compilation of technical records had started before the MPTS was organized, including the Plutonium Project Record (formerly the Metallurgical Project Record under Dr. R. S. Mulliken, Editor-in-Chief; the Los Alamos Technical Series, under the direction of Dr. N. E. Bradbury; and the scientific records of the SAM Laboratories and the University of California Radiation Laboratory. All of these were later absorbed in the MPTS.

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In November 1945, Major A. F. Thompson, Technical Assistant to the Director of the Research Division, was assigned the task of coordinating the information contained in the separate project activity histories into a complete and authoritative scientific record of all research conducted on the Manhattan Project. Shortly thereafter the Manhattan Project Editorial Advisory Board was instituted, with one member from the editorial staff of each project activity. (The names of the members of this Board may be found in Reference: App. B-27).

It is anticipated that the MPTS, when completed, will comprise some 125 volumes. (An outline giving main divisions, volume numbers, titles, volume editors, and probable classification of the volumes may be found in Reference: App. B-35) Those volumes which can be declassified in accordance with the recommendations of the Tolman Committee may be published and distributed to the public under such conditions that the distribution will be self-supporting - but only after approval by higher authority.

On 19 July 1946, General Groves authorized the reproduction of the volumes of the Series in a limited edition for project use and stated that the later publication of an edition for public use might be authorized of such time as approval had been obtained from various high governmental authorities. Although bids had been obtained from publishers, no further action had been taken prior to 31 December 1946.

General policies established by the Advisory Board included the following:

a. That the laboratory directors should agree to support a fair and uniform arrangement which would protect all authors on the project

from haphazard publication by an individual and would prevent the "scooping" of the MPTS.

b. That the volume of press releases would be kept to a minimum; tentatively, not more than 10% of the MPTS material from any project activity.

c. That the COD should send to the Publication Officer a number of copies of an abstract of each paper for which publication clearance was requested, in order to provide for the assignment of proper credit and the establishment of priority of work on a project-wide basis, for such papers as were released in advance of the MPTS.

d. That the Publication Officer would send a copy of the abstract to each Board member for review and clearance; and that concurrence of all Board members would be necessary before release for publication.

e. That all documents must be declassified by processing through the declassification system in the regular manner, prior to release for publication.

f. That each author should be requested to accompany his paper, when published, with a suitable credit and by-line, stating the contract number, the project activity at which the work was conducted, and when the document or information would appear in the MPTS (if it was to appear therein).

4-4. Other Publication Section Activities. - The Publication Section forwarded as much declassified scientific information as possible to the Office of Technical Services (OTS) of the Department of

Commerce, the official repository of scientific information. Under the provisions of Executive Order 9568 such information was to be made available to the public as widely as possible. Although the Manhattan Project was exempted from this provision to a great extent, the Publication Section sent to the OTS the declassified material for which wide distribution was proper and desirable.

Documents which were released through normal publication channels were routed through the Disposition and Liaison Unit of the Publication Section. This unit compiled, and circulated to the members of the Advisory Board, weekly informal lists giving the title, author, release data, and project contractor, with respect to each document.

Copies of all documents processed through the Publication Section were furnished to the Information Branch, Research Division, where they were available for project-wide distribution. The Information Branch issued two separate lists of declassified documents: (a) a restricted list for project-wide distribution only, and (b) a list of declassified documents for wide distribution, containing only such papers as had been forwarded to the OTS, Department of Commerce, for public distribution.

SECTION 5 - STATUS AS OF 31 DECEMBER 1946.

As of 31 December 1946, the declassification program herein described was in active operation. In the "Declassification Diary" (Reference: App. B-1), the entries for dates in the last part of the year 1946 show that recommendations have been made in considerable numbers, principally by the Committee of Senior Responsible Reviewers, for changes or improvements in the system, but that none of these recommendations had yet been approved.

There can be no doubt but that the policies and procedures instituted under the Manhattan District are subject to improvement, but any changes which may tend to relax the restrictions which have been enforced, or the vigilance of those who administer the program, must be scrutinized and weighed with extreme care before they are adopted. The first requirement of a sound policy must continue to be the guarding of the secrets which the United States still possesses.