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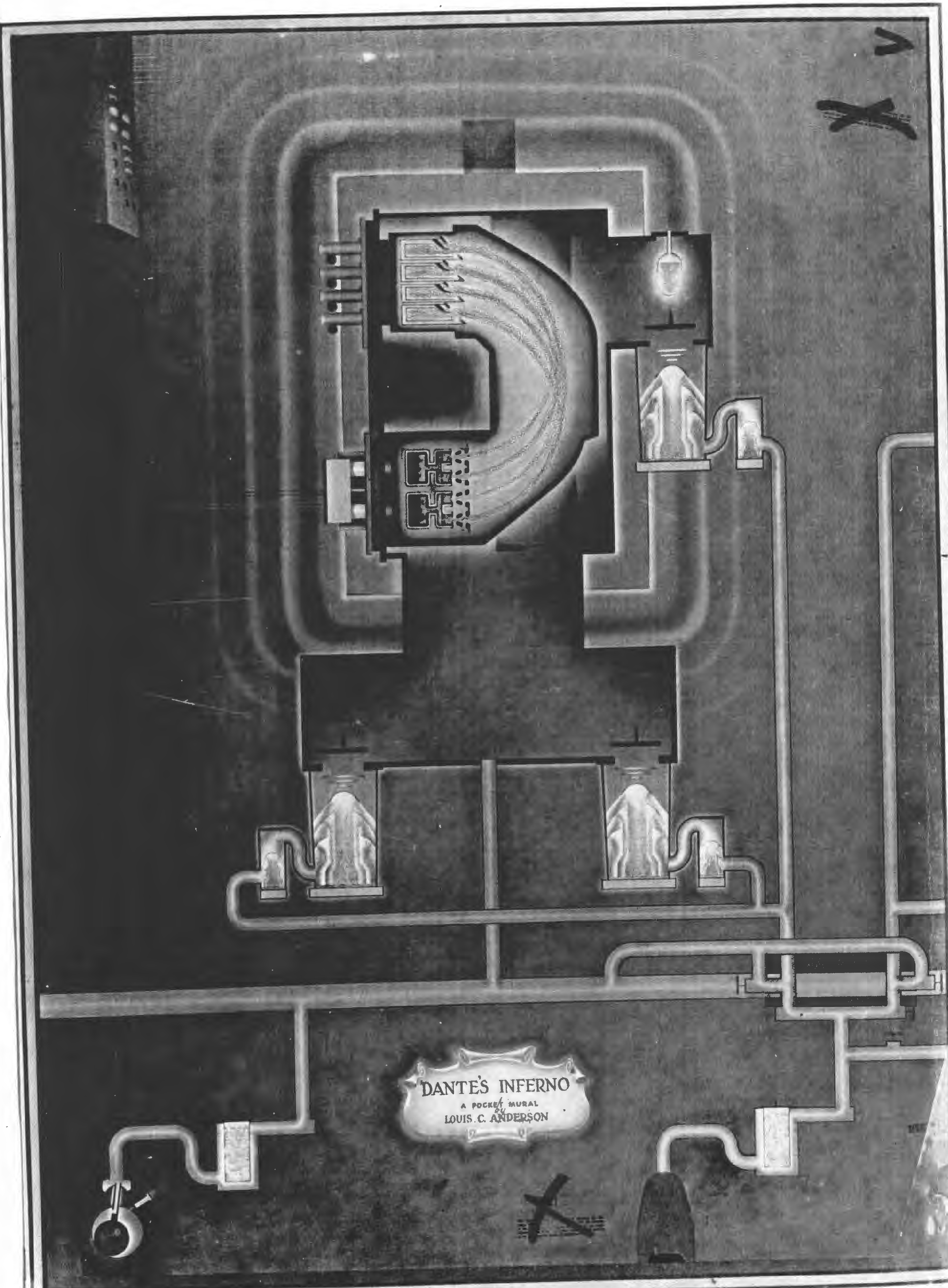
NO. 2 OF 4 SERIES A .

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATION


DANTE'S INFERNO
A POCKET MURAL
by
LOUIS C. ANDERSON

FOREWORD

The colorful illustration at the left represents the heart of the electromagnetic separation process in operation. This volume tells how the huge Electromagnetic Plant, containing hundreds of similar separation units, was successfully operated to produce materials for the atomic bomb. The period covered in this narrative began in January 1943, spanned a year of preparation and almost two years of operation to 1 January 1947. By 1 October 1945 the major objective of the plant operating organization had been achieved.

This volume is the last of six volumes describing separate phases of the Electromagnetic Project and it is recommended that the other volumes be read first, in order to achieve full appreciation of the story of plant operation, which was even more colorful than the illustration.

The volumes of Book V, Electromagnetic Project, are as follows:

Volume 1 - General Features

Volume 2 - Research

Volume 3 - Design

Volume 4 - Silver Program

Volume 5 - Construction

Volume 6 - Operation

The volume is completely referenced and contains a glossary of technical and code terms which are designated by an asterisk where they first appear in the text. A separate top secret appendix has been prepared to this volume in which production data, charts and graphs are shown.

31 August 1947

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATION

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SUMMARY

1. Introduction. - In 1942, by specific delegation of the President's authority under the War Powers Acts, an Electromagnetic Project was authorized to produce Uranium 235. The ultimate purpose of the operation of the resulting plant was to produce the largest possible amount of Uranium 235 in the shortest possible time. The scope of the operations included the processing, both chemically and physically, of uranium salts, the recruiting and training of labor, development work on the process, the solving of housing and transportation problems, and the guarding of the secret of the process. This entire work, as performed by the Operating Contractor, was controlled by the District Engineer of the Manhattan District, through the Y-12 Operations Office.

2. Contractual Agreements. - Although Stone and Webster Engineering Corporation was originally considered for both operation and construction of the project, it soon became apparent that this would be too big a job and a separate operating contractor was sought. After consideration of several companies, Tennessee Eastman Corporation was asked to accept this assignment, since it was felt that they had the industrial "know-how" and sufficient technically trained personnel who were not already engaged in war work. Following a letter of intent drafted on 6 January 1943, a formal contract, No. W-7401-eng-23, was made on 7 June 1943. This followed the standard War Department cost-plus-a-fixed-fee operations contract form, calling for services as a consultant

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regarding design, engineering, and construction; for recruiting and training personnel; for research and development work on the process; and for operation of the various parts of the plant on completion of construction. This contract was modified by 3 supplements as the scope of the contractor's responsibilities were modified to meet new developments of the project.

3. Mobilization. - Following the selection of Tennessee Eastman Corporation as the operating contractor, it was necessary to begin immediate training of their key personnel in the process and to initiate a program for recruiting other able personnel who could be trained. In order to do this TEC key personnel were sent to Berkeley, California, in January 1943, to receive training in the operation of the experimental units which were set up in the University of California Radiation Laboratory. Representatives of the Stone and Webster Engineering Corporation, the Westinghouse Electric and Manufacturing Corporation, the General Electric Company and the Army were also at Berkeley at this time, in order to maintain liaison between research, design, construction, operation and fabrication. Training in the chemical operations required was also going on at Berkeley, while further experimental operations were carried out at Rochester, N.Y. Most of the people who had been studying these operations were transferred to the site at the Clinton Engineer Works by September 1943. During this same period a drive to obtain the necessary labor for operation of the plant was begun. The requirements were estimated to be 2,500 people in February 1943. With the extension of the plant, estimates were increased in May 1944 to 13,500 and again, in December 1944, to 25,000. Since it was found im-

possible to obtain sufficient technically trained civilian personnel, it was necessary to detail technical personnel from both the Army and the Navy to the operating contractor. In order to train such a large group of people, classes were begun, with the help of the U. S. Office of Education, in Knoxville and in the TEC School at Oak Ridge. Further training continued on the development units, the Alpha development units being started in August 1943 and the Beta development units in November 1943. Training in the chemical processes began, with a few runs to produce feed material for the tracks, in October 1943. Following the organization of a procurement section in April 1943, it was realized that this section had a tremendous task and virtually the entire procurement section of the Holston Ordnance Works, which was operated by TEC, was transferred to the Clinton Plant.

4. Plant Operation. - In simplest terms, plant operations may be described in seven steps: (a) chemical preparation of feed material, (b) separation in the Alpha or first-stage racetracks, (c) recovery of unseparated material for recycling, (d) preparation of partially enriched material for second stage feed, (e) separation in Beta or second stage racetracks, (f) recovery of unseparated material for recycling in the second stage and, finally, (g) preparation of the final highly concentrated U-235 for shipment.

Initial operations in the Alpha or first stage chemistry began in October 1943. The functions of this department include the preparation of charge material, uranium tetrachloride (UCl_4) by the treatment of the orange oxide (UO_3), as received from the District, with carbon tetrachloride (CCl_4) and purification of the product by means of a vacuum sublimation (a distillation process). Since over 90% of the material fed to the tracks is not separated but condenses on the units or remains in the charge bottle, this material must be recovered and reprocessed. This is done by washing the units and treating the resulting acid solution with hydrogen peroxide (H_2O_2), which precipitates uranium peroxide (UO_4). This peroxide is filtered off and heated to give the orange oxide (UO_3) which is treated in the same manner as the material received from the District.

Initial racetrack operation began on 13 November 1943, on Alpha track 1, but extraneous materials in the oil cooling system caused shorts in the magnet coils which forced their removal and return to the manufacturer for rewinding. The start of Alpha track 2, in January 1944, made it the first track to begin continuous operation. By the end of April 1944, there were four Alpha I tracks in operation. The next Alpha track to come into operation, track 5, was started on 3 June 1944; this track was of the four beam hot source type, but used the magnet and vacuum system similar to the first four, or Alpha I tracks. This four beam type unit was also installed in the Alpha II tracks 6, 7, 8 and 9, with improved magnets and vacuum systems. Track 6, the first Alpha II track to start operations, began in July 1944, and the other three tracks followed in August, September and October, respectively. This type unit had numerous difficulties which had to be ironed out. Prominent among these was insulator failure, which was eliminated by heat shielding and the use of Zircon insulators. By November 1944, all 9 Alpha tracks had reached full operation. The concentration of this product was about 10.7% U-235.

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The first Beta racetrack was completed in March 1944, so preliminary operations using the same feed as the Alpha tracks could be started. The source unit was found to be unsatisfactory and a program of redesign and remodeling was started. On 11 May 1944, the first tank using Alpha product was started and satisfactory concentration was obtained in the product. In June 1944, Beta track 2 started on normal material, and it began using Alpha product as feed in September 1944. By December 1944, there were 3 Beta tracks operating at capacity. It was decided to construct a fourth Beta building, with two additional tracks, to bring the total Beta tracks to eight.

The S-50 and K-25 plants began to reach appreciable production, and in February production was high enough to permit feeding their product to the Alpha stage. Material of above normal U-235 enrichment was received in February 1945 from S-50, and in March 1945 from K-25. During the use of this enriched material Alpha production reached a maximum, during one week in July 1945. It was expected that K-25 product would reach a concentration of 3-5% and another Alpha chemistry building for processing this material was started. However, it was determined that K-25 could produce material of sufficient concentration to be fed directly to Beta. Therefore, the use of S-50 product as feed to K-25 was started, and the use of K-25 product as feed to Alpha was stopped in May 1945. Since this material was received from both S-50 and K-25 as uranium hexafluoride (UF_6), it was necessary to place a step in both Alpha and Beta chemistry for the conversion to the orange oxide (UO_3). By the middle of June 1945, the first material was fed to Beta from K-25.

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Using the more concentrated feed from K-25 during September, production rose to the desired concentration of U-235 in final product. With delivery of this more concentrated material from K-25 and Japan being occupied by American troops, the order was given on 4 September to close down Alpha.

The Beta chemistry operations followed the same general scheme as the Alpha operations. The feed was received in the Alpha pockets and had to be washed out and converted to the orange oxide (UO_3) which joined the material being recycled in Beta chemistry through the same procedure as described for Alpha chemistry. Batches had to be kept small to stay below the "critical mass" (mass large enough to start spontaneous fission of U-235 atoms). Difficulty was encountered with holdup in Beta chemistry and considerable remodeling was necessary. Beta chemistry was also responsible for preparation of the final uranium tetrafluoride (UF_4) for shipment, after washing the Beta product from the pockets delivered from the racetracks.

The first shipment of material to Los Alamos was Alpha product. These shipments continued until 11 May 1944. The first shipment of Beta product was on 7 June 1944.

In order to maintain control of the operations, numerous analyses and assays of materials were necessary. Also, in order to keep accountability of the valuable material and to determine where losses were occurring, it was necessary to keep extensive records of the processes. Much study and evaluation of these records helped in setting up and meeting production schedules.

The monthly cost of operation of the plant, starting at $1,879,000 in February 1944, rose to over 9 million dollars by the end of 1944. At the peak of operation in August 1945, the monthly operation cost was almost 9½ million dollars and by the end of 1946 the cumulative total cost for operations was over 237 million dollars including Government obligations.

5. <u>Process Improvement</u> The "debugging" and development of process equipment which had been designed without sufficient technical information was a major factor in the success of the Project. The process improvement group maintained liaison with the research group at Berkeley, established operating procedures, tested new equipment, and studied all equipment and accessories.

The development program at the plant, under the Process Improvement Division, was begun during the fall of 1943. The original nucleus of this group was primarily TEC personnel who had been working on the experimental units at Berkeley, and their initial operations were training new personnel and testing the equipment being installed. Several special groups were organized, such as the Electrical Group to study electrical circuits and controls, and the Vacuum Group for work on the vacuum system. After the start of the Alpha tracks, experimental tanks were operated in the tracks by the P. I. Division. The development tanks were used for testing experimental designs and much effort was expended in solving such problems as bushing failure, water leaks, Beta source units and Beta receivers. The work gradually shifted from "debugging" activities to basic research, such as "J" chamber research directed toward cost studies.

6. <u>Security</u> - Security was maintained by the operating contractor with the cooperation of the District Security and Intelligence Division.

This was done by furnishing employees only sufficient information to do their jobs, and by lectures and pictures discouraging loose talk and rumors. In connection with these activities, a guard force was initiated by the District on 4 March 1943. This was taken over by TEC on 1 October 1943 and eventually a maximum of over 9000 guards and guardettes were employed. The protection from fire was taken over by TEC on 8 November 1943.

7. Auxiliary Services. - The operating contractor maintained a Medical Department with Hospital Service on the Area. This group cooperated with the Safety Department to study hazards and reduce accidents. The safety record obtained was an enviable one. Other facilities which were provided or partially provided included transportation, housing, cafeterias, laundry service and water and power supply.

8. Organization. - In order to maintain contact with Y-12, a Y-12 Operations Office was maintained by the District. This office was headed by the Y-12 Operations Officer and was organized on the same plan as TEC, in order to maintain efficient contact with the operating contractor. The Y-12 Operations Officer also served as Y-12 Unit Chief, who was a technical advisor to the District Engineer. Close contact was maintained between the Y-12 Operations Office, headed first by Major W. E. Kelley from the beginning of the project to September 1944, by Lt. Col. J. R. Ruhoff from September 1944 to November 1945, by Colonel G. J. Forney from November 1945 to the present date, 1 January 1947. The management of TEC was headed by Dr. F. R. Conklin.

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATION

SECTION 1 - INTRODUCTION

1-1. Purpose. - The purpose of the Electromagnetic Project was to operate a plant to produce the largest possible amount of concentrated uranium 235 in the shortest possible time. The final production rate of the plant exceeded the original goal many ~~fold~~ times and the percent U-235 in the final product was considerably higher than that originally planned.

1-2. Scope. - The scope of operations encompassed the processing in a fabulous chemical and electrical plant, of vast quantities of uranium salts, procuring auxiliary raw materials as needed, providing replacement parts for machines which rapidly wore out in the process, and gathering the large number of personnel necessary to operate the plant. Concurrent with operation, continuous research and improvement had to be conducted, to improve the process wherever possible, in order to operate the plant at the highest possible peak of performance. Operation of the Electromagnetic Project (Y-12) presented a variety of entirely new industrial problems, and work which had been recently done on raw materials measured in grams had to be expanded to handle tons. The scientists who had been doing the research work had to have some 20,000 workers to operate the new plant. Most of these workers had to be recruited from a labor market within a radius of approximately 300 miles, with Knoxville as the center. All these operations had to be carried out in the utmost secrecy to preserve the security of the project.

1-3. Authorization. - The authority for the Manhattan District to operate the plant is contained in the same public laws and directives which authorized the design and construction. The authorities are fully described in Volume 1 of this book. In brief, the District authority is based upon specific delegation of the President's Authority under the War Powers Acts; upon recommendations contained in the approved 17 June 1942/ Report to the President, by Drs. Conant and Bush; and by the memorandum dated 17 September 1942, from the Commanding General, Army Service Forces to Brigadier General L. R. Groves, placing him in complete charge of all activities of the Manhattan District.

1-4. Administration. - As with the other production plants of the District, Y-12 plant operation was controlled by the District Office. In order to achieve the most effective results from all facilities, the District Engineer assigned each plant a specific part in the operational plan and it then became the responsibility of the Y-12 operations office and the operating contractor to produce the quantities and concentrations* required.

SECTION 2 - CONTRACTUAL ARRANGEMENTS

2-1. <u>Selection of Contractor.</u>

a. <u>Requirements.</u> - General Groves outlined, in meetings during December 1942 and January 1943, requirements of an operations contractor for the Electromagnetic Separation Plant, which included primarily industrial "knowhow", and availability of key personnel. During preliminary discussions with officials of Eastman Kodak and Tennessee Eastman Corporation, General Groves stated that he was not looking for "long beards", but particularly that he wanted operating people who could attack the problem from a production standpoint (See App. D1).

b. <u>Firms Considered.</u> - The original District plans had considered the Stone and Webster Engineering Corporation for both construction and operation of the project (See Vol. 3). It became quite evident that this would be too large a job for any one organization, and as the Stone and Webster Engineering Corporation was working on design and construction it was decided that a separate operating contractor should be chosen. The General Electric Company, Westinghouse Electric and Manufacturing Corporation of America, and Tennessee Eastman Corporation were other firms considered. Of these, the first two were considered to be occupied on other work to their capacity, and they did not have sufficient key personnel to put on the job (See App. D1).

c. <u>Selection of Tennessee Eastman Corporation.</u> - During December 1942 and January 1943, several meetings were held by General Groves and Col. Marshall, District Engineer of the Manhattan District, with Mr. James C. White, Vice-President and General Manager of Tennessee Eastman Corporation, and subsequently with Messrs. Lovejoy, Hargrave, Wilcox, Sulzer, and Dr. Chapman of Tennessee Eastman Corporation. General Groves impressed upon them the extreme necessity for secrecy, and then outlined the problems in some detail. The Tennessee Eastman Corporation (TEC) accepted the assignment after being told how important the project was to the successful prosecution of the war. A letter of intent was drafted on 6 January 1943, and served as a contract until 7 June 1943, when negotiations for the formal contract were completed (See App. D1).

2-2. <u>Provisions of Contract.</u> - Contract No. W-7401-eng-23, following the standard War Department cost-plus-a-fixed-fee Operations Contract form, provided that the scope of work of the contractor, Tennessee Eastman Corporation, would come under four Titles as follows:

a. <u>Consultant Service, Title I.</u> - The contractor would provide consultant service regarding the preparation of design, engineering, and construction of all features of the buildings, and regarding equipment and auxiliary services pertaining to the plant, and would review plans in connection with construction work on production buildings and equipment. Furthermore, the contractor was to consult and advise the Contracting Officer on any questions which might arise in connection with the plant. A fixed-fee of one dollar was to be paid for this service in addition to reimbursement of costs.

b. <u>Obtaining and Training Personnel, Title II.</u> - The contractor was to obtain key personnel for the operation of the plant, and was to train such personnel so that they could obtain experience with the process and operations involved, and with the administration of the plant. In addition to reimbursement of costs, payment of a fixed-fee of one dollar was specified.

c. Research and Development, Title III. - The contractor would perform or arrange for performance of such research and development work, for process and product improvement, as was deemed necessary or advisable, so that a final product of suitable specification and quantity could be produced. Reimbursement of costs were to be made for this service, and a fixed-fee of one dollar paid.

d. Plant Operation, Title IV. - The contractor would undertake all preparations necessary for the operation of the plant, including training of personnel for such operation, in addition to the training of key personnel mentioned in Title II. Upon completion of various process buildings, the contractor would undertake to operate such buildings to their maximum capacity and to the end of preparing a product of desired specification. Beginning with the month of May 1943, a fixed-fee of $75,000 was to be paid for each month during the term of the contract when all of the original seven production units of the plant were under operation. For each month until the seven production units were in operation, the fee was to be reduced by $7,500 for each production unit which had not been in operation during the month (See App. D2).

2-3. Contract Modifications.

a. General. - As operations progressed, it became apparent that certain contingencies, which could not be foreseen in such a novel enterprise, had arisen, and, consequently, modifications were made to the original Contract No. W-7401-eng-23, for the furtherance of the war effort. There were three such supplements, numbers 1, 3 and 4. Negotiations for Supplement Number 2 were lengthy, and its provisions were finally incorporated in Supplement #4.

b. Supplements #1 and #3. - Supplement #1, dated 15 August 1943, provided that the contractor could conduct auxiliary services for the operation of the town of Oak Ridge, at the Clinton Engineer Works and elsewhere, and that the personnel employed in these services, while employees of the contractor, would be used to facilitate serving the entire Clinton Engineer Works, until the District could provide the service from other sources. These personnel included cafeteria workers in the Townsite Area, and other employees, later absorbed by the Roane-Anderson Company (See Book 1, Vol. 12 Central Facilities). Supplement #3 dated 28 October 1943, authorized the contractor to make payment in advance to insurance carriers, to establish guarantee funds, to secure the payment to the carriers of losses or expenses over and above insurance premiums, for such insurance as would be required or approved by the Contracting Officer (See App. D3).

c. Supplement #4. - By reason of the expansion of the plant, provision was made to enlarge the scope of the contractor's work. The fixed-fee basis was changed somewhat from the original plan to afford the contractor protection in case the process, which was still not proved completely feasible, should not come up to expectation. The arrangement made provided that a fixed-fee of $22,500 was to be paid each month, whether any of the process units were in operation or not, and that an additional $7,500 would be paid each month for each process unit up to a maximum of 7 units, with $4,000 per month for each process unit in excess of 7. This supplement also provided for the disposition of surplus property by the contractor, with the approval of the contracting officer. The contract further provided for assignment, to the contractor, of such technical men from the Armed Forces as might be obtained by the Manhattan District, to fill critical needs in certain of the plant operating divisions (See App. D3)

SECTION 3 - MOBILIZATION

3-1. General. - Selection of a contractor to operate the Y-12 (electromagnetic) Plant solved only one of the many problems faced by the District. The Tennessee Eastman Corporation had many able men within their organization, and could get more from the parent organization, Eastman Kodak, but none of these men had any experience with this work, which was completely novel. The key personnel had to be trained first, so that they in turn could instruct those who were to work under them. Before this personnel could be trained in the various operations, they had to be recruited without being given the least hint of what work they would engage in. A procurement program to insure operation of a plant for which the needs were unknown had to be planned. An engineering office had to be formed to study and approve design, as well as to oversee layouts of buildings and disposition of equipment. An organization charged with debugging* and improving equipment was an absolute necessity. And, last but not least, auxiliary facilities of all types had to be provided at the site, which in the beginning was a hilly wilderness.

3-2. First Activity. - In January 1943, immediately after the TEC had accepted the task of operating the electromagnetic plant, certain of the members were taken to Berkeley, California, where the University of California was conducting major research and development work on plant problems, to become acquainted with operation. Conferences were held among the Stone and Webster Engineering Corporation, the General Electric Company, the Westinghouse Electric and Manufacturing Company, The Radiation Laboratories of the University of California, the Army and Tennessee Eastman Corporation.

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At these meetings problems were discussed, ideas for attacking the problems were exchanged, and plans for a speedy start of operations were made. Tennessee Eastman set up an office in Berkeley to provide first-hand information for key administrative and technical personnel, to analyze design, and to study training methods for chemical, mechanical, electrical, engineering and process phases of operation (See App. D1).

3-3. Training at Berkeley, California. - The Radiation Laboratories turned over two experimental mass spectrograph units known as the XA Tanks* to the Tennessee Eastman Corporation so that personnel could begin training and become acquainted with operational procedures. The number of personnel at Berkeley grew until it had reached a peak of 154 persons who were actually engaged in the new work, (See Vol. 2, App. B4). Bi-weekly seminars on phases of the work connected with the XA tanks, which proved to be of great help in discussing and solving problems, were conducted by the Radiation Laboratories. This group worked in Berkeley until September 1943, when most of them went on to the Clinton Engineer Works (See App. D1).

3-4. Preliminary Chemical Work. - When the Tennessee Eastman Corporation began participating in the project, much of the basic chemical research had been done, but a great deal of work still remained to be completed before large-scale preparation and recovery operations could be carried out. Some of this work was done at Berkeley, some at the Eastman Kodak Laboratories in Rochester, New York, and some at the University of California Agricultural School at Davis (See Vol. 2 Research). Approximately 4000 pounds of feed material*, the grey-green

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salt (UCl_4), was prepared at Davis, while activity at Rochester consisted of experimental work on analytical procedures, "liquid phase" processing (conversion of uranium orange oxide to grey-green salt) (See Par. 4-4o), "bulk recovery"* (treatment of solutions obtained in cleaning units) and sublimation (purification of feed material by vacuum distillation). Work continued in these locations until September 1943, when most of the personnel were transferred to CEW (See App. D1).

3-5. Boston Office. - In February 1943, an office was set up by TEC in Boston, to provide closer coordination between the operations contractor and the construction contractor, the Stone and Webster Engineering Corporation (See Volume 5, Construction). In March 1943, TEC was made responsible for coordination of design and work of research groups, construction contractors and suppliers. All plant layouts and various designs were reviewed at this office until its personnel was moved to CEW at the beginning of August 1943 (See App. D1).

3-6. Recruiting Personnel. -

a. Civilian. - While preliminary work and training of key personnel were being carried out, an intensive drive to obtain labor was begun (See App A2 & A18). During February 1943, the estimate of personnel needed for operation of one track was 1,450 people and for five tracks, 2,500. Employment offices were set up at various points in the country, but considerable difficulty was experienced. Recruiters were sent to distant points to interview and hire personnel, but the best results were accomplished in nearby Knoxville ~~(See App A8)~~. The city and its environs were found to be a very fruitful area. Through the aid of the U.S. Employment Office, a great many were hired, both to fill needs of additional personnel and to compensate for turnover

(See App. A5). A new estimate, made in May 1944, based on the limited operating experience available, raised requirements to almost 7,000, while a revision on the basis of needs for the extension increased the number of personnel required to 13,500. In December 1944, further estimates were made that 21,000 would be needed by January 1945, and that the requirements would increase linearly until 25,000 were employed by May 1945 (See App. D4). A chart showing the TEC organization in September 1945 is shown in App. A-1. The recruiting campaign continued throughout the period of operation, and costs of ~~the entire~~ this program, up to 30 June 1945, amounted to 34 dollars and 8 cents for each of the 44,346 persons hired up to that time (See App. D4). Charts showing the number of plant operating personnel ~~totals~~ are shown in Appendix A-3 and A-4. Employee earnings at Y-12 are shown in Appendix Exhibits A-10 to A-17 and Y-12 wage dividends to employees ~~is~~ are shown in App. A-22.

b. Military. - During the early period of operation, it was also found necessary to take trained chemists and engineers from the Army and Navy, and to fill critical posts in the plant operating staff from this source. Navy personnel were drawn from the men who had been commissioned but had previous training as chemists or engineers. The Army personnel were chosen from the ranks by the same criteria and formed into a Special Engineer Detachment, which also served to absorb returned personnel formerly employed in the District to the work which they were trained to perform. Both the Army and Navy personnel received service pay as determined by their rank or grade. By August 1945, there were 450 Army enlisted men working for TEC. The first three Naval Officers reported for duty on 16 March 1944. The number rose to a maximum of 143 by July 1944. Beginning 15 November 1944, the number of officers on duty steadily declined until by 31 December 1945 only seventeen remained on the roster. Of this number, two were detached within a short while. The remainder were retained by the District for an indefinite period. (See App. D5, 6 and 7; Book I, Vol. 8).

3-7. Training Personnel. - With the help of the U. S. Office of Education, classes were started to ground the new personnel in TEC policies and further courses were conducted to acquaint them with the work they were to perform (See App. A2). In keeping with the rigid security of the Manhattan District, personnel were given only as much information as was needed to carry out their assignments; in some cases, the aims of the operations were completely distorted to mislead the workers, yet described in such a manner as to keep them careful, alert and efficient in performing their duties (See App. B1). In the beginning, classes were held in Knoxville, utilizing the facilities of the University of Tennessee. Subsequently, classes were conducted at the TEC school in Oak Ridge, and others were conducted in the Y-12 Area. Preliminary instruction was given to track personnel (cubicle* operators) on dummy installations, and the XAX units (Alpha* Development Units) in the Y-12 Area were used for training, as were the XBX units (Beta* Development Units) as well as the process racetracks* themselves (See App. C12 and 13). To give training and develop technique without losing valuable Alpha product, the Beta racetracks were operated for some time on normal feed (uranium as found innature) (See Par. 4-6, also see App. D1 and 8).

3-8. Operation of the Alpha Development Units. - By August 1943, the XAX units were completed, and the first run with "innage" was started. (The term "innage" refers to the period in operating a unit during which actual separation of the isotope U-235 from U-238 is being accomplished.) The XAX operated with "cold source"* two beam* units such as those used in the Alpha I racetracks (See Par. 4-4d). This work continued for both training and experimentation on Alpha I units until December 1943, when XAX was converted to 4 beam "hot source"* units to provide operational experience for the Alpha II units (See App. C11) and (See App. D1).

3-9. Preliminary Chemistry Operations. - By late May 1945, new and larger Vapor Phase equipment (500 pound batches) had been developed and installed and had completely replaced the Liquid Phase process for preparing Alpha charge material. The Liquid Phase equipment was cleaned, put in a standby condition and ~~was~~ not used again for Alpha feed. However, the Liquid Phase process continued to be used for Beta charge material until 1 January 1947, except for a few experimental batches. The Primary Recovery Department (charged with cleaning units as they were removed from the tanks) operated with make-shift equipment but were able to process the XAX units. The Bulk Treatment (processing solutions from Primary Recovery) started very slowly, but made some runs in December 1943 (See App. D1).

3-10. Operation of the Beta Development Units. - During September and October 1942, plans for the XBX (Beta Development) units and the first Beta track building (No. 9204-1), housing tracks 1 and 2, were formulated and construction was started on the first Beta track building 15 May 1943. Some of the personnel from XAX was transferred to XBX, and when the first Beta M unit (emitter*) arrived in November

1943, operations were started. Many defects were found in this unit, and redesign was deemed necessary. The new design proved satisfactory, and the first successful runs were made in XBX during December 1943 (See App. D1). Until February 1944, the development units were used primarily for debugging the existing equipment and familiarizing personnel with operation; afterward, XBX was used for research and development problems, most of the debugging and all the personnel training being transferred to the track building (See App. D1).

3-11. Procurement. - With a view to handling the varied procurement problems presented by the task of providing for the needs of Y-12, a procurement department was formed in April 1943. Even with the almost total lack of knowledge concerning the replacement requirements of the new plant, it was realized that the first procurement organization was too small to cope with the problems presented, and almost the entire Tennessee Eastman Corporation's Holston Ordnance Works procurement section was transferred to Clinton (See App. D1). Ordering of spare parts in proper quantities was virtually impossible since no intelligent basis for estimating was available because of the lack of operating experience. Thus most estimates were shrewd guesses, a procedure which could not be expected to be very efficient, and in many cases proved to be quite erroneous. Early ordering of electrical supplies proved to be a wise move, but a shortage of spare parts for the bins* caused some to be shutdown, and resulted in a complete shutdown of Alpha track 5 for a short period. Extremely rare chemicals such as samarium, yttrium, rhenium and other rare earths were procured in small quantities for laboratory uses, while other substances which had previously had very limited commercial application were needed in staggeringly large quantities (4000 gallons of liquid nitrogen per week per track, for example). Delicate equipment of all types was needed in operation research and analysis; dosimeters, measuring the radiations in certain area, were needed to safeguard the health of personnel; pH meters, electrical devices measuring the acidity of solutions, were needed to control chemical phases of the work. One of the major procurement problems, on which most of the work was done by the Madison Square Area Office of the District, was obtaining and having processed the natural uranium used by the plant (See Book VII). Uranium, as uranium trioxide, for the Alpha process was received from 1943 through 24 March 1945 from the Mallinckrodt Chemical Company. Of the 309,238.4 pounds from this company, 8,150 pounds were received in 1943; 229,915.5 pounds in 1944; and 71,172.9 pounds in 1945. The Harshaw Chemical Company supplied large amounts of the chloride in 1944 and 1945. Miscellaneous receipts from U.S.E.D. amounted to approximately 48,000 pounds of uranium. Other sources brought the total of uranium received for the Alpha Process to 520,240.1 pounds (See App. D9).

SECTION 4 - PLANT OPERATION

4-1. General. - The superb accomplishments of the engineering and construction organization in delivering a plant theoretically capable of separating the required quantities of Uranium 235 by no means overshadow the work of the plant operations group in forcing the huge untested mass of buildings, machines and men actually to perform as planned. The task of whipping the bugs of equipment failure, low efficiencies and losses, with untrained personnel, while surrounded by the dirt and din of continuing construction work, was indeed a prodigious task (See App. C1, 2 and 4).

4-2. Material Flow. - The uranium ores which were processed in the plant were obtained from Mallinckrodt, du Pont and Linde (See T.S. App. to this volume and Vol. 3 Sect. 2). In the simplest terms, the plant operation may be described in seven steps; (a) Chemical preparation of feed material, (b) Separation in the Alpha or first-stage racetracks, (c) Recovery of unseparated material for recycling, (d) Preparation of partially enriched material for second-stage feed, (e) Separation in the Beta or second-stage racetracks, (f) Recovery of unseparated material for recycling in the second-stage and, finally (g) Preparation of the final concentrated U-235 for shipment.

4-3. First Plant Operation. - Preliminary work having been done in Rochester, in California, and at Brown University (See Vols. 2 and 3) on preparation of feed for the racetracks, the first step in production was started at the site in October 1943, when a group of chemical workers occupied the first-stage chemistry building and began the large scale preparation of feed material. Preparations were also made for recovery of untrapped material in the process bins, and for treatment of this material to make it available for re-use or recycling in the machines (See Par. 3-9) (See App. D1).

4-4. First Racetrack Operation.

a. Alpha Track 1. - The first Alpha I type racetrack (unit consisting of 96 two-beam units) (See App. C8) was turned over to the Tennessee Eastman Corporation on 13 November 1943 (See App. D10). Operation of this track was taken over by personnel trained on the "Development Units"* (See Par. 3-7). Processing was hampered by numerous difficulties, principally short circuits in the magnet coils, resulting in operation of no more than six tanks at any one time. By December, all operations in this building were stopped in order to remove magnet coils, for reworking by the manufacturer, when the presence of millscale, rust and other sediment was found in the oil cooling system. To forestall such trouble in the future, the cooling oil pipes in this track, and in other tracks being built, were torn out for special cleaning and for installation of individual cooling oil filters for each coil (See App. D11). During the shut-down period the efforts of the operating group were directed at more training and rebuilding of employee morale, which had been seriously lowered by the unfortunate beginning.

b. Alpha Track 2. - Operation began in Track 2 in January, with good results attained almost immediately. First eight and then sixteen tanks were temporarily turned over to the Radiation Laboratories as test units. During Bebruary 1944, the number of personnel employed rose to over 8,600 (See App. A3), and the operation of the plant was costing about $1,879,000 per month, making the total cost of operation about $8,641,000 by the end of February. A discussion of costs will be found in Par. 4-27; however, costs are given here and in ensuing paragraphs to illustrate the growth and magnitude of operations (See App. D8 & 12).

c. <u>Alpha Chemical Operations</u>. - During the early period of operation, plans for the Alpha Chemical cycle were formulated and they remained essentially unchanged all through operations, except for concentration of Uranium 235 in the feed material. The normal material to be processed was received as orange-oxide (uranium trioxide, UO_3) and had to be converted to the volatile grey-green salt (uranium tetrachloride, UCl_4) for use in the units. The steps necessary for conversion were reaction with carbon tetrachloride (CCl_4) and decomposition, by heat, of the resultant intermediate (UCl_5) to the grey-green salt (UCl_4). The reaction was carried out at about 130°C and a pressure of 125 lbs. per square inch maintained for 6 to 7 hours. The product was the intermediate (UCl_5) with liquid excess carbon tetrachloride (CCl_4). The slurry (solid and liquid) was then decanted and centrifuged, after which, the solid (UCl_5) was transferred to a drier and converted to uranium tetrachloride (UCl_4) by heating to 350°C in electrically heated drums. Purification was accomplished by subliming the grey-green salt in high temperature vacuum stills. Later, two processes for the preparation of feed material uranium tetrachloride (UCl_4) were used in the Beta process. The Liquid Phase was carried out somewhat as described above and the Vapor Phase was carried out as follows and in such a manner that the entire series of reactions takes place in one reactor: The uranium peroxide (UO_4XH_2O), obtained by precipitation from the nitrate solution, was dried and calcined to convert the peroxide to the trioxide (UO_3). This in turn was reduced in situ by alcohol to uranium oxide (UO_2). A mixture of nitrogen (N^2) and carbon tetrachloride (CCl_4) was fed into the system and into the uranium oxide (UO_2), to convert it to uranium tetrachloride (UCl4). The tetrachloride was dried and stored for use as feed material in the process.

Of the material fed to the tracks, about 90% remained unvaporized and was left either in the charge bottles or was condensed around the M-end, liners,* bins, and the E-end outside the receiver pockets, without being enriched. This material was recovered from the track units, when removed from servicing, with water and steam and such mechanical washing, scraping, brushing and vacuum cleaning as seemed necessary. The material (unused and contaminated uranium tetrachloride called "gunk") was put in solution with nitric acid, filtered to remove undissolved solids, concentrated and separated by an organic solvent such as Carbitol; washed, precipitated as uranium peroxide (UO_4XH_2O) which was converted to uranium tetrachloride (UCl_4), which again re-entered the cycle as feed material. To give some idea of the magnitude of the recycle as compared with production, the following figures are of interest: In the Alpha cycle, through 9 September, 1945, the date on which Alpha chemistry was disbanded, the ratio of U-235 that had been separated from the grey-green salt (UCl_4) fed into the tracks, was 1 to 5,825 (See App. C25, 29, 30, 31, 32, also see App. D13, 14 & 15).

d. <u>Operation of all Four Alpha I Tracks.</u> - During March 1944, Track 1 was again put into operation and Track 3 was started, although some trouble was experienced in the latter because of short-circuits within the magnet coils. Operation was not smooth because of continued shifting and training of personnel on the production units, and difficulties with the units themselves. On 14 April 1944, Track 4 started producing and by the end of the month all four Alpha I tracks, which are of the two beam type (See Vol. 3, Design) were contributing equally to production. Continued recruiting of personnel had brought the number employed at the end of April to over 11,000 (See App. A3), of which, 3,800 were engaged in actual plant operation while the rest were working on engineering and services, administration or procurement, or were being trained (See App. D17 & 18).

For the first few months of operations it must have seemed to everyone concerned that the plant would never operate properly. Each of the thousands of workers was beset by countless problems and troubles which were no sooner settled than new ones appeared. There were over 2,000 electrical troubles a month on each of the tracks; receiver pockets could not be cleaned, because uranium alloyed with the stainless steel; chemical equipment broke down; bins had to be shut down, because of temporary shortages of spare parts and because equipment which did not function as designed had to be modernized or replaced.

e. First Shipment to Los Alamos. - In spite of the difficulties to be overcome, the first shipments of useful product to Los Alamos were made in March 1944, just a few days more than a year after construction of the plant was begun. The shipments contained Uranium 235 concentrations of 13 to 15%, which were not sufficiently enriched for use in the bomb but were urgently needed for experimental work at the laboratory directed by Dr. J. R. Oppenheimer. Shipments of this material, which were taken from the Alpha stage, continued until 11 May 1944 (See App. D16 and 18). The first Beta product to be shipped to Los Alamos was delivered to the Army by TEC on 7 June 1944.

4-5. Forecast of K-25 Feed to Alpha. - Planning and coordination studies concerning the relationship of K-25, the gas diffusion plant, and Y-12 showed that the best possible use could be made of the installations if they were used in series; i. e., instead of trying to reach concentrations in K-25 comparable to those obtained by Beta in Y-12, K-25 output should be used as feed by Y-12. At that time it was expected that K-25 would take a very long time to reach concentrations above 3-5% U-235, and plans were laid to utilize this material in Alpha.

Studies were made of the hazards involved, and it was concluded that new facilities would have to be provided, both to handle the material in small batches and to avoid any preventable losses. Facilities also had to be provided for conversion of the corrosive white salt (uranium hexafluoride) to orange oxide (UO_3), for use as feed in the Alpha cycle, since the material from K-25 would be received as white salt (UF_6). The consequence of these studies was the design of a chemistry building designated as Building No. 9207. The subsequent spectacular performance of K-25, from which feed suitable for direct use in Beta (See Par. 4-19) was received, after shipments of 1.0% material (See Par. 4-18) were discontinued, obviated the need for this building (See App. D19).

4-6. Preliminary Beta Operation. - At the end of March 1944, the first second-stage racetrack, Beta Track 1, was put into preliminary operation, using the same feed as that used in Alpha (See App. C10). It had become evident from test and preliminary runs in XBX that the source unit (See App. C17) (See Vol. 3, Design) of the machines was unsatisfactory. It failed from inadequate heat shielding, inadequate protection of insulator supports, and inadequate cooling pads and expansion joints, so that an extensive remodeling and redesigning program was undertaken (See App. D8 and 16). During April, experimental work and personnel training on Beta machines continued, and significant improvements were made on the emitters (source units) (See App. C15 and 17).

4-7. Beta Chemistry Cycle. - The general scheme for the Beta Chemistry cycle was established quite early in operations and, as with Alpha, continued throughout with certain basic changes. Beta Chemistry caused considerable worry in the early stages, however, and was the object of a very intensive program to eliminate hold-up which caused intolerably low efficiencies (See Par. 4-12). The feed to Beta was delivered from Alpha in the receiver "Pocket " of the Alpha machines, and recovery of the enhanced material* (rich in U-235) was carried out as the first step of Beta Chemistry. After arriving in the Beta area, the pockets were carefully dismantled to avoid contaminating the enhanced fraction with U-238 (See App. C24). Carbon parts, which constituted a considerable portion of receiver units, were scraped, leached, burned and the ashes leached again to remove all possible uranium. Metal parts were leached and finally electrostripped (stripping metal from surface or reverse of electroplating) to remove the last possible traces of uranium. These various streams were purified to remove contaminant metals, principally iron, and the uranium was removed from the purified solution by precipitation with hydrogen peroxide. The treatment of the resultant yellow oxide (UO_4) followed the same procedure as described for the Alpha Chemistry Cycle (See Par. 4-4c, also see App. C37). Extraordinary care was taken to avoid losses, and batches were kept small, to stay well below the "Critical mass" (Mass large enough to start spontaneous fission of U-235 atoms). It was feared that if too much enhanced material was gathered in one place, a pile undergoing uncontrolled atomic fission would result. The operation of placing the grey-green salt (UCl_4) into charge bottles was performed in dry boxes (small chambers in which work is done in an atmosphere of dry air) to prevent the absorption of moisture (See App. C27 and 28). The filled charge bottles were then fed to the Beta tracks and recovery of the untrapped material was carried out in a

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procedure similar to that described for Alpha Chemistry Cycle.

4-8. Beta Operation on Enriched Alpha Product. - On 11 May 1944, one tank in Beta Track 1 was put into operation, using Alpha product as feed. Satisfactory enrichments of U-235 were obtained. Beta final product chemistry was ready to prepare the product in the form required by the Los Alamos Project (See App. D21) which was the green salt (uranium tetrafluoride UF_4). By the end of May, material containing satisfactory enrichment of this isotope had been produced in Track 1. At that time, total operating expenditures had risen to over $17,000,000 and there were 12,000 persons employed by TEC (See App. D18).

4-9. Beta Product Recovery. - Recovery of product from the Beta receiver pockets closely followed the steps described for recovery of enriched material from the Alpha receivers* (See Par. 4-7), as far as the formation of orange oxide (UO_3) (See App. C33). Materials were handled in smaller batches than the Beta recycle, principally to keep quantities below the "critical mass".

The final step before shipment was conversion of the orange oxide (UO_3) to the green salt, uranium tetrafluoride (UF_4), by treatment with hydrogen and hydrogen fluoride (HF) gases (See App. C38).

4-10. Operation of Alpha Track 5. - On 3 June 1944, the first of the four-beam track units was put into operation. This track was a compromise design (See Vol. 3, Design), which combined the improved four-source equipment developed for the Alpha II tracks with the old-style magnet of the Alpha I tracks, in an attempt to get maximum production as soon as possible with the knowledge at hand (See App. C21). It was realized at the time that if construction was put off for a certain amount of time, better results could be achieved. On the other hand, a happy medium had to be struck in order to get production, and

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Track 5 was constructed. Both operation and servicing proved to be tremendously difficult for a variety of reasons. Instead of the "Cold" source emitters used in the Alpha I type machines, Alpha II had "Hot" source emitters; i. e., instead of operating at ground potential, these units had a 35,000 volt potential. The high voltage insulators (bushings*) used failed at an alarming rate; bushing failures at one time accounted for 25% of all terminations* (See App. C18) (See App. D23). Personnel were poorly trained in operating this new type equipment, and were drawn from Track 5 to work in Tracks 6 and 7 as soon as they had gained experience. Many of the units as received from the manufacturer showed defects in workmanship due to the novelty of the parts and lack of jigs for manufacturing them, causing considerable delays in operation (See App. D8 and 24).

4-11. <u>Operation of Beta Tracks 1 and 2.</u> - In early June 1944, Beta Track 2 began operating on normal (unenhanced) material. A few runs, using Alpha product as feed, were made starting 22 June, but this feed was concentrated in Track 1. Track 2 was used principally for training purposes until September 1944. In June and early July 1944, it became apparent that there was considerable hold-up of recycle material in Beta chemistry, resulting in a shortage of feed to the tracks. This caused great concern, and extensive studies were conducted to find the cause. In a series of conferences between TEC, consultants and the Army, the problem was crystallized and plans were made to solve it. The final decision was that the complex piping and equipment in Beta Chemistry was causing the system to operate at 52% efficiency, that this piping should be removed and cleaned, and that much of it should be replaced by shorter, better designed equipment (See App. D25, 26 & 27).

4-12. <u>Alpha II Operation in 1944</u> - In the latter part of July 1944, Alpha Track 6, with improved type four-beam units, was put into operation. This track was the first of four improved tracks making up the Alpha portion of Y-12 Extension (See App. C9)(See Vol. 3, Design). Many of the difficulties which had been encountered in Track 5 were repeated here. Operating personnel had been able to gain some experience on Track 5, but the bushing failures persisted during operation of this track, causing as many as 40% of all terminations (See App. D23). After extensive experimentation it was decided to adopt unglazed zircon bushings in place of the ones then in service (See Par. 5-5). Track 7, 8, and 9, which were the last of the Alpha Tracks, were put into operation at the ends of August, September and October 1944, respectively (See App. D28, 29 and 30). The yield had increased by more than 100% of original estimate. By the end of 1944, operation of the plant was costing over 9 million dollars per month, total expenditures were over 65 million dollars, and over 20,000 workers were employed (See Appendices A3 and D32).

4-13. <u>Beta Track Operation Through December 1944</u> - Beta production continued to increase steadily through the early period of operation, as numerous difficulties were solved, as more material became available from Alpha production, and as operators became more skilled. The entire organization was under constant pressure for more and more production. Every feasible means was taken to fight absenteeism (See App.

A7 & C3) and to increase "innage" time on the machines, and any other measure was taken which promised to increase efficiency. As a result, the production increased over 10 fold from July 1944 to December 1944. By December 1944, the first 3 Beta tracks were operating on Alpha product as feed, although none was operating at capacity. Concentration kept pace with production (See App. D29, 32, 33, & 34).

4-14. Start of Steady S-50 Feed to Alpha. - During January 1945, the reclaiming of a quantity of material from carbon receiver parts, which had previously been stored, raised production by more than 10%. These carbons were so placed in the receiver that one side was rich in U-235, while the other side contained a much larger proportion of U-238; uranium reclaimed from these carbons assayed about 3-4% U-235, and thus there had been some reluctance to put this material into the Beta Recycle. In February 1945, the first shipments of S-50 material (from Liquid Thermal Diffusion Plant), except for the small amount received in October 1944, arrived at Y-12. Runs using this feed were first made in Beta Tracks 5 & 6. A few days later, on 19 March 1945, limited production was started in Alpha Tracks 6 and 7 with S-50 material as feed (See App. D35, 37, 38 and 39). These shipments to Y-12 continued through April 1945, after which S-50 product was used as feed for K-25. By this time Y-12 was receiving feed material from K-25. (See T. S. Appendix to this volume.)

4-15. Beta Operations January through March 1945. - On 4 January 1945, Beta Track 4 began operating with Alpha product as feed. Output of the Beta tracks continued to increase so that by March production had increased about 35%. By January, the Beta Chemistry recycle facilities were completely moved into the new building, 9206 (See Vol. 3, Design), and operation bugs were being ironed out (See App. D37, 38, 39 and 41).

4-16. Future Beta Facilities. - Early in 1945, plans were made for extending Beta Facilities to a fourth track building, and eventually converting Alpha Track 9 to a Beta Track. In addition, it was felt that a building devoted to Beta product chemistry alone, in view of the high projected output, should be constructed. These two buildings, known as 9204-4 and 9212 respectively, were to go into operation in October 1945. The plans for converting Alpha Track 9 were later abandoned in the early summer of 1945 (See Vol. 3, Design), (See App. D39).

4-17. Alpha Tracks on Enhanced Feed. - At the end of March 1945, K-25 feed to Alpha, with an increased concentration of U-235, was delivered. By 21 May deliveries to the Alpha cycle ceased in anticipation of higher assay* material being fed directly to the Beta cycle. (See App. D40). Production with this feed was slowed by numerous difficulties, principally cleaning bins to prevent mixing concentrations, and installing liners, the deliveries of which were extremely slow. (See App. C26). A production drop in March from its previous value in February, could be ascribed to the degassing* (vacuum) difficulties engendered by cleaning bins, to prevent mixing of the normal 0.7% feed, previously used, with the S-50 and K-25 feeds. These delays in attaining the proper vacuum averaged about 10 days per bin after cleaning, and reduced production considerably. In April, the production had climbed back and it increased steadily until the peak was reached in July. The concentration was also on the upswing during this period and continued through August 1945. The number of personnel employed, of which over half were in the Production Division, had risen to a new high of about 22,000 by the end of August (See App. A3), and cumulative operating costs were over 156 million dollars (See App. D31, 39, 43, 44, 45 & 46).

4-18. Continued Beta Operations on Alpha Product. - Improvement in Beta output continued unchecked throughout the first four months of 1945. In May, the effect of utilizing new type receivers with narrower slots to separate the precious U-235 more completely (See Par. 5-8) lowered the production somewhat, but the concentration came up materially from April's value of U-235. This gain is concentration counteracted the lowered production since the effectiveness of the material increased with concentration (See App. C20 and 23) (See App. D41, and 43).

4-19. K-25 - 7% Feed to Beta. - On 11 June 1945, the first 7% feed arrived from K-25, and by 13 June Beta tracks 5 and 6 were beginning to operate with this material. A new department was added to Beta Chemistry, charged with converting the white salt (UF_6) to orange oxide (UO_3) for use in the Beta cycle (See App. C35). The Alpha product feed was concentrated in Tracks 1 and 2, and the other four tracks operated on 7% K-25 feed. A small drop in concentration from the previous month's high was due to the quantity of lower concentration feed being utilized in four of the tracks - 7% rather than 11% Alpha product.

4-20. K-25 - 10% Feed to Beta. - July saw 10% feed arrive from K-25, displacing the 7% material previously delivered. As the 7% material was removed from the Beta recycle, it was returned to K-25 for further enhancement. Production in this month reached the phenomenal increase of 182% of the previous month. By 24 July 1945, the deadline immediately preceding use of the Atomic Bomb, schedules had been bettered to the highest concentration of product since the plant ~~has~~ had been put into operation (See App. D45).

4-21. K-25 - 23% Feed to Alpha. - On 5 August, 1945, the day before the Atomic Bomb was dropped at Hiroshima, 23% feed was first received from K-25, and by 15 September all tracks were operating fully on this feed. As Alpha product and 10% K-25 feed was removed from the Beta cycle, it was returned to K-25. (See Top Secret Appendix to this volume). During August the production rate and product concentration was further increased.

4-22. Shutdown of Alpha. - As the feed received from K-25 rose to the same concentration as the Alpha product, it became increasingly apparent that K-25 could replace the Alpha cycle completely. After 23% feed was delivered by K-25, plans were made to shut down Alpha as soon as it was quite certain that the occupation of Japan was proceeding satisfactorily. On 4 September the order was issued to shut down Alpha; from that day forward no new runs were to be started, and TEC started to put the tracks in stand-by condition. By 22 September, the last runs had ended in Alpha, and many of the bins had been cleaned. At the end of September personnel had dropped to about 16,000 (See App. A3), of which 9,100 were in the Production Division, and expenditures had risen to 166 million dollars (See App. B91 & 92).

4-23. Unavoidable Shutdowns.

a. The Mouse. - We shall try to describe here some of the more interesting, if sometimes tragic incidents, which caused shutdowns and delays of one sort or another. The first of these concerns a small mouse which delayed production on a bin in Alpha Track 2 for several days. To understand how a small amount of foreign matter can prevent reaching proper vacuum, one must have some conception of the incredibly low pressures in these bins, and the effect of material having an appreciable vapor pressure. The tanks operated under vacuum measured by approximately 6 ten millionths of an inch of mercury (.015 microns), while water, for instance, exhibits a vapor pressure of about 7 tenths of an inch at room temperature (20°C). The presence of the mouse in the bin prevented reaching the high vacuum necessary because the bin could not be degassed (removal of moisture or gases absorbed in the bin). Several days of pumping and leak hunting failed to reveal the source of the trouble, so the run was terminated and the bin opened. All that remained of the mouse was a bit of fur and tail (See App. D49).

b. <u>The Bird</u>. - Much more serious than the above incident was the case of the bird which perched on one of the outside insulators of the building housing Alpha tracks 6 & 7. His body caused a short, and he died from a shock of some 13.2 thousand volts, causing shutdown of the entire building. Several days were required for operations to become normal (See App. D39).

c. <u>Other Incidents</u>. - There were numerous other causes for shutdowns - everything from electrical storms and accidental tripping of switches to accidents in servicing the motor generators supplying current for the magnets in the tracks. In this last instance, the stone used to grind the commutator* in one of the generators broke, nicking the commutator deeply and delaying operation considerably. This happened in the building housing Alpha Tracks 6 & 7 at the end of February 1945, (See App. D39 and 42).

4-24. <u>Waste Disposal</u>. - There were accumulated, concurrent with the separation of fractions rich in U-235, other fractions rich in U-238.

For every pound of usable Alpha product, 10 pounds of "waste" (fraction rich in U-238) was separated, while in Beta, about 8 pounds of "waste" was accumulated for each pound of usable product. Although this U-238 material was considered "waste" as far as the Y-12 plant was concerned, strict accountability was kept on it, and storage, in the form removed from the receivers, was made in a restricted warehouse area at CEW (0101 Area near Elza Gate). The Alpha U-238 fraction had a concentration of U-235 amounting to 0.45% while the Beta U-238 fraction was somewhat lower with a concentration of 0.2 to 0.4% U-235 (See App. D50 and 51).

4-25. Control

a. Analyses. - Both the Alpha and Beta cycle analyses were aimed at uranium control, with minor emphasis on contaminant metals, principally iron. Analyses had to be made on solutions to know how much uranium they contained and on uranium compounds to ascertain their purity, and methods had to be developed to find uranium concentrations in all types of salvage such as piping, scrapped equipment, filter cloths and papers, rags, clothing and rubber gloves (See App. C34). Various methods of analysis were used depending on the probable concentration of solutions. For solutions in which a high concentration of uranium was known to be present, for instance, a complicated method, involving addition of certain chemicals and electrical measurements in the solutions, was used, while for solutions having a very small concentration of uranium, shining an ultra-violet light on the residues from evaporation of solutions and noting the light (fluorescence) gave accurate indication of the concentration present.

b. Assays on Feed and Product. - Assay, as opposed to analysis, was the function performed to find the concentration of U-235 in a mixture of U-235 and U-238 by purely physical method (fission count or mass spectrometry). These assays were made on the feeds to Alpha and Beta, and on the Beta product. When Alpha product was used as feed in the Beta cycle, one operation sufficed for determining the product from Alpha as well as the feed to Beta. When K-25 material was fed to the Beta cycle, ten batches were usually "composited" (an equal amount taken from each of ten batches received) and one assay was made. But four separate assays were made for each Beta shipment made to Los Alamos (See App. D52 & 53).

e. Accountability. - In consideration of the fabulous value of materials being handled, a strict accountability mechanism was set up. Inventories of the Alpha Cycle were made every four weeks and of the Beta Cycle every two weeks. These reports were carefully analyzed and the status of Y-12 accountability was reported to the District Engineer. The amount of uranium of various U-235 concentrations was carefully followed and studies were continually carried out to find where losses occurred in order to eliminate them. Based on the total amount of uranium processed in the Alpha tracks, 17.4% was unaccounted for on final accounting after closing down Alpha and cleaning out tanks. The loss in the Beta Cycle was considerably less, amounting to approximately 5.4% as of December 31, 1946. (See App. D51).

4-26. Production Schedules. - The procedure for making up production schedules consisted in evaluating the future performance of the plant under ideal conditions, and setting a mark to attain. Revisions were constantly made as improvements were put into operation and conditions of facilities and feeds were bettered. One of the earlier schedules of Y-12 Beta Production was summarized in a letter of 31 July 1944. Perhaps the most crucial schedule was one outlined in a letter from Col. Nichols to Dr. Oppenheimer on 3 July 1945, stating the amount that would be shipped to site "Y" by 24 July 1945. Activity at Y-12 was more feverish, if possible, than usual, and by the time of the dead-line, after all units in Beta with more than 50 hours of production had been terminated in order to draw the most possible product from the machines, the schedule was bettered by some 500 grams of U-235.

4-27. Production Cost. - A compilation of operating costs is shown in Appendix A19 and A20. At the beginning of plant operation at Y-12, in February 1944, the monthly cost was $1,879,000 per month, with the total cost of operation about $8,641,000. In March 1944, when the first shipment of product usable in an Atomic Bomb was made to Los Alamos, the total operating costs had risen to over 17 million dollars. By the end of 1944, operation of the plant was costing over 9 million dollars per month, and the total operating expenditures were over 65 million dollars. At the peak of operations in August 1945, the monthly cost of operation had increased to almost 9½ million dollars, and the total was over 237 million dollars by 31 December 1946. This amount does not include Government free issue of $18,158,156 for which reimbursement has not been requested under Contract W-7401-eng-23. It was estimated that after the shutdown of the Alpha portion of the plant was completed, the operating cost would drop to less than 7 million dollars per month. The cost for the last period of 1946 was about $2,700,000.

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SECTION 5 PROCESS IMPROVEMENT

5-1. "Debugging" Y-12. - In relating the events which took place during the struggle to get the Y-12 plant into operation, and to make it produce the required amounts of U-235, frequent mention has been made of redesign and improvements. This "debugging", of equipment designed "by guess and by chance", has been a major factor in the success of the work, and during most of the operating period the chief function of the Process Improvement group has been the "debugging" work. However, long range studies of underlying principles and conception of the basic improvements have not been neglected. The scope of process improvement work covered all phases of plant operations; however, the subject matter of this section has been limited to the work on the process equipment, because the chemical developments have been thoroughly discussed in Volumes 2 and 3.

5-2. Process Improvement Functions. - It was the function of the Process Improvement (called P.I.) Division, with allied groups, to maintain liaison with the experimental program carried on at Berkeley, where the first tests had been carried out, and to disseminate the appropriate technical information as well as to serve as host to evaluate ideas springing from all sources (See App. C6). Also, it was necessary for this group to establish procedures for the efficient operation of new and unique equipment and to handle routine testing, such as the analysis of diffusion pump oils, to determine if inability to obtain a vacuum was caused by the use of the wrong oil. A very important phase was the testing, in the development plant, and on a larger scale in sections of the plant itself, of newly installed equipment and of experimental models. Such studies resulted in the elimination of sources of repeated failure

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which threatened to cripple plant operation, such as the breakage of C insulators and M bushings and the disastrous rise in frequency of water leaks. The program also included the development of auxiliaries such as leak detectors and the Phillips "Ion Gage"* for pressure measurement, the design of radiation detectors, the design of abrasive cleaners for recovery, and more recently, cost studies and research programs, such as studies of the "arc source"*, insulator design and "spark transients" and their relation to electrical and mechanical failures.

5-3. Review of Work. - Much effort was spent on programs which proved to be unfruitful lines of attack, or which changing events subsequently proved to be unnecessary. Other efforts which did not offer immediate success had to be temporarily abandoned as more pressing problems took priority in manpower and equipment. However, the success of the electromagnetic plant was, in a large measure, made possible by the success of some of these development programs. Fundamental knowledge was obtained about hitherto unknown phenomena which will make possible the continued development and increased efficiency of this process. Now that time is no longer the great factor, programs of longer range development can be undertaken, and intensive cost studies of Beta equipment are underway. Unit components are being redesigned to improve serviceability and reduce cost, with a particularly good opportunity for improvement in view of the existent wartime methods of production.

5-4. Establishment of P.I. - The development program at the plant began during the fall of 1943, as the finishing touches were being put on the first Alpha production building. The Development Plant had already been built and the Physics Building and the first shop buildings almost finished. The men who formed the nucleus of the Process Improvement Division were primarily TEC men who had been working on the experimental program at the Radiation Laboratory at Berkeley, California. Near the end of September, the division began to assemble materials and set up shop facilities, and on 8 November 1943 P. I. took over the Alpha Development Plant, which had been used to train operating personnel prior to that time.

5-5. Initial Operations. - During these early days, and even up to mid-spring 1944, many of the activities had to be primarily directed toward the immediately urgent problems of getting the first plant units into operation, of continuing the training of the personnel required to operate the production equipment, and of testing the Alpha I and later the Beta and Alpha II equipment being installed in the plant. The Development Plant was crowded with people being trained in the use of the equipment. Although a certain amount of experimentation was being carried on concurrently, most of this work was connected with checking modifications of the units.

Two of the earliest problems were cleaning the product receiver pockets and finding bushings (high voltage insulators) that would stand up under plant operating conditions. The first problem was eliminated by coating the product receiver pockets with copper. The use of zircon in bushings was one of the most important factors in curtailing Alpha II bushing failures (See Par. 4-12).

5-6. Early Work of Special Groups. - Several other groups were active at this time. The Electrical Group made numerous recommendations for improving the electrical circuits and panel layout of Alpha power supplies and control circuits, worked on automatic high-voltage reclosing circuits, "thermohm-reactrol temperature control*", magnetic measurements and electrical "ground locators", and other problems (See App. D54). The Vacuum group made tests on vacuum valves, oils for mechanical and diffusion vacuum pumps, vacuum gages, gasket materials, and similar problems. A Technical Supervisory Group was set up in the production building and the first experimental U.S.E.D. group from Berkeley organized an 8-tank program, following the initial heart-breaking failure of the building's magnet (See Par. 4-4a). The Manufacturing Experiment Department was organized in January 1944, and by spring had taken over the major portion of experimentation in the Alpha I plant. The U.S.E.D. - P. I. receiver development group gradually transferred its activities from the Radiation Laboratory at Berkeley to Y-12, and engaged in the redesign of the first Beta receiver units (See App. D85) and made studies of the beam shape in the Alpha tracks. A theoretical group investigated certain problems of the magnetic field, Beta chemical recycle operation, and plant production. By mid-spring 1944, Process Improvement activities were on a sound footing. The Alpha Development Plant (XAX) had been reconverted to operate with the four-beam Alpha II equipment (See Par. 3-8) (See App. D55). The Alpha I plant was operating with a steady output and the first Beta building had started. The Beta Development Plant (XBX), under Refining Division, and later, U.S.E.D. - P. I. supervision, was making Beta equipment workable.

5-7. Starting Alpha II. - With the opening of the Alpha II plant (See Par. 4-12), another period of immediately urgent problems descended on the experimental groups. The testing program in the Alpha Development plant had proven that the new units could be operated satisfactorily.

However, the failures inherent in starting up production with the more complicated equipment were so frequent that it was questionable whether they could be made operable at all (See App. C22). It was decided to close the Alpha Development Plant and to combine its personnel with others, sent hurriedly from the Radiation Laboratory, to establish a 12-tank program to further prove this equipment, and to experiment on a larger scale. Special groups were organized to solve particular problems which were endangering the whole program, personnel was loaned for technical supervision, and operation and inspection procedures were established. Though the struggle was long and strenuous, it was for the most part successful, and a majority of the Alpha II experimentation was carried on by this Alpha Test Group, until the Alpha plant was closed in September 1945.

5-8. Refinement of Plant Equipment. - Gradually the critical plant problems were solved and longer range programs and more thorough studies were begun. In Beta, where precision was necessary and pressure was not so great, the test groups had time to iron out many of the difficulties of the Model 2 Source Unit (See App. D56) and the Gloria Receiver Unit, which were some of the more successful units that had been devised in the experimental program (See App. C19). Procedures for vacuum testing with helium leak detectors (a special type of mass spectrograph) were developed. Because of the success of the gas diffusion process (See Par. 4-5), the Alpha plant began to think in terms of chemical recovery and possible conversion to Beta type operation. Recovery liners were installed, material balances were made by maintaining careful inventories and/or records of all material into and out of each step in process and tank cleaning equipment was developed. (See App. D58).

Tests were made on operating Beta Units in Alpha tanks. In Alpha I, variations in width and spacing of the "accelerating slits" gave increased output (See App. D59). Four-beam operation in Alpha I and Beta was attempted but abandoned, because the increased output sought was secured with less complicated equipment. The receiver slot width in Beta was reduced in order to obtain a better separation (See App. D60), and a program was initiated to increase Beta receiver life, in view of the prospect of richer charges from the diffusion plants (See Par. 4-5). Work is now being directed toward the reduction of costs by the elimination of expensive materials, the simplification of component parts, the design of parts so they may be reused, and the elimination of run failures (See App. C16). Progress has been steady and is continuing at the present, although emphasis has been shifted from the quickest production to the most economical production methods possible.

5-9. Special Research Groups. - In addition to the general programs of plant experimentation, there have been special research and study groups. The High Voltage Group investigated sparking and its relation to equipment failure and plant production. The Special Instruments Laboratory developed radiation counters to aid in chemical recovery operations. The "J Research*" Group has been studying the nature of the arc source where ionization of the beam occurs (See App. D61). The "K Research*" Group has begun an intensive study of the filaments (K's) used in plant source units, a continued source of failure. The ceramic group and the experimental groups in the Alpha Development Plant have carried on a systematic study on the causes of insulator failure and important improvements in insulator design have resulted from their work (See App. D62 & 63). In the Beta Development Plant charge material studies have

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resulted in a better understanding of the nature and sources of the troublesome extraneous beams encountered in plant operation (See App. D94). Studies of the nature and control of drain and "electron oscillations" in electric and magnetic fields have begun and have already contributed to an understanding of the problem. These programs should produce gradually increasing dividends and a better understanding of the basic factors involved, and will lead to improvements in the electromagnetic separation of isotopes.

SECTION 6 - SECURITY

6-1. General. - As in the other phases of the project, certain definite measures were taken to protect the electromagnetic plant and the classified information concerning its operation. Following the general District policies (See Book I, Vol. 14), a Security and Intelligence organization was formed, which cooperated with the District and directed the activities at the plant. The measures adopted fall into three divisions: Military security, guarding, and fire protection.

6-2. Military Security. - The functions of military security, which consist of prevention of espionage, sabotage, and subversive activities, were started early in 1943, with the selection of the plant operator. Key officials were informed of the extreme secrecy of the work and were instructed in the proper handling of classified information (See App. D64).

A comprehensive and intense security program was initiated for new employees, following discussions between the District Engineer and Tennessee Eastman officials in April 1943. All employees were checked by routine character investigations, and all were subjected to a series of lectures, pictures and informal talks, emphasizing the necessity for not discussing their work and for not engaging in speculation or rumor spreading. Work was compartmentalized, so that no employee had access to any more information than necessary to do his job and, in many cases, the general information given workers was made deliberately misleading, such as, the explanation of the process describing the manufacture of "synthetic catalysts" (See App. B1).

Constant vigilance by the security forces produced a very enviable record for the project, in that there were no losses of time or material which could definitely be attributed to subversive activities, although in the years of 1944 and 1945 over 300 alleged security violations were thoroughly investigated. Early in 1946, an additional security safeguard was adopted in the form of the Keeler Polygraph, popularly known as the "Lie Detector" or "Keeler Feeler." This instrument, which measures the variations in palm moisture, respiration and pulse, was used on personnel having access to the Beta Final Product Chemistry Building to ascertain whether any of them had taken or knew of anyone taking material from the plant. The original tests were carried out under the supervision of Leonarde Keeler, inventor of the instrument, and one of his assistants has been retained at Y-12 to continue tests whenever necessary. (See App. D65 ~~and 102~~).

6-3. <u>Guard System.</u> - The guard system for Y-12 was established on 4 March 1943, with a contingent of "5 men per shift at all times", by order of the Area Engineer. At first the guards were either civil service employees or employees of the Stone and Webster Engineering Corporation, as a part of the overall CEW guard system. In June 1943, Y-12 Operations formed its own guard force, in anticipation of taking over the duties and responsibilities of safeguarding Y-12. The program was designed along the lines of a military organization with basic training provided as a grounding course, and further classes for "non-coms" and officers. The practical training consisted of doubling up the new TEC men with the guards who had been serving for some time. By early fall of 1943, the organization was large enough and sufficiently trained to take over the job, and responsibility for the protection of Y-12 was officially assumed by TEC on 1 October. By February 1944, the force numbered 650, and, in February 1945, an all time high of over 900 guards and guardettes were

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employed; a gradual decrease occurred after the change in badge system in July 1945, until about 400 were employed in September 1945, and on 31 December 1946, this number had been reduced to 298 (See App. D66 & 67).

6-4. Fire Protection. - Y-12 Operations organized a Fire Department in August 1943, with a nucleus of 6 employees who were to train the larger force of some 50 men. Equipment was purchased, a second fire house in the extension was built, and intensive training was carried out until the force was ready to assume its duties officially. On 8 November 1943, the responsibility for fire protection was officially given to the Tennessee Eastman Corporation.

This department was extremely active in fire prevention work and in presenting exhibits and lectures to make personnel fire prevention conscious. Some measure of the remarkable job they did is reflected in the extremely small loss due to fire sustained from November 1943 to June 1945. This loss amounted to approximately 35 thousand dollars of which 10 thousand dollars was from total destruction of a Stone and Webster Engineering Corporation building, and over half of the remainder could more accurately be ascribed to electrical breakdowns (See App. D68, 69, & 70). From June, 1945 to 1 January 1947, there were 341 fires with a total damage of only $3069.85.

6-5. Emergency Plan. - Commensurate with District policy to have plans in case of disaster, an Emergency Plan was formulated for Y-12. This plan described in detail what ~~shall~~ should be done for organizing on the spot action in case of various emergencies or disasters (See App. D71).

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SECTION 7 - AUXILIARY SERVICES

7-1. <u>Medical</u> - A Tennessee Eastman Medical Department, operating in conjunction with the District Medical Service (See Book 1, Vol. 7), was formed in 1943, for the purpose of maintaining employees' health and controlling communicable disease among employees, and for the control of occupational disease hazards. Hospital service commenced in September 1943, with a staff of 3 in a temporary building. As activity increased in the Y-12 area, the medical facilities were enlarged accordingly, the department gradually broadening the scope of their services and moving to permanent facilities in a new building during July 1944. Inspections of the Y-12 Area, particularly in the cafeterias, and inspections of housing facilities assigned to TEC personnel were made in cooperation with the District Medical Service. Inoculations were given to those desiring them, pre-employment examinations were conducted, and day and night medical service was provided for the employees (See App. C7). Surveys were made as to the hazards accompanying the use of the various chemical substances encountered in operation, and protective measures were devised to cope with them. By August 1945, the Tennessee Eastman Corporation Medical Department was employing 121 persons, and seeing approximately 24 thousand patients per month (See App. D72 & 73).

The Medical Department reached its peak employment with 123 persons in September 1945 and was seeing approximately 23 thousand patients per month. At the end of December 1946, the number of employees had dropped to 67 persons and the department ~~and~~ was seeing approximately 6000 patients per month.

7-2. <u>Employee Safety</u> -

a. <u>General</u> - Operation of Y-12, besides being subject to the ordinary industrial hazards which are present in all large commercial plants, gave rise to very special occupational problems.

The first manufacturing activity was carried out while construction was still in progress, offering many complications which would not have occurred in the normal operation of an industrial installation. To some degree, this condition existed all during operation, since changes were made continuously to improve quality and quantity of production.

b. Special Hazards. - The materials handled offered some particularly trying problems, since uranium is toxic as a chemical substance, and is radioactive as well. As previously explained (See Par. 4-7) meticulous care was exercised to keep large quantities of enhanced material from being accumulated in one place. Some of the by-products and raw materials likewise were extremely difficult to handle. The Liquid Phase process for converting orange oxide (UO_3) to grey-green salt (UCl_4), for instance, was carried out under high temperature and pressure, with phosgene, (a lung irritant considered to be a very efficacious war gas) and carbon monoxide as by-products. Any leak in the processing equipment, consequently, had a tendency to fill the process rooms with these two very toxic gases, in addition to vapors of carbon tetrachloride, which was a raw material in the reaction and is extremely nasty to inhale. Large quantities of liquid nitrogen were used in the operation of the racetracks and sublimation stills, the handling of which was hazardous because of its very low temperature (-196°C). Huge amounts of electricity were used throughout the process; each cubicle, of which there were 96 for each Alpha track and 36 for each Beta track, consumed about as much electricity as Radio station WJZ in New York (rated at 50 KW), some of it being at much higher voltage, however (See App. B2).

c. Safety Measures. - As a consequence, every effort was bent towards providing safe operating procedure and surroundings for the personnel. Gear guards, dosimeters and radiation monitor alarms, barriers near high tension electrical equipment, gas detectors and various other mechanical protections were provided, in addition to safety goggles, gas masks, protective clothing, gloves, safety shoes, etc. In conjunction with the District Safety Organization, both a USED Safety Section and a Tennessee Eastman Safety Section were formed. Their task was to inspect installations and advise supervision on safety procedures, as well as carry out an active campaign to make personnel safety conscious. The results obtained illustrate how successful their efforts were; cumulative frequency rate (number of disabling injuries per 1,000,000 man hours worked) having dropped from more than 8 to less than 7 from January 1944 to July 1945. The frequency rate was .8 as of 16 December 1946. A chart showing the record of severity and frequency will be found in Appendix A21. This shows the achievement in safety established at Y-12, when compared to other industries (See App. D74).

d. Fatalities - In spite of all the precautions taken and the care exercised, serious accidents were bound to occur. From the start of operations through December 1946, there had been eight fatal accidents in plant operations. One of these fatalities was an Army enlisted man assigned to TEC, who was electrocuted, and the other seven were civilian employees of whom four were electrocuted, one was gassed, one was burned and one was killed by a fall. All accidents, whether severe or not, were thoroughly investigated, and every possible effort was made to prevent their recurrence (See App. D75).

7-3. Facilities -

a. General - The almost overwhelming small details which beset the operations staff of Y-12 nearly matched in magnitude the immediate problem of turning out concentrated U-235. The sudden influx of a large number of operating personnel seriously overtaxed all the facilities: transportation, housing, etc.

b. Transportation - Transportation was one of the great early problems; transportation had to be provided on the CEW area; also, to surrounding communities for those who had not been provided with housing. The number of vehicles used quickly increased, from 72 in October 1943, to 222 in December. This service continued to increase until February 1944, when the CEW Bus Authority took over some of the off-area lines. This trend continued until all the transportation except that within Y-12 proper was taken over by the CEW Bus Authority. To alleviate the transportation difficulties by utilizing privately owned vehicles, a subsidized Share-The-Ride Plan was instituted, whereby TEC employees purchased, for $2.00 per week, tickets valid for home to work transportation in their own or other employees' automobiles. This usually was reimbursed to TEC by the Government (See App. C5) (See App. D76) and Book I Vol. 12)

c. Housing - Housing facilities at the beginning of operations were extremely limited and provided an additional problem to obtain personnel (See Book 1, Vol. 12). To facilitate procurement of personnel and to alleviate hardship and expenses for the employees of maintaining residences in Oak Ridge and for their families elsewhere, until adequate housing should become available in Oak Ridge, a system of living allowances was instituted and became effective 1 February 1944, and continued until 25 April 1945, when it was rescinded except for outstanding commitments made prior to the inauguration of the general practice. An assignment system based on type and importance of job, size of family and location of permanent home for allocating houses and dormitory space was instituted in December 1943, by the District Engineer, to distribute housing in the most efficient possible manner (See App. D77) (See Book I, Vol. 12, Central Facilities). On 18 June 1943, the first group of houses were allocated to be taken over on 2 August 1943. Housing continued to be a serious problem throughout 1944 and 1945.

d. Cafeterias - Although eating facilities on CEW Area were provided for off-duty hours, cafeterias and canteens had to be provided at Y-12 for on-the-job meals. Consequently, cafeterias and canteens were included in the plant design. The first hot meal was served at Y-12 in July 1943, in the canteens operated temporarily (before cafeterias could be provided) by the TEC Corporation. As the need for additional facilities increased, more canteens and cafeterias were erected. These establishments were rigidly inspected by the Medical Department, and were kept clean and sanitary at all times. The service grew until the 17 servings on the first day had risen to over 700 thousand food servings in August 1945; over 100 thousand other sales of confections and cigarettes were made in that month (See App. D78 and 86).

e. Laundry - Laundry service was inaugurated on 1 August 1943, to provide cleaning for the special plant uniforms supplied to operating personnel. A completely equipped laundry was operated, and, in August 1945, was processing almost 300 thousand pieces per month (See App. D79).

f. Water Supply. - Several types of water were needed on the Y-12 Area (See Vol. 3, Design). Besides the raw water, which could be obtained directly from the Clinch River when it was not turbid, there was a treated water supply. This in turn was used to provide the raw material for deionized water (water treated to prevent scaling in pipes), distilled water, and double distilled water for more delicate operations where impurities could not be tolerated. Very large amounts of water were used, the quantities, in August 1945, amounting to almost two million gallons of raw

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water and over six million gallons of treated water per day. To decrease the amounts of specially treated waters used for cooling purposes, these were recycled through cooling towers (See App. D80 and 81).

Water was obtained from regular Oak Ridge supply in quantities up to 200,000,000 gallons per month. To meet additional demands without requiring an addition to the water plant, arrangements were made to use Raw Water diverted from the line supplying the water treatment plant from the river. Raw Water had to have special treatment and a continual check kept on it, to either discontinue use for short periods or change to treated water if the turbidity reached a critical point. Raw water was used largely in cooling towers and at other points where large quantities were required and use could be made without danger of contamination of drinking water.

g. Power. - Very large amounts of electricity were needed for the operation of Y-12, most of it supplying the racetracks, but a substantial amount was used for chemical operations and lighting. This power, which was obtained from the Tennessee Valley Authority, reached a high of about 153 million kilowatt hours in July 1945. The cost of power consumed by the Electromagnetic plant as of 31 December 1946 was $9,848,695 (See App. B2).

h. General Utilities. - General Utilities Division was responsible for the operation of all service facilities. The volume and exacting requirements were in many cases beyond those of the usual industries. The major activities are briefly described below:

Steam is generated at two boiler plants at 175 pounds per sq. inch pressure and 100°F superheat or a temperature of about 470°F. Steam was used throughout the plant for many purposes aside from heating, such as air conditioning, water heating, process purposes.

In operating areas a large quantity of steam is used for deaerating distilled and demineralized water. Alpha Process buildings 9201-1 and 9201-2 are equipped with steam jet refrigeration, part of a system that supplies cooled air to the tracks. 9201-2 and 9201-3 use mechanical refrigeration. In stand-by buildings heat is required to maintain a temperature that will not permit the condensation of moisture on massive equipment. In summer, when the entire Electromagnetic plant was in operation about 4000 tons of coal were used per month and in winter 8000 to 9000 tons.

Compressed air is supplied throughout the area. The original installation was made with small units in each building. The maintenance on these units was excessive and capacity inadequate. A 1700 cu. ft. per minute rotary compressor was transferred from TVA and installed in 9404-2. Another unit used in construction was installed in 9404-9. The controls on all these units were set so that any drop in air pressure would automatically start the original small units as required.

Air condition is maintained at uniform temperature and humidity in buildings 9206, 9212, 9733-1, 9733-4, 9203, and 9211. Certain rooms are maintained at a very low humidity by means of special equipment. Ventilation of varying degrees was supplied some buildings for comfort of employees; others for removal of toxic gases, at rates up to 80 changes of air per hour. Air taken from outside into operating areas was passed through air filters. At maximum operation it was necessary to replace

8000 air mats per month. A sepcial crew was set up to handle this work. The mats were taken to a building equipped for removing dirty filtering medium and rethreading with new filter cloth. Warm dry air was supplied to certain equipment in many buildings through equipment known as Electro-Driers.

Liquid Nitrogen (Code 714) was used throughout the area at a rate of about 1,000,000 gallons per month. This was received in tank cars unloaded either in large storage tanks on the roof of track buildings or at central distribution (9727) from where it was transferred from storage in dollies, and distributed, often to other operations of C.E.W.

Dry Ice (Code 753) was used throughout the area at the rate of about 3,000,000 lbs. per month. Dry Ice was received in refrigerator cars at 9727. Here an operation was set up to saw the 50 lb. blocks into usable sizes, ~~and~~ which were distributed to the entire area. Saws and handling equipment were devised and modified to meet temperatures involved.

Distilled water was made originally from condensed steam. Later because of the large quantities required, Demineralized Water was substitited and used at a rate of about 650,000 gallons per month. This water was used largely for cooling electrical circuits of high voltage, hence the dielectric had to be maintained at highest possible level. In addition a uniform pressure at a uniform temperature had to be maintained regardless of outside air conditions. Water used in certain equipment had to be maintained within narrow PH limits in order to prevent corrosion and clogging small passages.

Electric Transformer type oil in excess of 1,000,000 gallons is required to fill most of the equipment and is used chiefly as a coolant for the electromagnets. The oil was used primarily for carrying away heat. To accomplish this, the oil was circulated by means of pumps through heat exchangers connected with water cooling towers. Some idea of oil capacity handled is given by the size of the main oil headers which are 16 inches in diameter for each building. A uniform temperature and pressure of oil to tracks had to be maintained. Any deviation had a tendency to create unpredictable electric grounds. To give greater assurance against electric grounds the dielectric of the oil was maintained at 35 KV. When it is considered that 25 KV is the highest dielectric value in oils that can be purchased under guarantee, and utility practice is not to change oil in electric equipment until the dielectric has reached a much lower value, this gives some indication of the fine operation required. In addition to regular filters in each system and at each coil on every track, to help maintain clean oil as long as possible, two oil purifying buildings were built, fully equipped, together with a laboratory for checking continually all oil in all buildings.

Twenty-two separate cooling towers, each made up of many cells, were installed and used to maintain proper temperatures of the oil through use of the heat exchangers and ~~of~~ the ~~calculating~~ circulating water. Many of the towers served three or four separate ~~functions~~ systems.

Refrigeration was required in all Beta Buildings and many Chemical Buildings as a part of the Electromagnetic process. Additional refrigeration was provided in part in air conditioning systems for all cafeterias and kitchens. Meat and fish storage (Bldg. 9771) was supplied with refrigeration. Service and operation of hundreds of water coolers for drinking purposes were maintained.

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Other materials such as Butane, Propane, Oxygen, Ammonia, etc., generally used in plant operations, were received and distributed either through system pipe lines or in containers.

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SECTION 8 - ORGANIZATION

8-1. Y-12 Operations Office.

a. General. - The Y-12 Operations Office was organized along the same administrative lines as that of the operating contractor, and its function was to provide the means for keeping the District Engineer in direct contact with the Y-12 plant (See App. D95). It represented higher authority in all phases of administration, production and engineering matters in the plant area. Heading Y-12 Operations was the Y-12 Operations Officer, who corresponded to the TEC Assistant Works Managers for Administration, Engineering and Maintenance, and Production. The Y-12 Operations Officer was also Y-12 Unit Chief, and in this capacity acted as technical adviser to the District Engineer.

b. Key Personnel. - Lt. Col. W. E. Kelley was Y-12 Unit Chief and Operations Officer from the start of the job to September 1944, at which time he was succeeded by Lt. Col. J. R. Ruhoff, who remained Unit Chief and Operations Officer until he in turn was succeeded on 9 November 1945 by Colonel G. J. Forney. Colonel Forney continued as Unit Chief and Operations Officer until the control of the Manhattan District was taken over by the Atomic Energy Commission on 1 January 1947.

Major George W. Russell, Executive Officer, came to Y-12 from the Madison Square Area in New York City on 27 November 1944, and was Executive Officer until March 1946. Frank Streit, who became Executive

Officer in March 1946, remained on duty until 30 August 1946, when he was temporarily succeeded by Major Thomas Glover, who was transferred from the Y-12 Area late in 1946.

Major Virgil P. Cline, Special Legal Assistant, acting as liaison between the Operations Officer and the District Office on legal matters.

Captain Lloyd R. Zumwalt, Technical Adviser, assisted as Technical Adviser to the Operations Officer from 12 August 1943 to 17 May 1946 on matters of production and changes in operating procedure.

Lt. Col. Mark C. Fox, in charge of Engineering, Construction and Supply Division was assigned to Y-12 from the Thermal Diffusion Plant, in April 1945 and continued on this assignment until 24 May 1946.

Major Donald C. Moore was in charge of Administration and Contract Management from 25 January 1943 to 17 June 1946.

Major Canfield Hadlock came to Y-12 from Madison Square Area in New York City to head the Production Division. Major Hadlock served in this capacity until 18 March 1946.

Mr. John C. Robinson who had been the Chemical Engineer in charge of phosphate chemical manufacture and sales for Phosphate Mining Company of New York and Florida was employed as Chief of the Production Division on 18 March 1946. This title was discontinued as of 25 November 1946, when Mr. Robinson became the Executive Officer of Y-12 Area. During the absence of the Chief of Y-12 Operations Division, Mr. Robinson acted as chief and as such, represented the District on all phases of administration, production and engineering matters, and performed liaison work between the operating contractor and the District Engineer. This liaison was maintained as of 1 January 1947, through ~~six~~ seven branches each headed by a Branch Chief. These branches are listed as follows: Engineering Service and Maintenance, Contract, Contract Management & Supply, Production Control, Special Hazards & Accountability, Process Improvement & Research, Chemical Production & Research.

S-2. Clinton Engineer Works - Tennessee Eastman Corporation

a. General. - The Tennessee Eastman organization at Y-12 was organized with a Works Manager in charge of the installation. He in turn delegated authority to Assistant Works Managers in charge of Production, Engineering and Maintenance, and Administration. The Assistant Works Manager for Production was in charge of chemical and racetrack production as well as chemical and process development. The Assistant Works Manager for Engineering and Maintenance was responsible for facilities as well as all phases of engineering and maintenance work. The Assistant Works Manager for Administration had charge of all administrative duties, including procurement (See Par. 3-11) and recruiting of personnel (See Par. 3-6a). The organization is shown in Appendix A-1.

b. Key Personnel - The key personnel of CEW-TEC was as follows:

Dr. Frederick R. Conklin, Works Manager, who has held this post since the beginning of TEC management of Y-12, was appointed on 1 March 1943. He had previously been General Superintendent at Tennessee Eastman's Holston Ordnance Works in Kingsport, Tennessee.

Dr. James G. McNally, formerly Superintendent of the Kodak Research Laboratories in Rochester, was Assistant Works Manager in charge of production; he remained in charge from the time of his assignment in April '43 until September 1945, when Tennessee Eastman put him in charge of its research program at Kingsport, Tennessee. He was not replaced as Assistant Works Manager.

Mr. James Ellis was Assistant Works Manager in charge of Engineering from 1 March 1943 until 1 February 1945, at which time he was transferred to other duties within the Tennessee Eastman Corporation, at Kingsport, Tennessee. His duties were absorbed by others and he was not replaced.

Mr. Lee G. Warren, Assistant Works Manager in charge of Engineering and Maintenance, was hired by Tennessee Eastman from the Tennessee Valley Authority in July 1943. He left the project 4 January 1946 and was not replaced.

Mr. Edgar P. Baker, Assistant Works Manager in charge of Administration, became associated with Tennessee Eastman in October 1944. He left the company and project 2 January 1946.

Mr. W. R. Chambers, Manager of Engineering, whose previous experience included 9 years on the staff of TVA, prior to which he had broad experience in industry as Chief Engineer in various Steel Companies, joined T.E.C. on 13 March 1943. While on TVA staff he had furnished much confidential information to the Manhattan District and to Stone and Webster. As Manager of Engineering he maintained small offices in Berkeley and Boston to obtain information from the design contractor and to advise on designs. Much of early plant operation was under his general supervision.

Mr. David C. Hull, Chemical Production Manager, served in that capacity from October 1944 to the present time, 1 January 1947.

Dr. John C. Hecker, Production Manager in charge of racetrack operation, was officially transferred to Y-12 in April 1943, from Distillation Products, Inc. He is still with the project as of 1 January 1947.

Dr. Clarence E. Larson, who came to Y-12 in 1943 from employment by the Office of Scientific Research and Development, was Director in charge of the Chemical Development.

Dr. Harvard L. Hull, Director of Process Improvement, was hired by Tennessee Eastman in June 1943; he had been chief engineer for the York Safe and Lock Company. He continued as Director of Process Improvement until 31 August 1946 when he went to Argonne Laboratory near Chicago.

Mr. Ronald L. Flanary was Comptroller for CEW-TEC; he had been at the Holston Ordnance Works before his transfer, first to Berkeley, in January 1943, and subsequently to Y-12. He was still with the project as of 31 December 1946.

8-3. Acknowledgements. - Acknowledgement for their help in making possible the achievements of the Y-12 Plant is made to:

The Tennessee Valley Authority, who besides supplying power for the project, gave of their time and effort to help survey and choose the site, as well as helping in the solution of various electrical problems; the United States Employment Service, who cooperated at all times to help recruit personnel for the plant; the United States Office of Education, who helped organize the training classes; the United States Bureau of Mines, who helped solve gas and ceramic problems; the United States Bureau of Standards, who cooperated on analytical problems; Selective Service, who cooperated with the District to keep trained personnel available; and Stone and Webster who designed and constructed the entire Y-12 Plant and cooperated in getting the Plant in operation.

[redacted]

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

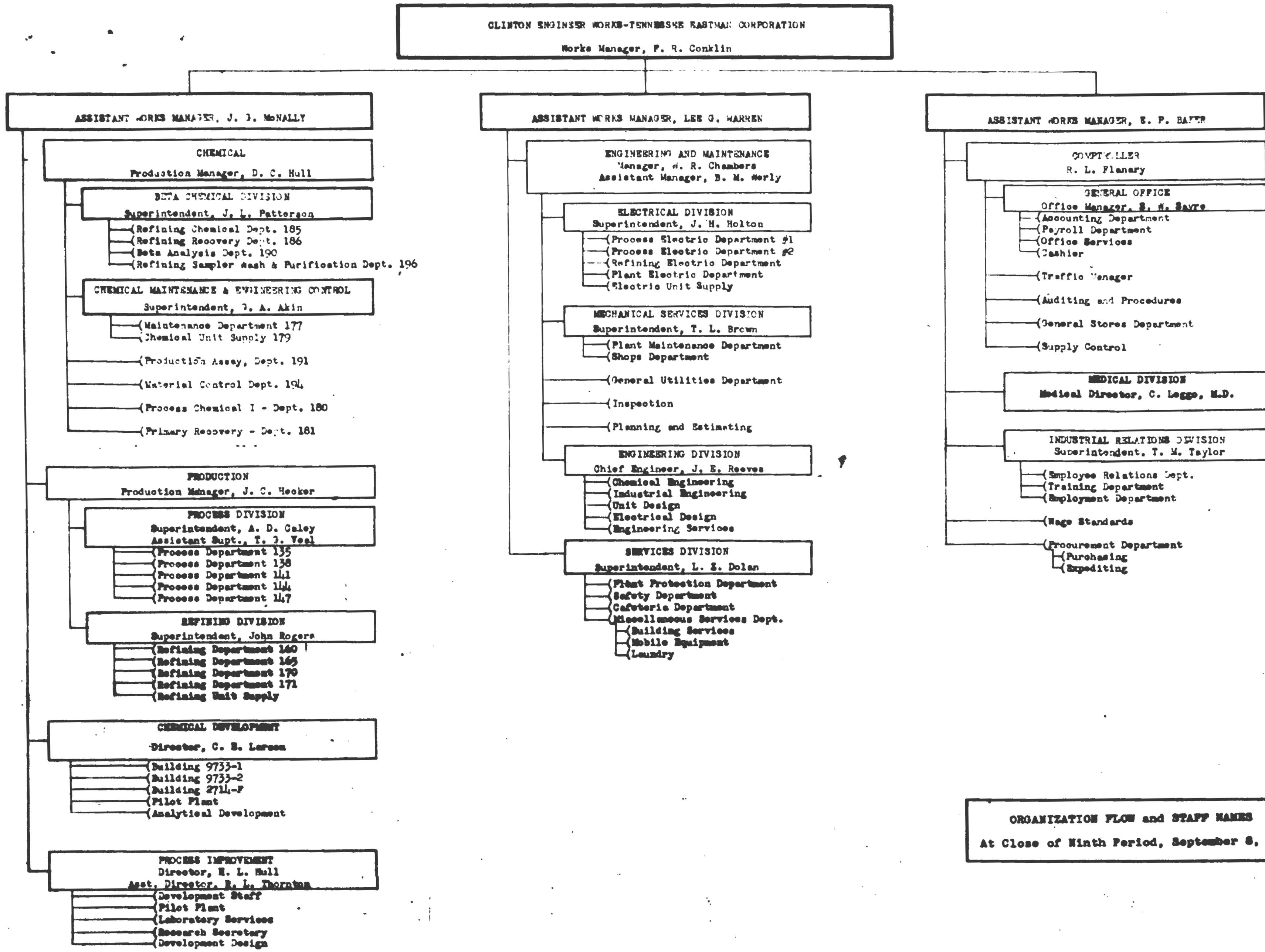
VOLUME 6 - OPERATION

APPENDIX "A"

CHARTS, GRAPHS AND TABULATIONS

[redacted]

No.	Description
A19	Status of Government Funds Advanced to CEW-TEC
A20	Status of Government Funds Advanced to CEW-TEC
A21	Accident Frequency and Severity Rates
A22	Wage Dividends for Y-12 Employees



ORGANIZATION FLOW and STAFF NAMES

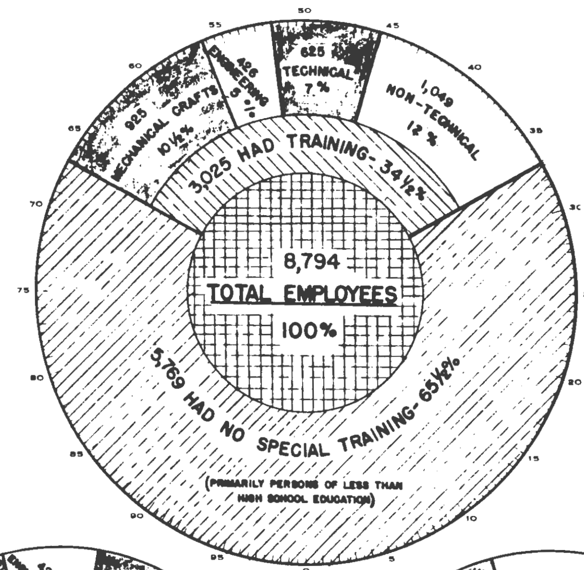
At Close of Ninth Period, September 8, 1945

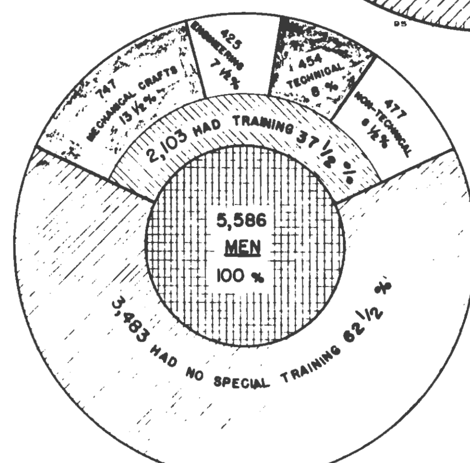
G.E.W.–T.E.C.

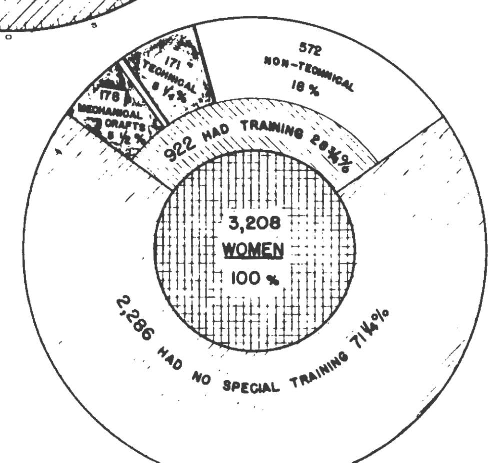
OCCUPATIONAL TRAINING STATUS AT TIME OF HIRE

Review of All Employees on Rolls Oct. 5, 1946

CLASSIFICATION	MEN NO.	MEN %	WOMEN NO.	WOMEN %	TOTAL NO.	TOTAL %
Mechanical Crafts						
Machine Shop	80	1.45	12	.37	92	1.05
Welder – Arc	39	.70	6	.19	45	.51
Welder – Acetylene	8	.14	2	.06	10	.11
Welder – Combination	16	.29	-	-	16	.18
Radio & Radar Mechanic	119	2.13	5	.16	124	1.41
Sheet Metal	38	.68	15	.47	53	.60
Drafting	37	.66	2	.06	39	.44
Inspection	2	.04	-	-	2	.02
Others – Not Classified	408	7.30	136	4.24	544	6.19
Total	747	13.37	178	5.55	925	10.51
Engineering						
Electrical Engineer	90	1.61	-	-	90	1.03
Mechanical	84	1.50	-	-	84	.96
Civil	37	.66	-	-	37	.42
Chemical	121	2.17	-	-	121	1.38
Mining	3	.05	-	-	3	.03
Industrial	2	.04	-	-	2	.02
Architectural	2	.04	-	-	2	.02
Aeronautical	3	.05	-	-	3	.03
Agricultural	6	.11	-	-	6	.07
Craft Engineer	50	.90	1	.03	51	.58
Others – Not Classified	27	.48	-	-	27	.31
Total	425	7.61	1	.03	426	4.85
Technical						
Chemistry	268	4.80	47	1.47	315	3.58
Physics	65	1.16	0	-	65	.74
Mathematics	52	.93	17	.53	69	.79
Metallurgy	1	.02	-	-	1	.01
Architecture	1	.02	-	-	1	.01
Home Economics	0	-	75	2.34	75	.85
Pre-Medical	16	.29	5	.16	21	.24
Others – Not Classified	51	.91	27	.84	78	.89
Total	454	8.13	171	5.34	625	7.11
Non-Technical						
Business Administration	30	.54	16	.50	46	.52
Statistics	1	.02	-	-	1	.01
Education	73	1.31	69	2.15	142	1.62
Law	16	.29	-	-	16	.18
Industrial Vocational	8	.14	-	-	8	.09
Auditing and Accounting	29	.52	6	.19	35	.40
Accounting	94	1.68	50	1.56	144	1.64
Secretarial Science	-	-	43	1.34	43	.49
Stenographic	10	.18	144	4.48	154	1.75
Typing	8	.14	65	2.03	73	.83
Clerical	38	.68	40	1.25	78	.89
Others – Not Classified	170	3.04	139	4.33	309	3.51
Total	477	8.54	572	17.83	1049	11.93
No Special Training	3483	62.35	2286	71.25	5769	65.60
Total Employees	5586	100%	3208	100%	8794	100%





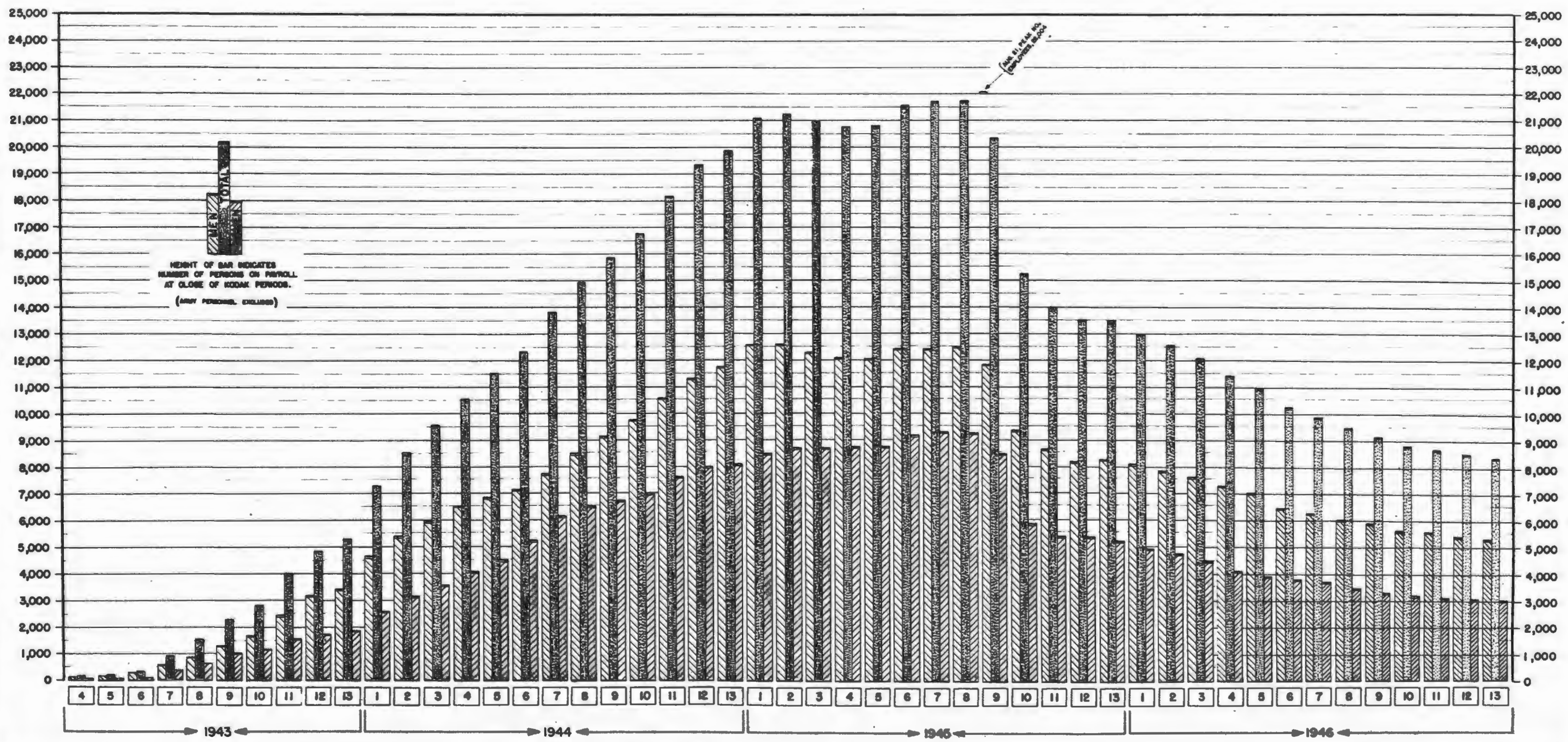


HS-148 (2ND REVISION)

[redacted]

G.E.W.–T.E.C.

NUMBER OF EMPLOYEES



ES-102

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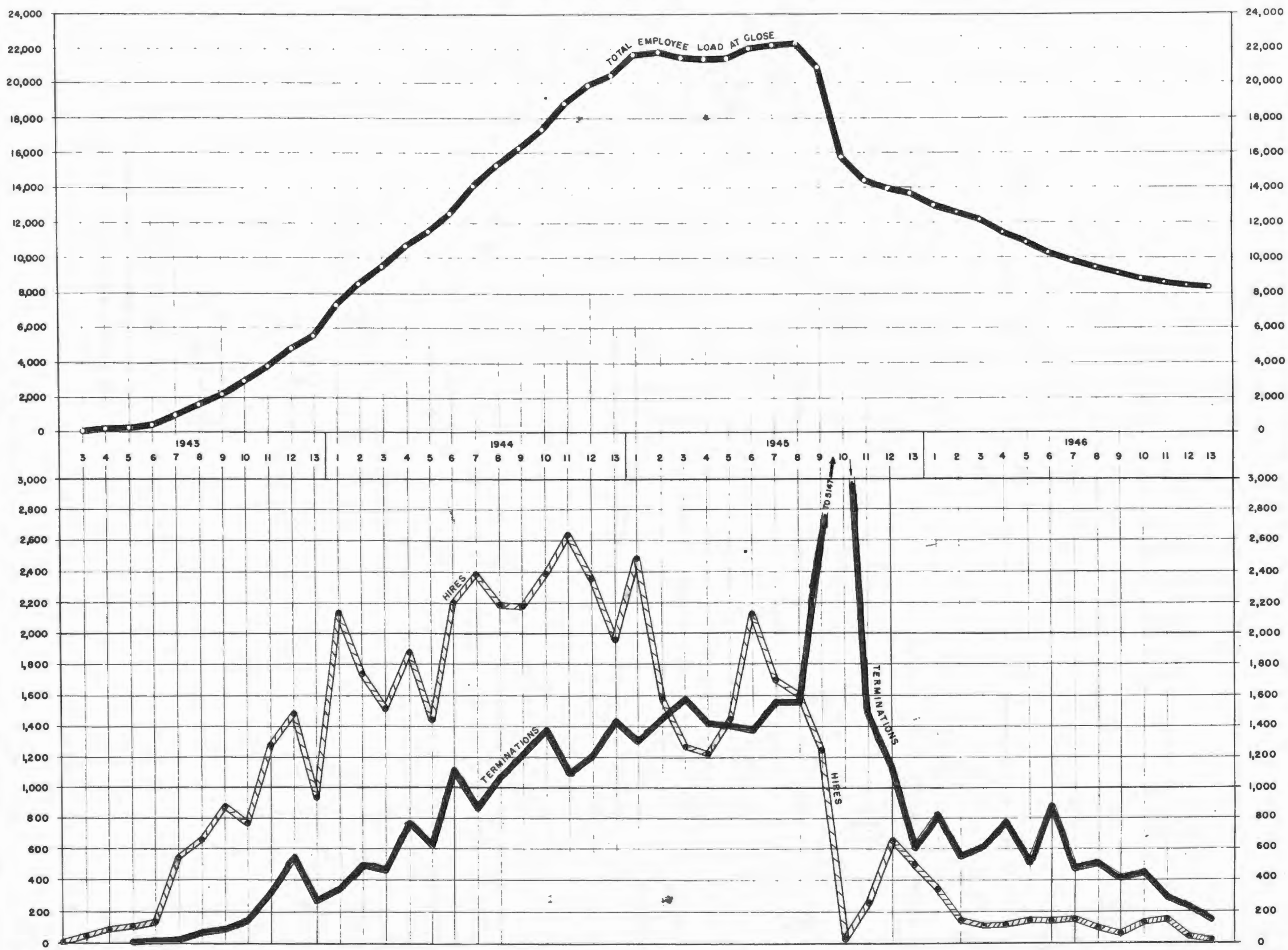
A

G.E.W.-T.E.C.

HIRES, TERMINATIONS AND EMPLOYEE LOAD

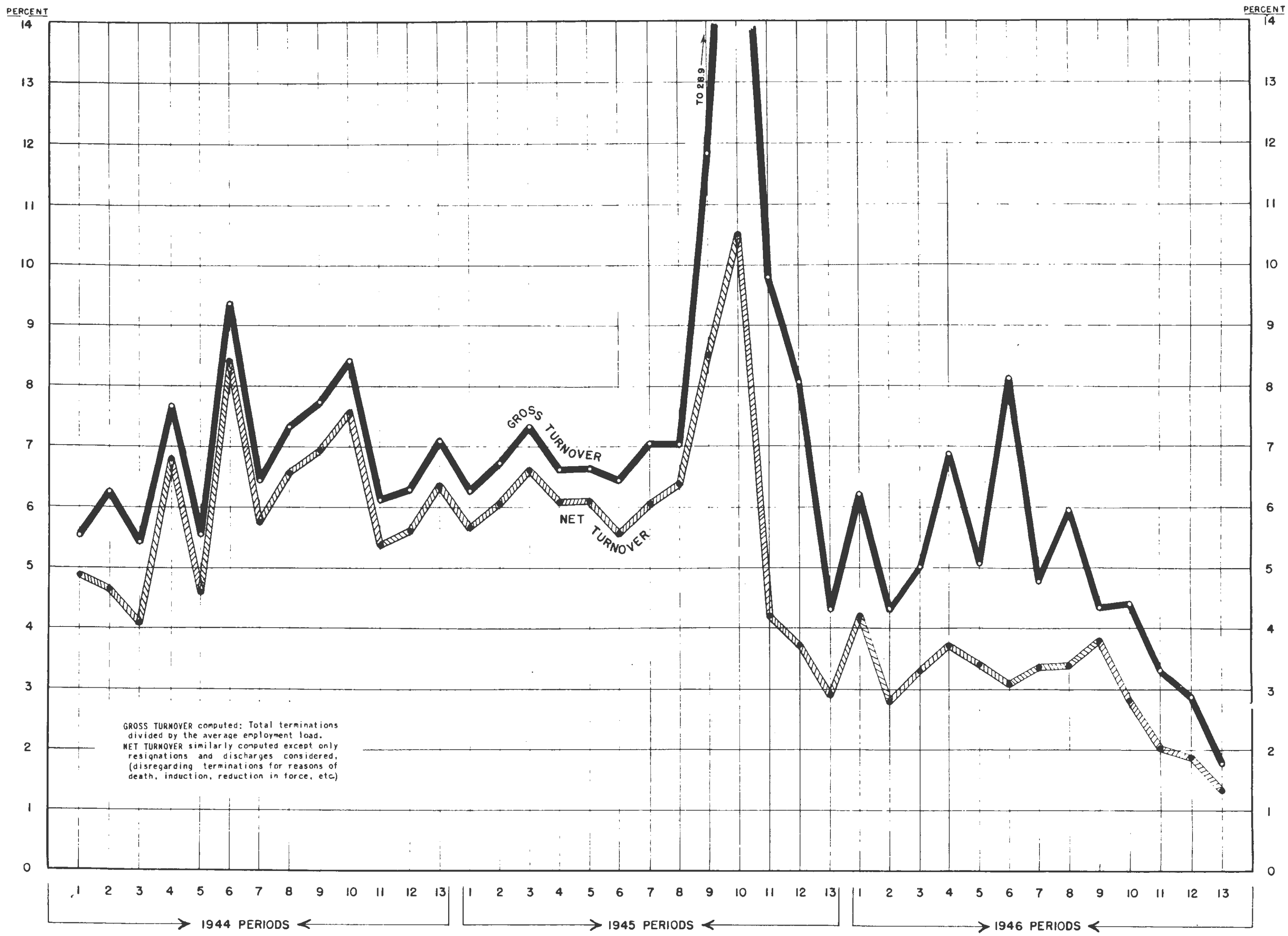


HS-137

[redacted]

C. E. W.—T. E. C.

EMPLOYEE TURNOVER PERCENTAGE



MS-130

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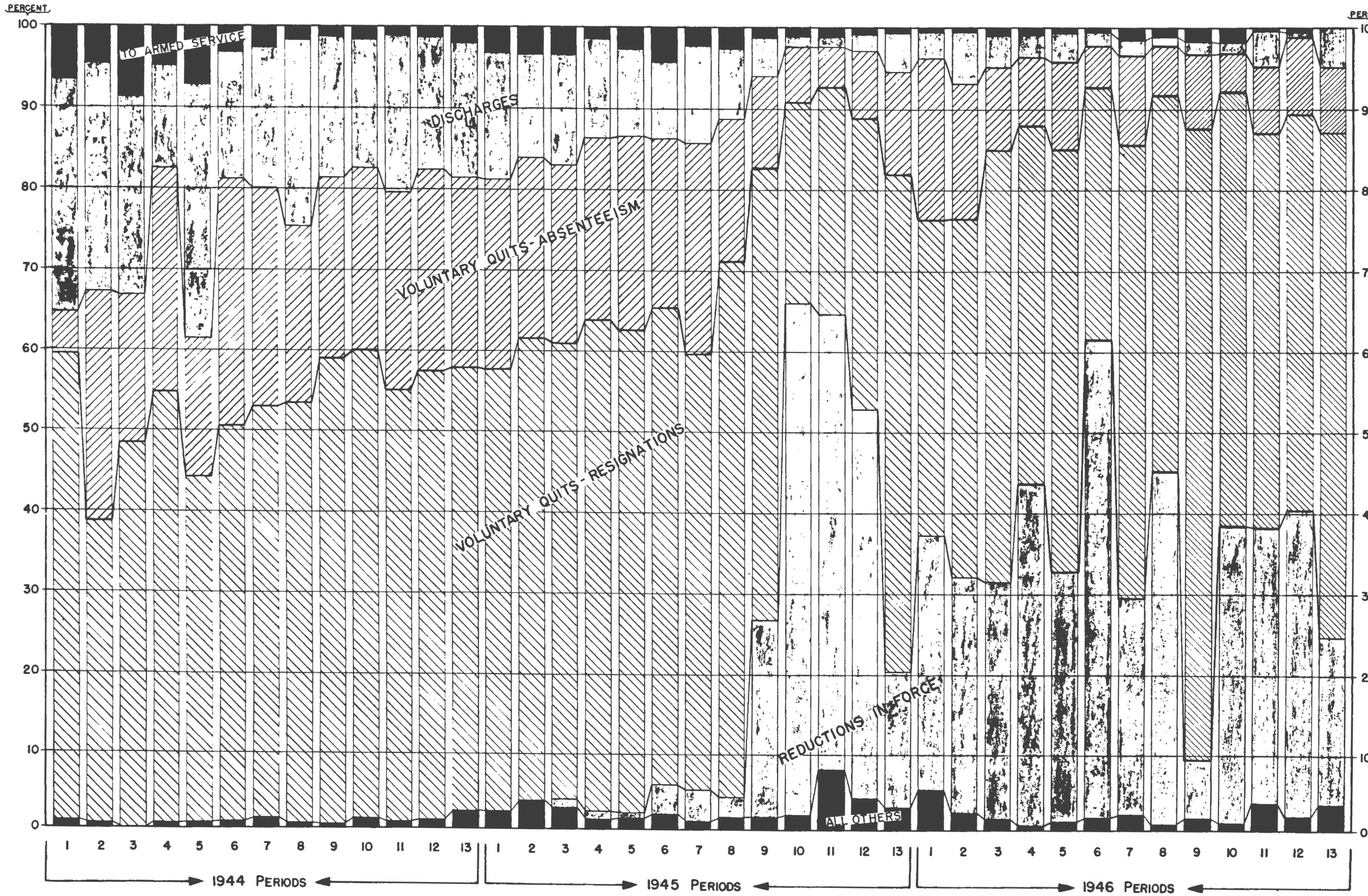
G.E.W.–T.E.C.

PERSONNEL TERMINATIONS BY PERCENTAGE DISTRIBUTION



HS-149

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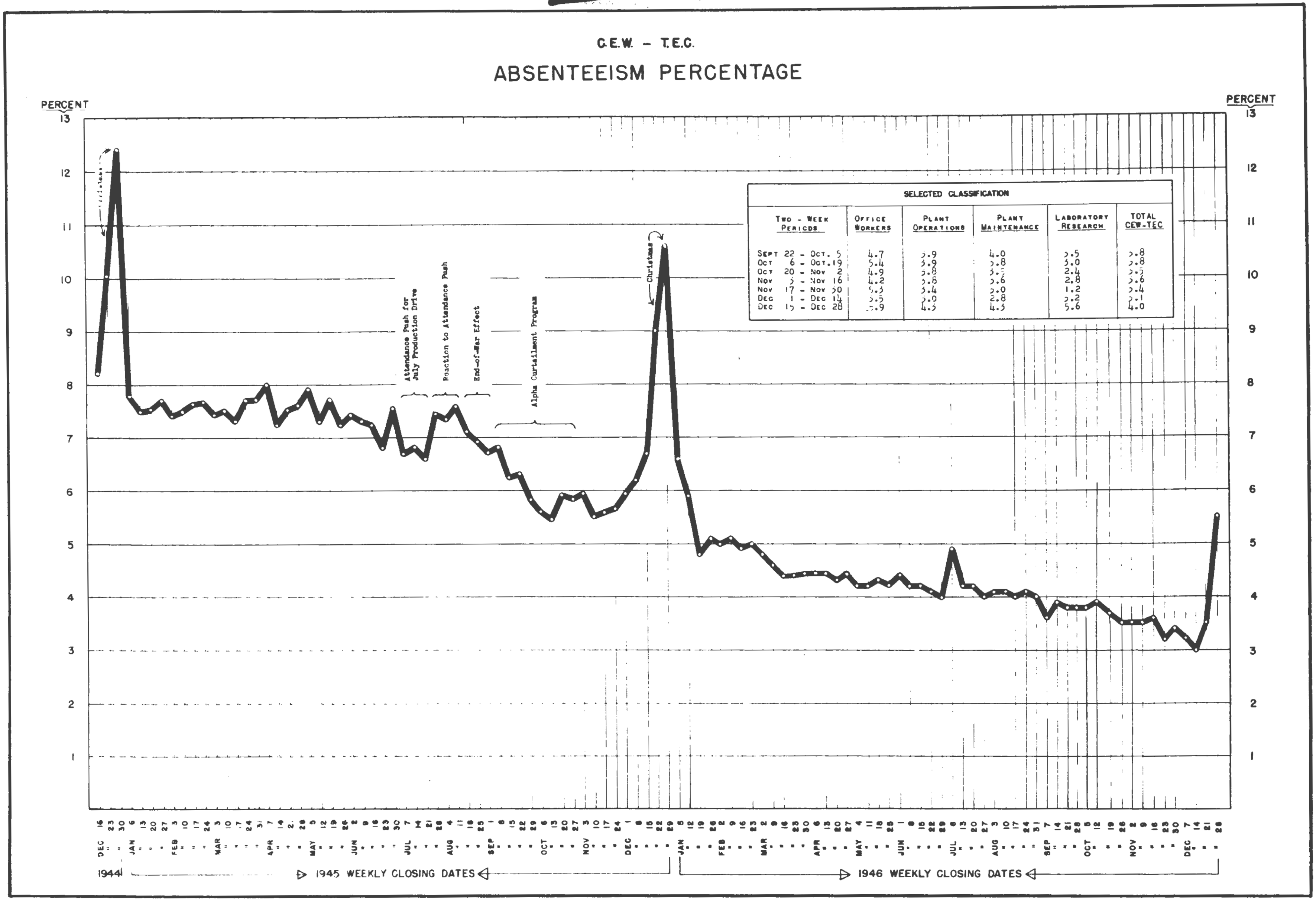

SELECTED CLASSIFICATION					
Two - Week Periods	Office Workers	Plant Operations	Plant Maintenance	Laboratory Research	Total CEW-TEC
Sept 22 - Oct. 5	4.7	3.9	4.0	3.5	3.8
Oct 6 - Oct. 19	5.4	3.9	3.8	3.0	3.8
Oct 20 - Nov 2	4.9	3.8	3.5	2.4	3.5
Nov 3 - Nov 16	4.2	3.8	3.6	2.8	3.6
Nov 17 - Nov 30	5.3	3.4	3.0	1.2	3.4
Dec 1 - Dec 14	3.5	3.0	2.8	3.2	3.1
Dec 15 - Dec 28	3.9	4.3	4.3	5.6	4.0

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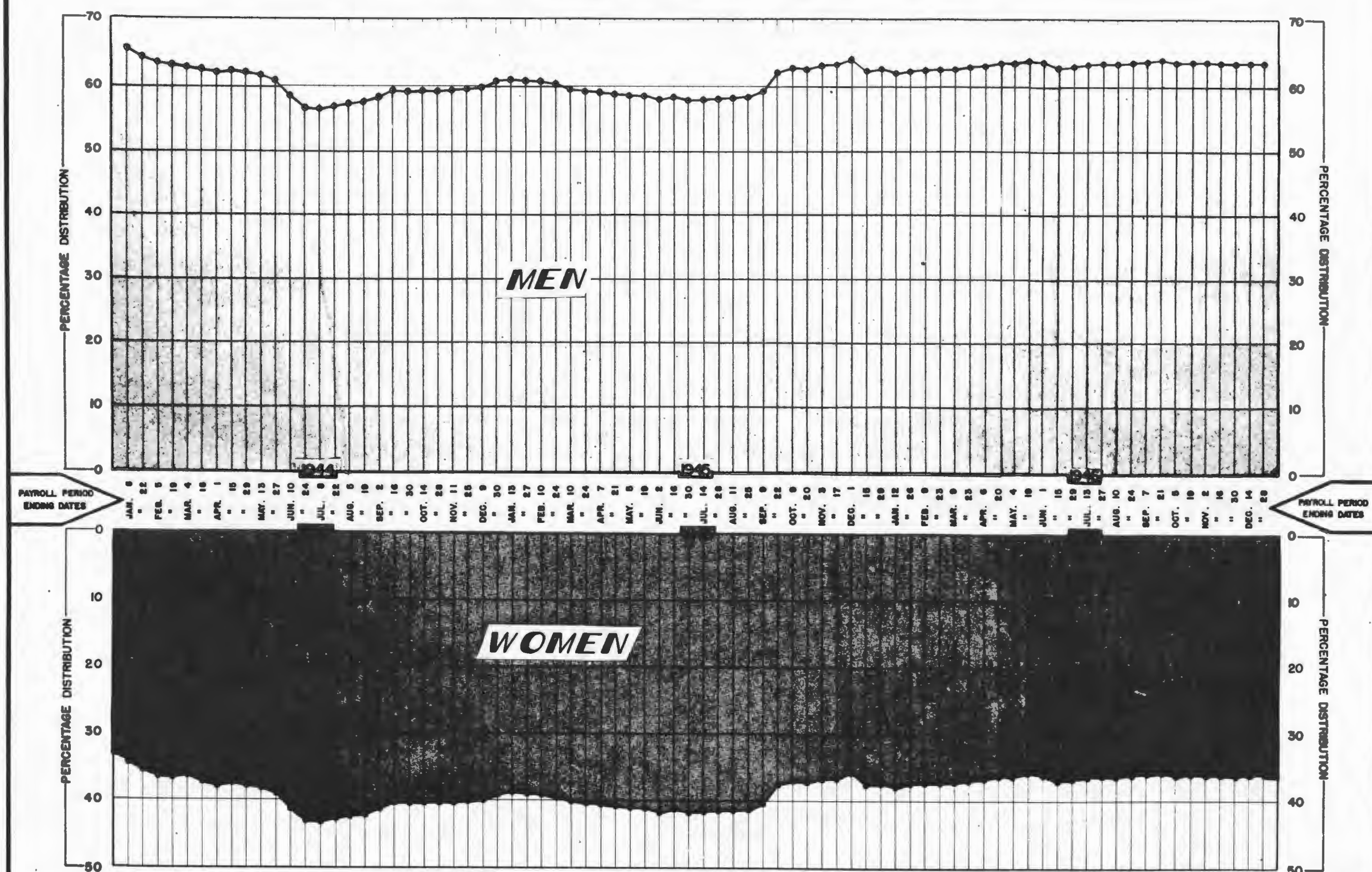
G.E.W.—T.E.C.

EMPLOYEE MALE-FEMALE PERCENTAGE DISTRIBUTION



HS-115

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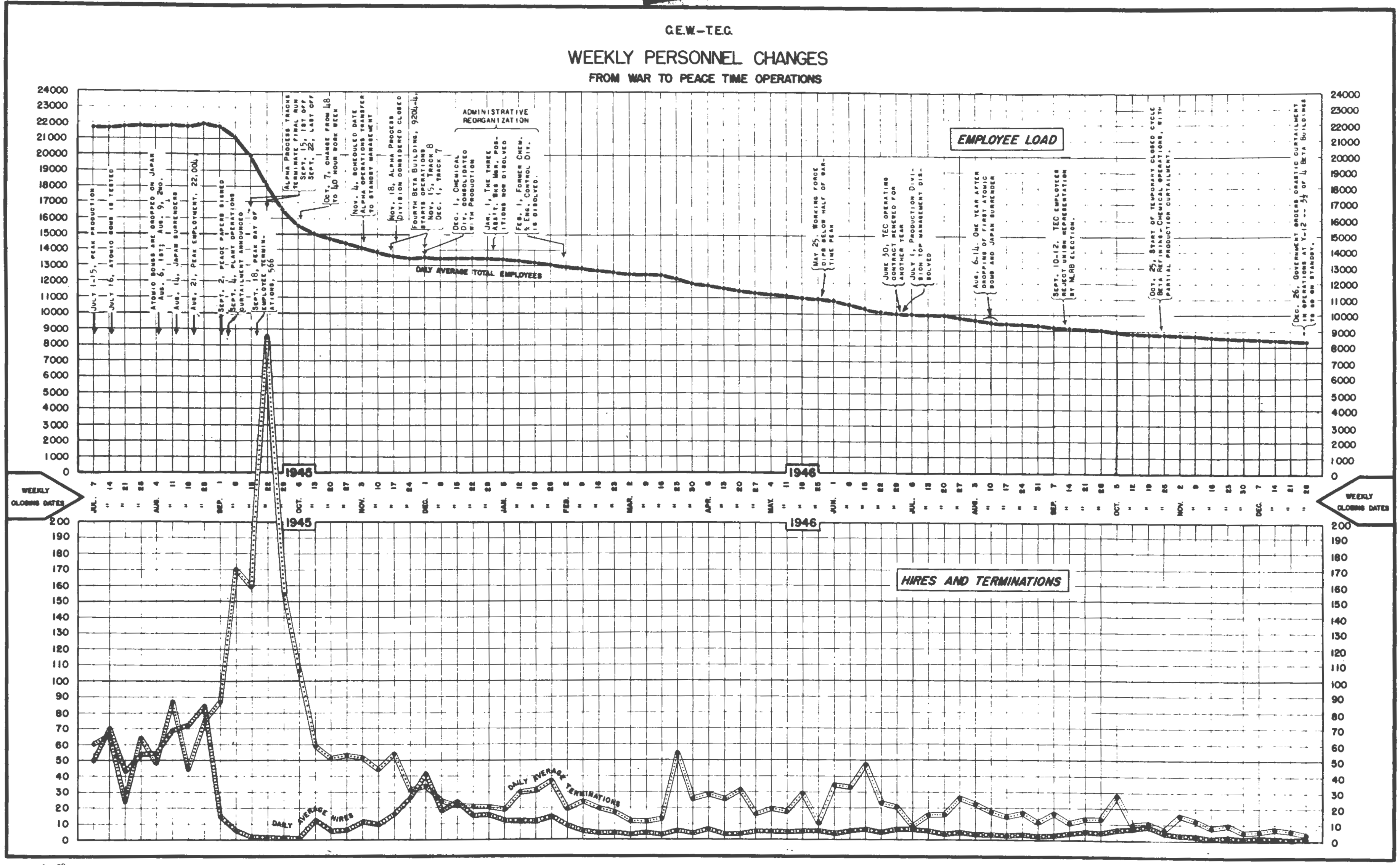


G.E.W.–T.E.C.
WEEKLY PERSONNEL CHANGES
FROM WAR TO PEACE TIME OPERATIONS
EMPLOYEE LOAD
DAILY AVERAGE TOTAL EMPLOYEES
HIRES AND TERMINATIONS
DAILY AVERAGE HIRES
DAILY AVERAGE TERMINATIONS
WEEKLY CLOSING DATES
1945
1946
ADMINISTRATIVE REORGANIZATION
JULY 1-15, PEAK PRODUCTION
JULY 16, ATOMIC BOMB IS TESTED
ATOMIC BOMBS ARE DROPPED ON JAPAN
AUG. 14, JAPAN SURRENDERS
AUG. 21, PEAK EMPLOYMENT, 22,004
SEPT. 2, PEACE PAPERS SIGNED
OCT. 7, CHANGE FROM 48 TO 40 HOUR WORK WEEK
NOV. 18, ALPHA PROCESS DIVISION CONSIDERED CLOSED
MAY 25, WORKING FORCE DIPS BELOW HALF OF WAR-TIME PEAK
JUNE 30, TEC OPERATING CONTRACT RENEWED FOR ANOTHER YEAR
JULY 1, PRODUCTION DIVISION TOP MANAGEMENT DISSOLVED
AUG. 6-14, ONE YEAR AFTER DROPPING OF FIRST ATOMIC BOMB AND JAPAN SURRENDER
SEPT. 10-12, TEC EMPLOYEES REJECT UNION REPRESENTATION BY NLRB ELECTION.

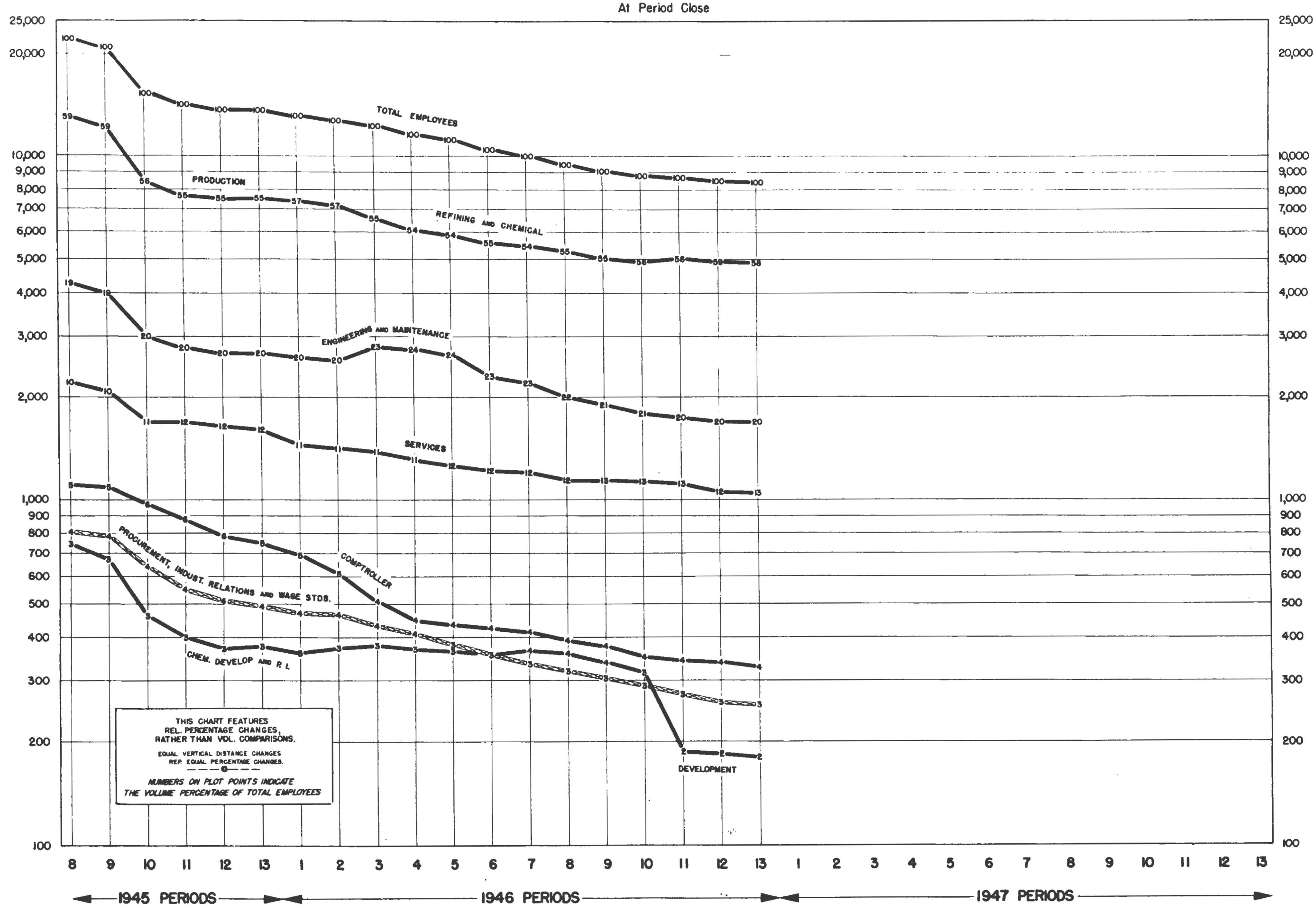
HS-126

A10

G.E.W.–T.E.C.

EMPLOYEE LOAD CHANGES WITH DEPARTMENTAL-GROUP COMPARISONS

At Period Close



HS-151 (Revised)

A11

SUMMARY ANALYSIS OF PLANT AND NLO-SPECIAL PAYROLLS

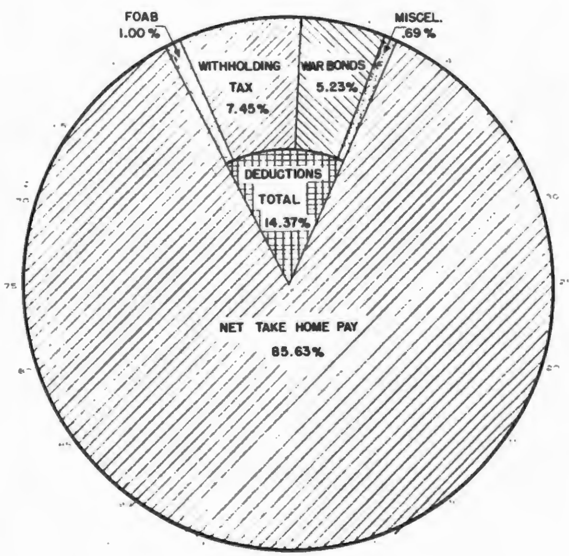
(COVERING APPROX 99. % OF C.E.W.-T.E.C. EMPLOYEES)

TWO WEEKS PAY PERIOD ENDING DEC. 28, 1946

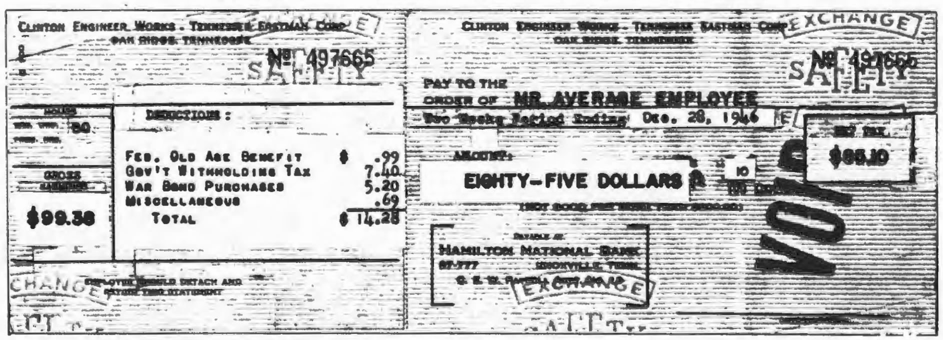
PAYROLL SUMMARY

	PLANT	NLO-SPECIAL	TOTAL
NUMBER EMPLOYEES	6,192	2,094	8,286
GROSS EARNINGS	$553,542.34	$269,909.32	$823,451.66
DEDUCTIONS:			
F.O.A.B.	$ 5,536.85	$ 2,626.73	$ 8,163.58
Gov't Tax	34,114.40	27,240.70	61,355.11
War Bonds	25,815.76	17,244.50	43,060.26
Miscel	3,766.00	1,964.03	5,730.03
Total	$ 69,233.01	$ 49,075.96	$118,308.97
NET PAY AMOUNT	$484,309.33	$220,833.36	$705,142.69

PERCENTAGE DISTRIBUTION OF GROSS EARNINGS



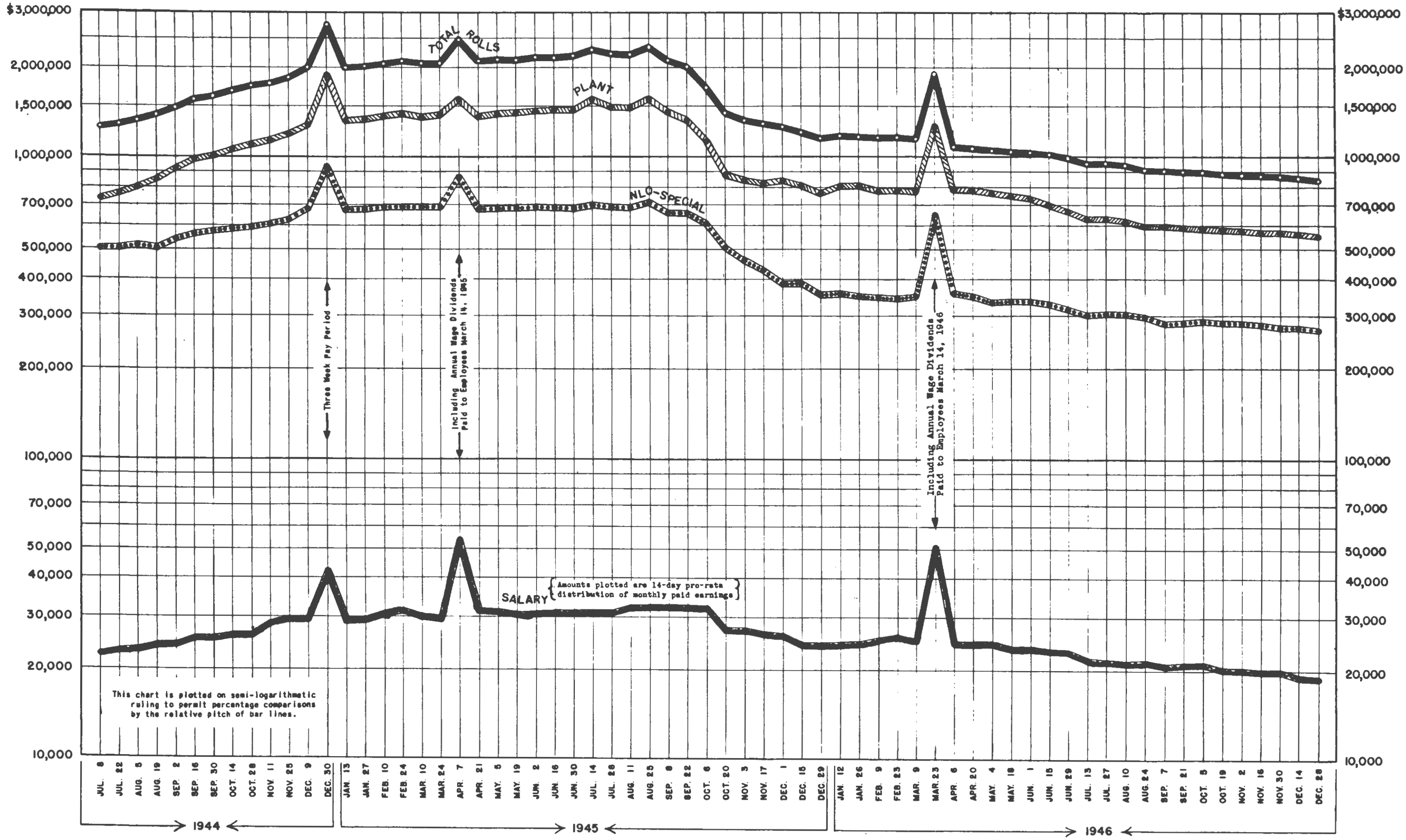
DOLLAR DISTRIBUTION - ARITHMETIC AVERAGE PAY CHECK



G.E.W.-T.E.C.

GROSS PAYROLL DOLLAR AMOUNTS

BY TWO WEEK PAY PERIODS



ES-121

CEW – TEC

AVERAGE WEEKLY GROSS EARNINGS PER EMPLOYEE

BY PAYROLL PERIODS

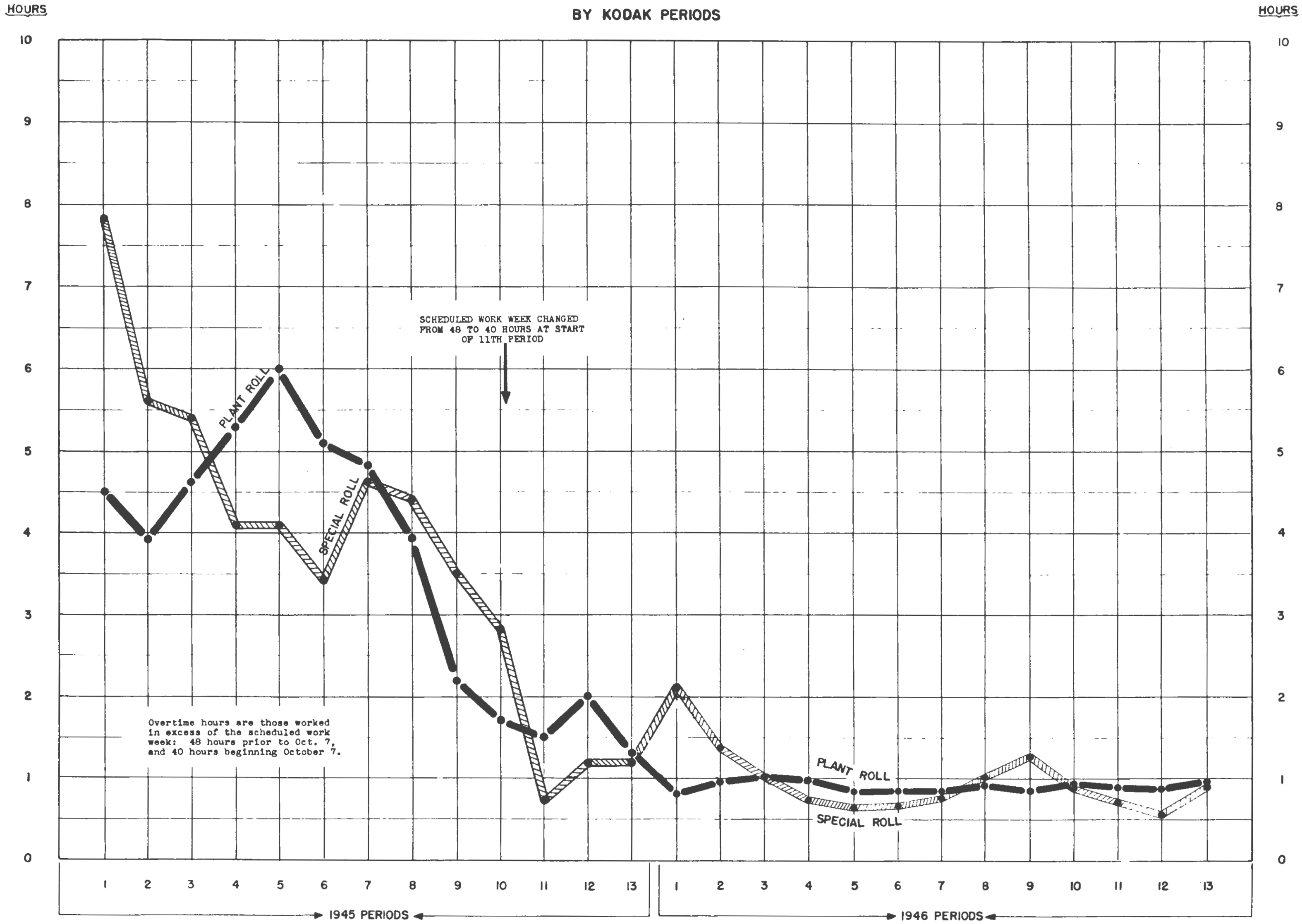
BS-130

[redacted]

CEW — TEC

AVERAGE OVERTIME HOURS PER EMPLOYEE

BY KODAK PERIODS



HS-140

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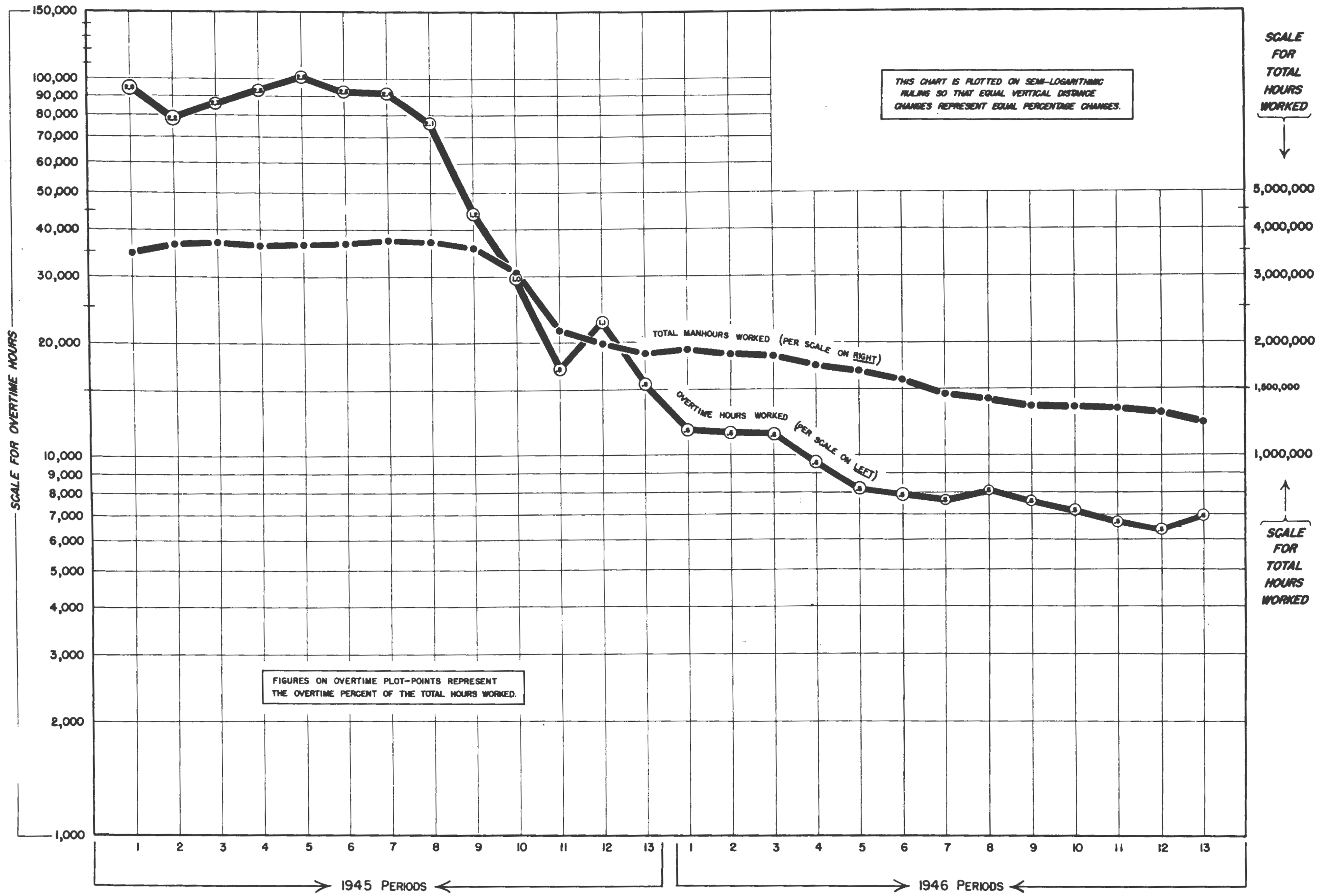
G.E.W.—T.E.C.

MANHOURS TOTAL WORK WITH OVERTIME COMPARISON



HS-153

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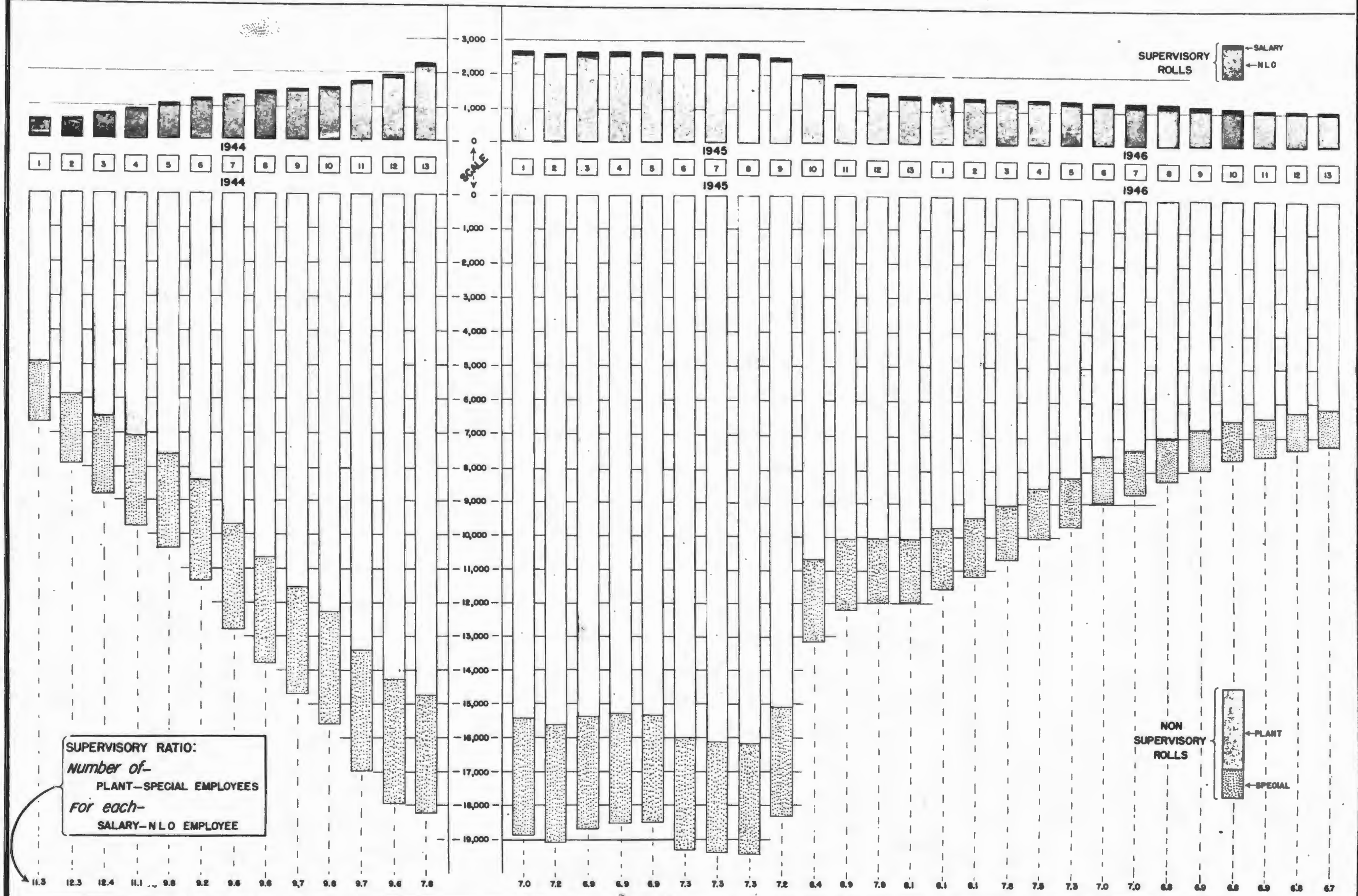
A15

[redacted]

G.E.W.–T.E.C.

EMPLOYEES BY ROLLS WITH SUPERVISORY SEPARATION COMPARISON

Numbers at Close of Kodak Periods



HS-154

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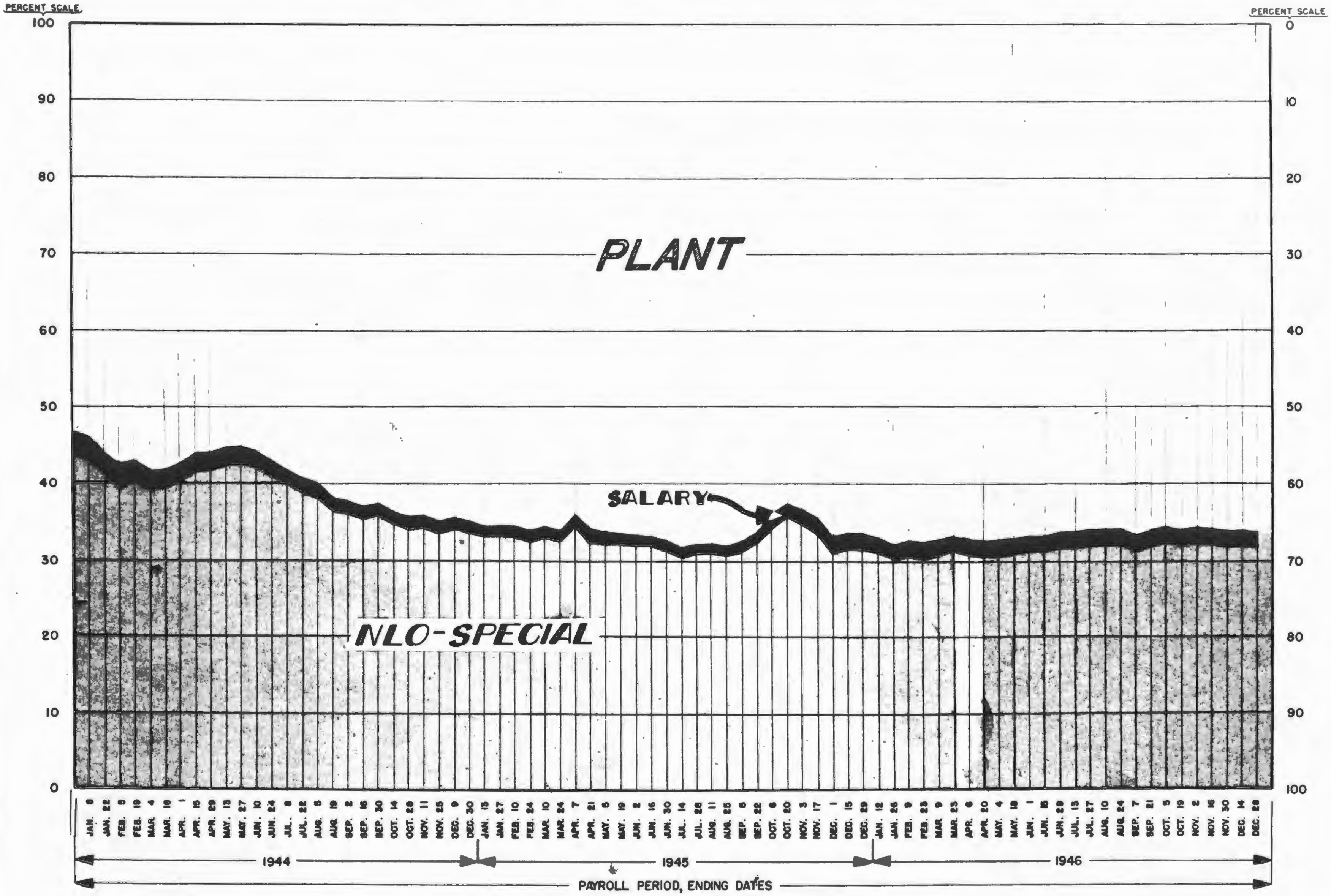
G. E. W. — T. E. C.

GROSS PAYROLL MONEY- PERCENTAGE DISTRIBUTION BY ROLLS



HS-117

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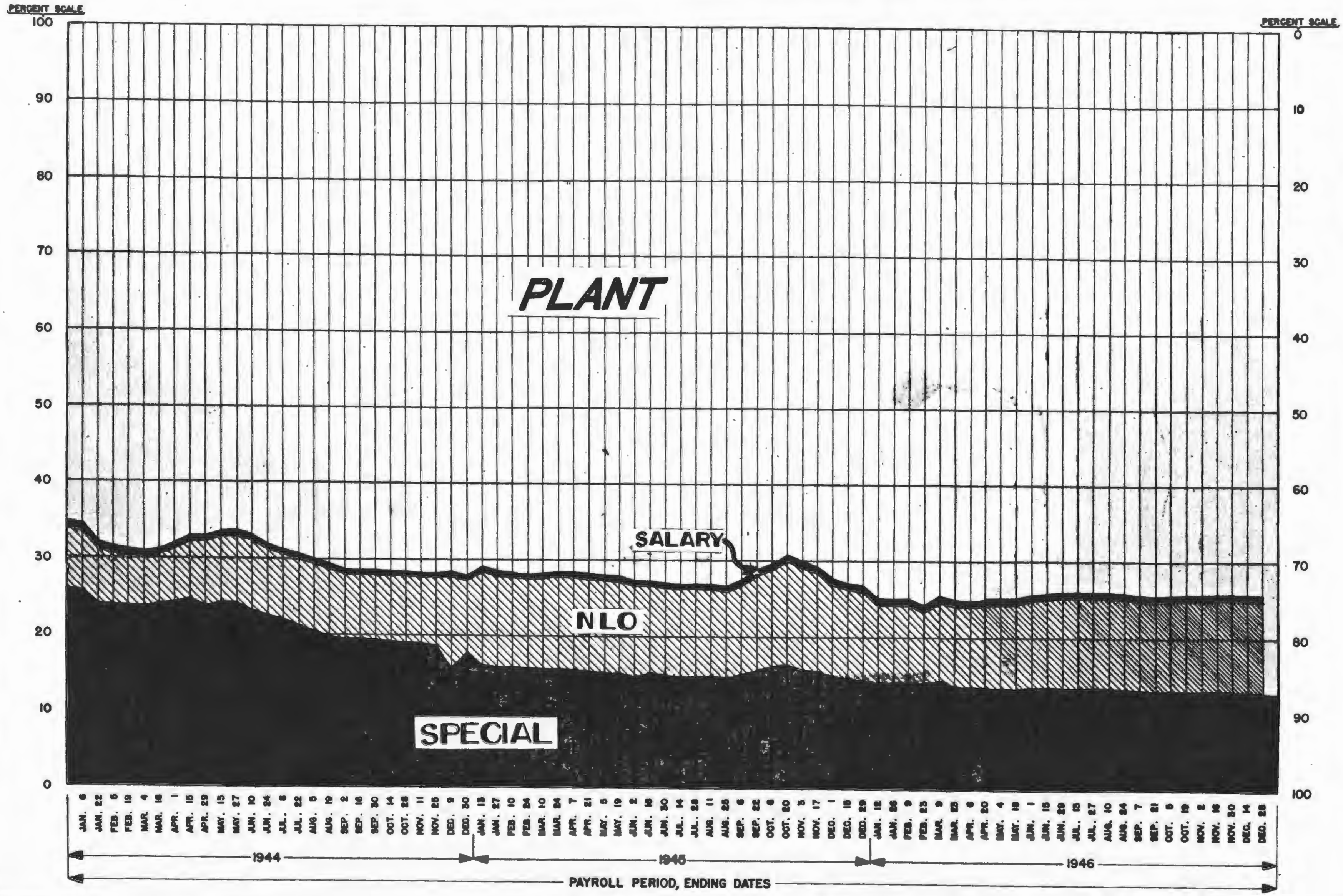
G.E.W.–T.E.C.

NUMBER OF EMPLOYEES – PERCENTAGE DISTRIBUTION BY ROLLS



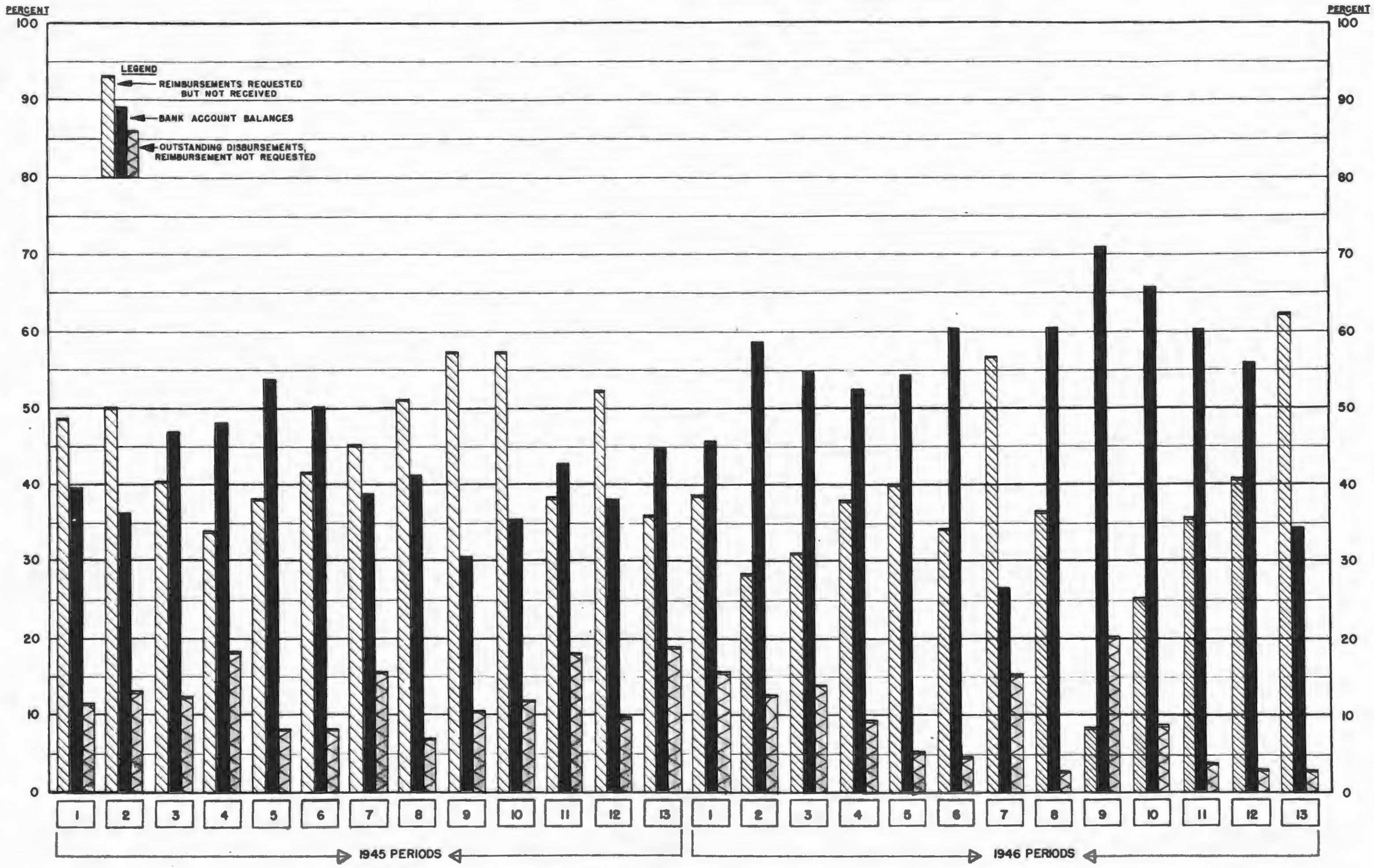
HS-118

[redacted]

[redacted]

STATUS OF GOVERNMENT FUNDS ADVANCED TO C.E.W.-T.E.C.

PERCENTAGE DISTRIBUTION AT CLOSE OF PERIOD



HS-143

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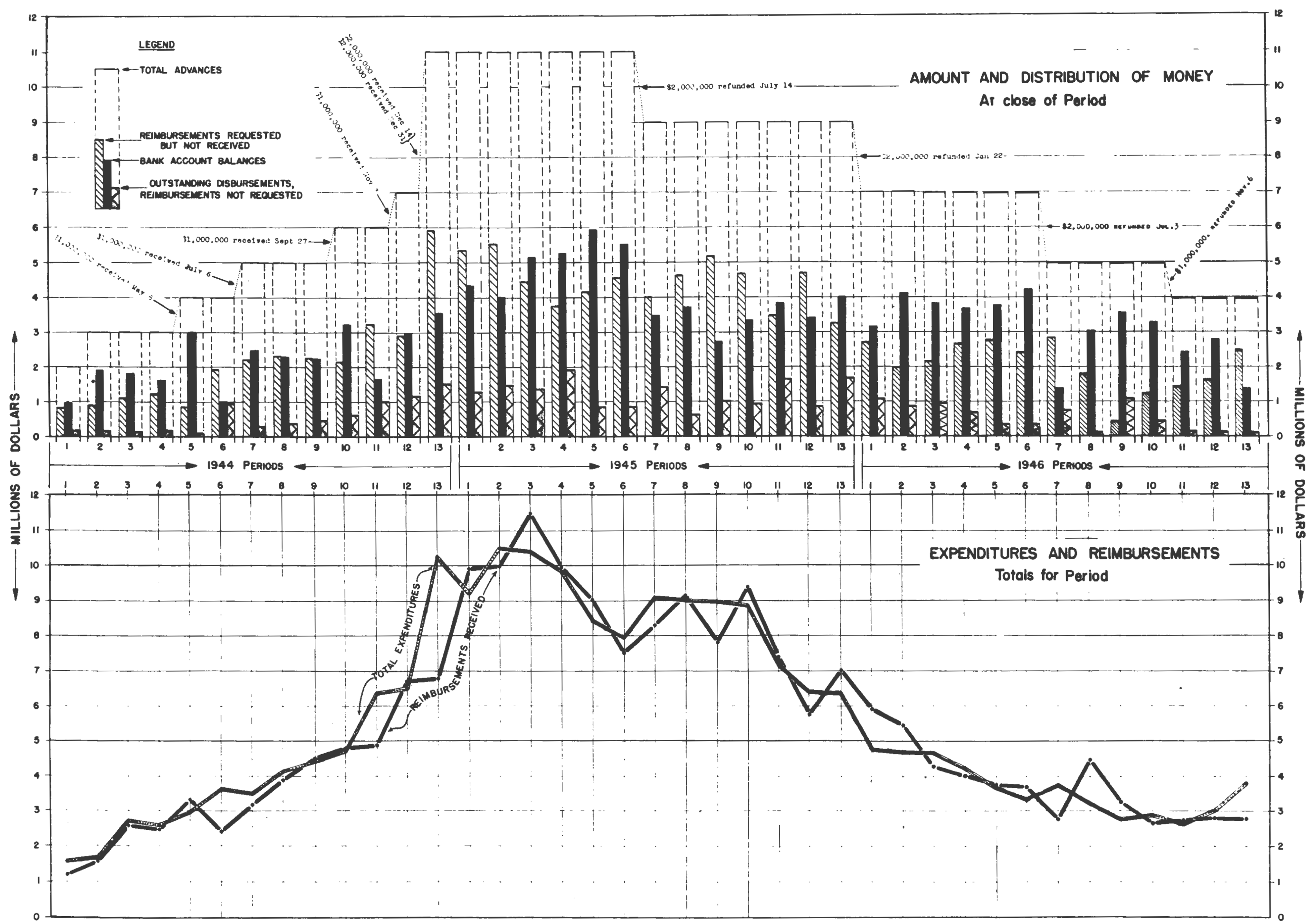
A20

STATUS OF GOVERNMENT FUNDS ADVANCED TO G.E.W.-T.E.C.



HS-104

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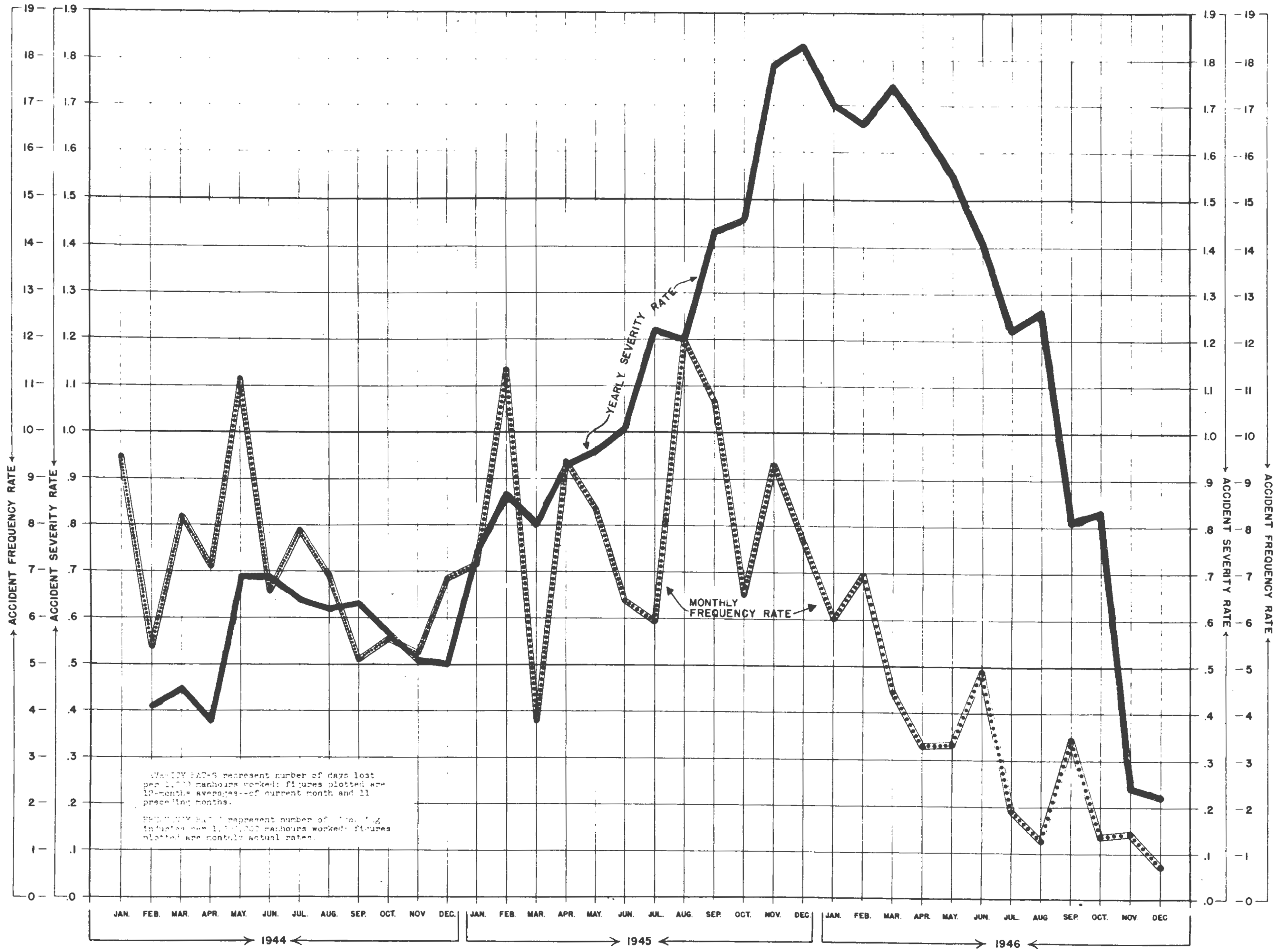
A21

C.E.W.—T.E.C.

ACCIDENT FREQUENCY AND SEVERITY RATES



HS-108

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Wage Dividends for Y-12 Employees

1. Prior to curtailment of operation at the Y-12 plant, which followed the decision on 26 December 1946 to continue to operate the K-25-27 plant at high concentration (as described in the Supplement to Book II, Vol. 5), the operating contractor, Tennessee Eastman Corporation, had experienced continuing difficulty in securing and retaining a sufficient number of qualified operating personnel. The war-time conditions, combined with the local living conditions and other factors inherent in the work at Oak Ridge, were responsible for this difficulty, and among the means adopted to overcome it was the establishment of the policy of awarding an annual wage dividend to each employee who fulfilled certain eligibility requirements. This policy was instituted 24 October 1945 and it was in operation through the year 1946. The wage dividends were based on the individual earnings during the calendar year; payment was made to all eligible employees who were still employed at the time of payment; and in order to increase the value of this incentive, the wage dividends were paid some time after the beginning of the year following, usually during the month of March or April. This policy was approved by the Manhattan District. Payments were made on 14 April 1945, 14 March 1946 and 14 March 1947.

2. This policy remained unchanged until December 1946, and, when announcement of the contemplated reduction of forces at Y-12 was made to the employees concerned, on 26 December, many of them assumed, with

[redacted] A22

[redacted]

considerable justification under the circumstances, that because they would be laid off in January they would be unfairly deprived of the wage dividends which would presumably be distributed at a later date. This assumption spread and there was added to it a rumor, which was not justified, that the Army had refused to approve the payment of the dividend. Considerable concern was thus aroused among the employees, disturbed as they naturally were in any case about the contemplated termination of their services. Hundreds of them sent letters to the President, or telegrams to Senator Kenneth McKellar of Tennessee, complaining of the unfair treatment which they assumed that they would receive. A letter along the same lines was sent by one employee to Senator Robert A. Taft (See attached exhibit). These communications were referred to the Commanding General of the Manhattan District, for reply or for explanation and report, and were received by him on or about 8 January 1947 and later, after steps were underway to assure that all the employees to be laid off would be treated with complete fairness in this matter (See attached exhibit).

3. On 30 December 1946, Col. E. E. Kirkpatrick, Deputy District Engineer, had expressed the Army's views to the Tennessee Eastman Corporation, stating that equitable treatment of the laid-off employees was imperative (See attached copy of TEC Bulletin). The Corporation instituted a revised policy on wage dividends, under which all employees hired by Tennessee Eastman Corporation on or before 1 October 1946, and continuously employed through 31 December 1946, were eligible to participate in the dividends earned during the year 1946, regardless of

[redacted]

[redacted]

whether they continued in the employ of the company after 31 December or not, except that this change in policy did not affect persons discharged for cause or voluntarily resigning before the date of payment.

4. The revised policy was explained to all employees in an announcement published in the "TEC Bulletin" which was issued 7 January 1947 (See attached Exhibit). In the same issue of this Bulletin other benefits to which terminated employees might be entitled--return travel, moving expenses, and vacation allowances--were also explained.

[redacted]

[redacted]

TO ALL EMPLOYEES

The Company is pleased to announce the following changes in the rules of eligibility for the Wage Dividend to be paid on March 14, 1947. These changes were approved by the Government, pursuant to our contract, on December 31, 1946. They apply only to the Dividend to be paid in 1947 and were approved because of the extraordinary circumstances that surround the present curtailment of our activity here, which will affect the majority of our employees in the months of January and February, 1947.

(1) All employees who were hired by the Company on or before October 1, 1946, and remained continuously in its employ from such hiring date through December 31, 1946, and who received wages, salaries, or sickness allowances from the Company during any part of 1946, will be eligible to participate in the Wage Dividend regardless of whether or not they continue in the employ of the Company after December 31, 1946; except that persons discharged for cause or voluntarily resigning before date of payment of the Dividend will not be eligible to participate in it.

(2) Employees whose first day or part of a day of actual work occurred on or after October 2, 1946, and before January 1, 1947, who received wages, salaries, or sickness allowances from the Company in or for the period between October 1 and January 1, and who remain continuously employed until, and are on the active payroll, on the date of payment, will also receive the Wage Dividend.

(3) Exceptions may be made in case an employee is temporarily absent on December 31, 1946, or on date of payment because of verified sickness, accident, vacation, scheduled day off, excused absence, or leave of absence.

The above are the changes that are of most immediate interest to you. A more nearly complete statement of all changes will appear in an early issue of the T. E. C. Bulletin.

Please note that Wage Dividend checks cannot be distributed in advance of March 14, because computation of individual payments could not begin before January 1. After the individual payments are computed there remains the necessity for careful check and audit of the entire payment before actual distribution. Therefore, eligible employees who leave the payroll before March 14 will receive their Wage Dividend checks by mail. These employees should be sure to leave their forwarding addresses with the Employment Department on terminating, and particularly careful to notify the Employment Department of any subsequent changes in address.

F. R. Conklin

January 2, 1947

[redacted]

Copy

[redacted]

December 31, 1946

Senator Robert A. Taft
Washington, D. C.

Dear Sir:

Clinton Engineer Works - Tennessee Eastman Corporation published in the paper that a bonus was to be paid to their employees, Oak Ridge plant included, for earnings in 1946. Now the Army has announced that 5000 of us would be terminated as quickly as possible and that we could not receive the bonus.

We left comfortable homes, good friends, comforts afforded in modern cities. Our children had to change schools in the middle of the term and are now facing that necessity again. We walked in mud for ten months; and to travel miles for adequate food and clothing supplies. Despite all reports, our salaries were not exorbitant with the operating companies here nor above the average anywhere. We didn't mind any of this for our one thought was to win the war and we put all our thoughts and energies in this job for we thought it was the best way we could help.

Now 5000 of us are terminated and are compelled to leave Oak Ridge within two weeks after termination. This bonus payment would help us immeasurably as we now have to hunt for a home and get coal to heat it with in the worst part of the winter.

I would be most grateful for any help you can give us.

Yours truly,

/s/ Milton Burkhart
113 Maple Lane
Oak Ridge, Tenn.

[redacted]

[redacted]

EIDM-WL-26

January 8, 1947

Honorable Kenneth McKellar
United States Senate
Washington, D. C.

Dear Senator McKellar:

I have your letter of 3 January 1947, with which you forwarded to me five telegrams you received, from several hundred employees of the Tennessee Eastman Corporation in Oak Ridge, Tennessee, with respect to their eligibility for wage dividends in the event that their services are terminated in the near future.

The matters referred to in these telegrams have been settled fairly by the announcement made in the "TEC Bulletin", published on 8 January 1947 at Oak Ridge, which resulted from the expression of Army views to Tennessee Eastman Corporation on 30 December, to the effect that equitable treatment of laid-off employees was imperative. These telegrams were sent without knowledge of our efforts in this respect.

All employees hired by Tennessee Eastman Corporation on or before 1 October 1946, and continuously employed through 31 December 1946, are now eligible to participate in the dividends earned during the year 1946, regardless of whether they continue in the employ of the company after 31 December or not, except that this change in policy does not affect persons discharged for cause or voluntarily resigning before the date of payment.

This policy, and also various other benefits to which terminated employees will be entitled--return travel, moving expenses, vacation allowances--are explained in some detail in the above-mentioned announcement, which is probably already in the hands of the employees who wired you.

As you may know, the Manhattan District throughout its history endeavored to effect savings in every was possible consistent with the attainment of its mission; since August 1945, when the emphasis was necessarily shifted from war-time speed to peace-time economy, efforts were renewed on finding ways and means of reducing unit costs.

[redacted]

[redacted]

I am glad to be able to say that these efforts have attained notable success. This improvement is responsible for the contemplated termination of the several thousand employees referred to in your telegrams and it is estimated that it will save the Government and the people tens of hundreds of thousands of dollars every month.

I am returning the telegrams, inclosed herewith.

Sincerely yours,

L. R. GROVES
Major General, USA

6 Incls.

[redacted]

T.E.C. BULLETIN

A NEWSPAPER FOR MEN AND WOMEN OF THE CLINTON ENGINEER WORKS — TENNESSEE EASTMAN CORPORATION

Volume 4, No. 1 Copyright 1947, Tennessee Eastman Corp. OAK RIDGE, TENNESSEE Tuesday, January 7, 1947

Wage Dividend Eligibility Rules Are Revised For 1947 Payment; Affects Distribution Next March

Following conversations between the Company and Col. E. E. Kirkpatrick, Deputy District Engineer, changes affecting the payment of the Wage Dividend in 1947 were approved by the Government on December 31, 1946, and announced to all employees on January 2, 1947. The change in the rules was dictated by the unusual circumstances surrounding the present reduction in force, the major part of which is expected to occur after the end of 1946, in which the Dividend was authorized, and before the date of payment.

The approved changes are as follows:

(1) All employees who were hired by the Company on or before October 1, 1946, and remained continuously in its employ from such hiring date through December 31, 1946, and who received wages, salaries, or sickness allowances from the Company during any part of 1946, will be eligible to participate in the Wage Dividend regardless of whether or not they continue in the employ of the Company after December 31, 1946; except that persons discharged for cause or voluntarily resigning before date of payment of the Dividend will

military bonus payments.

(4) Employees laid off on account of slack work between October 1 and December 31, 1946, but who return to work in 1947 within three months after lay-off, will also participate. Employees laid off prior to September 30, 1946, who return in 1946 within a period of three months after lay-off will also participate. Employees, however, who have been laid off for more than three months continuously will be treated as new employees upon their return to work.

(5) Exceptions may be made in case an employee is temporarily absent on December 31, 1946, or on date of payment because of verified sickness, accident, vacation, scheduled day off, excused absence,

Company Cites Rules For Paying Moving, Travel

Payment of the return travel and moving expenses of employees terminated as the result of the curtailment of operations announced on December 26, 1946, will be made under the terms of the procedure approved by the Government in 1945.

In order to qualify for return travel and moving expenses, the employee's termination must have occurred at the request of the Company.

A voluntary resignation disqualifies an employee for such expenses. Further, termination may not be the result of insubordination or other action taken to provoke discharge. Although the contracting officer may permit exceptions to these rules in unusual circumstances, they represent the policy to which the Company must and will strictly adhere.

Other Provisions Listed

Other general provisions of the procedure covering moving expenses for terminating employees follow:

Where, at the time of employment by the Company an agreement was made with the employee to pay return expenses to a particular point, the agreement will be fulfilled. However, in many cases no such agreement was made, and the Company's power to reimburse return expenses rests on Company policy. As approved by the Gov-

Dr. F. R. Conklin, Works Manager, Issues Statement On Curtailment Of Operations Effected In Y-12

Dr. F. R. Conklin, Works Manager, today released for publication in The Bulletin the following statement to all employees:

"On December 26, 1946, we were notified by our Government to curtail the work at Y-12. We immediately passed on to you as much of the Government's instructions as security rules would permit. The circumstances surrounding the decision were such as to permit no delay in notifying you, unfortunate as it was to disturb your enjoyment of the holiday season.

"I am sure all of you realize that the reduction in our work is not Tennessee Eastman Corporation's decision. It is the decision of our Government, made in the national interest. Oak Ridge is a great place for rumors, as you know. One I have heard is that TEC wanted this cutback to come at this time and could have prevented it had the Company desired. This is not true. Such a statement has not the slightest basis in actual fact. The Company is employed here to carry out the work laid down by the Government. Technological improvements reduced the extent of the work. We are obeying our orders.

Reductions To Be Orderly

"Our present expectation is that the reduction in force called for by our instructions will proceed in an orderly fashion at the rate of about 250 persons per day. No terminating employees will receive

eral plans can and have been made to spare terminating employees inconvenience as much as is practicable, we are still charged with the responsibility of retaining here an efficient force to carry on the remaining work. To do this means that the contemplated reduction in force must be carried out in accordance with orderly procedures. We cannot accord reduction in force status to an employee who, for personal reasons, wishes to leave, but whose performance, length of service, and attendance indicate that he should stay here, even though this would mean that a lower ranking employee would not need to leave against his wishes. To do so would be dodging our responsibility to the Government.

occur after the end of 1946, in which the Dividend was authorized, and before the date of payment.

The approved changes are as follows:

(1) All employees who were hired by the Company on or before October 1, 1946, and remained continuously in its employ from such hiring date through December 31, 1946, and who received wages, salaries, or sickness allowances from the Company during any part of 1946, will be eligible to participate in the Wage Dividend **regardless of whether or not they continue in the employ of the Company after December 31, 1946**; except that persons discharged for cause or voluntarily resigning before date of payment of the Dividend will not be eligible to participate in it.

(2) Employees whose first day or part of a day of actual work occurred on or after October 2, 1946, and before January 1, 1947, who received wages, salaries, or sickness allowances from the Company in or for the period between October 1 and January 1, **and who remain continuously employed until, and are on the active payroll on, the date of payment**, will also receive the Wage Dividend.

(3) Employees whose service was terminated in 1946 as the result of death, retirement, disability, or military or naval service, and women employees whose service is terminated after September 30, 1946, but before date of payment either to be married or on account of a marriage occurring in the last period of continuous employment with the Company, will participate in the Wage Dividend.

To establish eligibility to participate in cases of termination, three months or more must have elapsed between the last employment date and the date of termination. The termination date is extended by the number of weeks of any sickness allowance or vacation allowance, is not extended on account of military bonus payments.

(4) Employees laid off on account of slack work between October 1 and December 31, 1946, but who return to work in 1947 within three months after lay-off, will also participate. Employees laid off prior to September 30, 1946, who return in 1946 within a period of three months after lay-off will also participate. Employees, however, who have been laid off for more than three months continuously will be treated as new employees upon their return to work.

(5) Exceptions may be made in case an employee is temporarily absent on December 31, 1946, or on date of payment because of verified sickness, accident, vacation, scheduled day off, excused absence, or leave of absence.

Payment of the Dividend will be made on March 14, 1947, to qualified employees. As announced on January 2, details of computation and audit prevent earlier payment, so that checks must be mailed to persons eligible but no longer in the Company's employ on date of payment.

The delay between the announcement of the curtailment of work on December 26 and the announcement of the above changes on January 2 was necessary to permit time to work out the details of the required modification of the Company's contract with the Government. Both Government and Company officials expressed gratification that action could be taken to amend the former rules of eligibility, which required that all eligible employees must be at work on date of payment in order to receive the Wage Dividend.

The changes approved on December 31, 1946, affect only the Dividend to be paid in 1947. Terminating employees who may be eligible for it under the new rules are urged to keep the Employment Department informed of their correct mailing addresses.

Hospital Insurance Coverage Is Convertible By Individuals

Terminating employees wishing to continue hospitalization insurance coverage made available by the Oak Ridge Health Association must apply for individual policies at the association office, located on the second floor of the Dental Health Clinic.

Applications must be filed within 30 days after termination for the same type of individual or family policy carried under the TEC group insurance plan, it was pointed out by J. H. Stallings, business-

qualifies an employee for such expenses. Further, termination may not be the result of insubordination or other action taken to provoke discharge. Although the contracting officer may permit exceptions to these rules in unusual circumstances, they represent the policy to which the Company must and will strictly adhere.

Other Provisions Listed

Other general provisions of the procedure covering moving expenses for terminating employees follow:

Where, at the time of employment by the Company an agreement was made with the employee to pay return expenses to a particular point, the agreement will be fulfilled. However, in many cases no such agreement was made, and the Company's power to reimburse return expenses rests on Company policy. As approved by the Government, this policy is, generally, that the Company may pay the return expense of travel, and subsistence during travel, of an employee to the point from which the Company paid his expenses to the job, and, if an employee is married, the expense of travel, subsistence during travel, and the moving of household goods of his family to the point or points from which the Company paid such expenses to the job.

If the employee, members of his family, and his household goods were brought to the job from different points, it is obvious that the expense assumed by the Company may not cover return travel and moving costs for the full distance that a terminated employee may wish to go. However, in order to receive these expenses, the employee and his family will not be required to return to the point of origin. He and his family may return to any other destination of their choosing, and the Company will reimburse the employee for the expense up to the amount it would

In accordance with current license agreements, terminated employees must secure new license agreements or vacate premises occupied in Oak Ridge 15 days after termination.

If you are unable to meet this vacating date, personal contact should be made with the Occupancy Control Section of Facilities and Services Division, located in the USED Administration Bldg., Wing One, Second Floor, North, telephone 4041. The right to grant an extension is reserved by the Occupancy Control Section.

unfortunate as it was to disturb your enjoyment of the holiday season.

"I am sure all of you realize that the reduction in ou work is not Tennessee Eastman Corporation's decision. It i the decision of our Government, made in the national interest. Oak Ridge is a great place for rumors, as you know. One I have heard is that TEC wanted this cutback to come at this time and could have prevented it had the Company desired. This is not true. Such a statement has not the slightest basis in actual fact. The Company is employed here to carry out the work laid down by the Government. Technological improvements reduced the extent of the work. We are obeying our orders.

Reductions To Be Orderly

"Our present expectation is that the reduction in force called for by our instructions will proceed in an orderly fashion at the rate of about 250 persons per day. No terminating employee will receive less than seven days' notice of his actual termination date, unless he is released for cause or voluntarily resigns. Choice of the employees who will remain to staff the Refining areas will be made from the present personnel operating all the Refining buildings on the combined basis of their records of performance and attendance, and their length of Company service. Choice of those to remain in other departments will likewise be made on the basis of performance, attendance and length of Company service.

"Employees leaving with reduction in force status will receive separation pay as stated elsewhere in this issue of The Bulletin. You have already been notified of the recent important changes in the Wage Dividend plan, which should prove helpful to many of those leaving. This issue of The Bulletin also carries an explanation of the assistance to be given qualified employees in the matter of return travel and moving expenses. Please note that the Company's efforts to find carriers for the household goods of terminating employees are made only as a convenience to those employees.

Must Maintain Efficiency

"Any substantial reduction in force, wherever it may occur, is sad. I genuinely wish this one were not necessary. However, while general plans can and have been mad to spare terminating employees in convenience as much as is practicable, we are still charged wit the responsibility of retaining her an efficient force to carry on th remaining work. To do this mean that the contemplated reduction i force must be carried out in accordance with orderly procedures. W cannot accord reduction in forc status to an employee who, for personal reasons, wishes to leave, bu whose performance, length of service, and attendance indicate tha he should stay here, even thoug this would mean that a lower ranking employee would not need t leave against his wishes. To do s would be dodging our responsibilit to the Government.

"Representatives of TEC's hom plant and of Eastman Kodak Company, the USED, and other employers will be on hand to review worl histories of terminating employee and to interview those whom thes representatives may wish to tall to.

"Again, I wish this reduction i force were not necessary. Th Company wishes good luck to thos of the present plant staff who mus be terminated."

Revised Vacation Plan Affects Plant Roll

Recent changes in vacation regulations permit terminating employees payment in lieu of vacation, provided six months have elapsed since they were eligible for a vacation in the previous year and provided they meet length of service, attendance, and other eligibility requirements. Formerly, it was necessary for six months to have ensued since the last vacation in order for an employee to receive vacation pay at the time of termination.

As before, employees remaining on the payroll must work si

(Continued on Page 3)

Terminated Workers Are Eligible To Receive Separation Payment

According to established procedure, all employees who are terminated due to reduction in force, are eligible for separation pay based o length orf continuous service with Clinton Engineer Works-Tennesse

Male Member only	$24.85	$ 6.22
Female Member only	$34.67	$ 8.67
Male member and wife	$59.52	$14.88

In addition to the above payments, $3.12 is charged per quarter for each child covered, or an annual premium of $12.45 for each child.

W-2 FORMS AVAILABLE

W-2 forms covering 1946 earnings will be furnished each terminating employee with his final pay check. Employees continuing on the CEW-TEC payroll will receive W-2 forms prior to February 1.

Length of Service	Plant Payroll	Special Payroll
12 weeks to 24 weeks	None	None
24 weeks to 1 year	20 hours' pay	½ week's pay
1 year to 3 years	40 hours' pay	1 week's pay
3 years to 5 years	60 hours' pay	1½ week's pay

Rules For Paying Moving And Travel

(Continued from Page 1)

job, the Company will provide all-risk insurance coverage on household goods moved by common carriers contracted for by the Company at the rate of $625 per 1,000 pounds of goods up to a maximum of $2,500 of coverage. Employees may secure additional coverage at their own expense.

The employee may make his own household moving arrangements, and in such cases reimbursement will be made on presentation of receipted bills from the carrier, scaled down if necessary to the amount which the Company would have had to pay if it had made the moving arrangements. On the other hand, if an employee wishes, the Company will contract with a carrier for the move and pay directly to the carrier such sum as the employee may be eligible for. This will be done on the understanding that the Company will be bound only to use reasonable efforts to obtain a reliable carrier; will not be responsible for loss of or damage to goods before pick-up or while in transit; will assume no responsibility for expense to the employee resulting from the carrier's delay in pick-up or delivery; and that the carrier will look to the employee for payment of any charges in excess of what the Company is obligated to bear under this policy.

Storage Charge Not Covered

The Company may not assume charges for storage at destination in any case nor at intermediate points in cases where storage occurs for the employee's convenience.

The Company will bear the expense of return moving of the household goods now in the employee's house at Oak Ridge. It cannot pay the cost of picking up such household goods as an employee may have in storage at various points about the country.

The Company will bear the expense of moving household goods acquired by an employee's family after they came on the job, if the employee and his family were brought to the job at Company expense. The goods will be returned to the point from which other household goods were brought to Oak Ridge, or, if all such goods were acquired after arrival on the job, to the point from which the family was brought to the job.

An employee who was not the head of the family at the time of reporting to work, but became the head of a family thereafter, will be entitled to return travel and moving expenses of his family and household goods to the point from which he reported to work if part or all of his reporting to work expenses were paid by the Company.

Travel Expenses

In no event can the Company assume the expense of travel by other than the most direct route to destination. Subsistence expenses during travel will be reimbursed in the form of per diem allowances for the time required for direct travel. Travel by automobile will be reimbursed at five cents per mile for actual mileage traveled or mileage to destination as shown by Rand-McNally maps, whichever is less.

Travel expenses will be reimbursed upon the submission of statements of travel performed, properly signed and accompanied by receipts for travel expense in excess of $1 in all cases where travel is by common carrier and not by private automobile. It should be particularly noted that reimbursement cannot be made in the absence of such receipts.

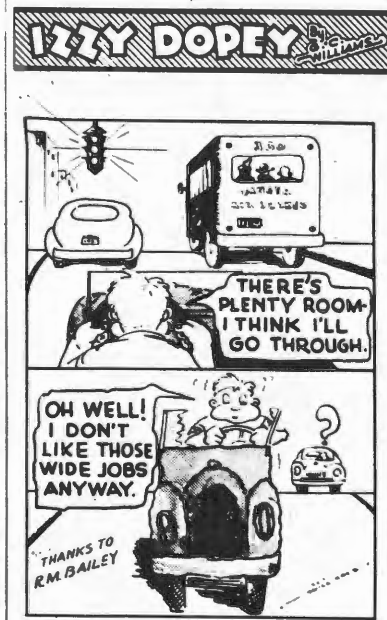
Before reimbursement checks can be mailed by the cashier, he must be informed by Roane-Anderson Company that the employee owes that company no money. Employees are requested to clear their Roane-Anderson accounts before leaving Oak Ridge.

It should be clearly understood by all employees that the Company cannot undertake the payment of per diem allowances to cover expenses arising from the delay of moving carriers.

Application For Expenses

Such return travel and moving agreements as are outstanding with employees do not specify a time within which the employees must apply for their return expenses. Accordingly, application must be made within a reasonable time after termination of employment, and the Company, with the Government's approval, has established such reasonable time as 30 days after the date of termination. Within that time the employee must indicate that he will apply for his return expenses or lose his rights. An employee cannot wait for an indefinite period to avail himself of the benefits under this policy.

This statement covers only the general principles of the Company's policy. It is not its intent to give full and detailed answers to any questions employees may have in this connection. For further information employees may get in touch with the Housing Section of the Employee Relations Department about household moving, and the Cashier's Office about travel expenses.



Revised Vacation Plan

(Continued from Page 1)

months between vacations.

A second procedure revision increases vacation time for plant roll employees who have completed two years of continuous service from one to two weeks.

Veterans who were employed by CEW-TEC previous to entering service, and who have since been reinstated here will be credited for the time spent in service in determining the length of their vacations, as well as eligibility date.

All other vacation eligibility requirements remain unchanged.

Color Printing To Be Discussed

Color printing techniques will be discussed by TEC Camera Club when members meet in the East Portal Building, Tuesday, January 14, at 7:30 p. m. One of the club members will demonstrate.

Rules for the use of the dark room have been discussed at previous meetings and any changes proposed in these rules will be given consideration later.

Don't jump at conclusions, other countries may not **have the Atomic** know-how.

TEC Fireman Is Winner Of Car

Howard Ross Baker (left foreground), of the TEC Fire Department, smiles proudly as he displays his new 1946 automobile, which was given away by the Oak Ridge Lions Club. Standing beside Baker is T. A. McKenzie, Superintendent of Plant Protection Department, and at right is Chief J. W. Hughey, of the Fire Department. A Navy Veteran, Baker lives with his wife in Knoxville.

[redacted]

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATION

APPENDIX "B"

DOCUMENTS

[redacted]

WAR DEPARTMENT
UNITED STATES ENGINEER OFFICE
MANHATTAN DISTRICT
CALIFORNIA AREA OFFICE
P. O. Box 559
BERKELEY, CALIFORNIA

This Document consists of 1 page
Copy 4 of 5 copies

IN REPLY REFER TO

U. S. ENGINEER OFFICE
MANHATTAN DISTRICT

-1

April 23, 1943

APR 26 1943
AM NEW YORK, N.Y. PM
7,8,9,10,11,12,1,2,3,4,5,6

Subject: Description of Process.

To: The District Engineer, Manhattan District, P. O. Box 42, Station F, New York, N. Y.

1. Forwarded herewith is a copy of the revised story of the process prepared by Dr. F. T. Howard, formerly of the Radiation Laboratory, but now with the Tennessee Eastman Corporation. Dr. Howard is in charge of the program for training the operators of this process, and he believed a more workable story of the process was needed for their men. This has the approval of Dr. Conklin, and the writer believes it is as acceptable as the one prepared by Dr. Ebersold.

2. It is noted that the story has been shortened and made simpler, and also that the main product is the gunk, something tangible and found in large quantities, whereas the material in the sampler (receiver) is simply used as a control.

H. A. FIDLER,
Captain, Corps of Engineers,
Area Engineer.

Incl: Revised Story of Process.

CC 1 and CC 2 to D. E. Man.Dist.
CC 3 to Brig. General Groves, w/incl.
CC 4 to Major . . Kelley, w/incl.
CC 5 File

B1

5/22/43

This [redacted]ument consists of 4 pages.
Copy 3 of 5 copies, Series B.
SWK 14766

[redacted]

This document contains information [redacted] the [redacted] defense of th[redacted] States within the meaning [redacted] Act. 50 U. S. C., 31 and [redacted] its transmission or the revelation [redacted] contents in any manner to an un[redacted]orized person is prohibited by law.

THE DSM PROJECT

SYNTHETIC CATALYST DIVISION

The Project

The government project on which we are working is known as the Development of Substitute Materials, or DSM, Project. The purpose is the development and manufacture of special substitute and synthetic materials for war uses. The names and nature of these materials, the methods of making them, the organizations involved, and the specific war uses are highly guarded secrets; therefore it is a necessary policy that no information be given to an individual unless it is absolutely necessary in order for him to carry out his work on the project. Enemy nations also need these materials and as a result they will endeavor to determine the methods being used and the progress being made by us. Further comment upon the need for secrecy is hardly necessary.

It is realized in spite of the necessity for strictly limiting the disclosure of information, that intelligent design, operation, and maintenance of process equipment requires some knowledge of the character and details of the processes. A broad description of the character of the process in use in this division is hereby given. Specific details will be furnished to individuals by their group leaders as they are needed in their work. It is to be kept in mind as explained above that such is secret information and is to be disclosed to no one outside this Division without specific authorization of the Division Director, and to only those in this Division who need the information for intelligent prosecution of their work.

The Function of This Division

The importance of catalysts in accelerating chemical reactions is well known. In fact many processes will not take place to an appreciable extent without a catalyst. Some vitally needed strategic materials are

[redacted]

dependent on catalysts for their successful production. The equipment being developed by this Division is for the synthetic production of one of these special catalysts. All of its properties and uses cannot be divulged since these do not enter into the work of this Division but into the manufacturing of strategic materials at other plants. It is thus not our function to divert our attention or efforts to investigations on these matters since they are well handled elsewhere. It is to be realized however that, although our Division is not actually developing and producing final strategic materials at our unit, the catalyst production is essential to the final vitally needed products.

<u>The Polatron Process</u>

Our process is dependent on the polar and magnetic properties of the molecules of various substances. A chemical preparation is acted upon by strong electrostatic and electromagnetic forces at rather high temperatures - the whole process taking place within a large vacuum tank. Each unit, tank and magnet, is called a Polatron. It is the behavior of the molecules when converted into polar phases in the strong magnetic field that is the basis of the catalyst formation.

The material fed into the process is called the "charge" material. The nature of the mixture is naturally withheld. Even in peace time it would be a "trade secret". It is referred to only as the "charge", specific types being numbered. Several molecular forms may be present in the charge. The object of the process is to convert as much of the charge as possible into certain polar forms which, because they can enter into unique surface-film and crystal-lattice arrangements, have special catalytic properties.

Inside the vacuum tank the charge is heated to the proper temperature. At that temperature, vaporized material passes from the reservoir into the converter passing first through a mixing chamber, and thence into the foreward chamber. Here due to bombardment in the strong electromagnetic and electrostatic fields certain conversions take place. The exact nature of these complicated changes need not be taken up at this time. However, certain polar and non-polar products are formed.

Products from the converter spray out through the slit opening of the converter, toward the G-slit and C-slit which give a particular shape to the electrostatic field. Most of the converter products condense as "gunk" on the C-nose and other cold surfaces near the transmitter unit. At the end of a run this so-called gunk is carefully washed from the D-assembly and sent to the chemists for the seperation and purification of valuable products.

By the action of the electrostatic and electromagnetic fields a very small portion, a sample, of the products from the converter is directed from the converter around to the sampler. By observing the meters connected to the polar (P) and non-polar (O) sampler units the operator is able to judge the efficiency of the converter and thus to adjust for optimum conditions. At the end of a run sample material is also sent to the chemist as a final check on the run.

Operational procedures require adjustment of characteristics of the converter power so as to secure the maximum conversion of material (greatest O + P) and the adjustment of the strength and geometry of the electrostatic field so as to secure the greatest polarizing efficiency, O/P.

[redacted]

As discussed previously, complete descriptions of all phases of the equipment cannot be provided. This brief introductory explanation of our process and of the function of the Division, it is hoped, will provide a working background to which details can be added as needed in your work. It is again to be emphasized that the information herein disclosed be carefully guarded as secret.

F. T. Howard

Frederick T. Howard

jr

Distribution:
Series A
1. Dr. Howard
2. Dr. Conklin
3. Dr. Aebersold
4. " "
5. File
Series B
1. Capt. Fidler
2. " "
3. " "
4. " "
5. Book 2
Series C.
1. Works Manager

SECRET

[redacted]

Y-12 POWER CONSUMPTION

Month	KWH
November 1943	3,260,000
December 1943	970,000
January 1944	230,000
February	9,580,000
March	18,380,000
April	28,640,000
May	34,740,000
June	38,810,000
July	48,080,000
August	59,960,000
September	71,910,000
October	90,540,000
November	111,940,000
December	126,000,000
January 1945	130,690,000
February	122,830,000
March	141,570,000
April	138,600,000
May	144,080,000
June	142,290,000
July	153,170,000
August	161,930,000
September	85,380,000

[redacted]

Month	KWH
October 1945	25,770,000
November	26,610,000
December	30,360,000
January 1946	32,280,000
February	30,110,000
March	33,310,000
April	32,520,000
May	33,930,000
June	33,150,000
July	33,110,000
August	34,130,000
September	32,520,000
October	31,250,000
November	26,660,000
December	28,000,000
TOTAL	2,317,340,000 KWH
	X 4.25 Mils per KWH
Total cost of power consumed at Y-12 to December 31, 1946.	$9,843,695 .00

MANHATTAN DISTRICT HISTORY

BOOK V - ELECTROMAGNETIC PROJECT

VOLUME 6 - OPERATION

APPENDIX "C"

PHOTOGRAPHS

No.	Description
1	Aerial Views of Y-12
2	Panoramic Views of Y-12
3	Presenteeism Contest
4	Mud
5	Ride Exchange
6	Suggestion System
7	Blood Test at the Hospital
8	Alpha I Racetrack
9	Alpha II Racetrack
10	Beta Racetrack
11	XAX Development Tanks
12	Alpha I Cubicle Room
13	Alpha II Cubicle Room with Operator
14	Alpha II Handling Dolly
15	Pulling the M-Unit
16	Servicing Beta Emitter
17	Beta Emitter
18	Cracked Bushings
19	Beta Receiver Pocket
20	Comparison of Zulu and Ubangi Receivers
21	Alpha II Type Receiver

[redacted]

C1 Aerial Views of Y-12

[redacted]

AERIAL VIEWS

FROM NORTH SHOWING Y-12 INSTALLATIONS IN FOREGROUND AND PART OF RESIDENTIAL DISTRICT IN BACKGROUND.

Y-12 INSTALLATIONS VIEWED FROM WEST.

Y-12 DURING CONSTRUCTION JUNE 1944.

[redacted]

C 2 Panoramic Views of Y-12

[redacted]

T.E.C. OAK RIDGE PLANT

Y-12 EXTENSION AREA VIEWED FROM SOUTH, JANUARY 1945.
MAIN PROCESS BUILDINGS IN CENTER.

35 A

MAIN Y-12 AREA VIEWED FROM NORTH, MARCH 1945. ~~CONTRAST THIS WITH 1943 AND 1944 SAME POSITION PICTURES SHOWN ADJOINING PAGE~~.

[redacted]

C 3 Presenteeism Contest

One of the methods used in the fight against absenteeism.

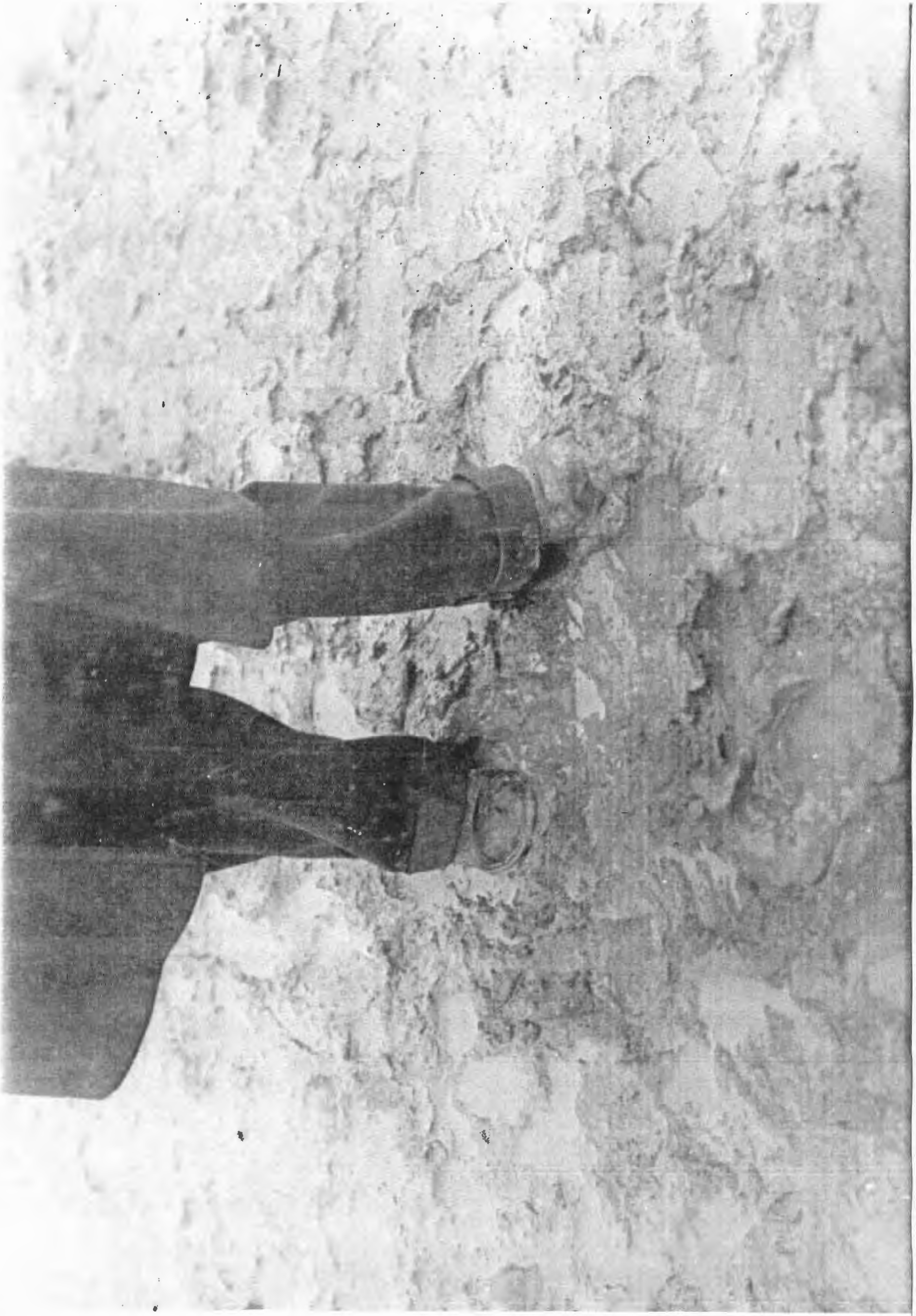
[redacted]


PRESENTEEISM CONTEST
PROCESS GROUPS 3-6-7
DEPT. 138
Best Percentage Group Wins Free Banquet On 2 Losing Groups
Group 3
Group 6
Group 7

[redacted] SECRET

C 4 Mud !

[redacted]



C5 Ride Exchange

Cooperation for transportation


RIDES WANTED
PASSENGERS WANTED

[redacted]

C6 Suggestion System

Ideas with a smile.

[redacted]


FIRE PREVENTION
CLEAN-UP
CAMPAIGN
C.E.W.
T.E.C.
SUGGESTION SYSTEM
ATTENTION!
$ – DOLLARS FOR IDEAS – $
Cash Awards up to $1000.00
REWARDS for IDEAS

[redacted]

C7 Blood Test at the Hospital

These tests are taken at regular intervals to check condition of employees health.

[redacted]


LABELS

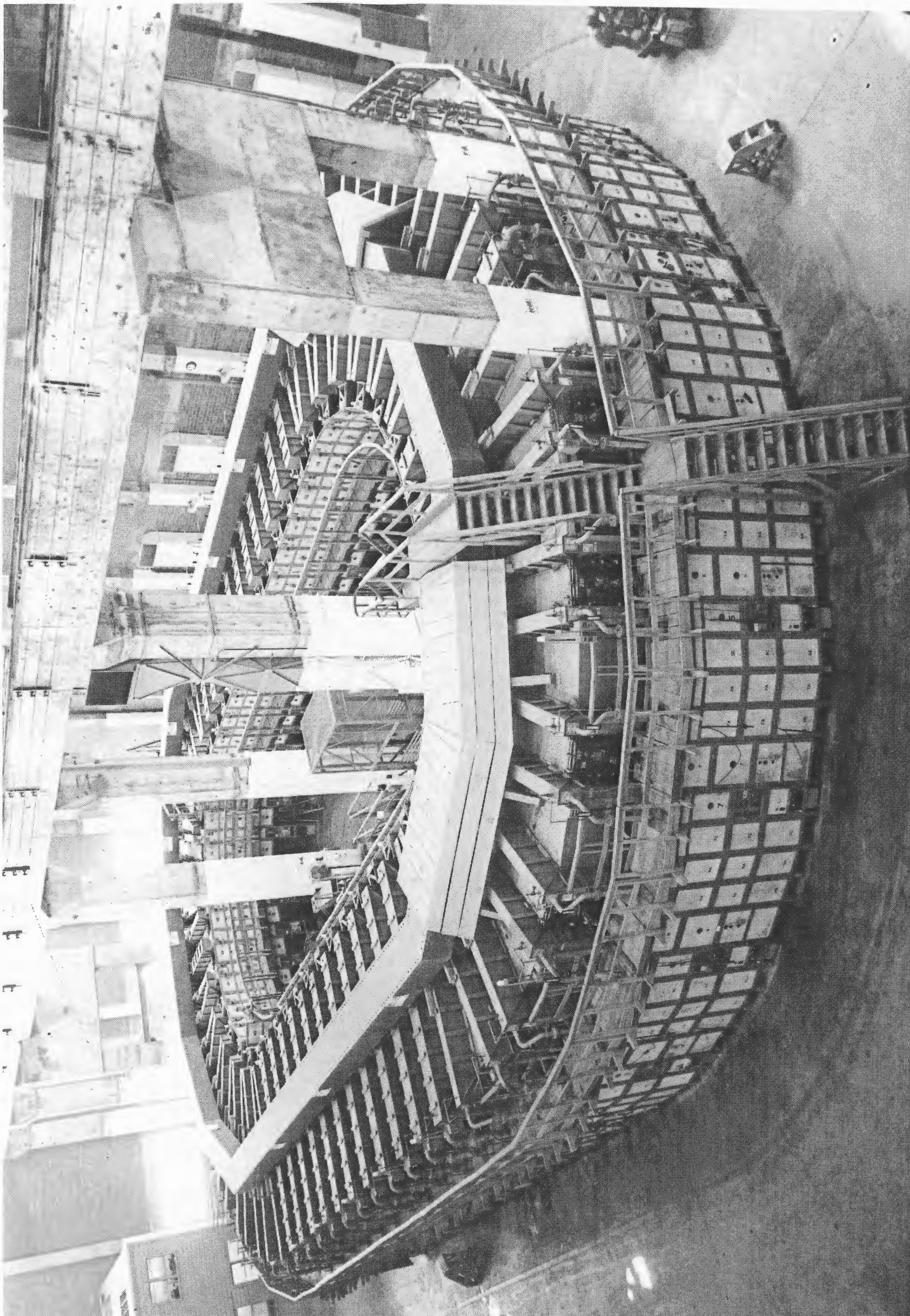
[redacted]

C8 <u>Alpha I Racetrack</u>

The Y-12 Plant contains four of this type racetrack in two buildings. A fifth track of the same shape has Alpha II separation equipment.

The man working on the handling dolly in the right foreground gives an indication of size.

[redacted]

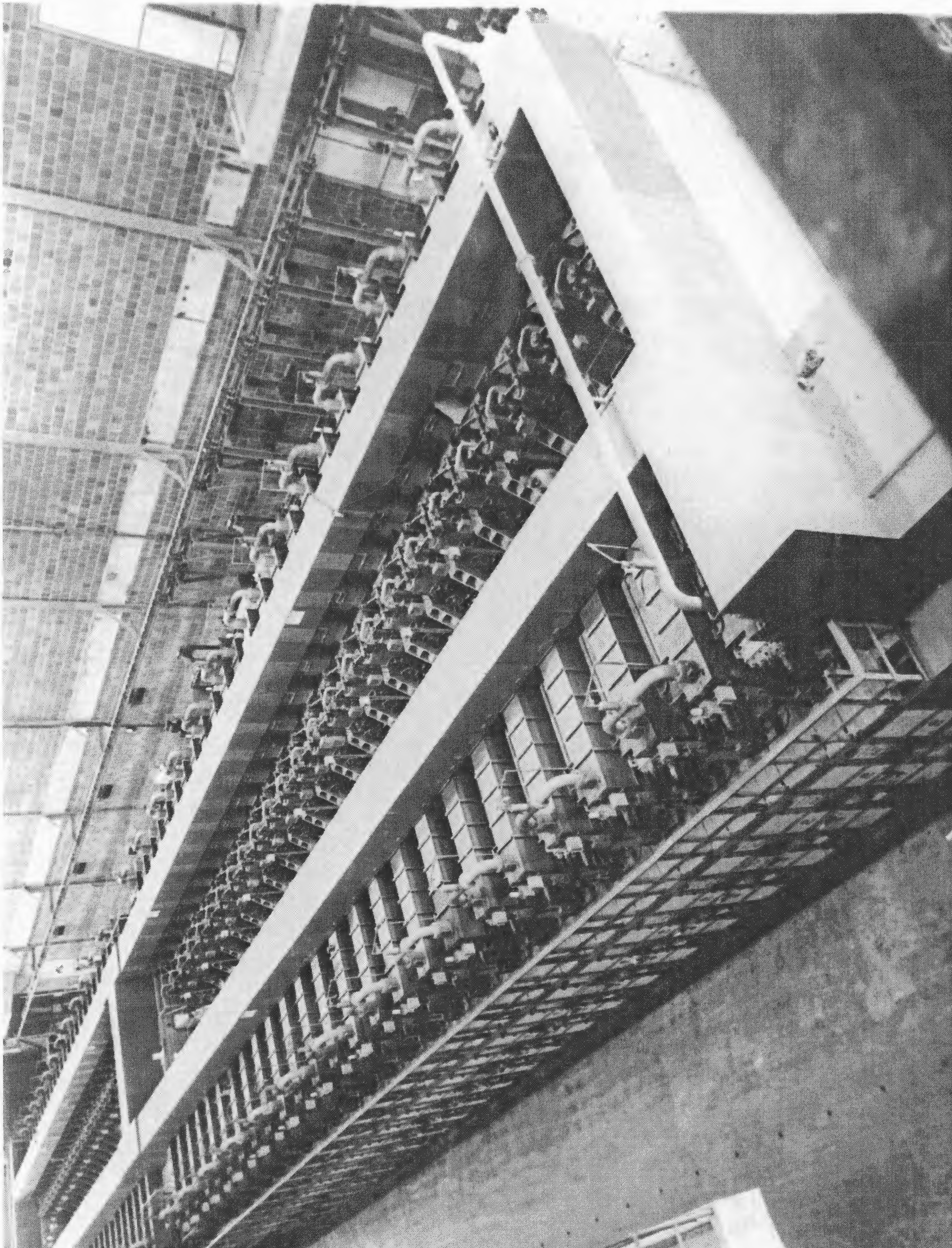


[redacted]

C9 Alpha II Racetrack

There are four of these huge magnets in the Y-12 Plant.

[redacted]



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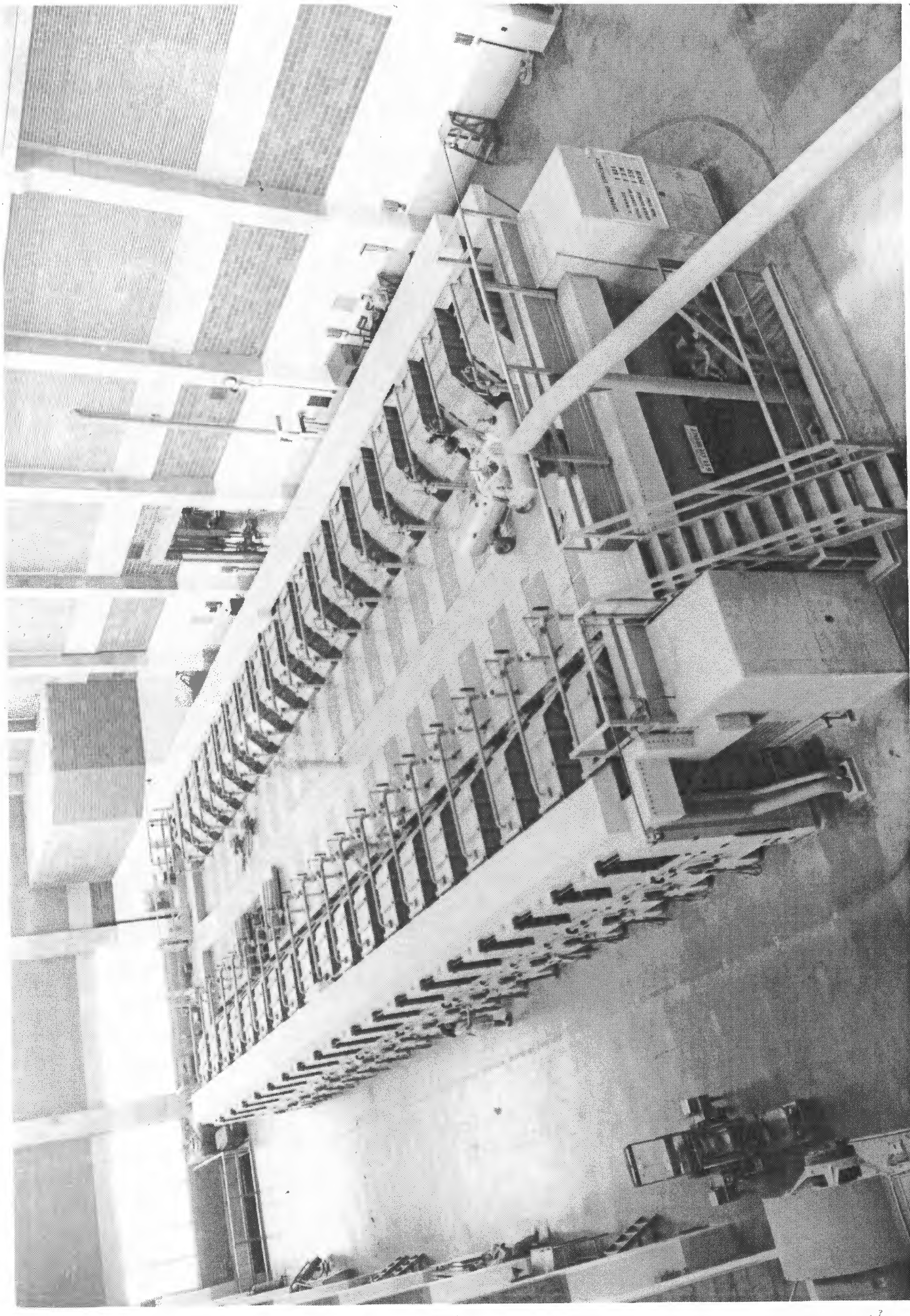
C10 Beta Racetrack

The second or refining stage of separation is accomplished in 6 Beta racetracks. Two more are under construction.

[redacted]



[redacted]

C11 XAX Development Tanks

Note that only two tanks are in this magnet which corresponds to the large magnets called the racetracks.

[redacted]

C12 Alpha 1 Cubicle Room

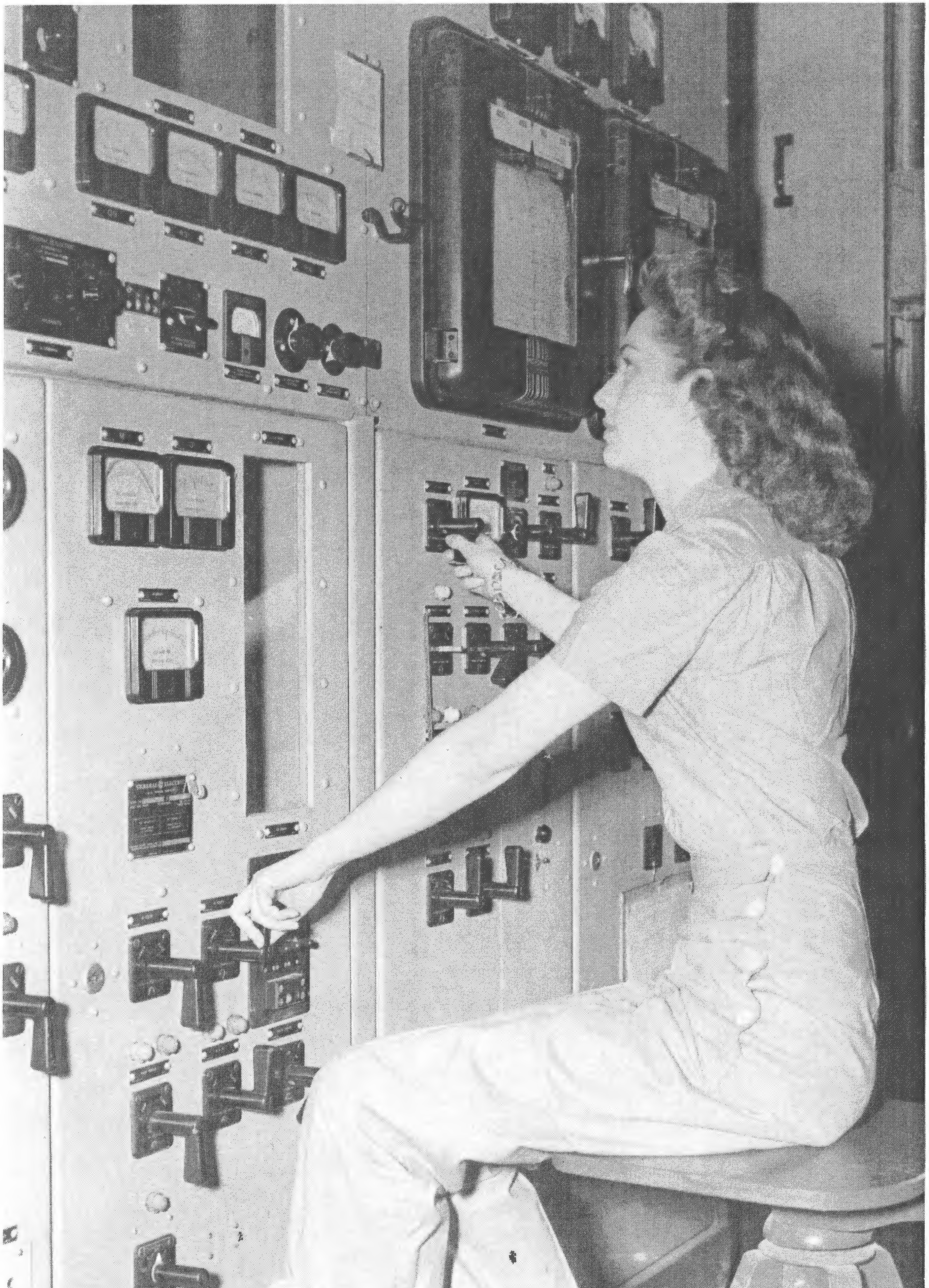
One cubicle (Control Unit) for each unit in the track.

[redacted]

C13 <u>Alpha II Cubicle with Operator</u>

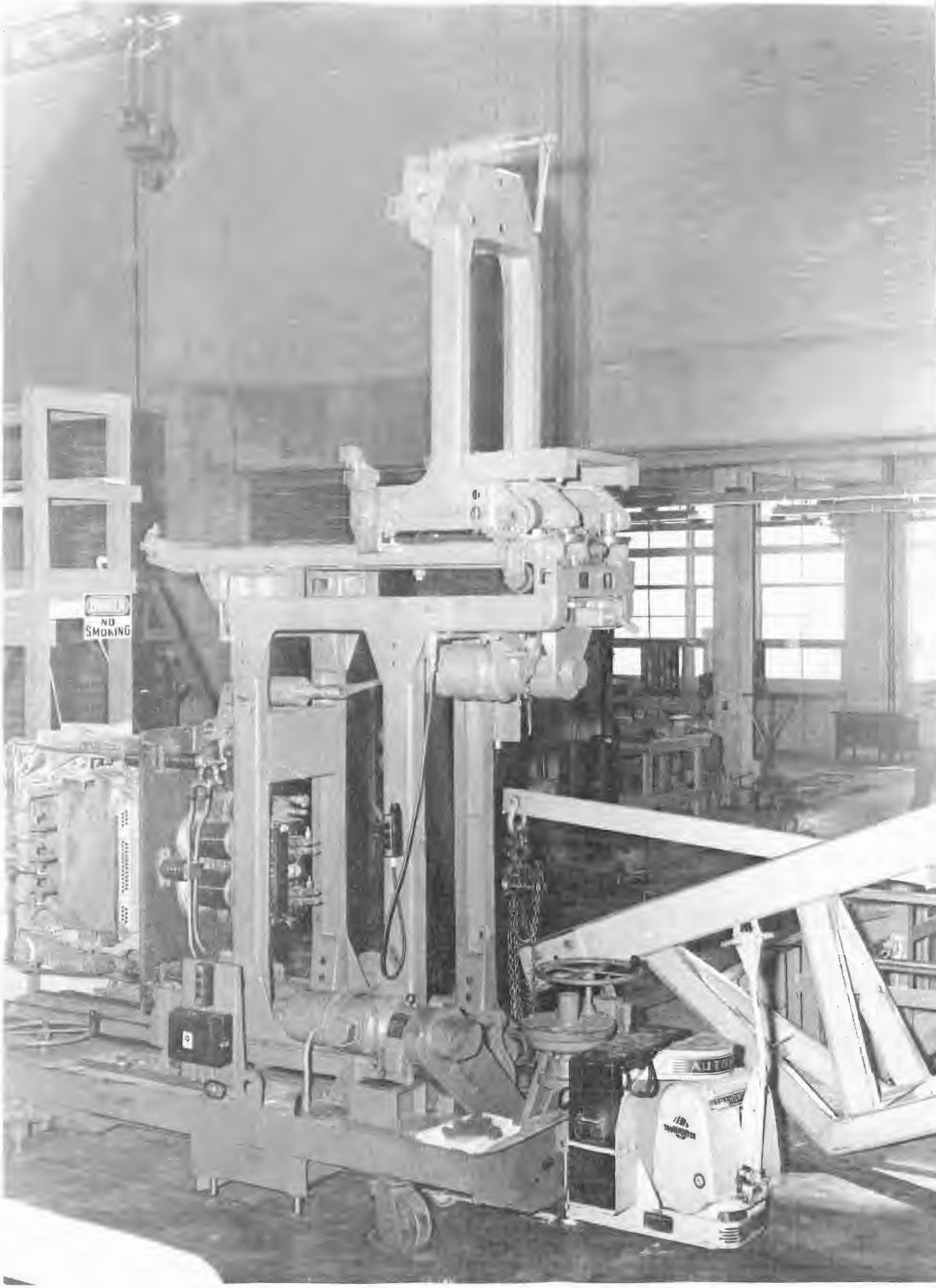
Beautiful equipment.

[redacted]



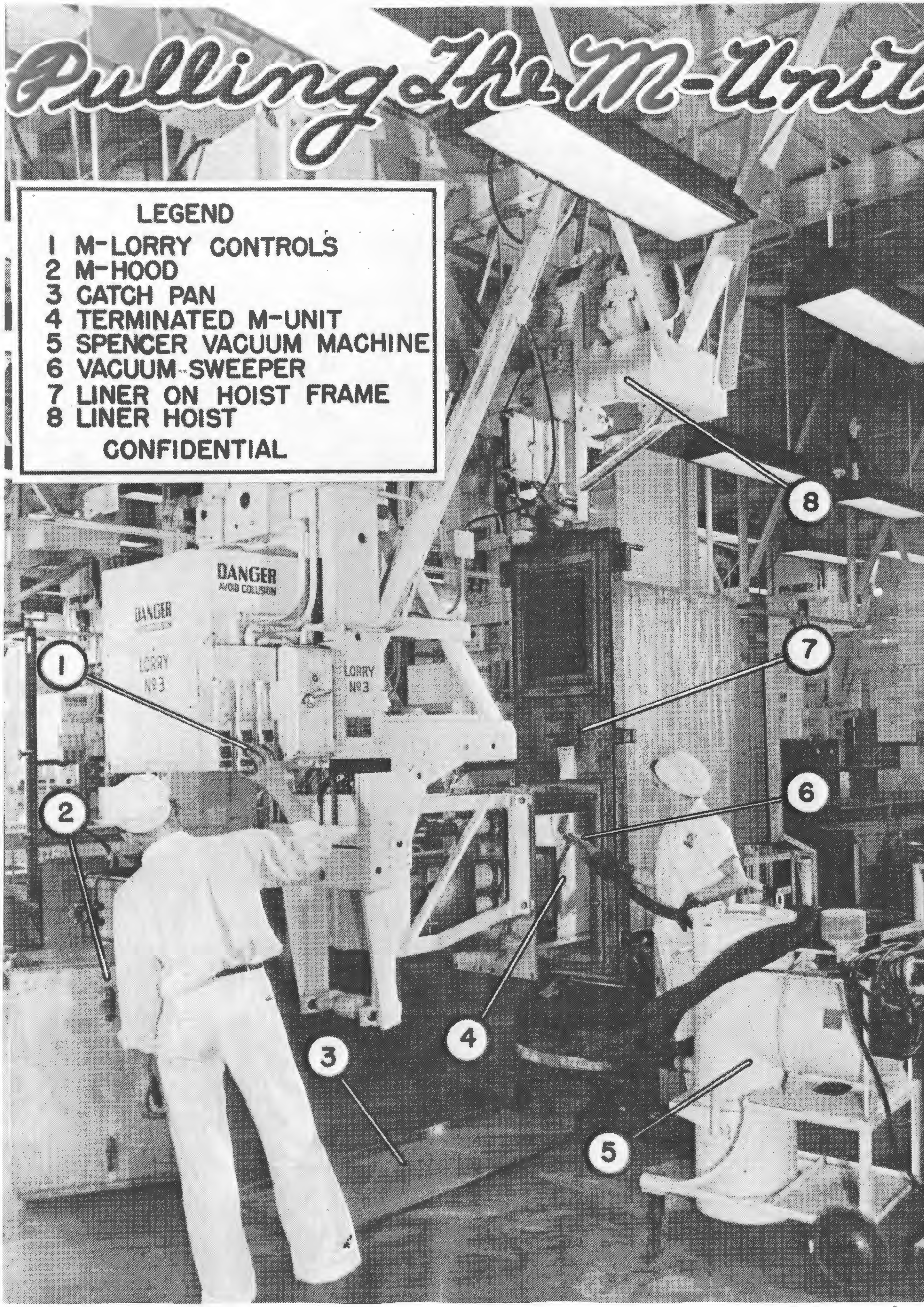
C14 Alpha II Handling Dolly

This dolly, electrically driven from a battery, is shown carrying the source unit which weighs approximately 1500 pounds.


NO SMOKING

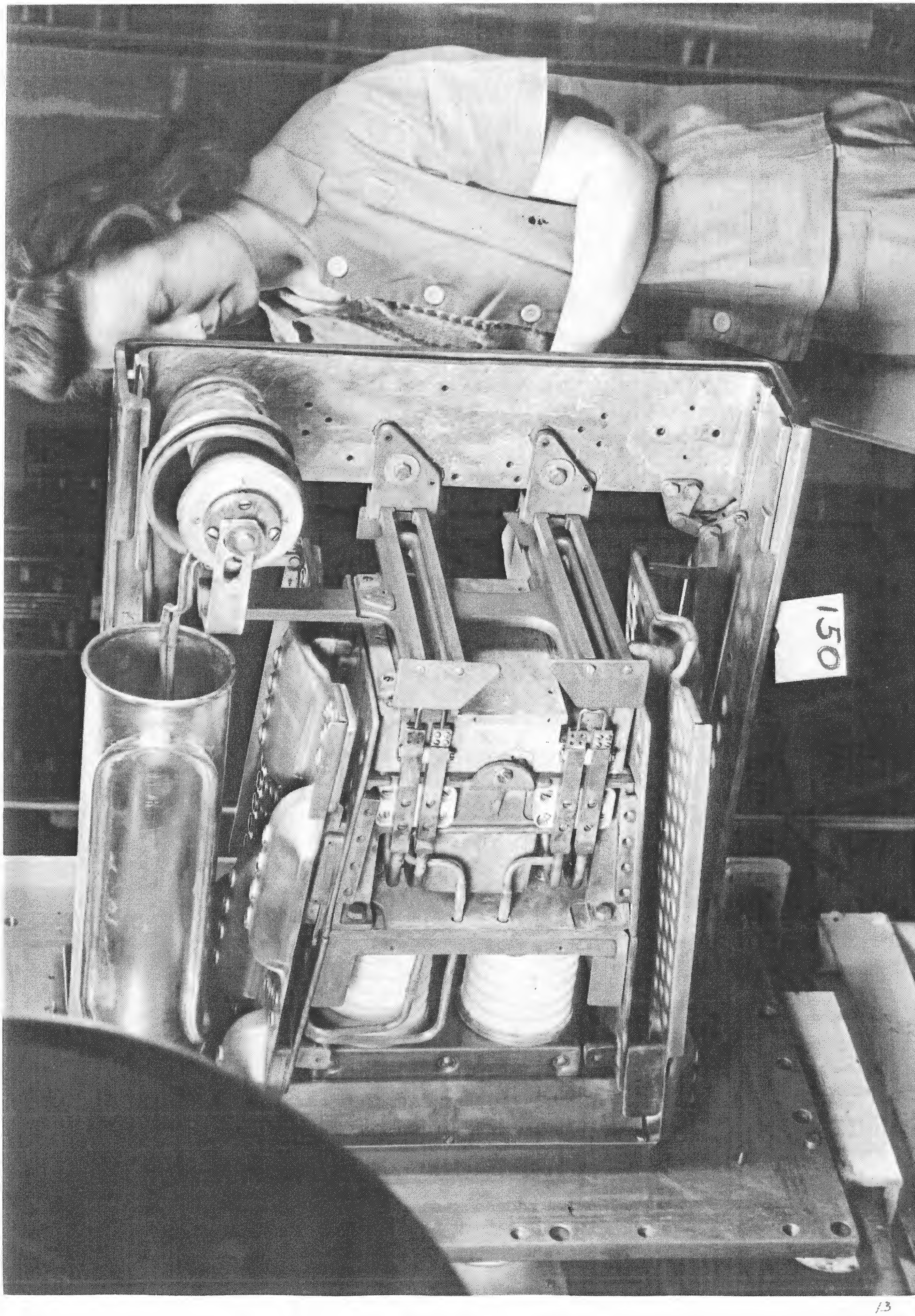
C15 Pulling the M-Unit

The Beta Source Unit (M-Unit) is shown being removed from the liner for washing. Note the operator using a vacuum cleaner to collect any loose material which might fall off.


Pulling The M-Unit
LEGEND
1 M-LORRY CONTROLS
2 M-HOOD
3 CATCH PAN
4 TERMINATED M-UNIT
5 SPENCER VACUUM MACHINE
6 VACUUM SWEEPER
7 LINER ON HOIST FRAME
8 LINER HOIST
CONFIDENTIAL
DANGER
AVOID COLLISION
LORRY
No 3
1
2
3
4
5
6
7
8

C16 <u>Servicing Beta Emitter</u>

Beta Source Unit being assembled.


150

[redacted]

C17 Beta Emitter

Beta Source Unit showing deposited Beta Feed material ~~(crud)~~ to be recovered.

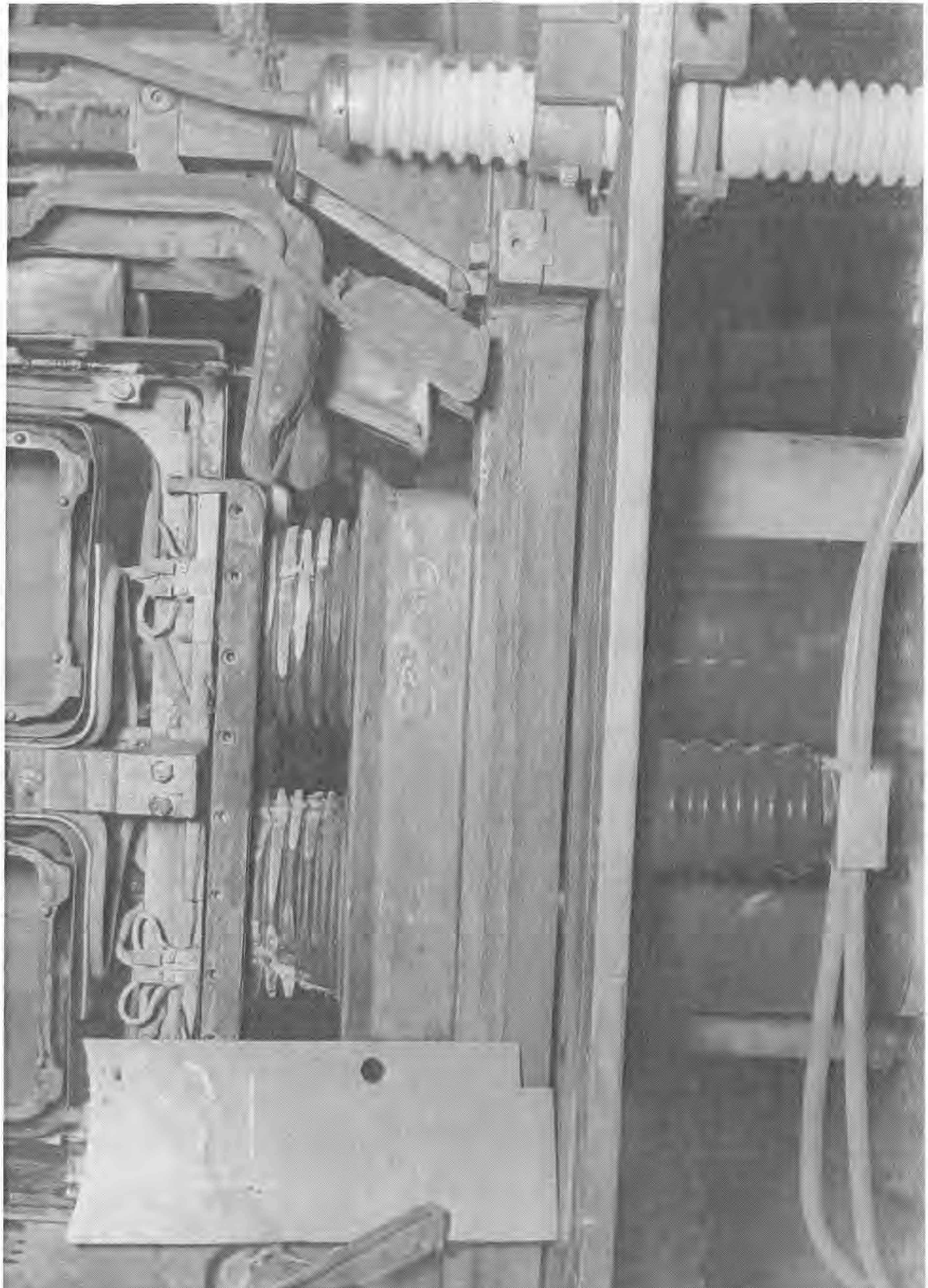
[redacted]

[redacted]

C18 Cracked Bushings

Section of Source Unit Showing cracked Alpha II M bushings after a run.

[redacted]



C19 Beta Receiver Pocket

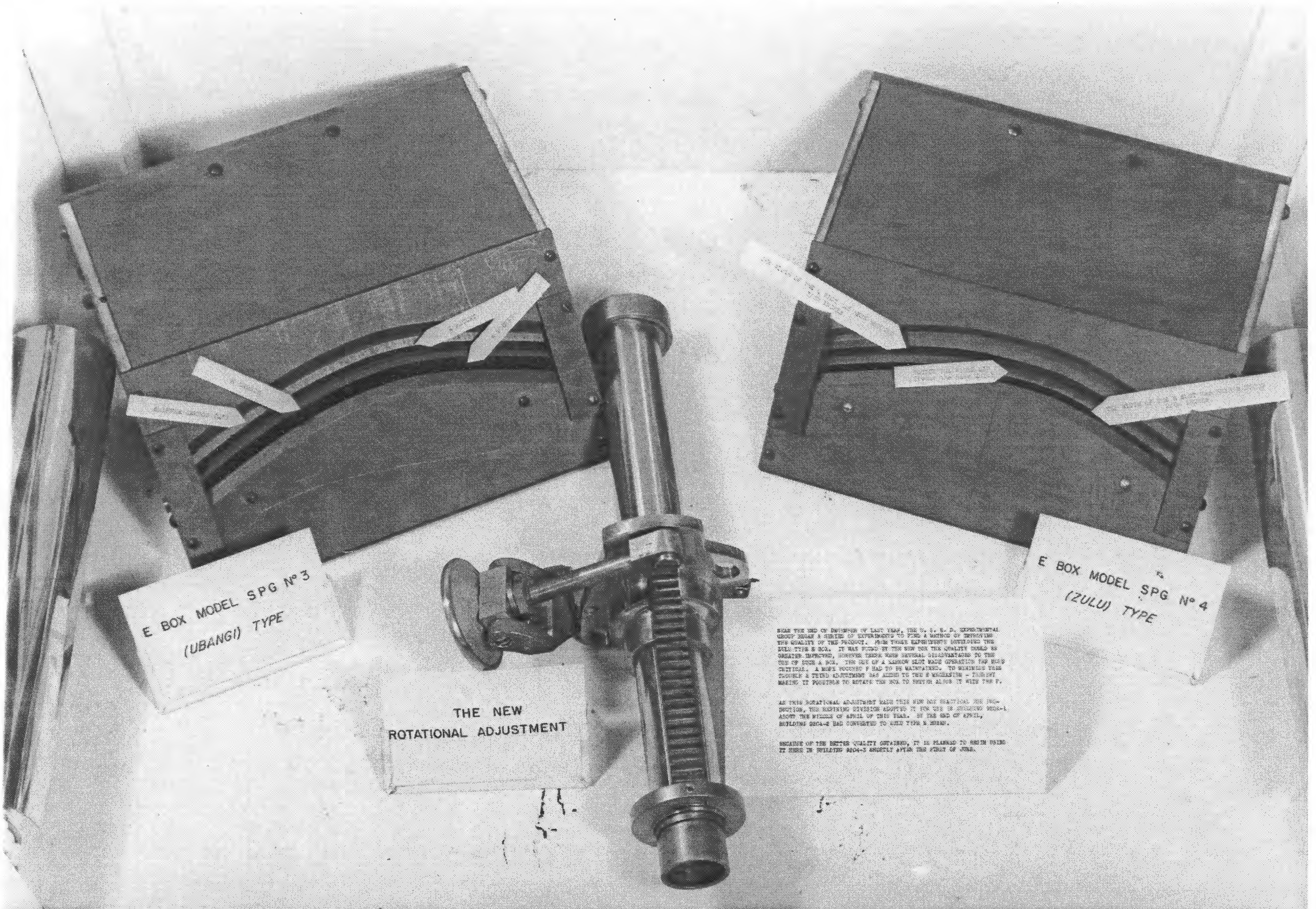
Experimental Model Beta type receiver pocket held by employee who helped to build it. Note code name of unit (Gloria).


JUNE 23 1944
USED
SPECIAL
109765
FRANK
&
GLORIA

~~TOP SECRET~~

C20 <u>Comparison of Zulu and Ubangi Receivers</u>

~~TOP SECRET~~


E BOX MODEL SPG Nº 3
(UBANGI) TYPE
THE NEW
ROTATIONAL ADJUSTMENT
E BOX MODEL SPG Nº 4
(ZULU) TYPE

[redacted]

C21 Alpha II Type Receiver

An Alpha II type receiver as used in Alpha track 5 for four beam operation.

[redacted]

C22 <u>E Assembly Support Parts, Alpha II</u>

A portion of the parts required to assemble an Alpha II Receiver Unit. Large number of parts complicated the servicing.


E ASSEMBLY SUPPORT PARTS, ALPHA II
WESTINGHOUSE DESIGN

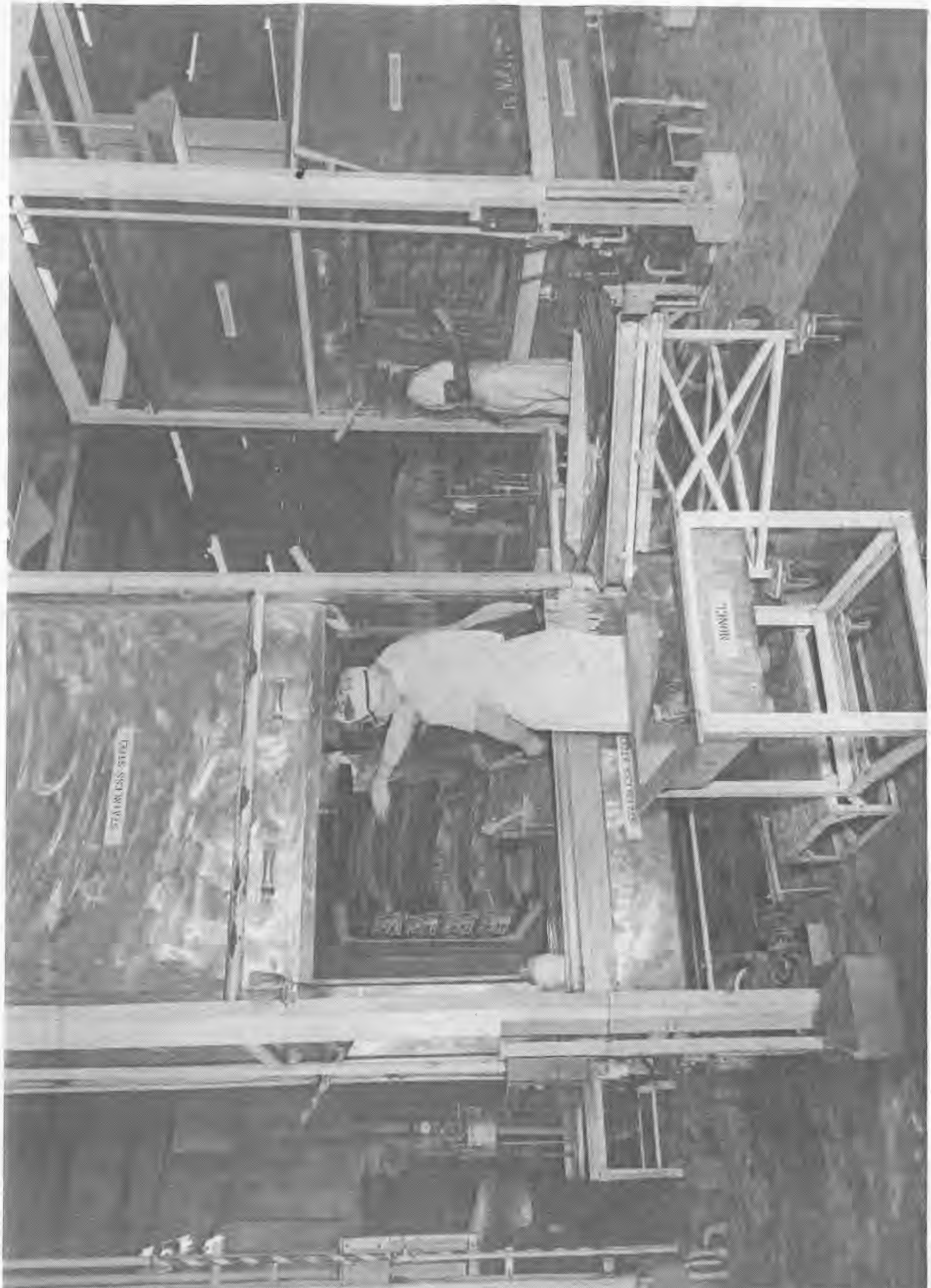
C23 <u>E Unit Disassembly, Beta</u>

All handling is done over stainless steel trays and the pockets containing product are wrapped with a transparent wrapper for shipment as the E (reciever) units are disassembled.

E-Unit Disassembly
This is a CHEMICAL AREA
1
2
3
4
5
LEGEND
1 E-POCKET REMOVAL
2 SMALL PARTS TRAY
3 E-POCKET TRANSFER TRAY
4 POCKET IN KODAPAK
5 OUTSIDE WRAPPING
CONFIDENTIAL

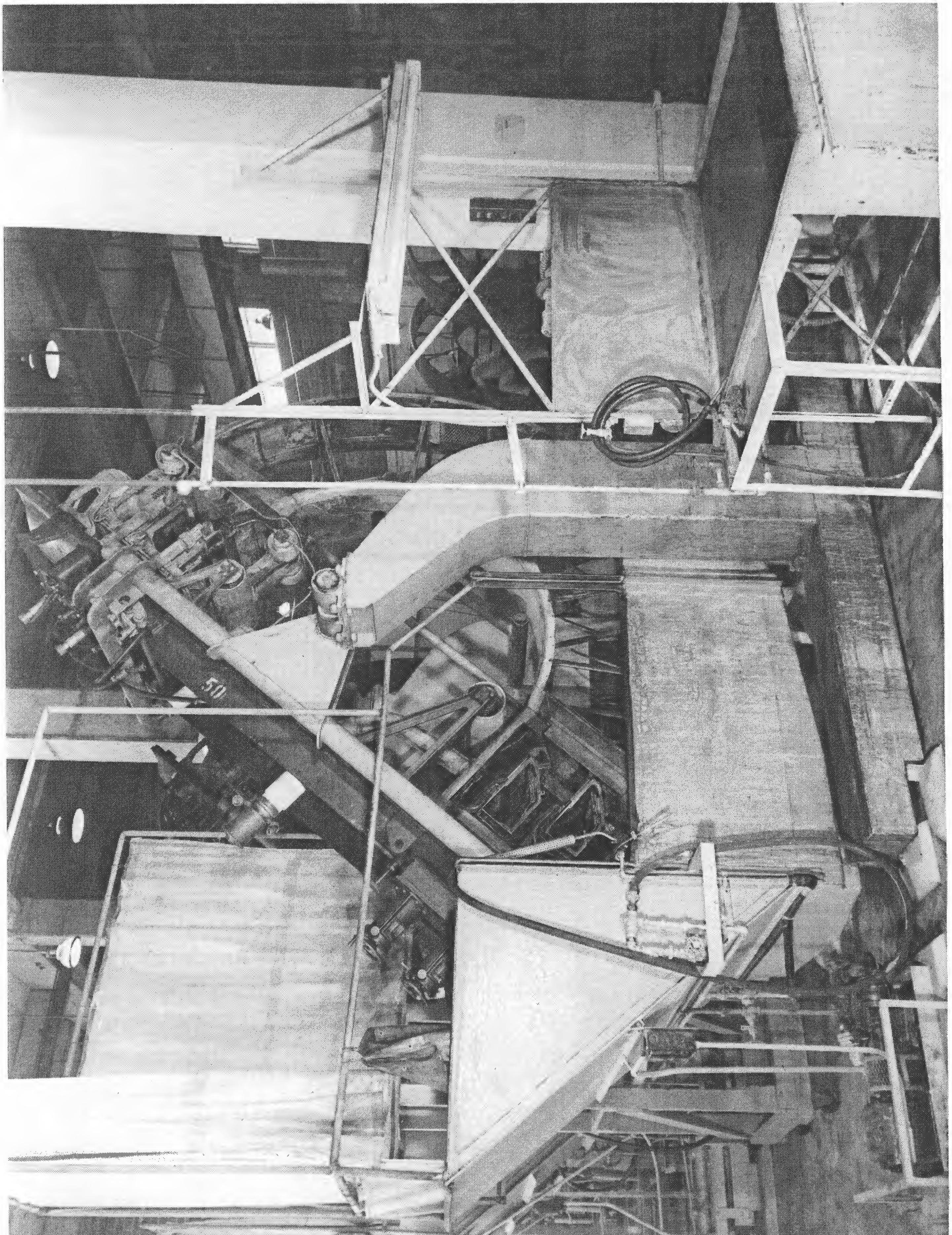
C24 Dismantling and Washing Receivers, Alpha II

Alpha II Receiver Units being dismantled in Wash Stand at left. Note R pockets containing Alpha product being wrapped in a transparent wrapper for transfer to Beta. Dismantled unit is being washed at right.


STAINLESS STEEL
MONEL

C25 <u>Alpha I D Unit in Washstand</u>

Receiver end of D unit is closest to the floor.


50

C26 Alpha II Bin Being Washed

Relative size is indicated by workman entering bin.

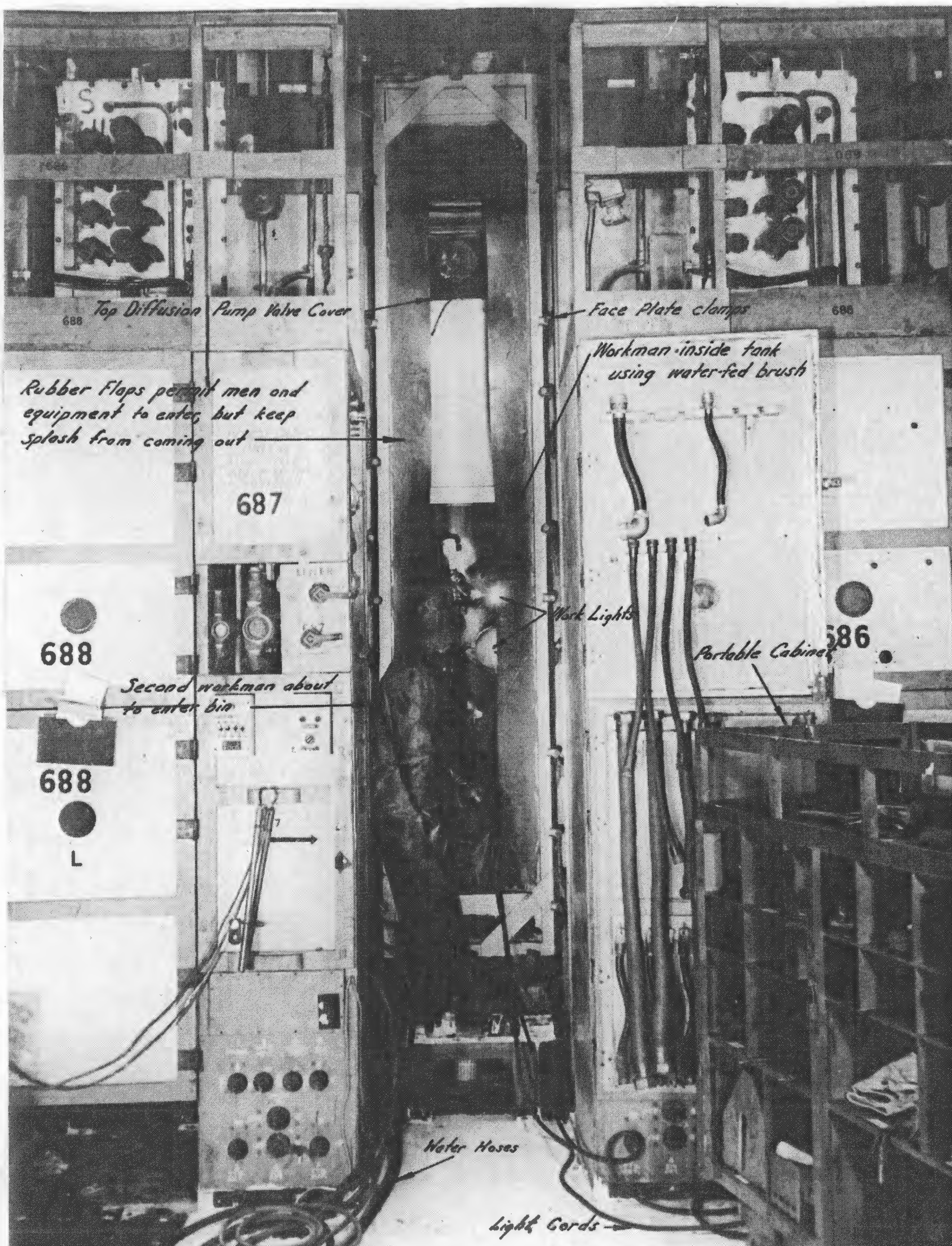


PLATE NO. 13 - WATER RINSE

RUBBER COVERED SPLASH DOOR AND

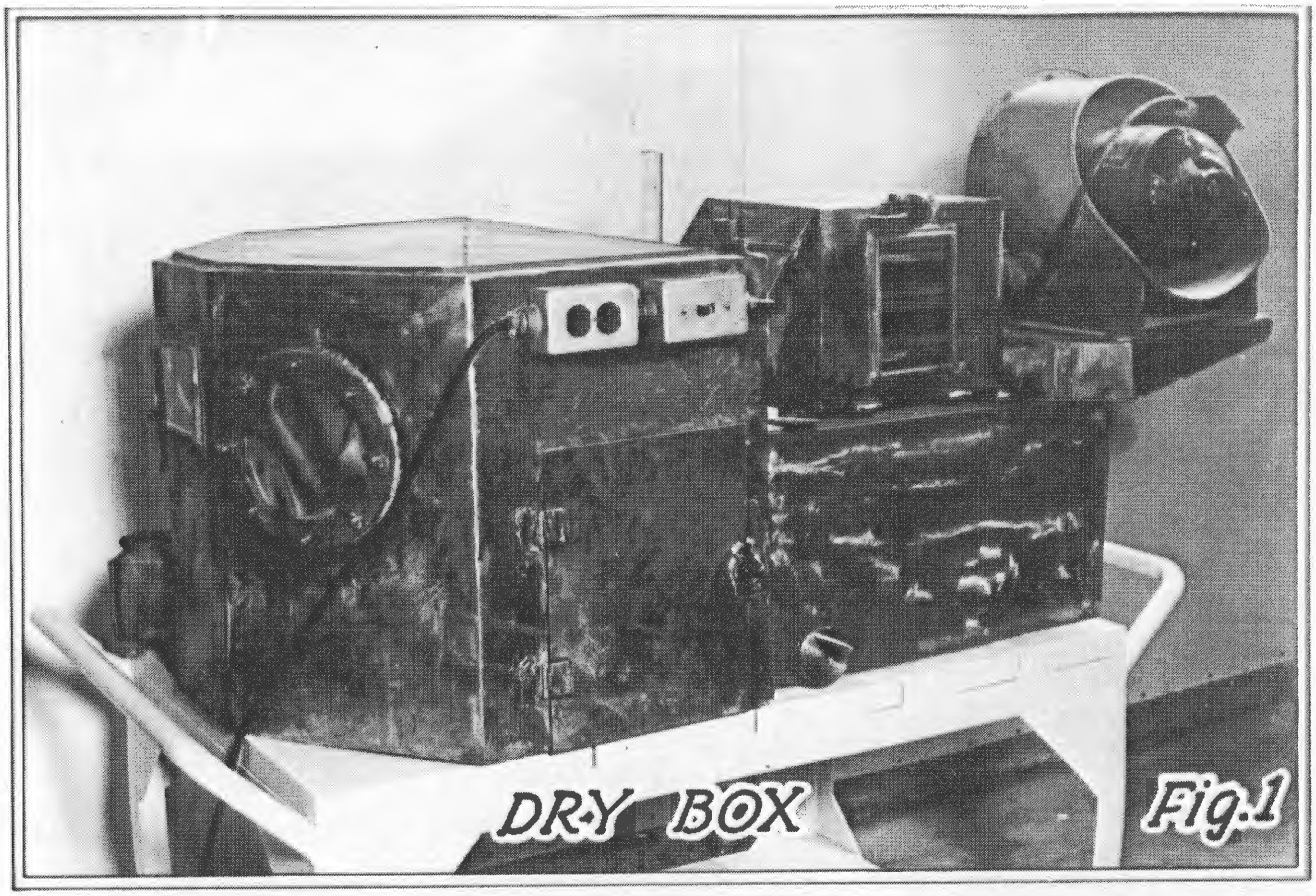
OTHER EQUIPMENT IN USE

C27 <u>Beta Charge Bottle</u>

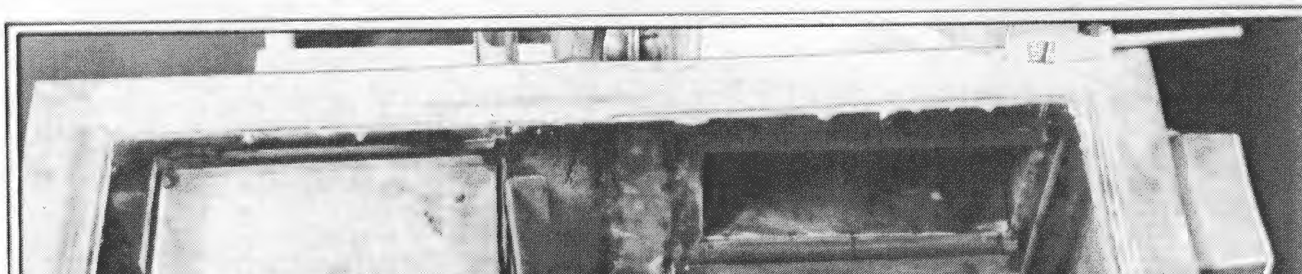
This is approximately a full size view of the Beta charge bottle which is filled with about one kilogram of charge material.

C28 Dry Box

Two views of a dry box in which charge material is handled to prevent the absorbtion of moisture.



DRY BOX Fig.1

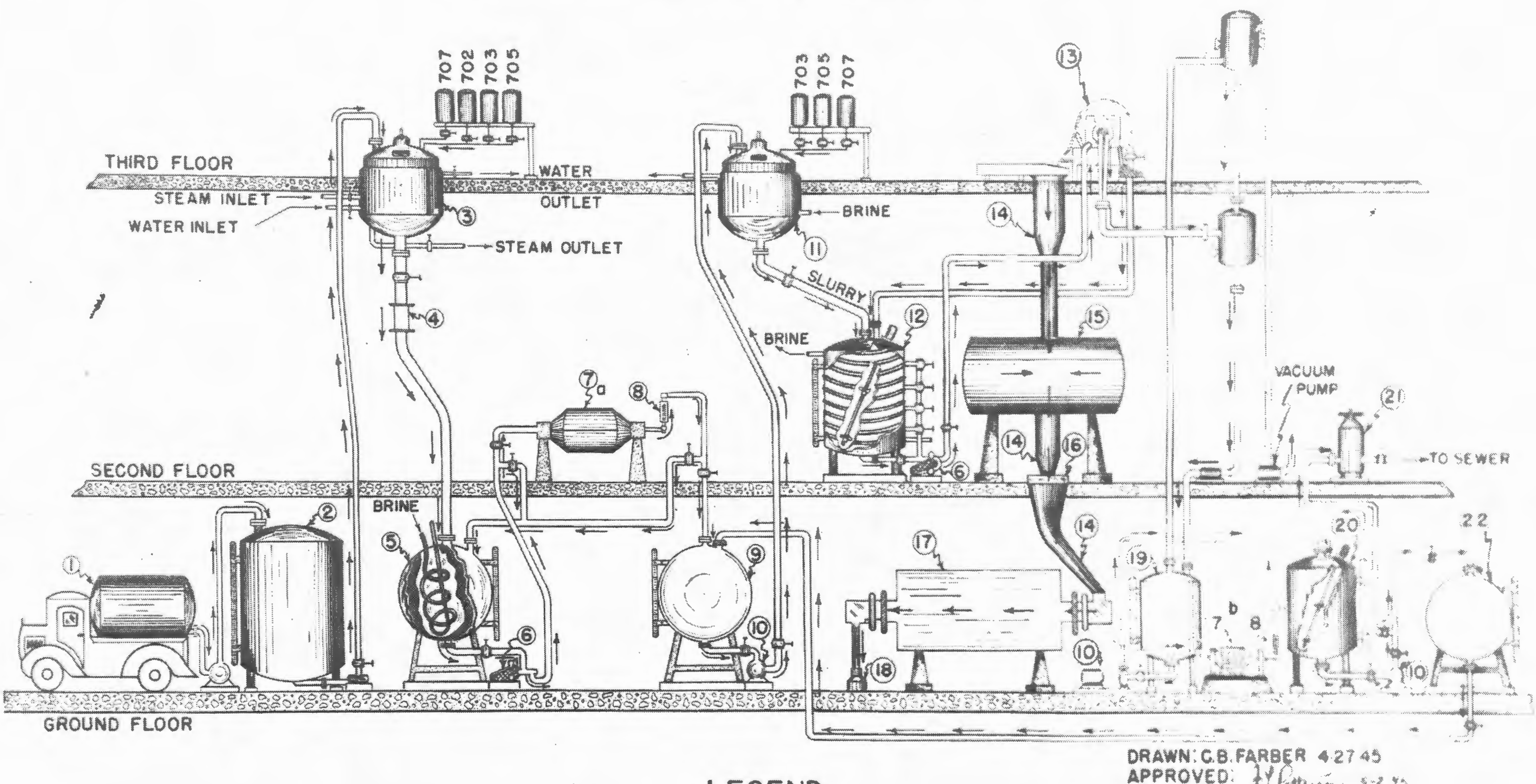


DRY BOX (Interior) Fig.2

C29 <u>Flow Diagram - Bulk Treatment</u>

Gunk solution obtained by washing Alpha units after a run in the racetrack is processed to the orange oxide (UO_3).

FLOW DIAGRAM- BULK TREATMENT- DEPT. 180

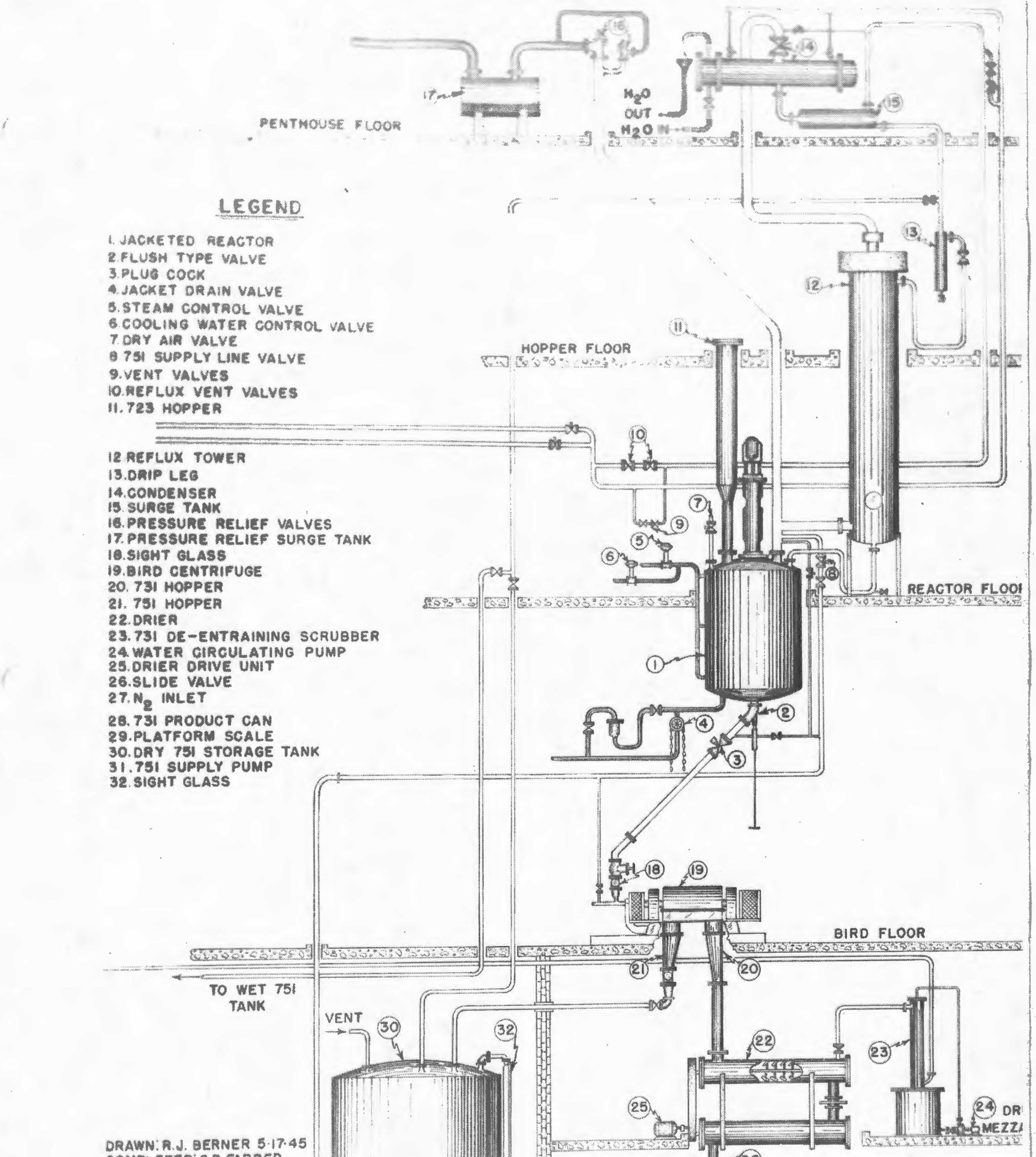


LEGEND

1. 1000 GAL. TANK TRUCK
2. 4000 GAL. G.L. GUNK STORAGE TANK
3. 750 GAL. G.L. REACTOR (OXIDATION PROCESS)
4. SCREEN FILTER BASKET
5. 1000 GAL. STORAGE TANK
6. CENTRIFUGAL PUMP- 60# HEAD
7. FILTER PRESS
   a. CARBON
   b. POLISHING
8. ROTOMETER-0-25 G.P.M.
9. 1000 GAL. STORAGE TANK
10. DURCO CENTRIFUGAL PUMP
11. 750 GAL. G.L. REACTOR (PEROXIDE PRECIPITATION PROCESS)
12. 1000 GAL. STORAGE TANK
13. OLIVER FILTER
14. HOPPER
15. VACUUM DRIER
16. SCREENER
17. CALCINER
18. 723 STORAGE CAN
19. FILTRATE STORAGE
20. TESTING TANK
21. ALSOPFILTER
22. HIGH 720 STORAGE TANK

030 <u>Flow Diagram - Liquid Phase (Alpha)</u>

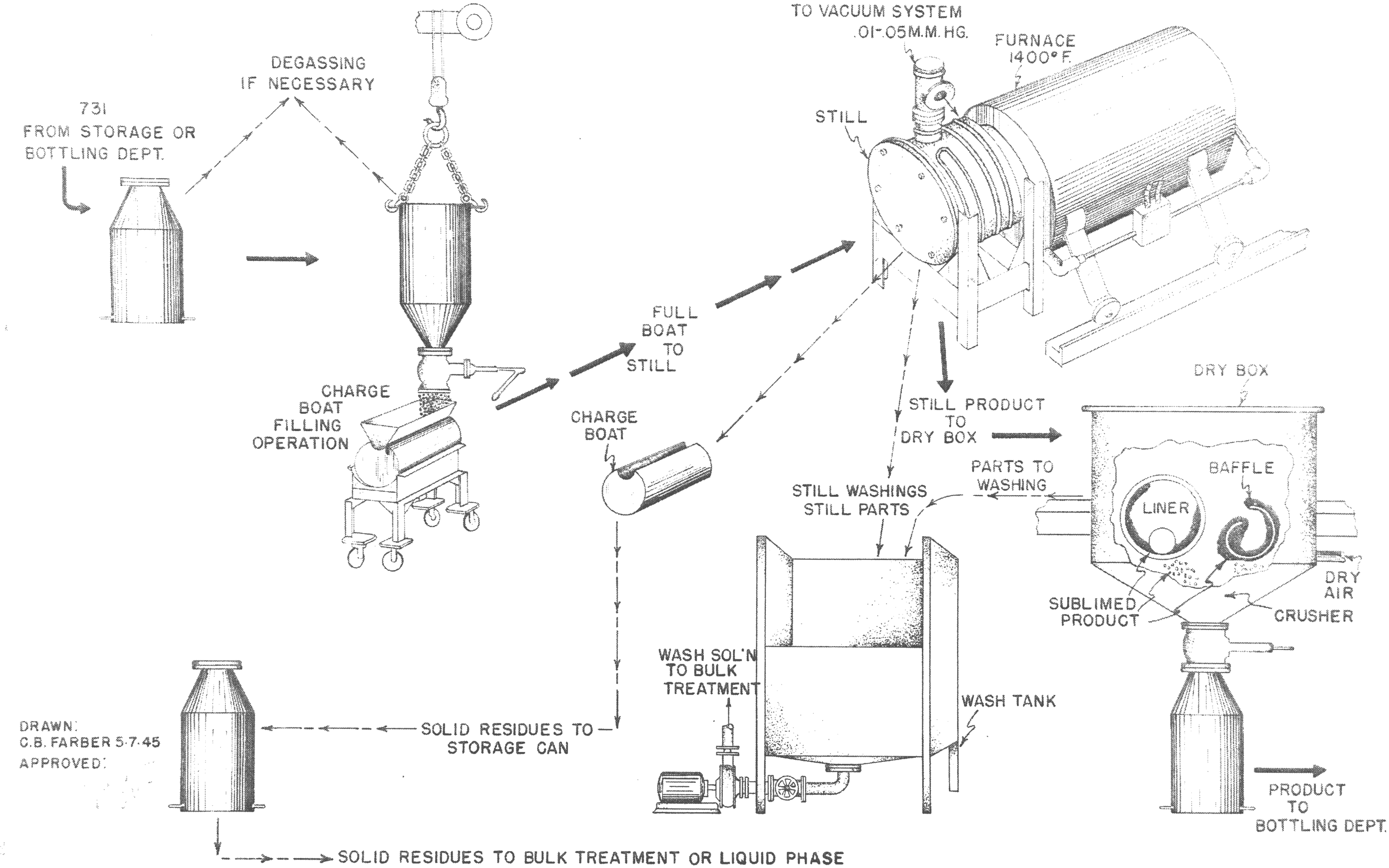
The orange oxide (UO_3) is converted to unpurified charge material which is the grey green salt, Uranium tetrachloride (UCL_4).


PENTHOUSE FLOOR
H_2O OUT
H_2O IN
LEGEND
1. JACKETED REACTOR
2. FLUSH TYPE VALVE
3. PLUG COCK
4. JACKET DRAIN VALVE
5. STEAM CONTROL VALVE
6. COOLING WATER CONTROL VALVE
7. DRY AIR VALVE
8. 751 SUPPLY LINE VALVE
9. VENT VALVES
10. REFLUX VENT VALVES
11. 723 HOPPER
12. REFLUX TOWER
13. DRIP LEG
14. CONDENSER
15. SURGE TANK
16. PRESSURE RELIEF VALVES
17. PRESSURE RELIEF SURGE TANK
18. SIGHT GLASS
19. BIRD CENTRIFUGE
20. 731 HOPPER
21. 751 HOPPER
22. DRIER
23. 731 DE-ENTRAINING SCRUBBER
24. WATER CIRCULATING PUMP
25. DRIER DRIVE UNIT
26. SLIDE VALVE
27. N_2 INLET
28. 731 PRODUCT CAN
29. PLATFORM SCALE
30. DRY 751 STORAGE TANK
31. 751 SUPPLY PUMP
32. SIGHT GLASS
HOPPER FLOOR
REACTOR FLOOI
BIRD FLOOR
TO WET 751 TANK
VENT
DRI
MEZZ
GROUND FLOOR
DRAWN: R.J. BERNER 5-17-45
COMPLETED: C.B. FARBER 5-19-45
APPROVED: 5-21-45

C31 Flow Diagram - Sublimation

Unpurified uranium tetrachloride (UCL_4) for use in the Alpha tracks is sublimed removing impurities and producing pure charge material (UCL_4).

FLOW DIAGRAM-SUBLIMATION-DEPT. 180



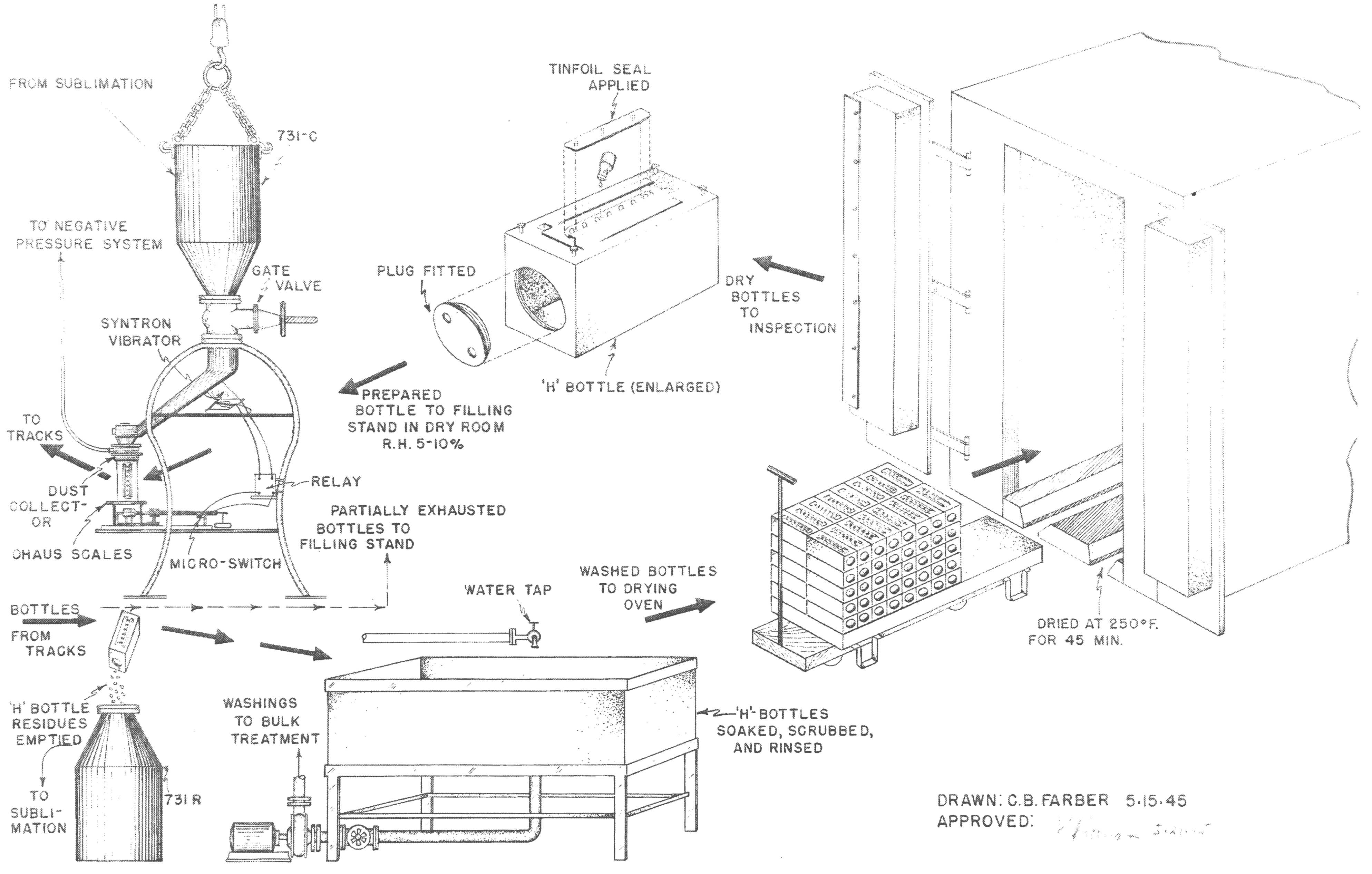
[redacted]

C32 <u>Flow Diagram - Bottling</u>

Purified uranium tetrachloride (UCl_4) is placed in charge bottles to be sent to the Alpha tracks.

[redacted]

FLOW DIAGRAM-BOTTLING-DEPT. 180

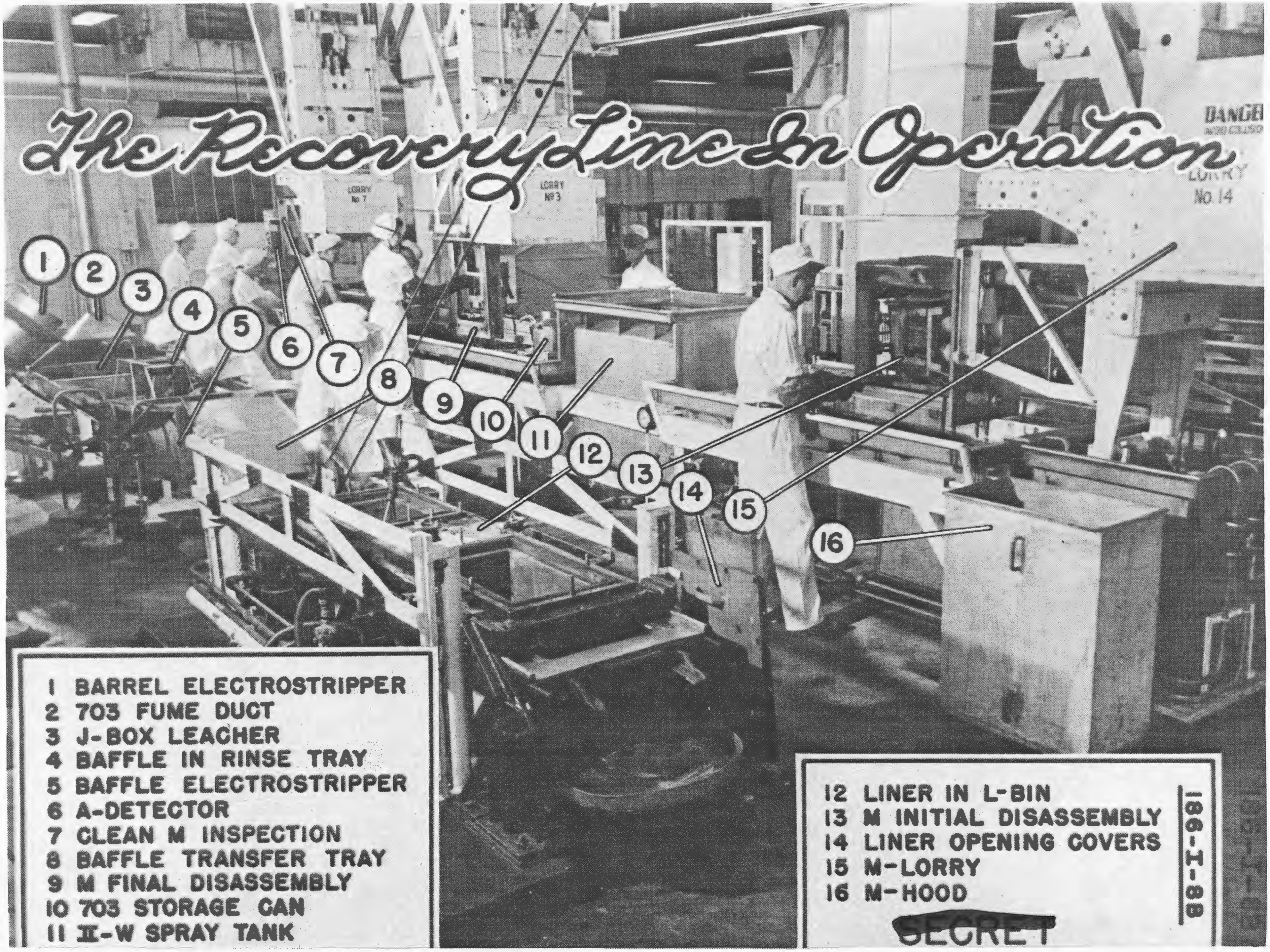


[redacted] SECRET

C33 <u>The Recovery Line in Operation</u>

This is the step where material is washed from the Beta units to start the recycle through chemistry.

[redacted]

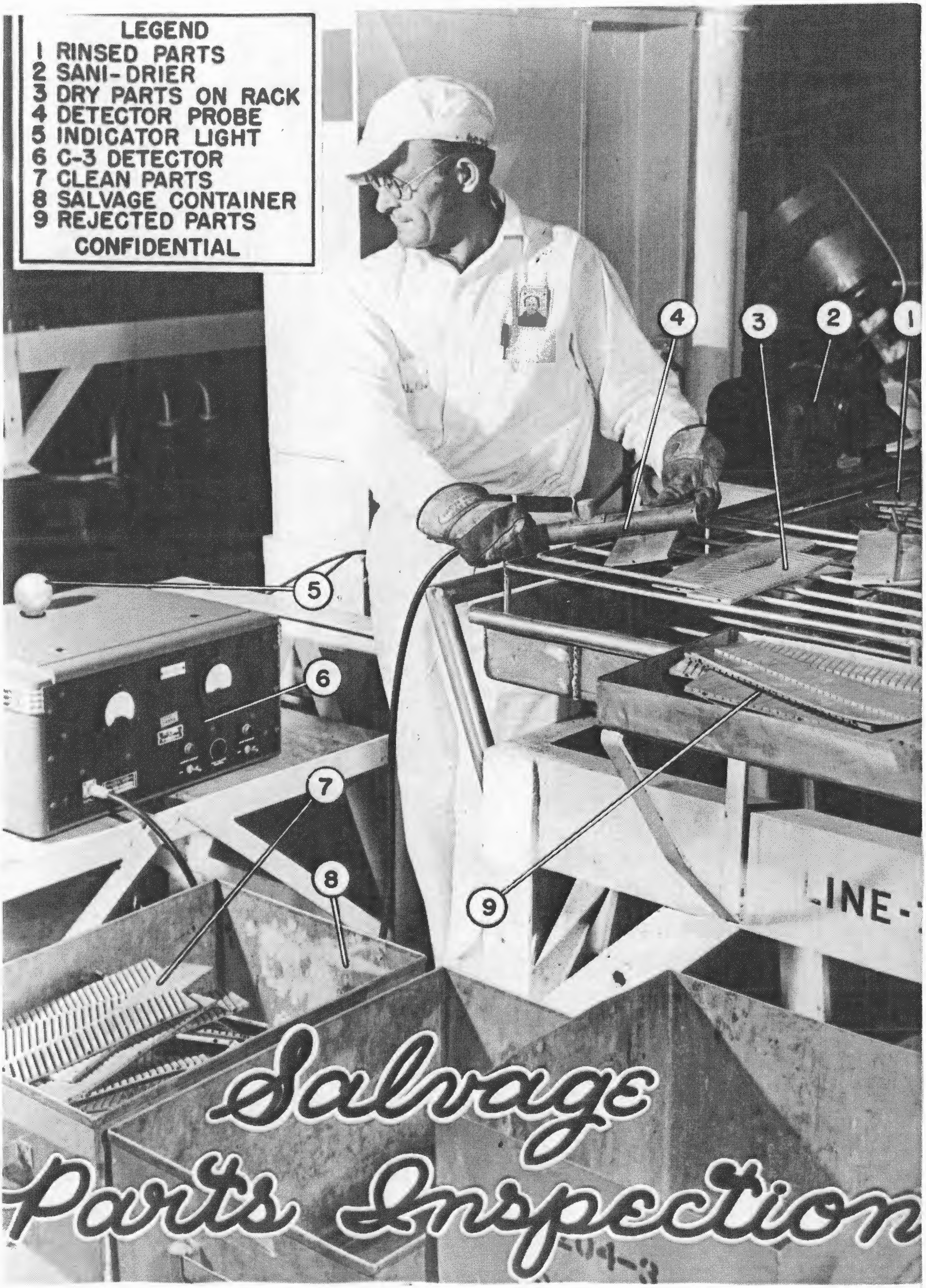

The Recovery Line In Operation
DANGER
LORRY No.14
LORRY No 7
LORRY Nº 3
1 BARREL ELECTROSTRIPPER
2 703 FUME DUCT
3 J-BOX LEACHER
4 BAFFLE IN RINSE TRAY
5 BAFFLE ELECTROSTRIPPER
6 A-DETECTOR
7 CLEAN M INSPECTION
8 BAFFLE TRANSFER TRAY
9 M FINAL DISASSEMBLY
10 703 STORAGE CAN
11 II-W SPRAY TANK
12 LINER IN L-BIN
13 M INITIAL DISASSEMBLY
14 LINER OPENING COVERS
15 M-LORRY
16 M-HOOD
186-H-88
SECRET

~~TOP SECRET~~

C34 <u>Salvage Parts Inspection</u>

The operator is inspecting salvage parts to determine the concentration of uranium by means of a radiation detector.

~~TOP SECRET~~


LEGEND
1 RINSED PARTS
2 SANI-DRIER
3 DRY PARTS ON RACK
4 DETECTOR PROBE
5 INDICATOR LIGHT
6 C-3 DETECTOR
7 CLEAN PARTS
8 SALVAGE CONTAINER
9 REJECTED PARTS
CONFIDENTIAL
4
3
2
1
5
6
7
8
9
LINE-
Salvage
Parts Inspection

[redacted]

C35 Beta Hex Conversion

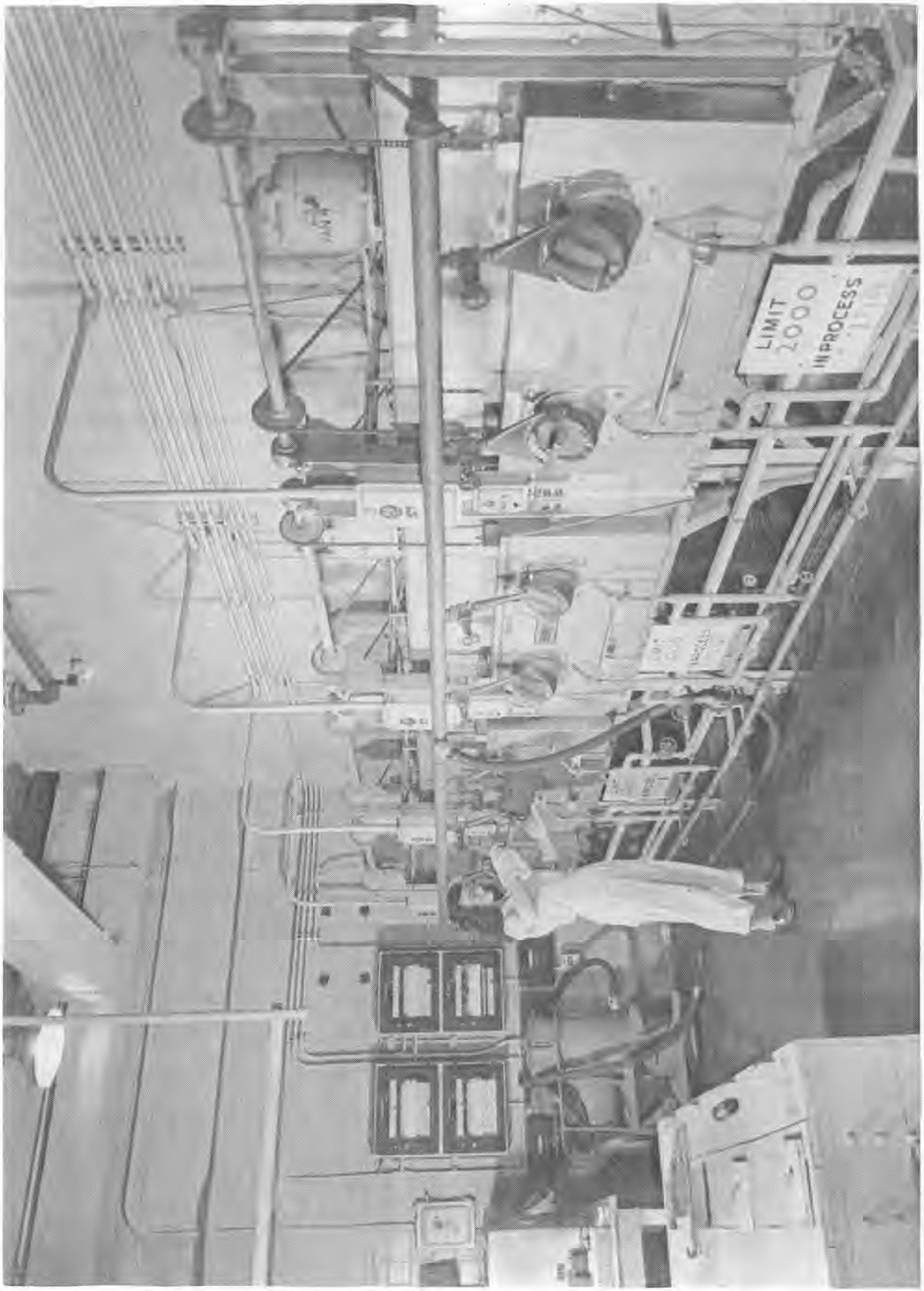
The Uranium hexafluoride (UF_6) received from K-25 as feed for Beta is converted to the orange oxide (UO_3).

[redacted]


LIMIT
1000
IN PROCES
LIMIT
IN PROCESS

C36 <u>Calcining Ovens in Beta Chemistry</u>

Uranium Peroxide (UO_4) on heating loses oxygen to produce the orange oxide (UO_3).

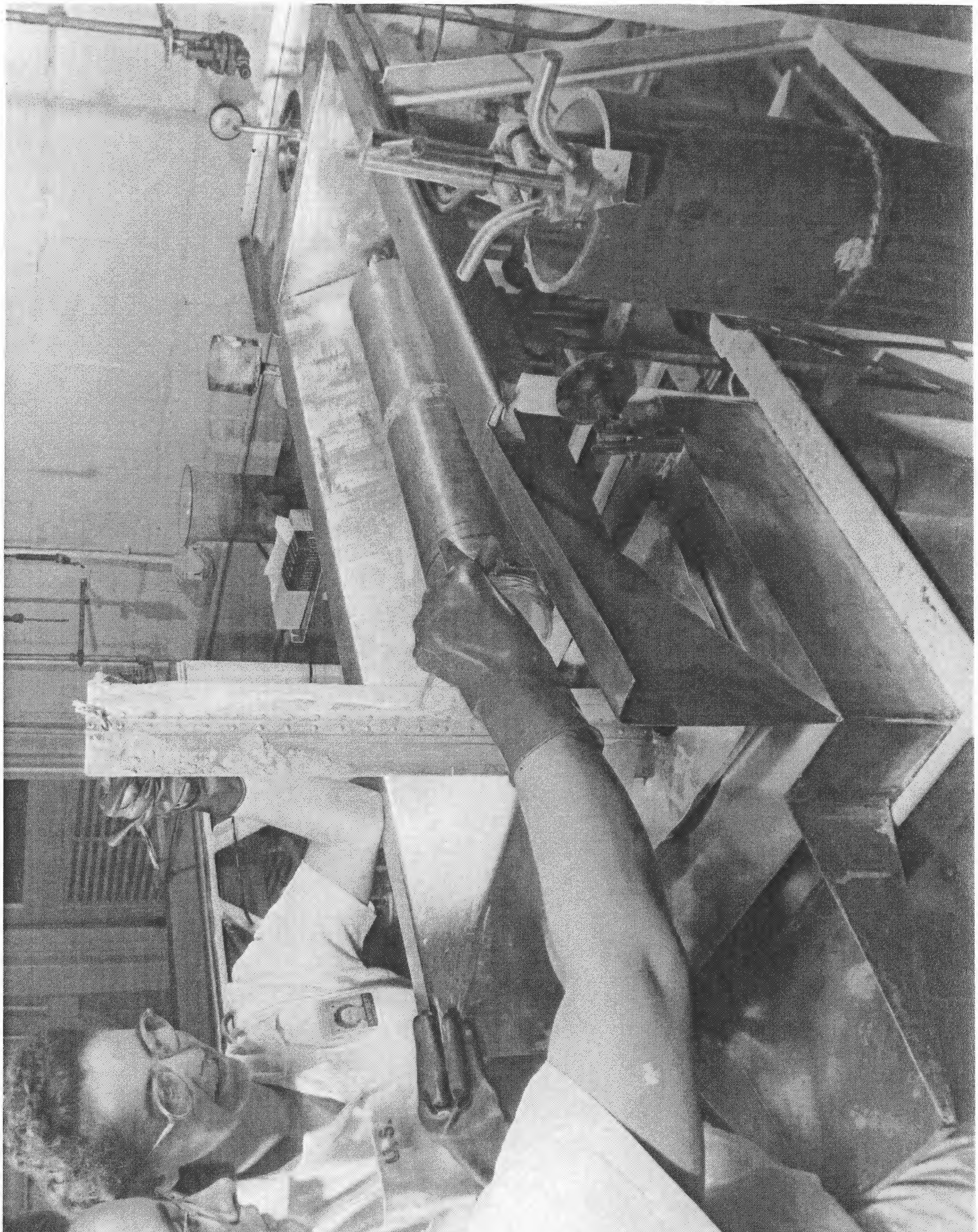

LIMIT
2000
IN PROCESS

[redacted]

037 Bowl Cleaning in Beta Chemistry

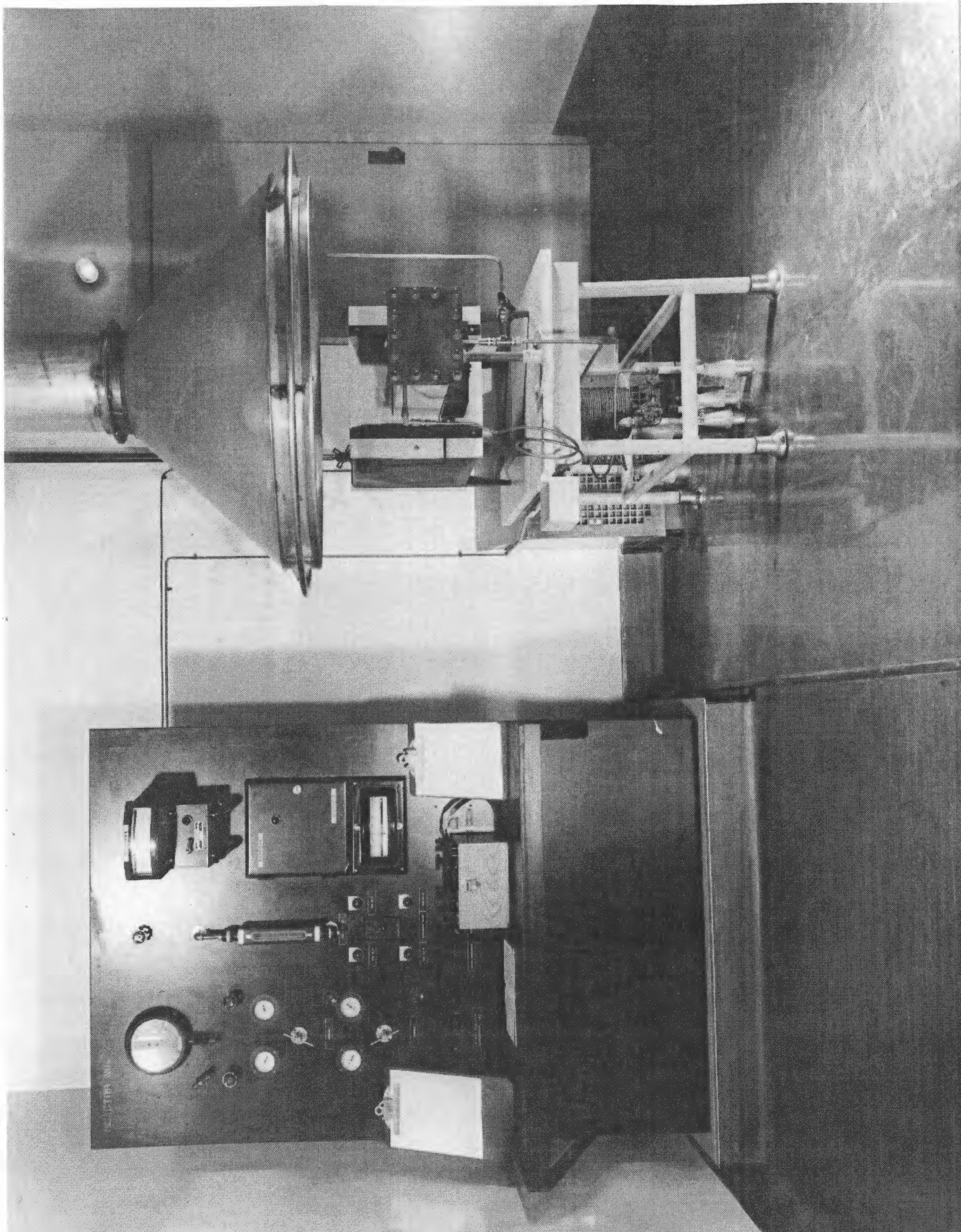
Uranium Yellow Oxide (UO_4) is scraped from the centrifuge bowls where it had been separated from the solution in which it was suspended after precipitation.

[redacted]



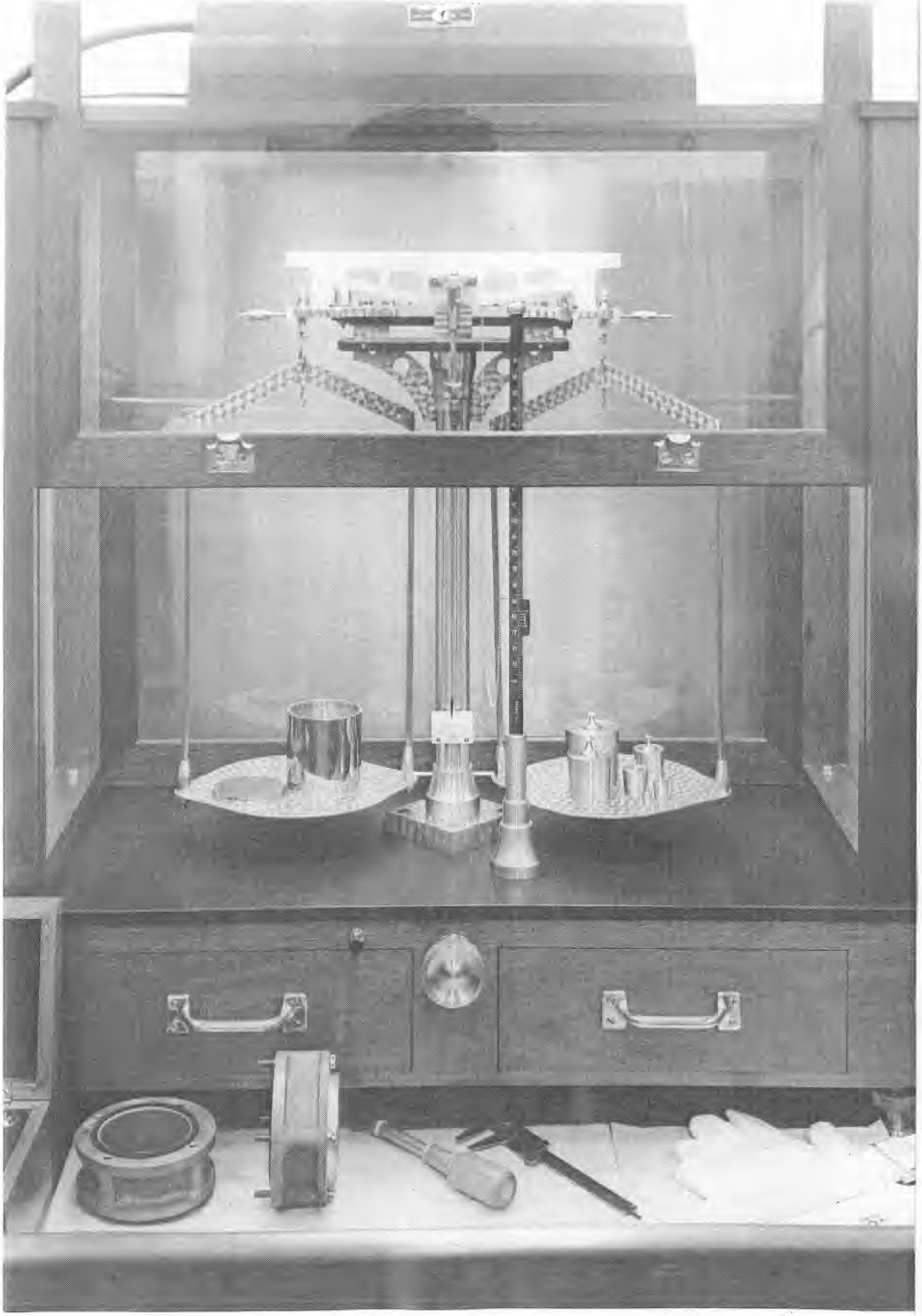
G38 Hydrogen Fluoride Furnace

The final product (UF_4) is produced in this furnace by treating the orange oxide (UO_3) with Hydrogen Fluoride (HF).



C39 <u>Shipping Container on Balance</u>

Gold plated container (on balance pan) is placed in cadmium lined jacket (shown at lower left) which is bolted together and sealed.



MANHATTAN DISTRICT HISTORY

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APPENDIX "D"

REFERENCES

No.	Description	Location	
1	TEC History 1945	District Files	
2	Contract W-7401-eng-23	"	"
3	Modifications, Contract W-7401-eng-23	"	"
4	Personnel File, Y-12 #230	"	"
5	"Activation of SED", 1 September 1943	"	"
6	Roster of Enlisted Men at TEC	"	"
7	Monthly Navy Roster for Bureau of Personnel	"	"
8	TEC History, January to June 1944	"	"
9	Procurement File (Y-12 File #400.12)	"	"
10	Y-12 Unit Chief Report, November 1943	"	"
11	Y-12 Unit Chief Report, December 1943	"	"
12	Y-12 Unit Chief Report, January 1943	"	"
13	Alpha Chemistry Operating Manual TEC #CDM 101	District Files	
14	"Alpha Chemistry" Memo by Dr. C. Winters, 20 November 1944	"	"
15	Alpha Physical Inventories, (API #1 and 2), 9 September 1945	"	"
16	Y-12 Unit Chief Report, March 1944	"	"
17	Y-12 Unit Chief Report, April 1944	"	"

[redacted]

No.	Description	Location
18	Y-12 Unit Chief Report, May 1944	District Files
19	Report on Bld. 9207, Chem. Group, Y-12 Area, 27 Nov. 1945 by Major W. E. Gates	Dist. Class. Files
20	"Beta Chemistry" Memo by Dr. C. E. Winters, 20 November 1944	District Files
21	Letter General Groves to Colonel Nichols, 12 January 1944 (Product Special File)	" "
22	"Lot EFI" (JM 37) Letter Dr. J. G. McNally to Major W. E. Kelly	" "
23	Alpha Termination Graphs	" "
24	Conference Memoranda (Y-12 File #337, July to Dec. 1944)	" "
25	Memo on Conference 9 August 1944, Major W. E. Kelly (Y-12 File #337)	" "
26	Report on Beta Production for July 1944 (Y-12 File #337)	" "
27	Y-12 Unit Chief Report, June 1944	" "
28	Y-12 Unit Chief Report, Aug. 1944	" "
29	Y-12 Unit Chief Report, Sept. 1944	" "
30	Y-12 Unit Chief Report, Oct. 1944	" "
31	Graphs Based on TEC Production Figures	" "
32	Y-12 Unit Chief Report, Dec. 1944	" "
33	Y-12 Unit Chief Report, July 1944	" "
34	Y-12 Unit Chief Report, Nov. 1944	" "
35	Receipt Ledger For S-50 Material (800 Series)	" "
36	Beta Fluoride Shipment Register	" "
37	Y-12 Unit Chief Report, Jan. 1945	" "
38	Y-12 Unit Chief Report, Feb. 1945	" "
39	Y-12 Unit Chief Report, March 1945	" "

[redacted]

[redacted]

No.	Description	Location
40	Receipt Ledger for K-25 Material (900 Series)	District Files
41	TEC History, January 1945	" "
42	Y-12 Unit Chief Report, April 1945	" "
43	Y-12 Unit Chief Report, May 1945	" "
44	Y-12 Unit Chief, Report, June 1945	" "
45	Y-12 Unit Chief Report, July 1945	" "
46	Y-12 Unit Chief Report, Aug. 1945	" "
47	Receipt Ledger for K-25 Material (1100) Series	" "
48	Receipt Ledger for K-25 Material (1200) Series	" "
49	TEC Run Termination Summaries	" "
50	Alpha Physical Inventory Reports	" "
51	Beta Physical Inventory Reports	" "
52	Standard Analytical Procedures Manual (TEC #CD 3801)	" "
53	Monthly Progress Reports Depts. 188, 190, 191.	" "
54	"A Review of Research and Development on the Project" by Oran E Nuller, D Spec. #2, 23 March 1944	TEC Library
55	Process Improvement Progress Report, March 1944 (XL Files)	District Files
56	Summary of Operations of Test Group 9204-1, 6 May to 30 June 1944 by R. L. Thornton XL 51-5-3	" "
57	Beta E Progress Report May and June 1944 by H. York XL 51-5-2	" "
58	Recovery Liners Alpha II by Crittendon & Wright, 15 November 1944 XL 8-6-802	" "
59	Final Progress Report of Alpha I Test Group 920101, by B. J. Mayer XL 52-5-3	" "

[redacted]

[redacted]

No.	Description	Location
60	Preliminary Reports on Beta Slot Width Studies by E Gardner & H. York XL 51-6-5	District Files
61	Period Progress Reports J. Research group by F. T. Howard & A. H. Barnes	TEC Library
62	TEC History Reports, Process Improvement Section	District Files
63	Monthly Progress Reports on Cooperative Ceramic Work from Norris Electrotechnical Lab.	TEC Library
64	Letter to J. C. White of TEC from District Security Officer (Y-12 File #380.01)	District Files
65	Memo to files by E. B. Brown, 23 October 1945 (Y-12 File 380.01)	" "
66	TEC History Reports, Guard Department Section	" "
67	Employee Breakdown, TEC (Y-12 File 230)	" "
68	TEC History Reports, Fire Department Section	" "
69	TEC History Reports, Fire Department Section	" "
70	Losses (Y-12 File 400.73)	" "
71	TEC Emergency Plan	" "
72	TEC History Reports, Medical Division Section	" "
73	Medical Studies and Health Hazards	" "
74	Safety (Y-12 File #729.3)	" "
75	Fatalities (Y-12 File 704.01)	" "
76	TEC History Reports, Administration Sec.	" "
77	TEC History Reports, Housing Department Section	" "
78	TEC History Reports, Cafeteria Section	" "

[redacted]

No.	Description	Location
79	TEC History Reports, Laundry Section	District Files
80	Water (Y-12 File #671.1)	" "
81	TEC Water Usage Reports	" "
82	TEC Power Consumption Reports	" "
83	Sewage (Y-12 File #671.2)	" "
84	TEC History Reports, Traffic Department Section	" "
85	"Beta Receiver Program of the Radiation Laboratory at Site X" January to April '44	" "
86	Health Studies and Hazards	" "
87	Letter Jam. Kelly to General Groves, 31 July 1944 (Y-12 Prediction File)	" "
88	Letter J. G. McNally to Lt. Col. Ruhoff (JM329), 1 June 1945 (Y-12 Prediction File)	" "
89	Letter Col. Nichols to Dr. J. R. Oppenheimer 3 July 1945 (Y-12 Prediction File)	" "
90	Letter Maj. Hadlock to Lt. Col. Peterson 1 August 1945 (Y-12 Prediction File)	" "
91	Y-12 Unit Chief Report, September, 1945	" "
92	Personnel, TEC (Y-12 File #230.145)	" "
93	Beta Chemical Production Reports	" "
94	Period Progress Reports, PI Division 8. Period 1945 and Later	" "
95	Y-12 Operations Personnel File	" "

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APPENDIX E

GLOSSARY

[redacted]

GLOSSARY OF TECHNICAL AND CODE TERMS

Accelerating Slits - Slits in the source unit which are used to speed up the particles that make the beam in the mass spectrograph.

Alpha - The designation given to operations connected with the first stage separation of Uranium 235 at the Electromagnetic plant.

Arc Source - The filament which is the source of the electrical discharge causing the ionization or charging of the particles that make up the beam.

Assay - Operation performed to find the percent of uranium 235 which is in the uranium present.

Atomic Weight - Relative weight of an equivalent amount of any element using the arbitrary basis that the atomic weight of oxygen is 16.

Beam - The path of the charged particles in the spectrograph, which is a semicircle from the emitter to the collector.

Beta - The designation given to operations connected with the second stage separation of Uranium 235 and preparation of the final product for shipment.

Bins - See tanks.

Bulk Recovery - Also called bulk treatment. That department in the chemical processing where the "gunk" solution obtained by washing units is processed to the orange oxide (UO_3).

Bushing. - An electrical insulator which passes through the face plate of the unit and must therefore be vacuum tight.

Chain Reaction - A nuclear reaction which is self sustaining in that practically every atom which reacts causes at least one other atom to react in the same manner.

Charge Material - The grey green salt Uranium tetrachloride (UCl_4) properly purified and ready to be placed in the mass spectrograph.

Cold Source - A source unit operating at ground potential.

Commutator - One section of the armature of an electric motor or generator.

Concentration - The % of the total Uranium present which is uranium 235.

Cubicle - The control unit for a mass spectrograph.

[redacted]

Debugging - Slang expression used to mean searching for and correcting faults in equipment.

Degassing - Pumping out the gasses which are absorbed on all materials and surfaces in the tanks.

Development Units - Experimental units that permit small scale operations similar to those in the racetracks.

Drain - The removal of stray charges by allowing them to "drain" off to ground potential. If allowed to build up they would cause sparking.

Electron Oscillation - Proper conditions of space and charge will cause electrons to oscillate between parts of the unit. This causes damage to the parts involved and sometimes elaborate precautions are necessary to prevent this phenomenon.

Enhanced Material - Also called enriched material. Used in this report to mean materials containing uranium with a higher concentration of uranium 235 than occurs in nature (1.%. above 0.7%).

Emitter - The unit which is the source of the beam in the mass spectrograph.

Feed Material - See charge material.

Hold Up - Material held in the system (pipes, pumps, tanks) which could not effectively be used as feed to the racetracks.

Hot Source - A source unit operating at high positive potential.

Ion Gage - An electrical instrument for the measurement of very low gas pressures.

J Research - Research work done on conditions in the section of the source unit where the particles that make up the beam are charged.

K Research - Research work done on the filament (called the K) which is the source of the electrons which by impact is responsible for producing the ions that form beam.

Liners - Water-cooled copper plates partially surrounding the units in the tanks used to assist in the recovery of the material.

Normal Uranium - Uranium as it occurs in nature containing approximately 99.3% of Uranium 238, 0.7% of Uranium 235 and 0.006% Uranium 234.

Racetrack - Also called track. One of the large electromagnets in which the mass spectrographs operate.

Receiver - The unit which collects the separated materials in the mass spectrograph and removes the charge from the ions.

Tanks--Also called bins. Steel tanks fitted into gaps in the electromagnet which serve as a vacuum tight housing, with connections to the vacuum pumps, into which the parts of the mass spectrograph are installed for operation.

Termination - (of a run) - The time when the operation of a mass spectrograph is stopped by turning off the electricity followed by pulling the units of the spectrograph from the tanks.

Thermohm - reactrol temperature Control - Method for controlling the temperature in the chamber where the charge is sublimed.

XAX - Alpha Development Units.

XBX - Beta Development Units.