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~~_____~~ January 4, 1952

HISTORY OF THE ~~P-10~~ PROJECT AS OF FEBRUARY 1, 1951

by GEORGE G. REED, JR.

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Pile Technology Unit

By Authority of *CB-PR-2/PR-24*
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SECRET

Tritium was produced from neutron bombardment of the Li^6 isotope (7.5 percent of the natural element) by the following reaction: $\text{Li}^6(n, \alpha)\text{T}$. In 1943, A. Langsdorf⁽¹⁾⁽²⁾ irradiated lithium carbonate and lithium acetate solutions in closed tubes in the Argonne National Laboratories pile for periods up to 10 to 20 KWH. Readily detectable amounts of tritium^{was} produced, of which it was estimated that five to ten percent was in the gas phase above the liquid or solid material at the conclusion of irradiation.

S. K. Allison⁽³⁾, of Argonne National Laboratories, in June, 1944, noted a request for the production of tritium from lithium at Hanford, for which the use of either lead or bismuth alloy in iron cans, or lithium fluoride or carbonate in aluminum cans, was suggested.

F. Seitz⁽⁴⁾ made a detailed proposal concerning alloys of lithium and bismuth, lead, aluminum, or magnesium for this purpose. Advantages of alloy over salt with respect to handling, heat conduction, and ease of removing residual hydrogen were indicated, and it was estimated, at temperatures up to 100°C , tritium should diffuse through the alloys at a rate of not over 1 cm. in 100 days. It was felt that, even with as much as 400 cc of tritium plus helium in a slug the size of a standard Hanford can, most of the gas would be accommodated in the slug, and would not be evolved until the melting point was approached.

L. B. Borst⁽⁵⁾⁽⁶⁾, of the Clinton Laboratories, later in 1944, reported on attempts to make tritium by irradiation of iron jacketed lead-lithium alloy slugs as proposed by Wigner⁽⁷⁾. Only 0.02 cc of tritium at a purity of 20 percent ^{was} obtained by heating the slugs to 500 to 600° to recover the product. Unspecified difficulties were encountered in the preparation and outgassing of the slugs, and this method was dropped. Meanwhile, the Clinton Laboratories Chemistry Division, following a request to produce three

cc of tritium, was investigating the use of lithium fluoride, iodide, nitrate, and carbonate salts (8). It was hoped that advantage could be taken of the decomposition of the carbonate to sweep out the tritium produced with carbon dioxide gas. However, such decomposition was not readily effected. Since the carbonate, nitrate, and iodide were not satisfactory with respect to pick-up of water and consequent hydrogen degradation of product, and thermal or radiation stability, the fluoride was selected for further work. In air, the fluoride showed little tendency to absorb water and was thermally very stable, but under irradiation some gas other than tritium was liberated. It was determined that tritium was not evolved at an appreciable rate until the salt was heated to at least 450°C.

An attempt was made to produce tritium continuously at Argonne National Laboratories by pile-irradiating 720 grams of lithium fluoride contained in the annulus between two 12 ft. long aluminum tubes, 1" and 5/8" o.d. respectively. To obtain the product, the tubes were maintained at 450°C and evacuated. In the first four months of 1945, approximately 3.5 cc of tritium at a purity of 10 to 50 percent were secured, compared to a predicted yield of 36 cc. Burn-out of the electric heaters stopped the operation.

A similar attempt at continuous production was made by the Technical Division of Clinton Laboratories (9)(10)(11). A group of small diameter copper tubes, packed with lithium fluoride, and with a header at one end, were inserted in the reactor. The tube bundle was contained in an insulated aluminum jacket with a central calrod heating element. It was planned to recover the product periodically by raising the temperature to 450°C and evacuating. Although calculations indicated that several hundred cubic centimeters of gas should have been formed, only about 20 cc were actually recovered after an irradiation of nine months.

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Since anything approaching quantitative recovery was apparently difficult to realize in continuous processing, batch irradiation and processing in work under the University of Chicago, Metallurgical Laboratories, sponsorship was initiated in March, 1946 (12). Sintered lithium fluoride pellets, prepared by a method worked out at Los Alamos by Novic and Anderson. (1), were packed in aluminum cans together with copper spacers, *to increase the apparent density of the* ~~for weight and heat transfer,~~ *slugs & to facilitate transfer* and irradiated at Hanford. This was the start of the SR-15 program. The producer cans were prepared and processed at Chicago (13). In the first tests, where the period of irradiation was only 17 days, there was no appreciable pressure developed in the cans and the metal surfaces were not corroded. As irradiation was increased, however, large amounts of free fluorine were *produced in the slugs which were deformed by the increasing internal pressure* ~~detected,~~ and the resultant swelling of the cans limited the permissible exposure (14). The free gas within the cans prior to heating the pellets contained very small amounts of tritium, though perhaps somewhat more helium, and to *obtain this result* recover tritium rapidly it was necessary to heat to 700°C. *rework* It appeared that all the tritium remained in the lithium fluoride lattice at ordinary temperatures, and it was determined that it was evolved as hydrogen isotope molecules and not as the fluoride.

Continuing difficulties were experienced with fluorine produced during irradiation, and with erratic variations in tritium yield (15)(16)(17).

Tritium production and equipment development was continued at Argonne National Laboratories until July, 1948, when Hanford was requested to relieve Argonne National Laboratories of production duties.

On approximately October 1, 1948, the P-10 Project, which covered the design, construction, and operation of facilities for the extraction of tritium from irradiated, lithium-bearing slugs, was initiated. At the time the P-10 Project was initiated, only the lithium fluoride process had been

demonstrated. Because of this, initial construction was of two lines for the extraction of lithium fluoride slugs, with associated slug handling and product collection and storage facilities. *It was planned that* At a later time, new lines would be built *later* for the extraction of lithium aluminum slugs. On September 22, 1948 in 105-B, and October 20, 1948 in 105-F, rupture of *LiF slugs* ~~several cases~~ and subsequent ~~rupture~~ *rupture* of process tubes in the reactors ~~had~~ necessitated pile shutdown, *Because of this,* and the remaining lithium fluoride slugs were withdrawn and shortly thereafter replaced with lithium aluminum alloy slugs.

Consideration was given to the use of an alloy of lithium as an alternative to lithium fluoride by the Chemistry Division of Argonne National Laboratories in early 1947 (15). Base metals considered included magnesium, aluminum, lead, and bismuth. Due to the physical nature of the various alloys, the alloy of aluminum was chosen as the most promising. Consequently, investigation was made of means of producing three to five percent lithium content aluminum alloys (19).

An aluminum alloy which was approximately four percent in lithium would provide a slug substantially the same in total lithium content as the lithium fluoride slug then in use.

Test samples of 3.5 percent lithium in aluminum were irradiated at Hanford during the last half of 1948, and it was found that much larger yields per exposure unit were obtained with the lithium aluminum slugs than with the lithium fluoride slugs. The yields were relatively predictable, no slug swelling was observed, and a lower extraction temperature was feasible. About the time this information was available, the ~~rupture~~ of the lithium fluoride slugs occurred, and the remaining lithium fluoride slugs were discharged in favor of the lithium aluminum.

By January 1, 1949, over 500 lithium aluminum slugs, fabricated by Argonne National Laboratories, had been charged as SR-65 material, and were under irradiation at Hanford. This total was rapidly increased, until by the end

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of May, 1949, 1127 slugs were under irradiation at Hanford. (24).

Facilities for the extraction of tritium were completed and placed in operation during 1949. The first phase of the design and construction work was completed in February and two extraction lines were operated to extract approximately 800 lithium fluoride slugs in March, April, and May. The plant was then converted to extract lithium aluminum alloy slugs. The first line was started in August and by the end of November all four lines were in operation. During December, the extraction rate for one-shift operation was only 15 percent below the pile discharge rate. (25).

Tritium generation in the Hanford pile was about 3.5 times the most optimistic estimate made when the F-10 Project was initiated in late 1948. In addition, tritium purity was averaging 93 percent, much higher than expected, and high enough to avoid an extensive and wasteful isotopic purification step. (26).

The advance of the tritium program from the first laboratory experiments at Argonne National Laboratories to the operation of a plant at Hanford required the solution of several major and many minor problems, most of which were unduly complicated by the requirement that design and construction proceed concurrently with research and development work. For example, alloys slugs with six months exposure were not available for experimental work until after the plant had been designed and built.

The control or elimination of radiation hazards was the most important problem in the design and construction of extraction facilities. Two separate radiation problems were present, the handling of radioactive slugs and the handling of highly radioactive tritium. Although the solution of the slug handling problem required a large amount of careful and detailed design work, the only really complicating effect was the limitations placed on the design of the extraction furnace. The radiation problems associated with the handling

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of some thousands of curies of tritium per day were more difficult to solve.

Although at the end of 1949 a process had been developed and a plant was being operated for the production of substantial quantities of high purity tritium, a considerable amount of development work remained to be done before the full potentialities of the process and plant could be developed and the operation placed on a routine basis.

During 1949, extraction operations proceeded following two general principles: (a) extract a backlog of 724 irradiated slugs which had been discharged from the piles prior to January 1, 1950; and (b) extract the quantities of tritium committed to the Atomic Energy Commission by the General Electric Company on schedule. The extraction of the commitment during 1950 meant eliminating the inventory of slugs which had been discharged from the piles, and planning subsequent discharge of slugs from the piles in order to obtain maximum exposure consistent with meeting the production commitment. (27).

The original production commitment, established in 1949, required the delivery of a certain quantity of tritium to the Los Alamos Scientific Laboratory by the end of December, 1950. This amount of tritium was extracted by July, 1950, and the needs were reviewed during July and August of 1950. The commitment for isolation of tritium was revised increasing the original commitment for 1950 by slightly more than a factor of two. This goal was attained by December 27, 1950.

The maximum processing rate was attained in December with the extraction of 347 slugs. The minimum rate was experienced during October with the extraction of 60 slugs, however, this was at the peak of construction activities. The maximum rate obtained, however, was not the ultimate maximum production capacity of the glass extraction lines.

A third objective was to increase the size of the extraction group by procurement and training of new personnel. This was done in preparation for

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for an increased extraction load in 1951, anticipated from slug discharge of the H-10 load. At the end of 1950, the operation was 51 percent staffed for maximum production from the glass lines.

The attainment of the three objectives was accomplished under adverse conditions. The factors contributing to the adverse conditions include:

1. Through the year, process developments and equipment revisions were so numerous and frequent that the operation of the equipment was an art, rather than a routine operation.
2. The radiological health hazards associated with the process were unique. Routinely, personnel were found to contain tritium oxide in the body fluid. The instances of contamination were generally far below the maximum permissible concentration, but occasionally individuals were found to contain amounts of tritium near or in excess of the ^Qmaximum permissible concentration. When this happened, the contaminated personnel were kept away from the operation until biological elimination of the excessive contaminant occurred. Since the source route by which personnel received such exposures was unknown, though suspected, each incident resulted in the addition of another restrictive bit of procedure to a list which was already impressive in scope.
3. Revisions and additions to the process equipment and area proceeded simultaneously with production operations during most of the year. The effect of this can best be demonstrated by the example that, during certain periods, glass line high vacuum equipment was operated at the same time concrete was being torn out by use of air hammers nearby in the building. (28).

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under construction at the General Engineering Laboratory of the General

The first metal extraction unit was installed, and a second unit was

slugs fabrication was required.

able to permit construction of a new manufacturing plant before additional

notification were received to resume production, enough time would be avail-

slugs were on hand to permit removal of the slug manufacturing facility. (1)

two H-10 loads, it was thought by the Pile Technology Division that sufficient

lithium aluminum slugs for irradiation. By providing sufficient slugs for

tritium production at Hanford, no delay would be encountered in obtaining

slugs to charge an additional H-10 load. (1) It was decided to resume

for poison tube needs. The commitment a celled storage of sufficient excess

slugs, however, were fabricated for two additional H-10 loads plus enough

was only the processing of the slugs from the first H-10 load. Sufficient

The expanded goal, however, was cut back in several steps, until it

of the expanded extraction facilities until January 1, 1954.

the expanded irradiations were considered to be sufficient to insure operation

loads being irradiated simultaneously in two piles. The slugs provided by

the complete use of one of the piles for tritium production or H-10 type

108-B, 108-D, or a new building. Slug irradiation would extend to either

facility would be operated by one of the Manufacturing Divisions in either

project was continually increased until it was planned that an expanded

the loss of neutrons to the 7500 lithium aluminum slugs. The scope of the

were used as fuel slugs to provide sufficient excess neutrons to make up

addition to the poison slugs. Slugs made of aluminum enriched with U-235

was for the irradiation of approximately 7500 slugs in the H-10 load, in

~~Many changes were the keynote of the P-10 Project. The original planning~~

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Other modifications and enlargement of facilities included:

1. A 300 foot stack for the discharge of process air into the atmosphere was completed;
2. A new office building of temporary structure, but steam heated and air conditioned, was built and put into use, providing twelve offices and a conference room;
3. An electrical fire detection system was installed throughout the 108-B Building, and a heat actuated sprinkler system was taken out of service;
4. The 108-B exclusion area was formed, and a dual gatehouse serving both 108-B and 105-B areas was put into service;
5. New air supply and exhaust systems with much larger capacities were completed;
6. Modification of the glass extraction lines was nearing completion;
7. A new product storage building for use with the 12 liter product container was to be built;
8. A "hot" metallurgical laboratory located in the 108-B Building was planned;
9. A laboratory for the detection of tritium contamination of the operators by a urinalysis procedure was to be built;
10. An analytical laboratory with space for two mass spectrometers, a vacuum rack, glass blowers' bench, sample storage hood, and additional spectrometer space was planned;
11. Shop space was to be provided in the 108-B Building for servicing organizations;
12. A stripping line was to be fabricated by the General Engineering and Consulting Laboratories;
13. The P-10-A area was to be converted to use as a critical items stock room, urinalysis laboratory, metallurgical laboratory, and "cold"

equipment test shop;

14. The Instrument Development Room facilities were to be enlarged by installation of a second hood, a vacuum rack, and an increase in the number of fresh air mask supply hoses from three to five;
15. A packaging system for using the 12 liter metal containers with the glass lines was being designed;
16. A large number of smaller modifications and/or additions to the facilities were either completed, in progress or proposed.

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P-10 FACILITIES

PRELIMINARY NEGOTIATIONS

In 1946, it was recommended, by the district engineer for the War Department, United States Engineer Office, that it was desirable to transfer all of the functions of production to Hanford, a production installation; thereby relieving the Argonne National Laboratory, a research installation, from production duties. (18) This decision was based on the belief by Argonne National Laboratories that the principal problems of production were solved, as a result of a meeting held at Clinton Laboratories, October 25, 1946, during which, Dr. T. S. Chapman discussed with Major F. A. Valente the possibility of Hanford assuming full production responsibility for the product extracted from the irradiation of Special Request 15. This responsibility was to include the procurement of lithium fluoride, the preparation and canning of the pellets, the irradiation of the slugs, the extraction of the product and its subsequent shipment to the consumer.

It is of interest to note that the knowledge of the hazards of the process at that time was very limited. The hazards are listed as follows:

" Toxicity:

The irradiation of these slugs should be kept below 200 MWD per adjacent ton, since the evolution of fluorine gas may occur in large amounts. A disease known as fluorosis is a potential hazard in this process. In so far as the product of interest is concerned, 0.1 cc of it is considered the permissible body content. "

" Radiation Dosage:

At approximately six inches, the activity of the irradiated pellets of lithium fluoride is below tolerance; but the activities of the aluminum cans and the copper disks are relative high. (18) "

As a result of the recommendation that Hanford take over all production facilities (18), J. M. West included in his trip program for a visit to Argonne National Laboratories during the period October 30 to November 6, 1946, the inspection of the lithium fluoride slug preparations and the processing

of the irradiated slugs for the extraction of tritium. As a result of this trip,

Mr. West made the following comments: (20)

- "A. Lithium fluoride powder is irritating to the skin and respiratory organs. Special handling and ventilating are required to protect workers who prepare the wafers from contact with the fluoride or from inhaling too much fluoride dust. Lithium fluoride vapors also attack the platinum boat and quartz tube in the extraction system, making frequent replacements necessary. An extensive search for a more suitable lithium compound seems justified.
- "B. The rate of release of product from the lithium fluoride is very slow, even at 800°C. About 10 to 12 hours are required to effectively remove the product. Higher temperatures are impractical, because lithium fluoride melts at 870°C and immediately attacks the platinum boat and quartz tube. Substitute materials in which the fluoride or other compound could be melted should be investigated.
- "C. The apparatus, in its present form, is of the laboratory type, and considerable development aimed toward making it more rugged and easier to maintain would be in order before a large scale production is attempted."

As a result of Mr. West's comments, tritium production and equipment development was continued at Argonne National Laboratories. On July 26, 1948, D. F. Shaw of the Atomic Energy Commission requested R. C. Muir of The General Electric Company at Hanford to explore the possibility of setting up facilities at Hanford for preparing lithium slugs and for processing the tritium produced, such facilities to be ready for use January 1, 1949. An answer to this request was required by August 15, 1948. (21)

During the week of August 2, 1948, C. N. Cross, Manager of the Manufacturing Divisions, and J. C. L. Chatten, of the Technical Divisions, visited Argonne National Laboratories to evaluate the feasibility of placing all required facilities for tritium production into operation at Hanford by January 1, 1949. They reported: (22)

- "A. Scale-up of all production facilities by a factor of ten, to be in production by January 1, 1949, was not feasible.

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- "B. Production could be increased by installing additional extraction facilities to supplement Argonne National Laboratories' total production capacity. Dr. T. S. Chapman, of Argonne National Laboratories, was confident that all necessary slugs could be produced in his laboratories.
- "C. Extraction of tritium from lithium fluoride is done under very high vacuum and in essentially all glass equipment. Hanford has a real lack of trained personnel in this field and thus finds it difficult to guarantee increased production. In order to meet the January 1, 1949 schedule, Hanford has the choice of curtailing work on other vital projects such as 234-5, or obtaining the services of expert personnel to assist in this program. Assistance from the Atomic Energy Commission in obtaining qualified personnel will undoubtedly be necessary.
- "D. The above discussion enters into only the required additional extraction facilities to supplement those now in operation at Argonne National Laboratories to meet the required production rate by January 1, 1949.
- "E. Although there remains a tremendous amount of development work to be done, a brief study led the authors to believe that necessary facilities could be installed at Hanford by the middle of 1949. Argonne National Laboratories would be asked to continue and push the development of the lithium aluminum alloy. It was believed that the project would be developed as an adjunct to the 234-5 Project due to certain equipment and process similarities.
- "F. The authors recommended that the installation of additional extraction facilities be deferred until the middle of 1949, at which time, they believed that a program could be in operation as an addition to the 234-5 Project."

In addition to the 234-5 Project, numerous other locations at Hanford were surveyed, and it was finally decided to use the 108-B Building. Since the building was already available, this meant that the construction could be completed somewhat sooner than the middle of 1949.

In a letter from F. C. Schlemmer, of the Hanford Operations Office of the Atomic Energy Commission to H. C. Muir of General Electric, (29) the Hanford Works was authorized to proceed with the construction of facilities for production of tritium. On approximately October 1, 1948, the P-10 Project, which covered the design, construction, and operation of facilities for the extraction of tritium from irradiated lithium bearing slugs, was initiated. At the time the P-10 Project was initiated, only the lithium fluoride process had been demonstrated.

Because of this, initial construction was of two lines for the extraction of lithium fluoride slugs, with associated slug handling and product collection and storage facilities. At a later time, new lines would be built for the extraction of lithium-aluminum slugs. On September 22, 1948, in 105-B, and October 20 in 105-F, rupture of several cans and consequent rupture of process tubes in the reactors had necessitated pile shutdown. The remaining lithium fluoride slugs were withdrawn and shortly thereafter replaced with lithium aluminum alloy slugs. (30)

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ORIGINAL FACILITIES

It was planned to start operation of the P-10 extraction equipment in January, 1949, and the backlog of lithium fluoride slugs was thought to be such that two months of operation would be sufficient to erase the backlog. Design was to be complete by December 10, 1948, and installation of the first two glass extraction lines was scheduled to start December 13, 1948. All heavy construction was scheduled to be completed by December 31, 1948, and completion of all construction by January 8, 1949. (23)

Construction of the actual glass extraction line and preliminary testing of the first line delayed start-up until March 18, 1949, when the first lithium fluoride extraction was completed at Hanford. The first run was completed on the second extraction line on March 23, 1949. The last of the lithium fluoride material was processed by May 25, 1949, (31) at which time the hood room was locked until decisions on personnel protection could be made. Up to this time; it was thought that the high velocity air flow into the hoods associated with the glass lines was sufficient to provide adequate protection from any escaping tritium. At about this time, however, a means of analysis for tritium in the bodies of the operators was first obtained, and as a result, it was found that several cases of excessive concentrations of tritium in the bodies of the operators had occurred. Because of this, a fresh air mask system was to be installed, concurrently with the construction of lines three, four, and five. Line five was to be used temporarily as a development line, and lines three and four were to be used for extraction of the lithium aluminum alloy slugs.

After installation of the air mask system and the construction of line three, the first lithium aluminum alloy slug extraction was made in late August of 1949. (26)

The original facilities were as follows:

- A. Equipment for the handling and drying of slugs in the 105-B Building was fabricated and installed.
- B. A special cask and a truck with a proper bed was provided to move the slugs from the 105 Building to the 108 Building.
- C. Alterations to the 108 Building were made as required. New work on the first floor included facilities for can opening and material handling, and on the third floor, facilities for extraction of product which included vacuum furnaces, special high vacuum glass process lines, and related equipment were installed.
- D. The existing heating and exhaust system in the 108 Building was altered as required.
- E. A crib near the 108 Building was provided for liquid waste disposal.
- F. A building for lag storage of product was constructed.

The facilities specified above substantially duplicated the type of facilities used at Argonne National Laboratory for the processing of lithium fluoride slugs. Current evidence obtained at the Argonne National Laboratory demonstrated that only minor changes were required for the processing of lithium aluminum slugs. (32)

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ORIGINAL PROCESS

The original process used with the lithium fluoride slugs was as described below:

A slug was removed from the transport cask; the can was punctured to relieve gas pressure with an electric drill, cut into halves by a rotary knife, and then the two halves were forced through a die which sliced the can, and the contents fell into a catch tray below. The pellets were separated from the copper spacers and other bits of metal and placed in a dessicator until wanted. The scrap, copper spacers, and aluminum from the can, was placed in a scrap cask. When sufficient pellets were accumulated in the dessicator for a charge, they were removed and weighed on a balance, placed in a copper boat, and carried by hand up to the extraction facility. The can removal was carried out on the first floor of the 108-B Building, and the extraction operation was carried out on the third floor.

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• The original process used with the lithium aluminum slugs was as described below:

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ANALYTICAL METHODS

SPECTROGRAPHIC ANALYSIS

An emission spectrographic method of analysis for the percentage of tritium in product was first developed and used by the Argonne National Laboratories with the product resulting from extraction of the lithium fluoride slugs which Argonne processed. The method was based on the isotope shift in the fine structure of the Balmer Series of the hydrogen spectrum. A comparison of the H_{α} and the T_{α} line intensity on a photographic emulsion gave the ratio between the two isotopes of hydrogen, and since the mixture was presumed to be a two component mixture, i.e., the two isotopes of hydrogen, the percent tritium was given by 100 divided by one plus the ratio of the hydrogen to tritium intensities.

Sample preparation involved torching the sample bulb for 15 minutes while evacuating with a mercury diffusion pump. After evacuation, the sample was admitted to the bulb, and then the pressure was adjusted to as high a pressure as would support an electrodeless discharge. The discharge was continued for a few minutes, and then the bulb was sealed off.

The only photographic plates which were available for the spectrograph usage at that time were of a coarse grained nature which interfered with obtaining the best possible accuracy from the method.

While the method was used at Hanford, a total of 48 product and 11 by-product samples were submitted for analysis by the P-10 Project. Of the product samples submitted, the purity range encountered was 15 percent tritium to 58 percent tritium, and the average purity was 35 percent tritium.

It was the belief of the analysts that the accuracy was only $\pm$ 25 to 50 percent. They believed that, in some manner, the walls of the sample container were active adsorbers, and found that it was often necessary to start the discharge by some other means than the high frequency oscillator used to cause the discharge

under operating conditions when the photographic emulsion was exposed.

The method was terminated ^{with} ~~because~~ P-10 production was interrupted with the completion of processing of the LiF slugs. With the advent of the lithium-aluminum alloy, product purities were expected to be at least 90 percent and a method which gave the purity to within ± 0.5 percent was desired. In the opinion of the group making the spectrographic analysis, the best obtainable precision and/or accuracy was ± 2 to 3 percent, and this was possible only after considerable work on film calibration, sampling methods, and obtaining much higher grade film. *Verbal with J.A. Parodi & E.Z. Block*

ION CHAMBERS

Since tritium is naturally radioactive, it was possible to use the radioactivity as a measure of purity in the two component mixture tritium-hydrogen. Ion chambers were built which used the tritium-hydrogen mixture as the gas being ionized, and the decay of tritium as the ion producing source. The current produced in such an ion chamber was determined by measuring the voltage developed across a precision resistance. This voltage was proportional to the current produced by the ions being collected on the measuring electrode under the influence of a high voltage electrostatic field. The characteristics of a particular ion chamber were observed, using a particular gas mixture, by plotting the isobars of the ion current produced against the voltage impressed on the ion chamber. A region was found where the ion current was approximately constant with increasing voltage. This is known as the saturation ion current. This was ^{caused by collection of} ~~because~~ all of the primary ions of a given polarity produced by the tritium decay ~~were collected~~ on the measuring electrode. A graph which plotted log pressure corrected to 0° C vs log saturation ion current indicated that the isosteres of a two component mixture were very closely approximated by straight lines, and so an ion chamber calibration was based on these facts.

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The first ion chambers used at Hanford were designed and built at Argonne, and, ^{in early work,} ~~at first,~~ were calibrated by reference to the purity obtained by the spectrographic analysis. In later work, it was found that the Regnault method gave more satisfactory calibrations.

Ion chambers made a very desirable analytical tool, because they provided an on-line means of analysis. In the period covered by this report, no data had been obtained as to the approximate accuracy, or even the precision obtainable. Recently, calibration of ion chambers was done by use of the purity indicated by mass spectrometer analysis. Routinely, purities were determined by mass spectrometer samples, but when a satisfactory mass spectrometer analysis was not available, the ion chambers provided a good back-up device.

During the period covered by this report, no extensive development work was carried on toward providing better ion chambers, but such work was planned to be done, mainly by Hanford, with Argonne and Knolls Atomic Power Laboratories carrying out investigations on associated phenomena, such as background effects and nitrogen sensitivity. (34)

REGNAULT DENSITY METHOD

The Regnault density method measured the apparent molecular weight of the gas sample by finding the weight of a known volume of gas. The apparent molecular weight was then compared to the molecular weight of tritium, and by this comparison the percent purity of the tritium was determined.

The method as used at Hanford was developed at Argonne⁽³⁵⁾, and installed at Hanford at the same time that the glass lines for the processing of lithium-aluminum slugs were constructed.

The method showed an extreme sensitivity to air contamination of the sample and at best, the probable error was found to be ± 0.4 percent. ~~Furthermore,~~ The sample bulbs used micro stopcocks which had a tendency to in-leak air, and thus gave spurious results. ^{analytical} The balance used was sensitive to fluctuations of the

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room temperature, static charges, vibrations, drafts in the hood in which it was necessary, from a health hazard standpoint, to use ~~the balance~~^{it}, and ~~balance~~ rest-point changes. Thus, it was very delicate instrument being used under very non-ideal conditions.

Use of the method started in October of 1949, and continued until approximately November of 1950, when mass spectrometer analysis became routinely available, and also because a planned move the the equipment from the glass lines hood room to the Instrument Development Room was started. After installation was complete in the Instrument Development Room, a few determinations were attempted by personnel from Technical Services, but sample contamination continued to be a major problem and the method was dropped. (36)

BUOYANCY BALANCE

The buoyancy balance was based on Archimedes principle and was successfully designed and constructed by Dr. W. D. Davis of Knolls Atomic Power Laboratories. Plans for the installation of the buoyancy balance were made in April of 1950 by Dr. A. R. Matherson and A. A. Johnson.

By September of 1950, the device had been installed in the Instrument Development Room at Hanford and some use was made of the instrument as part of the development program. The buoyancy balance use was limited because ~~a large sample was required~~, it did not show the nature of contaminants, it was time consuming, and it required the transfer of a large ^{sample} amount of tritium from the production group lines into the Instrument Development Room to make the determination. (37)

MASS SPECTROMETRY

On June 15, 1950, C. R. McCully issued a document which reviewed the analytical tools available or possible for use in connection with the P-10 program. He found the mass spectrometer method preferable because:

- A. Sample requirements were negligible.

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- B. Precisions of ± 0.5 percent were thought to be readily obtainable.
- C. Contaminants were measurable.
- D. Semi-trained operators were usable as analysts.
- E. It was possible to select equipment to fit space requirements.
- F. A maximum of six months was necessary to procure and install the equipment. (38)

A Consolidated-Nier Isotope Ratio mass spectrometer was ordered on ~~RM-66805~~, a purchase requisition ~~which was~~ dated August 11, 1950. Actual negotiations were carried out before this date, and installation of the equipment was started on August 16, 1950. (39) By September 5, 1950 the first analysis of P-10 process samples was reported, and analyses continued on a semi-routine basis from then. (40)

In November, 1950, a meeting was held between the Technical Services group in charge of the mass spectrometer and members of the P-10 Development to discuss the results to date, which were not thought to be satisfactory. Precision between duplicate samples was not as good as desired, and frequent cases of sample loss or contamination were noticed. As a result of the meeting, a study of the types of sample containers was instituted, as well as an investigation into the effect of materials used for construction of the sample containers, and the sampling methods. Meanwhile, Analytical was to continue its research and development program. (41)

The results which had been obtained, however, were good enough, so that a second mass spectrometer was ordered on January 7, 1951. The second instrument was to have sufficient resolution to distinguish between the mass four peak due to helium, and mass four peak due to hydrogen-tritide. A General Electric mass spectrometer was selected as the second mass spectrometer for P-10.

Operating experience indicated that re-usable sample bulbs were not satisfactory since the types in use required a stopcock. The stopcocks were subject to leakage and tritium was reactive with stopcock greases. A group of breakseal sample bulbs were constructed and ^{tested} ~~tried~~. The results indicated that the breakseal bulbs

did hold promise of being more satisfactory than the stopcock type bulbs.

// Concurrently a method of taking samples in all-metal capsules was undertaken as a development project. An attempt was ^{made} to use cold-welding to provide the vacuum tight seal. ~~Tests~~ Tests were also started on the adsorptive and/or exchange properties of various materials, such as 2-S aluminum, 347 stainless steel, Apiezon ^{stopcock} grease and wax, and neoprene and teflon gaskets. (42)

Also under consideration at this time was development of a means of taking on-line samples for mass spectrometer analysis. This was to eliminate the need for transfers of bulbs containing tritium, and gave a direct connection with the production line. Also coming into consideration was the fact that with this means of sampling, less air gases would get into the mass spectrometer manifold, and thus the ^{incidents} chances of high background, sample contamination, or sample losses were minimized.

In the period covered by this report, there were three sample exchanges, one with Argonne to provide comparative samples for ion chamber calibration, (43) one with Los Alamos to get analysis of some selected samples prior to installation of a mass spectrometer at P-10, and the third with Knolls to give comparison of the mass spectrometer analysis of by-product samples between the Consolidated-Nier mass spectrometer at Hanford and the General Electric mass spectrometer at Knolls. (41 & 44)

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EXPANSION PROGRAM

INTRODUCTION

Facilities for the extraction of tritium from irradiated lithium fluoride slugs were installed on the third floor of 108-B in early 1949 under Project C-316. Of the five extraction lines which were to be installed for use in extraction of tritium from the lithium fluoride slugs, only lines 1 and 2 were fully completed, as difficulties which ^{were} encountered during the irradiation of the lithium fluoride slugs necessitated the development of a new type of slug for tritium production. An alloy of 3.5 percent lithium in aluminum was found to be satisfactory, and facilities for fabrication of this type of slug were installed on the first floor of 108-B under Project C-334.

Also as a part of Project C-334, the extraction facilities installed on lines 1 and 2 were modified and lines 3 and 4 were completed so that four lines were available for processing irradiated lithium-aluminum slugs. Numerous modifications in the slug handling and personnel protection equipment were included, since additional hazards of radiation and radioactive contamination of personnel and equipment were discovered and/or anticipated.

At the same time, line 5 was equipped for control purposes, including gas analysis of non-irradiated P-10-A slugs. Line 5 was also used to evaluate proposed new P-10 operating techniques.

Plans were under consideration for expansion of all facilities at Hanford connected with the production of tritium. The slug fabrication facility expansion was to be done first, so that slugs could be produced in the quantity necessary to meet irradiation schedules. It was also thought that while irradiation of slugs was in progress, new extraction facilities would be installed and ready for operation as needed.

P-10-B

The P-10-B Project was concerned only with the installation of "cold" facilities

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which were needed for the following reasons:

1. The expansion of slug fabrication facilities made it necessary to have additional lines available for gas testing of slugs.
2. The expansion of the production commitments made it necessary to have additional extraction facilities. Because of its strategic location, it was possible to easily and quickly convert line 5 for this use.
3. The adoption of Line 5 as a production unit made it necessary to provide test and development facilities elsewhere in 108-B. The productive effort of personnel engaged in experimental work on Line 5 was reduced due to the necessity that they comply with SWP conditions. The work that was planned included furnace improvement, the test of glass replicas of metal components, and other studies which were directed toward technological knowledge of the process.

In view of these situations, the next step in the P-10 expansion program was the construction of "cold" facilities, as proposed in this project, and the conversion of Line 5 to a production unit similar to Lines 1 - 4. Work was initiated under Suspense Code M-759.

A portion of the second floor of 108-B, directly under the glass lines hood room, was ^{to be} partitioned off for the "cold" facilities. The proposed laboratory was to have four vacuum lines available for gas testing and one for development work. Attendant equipment, such as a general laboratory table, glass blowers' bench, annealing furnace, and shelving, was to be included.

The existing obsolete chemical equipment which occupied space of the second floor was ^{to be} removed and the floor repaired as required.

Also included was the conversion of the experimental line 5 in the hood room into a P-10 extraction line, the same as line 1 - 4. Equipment already in line 5 was ^{to be} transferred to one of the new experimental lines in the "cold" laboratory. (45)

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P-10-C

Suspense Code M-760, issued early in 1950, covered the development of an improved extraction unit (metal line) as outlined in some detail below. This work was done by the General Engineering Laboratory of the General Electric Company. It included the design, fabrication, and testing of one metal extraction line which used palladium separation. The development and construction of the metal extraction line was entitled P-10-C. Work on an extraction furnace for use with the P-10-C line was handled by Hanford forces. Product packaging methods were developed by Los Alamos and suitable facilities were installed at Hanford.

In addition to the metal extraction line, the Knolls Atomic Power Laboratory was to scope a facility entitled the "Metal Stripping Line". The purpose of the metal stripping line was to improve product recovery by processing the outgas and by-product fractions resulting from the operation of the metal extraction line. Stripping of these fractions made attainable a higher recovery efficiency for the process and made reduction of contamination and radiation health hazards possible by preventing gross loss of product from these waste fractions to the atmosphere.

The P-10-C Project did not include funds for the development of the metal stripping line. Funds for the metal stripping line were separately requested at a later date.

METAL LINE SPECIFICATIONS

The General Engineering Laboratory was to develop, build, test, and pack for shipment an equipment for the extraction of tritium from helium. Shipment and installation of the equipment at Hanford were not required.

The process, which the equipment was to perform, was similar to that used in connection with the glass extraction lines. The equipment was to be capable

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of processing 12 liters (standard conditions) of mixed gas during one eight hour shift, and was to include all components necessary to the specified process except the furnace, furnace controls, and furnace instrumentation.

The major components; a hood enclosed extraction line, an operating control desk, and an instrument panel; were arranged generally as shown in drawings submitted by the General Engineering Laboratory.⁽⁴⁶⁾ The equipment was to be designed for minimum hazard during operation and maintenance. Operation and instrumentation were to be from a remote control station, separated from the process hood by a transparent, pressure tight barrier. The use of glass was to be avoided and the equipment was to be sufficiently rugged to minimize the possibility of breakage during operation. The parts likely to require disassembly were to be suitably flanged or screwed, and accessible through the open doors of the hood. The air velocity through any opening in the hood was to be at least 200 linear feet per minute, with a vacuum of 1 inch of water available at the hood exhaust duct. The ventilating air exhausted from the hood was not to be filtered.

EQUIPMENT

A mixture of tritium and helium was pumped from the furnace and into the palladium separator. The separator was designed to pass only the hydrogen isotopes. Positive displacement pumps were used to force the accumulated tritium into a measurement volume and later, into suitable storage containers.

A flange connection using a molded neoprene "O" ring was available for attaching the furnace coupling. The flange was designed to accommodate

manifold. The manifold was approximately 4 feet above the level of the floor and in a horizontal position. Hanford supplied a suitable furnace coupling which fastened by means of a flange to the metal line manifold, and by means of a special compression fitting to the furnace.

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The gas pumps ~~were~~ were metal Toepler pumps of sufficient capacity to handle the specified production. They were capable of establishing an inlet pressure of _____

In order to select the pump for this application, several alternate methods were considered. The alternate systems included electro-magnetic or air-vacuum, constant displacement pumps; and mercury jet pumps. In the electro-magnetic design, the mercury column was actuated by a magnetic field. A pump which had been used for pumping liquid metals was re-designed and a model was built. This method was compared with other systems. Mercury jet pumps were investigated and evaluated. The air-vacuum method had proved itself in Toepler pump designs. It was believed that one or more other methods might be preferable, but the air-vacuum operated metal Toepler pump was the most servicable without resorting to an extensive pump development program.

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1000
1000*

The measurements volume was an all-welded, stainless steel, cylindrical tank.

The volume of the container was approximately 8 liters and it was welded into the gas handling line.

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A vapor trap was provided for preventing the transfer of condensible vapors

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from the gas handling system to the vacuum system or in the reverse direction. This trap was designed to accomodate a $1\frac{1}{2}$ inch diameter manifold. It was possible to open the trap by means of a flange and gasket connection in the event that such access was necessary. The trap was cylindrical in design, approximately 6 inches in outside diameter, and 10 inches high. It had a pumping speed in excess of 300 liters per second, thereby representing a negligible resistance to flow in the vacuum pumping system. Liquid air, supplied manually from outside the hood, was the coolant used for the trap.

Two mercury diffusion pumps operating in parallel were used for pumping the vacuum manifold

The pumps were of a three stage, non-fractionating design with external heaters. Experience with these pumps in conjunction with mass spectrometers had indicated that they would be satisfactory in this application.

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This pump was a relative newcomer to the vacuum equipment field. However, there was ample evidence that it performed well and required little maintenance.

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The roughing pump valve was to be

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open during "rough" pumping operations, and its design was identical to the foreline vacuum valve.

Seats were neoprene against stainless steel. The valves were NRC drawing C-2891 or equal. These valves were of the same design as those being used elsewhere.

Solenoid operated valves were used for gas line valves. They were made entirely of stainless steel

Neoprene against stainless steel served as the seat.

Investigation of various commercially available valves was undertaken. The Skinner solenoid valve was ^{found to be} the only usable valve of this type commercially available.

The exhaust valves were strategically placed to permit exhausting any part of the gas handling system into the vacuum manifold. Solenoid operated vacuum valves were used. They were of stainless steel construction with neoprene against stainless steel as a vacuum tight seat.

A service system for the metal Toepler pumps, was furnished to supply gas and vacuum through Kinney vacuum pumps and Gast compressors. It was intended that helium was to be used as the operating gas, and in order to conserve helium, a means of continuous recycling of the operating gas was included.

The system as a whole, including all tubing, valves, flanges, volumes, and pumps was constructed of stainless steel.

All of the pumps, both gas and vacuum were fitted with gasketed flanges to facilitate their removal for servicing, should it be necessary. Gas line valves and exhaust valves were welded permanently into the system. Their operators, plunger

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inserts, however, were removable and replaceable.

Disposition of the various components of the system was such that they were accessible and yet occupied a minimum floor area. It was anticipated that the proposed design insured a minimum of one year of trouble-free operation.

The equipment was assembled and tested in Schenectady with helium and hydrogen. All components were adjusted, calibrated, and an operating check was made. The system had an overall in-leakage rate of less ^{than} ~~the~~ 0.15 micron cubic foot per hour, on the final test, as indicated by a mass spectrometer type leak detector. Six dry runs with helium and hydrogen mixtures, ^{which} followed the developed operating procedure, were made. The tests were witnessed by Hanford representatives. (46)

P-10-D. PART I

The P-10-D Project covered the installation of facilities in the 108-B that were necessary to accommodate the two metal lines (one extraction and one stripping) mentioned under the P-10-C Project. Design, test work, and construction of P-10-D was started at Hanford under Suspense Code M-761. The work was subdivided as follows:

ARCHITECTURAL

All of the remaining space on the third floor of 108-B that was not used as a part of the P-10 extraction installation (glass lines) was partitioned off for housing and controlling the P-10-C metal extraction line and the future metal stripping line. One room of temporary construction was provided for housing a Consolidated-Nier mass spectrometer, and a permanent type room was constructed for "hot" instrument calibration and analytical weight determinations.

On the second floor, a battery room was built to house stand-by power for critical air supply features. On the first floor, an outgassing room was provided for furnace tube outgassing. An addition was built onto 108-B to house the new ventilation supply unit.

Suitable overhead supports were installed in the elevated part of the building over the P-10-D installation to accommodate the air mask supply blowers, the air monitoring pumps, Kanne Chambers, and other miscellaneous equipment.

FURNACES AND RELATED PROCESS ITEMS

Furnaces for use ^{with} on the P-10-C line were designed, tested, and installed. The furnace was capable of holding a pot containing approximately 30 P-10 slugs plus auxiliary slugs such as lead, and heating the pot and its contents uniformly. It had two inches of lead for radiation shielding and was completely enclosed in a separately ventilated hood. Features were provided

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for continuously sweeping out any diffusion products which penetrate the walls of the furnace pot, thereby avoiding the possible personnel hazard of high product concentrations in the furnace spaces between the pot and the shield.

It was expected that the pots would be discarded after each use for extraction of irradiated slugs. When the pots were charged with radioactive material, they were transported and stored in casks with adequate radiation shielding. Suitable casks and a burial ground for the stripped irradiated alloy were provided as a part of this project.

Facilities in the existing can-opening room on the first floor of 108-B were provided for loading slugs into the new furnace pots. Cask handling and transporting facilities were provided for transfer of casks between the first and third floors.

Two furnaces and vacuum equipment were provided for outgassing furnace pots prior to use. The furnaces were of the same general design as the melting furnaces, but required no radiation shielding. In conjunction with the outgassing system, provision was made for leak detection using a standard mass spectrometer type leak detector.

VENTILATION AND CONTAMINATED AIR HANDLING FACILITIES

The new P-10-D installation was supplied with conditioned air from the existing P-10 supply fan because of its close proximity. The present P-10 glass lines installation was supplied with air from an air-conditioning unit in the new building addition.

An exhaust system was installed to take air from the new P-10-C extraction line hoods, furnace hoods, and the decontamination hood. In addition, the analytical and spectrometer rooms were connected into the existing exhaust system. A 300 feet concrete stack was erected, through which all ^{of the} exhaust air ~~exhaust~~ ^{areas was} from the "hot" P-10 processes ~~were~~ discharged. The subcontract installation cost of this stack was included in the project.

The existing P-10 exhaust system was interconnected with the new P-10-D exhaust system so that they both would discharge through a common duct leading to the stack.

Each glass line furnace was hooded to permit continuous and controlled removal of any tritium which diffused through the heated furnace tube walls.

The gases withdrawn from this contamination source were water scrubbed prior to discharge through the old exhaust stack. The scrubber liquid effluent was discharged to an existing crib. When the new stack was placed in operation, ~~this~~ ^{scrubbing} was discontinued.

AIR MASK SYSTEM

The blower installation used to supply clean air to the fresh air masks in the P-10 process hood room was expanded to include new air mask outlets in the P-10-D extraction and analytical rooms.

AIR MONITORING

There were three air monitoring systems on the third floor of 108-B. With the addition of six more systems for P-10-D, it was essential (space-wise) to centralize all of the air monitoring panels on a machinery platform located above the P-10-D rooms.

INSTRUMENT DEVELOPMENT ROOM

This room contained a glass vacuum extraction unit that was used for calibrating P-10 product analysis instruments. The unit was similar to the existing glass lines units, with some minor differences. The existing balance table and hood were relocated in this room. Certain specialized equipment was provided, such as a cathetometer and a buoyancy balance. The latter was arranged for apparent molecular weight determinations of product.

MASS SPECTROMETER ROOM

A commercial mass spectrometer, with some minor variations, was purchased

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and installed for use as the prime product analysis standard.

PIPING

All necessary service and drainage piping was provided to each new room.

ELECTRICAL

Instrument panels for the operation of the P-10-C units were provided as a part of the P-10-C Project. However, P-10-D included the necessary wiring between the panels and the units.

Electrical furnaces, as described previously, were installed along with the necessary control panels and auxiliaries. Normal lighting and power requirements were provided for each new room.

The air mask blower had direct current drive motors and stand-by batteries, sufficient so that, in the event of a normal power failure, the motors continued to run without interruption.

All P-10 fan and lighting circuits were connected into the 100-B area emergency power circuits so that operations would be interrupted only momentarily in the event of a power failure.

MISCELLANEOUS

- A. Obsolete tanks and their foundations, which were located adjacent to the proposed 300 foot stack area were removed prior to stack erection.
- B. An auxiliary steam line was provided so that 108-B was not shut down, if the 105-B main steam supply valve were closed.
- C. Additional casks and facilities for handling slugs between the irradiation piles and the 108-B can-opening room were provided.
- D. A Collins Helium Cryostat was purchased for low temperature studies.
- E. An installation for outgassing shipping containers was included. It was based on a process developed at Los Alamos.
- F. Developmental work was planned for the P-10-B (Cold Laboratory) Facilities

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which required the hooding of one of its three vacuum racks and also the installation of a conventional laboratory work hood. Both of the above hoods required an exhaust system for personnel protection, as work with uranium was planned for each unit.

- G. Each of the five glass extraction units were equipped with another melt furnace, and the necessary electrical interconnects were made. (46)

P-10-D, PART II

Additional development facilities were provided, so that delays to the accomplishment of the P-10 program would not be encountered. Immediate prosecution of the construction was made possible by utilizing funds already allocated for other work, which was on a deferred schedule.

The project did not include the construction or installation of a metal stripping line. At such time as engineering and economic feasibility of stripping was determined, funds for procurement of stripping equipment were to be requested under a separate project proposal.

New hood facilities in the Instrument Development Room were planned for "hot" development work and for reprocessing air contaminated tritium from the glass lines. Current reprocessing was performed in one of the existing production glass lines (line 2). The new reprocessing facilities ~~would also~~ ^{were to} provide a "hot" development hood for evaluating new gettering and scavenging systems for tritium collection, and make glass line 2 available for a production unit.

Performance tests were conducted during the last quarter of 1950 on the extraction furnace prototype by the General Electric Company at Hanford, and on the metal extraction line by the General Engineering Laboratory in Schenectady. The operation of the prototype outgassing furnace proved successful with the exception of the cooling cycle. The cooling period of the furnace was longer

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than was originally anticipated. The metal unit extraction operation was tested with the use of "cold" materials, and results indicated that the separation cycle could be accomplished in a shorter period than was first expected. These conditions indicated that the total extraction cycle was limited by the operation of the furnace. A second furnace installation would provide sufficient capacity so that the tritium output would be limited only by the capacity of the metal extraction line. The second furnace would also serve as a standby unit.

Operation of the mass spectrometer procured on Project C-399 and of the emission spectrometer obtained on a trial basis indicated the need for additional analytical equipment to:

1. Increase the capacity for the number of analyses performed.
2. Increase the accuracy of the mass spectrometer analyses.
3. Develop techniques for estimating the analytical accuracy.

The existing glass lines provided for the collection of tritium in 500 cc cylindrical Pyrex glass flasks. This glass packaging system was modified to provide for the new metal collection and shipping container developed by Los Alamos. The General Engineering Laboratory designed the metal extraction unit to accommodate the new Los Alamos shipping container.

To promote an efficient operation program for tritium production, adequate office facilities were provided to consolidate all technical and management activities. Formerly supervisors, secretarial, and technical personnel shared crowded offices in 1704-B Building. Managerial problems could not be conducted efficiently between supervisors and members of other groups due to the office space shortage. The offices located in the 108-B Building were urgently required for analytical and development work areas. Maximum security conditions were attained by a consolidation of all P-10 office and service functions within the 108-B Exclusion Area.

Fire detection and prevention facilities had to be increased to provide adequate protection to the 108-B process building. At that time, a sprinkler system was located over the portion of 103-B containing the glass extraction and control areas. The fire protection sprinkler system constituted an operational hazard in that accidental tripping of a sprinkler head would flood the extraction area, damaging the glass lines, and spreading radioactive contamination through other working areas of the 108-B Building. An electrical fire detection system was to be installed in lieu of the sprinkler system.

Space and equipment were needed for Health Instrument Division, Maintenance Division, and the Instrument Division. The facilities permitted the servicing divisions to provide the P-10 Production groups with the proper service.

The additional facilities covered by Project P-10-D, Part II included:

1. A second hooded vacuum glass rack in the Instrument Development Room for experimental purposes, similar in size and equipment to the glass extraction lines. The air mask system in the Instrument Development Room was increased from 3 to 5 masks. The existing ventilation, service piping, and drainage systems were extended to serve the new hood.
2. A second furnace of existing design was installed in a new hood beside the original metal line furnace facilities. The exhaust duct system was modified, but no increase in size or replacement of fan equipment was necessary. New electrical controls and pot cask handling facilities were procured and installed. The capacity of the outgassing furnaces was to be increased to meet furnace pot requirements of the metal line. The cooling cycle of the outgassing furnaces was to be minimized with the installation of an air sweep system.
3. A new metal packaging system was to be installed to replace the existing

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glass collection system. The metal system was to be supported from a steel frame mounted on the floor inside of the hood, but independent of the glass vacuum racks. The shipping container was to be located on a sliding shelf to facilitate easy installation and removal.

4. The Pile Technology Service Building was of temporary construction and provided 3200 square feet of floor space for twelve offices, a conference room, toilet facilities for men and women, and a janitor's closet. A concrete block foundation was provided for the one story frame structure. The building was steam heated and air conditioning was provided by evaporative coolers.
5. The mass spectrometer with related equipment, which was temporarily enclosed on the 3rd floor of 108-B, was to be relocated in the analytical room. This space was formerly designated as office area. A second mass spectrometer of improved design was to be purchased and installed with all necessary service connections. A glass blower's bench, a small glass vacuum rack, and a sample storage hood were to be installed to provide facilities for routine instrument calibration and glass "mock-ups" to be used in conjunction with the operation of the mass spectrometers. This room would then serve as a prime product analytical facility.
6. An emission spectrometer was to be procured and installed with necessary service connections. This instrument was thought to be especially adapted for automatic scanning of product samples.
7. An electric thermal fire detection system was installed throughout the 108-B Building. The existing sprinkler system protection for the glass extraction lines was deactivated. Modifications were made to improve the fire prevention in the glass extraction area. These improvements included:

[REDACTED]

- a. Painting wood joists with fire resistant paint.
 - b. Sealing the top of wood joists with transite sheathing.
 - c. Replacing wood cabinets, benches, and tool boxes with metal furniture.
 - d. Replacing wood doors and louvers with commercial metal access and ventilation openings.
8. Miscellaneous items included were:
- a. Six mass spectrometer type leak detectors were to be procured..
 - b. Two "Pete" type Health Instrument survey instruments for detecting tritium contamination of surfaces were to be fabricated.
 - c. Vacuum testing and service facilities were to be provided for the Maintenance Division in Cell Room #1 adjacent to the metal extraction unit.
 - d. An Equipment Development Shop was to be located in the south-west corner of the second floor in 108-B Building. The hydrogen furnace, radiation bottle, and radio frequency induction heater were to be relocated to this space. Work benches, shelving, service piping, and drainage systems were to be installed.
 - e. Adequate facilities were to be provided for the Instrument Division to perform necessary services to P-10 production and analytical equipment. The Instrument Shop was to be located on the second floor in a former office. It was to include work benches, shelving, and a test rack.
 - f. A stack gas sampling system was to be installed to permit the Health Instrument Division to obtain representative air exhaust samples.
 - g. Three mercury vapor detection instruments were to be procured for

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health monitoring.

- h. A binocular microscope and a borescope were to be purchased for metallurgical studies. These instruments were to be mounted in the existing can-opening room.
1. The existing P-10 glass extraction area air monitoring facilities were to be expanded from intermittent recording to continuous recording. Intermittent recording was undesirable in that peak contamination readings were not noted. Additional alarm horns and lights were to be added to increase signalling protection for operators.

P-10-X (48)

Tritium application research had led to decisions affecting the scope of the tritium production program at Hanford. One pile, 105-H, was charged with enriched fuel and the previously evaluated lithium aluminum alloy slugs and a project, P-10-Y, was scoped by the P Division for an extended use period. The first scope of P-10-X provided a Manufacturing Divisions' production plant in the 108-D Building with development and plant assistance activities provided the 108-B Building.

This program was initiated when funds in the amount of \$100,000 were were allocated on May 22, 1950, to cover scoping costs for the enriched fuel slug shipping phase, and tritium extraction phase. This scope was started during the summer of 1950 on a two pile basis and a certification of funds in the amount of \$6,500,000 was requested for the P-10-X program at Hanford.

During the fall of 1950, scoping was proceeding on a two-pile basis when two factors altered the picture. These were:

1. 105-DR was charged on plutonium service and the two-pile tritium production program was postponed.
2. Development within the health control and processing fields allowed major reductions in required stripping facilities.

As a result of these factors, the installation was rescope and reduced by planning revisions of the existing 108-B installations for production purposes, and construction of a new building in the 108-B area for continued development and plant assistance. This revised scope was completed in late 1950. The indicated cost for the extraction phases alone under this scope was \$4,000,000. Preparation of a formal project proposal was started on this basis. In order to meet construction requirements, two letters were submitted to the Atomic Energy Commission by the Project Engineering Divisions in November, 1950.

1. One letter requested the allocation of funds for engineering and procurement of critical materials for the P-10-X extraction facility, known as Project C-412.
2. A second letter requested the allocation of similar funds for the enriched fuel slug phase of this work known as Project C-411.

The two phases were separated, as indicated above, at the request of the Atomic Energy Commission. The second item, enriched fuel slug phases, was covered in a separate Project Proposal and is not discussed further herein.

The requested funds for engineering and advance ordering of materials as required for the extraction phases were approved and this work proceeded. However, a document dated February 6, 1951 instructed the General Electric Company to develop interim proposals designed to handle only those slugs which were then charged in the 105-H pile.

This instruction led to a decision to rescope C-412 again on a minimum basis to permit the extraction of the H-10 load in 108-B concurrent with development and plant assistance activities there but without any major new construction. This work was presented by F. A. Bowman and J. C. Chatten entitled "Design Criteria, Project C-412"; and incorporated in 108-B those features required for a production plant which had not previously been planned for the development facility.

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The estimated cost level related to this most recent rescoping was \$1,550,000, a considerable reduction below the scope previously discussed for C-412. In view of the reduced magnitude of the program and their previous tritium production experience, the Pile Technology Division was to sponsor this work through the extraction of the H-10 load.

Funds in the amount of \$615,000 were allocated for partial design, procurement and necessary development work for subject facilities prior to submission of a project proposal. When the current scope was developed, it was clear that additional funds and an approval to start construction would be required prior to the time that a formal project could be prepared and presented. A document was submitted to the Atomic Energy Commission ^{which} ~~to~~ outlined the current scope and planning and also request ^{ed} additional funds with construction approval. An additional \$355,000 was approved to provide a total authorized fund of \$950,000 for the P-10-X program. Modification 1 authorized design, procurement and field construction to proceed as necessary to meet tritium production schedules.

The construction under the various phases of the P-10-C and D Project was very nearly complete. This installation was designed to carry the P-10 development program through the calendar year 1951, by which time the production plant proposed under P-10-X was scheduled to be ready for P Division operation. Accordingly, the P-10-C and D work, as sponsored by the Pile Technology Division, was arranged to handle development and plant assistance phases along with the early production phases. The February 6, 1951 letter advising the General Electric Company of the "Hanford one load plan" for the P-10-X program led to a decision which placed a heavy production effort on the existing facilities. These installations were not designed as such and certain additions and modifications were necessary. Those items were as follows:

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- A. Stripper Line (addition)
- B. Spare Extraction Line (addition)
- C. Product Storage Building (addition)
- D. Product Container Outgassing Facilities (addition)
- E. "Hot" Maintenance and Instrument Shop (modification)
- F. Health Instrument Facilities (modification)
- G. Metallurgical Facilities (addition)
- H. Air Contaminated Product Facilities (addition)
- I. Miscellaneous (modifications and additions)

The above listed items are expanded in the following paragraphs.

STRIPPER LINE

A stripper line for recovery of tritium from air contaminated batches was considered an essential appendage to the present metal extraction line. In addition, it was very important to design the stripping appendage to extract tritium from by-product in order to insure that line capacity and product recovery was adequate for the short term objective. This equipment was to be available for installation during August, 1951, at the conclusion of metal line testing and prior to the start of continued production.

Project C-399 authorized the expenditure of \$13,604 by the General Engineering Laboratory, General Electric Company, Schenectady, New York, to proceed on an "assistance to Hanford" basis in providing a flow diagram, cost estimate, space and time requirements, and ^{to determine the} engineering feasibility of fabrication ^{of} ~~for~~ a stripping line.

The General Engineering Laboratory was authorized to incur expenses of \$18,000 as part of C-399, on December 8, 1950, by letter from A. B. Greninger to B. R. Prentice, approved by J. E. Travis, December 11, 1950, to construct a sorption vessel for this equipment. In addition, \$41,117 was authorized by a letter to B. R. Prentice from A. B. Greninger dated March 6, 1951, with approval of J. E. Travis, Atomic Energy Commission, dated March 9, 1951, to

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to permit the General Engineering Laboratory to complete the fabrication of the stripper line. This equipment, with the necessary liquid nitrogen system, was to be installed in the existing metal extraction line at Hanford.

SPARE EXTRACTION LINE

The procurement of one metal extraction line (in addition to the metal line provided by Project C-399) from the General Engineering Laboratory, Schenectady, New York, was authorized by letter to B. R. Prentice from C. N. Gross dated November 27, 1950, with approval of J. E. Travis, Atomic Energy Commission, on November 28, 1950. More recent plans did not provide for the installation of this unit but did include shipment to and storage at Hanford.

The General Electric Company was directed to complete construction but to defer installation of this second metal line.

PRODUCT STORAGE BUILDING

The use of the new product vacuum tanks (shipping containers) necessitated the construction of a new product storage building. Existing facilities did not accommodate the larger size of the new design metal product container nor the increased numbers of product containers. A reinforced concrete storage building designed to be "bomb resistant" was needed for this purpose. In addition, it was to be provided with safety features designed to dissipate the product via the ventilation stack in the event of container rupture or leakage during storage. The existing temporary arrangements did not have these safety features.

PRODUCT CONTAINER OUTGASSING FACILITIES

Tritium was to be shipped from the Hanford Works in metal product containers (vacuum tanks). These containers were in the process of fabrication (as an operating supply item) in accordance with Los Alamos design and were to be shipped to Hanford in an evacuated condition. Tests

for extended periods. They indicated that vacuum tank outgassing facilities would be required to permit re-evacuation and vacuum testing of the containers. There were no provisions included in the existing installations to handle this work.

"HOT" MAINTENANCE AND INSTRUMENT SHOP

The temporary "hot" maintenance shop in the cell next to the extraction line cell was essentially only a ventilated work area in which a work bench and associated equipment were provided.

The facility would have been adequate for necessary "hot" work of a development nature, where speed of execution was not at a premium. The intended production load on the metal line in 1951-1952 required a different treatment of the area, however, to permit rapid restoration of the metal line to service in the event of failure of any of the equipment; Similar shops were planned ⁱⁿ the P Division sponsored C-412.

Because of the limited experience with the operation of the vital equipment it was difficult to decide what arrangements should be made for repairs. It was believed that a minimum but adequate shop had been scoped by planning the installation of ventilated hoods for both instrument and mechanical repair with vacuum test, electronic, welding and decontamination equipment provided.

HEALTH INSTRUMENT FACILITIES

There were no Health Instrument laboratory facilities in the 108-B Area at this time. In order to overcome this shortage, urine and air samples were analyzed in the 200 Area Health Instrument control laboratory. This laboratory was inadequate to handle the expected analytical load of 150 air samples and 500 urine samples per week resulting from the additional controls which were to be established concurrent with expanded production. Also, the Health Instrument Divisions desired to return this control laboratory

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to the intended service. The Health Instrument laboratory facility, planned for 108-B, by this project, was to correct both of these deficiencies.

The third floor control gallery in 108-B was provided with a temporary Health Instrument station which was equipped with portable metering equipment, records depositories and a personnel desk. Experience indicated the need for a permanent station of this type which would be equipped with improved radiation detection instruments, ^{currently} ~~which were~~ under development. These instruments were specifically designed to detect the low energy beta radiation associated with tritium.

METALLURGICAL FACILITIES

At that time, there were no available facilities in the 108-B Area to make metallurgical studies of irradiated P-10 alloys. These facilities were needed to permit the study of the behavior and action of the alloy on the furnace pot. Further investigations were needed on the reaction of tritium and by-products upon the components of the metal extraction line. The lack of these facilities greatly restricted plant assistance work. In view of the pioneering nature of tritium production, this was considered a highly undesirable situation, and facilities were needed to permit analysis of these problems.

AIR CONTAMINATED PRODUCT FACILITIES

Occasionally, during the operation of the glass lines, batches of product inadvertently became air contaminated. Product purity specifications precluded shipment of such batches, and the existing tritium separation arrangements were not designed to recover ^{the} ~~such~~ potentially explosive air contaminated product. It was preferable to reprocess this material independently of the stripper being procured for the metal line. Therefore, one glass line was to be fitted for this purpose. Suitable sorption and de-sorption techniques

were to be used.

MISCELLANEOUS

Ventilation

The various rearrangements and additions previously described necessitated increases in air flows to maintain safe operating conditions.

Air Monitoring

Increased production scale activities and added auxiliaries increased operating requirements for air monitoring equipment.

Air Mask Equipment

Increased production scale activities necessitated major additions to this protective measure along with a means for giving closer control of the flow rate to the air mask units.

Slug Drying

The existing slug drying facilities did not have the capacity to handle the scheduled production load.

Casks

The increased production load required additional casks to facilitate operation.

BURIAL GROUND

The tritium extraction program required the disposal of large quantities of furnace extraction pots and tubes, slug cans and other radioactive materials. The existing, "P" Division supervised, contaminated burial grounds were becoming crowded and over-loaded. New burial ground sites were needed for safe and adequate disposal of contaminated materials.

AIR SAMPLING STATIONS

Existing portable air sampling equipment was in hazardous locations on the building floors. Provisions were desired to improve the safety and appearance of the area.

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AIR MASK WASHING

Air masks were currently cleaned for reuse by washing in a laboratory sink. In months to come, it was expected that up to 150 masks per day would require washing, disinfecting, drying, and surveying to insure freedom from contamination prior to reuse. The existing facility was wholly inadequate for this use. Consequently, an area of the building was allocated for the sole purpose of air mask cleaning.

MISCELLANEOUS STORAGE

Miscellaneous operating supplies were temporarily stored in an area of the building which was to be occupied by the Metallurgical Laboratory. Consequently, another area of the building was to be fitted for such storage.

LABORATORY WORK SHOP AND RENOVATION OF WOMEN'S LOUNGE

Currently, the women's lounge area on the first floor of 108-B was occupied by a laboratory work shop since no female personnel were employed in the building. Because of difficulties in staffing certain operations (Analytical and Health Instrument laboratories) with male personnel, these positions were to be filled with female personnel. It was necessary, therefore, to re-activate the women's lounge to that service by relocating the laboratory work shop.

FIRE PROTECTION

There were no provisions within the 108-B Building for attaching fire hoses to hydrant connections. In cases of need, the Fire Division would find it necessary to carry lengths of hose from hydrants outside the building to the fire location. This was undesirable and was to be corrected.

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PROCESS IMPROVEMENTS

The splashing of molten alloy into the furnace cap-seal assembly was
a major problem.

The glass lines were in the process of complete revision so that the number of stopcocks in contact with the product gases would be minimized. In the product system, mercury seals were used in place of stopcocks. An additional furnace was installed in each line with appropriate connections, so that furnace cooling cycles would not limit the process. Larger volumes were used to accommodate the larger yields resulting from greater exposure of the slugs. Traps using barium oxide were installed instead of cold traps to remove water vapor evolved with the extracted gases.

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P-10 GROUP

Organization Chart

February, March, April 1949

A. A. Johnson, P-10 Group Head
 J. C. L. Chatten, Assistant Group Head
 R. A. Rohrbacher, R. W. Vivian, Engineers
 Two Process Operators*
 C. R. E. Smith, Chemist

May, June 1949

A. A. Johnson, Pile Engineering Section Head
 J. C. L. Chatten, P-10 Group Head
 R. A. Rohrbacher, R. W. Vivian, Engineers
 Two Process Operators*
 C. R. E. Smith, Chemist

July through October 1949

A. A. Johnson, Pile Engineering Section Head
 J. C. L. Chatten, P-10 Group Head
 R. A. Rohrbacher, R. W. Vivian, Engineers
 Two Process Operators*
 One Glassblower*
 C. R. E. Smith, Chemist

November 1949

A. A. Johnson, Pile Engineering Section Head
 J. C. L. Chatten, P-10 Group Head
 R. A. Rohrbacher, R. W. Vivian, Engineers
 Four Process Operators*
 One Glassblower*
 C. R. E. Smith, Chemist

December 1949

A. A. Johnson, Pile Engineering Section Head
 J. C. L. Chatten, P-10 Group Head
 R. A. Rohrbacher, R. W. Vivian, Engineers
 Four Process Operators*
 One Glassblower*
 C. R. E. Smith, Chemist
 E. J. Eschbach, Engineer

*Non-Exempt Employees

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January 1950

<u>A. A. Johnson, Pile Engineering Section Head</u>	
<u>J. C. L. Chatten, P-10 Group Head</u>	
	<u>R. A. Rohrbacher, R. W. Vivian, Engineers</u>
	<u>G. G. Reed, Jr., Chemist*</u>
	<u>Five Process Operators*</u>
	<u>One Glassblower*</u>
	<u>C. R. F. Smith, Chemist</u>
	<u>E. A. Eschbach, Engineer</u>
	<u>One Technical Assistant*</u>

February 1950

<u>A. A. Johnson, Pile Engineering Section Head</u>	
<u>J. C. L. Chatten, P-10 Group Head</u>	
	<u>R. A. Rohrbacher, R. W. Vivian, Engineers</u>
	<u>Four Process Operators*</u>
	<u>One Glassblower*</u>
	<u>C. R. F. Smith, Chemist</u>
	<u>E. A. Eschbach, Engineer</u>
	<u>One Technical Assistant*</u>
	<u>H. F. Zuhr, Engineer**</u>

March 1950

<u>A. A. Johnson, Pile Engineering Section Head</u>	
<u>J. C. L. Chatten, P-10 Group Head</u>	
	<u>R. A. Rohrbacher, R. W. Vivian, Engineers</u>
	<u>Five Process Operators*</u>
	<u>One Glassblower*</u>
	<u>E. A. Eschbach, Engineer</u>
	<u>One Technical Assistant*</u>
	<u>A. R. Matheson, Chemist</u>
	<u>C. R. F. Smith, Chemist</u>
	<u>H. F. Zuhr, Engineer**</u>

*Non-exempt Employees

**On Loan from 234-5 Plant Assistance

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April 1950

A. A. Johnson, Pile Engineering Section Head
J. C. L. Chatten, P-10 Group Head
E. A. Rohrbacher, Engineer
R. W. Vivian, Engineer
Five Process Operators*
One Glassblower*
T. W. Gore, Engineer
A. R. Matheson, Chemist
P. A. Carlson, Engineer*
C. R. F. Smith, Chemist
E. A. Eschbach, Engineer
One Technical Assistant *
H. F. Zuhr, Engineer**

May 1950

A. A. Johnson, Pile Engineering Section Head
J. C. L. Chatten, P-10 Production Sub-group Head
E. A. Rohrbacher, P-10 Operations
C. R. McNutt*, R. W. Vivian, Engineers
Nine Process Operators*
Two Glassblowers*
W. M. Harty, P-10 Development Sub-group Head
One Steno-typist "C"*
A. R. Matheson, Cold Development
P. A. Carlson, Engineer*
J. W. Finnigan, Engineer*
C. R. F. Smith, Chemist
A. T. Taylor, Engineer
E. A. Eschbach, Hot Development
G. A. Wheeler, Engineer*
One Technical Assistant*
H. F. Zuhr, Engineer**
T. W. Gore, Engineer

*Non-exempt Employees

**On loan from 234-5 Plant Assistance

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June 1950

<u>A. A. Johnson, Pile Engineering Section Head</u>	
<u>J. C. L. Chatten, P-10 Production Sub-group Head</u>	
	<u>R. A. Rohrbacher, P-10 Operations</u>
	<u>R. B. Cuenther*, C. R. McNutt*, R. R. Vivian, Shift Supervisors</u>
	<u>Thirteen Process Operators*</u>
	<u>Two Classblowers*</u>
<u>W. M. Harty, P-10 Development Sub-group Head</u>	
	<u>One Steno-typist "C"*</u>
	<u>A. R. Matheson, Cold Development</u>
	<u>P. A. Carlson, Engineer*</u>
	<u>E. M. Carr, Chemist*</u>
	<u>J. W. Finnigan, Engineer*</u>
	<u>C. R. F. Smith, Chemist</u>
	<u>A. T. Taylor, Engineer</u>
	<u>One Technical Assistant*</u>
	<u>E. A. Eschbach, Hot Development</u>
	<u>J. E. Fletcher, Engineer*</u>
	<u>G. C. Reed, Jr., Chemist*</u>
	<u>R. W. Reid, Jr., Engineer*</u>
	<u>E. A. Weakley, Engineer*</u>
	<u>C. A. Wheeler, Engineer*</u>
	<u>One Technical Assistant*</u>
	<u>H. F. Zuhr, Engineer**</u>
	<u>T. W. Gore, Engineer</u>

*Non-exempt Employee

**On loan from 234-5 Plant Assistance

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July 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

R. A. Rohrbacher, P-10 Operations

R. B. Guenther*, C. R. McNutt*, R. W. Vivian, Shift Supervisors

Eleven Process Operators*

Two Glassblowers*

W. M. Harty, P-10 Development Sub-group Head

One Steno-typist "C"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

A. T. Taylor, Engineer

Four Technical Assistants*

E. A. Eschbach, Hot Development

P. A. Carlson, Engineer*

J. F. Fletcher, Engineer*

G. G. Reed, Jr., Chemist*

R. W. Reid, Engineer*

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Two Technical Assistants*

H. F. Zuhr, Engineer

T. W. Gore, Engineer

R. I. Olson, Engineer

*Non-exempt Employees

August 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

R. A. Rohrbacher, P-10 Operations

R. B. Guenther*, C. R. McNutt*, R. W. Vivian, Shift Supervisors

Fifteen Process Operators*

W. F. Ekern, Engineer

V. H. Nelson, Engineer

L. G. Rulon, Chemist

W. M. Harty, P-10 Development Sub-group

One Steno-typist "C"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

A. T. Taylor, Engineer

Four Technical Assistants*

E. A. Eschbach, Hot Development

P. A. Carlson, Engineer*

J. F. Fletcher, Engineer*

G. G. Reed, Jr., Chemist*

R. W. Reid, Engineer*

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Two Technical Assistants*

H. F. Zuhr, Engineer

T. W. Gore, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

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September 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

One Steno-typist "C" *

R. A. Rohrbacher, P-10 Operations

W. F. Ekern, Engineer

L. W. Lang, Engineer

L. G. Rulon, Chemist

C. R. McNutt, V. H. Nelson, R. W. Vivian, Shift Supervisors

Seventeen Process Operators*

W. M. Harty, P-10 Development Sub-group Head

One Steno-typist "C" *

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

N. Endow, Chemist

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

Two Technical Assistants*

E. A. Eschbach, Hot Development

P. A. Carlson, Engineer*

J. F. Fletcher, Engineer*

G. G. Reed, Jr., Chemist*

R. W. Reid, Engineer*

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Three Technical Assistants*

H. F. Zuhre, Engineer

A. T. Taylor, Engineer

T. W. Gore, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

October 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

One Steno-typist "C"*

One General Clerk "A"*

R. A. Rohrbacher, P-10 Operations

W. F. Ekern, Engineer

C. R. McNutt, V. H. Nelson, L. G. Rulon, Shift Supervisors

Sixteen Process Operators*

W. M. Harty, P-10 Development Sub-group Head

One Steno-typist "C"*

One General Clerk "A"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

N. Endow, Chemist

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

One Technical Assistant*

E. A. Eschbach, Hot Development

P. A. Carlson, Engineer*

D. L. Condotta, Engineer*

L. W. Lang, Engineer

G. G. Reed, Jr., Chemist*

R. W. Reid, Engineer*

R. W. Vivian, Engineer

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Four Technical Assistants *

H. F. Zuhr, Engineer

J. F. Fletcher, Engineer*

A. T. Taylor, Engineer*

T. W. Gore, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

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November 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

One Steno-typist "C"*

One General Clerk "A"*

R. A. Rohrbacher, P-10 Operations

W. F. Ekern, Engineer

C. R. McNutt, V. H. Nelson, L.G. Rulon, Shift Supervisors

Sixteen Process Operators*

W. M. Harty, P-10 Development Sub-group Head

P. A. Carlson, Engineer*

One Steno-typist "C"*

One General Clerk "A"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

N. Endow, Chemist

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

One Technical Assistant*

E. A. Eschbach, Hot Development

D. L. Condotta, Engineer*

L. W. Lang, Engineer

G. G. Reed, Jr., Chemist*

R. W. Reid, Engineer*

R. W. Vivian, Engineer

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Four Technical Assistants*

H. F. Zuhre, Engineer

J. F. Fletcher, Engineer*

A. T. Taylor, Engineer

T. W. Core, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

December 1950

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

One Steno-typist "C"*

One General Clerk "A"*

R. A. Rohrbacher, P-10 Operations

W. F. Ekern, Engineer

C. R. McNutt, V. H. Nelson, L. C. Rulon, Shift Supervisors

G. A. Wheeler, Engineer*

Twenty Process Operators*

W. M. Harty, P-10 Development Sub-group Head

P. A. Carlson, Engineer*

One Steno-typist "D"*

One General Clerk "A"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

N. Endow, Chemist

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

E. A. Eschbach, Hot Development

D. L. Condotta, Engineer*

L. W. Iang, Engineer

G. G. Peed, Jr., Chemist*

R. W. Reid, Engineer*

R. W. Vivian, Engineer

E. A. Weakley, Engineer*

H. F. Zuhr, Engineer

J. F. Fletcher, Engineer*

A. T. Taylor, Engineer

T. W. Gore, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

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January 1951

W. K. Woods, Pile Technology Division Head

J. C. L. Chatten, P-10 Production Sub-group Head

One Steno-typist "C"*

One General Clerk "A"*

R. A. Rohrbacher, P-10 Operations

W. F. Ekern, Engineer

C. R. McNutt, V. H. Nelson, L. G. Rulon, Shift Supervisors

Fifteen Process Operators*

W. M. Harty, P-10 Development Sub-group Head

P. A. Carlson, Engineer*

One Steno-typist "C"*

One Steno-typist "A"*

One General Clerk "A"*

A. R. Matheson, Cold Development

E. M. Carr, Chemist*

N. Endow, Chemist

J. W. Finnigan, Engineer*

C. R. F. Smith, Chemist

One Technical Assistant*

E. A. Fachbach, Hot Development

D. L. Condotta, Engineer*

I. W. Lang, Engineer

C. G. Reed, Jr., Chemist*

K. W. Reid, Engineer*

R. W. Vivian, Engineer

E. A. Weakley, Engineer*

G. A. Wheeler, Engineer*

Four Technical Assistants*

H. F. Zuhr, Engineer

J. F. Fletcher, Engineer*

A. T. Taylor, Engineer

T. W. Gore, Engineer

R. L. Olson, Engineer

*Non-exempt Employees

PERSONNEL ASSIGNED TO THE P-10 PROJECT BY MONTHS

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P-10-A

ORIGINAL FACILITIES

When promising results were obtained with the first of the lithium aluminum alloy slugs to be irradiated at Hanford, the Atomic Energy Commission requested the General Electric Company at Hanford to undertake their manufacture as an essential step in the production of tritium.⁽⁵⁶⁾ This request was based on the desirability of releasing the Argonne facilities used in slug fabrication for other research purposes, and combining the alloy production and tritium extraction operations at Hanford. It was recognized that the anticipated irradiation requirements for this alloy were only 2200-4200 four-inch slugs per year, obtainable from 26-50 billets weighing about 50 pounds each, and that much development work remained to be done on the special alloying process involved. Development studies were thought to require alloy preparation in amounts materially exceeding net irradiation requirements.

There were no melting and casting furnaces at Hanford of the two special types required for this work. Extrusion with the press available in the 314 Building was considered; but was rejected in favor of continuing with off-site service because the alloy must not be contaminated with uranium, and the small volume of material to be extruded did not justify the purchase of new press equipment.

Facilities for lithium aluminum slug preparation were installed under Suspense Code 482,000 in 108-B, which also housed the tritium extraction equipment installed under Project C-316.

The original P-10-A Project specified the following:

- A. Existing unused Power Division chemicals handling equipment were to be removed from the first floor of 108-B.

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- B. Concrete block wall partitions were to be erected on the first floor to separate the alloy slug manufacturing facilities from continuing Power Division work and the tritium extraction operations.
- C. A small degreasing and solvent storage building (1717-C) was to be erected. A 12' x 12' transite covered steel frame building (to be located east of the 108-B Building) was provided for degreasing the lithium prior to use, and for storing solvents and the lithium used in the operation.
- D. A security fence was to be erected surrounding the 108-B Building which provided access through the 105-B badgehouse.
- E. Miscellaneous equipment used in the process was to be installed.

The major items of equipment which were installed in the original P-10-A facility included a small melting furnace of Hanford design for melting of metallic lithium. Provision was made for casting the molten lithium into aluminum capsules within the inert atmosphere of the furnace. Two induction heated vacuum furnaces with a common 50 kilowatt power source and evacuation facility were provided for melting the capsules along with 2-S aluminum to give a suitable lithium aluminum alloy (3-4% lithium). The billet was cast under vacuum in a graphite mold within the furnace proper. A No. 3 Warner and Swasey turret lathe which was available on the plant was relocated to the P-10-A facility for machining of extruded rod into slugs. Also included as part of this project were workbenches, cabinets, service carts, a power hacksaw, scales, a preheat oven, and a bar storage rack.

The raw materials which were used were 99 plus percent pure lithium as supplied by the Maywood Chemical Company, and standard 2-S aluminum rod of 2 inch diameter.

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ORIGINAL PROCESSPREPARATION OF MATERIALS

The furnace charge was made up of 2-S aluminum rods and 10 aluminum capsules, each of which contained approximately 1/10 of the required amount of lithium. In forming the prepared capsules, a resistance heated furnace was used to cast the lithium into the aluminum capsules. Ten empty capsules were placed in the lower portion of the furnace and the required amount of degreased lithium was charged above. After sealing, an argon atmosphere was maintained to minimize oxidation of the lithium during melting and casting. The furnace was heated until the lithium melted, as determined by visual observation, and the lithium was apportioned approximately equally among the 10 capsules. After they had cooled to room temperature, the capsules were removed from the inert atmosphere and immediately sealed with special caps.

The molds, crucibles, and stopper rods used in the induction furnace were made of special graphiter. These items required outgassing prior to their initial use for casting. This was accomplished by heating in the drying oven to 500° F and holding at that temperature for at least three hours.

Just before assembly of the furnace components, the stopper-rod seat was smoothed with a special reamer. Then the mold was placed in the bottom of the induction furnace in a detachable assembly. The complete unit was raised and bolted to a gasketed flange on the furnace for vacuum seal. The crucible was placed in the upper portion of the furnace, so that it was approximately centered in the furnace coils. The stopper rod was seated over the pour hole, and the charge added to the crucible. The stopper rod holder was then inserted through a special seal in the lid, and the lid lowered so that its gasket formed a vacuum seal with the quartz furnace tube. The top of the stopper rod holder was bolted to a lever arm on top of the furnace lid.

After the furnace was evacuated with the Stokes vacuum pump until a vacuum of better than 100 microns was obtained, the heating of the metal was started.

During heating of the melt, some lithium was distilled. Since the furnace lid was water cooled to protect the gaskets, much of the distilled lithium condensed on its inside surface. Due to the fact that its oxide sorbed large quantities of water vapor, the accumulated lithium was removed from the furnace lid as soon as the furnace was opened to air.

BILLET CASTING

The charge of lithium and aluminum was heated to 1650° F, as measured by optical pyrometry, and the temperature was held for 15 minutes.. The stopper rod was slowly lifted from its seal, allowing the melt to flow through the pour hole into the mold. After all of the melt had been poured, the furnace was turned off and the billet was allowed to cool under vacuum. When cool, the billet and mold were removed from the furnace bottom. The billet was later removed from the mold. (58)

The cast billet was given a number and taken to the cut-off saw, where the pipe formed in the top of the billet, during cooling, was cut off. The sawdust formed by cutting a thin slice from the bottom was collected and sent to the 300 Area for chemical and spectrographic analysis. Prior to shipment the rough exterior "skin" was removed by the Warner and Swasey turret lathe.

BILLET EXTRUSION

When a group of finished billets had been accumulated, they were wrapped in waterproof paper and boxed in plywood boxes. Early shipments were made to the Detroit Gasket and Manufacturing Co., Detroit, Michigan, for extrusion. During transportation of the alloy off-site, the shipments were accompanied by Atomic Energy Commission couriers. Upon receipt of the billets by the extrusion plant, they were removed from the boxes and individually extruded in a horizontal press. The extrusion was through a die chosen by the plant such

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that the final rod diameter was 1.385 ± 0.005 ". The extruded rod was cut into 65" lengths, and each length was identified with the billet number. The rods were then stretch straightened, and boxed for shipment to Hanford. The extrusion plant was required to identify and return all scrap with the finished rods. (59)

SLUG FABRICATION

Upon receipt of the shipment by Hanford, it was sorted according to billet number, and accountability checks were made. The rod was then stored on a metal rack until it was machined into slugs, and the scrap was buried.

The rod from a billet being processed was put in the lathe and cut into pieces of approximate slug length. The maximum number of usable pieces were cut from the rod of an individual billet and rough machined to diameter. A second machining operation finished the slug to final dimensions of 4.000 ± 0.010 " length and 1.360 ± 0.005 " diameter. The finished slugs were identified by billet number and slug number. They were placed in standard Hanford wooden slug boxes and sent to 300 Area "P" Division for further processing. (59)

SLUG TESTING

Slug testing included destructive and non-destructive tests. All of the slugs were subject to critical inspection for a smooth weld with no portion of the bead overhanging the edge of the can, and no large scratches in the cap or can. A small overhang of the weld bead could be removed by filing, but if there were large blow holes or other visible defects, the slug was scrapped. After weld inspection, the slugs were tested in the bubble tester. Representative samples were taken from each finished lot for further testing. (59)

ANALYTICAL METHODS

There were four analytical tests used in connection with the P-10-A Project. These were: ^aAnalysis for percentage of lithium, analysis for the percentages of trace elements, analysis for surface and contained gases, and testing ^{of relative sample} for the reactivity of slugs from each billet.

LITHIUM CONTENT

The analysis for the percentage of lithium in the melt was done by a flamephotometer analysis. This was essentially a comparison of a specific lithium spectral line ^{intensity} produced from the sample in a controlled gas flame with that produced in the same flame by a standard. (60)

SPECTROGRAPHIC ANALYSIS FOR IMPURITIES

Spectrographic analysis of filings from each billet indicated the extent of trace impurities. It was found that the sampling method did not introduce significant amounts of iron, allowing ^{iron also} it to be determined directly on the spectrographic plates. The method was in the form of a visual quantitative comparison with standards, and the accuracy was estimated to be within a factor of two of the true value. Since the impurities were in such trace amounts, this was thought to be sufficiently accurate. This method indicated the quantities of antimony, boron, chromium, cobalt, copper, iron, magnesium, manganese, nickel, potassium, sodium, tin, zinc, and zirconium. During the use of 99.95 plus percent pure aluminum for slug fabrication, the usual total of these impurities was less than 460 parts per million. (61)

GAS ANALYSIS

The analysis for gas in the slugs was made using an extraction procedure and apparatus similar to that used for the glass extraction lines. The desired limits of acceptability of a lot of slugs were that each slug should contain less than 2 cc of surface hydrogen, and less than a total of 4 cc of hydrogen.

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The extraction of the gas was done in two steps. The surface gas was that removed during heating and the internal gas was that removed by subsequent heating. The method required at least semiskilled operators, since high vacuum apparatus requiring manual control was used.

Each test slug was decanned by sawing open the can with a hand hacksaw prior to placing it in a furnace tube. Precautions were taken to prevent moisture and oil contamination.

The first portion of the slug gas test program was carried out in the glass extraction line 5 in the glass lines hood room. After the construction of the P-10-B Cold Laboratories, five test lines were available, and line 5 was released for other work.

The normal results of the gas analysis showed large inconsistencies, and it was thought that if the need for such testing again arose, some other method of testing might be preferable. Among the items that interfered ^{with the analysis} were the breakdown of water vapor on the surface of the hot stainless steel furnace tube, with subsequent permeation of the furnace tube by the hydrogen produced; off-gassing of the greases and gaskets used in the line; and breakdown of water vapor and hydrocarbons (52)

REACTIVITY TESTING

The final test on the slugs was performed by selecting a random sample of slugs from each billet and testing their relative reactivity in the 305 test pile. The method for random sampling was developed by the Statistics group. The relative reactivity was reported in percent blackness as compared to a standard lead-cadmium slug, which was assumed to be 100 percent black to incident neutrons, i.e., all incident neutrons are absorbed within the slug.

It was assumed that within the lithium concentration range of interest, 3.2 to 3.7 percent lithium, the blackness varied linearly with the concentration. This assumption was proved valid by a series of tests using standard slugs for the evaluation. Thus, it gave a final check on the lithium concentration

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and/or the presence of other elements with high thermal neutron capture cross sections. (63)

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P-10-A EXPANSION

When the production commitments were revised toward a much expanded goal, the slug machining facilities did not have sufficient capacity to meet charging schedules. By modification of the process, minor equipment additions were sufficient to meet the proposed charging schedule.

The new equipment installed greatly increased the capacity of the machining operation without significant increase of personnel by accelerating individual operations. The equipment on hand for billet casting was found to have sufficient capacity for the increased load.

A circular saw was procured for use in cutting finished rods into pieces approximately 4 1/8" long. Two ^{new} lathes were procured, one for skinning the billets and the other for trimming the canned slug and cap assembly prior to welding. An air operated chuck was installed on the Warner and Swasey turret lathe, which permitted single cut finish machining of the rough-cut pieces of rod. An arc welding machine was procured to minimize the time delay between slug finishing and welding of the final assembly, and a bubble tester was fabricated for testing the finished slugs.

Additional storage space was provided by enlarging the P-10-A work area and also by making an enclosed storage area out of the railroad loading dock associated with the 108-B Building. Additional office, toilet, and locker facilities were provided for the increased number of personnel associated with both the P-10 and P-10-A Projects. (64)

The expanded facilities were accepted for use by the Pile Technology Division on October 18, 1950, and were physically complete by February 1, 1951.

A later revision of the production commitment required that sufficient lithium aluminum slugs should be fabricated for a second H-10 load plus poison slugs, and placed in storage. By December 1950, sufficient slugs had been fabricated for the second H-10 load, and additional slugs for a third such

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load were being prepared. Sufficient slugs would then be on inventory to cause no delay in supplying lithium aluminum slugs, should notification be given to resume irradiations. (59)

It had been planned that the P Division would assume control of the P-10-A facility and personnel, but with revision of commitments, the transfer of the facility was cancelled. The transfer of personnel did occur, however, since the personnel could ~~later~~ be used for similar work done by the P Division in the 300 Area, after P-10-A terminated operations. The transfer of personnel was completed when R. Teats was transferred to P Division on January 8, 1951. Slug fabrication and billet casting operations were terminated by March 15, 1951. (59)

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PROCESS IMPROVEMENTS

PREPARATION OF MATERIALS

Various kinds of molds and several methods of mold preparation were tried. It was found that an outgassed graphite mold without a mold wash gave the most consistent and satisfactory results. The molds ^{casted} used included steel, cast iron and various graphites. The mold washes tested were hydrograf (colloidal graphite in water) and zirconite (aqueous). They apparently had no advantages, and had the disadvantages of introducing additional quantities of water. The mold type finally selected for use was a shell, 8" o.d., 6 1/8" i.d., 20" long, with a 5 1/16" insert for the top. The material of construction of the mold was National Carbon Electrode Graphite, type C. S. 312.

The crucibles used were Joseph Dixon Company, Composition C-7, clay graphite induction furnace crucibles. These crucibles were 10 3/4" o.d., 9" i.d., 15" long, with a glazed exterior. Prior to the initial use of each crucible it was necessary to drill a pour hole, and cut two slots for the crucible lifting device. Crucible extensions were made from old crucibles, cut to a ring 7 1/2" long.

Outgassing of molds, crucibles, and stopper rods was carried out by heating these items to approximately 1400° F and holding at that temperature for a minimum of 30 minutes, and until a vacuum of less than 100 microns was obtained, as measured on a Stokes McLeod gage. After outgassing, these items were stored in the drying oven at 200° C until used. Mold assemblies were outgassed prior to each use.

The aluminum was supplied in 6 pound ingots, and the charge was made up of these, plus cut pieces. The pieces were cut from ingots on the cut-off saw, using kerosene as a lubricant. They were thoroughly preheated prior to charging in the furnace in order to drive off traces of kerosene.

Just before termination of slug fabrication, information was received from Maywood Chemical Company, that the lithium could be supplied packed in dry helium rather than light oil. However, since sufficient lithium was on hand for the needs of the P-10-A process, none of this material was procured for test purposes.

Because of the desirability of minimizing gamma radiation from the irradiated slugs, the 2-S aluminum originally used was replaced with 99.85 percent pure aluminum. This purity was later increased to 99.95 plus percent aluminum. The gamma radiation from irradiated aluminum was largely due to the Fe^{59} (46 day half-life) activity. The amount of iron introduced by the various machining operations was negligible.

BILLET CASTING

A special charging device was added to the furnace lid for retention of solid lithium until enough aluminum had melted to allow room for the lithium in the crucible. This also aided in minimizing lithium volatilization.

The casting procedure was changed in several respects, mostly aimed toward reduction of pipes in the cast billets. The charge was heated to $1400^{\circ} \pm 50^{\circ} \text{ F}$ and held at that temperature for 45 minutes, using the lower portion of the furnace heating coils so that a cast-iron mold hot-top would also be thoroughly heated. The power was turned off the furnace, and the melt was held in the crucible without heating for 25 minutes. After this period, the power was again turned on and set for 20 kilowatts, and the melt was *immediately* poured. After the crucible was empty, heating was continued at 20 kilowatts for 10 minutes.

The stopper rod was slowly lifted to pour the melt, as otherwise, excessive splashing of the first portion of the melt to reach the bottom of the mold would occur. Since the outside surfaces of the billet were completely removed before extrusion, more efficient use of the furnaces could be achieved

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by removing the billet after it had cooled as little as two hours.

When the bottom of the billet was cropped, the sawdust was saved and sent to the 300 Area for chemical and spectrographic analysis. The required standards of acceptability were 3.2 to 3.7 percent lithium, and the following concentrations of impurities:

Fe less than 100 ppm

Cu less than 50 ppm

B less than 5 ppm

Co less than 20 ppm

Mn less than 50 ppm

Cd less than 1 ppm.

A separate lathe was procured for removing the rough surface on the billet, so that each of the three lathes could be left in a semi-permanent set-up. Billets were cropped and skinned to sound metal, free from inclusions, porosity, cracks, and blow holes.

BILLET EXTRUSION

Due to the number of important variables in operation of an extrusion press, it was necessary to specify certain of these variables for the press operators guidance. A group of test billets were extruded under varying conditions, in order to arrive at a set of operating conditions which would normally give satisfactory rods. All subsequent purchase requisitions for extrusion had the following specifications:

Pre-heat Furnace Temperature	850° F
Billet Pre-heat Temperature	800° F
Billet Can Temperature	660° F
Breaking Pressure	1150 to 1400 psi
Feed Rate to give	5 feet per minute of extruded rod
Billet Heel Size	7/8" ± 1/8"

The extruded rod was cut to 65" pieces, and each piece was stretch and hand straightened. The amount of elongation from stretch straightening, ~~that was observed~~^{to be} was 2" to 2 3/4" per 65" length of rod. This gave finished rod of the correct diameter and within the tolerance of a maximum deviation of 0.012" from a straight edge per linear foot of rod.

SLUG MACHINING

The rods were cut into pieces 4 1/8" $\pm$ 1/16" long on the circular saw, and then randomly placed in the slug cart. All of the rod from each billet was processed in one group, before the next billet was cut. After completion of slug cutting, the pieces were taken to the Warner and Swasey turret lathe for finish machining.

The pieces were machined by placing one end of the slug in the air operated chuck, gripped with the chuck, cutting about 60 percent of the length to the desired diameter of 1.355" $\pm$ 0.005", and making a facing cut on the exposed end of the slug of less than 1/16". The finished end of the piece was placed in the lathe, and butted against a stop in the chuck. The balance of the piece was then machined to diameter and cut to the finished length of 4.000" $\pm$ 0.010". After the machining steps were completed, the finished piece was inserted into an aluminum can, and capped with an aluminum wafer.

The can was carefully cut off flush with the cap, using a slow enough feed to prevent distortion or pulling of the can. The trimmed assemblies were immediately welded.

The arc welder used argon as the inert gas, at a flow rate of 4 to 6 liters per minute. The electrode was 1/8" diameter tungsten, extending 1/4" to 3/8" beyond the tip of the torch sheath. A current of 50 to 80 amperes was used, and the arc distance was such that a sputterless arc was produced.

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The arc was struck near the middle of the cap, with the table slowly rotating. When a molten pool formed under the arc, the rotation was stopped and the arc was moved out to the interface of the cap and can. Rotation of the slug was resumed, when the bead began to form, keeping a molten pool ahead of the arc. The weld bead was overlapped around the can for a distance of 1/4" to 1/2", and the arc was slowly moved to the center of the cap and broken. Weld bead overhangs were reduced by filing to allow clearance through the ring gage.

The welded slugs were tested individually by inserting in a bubble tester, containing odorless kerosene or the equivalent. A vacuum of 28.0" to 29.5" of mercury was used, and the weld bead and can were observed for at least 10 seconds to determine if a string of bubbles was coming from one spot. If the string of bubbles was observed, it meant that there was a flaw, and the piece was rejected.

The slugs that passed the bubble test were then tested for dimensions; the outside diameter was tested with a snap gage, to be 1.438" $\pm$ 0.013", the maximum length was measured with a steel rule for no more than 4.165", and the piece was to pass through a tube 1.455" i.d., and 5" long. The surface was to be free of dents, cuts, or scratches deeper than 0.006" as judged by visual comparison with standards. The weld bead was to be free of pin holes, porosity or larger defects.

Each completed piece, after final inspection, was stamped on the end opposite the weld with the letters P-10-A. On a line beneath the letters P-10-A, the billet identification number was stamped; and on a third line, the slug number. Certain proportions of each lot were tested for reactivity and gas content. The balance of the slugs and those returned from the reactivity test were stored.

P-10-AOrganization Chart

July 1949 through January 1950

E. A. Smith, Group Head, 300 Area Plant Assistance, Metallurgy and Control Divisions
R. Teats, Metallurgist
Two Process Operators*

February 1950

J. C. L. Chatten, P-10 Group Head
R. Teats, P-10-A Sub-group Head
G. G. Reed, Jr., Chemist*
Five Process Operators*

March, April, May 1950

J. C. L. Chatten, P-10 Group Head
R. Teats, P-10-A Sub-group Head
W. K. Kratzer, G. G. Reed, Jr., Shift Supervisors
Seven Process Operators*

June 1950

J. C. L. Chatten, P-10 Production Sub-group Head
R. Teats, Assistant Sub-group Head
W. K. Kratzer, L. W. Lang, Shift Supervisors
Seven Process Operators*

July 1950

J. C. L. Chatten, P-10 Production Sub-group Head
R. Teats, Assistant Sub-group Head
L. W. Lang, W. K. Kratzer, Shift Supervisors
Nine Process Operators*

August 1950

J. C. L. Chatten, P-10 Production Sub-group Head
R. Teats, Assistant Sub-group Head
L. W. Lang, W. K. Kratzer, Shift Supervisors
Ten Process Operators*

September 1950 through January 1951

J. C. L. Chatten, P-10 Production Sub-group Head
R. Teats, Assistant Sub-group Head
Four Process Operators*
G. B. Marsh, Slug Accountability*

*Non-exempt Employees

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HEALTH HAZARDS

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ORIGINAL SAFEGUARDS

The original installation included hooded vacuum racks and an enclosed hood room. The ventilation system was such that the air supplied to the whole building was 18,000 cubic feet per minute, and the amount exhausted through the various hoods was approximately 20,000 cubic feet per minute. The process air which was exhausted through the glass lines hoods was discharged through a small stack located atop the 108-B Building. The top of the stack was approximately 75 feet above ground level.

Personnel were required to wear lab coats, safety glasses, and gloves. In glass line manipulations, rubber gloves were used; and in can opening room operations, horsehide gloves were used.

No survey instruments were available which were designed for use with the low energy beta radiation associated with tritium. The instruments which were used included the C. P., V. G. M., Zeuto, and a portable Beckman which was used in the can opening room. Considerable difficulty was encountered with these instruments due to tritium gas penetrating the ionization chambers. The C. P. and Zeuto were particularly sensitive to this phenomena. Once the tritium had penetrated the chamber, it tended to remain there, putting the instrument out of service for periods of time up to several hours.

The decanned, irradiated, lithium fluoride pellets were stored in a dessicator after decanning and prior to making up a charge in a copper boat. The dessicator was kept in the can-opening room hood. The charged boat was placed in a sheet metal container with a hinged, flap type lid, and then carried to the extraction line furnace by hand. After completion of the run, the spent pellets and copper boat were returned to the can-opening room in the same manner. The copper boats were re-used as much as possible, and to do this, it was necessary to knock out the sintered mass of pellets from the

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boat, using a hammer. No attempt was made at protection other than doing this job in the can-opening room hood.

SAFEQUARD ADVANCES (65)(66)

Concurrently with the completion of the lithium fluoride slug processing, a method was developed for the detection of tritium in the urine, using the urine sample in an acetylene generator, and measuring the radioactivity of the resultant gas with a vibrating reed electrometer. It was found the appreciable contamination of several of the operating personnel had occurred. For this reason, the glass lines hood room was locked until a more adequate means of protection could be devised.

It was decided that in all future operations, Mine Safety Appliances half-face fresh air masks were required, and a suitable system was installed. In addition, an air monitoring system was installed which used Kanne Chambers as the detection instrument. The monitoring system which was originally installed used two Kanne Chambers, one for the hood room air, and one for the stack exhaust air. The hood room Kanne Chamber continually sampled the air in front of the process hoods, the decontamination hood, and product storage areas in the hood room. The second Kanne Chamber monitored the air being discharged through the stack, and thus checked the hood room air and the gases being released from the lines and vacuum pumps. A multiple point, intermittent recorder was used to record the Kanne Chamber readings.

At first, vacuum pumps discharged directly into the hoods. This was changed so that the discharge was piped to the top of the hood, i.e. the entrance of the hood exhaust duct. Finally, a special manifold was installed which received the gases discharged by the vacuum pumps. With the early expansion programs, two additional Kanne Chambers were installed. The third Kanne Chamber to be installed in the 108-B was used to monitor the gas in the vacuum .

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pump discharge manifold. A fourth Kanne Chamber was installed for use in monitoring can-opening room activities. The fourth Kanne Chamber readings were recorded using an Esterline-Angus recorder on a continuous recording basis. The other three Kanne Chamber readings were recorded intermittently using a Leeds and Northrup four point intermittent recorder.

With P-10-C, P-10-D parts I and II, and P-10-X, additional Kanne Chambers were installed as required, with the final total being 18 units.

The monitoring thus provided were identified as follows:

<u>Kanne Chamber No. and Place Monitored</u>	<u>No. of Sampling Points</u>
1. Cell #2 Room Air	4
2. Process and Furnace Hood, Cell #2	4
3. Vacuum Pump and Furnace Air Sweep, Cell #2	2
4. Decontamination Hood and IDR Hoods	3
5. Analytical Room Hoods (second floor)	6
6. 300' Stack	1
7. Vacuum Pumps (glass lines)	common manifold
8. Room Air (glass lines)	8
9. Exhaust Duct (glass lines)	1
10. Can Opening Room	6
11. Product Storage Building	1
12. Cell #1 Room Air (Instrument and Maintenance Shops)	4
13. Cell #1 Hoods	2
14. IDR Room Air and Balance Hood	3
15. Analytical Room Air	4
16. Operating Gallery and Emission Spectrometer Room (special large volume Kanne Chamber)	6
17. Hot Metallurgical Room Air	4
18. Hot Metallurgical Hood Exhaust	3

Each Kanne Chamber was connected to an Esterline-Angus continuous recorder, so that continuous readings of all monitors would be provided. The glass lines vacuum pump discharge manifold entered the glass lines exhaust duct downstream from the exhaust duct Kanne Chamber sampling point, thus preventing interference with the monitoring of the hood air.

For personnel protection, a warning system consisting of audible and visual signals actuated by the Kanne Chambers was in service. The limits set on the warning devices were as follows:

For areas requiring the use of fresh air masks, the area was to be evacuated when a Kanne Chamber reading of 3.5×10^{-12} amperes above background occurred. Normally, the alarm was set to trip with a reading of 10×10^{-13} amperes. Re-entry to the area was permitted when the reading had dropped to 1.8×10^{-12} amperes above background or less.

For areas where fresh air masks were not used, such as the can-opening room and the analytical room, a reading of 3.5×10^{-13} amperes above background was the limit. Re-entry was permitted when this dropped to 1.8×10^{-13} amperes above background or less.

If the alarm connected with the stack exhaust was actuated, but not the hood room air monitor warning alarms, hood doors were to be shut until this reading was reduced. The limit had been set for 3.5×10^{-11} amperes above background, and re-opening of the hood doors for routine operations was permissible when this dropped to 1.8×10^{-11} . Normally, the alarm was set to operate at 10×10^{-12} amperes.

Backgrounds were normally taken to be the reading obtained from sampling the fourth floor air with the Kanne Chamber being tested. At one time, samples of the outside air were introduced through a long hose, to determine if the use of the fourth floor air was valid. Since no difference was detected, the fourth floor air was used as the means of determining the background current for each Kanne Chamber.

The Kanne Chambers were sensitive to all tritium bearing components of the air being sampled. These included tritium gas, tritiated water, other tritiated compounds, and dust particles carrying tritiated substances. The "DeWitt", an instrument later described was similar to the Kanne Chamber in its sensitivity for all forms of air contamination.

A means of urine analysis was devised, which was more rapid and gave more reliable results. The liquid to be tested was placed in an aluminum

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carbide generator, and the evolved methane was measured for radioactivity using a proportional counter. In addition to the analysis of urine samples by this method, other liquid samples could also be monitored. In order to determine the actual quantity of tritiated water in the air, air samples of known volume from the place for which this information was desired were passed over a known quantity of anhydrous calcium chloride. The adsorbed water was later distilled and measured for quantity. Then the activity of this water was measured using a procedure similar to that used for urine samples, thus giving an indication of the quantity of tritiated water which was present in the air sample.

Due to difficulty in obtaining an adequate grade of aluminum carbide, the next approach used was an internal counter filled with hydrogen gas at atmospheric pressure. The hydrogen was generated from the liquid sample using metallic calcium.

This procedure was developed into a satisfactory routine, with a current capacity of 6-8 samples per hour per instrument, and reproducibilities of 5 - 10 percent on routine operation.

The frequency of urine sampling was gradually increased until process operators were required to leave a urine sample each work day. Those working in the exclusion area, but only infrequently in the hood rooms were sampled once a week.

New detection equipment was developed for use in surveying flat surfaces, and a portable air monitoring system was devised. The instruments used windowless probes. The survey instrument developed for flat surfaces was entitled the "Pete". If an irregular surface was to be surveyed, it was necessary to take a smear of the surface with a paper towel, and then check the towel for pick-up of contamination. The counter gas used in the "Pete" was a continuous flow of 90 percent argon - 10 percent methane

at atmospheric pressure.

A mobile proportional counter for monitoring airborne tritium and tritium bearing particles was developed along the same line as the "Pete". This instrument, dubbed "DeWitt", mixed the sampled air with methane (10 percent air - 90 percent methane) and counted the mixture. At the time of this report no suitable substitute for methane or denaturant for methane had been found which made the resultant gas mixture relatively non-inflammable while still retaining the desirable counting characteristics.

All of the process air exhausted through the various hoods was vented to the atmosphere through a 300 foot stack. These hoods included the extraction lines hoods, the Instrument Development Room hoods, the Analytical hoods, and the furnace hoods. In addition, the air in the product storage building and "hot" Metallurgical Laboratory was to be exhausted to the stack.

A scrubber was used temporarily until the 300 foot stack was completed and put into service, in order to remove any tritiated water present in the exhausted air from reaching the air leaving the stack. The extraction furnaces were separately hooded, as a means of preventing any tritium which diffused through the furnace tube during extraction from reaching the hood atmosphere and possibly the room air.

Interlocks were installed on the air supply and exhaust systems, so that in the event of an exhaust failure, the air supply would immediately be shut-down. This was to prevent turbulent air from sweeping any tritiated material from the hoods and hood rooms. However, in the event of an air supply failure, the exhaust system continued to function. Each hood was provided with filter pads around its base, so that when the hood doors were closed, air flow through the hoods to the exhaust duct would be maintained.

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A separate burial ground for P-10 waste material was constructed. All solid, potentially contaminated waste, and all "hot" waste mercury ^{were} ~~are~~ disposed through burial there. The "hot" mercury was confined in a sealed cast iron pipe before burial, and the solid wastes were confined in sealed cardboard cartons; except for can-opening scrap, which was ^{collected in a plastic bag} ~~collected in a plastic bag~~ buried as it was, and sealed furnace tubes.

Spent furnace tubes were sealed with a greased neoprene gasket and then capped prior to burial in the burial ground. After sealing of the furnace tube, an extension was added to the nearest hood room Kanne Chamber air sampler and the seal was "sniffed". If a reading of over 10 times the hood room air background was obtained, the furnace tube was either resealed or retained in the hood until the activity had been dissipated.

All liquid wastes, with the exception of mercury, were discharged to the ground through a crib located north of the 108-B Exclusion Area. Samples of the ground water had been taken from near the crib and analyzed for tritium. The results of the analysis were well below the maximum concentration limit for drinking water.

PRESENT OPERATING STANDARDS ⁽⁶⁵⁾

There were two types of danger zones established in the 108-B Building. These were ^{classified as} ~~either~~ inner ~~or~~ outer danger zones. The extraction line hood room and the Instrument Development Room were classified as inner danger zones; and full Special Work Permit clothing, gloves, full face MSA fresh air masks, safety glasses, shoe covering, and safety shoes were required. A minimum air flow of 7 cubic feet per minute was maintained at the face of the fresh air masks. The glass lines control panels area, the analytical room, the can-opening room, and the ~~the~~ product storage buildings were classified as outer danger zones. In these areas, laboratory coats and safety shoes were required. Outer danger zone areas which indicated the presence of

surface contamination required the added precaution of using gloves and shoe covering. At the time of this report only the can-opening room had this requirement.

For inner danger zone work, clean Special Work Permit clothing was used twice per shift. For other danger zone work, clean Special Work Permit clothing was usually used once per shift. Goatskin gloves were used in hood work, and they were changed a minimum of twice per week. If they became greasy or "hot" they were immediately discarded. No attempt was made to salvage used goatskin or rubber gloves, and they were buried with contaminated waste. Rubber gloves were used for stopcock regreasing and decontamination hood work. These were discarded into the contaminated waste after completion of each job. Canvas gloves were used in can-opening room work, and these were changed for clean after completion of each job. Fresh air masks were washed in soap solution and disinfectant after each shift, and sooner if contamination was suspected.

Personnel were required to wash their hands thoroughly each time after leaving a danger zone. In addition, each time the exclusion area was left for other than Special Work Permit purposes, after working in an inner danger zone, a shower was required prior to departure. In all cases of doubt about skin contamination, smears of the suspect area were taken and checked on the "Pete". If loose contamination was present, standard decontamination procedures were followed until this was reduced to the detection limit of the "Pete".

For all danger zone work, either Special Work Permits or Special Hazard Procedures were used to maintain control of operations. Normal Maximum Permissible Exposures were used for the limit of total exposure, A maximum of 25 mrem was allowed for external exposure. The remainder of

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25 mrem was allotted to the presence of tritium in the body fluids as an added safeguard in case internal contamination occurred, since there was usually a time delay of 16-24 hours until the urine analysis results were obtained. When the proposed laboratory in 108-B was placed in service, the most recent urine analysis was to be used to determine the external exposure limit.

Personnel leaving daily urine samples were removed from all danger zone work when a concentration of 35 micro-curies of tritium per liter was reached. Personnel being sampled weekly were removed from this type of work when 20 micro-curies per liter was reached. The conditions to be met for re-entry of the contaminated personnel into danger zone activities were as follows: the concentration of tritium was to have dropped below 5 micro-curies per liter; the integrated exposure, since contamination, was to have dropped below 300 mrem per week; and agreement of the Medical Department was to be obtained.

The route of personnel contamination was still unknown. As a means of prevention of re-occurrence of personnel contamination, each time a personnel contamination incident occurred; an investigation of all the circumstances was performed. Any suspect items of procedure were revised. This was, in effect, use of the principle of locking the barn door after a horse was stolen, to prevent future thefts.

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BIBLIOGRAPHY

1. ANL-SL-290, Lithium Sources for Tritium Production-History, Alloy Comparison, and Program, May 24, 1950 by C. E. Stevenson.
2. CP-902, Slow Neutron Cross-section of Deuterium, Half-life of H^3 , August 30, 1943, A. Langsdorf
3. MUC-SKA-688(N-1329a), Memo, June 5, 1944, S. K. Allison
4. MUC-FS-41 (N-1329b), Memo to S. K. Allison, June 30, 1944, F. Seitz
5. M-CP-2033, Semi-Monthly Report of the Physics Section, Clinton Laboratories, August 15, 1944, A. H. Snell, L. W. Nordheim, E. O. Wollan
6. M-CP-2222, Monthly Report of the Physics Section, Clinton Laboratories, December 31, 1944
7. CS-1955 I (A-2834), Project Council Information Meeting, Chemistry, July 18, 1944.
8. Mon C-35, Production and Purification of Tritium, November 29, 1945, C. V. Cannon et al
9. Mon N-4, Technical Division Report, July 1945, Clinton Laboratories Technical Division
10. Mon N-175, Technical Division Report for September 1946, Technical Division, Clinton Laboratories
11. Mon N-212, Technical Division Report for November 1946, Technical Division Clinton Laboratories
12. N-2240 (CP-G) Secret Letter, March 1, 1946, H. L. Anderson to Hood Worthington
13. CC-3561, Nuclear Chemistry Division Report for June 1946, Metallurgical Laboratory, University of Chicago
14. CC-3780, Chemistry Division, Section C-I for October - December 1946, Metallurgical Laboratories, University of Chicago
15. ANL-4021, Chemistry Division Section C-I for April - June 1947, Argonne National Laboratories.
16. M-3565, Technical Information Meeting Reports, October 13 - 17, 1947, Abraham et al, Argonne National Laboratories
17. ANL-4159, Tritium Production Process, May 25, 1948, N. Chellew and J. Maguire
18. GEH-10,151 and 10,152, Re: Meeting on October 15, 1946 at Clinton National Laboratories Regarding Production of Tritium from Request #15, October 25, 1946, H. E. Skinner, Corps of Engineers

2 of 2

19. ANL-4003, Metallurgy Division Report for April - June 1947, Argonne National Laboratories
20. 7-5518, Trip Report, Visit to ANL, December 10, 1946, J. M. West
21. GEH-13,024, Tritium Production, July 26, 1948, D. F. Shaw to R. C. Muir
22. HW-10719, Tritium Production, August 11, 1948, C. N. Cross to R. C. Muir
23. HW-11828, 100 Areas Technical Activities Report, P-10 Project, November 1948 A. A. Johnson and J. C. L. Chatten to Files
24. GEH-15,017 (ANL-SL-163), Report of the Tritium Process Development Group for Month Ending May 31, 1949, June 15, 1949, L. Burris, Jr.
25. HW-14338-G, Pile Technology Division Monthly Report for August 1949, September 8, 1949, W. K. Woods
26. HW-15210, P-10 Operations, November 28, 1949, A. A. Johnson and J. C. L. Chatten
27. HW-15645, Annual Report of the Technical Divisions for 1949, January 10, 1950, Members of the Technical Divisions
28. HW-19952, Annual Report of the Technical Divisions for 1950, January 10, 1950, Compiled by Members of the Technical Divisions
29. AEC-TSYX-255-1A (15-661), Tritium Production, September 20, 1948, Letter, E. C. Schlemmer to R. C. Muir
30. HW-11499-G, Pile Technology Division Monthly Report - October 1948, November 15, 1948, W. K. Woods
31. HW-2650-T, P-10 Project Notes, Secret Notebook Issued to R. W. Vivian, December 6, 1948
32. HW-11903, Project Proposal - Facilities for Processing Irradiated SR-15 and SR-65 Slugs, Project C-316, December 20, 1948, J. S. McMahon
33. Private Communication, J. C. L. Chatten to G. G. Reed, Jr.
34. Unpublished Documents, Subject: Ion Chambers, G. G. Reed, Jr.
35. ANL-SL-250, Progress Report - Development of Metal Recovery Line for Tritium Production, February 13, 1950, I. O. Winsch - W. J. Meeham
36. HW-18802, The Regnault Method as Applied to Tritium Purity Determinations, September 11, 1950, J. W. Finnigan
37. Private Communication, J. W. Finnigan to G. G. Reed, Jr.
38. HW-18104, Methods for the Analysis of P-10 Product, June 15, 1950, C. R. McCully
39. HW-18681, Minutes of the P-10 Weekly Meeting # 22 (August 18), August 24, 1950, J. C. L. Chatten - W. M. Harty

DECLASSIFIED

DECLASSIFIED

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40. HW-18947, Minutes of the P-10 Weekly Meeting # 25, (September 15), September 23, 1950, J. C. L. Chatten - W. M. Harty
41. HW-19760, Minutes of the P-10 Weekly Meeting # 34(December 1), December 20, 1950, J. C. L. Chatten - W. M. Harty
42. HW-19822, Minutes of the P-10 Weekly Meeting # 35 (December 8), December 29, 1950, J. C. L. Chatten - W. M. Harty
43. GEN-15,729, P-10 Shipment, December 2, 1949, D. G. Sturges to V. D. Donihee
44. HW-19925, Minutes of the P-10 Weekly Meeting # 36(December 15) December 29, 1950, J. C. L. Chatten - W. M. Harty
45. HW-14789, P-10-B (Cold Facilities), March 1, 1950, S. F. Schure
- ○ 46. HW-18459 and Attachments, P-10-C Part I (Metal Prototype Unit), P-10-D ("Hot" Development Facilities), August 7, 1950, S. F. Schure
47. HW-20107, Additional "Hot" Development Facilities, March 12, 1951, S. F. Schure
48. HW-20892, P-10-X Extraction Facilities, Project C-412, June 4, 1951, S. F. Schure
49. Private Communication, R. W. Vivian to G. G. Reed, Jr.
50. Private Communication, F. A. Eschbach to G. G. Reed, Jr.
51. HW-19778, Interim Report: Glass Lines Revisions of the Tritium Process November 1, 1950, P. A. Carlson
52. HW-20315, Minutes of the P-10 Weekly Meeting # 41(January 19), February 15, 1951, J. C. L. Chatten - W. M. Harty
53. HW-20251, Production Test 108-B-18, February 9, 1951, L. W. Lang
54. HW-20626, Special Report-Split Temperature Extractions, March 26, 1951, L. W. Lang
55. HW-20560, Production Test 108-B-36 - Completeness of Extraction, March 17, 1951, L. W. Lang
56. GEN-13,919, Installation of Additional P-10 Facilities, January 1, 1949 Letter, R. C. Hageman to G. R. Prout
57. HW-12904, Project Proposal - Facilities for Manufacture of Li-Al Alloy Slugs, Project C-334, April 22, 1949, J. S. McMahon
58. HW-2899-T, Secret Notebook, Personal Notes and Observations, issued August 2, 1949, R. Teats
59. Personal Communication, R. Teats to G. G. Reed, Jr.

60. Personal Communication, R. H. Moore to G. G. Reed, Jr.
61. Personal Communication, P. R. Anderson to G. G. Reed, Jr.
62. HW-18789, Gas Analysis of Li-Al Alloy, September 11, 1950, C. R. F. Smith
63. Personal Communication, R. E. Nather to G. G. Reed, Jr.
64. HW-14802, P-10-A Expansion - Reason Sheet, Estimate, and Drawings, April 12, 1950, S. F. Schure
65. HW-21231, Terminal Report - P-10 Hazards Control Committee, August 17, 1951, H. A. Kornberg
66. Personal Communication, W. F. Ekern to G. G. Reed, Jr.

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