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# PRODUCTION OF ZIRCONIUM AT Y-12

By
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October 12, 1951

Carbide and Carbon Chemicals Company
Oak Ridge, Tennessee

Technical Information Service, Oak Ridge, Tennessee

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CARBIDE AND CARBON CHEMICALS COMPANY
A DIVISION OF UNION CARBIDE AND CARBON CORPORATION

Y-12 PLANT

W-7405-Eng-26

CHEMICAL DIVISION

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CHEMICAL DEPARTMENT

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# PRODUCTION OF ZIRCONIUM AT Y-12

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## ABSTRACT

A general description is given of the permanent zirconium plant at Y-12. Equipment is described and materials of construction are listed. Photographs illustrating principal equipment and reduced construction drawings are also presented. Operating conditions and costs information are listed.

Oak Ridge, Tennessee

October 12, 1951

# INTRODUCTION

Production of purified hafnium-free zirconium was begun at Y-12 in January, 1950. At the request of the Atomic Energy Commission, a quick installation of equipment was made in order to produce 25,000 pounds of zirconium as oxide for initial experiments for the Naval Reactor Program. Less than 0.1% contained hafnium was specified. At that time, a program was started on designing a more efficient plant for the production of 150,000-200,000 pounds of zirconium per year. The permanent zirconium plant was completed in October, 1951. Additions were made to the extraction facilities and equipment for continuous purification by the phthalate process and continuous drying and calcining were provided.

At the time of this writing, the permanent zirconium plant is in the start-up stage. This report describes the equipment and process as they now exist and the operational plans which have been developed from experience and from laboratory and pilot plant work.

The original proposal for the permanent zirconium plant is outlined in a report, Y-573, "Separation of Zirconium and Hafnium - Proposal for Construction and Operation of Zirconium Production Plant", J. M. Googin and G. A. Strasser, March 14, 1950. These plans have been followed to completion with but few changes. Greater length of extraction and stripping columns was installed than was first planned in order to effect more complete separation which was later requested. Later information obtained on calcining showed that protection against contamination in this stage was more difficult than had been expected, and consequently the expense of more elaborate calcination equipment was required. Corrosion of exteriors from vapors in the processing areas was found to be a serious problem and more elaborate ventilation and protective measures were taken than had been planned in the proposal. Otherwise the original proposal has been followed through approximately as first outlined.

It is suggested that reference should be made to report Y-573 relative to studying the report presented here.

## DESCRIPTION OF PROCESS

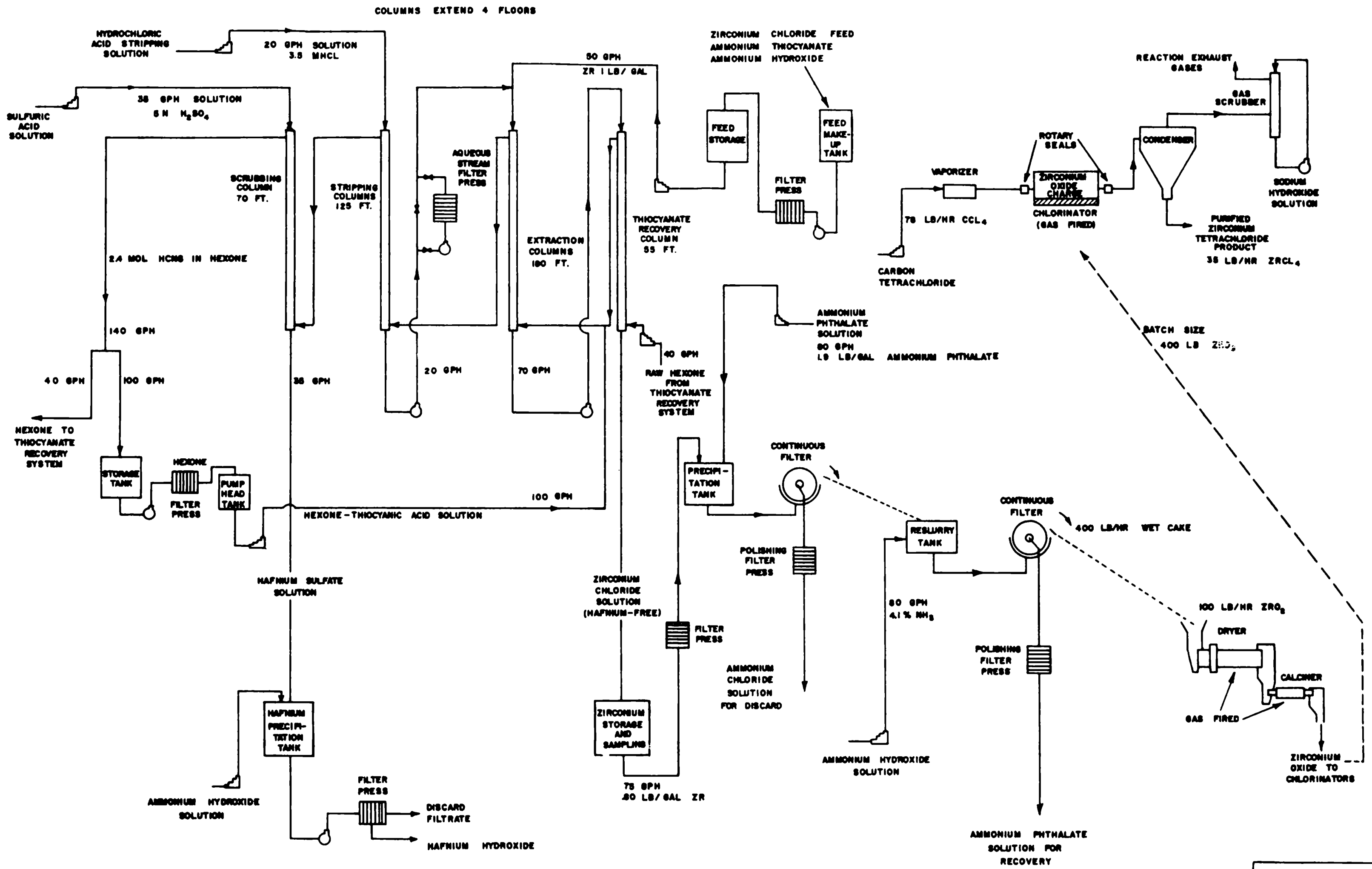
The attached flow sheet and photographs illustrate the permanent zirconium plant in Building 9211 at Y-12.

Zirconium tetrachloride, normally containing from 1.5 percent to 2.0 percent hafnium, is received from Titanium Alloy Manufacturing Division of the National Lead Company for use as feed material. Hafnium is removed from zirconium by an extraction process and resulting solutions are further purified by phthalate precipitation. Zirconium phthalate is converted to zirconium hydroxide by ammonium hydroxide leaching and the zirconium hydroxide is dried and calcined. The zirconium oxide is then chlorinated to form zirconium tetrachloride, which is used in magnesium reduction to the metal.

The steps in processing at Carbide and Carbon Chemicals Company, Y-12 Plant, are shown on the attached flow sheet and outlined as follows:

### Hafnium Separation

Hafnium is separated from zirconium by a solvent extraction process employing methyl iso-butyl ketone. The separation is carried out in continuous counter-current spray towers. Solution containing normal zirconium is fed in the center of the extraction plant. The zirconium solution flows out the bottom of the plant while the hafnium is carried by the solvent to the top of the plant.




PERMANENT ZIRCONIUM PLANT
GENERAL FLOW DIAGRAM
SEPT. 20, 1951

Zirconium tetrachloride is dissolved in water (top center of flow sheet) and the required quantities of ammonium thiocyanate and ammonium hydroxide are added to form the extraction feed solution. Some of the equipment used is shown in Figure 1, "Feed Make-up and Storage Area - Tank Pit". Feed solution is pumped to the column (Figure 2, "Base of Extraction Columns-First Floor"). There are three columns for extraction, two columns for stripping, one column for scrubbing, and one column for thiocyanate recovery. Columns are controlled by operators on the third floor (Figure 3, "Extraction Control Area").

Hafnium thiocyanate is preferentially extracted into hexone-thiocyanic acid solution, which is pumped into the bottom of the extraction column. Hexone from the extraction column flows into the stripping column, counter-current to a stripping solution of dilute hydrochloric acid. Aqueous stripper solution containing stripped zirconium is fed back into the extraction column with the extraction feed solution. Stripped hexone containing very pure hafnium flows into the scrubbing column where it is scrubbed with sulfuric acid solution. This hexone, free of metal, but still containing thiocyanic acid is recirculated to the extraction columns.

For smallest useage of thiocyanate, it is desirable to have thiocyanate concentration in the product stream at a very low level. This is accomplished

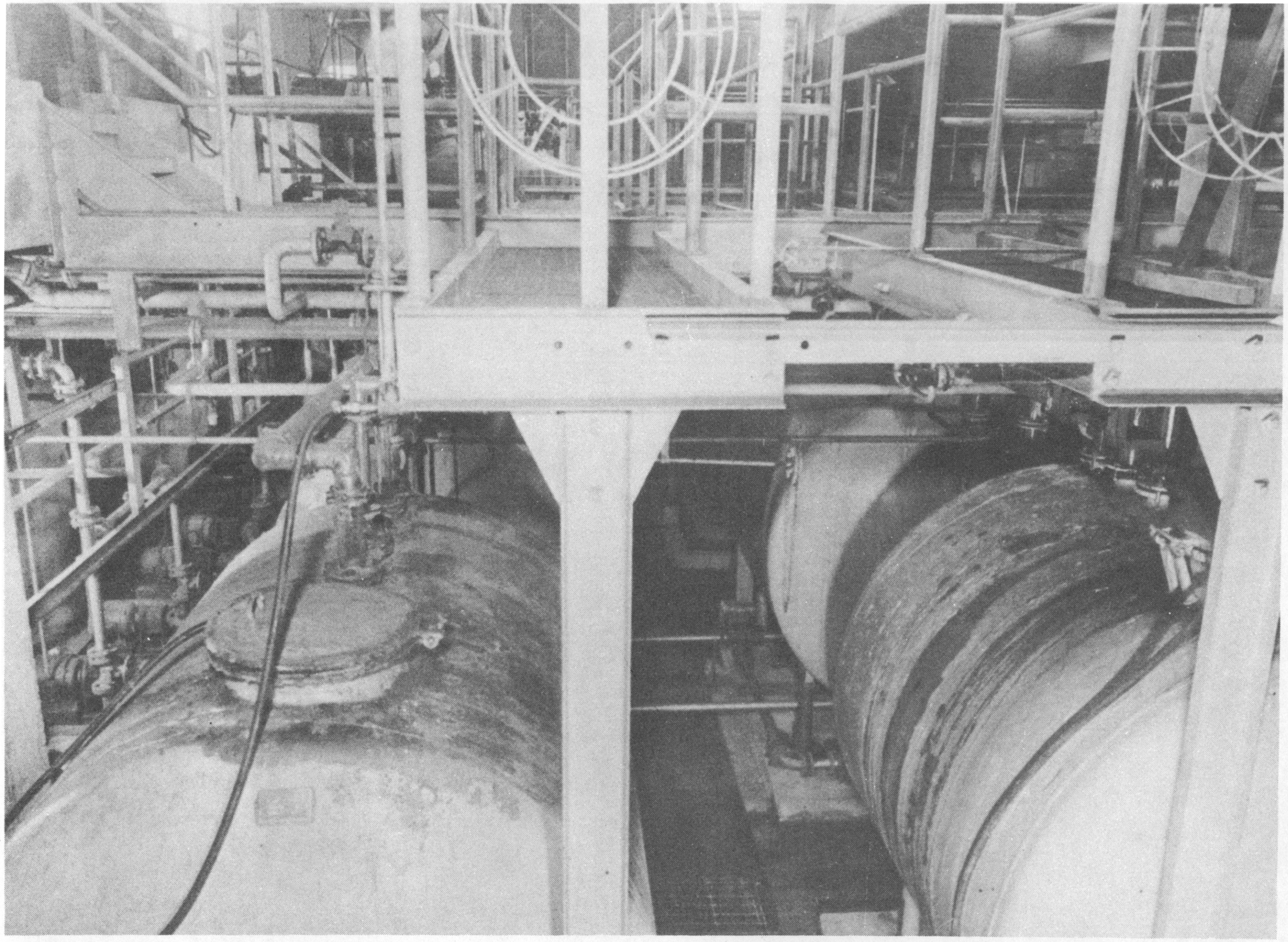


FIGURE 1. FEED MAKEUP AND STORAGE AREA-TANK PIT

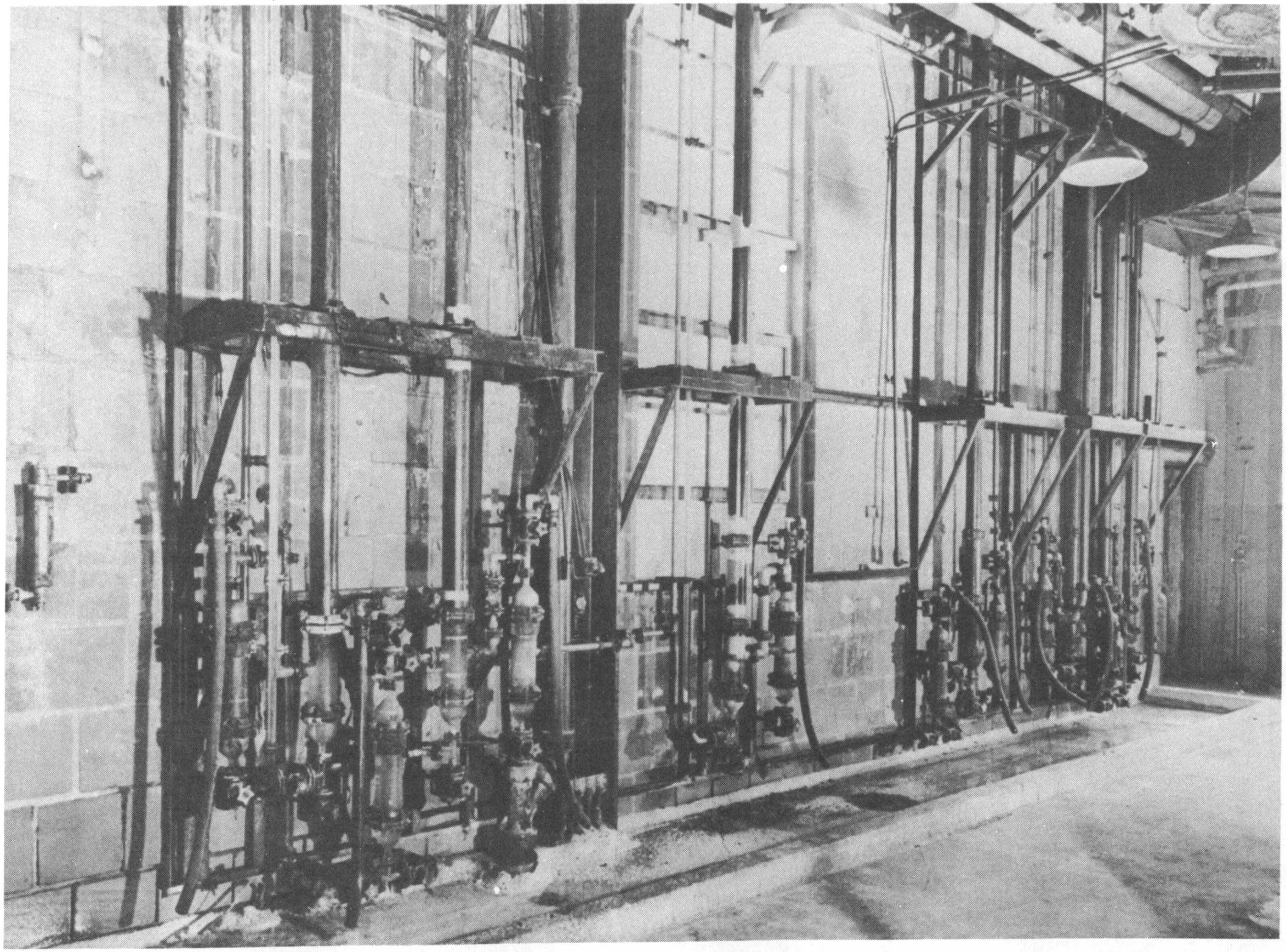


FIGURE 2. BASE OF EXTRACTION COLUMNS- FIRST FLOOR

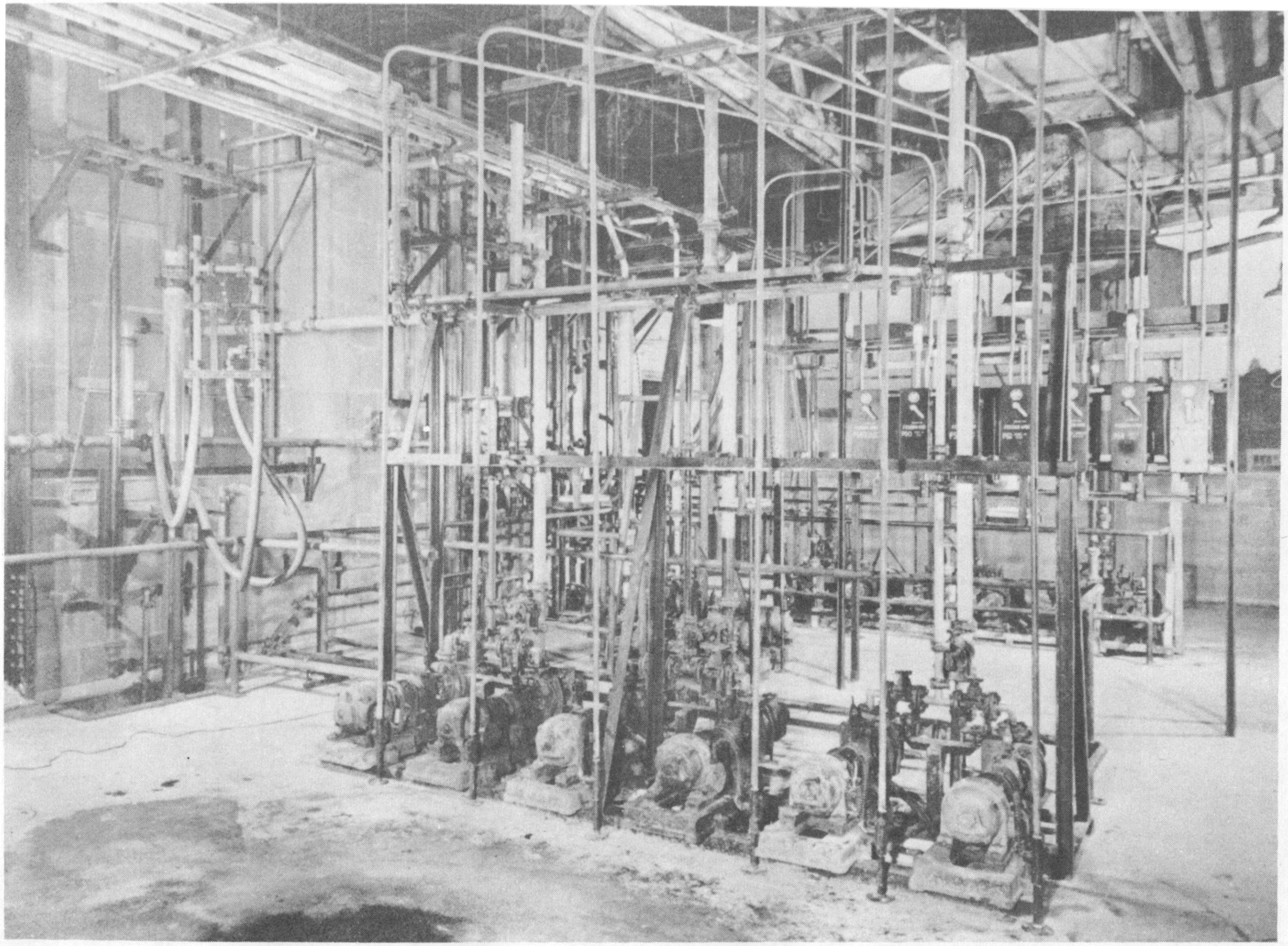


FIGURE 3. EXTRACTION CONTROL AREA – THIRD FLOOR

by directing the aqueous solution from the third extraction column into a thiocyanate recovery column. The thiocyanate recovery column is fed with raw hexone at a rate of approximately one-third the total hexone flow. Hexone from this column contains thiocyanic acid at the proper concentration for extraction and is mixed with the hexone entering the extraction columns. Raw hexone to be fed to the thiocyanate recovery column is prepared from a portion of the scrubbed hexone diverted to an ammonium neutralization system. Ammonium thiocyanate from this system is used in feed makeup.

Zirconyl chloride solution, hafnium-free, goes from the last extraction column to a tank for storage and sampling, and then to be further processed by precipitation with ammonium phthalate solution.

The hafnium is recovered from the hexone by sulfuric acid scrubbing. Hafnium is recovered from the sulfuric acid solution as hafnium hydroxide by precipitation with ammonium hydroxide.

Separation of Other Impurities

While hafnium is the element requiring special separation procedures, it is also necessary to remove other metal ions present as impurities in the feed material. This purification is carried out by precipitating zirconium as zirconyl phthalate. The phthalate precipitation is very selective for zirconium and hafnium, while other impurities, such as iron, copper, cadmium, etc., remain in solution and are thus separated.

In the permanent zirconium plant, ammonium phthalate solution and zirconium chloride solution are fed continuously to a precipitation tank, which, in turn, feeds a continuous Eimco filter. This equipment is shown in Figure 4, "Phthalate Precipitation Equipment and Filters." Cake is scraped continuously from the filter and reslurried with ammonium hydroxide solution. This slurry is filtered on a continuous Oliver filter. The ammonium phthalate solution from the filter is recovered by evaporation. (Figure 5, "Ammonium Phthalate Evaporator").

Zirconium hydroxide cake from the Oliver filter falls from the filter scraper blade through a chute into a continuous gas-fired drier, manufactured by the Bartlett-Snow Company. This is shown in Figure 6, "Assembly Work on Drier - Third Floor." The dried zirconium hydroxide falls continuously into silica-lined calciners in which it is converted to high purity zirconium oxide, (Figure 7, "Calciner - Second Floor"). Calciners were also manufactured by the Bartlett-Snow Company, and liners are supplied by the Amersil Company and the General Ceramics Company.

Hafnium hydroxide is redissolved and purified by the same chemical process

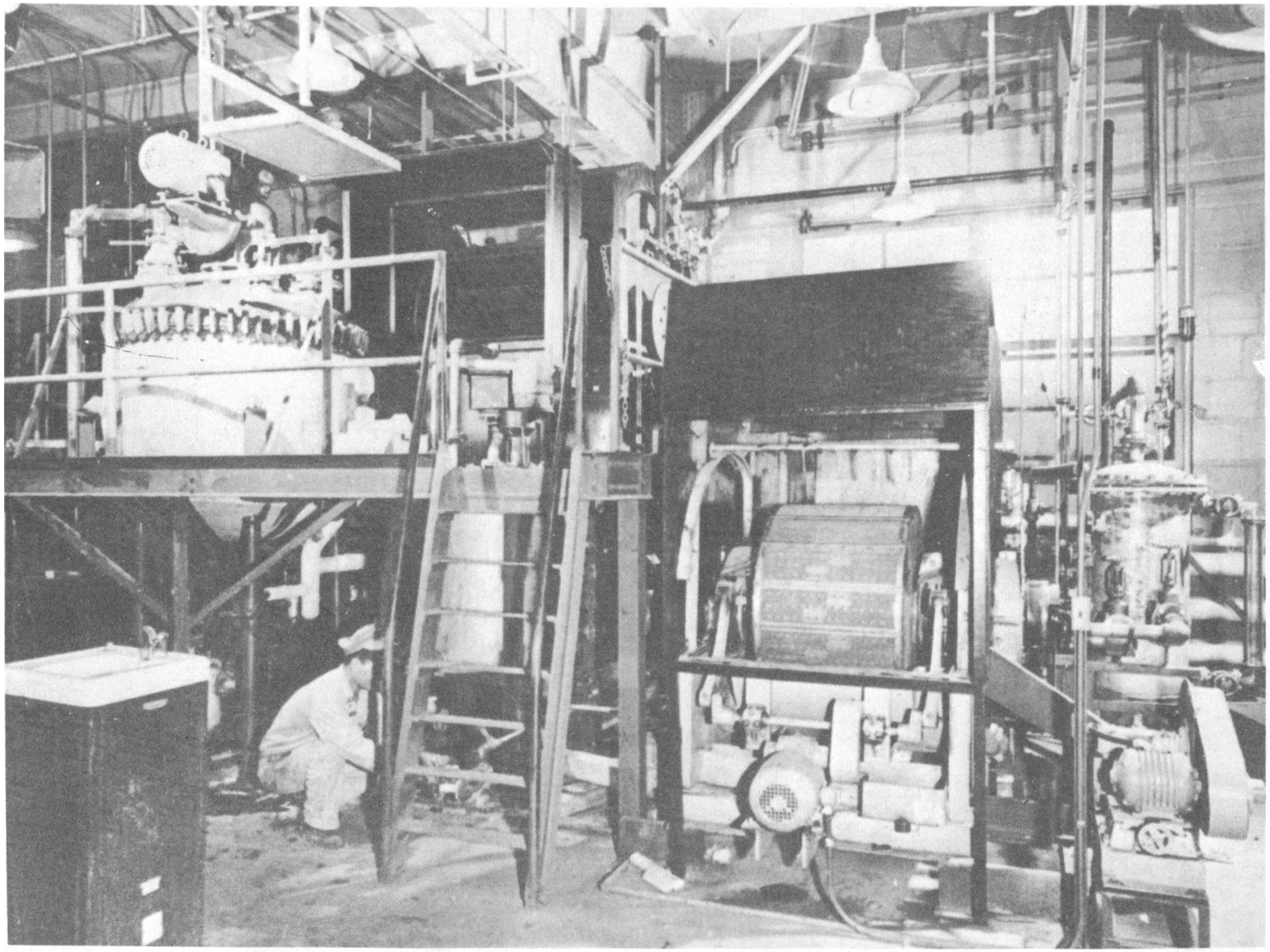


FIGURE 4. PHTHALATE PRECIPITATION EQUIPMENT AND FILTERS - FOURTH FLOOR

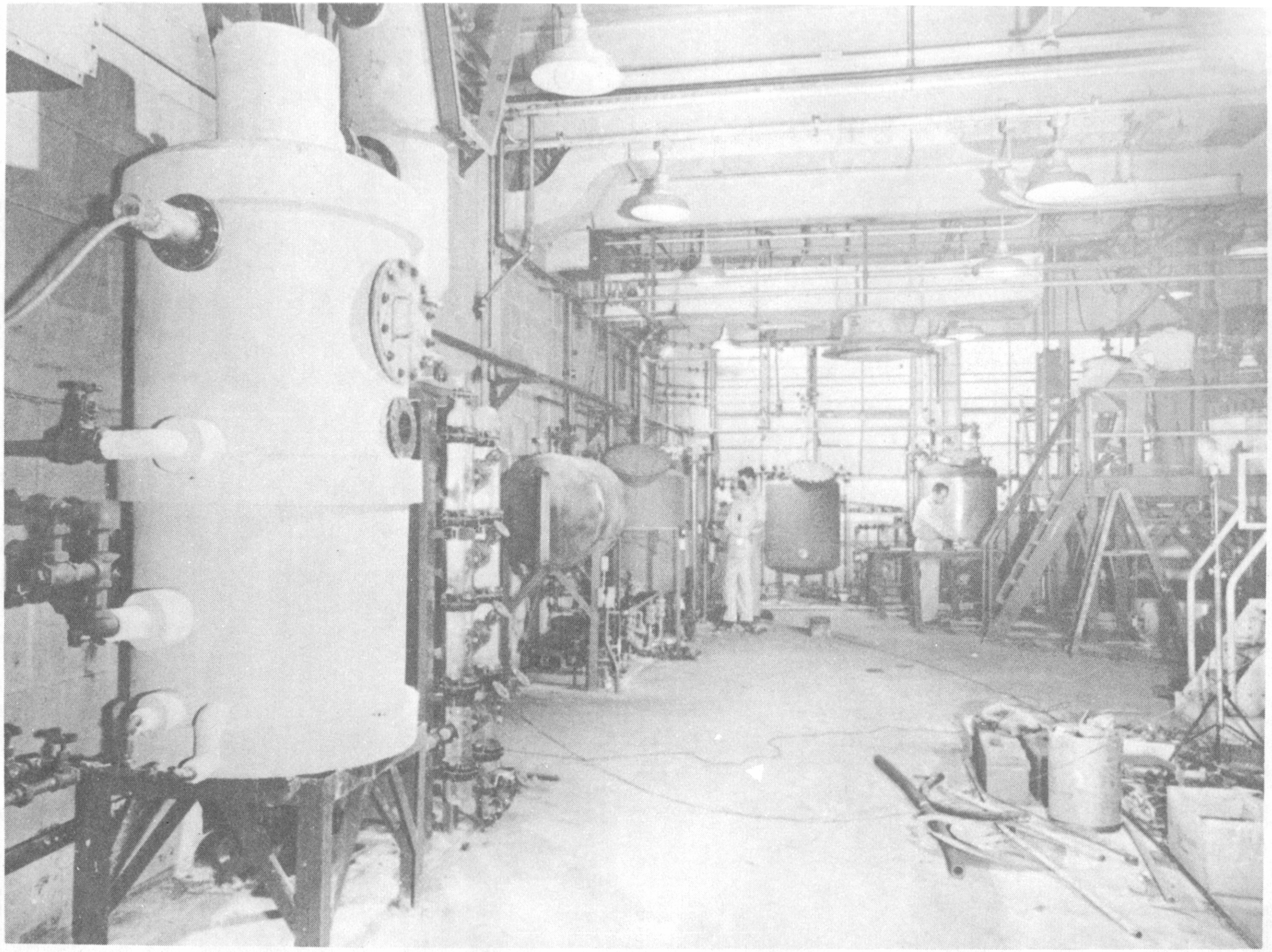


FIGURE 5. AMMONIUM PHTHALATE EVAPORATOR, MISCELLANEOUS HEAD TANKS IN BACKGROUND - FOURTH FLOOR

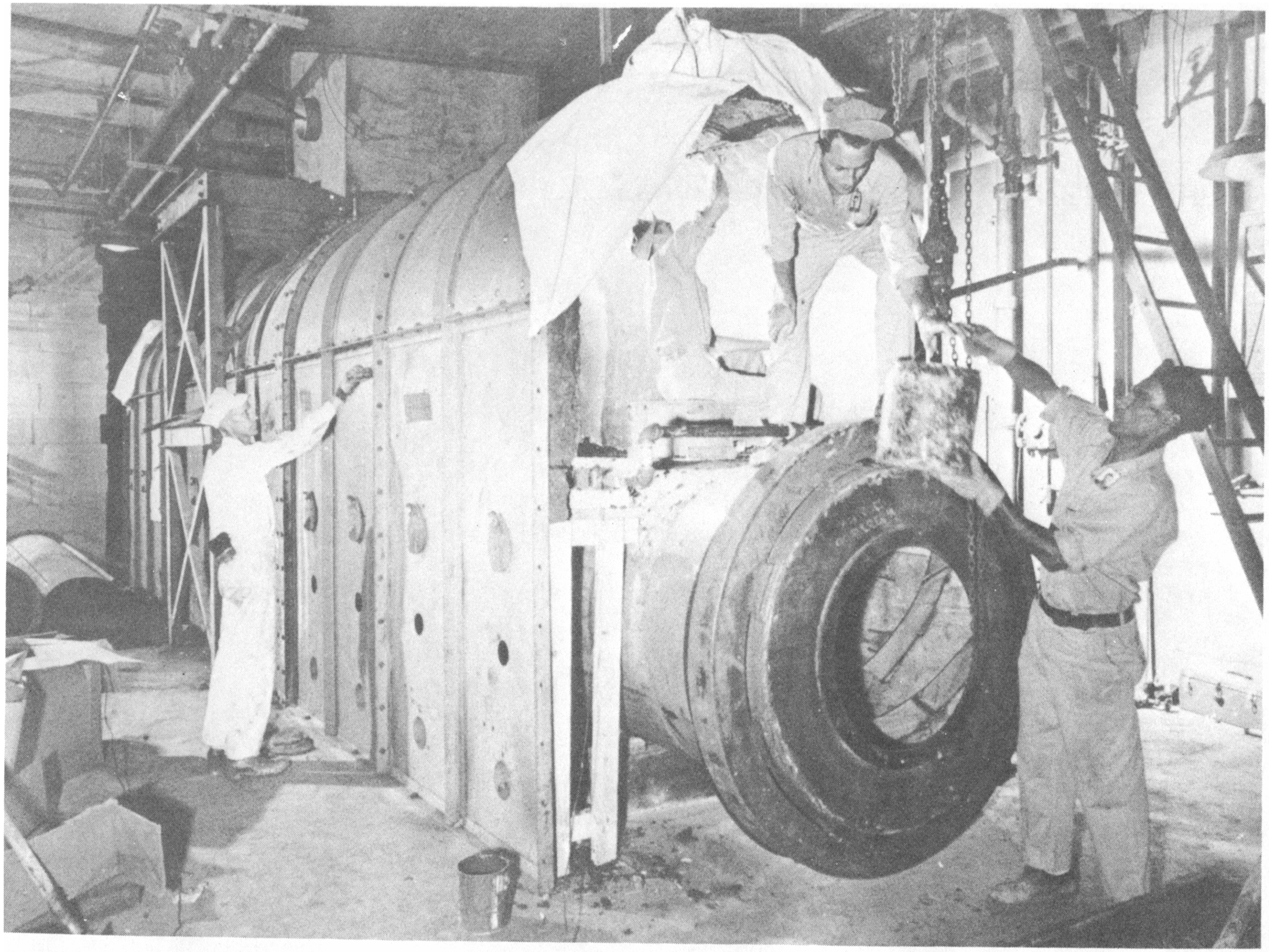


FIGURE 6. ASSEMBLY WORK ON DRIER – THIRD FLOOR

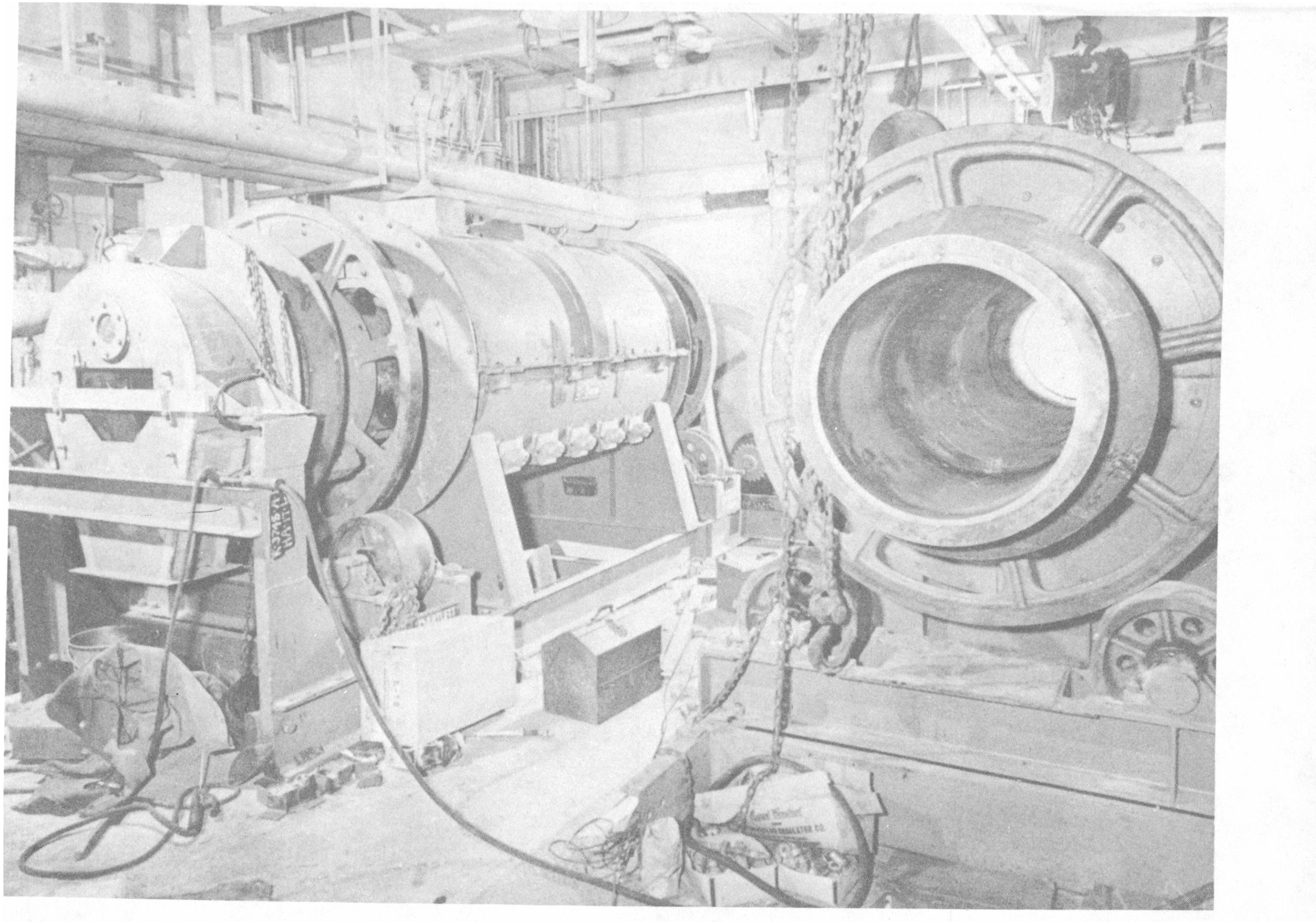


FIGURE 7. CALCINERS — SECOND FLOOR.

used for zirconium hydroxide. Some of the equipment in which this work is carried out may be seen in Figure 8, "Hafnium Purification Equipment."

## Chlorination

The method of chlorination that was used at Y-12 consisted of direct chlorination of the oxide with carbon tetrachloride in a rotary horizontal reactor. Zirconium oxide was charged batchwise into the reactor. Carbon tetrachloride was fed through a vaporizer into the rotary reactor forming volatile zirconium tetrachloride. The zirconium tetrachloride gas was collected in an air-cooled condenser and cleaned batchwise into shipping containers. The reaction gases were scrubbed in a sodium hydroxide system, (Figure 9, "Control Panel and Condensers of Horizontal Chlorinators - First Floor").

# MATERIALS OF CONSTRUCTION

## Handling of Process Materials

General selection of materials of construction at various stages of processing is given in Table I, "Materials of Construction for Handling of Process Materials". This table gives the actual construction of the permanent zirconium plant. Selection has been made based on chemical resistance to process solutions of various materials, and availability of standby equipment at Y-12.

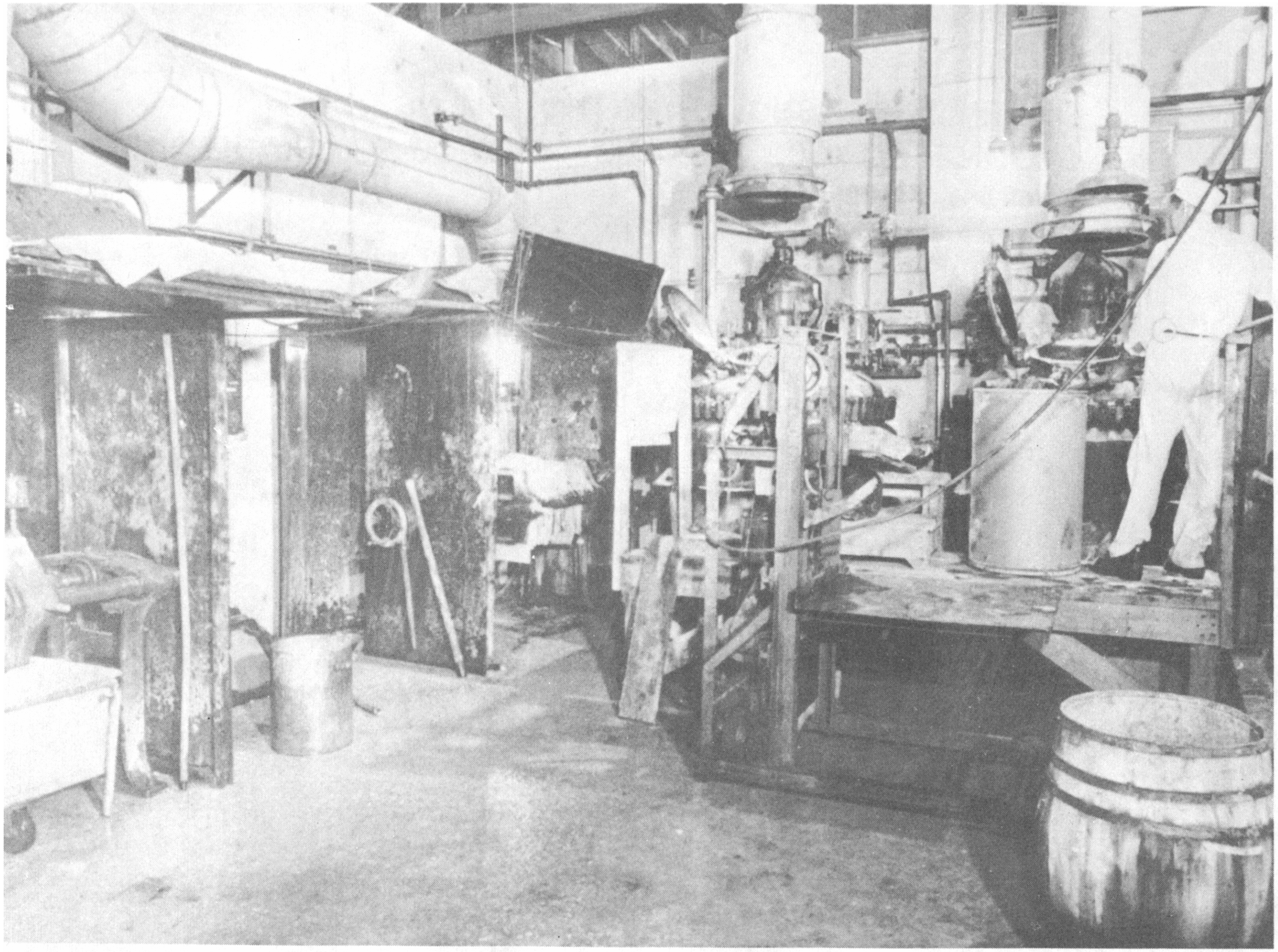


FIGURE 8. HAFNIUM PURIFICATION EQUIPMENT

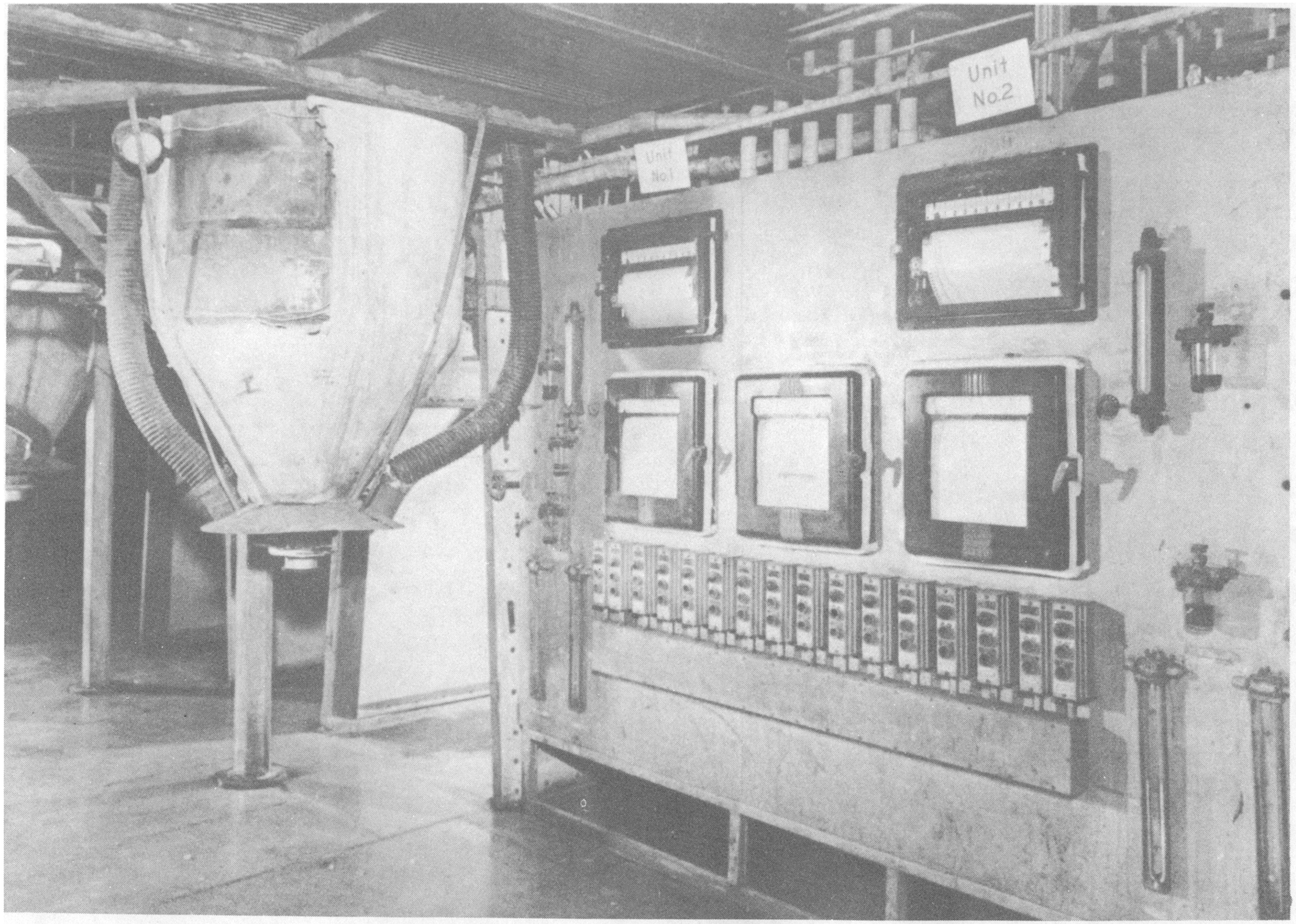



FIGURE 9. CONTROL PANEL AND CONDENSERS OF HORIZONTAL CHLORINATORS –FIRST FLOOR

TABLE I

MATERIALS OF CONSTRUCTION FOR HANDLING OF PROCESS MATERIALS

| EXTRACTION | Tanks and Equipment | Pipe | Valves | Diaphragms | Pumps | Gaskets | Packing | Pump Lubrication |
|---|---|---|---|---|---|---|---|---|
| Aqueous Extraction Solution, and Stripping Solution (0.2-0.5 mol HCl) | Glass-lined, Rubber-lined | Glass | Glass-lined | Tygon, Neoprene | Durchlor, Hastelloy C | Koroseal, Neoprene | Teflon, Durco 400-B | Nordcoseal 755-S Rockwell Mfg. Co., Pittsburgh |
| Hexone (Acid) | Glass-lined, Stoneware | Glass | Glass-lined | Neoprene | Durchlor, Hastelloy C | Neoprene | Teflon, Durco 400-B | Nordcoseal 755-S |
| Hexone (Neutral)* | Glass-lined, Stoneware | Glass | Glass-lined | Butyl Rubber Neoprene | - | Butyl Rubber, Neoprene | Teflon, Durco 400-B | Nordcoseal 755-S |
| Sulfuric Acid (5 Mol) | Glass-lined | Glass | Glass-lined | Tygon | - | Koroseal | Teflon | Nordcoseal 755-S |
| Sulfuric Acid (Conc.) | Black Iron | Black Iron, Glass | Black Iron | - | Black Iron, Carpenter 20 SS | - | Teflon | Nordcoseal 755-S |
| Conc. HCl (for Stripper Makeup) | Glass-lined | Glass | Glass-lined | Tygon | Haveg | Koroseal | Teflon | Nordcoseal 755-S |
| **PURIFICATION** | | | | | | | | |
| Extraction Effluent | Glass-lined, Wood, Hastelloy C, Rubber-lined | Glass, Hard Rubber | Glass-lined, Rubber-lined | Tygon | Durchlor Hastelloy C | Koroseal | Teflon | Nordcoseal 755-S |
| Ammonium Phthalate Solution | SS 316 | SS 316 | SS 316 | - | SS 316, Black Iron | Koroseal | Asbestos | Nordcoseal 755-S |
| Drying (to 300°C) | SS 316 | | | | | | | Nordcoseal 755-S |
| Calcining (to 700°C) | Fused Quartz | | | | | | | Nordcoseal 755-S |
| **CHLORINATION** | | | | | | | | |
| $CCl_4$ | SS 316 | Black Iron | Black Iron | | Black Iron | - | Asbestos | Nordcoseal 755-S |
| $ZrCl_4$ Gas (above 350° C) | Carbon, Quartz | | | | | | | |
| $ZrCl_4$ Solid (below 350° C) | Nickel | | | | | | | |

*Protection against acid is made since possibility of acid condition exists in most cases. Pure hexone is a good organic solvent but is not corrosive.

Background for selection is given in a report, Y-589, "Corrosion Study for a Chemical Processing Plant", Frank A. Knox, August, 1950.

In general it is found that HCNS in hexone is corrosive to about the same extent as HCl. Metals which can be used to resist this combination are Hastelloy C and Durchlor. Various rubber-like materials may be used for gasket material, although hexone is a solvent for many gasket and diaphragm materials. Butyl rubber and Neoprene appear to be the most satisfactory for resistance to neutral hexone. A large amount of process piping is standard Pyrex glass with flange fittings; this gives resistance to most of the process solutions and also provides visibility.

For resistance to sulfuric acid, glass has been used for dilute solutions. Concentrated sulfuric acid is handled in black iron, and carpenter 20 stainless steel is used as piston material in a metering pump where the piston is alternately exposed to sulfuric acid and the atmosphere.

Concentrated hydrochloric acid is handled in glass-lined tanks and glass piping. A Haveg metering pump is used for metering concentrated hydrochloric acid. Chemical resistance is good, although mechanical properties are not as satisfactory as desired.

In the phthalate purification step, an acid-resistant filter of wood is being used. It is indicated at this time that a totally rubber-covered steel filter might be more suitable. Filter media for hydrochloric acid solutions is high temperature Vinyon or Dynell. Particle size is small and a tight weave is required.

The dryer is constructed of 316 stainless steel, which has been shown in the laboratory to be satisfactory up to 300 degrees Centigrade from the corrosion standpoint. Extensive tests on metals for calcining zirconium oxide failed to show a satisfactory metal. A fused quartz lined calciner was developed for this application in conjunction with the Bartlett-Snow Company, the Amersil Company, and the General Ceramics Company. Efficiency of this equipment will be shown by operation.

Materials of construction for zirconium chlorination are limited for zirconium tetrachloride in the gas phase. Fused quartz has been found to be resistant at very high temperatures. Carbon is good in the range of 350 to 650 degrees Centigrade. Nickel is good at 350 degrees Centigrade and below, and is fairly satisfactory up to 550 degrees Centigrade, although it gives some contamination in this range.

## General Protection Against Corrosion

Operation of the temporary zirconium plant showed that a severe corrosion problem can result from vapors of process solutions in the extraction and purification plants. However, general corrosion can be controlled by taking proper protective measures.

Structural supports for extraction columns are fabricated from 316 stainless steel angle and non-reusable stainless steel pipe. This stands up with only surface discoloration under the conditions present, that is, spills of dilute hydrochloric acid and vapors of HCl under oxidizing conditions.

Filters are completely enclosed and ventilated. Hoods for filters are constructed of 1/2 inch marine plywood and coated with one coat of Penkote protective coating.[1] Glass pipe flanges on the columns are cast iron coated with seven layers of a baked phenolic resin coating.[2] Nuts and bolts on flanges of columns are of stainless steel 316.

Duct work for feed makeup exhaust system is fabricated of 316 stainless steel coated with baked on Heresite. Duct work for exhaust on filter hoods is fabricated from mild steel coated with baked Heresite.

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[1]Penkote 500, Penisular Chemical Product Company, Van Dyke, Mich.

[2]Heresite P403, Heresite Chemical Company, Manitowoc, Wis.

# PROCESS CONDITIONS AND EFFICIENCY

## Extraction

Present operating conditions for the extraction columns are outlined as follows:

Length of Columns (Total)

| | |
|---|---|
| Extraction | 180 Ft. |
| Stripping | 125 Ft. |
| Scrubbing | 65 Ft. |
| Thiocyanate Recovery | 55 Ft. |
| | |
| Hexone Rate | 140 GPH |
| CNS Concentration in Recycle Hexone | 2.7 Molar |
| | |
| HCl Rate, Stripping Section | 18-20 GPH |
| HCl Concentration | 3.5 Molar |
| CNS, Concentration In | 0.0 Molar |
| CNS, Concentration Out | 2.5-3.0 Molar |
| | |
| Feed Rate, Zirconium Oxychloride Solution | 50 GPH |
| HCl Concentration | 1 Molar |
| HCNS Concentration | 2.6 Molar |
| Zr Concentration | 1 #/gal. |
| | |
| $H_2SO_4$ Rate, Scrubber Solution | 35 GPH |
| $H_2SO_4$ Concentration | 5 Normal |
| | |
| CNS Conc., Feed to Thiocyanate Recovery Column | 1.60 Molar |
| CNS Conc., Discharge from Thiocyanate Recovery Column | 0.1 Molar |
| CNS Conc., Hexone to Column | 0.0 Molar |
| CNS Conc., Hexone from Column | 2.50 Molar |
| Rate of Hexone to Thiocyanate Recovery Column | 40 GPH |
| Rate of Aqueous Solution in Column | 70 GPH |
| | |
| Conc. Hf in Raw Feed | 1.5-2.0 % |
| Conc. Hf in Product Zr | $<100$ PPM |
| Conc. Zr in Product Hf | Approximately 2 % |

| | |
|---|---|
| Yield of Zr Product Based on Feed Solution | 96% |
| Percent Recycle of Hexone | 96.5-97.0 % |
| Percent Loss of Hexone | 3-3.5 % |
| Amount Makeup Hexone | 90 Gals/day |

| | Optimum for Extraction Section | Optimum for Stripping Section |
|---|---|---|
| Distribution Coefficient Hf Org/Aq | 1.5 | 0.7 |
| Distribution Coefficient Zr Org/Aq | 0.3 | 0.15 |
| Separation Factor | 4-5 | 4-5 |

Operation of the extraction units is carried out to achieve the best balance between product purity and yield of zirconium. Increased purity of zirconium can be obtained at the cxpense of yield and Hf purity. With the present method of operation it is possible to obtain a yield of better than 96% of Zr containing less than 100 ppm Hf while obtaining hafnium product containing between 0.5% and 3.0% Zr.

## Purification

Efficiency of the purification plant has not yet been established, and it is expected that considerable process improvement work will be required to obtain maximum efficiency. It is expected that 98 % yield of zirconium will be obtained and that product purity will be equal to, or better than, purity of product from the initial installation based on batch operation.

Phthalate recovery is expected to be about 80 percent. Recovery efficiency is very dependent on filter operation and wash distribution on the filter.

Recycle of ammonium hydroxide from the evaporator may be a practical step for economy. It is planned to add fractionating and condensing equipment for recovery and recycle of ammonium hydroxide if it is economically justified.

Drying and Calcining

Operating experience with the rotary equipment is limited but serious dust losses are not anticipated. Available rotoclones and scrubbers will be activated if necessary.

Operating Costs

Typical operating costs are given in the following tables. Table II gives the cost for $ZrO_2$ production in the month of January, 1951. Table III gives cost for $ZrO_2$ production total for the fiscal year July, 1950 through April, 1951.

These costs resulted from operation of the temporary zirconium production facilities. Considerable economies in both labor and materials are expected from operation of the permanent zirconium plant. Estimated costs in report Y-573, p10, are expected to be in line with actual cost if allowance is made for general price advances.

## TABLE II

### UNIT COST OF $ZRO_2$ PRODUCTION, JANUARY, 1951

| | | Total Cost | | Cost Per Pound Zr Produced |
|---|---|---|---|---|
| | | $93,523 | | $3.002 |
| Material | | | | |
| Ammonium Hydroxide | 1584 | | .051 | |
| Lime | 133 | | .004 | |
| Hydrochloric Acid | 1874 | | .061 | |
| Salicylic Acid | 38934 | | 1.251 | |
| Sulfuric Acid | 658 | | .021 | |
| Ammonium Thiocyanate | 10057 | | .323 | |
| $ZrCl_4$ | 35165 | | 1.129 | |
| Hexone | 2186 | | .070 | |
| Natural Gas | 693 | | .022 | |
| Steam | 1534 | | .049 | |
| Treated Water | 536 | | .017 | |
| Electricity | 134 | | .004 | |
| Operating Labor, Direct | | 13,667 | | .439 |
| Maintenance, Labor, & Material | | 15,763 | | .506 |
| Allocated Plant Expense | | 12,455 | | .400 |
| Analytical | | 3,740 | | .120 |
| Miscellaneous* | | 9,128 | | .293 |
| Total | | $148,276 | | $4.761 |

Pounds Zirconium as Oxide Produced - 31,134

* Protective Clothing, Shipping Charges, Janitorial Services, Etc.

# TABLE III

## UNIT COST $ZRO_2$ PRODUCTION FROM JULY, 1950 THRU APRIL, 1951

| | | Total Cost | | Cost/lb. |
|---|---|---|---|---|
| Material | | $731,971 | | $2.943 |
| Ammonium Hydroxide | $13,041 | | .052 | |
| Lime | 1,710 | | .007 | |
| Hydrochloric Acid | 22,408 | | .090 | |
| Salicylic Acid | 278,764 | | 1.121 | |
| Sulfuric Acid | 3,679 | | .015 | |
| Ammonium Thiocyanate | 89,211 | | .359 | |
| $ZrCl_4$ | 287,050 | | 1.154 | |
| Hexone | 14,985 | | .060 | |
| Caustic Flake | 41. | | .000 | |
| Natural Gas | 5,807 | | .023 | |
| Steam | 10,821 | | .044 | |
| Treated Water | 3,280 | | .013 | |
| Electricity | 1,174 | | .005 | |
| Operating Labor | | 110,385 | | .443 |
| Maintenance, Labor, & Material | | 148,453 | | .596 |
| Allocated Plant Expense | | 124,067 | | .498 |
| Analytical | | 33,471 | | .135 |
| Miscellaneous | | 88,920 | | .357 |
| Total | | $1,237,267 | | $4.972 |

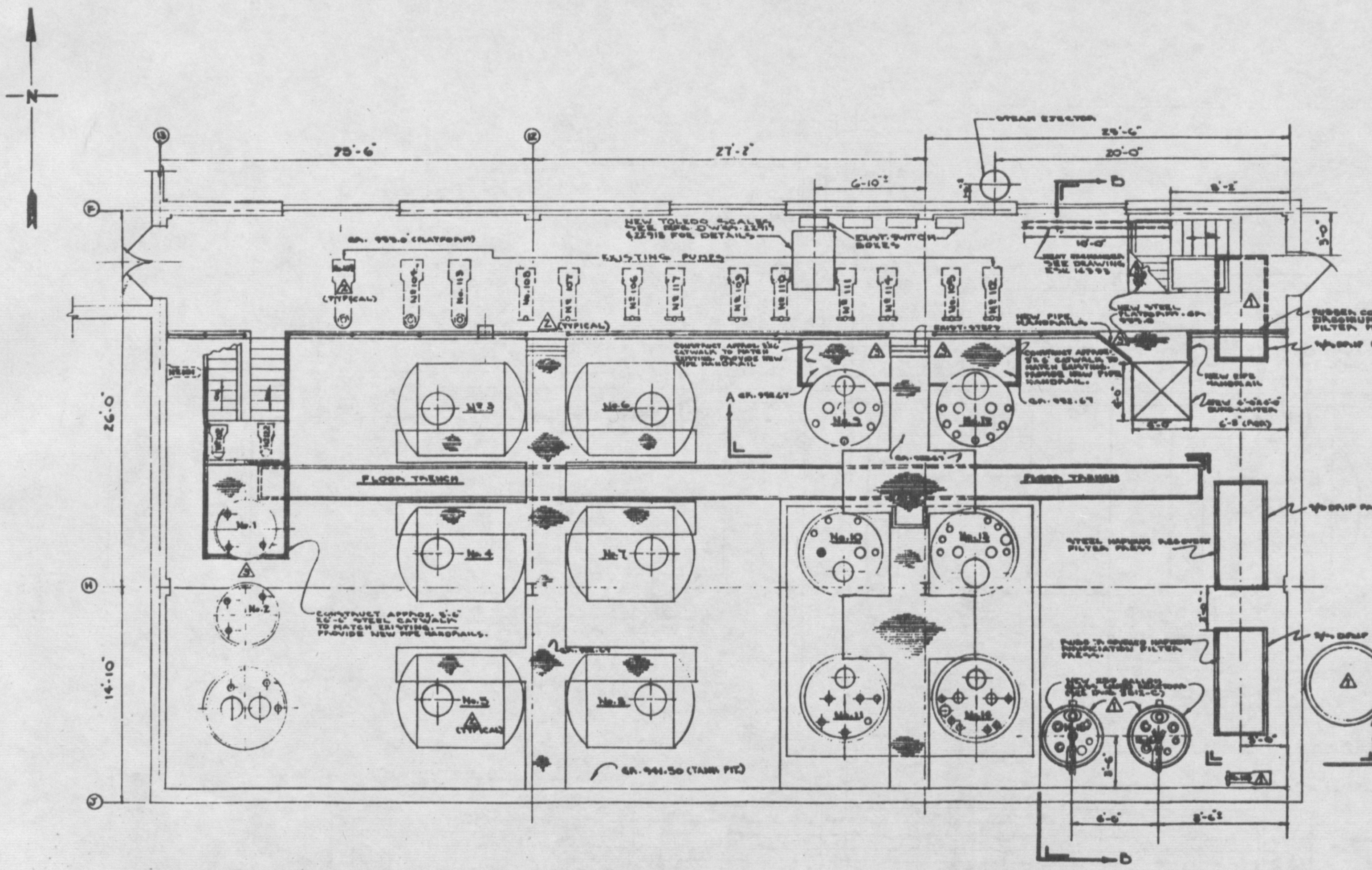
Pounds Zirconium as Oxide Produced - 248,751

## BIBLIOGRAPHY OF Y-12 LITERATURE BEARING ON PRODUCTION OF ZIRCONIUM MATERIALS

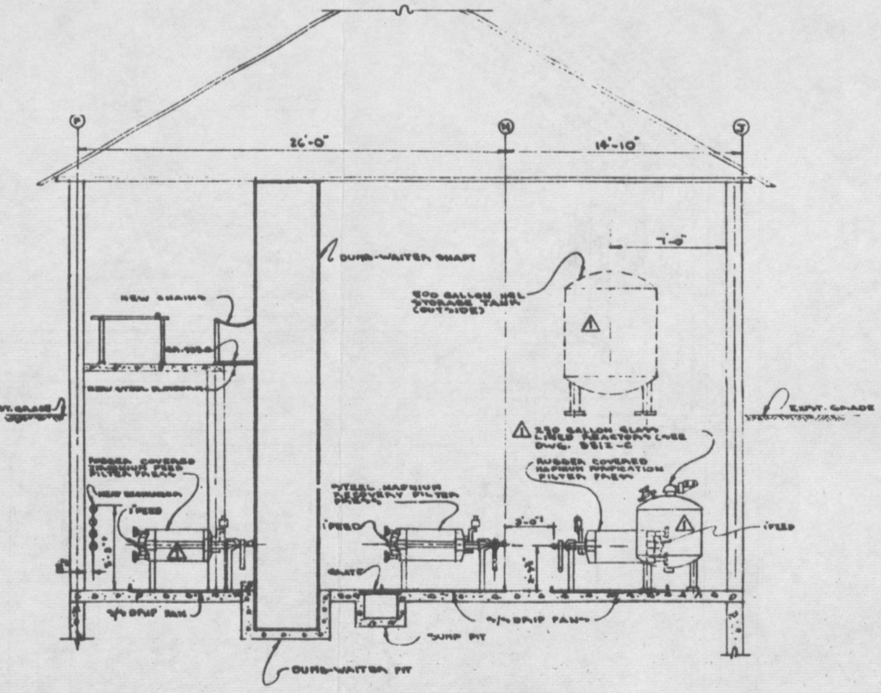
Bibliographies of Y-12 reports and reports of the MIT Practice School (Y-B4-43 and Y-B4-44) have been prepared by Mrs. Frances Sachs of the Y-12 Technical Information Center. Reports listed in these bibliographies contain important background material regarding the present processes for extraction, purification, and chlorination of zirconium materials at Y-12.

## CONSTRUCTION DRAWINGS

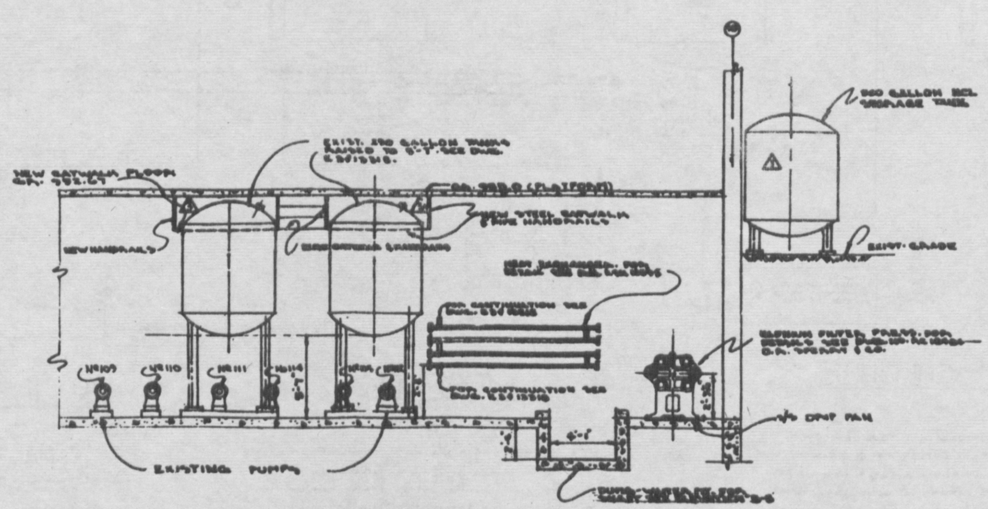
Reduced drawings are given of principal engineering designs used in construction of the permanent zirconium plant. Drawings were prepared by Mr. F. S. Patton of the Engineering Department at Y-12 and were used as the basis of field instruction to construction personnel.



TANK FARM PLAN



ELEVATION—BB



ELEVATION—AA

## TANK SCHEDULE

(4)

1, 6, 7 & 8 —— PHTHALATE STORAGE
2 —— $NH_4OH$
3 —— FEED STORAGE
4 & 5 —— PRODUCT STORAGE
9, 10, 12 & 13 —— FEED MAKEUP AREA
11, 14, 15 & 16 —— HAFNIUM

## PUMP SCHEDULE

(4)

P—101 DURICHLOR MODEL X2MDR-60 —— 1 H.P.
P—102 PROPORTIONEER DUPLEX —— 3/4 H.P.
P—103 DURICHLOR MODEL X26/2R-104 —— 10 H.P.
P—104 DURICHLOR MODEL X26/2R-104 —— 10 H.P.
P—105 DURICHLOR MODEL X26/2R-104 —— 10 H.P.
P—106 DURCO HAZ'S MODEL H25MDR 120R34 —— 3 H.P.
P—107 DURCO HAZ'S MODEL H25MDR 120R34 —— 3 H.P.
P—108 DURICHLOR MODEL X26/2R 104 —— 10 H.P.
P—109 DURCO HAZ'S MODEL H25MDR 120R84 —— 3 H.P.
P—110 DURICHLOR MODEL X-30R 62 (SPARE) —— 3 H.P.
P—111 DURICHLOR MODEL X-30R 62 —— 3 H.P.
P—112 DURICHLOR MODEL X-3MDR 74 —— 1 1/2 H.P.
P—113 DURICHLOR MODEL X-26/2R 104 —— 10 H.P.
P—114 DURICHLOR MODEL X-30R-62 —— 3 H.P.
P—115 DURICHLOR MODEL X-2MDR 60 —— 1 H.P.
P—117 DURICHLOR MODEL X-30R 62 —— 3 H.P.
P—122 DURICHLOR MODEL X-26/2R 104 —— 10 H.P.

## REF. DWG'S.

E 3f 13318 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— FLOW DIAGRAM.

E 10f 13434 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— LUCITE COVERS.

E SK 14393 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— HEAT EXCHANGER.

E SK 14664 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— FEED EXHAUST SYSTEM.

E SK 14638 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— REACTOR EXHAUST SYSTEM.

C SK 14667 —— PERMANENT ZIRCONIUM PLANT FEED MAKEUP AREA —— SCALES EXHAUST HOOD

R.C. 15484 —— 18 TYPE R.C. FILTER PRESS. D.R. SPERRY & CO.

3312-C —— 250 GALLON REACTOR—GLAS COTE PRODUCTS, INC.

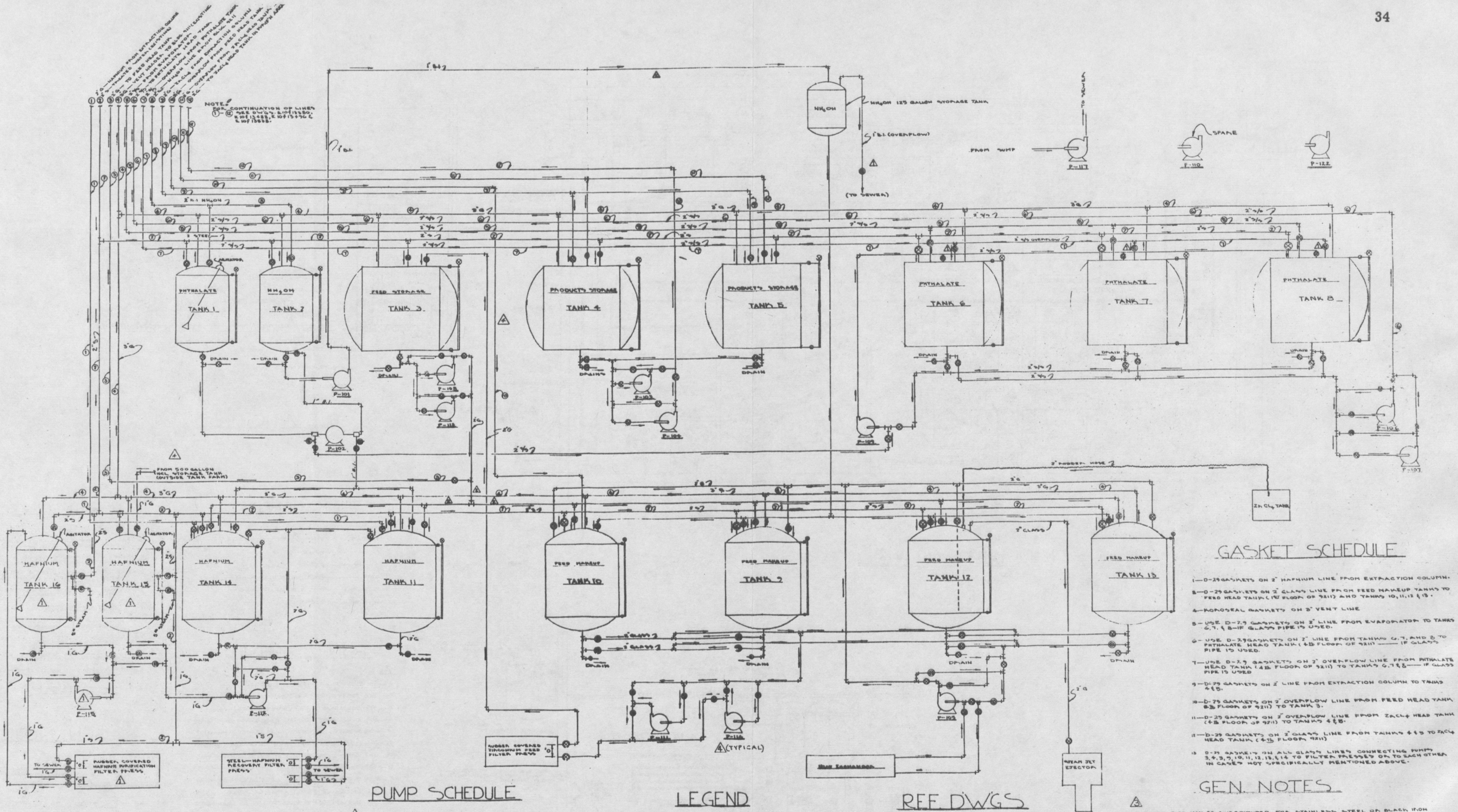
22917 —— PIT LAYOUT —— TYPE 9900 —— TOLEDO SCALES

22918 —— FRAME DETAILS —— TYPE 9900 TOLEDO SCALES

## GEN. NOTES

1. —— DIMENSIONS SHOWN MAY BE VARIED TO MEET FIELD CONDITIONS.
2. —— EXISTING EQUIPMENT SHOWN IN LIGHT LINES WHILE NEW EQUIPMENT IS IN HEAVY.
3. —— FILTERS TO BE EQUIPPED WITH SUITABLE SIZED DRIP PANS CONSTRUCTED IN FIELD.
4. —— FOR FRAME & PIT DETAILS OF TOLEDO SCALES SEE MANUFACTURES DWGS. 22917 & 22918.
5. —— FOR LOCATION OF SCALES SEE DRAWING C SK 14667.
6. —— DUMB WAITER REMOVED FROM BLDG. 9207 & INSTALLED IN BUILDING 9211 AS SHOWN. INSTRUCTIONS FOR BOTH IN W.O. 364359.
7. —— FOR EXHAUST TO FEED MAKEUP AREA SEE DWGS. E SK 14664, E SK 14638 & C SK 14667.

PERMANENT ZIRCONIUM PLANT EQUIPMENT LOCATION-FEED MAKEUP AREA, PLAN & ELEVATIONS




## GASKET SCHEDULE

1—D-29 GASKETS ON 2" HAFNIUM LINE FROM EXTRACTION COLUMN.

3—D-29 GASKETS ON 2" GLASS LINE FROM FEED MAKEUP TANKS TO FEED HEAD TANK (1ST FLOOR OF 9211) AND TANKS 10, 11, 12 & 13.

4—KOROSEAL GASKETS ON 3" VENT LINE

5—USE D-29 GASKETS ON 2" LINE FROM EVAPORATOR TO TANKS 6, 7, & 8—IF GLASS PIPE IS USED.

6—USE D-29 GASKETS ON 2" LINE FROM TANKS 6, 7, AND 8 TO PHTHALATE HEAD TANK (4th FLOOR OF 9211) —— IF GLASS PIPE IS USED.

7—USE D-29 GASKETS ON 2" OVERFLOW LINE FROM PHTHALATE HEAD TANK (4th FLOOR OF 9211) TO TANKS 6, 7 & 8 —— IF GLASS PIPE IS USED

9—D-29 GASKETS ON 2" LINE FROM EXTRACTION COLUMN TO TANKS 4 & 5.

10—D-29 GASKETS ON 2" OVERFLOW LINE FROM FEED HEAD TANK 4th FLOOR OF 9211) TO TANK 3.

11—D-29 GASKETS ON 2" OVERFLOW LINE FROM ZRCL4 HEAD TANK (4th FLOOR OF 9211) TO TANKS 4 & 5.

12—D-29 GASKETS ON 2" GLASS LINE FROM TANKS 4 & 5 TO ZRCL4 HEAD TANK (4th FLOOR 9211)

13 D-29 GASKETS ON ALL GLASS LINES CONNECTING PUMPS 3, 4, 5, 9, 10, 11, 12, 13, & 14 TO FILTER PRESSES OR TO EACH OTHER IN CASES NOT SPECIFICALLY MENTIONED ABOVE.

## PIPE MARK SCHEDULE

1 — 2" GLASS —— HAFNIUM LINE FROM EXTRACTION COLUMN (NEW)
2 — 2" STEEL. —— TREATED WATER SUPPLY FROM BLDG. 9211 (EXISTING)
3 — 2" GLASS —— FROM MAKEUP TANKS TO FEED HEAD TANK (NEW)
4 — 3" GLASS —— VENT HEADER TO BLDG. 9211 (EXISTING)
5 — 2" S/STEEL —— FROM EVAPORATOR TO TANKS 6, 7, AND 8 (NEW)
6 — 2" S/STEEL —— TO PHTHALATE HEAD TANK FROM TANKS 6, 7, & 8 (NEW)
7 — 2" S/STEEL —— FROM PHTHALATE HEAD TANK TO TANKS 6, 7, & 8 (NEW)
8 — 2" B. IRON —— $NH_4OH$ LINE FROM BLDG. 9211 (NEW)
9 — 2" GLASS —— $ZRCL_4$ FROM EXTRACTION COLUMN TO TANKS 4 & 5 (NEW)
10 — 2" GLASS —— OVERFLOW FROM FEED HEAD TANK & THIOCIANATE RETURN LINE
11 — 2" GLASS —— OVERFLOW FROM $ZRCL_4$ HEAD TANK TO TANKS 4 & 5 (NEW)
12 — 2" GLASS —— FROM TANKS 4 & 5 TO $ZRCL_4$ HEAD TANK (NEW)

## PUMP SCHEDULE

△4

P—101 DURICHLOR MODEL X-2MBR-60 (1 H.P.)
P—102 ½ PROPORTIONEER DUPLEX PUMP (¾ H.P.)
P—103 DURICHLOR MODEL X 26 R 104 (10 HP)
P—104 DURICHLOR MODEL X 26 R 104 (10 HP)
P—105 DURICHLOR MODEL X 26 R 104 (10 HP)
P—106 DURCO KA 25 MO. MODEL H 25 MDR 82 OR 84 (3 H.P.)
P—107 DURCO KA 25 MO MODEL H 25 MDR 82 OR 84 (3 HP.)
P—108 DURICHLOR MODEL X-26 R 104 (10 HP)
P—109 DURCO KA 25 MO MODEL H 25 MDR 82 OR 84 (3 H.P.)
P—110 DURICHLOR MODEL X-50 R 62 (3 HP) (SPARE)
P—111 DURICHLOR MODEL X-50 R 62 (3 HP)
P—112 DURICHLOR MODEL X-3 MDR 74 (1½ HP)
P—113 DURICHLOR MODEL X-26 R 104 (10 HP)
P—114 DURICHLOR MODEL X-50 R 62 (3 HP)
P—115 DURICHLOR MODEL X-2 MBR-60 (1 HP)
P—117 DURICHLOR MODEL X-50 R 62 (3 HP)
P—122 DURICHLOR MODEL X-26 R-104 (10 H.P.)

## LEGEND

S/S —— INDICATES STAINLESS STEEL PIPE
S —— INDICATES STEEL PIPE
G —— INDICATES PYREX GLASS PIPE
B.I. —— INDICATES BLACK IRON PIPE
⊗ —— INDICATES ALL TYPES OF VALVES
∿∿∿ —— INDICATES RUBBER HOSE
① —— ⑫ —— PIPE NUMBERING (SEE PIPE SCHEDULE)
← —— INDICATES DIRECTION OF FLOW
P-101 —— P-116 —— PUMP NUMBERING (SEE PUMP SCHEDULE)

## REF. DWGS

△4

E 10† 13319 —— PERMANENT ZIRCONIUM PLANT — EQUIPMENT LOCATION — FEED MAKEUP AREA

E 10† 13380 —— PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — PURIFICATION AREA

E 10† 13488 —— PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — EXTRACTION CONTROL AREA

E 10† 13496 —— PERMANENT ZIRCONIUM PLANT — GENERAL PIPING LAYOUT

E 10† 13538 —— PERMANENT ZIRCONIUM PLANT — FLOW DIAGRAM — EXTRACTION COLUMNS

BREAK ALL SHARP EDGES UNLESS OTHERWISE SPECIFIED
TOLERANCE UNLESS OTHERWISE SPECIFIED — FRACTIONS ± DECIMALS ±

## GEN. NOTES

△3

1—GLASS PIPE MAY BE SUBSTITUTED FOR STAINLESS STEEL OR BLACK IRON PIPES WHEREVER IT IS MORE EXPEDIENT

2—ALL PIPING SHOWN DIAGRAMMATICALLY ONLY. EXACT LOCATION AND METHOD OF SUPPORT TO BE DETERMINED IN THE FIELD.

3—PITCH ALL PIPE TO LOW POINTS FOR DRAINING LINES AND TO AVOID AIR POCKETS IN PUMP SUCTION AND DISCHARGE LINES.

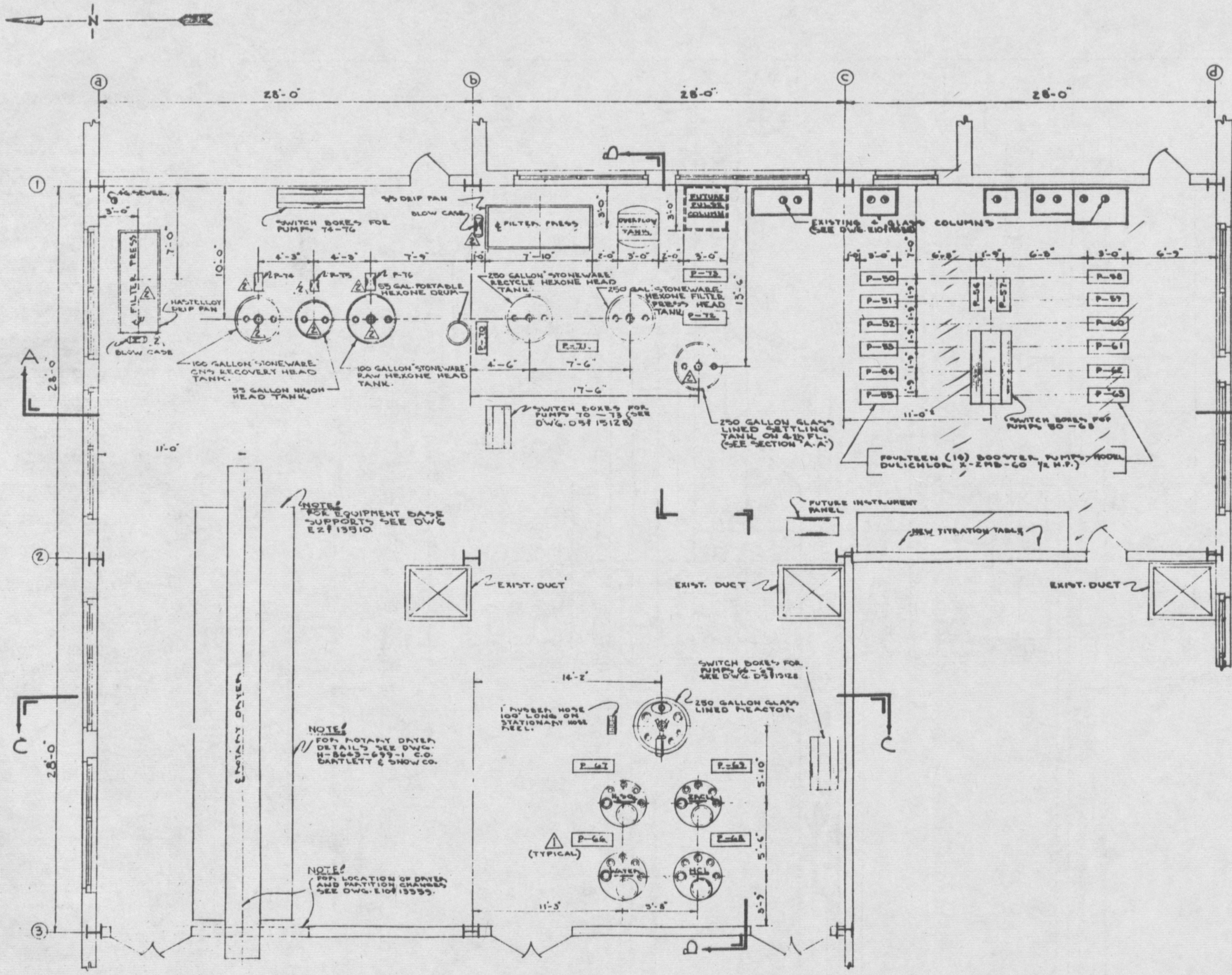
4—ALL VALVES ON GLASS LINES TO BE HILLS-McCANNA VALVES. — GLASS LINED —

5—ALL PIPING TO BE 2" PYREX GLASS EXCEPT WHERE OTHERWISE NOTED.

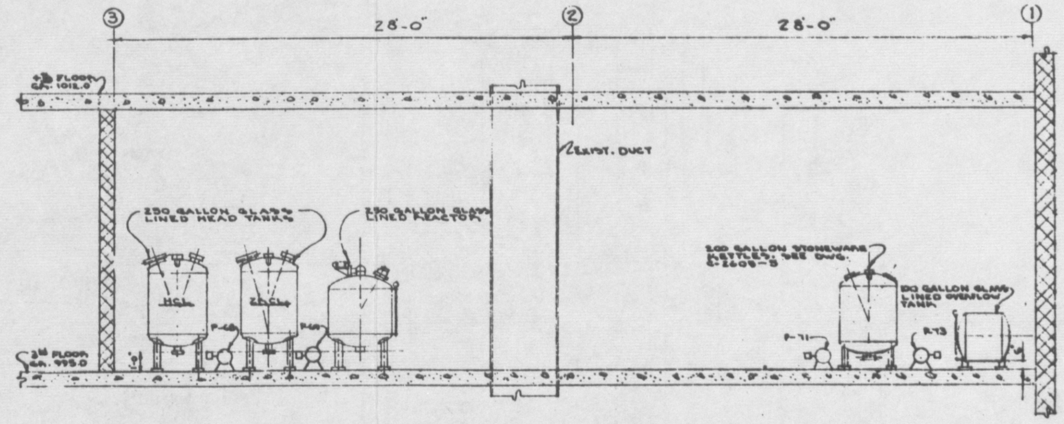
6—USE HILLS McCANNA STAINLESS STEEL DIAPHRAGM VALVES ON STAINLESS STEEL LINES BRASS OR STEEL GATE VALVES ON BLACK IRON LINES.

7—FOR LOCATION OF EQUIPMENT IN THE FEED MAKEUP AREA SEE DWG. E10† 13319. FOR CONTINUATION OF LINES ① — ⑫ SEE DWGS. E10† 13380, E10† 13488, E10† 13496 & E10† 13538.

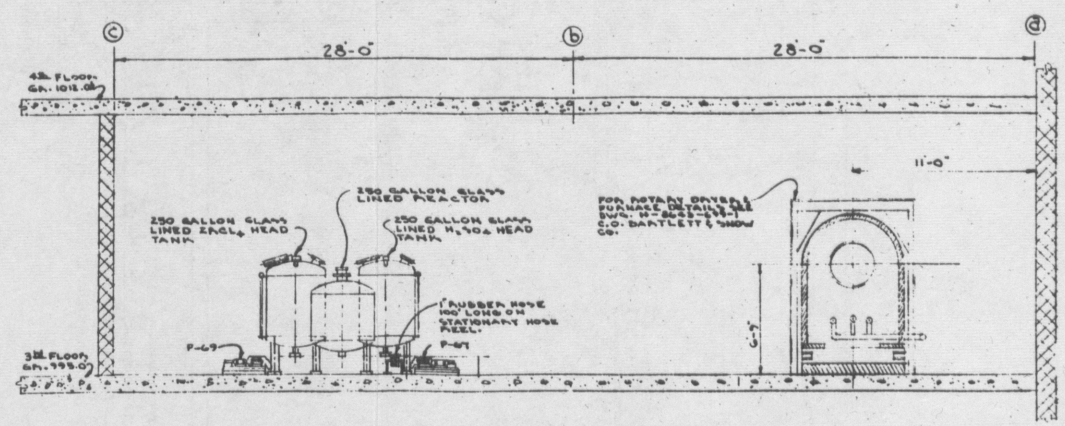
PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM, FEED MAKEUP AREA



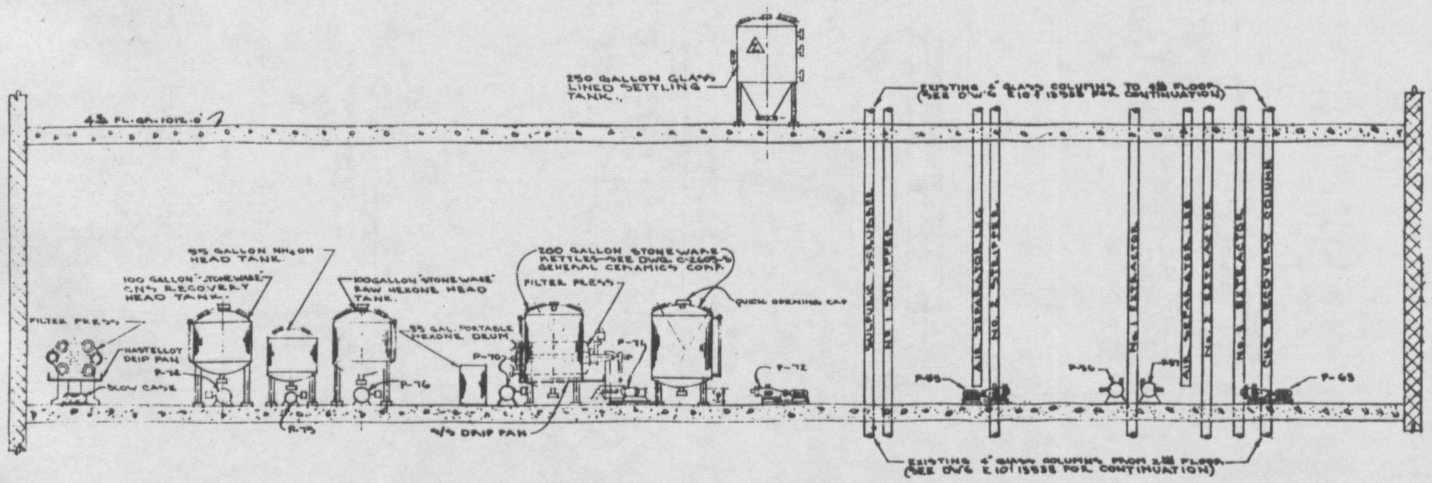

PART PLAN—3rd FL.
(EXCEPTION NOTED)




SECTION—B-B




SECTION—C-C




SECTION—A-A

## PUMP SCHEDULE

△2

P-50 —P-65 DURICHLOR X-ZMB-60 (½HP)
P—66 MILTON ROY DUPLEX
P—67 MILTON ROY SIMPLEX
P—68 MILTON ROY DUPLEX
P— 69 MILTON ROY SIMPLEX (HASTELLOY)
P— 70 MILTON ROY SIMPLEX
P—71 MILTON ROY SIMPLEX
P—72 DURICHLOR X ZMB 60 (1 H.P.)
P—73 MILTON ROY SIMPLEX (HASTELLOY)
P—74 DURICHLOR X-30R-6Z
P—75 MILTON ROY SIMPLEX (3/8)
P— -76 MILTON ROY SIMPLEX (HASTELLOY)

## REF. DWG'S.

△2

E10# 13359 —— PERMANENT ZIRCONIUM PLANT— EQUIPMENT LOCATION — PURIFICATION & CALCING AREA — PLAN & SECTIONS.

E10# 13588 —— PERMANENT ZIRCONIUM PLANT— FLOW DIAGRAM — EXTRACTION COLUMNS.

E10# 13487 —— PERMANENT ZIRCONIUM PLANT— PIPING LAYOUT —— EXTRACTION CONTROL

EZ# 13510 —— PERMANENT ZIRCONIUM PLANT— EQUIPMENT BASES — 3rd FLOOR.

DSK 14646 —— PERMANENT ZIRCONIUM PLANT— FILTER PRESS EXHAUST SYSTEM.

D3# 15128 —— PERMANENT ZIRCONIUM PLANT— ONE LINE DIAGRAM — EXTRACTION CONTROL AREA.

H-8643-699-1 —— ROTARY DRYER — C.O. BARTLETT & SNOW CO.

R.C. 18484 —— SPERRY FILTER PRESS — D.R. SPERRY & CO.

C 2605-3 —— 200 GALLON STONEWARE KETTLE — GENERAL CERAMICS CORP.

B812-C —— 250 GALLON GLASS LINED REACTOR — GLASCOTE PRODUCTS.

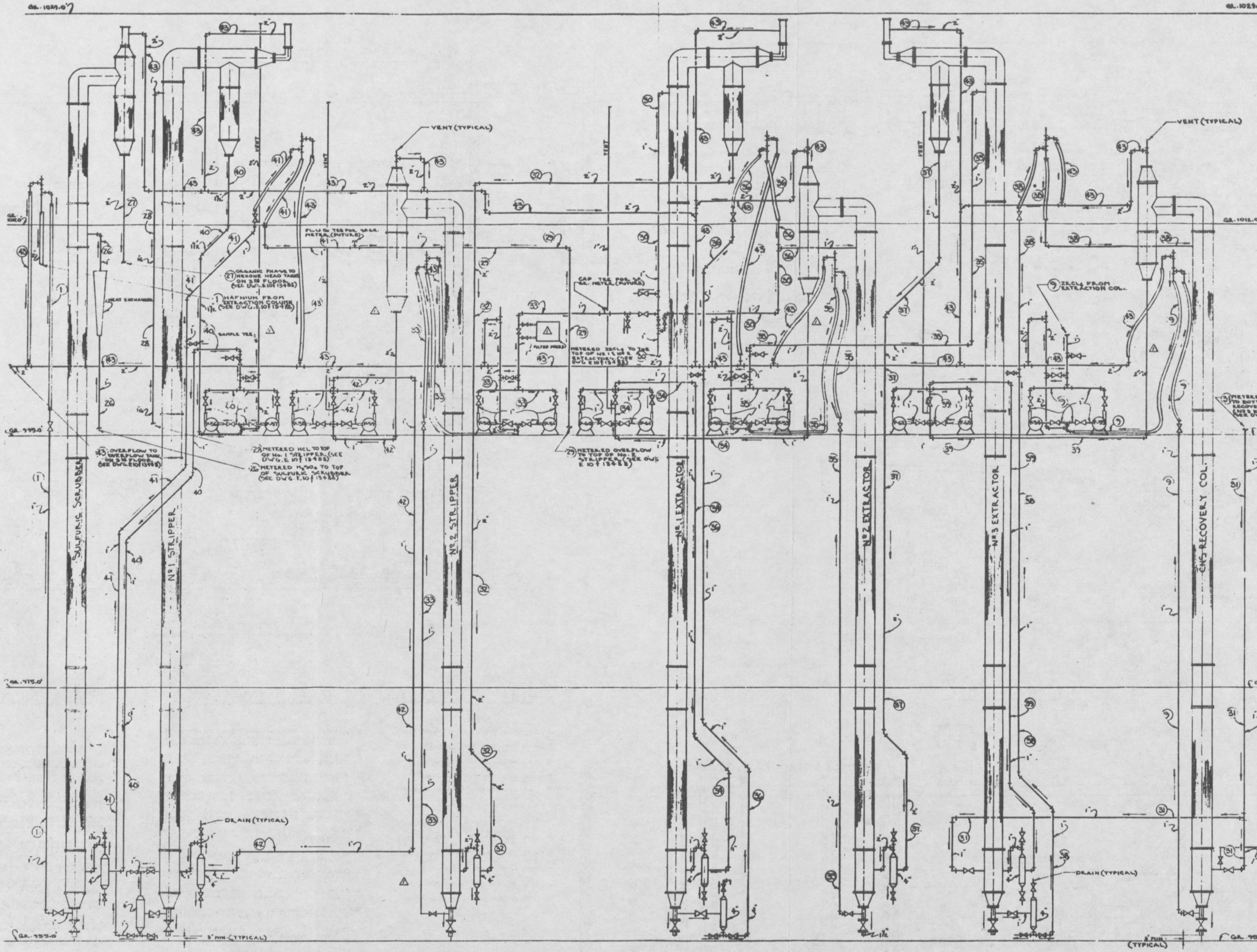
G788-B-1 250 GALLON EFFLUENT HEAD TANK ALLOY FABRICATORS, INC.

## GEN. NOTES

△2

1 — ALL EQUIPMENT SHOWN ON 3rd FLOOR TO BE NEW EXCEPT AS NOTED.
2 — ALL TANK SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
3 — DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET FIELD CONDITIONS.
4 — SEE MANUFACTURERS DRAWINGS FOR DETAILS OF ROTARY DRYER, FILTER PRESS, 200 GAL. STONEWARE KETTLES, GLASS LINED REACTOR, & 250 GALLON HEAD TANKS.
5 — NEW PUMPS (INDICATED BY P-50 — P-76.) TO BE LOCATED APPROXIMATELY WHERE SHOWN BUT EXACT LOCATION TO BE DETERMINED BY FIELD.
6 — ALL FILTERS TO BE EQUIPPED WITH EITHER STAINLESS STEEL OR HASTELLOY DRIP PANS AS NOTED. SIZE & CONSTRUCTION OF DRIP PANS TO BE DETERMINED BY FIELD.
7 — TITRATION TABLE TO BE SIZED & CONSTRUCTED BY FIELD.
8 — SWITCH BOXES FOR PUMPS 50 — 76 TO BE LOCATED APPROXIMATELY WHERE SHOWN BUT MAY BE VARIED TO MEET FIELD CONDITIONS.
9 — INSTRUMENT PANEL (FUTURE) TO BE FOR SPECIFIC GRAVITY METERS.
10 — ALL TANKS TO HAVE SIGHT GLASSES. SIZE OF SIGHT GLASSES DEPENDS UPON AVAILABLE OPENINGS.
11 — FOR FILTER PRESS EXHAUST SYSTEM SEE DWG. DSK 14646.

PERMANENT ZIRCONIUM PLANT EXTRACTION CONTROL AREA EQUIPMENT LOCATION-PLAN & SECTION




FLOW DIAGRAM

## PIPE MARK SCHEDULE

(26)—METERED $H_2SO_4$ THRU P—66 TO TOP OF THE SULFURIC SCRUBBER.

(27)—ORGANIC PHASE FROM TOP OF THE SULFURIC SCRUBBER TO HEXONE HEAD TANKS.

(28)—METERED HCL THRU P—68 TO TOP OF THE Nº 1 STRIPPER.

(29)—METERED OVERFLOW THRU P—70 TO TOP OF THE Nº 2 STRIPPER.

(30)—METERED $ZRCL_4$ THRU P—69 TO TOP OF Nº 1 & Nº 2 EXTRACTORS.

(31)—METERED HEXONE THRU P—71 TO BOTTOM OF THE CNS RECOVERY COLUMN & THE Nº 3 EXTRACTOR.

(32)—ORGANIC PHASE FROM TOP OF Nº 1 EXTRACTOR TO BOTTOM OF Nº 2 STRIPPER.

(33)—AQUEOUS PHASE FROM BOTTOM OF THE Nº 2 STRIPPER (THRU GRAVITY LEG & PUMPS 50-51) TO LINE 30 & TO THE TOP OF Nº 1 EXTRACTOR.

(34)—ORGANIC PHASE FROM AIR SEPARATOR LEG OF Nº 2 EXTRACTOR THRU PUMPS 60-61 TO THE BOTTOM OF Nº 1 EXTRACTOR.

(35)—AQUEOUS PHASE FROM BOTTOM OF Nº 2 EXTRACTOR (THRU GRAVITY LEG & PUMPS 52-53) TO TOP OF Nº 3 EXTRACTOR.

(36)—AQUEOUS PHASE FROM BOTTOM OF Nº 1 EXTRACTOR (THRU GRAVITY LEG) TO TOP OF THE Nº 2 EXTRACTOR.

(37)—ORGANIC PHASE FROM TOP OF Nº 3 EXTRACTOR TO BOTTOM OF Nº 2 EXTRACTOR.

(38)—AQUEOUS PHASE FROM BOTTOM OF Nº 3 EXTRACTOR (THRU GRAVITY LEG) TO TOP OF THE CNS RECOVERY COLUMN.

(39)—ORGANIC PHASE FROM AIR SEPARATOR LEG OF THE CNS RECOVERY COLUMN (THRU PUMPS 62-63 TO BOTTOM OF Nº 3 EXTRACTOR.

(40)—ORGANIC PHASE FROM TOP OF Nº 1 STRIPPER (THRU PUMPS 56-57) TO BOTTOM OF THE SULFURIC ACID SCRUBBER.

(41)—AQUEOUS PHASE FROM BOTTOM OF Nº 1 STRIPPER (THRU GRAVITY LEG) TO TOP OF THE Nº 2 STRIPPER.

(42)—ORGANIC PHASE FROM AIR SEPARATOR LEG OF Nº 2 STRIPPER (THRU PUMPS 58-59) TO BOTTOM OF Nº 1 STRIPPER.

(43)—OVERFLOW FROM ALL EXTRACTION COLUMNS AND GRAVITY LEGS TO THE OVERFLOW TANK ON 3RD FLOOR.

(9)—$ZRCL_4$ FROM BOTTOM OF THE CNS RECOVERY COLUMN (THRU GRAVITY LEG & PUMPS 54-55) TO FEED MAKE UP AREA IN THE TANK FARM OR THE PURIFICATION AREA ON THE 4TH FLOOR.

(1)—HAFNIUM FROM BOTTOM OF THE SULFURIC SCRUBBER (THRU GRAVITY LEG) TO FEED MAKE UP AREA IN THE TANK PIT.

## GENERAL NOTES

1—ALL PIPING SHOWN DIAGRAMMATICALLY ONLY.

2—ALL PIPING TO BE PYREX GLASS SIZED AS SHOWN.

3—ALL VALVES TO BE HILLS-MCCANNA GLASS LINED VALVES.

4—ALL HILLS-MCCANNA GLASS LINED VALVES ON THE 1ST FLOOR TO BE NICKLE-PLATED.

5—USE D-29 GASKETS ON ALL GLASS LINES.

6—USE 347 S/S WELDING RODS WHEN WELDING S/S TO S/S OR S/S TO B.I. IN THE CONSTRUCTION OF COLUMN SUPPORTS.

7—ELEVATION OF OVERFLOW LINE ON 3RD FLOOR TO BE 1000.35'. PITCH OVERFLOW LINE TOWARD OVERFLOW TANK (SEE DWG E10# 13488)

8—PUMPS 50-63 TO BE DURICHLOR X-ZMB-60 (1-H.P) BOOSTER PUMPS FOR LOCATION OF PUMPS SEE DWG. E 10# 13488.

9—FOR CONTINUATION OF LINES (1), (9), 26, 27, 28, 29, 30 & 31 SEE DWGS. E3# 13318, E10# 13380, E 10# 13488 & E 10# 13496.

10—ALL COLUMNS TO BE 4" PYREX GLASS PIPE EXCEPT FOR ONE (1) 13" SECTION OF 6" GLASS PIPE & A 6x4 SPECIAL REDUCING ELL AT THE TOPS OF ALL COLUMNS.

## REF. DWGS.

E 3# 13318 — PERMANENT ZIRCONIUM PLANT — FLOW DIAGRAM — FEED MAKEUP AREA.

E 10# 13380 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — PURIFICATION AREA.

E 10# 13488 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — EXTRACTION CONTROL AREA.

E 10# 13496 — PERMANENT ZIRCONIUM PLANT — GENERAL PIPING LAYOUT.

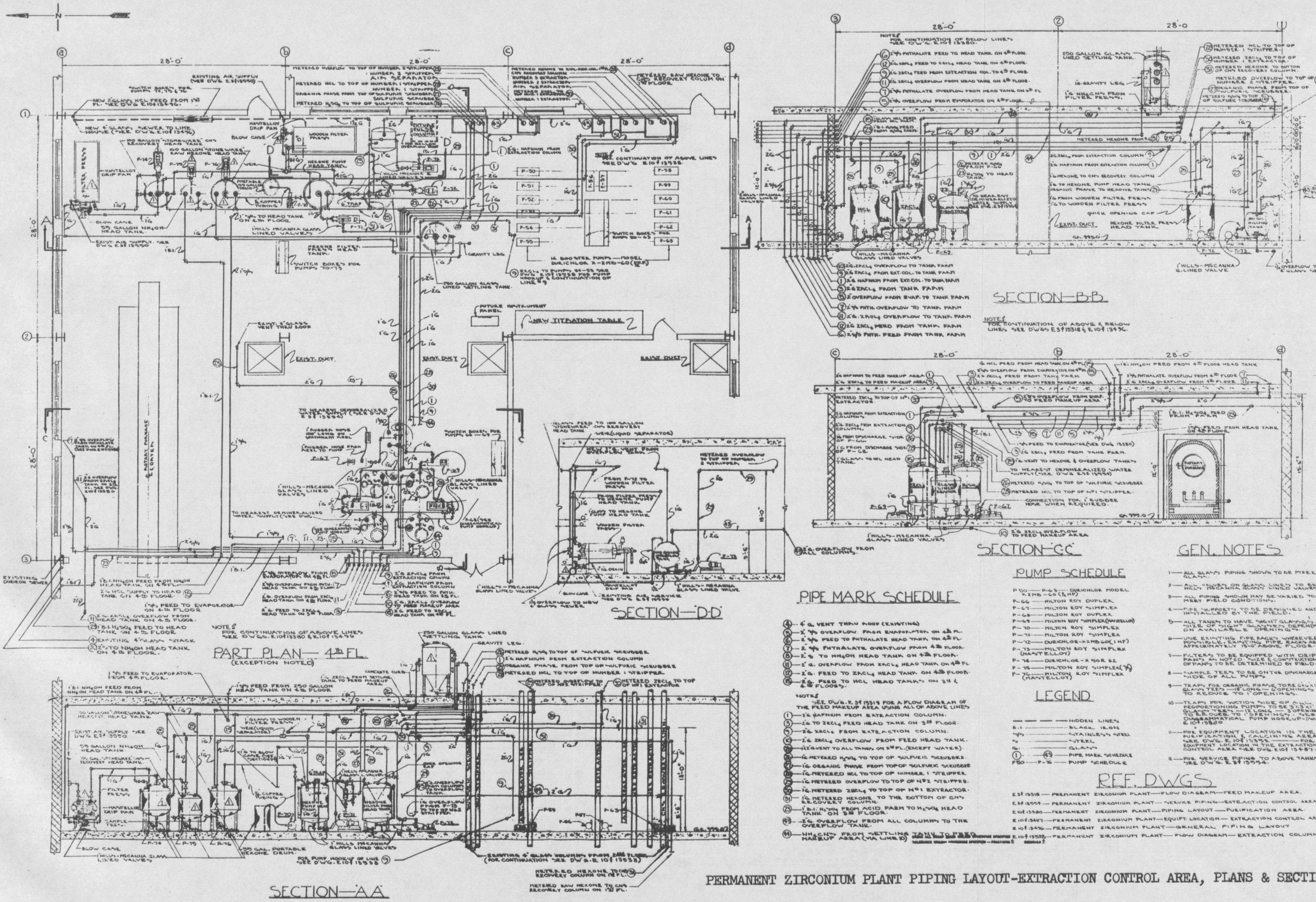
## LEGEND

(1), (9) & (26)—(43) PIPE MARK SCHEDULE

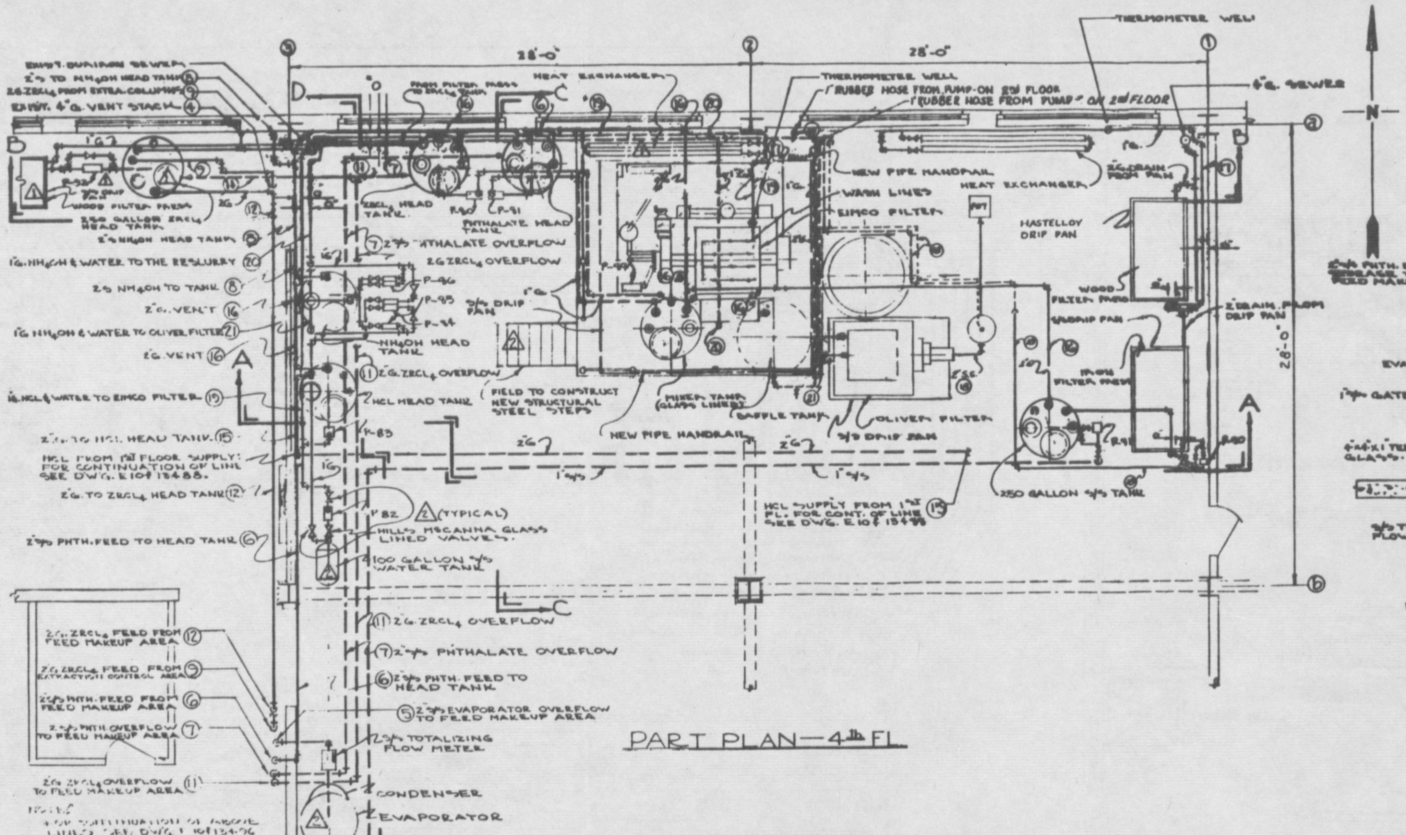
(P50)—(P63) DURICHLOR X-ZMB-60 (1 H.P) BOOSTER PUMPS

RUBBER GRAVITY LEGS

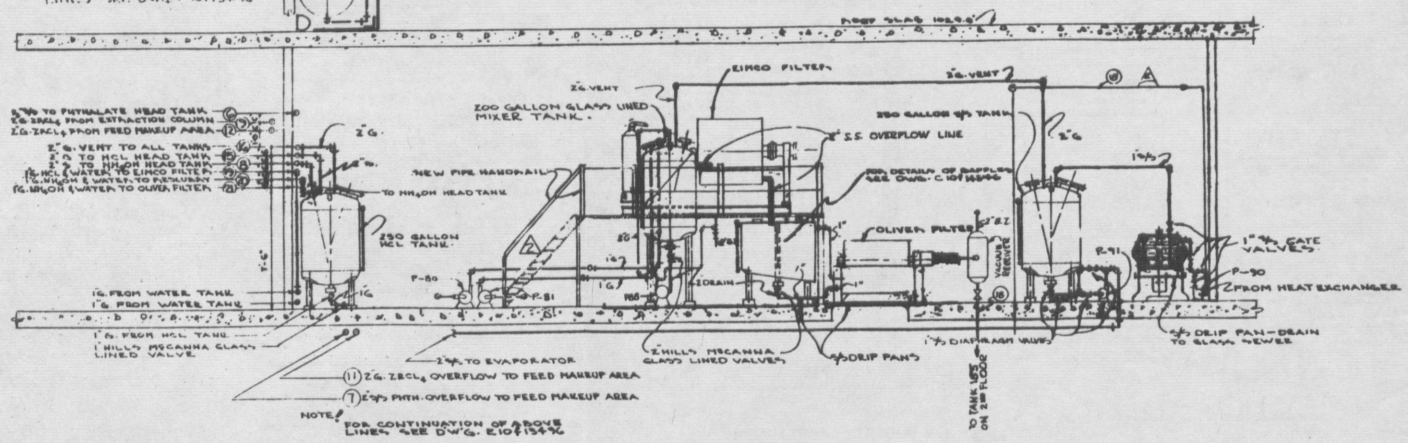
PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM EXTRACTION COLUMNS



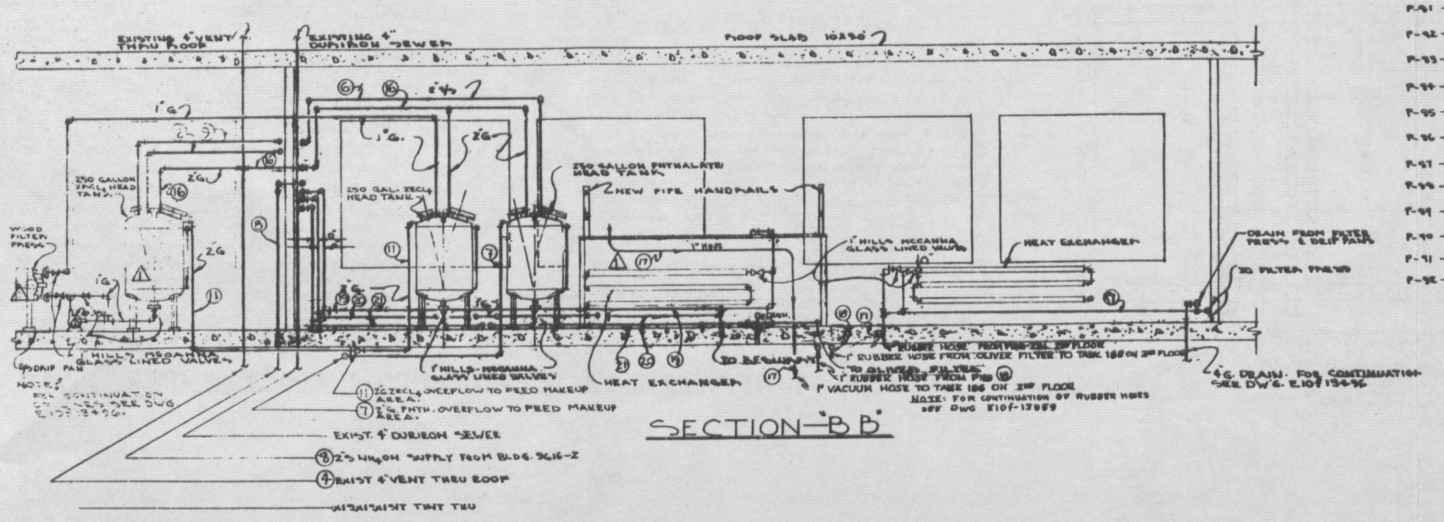

PERMANENT ZIRCONIUM PLANT PIPING LAYOUT-EXTRACTION CONTROL AREA, PLANS & SECTIONS



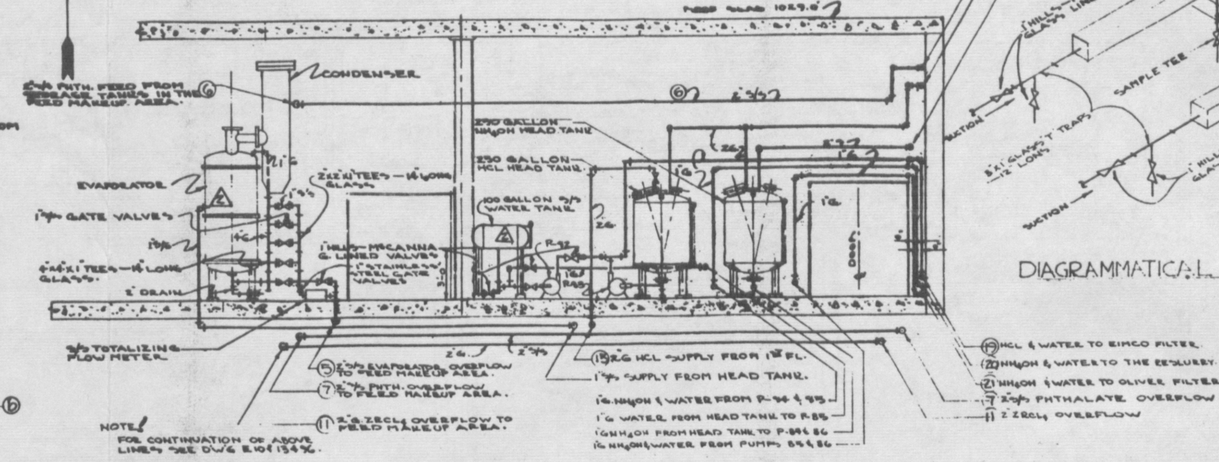
PART PLAN—4th FL



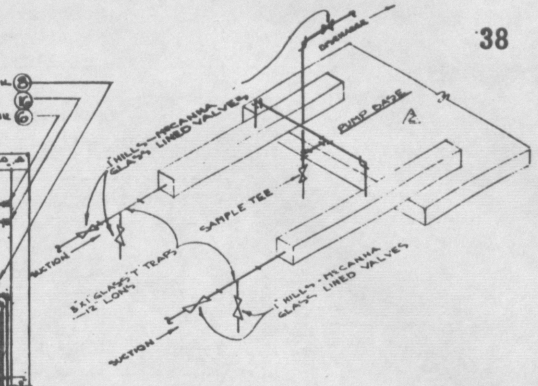
SECTION—"AA"



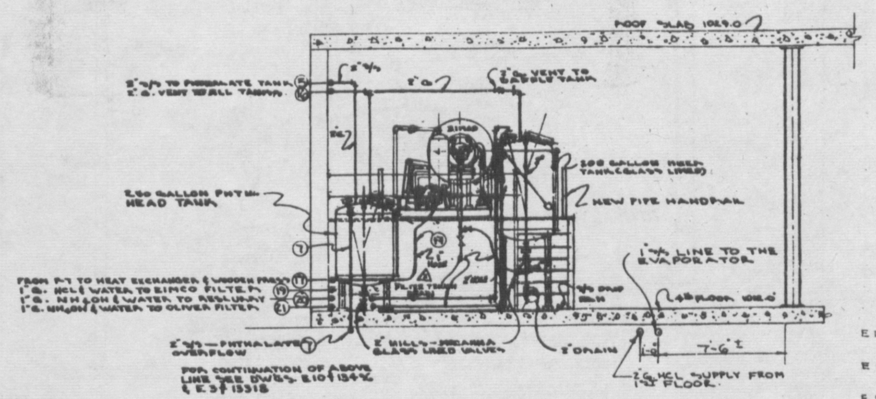
SECTION—"BB"



SECTION—"DD"



DIAGRAMMATICAL PUMP HOOKUP



SECTION—"CC"

## LEGEND

| | |
|---|---|
| S/S | STAINLESS STEEL |
| S | STEEL |
| G. | PYREX GLASS PIPE |
| B.I. | BLACK IRON |
| (wavy line) | FLEXIBLE RUBBER HOSE |
| P-80—P-92 | PUMP NUMBERING (SEE PUMP SCHEDULE) |
| (4)—(21) | PIPE NUMBERING (SEE PIPE MARK SCHEDULE) |
| (dashed line) | HIDDEN LINES (UNDER FLOOR OR PLATFORM) |

## REF. DWG'S.

E 10 of 13359—PERMANENT ZIRCONIUM PLANT—EQUIPMENT LOCATION—PURIFICATION & CALCINING AREAS.

E 10 of 13496—PERMANENT ZIRCONIUM PLANT—GENERAL PIPING LAYOUT.

E 10 of 13488—PERMANENT ZIRCONIUM PLANT—PIPING LAYOUT—EXTRACTION CONTROL AREA.

## PUMP SCHEDULE

△2

| | | |
|---|---|---|
| P-80 | MILTON ROY SIMPLEX | HASTELLOY |
| P-81 | MILTON ROY SIMPLEX | STAINLESS STEEL |
| P-82 | MILTON ROY SIMPLEX | STAINLESS STEEL |
| P-83 | MILTON ROY SIMPLEX | 7/8"x8" HAVEG |
| P-84 | MILTON ROY SIMPLEX | STAINLESS STEEL |
| P-85 | MILTON ROY DUPLEX | STAINLESS STEEL |
| P-86 | HILLS McCANNA DUPLEX | STAINLESS STEEL |
| P-87 | VACUUM PUMP (H-4) | NASH HYTOR |
| P-88 | MIXER PUMP | DURICHLOR X-3MBE-30 |
| P-89 | VACUUM PUMP | NASH HYTOR |
| P-90 | DURCO PUMP | STAINLESS STEEL |
| P-91 | DURCO PUMP | STAINLESS STEEL |
| P-92 | DURICHLOR MODEL X-2MB 60 (1 HP) | |

## PIPE MARK SCHEDULE

△2

- (9) 2" G. ZrCl₄ FROM EXTRACTION COLUMN
- (4)—3" G VENT FROM 1st FL. TO EXISTING 4" STACK.
- (5)—2" S/S FROM EVAPORATOR ON 4th FLOOR.
- (6)—2" S/S FEED TO PHTHALATE HEAD TANK ON 4th FLOOR.
- (7)—2" S/S PHTHALATE OVERFLOW FROM 4th FLOOR.
- (8)—2" S. FEED TO $NH_4OH$ HEAD TANK ON 4th FLOOR.
- (11)—2" G. OVERFLOW FROM $ZrCl_4$ HEAD TANK ON 4th FL.
- (12)—2" G. FEED TO $ZrCl_4$ HEAD TANK ON 4th FLOOR

NOTE

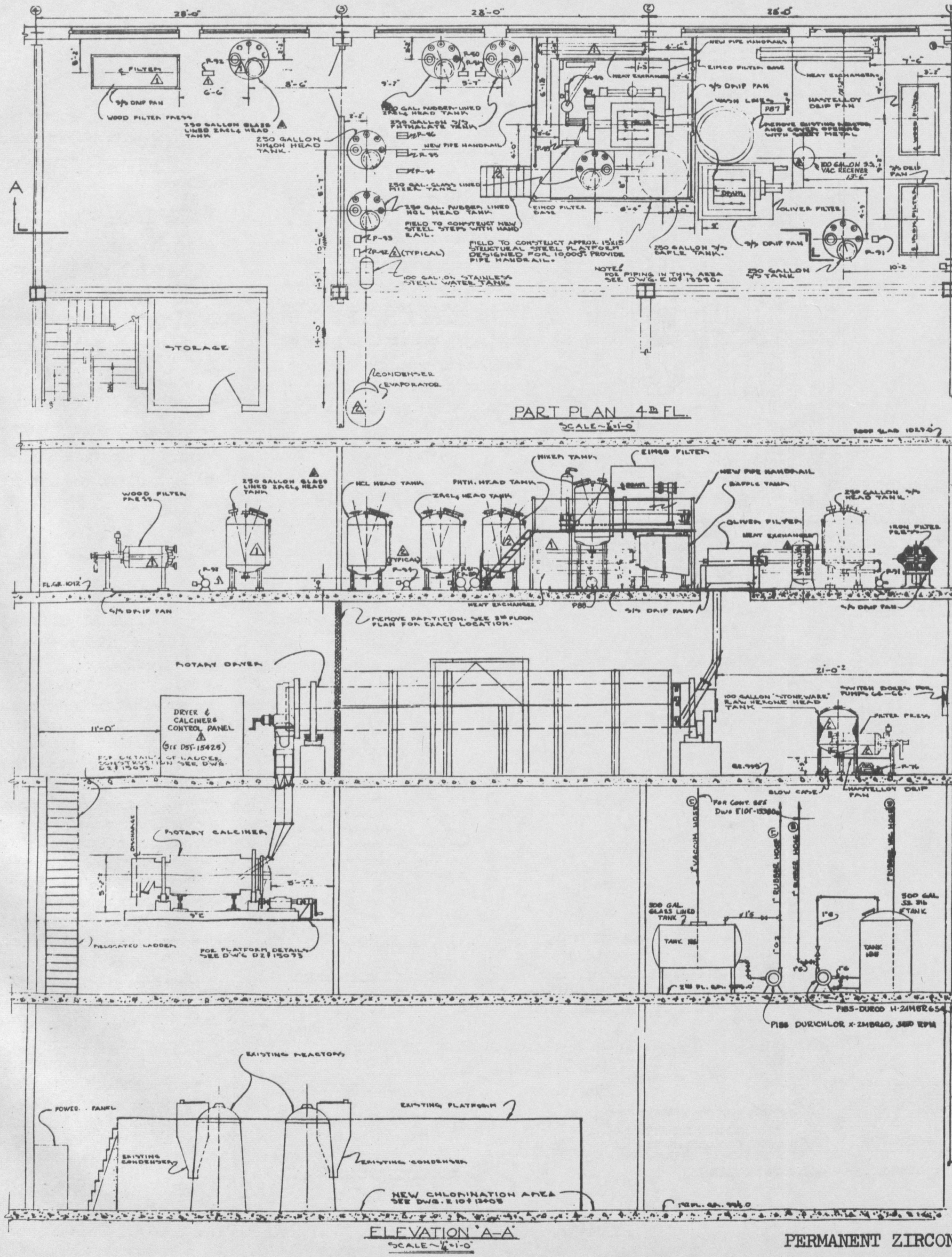
SEE DWG. E 3 of 13318 FOR A FLOW DIAGRAM OF THE FEED MAKEUP AREA USING ALL OF THE ABOVE LINES.

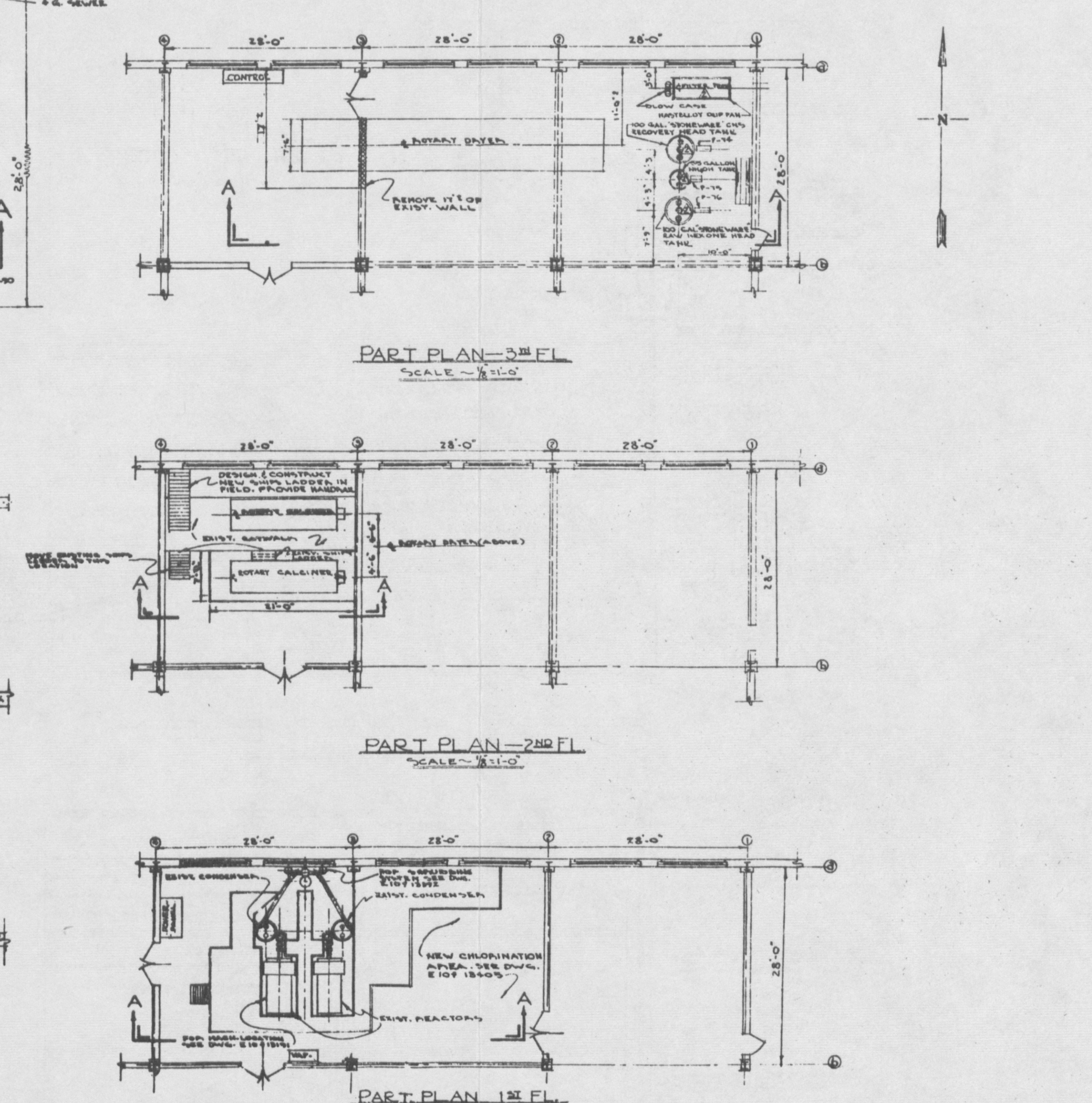
- (15)—2" G. FEED TO HCL HEAD TANK ON 4th FLOOR
- (16)—2" G. VENT TO ALL TANKS (EXCEPT WATER).
- (17)—1" G. FROM P-7 TO HEAT EXCHANGER & WOODEN PRESS.
- (18)—1" G. FROM OLIVER FILTER TO IRON FILTER PRESS
- (19)—1" G. HCL & WATER TO EIMCO FILTER.
- (20)—1" G. $NH_4OH$ & WATER TO THE RESLURRY.
- (21)—1" G. $NH_4OH$ & WATER TO THE OLIVER FILTER.

## GEN. NOTES

1. ALL GLASS PIPING SHOWN TO BE PYREX GLASS.
2. ALL VALVES ON GLASS LINES TO BE HILLS McCANNA GLASS LINED VALVES, EXCEPT WHERE NOTED.
3. USE HILLS McCANNA S/S DIAPHRAGM VALVES ON S/S LINES & BRASS OR STEEL GATE VALVES ON STEEL OR BLACK IRON LINES.
4. PIPING SHOWN DIAGRAMMATICALLY ONLY AND MAY BE VARIED TO MEET FIELD CONDITIONS.
5. PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
6. GLASS PIPE MAY BE SUBSTITUTED FOR S/S OR STEEL PIPES WHEREVER IT IS MORE EXPEDIENT.
7. PIPING HOOKUP FOR WOOD FILTER PRESSES IS THE SAME AS SHOWN FOR IRON FILTER PRESS.
8. ALL FILTER PRESSES TO BE EQUIPPED WITH DRIP PANS AS NOTED. DRIP PANS TO BE SIZED & CONSTRUCTED IN THE FIELD.
9. FOR EQUIPMENT LOCATION IN THE PURIFICATION & CALCINING AREAS SEE DWG. E 10 of 13359.
10. DIAGRAMMATICAL PUMP HOOKUP TO APPLY TO ALL MILTON ROY DUPLEX PUMPS.

PERMANENT ZIRCONIUM PLANT PIPING LAYOUT-PURIFICATION AREA, PLAN & SECTIONS




## REF. DWG'S.

E 24 15310 — PERMANENT ZIRCONIUM PLANT — EQUIPT. BASES — PURIFICATION & EXTRACTION CONTROL AREAS.

D 24 15093 — PERMANENT ZIRCONIUM PLANT — STRUCTURAL ALTERATIONS — EXTRACTION CONTROL AREA.

E 104 15530 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — PURIFICATION AREA.

E 104 13191 — PERMANENT ZIRCONIUM PLANT — REVISED MACHINE LOCATION — CHLORINATION SYSTEM.

E 104 13592 — PERMANENT ZIRCONIUM PLANT — SCRUBBING SYSTEM — ZIRCONIUM CHLORINATION.

E 104 18405 — PERMANENT ZIRCONIUM PLANT — EQUIPMENT LOCATION — REALTOR AREA.

H-8643-699-1 — ROTARY DRYER — C.O. BARTLETT & SNOW CO.

8643-707-1 — ROTARY CALCINER — C.O. BARTLETT & SNOW CO.

310 CD-482 — EIMCO 4'-0" DIA. DRUM FILTER — EIMCO CORPORATION.

32 & 258 304R — OLIVER 3'-0 DIA. DRUM FILTER — OLIVER UNITED FILTER.

AC 18484 — SPERRY FILTER PRESS — D.R. SPERRY AND CO.

DBF-15425 — CONTROL PANEL

## GEN. NOTES

1 — ALL EQUIPMENT AND CONSTRUCTION SHOWN ON 2ND, 3RD, & 4TH FLOORS TO BE NEW, EXCEPTION NOTED.

2 — ALL EQUIPMENT SHOWN ON 1ST FLOOR IS EXISTING.

3 — ALL TANK SUPPORTS TO BE DESIGNED IN THE FIELD.

4 — DIMENSIONS SHOWN ARE APPROXIMATE AND MAY BE VARIED TO MEET FIELD CONDITIONS.

5 — SEE MANUFACTURES DRAWINGS FOR DETAILS OF ROTARY DRYER, ROTARY CALCINERS, EIMCO & OLIVER FILTERS & FILTER PRESSES.

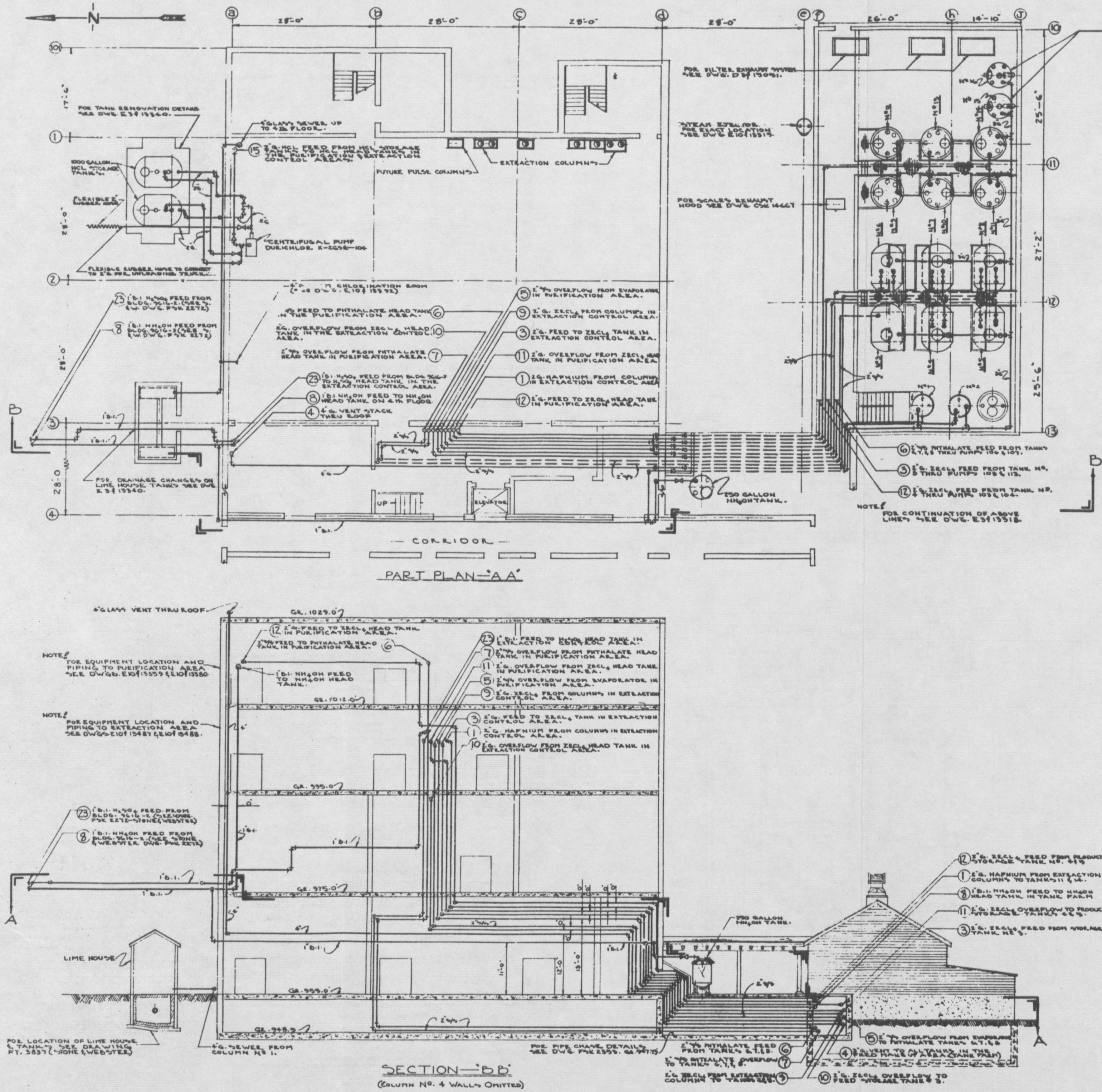
6 — PUMPS (INDICATED BY P-74—P-92) TO BE LOCATED APPROX. WHERE SHOWN BUT EXACT LOCATION TO BE DETERMINED IN FIELD.

7 — FOR PUMP SCHEDULE SEE DWG. NO. E104 15580.

8 — ALL FILTER PRESSES TO BE EQUIPPED WITH DRIP PANS AS NOTED. DRIP PANS TO BE SIZED AND CONSTRUCTED IN THE FIELD.

9 — ALL TANKS TO BE EQUIPPED WITH SIGHT GLASSES. SIZE OF GLASSES WILL DEPEND ON SIZE OF EXIST. OPENINGS IN TANKS.

PERMANENT ZIRCONIUM PLANT EQUIPMENT LOCATION, PURIFICATION & CALCINING AREA, PLANS & ELEVATION




## GENERAL NOTES

1. FOR SERVICE PIPING TO THE FEED MAKE UP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS E-3# 13557, E3# 13550, & E3# 13554.
2. FOR EQUIPMENT LOCATION TO THE FEED MAKE UP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS E10# 13319, E10# 13399, & E10# 13487.
3. FOR EXHAUST SYSTEM IN THE EXTRACTION CONTROL AREA & PURIFICATION AREA SEE DWGS. E3# 13490 & ESK 14664.
4. FOR REACTOR EXHAUST SYSTEM IN THE FEED MAKEUP AREA SEE DWG. ESK 14638.
5. FOR FILTER PRESS EXHAUST SYSTEMS IN THE FEED MAKEUP AREA, EXTRACTION CONTROL AREA, & PURIFICATION AREA, SEE DRAWINGS D3# 15051, DSK 14646 & DSK 14674.
6. ALL PIPING SHOWN DIAGRAMMATICALLY ONLY. EXACT LOCATION TO BE DETERMINED BY THE FIELD.
7. ALL PIPING SHOWN TO BE PYREX GLASS EXCEPT WHERE NOTED.
8. PIPE SUPPORTS TO BE DESIGNED AND INSTALLED BY THE FIELD.
9. FOR CONDUIT PLAN OF THE EXTRACTION CONTROL AREA SEE DWGS ESK 14640 & D3# 15128.

## PIPE MARK SCHEDULE

- (1) 2" G. HAFNIUM FROM COLUMNS IN EXTRACTION CONTROL AREA TO HAFNIUM TANKS 11 & 14 IN FEED MAKEUP AREA.
- (3) 2" G. ZRCL4 FEED FROM STORAGE TANK No 3 IN FEED MAKEUP AREA TO ZRCL4 HEAD TANK IN EXTRACTION CONTROL AREA.
- (4) 3" G. VENT FROM ALL TANKS IN THE FEED MAKEUP AREA TO THE NORTH WALL OF BLDG. 9211 & THEN THRU ROOF WITH A 4" STACK.
- (5) 2" S/S OVERFLOW FROM EVAPORATOR IN PURIFICATION AREA TO PHTHALATE STORAGE TANKS 6, 7, & 8 IN THE FEED MAKE UP AREA.
- (6) 2" S/S PHTHALATE FEED FROM PHTHALATE TANKS 6, 7, & 8 IN FEED MAKEUP AREA TO PHTHALATE HEAD TANK IN PURIFICATION AREA.
- (7) 2" S/S OVERFLOW FROM PHTHALATE HEAD TANK IN PURIFICATION AREA TO PHTHALATE STORAGE TANKS 6, 7, & 8 IN THE FEED MAKEUP AREA.
- (8) 1" B.I. NH4OH FEED FROM BLDG. 9616-2 TO NH4OH HEAD TANK IN THE FEED MAKEUP AREA. (SEE S. & W. DWG. FSK. 2272)
- (9) 2" G. ZRCL4 FROM COLUMNS IN EXTRACTION CONTROL AREA TO PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKE UP AREA.
- (10) 2" G. OVERFLOW FROM ZRCL4 HEAD TANK IN EXTRACTION CONTROL AREA TO FEED STORAGE TANK No 3 IN FEED MAKEUP AREA.
- (11) 2" G. OVERFLOW FROM ZRCL4 HEAD TANK IN PURIFICATION AREA TO PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKEUP AREA.
- (12) 2" G. ZRCL4 FEED FROM PRODUCT STORAGE TANKS 4 & 5 IN FEED MAKEUP AREA TO ZRCL4 HEAD TANK IN PURIFICATION AREA.
- (15) 2" G. HCL FEED FROM HCL STORAGE TANKS ON THE NORTH SIDE OF BLDG. 9211 TO HCL HEAD TANKS IN THE PURIFICATION & EXTRACTION CONTROL AREAS.
- (16) 2" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE PURIFICATION AREA.
- (23) 1" B.I. H2SO4 FEED FROM BLDG. 9616-2 TO H2SO4 HEAD TANK IN THE EXTRACTION CONTROL AREA. (SEE S. & W. DWG FSK 2272)
- (25) 1" & 2" G. VENT TO ALL TANKS (EXCEPT WATER) IN THE EXTRACTION CONTROL AREA.

## TANK SCHEDULE

- 1, 6, 7 & 8 — PHTHALATE STORAGE
- 2 — NH4OH
- 3 — FEED STORAGE
- 4 & 5 — PRODUCT STORAGE
- 9, 10, 12 & 13 — FEED MAKEUP
- 11, 14, 15 & 16 — HAFNIUM

## LEGEND

- (1)—(25) — PIPE NUMBERING (SEE PIPE MARK SCHEDULE)
- — — — — HIDDEN LINES
- B.I. — BLACK IRON
- S/S — STAINLESS STEEL
- S — STEEL
- ~~~~ — FLEXIBLE RUBBER HOSE
- G. — GLASS
- (7) — EXTRACTION COLUMNS

[illegible]

## REF. DWGS.

- FSK 2353 — TANK FARM STORAGE PLATFORM — STONE & WEBSTER.
- FSK 2272 — YARD PIPING — BLDG. 9211 — STONE AND WEBSTER.
- FT 3837 — PERMANENT ZIRCONIUM PLANT — PUMP HOUSE AND SAMPLING TANKS.
- ESK 14640 — PERMANENT ZIRCONIUM PLANT — CONDUIT PLAN — EXTRACTION CONTROL AREA.
- DSK 14674 — PERMANENT ZIRCONIUM PLANT — FILTER PRESS EXHAUST SYSTEM — PURIFICATION AREA.
- CSK 14667 — PERMANENT ZIRCONIUM PLANT — SCALES EXHAUST HOOD — FEED MAKEUP AREA.
- ESK 14638 — PERMANENT ZIRCONIUM PLANT — REACTOR EXHAUST SYSTEM — FEED MAKEUP AREA.
- ESK 14664 — PERMANENT ZIRCONIUM PLANT — FEED EXHAUST SYSTEM — FEED MAKEUP AREA.
- DSK 14646 — PERMANENT ZIRCONIUM PLANT — FILTER PRESS EXHAUST SYSTEM — EXTRACTION CONTROL AREA.
- D3# 15051 — PERMANENT ZIRCONIUM PLANT — FILTER PRESS EXHAUST SYSTEM — FEED MAKEUP AREA.
- E3# 13490 — PERMANENT ZIRCONIUM PLANT — EXHAUST SYSTEM — PURIFICATION AREA.
- E3# 13518 — PERMANENT ZIRCONIUM PLANT FLOW DIAGRAM — FEED MAKE UP AREA.
- E10# 13319 — PERMANENT ZIRCONIUM PLANT — EQUIPMENT LOCATION — FEED MAKEUP AREA.
- E10# 13399 — PERMANENT ZIRCONIUM PLANT — EQUIPT. LOCATION — PURIFICATION & CALCINING AREAS.
- E10# 13380 — PERMANENT ZIRCONIUM PLANT PIPING LAYOUT — PURIFICATION AREA.
- E10# 13487 — PERMANENT ZIRCONIUM PLANT — EQUIPT. LOCATION — EXTRACTION CONTROL AREA.
- E10# 13488 — PERMANENT ZIRCONIUM PLANT — PIPING LAYOUT — EXTRACTION CONTROL AREA.
- E10# 13538 — PERMANENT ZIRCONIUM PLANT — FLOW DIAGRAM — EXTRACTION COLUMNS.
- E3# 13550 — PERMANENT ZIRCONIUM PLANT — SERVICE LINES — EXTRACTION CONTROL AREA.
- E3# 13554 — PERMANENT ZIRCONIUM PLANT — SERVICE LINES — PURIFICATION AREA.
- E3# 13557 — PERMANENT ZIRCONIUM PLANT — DEMINERALIZED WATER — FEED MAKEUP AREA.
- E2# 13340 — PERMANENT ZIRCONIUM PLANT — CONTACT TANK RENOVATION — BLDG. 9510-4.
- E10# 13892 — PERMANENT ZIRCONIUM PLANT — CHLORINATION SCRUBBING SYSTEM.
- D3# 15128 — PERMANENT ZIRCONIUM PLANT — ONE LINE DIAGRAM — EXTRACTION CONTROL AREA.

PERMANENT ZIRCONIUM PLANT, GENERAL PIPING LAYOUT