NOTICE

**CERTAIN DATA
CONTAINED IN THIS
DOCUMENT MAY BE
DIFFICULT TO READ
IN MICROFICHE
PRODUCTS.**

UNCLASSIFIED

(CLASSIFICATION)
HANFORD TECHNICAL RECORD
GENERAL ELECTRIC

HANFORD ATOMIC PRODUCTS OPERATION - RICHLAND, WASHINGTON

HW--60796

DE91 001396

DATE

July 17, 1959

THIS DOCUMENT CONTAINS RESTRICTED DATA AS
DEFINED IN THE ATOMIC ENERGY ACT OF 1954.
ITS TRANSMITTAL OR THE DISCLOSURE OF ITS
CONTENTS IN ANY MANNER BY AN UNAUTHORIZED
PERSON IS PROHIBITED.

TITLE

PROTOTYPE F-F6 DEMISTER INSTALLATION AT
PUREX FOR THE FUTURE SINGLE-STAGE RECOVERY
OF NITRIC ACID FROM HIGH-LEVEL WASTES -
DEFINITIVE DESIGN

☐ OTHER OFFICIAL CLASSIFIED INFORMATION

THIS MATERIAL CONTAINS INFORMATION AFFECTING
THE NATIONAL DEFENSE OF THE UNITED STATES
WITHIN THE MEANING OF THE ESPIONAGE LAWS,
TITLE 18, U. S. C., SECS. 793 AND 794, THE TRANSMISSION OR REVELATION OF WHICH IN ANY MANNER
TO AN UNAUTHORIZED PERSON IS PROHIBITED BY
LAW.

AUTHOR

L. R. Michels

ISSUING FILE

THIS DOCUMENT MUST NOT BE LEFT UNATTENDED OR WHERE AN UNAUTHORIZED PERSON MAY HAVE ACCESS
TO IT. WHEN NOT IN USE, IT MUST BE STORED IN AN APPROVED LOCKED REPOSITORY WITHIN AN APPROVED
GUARDED AREA. WHILE IT IS YOUR POSSESSION AND UNTIL YOU HAVE OBTAINED A SIGNED RECEIPT FROM
CLASSIFIED FILES, IT IS YOUR RESPONSIBILITY TO KEEP IT AND ITS CONTENTS WITHIN THE LIMITS OF
THIS PROJECT AND FROM ANY UNAUTHORIZED PERSON. ITS TRANSMITTAL TO, AND STORAGE AT YOUR PLACE
OF RESIDENCE IS PROHIBITED. IT IS NOT TO BE DUPLICATED. IF ADDITIONAL COPIES ARE REQUIRED,
OBTAIN THEM FROM THE RELATED ISSUING FILE. ALL PERSONS READING THIS DOCUMENT ARE REQUESTED
TO SIGN IN THE SPACE PROVIDED BELOW.

ROUTE TO:

PAYROLL NO.

LOCATION

FILES ROUTE
DATE

SIGNATURE AND DATE

B.M. DOBBE

12416

2716

JUL 27 1959

[Signature] 7/31/59

[Signature]

[Signature]

[Signature] 8-31

**RECORD
COPY**

Indefinite Retention

Disposal Date

Authority

Authority

C-3195-MS (7 - 53) A.E.C.-G.E.-RICHLAND, WASH.

UNCLASSIFIED

(CLASSIFICATION)

UNCLASSIFIED

HW-60796
Page 1

This Document Classified By:

[Signature]

This document consists of
23 pages. Copy 7 of
29 copies.

PROTOTYPE F-F6 DEMISTER INSTALLATION AT PUREX
FOR THE FUTURE SINGLE-STAGE RECOVERY OF NITRIC
ACID FROM HIGH-LEVEL WASTES
DEFINITIVE DESIGN

SPECIAL RE-REVIEW
FINAL DETERMINATION

Declassification Confirmed
By *[Signature]*
Re-Reviewed 3-5-81
Date
By: *[Signature]*
Re-Reviewed 3-5-81
Date

by

L. R. Michels

Extraction Design and Development
Facilities Engineering
Chemical Processing Department

CLASSIFICATION CAN BE LIFTED General Electric Company
Hanford Atomic Products Operation

Per DOC Map 1973

By B. Roberts 2/14/74

July 17, 1959

D I S T R I B U T I O N

1. CR Anderson	16. TG LaFollette
2. JM Blackburn	17. PR McMurray
3. LP Bupp	18. LR Michels
4. GK Carpenter	19. HC Rathvon
5. JR Cartmell	20. EL Reed
6. VR Cooper	21. HP Shaw
7. BM Dobbs	22. SG Smolen
8. E Doud	23. JH Warren
9. JB Fecht	24. JC Willi
10. RG Geier	25. LL Zahn
11. KG Grimm	26. 300 Files
12. ER Irish	27. Record Center
13. EM Johnston	28. Extra
14. CE Kent	29. Extra
15. PS Kingsley	

MASTER

DISTRIBUTION OF THIS DOCUMENT IS UNLIMITED
ps

UNCLASSIFIED

UNCLASSIFIED

HW-60796

Page 2

TABLE OF CONTENTS

	<u>Page</u>
Introduction	3
Summary	3
Phase I - Prototype Demister Design	4
Demister Process Criteria	5
A. Estimated Decontamination Requirements	5
B. Vendor Information on Demister Performance	6
C. Selection of Demister Wire	7
Table 1 - Demister Cost and Corrosion Data	9
1. Stainless Steel - Type 304 - Fully Annealed	8
2. Nionel	3
3. Titanium - Grade MS-T40	8
4. Zirconium	10
5. Tantalum	10
D. Demister Specifications	10
Phase I Costs	11
Phase II Design - Single-Stage Acid Recovery From Purex Wastes	12
Incentives for Development of the Phase II Single-Stage Process	12
Table II - Estimated Operating Cost Savings Through Bypassing of E-F11	13
Phase II Costs and Schedules	13
Other Phase II Alternates Considered	15
Alternate I	15
Alternate II	15
Alternate III	15
Acknowledgement	15

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

UNCLASSIFIED

HW-60796
Page 3

PROTOTYPE F-F6 DEMISTER INSTALLATION AT PUREX
FOR THE FUTURE SINGLE-STAGE RECOVERY OF NITRIC
ACID FROM HIGH-LEVEL WASTES
DEFINITIVE DESIGN

INTRODUCTION

At present, the Purex Plant employs a two-stage process for the recovery of nitric acid from high-level wastes. As shown in the attached Process Flow Sketch, H-2-57496, the HAW stream discharged from the HA Column is concentrated in the E-F11 Concentrator and condensed acid overheads from E-F11 are routed to the E-F6 Concentrator for the second stage of evaporation and decontamination. Recovered acid vapor from E-F6 is concentrated into a 50 weight percent recycle product through rectification in the In-Canyon Absorber, T-F5, and fractionation in the Vacuum Acid Fractionator, T-U6.

Recent experience has indicated the need for early improvements in Purex acid recovery - waste concentration techniques to reduce maintenance and operating expenses. While the conversion to a single-stage acid recovery process at Purex is extremely attractive from an economic standpoint, design cannot be finalized until additional information is made available on the performance of present equipment in a single-stage process.

SUMMARY

This report summarizes the results of a design study on the Phase I installation of a prototype demister (vapor filter) between the E-F6 Concentrator and the T-F5 Acid Absorber. Further, the results of an engineering study are presented on the feasibility of the subsequent Phase II bypassing of the E-F11 Concentrator and auxiliaries to permit single-stage acid recovery, once satisfactory performance of the Phase I prototype equipment has been demonstrated.

The over-all economic incentive for adoption of a single-stage acid recovery process at Purex is a potential direct operating cost savings of about \$200,000 per year through reduced steam consumption and reduced equipment corrosion. Other less-tangible incentives are discussed in a later section of this report.

Although the performance of the proposed Phase I equipment in the single-stage acid recovery process cannot be guaranteed at this time, vendor data on demister performance in similar types of systems provides a high degree of optimism for the eventual success of the single-stage process.

The cost of the Phase I prototype equipment, comprising the F-F6 Demister vessel packed with 6-mil tantalum wire mesh, the 16-inch diameter vapor jumper to T-F5 and the liquid drain jumper to E-F6 has been estimated at \$39,000. Barring unforeseen procurement and shop scheduling problems, the Phase I equipment would be ready for installation within three to four months after authorization.

UNCLASSIFIED

HW-60796

Page 4

The cost of the Phase II rerouting of process streams to permit single-stage acid recovery has been estimated at about \$61,000, including the cost of jumpers, a spare demister vessel, design and a 20 percent contingency. Beneficial use of the Phase II equipment could be obtained within 2 to 3 months after Phase II authorization. Since delivery of the spare demister vessel need not conform to the above schedule, the spare demister vessel could probably be procured off-site.

In recognition of the large incentive for the over-all Phase I - Phase II installation (6 months payout), the recommendation is made that the Phase I prototype equipment be fabricated, installed and tested as soon as possible.

In the event the Phase I prototype demister should fail to provide adequate decontamination of E-F6 overhead vapor to permit future Phase II single-stage acid recovery, it would appear desirable to retain the Phase I equipment in service. Under these conditions the demister should provide added acid decontamination in the present two-stage process, resulting in lower activity levels for the T-F5 Acid Absorber and T-U6 Vacuum Fractionator condensed overhead streams discharged to the 216-A5 Crib and the Purex Swamp, respectively. Lower activity levels in these streams are desired objectives of the long-range Waste Disposal Program of the Chemical Processing Department.

The benefits to be gained by the substitution of new tantalum demister pads for the present Raschig ring packing in the spare Purex concentrators should be evaluated following the Phase I demister tests. Replacement of present concentrator packing with tantalum wire mesh should result in future benefits when spare concentrators are placed in service, in reducing entrained acid, uranium solution and radioactive contamination in 1CU, 2EU and waste concentrator services.

Phase I Prototype Demister Design

The following drawings comprise the Phase I design:

- H-2-57494 - Engineering Flow Diagram
- H-2-57499 - Purex Prototype F-F6 Demister Vessel
- H-2-57497 - Vapor Jumper, F-F6-T-F5
- H-2-57498 - Jumper Assembly F-F6-E-F6("Z")
- H-2-57500 - Cell Arrangement - One-Line Diagram

As described in the above engineering flow diagram and the demister vessel drawing, the prototype F-F6 demister vessel would be mounted directly on top of the E-F6 Concentrator, making use of the supports and dowel pins normally reserved for the installation of a condenser. (The E-F6 Concentrator is the only standard Purex concentrator at present where overheads are not condensed.) The demister vessel would be 5'-0" in diameter by 6'-0" high with 16-inch diameter inlet and outlet remote flange connections. Class I construction would be employed. The tangential gas inlet which has been provided is necessary from vessel layout considerations; any process benefits derived from the creation of an inlet cyclonic effect would be minor in the subject application. The vessel would be insulated and sheathed.

UNCLASSIFIED

HW-60796
Page 5

The demister pad would be procured from the vendor as a complete assembly comprising a 6-inch thick Yorkmesh Type-326 pad constructed of 6-mil tantalum wire mesh (or equivalent), with bottom and top 304-L stainless steel support grids. The demister mesh assembly would be about 5'-0 $\frac{1}{2}$ " in diameter to permit a compression fit into the 5'-0" diameter vessel. Process aspects governing demister selection are discussed in a later section of this report.

Drawing H-2-57497 shows details of 16-inch diameter jumper required to route vapor from the new demister vessel to the present vapor inlet of the T-F5 Acid Absorber. The nozzle directly above the lower 16-inch remote flange would be provided for possible future measurement of demister pressure drop.

Drawing H-2-57498 shows details of the 2-inch diameter drain jumper with a 2-foot loop-seal for return of entrained liquid from the demister to the E-F6 concentrator.

The existing instrument jumper, H-2-54023, used to indicate the absolute pressure in the present vapor jumper, would be retained for measurement of gas pressure at the inlet side of the demister. However, piping within the P&O Gallery would be changed to permit use of this jumper for initial filling of the loop seal with water. In normal service, however, the jumper would be used for measurement of absolute pressure at the demister inlet and for the detection of buildup of liquid within the demister vessel should unanticipated plugging of the drain system occur. Draining of liquid from the demister vessel to the demister gas inlet duct is not considered advisable owing to the high vapor velocity (about 100 -150 feet per second) and the possibility of re-entraining the liquid back into the vapor stream.

A 3-inch spare nozzle has been provided at the top of the demister for possible future service in the spray washdown of the demister pad.

Drawing H-2-57500 shows the over-all assembly of the demister vessel and supporting jumpers within F-Cell.

Demister Process Criteria

A. Estimated Decontamination Requirements

The present over-all decontamination factor for the two-stage acid recovery process between E-F11-1 bottoms (1WW) and T-F5 bottoms acid ranges between 5×10^5 and 1×10^6 . The activity of recovered acid from T-F5 normally varies from 500 to 1,000 micro curies per gallon, although acid activity has risen to 10,000 microcuries per gallon on process upset.

Owing to the absence of samplers between the E-F11 and the E-F6 concentrators, the relative performance of each concentrator in the decontamination of recovered acid cannot be assigned precisely. However, in a two-stage evaporation process, with identical equipment in each stage, the first stage would usually be expected to provide a considerably higher decontamination factor than the

UNCLASSIFIED

HW-60796

Page 6

second. For purposes of establishing demister criteria, however, it was assumed conservatively that each concentrator at present provides a d.f. of about 1×10^3 . On this basis, the substitution of a demister for a concentrator would establish the minimum required demister decontamination factor at 1×10^3 , in order not to exceed an activity level of 1,000 microcuries per gallon in recovered acid. The objectives of the CPD long-range waste disposal program would imply that in the future recovered acid should contain less than 1,000 microcuries per gallon.

The recent sampling of the 2WW stream (E-F6 Bottoms) by Purex Technology at the end of a Purex campaign indicates that a demister d.f. of only 55 would be required, since it was observed that the larger share of the over-all acid decontamination was obtained in the primary concentrator, E-F11.

B. Vendor Information On Demister Performance

A demister provides decontamination through the removal of entrained liquid droplets from the vapor stream. Information supplied by a vendor (References 1 and 2) indicates that demister performance is a function of entering droplet size, gas velocity, wire diameter, wire mesh bulk density, and demister pad thickness. The Yorkmesh style 421 demister employs 11 mil wire and the style 326 employs 6 mil wire. For a 4-inch thickness of the 421 mesh, an entrainment separation efficiency of better than 99.9 weight percent (10^3 d.f.) can be obtained when entering particles are 10 microns in size or larger. In the range of 5 to 10 microns, the efficiency falls to about 95 percent while for particles less than 5 microns, efficiency falls off rapidly. The style 326 mesh for the same 4-inch pad thickness would be expected to provide improved separation by a factor of about 2 over the 421 mesh. The vendor has estimated that the particles discharged from the Raschig ring section of a Purex concentrator in the subject service are above 10 microns in size (Reference 3) and therefore 99.9 + weight percent removal of particles can be obtained. Within the velocity range of 3 to 14 feet per second, demister separation efficiency appears to be independent of vapor velocity.

In Reference 1, the vendor cites actual demister performance data in the evaporation of boiler feed-water with a concentration of 4,000 to 6,000 ppm total dissolved solids in the bottoms. A demister employing a 4-inch thickness of

- -- -- --
- (1) Letter, EW Poppele, Otto H. York Company to LR Michels, "Concentrator Demister," dated March 5, 1959.
 - (2) York, Otto H., "Performance of Wire Mesh Demisters" Chemical Engineering Progress, August 1954.
 - (3) Letter, EW Poppele, Otto H. York Company, to LR Michels, "Concentrator Demister," dated April 20, 1959.

UNCLASSIFIED

HW-60796
Page 7

style 421 mesh produced a condensate of 0.09 ppm (5.5×10^4 d.f.), as contrasted to 0.04 ppm (1.25×10^5 d.f.) for a 4-inch thickness of the 326 mesh. A 10-inch thickness of 326 mesh reduced solids in the above tests to less than 0.02 ppm for a d.f. of better than 2.5×10^5 . In these tests the demister pad was installed directly above the boiling liquid and no other deentrainment devices were employed between the boiling liquid and the demister pad.

Since decontamination is achieved through the mechanism of removal of entrained droplets, the demister would have negligible benefit in removal of volatile fission products such as ruthenium tetroxide or volatile halogens.

C. Selection of Demister Wire

In view of the required decontamination performance, defined above, only 11 and 6 mil wire can be considered for construction for the demister pad. Whereas, a corrosion rate of say 5 mils per year is considered excellent for canyon vessels, the above rate would result in a 10-mil per year reduction in diameter for demister wire and less than one year's service life would result. In order to secure a minimum demister service life of say 3 years, demister wire must be selected with a corrosion rate, as determined by weight loss, not to exceed about 0.4 mils per year for the 6-mil wire and about 1 mil per year for the 11-mil wire. The minimum 3 year service life arises from a consideration of the need to replace the demister vessel itself, at a cost of \$10,000, not including the cost of the demister pad, whenever corrosion failure of the pad occurs.

In operation, the demister would be exposed to vapor and entrained liquid particles resulting from the evaporation of the Purex 1WW stream, which has the following approximate composition at the present time:

<u>Composition</u>	<u>Concentration, Mols Per Liter</u>
Nitric Acid	6.2
Sodium Nitrate	0.4
Ferric Sulfate	0.3 (includes Cr and Ni)
Sulfuric Acid (free)	0.4
Phosphoric Acid	0.01
Chloride	Trace
Fission Products (mixed)	0.05

While the vapor itself contains only 0.87 mols per liter of nitric acid (equivalent basis), the entrained droplets would have a composition approaching that of the 1WW stream given above. The demister would operate at a temperature of about 230 degrees Fahrenheit and a pressure of about 14.3 PSIA.

Only a limited number of materials can be considered to meet the above stringent requirements and unfortunately many of these materials are quite expensive when woven into fine demister wire mesh.

UNCLASSIFIED

HW-60796
Page 8

The following materials were considered for the demister wire mesh: 1) stainless steel, type 304, fully annealed; 2) nionel; 3) titanium, grade MS-T-40; 4) zirconium; and 5) tantalum.

The results of corrosion tests (References 4 and 5) performed by the Hanford Laboratories Operation on samples of demister wire furnished by a vendor are presented in Table I along with preliminary costs of the respective demister pads. The purpose of the corrosion testing was to arrive at the optimum demister material, by a process of elimination, and therefore corrosion data in Table I are not complete. In some instances, the corrosion rates appeared to be more a function of manufacturing procedures used in the drawing of fine wires rather than characteristic of the basic metals themselves. The following comments on the various demister wire samples are therefore limited specifically to the samples furnished by the vendor.

1. Stainless Steel - Type 304 - Fully Annealed

The observed rate of attack of the vendor's 6-mil wire in vapor from boiling nitric acid, both with and without the presence of sulfuric acid, is in excess of the desired rate of 0.03 mils per month (0.4 mils per year). Further, type 304 stainless steel, in the presence of nitric acid and traces of sulfate, suffers from intergranular attack. In the early stages of corrosion testing, little weight loss is usually experienced, but as testing proceeds, discrete grains are sloughed from the surface, leading to accelerated corrosion rates, as determined by measurement of weight loss. Although the cost of the 304 demister pad is low, the use of 304 fully annealed wire cannot be recommended for the subject application.

2. Nionel

Nionel has been considered as a material of construction for the demister because of its known resistance to sulfuric acid. However, a test coupon of nionel metal exposed in vapor from boiling synthetic 1WW (Solution III) showed a corrosion rate of about 3 mils/month. This rate precludes further consideration of nionel in the subject application.

3. Titanium - Grade MS-T40

Samples of vendor's 6 and 11 mil titanium wire, as received, were characterized by heavy black oxide coatings, which were formed as a result of wire drawing operations. Initial corrosion tests (44 hour duration) reflected increased rates attributed to dissolution of this coating.

(4) Letter, LR Michels to PS Kingsley, "Demister Pad for E-F6 Purex Concentrator," dated April 21, 1959.

(5) Letter, WL Walker to LR Michels, "F-6 Demister Pad," dated June 5, 1959.

DECLASSIFIED

TABLE I - DEMISTER COST AND CORROSION DATA (1)

Material	Stainless Steel 304 Fully Annealed	Stainless Steel 304-L	Titanium MS-T40	Titanium MS-T40
Time	421	20	421	326
Demister Construction Designation	11	20	11	6
Wire Diameter, Mils				
Relative Properties of Wire Strength	Excellent	Excellent	Good	Fair
Appearance	Bright	Bright	Black Oxide Coating	Black Oxide Coating
Resistance to Burning	Excellent	Excellent	Ignites (3)	Ignites (3)
Demister Pad Cost (4)	\$ 375	\$ 890	\$3,600	\$ 6,700
(5)-0" Diameter x 6" Thick Variable wire diameter				
Corrosion Rates - Mils/Month (6)	Mils/Mo	Mils/Mo	Mils/Mo	Mils/Mo
Wire Samples Exposed in Vapor From Boiling (230° F) Solutions of Following Compositions:	Hours	Hours	Hours	Hours
Solution I (7)				
6.2 M HNO ₃	0.1	48	0.01	66
	0.1	72 (7)	0.02	48
	0.1	65	0.02	48
			0.01	72
			0.05	48
Solution II				
6.2 M HNO ₃	0.30	24	0.07	44
0.4 M H ₂ SO ₄	0.05	72	0.03	24
0.5 M H ₂ SO ₄	0.12	44		
	0.01	24		
Solution III (Synthetic LMD)				
6.2 M HNO ₃	0.2	96	0.3(10)	72
0.4 M H ₂ SO ₄				
0.3 M Fe ₂ (SO ₄) ₃				
0.4 M NaNO ₂				
0.01 M H ₂ PO ₄				

Notes:

- (1) Demister quotations and demister wire samples furnished by Otto H. York Co., Inc.
- (2) Sample furnished by HLO Corrosion Lab.
- (3) Burns with an intense white flame after being ignited with a match.
- (4) Approximate costs, less cost of 304-L stainless steel support grid.
- (5) Vendor unable to find another supplier for 6 mil zirconium wire. Only 11 mil wire presently available in zirconium for demister application.
- (6) Rates calculated from weight loss. Multiply rates in Table by 2 to obtain reduction in wire diameter in mils/month.
- (7) Boiling of solution occurred during corrosion testing.
- (8) Measured by micrometer.
- (9) Test performed with 1/8" thick niobium sheet.
- (10) This test performed with 1/16" titanium weld rod.

84-40796
 Page 9

<u>Zirconium</u>	<u>Miconal</u>	<u>Zantal</u>
326	326	326
5 (8)	6	5 (8)
Poor	-	Excellent
Bright	-	Bright
Ignites (3)	-	Excellent
No quote (5)	\$2,100	\$20,800

<u>Hours</u>	<u>Mils/Mo. Hours</u>	<u>Mils/Mo. Hours</u>
--------------	-----------------------	-----------------------

0.03	94	0.01	94
<0.01	48	<0.01	48
	(2)		
	3.4 (9)		72

UNCLASSIFIED

HW-60796
Page 10

The titanium wire appeared to be satisfactory for service in HNO_3 vapor in the absence of sulfate. However, the use of titanium wire cannot be recommended owing to a) the high corrosion rates in the presence of sulfate, and b) the tendency for 6-mil titanium wire to ignite in air when exposed to a flame. Ignition might occur accidentally when the demister pad assembly was being welded into the demister vessel.

The observed rate of 0.3 mils/month for titanium weld rod exposed to vapor at 230°F from synthetic 1WW solution indicates that corrosion allowances of the order of 4 to 10 mils per year should be provided for titanium process equipment (reboilers, etc.) in handling boiling 1WW solution.

4. Zirconium

From a resistance to corrosion standpoint only, the 5 mil zirconium wire was satisfactory. However, the use of zirconium is not recommended for the following reasons:

- a. The wire is no longer available in a 5 or 6 mil diameter. Only 11 mil wire is currently available.
- b. The 5 mil wire has poor mechanical strength.
- c. The 5 mil wire ignites easily and burns with an intense white flame.

However, as a result of the above HLO corrosion results, it is suggested that zirconium be considered seriously as a material of construction for other applications where high resistance to nitric and sulfuric acids is desired and where heavier zirconium sections can be employed.

5. Tantalum

Tantalum is essentially immune to attack in the subject application, has high mechanical strength and does not appear to support combustion. A demister constructed of 6 mil tantalum wire should have a service life far in excess of 5 years. Despite its high cost, tantalum is obviously the best (and only) material currently available for the subject service and its use is recommended.

D. Demister Specifications

The demister pad was sized to handle the present E-F11 Concentrator vapor load at a Purex 4.0 capacity factor. Under these conditions 34,200 pounds total vapor per hour, containing 5 weight percent HNO_3 and 95 weight percent water vapor must be handled. The corresponding flow rate at 230°F and

UNCLASSIFIED

HW-60796

Page 11

14.3 PSIA would be about 276 cubic feet per second. In order to limit the superficial vapor velocity to 14 feet per second, the maximum velocity at which the demister deentrainment potentialities can be realized, 19.6 square feet of demister cross section would be required, resulting in a 5'-0" diameter unit. In sizing the demister for 4.0 C.F., excess capacity would be available to handle possible concentrator vapor surges under present operation.

The selection of demister pad thickness and wire diameter is dictated by uncertainties noted above on required decontamination performance, the estimated \$204,000 per year operating cost savings for the proposed single-stage process, the cost of demister pads as a function of wire diameter, and the need to reduce activity in the T-F5 and the T-U6 condensed overhead streams compatible with the long-range Waste Disposal Program. A conservative approach dictated in general that a minimum wire diameter and a maximum thickness of demister pad be used. On this basis it is recommended that a 6-inch thickness of 6 mil tantalum wire (style 326) be employed.

In tantalum, 6 mil wire is the minimum diameter of wire which can be drawn uniformly and woven into a demister. Increasing pad thickness above 6-inches would provide only minor additional decontamination. On the premise that particles entering the demister are above 10 microns in size, a demister decontamination factor above 10^3 should be realized for radioactive contamination entrained in liquid droplets.

Pressure drop through the demister pad should be of the order of 1-inch of water at 4.0 capacity factor.

Phase I Costs

The costs associated with the Phase I prototype demister installation, as estimated by Construction Engineering and Utilities, are as follows:

	<u>Total Cost</u>	
	<u>Labor</u>	<u>Materials</u>
Demister		
Vessel	\$ 5,500	\$ 4,400
Pad (6" thick - 6 mil Ta)	-	20,900
Total Demister	\$ 5,500	\$25,300
16" Vapor Jumper	900	4,100
2" Drain Jumper	400	700
Cold Side Piping	200	100
Radiograph Welds	-	1,000
Handling to Job Site	400	-
Total	\$ 7,400	\$31,200
Total Phase I Costs (Round-Off)	\$39,000	

UNCLASSIFIED

HW-60796
Page 12

Phase II Design - Single-Stage Acid Recovery From Purex Wastes

The following drawings comprise the Phase II engineering study:

H-2-57496 - Process Flow Sketches - Purex Prototype F-F6 Demister

H-2-57495 - Engineering Flow Diagram - Future Routings to Bypass
E-F11 Concentrator

As noted in the Process Flow Sketch (drawing H-2-57496), it is proposed that single-stage acid recovery be accomplished, following demonstration of the F-F6 demister performance, by the bypassing of the E-F11 concentrator and by interchange of the functions of tanks TK-F7 and TK-F12.

New jumpers and routings required for Phase II are delineated in the Engineering Flow Diagram, H-2-57495. In interchanging the functions of TK-F7 and TK-F12, pumps P-F7 and P-F12 must be interchanged, and the present steam-jet jumper on TK-F12 must be relocated to TK-F7.

Nozzle GG, the overflow nozzle provided originally on Concentrator E-F6, has been damaged and is presently blanked. Modification of the gasket design of the female connector for GG for the original overflow jumper to TK-F7 should be attempted to assure leak-tight service for Phase II. In the event a leak-tight jumper cannot be developed for this routing, it may be necessary to use the present E-F11 Concentrator in the F6 position and repair nozzle GG of E-F6 in the hot shop, following concentrator decontamination.

In H-2-57495, a new overflow routing has been provided to direct process condensate from the 3WB Concentrator (E-H4-2) to TK-F12. At present, 3WB overflows are discharged to the 216-A5 Crib, following neutralization with calcium carbonate. While the routing of E-H4 overflows to TK-F12 is not required under Phase II to develop the single-stage acid recovery process, the E-H4 overflows would serve as a substitute for the present dilution water added to the waste concentrator. Advantages would be derived through increased acid recovery, a reduction in calcium carbonate consumption, and a reduction in flow to the 216-A5 Crib.

As shown in H-2-57495, nine new jumpers are required for development of the single-stage process and two additional jumpers are needed to route E-H4 overflows to TK-F12, for a Phase II total of 11 new jumpers.

Incentives for Development of the Phase II Single-Stage Process

The future Phase II bypassing of a Purex concentrator in acid recovery service would permit major economies in operation of the Purex Plant. From an operating cost standpoint, the bypassing of E-F11 would permit tangible savings in direct operating costs of about \$204,000 per year at a Purex capacity of 2.5 C.F.

UNCLASSIFIED

HW-60796
Page 13

TABLE II

ESTIMATED OPERATING COST SAVINGS THROUGH BYPASSING OF E-F11

<u>Item</u>	<u>Annual Savings</u>	
	<u>Units/Year</u>	<u>Dollars/Year</u>
Reboiler Steam	175 MM lb.	\$100,000*
Condenser Raw Water	356 MM Gal.	-
Reboiler Replacement	1.2 Reboilers	54,000
Concentrator Replacement	0.2 Concentrators	50,000
Total		\$204,000

*Coal Cost Only

Further, the present E-F11 (or E-F6) Concentrator, the E-F11-2 Condenser, the two stainless steel reboilers plus about 25 jumpers would become available as spare equipment for E-F6 or other Purex concentrator services. Present E-F11 and E-F6 stainless steel reboilers have an average service life of only about 21 months each. The bypassing of E-F11 would not only free two reboilers for service as spares, but would ease the present tight procurement problem with respect to new spare reboilers. In addition, present concern for the integrity of steam piping-in-concrete at the E-F11 position would be reduced. Maintenance on the E-F11 steam traps within Trap Pit #2 would be eliminated.

While an operating cost credit cannot be assigned for savings in raw water, the bypassing of E-F11 would reduce Purex water consumption by about 940 gallons per minute, thus reducing future concern with respect to Purex raw-water supply.

From the standpoint of immediate and long-range waste disposal, the elimination of E-F11 would provide a reduction of about 940 gallons per minute in cooling water disposal and a reduction of about 55 gallons per minute in flow of steam condensate to the 216-A6 Crib. The 216-A6 Crib is currently operated at close to its maximum capacity. The advantages from the rerouting of E-H4 overheads to E-F6 to reduce the flow of process condensate to the 216-A5 Crib have been discussed.

Phase II Costs and Schedules

It would appear desirable to perform the Phase II bypassing of E-F11 in two separate steps following satisfactory demonstration of the Phase I prototype demister equipment. Costs and schedules for the various work items of Phases IIA and IIB are as follows.

UNCLASSIFIED

HW-60796
Page 14

PHASE IIA

	<u>Total Cost</u>		
	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
Fabrication of 11 new jumpers	\$4,400	\$7,700	\$12,100
Fabrication of Burial Box for 8 old jumpers	400	450	950
Cold side modifications	200	100	300
Handling to Job Site	<u>400</u>	<u>-</u>	<u>400</u>
Semi-Total	\$5,400	\$8,350	\$13,750
Contingency at 20%			2,750
Design			<u>4,000</u>
Total			\$20,500

*Check for Burial Box
for 8 old jumpers
included*

Phase IIA beneficial use is estimated within 2 to 3 months following Phase IIA authorization.

PHASE IIB

	<u>Total Cost</u>		
	<u>Labor</u>	<u>Materials</u>	<u>Total</u>
Procurement of Spare Demister Vessel	\$5,500	\$25,300	\$31,800
Modification of Graphic Panel Board	<u>1,300</u>	<u>50</u>	<u>1,350</u>
Semi-Total	\$6,800	\$25,350	\$33,150
Contingency at 20%			6,630
"As-Built" Design Revisions			<u>300</u>
Total			\$40,080

From a scheduling standpoint, completion of the items of Phase IIB would not be considered critical. The spare demister vessel above could probably be procured off-site.

UNCLASSIFIED

HW-60796
Page 15

The total Phase II cost, the summation of Phase IIA and IIB costs, is about \$61,000.

Other Phase II Alternates Considered

Several alternates were considered for the rerouting of Purex streams to achieve single-stage recovery of nitric acid from high-level wastes. Alternates considered and reasons for rejection were as follows.

Alternate I

Alternate I would entail installation of the demister vessel on top of the present E-F11 concentrator, in place of the E-F11-2 condenser. Present routings for process solutions could be maintained intact. This alternate was discarded owing to the difficulty of routing decontaminated vapor from the E-F11 position to the Acid Absorber, T-F5.

Alternate II

Alternate II would involve installation of the demister on top of E-F6, the pumping of LWF from TK-F7 to E-F6 rather than to E-F11 as at present, and the overflow of LWW from E-F6 directly into TK-F12. This alternate is attractive since fewer jumpers would be required for the single-stage process. However, only two alternate routings, Headers #7706 and #7707, are potentially available for the routing of LWW from E-F6 to TK-F12 by gravity flow. Unfortunately, wall nozzles for both headers are at an elevation about 1-foot higher than the concentrator overflow nozzle. Use of either header would necessitate operating the reboilers of the E-F6 Concentrator with at least 1-foot greater submergence than at present or development of a steam jet to lift boiling LWW solution to the desired elevation. Neither alternate appeared desirable, in competition with Alternate III.

Alternate III

Alternate III, which involves installation of the demister on top of E-F6 and interchange of the functions of Tanks TK-F7 and TK-F12 (this proposal), is recommended as the most desirable alternate.

Acknowledgement

H. C. Rathvon of Purex Technology suggested many of the routings incorporated into H-2-57495 for the single-stage acid recovery process.

UNCLASSIFIED

HW-60796
Page 16

W. L. Walker of HLO Corrosion Laboratory performed the corrosion tests on demister wire. The Otto H. York Company, Inc., provided cost information on demister pads and supplied samples of demister wire for corrosion testing. J. C. Willi of Construction Engineering and Utilities performed the mechanical design of the demister vessel and jumpers.

L.R. Michels

Extraction Design and Development
Facilities Engineering
CHEMICAL PROCESSING DEPARTMENT

LR Michels bp

TABLE I

<u>Material</u>	<u>Stainless Steel 304 Fully Annealed</u>	<u>Stainless Steel 304 Fully Annealed</u>	<u>Stainless Steel 304-L</u> (2)	<u>Titanium MS-T40</u>
<u>Demister Construction Designation</u>	421	326	-	421
<u>Wire Diameter, Mils</u>	11	6	20	11
<u>Relative Properties of Wire:</u>				
Strength	Excellent	Excellent	Excellent	Good
Appearance	Bright	Bright	Bright	Black Oxide
Resistance to Burning	Excellent	Excellent	Excellent	Ignites (3)
Demister Pad Cost (4) (5'-0" Diameter x 6" Thick Variable wire diameter)	\$ 375	\$ 850	-	\$3,600
<u>Corrosion Rates - Mils/Month</u> (6)	<u>Mils/Mo</u> <u>Hours</u>	<u>Mils/Mo</u> <u>Hours</u>	<u>Mils/Mo</u> <u>Hours</u>	<u>Mils/Mo</u>
Wire Samples Exposed in Vapor From Boiling (230° F) Solutions of Following Compositions:				
<u>Solution I</u> (7) 6.2 M HNO ₃	0.1 48 0.1 72 0.1 65	0.2 48 0.1 72 (7) 0.3 65	0.01 66 0.02 48 0.02 48 0.01 72 0.05 48	0.20 0.01 0.02 0.02 0.04 0.02 0.05
<u>Solution II</u> 6.2 M HNO ₃ 0.5 M H ₂ SO ₄	0.30 24 0.05 72 0.12 44 0.01 24	0.12 48 0.08 72 0.06 44 0.04 24		0.07 0.03
<u>Solution III (Synthetic LWd)</u> 6.2 M HNO ₃ 0.4 M H ₂ SO ₄ 0.3 M Fe ₂ (SO ₄) ₃ 0.4 M Na NO ₃ 0.01 M H ₃ PO ₄	0.2 96	0.3 96		(2) 0.3(10)

Notes:

- (1) Demister quotations and demister wire samples furnished by Ctto H. York Co., Inc.
- (2) Sample furnished by HLO Corrosion Lab.
- (3) Burns with an intense white flame after being ignited with a match.
- (4) Approximate costs, less cost of 304-L stainless steel support grid.
- (5) Vendor unable to find another supplier for 6 mil zirconium wire. Only 11 mil wire presently available in zirconium for demister application.
- (6) Rates calculated from weight loss. Multiply rates in Table by 2 to obtain reduction in wire diameter in mils/month.
- (7) Bumping of solution occurred during corrosion testing.
- (8) Measured by micrometer.
- (9) Test performed with 1/8" thick nickel sheet.
- (10) This test performed with 1/16" titanium weld rod.

UNCLASSIFIED

HW-60796
Page 9

- DEMISTER CCST AND CORROSION DATA (1)

	Titanium MS-T40	Zirconium	Zirconium	Niobium	Tantalum
	326	421	326	326	326
	6	11	5 (8)	6	5 (8)
Coating	Fair Black Oxide Coating Ignites (3)	- - -	Poor Bright Ignites (3)	- - -	Excellent Bright Excellent
	\$ 6,700	\$15,800	No quote (5)	\$2,100	\$20,800
ours	Mils/Mo. Hours	Mils/Mo. Hours	Mils/Mo. Hours	Mils/Mo. Hours	Mils/Mo. Hours
4		Wire			
8		Sample			
2		Not			
8		Available			
8					
2	0.54 44				
4	0.20 72				
	0.10 48				
	0.50 72				
	0.44 48				
2	0.22 94		0.03 94	3.4 (2) 72	0.01 94
	0.16 48		<0.01 48		<0.01 48

PRESENT MAJOR ROUTING

PROPOSED MAJOR ROUTING
CONCENTRATION

HW-60796

PAGE 17

INGS-2-CYCLE CONVERSION

LEGEND

- NEW ROUTINGS
- EXISTING ROUTINGS

SINGLE STAGE WASTE WITH F-F6 DEMISTER

APPROVED

NO.	DESCRIPTION	REV.	DATE	APPROVED BY	DATE
	REVISIONS				
CLASSIFICATION		DATE			
NONE		DATE 2-17-57			
H-2-57496		H-2-57496			
SCALE: NONE		APPROVALS			
DRAWN AND CHECKED BY: [Signature]		DATE: [Date]			
CHECKED BY: [Signature]		DATE: [Date]			
NO. 10-1014		DATE: [Date]			
U. S. ATOMIC ENERGY COMMISSION					
HANFORD ATOMIC PRODUCTS OPERATION					
GENERAL ELECTRIC					
PROCESS FLOW SKETCHES					
PUREX PROTOTYPE					
F-F6 DEMISTER					
NO. 202-4		NO. 7000			
H-2-57496		H-2-57496			

U.S. 37496	REV. FUTURE ROUTINGS
H-2-57496	REV. PROTOTYPE F-F6 DEMISTER
NO.	DATE
NO.	DATE
NO.	DATE

E O GALLERY

FUTURE PRESSURE TAP
AND DEMISTER D.P.

EQ55-16" M21-P

E-F5
CONDENSER

TO 216-A3 CRIB

ACID TO VACUUM FRACTIONATOR
VIA TK-F5

T-F5

HNO₃ FRACTIONATOR

GENERAL NOTES

1. DEMISTER VESSEL (NEW)
5'-0" 10 X 6'-0" HIGH
PACKING - TANTALUM WIRE MESH
6" DEPTH - YORKMESH TYPE - 326 - 6 MIL
TANTALUM WIRE MESH OR EQUAL.
2. LIQUID DRAIN JUMPER (NEW)
PROVIDE 2'-0" LOOP SEAL

LEGEND

- NEW (HEAVY)
- - - EXISTING (LIGHT)

APPROVED

H-2-57500	2" CELL ARRANGEMENT, 1 LINE DIA.
H-2-57499	2" DEMISTER
H-2-57498	JUMPER F-F6-PG(2)
H-2-57497	JUMPER F-F6-F5
H-2-57496	P.D. PUREX F-F6 DEMISTER
H-2-57495	E.R.D. FUTURE ROUTING, F-F6 DEMIS.
H-2-57494	PERFORMANCE EVALUATION

NO.	DESCRIPTION	REV.	DATE	APP'D.	FOR	DATE
	REVISIONS					
	CLASSIFICATION					
	NONE					
	H-2-57494					
	SCALE: NONE					
	DESIGNED BY: H-2-57494					
	CHECKED BY: H-2-57494					
	DATE: H-2-57494					
	APPROVAL					
	DO-1014					
	U. S. ATOMIC ENERGY COMMISSION					
	HANFORD ATOMIC PRODUCTS OPERATION					
	GENERAL ELECTRIC					
	ENGINEERING FLOW DIA.					
	PUREX PROTOTYPE					
	F-F6 DEMISTER					
	202-A					
	7001					
	H-2-57494

HW-60796
PAGE 19

WELL - DARTY POINT

WELL
5.

6'-11 1/2\"/>

NOTATIONS					
F	G	H	J		
Q	R	S	T	U	V

SECTION A-A
SCALE: 1/4\"/>

DETAIL II

GEN. NOTES

1. MATERIALS & CONSTRUCTION TO CONFORM TO HWS-5796. ALL STAINLESS STEEL TO BE TYPE 304 L, CORROSION PASSED. RADIOGRAPH OF WELDS IS NOT REQUIRED.
2. A HYDROSTATIC TEST SHALL BE PERFORMED WITH A 12'-0\"/>

APPROVED

QTY.	IN.	DESCRIPTION	MAT'L	REMARKS
X	1	ASSEMBLY		
1	2	16" UPPER REMOTE FLANGE	SST	H-2-52755
1	3	16" SCH. 10 PIPE	SST	
1	4	16" 90° 3R ELL. SCH. 10	SST	
1	5	3" WAY VERT. MALE CONN.	SST	H-2-52800
1	6	KICK PLATE 2"	SST	H-2-30600
2	7	R 22" X 10" X 1/2"	SST	
2	8	R 14" X 2" X 1/2"	SST	
1	9	16" LOWER REMOTE FLANGE	SST	H-2-52801
1	10	2" SCH. 40 PIPE	SST	
W/1	11	DEMISTER TOP 1/2 BTH & 1/2" THK.	SST	
1	12	2" HORIZ. MALE CONN.	SST	H-2-52700
10	13	6 W 15.5	CST	
12	14	PAD R 8" X B" X 1/2"	SST	DET. I
1	15	FOOTPAD R 12" X 12" X 3"	SST	SEE PLAN
1	16	DEMISTER PAD ASSEMBLY		SEE NOTE 6
1	17	PA - R 8" X 4" X 1/2"	SST	
1	18	6" 7" SMM STOCK 3" TOTAL THICKNESS	C.BT.	
1	19	GAUGE RING H-2-52632		DET. #6
1	20	GASKET H-2-52631		DET. #6
5	21	GAUGE RING RET. SCREW		H-2-52630
1	22	FOOTWAD R 9 1/2" X 11 1/2" X 1/2"	SST	SEE PLAN
2	23	2" DIA. ROD - 6" LONG	C.SF.	DET. I
5 H. 24	24	1/2" PLATE	C.ST	DET. I
1	25	DEMISTER SIDEWALL R 1/2" THK.	SST	
1	26	2" THK. OWENS-CORNING KAYLO		SEE NOTE 9
12	27	2" SCH. 40 PIPE	SST	SEE ASSY
1	28	1" THK. OWENS-CORNING KALO		SEE NOTE 9
1	29	20GA (1/32" SMT) INSULATION JACKET	SST	SEE NOTE 4
1	30	SHORT DOWEL	SST	H-4-57333
2	31	R 9" X 8" X 1/2"	SST	
1	32	3" VERT. MALE CONN.	SST	H-2-52801
30	33	BAR 1/2" X 1" X 5"	SST	
3	34	STUD	SST	H-2-52806

REVISIONS		REV. NO.	DATE	BY	CHKD.
NONE					
CLASSIFIED BY		CLASSIFIED BY			
H-2-57499		DATE 6-17-79			
SCALE:		APPROVAL			
DESIGNED BY		CHECKED BY			
DATE 6-17-79		DATE 6-17-79			
DRAWN BY		DATE 6-17-79			
INSTR. BY		DATE 6-17-79			
PROJECT NO. DO-1014		PROJECT TITLE PUREX PROTOTYPE			
U.S. ATOMIC ENERGY COMMISSION		F-F6 DEMISTER			
HANFORD ATOMIC PRODUCTS OPERATION		VESSEL			
GENERAL ELECTRIC		SCALE 202A			
H-2-57499		DATE 6-17-79

HW-60796
PAGE 20

KEY PLAN

DETAIL I

QTY.	AS	DESCRIPTION	MATL.	REMARKS
X	1	ASSEMBLY		
2	2	16" UPPER REMOTE FLANGE	SST	H-2-57497
22'	3	16" SCH. 10 PIPE	SST	
2	4	16" SCH. 10 90° 3R ELBOW	SST	
1	5	16" SCH. 10 90° LR ELBOW	SST	
1	6	LIFTING BAIL	CST.	H-2-3249
1	7	R 16" x 16" x 1/2"	SST	DET. I
1	8	R 13" x 7" x 1/2"	CST.	DET. I
2	9	BRACES 6 W 8 2" 1'-6" LONG	CST.	DET. I
1	10	R 13" x 2" x 1/2"	CST.	DET. I
AS REQD.	11	1 1/2" INSULATION OWENS CORNING, KAYLO		SEE NOTE 2
AS REQD.	12	20 GA. R. 304L	SST	SEE NOTE 2
2	13	GAUGE RING 4-2-52632		DET. 6
2	14	GASKET H-2-52631		DET. 6
2	15	GAUGE RING RET. SCREW		H-2-52630
1	16	2" 3WAY VERT. MALE CONN.		H-2-52781
1	17	KICK PLATE	SST	H-2-30600
2'	18	1/2" SCH. 40	SST	
2	19	GUSSETS 12" x 12" x 1/2"	SST	SEC. D-B

AS BUILT DIMENSION LIST										
JUMPER IDENTIFICATION NUMBER	INSTALLATION DWG. NO.	CELL	LINE NO.	DIMENSIONS						
				A	B	C	D	E	F	G
F-F6-F5	H-2-55510	F								
				T	U	K	L			

GENERAL NOTES

- MATERIALS & CONSTRUCTION TO CONFORM TO HANFORD STD. SPEC. HW 5 5736. PIPING MATERIALS TO BE 304L, CORROSION PASSED. RADIOGRAPH OF WELDS IS REQUIRED.
- JUMPER TO BE INSULATED WITH 1 1/2" KAYLO # 20 GA. SST. IN ACCORDANCE WITH SPECIFICATION HW-5503, REF. 1.

APPROVED

REVISIONS		REV. NO.	DATE	BY	DATE
NONE					
CLASSIFIED BY		H-2-57497			
SCALE: 1"=1'-0"		APPROVALS			
DESIGNED BY		CHECKED BY			
DRAWN BY		DATE			
REVISIONS		DATE			
U.S. ATOMIC ENERGY COMMISSION		GENERAL ELECTRIC			
VAPOR JUMPER		F-F6-T-F5			
DUREX PROTOTYPE F-F6 DEMISTER		H-2-57497

HW-60796

PAGE 2-1

QTY.	IN	DESCRIPTION	
X	1	JUMPER ASSEMBLY	
1	2	2" 3JAW TYPE CONN. HORIZ	H-2-52700
1	3	3" 3JAW TYPE CONN. VERT.	H-2-52916
13	4	2" SCH. 40 PIPE	SST.
3	5	2" 90° LR ELBOW	
1	6	2" 180° RETURN	
1	7	3" X 2" CONC. REDUCER	
1	8	2" PIPE CLAMP	H-2-5356
1	9	LIFTING BAIL	H-2-3245
1	10	1/4" X 2" X 2 1/2" BAR	SST.
1	11	1/4" X 2" X 1 1/2" BAR	SST.
1	12	ST. 4" L. 5.2 X 8" LONG	C. STL.
2	13	1/4" X 2" X 2" BAR	SST.
346	14	3" SCH. 40 PIPE	C. STL.
123	15	LEAD	

GENERAL NOTES

1. MATERIAL FABRICATION & TESTING SHALL BE AS PER HANFORD STD. SPEC. HWS 5736 REV. 1.
2. TEST @ 200 PSIG HYDROSTATICALLY.

JUMPER DATA

JUMPER IDENTIFICATION	INSTALLATION DWG. NO.	CELL	LINE NO.	EQUIP CONN.	EQUIP CONN.	AS-BUILT DIMENSION	A	B	C
F-F6-F6(Z)	H-2-53510	F			"Z"				

APPROVED

NO.		DESCRIPTION		REV BY	APPRO BY	FOR	DATE
		REVISIONS					
		CLASSIFICATION		CLASSIFIED BY			
		NONE		DATE 6-17-77			
H-2-57498						0	
SCALE: NONE		APPROVALS					
DRAWN BY: G. WOOD		DATE: 6-17-77					
CHECKED BY: DATE							
ISSUED BY: DATE							
DISC. ENG. DATE							
INSTR. NO.							
PROJECT NO. DO-1014							
U. S. ATOMIC ENERGY COMMISSION HANFORD ATOMIC PRODUCTS OPERATION GENERAL ELECTRIC							
JUMPER ASSEMBLY F-F6-F6("Z")							
REV. 202-A		ECS 8405					
H-2-57498							

NO.	DWG. NO.	DRAWING TITLE
		REFERENCE DRAWINGS
		NEXT USED ON H-2-53510

FOR DESIGN FOR CONSTRUCTION

[illegible]

- END -

DATE FILMED

11 / 26 / 90