NOTICE

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

UNCLASSIFIED

HW--55455

DE92 004561

This document classified by

Gle L. Zahn, Jr.

REVISED DEFINITIVE PROCESS DESIGN
"E" METAL DISSOLVING EQUIPMENT
REDOX FACILITY

By

W. A. Graf

March 31, 1958

Due to film deterioration,
portions of this document
may be illegible. *PXL-11-91*

Extraction Design & Development
Facilities Engineering Operation
CHEMICAL PROCESSING DEPARTMENT
General Electric Company - Hanford Atomic Products Operation

MASTER

DISTRIBUTION RESTRICTED TO U.S. ONLY
YR

UNCLASSIFIED

DISTRIBUTION

1. R. G. Barnes
2. O. F. Beaulieu
3. C. R. Bergdahl
4. L. P. Bupp
5. B. F. Campbell
6. V. R. Chapman
7. V. R. Cooper
8. J. B. Fecht
9. W. F. Garetson
10. R. G. Geier
11. W. A. Graf
12. K. G. Grimm
13. C. T. Groswith
14. D. R. Gustavson
15. M. K. Harmon
16. O. F. Hill
- 17-22. C. E. Kent
23. G. P. Kesel
24. N. Ketzlach
25. T. G. LaFollette
26. C. A. Lyneis
27. W. K. MacCready
28. P. E. L. Nussbaum
29. A. M. Platt
30. E. L. Reed
31. H. P. Shaw
32. J. J. Shefcik
33. R. H. Silletto
34. A. B. Snyder
35. R. E. Tomlinson/W. G. Browne
36. J. H. Warren
- 37-38. L. L. Zahn
39. Record Copy
40. 300 File

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

REVISED DEFINITIVE PROCESS DESIGN
E-METAL DISSOLVER EQUIPMENT
REDOX FACILITY

I. INTRODUCTION

Since the original definitive process design for E-metal dissolvers (Reference 1) was issued on September 30, 1957, several programs affecting dissolving equipment and capacity have been studied. These include:

1. Processing of enriched material of uranium²³⁵ content up to 1.25%.
2. Processing of the new production reactor fuels.
3. Reprocessing of low enrichment fuels from non-production reactors.

While considering these programs it became clear that new dissolver equipment should be designed to provide the maximum processing flexibility within the limits of space and established production capabilities.

II. PURPOSE

The purpose of this report is to present the revised process design to be used as the basis for the detail design of Redox dissolvers each of which shall meet the following:

- a. Process irradiated natural uranium slugs (standard Hanford or I&E type) at 43% of Phase II Redox production rates.
- b. Process irradiated enriched uranium up to .94% U²³⁵ isotopic content in slugs (standard Hanford or I&E type) at rates up to 43% of Phase II capacity.
- c. Process irradiated fuel elements of cluster design from new reactors with cladding material of aluminum or zirconium, enrichments to .94% U²³⁵ and dimensions of ten feet long and 10 inches square.

This report is also to form the basis for slug distribution tests to be performed by HLO concurrent with the final design effort.

III. SUMMARY

It is proposed that new dissolvers of the type indicated on SK-2-7180 and SK-2-7181 be installed in Cell A and Cell B of the Redox Plant. These dissolvers are designed to meet the processing requirements, as stated and will be equipped with new downdraft type towers. No spare equipment will be purchased at this time, since one unit, when operating full time at peak capacity, will carry the full E-metal load as forecast. The second installed unit provides the necessary spare functions, as well as providing flexibility of operation and scheduling.

In addition to the dissolver vessels and towers, approximately 55 jumpers must be fabricated which include eight liquid transfer jets and two air bleed valves.

The project is estimated to cost \$600,000 and is scheduled for physical completion 17 months after construction authorization. A beneficial-use target data for the first installation is October 1, 1958, with the second scheduled to reach this point about 15 months after construction authorization.

IV. DESCRIPTION OF WORK

The installation of the new dissolver equipment in the Redox Facility will require three main phases of work.

A. Fabrication

1. Two new dissolvers and accessories, as indicated, on SK-2-7180 and SK-2-7181 must be fabricated.
2. Two new downdraft type dissolver towers similar to H-2-30478 must be fabricated. These units must have remotely removable flange gaskets.
3. Approximately 55 remote process jumpers must be fabricated and prepared for installation.

B. Cell Preparation

The new dissolver installations are scheduled for cells A and B to simplify design and fabrication, since these cells are essentially identical. However, Cell C will be altered to make use of the downdraft dissolver tower unit now operating in Cell A. To accomplish this the present C Cell dissolver tower should be removed and replaced by the present A Cell unit. The original C Cell jumpers should be replaced and C-cell placed in operation.

The dissolver tanks and attached jumpers from Cells A and B, the dissolver tower from Cell B should be removed from the cell and disposed of or salvaged as radiation levels permit. The Cell C dissolver tower should also be included in the disposal program.

C. Installation

The new dissolvers, towers, and associated jumpers, as indicated of SK-2-7179 will be installed in Cells A and B. These installations should be accomplished with minimum interference with normal building operation. While cell equipment is being installed, miscellaneous service area re-arrangement may be performed including, in each cell, relocation of two gang-valves, relocation of tower coil controls and differential pressure connections, installation of new weight factor instruments and water addition for the dissolver seals, and installation of manual control for the air bleed valve.

V. DESCRIPTION OF EQUIPMENT

A. The Dissolver Tank

The revised dissolver design, as shown on SK-2-7180 and SK-2-7181 is an adaptation of the annulus concept presented in Reference 1. The

advantage of the revised design is that it permits direct access to the entire slug crib thereby permitting charging of both bulk dumped material and fuel rod assemblies so prevalent in recent reactor designs.

These dissolvers are designed to have a 12 ton capacity for conventional Hanford type fuel elements of either irradiated natural uranium or enriched metal up to .94% U^{235} in a geometric configuration which assures nuclear-safety throughout the operating cycle. This unit as designed will process fuel elements of the specified enrichment range with physical dimensions up to ten feet in length and ten inches square. The crib capacity under these circumstances is dependent on the fuel element design and charging and packaging methods; therefore no estimate of crib capacity has been attempted.

The dissolver design meets all the process criteria as established in Reference 2 except that the normal operating level (slug cover for normal charge) is 1200 gallons rather than the 1000 gallons specified. In addition, processing variations have been considered which may permit the dissolution of zirconium clad fuel element using the Zirflex Process. This flexibility is important since many of the alternate fuel element for the NPR Project being sought for Hanford construction are of zirconium cladding with other specifications falling within the range of these dissolvers.

Specific vessel data of operating significance are:

<u>Description</u>	<u>Liquid Capacity Gallons</u>	<u>Liquid Height Above Tank Bottom - Inches</u>
Minimum Operating Level	500	30
Normal Operating Level (Liquid covers standard charge)	1200	72
Maximum Operating Level	1500	83
Overflow Invert	2470	114

The vessel freeboard at maximum operating level is approximately two feet seven inches or 970 gallons and the vapor space above the liquid at this level is three feet three inches.

The vessel coil is designed to provide the required heating and cooling services required at various stages of the process cycle. The total heat transfer area is 200 square feet all of which is submerged at the minimum operating level.

The charging chute cover is provided with a water seal to prevent excessive air leakage. This system is new to Hanford dissolvers and should minimize uncontrolled air inleakage. Since some air is needed for proper operation of the system, a bleed valve similar to the Purex dissolver system is installed with the valve operable from a manual loading station

on the operating panel. The loading station should be located to permit observation of the system differential pressure instruments during adjustment of the air bleed rate.

Nuclear considerations require that a neutron moderator and absorber be placed in the hollow portion under the tank. Details of this unit are as yet incomplete, however, the design is expected to be basically a hollow stainless steel cylinder enclosing a thin layer of cadmium or boron compound plus a thicker layer of either masonite or graphite depending on the nuclear properties. Water would be satisfactory for this moderation and absorption function; however, the instrumentation associated with liquid vessels and the temperature and boil-off problem favor solid materials.

The dissolving equipment should be designed in accordance with HW-5796, Rev. 1 and fabricated of 304L stainless steel. Some external portions not exposed to highly corrosive media may be carbon steel coated with Amercoat 55 or approved equal. All internal permanent piping below the maximum operating level except the coil should be schedule 80 pipe.

The dissolver is normally expected to operate in the range of minus three to six inches of water pressure. The water seal on the charging opening lid should be designed to seal from plus six inches to minus twelve inches of water. This seal then establishes the working pressure limits for the vessel.

The charging opening lid must be designed to remain in place by gravity at the plus six inches of water internal pressure. The seal pot on the overflow line is installed to limit air leakage and is not for pressure control. Therefore, the seal pot may be designed with convenient dimensions except that under no circumstances should this seal break before the lid seal.

B. Dissolver Tower

The two new dissolver towers should be designed and fabricated in accordance with drawing H-2-30563 and shall be provided with a remotely replaceable type flange gasket. This unit is identical with the existing spare tower and interchangeable with other Redox dissolver towers. Detailed design may dictate that some special nut extension may be required to assure impact wrench clearance or visibility for the new arrangement.

VI. COST AND TIMING

The original project proposal document, Reference 3, indicated the urgent need for the E-metal dissolvers, and this urgency still exists for early completion of at least one complete installation. Present schedules call for completion of the first installation by October 1, 1958, with the second unit ready 15 months after construction authorization and physical completion at 17 months after construction authorization. The overall project cost is estimated to be \$600,000.

VII. REFERENCES

1. HW-52845, "Definitive Process Design - E-Metal Dissolving Equipment - Redox Facility" by WA Graf dated September 30, 1957.
2. HW-51683, "Redox E-Metal Dissolvers - Process Design Criteria", by RG Barnes dated July 27, 1957.
3. HW-52036, "Project Proposal - E-Metal Dissolvers - Redox (Project CG-772)" by RH Silletto dated August 27, 1957.

Extraction Design & Development
Facilities Engineering
CHEMICAL PROCESSING DEPARTMENT

WA Graf:gmw

APPROVED
FOR DESIGN
NOT FOR CONSTRUCTION

PLAN VIEW

ELEVATION

SCOPE

1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18		19		20		21		22		23		24		25		26		27		28		29		30		31		32		33		34		35		36		37		38		39		40		41		42		43		44		45		46		47		48		49		50		51		52		53		54		55		56		57		58		59		60		61		62		63		64		65		66		67		68		69		70		71		72		73		74		75		76		77		78		79		80		81		82		83		84		85		86		87		88		89		90		91		92		93		94		95		96		97		98		99		100																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39										40										41										42										43										44										45										46										47										48										49										50										51										52										53										54										55										56										57										58										59										60										61										62										63										64										65										66										67										68										69										70										71										72										73										74										75										76										77										78										79										80										81										82										83										84										85										86										87										88										89										90										91										92										93										94										95										96										97										98										99										100									
1										2										3										4										5										6										7										8										9										10										11										12										13										14										15										16										17										18										19										20										21										22										23										24										25										26										27										28										29										30										31										32										33										34										35										36										37										38										39																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																											

GENERAL NOTES

1. ALL MATERIAL TO BE DOW L 351.
2. FOR LISTING YOURS SEE N-3-9607 ALLY 2.

SCOPE

[illegible]

REV	DATE	BY	CHKD	DESCRIPTION
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				
21				
22				
23				
24				
25				
26				
27				
28				
29				
30				
31				
32				
33				
34				
35				
36				
37				
38				
39				
40				
41				
42				
43				
44				
45				
46				
47				
48				
49				
50				
51				
52				
53				
54				
55				
56				
57				
58				
59				
60				
61				
62				
63				
64				
65				
66				
67				
68				
69				
70				
71				
72				
73				
74				
75				
76				
77				
78				
79				
80				
81				
82				
83				
84				
85				
86				
87				
88				
89				
90				
91				
92				
93				
94				
95				
96				
97				
98				
99				
100				

HW-55455
PAGE 11

GENERAL NOTES

1. ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE NOTED.
2. ALL DIMENSIONS TO FACE UNLESS NOTED OTHERWISE.
3. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
4. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
5. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
6. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
7. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
8. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
9. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.
10. ALL DIMENSIONS TO CENTERLINE UNLESS NOTED OTHERWISE.

APPROVED
FOR RELEASE
NOT FOR CONSTRUCTION

DETAIL I H-2-30563

END

DATE
FILMED
2105192

I