HDC-2094

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15. Extra

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March 31, 1951

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DESIGN STUDY GEO-14

SEGREGATION OF REDOX & TBP UO₂ PRODUCTION

Revised March 29, 1951

Prepared by:

J. O. Ludlow

Approved:

J. M. Frame
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MASTER

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DESIGN STUDY GEO-14
SEGREGATION OF REDOX & TEP UO₃ PRODUCTION

INTRODUCTION:

Authorization has been received in the form of Modification No. 5 to Directive HW-158, dated March 23, 1951 to provide the necessary equipment and piping in the currently planned UO₃ plant to permit the segregation of UO₃ arising from the processing of stored metal waste (TEP) from that arising from "current" pile operation (Redox).

In anticipation of this, the "S" Division, Manufacturing Divisions, requested in a letter C. N. Gross to W. E. Johnson, dated January 18, 1951, that a study be made of the feasibility and cost of providing facilities for such segregation.

This report is the result of that study as revised by Disposition of Comments, J. M. Frame to File, dated March 16, 1951.

CONCLUSIONS:

By providing additional liquid storage and handling equipment, the desired segregation can be accomplished at a cost estimated to be approximately \$128,000. \$106,500 would be for Construction and \$21,500 for Engineering. The schedule for this work will be reflected in the forthcoming modification to the C-361 Project Proposal.

The general method of operation is alternately to store and process solution from TEP and Redox. The solution from TEP will be of a composition equivalent to the formula UNH and will require five days each week to process in the decomposition pots. The solution from Redox is received as 60% UNH and is batch concentrated in the storage tank to between 80 and 100% UNH, depending on stability. This solution will be processed in the decomposition pots in two days.

EQUIPMENT DESCRIPTION:

The equipment and piping is shown on SK-2-682, Sheets 1 and 2 (copies attached).

The evaporators in 224-U Building, operating on TEP material only, at ten tons of Uranium per day, will produce 41,935 pounds of UNH melt per twenty-four hour day. The Redox facilities, operating at 3 1/8 tons Uranium per day, will produce 21,808 pounds of 60% UNH (40% H₂O) solution per day. Seven days Redox solution will be batch concentrated in five days to a composition equivalent to 80-100% UNH, depending on stability.

Since the UNH Solution produced in seven days by the Redox Facilities required two days to be processed in the pot room, at least seven thousand gallons minimum storage must be provided for TEP UNH Melt. An eight foot diameter by thirty foot tank will provide 11,280 gallons capacity. This is a standard size tank and will provide adequate leeway in scheduling of operations. Using the same tank size for storage of Redox Solution will allow a maximum of seven days storage, based on dilute volume.

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In order to improve segregation of the two materials being processed in the same pots, facilities must be provided for dissolving and disposing of encrusted UO_3 as required. A small acid header is to be installed around the pot room. Acid will be provided from Tank TK-C-4 (Project C-362). Flexible tube outlets adjacent to each pair of pots allows the acid to be added to any pot desired. In order to receive and dispose of the dissolved material, a four foot by five foot surplus tank TK-X-20 will be installed outside the E cell door of Building 224-U. Appropriate valving and a steam jet J-1 are provided to aspirate dissolved material through the header and discharge into TK-X-20. Tank TK-X-20 will be vented to Tank TK-X-19 - the TBP UNH melt storage tank. A liquid discharge jet - J-2 - is installed in Tank TK-X-20, and a three valve manifold used to route the solution to Tanks TK-X-18, TK-X-19, or to the X1-X2 inlet manifold.

As some material will be held up in the solids handling system at the time of change-over, it may be necessary to recycle the first portion of oxide (a pot full, perhaps).

Coils are provided in Tanks TK-X-18 and TK-X-19; those in TK-X-19 to keep the melt fluid, and those in TK-X-18, in addition, for batch concentration (controlled by a temperature controller, with a limiting orifice and control valve in the steam line). Remotely operated interlocked valves are used on the TK-X-18 vapor line, one connecting to the TK-X-1-X-2 vent header, and one to a line allowing the boil-off to be conducted to either T-B4 or T-D4 (one or the other). TK-X-19 is vented to the X-1 - X-2 vent header.

Pump P-X-18 located in the Redox storage tank TK-X-18 pumps UNH solution through the existing recirculation header with outlets at each decomposition pot and returns the excess to TK-X-18. Pump P-X-19, located in the TBP Melt storage tank TK-X-19, pumps through the recirculation header and returns the excess to TK-X-19. Remotely operated interlocked valves will be used to insure routing from and to the proper tank. Pump P-C-1 is left as now connected, thus allowing TK-C-1 to be pumped through the recirculation header and the excess returned to TK-C-1. Manual valves will be used in this application. Pumps P-X-18 and P-X-19 will have bypasses installed to allow circulation of the tank contents. Circulation rate will be controlled by a flow limiting orifice in the discharge to the salt loop header and a throttling valve in the circulating line. A pressure indicator should be installed in the pump discharge for proper regulation of the circulating throttling valve. Present pitch of the salt loop header and the proposed location of TK-X-18 and 19 are such that the salt loop header and the connecting lines will drain to TK-18 and/or TK-19. Steam addition through a small reducing valve will be provided at the high point of the salt loop in the pot room for back flushing these lines.

The service required of pumps P-X-18 and P-X-19 is intermittent, since each pump will be in operation 2 or 5 days per week at a nominal rate of 100 gpm. At the time of changing from Redox material to TBP material, it is necessary that pump P-X-18 and the piping connected to it completely drain. These same requirements must be met by pump P-X-19 after it is operated. These requirements can best be met by using a submerged type pump located directly in the tank. In order to utilize TK-X-19 for storage of TBP material, it is necessary to install an additional pump from TK-C-1 to this storage tank. Since this is a batch transfer operation - frequency once a day - and good drainability is required, a submerged type pump of 100 gpm capacity is recommended for this service. It is recommended that pumps P-X-18, P-X-19, and P-C-1-2 be made identical.

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A revision request has been submitted and accepted by the Scope Committee altering Project C-361 to allow additional gas cooling and condensing load in the gas cooler EA-2.

The fume line and gas absorber (TA-1) will be adequate to handle the loads without change.

The instrumentation necessary for the new storage system consists of weight factor indicators in each of the new storage tanks, a two pen temperature recorder with a temperature element in each storage tank - temperature element in TK-X-18 will control the steam rate to the boil off coil - ammeter and motor control for the new pumps, and valve operators for the remotely operated interlocked valves on the liquid and vent lines. There will be manual control of the steam to the heating coil on TK-X-19.

The instrumentation necessary for TK-X-20 consists of locally mounted weight factor indicator and temperature indicator.

DECOMPOSITION POT CYCLES

In the following it has been assumed that the 180 minute decomposition period, as set up by Mallinckrodt, must be maintained even though all indications are that this decomposition period can be shortened and still produce material satisfactory for use at K-25. The cooling and unloading cycle has been maintained at 105 minutes as set up during the original scoping of Project C-361. Latest information from Mallinckrodt on time required for unloading the pots is that the entire operation can be handled easily in less than 60 minutes. The longer cycle times will be used in each case in order to present a conservative picture of the probable operation of the decomposition pots.

The pot cycle, when operating on UN melt from TBP, is calculated to be as follows:

(1) Charge decomposition pots with 50 gallons of UNH melt from TK-X-19 via the circulation header -	15 minutes
(2) Turn on heaters and concentrate to preset temperature - equivalent to a composition of UN - 1 H ₂ O -	143 minutes
(3) Reduce heat and decompose the charge -	180 minutes
(4) Turn off heaters, cool, open loading port, and unload the pot -	<u>105 minutes</u>

The total time per cycle is -

7 hours, 23 minutes

It will require an average of approximately 15.5 batches of this size per pot to handle one week's production of the TBP plant, or an average time per week of 4 days, 18 hours, and 18 minutes. An even number of batches per week can be attained by slightly increasing the loading per pot if desired, or 15 batches per pot can be run one week and 16 batches per pot the following week.

The pot cycle, when operating on Redox material, is calculated to be as follows:

(1) Charge decomposition pots with UNH solution from TK-X-18 via the circulation header -	15 minutes
(2) Turn on heaters and concentrate to preset temperature - equivalent to a composition of UN - 1 H ₂ O -	143 minutes

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- (3) Reduce heat and decompose the charge - 180 minutes
- (4) Turn off heaters, cool, open loading port, and unload the pot - 105 minutes

The total time per cycle is - 7 hours, 23 minutes

If 80% UNH solution is produced in TK-X-18, pots will be charged with 58 gallons of solution and 462 lbs. per pot of UO_3 will be produced. Operating in this fashion 6.3 batches per pot are required to process one week's Redox production. Average time required per week is 46 hours, 31 minutes. Six batches per pot can be used for two weeks and for the third week, seven batches per pot.

If 80% UNH is used as above, the total free time of the pot room per week is 7 hours, 11 minutes. This is in addition to the 20% down time available in each type of operation above for maintenance.

If 100% UNH is produced in TK-X-18, pots will be charged with 50 gallons of solution and 600 lbs. of UO_3 per charge produced. These are the same figures as used during the TEP operation.

It will require 4.33 batches per pot operating on 100% UNH to handle one week's Redox production, or an average time per week of 35 hours, 40 minutes. In order to arrive at an even number of batches per pot per week, 5 batches can be used for 4 weeks and 4 batches for one week.

If 100% UNH is used during the Redox operation as above, the total free time in the pot room per week is 17 hours and 38 minutes. Again this is in addition to the 20% maintenance allowance.

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Use 3/4
Cross 4
of line

BLDG 224-U

CELL "E"

CELL "D"

See Enlarged View

CELL "C"

Connect Vent in
Transition Piece

TD-4

TK-C-3

TK-C-2

P-CI-12

TK-C-1

100
El
To

Conn
Trans

4" Vent P-100

2" P-100

2" P-100

Use Double End Single
Cross Arm For Support
of Lines.

2" P-100

3" P-100

Insulate & Str Trace
All Outside Lines

Slope All Outside
Lines To TK-X18 & X19

4" P-100

25 G. W. Flow Limit Orifice in

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CELL B

CELL A

100 GPM Pump P-CI-2
Electric Control For P-CPE
To Be on UO₃ Panel

Connect Vent in
Transition Piece

TB-4

W 73279.44

N 38133.61

13410.44

5

CELL "D"

CELL "C"

CELL "C"

250
P-X.

1000 #/Hr. Flow Limit Orifice

Steam Heating Coil - Control on L
120 Ft 2" Sch 40 Pipe Coil.
Condensate From Coil To Drain

3 EU /
20 L-S

PLOT PLAN

Scale 1" = 10'

ther f

2016

Funer

NT Connect
Vent Header

1/2 TK-X2 Manifold

ELDG 203-U

W 73210.44
N 38075.71

N 38075.71

11 13410.44

CELL "D"

3EU or XS-UNH To
Circulating Loop from
TK-X18 or TK-X19
3EU From Circulating
Loop to Storage TK-X18
or XS-UNH From Circulating
Loop to Storage TK-X19

CL

D

1005

1005

D"

3EU From Circulating Loop To Storage

XS-UNH From Circula Loop To Storage

SECTION A-A

Scale 1" = 10'

From Circulating
Storage

NEW Storage Easin

4

CELL D

Scale $\frac{1}{2}'' = 1'$

XS-UNH-
Th-CI To

GENERAL NOTES

1. Acid Lines To Be 347 or 304 ELC
2. Steam Supply & Condensate Black Iron
3. All Lines & Equipment in Contact With Molten Salt or Vapors From Molten Salt To Be 309 Ssb
4. Pumps P-CI-2, P-XIB & P-XI9 To Be 100 G.P.M.

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477. 13548 3-21-51

H-2-41099	Structural Bldg. 203-U
H-2-50054	Piping Arrgt Cell "C" Plan
H-2-2960 SH. 19W-56	
DWG. NO.	TITLE
REFERENCE DRAWINGS	

NO.

S

DR.

CHI

ENC

PRC

BLD

NO'S

Scale $\frac{1}{2}'' = 10'$

C
Iron
With Molten Salt
ge 3095cb
- 100 G.P.M.

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FIER

47. 13541 € 5-21-51

7-203-U
11 "C" Plan

TITLE

CE DRAWINGS

BLDG. NO'S. 35 D

DWG. NO. 5K-2-682 SHT 1

SCALE: AS NOTED

DRAWN BY *J. L. MacBrinn 2-1-51*

CHECKED BY

DATE _____

DATE _____

BY

DEPT.

DATE _____

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PRELIMINARY

NOT APPROVED FOR CONSTRUCTION

ENG. REP. NO.

PROJECT NO. GEO-14

GENERAL ELECTRIC CO. HANFORD WORKS

ADDITIONAL EQUIPMENT
& PIPING FOR UO_3 SEGREGATION.

1006 $\frac{1}{2}$ " IPS P-100

PE-2

FE-3

FE-4

FE-

Vacuum Line T. Th. XRO
& Acid Filling Line

PE-5

PE-6

PE-7

2 T. TH. X20 1" I.P.S F-100
ing Line

PE-8

PE-9

PE-10

PE-11

PE-12

PE-13

Pitch Vacuum Hrs. Towers

1" Vacuum Line
& Acid Filling Line

TOWERS TH-X 20

PE-14

PE-15

PE-16

Vacuum Line 1" I.P.S. P-100
& Acid Filling Line

PE-16

PE-17

PE-18

1" I.P.S. - P-100

Vacuum Line To Tk: X20
& Acid Filling Line

Line 1" I.P.S. P-100
Filling Line

FE-18

0

1" Y
ξ A

1" Vacuum Line
& Acid Filling Line

Line 1006

Vacuum Line 1" I.P.S.
& Acid Filling Line

G1.5F801

PE-4

TYPICAL ELEVA

ELEVATION

ne 1" I.P.S F-100
ling Line

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BLDG. NO'S. 3

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