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SUBJECT: THOREX PILOT PLANT: Decontamination of the Feed
Adjustment System and Radiation Exposures Received by
Personnel Engaged in Modifying a Vapor Line in the System
TO: F. L. Culler

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1.0 INTRODUCTION

During volume reduction and acid boil-off of unadjusted feed solution for run HD-15, the feed adjustment tank (S-2) pressurized at an evaporation rate of 25 liters per hour. The acid vapors from the feed adjustment tank passed through a 3-in. line to the acid fractionator (S-9), entering S-9 into a void between two sections packed with Raschig rings.

In order to inspect the vapor line and the packing supports and to modify the vapor line, the equipment was decontaminated and the line was removed. Only two cubicles required decontamination, the S-2 cubicle, which contains the S-2 tank, and the N-1 cubicle, which contains the acid fractionator, the extraction column, a phase separator for the extraction column aqueous waste stream, and a surge tank for the aqueous waste stream.

This work was begun after run HD-15 hot feed solution had exhausted and was done along with shutdown operations.

2.0 SUMMARY

Ten days were required to alter the S-2 to S-9 vapor line, eight days for decontamination and two days to remove the shielding blocks from the front of the cubicles, remove the line, replace the line, and close the cubicles.

The internal surfaces of the feed adjustment tank were decontaminated easily in seven treatments with 30% nitric acid and five treatments with 20% sodium hydroxide--2% sodium tartrate. A large open-top container which contained S-2 tank was more difficult to decontaminate because the jet for emptying the container had plugged. It was necessary to syphon the container to the cell sump. After five nitric acid treatments and four caustic-tartrate treatments in the container, the radiation background in S-2 cubicle was 300 mr/hr, allowing a working time of 20 min.

The feed tank (S-4), acid fractionator (S-9), extraction column (N-1), and aqueous waste surge tank (N-5) were decontaminated to 35 min working time in N-1 cubicle. The feed tank required three acid and two caustic-tartrate treatments (100 liters each). The acid fractionator required two treatments, each, of acid and caustic-tartrate (400 liters each), and the extraction column and waste surge tank required four acid treatments (300 liters each) and two caustic-tartrate treatments (300 liters each). The phase separator was shielded with lead, reducing the radiation level from 11,000 to 500 mr/hr.

Eleven maintenance personnel worked in the cell a total of 74 man-hr. The total exposure received on this job, measured with film badges, was 1,715 mr (PTR), giving an average dosage rate of 23 mr/hr.

3.0 EQUIPMENT DECONTAMINATION

3.1 Feed Adjustment Tank, S-2

Decontamination of S-2 tank was started at 2200 on January 16, 1956. The tank was rinsed with 100 liters of water for 30 min, and analysis of this solution indicated 2.84×10^4 U²³³ alpha cts/min/ml. The rinse was jetted to the dissolver tank, and the uranium was recovered after processing was resumed.

The internal surfaces of the tank were easily decontaminated by use of the internal jet recirculation system. Seven treatments with 30% nitric acid and five treatments with 20% caustic--2% sodium tartrate were given to the tank (five treatments with each solution would have been sufficient, Table 3-1).

The cubicle was sprayed four times, twice with 30% nitric acid, once with caustic-tartrate solution and once with water.

During the last five internal treatments given to S-2 tank, the radiation level remained at about 750 mr/hr at 3 in. from the side of the tank because

of contamination held up between the outer wall of the tank jacket and a large open-top container, or outer shell, in which S-2 tank was contained.

After five 30% nitric acid treatments and four caustic-tartrate treatments, with steam on the tank jacket, the background in the cubicle was 300 mr/hr, allowing a working time of 20 min.

Table 3-1

S-2 Decontamination

Solution	Volume, liters	Contact Time, hr	Radiation at Side of Tank, mr/hr
Acid ^a	670	0.5	-
Caustic-tartrate ^b	700	0.5	-
Acid	670	1	-
Caustic-tartrate	700	1	-
Acid	670	1	-
Caustic-tartrate	700	1	-
Acid	670	1	-
Acid	670	1	750
Caustic-tartrate	700	1	725
Acid	670	1	725
Caustic-tartrate	700	1	760
Acid	670	1	750

^a 30% nitric acid

^b 20% sodium hydroxide--2% sodium tartrate

3.2 Acid Fractionator, S-9

The solution in S-9 was jetted to the miscellaneous waste tank, N-16, and then S-9 was rinsed with 100 gal of water. The fractionator was decontaminated from a beginning radiation level of 2,000 mr/hr to 110 mr/hr (measurements made at the top of S-9) by two treatments with caustic-tartrate solution, two acid treatments and one water rinse (Table 3-2).

About 200 liters of each batch of solution was allowed to flow to S-9 from the roof through the quick-disconnect panel to fill the reboiler and lower portion of S-9. The steam was turned on the S-9 jacket, the airlift from S-9 to the recovered acid tank, S-5, was turned on, and the fractionator was operated at total reflux. An additional 200 liters of each batch of solution was allowed to flow to S-9 at a slow rate so as not to overflow to S-2 tank.

Table 3-2

S-9 Decontamination

Solution	Volume, liters	Contact Time, hr	Radiation Level, mr/hr
Caustic-tartrate ^a	400	1	-
Acid ^b	400	1	300
Caustic-tartrate	400	1	110
Acid	400	1	140
Water	380	c	110

^a 20% sodium hydroxide--2% sodium tartrate.

^b 30% nitric acid.

^c Transfer jet was on during addition.

3.3 Feed Tank, S-4

The decontamination of S-4 consisted of three 30% nitric acid treatments of 100 liters each, and two 20% sodium hydroxide--2% sodium tartrate treatments of 100 liters each. The solutions were made up in the decontamination solution makeup tanks on the roof and dropped to S-4 through the quick-disconnect panel. The solutions were pumped by the feed pump from S-4 tank to the extraction column feed pot, N-9, overflowing back to S-4. The S-4 decontamination jet was turned on and the solutions were recirculated at 85°C. During the first acid wash, a sample bottle was placed on the S-4 sampler and a sample was recirculated for 1 hr. Each of the three feed points was opened for 15 min, and the solution was pumped through these valves and lines to A-column.

Samples taken of the first acid wash contained less than 10^4 U²³³ alpha cts/min/ml. After 5 treatments with the decontamination solutions, the samples showed only 75 cts/min/ml.

3.4 Extraction Column and Aqueous Waste Catch Tank, N-5

At the start of decontamination, the radiation from the extraction column cubicle was 3,000 mr/hr at the cubicle entrance. After four acid and two caustic-tartrate treatments, the radiation was 770 mr/hr (Table 3-3).

The solutions were prepared in the decontamination solution makeup tanks on the roof and allowed to flow to the column through the quick-disconnect panel. Each treatment was pulsed for 1 hr in the column and allowed to flow to N-5 tank in which the solution was jet recirculated for 1 hr. The column was flushed with water by pumping from the IAX, M-13, head tank and by running water through the pulse leg.

Lead shielding was installed around the phase separator, N-11, in the cubicle, reducing the radiation from 11,000 to 500 mr/hr.

Table 3-3.

Extraction Column and Aqueous Waste Holdup Tank Decontamination

Solution	Volume, liters	Contact Time, hr	Radiation Level, mr/hr
Start	-	-	3,000
Acid ^b	300	1	-
Caustic-tartrate ^c	300	1	850
Acid	300	1	800
Caustic-tartrate	300	1	800
Acid	300	1	770
Acid	300	1	-

^a Measurements were taken at block wall enclosing the front of the cubicle.

^b 30% nitric acid.

^c 20% sodium hydroxide--2% sodium tartrate.

4.0 RADIATION EXPOSURE RECEIVED DURING REPAIR

Eleven maintenance personnel worked in S-2 and N-1 cubicles, a total of 74 hr, receiving a total of 1,715 mr on their film badges (PTR). The average exposure rate was 23 mr/hr. During this time the following jobs were accomplished:

1. S-2 cubicle facing of concrete block was opened.
2. The S-2 to S-9 vapor line was removed and Raschig rings were scooped out of the bottom packing in S-9 so that about 1 in. of space was left between the top of the bottom bed and the vapor inlet line.
3. N-1 cubicle was opened and the phase separator was shielded with lead.
4. The vapor line was rerouted and an inverted jackleg with two flush lines was installed.
5. Both cubicles were sealed.

Table 4-1

Exposures Received by Personnel Engaged in
Modification of the S-2 to S-9 Vapor Line

Period of January 20-27			
No. ^a	Craft	Time in Area, hr	Exposure, ^b mr (PTR)
9	Pipefitter	23.5	395
27	Pipefitter	27.0	415
28	Welder	8.0	245
42	Millwright	1.0	95
78	Lead Burner	0.5	65
79	Lead Burner	0.5	65
81	Millwright	1.0	115
85	Welder	8.0	0
101	Laborer	2.0	175
102	Laborer	2.0	145
103	Laborer	0.5	0
Totals		75.0	1,715

^a Each person is identified by a number.

^b Measured with film badges. Each craftsman was issued a special film badge which he wore only while working on this job. The badges were returned each day after completion of work in the cell.