DEC 20 1994

ENGINEERING DATA TRANSMITTAL

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1	1	Cog. Eng. R. L. Watser	<i>[Signature]</i>	12/9/94		Central Files (2)	<i>[Signature]</i>	12-04		3	
1	1	Cog. Mgr. D. G. Harlow	<i>[Signature]</i>	12/9/94		O.S.T.I. (2)	<i>[Signature]</i>	12-07		3	
1	1	QA	<i>[Signature]</i>	12/9/94							
1	1	Safety R. V. Skinner	<i>[Signature]</i>	12-9-94							
		Env.									
		See Document Distribution Sheet									

18. E. N. Dodd III <i>[Signature]</i> 11/8/94 Signature of EDT Originator Date	19. E. N. Dodd III <i>[Signature]</i> 12/6/94 Authorized Representative for Receiving Organization Date	20. D. G. Harlow <i>[Signature]</i> 12/9/94 Cognizant Manager Date	21. DOE APPROVAL (if required) Ctrl. No. NA ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments
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Document Title: UO₃ Building Hazard Classification - Deactivated State

Release Date: December 15, 1994

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

WHC Information Release Administration Specialist:

Kara M. Broz

December 15, 1994

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Uranium Trioxide (UO₃) Building Hazards Classification - Deactivated State**I. SUMMARY**

As part of the Plutonium-Uranium Extraction (PUREX)/UO₃ deactivation project, hazardous and radiological materials were removed from the UO₃ Facility and equipment/systems placed in a condition such that necessary surveillance and maintenance are minimized. At the conclusion of these activities the facility will be turned over to Inactive Facilities. This document determines the hazard classification of the UO₃ Facility including all structures and equipment to be included in this turnover. These buildings are:

<i>Building</i>	<i>Title</i>
203-U	Miscellaneous storage
203-UX	Concentrated UNH storage
211-U	50% recovered nitric acid storage
224-U	Wet processing area
224-UA	Calciner Building
241-U-017	Process condensate crib
2715-U	Oil storage building
2715-UA	Insulation shop
2716-U	Valve station
272-U	Maintenance shop
272-UA	Contaminated equipment storage
207-U	Retention Basin
216-U-8	Crib
216-U-12	Crib
MO-107	Operations offices
MO-321	Change trailer at 211-U
MO-351	Process engineering offices
MO-419	Planning/scheduling offices
MO--722	Operations/engineering offices

Notably, this excludes the 2714U Building and T-Hoppers being used to store UO₃ powder from facility operations. These items are covered in the current UO₃ Safety Analysis Report (SAR) and are being retained by the PUREX Facility organization and are beyond the scope of this document.

The UO₃ Facility, as described above, in the deactivated state is classified as an "other industrial facility." This classification is based on DOE-STD-1027-92, DOE-EM-STD-5502-94, and WHC-CM-4-46, Safety Analysis Manual.

II. FACILITY DESCRIPTION

Extensive facility description material based on the facility operations conditions is contained in the UO₃ SAR, WHC-SD-CP-SAR-002. Additionally, facility description material reflecting both the operations configuration and the deactivated state of systems and equipment was developed for the turnover of the UO₃ Facility (WHC-SD-CP-TI-194, Rev 0). The key items of note in the facility description are: (1) with the exception of the material listed in Appendix A from the final inventory of the UO₃ Facility, the radiological material has been removed; (2) facility systems and utilities have been deactivated including the steam, electrical and water systems; and (3) tanks have been flushed and are identified as "empty" and non-hazardous per regulatory requirements. The UO₃ facility will be maintained in this condition for an extended period during which surveillance and maintenance activities constitute the facility operations.

III. INVENTORY AT RISK and FINAL HAZARD CLASSIFICATION

Appendix A (pg A-1) identifies the final inventory of radiological material in the UO₃ Facility processing equipment. This remaining material as either powder or, in many cases, hard cakes of material is fixed to the equipment. As a result, the use of a release fraction of 10^{-3} as identified in STD-1027 is conservative.

Appendix B is a comparison of the final inventory numbers to both the category 3 values as identified in STD-1027 and the 40 Code of Federal Regulation (CFR) 302 values as required by EM-STD-5502. The comparison to category 3 values does not use the release fraction and results in 0.115 of the category 3 limits for the uranium isotopes. The isotopic distribution is taken from the average values identified in the UO₃ SAR, this reference page is included in Appendix A (pg A-2).

Similarly, the next section of the analysis compares the inventory values to the 40 CFR 302 limits for these isotopes. The release fraction as discussed above is used for this comparison. The results for each isotope are then summed, consistent with STD-1027 and the result is 0.005 of the 302 values. While the process tank heels as identified in Appendix A do contain some uranium, the quantity is not significant based on the small concentrations and volumes identified. Additionally, based on these calculations any uncertainty in material inventory, even on the order of 100 percent would not change the classification of the UO₃ Facility.

Included in Appendix A (beginning with pg A-3) is a copy of the flushing report for the UO₃ process tanks. The only materials identified in 40 CFR 302 that, based on process knowledge, could potentially exist in the heels of these tanks are nitric acid and chromium. The 40 CFR 302 limits for these materials are 1000 and 5000 lbs respectively. Additionally, using the release fraction for liquids (10^{-3}) as identified in STD-1027 and the per EM-STD-5502, the limit for these materials at UO₃ would be 1,000,000 and 5,000,000 pounds respectively. Based on the concentrations and heel volumes identified in the

flushing report the material in UO_3 is significantly less than these limits. Appendix C is a spreadsheet calculation of these limits. Based on current heel volumes there is a total of 4,600 gallons (equivalent to ~24 pounds of nitric acid) remaining.

Similarly, using the highest value for chromium at $4.53E-2 \mu\text{G/ML}$ and assuming this concentration for all tank heels the total quantity of chromium is less than a gram for all tanks. This value is much less than the limits especially considering the release fraction of $1E-3$.

IV. FINAL HAZARDS CLASSIFICATION

Based on these calculations and the discussion above, the UO_3 Facility in the deactivated state is classified as a "other industrial facility" per the DOE standards and applicable WHC requirements. As such the current OSHA standards and requirements should be evaluated to determine those applicable to planned facility activities and operations.

V. REFERENCES

SD-CP-SAR-002, UO_3 Plant Safety Analysis Report

DOE-STD-1027-92, Hazards Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23

DOE-EM-STD-5502-94, Hazards Baseline Documentation

WHC-SD-CP-TI-194, UO_3 Plant Turnover - Facility Description Documentation

WHC-CM-4-46, Safety Analysis Manual

APPENDIX

A

PUREX/OU₃ PLANT ADMINISTRATIONUO₃ PLANT - NUCLEAR MATERIALS
INVENTORYManual
Section
Page
Effective DateWHC-CM-5-9
4.18, REV 3
14 of 20
July 15, 1992Figure 4. UO₃ Plant Physical Inventory - Powder Sheet.% U = 82.68

LOCATION	WEIGHT LBS.	GRAMS U ENR < 20%
X-5 Cyclone	20	7,501
X-3 Hopper	80	30,002
X-7 Hopper	180	67,505
X-11 Hopper	50	18,751
X-3 Bags	85	31,877
X-11 Bags	40	15,001
X-12 Filter	18	6,751
Misc.		

% U = 82.30

LOCATION	WEIGHT LBS.	GRAMS U ENR < 20%
X-22-1 Cycl	18	6,719
X-22-2 Cycl	18	6,719
X-26-1 Hopp	28	10,453
X-28-1 Hopp	25	9,333
X-28-2 Hopp	25	9,333
X-28-1 Bags	70	26,131
X-28-2 Bags	70	26,131
X-29-1 Hopp	25	9,333
X-29-2 Hopp	25	9,333
X-29-1 Bags	20	26,131
X-29-2 Bags	70	26,131
X-29-1 Drum	- 0 -	- 0 -
X-29-2 Drum	- 0 -	- 0 -

% U = 82.30

LOCATION	WEIGHT LBS.	GRAMS U ENR < 20%
G. Calciner	50	18,665
H. Calciner	50	18,665
J. Calciner	50	18,665
K. Calciner	50	18,665
L. Calciner	50	18,665
M. Calciner	50	18,665
G P/U Bin	2	747
H P/U Bin	2	747
J P/U Bin	2	747
K P/U Bin	2	747
L P/U Bin	2	747
M P/U Bin	2	747
X-29 Vent	50	18,665
X-31-1 Filt	40	14,932
X-31-2 Filt	40	14,932
Vacuum Bins	- 0 -	- 0 -
Misc.	NA	NA

PAGE TOTAL 508,136

Date of Inventory 10-4-94
 Custodian H. Res. Riney
 Safeguards _____

Table D-1. Isotopic Composition of Uranium in UO_3 .

Lot No.	^{238}U	^{236}U	^{235}U	^{234}U
86/4	99.169	0.078	0.744	0.009
86/7	99.088	0.075	0.828	0.009
86/9	99.091	0.073	0.827	0.009
86/11	99.059	0.071	0.862	0.008
86/13	99.005	0.068	0.917	0.010
Average	99.082	0.073	0.836	0.009

PST88-3141-D1

Using the average isotopic abundances from the above table, it can be shown that:

- One gram of UO_3 contains 0.8322 g of uranium total and contains 0.8246 g ^{238}U , 6.075×10^{-4} g ^{236}U , 6.957×10^{-3} g ^{235}U and 7.490×10^{-5} g ^{234}U . These amounts of uranium isotopes correspond to the following number of curies per gram of UO_3 .

Table D-2.

Uranium isotope	Half-life (s)	Curies in 1 g of UO_3
^{238}U	$1.41 \text{ E} + 17$	$2.77 \text{ E} - 07$
^{236}U	$7.39 \text{ E} + 14$	$3.89 \text{ E} - 08$
^{235}U	$2.22 \text{ E} + 16$	$1.48 \text{ E} - 08$
^{234}U	$7.74 \text{ E} + 12$	$4.58 \text{ E} - 07$
Total		$7.89 \text{ E} - 07$

PST88-3141-D2

Sample calculation

If $C_i = \text{Ci/g of pure uranium isotope}$

$$C_i = 3.94 \times 10^{10} f/t_{1/2}$$

where:

f = fractional abundance of U isotope

$t_{1/2}$ = half-life of uranium in s.

ENGINEERING CHANGE NOTICE

Page 1 of 1

1. ECN 190052

Proj.
ECN

2. ECN Category (mark one)		3. Originator's Name, Organization, MSIN, and Telephone No.		4. Date	
Supplemental ☐ Direct Revision ☒ Change ECN ☒ Temporary ☐ Standby ☐ Supersedure ☐ Cancel/Void ☐		Edward Gonsalves, UO ₃ , T7-20, 373-2574		November 30, 1994	
5. Project Title/No./Work Order No.		6. Bldg./Sys./Fac. No.		7. Approval Designator	
Update to Suporting Document		UO ₃ Plant		N/A	
8. Document Numbers Changed by this ECN (includes sheet no. and rev.)		9. Related ECN No(s).		10. Related PO No.	
WHC-SD-CP-RPT-012 Rev. 0		N/A		N/A	
11a. Modification Work		11b. Work Package No.		11c. Modification Work Complete	
☐ Yes (fill out Blk. 11b) ☒ No (NA Blks. 11b, 11c, 11d)		N/A		N/A	
		Cog. Engineer Signature & Date		Cog. Engineer Signature & Date	
11d. Restored to Original Condition (Temp. or Standby ECN only)					
N/A					
12. Description of Change					
Update to the Report of Clean Out and Flushing of UO ₃ Plant Processing Equipment.					
13a. Justification (mark one)					
Criteria Change ☐		Design Improvement ☒		Environmental ☐	
As-Found ☐		Facilitate Const. ☐		Const. Error/Omission ☐	
13b. Justification Details					
Update on the UO ₃ Clean Out.					
14. Distribution (include name, MSIN, and no. of copies)				RELEASE STAMP	
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RELEASE AUTHORIZATION**Document Number:** WHC-SD-CP-RPT-012, REV 1**Document Title:** Report of Clean Out and Flushing of UO3 Plant Processing Equipment**Release Date:** 12/2/94

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WHC Information Release Administration Specialist:
Kara M. Broz

December 2, 1994

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A-5

SUPPORTING DOCUMENT		1. Total Pages ¹⁴ 12 ¹²
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REPORT OF CLEAN OUT AND FLUSHING OF UO₃ PLANT PROCESSING EQUIPMENT

The UO₃ Plant went through a clean out leading to the deactivation of the facility. This clean out consisted of three phases. Phase I consisted of the removal of residual process material and the deactivation of most process equipment and instrumentation. Phase II consisted of the fixing or removal of contamination so storm water processing would be no longer required. Phase III consisted of the remaining activities that had to be completed before the facility was turned over to the Surplus Facility Program. Since the activities of Phase II and III were closely related, these two phases were worked simultaneously.

The first part of this document will summarize the Phase I clean out procedures and their results. Phase I was completed on February 28, 1994. The second part will summarize the Phase II/III clean out procedures and their results. Phase II/III was completed before December 31, 1994. Because tanks and equipment were flushed simultaneously or in a specific sequence, the clean out processes will be discussed per workplan.

Phase I

Work Plan WP-UO-0061 : Clean Out of Tanks TK-302-U and TK-303-U
 Work Plan WP-UO-93-001 : Clean Out of Tanks TK-306-U, TK-307-U and TK-308-U
 Work Plan WP-UO-93-013 : Removal of UNH from TK-X-30
 Work Plan WP-UO-93-004 : Flushing the UNH Concentration System
 Work Plan WP-UO-93-005 : Flushing of the Recovered Acid System
 Work Plan WP-UO-93-006 : Calciner Clean Out
 Work Plan WP-UO-0055 : H Calciner Clean Out
 Work Plan WP-UO-93-014 : Powder Handling System Clean Out

Phase II/III

Work Plan WP-U-94-008 : Documentation of the 224-U Legacy Equipment
 Work Plan WP-U-94-010 : Clean Acid Header Drop Legs
 Work Plan WP-UO-94-012 : Ship KOH To Tank Farms
 Work Plan WP-UO-94-013 : Ship Tank C-2 to Purex and Flush Neutralization System

Phase I

Work Plan WP-UO-0061 : Clean Out of Tanks TK-302-U and TK-303-U

This work plan covered the removal of the nitric acid heels, flushing and inspection of tanks TK-302-U and TK-303-U.

The tanks were initially flushed from the top with at least 700 gallons of water to rinse the sides. The solution was vacuumed into a contractor's truck. Then deposits of crystals and scales from around the lower portion of the tanks were scraped and vacuumed into the contractor's truck. The tanks were flushed with water three more times.

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-UO-0061

Sample Point	Sample#	Date	pH	Cr(uG/ML)	Comments
TK-303-U	U6754	9/22/93	2.70	4.53E-2	Tank was pumped dry.
TK-303-U	U6755	9/22/93	2.94	2.36E-2	Final Rinse Sample
TK-302-U	U6762	9/24/93	7.31	1.36E-2	Tank was pumped dry.
TK-302-U	U6763	9/24/93	7.07	2.94E-2	Final Rinse Sample

Work Plan WP-UO-93-001: Clean Out of TK-306-U, TK-307-U and TK-308-U

Work Plan WP-UO-93-001 provided instructions for the flushing of the 211-U Tank Farm tanks. Tanks TK-306-U, TK-307-U, and TK-308-U stored the nitric acid (50% in strength, 10 M) produced as byproduct from the UO_3 process.

The initial step in the flushing of these tanks was a cascade flushing using approximately 2500 gallons of rainwater stored in TK-301-U. The flushing path was from TK-301-U to TK-308-U to TK-307-U to TK-306-U to TK-C-1. As the solution was being transferred to TK-C-1 samples were taken to determine whether it should go to Purex or it could be processed at the UO_3 facility. The cascade flushing was repeated three more times.

The next step in the flushing of the tanks was to flush them with 1000 gallons of water from TK-301-U and recirculate the water for one hour. Samples were collected.

After the cascade flushing, each tank was individually flushed with approximately 1000 gallons of raw water. The water was brought in a tank truck. After the flushing the solution was sampled and transferred to TK-C-1.

The last part of this work plan was the cleaning of the P307 Pump Pit and the 211-U Pipe Trench. Using a water truck, water was sprayed on the pipes and the pipe trench and allowed to drain towards the pump pit. A sample was collected from the pit and the pit emptied. Then the pump pit and pipe hardware were sprayed with a hose to remove the acid residue. Then the solution was sampled and discharged.

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-UO-93-001

Sample Point	Sample#	Date	U(g/L)	pH	Comments
TK-306-U	U6676	8/26/93	9.97E-1	2.63	Pumped Dry
TK-307-U	U6677	8/26/93	5.26E-4	2.73	Pumped Dry
TK-308-U	U6678	8/26/93	9.97E-1	2.82	Pumped Dry
TK-306-U	U6684	8/27/93	4.04E-4	2.64	Pumped Dry
211-U Pump Pit	U6703	9/07/93	3.05E-2	2.24	Last Sample Taken
TK-301-U	U6766	9/30/93	3.29E-4	2.59	Pumped Dry

Work Plan WP-UO-93-013 : Removal of UNH from TK-X-30

This work plan provided the instructions for transferring about 1100 gallons of UNH from TK-X-30, and solution from TK-C-2 to TK-C-1. The solution from TK-C-2 was recirculated and filtered to remove solids before being transferred to tank TK-C-1.

After the UNH was removed from Tank TK-X-30, the tank was immediately flushed with 200 gallons of water. Then it was flushed two more times, each time with 200 gallons of water, to reduce the uranium and acid concentrations. The flushing of TK-X-30 prepared the tank for Work Plan WP-UO-93-004.

Work Plan WP-UO-93-004 : Flushing of the UNH Concentration System

Work Plan WP-UO-93-004 provided the instructions for the flushing of the UNH Concentration System to remove as much UNH and nitric acid as possible. The equipment covered in this work plan are: Tanks TK-X-1, TK-X-2, TK-X-20, TK-X-30, TK-X-38, TK-D-13, concentrators E-D-2, E-D-6, E-D-7, the loop header and the calciner hot boxes. Because the drain lines to the hot boxes were found plugged after the final processing campaign, the hot boxes' drain lines could not be flushed.

Tank TK-X-2 was flushed with approximately 300 gallons of raw water. This water was then discharged to TK-X-1 and then to TK-X-38 and then TK-C-2. Tank TK-X-2 was then flushed with 2985 gallons of water using a spray nozzle to flush all of its sides. The solution was then transferred to TK-X-1.

Tank TK-X-1 was also flushed using a spray nozzle to flush its sides. It was flushed until the tank contained 6052 gallons of solution. The solution in TK-X-1 was used in the flushing of the UNH concentration system.

The TK-D-13 Catch Tank was flushed using deluge water. Water was sent through the drain lines for 1 to 2 minutes in order to flush them. The flushing solution was sent to TK-C-2.

The concentrators ED-2 and ED-7 were flushed using the solution from TK-X-1 via a sanpiper pump. The solution then drained into TK-X-30.

Concentrator ED-6 could not be flushed because its bottom was plugged with solid UNH that had leaked past the valve during the final processing campaign.

The Loopheader, the TK-X-30 filters (F1 and F2), and the process lines from the loop header to the calciners, located in the hot boxes, were flushed simultaneously with solution from tank TK-X-30. These were flushed for thirty minutes. Then the filters and loopheader were steamed out for ten minutes. The solution was then allowed to drain into TK-X-30, from where it was transferred to TK-C-7 and concentrated in TK-C-2.

Tank TK-X-20 was flushed by using 200 gallons of water. The solution was transferred to TK-X-2 and the residual was drained from the tank and jetted to TK-C-7 and concentrated in TK-C-2.

Tank TK-X-38 had to be flushed repeatedly to remove residual acidity from solids. A spray nozzle was used to flush this tank. Most of the solution was allowed to drain into the 203-U Sump, from where it was jetted to TK-C-7 and concentrated in tank TK-C-2. The rest was emptied using a tubing pump.

To finalize work plan WP-UO-93-004 the flush solution in TK-X-2 was used to flush TK-X-1 in batches of 2,000 to 3,000 gallon quantities. Then the solution was transferred through the concentrators to TK-X-30 for further flushing of that route. The final transfer was from TK-X-30 to TK-C-7 and then to TK-C-2 where the flush solution was concentrated.

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-UO-93-004

Sampled Vessel	Sample#	Date	U(g/L)	pH	Comments
TK-X-1	U6819	11/05/93	1.33E-1	4.35	Heel Vol:-225 gal
TK-X-2	U6810	11/03/93	4.28E-4	2.60	Heel Vol:-225 gal
X-30 Filters	U6823	11/05/93	5.17E-1	3.21	Last Sample Taken
Loop Header	U6823	11/05/93	5.17E-1	3.21	Last Sample Taken
TK-X-20	U6835	11/11/93	1.63E-3	8.24	No heel in Tank
TK-X-38	U6783	10/13/93	2.31E-3	8.02	Heel Vol: -40 gal
TK-X-30	U6828	11/09/93	7.35E-2	6.61	No heel in Tank
TK-D-13	U6657	08/16/93	1.35E-4	5.46	No heel in Tank

Work Plan WP-UO-93-005 : Flushing of the Recovered Acid System

In this work plan the recovered acid system was flushed and prepared for shutdown. The equipment cleaned in this work plan were Tank TK-C-3, Coolers E-A-4 and E-C-6, acid tower TA-3 and the calciner off-gas system.

The fume vent header was steamed out for 20 minutes to remove as much uranium as possible. The steam was introduced into the fume vent header through each cell wet scrubber and then through the gas cooler (EA-4). Much of the contamination drained into the off gas acid pots. These were constantly drained through out the steam out. The steam condensate drained to the acid recovery tower (TA-3) and then to TK-C-3. The TA-3 tower was filled with water during the steam out to control any potential contamination from going up the stack. Both the fume and vessel vent were operated during this activity.

The acid tower (TA-3) was flushed with 400 gallons from TK-C-9. The solution was drained to TK-C-3. This process was repeated five times.

To flush Tank TK-C-3 water was added through the acid tower TA-3. The solution was transferred from TK-C-3 to TK-C-7 and concentrated in TK-C-2.

The acid scrubbers were flushed down with the acid from TK-C-4. The scrubbers were flushed down for 30 minutes. The flush solution was then allowed to drain back to TK-C-4. Then they were flushed five more times with the contents of TK-C-3 through gas cooler E-C-6. The flush solution was transferred to TK-C-7 and then concentrated in TK-C-2.

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-UO-93-005

Sampled Vessel	Sample#	Date	U (g/L)	pH	Comments
TK-C-3	U6832	11/11/93	8.48E-3	2.71	Last Sample Taken Last Vol: 147 gal
E-C-6 and Acid Scrubbers	U6833	11/11/93	9.36E-2	2.68	Last Sample Taken Sampled at TK-C-7
TA-3 (Tray 1)	U6834	11/11/93	1.50E-5	7.75	Tower is Empty

Work Plan WP-UO-93-006 : Calciner Clean Out

This work plan provided the instructions for the clean out of the calciners. This consisted of the removal of the calciners' lids, vacuuming the loose UO_3 powder, the cleaning of the 45's and the feed points.

The first step in this clean out was to have an insulator remove and dispose of insulation in order to remove the lids. Later, the powder temperature sensors, the calciner vacuum gauges and sensor lines, thermocouple wells, feedpoints and offgas 45 elbows were removed.

A vacuum hose, with a screen to prevent the vacuuming of UO_3 clods, was attached to the powder handling system to remove the loose UO_3 powder from the calciners. This powder was then routed to either the X-22-1 or X-22-2 cyclones and the X-26-1 storage bin. The clods were placed in a bucket for later rework with H calciner material. A millwright replaced the calciner lids and then sealed them with a caulking material.

The 45 elbows were cleaned in the decon sink. A mixture of HNO_3 (15% to 20%) and water was used for this purpose. Then the elbows were rinsed with water and the decon sink solution jetted to TK-C-7, and concentrated in TK-C-2.

Work Plan WP-UO-0055 : H Calciner Clean Out

This work plan covers the cleaning of the H calciner. The H calciner feed line was inadvertently left on while the agitator and the heaters were already in the shut down mode at the end of processing campaign 89-1. When this situation was discovered, the feed valves were immediately turned off. The agitator and the heater were turned back on to loosen the UO_3 powder; however, some UO_3 powder and some crystallized UNH was caked inside the calciner.

After a millwright removed the calciner lid, uranium was scraped, chipped, and vacuumed off the calciner lid and the calciner trough. The uranium that was vacuumed was routed through the powder handling system. The calciner lid was replaced.

The lumps of UNH and the UO_3 powder were dissolved in the decon sink with a mixture of HNO_3 (15% to 20%) and water. The solution was then jetted to tank TK-C-7 and concentrated in TK-C-2.

Tank TK-C-4 was flushed seven times with 200 gallons of water each time via the decon sink to TK-C-7. During the seventh flush, the 200 gallons of water were routed through the Luckey Pot Room, E and F Cells to remove some acid which was trapped in the pipes. The solution was jetted to TK-C-2 from TK-C-7. The solution was tested with litmus paper each time, until it showed a pH of 4.1. Then the solution was sampled (Sample# 6975).

FINAL CLEAN OUT SAMPLE AND RESULTS FOR WP-UO-0055

Sampled Tank	Sample#	Date	U	pH	Comments
TK-C-4	U6975	2/26/94	1.21E-2	3.52	Final Rinse Sample

Work Plan WP-UO-93-014 : Powder Handling System Clean Out

This work plan provided the instructions for the clean out and recovery all of the flowable UO_3 powder in the 224-UA powder handling system of the powder handling system. The pick-up bins, cyclones, bag filter and hoppers were emptied of all flowable powder. The recovered UO_3 powder was transferred to T-hoppers for safe storage. The equipment covered in this work plan were Pick-up bins G, H, J, K, L and M; Cyclones X-22-1 and X-22-2; Bag Filters

X-28-1, X-28-2, X-29-1, and X-29-2; Storage Hopper X-26-1; Exhausters X-21-1, X-21-2, X-21-3, X-32-1 and X-32-2; HEPA Filter X-31-1 and X-31-2; and Stack 296-U-2.

To remove the powder from the pick-up bins, air was drawn in through all six pick-up bins at the same time to minimize the powder hold up in TEEs and stagnant branches between the pick-up bins and the cyclones. Any powder that remained in the calciner downcomers was drained to the pick-up bins. The downcomer was determined empty when no more powder transfer was visible through the observation port. The pick up bins were then vacuumed empty through the access inspection port. The clean out of the pick-up bins progressed from the extremities (M and G cells) toward the cyclones, exhausters and bag filters.

The secondary bag filters X-29-1 and X-29-2 were cleaned out using the blow rings for four hours each. To enhance the effectiveness of the airblow, the pick-up bins were valved out. This minimized the velocity of the air passing through the filter bags, thus minimizing the holding of powder particles against the side of the filter bags. The powder from the X-29-1 and X-29-2 catch drums was vacuumed into storage bin X-26.

The primary bag filters X-28-1 and X-28-2 were cleaned out using the blow rings for four hours each. As for the secondary filter clean out, the pick-up bins were valved out to minimize the velocity of the air holding the particles against the side of the filter bags.

The process engineer inspected the contents of the X-26 storage hopper and estimated that 1200 lbs of UO_3 powder were in the hopper. This powder was loaded into T-hopper T-555. At the end of this work plan, blanks were installed to isolate the powder handling system.

Phase II/III**WP-U-94-008 : Documentation of the 224-U Legacy Equipment**

The Legacy Equipment is the equipment which was used to calcine the UNH and handle the UO_3 powder before the construction of the 224-UA Building. This equipment is located in the E-Cell, F-Cell, the Old Load Out Room, the Luckey Pot Room, the southern part of the roof of the 224-U Building and the Old Powder Handling System Tower.

This workplan documented the physical and radiological conditions of the equipment via videotape. It also resolved any problems which were found during the documentation which might present a hazard to workers in the future.

The Legacy Equipment consists of eighteen (18) electric pots (PE-1 through PE-18), two (2) Luckey Pots, the X-5 Cyclone, the X-6 and LE-2 Hammer Mills, the X-7 Storage Bin, the X-8 Screw Conveyor, the X-4-1 and X-4-2 exhausters, the X-3 Bag Filter, the X-11-1 and X-11-2 Bag Filters, the X-12-1 and X-12-2 Glass Wool Filters, the X-13 Exhaust Fan, the TA-1 Acid Tower and the EA-2 Gas Cooler.

The calcining pots were opened and their insides were video taped and photographed. The pots only contained small amounts of residual UO_3 powder. Four of the pots contained oil that had leaked from the agitator gear boxes which are located over the pots. This oil was removed with conweb and properly disposed. Work Package 2U-94-00137 was written to drain the oil out of the remaining agitator gear boxes.

Much of the equipment has view ports, but the video taping of their internal conditions was made impossible because of caked UO_3 powder on the glasses. Estimates of the residual UO_3 powder were taken from the WHC-CM-5-9, Section 4.18, Rev 3, Page 4 of 20. These estimates are:

X-3 Bags	:	85 lbs of UO_3
X-3 Bag Filter Hopper	:	80 lbs of UO_3
X-5 Cyclone	:	20 lbs of UO_3
X-7 Hopper	:	180 lbs of UO_3
X-11 Bags	:	40 lbs of UO_3
X-11 Hopper	:	50 lbs of UO_3
X-12 Glass Wool Filter	:	18 lbs of UO_3

During the documentation of E and F Cells the operators found old equipment which was used on December 1965, when a series of special thorium oxide tests were run (See Figures 1, 2, and 3). Since this equipment did not have equipment numbers, unique UO_3 ID numbers (LE-#) were assigned. The equipment found consisted of:

1. Two (2) pumps
2. Weight Scale
3. Solution Tank (LE-7)
4. Dissolution Tank (LE-8)
5. Scrubber Acid Tank (LE-6)

6. Cooler (LE-4)
7. Filter (LE-5)
8. Scrubber (LE-3)
9. Part of the Vessel Vent System (LE-9)

Both the solution (LE-7) and dissolution (LE-8) tanks had alpha readings on the flanges. LE-7 had alpha contamination levels of 10,000 dpm direct and 5000 dpm smeared. LE-8 had alpha contamination levels of 2,500 dpm direct and 1000 dpm smeared. The areas that smeared the alphas were wrapped to contain the contamination and decontaminated on a later date.

Operators opened the drain valves of the TA-1 and EA-2 Gas Cooler to verify that the equipment had been drained. No liquid was found in either the acid tower nor the gas cooler.

WP-U-94-010 : Clean Acid Header Drop Legs

This work plan drained the acid header drop legs located in E and F Cells, and the Luckey Pot Room. These stub pipes had been blanked years ago when the old pot calciners were taken out of service. These stub pipes are part of the acid loop header, but could not be flushed along with the loop header during the TK-C-4 flush (WP-UO-0055), due to a blank which isolated about fifteen (15) feet of the acid header. These stub pipes were drained empty and the acid disposed per proper procedures.

WP-UO-94-012 : Ship KOH To Tank Farms

This work plan cleaned the UO₃ Plant KOH Storage Tank TK-X-36 and the associated piping. Since the transfer of KOH had to pass through TK-C-1, this tank was preflushed. TK-C-1 will be flushed in work plan WP-UO-94-013. The potassium hydroxide (KOH) was removed and transferred to Tank Farms. To meet the Tank Farms' needs, the KOH had to be diluted with water. The KOH was transferred from TK-X-36 to TK-C-1. Then TK-X-36 was flushed twice with 1000 gallons of water. This flush water was added to the KOH in TK-C-1.

After the KOH transfer, tank TK-X-36 tank TK-X-36 was flushed twice more to remove the KOH heel with 1000 gallons of water using a spray nozzle until a pH of 7.31 was reached (Sample U-7292). The flush solution was transferred into TK-C-1 where it mixed with the KOH left from the transfer and then loaded into the Tank Truck for transfer to Tank Farms. The spray nozzle was removed from TK-X-36 and installed on tank TK-C-1 and flushed twice with 400 gallons of water until a pH of 9.67 was reached (Sample U-7296).

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-UO-94-012

Sampled Vessel	Sample#	Date	U (g/L)	pH	Comments
TK-X-36	U7292	11/8/94	4.69E-6	7.31	<5 gallon heel
TK-C-1	U7296	11/10/93	7.42E-4	7.42	Not Final Flush

WP-UO-94-013 : Ship Tank C-2 to Purex and Flush Neutralization System

This work plan removed the flush material that had accumulated in tank TK-C-2 after having completed Phase II of clean out of the UO₃ Plant. This work plan also flushes the condensate neutralization system and its associated chemical storage and handling systems. The equipment covered in this work plan are Tanks C-1, C-2, C-5, C-7, C-8, C-9 and X-37, and associated pumps and piping.

The contents of tank TK-C-2 were transferred to tank TK-C-1 after being recirculated and filter to remove any large debris. This contents were then transferred to TK-C-1 from where they were transferred to the tank truck for shipment to Purex.

The phosphoric acid in tank C-8 was drained to a minimum heel, with the use of a portable pump, into an approved DOT 30-gallon shipping container (salvage drum). Then a spray nozzle was used to spray 100 gallons of sanitary water in the tank. The solution was then agitated using a stainless drum mixer and recirculated through pump P-C8. During the recirculation of the solution drain valves opened to flush the acid out of them. This tank was flushed until a pH of 6.58 was reached (Sample U-7316). This final rinse solution was used to flush the transfer line to TK-C-5 as the solution was transferred from TK-C-8 to TK-C-5.

Tank TK-D-8 contents were drained into a poly drum. Both the suction and discharge piping of the spray pump were allowed to drain into quart bottles. Then TK-D-8 was flushed with water which discharged into TK-C-5, where it mixed with the solution from TK-C-8. The discharged solution from TK-D-8 was tested with pH paper; this read as a pH of 7. The suction and discharge piping of the spray pump were flushed with this solution. A sample of the TK-D-8 discharged solution was taken (Sample U-7307).

Tank TK-C-5 was agitated and sampled (Sample U-7312). Then the solution from TK-C-5 was drained into TK-C-7. The outlet flange was loosened to ensure complete drainage.

The first step in the cleaning of tank X-37 was to open its drain valve and emptying approximately 350 gallons of solution into the 203-U sump. During the draining the contents of the tank were sampled (Sample U-7286). The sample results showed that this tank did not contain hazardous material and the flushing of the tank was not necessary. The solution was then jetted to tank C-7 and then to TK-C-2. The solution was then recirculated through the C-2 filter to remove any large debris and transferred to TK-C-1.

Four hundred gallons of water were then added to TK-C-2 and transferred to TK-C-1. Another 400 gallons of water were added to TK-C-2 and valves were opened to flush piping associated with the C-2 filter and TK-C-2. This solution was then transferred to TK-C-1 with a diaphragm pump.

The solution inside TK-C-1 was agitated for one hour. The solution was transferred into the tank truck. During the transfer the sample line was flushed and samples were collected (U-7319 & U-7320). The pH of the solution was also tested with pH paper, which read as a pH of 6.

This work plan also flushed the remaining tanks in the UO₃ Plant. Tank TK-C-9 was drained and sampled (U-7302). Tank TK-D-10 was drained. Then this

tank was filled with water and allowed to drain into a poly drum. After one quart of solution had drained, the flowing stream was sampled for pH. The sample had a pH of 7. A sample was collected and sent to the lab (U-7309). The poly drum was pumped into the elementary neutralization tank C-5.

The contents of Tank TK-C-10 were allowed to drain into TK-C-7. Then TK-C-10 was flushed with water and allowed to overflow into TK-C-7 until TK-C-7 weight factor increased by one division on the chart. The contents of TK-C-10 were sampled (U-7303). Then Tank TK-C-10 was drained into TK-C-7.

Water was added to the D-4 Seal Pot and allowed to overflow into TK-C-7 until TK-C-7 weight factor increased by one division on the chart. Then the contents of TK-D-4 were sampled (U-7305).

Water was added to the D-5 Seal Pot and allowed to overflow into the D-Cell floor drain. Then the D-Cell floor drain contents were transferred to TK-C-7, until TK-C-7 weight factor increased by one division on the chart. Then the contents of TK-D-5 were sampled (U-7306).

The TK-C-2 Seal Pot was flushed with water until the overflowing water increased the weight factor of TK-C-7 by one division on the chart. Then a sample of the contents of the TK-C-2 Seal Pot was collected (U-7304).

The U-4 stack flowmeter condensate traps were drained into 1-quart poly bottles. The bottles were then drained into TK-C-7.

Other vessels and seal pots were verified empty. These sealpots are : A-Cell Seal Pots, the X-20 Seal Pot, the X-30 Seal Pot, TK-D-13, TK-D-9 and D-D-1.

After all tanks and pots had been flushed, and routed through TK-C-7 to TK-C-2, the 224-U backside sumps were jetted to TK-C-7. The contents of tank TK-C-7 were sampled and jetted into tank TK-C-2 which was sampled and pumped into TK-C-1. Tank TK-C-1 was sampled and pumped into the Tank Truck and shipped to Purex.

FINAL CLEAN OUT SAMPLES AND RESULTS FOR WP-U0-94-013

Sample Point	Sample#	Date	U(g/L)	pH	Comments
TK-C-8	U7316	11/17/94	N/A	6.58	No heel in Tank
TK-X-37	U7286	11/03/94	3.40E-6	5.10	Last Sample Taken
TK-C-1	U7319	11/17/94	5.53E-2	6.67	Final Flush
TK-C-1	U7320	11/17/94	3.51E-2	6.64	Final Flush
TK-C-9	U7302	11/16/94	<9.80E-7	4.97	No heel in Tank
TK-D-10	U7309	11/16/94	4.59E-4	6.48	No heel in Tank
TK-D-8	U7307	11/16/94	3.86E-6	8.10	No heel in Tank
TK-C-5	U7312	11/17/94	6.79E-6	6.90	< 5 gallon heel
TK-C-10	U7303	11/16/94	1.77E-3	7.00	No heel in Tank
TK-D-4	U7305	11/16/94	6.66E-4	6.47	Last Vol: -25 gal
TK-D-5	U7306	11/16/94	8.13E-4	6.76	Last Vol: -25 gal
TK-C-7	U7317	11/17/94	4.12E-2	6.97	Open Tank
TK-C-2	U7318	11/17/94	5.53E-2	6.65	<5 gallon heel
TK-C2 Seal Pot	U7304	11/16/94	1.62E-6	8.27	Open Tank

APPENDIX

B

Hazard Classification Determination For UO_3

Define the specific activities for the isotopes:

$$\text{SA}_{238} := 3.35 \cdot 10^{-7} \cdot \frac{\text{Ci}}{\text{gm}} \quad \text{SA}_{235} := 2.13 \cdot 10^{-6} \cdot \frac{\text{Ci}}{\text{gm}}$$

$$\text{SA}_{236} := 6.47 \cdot 10^{-5} \cdot \frac{\text{Ci}}{\text{gm}} \quad \text{SA}_{234} := 6.16 \cdot 10^{-3} \cdot \frac{\text{Ci}}{\text{gm}}$$

Define the isotopic percentages for UO_3 powder:

$$\text{P}_{238} := 0.991 \quad \text{P}_{236} := 0.0007$$

$$\text{P}_{235} := 0.009 \quad \text{P}_{234} := 0.00009$$

The total inventory of the UO_3 facility is:

$$\text{Tot} := 508136 \cdot \text{gm}$$

Calculate the curies of each isotope:

$$\text{Act}_{238} := \text{Tot} \cdot \text{P}_{238} \cdot \text{SA}_{238} \quad \text{Act}_{238} = 0.169 \cdot \text{Ci}$$

$$\text{Act}_{236} := \text{Tot} \cdot \text{P}_{236} \cdot \text{SA}_{236} \quad \text{Act}_{236} = 0.023 \cdot \text{Ci}$$

$$\text{Act}_{235} := \text{Tot} \cdot \text{P}_{235} \cdot \text{SA}_{235} \quad \text{Act}_{235} = 0.01 \cdot \text{Ci}$$

$$\text{Act}_{234} := \text{Tot} \cdot \text{P}_{234} \cdot \text{SA}_{234} \quad \text{Act}_{234} = 0.282 \cdot \text{Ci}$$

Identify the Activity limits for these isotopes from 1027-92:

$$\text{U238}_{1027} := 4.2 \cdot \text{Ci} \quad \text{U236}_{1027} := 4.2 \cdot \text{Ci}$$

$$\text{U235}_{1027} := 4.2 \cdot \text{Ci} \quad \text{U234}_{1027} := 4.2 \cdot \text{Ci}$$

Calculate the ratio of isotopes to the 1027-92 limits and the total ratio.

$$\text{R1027}_{238} := \frac{\text{Act}_{238}}{\text{U238}_{1027}} \quad \text{R1027}_{236} := \frac{\text{Act}_{236}}{\text{U236}_{1027}} \quad \text{R1027}_{238} = 0.04$$

$$\text{R1027}_{236} = 0.005$$

$$\text{R1027}_{235} := \frac{\text{Act}_{235}}{\text{U235}_{1027}} \quad \text{R1027}_{234} := \frac{\text{Act}_{234}}{\text{U234}_{1027}} \quad \text{R1027}_{235} = 0.002$$

$$\text{R1027}_{234} = 0.067$$

$$\text{R1027}_{\text{tot}} := \text{R1027}_{238} + \text{R1027}_{236} + \text{R1027}_{235} + \text{R1027}_{234}$$

$$\text{R1027}_{\text{tot}} = 0.115$$

Calculate the ratio of these isotopes to 40CFR 302.4 Appendix B values. Per DOE-EM-STD-5502-94 the releasable values to be compared to the 40CFR302 values are to be based upon the release fractions identified in appendix A of DOE-STD-1027-92. For powder the release fraction is 1E-3. This is identified below.

$$RF := 1 \cdot 10^{-3} \quad U238_{302} := 0.1 \cdot Ci \quad U236_{302} := 0.1 \cdot Ci$$

$$U235_{302} := 0.1 \cdot Ci \quad U234_{302} := 0.1 \cdot Ci$$

$$R302_{238} := \frac{Act_{238} \cdot RF}{U238_{302}}$$

$$R302_{236} := \frac{Act_{236} \cdot RF}{U236_{302}}$$

$$R302_{235} := \frac{Act_{235} \cdot RF}{U235_{302}}$$

$$R302_{234} := \frac{Act_{234} \cdot RF}{U234_{302}}$$

$$R302_{tot} := R302_{238} + R302_{236} + R302_{235} + R302_{234}$$

$$R302_{tot} = 0.005$$

Calculations by: *EDD* 12/8/94
 PEER REVIEWED BY: *Wen Clapp* 12-8-94

APPENDIX

C

Given: Approximately 4600 gallons of very dilute (nitric acid) tank heels in UO3 plant.
Conservatively assume no buffering of acid solution, 100% ionization, and a pH of 2.

Wanted: Weight of HNO₃ present in tank heels.

Solution: $[H^+] = 10^{-2} = 0.01$ g-ion/l (for pH=2)
HNO₃ g-mol/l concentration will be equivalent to H⁺ g-ion/l concentration.

$$4600 \text{ gal} \times \frac{3.79E+00 \text{ l}}{1 \text{ gal}} \times \frac{0.01 \text{ g-mol H}^+}{1} \times \frac{1 \text{ g-mol HNO}_3}{1 \text{ g-mol H}^+} \times \frac{63 \text{ g HNO}_3}{1 \text{ g-mol HNO}_3} \times \frac{2.20E-03 \text{ lbs HNO}_3}{1 \text{ g HNO}_3} = 24.18 \text{ lbs HNO}_3$$

CALCULATED BY: *Doni Olesp* 12-8-94

Peer Review by: *ED. M. Diller* 12/8/94