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RESPONSE TO OHIO ENVIRONMENTAL PROTECTION AGENCY LETTER REFERENCE: URANYL NITRATE REMOVAL ACTION

02/07/94

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DOE-FN/OEPA
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LETTER
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Department of Energy
Fernald Environmental Management Project
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FEB 07 1994

DOE-0934-94

Mr. Thomas A. Winston, P.E.
Chief, Southwest District Office
Ohio Environmental Protection Agency
40 South Main Street
Dayton, Ohio 45402-2086

Dear Mr. Winston:

RESPONSE TO OHIO ENVIRONMENTAL PROTECTION AGENCY LETTER REFERENCE: URANYL NITRATE REMOVAL ACTION

Reference: 1. Letter, J. P. Hamric to T. A. Winston, "Response to Ohio Environmental Protection Agency Letter Reference: Uranyl Nitrate Removal Action," dated January 31, 1994.

In the referenced letter, the Department of Energy-Fernald Field Office (DOE-FN) committed to supply your office with additional information concerning the Uranyl Nitrate (UNH) Removal Action. Enclosed is a description of the Project Scope (attachment 1) and the UNH Processing Control Philosophy (attachment 2). Also, as stated in my letter of January 31, 1994, significant improvements were uncovered during the 50% design review for this project. The potential improvements consisted of:

1. Moving the processing site to a location that is indoors and capable of neutralizing the material in larger batches;

2. Eliminating approximately 800 lineal feet of three inch stainless steel traced and insulated piping.

In addition to the potential cost savings and increased efficiency, the primary benefit of this modification is the inherent safety improvements associated with the revised plan.

The current projected schedule indicates the system would be installed and startup testing completed by the end of July 1994. Following startup testing, the operation will be subjected to appropriate Health and Safety Operational Readiness Reviews and Assessments. The DOE-FN is in the process of attempting to implement appropriate methodologies in order to expedite these requirements. Following the completion of Health and Safety evaluations, the actual processing of material would commence.

Recycled and Recyclable

The Process Flow Diagram and Piping and Instrumentation Diagrams developed to date are no longer accurate as a result of the recent decision to revise the plan. These diagrams will be forwarded to you as soon as they are revised.

Additional information on this project will be transmitted to your staff as it becomes available.

Also, as stated in my letter of December 7, 1993, DOE-FN will provide OEPA with a monthly status update of the project.

If you or your staff have any questions, please fell free to contact Doug Maynor at (513) 648-3173 or Johnny Reising at (513) 648-3139.

Sincerely,

J. Phil Hamric
Manager

FN:Reising

Enclosure: As Stated

cc:

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PROJECT

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SCOPE OF WORK

URANYL NITRATE PROCESSING SYSTEM

FERNALD ENVIRONMENTAL RESTORATION MANAGEMENT CORPORATION

REV. 0
Dec. 21, 1993

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1.0 EXISTING SITUATION

The Fernald Environmental Management Project (FEMP), formerly known as the Feed Materials Production Center (FMPC), is owned by the U.S. Department of Energy (DOE) and was operated from 1952 until 1989 for the processing of high purity uranium metal.

In 1989, facility production operations were placed on standby to focus on environmental remediation. The facility was formally shut down in 1991. At present, remaining workforces at the facility are focused solely on the implementation of environmental restoration related initiatives.

Among the materials left on site following the cessation of production is approximately 200,000 gallons of uranyl nitrate hexahydrate (UNH - uranium compounds in nitric acid) solution stored in eighteen stainless steel storage tanks. The uranium content of the tank contents ranges from 22 to 318 grams U/liter. Three tanks have a U-235 content of 1% or more. This material is currently classified as a hazardous waste under 40 CFR 261.22 due to its corrosivity and under 40 CFR 261.24 due to its chromium and barium content.

For further details of tank contents, see Appendix 1, UNH Storage Tank Data. Note, however, that the analyses of tank contents given in Appendix 1 are preliminary and subject to revision and further development. A sampling program to provide a full analysis of each tank is ongoing, and the results will be made available to the UN Design Team.

2.0 OBJECTIVE

The extended storage of this hazardous waste material in its current form is not a desirable arrangement. The possibility of a tank rupture, or leakage from valves, flanges, and fittings represents a potentially adverse threat to the environment and personnel. Therefore, it is desired to remove the material from the tanks to minimize this possibility and to process the material into a form which would be more amenable to extended storage and/or shipping.

The primary objective of any processing is to neutralize the acidity such that the material no longer represents a corrosive threat to its storage media, and is no longer considered a hazardous waste due to its corrosivity. A secondary objective of processing is to remove or convert the metals (for example, conversion of hexavalent chromium to trivalent chromium) in the solution so that they may be safely disposed. As this material has already been classified as waste, recovery of metals for resale or recycling is not an objective.

3.0 GENERAL PROCESS DESCRIPTION

DWG. SK-RES2305-OPL-1 (Block Flow Diagram)

To achieve the processing objectives previously outlined, it is planned to neutralize the UN solutions with an appropriate alkaline solution, precipitate and recover the metals from the solution, and process the remaining neutralized liquid into an effluent suitable for release.

3.1 Background

Neutralization of uranyl nitrate solutions and precipitation of the uranium from the solution has previously been accomplished with magnesium hydroxide. This procedure is well established, and has been used intermittently in the existing plant since 1972. Previous testing has also indicated that all the metals of concern, uranium, chromium, and barium, will precipitate out of UN solution. They may then be removed by filtration and drummed. The testing also showed that the filter cake resulting from this operation is not a hazardous waste per the Toxicity Characteristic Leaching Procedure (TCLP), and the filtrate is suitable for processing in the biodenitrification process on site and subsequent release.

In 1992, approximately 20,000 gallons of UN solution were processed as previously mentioned in a plant test (PTA-90-2/3-003-0). During this plant test, UN solution from several storage tanks was blended together to reduce the overall isotopic concentration of U-235 in the resulting blend below 1.00% and also to improve the homogeneity and filterability of the overall solution. The blended solution was then diluted with process water to reduce the uranium concentration below 50 grams U per liter. The dilute solution was heated to approximately 110 to 130 degrees F, and neutralized with magnesium hydroxide. Upon neutralization, uranium, primarily in the form of magnesium diuranate, and various salts of barium and chromium precipitated from the solution. The solids were filtered from the solution in a rotary vacuum filter and drummed, and the filtrate collected in a hold tank. Subsequent laboratory analysis revealed that the filter cake passed the TCLP, and the filtrate contained no contaminants at concentrations which would prevent its processing in the plant biodenitrification unit.

Laboratory testing was also done on proposed additional blended UN from the remaining inventory. The analysis showed that the UN solutions, if processed in the manner of the plant test, would produce a filterable slurry with no leachable solid toxic constituents in excess of TCLP allowances and a liquid which could be processed in the biodenitrification unit.

Upon completion of the plant test, operations were suspended pending conversion of the plant test procedure into a more formal operating procedure to complete processing of the UN. However, shortly after this processing resumed, a hold on any movement of UNH was put into place by the DOE following a spill of UNH unrelated to the plant test. This hold required further study and assurances of system integrity

before any processing could restart.

3.2 Processing Plan

To expedite removal and neutralization of the UN solutions from the storage tanks, it is planned to process the material in a manner similar to the plant test procedure. The UN solutions will be diluted with water, neutralized with magnesium hydroxide to initiate precipitation of metals, and the metals removed from the neutralized liquid via filtration. See block flow diagram, DWG. SK-RES2305-OPL-1.

The key difference between the new processing plan and the old plant test procedure is that the UN solutions will not be blended together prior to dilution and neutralization. This is done to expedite removal of the solutions from the storage tanks and to allow construction of a transfer piping network with only one source and only one termination, thus removing the possibility of sending UN to an unintended destination. Further details of the UN piping system are discussed in Section 4.

It is believed that the individual tank contents of UN can be processed by this procedure. This must, however, be proven prior to any actual processing. The UN Design Team will be responsible for defining and conducting the necessary laboratory tests to prove that the individual solutions can be neutralized with magnesium hydroxide, the metals precipitated, and the resulting slurry filtered. The UN Design Team will also be responsible for ensuring the disposability of the resulting filter cake and filtrate.

study

Note that processing of tanks with a U-235 enrichment of 1.00% or more will result in a filter cake of the same enrichment. The UN Design Team will address the special storage and disposal requirements of this material, and investigate methods for alleviating this problem such as solids blending with lower enrichment material after filtration.

study

4.0 DESCRIPTION OF PROCESSING FACILITIES

DWG. SK-RES2305-OPL-1 (Overall Piping Layout)
SK-RES2305-02 (UNH Handling System) ← ?

Processing of the UN solutions will be accomplished using a combination of new and existing equipment. In general, existing tanks, both storage and processing tanks, will be used, while the interconnecting piping and transfer pumps will be installed new. New instrumentation will be installed as required to enhance process safety and to provide improved monitoring of the process.

Note: All piping and equipment sizes given are conceptual and are subject to confirmation by the UN Design Team.

4.1 New Facilities

4.1.1 Plant 2/3

Storage Tanks and Transfer System

Within Plant 2/3, a new dedicated header (3", 304L SS) will be installed to transfer UN solutions from the individual storage tanks to the dilution tank F1-608. This header will be routed in existing racks and will run from the NFS tanks through the digestion side of Bldg. 2/3, down the east-west rack along 102nd Street and turn south to F1-608. Full-port plug valves will be installed at key locations along the header: 1) CD Blend Tank Area; 2) inside the Digestion Tank Area; 3) in the east-west rack along 102nd Street at the intersection with the north-south rack from the Hot Raffinate Building; and 4) in the east-west rack along 102nd street at the intersection with the north-south rack to the Refinery Sump Area. All piping will be arranged so that all valves and flanged connections are located within secondary containment areas, either permanent or temporary. Drain valves will be installed on either side of each block valve. These drain valves may also be used for flushing should the header become plugged.

Further hard piping (3", 304L SS) will be installed in the existing rack from the Hot Raffinate Building to the intersection with the east-west rack along 102nd Street. A short length of hard pipe (3", 304L SS) will be installed from the OK Liquor Tank Area through the east-west rack along 102nd Street to its intersection with the north-south rack to the Refinery Sump Area. These headers will be tied in turn into the main transfer header for processing of the Hot Raffinate Tanks and the OK Liquor Tank.

A new progressive cavity type pump will be used to pump the UN solutions from the individual storage tanks to the dilution tank F1-608. This pump will be skid-mounted for portability, and will be connected in turn to each tank for processing. Two pump skids will be purchased to allow for optimum hook-up and for sparing. The pump will be connected to each tank with temporarily installed hard piping (3", 304L SS), utilizing braided stainless steel flex hoses for final fit-ups. The pump discharge will be connected to the main transfer header at each of the valved points in turn through temporarily installed hard piping, again using braided stainless steel flex hoses for final fit-ups. A recirculation line from the pump back to the source tank may be used in some cases to allow for greater tank agitation than that provided by the existing tank agitators.

After a tank has been emptied of UN solution, it will be rinsed with nitric acid, followed by a water rinse. Both the rinse acid and water will be pumped to F1-608 for processing in the same manner as UN. Upon emptying and rinsing of a given UN storage tank, the pump skid will be disconnected from that tank, moved, and reconnected to another tank in the same group of tanks. After all tanks in a group are emptied and rinsed, the pump skid will be relocated to the next group of tanks to be processed. At this time, the main transfer header piping between

the previously processed tanks and the current tank group may be decontaminated, decommissioned, and abandoned in place or dismantled and removed. Tanks will be processed in the order from farthest from F1-608 to nearest, namely: 1) NFS Tanks; 2) CD Blend Tanks; 3) Digestion Tanks; 4) Hot Raffinate Tanks; and 5) OK Liquor Tank. In all cases, the pump skid will be located within the secondary containment area of each tank or group of tanks.

Instrumentation for control of the pump skid will be installed on a local panel mounted on the skid. This instrumentation will include a pump speed controller for controlling flow, an instantaneous flow readout, a flow totalizer, a pump speed readout, pump start and stop switches, and pump run lights.

Additional instrumentation will be installed at each storage tank. A level transmitter will be used to measure the level in the storage tank, and a thermowell will be installed to measure the temperature at three different levels within the tank. Installation of these instruments will utilize existing nozzles on the tanks. This instrumentation may be moved from tank to tank with the pump, and readouts from the instrumentation will be installed on the pump skid panel.

Dilution System

Existing tank F1-608 will be used to dilute the UN solutions with process water to a uranium concentration of approximately 50 grams per liter. Since the dilute solution must be at least approximately 110 degrees F for optimum neutralization and precipitation, warm process water at approximately 140 degrees F will be used to partially fill the tank, and the cool UN added to it. The process water will be heated with a new direct steam injection heater. Water temperature should never exceed 140 degrees F to minimize formation of NOx upon addition of UN.

A new progressive cavity type pump will be installed to transfer the dilute UN solution from F1-608 to the precipitation tanks F1-609 and F1-610. New piping will also be installed. A new recirculation line will be installed from the pump discharge back to F1-608 to promote better tank mixing.

New instrumentation for F1-608 includes level indication / alarm and temperature indication at three different levels within the tank. All new F1-608 instrumentation will utilize existing tank nozzles. Flow meters will be installed to measure and totalize the flow of both process water and steam used for dilution and heating. Temperature indication of the warm process water will be provided. Flow out of F1-608 will be controlled by adjusting the pump speed, and both instantaneous and total flow readouts will be provided. All instrumentation will be mounted on a new local panel located in the Refinery Sump Area.

New temporary diking for secondary containment will be installed around the Refinery Sump Area. This diking, approximately 12" high, will

encompass the entire Refinery Sump Area and will be sufficient to contain the contents of the largest tank within the area.

Neutralization / Precipitation System

Existing tanks FI-609 and FI-610 will be used for neutralization and precipitation of the dilute UN solutions. These tanks will be revamped with new instrumentation, and a new progressive cavity type pump will be installed to transfer the neutralized UN slurry to the filtration system in Plant 8. A new header (3", 304L SS) will be installed to transfer the slurry to Plant 8.

New tank instrumentation will include level and temperature indication for both tanks. Flow out of the tanks will be controlled by adjusting the pump speed, and both instantaneous and total flow readouts will be provided. All new instrumentation will be mounted on the same local panel with the new Dilution System instrumentation.

4.1.2 Plant 8

Within Plant 8, most new installations center around the existing filter feed tanks, F43-203 and F43-203A. These tanks will be provided with new level indication and alarm, and a new progressive cavity type pump will be installed to transfer neutralized UN slurry to the existing East - West Eimco filters. New piping (3", 304L SS) will be installed from the tanks to the filters. The existing filters will be provided with new level instrumentation. A new level controller will control the flow of slurry to the filter by adjusting the speed of the transfer pump. Flow measurement will be calculated from the pump speed, and both instantaneous and total flow readouts will be provided. All new instrumentation will be mounted on a new local panel within Plant 8.

4.2 Utilization of Existing Facilities

Note: The UN Design Team will be responsible for verifying the integrity and adequacy of any existing systems intended for re-use. The UN Design Team shall also provide all drawings necessary to show the as-built configuration of any existing systems intended for re-use. If any existing systems are found inadequate for the planned service, the UN Design Team shall design suitable alternatives.

4.2.1 Plant 2 / 3

Several existing systems within Plant 2 / 3 are planned for use. In addition to the existing storage and processing tanks mentioned earlier, these include: 1) Nitric acid distribution system for tank rinsing; 2) Process water system for tank rinsing and dilution; 3) Magnesium hydroxide injection and pH control system; 4) Tank agitators; and 5) Secondary containment systems. Additionally, although new piping has been planned for all major transfer lines, should suitable existing

pipe runs be located, their use should not be precluded.

4.2.2 Plant 8

The major system planned for re-use within Plant 8 is the existing East-West Eimco filter system. This includes the filters themselves, along with the vacuum-producing system, filter cake drumming system, filter precoat system, and the filtrate collection system. Also associated with Plant 8, the existing plant biodenitrification facilities will be utilized. The UN Design Team will be responsible for evaluating the most expeditious use of the filtration system (use of either one or both of the existing filters). The UN Design Team shall confirm the adequacy of the existing biodenitrification system to handle the expected filtrate effluent from the processing system without disrupting the present system load. The UN Design Team will also coordinate any planned changes in the Plant 8 area with ongoing operations or any other Plant 8 Revamp Projects.

5.0 DESIGN BASIS

Filters expected to be limiting factor

As stated previously, the primary objective of this project shall be to empty and neutralize the UN storage tank contents. Consistent with this objective, the UN Design Team will be responsible for defining the flowrates and conditions required to accomplish the objective in a minimum amount of time while minimizing the risks to personnel and the environment.

It is anticipated that the limiting factor in processing will be the existing filtration operation. Pump-out, dilution, and neutralization operations shall be designed to support operation of the filtration system on a continuous 24 hr/day, 7 day/week basis. By use of variable speed pumps with a flow range capability of approximately 25 to 100 gpm (subject to confirmation), batchwise processing may be arranged in an optimum manner to support the filtration operation.

6.0 STUDIES

Several issues will be investigated during the detailed design phase of this project. Results of these studies will be incorporated into the design as appropriate.

- Determine optimum usage of pump skids, i.e., pump with one skid while hooking up and recirculating / agitating with the other.

- Investigate moving neutralization / precipitation operation closer to the filtration operation to lessen the possibility of line plugging during slurry transfers.

- Study transfer of filtrate from the filtrate hold tank back to the dilution tank for use as dilution water. This would cut back on the total amount of process water used and thus feed to the biodenitrification unit. Some method of transferring this filtrate back into the process must be developed to allow for off spec filtrate. Note that there are existing facilities to accomplish this.

- Determine optimum utilization of filtration equipment, i.e., use of both the East and West Eimco filters vs. use of the Large Eimco filter.

- Examine insulation of Dilution Tank F1-608 and Precipitation Tanks F1-609 and F1-610 to allow for operation during winter months.

- Determine optimum utilization of existing piping.

- Study use of alternate materials of construction, such as CPVC, instead of 304L SS. Incorporate into study a risk assessment of the increased likelihood of rupture or breakage resulting from accidental impacts upon the piping.

- Examine options for handling material with U-235 enrichment of 1.00% or greater, such as blending material prior to neutralization and precipitation, or mixing of solid material after filtration.

- Investigate ways of mitigating NOx emissions from the tanks during processing.

- Examine existing tankage capacity which could be utilized as filter feed surge tanks to speed emptying and neutralization of the UN storage tanks.

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APPENDIX 1

UNH STORAGE TANK DETAILS

ATTACHMENT 2

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UNH Disposition Project, Storage Tank Information

#	TANK	LOCATION	GALLONS	(g)U/ liter	%U-235	Cr (ppm)	Ba (ppm)	NORMAL
1	NE	CD BLEND	16,500	261	0.951	90.00	72.28	0.47
2	SW	CD BLEND	18,884	66	0.998	64.08	216.60	1.33
3	SE	CD BLEND	17,931	104	0.989	19.14	21.76	0.54
4	D1-10	DIGEST	2,587	143	1.290	404.00	74.72	4.69
5	F1-1	DIGEST	2,227	173	0.951	69.34	87.80	0.84
6	F1-25	DIGEST	21,632	130	0.998	44.70	51.55	1.30
7	F1-26	DIGEST	1,246	138	0.955	59.12	18.69	3.45
8	D1-7	DIGEST	3,559	51	0.990	N/A	N/A	0.07
9	D1-1	DIGEST	3,150	134	0.956	82.40	12.18	4.19
10	F1-301	HOT RAFFIN	2,301	59	0.990	68.98	108.34	0.67
11	F1-302	HOT RAFFIN	1,530	39	0.990	42.36	47.18	0.77
12	F1-303	HOT RAFFIN	1,764	22	0.990	46.86	28.24	2.25
13	F1-308	HOT RAFFIN	2,299	28	0.990	71.28	62.24	2.34
14	F2-606	NFS	23,975	102	1.000	59.90	92.76	1.12
15	F2-608	NFS	20,712	79	0.990	118.42	81.46	1.57
16	FS-607	NFS	25,590	62	1.000	22.58	42.86	1.06
17	F2-605	NFS	24,280	64	0.990	69.46	92.54	1.69
18	F3E-223	OK LIQUOR	12,180	318	0.990	N/A	N/A	N/A
	TOTALS		202,347	110	1.000	83.3	69.5	

DESCRIPTION OF THE MATERIAL IN EACH UNH TANK AT FERMCO

1. Tank NE

Tank NE contains metal oxide and most probably magnesium fluoride dissolved in nitric acid. It has some residual solids (hair line of solids). The solids are of the consistency of sand (magnesium fluoride). The metal was oxidized before being dissolved and contains magnesium fluoride from bomb reduction liners. Most of the uranium is from machining operations at Fernald, Hanford, and SR. Transuranics are expected to be < 10 ppb.

2. Tank SW

Tank SW contains refinery thickener slurry (RTS) reacidified with nitric acid. The refinery thickener slurry was produced from treating refinery plant sump water with magnesium oxide to pH 8.0 and allowing it to settle. The clear liquid was decanted. The slurry (settled solids) was acidified with HNO_3 to dissolve the solids and this solution was concentrated from 20 g U/l to 60 g U/l in an evaporator. As the solution cools a lot of crystals and magnesium salts form. The U for the most part stays in solution. Approximately 3,000 gallons of the 18,000 gallons will be crystals/solids. The solution can be drained off through a side valve leaving the crystals in the tank. Without heating the tank it probably would require a diaphragm pump to pump off the solution and leave the crystals in the tank. Barium sulfate was added prior to the evaporator. (Solution was circulated through a steam bundle back into a tank to concentrate the uranium.) Aluminum was also added to complex fluoride. This UNH was generated in 1986 and is expected to contain about 20 ppb transuranics including Pu.

3. Tank SE

Tank SE contains a blend of the first two tanks (NE and SW). This is a batch that had been prepared to go through solvent extraction. Approximately 2,000 gallons of solids are probably on the bottom of the tank. The solids are probably sandy (they would typically dump solids on floor and shovel up). This UNH was generated in 1987 and is expected to contain TRU < 10 ppb Pu.

4. Tank D1-10

Same as NE tank, except tank is used to hold dissolved enriched U_3O_8 (higher enrichment than other tanks). This material did not go through an evaporator. There probably is very little solids in this material. TRU is expected to be about 5 ppb Pu.

5. Tank F1-1

Tank F1-1 contains U_3O_8 dissolved in nitric acid. It is believed to contain quite a bit of solids (magnesium fluoride) from bomb liners. The tank probably contains approximately 25 percent solids. This is solution that was being blended into extraction because of low isotopic. The TRU content is approximately 10 ppb Pu.

6. Tank F1-25

Tank F1-25 contains the last batch made up for solvent extraction. This material is one-half RTS (refinery thickener slurry) and one-half dissolved U_3O_8. The tank probably contains 2,000 gallons of solids. The solids are easily suspended and pumpable. (If the solution is dropped out the bottom of the tank, the solids will drain out with the solution.) Solids are mainly magnesium salts (white) and are easy to filter. (The solution reportedly ran well through extraction.) Crystallization temperature for this solution ($Mg(NO_3)_2$) is probably -50° F.

7. Tank F1-26

Tank F1-26 is a heel from the first batch neutralized by FERMCO for disposal (prior to accident). The tank contains mainly solids from solution drained from the tank during FERMCO disposal operation. Originally this was a blending tank to get <1% enrichment. The solution in this tank is about the same as the solution in tank F1-25 (Item 6) - down to the side draw. (The solids will come out the bottom of the tank.)

8. Tank D-7

This tank was generated before 1980 from cleanup of a solvent spill. It contains RTS and solvent. The U-235 is incorrect. It should be normal. The mix was never acidified and is mostly solids. Fernald could never decide what to do with this material. It probably contains approximately 25 percent TBP. The solids will drain out of the tank.

9. Tank D1-1

This tank contains dissolved U_3O_8 (acidified) with approximately 500 gallons of magnesium salts and solids. The solids will suspend and are not crystals. The free acid of the solution is about 4 N. The TRU content is approximately 15 ppb Pu.

10, 11, and 12. Tanks F1-301, F1-302, and F1-303

These tanks contain solids from acidifying the RTS (refinery thickener slurry). The solids contained in the tanks are mainly magnesium salts and solids that remained after pumping the clear solution off tanks F1-25 and F1-26 (Items 6 and 7). Very high solids. Maybe 50% crystals/solids. It may require the use of an ODS pump to transfer solution from these tanks. Centrifugal pumps may be used on the rest of the tanks. This solution would normally have been filtered through the rotary drum vacuum filter before running it through the evaporator. The solution is black and heavy in solids (from refinery thickener - could be dirt and garbage). Once the tank is heated to dissolve the crystals, the insoluble solids should drain out with the liquid. The insoluble solids are fairly fine and may need a precoat to filter. The TRU content should be approximately 10 ppb Pu.

13. Tank F1-308

This tank contains clear filtrate from filtering solution similar to that in tanks F1-301, F1-302, and F1-303 (Items 10, 11, and 12). The next normal processing step would have been to run the solution through the evaporator, concentrate up to 60 g U/l, and filter prior to extraction. This type of solution typically will foam in the evaporator at 70 g U/l. The magnesium salts apparently cause foaming. When the material foams, it would shoot up and go through the condenser. The TRU content is probably 10 ppb.

14. Tank F2-606

This tank contains the same material as the SE tank (Item 3). It contains acidified RTS (refinery thickener slurry) and approximately 5,000 gallons of crystals with very little insoluble solids. The tank is a jacketed tank. It will probably be possible to drain the solution and leave the crystals in the tank. If the tank is heated to dissolve the crystals and then the tank is drained, not many solids would drain out. It is a horizontal tank with a small prop agitator. The TRU content is approximately 20 ppb.

15, 16, 17. Tanks F2-608, F2-607, and F2-605

These tanks contain acidified RTS (refinery thickener slurry) saturated with magnesium salts. The solution has been concentrated in the evaporator. The tanks are horizontal, jacketed tanks. It will be difficult to pump or drain solutions from the tanks without heating the tanks. The tanks probably have 10,000 gallons of crystals and solids as they set. Solution removal will probably require pumping off through top of the tanks unless they are heated. These tanks do not have a side withdrawal. When the tanks are heated, NO_x fumes vent from the tanks. Approximately 110 degrees F will dissolve the crystals. Barium and aluminum was added at the evaporator. If heated, probably 2,000 gallons of solids will remain. Anything other than sweeter (higher enrichment material used to upgrade the enrichment) will have aluminum in it. The solution was analyzed for free fluoride. The fine solids will pump through. The TRU content is approximately 15 ppb in these three tanks.

18. Tank F3E-223

This tank contains good product from solvent extraction. No solids are present and the solution is re [illegible] (318 g U/1). The extraction product come [illegible] about 100 g U/1. A boildown consisting [illegible] used to drive off some of the water. [illegible] probably 9 to 10 ppb Pu. Spec for Pu was [illegible]

URANYL NITRATE PROCESSING SYSTEM

CONTROL PHILOSOPHY

GENERAL

The existing inventory (~200,000 gallons) of uranyl nitrate hexahydrate (UNH) that is stored in 18 storage tanks will be pumped in batches to a dilution tank where it will be mixed with warm water to reach a final solution temperature of 120 F and containing ~50 gU/l. The dilute UNH will then be neutralized in batches with magnesium hydroxide. The excess nitric acid will be neutralized to form soluble magnesium nitrate and the UNH will react to form a magnesium diuranate precipitate. The neutralized UNH slurry will then be filtered continuously on two (east and west Eimco) rotary vacuum filters in Plant 8. The filter cake will be collected in drums and the high-nitrate filtrate will be discharged for treatment in the Biodenitrification facility.

1. SYSTEM DESCRIPTION

UNH Storage and Transfer System

Uranyl nitrate solution containing some suspended solids is stored in eighteen UNH storage tanks. Each of the 18 UNH storage tanks will be agitated to suspend any solids and dissolve any crystals that may have settled in the tank. Existing agitators will be used when possible. In addition, a spare UNH transfer pump will recirculate the tank contents prior to transfer. Piping connections will be installed to allow recirculation of the contents of all 18 UNH tanks.

A positive displacement pump will transfer batch quantities of UNH solution/slurry to the dilution tank (F1-608) in the Refinery Sump. Once each UNH storage tank is emptied, it will be rinsed with a dilute solution (1 Normal) of nitric acid followed by a water wash.

UNH Dilution and Transfer System

Various quantities of UNH solutions will be mixed with warm water (~140 deg. F) in tank F1-608 to produce approximately 20,000 gallon batches of warm (~120 deg F) UNH solution containing about 50 gU/l. The warm water will be produced by mixing steam with recycled wastewater filtrate from Plant 8 or with process water. Each tank of dilute UNH solution will be transferred batchwise to the neutralization system with a positive-displacement pump.

UNH Neutralization System

UNH solution will be neutralized batchwise using two tanks (F1-609 and F1-610). Metered quantities of dilute UNH solution and approximately 55 percent magnesium hydroxide slurry will be pumped to each of the two 5,000 gallon neutralization tanks. Magnesium hydroxide addition will be controlled to maintain a final pH of 7. By using a batch method, complete neutralization of the mixture can be verified before transferring the resulting slurry to the filtration step. The neutralized slurry will consist of soluble magnesium nitrate, excess magnesium hydroxide, insoluble magnesium diuranate and any other insoluble solids that were present in the original UNH solution/slurry.

Once the UNH neutralization is complete, as verified by reaching a final pH of 7, the entire contents of the neutralization tanks will be transferred, using a positive-displacement pump, to the filter feed tanks (F43-23 or F43-23A) in Plant 8.

Slurry Filtration System

The neutralized slurry will be filtered continuously on two rotary vacuum filters (east and west EIMCO) located in Plant 8. The slurry will be pumped from either of the two feed tanks to both filters. An overflow form each filter will return excess slurry back to the appropriate feed tank. This system will ensure that the filter basins are full at all times, even when the filtration rates for the slurry change. Filter cake from the filters will be drummed directly as it is produced at the filters.

Filtrate will be collected in Tank 25A. Once sampled and approved for transfer, the tank contents will be transferred to the BDN system by way of the General Sump. If contaminants are detected in the filtrate, the contents will be transferred to the dilution tank F1-608 for reprocessing.

2. TYPICAL UNH TANK PROCESSING CAMPAIGN

The following steps are required for the complete processing of one typical UNH storage tank. These steps will be repeated for each of the eighteen UNH storage tanks.

- Agitate UNH tank.
- Transfer appropriate amount of recycle filtrate (or process water) through the inline steam heater (heat to 140 degrees fahrenheit) to dilution tank F1-608.
- Transfer appropriate quantity of UNH from storage tank to produce approximately 20,000 gallons of diluted UNH solution at 120 degrees fahrenheit. Target uranium concentration of 50g/l will be maintained, wherever possible. Enriched uranium concentration of the UNH solution in dilution tank F1-608 will be maintained below 1.000% by blending, as necessary.
- Pump sufficient quantity of dilute UNH to empty neutralization tank, either F1-609 or F1-610, to cover the agitator blades and the pH probe.
- While agitating, add $Mg(OH)_2$ to initially neutralize to pH 5.5.
- Continue adding dilute UNH solution and magnesium hydroxide simultaneously while maintaining a pH of 5.5 until the tank is almost full. Keep sufficient space for further addition of magnesium hydroxide to adjust the final pH to 7. Keep agitating for one hour and ensure that final pH is maintained at 7.
- Pump neutralized UNH slurry to Plant 8.
- When one batch in neutralization tank F1-609/F1-610 is fully neutralized, start the batch neutralization operation in the second empty tank.
- Repeat neutralization steps until tank F1-608 is empty.
- Refill dilution tank F1-608 from the UNH storage tank under processing.
- Continue neutralization and transfer of neutralized UNH slurry to Plant 8 until the UNH tank

under processing is empty.

- Rinse the UNH storage tank first with 1.0 N nitric acid by agitating for one hour and then with process water. Transfer both of the rinses to dilution tank F1-608.

- Process both the acid and water rinses through the neutralization steps and transfer the neutralized slurry to Plant 8 for filtration.

- Filters at Plant 8 will be operated continuously 24 hours per day and 7 days per week per existing standard operating procedures for filtration (O8-C-605) and precoating of filters (8-C-104).

- Filtrate from Plant 8 will be transferred to high nitrate tank via General Sump.

3. INSTRUMENTATION AND CONTROLS

The following instruments and controls are required to process the UNH.

UNH Storage Tanks (18)

- Level measurement with local indicator on the UNH transfer pump skid.
- Temperature measurement at 3 levels in each UNH tank during agitation and transfer. Local temperature indicators on the UNH transfer pump skid.
  - Temperature and level measurement equipment shall be moveable from tank to tank during processing.
- Existing agitators and their controls will be used on the UNH tanks.

UNH Transfer Pump (2 required)

- All pump controls and displays will be mounted on the local pump skid.
- Pump on-off with indicator lights.
- Pump speed controller to regulate flow.
- Discharge pressure measurement and display with high and low level alarm and auto pump shut-off.
- Discharge flow measurement based on pump speed. Local flow display on pump skid.
- Flow totalizer with ability to shut-off pump based on volume transferred.

UNH Dilution Tank (F1-608)

- Level measurement with local display on dilute UNH transfer pump skid.
- High level switch with local alarm and automatic shut-off valve that closes inlet lines (UNH and dilution water) to tank.
- Temperature measurement at three levels with local indicators on the dilute UNH transfer pump skid.

Dilution Water Supply System

- Flow measurement and totalizer in dilution water line prior to mixing with steam. Local indicators on dilute UNH pump skid.
- Flow measurement and totalizer in steam line prior to mixing with water. Local indicators on

dilute UNH pump skid.

- Temperature measurement of heated dilution water with local display on diluted UNH pump skid.
- Steam flow control valve to maintain dilution water at preset temperature at various water flow rates.

Dilute UNH Transfer Pump

- All pump controls and displays will be mounted on the local pump skid.
- On-off switch with indicators.
- Discharge flow measurement and flow totalizer with local readout on pump skid.
- Automatic pump shut-off at pre-set volume transferred (based on inline flowmeter).
- Low pressure and high pressure discharge pressure measurement, alarms and automatic pump shut-off.
- Flow measurement in pipe to neutralization tanks with totalizer and local readout on pump skid.

Neutralization Tanks (F1-609 and F1-610)

- Level measurement with local indicators.
- High-level switch with local alarm and automatic shut-off valve in dilute UNH and magnesium hydroxide inlet lines to each tank.
- pH probes connected to existing local indicators for each tank.
- Temperature measurement at single location in each tank with local indicator on neutralized UNH pump skid.

$Mg(OH)_2$ Feed System (existing) to Neutralization Tanks

- Agitator on-off controls (existing) on $Mg(OH)_2$ Day Tank (F1-617)
- $Mg(OH)_2$ transfer pump on-off controls (existing) from bulk storage, Tank 12, to Tank F1-617.
- $Mg(OH)_2$ feed pump controls (existing) from Day Tank (F1-617) to Neutralization Tanks (F1-609 and F1-610).

Neutralized UNH Slurry Transfer Pump

- All pump controls and indicators will be mounted on the local pump skid.
- On-off switch with indicators.
- Discharge flow measurement and flow totalizer with local readout on pump skid.
- Automatic pump shut-off at pre-set volume transferred.
- Low pressure and high pressure discharge pressure measurement, alarms and automatic pump shut-off.

Plant 8 Filter Feed Tanks (G43-23 and G43-23A)

- Agitator on-off controls on both tanks (existing)
- Level measurement with local display on Filter Feed Pump skid.
- High level switch with local alarm and automatic shut-off valve (in each tank) in incoming neutralized UNH slurry line from neutralized UNH transfer pump.
- Position switches and automatic controls on slurry lines to allow the filter overflow to only return to the filter feed tank that is feeding the filters.

Rotary Vacuum Filter Feed Pump

- All pump controls and displays will be mounted on the local pump skid.
- On-off switch with indicators.
- Discharge flow measurement and flow totalizer with local readout on pump skid.

- High pressure and low pressure discharge pressure measurement, alarms and automatic pump shut-off.

Rotary Vacuum Filters System (2)

- Use existing on-off controls and indicators.

Filtrate Tank 25A

- Level measurement with local indicator and local high level alarm.