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REMOVAL ACTION NUMBER 20, URANYL NITRATE NEUTRALIZATION PROJECT FINAL REPORT

11/15/96

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DOE-FEMP EPAS
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REPORT

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Department of Energy

Ohio Field Office
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NOV 1 5 1996

DOE-0163-97

Mr. James A. Saric, Remedial Project Director
U.S. Environmental Protection Agency
Region V - SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

REMOVAL ACTION NUMBER 20, URANYL NITRATE NEUTRALIZATION PROJECT FINAL REPORT

Enclosed is the Final Report for Removal Action No. 20, Uranyl Nitrate Neutralization Project. Submittal of this document to the U.S. Environmental Protection Agency and the Ohio Environmental Protection Agency completes this removal action.

If your have any questions, please contact Mr. John Trygier (513) 648-3154.

Sincerely,

Susan M Lee

for Johnny W. Reising
Fernald Remedial Action
Project Manager

FEMP:Danner

Enclosure: As Stated

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REMOVAL ACTION NO. 20

URANYL NITRATE NEUTRALIZATION (UNH) PROJECT
FINAL REPORT

OCTOBER 1996

FERNALD ENVIRONMENTAL MANAGEMENT PROJECT
FERNALD, OHIO

U. S. DEPARTMENT OF ENERGY
FERNALD AREA OFFICE

FEMP DOCUMENT CONTROL NO.0 (REV. 0)

Abbreviations, Acronyms, and Initials

BDN	Biodenitrification
cfm	cubic feet per minute
CD	Continuous Digestion
CFR	Code of Federal Regulations
DF&O	Ohio EPA Director's Findings and Orders
DOE	U.S. Department of Energy
EPA	Environmental Protection Agency
FEMP	Fernald Environmental Management Project
FMPC	Feed Materials Production Center (previous name of the FEMP)
FERMCO	Fernald Environmental Restoration Management Corporation
g-U/l	grams of Uranium per liter
HEPA	High Efficiency Particulate Air-filter
HWMU	Hazardous Waste Management Unit
NAR	Nitric Acid Recovery System (2 tanks)
NFS	Nuclear Fuel Services
NPDES	National Pollutant Discharge Elimination System
NTS	Nevada Test Site
OAC	Ohio Administrative Code
Ohio EPA	Ohio Environmental Protection Agency
ppm	Part per million
RA	Removal Action
RCRA	Resource Conservation and Recovery Act of 1976, as amended
RWP	Radiological Work Permit
SAR	Safety Analysis Report
SOT	System Operability Test
STEL	Short-Term Exposure Limit
TCLP	Toxicity Characteristic Leaching Procedure
UNH	Uranyl Nitrate Hexahydrate (crystals or solution)
U.S. EPA	United States Environmental Protection Agency
WAC	Waste Acceptance Criteria
WWTS	Wastewater Treatment System

EXECUTIVE SUMMARY

ES.1 REMOVAL ACTION NO. 20 SCOPE

The purpose of Removal Action No. 20 (RA No. 20), Uranyl Nitrate (UNH) Neutralization Project, was to safely neutralize and disposition approximately 200,000 gallons of uranium dissolved in nitric acid. This action successfully removed a significant threat to the environment. The UNH Neutralization Project's scope of work included:

- Removal of UNH solutions from 19 storage tanks
- Neutralization of the acid and precipitation of uranium
- Decontamination of the UNH solution storage tanks
- Filtration of resulting slurry
- Disposition of filtrate
- Drumming and staging of filtered solids

ES.2 RA No. 20 ACTIVITIES

Removal Action No. 20 addressed nineteen storage tanks containing the UNH solutions. The UNH solutions were transferred from their storage tanks to either Tank F1-25 or Tank F1-26 in Building 2A and diluted with water to reduce the uranium and acid concentrations. The diluted solution was then neutralized with magnesium hydroxide slurry, magnesium oxide or lime to precipitate magnesium diuranate and other metal hydroxides. The neutralized solution was then transferred to the Plant 8 Wastewater Treatment System (WWTS) and the precipitated metals were removed from the neutralized solution via filtration. The filtered solids were drummed and staged on-site pending disposal at the Nevada Test Site (NTS). The resulting filtrate water was processed through the Biodenitrification Facility (BDN) to produce an effluent suitable for release under the existing site National Pollution Discharge Elimination System (NPDES) permit. The emptied UNH solution storage tanks were decontaminated to achieve compliance with the RCRA closure guidance requirements.

The solid filter cake was determined to be non-RCRA hazardous and it was repackaged to meet the acceptance criteria for shipment to the NTS for management as low-level radioactive waste. The liquid filtrate was tested to confirm its acceptability for discharge under the site's NPDES permit.

ES.3 OHIO DIRECTOR'S FINDINGS AND ORDERS (DF&O)

On December 27, 1994, the Ohio EPA Director issued Director's Findings and Orders (DF&O) for the FEMP UNH system. Based on the Findings, the DF&O contained five Orders, one of which required that neutralization of the UNH inventories begin on January 17, 1995. Due to technical difficulties with the UNH system, this start up date was missed. However, on March 24, 1995, an in-situ neutralization process was begun. On June 15, 1995, the batch processing of UNH inventories began and the in-situ process was discontinued.

ES.4 RA NO 20 ADDENDUM

The Nitric Acid/Residual Waste Project was initiated as an addendum to RA No. 20 and was conducted in accordance with the RA No. 20 work plan, following the RA No. 20 neutralization process. It included the removal of uranium contaminated organic liquids stored in Tank D1-7, removal and treatment of the nitric acid residues stored in Tanks F1-23 and F1-24, and removal of UNH crystals in Tank D1-11.

The organic liquid in Tank D1-7 was removed, containerized, the aqueous phase was processed in the same manner as the UNH and the tank was decontaminated.

The nitric acid residues in Tanks F1-23 and F1-24 were removed, processed in the same manner as the UNH and the two tanks were decontaminated.

The UNH crystals in Tank D1-11 were dissolved, removed from the tank, processed in the same manner as the UNH and the tank was decontaminated.

ES.5 CONCLUSIONS

The RA No. 20 objectives of removing and neutralizing stored UNH solutions were met and all storage and process tanks were decontaminated. The objectives of the addendum to RA No. 20, which included removal of waste solutions from four additional tanks, were also met and the tanks were decontaminated.

1.0 INTRODUCTION

The Fernald Environmental Management Project (FEMP) is a U.S. Department of Energy (DOE) owned facility. The FEMP was formerly operated as the Feed Materials Production Center (FMPC), a high purity uranium production facility. When production operations ceased in July 1989, process residues of UNH solutions remained in nineteen storage tanks located in five Plant 2/3 storage tank areas. Due to the acidic nature of the material (pH < 1), it was determined that the material would corrode the storage tanks if it was not dealt with in a timely manner.

Removal Action (RA) No. 20, Uranyl Nitrate Neutralization Project, was implemented to neutralize these uranyl nitrate (UNH) solutions and decontaminate the storage tanks that contained them.

1.1 RCRA STATUS

The uranyl nitrate was an acidic liquid with a pH of less than 2 and containing more than 10 grams per liter (g/l) uranium and varying levels of heavy metals. Based on Ohio Administrative Code (OAC) 3745-51-22 and OAC 3745-51-24 and 40 Code of Federal Regulations (CFR) 261.22 and 40 CFR 261.24, the UNH residues were declared characteristically hazardous for corrosivity (EPA Waste Number D002). The UNH residues did not pass the toxicity characteristic leaching procedure (TCLP) test for barium, chromium, lead and mercury (EPA Waste Numbers D005, D007, D008 and D009 respectively). Therefore, the UNH process residues were subject to hazardous waste regulation under OAC 3745-51-04 and 40 CFR 261.4 because they had not been removed from process equipment within 90 days after production ceased. The storage tanks containing the solutions were declared hazardous waste management units (HWMUs).

1.2 UNIT DESCRIPTION

As required, all UNH storage tanks are cylindrical and have secondary containment, and sump systems that were visually inspected daily and leak tested. All tanks, pipes, pumps, valves and fittings through which the UNH was stored or processed were constructed of stainless steel. The UNH tanks were associated with five HWMUs: Nos. 46, 47, 48, 49 and 50 (See Figure 1-1).

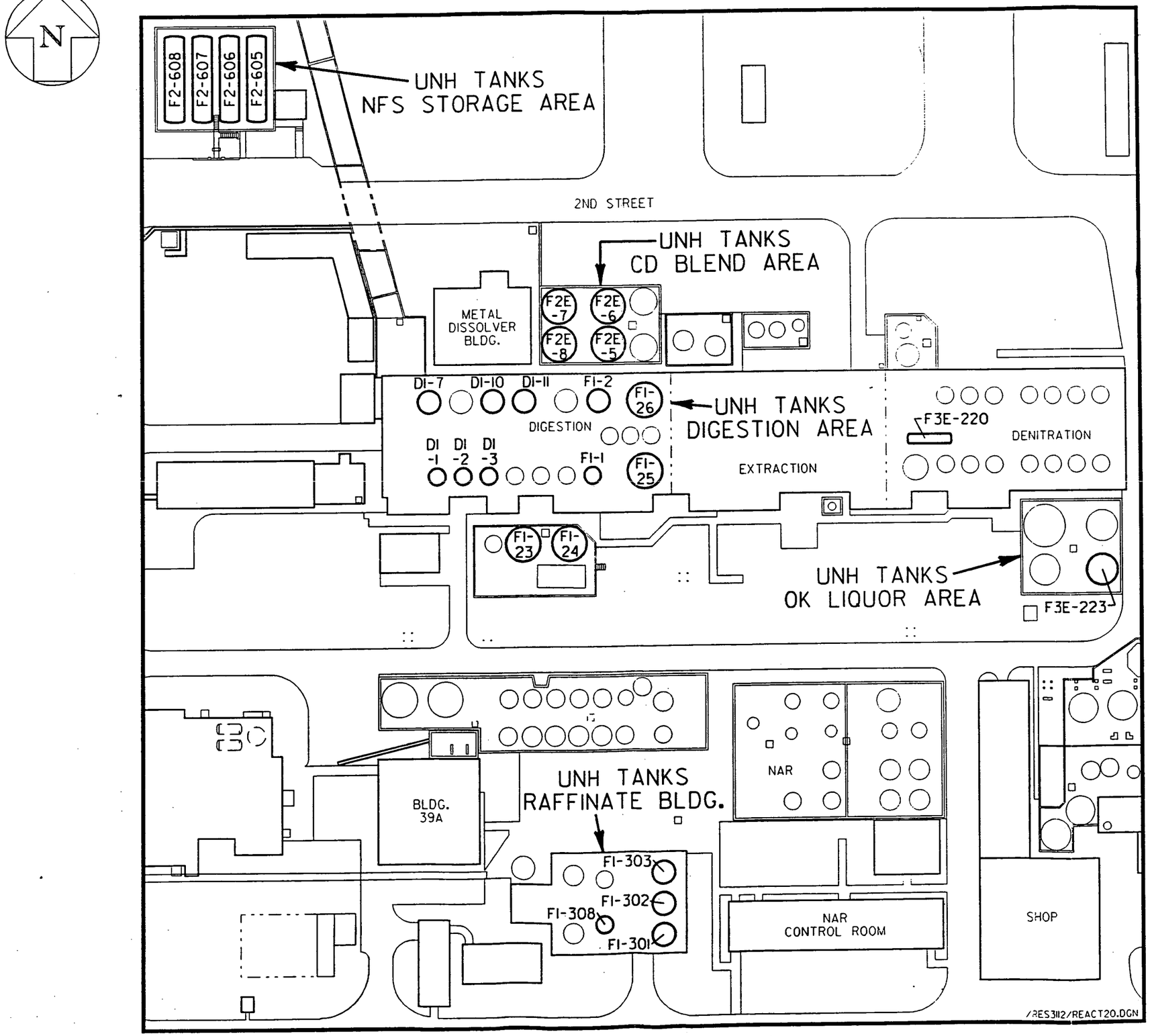
The Nuclear Fuel Services (NFS) Storage area contains Tanks F2-605, F2-606, F2-607, and F2-608. These tanks are all horizontally mounted (Photograph 1) [Photographs are located at the end of this report]. Ancillary equipment included stirring motors and liquid level indicators.

The Continuous Digestion (CD) Blend Area is located outside and north of the Digestion Area of Plant 2/3. This area contains storage Tanks F2E-5 (SE), F2E-6 (NE), F2E-7 (NW) and F2E-8 (SW). Ancillary equipment for these vertical tanks included agitators and high pressure sensing devices with alarms.

Tank F2E-223 is located outside in the OK Liquor Area. The area is diked and on the southeast side of Plant 2A (Photograph 2). Ancillary equipment for this tank included piping and high level sensors and an alarm. This tank is oriented horizontally. Tank F3E-220 is located indoors on the ground floor at the east end (Denitration) of Plant 1.

The Digestion Area, is located indoors on the ground floor at the west end of Plant 2A. This area contains Tanks D1-1, D1-2, D1-3, F1-1, F1-2, F1-25, D1-7, D1-10, and F1-26. Ancillary equipment to Tanks F1-25 and F1-26 included agitator, level indicating gauges, pumps and piping. Ancillary equipment to Tanks D1-1, D1-2, D1-3, D1-7, and D1-10 included pumps and agitators. All tanks in this area are vertical in orientation.

FIGURE 1-1 LAYOUT OF REMOVAL ACTION #20 AREA



The Hot Raffinate Area is located south of Plant 2A inside the Hot Raffinate Building. This unit contains Tanks F1-301, F1-302, F1-303, and F1-308. Ancillary equipment included agitators, pumps and associated piping. These tanks are oriented vertically.

The UNH material and the ancillary equipment have been removed and the storage tanks decontaminated; however the tanks currently remain in place.

1.3 UNH HISTORY

In 1992 testing was conducted to determine the optimum parameters and methods for converting various solutions of UNH into a stable filter cake. Approximately 20,000 gallons of UNH solution from three storage tanks were blended and processed using magnesium hydroxide to neutralize and precipitate the uranium from the solution. Blending the solutions reduced the overall isotopic concentration of U-235 to below 1.00%. Dilution water was then added to reduce the overall uranium concentration to less than 50 grams per liter.

The resulting neutralized slurry contained heavy metals, including uranium, barium, chromium, and excess of magnesium hydroxide. This slurry was then transferred to the Plant 8 Wastewater Treatment System (WWTS) for filtration. The precipitated solids were filtered from the solution and drummed, and the filtrate was transferred to the high nitrate filtrate storage tank for further processing through the existing BDN facility to remove nitrates before discharge. The process generated approximately 380,000 gallons of filtrate and 503 drums of filter cake. Subsequent laboratory analysis demonstrated that the filter cake passed the TCLP and met the Nevada Test Site (NTS) waste acceptance criteria (WAC). The filter cake was shipped to the NTS and the filtrate was discharged in accordance with the FEMP National Pollution Discharge Elimination System (NPDES) permit.

In April 1993, approximately 30 gallons of UNH were released. The released material was collected, and properly containerized and stored on-site. Due to this mishap a hold was placed on further processing of UNH solutions.

1.4 DIRECTOR'S FINDINGS AND ORDERS

On December 27, 1994, Ohio EPA issued a Director's Final Findings and Orders (DF&O) to the DOE and FERMCO for the UNH project. These DF&Os presented 29 "Findings in Fact," upon which the Orders for the UNH project were based.

The Orders required the following:

1. U.S. DOE and/or FERMCO shall begin neutralization/removal of the hazardous waste in the UNH system no later than January 17, 1995. The tanks shall be processed in accordance with the UNH Processing Schedule submitted to Ohio EPA on November 7, 1994. The UNH Processing Schedule may be revised with the written approval of Ohio EPA.
2. U.S. DOE and/or FERMCO shall complete neutralization/removal of the hazardous waste from the UNH System, as identified in the UNH Processing Schedule, no later than September 25, 1995.
3. DOE and FERMCO shall continue to inspect the UNH System in accordance with OAC rules 3745-65-15 and 3745-66-95 until all hazardous waste has been removed from the UNH System. U.S. DOE and/or FERMCO shall repair any deterioration or malfunction of UNH System equipment or structures pursuant to OAC rule 3745-65-15(C).

4. No later than January 17, 1995, U.S. DOE and/or FERMCO shall submit to Ohio EPA's Southwest District Office a contingency plan specific to the UNH System which, at a minimum, addresses responses to catastrophic failures of the tanks and/or ancillary equipment.

5. DOE and/or FERMCO shall decontaminate the UNH System's tanks and ancillary equipment in accordance with OAC rules 3745-66-11, 3745-66-14, 3745-66-97. By no later than October 25, 1995, U.S. DOE and/or FERMCO shall submit to Ohio EPA for review and approval a report demonstrating that the tanks have been properly decontaminated.

2.0 REMOVAL ACTION ACTIVITIES

2.1 TANKS INCLUDED IN UNH PROJECT

The RA No. 20 work plan listed nineteen tanks that would be addressed by the removal action field activities. One tank, Tank D1-7, was later removed from the list because the material in the tank consisted of a mixed organic and aqueous component which could not be processed in the same manner as the UNH solutions. The material in Tank D1-7 was eventually processed under RA No. 20, the Nitric Acid/Residual Waste Project (Section 2.10).

Throughout the UNH Project, additional tanks were added to the project scope to meet field conditions. For example, concern of a pending failure of the steamcoil piping for Tank D1-1 resulted in transferring the UNH in Tank D1-1 to Tank D1-2. Rinseates generated during the decontamination of Tank D1-1 were transferred into Tank D1-3. In all, 26 tanks were ultimately involved in the scope of this project, these tanks are listed in Table 2-1.

2.2 NEUTRALIZATION PROCESS DESCRIPTION

The optimum processing parameters for the UNH Project were developed from the testing conducted in 1992 (Section 1.3). The process chemistry principally involved the removal of uranium having a valence state of +6, dissolved in nitric acid, by the addition of magnesium hydroxide [$Mg(OH)_2$] to the solution. In this process the following two reactions occurred:

$$2\ UO_2(NO_3)_2 + 3\ Mg(OH)_2 \rightarrow MgU_2O_7 \downarrow + 2\ Mg(NO_3)_2 + 3\ H_2O$$

$$UO_2(NO_3)_2 + Mg(OH)_2 \rightarrow UO_2(OH)_2 \downarrow + Mg(NO_3)_2$$

Table 2-1, Listing of All RA No. 20 Project Related Tanks

TANK ID NUMBER	TANK LOCATION	TANK CONTENTS
D1-1	Digestion	Transferred to D1-2
D1-2	Digestion	UNH from D1-1
D1-3	Digestion	Rinseate from D1-1
D1-10	Digestion	UNH
F1-1	Digestion	UNH
F1-2	Digestion	UNH from F1-26
F1-301	Hot Raffinate	UNH/Solids
F1-302	Hot Raffinate	UNH Solids
F1-303	Hot Raffinate	UNH/Solids
F1-308	Hot Raffinate	UNH
F2E-5 (SE)	CD Blend (Outside)	UNH
F2E-6 (NE)	CD Blend (Outside)	UNH
F2E-7 (NW)	CD Blend (Outside)	UNH from F2E-5
F2E-8 (SW)	CD Blend (Outside)	UNH Residue
F2-605	NFS Storage (Outside)	UNH Residue
F2-606	NFS Storage (Outside)	UNH Residue
F2-607	NFS Storage (Outside)	UNH Residue
F2-608	NFS Storage (Outside)	UNH Residue
F3E-220	Denitration	Scrubber UNH
F3E-223	OK Liquor (Outside)	UNH
F1-25	Digestion	UNH
F1-26	Digestion	UNH (Transferred to F1-2)
Nitric Acid/Residual Waste Project Tanks		
D1-7	Digestion	Hydrocarbon/low pH water
D1-11	Digestion	UNH Crystals
F1-23	NAR System	Nitric Acid
F1-24	NAR System	Nitric Acid

The resulting precipitated solids were a mixture of magnesium diuranate (MgU_2O_7) and uranyl hydroxide ($UO_2(OH)_2$), as well as other dissolved species (Barium - Ba, Chromium -Cr, Lead - Pb, Mercury - Hg, etc.). These metals were precipitated in their hydroxide forms. The slurry produced by this reaction met the Plant 8 WWTS requirement of a pH range of 5 to 9.

The neutralization reaction also produced magnesium nitrate which stayed in solution in the neutralized slurry. This resulted in a "high nitrate filtrate" during the solids filtration and was handled separately from other wastewater streams. This filtrate was stored in the site's high nitrate storage tank and the temporary high nitrate storage tank. From there it was metered into the wastewater stream entering the BDN facility where the nitrates were biologically decomposed. The resulting wastewater was subjected to sampling and was shown to be within NPDES specifications prior to discharge to the Great Miami River.

2.3 UNH TRANSFER SYSTEM

A new 3-inch diameter stainless steel transfer piping system was constructed to transfer UNH solutions from each storage tank to the neutralization tanks. Connection of each tank to the transfer system was accomplished either by the use of a flexible braided chemical resistant hose connected to a discharge valve assembly on the bottom of the tank. Each time a new hose connection was made to empty a storage tank, the connection was hydro-tested before the transfer.

The new transfer system used progressive cavity pumps to handle the various liquids involved in the removal action activities. Separate pumps were used to transfer UNH solutions from the storage tanks to the neutralization tanks; to transfer magnesium hydroxide slurry from a storage tanker to the neutralization tanks; and, to transfer the

neutralized slurry from the neutralization tanks to the Plant 8 WWTS. Pumps used to transfer the UNH solutions from the storage tanks were skid mounted to allow them to be positioned at various locations along the transfer system.

2.4 IN-SITU NEUTRALIZATION

A System Operability Test (SOT) was initiated for the newly constructed UNH transfer system in December 1994. During the SOT several problems were encountered that required the system to be turned back over to Construction. In addition to the problems found during the SOT, a piping joint failed on December 28, 1994. An engineering design review team was formed to further evaluate the system. The engineering design review team presented its findings and proposed path forward to U.S. and Ohio EPA on January 20, 1995. Due to problems with the equipment and safety concerns, this date for start-up was missed.

DOE and FERMCO proposed to Ohio EPA to begin in-situ magnesium oxide addition to neutralize the UNH. The in-situ processing would allow the UNH solutions to be neutralized, although at a slower pace, while the problems with the transfer system were being corrected. This proposal was approved by Ohio EPA and it was further agreed that the in-situ neutralization constituted start-up of the UNH project and halted any further potential fines or penalties associated with missing the January 17, 1995, start-up required by the DF&O.

The in-situ addition of magnesium oxide began on March 24, 1995 by mid-June four tanks (F1-2, F1-302, F1-303, and F1-308) were neutralized and the fifth tank, F2E-8, was partially neutralized.

2.5 BATCH NEUTRALIZATION

Batch neutralization of the UNH solutions using the revised and newly constructed transfer system began on June 15, 1995. Tanks F1-25 and F1-26 were used as the batch neutralizing tanks. Prior to transferring UNH solution to Tank F1-25 or F1-26, process water was added to the tank to a level calculated to result in a uranium concentration < 100 grams per liter, an acid concentration less than or equal to 1 Normal. The tank was then considered ready to receive UNH solution from the storage tanks.

Following the addition of the UNH solution to the dilution water, the tank agitator was started. Magnesium hydroxide was then transferred from a storage tanker to one of the neutralization tanks (F1-25 or F1-26) using a progressive cavity pump. A chemical operator controlled the total quantity of UNH solution transferred and the flow rate. The flow rate of magnesium hydroxide was adjusted to allow the neutralization/precipitation reaction to occur at an optimum rate and varied based on the solution in each storage tank. Magnesium hydroxide was transferred to reach a pH of greater than 6.0. The quantity to be transferred was a direct result of the bench-scale testing. An operator monitored the pH indicators, and an automatic recorder monitored the neutralization tank pH as it rose. The recorder results were used to further refine the neutralization process by allowing a comparison between the metered magnesium hydroxide feed rate and the solution pH increase over time. After the addition of the metered amount of magnesium hydroxide, bagged magnesium oxide and/or bagged lime were manually added to the solution to ensure a complete reaction and to adjust the final pH, if needed. Batch neutralization of the FEMP's UNH inventories was completed on August 30, 1995, approximately one month before the DF&O mandated completion date of September 25, 1995.

2.5.1 Process Controls

In order to control and refine the UNH neutralizing, three types of samples were taken during neutralizing: operation/process sampling, in-process sampling, and analytical laboratory samples.

Operations/Process Sampling

Probes to monitor pH were installed in the dilution/neutralization tanks (F1-25 and F1-26) to provide operators with a continuous recorded reading on the liquid pH during the neutralization process. The pH indicators were also used to control the rate and quantity of magnesium hydroxide addition to the process. Once the desired pH was reached, a sample was collected from the tank and analyzed for pH using a bench pH meter. The bench pH meter was used to resolve any concerns about the accuracy of the pH probes in the tanks.

Thermocouples were also installed in neutralization Tanks F1-25 and F1-26 to provide a continuous, recorded temperature during dilution and neutralization. The temperature was monitored to control the mixing rate as a means to control the neutralized liquid temperature and, thus, control NO_x generation.

In-Process Sampling

In-process samples were taken and field analyzed using portable equipment to monitor for the presence of uranium and to measure pH.

The presence of uranium was determined by using a dimple plate screening technique which used potassium ferrocyanide and glacial acetic acid. If uranium was present in a drop of the sample, the dimple would turn green. This analysis was qualitative and would detect uranium present in concentrations well below the Plant 8 filtrate discharge limits of 0.048 grams of Uranium per liter (g-U/l). If there was an indication that uranium was present, laboratory analysis was required to determine the quantitative uranium concentration and whether it exceeded the transfer limit of 48 mg/L per FEMP procedure. If the limit was

exceeded, additional magnesium hydroxide would have been added to the solution to further precipitate the uranium until the limit was attained. The pH sample was analyzed using a bench top portable pH meter which provided a cross check for the tank pH probes.

Analytical Laboratory Sampling

Samples were periodically extracted from in-process liquid, filter cake, and filtrate and transported to the Analytical Laboratory for chemical analysis. Sampling was routinely performed on the diluted UNH for uranium inventory accountability, on the filtrate prior to its discharge to the General Sump, and on the filter cake to confirm its suitability for disposition.

2.6 EQUIPMENT DECONTAMINATION

Following removal of the UNH solutions, the storage tanks and ancillary equipment, as described below, were decontaminated with process water.

2.6.1 Tank Decontamination

After all UNH solutions were removed from a storage tank, the tank was inspected. Using a spray nozzle, process water was applied to the internal tank surfaces to remove any remaining solids. The solids were then transferred for neutralizing to Tank F1-25 or F1-26. After the solids were removed, or if solids were not present, the internal surfaces of each emptied storage tank were rinsed. Following the rinse, the rinseates were transferred for neutralizing to Tank F1-25 or F1-26. A sample of the final rinseate was collected and an analysis performed. If the pH of the rinseates was above 2, and the heavy metals concentrations below the levels specified by the Ohio Closure Plan Review Guidance Interim Final, September, 1993 the rinse was deemed to be complete and the tank was deemed decontaminated. The results of the rinseate analyses for each tank and the rinse standards are provided in Table 2-2.

Table 2-2, Tank Rinseates Analysis and Rinse Standards

Tank ID Number	pH	lead (mg/l)	barium (mg/l)	chromium (mg/l)	mercury (ppb)	total uranium (mg/l)
D1-1	7.16	0.004	<0.200	0.367	<0.2	9.8
D1-2	7.16	0.029	<0.200	0.334	<0.2	9.0
D1-3	7.90	0.030	<0.200	0.061	<0.2	1.3
D1-10	5.54	0.004	<0.200	0.153	0.2	50.8
F1-1	7.71	<0.020	<0.200	0.010	<0.2	8.4
F1-2	8.58	0.008	<0.200	0.188	<0.2	21.0
F1-301	7.18	0.024	<0.200	0.162	<0.2	863
F1-302	8.94	<0.020	<0.200	0.054	<0.2	15.6
F1-303	8.63	0.043	<0.200	0.204	<0.2	31.1
F1-308	9.24	0.029	<0.200	0.538	<0.2	30.4
F2E-5 (SE)	5.57	0.102	0.823	0.129	<0.2	277
F2E-6 (NE)	6.89	<0.003	<0.200	0.032	<0.2	32.3
F2E-7 (NW)	3.97	0.089	0.39	0.253	<0.2	305
F2E-8 (SW)	5.56	0.102	0.852	0.124	<0.2	275
F2-605	9.67	<0.020	<0.200	<0.010	<0.2	5.5
F2-606	9.19	<0.020	0.217	0.030	<0.2	13.9
F2-607	9.32	<0.020	<0.200	0.023	<0.2	8.3
F2-608	9.55	<0.020	<0.200	<0.010	0.2	2.8
F3E-220	7.00	0.028	<0.200	0.116	<0.2	2.4
F3E-223	7.12	<0.020	<0.200	<0.010	0.3	25.4
F1-25	9.55	0.096	<0.2	0.087	1.86	38.7
F1-26	9.38	0.079	<0.2	0.089	0.44	12.7
Rinseate standards[1]	<12.5 >2.0	0.6	1.0	1.0	30.0	NA

[1] Rinseate standards are based on criteria established in Section 3.10 of Ohio Environmental Protection Agency (OEPA) Closure Plan Guidance, Interim Final, September 1, 1993.

2.6.2 Ancillary Equipment Decontamination

In support of this removal action, portions of the old UNH transfer system that connected the storage tanks were removed. This ancillary equipment consisting of old piping, valve assemblies, and line connectors were containerized in white metal boxes and decontaminated by rinsing in the white metal boxes. Samples of the rinseates were collected and analyzed to verify decontamination. The analytical results of the rinseate samples are provided in Table 2-3.

2.7 WASTE MANAGEMENT

The wastes generated during the UNH project are tabulated in Table 2-4.

2.7.1 Filtration of Neutralized Slurry

Following the neutralization of the UNH solutions in either Tank F1-25 or F1-26, the neutralized slurry was transferred to storage tanks at Plant 8. The slurry was then processed through the EIMCO™ rotary vacuum filters to separate the precipitated solids from the liquid (Photograph 3). The solid filter cake was drummed and the liquid (filtrate) was transferred to the Filtrate Receiver, Tank 25A.

Once the filtrate receiver tank was full, verification samples were taken and analyzed for uranium and pH. The filtrate water was processed through the FEMP's General Sump, Plant 8 WWTS, and BDN facility, as required, before discharge in accordance with the FEMP NPDES discharge permit.

2.7.2 Drumming of Filtered Solids

As stated above, solid filter cake from the neutralized slurry were collected in 55-gallon drums. A total of 2,100 drums of solids were filtered from the neutralized slurry. Verification sampling was periodically performed on the drummed material as required by the sampling and analysis plan in the RA No. 20 Work Plan and the NTS WAC.

Table 2-3, Rinseate Analytical Results

Sample No.	Box No.	pH	Pb (mg/l)	Ba (mg/L)	Cr (mg/L)	Hg (mg/L)
407-2-2	739340	6.41	<0.027	<0.2	0.09	<0.0002
407-2-3	739629	7.38	<0.027	<0.2	0.02	<0.0002
407-2-5	653854	4.52	<0.027	0.224	0.155	<0.0002
408-2-2	04376	8.87	<0.027	<0.2	0.08	<0.0002
408-2-3	654146	9.20	<0.027	<0.2	<0.01	<0.0002
408-2-4	654798/ 654788[1]	9.19	<0.027	<0.2	<0.01	<0.0002
408-2-5	739328	9.26	<0.027	<0.2	<0.01	<0.0002
408-2-7	739849	9.23	<0.027	<0.2	0.024	<0.0002
Rinseate standards[2]		>2.0 <12.5	0.6	1.0	1.0	0.03

[1] Box No. 654788 was only one half full and, therefore, combined with Box No. 654798.
[2] Rinseate standards are based on criteria established in Section 3.10 of OEPA Closure Plan Guidance, Interim Final, September 1, 1993.

Table 2-4, UNH Projects Wastes Generated

WASTE	VOLUME	CONTAMINANT	DISPOSITION
Recyclable PPE	16,200 LB	Rad	Clean and reuse.
Trash and non-recyclable PPE	2,507 CU. FT.	Rad	Compacted, shipped off site.
Filtered solids	15,750 CU. FT.	Rad	Stored on site pending disposition at NTS.
Wastewater	160,000 GL	Rad	Treat in FEMP WWTS
Filtered solids, Nitric Acid/Residual Waste Project	105 CU. FT.	Rad	Stored on site pending disposition at NTS.
Organic liquids, Nitric Acid/Residual Waste Project	700 GL	Rad	Shipped to Oak Ridge TSCA incinerator 8/21/96.

2.8 SAFETY AND HEALTH

A Safety Analysis Report (SAR), as required by DOE Order 5480, was prepared for the UNH project prior to commencement of neutralization. The SAR identified the safety basis and operating limits for the project. A Project Specific Health and Safety Plan was prepared to support the field activities. Requirements for personal protective equipment (PPE) for operators were specified by the project Specific Health and Safety Plan as well as the Radiological Work Permits (RWP) issued to support the project as required by site procedures.

2.8.1 NO_2

During the neutralization of UNH, the heat of reaction could produce nitrogen dioxide (NO_2). Precautions were taken to protect operators from exposures to this gas. Airline respirators were worn by maintenance personnel in the work areas at the times when the gas could be generated. In addition to the airline respirators, both personal and area monitors were used.

Two MDA™ Scientific Single Point Monitors were used for NO_2 area monitoring. These monitors had unique klaxon-sounding alarms, which readily distinguished them from other alarms in the Plant 2/3 complex. These alarms were set to alarm at a concentration of one-half part per million (ppm) NO_2.

Ten Metrosonic™ pm--7700 personal monitors were used by operators in the process areas. Whenever any work was done at the UNH project where NO_2 could be released, workers wore the Metrosonics™ monitors. If workers were in air-purifying respirators equipped with high efficiency particulate air-filter (HEPA) cartridges, which did not provide protection from NO_2, the Metrosonics™ instrument was set to alarm at 0.5 ppm. The airline respirator, however, was approved for use in atmospheres with up to 15 ppm NO_2, so workers using airlines wore Metrosonics™ monitors set to alarm at 15 ppm.

In the event of an alarm from either the MDA™ or the Metrosonics™ monitors, workers would exit the UNH processing area. The Industrial Hygiene (IH) technician assigned to the UNH project would then be notified to check out the instrument and the area where the alarm occurred.

NO_2 was rarely detected; however, the Metrosonics™ monitors occasionally would sound a false alarm when exposed to radio frequency interference caused by transmissions from 5-Watt FM two-way radios. The MDA™ single point monitors occasionally had false alarms when the internal absorbent canister and filter plugged up or the paper indicating tape ran out. All alarms were treated as real until verified to be otherwise. The monitors did detect significant NO_2 (greater than or equal to 0.5 ppm NO_2) during the following incidents when UNH solution was present.

01/18/95 While taking readings, or outages, on UNH tanks, monitor alarmed over tank D1-10. Short-term exposure limit (STEL) NO_2 concentration was 0.0 ppm, peak concentration was 6.0 ppm.

03/24/95 During in-situ neutralization of Hot Raffinate Building Tanks 302 and 303, MDA™ alarmed at 0.7 ppm NO_2. Building was cleared and ventilated.

04/04/95 When a Maintenance crew was disconnecting steam coil lines beneath UNH Tank D1-1 in Digestion Area of Refinery, approximately 3 gallons of UNH sprayed out. Pipefitters in air-purifying respirators with acid gas/organic vapor/HEPA cartridges and Saranex™ chemical protective coveralls were hosed down and left the area. Estimated STEL to the pipefitters was 2.2 ppm. None smelled any NO_2. MDA™ monitor at control point showed 5.9 ppm NO_2 when observed by departing IH technician.

04/24/95 During in-situ neutralization of Tank 308, personal monitor alarmed. NO_2 STEL concentration was 0.3 ppm, maximum concentration was 0.9 ppm. No further alarms occurred after an exhaust was added to one of the other tank ports.

04/24/95 While removing line from bottom of Tank F1-1, MDA™ alarmed at 0.6 ppm NO_2. Workers left area.

05/05/95 Personal NO_2 monitor alarmed when worker approached a bucket used to catch UNH from a line being removed from Tank F-308. STEL concentration was 0.0 ppm, maximum concentration was 1.1 ppm.

05/10/95 Personal NO_2 monitor alarmed when pipefitters tried to break UNH line inside NFS pump house. STEL NO_2 concentration was 0.0 ppm, maximum concentration was 1.7 ppm.

05/11/95 While pipefitters wearing airline respirators were draining UNH lines in NOS pump house, STEL NO_2 concentration was 2.7 ppm, maximum concentration was 10.4 ppm.

07/17/95 A draft from the outdoor CD Blend tank area apparently carried NO_2 into the Digestion Area through an open door on the second floor setting off the MDA™ at Tank F1-26.

A NO_2 fume scrubber was installed on the UNH process Tanks F1-25 and F1-26 to enhance the exhaust ventilation. Operation of the fume scrubber was limited to the process steps with the potential of generating NO_2. The scrubber was operated when receiving UNH or rinse water from a UNH storage tank or when magnesium hydroxide was being added to the dilute UNH solutions.

2.10 NITRIC ACID/RESIDUAL WASTE

The Nitric/Acid Residual Waste Work Plan was submitted as an Addendum to the RA No. 20 Work Plan. This project addressed the contents of tanks F1-23, F1-24, D1-7, and D1-11. The work plan for this addendum was accepted by Ohio EPA on August 23, 1995, and approved by U.S. EPA on August 31, 1995.

2.10.1 Nitric Acid Neutralizing

Tanks F1-23 and F1-24 were components of the Nitric Acid Recovery (NAR) System. Neutralizing of the nitric acid stored in these tanks began on September 8, 1995. Three batches of nitric acid were transferred from these two tanks into Tank F1-25 and neutralized by adding magnesium hydroxide. A fourth batch of nitric acid was transferred into Tank F1-26 and held for use in processing the materials in Tanks D1-7 and D1-11. The total volume of nitric acid removed from Tanks F1-23 and F1-24 was approximately 30,000 gallons. Decontamination of Tanks F1-23 and F1-24 was completed on September 15, 1995. Results of rinseate samples collected from these tanks showed that the residual contamination was below required clean-up levels. This data is provided in Table 2-5.

2.10.2 Tank D1-7 and D1-11 Processing

A Readiness Assessment (RA) for processing the waste in Tank D1-7 was completed on September 18, 1995. The liquid contained in Tank D1-7 had both an aqueous and an organic component. The organic component was transferred from Tank D1-7 into 14 drums. The drummed liquid was bulked and shipped to the TSCA Incinerator at Oak Ridge, Tennessee in the Fall of 1996 in accordance with the facility waste acceptance criteria. After Tank D1-7 was emptied, it was rinsed using Alconox and process water to remove residual organics. Samples of the rinseate were collected for analysis. The analytical results (Table 2-5) confirm that the tank has been decontaminated.

Table 2-5, Tanks F1-23, F1-24, D1-7 and D1-11 Rinsate Results

Tank ID Number [1]	pH	lead (mg/l)	barium (mg/l)	chromium (mg/l)	mercury (ppb)	total uranium (mg/l)
F1-23	9.05	< 0.021	< 0.200	0.054	<0.2	0.3
F1-24	9.29	<0.021	<0.200	0.025	<0.2	< 0.1
D1-7	8.96	< 0.024	<0.200	0.012	< 2.0	5.5
D1-11	7.68	0.028	<0.200	<0.010	< 2.0	1.3
Rinseate Standards[1]	> 2.0 < 12.5	0.6	1.0	1.0	30.0	N/A

[1] Rinseate standards are based on criteria established in Section 3.10 of OEPA Closure Plan Guidance, Interim Final, September 1, 1993.

The Tank D1-7 aqueous component was transferred to Tank D1-11. Addition of the aqueous phase from Tank D1-7 successfully dissolved the crystals that were present inside Tank D1-11. The liquid in Tank D1-11 was transferred to Tank F1-26 for neutralization. Neutralization of the liquid was accomplished by adding bagged magnesium oxide to the agitated liquid inside Tank F1-26. After treatment, the neutralized slurry was transferred to Plant 8 for processing.

Tanks D1-11, F1-25, and F1-26 were decontaminated using pressure water spray on the internal tank surfaces. Analytical results of Tank D1-11 rinseates are provided in Table 2-5 and results for F1-25 and F1-26 are provided in Table 2-2.

3.0 CONCLUSIONS

The objective of RA No. 20 was the safe removal and neutralization of the FEMP's inventory of UNH, decontamination of UNH and NAR storage tanks, and drumming and dispositioning of the solids filtered from the neutralized slurry.

A total of 205,000 gallons of UNH was neutralized and filtered safely and effectively. The magnesium diurnate slurry (neutralized UNH) was filtered in Plant 8 producing 2,100 drums of filter cake. The filter cake has been tested and meets the WAC for disposal at the NTS. Shipment of the filter cake is on-going. As of September 30, 1996, 15,022.5 cubic feet of filter cake had been shipped to NTS. The resulting rinsate was processed through the FEMP WWTS.

The tanks that were used to store the UNH solutions were decontaminated and verified RCRA-clean through laboratory analyses of decontamination rinseate samples.

The objectives of the Nitric Acid/Residual Waste Project, which was completed as an addendum to RA No. 20, included the removal of organic liquids from Tank D1-7, removal and neutralization of nitric acid residues stored in Tanks F1-23 and F1-24 (Nitric Acid Recovery System), and removal of UNH crystals from Tank D1-11. These objectives were also successfully met.

The organic and low pH water in Tank D1-7 was removed and contained in fourteen drums. This material was bulked and shipped to the incinerator at Oak Ridge, Tennessee, in the fall 1996. Tank D1-7 was decontaminated and analysis of rinseate samples from the tank demonstrates that it is RCRA-clean.

Thirty thousand gallons of nitric acid were removed from Tanks F1-23 and F1-24 and neutralized. These two tanks were cleaned and analyses of rinseate samples demonstrated that the tanks were RCRA-clean.

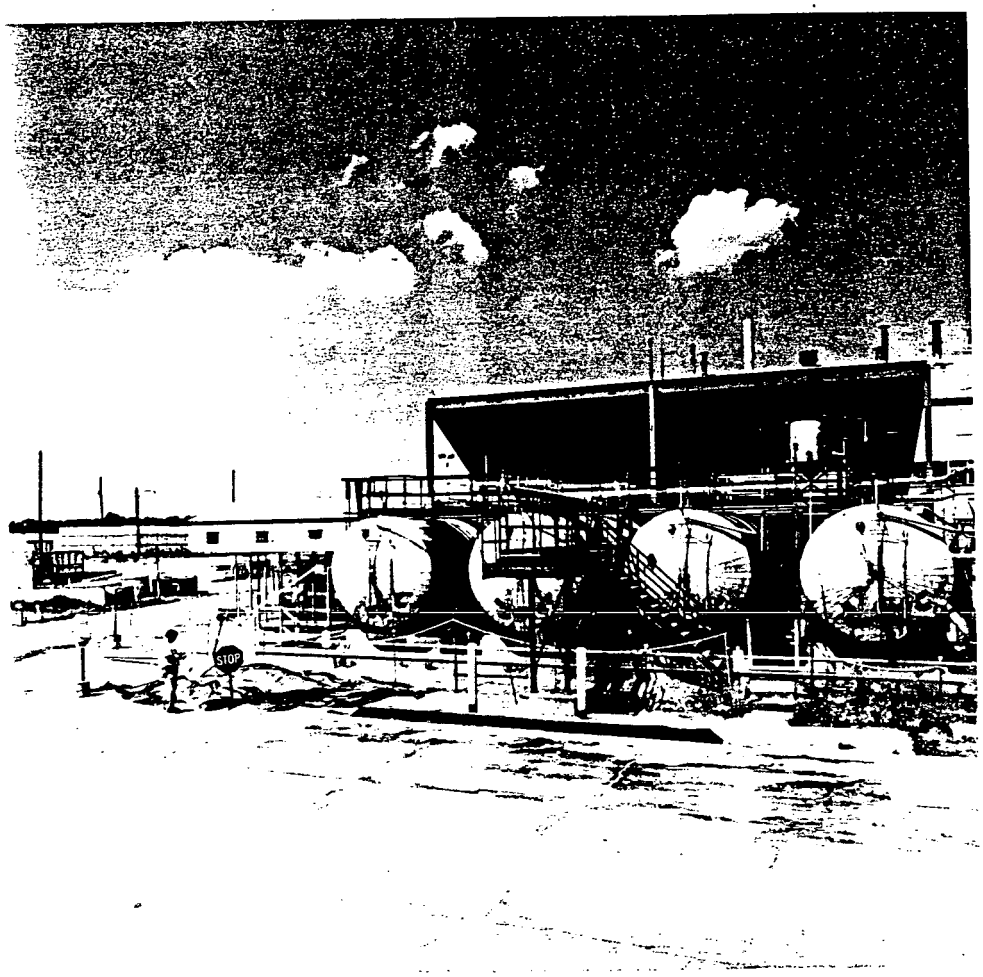
The UNH crystals that had formed in Tank D1-11 were solubilized, removed, and treated. Analyses of samples of the decontamination rinseates from this tank demonstrate that it is RCRA-clean.

All of the activities completed under RA No. 20 were safely completed.

PHOTOGRAPHS

PHOTOGRAPH 1

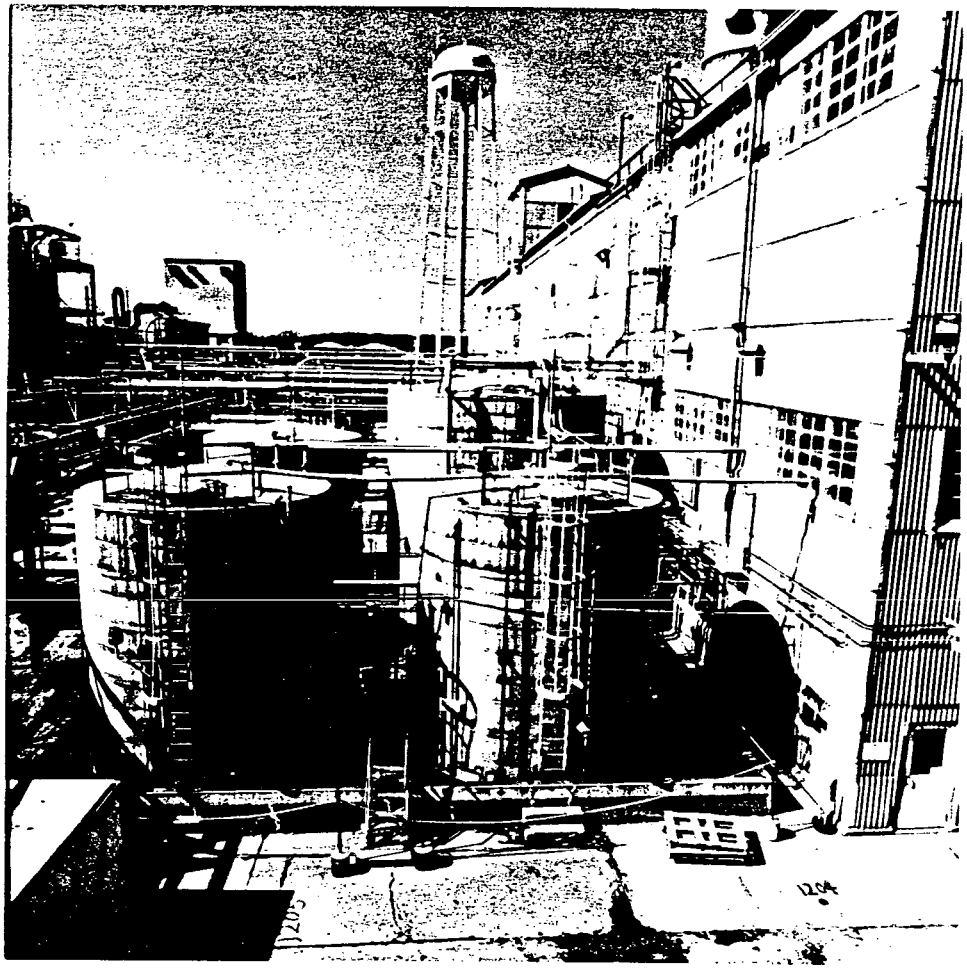
NFS Storage Area
Contains Tanks F2-606. F2-607, F2-607, and F2-608
(looking north)



photograph #5998-113

PHOTOGRAPH 2

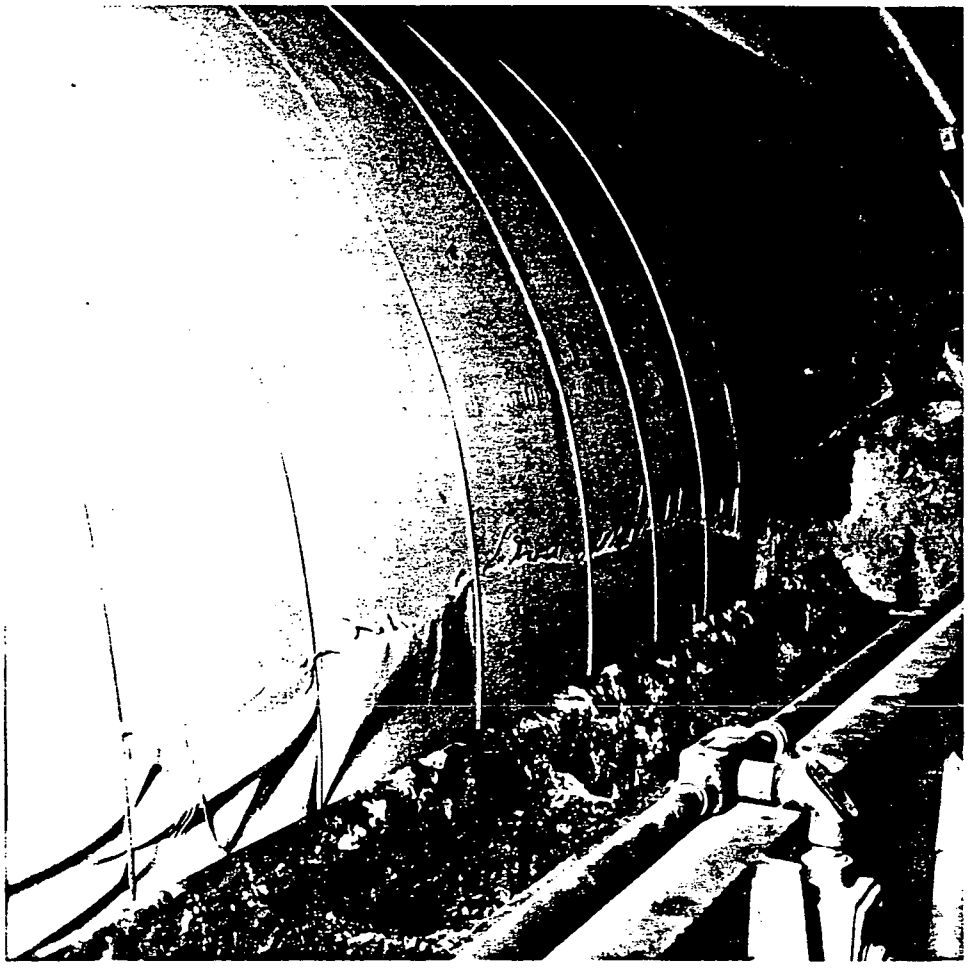
OK Liquor Tanks
Southeast of the Plant 2/3 Area
(looking west)



photograph #55649-2

PHOTOGRAPH 3

EIMCO™ Vacuum Filter
Inside Plant 8



photograph #5879-13