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FMPC WASTE INVENTORY DATA - (USED AS A REFERENCE IN OU1 RI AND OU1 FS)

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# NLO, Inc.

A SUBSIDIARY OF NL INDUSTRIES, INC.

CINCINNATI, OHIO 45239

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under NLO

SUBJECT FMPC WASTE INVENTORY DATA

TO W. J. Grannen

FROM T. A. Poff

REFERENCE

In accordance with discussions between NLO (P. I. Campisi and T. A. Poff) and Frost & Jacobs (Bill Hawkins), attached are the following items concerning quantities and characteristics of wastes stored at the FMPC site.

1. Revised Report of Pit and Silo Construction History
2. FMPC Waste Inventory
3. Elemental Constituents of FMPC Pits and Silos
4. Sketch of FMPC Waste Management Facilities (Preliminary)

T. A. Poff

T. A. Poff

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Attachment

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# FMPC WASTE STORAGE PITS AND SILOS

The FMPC has used two types of facilities for the long term storage of low-level radioactive wastes: above-ground concrete silos and in-ground pits. There are four waste storage silos and six waste storage pits in the FMPC waste storage area, which is located west of the Production area (Figure 1).

The six waste pits are identified by number based on the chronological sequence of their construction. They are further identified as "dry" or "wet" pits, based upon the physical state of waste materials as they were placed into the pits. If the material was pumped into the pit as a slurry, the pit is known as a wet pit. If the material was dumped as a dry solid, the pit is a dry pit. Pits 3 and 5 are wet pits; Pits 1, 2, 4, and 6 are dry pits. As pits have been filled, they have been stabilized by covering with clean uncontaminated fill and grading to provide surface drainage away from the contained waste. Pits 1, 2, and 3 have been filled and are now covered in this manner. Pit 5 no longer serves as a settling basin, but filtered effluent still flows across the pit prior to discharge. Pits 4 and 6 are not yet filled; Pit 4 currently receives limited waste streams which cannot otherwise be effectively handled, and Pit 6 is not currently in use as an active waste pit.

The four waste storage silos are large cylindrical concrete structures which were used to store radioactive wastes generated during the first decade (1952-1959) of the FMPC's operations. Silos 1, 2, and 3 are filled and no longer in use; Silo 4 has never been used and remains empty.

The pits and silos are located inside the patrolled security area of the FMPC. Monitoring of these facilities includes daily inspections, groundwater monitoring wells, surface water sampling, and site boundary air sampling.

## Pit 1

**Constructed:** 1952 **Cost:** Est. $24,000.00

**In use:** 1952 - Mid 1959

**Construction:** Pit 1 was originally an "in-ground" facility which was constructed by digging a large basin into the existing native clay and then lining parts of the bottom with an additional 4 feet of clay. The capacity of the pit was expanded in 1957 when excavated spoil material from the construction of Pit 2 was used to build up the berm an extra 5 feet on the west side.

**Dimensions:** Original maximum depth = 17 feet; original volume = 29,000 cy
Expanded maximum depth = 17 feet; expanded volume = 40,000 cy

**Pit Operation:** During the period 1952-1959, there was no need for a settling lagoon for FMPC waste streams. Waste slurries were filtered or calcined to remove water from the solids, and the filter cakes or calcined dry waste was placed in one of the concrete silos. Other solid wastes were placed in Pit 1. (During 1958-1959 Pit 1 was used as a clearwell for Pit 2.)

**Pit Contents:** Pit 1 received the following radioactive wastes: neutralized waste filter cake, sump cakes from the production plants, depleted slag, scrap graphite, contaminated brick, and sump liquor. Current waste volume contained in the pit is 40,000 cubic yards (40,500 MT), containing 52,000 kg U (0.71% $^{235}U$).

**Comments:** Pit 1 was constructed with 8" decant pipes through the west berm. These decant pipes were rarely used during the pit's operating life.

## Pit 2

| | | |
|---|---|---|
| Constructed: | 1957 | Cost: $25,573.00 |
| In use: | 1957 - Mid-1964 | |

**Construction:** Pit 2 was constructed in the location of a small pond northeast of Pit 1. The pit is an in-ground facility which was constructed by excavating a basin into the existing native clay.

**Dimensions:** Maximum depth = 13 feet; volume = 13,000 cy.

**Pit Operation:** As with Pit 1, filter cakes and solid waste were placed in Pit 2. During 1958-1959, it became necessary to use Pit 2 for the disposal of neutralized, concentrated Refinery raffinate residues because the drying equipment available could not process all of the raffinate output. The remaining capacity of Pit 1 was used as a clearwell for the effluents going to the Great Miami River.

**Pit Contents:** Pit 2 received the following radioactive wastes: neutralized waste filter cake, sump cakes from the production plant, depleted slag, scrap graphite, contaminated brick, and sump liquor. It was also used as a settling pond for neutralized raffinate residues for about one year prior to the completion of Pit 3. Current waste volume contained in the pit is 13,000 cubic yards (13,000 MT), containing 1,206,000kg U (0.21% $^{235}U$). and 400 kg of thorium.

**Comments:** Like Pit 1, Pit 2 was constructed with 8" decant pipes through the west berm. These decant pipes were rarely used during the pit's operating life.

## Pit 3

**Constructed:** 1958 - June 1959 Cost $163,298.00

**In use:** June 1959 - October 1968 (as settling pit)
1975-1977 (remaining capacity filled with solid waste)

**Construction:** Pit 3 was constructed by excavating a large basin down into an underlying layer of blue clay, which provided an impervious base for the bottom as well as a lining for the walls. A minimum of 12" of compacted clay was used to line the inner slopes of the walls. In 1965, the pit capacity was expanded by adding 2 feet of additional material to the top of the pit walls. The pit consisted of a large settling basin with a concrete spillway overflowing into a clay-lined clearwell.

**Dimensions:** Original maximum depth = 25 feet; original volume = 226,500 cy
Expanded maximum depth = 27 feet; expanded volume = 248,500 cy

**Pit Operation:** Pit 3 was the first "wet" pit built specificallly for the purpose of settling solids from wet waste streams. The waste slurries were pumped from Plant 8 and the General Sump into the pit, with the clarified effluent overflowing the spillway into the clearwell prior to discharge to the Great Miami River.

**Pit Contents:** The principal waste contained in Pit 3 is lime-neutralized radioactive raffinate concentrate. In December 1958, lime sludge from the Water Treatment Plant began being added to supplement the lime used for raffinate neutralization. During the late 1960's large quantities of radioactive slag leach residues were pumped to Pit 3 until October 1968, when Pit 5 took over as the settling basin. From 1975 to 1977, solid wastes (filter cake and fly ash) were used to complete the filling of the pit.

Current waste volume contained in the pit is 227,000 cubic yards (255,000 MT), containing 129,000 kgU (0.78% $^{235}U$), and 400 kg of thorium.

**Comments:** Following the filling of the pit in 1977, clean fill was placed over the contained wastes as they stabilized and were capable of supporting the earth burden. Surface water drainage from the mounded pit cover flows too the clearwell prior to discharge to the Great Miami River.

## Pit 4

**Constructed:** 1960 **Cost:** $35,716.00

**In us:** August 1960 - Present

**Construction:** Pit 4 was constructed in the same manner as Pit 3, by excavating down into the underlying clay strata to provide impervious material for lining the pit walls and bottom. A minimum of 12" of compacted clay was used to line the inner slopes of the pit walls.

**Dimensions:** Maximum depth = 24 feet; volume = 53,000 cubic yards

**Pit Operation:** Solid wastes are dumped from a concrete dumping pad and pushed into the pit by a bulldozer. Rainwater which collected in the pit was drained to Pit 3 until it became filled (approximately 1977). Rainwater is now pumped to Pit 5 as necessary.

**Pit Contents:** Pit 4 has received the following radioactive wastes: Plant 8 trailer cake, process residues, contaminated graphite, and non-burnable trash. Current waste volume contained in the pit is about 50,000 cubic yards (64,866 MT), containing 3,000,371 kgU (0.18% $^{235}U$), and 61,700 kg of thorium. Between May 1981 and April 1983, Pit 4 also received 23,499 pounds of low-level radioactive waste containing barium chloride salt.

**Comments:** Pit 4 is currently is use, but materials placed there are now restricted to radioactively contaminated construction rubble, asbestos, and graphite. New groundwater monitoring wells have been installed down gradient from Pit 4.

## Pit 5

**Constructed:** July 1968 - December 1968 Cost: $220,000.00

**In use:** October 1968 - August 1983

**Constructed:** Pit 5 was constructed by cut and fill, using the excavated material to build a dike, extending the pit approximately 10 feet above grade. The pit is lined with 60 mil thick Royal-Seal EPDM Elastomeric Membrane (Uniroyal).

Water percolation was encountered during excavation of the pit. These porous seams were excavated and filled with clay prior to installing the liner.

**Dimensions:** Maximum depth = 30 feet; volume - 115,000 cubic yards

**Pit Operation:** Wastes from the Refinery and Plant 8 were pumped in the form of a thin slurry to the pit which served as a settling basin. The clarified effluent flowed by gravity to the clearwell from which it was discharged to the Great Miami River. As of August, 1983, solids in the waste streams were removed by filtration prior to being pumped to Pit 5. Process effluent still flows across the pit, but the pit is no longer used for settling solids.

**Pit Contents:** Pit 5 contains the following radioactive wastes: settled solids from neutralized raffinate, slag leach slurry, and sump slurries. Water Treatment Plant lime sludge was also added to supplement the lime used for raffinate neutralization. Current waste volume contained in the pit is approximately 102,500 cubic yards (87,753 MT), containing 50,261 kgU (0.83% $^{235}U$), and 17,000 kg of thorium.

**Comments:** The EPDM liner in Pit 5 has proven to be extremely durable and resistant in regard to attack by chemicals or sunlight. Occasional joint failures and tears have been observed and repaired.

## Pit 6

**Constructed:** September 1978 - June 1979 **Cost:** $130,000.00

**In use:** June 1979 - March 1985

**Construction:** Pit 6 was constructed in the same fashion as Pit 5, with a 60 mil EPDM Hydroseal liner from American Hydrotech. During excavation water percolation was encountered.

**Dimensions:** Maximum depth = 24 feet; volume = 14,000 cubic yards

**Pit Operation:** Contaminated solid wastes are dumped into Pit 6 and then bulldozed or clam-shelled into the center of the pit. Only non-coarse, non-pyrophoric wastes have been placed in the pit to date, in order to build a protective layer over the membrane liner. Collected rainfall is pumped to Pit 5 for discharge via the clearwell.

**Pit Contents:** Pit 6 has received the following radioactive wastes: depleted slag, scrap green salt, process residues, and filter cake. Current waste volume contained in the pit is approximately 9,000 cubic yards (6,601 MT), containing 427,857 kgU (0.19% $^{235}U$).

**Comments:** Pit 6 is not currently in use as an active waste pit. No joint failures or tears have been observed except dumping pad, and these have been repaired as they occur.

## Silos 1 & 2 (K-65 Silos)

**Constructed:** 1951 - 1952

**In use:** 1952 - 1959

**Construction:** The silos were constructed on-grade with floors of 4" concrete over an 8" layer of gravel containing an underdrain system of 2" slotted pipe draining to a collection tank. Below the gravel is a 2" layer of asphaltic concrete underlain by 18" of compacted impervious clay. The walls are 18" thick pre- and post-stressed concrete with a 3/4" gunite coating on the exterior. The domed roofs are 4" thick reinforced concrete.

**Dimensions:** Diameter = 80 feet; height = 26-3/4 feet to top of wall + 9-1/4 feet to top of dome.
Volume = 1,000,000 gallons or 125,000 cubic feet to top of wall (139,000 cubic feet to top of dome).

**Operation:** Waste raffinate slurries were pumped into the silos where the solids would settle. The clarified liquid was then decanted to a treatment facility through valves placed at 1 foot intervals along the 26 foot height of the silo wall. As the depth of solids reached the level of a valve, it was sealed and the next higher valve used for decanting. Settling and decanting were continued in this way until the silos were filled to approximately 4 feet below the top of the vertical wall.

**Contents:** Silos 1 and 2 contain Refinery residues (K-65) that resulted from the processing of pitchblende ores from South Africa. The material was stored at the FMPC under contract with the supplier of the ore (African Metals Corporation, now Afrimet-Indussa), which retained ownership until July 1983, when DOE agreed to assume ownership. The K-65 is a radioactive solid residue resulting from the acid digestion of pitchblende. It is insoluble in nitric acid and consists mostly of siliceous matter. The radioactivity of the material is caused by the presence of radium. K-65 also contains other insoluble metallic compounds.

Current waste volume contained in the K-65 silos is 195,000 cubic feet (8,800 MT), containing 11,200 kgU (0.71% $^{235}U$), with 1652 grams of radium - 226.

**Comments:** In 1964 the walls of the silos were covered with an earthen embankment to provide long term protection and support, and to minimize gamma radiation levels in the area of silos. In 1979 all tank openings were sealed with gaskets, however, some radon still migrates to the outside. Radon is measured at seven boundary stations and two off-site background locations.

## Silos 3 & 4 (Cold Metal Oxide Silos)

**Constructed:** 1951 - 1952

**In use:** 1952 - 1959

**Construction:** The silos were constructed on-grade with floors of 4" thick reinforced concrete. The walls are 8" thick pre- and post-stressed concrete with 3/4" gunite coating on the exterior. The domed roofs are 4" thick reinforced concrete.

**Dimensions:** Diameter = 80 feet; Height = 26-3/4 feet to top of wall, + 9-1/4 feet to top of dome
Volume = 139,000 cubic feet to top of dome

**Operation:** Waste raffinate slurries were dewatered in an evaporator and spray calciner to produce a dry, powder-like waste form. This calcined waste was pneumatically conveyed to the silo. Excess conveying air was filtered through a bag house dust collector.

**Contents:** Silo 3 contains the calcined residues from FMPC refinery processing of ore concentrates, and contain only the trace of radium not removed in the concentrate process. The residues contain oxides of the metals which were present as impurities in the ore concentrate. Silo 4 has never been used and remains empty.

Current waste volume contained in Silo 3 is 139,000 cubic feet (3,500 MT), containing 18,000 kgU (0.72% $^{235}U$).

**Comments:** The cold metal oxides stored in Silo 3 are not a significant source of radon or gamma radiation.

## Glossary

| | | |
|---|---|---|
| Calcined | = | Waste form achieved by heating to a high temperature in order to dry and oxidize the material. |
| Curie | = | The quantity of any radioactive nuclide in which $3.7 \times 10^{10}$ disintegrations occur per second. For example, 1 curie of radium = 1 gram. A piocurie (pCi) = $1 \times 10^{-9}$ curie. |
| EPDM | = | (Ethylene Propylene Diene Monomer) Synthetic elastomeric liner material. It is chemically resistant to most acids, bases, and salts in solution, and also provides excellent resistance to ozone, heat, and temperature. |
| MT | = | Metric ton; equals 2205 pounds. |
| Raffinate | = | The aqueous waste stream left behind after organic solvent extraction of uranium from nitric acid digested feed slurries. The raffinate, containing nitric acid and non-extractable impurities, is neutralized to precipitate solids and then filtered to produce a raffinate waste filter cake. |
| Scrap Graphite | = | Graphite pieces resulting from breakage of the graphite crucibles used to contain uranium during melting and casting operations. |
| Slag | = | Magnesium Flouride ($MgF_2$) which is formed as a by-product during the reduction of uranium tetraflouride ($UF_4$) by thermite reaction with magnesium metal chips. |

| ILITY | WASTE DESCRIPTION | WASTE QUANTITY | COMMENTS |
|---|---|---|---|
| 1* | Mixed solids, dry | 40,000 $yd^3$ | Retired, cove |
| 2* | Mixed solids, dry | 13,000 $yd^3$ | Retired, cove |
| 3* | Mixed sludges, wet | 227,000 $yd^3$ | Retired, cove |
| 4* | Slags, abrasives, metals, dry | 50,000 $yd^3$ | Full in FY-85 |
| 5* | Mixed sludges, wet | 102,500 $yd^3$ | Full |
| 6* | Slags, misc. materials, wet and dry | 9,000 $yd^3$ | 65% full (75% |
| 1* | High radium tailings, wet | 3,611 $yd^3$ | Full |
| 2* | High radium tailings, wet | 3,611 $yd^3$ | Full |
| 3* | Low radium metal oxides, dry | 5,148 $ft^3$ | Full |
| 4 | --- | --- | Empty, never u |
| : 1* | Wet filter cakes, misc. dry wastes | 18,000 drums | Curbed pad, 45 full |
| : Solvent Bulk* age Tanks | Spent 1,1,1-trichloroethane | 13,000 gallons | Diked, stainle steel tanks |
| dous Waste* : Storage Pad | Solvent Still Bottoms, PCB's | 40 drums | Covered, curbe pad |
| Oil* age Pad | Cutting and cooling oils from machining uranium | 1,481 drums | Controlled, cu pad |
| Metal Pile* | Contaminated iron and steel scrap | 8,000 tons | Curbed pad |
| r Scrap Pile* | Contaminated copper motor windings | 1,350 tons | Curbed pad |
| ıry Landfill | Cafeteria waste, misc. trash | 11,500 $yd^3$ | Full-Permit re quested for expansion |
| ;ludge Ponds | Spent lime from Water Treatment Plant | 10,000 $yd^3$ | In-ground unli ponds |
| d Fly Ash Pile | Boiler Plant coal fly ash | 50,000 $yd^3$ | Retired, cover |
| : Fly Ash Pile | Boiler Plant coal fly ash | 33,000 $yd^3$ | Active |

s are low-level radioactive wastes or are contaminated with radioactive materials.