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Mallinckrodt

CORPORATE
ENGINEERING
DIVISION

MALLINCKRODT, INC. - COLUMBIUM-TANTALUM PLANT

ENVIRONMENTAL INFORMATION

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1. INTRODUCTION

1.1 Description Of The Proposed Action

(To be provided by the NRC)

1.2 Alternatives To The Proposed Action

(To be provided by the NRC)

2. FACILITY

2.1 Description Of The Current Operation

2.1.1 Raw Material Storage, Handling, And Grinding

Incoming ore-lots are stored in steel drums within a fenced-in restricted area south of Buildings 705 and 706 indicated on the attached Partial Plot Plan - Figure 1. Ore-lots selected for production are transported by forktruck to a staging area southeast of Building 245. As needed, drums are transported to Building 238 for introduction to the ball mills. Dry dust collectors are used while dumping ore into the mills. Any ore dust collected is dumped into the mills at regular intervals.

Refer to Figure 2 - Processing Flow Chart. Two 5 foot diameter by 6 foot long steel ball mills are used for reduction of the ore particle size. Each mill is charged with 3,300 to 3,800 pounds of ore, 100 gallons of water, and 500 milliliters of 50 percent NaOH solution. After rotation of the ball mills, the ore slurry is pumped to the ore boildown tanks. Water used to rinse the mills is also pumped to the boildown tanks.

Two boildown tanks equipped with internal steam coils are used to concentrate the ore slurry for the subsequent dissolving step. Boil-off steam is vented from the tanks to the atmosphere through blowers, and condensate from the steam coils is collected to be used as distilled water in the K_2TaF_7 crystallization.

2.1.2 Dissolving

Three 5,000 gallon rubber-lined steel tanks are used for this operation. They are vented to the Building 238 west acid scrubber through blowers. Nominally, 20,000 pounds of slurry is charged to a dissolver from the boildown tanks. The ore slurry is charged with 0.11 gallons of 70 percent HF per pound of ore in increments of 50 to 100 gallons depending upon the temperature of the batch. Once a temperature of 75 to 85 degrees centigrade is reached, it is maintained by the addition of more 70 percent HF. Fifteen percent of the volume of the batch is added as 93 percent H_2SO_4. After the batch is digested for 4 hours,

samples are taken. Based upon the results of the samples, the batch is adjusted with 70 percent HF or 93 percent H_2SO_4 until the desired parameters are met. After dissolving is complete, the batch is ready for gangue washing of the unreacted ore (URO).

Dual systems each consisting of three 5,000 gallon rubber-lined steel tanks are used in a 4-stage counter-current mode for URO washing. The wash medium is raffinate from the solvent extraction which has been fortified with 93 percent H_2SO_4. The washing is done by mixing, settling, and decantation of the clears to the next stage. Solvent extraction feed issues as the clears from the first stage, and URO slurry for URO processing/recovery issues from the fourth stage. The wash systems are vented to the Building 238 east acid scrubber through blowers except for two tanks which are vented through blowers to the west acid scrubber.

URO consists of two parts in this context. The portion of the ore which does not dissolve in the previous step contains Ca, Al, Ra, U, Th, and other species present in the original ore charge. This portion amounts to roughly 10 percent of the ore charged, but varies with the type of ore. Another insoluble fraction containing Mn and Fe is produced when the 93 percent H_2SO_4 is charged. The Ra, U, and Th is recovered by washing away the soluble $FeSO_4$, $MnSO_4$, and other soluble compounds from the insoluble fraction with water, filtration of the solid fraction, and drying. The dried URO is packaged in 55 gallon drums for disposition.

2.1.3 Processing Ta/Cb solutions

The clear solution from the first URO washing stage is held in either a 3,000 or 5,000 gallon rubber-lined steel tank for final adjustment to solvent extraction feed. The vessels used for feed preparation are vented to the Building 238 east acid scrubber. After adjustment, the feed solution is pumped through a horizontal plate filter to one of two feed storage tanks in Building 246 which is part of the solvent extraction plant.

The purification and separation of the Columbium and Tantalum is carried out by solvent extraction with Methyl Isobutyl Ketone (MIBK) in two mixer/settler systems. In the first system, the Columbium/Tantalum are separated from impurities by extraction into the MIBK. The organic phase is scrubbed with 4M H_2SO_4 for further purification. In the second mixer/settler system, the Columbium is back-extracted into water to separate it from the Tantalum. All streams exiting from the mixer/settler systems are passed through steam stripping columns to remove residual MIBK which is condensed and recycled to the process.

Raffinate to be neutralized is transferred to a 2,000 gallon raffinate hold/feed tank from one of the raffinate storage tanks in the solvent extraction area. Raffinate which is to be used in the 4-stage counter-current URO washing system is transferred directly to that system from the solvent extraction plant. Raffinate to be neutralized is pumped from the hold/feed tank through a fixed line where it is mixed with an equal volume of 24 percent aqueous NH_3 and 1/4 gallon of water per gallon of raffinate. The neutralized raffinate is discarded to the plant sewer system.

Subsequent to the solvent extraction process, the steps which lead to finished solid products include precipitation, filtration, drying and calcining for Columbium Oxide, and crystallization, centrifugation and drying for Potassium Fluotantalate. Radioactive materials are not associated with these final steps which therefore are not included.

2.1.4 Water Supply And Consumption

The Mallinckrodt St. Louis Plant receives its supply water from the City of St. Louis Water Division. Water Use Diagram - Figure 3. shows the average daily water supply and effluent volumes from the C-T process as well as non-contact process cooling water for C-T. The volumes shown are based on current production rates and are averages based on a 365-day year. The cooling tower provides non-contact process cooling water for all of Plant 5.

2.1.5 Process Chemical Storage

93% Sulfuric Acid Storage

A 12,000 .. horizontal steel storage tank is located in Plant 5 yard and i .mospheric tank. The sulfuric acid is delivered in tank trucks. om this tank the sulfuric acid is transferred to a 1,000 gallon vertical steel "Day" tank and then distributed to C-T (Bldgs. 238 and 246).

70% HF Storage Tanks

A 5,000 gal. vertical rubber-lined steel 70% HF storage tank and a 10,000 gal. horizontal steel 70% HF storage tank are located adjacent to Bldg. 236. The HF is delivered in tank trucks. Each tank is protected against over-pressure by a 25 psi rupture disc and emissions from these tanks are scrubbed by a Venturi-type scrubber. Both tanks are located inside a 10,000 gal. concrete dike.

MIBK Storage Tanks

A 6,700 gal. vertical carbon steel tank is located in a diked solvent storage tank farm in Plant 5 yard area. The MIBK is received in tank trucks. From this tank, the MIBK is transferred, as needed, to a 1,000 gal. coated steel vertical storage tank located in a diked area, adjacent to Bldg. 247. The 1,000 gal. tank is used to feed the process.

Anhydrous Ammonia Storage Tank

A 14,000 gal. horizontal steel storage tank is located in the Plant 2 yard area and is designed to handle anhydrous ammonia which is received in tank trucks or railcars. The anhydrous ammonia is absorbed in water in the converter located adjacent to the storage tank. 24% aqueous ammonia is produced and transferred to storage tanks in Plant 5.

The anhydrous ammonia storage tank is protected against over-pressure by a spring loaded relief valve and has a number of other required safety devices.

24% Aqueous Ammonia Storage Tanks

A 20,000 gal. horizontal carbon steel and 10,000 gal. horizontal carbon steel storage tanks are located in Plant 5 yard. These tanks are used to receive, store and transfer 24% aqueous ammonia to C-T. (Bldgs. 238, 247 and 248). Each tank is protected with a conservation vent (8 psi pressure/6 oz. vacuum).

2.2 Waste Confinement And Effluent Control

2.2.1 Liquid Wastes

Natural-uranium, natural-thorium and their respective daughter-products are present in small quantities in the ores processed for their columbium and tantalum values. Virtually all of the U-nat and Th-nat remains in the unreacted ore after processing. Very small soluble quantities are released in the waste stream from the filter presses. Unreacted ore is not released in the waste stream.

Liquid effluent from the C-T Plant commingles with all other effluents from the St. Louis Plant in two 1.1 million gallon equilization basins which comprise Plant 7W. A dilution of approximately 10 to 1 occurs in the equilization basins. The concrete basins are used for pH adjustment of the effluent before discharge to the Metropolitan St. Louis Sewer District POTW.

2.2.2 Residual Solids

Unreacted-ore (URO) obtained from the dissolution and feed liquor separation process is neutralized, filtered, and washed in a press and dried in a steam-heated pancake dryer. Each batch of dried URO is analyzed for radium-226, uranium, and thorium. The URO is a dry solid in the form of chemical oxides which has an average combined uranium/thorium concentration of 1 percent by weight.

The dried URO is packaged in 55-gallon 17H STC drums and stored on-site until enough material has been generated to make a truckload shipment to an NRC or Agreement State licensed facility. After packaging, the drums are physically cleaned, labeled, and surveyed for gamma levels and removable contamination. Building 704 is used to store an approximate maximum of 75,000 pounds of drummed URO at any given time.

Prior to off-site shipment, each drum of URO is resurveyed for gamma levels and wipe tested for alpha surface contamination. All trucks used for these shipments are surveyed for previous contamination prior to loading. After loading, the truck is surveyed to determine DOT compliance. Truckload quantities of URO are shipped via exclusive use vehicles.

2.2.3 Gaseous Wastes

2.2.3.1 Airborne Particulates

Airborne particulates are generated when the ore is charged into the ball mills and when the unreacted ore (URO) is removed from the pancake dryer. The following systems are used to control airborne concentrations.

Ball Mill Charging Station Dust Collector

Each ball mill is equipped with a drum dumper and a bag type dust collector to control any dust created during the charging operation. Each dust collector has a 1200 cfm design which provides 130 fpm face velocity at the hood opening.

URO Dryer Scrubber

The URO dryer scrubber is a 6" steel venturi scrubber and separator system with a standard size nozzle. It uses approximately 10 gpm of once through city water and scrubs approximately 115 cfm.

2.2.3.2 Radon Releases

Control systems are not used at the C-T Plant for removal of the very small quantity of radon present in the air exhaust streams.

2.2.3.3 Fluoride Emissions

Air containing volatile fluorides as hydrofluoric acid is collected by ventilation systems and are passed through the following scrubber systems before being vented to the atmosphere.

West Acid Scrubber (Tanks 328, 3305, 3302, 312, 325)

This scrubber is a 3 ft. dia. counter current packed tower scrubber with 5-1/2 ft. of packing. The air from five 5000 gal. tanks is ducted to this scrubber, which is sized for 2000 cfm. The scrubber uses approximately 43 gpm of once through city water.

East Acid Scrubber (Tank 315, 324, 376, 302, 372, 366, 3317, 3401, 3402)

This scrubber is a 4 ft. diameter counter current packed tower scrubber with 5-1/2 ft. of packing. The air from seven 5000-gallon and two 2300-gallon tanks is ducted to this scrubber, which is sized to handle 4000 cfm using 75 gpm of once through city water.

2.2.3.4 Ammonia Emissions

Air containing ammonia is collected by ventilation systems and passed through the following scrubber system before being vented to the atmosphere.

Ammonia Scrubber (TARP Press, Sump Press, 371, 3315, 3301, Ta Press, 3X5, CRN and CRN Overflow Tank)

This scrubber is a 9 ft. diameter counter current packed tower scrubber with 3 ft of packing. The air from 3 filter presses, 5 tanks and the continuous raffinate neutralizer is ducted to this scrubber which is sized to handle 30,000 cfm with a recirculation rate of 510 gpm and a make-up rate of 5 gpm city water.

2.2.3.5 Other Releases

In addition to the previously described scrubber, C-T has a scrubber on the HF storage tanks, 2 Cb precipitation scrubbers, 2 Cb dryer scrubbers, and a Cb calciner scrubber.

2.2.4 Associated State Or Local Permits And Controls

The State of Missouri delegates authority for air permitting to the City of St. Louis. Below is a list of source permits for air emissions from the City of St. Louis Air Pollution Control Division for the C-T Plant.

Permit No.	Description
3	Cyclone collector, spray jet and high energy scrubber in series - Columbium-Tantalum calciner
7	Water scrubber - Tantalum metal dissolving
22	Spray jet contactor - Second calciner addition
34	No. 1 acid scrubber - Various sources from total dissolving and blend tanks
35, 36	No. 2 acid scrubber - Additional sources from decant and feed tanks
38	Packed scrubber - Horizontal belt filter vacuum system
62, 63	No. 3 acid packed scrubber - Dissolving tanks and hold tanks
64, 65	No. 2 acid scrubber - Additional neutralization tanks
66	Venturi water scrubber - URO dryer
67, 68, 69, 70	No. 3 acid scrubber - Additional sources; crystallizer vents

85 Dust collector - Number 102 ball mill

86 Dust collector - Number 101 ball mill

Liquid effluent discharge, including radioactive materials, is controlled by the Metropolitan St. Louis Sewer District under Ordinance Number 4786.

2.2.5 Decommissioning Plans

At the end of the C-T Plant life, Mallinckrodt, Inc. will elect to either retain the facility under license with the NRC and defer decommissioning to an unspecified date, or proceed immediately with decommissioning of the facility. When the decision is made to decommission the facility, Mallinckrodt will decontaminate the C-T Plant to levels in force for unrestricted use at the time of decommissioning. Mallinckrodt will prepare detailed plans, including removal of licensed materials and decontamination of surfaces, when the decision to decommission the facility is made.

3. THE AFFECTED ENVIRONMENT

3.1 Site Location

The Columbium-Tantalum Plant (C-T Plant) is part of a large complex known as the Mallinckrodt St. Louis Plant. The St. Louis Plant is located within the City of St. Louis at Second and Mallinckrodt Streets in an area zoned for heavy industry. The property is at approximately 38°39'40"N latitude and 90°11'30"W longitude.

3.2 Climatology and Meterology

(To be provided by the NRC)

3.2.1 Climatology

(To be provided by the NRC)

3.2.2 Winds, Tornados, and Storms

(To be provided by the NRC)

3.2.3 Meterology

(To be provided by the NRC)

3.2.4 Air Quality

(To be provided by the NRC)

3.3 Demography and Socioeconomic Profile

(To be provided by ORNL)

3.4 Land

(To be provided by ORNL)

3.4.1 Site Area

The Mallinckrodt, Inc. Columbium-Tantalum manufacturing facility is part of Mallinckrodt's St. Louis Plant manufacturing complex. The St. Louis Plant is comprised of roughly 100 buildings on 18.2 hectares (45 acres) of land spread over 12 city blocks, two miles north of downtown St. Louis, Missouri. Refer to Figure 4 - Plot Plan. The Columbium-Tantalum manufacturing facility occupies approximately 1 hectare (2.5 acres) at the southeast side of this complex. A storage area for Columbium-Tantalum raw materials occupies approximately 0.5 hectare (0.8 acre) in the northeast segment of the site. The remainder of the site consists of other organic and inorganic chemical production units, office buildings, warehouses, workshops, and miscellaneous structures associated with Mallinckrodt's general line chemical manufacturing business. Other major products made at this site are opiates, X-ray contrast media, Stearates, Tannin, Potassium Iodide and Potassium Chloride.

3.4.2 Adjacent Area

The area immediately surrounding the Mallinckrodt St. Louis Plant is used for other heavy industrial manufacturing operations and smaller commercial operations. The plant is bounded by the Mississippi River levee on the East side and by Broadway (St. Louis city street) running parallel to Interstate Rte. 70, on the West side. Nearest neighbors to the plant boundaries include a lumberyard, a scrap steel yard, a paper products warehouse, a piping supply warehouse, a tobacco products distributor, a small eating establishment and a bank. The neighborhood continues with the same commercial mix to the North for several miles until it reaches the residential area of Baden, MO. It continues to the South and merges with the St. Louis downtown area. The area west of Highway 70 is a mixture of residential and commercial neighborhoods stretching some 30 km. before reaching agricultural areas. Across the Mississippi River are the heavy industrial centers of Granite City, Illinois; Brooklyn, Illinois; and East St. Louis, Illinois, along with residential areas in Venice, Illinois. These areas all contain some heavy industry, small manufacturing facilities, residential areas, churches, schools, and shopping centers. There is almost no agricultural use of land within an 8 km. radius of the plant site.

3.4.3 Historic Significance

The Federal Register lists eight National Historic Landmarks (NHL) and one National Historic Site (NHS) within an 8 km. radius of the plant site.

1. Eads Bridge, Spanning the Mississippi River at Washington Ave. (10/15/66) NHL

2. Jefferson National Expansion Memorial Site, Mississippi River between Washington Ave. and Poplar Street (10/15/66)NHS

3. Anheuser-Busch Brewery, 721 Pestalozzi Street, Brew House, Stable & Executive Office (orig. Lyon School) (11/13/66) NHL

4. Goldenrod, 400 North Wharf Street (12/24/67) NHL

5. Wainwright Building, 707 Chestnut Street (5/23/68) NHL

6. U.S. Custom House & Post Office (Old Post Office), 8th & Olive Street (11/22/68) NHL

7. St. Louis Union Station, 18th & Market Streets (6/15/70) NHL

8. Joseph Erlanger House, 5127 Waterman Avenue (12/8/75) NHL

9. Scott Joplin House, 1628a Morgan Street (Delmar)(12/8/76) NHL

3.4.4 Floodplains And Wetlands

The lowest elevation of the C-T processing area corresponds to a river stage of 45.29 feet at the Eads Bridge in St. Louis. None of the recorded flood stages tabulated below have exceeded this level. The Mississippi River levee was completed in 1974. It is designed for a flood stage of 52 feet 0 inches at the Eads Bridge.

Year	Flood stage
1785	42.0 feet (estimated)
1844	41.4 feet (estimated)
1927	36.1 feet
1944	39.1 feet
1947	40.2 feet
1951	40.3 feet
1973	43.3 feet (levee under construction)

3.5 Hydrology

3.5.1 Surface Water

The C-T plant is located three-eighths of a mile west of the west bank of the Mississippi River which is the only surface water in the vicinity of the C-T Plant. No discharges are made to the Mississippi River.

3.5.2 Groundwater

All water used at the St. Louis Plant, which includes the C-T Plant, is provided by the City of St. Louis Water Division which obtains its

water from the Mississippi River. Well water is not used by the St. Louis Plant. The static water table is 7 feet below grade with alluvial clay occurring 10 feet below grade at the C-T Plant. The gradient is toward the Mississippi River.

3.6 Geology, Mineral Resources and Seismicity

(To be provided by the NRC)

3.7 Biota

The affect on terrestrial and aquatic biota is not applicable to the heavy industry city environment of the C-T Plant.

3.8 Background Characteristics

3.8.1 Radiological

(To be provided by the NRC)

3.8.1.1 Total Body Dose Rates

(To be provided by the NRC)

3.8.1.2 Soil, Vegetation and Water

(To be provided by the NRC)

4.0 ENVIRONMENTAL CONSEQUENCES OF PROPOSED LICENSE RENEWAL

4.1 Monitoring Programs and Results

4.1.1 Effluent Monitoring Programs

4.1.1.1 Radiological

Liquid Effluent

Radiometric measurements are made to determine the amount of uranium and thorium present in both the ore processed each month and in the unreacted-ore remaining each month. Any uranium or thorium unaccounted for in the unreacted-ore is assumed to have been present as soluble material in the waste stream as it comes from the C/T facility. Inventory balances for the last two years indicate that no loss is occurring. If we assume maximum errors in our sample collection/measurement system, and maximum throughput of uranium and thorium, the concentrations of U-nat and Th-nat discharged in any one month would be 1/100,000 and 5/100,000 of the respective maximum permissible concentrations (MPCs). Similarly, the total activity discharged in any one year would be 0.06 Ci. Even if it were assumed that 100 percent of the activity was lost to the waste stream, concentration and activity limits would not be exceeded.

Air Effluent

MI currently monitors for airborne particulates at 29 on-site stations each month. Refer to Table 1 for the description of the stations. The highest levels are around the ore milling areas, the URO processing areas, and the incinerator area. Occupancy time in the ballmilling areas and in the URO processing area averages about 20 hours per 7-day work week. The average burn-time of the incinerator is 6.5 hours per 7-day work week.

Radon progeny working-levels are monitored at the same 29 on-site stations each month. The working-levels within all restricted and unrestricted areas are well within NRC limits for unrestricted areas.

Air concentrations and working-levels are under those for which an air monitoring program is required at most of the 29 stations. MI may elect to discontinue monthly sampling and perform quarterly sampling at some of these 29 stations to verify continued compliance.

4.1.1.2 Non-radiological

MI does not have a monitoring program for non-radiological gaseous or liquid effluents from the C-T Plant.

4.1.2 Environmental Monitoring Program

4.1.2.1 Radiological - (on-site and off-site)

On-site

Monthly air samples are taken at the perimeter of the C-T Plant on four sides and at other locations at the St. Louis Plant where ore and URO is stored or handled. Included in these monthly air samples is the point of discharge of the C-T incinerator stack. Liquid effluent release is monitored by the inventory balance method to demonstrate compliance.

Off-site

An off-site radiological environmental monitoring program is unnecessary because of the very low release levels from the C-T Plant.

4.1.2.2 Non-radiological - (on-site and off-site)

MI does not find it necessary to have an onsite or off-site non-radiological environmental program.

4.1.3 Summary of Effluent and Environmental Monitoring Data

4.1.3.1 Air Effluent/Environmental

Airborne concentrations of long-lived particulates are summarized in Table 1. Results of measurements from 1982 through May 1985 are presented. Effluent air is sampled at the boundaries between restricted and unrestricted areas around Building 238. The sampling stations are located at the north, south, east, and west boundaries. The average results given in Table 1 for the boundary samples are repeated below. In addition, effluent air is sampled at the point of discharge from the incinerator. The average burn-time of the incinerator is 6.5 hours per week. Accordingly, the results for the incinerator listed below have been time-averaged by multiplying the values given in Table 1 by the ratio of 6.5 hr/wk divided by 168 hr/wk.

Long-lived Particulates - Microcuries per Milliliter

Year	North-238	South-238	East-238	West-238	Incinerator
1982	3.2E-14	7.1E-14	8.3E-14	7.6E-14	3.2E-14
1983	7.2E-14	4.7E-14	6.3E-14	5.8E-14	1.7E-13
1984	6.8E-14	6.9E-14	1.8E-14	1.0E-13	1.9E-12
1985	8.7E-14	2.0E-13	1.1E-13	1.5E-13	4.9E-13

Working-levels of radon daughter-products are summarized in Table 2. Results of measurements from 1982 through May 1985, are presented. The following results taken from Table 2 include regional radon-daughter background which is on the order of 1.0E-03 working-levels. When the values from Table 2 for the incinerator were corrected by the time-averaging factor (6.5/168), the resulting working-levels were much less than background.

Radon-daughter Working Levels

Year	North-238	South-238	East-238	West-238	Incinerator
1982	2.8E-03	2.6E-03	3.2E-03	2.2E-03	3.3E-05
1983	2.3E-03	2.0E-03	1.8E-03	4.8E-03	5.4E-05
1984	2.6E-03	2.1E-03	2.5E-03	2.2E-03	1.1E-04
1985	2.7E-03	2.5E-03	2.9E-03	2.5E-03	6.2E-05

The above results are well within the permissible air concentrations for long-lived particulates and the working-levels for radon daughter-products.

4.1.3.2 Water Effluent/Environmental

Although soluble U-nat and Th-nat may be released in the waste stream, the quantities are too small for us to measure. Our recent inventory balances indicate that no uranium or thorium is being lost via the waste stream within the statistical errors of our measurement system. Assuming a worst case situation where errors are at maximum, our losses in any one month would be as follows:

1983	Throughput lbs/month	Estimated loss/month
U-nat	128	13
Th-nat	98	10
1984		
U-nat	43	4
Th-nat	104	10

Given:	X = lbs-U/month	(lost to waste stream)
	Y = lbs-Th/month	(lost to waste stream)
	A = 307 uCi/lb-U	(S.A. = 6.77E-7 Ci/g)
	B = 99.2 uCi/lb-Th	(S.A. = 2.19E-7 Ci/g)
	V = 3.7E + 11 ml/month	(total plant flowrate)
	MPC(U) = 1E-3 uCi/ml	(from 10 CFR-20 table)
	MPC(Th) = 6E-5 uCi/ml	(from 10 CFR-20 table)

Then: A * X / V = < MPC (uranium)
And: B * Y / V = < MPC (thorium)

The value 3.7E+11 ml/month listed above is the average discharge rate, excluding evaporation, from the entire St. Louis Plant. The calculated monthly concentrations based on the maximum values above are on the order of 1.1E-8 uCi/ml for uranium, and 2.7E-9 uCi/ml for thorium. These concentrations are many orders of magnitude below the respective MPCs.

307 * 13 / 3.7E+11 = 1.1E-8 << 1E-3 uCi/ml (uranium)
99.2 * 10 / 3.7E+11 = 2.7E-9 << 6E-5 uCi/ml (thorium)

The total activity discharged yearly may also be calculated from the above data. The calculated activities are 0.05 curie for uranium, and 0.01 curie for thorium. The sum of the uranium and thorium activity is 0.06 curie which is only 6 percent of the maximum permissible 1.0 curie/year.

4.2 Direct Effects and Their Significance

4.2.1 Air Quality

(To be provided by the NRC)

4.2.2 Land Use

(To be provided by the NRC)

4.2.3 Water

(To be provided by the NRC)

4.2.4 Ecology

4.2.4.1 Terrestrial Biota

(To be provided by the NRC)

4.2.4.2 Aquatic Biota

(To be provided by the NRC)

4.2.5 Radiological Impacts

4.2.5.1 Doses from Airborne Releases

(NRC will calculate doses)

There is virtually no airborne release of long-lived particulates from the C-T Plant since ore feedstocks are wet ball-milled and subsequent processing steps involve solutions in closed systems. After the crystalline structure of the ore has been fractured by ball-milling, radon gas could possibly be released from exhaust stacks on Building 238. Stack data and distances needed for dose calculations are tabulated below. Also provided is an estimate of the maximum quantity of uranium and radium which could be present in the C-T processing system at any one time.

Distance in feet to MI property lines

Stack	North	East	South	West
1	917	508	261	497
2	886	499	272	507
3	905	497	290	509
4	929	484	249	520
5	928	405	250	600
6	882	382	293	621
7*	882	382	293	621

*Incinerator

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Distance in feet to C-T restricted lines

Stack	North	East	South	West
1	174	153	73	22
2	133	140	87	31
3	161	142	106	33
4	186	128	63	48
5	185	50	60	125
6	140	27	104	147
7*	30	4	6	9

*Incinerator

Nearest residence measured from center of Building 238

Straight distance 819 feet NW (450 feet N, 684 feet W)

Nearest residence to incinerator

Straight distance 1455 feet due W

Stack Descriptions

Stack	Diameter	CFM	Elevation
1	12"	1000	32' 6"
2	6"	1200	27' 9"
3	6"	1200	27' 9"
4	12"	2000	38' 7"
5	17.75" x 14"	3900	37' 3"
6	12"	500	28' 0"
		9800	
7	15"	130*	34' 9"

*At 32 degrees F and 1 atmosphere Temperature at point of discharge is 980 degrees F

Estimated time from ore input to URO output

Process	Hours
Milling	6
Milled ore slurry tanks	48
Total dissolving tanks	48
Extractions (4)	68
Washing	24
Filtering and drying	12
	206

Throughputs of Uranium/Radium-226

Year	Pounds-U	mCi-Ra
1978	1887	283
1979	2367	205
1980	1680	252
1981	1695	254
1982	2655*	398
1983	1536	230
1984	516	77

*Maximum yearly throughput

Fraction of Uranium/Radium present at any one time

$$2655 \frac{\text{lbs-U}}{\text{year}} * \frac{206 \text{ hours}}{8760 \text{ hr/y}} = 62 \text{ lbs-U or } 9 \text{ mCi-Ra}$$

In addition to the above information tabulated for the C-T incinerator, concentrations of long-lived particulates and radon progeny working levels are given in paragraph 4.1.3.1 for the incinerator effluent.

4.2.5.2 Doses from Aqueous Releases

(NRC will calculate doses)

If we assume maximum errors in our collection/measurement system, the largest potential release calculated on the basis of paragraph 4.1.3.2 is as follows:

Material	uCi/ml	Ci/Year
U-nat	1.1E-08	0.05
Th-nat	2.7E-09	0.01

4.3 Indirect Effects and Their Significance

4.3.1 Socioeconomic Effects

Mallinckrodt, Inc. employed 913 individuals at the St. Louis Plant as of December, 1984, 65 of which worked at the C-T Plant. The total number of individuals employed in the City of St. Louis was 301,400 as of the same date according to the Missouri Division of Employment Security. Continuance or discontinuance of the C-T Plant would not result in any significant socioeconomic effect.

4.3.2 Potencial Effects of Accidents

4.3.2.1 Radioactivity Releases

Incoming ore is received in burlap bags or in drums. After receipt, bagged ore is transferred to 55-gallon drums for transport and storage on-site. Spillage of the ore is very infrequent, readily observable, and easily cleaned up. After the ore is dissolved, the solutions or slurries are pumped from tank to tank through piping. Building 238 does not have floor drains but is provided with floor sumps for recovery of any material. Material which could leak from tanks, pumps, or pipes would be contained within the building, flushed with water into the sumps, and pumped back into the system. Such accidents should not affect the environment.

4.3.2.2 Non-radiological Releases

It is extremely unlikely that hydrofluoric acid or anhydrous ammonia could be released in quantities sufficient to affect the environment. Controls are in place to mitigate any potential effect on the environment. The two 70 percent hydrofluoric storage tanks are diked to contain any HF which may leak. Unless the air temperature was high (i.e., 95°F), no significant release would occur from HF collected in the dike. The anhydrous ammonia tank is equipped with a water spray to reduce vapors until emergency actions can be taken by the MI Fire Brigade and the City of St. Louis Fire Department.

4.3.2.3 Transportation Accidents

The combined natural-uranium and natural-thorium content by weight is about 0.1 percent for ore and 1.0 percent for URO. Such low specific activity materials are not a significant hazard in the transportation cycle.

4.3.2.4 Natural Phenomena (Tornado, Earthquake, Flood, Fire)

(To be provided by the NRC)

4.3.2.5 Accidents Which Have Occurred in the Past Five Years and Impacts

No accidents have occurred in the past five years involving Mallinckrodt, Inc., C-T materials.

LONG-LIVED
PARTICULATES
Microcuries/ml

	Jan-82	Feb-82	Mar-82	Apr-82	May-82	Jun-82	Jul-82	Aug-82	Sep-82	Oct-82	Nov-82	Dec-82	AVERAGE
Ball Mill 238-1 North	4.511E-12	1.652E-12		1.085E-12			2.750E-13				9.329E-13	2.220E-13	5.774E-13
Ball Mill 238-1 South			1.331E-12	2.350E-12						2.438E-13		7.440E-14	1.591E-13
By T-312 in 238-1						5.694E-12	1.063E-13				6.921E-13	1.086E-12	8.891E-13
By Feed Sparkler 238-1												1.552E-12	1.552E-12
At Uro Desk 238-1		3.140E-12	1.203E-11	8.230E-13	4.735E-13		8.140E-12	1.390E-12	8.125E-13	9.208E-13	3.358E-12	4.397E-13	1.384E-12
At K2 Dryers 238-1												3.849E-14	3.849E-14
By T-353 238-1												3.364E-13	3.364E-13
By T-341 238-1												4.340E-13	4.340E-13
By T-328 238-1												3.664E-13	3.664E-13
Outside Ball Mill 238-1												2.255E-13	2.255E-13
Ball Mill 238-2 North	8.900E-13	1.876E-12		5.098E-11	2.820E-12				7.042E-13	4.761E-11		1.250E-12	1.652E-11
Ball Mill 238-2 South			2.245E-12									1.060E-12	1.060E-12
By Feed Desk 238-2												3.818E-13	3.818E-13
By T-372 238-2												4.933E-13	4.933E-13
By Uro Press 238-2		2.016E-12	3.377E-11		4.100E-12				2.708E-13			1.978E-13	2.343E-13
Above K2 Dryers 238-2												2.530E-13	2.530E-13
Above C.C. 238-2												4.631E-13	4.631E-13
By T-341 238-2												1.539E-13	1.539E-13
By T-328 238-2												1.881E-13	1.881E-13
Outside Ball Mill 238-2												5.690E-12	5.690E-12
Western Boundary 238						5.503E-13	5.317E-14					7.646E-14	7.646E-14
Between 238 & 248				0.000E+00								3.455E-14	3.455E-14
Eastern Boundary 238							2.317E-13					8.296E-14	8.296E-14
Southern Boundary 238							5.790E-14					7.091E-14	7.091E-14
Northern Boundary 248				2.296E-13				6.370E-14				0.000E+00	3.185E-14
Ore Staging Area by 222							1.159E-13					0.000E+00	0.000E+00
CT Incinerator Stack								1.529E-12				1.260E-13	8.275E-13
Plant 6 Canopy					2.264E-13	2.392E-14					0.000E+00	0.000E+00	0.000E+00
Inside 704												3.948E-14	3.948E-14
Average	2.701E-12	2.171E-12	1.234E-11	9.245E-12	1.905E-12	2.089E-12	1.283E-12	9.942E-13	5.958E-13	1.626E-11	1.246E-12	5.288E-13	1.123E-12
Average 238	2.701E-12	2.171E-12	1.234E-11	1.381E-11	2.465E-12	5.694E-12	2.840E-12	1.390E-12	5.958E-13	1.626E-11	1.661E-12	7.453E-13	1.570E-12
Perimeter Average				1.148E-13		5.503E-13	1.143E-13	6.370E-14				5.298E-14	5.935E-14

TABLE 1.

LONG-LIVED
PARTICULATES

Microcuries/ml	Jan-83	Feb-83	Mar-83	Apr-83	May-83	Jun-83	Jul-83	Aug-83	Sep-83	Oct-83	Nov-83	Dec-83	AVERAGE
Ball Mill 238-1 North	8.050E-13	2.449E-13	1.005E-13	1.131E-12	1.350E-13	4.592E-13	4.177E-13	1.509E-12	5.411E-13	7.612E-14	1.485E-13	0.000E+00	4.549E-13
Ball Mill 238-1 South	1.988E-14	8.125E-14	2.101E-13	1.773E-12	2.774E-13	1.875E-12	4.318E-13	2.316E-13	3.794E-13	2.230E-13	7.699E-13	3.534E-13	3.915E-13
By T-312 in 238-1	3.096E-13	2.358E-13	2.681E-13	2.387E-13	7.140E-14	4.486E-13	1.887E-13	4.756E-13	8.650E-12	2.513E-13	1.977E-13	6.940E-13	2.054E-12
By Feed Sparkler 238-1	2.590E-13	4.329E-12	1.248E-13	1.568E-13	2.191E-13	1.045E-11	1.964E-13	3.477E-13	2.797E-12	0.000E+00	0.000E+00	1.133E-12	8.555E-13
At Uro Desk 238-1	1.305E-12	2.028E-12	6.673E-13	3.127E-13	9.615E-13	7.927E-12	4.869E-13	5.194E-13	1.472E-13	0.000E+00	6.029E-14	6.691E-14	1.588E-13
At K2 Dryers 238-1	5.678E-13	1.160E-13	4.357E-13	3.587E-13	4.204E-13	3.135E-12	0.000E+00	2.002E-13	2.332E-12	2.135E-13	6.907E-14	7.235E-14	5.774E-13
By T-353 238-1	2.413E-13	4.444E-14	3.398E-14	1.229E-13	8.388E-14	2.536E-13	0.000E+00	1.236E-13	1.781E-13	4.726E-14	5.944E-14	6.352E-14	9.438E-14
By T-341 238-1	1.807E-13	4.717E-14	1.117E-13	6.774E-14	2.174E-13	7.810E-14	0.000E+00	2.029E-13	2.030E-13	1.050E-13	0.000E+00	3.021E-13	1.626E-13
By T-328 238-1	1.731E-13	1.970E-13	1.181E-14	1.792E-13	1.057E-13	7.921E-14	6.954E-14	2.473E-13	1.534E-14	3.296E-14	0.000E+00	2.835E-13	1.158E-13
Outside Ball Mill 238-1	5.123E-13	2.974E-12	2.623E-13	1.221E-13	0.000E+00	4.371E-13	2.110E-13	2.071E-13	8.440E-13	0.000E+00	1.935E-13	5.328E-14	2.590E-13
Ball Mill 238-2 North	5.226E-13	3.096E-14	5.563E-13	1.770E-13	1.273E-13	7.221E-13	2.378E-13	1.697E-13	2.611E-13	4.259E-13	6.420E-13	0.000E+00	2.997E-13
Ball Mill 238-2 South	2.659E-12	8.232E-13	8.484E-14	1.622E-12	8.019E-13	6.686E-13	6.996E-14	6.865E-13	3.395E-13	4.428E-13	0.000E+00	1.557E-13	3.249E-13
By Feed Desk 238-2	2.735E-12	2.322E-13	1.814E-13	4.134E-13	3.582E-13	5.359E-13	4.498E-13	5.219E-13	2.182E-13	1.487E-13	4.347E-14	4.076E-14	1.946E-13
By T-372 238-2	4.175E-13	9.557E-14	3.384E-13	0.000E+00	2.590E-13	2.376E-13	2.422E-12	4.049E-12	1.370E-12	0.000E+00	9.642E-14	1.995E-13	1.143E-12
By Uro Press 238-2	1.010E-14	6.781E-13	4.006E-13	2.216E-13	6.777E-13	6.511E-13	3.871E-13	3.300E-13	9.990E-13	1.604E-14	0.000E+00	1.925E-13	3.075E-13
Above K2 Dryers 238-2	1.036E-13	4.022E-13	7.879E-13	3.755E-13	5.925E-13	2.692E-12	2.033E-13	1.284E-12	1.683E-13	1.566E-13	6.063E-12	9.347E-14	1.553E-12
Above C.C. 238-2	1.391E-13	5.718E-12	1.516E-13	2.968E-13	0.000E+00	3.845E-13	8.555E-14	5.194E-13	8.613E-14	1.683E-14	2.647E-13	1.686E-13	2.111E-13
By T-341 238-2	2.018E-13	1.678E-13	2.890E-13	1.124E-13	0.000E+00	6.431E-13	1.273E-13	0.000E+00	1.781E-13	4.263E-13	4.588E-13	0.000E+00	2.126E-13
By T-328 238-2	5.111E-14	6.724E-13	2.849E-13	1.517E-13	4.703E-13	6.747E-14	0.000E+00	4.828E-14	0.000E+00	3.972E-13	4.838E-13	4.821E-14	1.955E-13
Outside Ball Mill 238-2	1.247E-12	6.137E-13	3.140E-13	2.614E-14	3.639E-13	4.077E-12	5.296E-13	1.794E-13	3.636E-13	3.575E-13	2.081E-13	4.235E-14	2.302E-13
Western Boundary 238	0.000E+00	1.670E-13	0.000E+00	0.000E+00	1.059E-13	1.795E-13	2.721E-13	5.126E-14	5.154E-14	9.676E-15	1.245E-14	1.663E-13	5.825E-14
Between 238 & 248	1.172E-13	3.061E-13	4.188E-14	1.525E-13	1.776E-14	1.268E-14	1.901E-13	1.097E-13	1.952E-13	2.503E-13	0.000E+00	5.190E-14	1.214E-13
Eastern Boundary 238	5.711E-14	1.098E-13	4.609E-14	0.000E+00	1.204E-13	1.070E-13	2.264E-13	1.391E-13	0.000E+00	1.351E-13	4.251E-14	0.000E+00	6.334E-14
Southern Boundary 238	1.673E-13	1.565E-13	1.442E-13	0.000E+00	0.000E+00	0.000E+00	2.253E-13	0.000E+00	7.693E-14	1.741E-14	1.370E-13	2.210E-15	4.671E-14
Northern Boundary 248	5.670E-14	0.000E+00	0.000E+00	0.000E+00	4.064E-14	0.000E+00	0.000E+00	4.575E-14	2.581E-13	5.480E-14	0.000E+00	2.285E-15	7.219E-14
Ore Staging Area by 222	6.873E-14	0.000E+00	1.123E-13	0.000E+00	0.000E+00	7.814E-14	1.586E-13	4.031E-14	0.000E+00	8.182E-14	1.799E-13	0.000E+00	6.041E-14
CT Incinerator Stack	1.067E-11	3.798E-12	3.074E-12	5.090E-11		1.617E-13	3.220E-13	7.342E-13	3.988E-12	3.301E-12	1.529E-12	1.292E-11	4.493E-12
Plant 6 Canopy	1.474E-13	0.000E+00	0.000E+00	3.564E-14	0.000E+00	0.000E+00	1.907E-13	8.247E-14	2.766E-13	1.246E-13	3.305E-14	9.321E-14	1.220E-13
Inside 704	3.016E-13	1.426E-13	9.790E-14	4.267E-14	7.026E-14	7.688E-15	0.000E+00	2.224E-13	1.330E-13	1.827E-14	2.404E-13	3.255E-13	1.879E-13
Average	8.292E-13	8.418E-13	3.149E-13	2.034E-12	2.321E-13	1.254E-12	2.793E-13	4.579E-13	8.638E-13	2.527E-13	4.114E-13	6.041E-13	5.180E-13
Average 238	6.230E-13	9.866E-13	2.808E-13	3.930E-13	3.071E-13	1.791E-12	3.257E-13	5.926E-13	1.004E-12	1.669E-13	4.878E-13	1.982E-13	4.898E-13
Perimeter Average	7.966E-14	1.479E-13	4.643E-14	3.050E-14	5.694E-14	5.984E-14	1.828E-13	6.916E-14	1.164E-13	9.346E-14	3.839E-14	4.454E-14	7.238E-14

TABLE 1.

LONG-LIVED
PARTICULATES
Picrocuries/ml

	Jan-84	Feb-84	Mar-84	Apr-84	May-84	Jun-84	Jul-84	Aug-84	Sep-84	Oct-84	Nov-84	Dec-84	AVERAGE
Ball Mill 238-1 North	1.665E-13	1.346E-13	0.000E+00	3.436E-13	2.230E-13	6.292E-13	2.361E-14	9.474E-12	1.586E-11	2.235E-13	1.969E-12	4.535E-12	6.312E-12
Ball Mill 238-1 South	1.469E-13	5.138E-14	0.000E+00	4.027E-14	5.224E-14	8.338E-13	2.701E-13	5.879E-12	8.020E-12	1.529E-13	3.662E-13	2.431E-12	3.370E-12
By T-312 in 238-1	2.883E-13	0.000E+00	0.000E+00	6.673E-14	8.359E-14	2.244E-13	7.047E-13	2.510E-13	3.065E-13	1.532E-13	3.018E-13	2.013E-12	6.051E-13
By Feed Sparkler 238-1	0.000E+00	0.000E+00	0.000E+00	2.543E-13	0.000E+00	2.205E-12	1.486E-12	5.873E-13	1.639E-13	0.000E+00	2.617E-13	2.610E-12	7.246E-13
At Ore Desk 238-1	2.445E-13	0.000E+00	0.000E+00	2.432E-13	3.519E-13	6.508E-13	4.340E-13	3.782E-13	9.994E-14	1.110E-13	7.094E-14	1.539E-12	4.398E-13
At K2 Dryers 238-1	4.722E-13	0.000E+00	0.000E+00	1.705E-13	9.665E-14	7.072E-13	9.183E-13	1.836E-13	4.393E-13	0.000E+00	1.602E-13	4.155E-13	2.397E-13
By T-353 238-1	1.216E-13	0.000E+00	6.250E-14	0.000E+00	2.478E-13	1.037E-13	3.506E-13	0.000E+00	2.855E-14	0.000E+00	0.000E+00	6.251E-13	1.307E-13
By T-341 238-1	3.068E-14	3.171E-14	0.000E+00	0.000E+00	4.888E-14	9.300E-14	6.422E-13	4.514E-13	2.756E-13	4.086E-14	2.575E-13	1.216E-12	4.471E-13
By T-328 238-1	1.078E-13	9.548E-14	6.574E-14	8.318E-14	3.135E-13	1.205E-13	3.189E-13	2.730E-13	5.552E-15	9.850E-14	2.325E-13	5.656E-13	2.351E-13
Outside Ball Mill 238-1	3.220E-13	0.000E+00	4.417E-14	2.433E-13	2.992E-13	3.588E-13	5.849E-13	4.846E-12	6.996E-13	2.145E-13	1.860E-13	8.531E-13	1.360E-12
Ball Mill 238-2 North	4.323E-14	3.287E-14	1.057E-13	5.253E-14	4.956E-14	2.281E-13	8.173E-14	1.687E-11	5.761E-13	2.840E-13	3.801E-13	0.000E+00	3.622E-12
Ball Mill 238-2 South	8.732E-12	0.000E+00	2.004E-13	4.647E-14	7.999E-13	5.459E-13	1.913E-13	1.558E-11	2.809E-13	1.257E-13	1.892E-13	9.210E-13	3.419E-12
By Feed Desk 238-2	9.462E-14	3.024E-14	7.190E-13	6.470E-14	4.441E-13	4.962E-13	3.604E-14	8.850E-13	4.220E-13	0.000E+00	3.547E-13	4.734E-13	4.270E-13
By T-372 238-2	5.168E-14	9.296E-14	2.535E-14	8.700E-14	4.832E-13	1.355E-12	1.151E-13	3.253E-12	1.588E-12	1.236E-13	5.012E-13	7.327E-13	1.240E-12
By Ore Press 238-2	2.714E-13	4.923E-12	1.770E-13	2.985E-13	5.204E-13	2.648E-12	1.123E-13	1.481E-13	1.246E-13	3.761E-14	6.086E-12	6.745E-12	2.629E-12
Above K2 Dryers 238-2	5.577E-13	8.060E-14	3.892E-13	1.327E-13	7.435E-14	5.033E-13	1.466E-13	1.459E-13	7.742E-13	0.000E+00	1.081E-12	4.965E-13	4.995E-13
Above C.C. 238-2	4.537E-13	0.000E+00	0.000E+00	1.642E-13	6.903E-14	8.295E-13	6.228E-13	7.934E-14	4.202E-13	0.000E+00	1.396E-13	1.142E-12	3.562E-13
By T-341 238-2	4.464E-13	2.974E-15	1.870E-13	1.294E-13	4.444E-14	6.975E-14	0.000E+00	1.991E-13	7.012E-13	5.733E-14	2.945E-13	3.021E-12	8.546E-13
By T-328 238-2	1.625E-14	0.000E+00	1.122E-13	2.157E-14	0.000E+00	1.781E-13	2.375E-13	1.321E-13	1.466E-13	1.328E-13	0.000E+00	1.551E-13	1.133E-13
Outside Ball Mill 238-2	5.068E-14	1.601E-13	1.296E-12	0.000E+00	3.657E-13	3.727E-13	0.000E+00	2.862E-13	2.707E-13	0.000E+00	4.737E-13	3.520E-13	2.765E-13
Western Boundary 238	4.369E-14	5.166E-14	1.198E-13	5.142E-14	0.000E+00	0.000E+00	0.000E+00	0.000E+00	7.669E-14	0.000E+00	1.712E-13	1.247E-13	1.417E-13	1.029E-13
Between 238 & 248	0.000E+00	0.000E+00	7.723E-15	1.040E-13	0.000E+00	5.667E-14	2.153E-14	8.587E-14	0.000E+00	4.369E-14	2.289E-14	2.848E-13	8.745E-14
Eastern Boundary 238	7.998E-14	9.303E-14	0.000E+00	0.000E+00	0.000E+00	2.418E-13	6.204E-14	0.000E+00	0.000E+00	0.000E+00	5.167E-14	3.890E-14	1.811E-14
Southern Boundary 238	0.000E+00	0.000E+00	1.845E-14	0.000E+00	0.000E+00	9.665E-14	0.000E+00	0.000E+00	9.339E-14	9.044E-14	3.692E-14	1.265E-13	6.945E-14
Northern Boundary 248	1.062E-14	5.007E-14	0.000E+00	1.426E-13	6.665E-14	1.999E-13	0.000E+00	1.991E-14	2.776E-14	7.115E-14	0.000E+00	3.232E-13	6.840E-14
Ore Staging Area by 222	7.930E-15	8.664E-14	2.673E-14	0.000E+00	0.000E+00	1.432E-14	3.058E-14	0.000E+00	0.000E+00	0.000E+00	2.326E-14	0.000E+00	4.652E-15
CT Incinerator Stack	2.372E-12					6.207E-11	8.801E-12				5.347E-13	9.513E-11	4.783E-11
Plant & Canopy	2.879E-14	0.000E+00	2.141E-14	9.280E-15	0.000E+00	0.000E+00	0.000E+00	1.637E-13	0.000E+00	0.000E+00	0.000E+00	6.371E-14	4.543E-14
Inside 704	0.000E+00	7.112E-14	4.088E-14	0.000E+00	2.220E-14	1.114E-13	0.000E+00	0.000E+00	6.456E-14	0.000E+00	0.000E+00	1.150E-14	1.521E-14
Average	5.235E-13	2.139E-13	1.293E-13	9.819E-14	1.663E-13	2.619E-12	5.584E-13	2.152E-12	1.121E-12	7.614E-14	4.690E-13	4.374E-12	2.605E-12
Average 238	6.309E-13	2.818E-13	1.692E-13	1.221E-13	2.284E-13	6.576E-13	3.639E-13	2.995E-12	1.560E-12	8.778E-14	6.403E-13	1.542E-12	1.365E-12
Perimeter Average	3.066E-14	3.895E-14	2.919E-14	5.960E-14	1.333E-14	1.190E-13	1.671E-14	3.649E-14	2.423E-14	7.530E-14	4.724E-14	1.630E-13	6.926E-14

TABLE 1-

LONG-LIVED
PARTICULATES

Microcuries/ml	Jan-85	Feb-85	Mar-85	Apr-85	MAY-85	Average
Ball Mill 238-1 North	7.399E-14	4.597E-13	0.000E+00	1.928E-13	1.572E-12	4.597E-13
Ball Mill 238-1 South	0.000E+00	0.000E+00	0.000E+00	1.300E-13	1.862E-12	3.984E-13
By T-312 in 238-1	2.176E-13	6.544E-13	1.812E-13	1.883E-13	5.476E-13	3.578E-13
By Feed Sparkler 238-1	6.861E-13	7.367E-13	2.421E-13	2.060E-13	1.572E-12	6.886E-13
At Uro Desk 238-1	1.799E-12	4.782E-13	1.824E-13	0.000E+00	2.635E-12	1.019E-12
At K2 Dryers 238-1	1.382E-12	3.789E-13	1.266E-13	9.773E-14	1.971E-12	7.912E-13
By T-353 238-1	2.068E-12	0.000E+00	1.890E-12	0.000E+00	2.029E-13	8.322E-13
By T-341 238-1	1.979E-13	7.953E-13	1.605E-13	3.237E-13	4.282E-13	3.811E-13
By T-328 238-1	2.623E-13	3.368E-14	1.207E-12	5.303E-14	7.331E-13	4.578E-13
Outside Ball Mill 238-1	1.298E-13	3.158E-13	9.329E-14	6.180E-13	2.800E-12	7.914E-13
Ball Mill 238-2 North	7.475E-14	2.527E-13	0.000E+00	6.997E-12	4.929E-13	1.563E-12
Ball Mill 238-2 South	2.243E-13	3.705E-13	0.000E+00	3.993E-12	1.684E-12	1.254E-12
By Feed Desk 238-2	9.679E-14	0.000E+00	8.468E-13	1.033E-12	1.198E-12	6.349E-13
By T-372 238-2	1.941E-12	2.796E-13	1.626E-13	9.280E-13	1.431E-11	3.524E-12
By Uro Press 238-2	2.645E-12	1.988E-13	4.643E-11	6.862E-13	4.623E-11	1.924E-11
Above K2 Dryers 238-2	1.431E-12	8.348E-14	2.354E-13	4.327E-13	1.014E-14	4.385E-13
Above C.C. 238-2	1.571E-12	1.075E-14	5.347E-13	1.420E-12	6.626E-13	8.398E-13
By T-341 238-2	5.353E-13	3.769E-13	3.119E-13	2.670E-12	8.916E-13	9.575E-13
By T-328 238-2	0.000E+00	1.359E-13	2.297E-13	9.280E-13	5.586E-13	3.704E-13
Outside Ball Mill 238-2	2.009E-13	5.436E-13	0.000E+00	4.505E-12	1.825E-12	1.415E-12
Western Boundary 238	1.866E-13	0.000E+00	0.000E+00	1.051E-13	4.615E-13	1.506E-13
Between 238 & 248	1.051E-13	8.631E-14	0.000E+00	8.988E-14	1.997E-12	4.557E-13
Eastern Boundary 238	4.935E-14	6.040E-14	1.488E-13	6.818E-14	2.251E-13	1.104E-13
Southern Boundary 238	4.539E-13	3.158E-13	0.000E+00	4.249E-14	1.775E-13	1.979E-13
Northern Boundary 248	0.000E+00	1.344E-14	0.000E+00	1.226E-13	3.012E-13	8.745E-14
Ore Staging Area by 222	0.000E+00	8.054E-14	0.000E+00	2.172E-14	7.969E-14	3.639E-14
CT Incinerator Stack	3.938E-12	6.533E-13	4.591E-11	0.000E+00		1.263E-11
Plant 6 Canopy	1.319E-13	2.105E-13	0.000E+00	0.000E+00	2.789E-13	1.243E-13
Inside 704	2.125E-13	1.510E-13	0.000E+00	1.069E-13	0.000E+00	9.408E-14
Average	7.108E-13	2.648E-13	3.410E-12	8.951E-13	3.061E-12	1.734E-12
Average 238	7.768E-13	3.053E-13	2.642E-12	1.270E-12	4.109E-12	1.821E-12
Perimeter Average	1.590E-13	9.519E-14	2.976E-14	8.565E-14	6.325E-13	2.004E-13

TABLE 1.

RADON-DAUGHTER Working Levels	Jan-82	Feb-82	Mar-82	Apr-82	May-82	Jun-82	Jul-82	Aug-82	Sep-82	Oct-82	Nov-82	Dec-82	AVERAGE
Ball Mill 238-1 North		5.350E-03	2.890E-04	1.917E-03					4.330E-04	0.000E+00	1.724E-03	1.388E-03	1.58[illegible]-03
Ball Mill 238-1 South												2.113E-03	2.113E-03
By T-312 in 238-1						3.580E-03						1.190E-02	7.740E-03
By Feed Sparkler 238-1												1.113E-02	1.113E-02
At Uro Desk 238-1				2.966E-03	2.568E-03		1.335E-03	3.149E-03		3.175E-03	1.017E-02	6.184E-03	4.221E-03
At K2 Dryers 238-1												4.497E-03	4.497E-03
By T-353 238-1												9.276E-03	9.276E-03
By T-341 238-1												8.855E-03	8.855E-03
By T-328 238-1											1.082E-02	5.763E-03	8.292E-03
Outside Ball Mill 238-1												2.998E-03	2.998E-03
Ball Mill 238-2 North												1.331E-02	1.331E-02
Ball Mill 238-2 South												1.129E-02	1.129E-02
By Feed Desk 238-2												6.854E-03	6.854E-03
By T-372 238-2												9.792E-03	9.792E-03
By Uro Press 238-2												7.074E-03	7.074E-03
Above K2 Dryers 238-2												8.813E-03	8.813E-03
Above C.C. 238-2												7.421E-03	7.421E-03
By T-341 238-2												4.690E-03	4.690E-03
By T-328 238-2												6.081E-03	6.081E-03
Outside Ball Mill 238-2												4.404E-03	4.404E-03
Western Boundary 238						2.060E-03	1.840E-03					2.577E-03	2.159E-03
Between 238 & 248												4.226E-03	4.226E-03
Eastern Boundary 238							2.430E-03					4.029E-03	3.230E-03
Southern Boundary 238							2.270E-03					2.858E-03	2.564E-03
Northern Boundary 248								2.160E-03				3.350E-03	2.755E-03
Ore Staging Area by 222												1.405E-03	1.405E-03
CT Incinerator Stack								8.490E-04				8.520E-04	8.505E-04
Plant 6 Canopy	0.000E+00				2.400E-03	1.880E-03					4.570E-03	2.249E-03	2.220E-03
Inside 704			2.350E-03									1.579E-02	9.070E-03
Average	0.000E+00	5.350E-03	1.320E-03	2.441E-03	2.484E-03	2.507E-03	1.969E-03	2.053E-03	4.330E-04	1.588E-03	6.821E-03	6.247E-03	5.825E-03
Average 238		5.350E-03	2.890E-04	2.441E-03	2.568E-03	3.580E-03	1.335E-03	3.149E-03	4.330E-04	1.588E-03	7.571E-03	7.191E-03	7.022E-03
Perimeter Average						2.060E-03	2.180E-03	2.160E-03				3.408E-03	2.987E-03

TABLE 2.

RADON-DAUGHTER Working Levels	Jan-83	Feb-83	Mar-83	Apr-83	May-83	Jun-83	Jul-83	Aug-83	Sep-83	Oct-83	Nov-83	Dec-83	AVERAGE
Ball Mill 238-1 North	5.007E-03	1.930E-03	4.060E-03	1.990E-03	2.649E-03	4.253E-03	1.149E-02	1.218E-02	3.413E-03	6.513E-03	4.342E-03	3.715E-03	5.129E-03
Ball Mill 238-1 South	4.014E-03	2.160E-03	1.980E-03	2.803E-03	4.384E-03	5.413E-03	4.283E-03	9.428E-03	3.715E-03	6.307E-03	4.584E-03	4.535E-03	4.467E-03
By T-312 in 238-1	3.070E-03	1.989E-03	5.848E-03	1.857E-03	3.571E-03	3.335E-03	4.264E-03	8.528E-03	6.005E-03	7.478E-03	4.925E-03	7.560E-03	4.869E-03
By Feed Sparkler 238-1	1.101E-02	8.980E-03	4.156E-03	4.510E-03	2.733E-03	6.608E-03	1.199E-02	7.261E-03	4.969E-03	8.009E-03	4.795E-03	5.227E-03	6.687E-03
At Uro Desk 238-1	4.345E-03	3.540E-03	3.800E-03	3.228E-03	2.469E-03	1.108E-02	4.121E-03	8.045E-03	6.996E-03	5.875E-03	3.974E-03	7.733E-03	5.434E-03
At K2 Dryers 238-1	3.741E-03	2.700E-03	5.837E-03	1.857E-02	3.083E-03	2.185E-03	8.575E-03	5.694E-03	2.654E-03	6.869E-03	3.456E-03	5.886E-03	5.771E-03
By T-353 238-1	6.131E-03	3.965E-03	6.860E-03	4.731E-03	1.012E-03	1.758E-03	7.344E-03	6.843E-03	3.184E-03	6.899E-03	2.462E-03	3.240E-03	4.536E-03
By T-341 238-1	4.260E-03	4.641E-03	8.710E-03	4.068E-03	1.852E-03	1.972E-03	5.117E-03	7.104E-03	3.184E-03	6.610E-03	4.005E-03	3.499E-03	4.585E-03
By T-328 238-1	4.156E-03	5.306E-03	6.138E-03	3.272E-03	3.218E-03	2.175E-03	6.254E-03	7.731E-03	3.413E-03	6.221E-03	4.391E-03	7.768E-03	5.004E-03
Outside Ball Mill 238-1	5.573E-03	3.240E-03	1.194E-03	1.990E-03	2.264E-03	2.513E-03	4.388E-03	7.836E-03	5.227E-03	6.394E-03	3.474E-03	4.005E-03	4.009E-03
Ball Mill 238-2 North	4.393E-03	3.400E-03	2.420E-04	1.415E-03	2.457E-03	3.357E-03	9.350E-03	7.391E-03	4.294E-03	6.523E-03	2.123E-03	2.702E-03	3.971E-03
Ball Mill 238-2 South	4.780E-03	4.950E-03	1.194E-03	1.901E-03	3.420E-03	5.542E-03	8.985E-03	6.349E-03	5.270E-03	5.741E-03	1.642E-03	2.461E-03	4.353E-03
By Feed Desk 238-2	5.384E-03	1.191E-03	8.490E-03	1.548E-03	2.553E-03	6.090E-03	4.649E-03	6.112E-03	4.149E-03	7.301E-03	3.715E-03	3.715E-03	4.575E-03
By T-372 238-2	6.187E-03	1.355E-03	4.643E-03	2.609E-03	3.372E-03	4.883E-03	5.642E-03	7.438E-03	6.653E-03	8.009E-03	4.873E-03	6.696E-03	5.197E-03
By Uro Press 238-2	7.274E-03	2.510E-03	7.781E-03	4.775E-03	3.615E-03	6.428E-03	6.007E-03	7.723E-03	9.987E-03	6.437E-03	3.974E-03	6.307E-03	6.068E-03
Above K2 Dryers 238-2	6.079E-03	1.887E-03	3.758E-03	2.609E-03	1.807E-03	2.948E-03	3.552E-03	3.343E-03	7.478E-03	4.493E-03	2.461E-03	6.307E-03	3.894E-03
Above C.C. 238-2	5.243E-03	5.360E-03	1.315E-02	1.371E-03	1.896E-03	2.078E-03	4.454E-03	4.806E-03	7.085E-03	5.838E-03	1.642E-03	4.018E-03	4.745E-03
By T-341 238-2	5.351E-03	6.670E-03	7.008E-03	2.122E-03	2.910E-03	2.931E-03	6.443E-03	6.373E-03	2.750E-03	3.956E-03	2.333E-03	3.845E-03	4.391E-03
By T-328 238-2	6.282E-03	5.923E-03	3.335E-03	2.520E-03	3.527E-03	2.824E-03	1.421E-03	5.589E-03	2.894E-03	4.633E-03	2.316E-03	7.768E-03	4.086E-03
Outside Ball Mill 238-2	6.027E-03	2.300E-03	1.013E-02	1.857E-03	3.035E-03	3.517E-03	4.701E-03	7.580E-03	4.968E-03	6.803E-03	3.426E-03	6.307E-03	5.054E-03
Western Boundary 238	1.559E-03	2.170E-03	9.667E-04	3.537E-04	5.731E-04	2.465E-03	2.619E-03	4.027E-03	3.522E-02	2.462E-03	2.678E-03	3.088E-03	4.848E-03
Between 238 & 248	1.299E-03	1.858E-03	9.286E-04	3.980E-04	5.780E-04	2.878E-03	2.369E-03	2.925E-03	2.894E-03	3.542E-03	3.088E-03	2.506E-03	2.105E-03
Eastern Boundary 238	2.080E-03	2.370E-03	7.960E-04	3.537E-04	1.927E-04	1.012E-03	1.990E-03	2.925E-03	1.944E-03	2.750E-03	3.329E-03	1.987E-03	1.811E-03
Southern Boundary 238	1.611E-03	2.130E-03	9.667E-04	3.980E-04	8.817E-04	1.402E-03	1.619E-03	4.975E-03	1.785E-03	2.461E-03	3.233E-03	2.462E-03	1.994E-03
Northern Boundary 248	1.606E-03	1.642E-03	9.667E-04	3.095E-04	7.935E-04	2.320E-03	4.492E-03	2.298E-03	3.329E-03	3.522E-03	2.333E-03	3.474E-03	2.257E-03
Ore Staging Area by 222	2.220E-03	1.284E-03	1.105E-03	2.211E-04	3.854E-04	1.972E-03	1.848E-03	2.821E-03	1.944E-03	2.246E-03	2.808E-03	3.570E-03	1.869E-03
CT Incinerator Stack	8.659E-04	1.660E-03	1.078E-03	4.080E-03		5.905E-04	4.164E-04	1.361E-03	6.090E-04	3.754E-03	2.215E-04	1.120E-03	1.432E-03
Plant 6 Canopy	2.310E-03	3.140E-03	1.857E-03	1.402E-03	1.782E-03	1.257E-02	2.309E-02	1.682E-02	3.763E-03	4.795E-03	4.969E-03	4.680E-03	6.765E-03
Inside 704	2.326E-01	1.296E-02	4.350E-02	4.446E-02	1.171E-01	2.374E-01	2.810E-01	1.289E-01	2.392E-01	1.952E-01	6.528E-01	4.774E-01	2.219E-01
Average	1.222E-02	3.559E-03	5.534E-03	4.197E-03	6.361E-03	1.188E-02	1.526E-02	1.070E-02	1.341E-02	1.199E-02	2.567E-02	2.081E-02	1.179E-02
Average 238	5.415E-03	3.700E-03	5.416E-03	3.487E-03	2.791E-03	4.095E-03	6.152E-03	7.168E-03	4.914E-03	6.345E-03	3.446E-03	5.165E-03	4.841E-03
Perimeter Average	1.631E-03	2.034E-03	9.249E-04	3.626E-04	6.038E-04	2.015E-03	2.618E-03	3.430E-03	9.034E-03	2.947E-03	2.932E-03	2.703E-03	2.603E-03

TABLE 2.

RADON-DAUGHTER Working Levels	Jan-84	Feb-84	Mar-84	Apr-84	May-84	Jun-84	Jul-84	Aug-84	Sep-84	Oct-84	Nov-84	Dec-84	AVERAGE
Ball Mill 238-1 North	5.672E-03	2.652E-03	1.736E-03	4.678E-04	4.711E-04	4.196E-03	1.991E-03	5.859E-03	8.322E-03	3.245E-03	2.783E-03	2.344E-03	3.312E-03
Ball Mill 238-1 South	2.550E-03	2.455E-03	2.372E-03	7.938E-04	1.269E-03	6.200E-03	3.908E-03	4.185E-03	5.779E-03	1.942E-03	3.071E-03	2.259E-03	3.065E-03
By T-312 in 238-1	8.446E-02	7.035E-04	3.170E-03	4.706E-03	4.248E-03	4.007E-03	2.138E-03	5.998E-03	1.557E-02	2.184E-03	2.046E-03	3.402E-03	1.105E-02
By Feed Sparkler 238-1	8.790E-03	9.673E-04	5.015E-03	3.572E-03	1.478E-03	3.175E-03	1.084E-02	4.334E-03	1.274E-02	3.761E-03	2.847E-03	3.862E-03	5.115E-03
At Uro Desk 238-1	8.593E-03	1.803E-03	6.955E-03	4.593E-03	1.759E-02	4.461E-03	2.802E-03	1.739E-02	5.606E-03	2.589E-03	2.537E-03	1.361E-03	6.357E-03
At K2 Dryers 238-1	7.022E-03	8.354E-04	5.299E-03	3.742E-03	2.114E-03	8.392E-03	1.549E-03	7.050E-03	6.293E-03	3.687E-03	5.094E-03	5.465E-03	4.712E-03
By T-353 238-1	5.205E-03	6.155E-04	5.489E-03	4.253E-03	3.847E-03	3.327E-03	1.180E-03	4.508E-03	4.739E-03	2.427E-03	2.864E-03	4.838E-03	3.608E-03
By T-341 238-1	1.363E-03	4.419E-03	2.661E-03	3.402E-03	3.590E-03	3.856E-03	2.065E-03	5.490E-03	5.548E-03	2.507E-03	2.772E-03	7.724E-03	3.783E-03
By T-328 238-1	3.693E-03	7.955E-03	2.950E-03	5.954E-03	3.200E-03	3.931E-03	2.802E-03	1.237E-03	8.264E-03	4.692E-03	2.783E-03	4.914E-03	4.365E-03
Outside Ball Mill 238-1	2.198E-03	2.848E-03	2.893E-03	1.872E-03	2.260E-03	4.839E-03	2.286E-03	8.379E-03	6.761E-03	2.507E-03	2.098E-03	2.988E-03	3.494E-03
Ball Mill 238-2 North	1.451E-03	3.517E-04	1.736E-03	1.247E-03	2.198E-03	3.931E-03	3.097E-03	7.281E-03	7.744E-03	2.581E-03	2.210E-03	2.040E-03	2.989E-03
Ball Mill 238-2 South	8.793E-04	1.571E-03	1.446E-03	1.361E-03	3.660E-03	4.763E-03	2.286E-03	3.487E-03	9.015E-03	2.670E-03	2.172E-03	2.041E-03	2.946E-03
By Feed Desk 238-2	1.183E-02	2.022E-03	2.177E-03	2.608E-03	2.428E-03	4.007E-03	2.360E-03	6.415E-03	8.957E-03	4.612E-03	3.746E-03	2.873E-03	4.503E-03
By T-372 238-2	2.603E-03	6.629E-03	7.429E-03	1.701E-03	2.114E-03	5.595E-03	1.622E-03	6.877E-03	7.339E-03	2.802E-03	5.974E-03	4.882E-03	4.631E-03
By Uro Press 238-2	1.285E-02	9.281E-03	7.807E-03	2.892E-03	6.752E-03	8.165E-03	1.254E-03	3.602E-03	7.166E-03	3.883E-03	7.775E-03	4.612E-03	6.337E-03
Above K2 Dryers 238-2	9.035E-03	3.241E-03	7.145E-03	3.346E-03	2.905E-03	2.873E-03	3.687E-03	3.872E-03	4.392E-03	3.245E-03	3.895E-03	2.259E-03	4.158E-03
Above C.C. 238-2	7.464E-03	4.836E-04	6.766E-03	1.871E-03	1.166E-03	2.646E-03	1.696E-03	4.450E-03	3.410E-03	3.074E-03	5.320E-03	1.633E-03	3.332E-03
By T-341 238-2	6.580E-03	1.011E-03	9.215E-03	7.258E-03	1.901E-03	2.873E-03	1.622E-03	3.139E-03	3.121E-03	2.589E-03	4.869E-03	1.800E-03	3.748E-03
By T-328 238-2	3.517E-03	1.187E-03	5.207E-03	4.763E-03	2.979E-03	3.705E-03	2.507E-03	4.812E-03	3.063E-03	3.964E-03	2.537E-03	3.704E-03	3.495E-03
Outside Ball Mill 238-2	2.374E-03	7.857E-04	3.124E-03	1.077E-03	2.869E-03	4.083E-03	2.876E-03	7.628E-03	8.033E-03	4.719E-03	3.028E-03	2.842E-03	3.620E-03
Western Boundary 238	3.094E-03	2.210E-03	1.331E-03	7.938E-04	4.711E-04	2.041E-03	2.655E-03	4.565E-03	4.103E-03	1.622E-03	1.064E-03	2.992E-03	2.245E-03
Between 238 & 248	1.407E-03	9.233E-04	1.183E-03	6.804E-04	5.517E-04	2.344E-03	2.517E-03	3.583E-03	4.334E-03	1.696E-03	2.172E-03	2.693E-03	2.007E-03
Eastern Boundary 238	1.011E-03	2.406E-03	1.388E-03	9.073E-04	1.094E-03	1.512E-03	3.613E-03	4.623E-03	4.276E-03	3.097E-03	2.128E-03	3.815E-03	2.489E-03
Southern Boundary 238	1.275E-03	5.716E-04	1.278E-03	1.077E-03	1.056E-03	2.041E-03	2.802E-03	4.161E-03	3.987E-03	2.212E-03	2.023E-03	2.842E-03	2.110E-03
Northern Boundary 248	3.192E-03	2.210E-03	7.521E-04	3.402E-04	1.689E-03	2.571E-03	3.613E-03	2.663E-03	6.771E-03	2.581E-03	2.210E-03	2.797E-03	2.616E-03
Ore Staging Area by 222	1.011E-03	6.155E-04	8.044E-04	5.670E-04	1.269E-03	1.815E-03	1.327E-03	2.023E-03	3.930E-03	2.433E-03	2.697E-03	3.024E-03	1.793E-03
CT Incinerator Stack	8.165E-04				1.963E-03	1.039E-02	1.439E-03				6.743E-04	1.767E-03	2.842E-03
Plant 6 Canopy	5.598E-03	4.370E-03	1.180E-02	2.587E-03	5.395E-03	2.646E-03	3.761E-03	2.790E-03	6.010E-03	2.507E-03	2.210E-03	3.780E-03	4.455E-03
Inside 704	2.244E-01	6.722E-02	3.028E-03	1.999E-03	1.478E-03	3.629E-03	1.696E-03	2.232E-03	3.756E-03	9.808E-03	1.264E-03	6.955E-03	2.729E-02
Average	1.483E-02	4.726E-03	3.970E-03	2.515E-03	2.897E-03	4.069E-03	2.689E-03	5.094E-03	6.394E-03	3.201E-03	2.995E-03	3.397E-03	4.706E-03
Average 238	9.406E-03	2.591E-03	4.480E-03	3.074E-03	3.452E-03	4.451E-03	2.728E-03	5.800E-03	7.093E-03	3.184E-03	3.521E-03	3.392E-03	4.431E-03
Perimeter Average	1.996E-03	1.664E-03	1.186E-03	7.597E-04	9.724E-04	2.102E-03	3.040E-03	3.919E-03	4.694E-03	2.242E-03	1.919E-03	3.028E-03	2.294E-03

TABLE 2.

RADON-DAUGHTER Working Levels	Jan-85	Feb-85	Mar-85	Apr-85	MAY-85	Average
Ball Mill 238-1 North	3.134E-03	1.400E-03	6.606E-04	2.596E-03	1.767E-03	3.117E-03
Ball Mill 238-1 South	2.646E-03	1.867E-03	1.074E-03	2.100E-03	2.811E-03	2.892E-03
By T-312 in 238-1	8.638E-03	2.534E-03	1.074E-03	3.009E-03	1.687E-03	4.944E-03
By Feed Sparkler 238-1	1.755E-02	6.135E-03	4.789E-03	3.149E-03	1.928E-03	6.421E-03
At Ore Desk 238-1	1.504E-02	6.002E-03	5.698E-03	7.069E-03	1.526E-03	6.165E-03
At K2 Dryers 238-1	1.414E-02	1.440E-02	8.918E-03	3.499E-03	1.366E-03	6.348E-03
By T-353 238-1	1.553E-02	1.060E-02	8.588E-03	2.596E-03	1.446E-03	5.243E-03
By T-341 238-1	1.240E-32	1.620E-02	1.272E-02	2.939E-03	1.607E-03	6.313E-03
By T-328 238-1	1.595E-02	8.602E-03	7.102E-03	3.639E-03	2.088E-03	5.536E-03
Outside Ball Mill 238-1	6.616E-03	1.801E-03	1.982E-03	3.709E-03	1.847E-03	3.706E-03
Ball Mill 238-2 North	2.646E-03	8.002E-04	1.074E-03	2.729E-03	2.651E-03	3.154E-03
Ball Mill 238-2 South	2.925E-03	1.600E-03	4.955E-04	2.596E-03	2.570E-03	2.900E-03
By Feed Desk 238-2	1.072E-02	7.669E-03	2.890E-03	4.269E-03	1.847E-03	5.072E-03
By T-372 238-2	1.421E-02	1.187E-02	6.111E-03	6.509E-03	2.169E-03	6.250E-03
By Ore Press 238-2	1.226E-02	1.707E-02	7.019E-03	8.398E-04	4.097E-03	6.326E-03
Above K2 Dryers 238-2	1.497E-02	1.120E-02	7.762E-03	2.869E-03	1.928E-03	5.353E-03
Above C.C. 238-2	1.379E-02	1.174E-02	8.671E-03	5.529E-03	2.008E-03	5.388E-03
By T-341 238-2	1.045E-02	1.054E-02	1.098E-02	7.279E-03	2.490E-03	5.219E-03
By T-328 238-2	1.121E-02	1.174E-02	8.505E-03	4.969E-03	1.366E-03	5.156E-03
Outside Ball Mill 238-2	8.218E-03	5.068E-03	6.606E-04	4.129E-03	1.526E-03	4.362E-03
Western Boundary 238	2.995E-03	2.134E-03	9.909E-04	1.960E-03	2.651E-03	2.498E-03
Between 238 & 248	2.100E-03	2.174E-03	4.129E-04	1.120E-03	2.249E-03	2.251E-03
Eastern Boundary 238	1.880E-03	2.601E-03	1.569E-03	1.680E-03	2.972E-03	2.895E-03
Southern Boundary 238	1.880E-03	2.201E-03	1.404E-03	9.798E-04	3.454E-03	2.505E-03
Northern Boundary 248	2.437E-03	1.667E-03	1.156E-03	9.798E-04	2.731E-03	2.685E-03
Ore Staging Area by 222	2.368E-03	1.334E-03	9.909E-04	1.260E-03	2.490E-03	2.139E-03
CT Incinerator Stack	1.512E-03	7.239E-04	3.823E-03	1.548E-04		1.617E-03
Plant & Canopy	1.881E-03	1.267E-03	1.239E-03	5.599E-04	2.811E-03	2.773E-03
Inside 704	2.437E-03	1.467E-03	4.955E-04	9.798E-04	3.052E-03	5.119E-03
Average	8.018E-03	6.013E-03	4.098E-03	2.954E-03	2.255E-03	4.288E-03
Average 238	1.065E-02	7.942E-03	5.339E-03	3.800E-03	2.036E-03	4.993E-03
Perimeter Average	2.258E-03	2.147E-03	1.107E-03	1.344E-03	2.811E-03	2.567E-03

TABLE 2.

MALLINCKRODT, INC.

PARTIAL PLOT PLAN

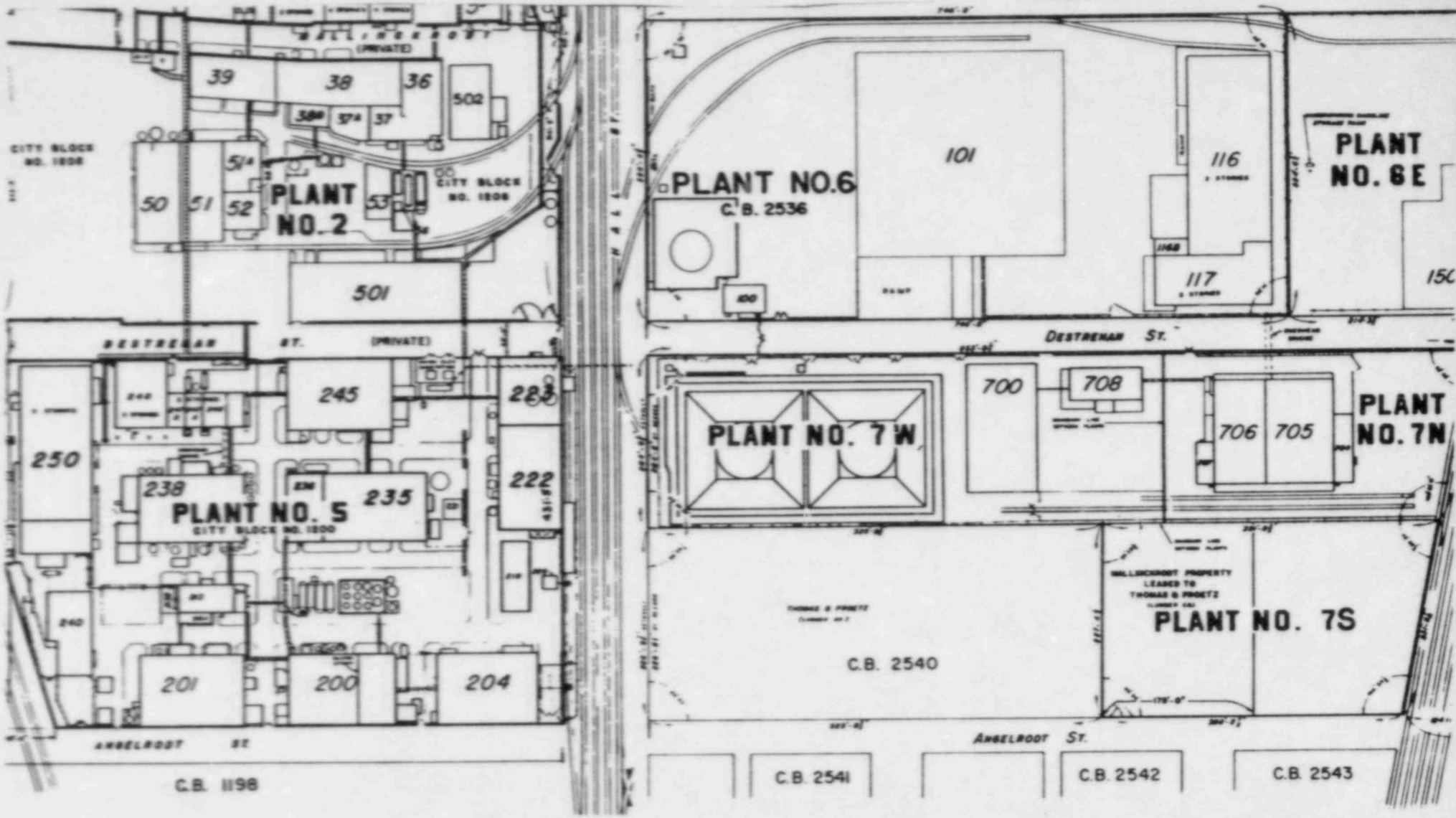

FIGURE 1

MALLINCKRODT, INC - PROCESSING FLOWCHART

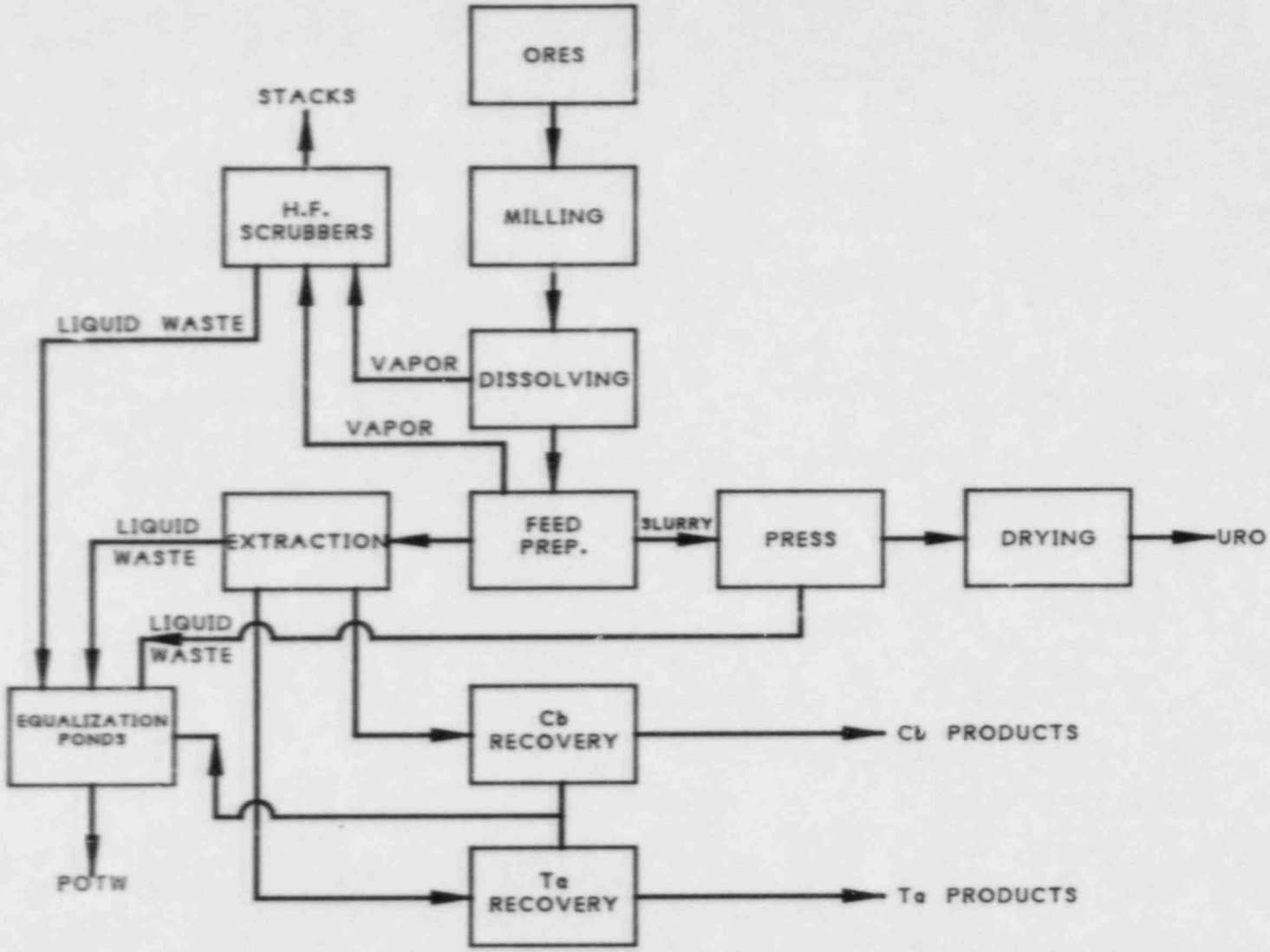

FIGURE 2

WATER USE DIAGRAM FOR MALLINCKRODT,INC. AT ST.LOUIS,MO.

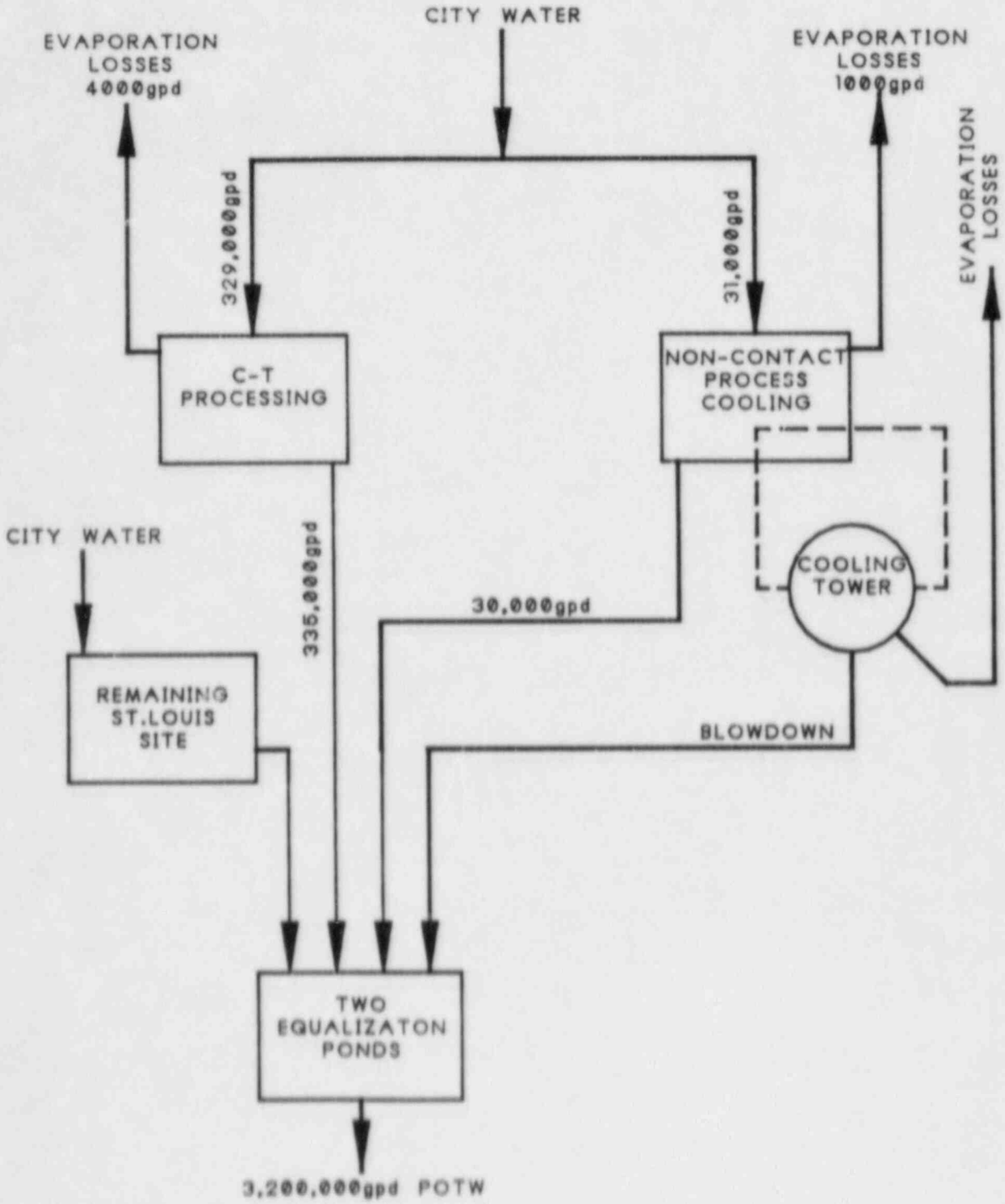

FIGURE 3

MALLINCKRODT, INC.

PLOT PLAN

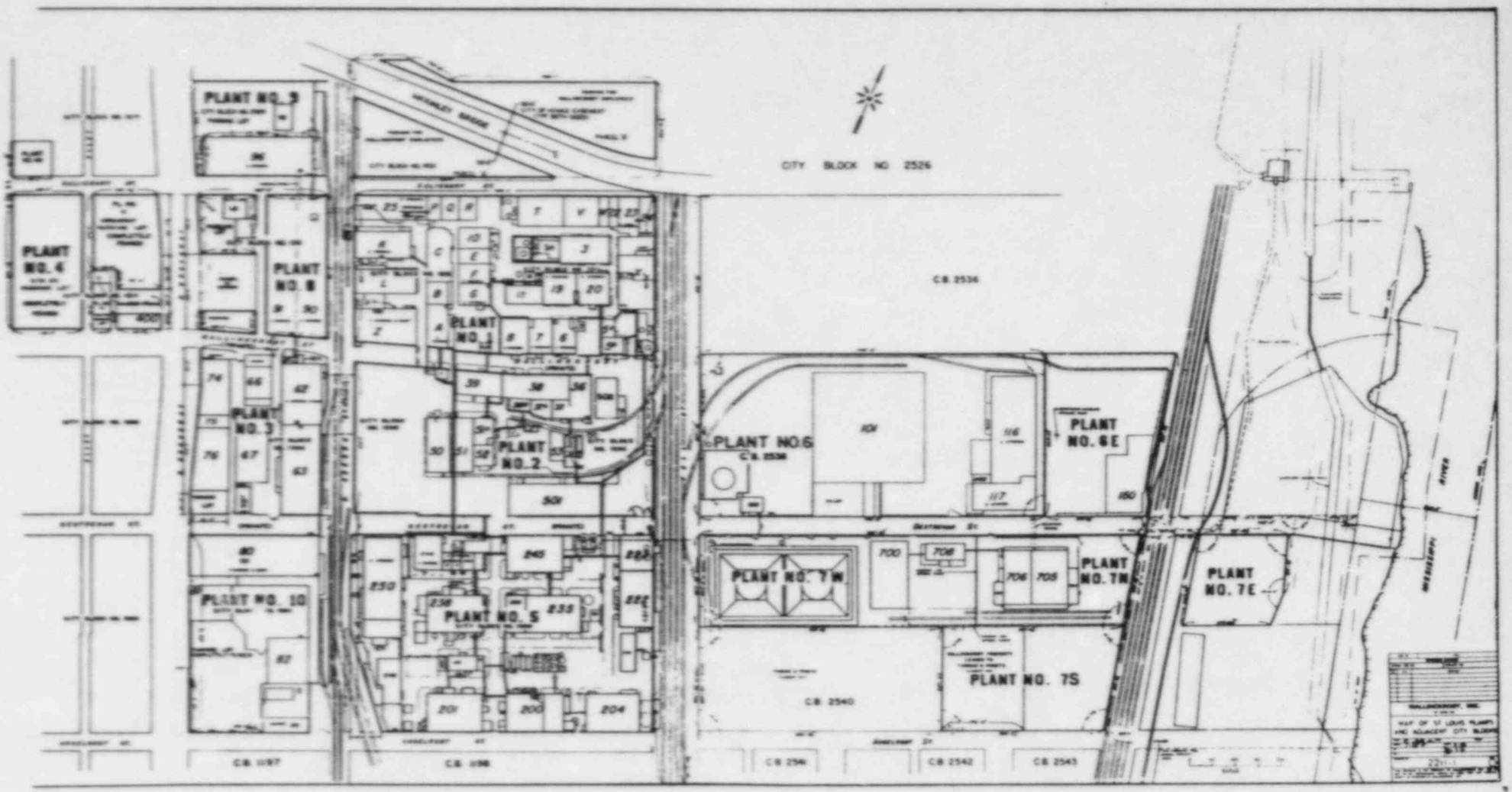

FIGURE 4