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History & Background Relative to the Radiological Re-monitoring of Mallinckrodt by the Energy Research & Development Administration

Prepared for Mallinckrodt, Inc.

by Mont G. Mason

Under Contract E-3965-1001-SJF

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(Prepared by Mont G. Mason under contract to Mallinckrodt, Inc.)

Preface

This information has been assembled to assist ERDA in carrying out their radiological survey and reassessment of Mallinckrodt's properties in St. Louis, Mo. which were formerly used to process uranium feed materials for the U.S. government.

No claim is made that this summary is either complete or entirely free of errors. It represents a best effort to recover data from old and often fragmentary company records or personal log books, supported or filled in by the recollection of present or former Mallinckrodt employees who worked in the company's former uranium feed materials operations.

Only Mallinckrodt's records were examined in preparing this summary. Records and files of the former USAEC were not examined or searched although pertinent information is believed to be available in those records.

The era of interest began with Mallinckrodt's pioneer development work in 1942 and ended in 1960-61 when the USAEC released Mallinckrodt's property for unrestricted use.

Introduction

This summary covers uranium work for the U.S. government at plants in St. Louis, Mo. during the era from 1942 through 1957-58. It does not cover work related to or at Weldon Spring or any other era or location. All of the work referred to herein was performed on Mallinckrodt land, some of it in Mallinckrodt-owned buildings.

Mallinckrodt's uranium work in St. Louis was concerned with the chemical treatment of impure natural uranium feed materials so as to produce a very pure uranium trioxide (UO_3). Additional steps were operated to produce uranium dioxide (UO_2), uranium tetrafluoride (UF_4), & uranium derby metal. Derby metal was vacuum recast to form purified ingot metal.

Other work was done at various times for brief periods including:

(1) Machine natural uranium metal rods to make reactor fuel slugs.
(2) Revert UF_4 to UO_2 or to U_3O_8.
(3) Recover scrap uranium metal.
(4) Produce UO_2F_2.
(5) Extract and concentrate thorium 230 from pitchblend raffinate.
(6) Experimentally purify or rework very low enrichment UF_4.

Introduction (Continued)

There was no production work with natural thorium, or with highly enriched uranium, or fission products, or by-product material. There was no production or operation with UF_6, nor any concentrating of U_{235}.

There was production work to extract and purify uranium directly from pitchblend ore, which work also involved separating the radium 226 and its daughters into a special residue fraction (K65), but there was no work done to further separate or concentrate radium or its daughters.

No uranium or other radioactive material was disposed of by incineration. None of the process materials or residues or wastes were disposed of by burial at the St. Louis plants or by Mallinckrodt anywhere.

Solid process wastes or residues were collected at the point of process origin and delivered to USAEC on-site. The USAEC removed those materials from the plant site to other USAEC sites for processing or disposal.

There was no known incident of massive release of uranium or other radioactive material to plant process sewers, or known incident of accidental plant release of materials to cause gross contamination of adjacent private or public property.

Beginning about 1945, many process wastes or residues were taken from the St. Louis plants to a government storage site near the airport in St. Louis County. Inventories of finished goods were also stored in secured government buildings in the vicinity of that site. All of that storage was done by the U. S. government. Mallinckrodt did not direct the storage of any of those materials at those locations or have responsibility for their storage or security or for the properties used for those purposes.

Summary

Mallinckrodt's uranium work for the U. S. government began in March, 1942 at the request of Dr. A. H. Compton. Mr. Edward Mallinckrodt Jr. was asked to undertake the development of uranium refining processes to furnish materials for the World War II Manhattan project. This effort continued through 1966 when Mallinckrodt's contract work ended.

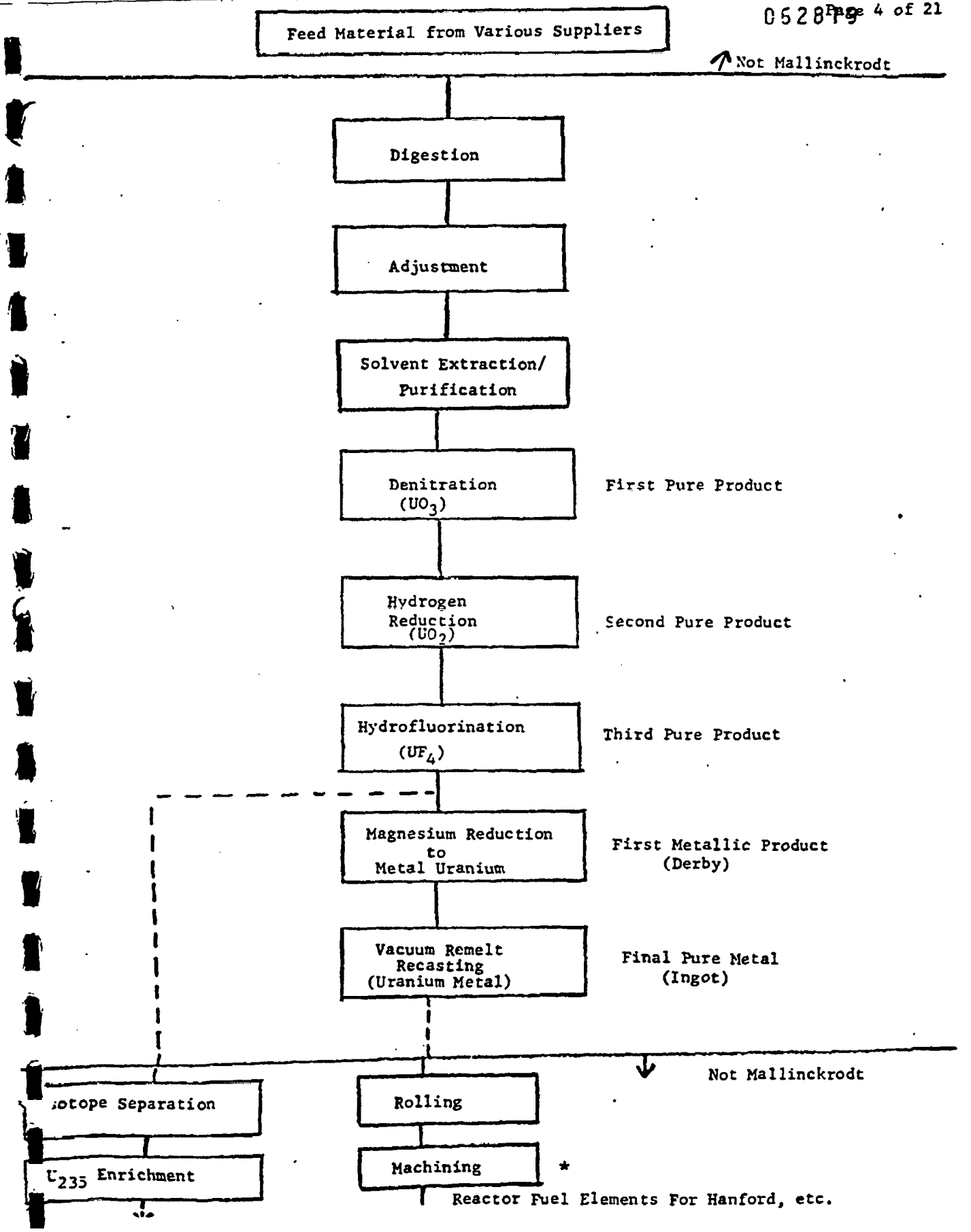
During that era of 24 years the Company designed and operated feed materials facilities in St. Louis, Mo. and St. Charles County which employed a total of about 3300 individuals and produced more than 100,000 tons of purified natural uranium materials.

The plants in St. Louis, Mo. were constructed and operated on Mallinckrodt land. In St. Charles County the land and buildings and everything therein belonged to the U. S. government.

Summary (Continued)

During that era Mallinckrodt was a prime contractor to the U. S. government. From 1942 until 1947 the contract was managed by the U. S. Manhattan project. The contract was transferred to the USAEC after it was formed in 1946-47 and came under the USAEC New York operations at that time, where it remained until 1954. Then it was transferred to USAEC Oak Ridge operations, where it remained until work ended in 1966. From 1942 through 1954 it was a unit price contract; after 1954 it was a cost plus fixed fee contract.

The operational technology was complex but the processing was straight forward and involved the following basic steps:


Feed Material from Various Suppliers
Not Mallinckrodt
Digestion
Adjustment
Solvent Extraction/ Purification
Denitration (UO_3)
First Pure Product
Hydrogen Reduction (UO_2)
Second Pure Product
Hydrofluorination (UF_4)
Third Pure Product
Magnesium Reduction to Metal Uranium
First Metallic Product (Derby)
Vacuum Remelt Recasting (Uranium Metal)
Final Pure Metal (Ingot)
Not Mallinckrodt
sotope Separation
U_{235} Enrichment
Rolling
Machining
*
Reactor Fuel Elements For Hanford, etc.

Summary (Continued)

From 1942 through 1945, Mallinckrodt's production was done in previously existing Mallinckrodt buildings on company land at "the Main Plant" and at "Plant 4" in St. Louis city.

In 1946 a new refinery at 6[illegible] Destrehan, in St. Louis city, began operating to process pitchblend ore and to produce pure UO_2. At that time the "Main Plant" refinery for U_3O_8 feed (and some pitchblend) was closed. The new refinery was called Plant 6.

During 1950-51 additional plants began operating at Destrehan to produce (1) metal and (2) green salt (UF_4). At that point the "Plant 4" production operations ended. The new plants were called Plant 6E (metal) and Plant 7 (UF_4). The Plant 4 facilities were then modified to be used as a metallurgical pilot plant where development work with uranium metal continued until 1956.

During 1948-1949-1950 the USAEC carried out decontamination at the "Main Plant". Work was performed and supervised by Mallinckrodt personnel to meet USAEC criteria. Final contamination surveys and clearance for unrestricted use of the property was given by USAEC personnel from its NYOO Health and Safety Division. By 1951 all of the Main Plant property had been returned to Mallinckrodt for unrestricted use.

During 1955-1956 Plant 4 was closed. In 1957 all operations at Destrehan were closed and transferred to a new USAEC feed material processing center at Weldon Spring, Mo. which Mallinckrodt operated for the USAEC.

The USAEC organized a task force and hired a sub-contractor to carry out decontamination of the Plant 4 and Destrehan properties. In 1961-62 the decontaminated property was returned to Mallinckrodt by the USAEC for unrestricted use. Some decontaminated production buildings remained at Destrehan, none at Plant 4. All contaminated buildings had been removed by USAEC. Contaminated earth had been removed and backfilled by USAEC.

Since receiving its property from USAEC for unrestricted use, Mallinckrodt has used it for various purposes related to its commercial chemical operations. Some buildings that remained at that time have been torn down. Some at Destrehan are currently used as warehouses. New buildings have been constructed at both Plant 4 and at Destrehan.

Parts of the Destrehan site have been used to store columbium-tantalum "ore" which contains varying small amounts of uranium-thorium and is a USNRC licensed material. Bulk storage of that material there continues at the present time which adds to the radioactivity "background" at present Plant No. 6, Plant No. 7N, and Plant No. 7W.

Large amounts of potassium compounds are also stored in warehouses at the above plants. The naturally occurring, beta-gamma emitting potassium 40 isotope in that material also adds to the radioactivity background of that area.

Summary (Continued)

The USAEC did not decontaminate radioactivity to background at the Main Plant, or at Plant 4 or at Destrehan, but only reduced it to the "acceptable levels" that were standard at that time. These are not the same as levels currently recommended by USNRC for release for unrestricted use of licensed source material operations.

APPENDIX A

Identification of Buildings Used For Uranium Project Work

TABLE 1

(Name used commonly by project people vs current designation)

Common Usage	Current Designation
"Main Plant"	Plant No. 1 Plant No. 2
"Building 51"	The Complex at Plant No. 2: 50,51,51A,52,52A,55
"Plant 1"	Same as "Main Plant"
Project 89	Plant 1, Plant 2
Project 90	(Green Salt) Plant 10 (Bldg. 400)
Project 91	(Derby) Plant 10 (Bldg. 400)
Project 92	(Recast) Plant 10 (Bldg. 400)
"Plant 6"	All of Destrehan Site
"Plant 6E"	Building 116 at Plant No. 6
"Plant 7"	Building 704,705,706,707,708 at Plant Nos. 7N & 7W
"Plant 4"	Part of Plant No. 10

APPENDIX A (Continued)

Identification of Buildings Used For Uranium Project Work

TABLE 2

(Existing Buildings that were formerly used)

Plant	Building No.	Use
1	25-1	Lab, R&D, Control
	25-2	Lab, Q.C. Spectrophotometry
	Alley	R&D Extraction
	K-1-E	Pilot Plant, Semi-work (Pitchblend)
	A	General Plant Mechanical
2	50	General storage, utility, UF_4 experim
	51	Digest & Treat U_3O_8 Feeds
	51A	Denitrate and hydrogen reduce
	52	Ether Extraction
	51X	Outside for extraction of pitchblend liquor
	38B	Personnel Change House
	40	Temporary storage of residues
10	None, except part of RR Dock	Movement of materials
6	100	Electric Substation
	116-1	Mfg. U metal, Whse
	116-2	Whse, Office, Graphite machining
	116-B	Electric Substation
	117-1	Security, Change House (Trace Pitchblends)
	117-2	Lunchroom, Laundry, Contractor Change Rm. (Trace Pitchblends)
	101? removed? see next pg	
7N	704	HF Off Gas Treatment
	705	Mfg. UO_2, UF_4
	706	Storage UO_2, UO_3, UF_4
	707	Mfg. $H_2 + N_2$ from NH_3
	~~to 709?~~	
7W	708	Magnesium storage, Pkg.
	709	Whse., Safety Office, Some Core Machining

APPENDIX A (Continued)

Identification of Buildings Used For Uranium Project Work

TABLE 3

(Buildings Not Listed in Table 2, that have been removed)

Plant	Building	Location
1	None	
2	55	Shotgun Lab - Temp. Structure
	52X	Canopy Enclosures - Temp. Structures
10	400	Main Mfg. Building for UF_4 & Metal Slag Handling, Maint., Laboratory, Offices, Change House
	401	Maint., Metal Process & Storage, UF_4 Pilot Plan
	406	Magnesium storage
	408	Slag, Dolomite, KOH, NH_3, HF, and other storage; Processing
6	Note: Only major buildings are listed here:	
	101	Offices, R&D Lab, Receiving, Decontamination (Trace Pitchblend)
	102	Main Control Lab, R&D Lab, Lab offices (Minor Pitchblends)
	103	Air Conditioning for 102
	104	Main Refinery Bldg. Ore to UO_3 to UO_2 (Pitchblends)
	104A & AA	Main Refinery Ore Handling & Milling(Pitchble
	104B	Main Refinery Pilot Plant Area (Pitchblends)
	105	Main Refinery Ether House - Extraction (Trace Pitchblends)
	106, 106A	Nitric Acid Recovery
	107	Tank Farm Pump House
	108	Shotgun Sample Prep Lab.
	110	Main Warehouse for bag goods, ore, concentrate (Pitchblends)
	110A	Main Warehouse Part used as Ledoux Lab (Pitchblends)
	110B	Automotive Repair
	111	North-Ledoux Lab (Pitchblends) South-Maint.Shc
	112-1	Maint. Shop, Maint. Stores, Health Lab. Dispensary
	112-2	MCW & AEC Administration Offices
	114	Scale House; temporary storage of residues (Pitchblends)
	115 & 119	Steam Plant
	120 & 121	U Metal Dissolver, Misc. Digest & Recovery (Pitchblends
	123	Ammonia & Dissassociator
	116C	Slag Grinding & Packaging

TABLE 3 (Continued)

Plant	Building	Function
7N	703	HF Tank Farm
	709	HF Refrigeration [illegible] Pump House
	710	NH_3 Tank Farm and Pump House
7N	711	Mechanical Storage
	712	Thorium 230 Extraction (Tempora
	701	Slag Treatment for U Metal Recovery

APPENDIX A (Continued)

TABLE 4

(New Construction and Its Orientation T, Old Buildings)

Plant	New Building	Where
1	None	
2	None	
10	81	Covers approx. the North 1/2 of old Bldg. 400 which was the UF_4 Mfg. area
	101	Covers approximately: Ore Room, Digestors, Radium Filte of 104 (SW corner 101) 114 Scale House (SW of center 101 Storage Bays of Whse 110 (NW corner 101) Ledoux Lab 111 (NE corner of 101) Maint. Shop 112 North edge of Lab 102 (SW corner 1

APPENDIX A (Continued)

TABLE 5

(MCW Engineering wings that are useful to locate Buildings)

2211-1	Plant Map; Plants No. 1, 2, others
3506-1	Plant No. 10
3506-2	Plant No. 6
3509-3	Plant 7N, Plant 7W

APPENDIX B

Expanded Discussion of Mallinckrodt Uranium Processing Operations

Purifying Uranium Feed Materials

Mallinckrodt's uranium work for the U.S. government started in 1942. The feed material was uranium black oxide, U_3O_8, which had been previously extracted from ore and had been concentrated elsewhere, and was free of radium or its daughters.

Laboratory development work was done at Plant No. 1 in laboratory building No. 25, second floor, and in the alleyway adjacent to the southwest side of that building.

A batch operation production process was then installed at Plant No. 2 in Buildings 50, 51, 51A, & 52.

(1) In Building 51 the U_3O_8 was digested in nitric acid.

(2) In Building 52 the uranium nitrate solution was purified by organic extraction with ether to yield very pure UNH (uranyl nitrate hexahydrate).

(3) In Building 51A the UNH underwent thermal decomposition by pot denitration to yield UO_3 (uranium trioxide, also called orange cake).

(4) Also in Building 51A, the UO_3 powder was converted to UO_2 powder through high temperature solid-gas reaction with hydrogen (uranium dioxide, also called brown cake).

At this point, the UO_2 powder was packaged and removed from Plant No. 2.

Solid residues from extraction were drummed, stored temporarily, and later removed from Plant No. 2 to government sites elsewhere for scrap recovery.

During July, 1942, Building 51A began producing approximately 1 ton of UO_2 per day. This production continued until 1945-1946 when the area was closed in preparation for start-up of a new refinery at Plant No. 6.

Radium bearing materials were not processed or stored at any time in the Plant No. 2 buildings.

Building 50 was used as a utility area. Some tanks were installed there to store liquids for use in Building 51. Incoming feeds were stored there along with packaged products. It also served as a mechanical repair area and for other utility purposes as needed. For a short time one corner of it was used for development work on the UF_4 process.

APPENDIX B

Purifying Uranium Feed Materials (Continued)

Building 55 was used as the "shotgun lab" where samples of UO_3 were treated and tested for neutron absorbtion. A 100 mg radium-beryllium neutron source used in that test made it necessary to make Building 55 a special restricted area.

The laboratory at Plant No. 1 in Building 25-2W provided quality control services; a portion of 25-1W provided quality control services. Later, a laboratory to furnish production control services was installed at Plant 10 in Building 400.

Part of Building 38A was used as the change house for the uranium project workers.

General maintenance services were furnished by the plant mechanical department which was based at Building A in Plant No. 1

No specific area was assigned initially to project management or administrative services. The early uranium project was a semi-works operation for which administration and services were furnished from company headquarters, Building Z. However, provision was made for those and other services at the new Plant No. 6 which became available in 1946.

Pitchblend Ore As Feed Material

In about July, 1944, Mallinckrodt began development work to extract and purify uranium directly from high grade pitchblend ore. Ore containing 30% uranium or more was available from mines in the African Congo. However, because of its radium content, that ore or its extraction residues presented radiological problems that were not present in processing the previously extracted U_3O_8 feed material or other similar mill concentrate.

The radium content of the pitchblend ore was approximately 0.3 curies (0.3 grams) per ton of uranium. The U.S. government projected a production need of 1000 tons per year from pitchblend, equal to about 300 grams of radium to be processed per year.

Because of the government's urgent need for uranium which could only be met by finding a way to extract it from that ore, Mallinckrodt agreed to undertake the work but was determined to confine all radium bearing materials to a limited small area and to prevent the spreading of any radium material into other plant areas. This called for strict administrative control. Management also decided to do pilot plant scale work to obtain design data for constructing a new refinery to process pitchblend.

The laboratory in 25-2 was again used for development work. Building K-1-E in Plant No. 1 was selected for the pilot plant work. By the end of 1944 the work in Building K-1-E provided sufficient data to begin the engineering design for a pitchblend refinery at Plant No. 6.

APPENDIX B

Pitchblend Ore As Feed Material (Continued)

The process in K-1-E dissolved pitchblend in nitric acid, then stri d the radium along with lead and radium daughters from the liquor by - fate precipitation and filtration, yielding a "lead gangue cake" which contained the radium. A second step treated the filtered liquor with barium to neutralize excess sulfate; this gave a barium sulfate precipitate that carried down all remaining radium. The lead gangue cake and the barium cake were packaged separately and returned to the government for transfer off-site. This method also eliminated the regrowth of the radon daughter of radium later on in the process.

Pilot plant operations in K-1-E yielded properly adjusted and radium-free feed liquor which was conveyed in containers by hand cart to Plant No. 2 where it was first treated in vessels outside of Building 52, then taken into 52 for final purification, then into Building 51A for denitration and hydrogen reduction to UO_2.

That UO_2 became part of the inventory to be used as needed along with the UO_2 made from U_3O_8.

All of the pitchblend work was transferred to new manufacturing buildings at Plant No. 6 in 1946 at which time the uranium processing buildings in Plant No. 1 and Plant No. 2 were closed.

Production of UF_4 (Green Salt)

Work began in 1942 to manufacture UF_4 (uranium tetrafluoride - green salt) by the high temperature gas-solid reaction of UO_2 with HF (Hydrofluoric Acid). Preliminary work to develop process equipment was done in the "sulfur burner room" in Building 50 at Plant No. 2. That process and equipment was scaled up and installed on the 1st. floor north of Building 400 at Plant No. 10. It was a batch process by which UO_2 powder in trays was placed inside of an electrically heated muffle furnace through which anhydrous HF gas was passed. The trays of UF_4 thus formed were emptied into fiberboard containers for storage until needed elsewhere.

Excess HF was neutralized with lime or potassium hydroxide solution to recover uranium. Neutral solutions were discharged to process sewers. Cakes were packaged to be shipped elsewhere for recovery.

Pilot plant work to develop a continuous furnace green salt process was done in Building 401 at Plant No. 10. The process was installed in Building 705 at Plant No. 7N which began operating in 1951. At that time the UF_4 operations at Plant No. 10 were shut down. Note: The area referred to as Plant No. 10 was called Plant No. 4 during the era of uranium work there.

APPENDIX B (Continued)

Production of Uranium Metal

Processes to manufacture uranium metal were installed at Buildings 400 and 401 at Plant No. 10. Work began in 1942; production started in 1943-1944.

This was a 2-stage process which used parts of the first and second floors of Buildings 400 and 401. Magnesium metal for the first stage was stored in Building 406; residues were stored in Building 408.

The first stage involved reacting UF_4 with ground magnesium metal to produce a solid uranium metal regulus called a "derby". This batch process, thermite reaction was carried out in dolomite lined, steel reaction vessels (called bomb shells) which were heated inside of electric muffle furnaces. The cooled shells were "broken out" to expose the derby and the magnesium fluoride slag. The derby was cleaned and made ready for the second step. The slag was crushed and packaged for shipment elsewhere (Vitro) for recovery of its uranium content.

This so-called "derby step" (also referred to as KB-2 operations) remained in continuous operation at Plant No. 10 until 1950 when it was closed after Building 116 at Plant No. 6 began operations.

The second stage involved melting and recasting derbies and other forms of uranium metal inside of an induction heated vacuum furnace. The molten metal was poured (cast) into a mold to form a cylindrical ingot rod about 6 inches in diameter.

The crude metal was loaded into graphite crucibles which were placed inside the vacuum furnaces. The molds to form the ingot were also graphite. During the melting in-vacuo, dross and slag gloated to the top of the crucible. The beta emitting UX1-UX2 daughters of U_{238} sublimed and cooled on the furnace lid. The ingot was thus initially low in beta activity.

Dross from the crucibles and other furnace residues was packaged separately for recovery elsewhere. (Vitro and, later, at Destrehan).

Finished ingots were sawed to suitable lengths and packaged for storage in Building 400 awaiting shipment elsewhere.

Finished metal had various code names including tube alloy and YM5.

There were no wet operations. Uranium residues consisted entirely of metal or black oxide (U_3O_8).

The recasting step at Building 400 remained in continuous operation until 1950 when it was transferred to Building 116 at Plant No. 6.

The "Plant 6" Refinery

In 1944 a decision was reached to construct a new refinery for manufacturing pure U by direct extraction from pitchblend ore. Process design and engineering was based upon the work done in K-1-E, in combination with work in 51, 52, & 51A. Vacant Mallinckrodt land at Plant 6 was selected because of its proximity and because there was sufficient space to construct other buildings for administration, laboratories, warehousing, maintenance, and other support services to enable the site to function as an independent unit. Security also was a factor in that selection.

During the first half of 1946 the new facilities were placed in operation. All uranium work at the "Main Plant" stopped and buildings there were sealed to await future clean-up. "Plant 4" was not affected by this change.

The Plant 6 refinery process in Building 104 was designed for pitchblend and included new operations to

(1) Recover radium as a separate residue which the AEC stored elsewhere.

(2) Recover raffinates as a separate residue which the AEC stored elsewhere.

(3) Remove sulfate by barium precipitation, yielding a radium bearing cake which the AEC stored elsewhere.

Incoming pitchblend ore, which arrived by rail in carload lots, was stored in Warehouse 110. The radium cake (K65) was packaged in drums and stored in Building 114 until removed by AEC. Raffinate cake was collected in dumpsters, transferred to dump trucks which AEC operated to remove the cake daily for transport elsewhere. The barium cake was handled in a similar manner.

The feed liquor was extracted with ether in a manner similar to that used at Building 52, yielding pure UNH.

The UNH was denitrated in Building 104, much like it was done at Building 51A, to yield UO_3.

The UO_3 was reduced with hydrogen in Building 104 the same way it was done at Building 51A, to yield UO_2.

The UO_2 was sent to "Plant 4" or elsewhere for further processing.

Thus, all of the manufacturing work formerly done in several buildings at the "Main Plant" was now done under one roof at Plant 6 in Building 104.

APPENDIX B

The "Plant 6" Refinery (Continued)

Laboratories, offices, maintenance shop, steam plant, and all other services were also provided by or from other buildings at Plant 6. The area continued to expand with new construction and greater production through 1954.

In 1949 a second digest line was added to Building 104 to handle "mill concentrates" that were very similar to modern "soluble" uranium feeds.

By 1952, pitchblend feed was largely eliminated at Plant 6; it completely ended in 1954. The pitchblend and radium equipment was placed on standby but was not removed at that time. It remained in place until AEC began decontaminating Plant 6 in 1958.

"Plant 6E"

Building 116 was constructed at Plant 6 to replace the metal steps at Building 400 (old Plant 4). It began operating in 1950 and remained in operation until AEC closed the Destrehan site in 1957.

"Plant 7"

Buildings 703, 704, 705, 706, 707 & 708 were built to replace the green salt steps at Building 400 and the UO_2 step at Building 104. This new area was known as "Plant 7". It became operational in 1951 at which time the green salt steps at "Plant 4" were closed.

Building 700 was placed in service in 1954 to serve as a warehouse. Part of it was used temporarily for machining reactor cores.

Building 701 was placed in service about 1955 to remove metallic uranium from slag by a wet grinding/mill floatation process.

Ionium

In 1954-1955 temporary Building No. 712 was constructed to fill a special AEC order for Thorium 230 which was extracted from old pitchblend raffinates. This was a restricted "hot lab" operation which ended during 1956. The building and equipment remained when the AEC began decontamination.

General

The principle manufacturing operations and sources of radiological contamination are listed above. Other buildings were not directly involved in manufacturing so any contamination in them was indirect.

Process water, sanitary wastes, and storm water all went to common sewers which flowed directly to the Mississippi River.

APPENDIX B (Continued)

Decommissioning/Decontamination - Main Plant

In 1949, the Mallinckrodt Uranium Division in conjunction with the USAEC NYOO began work to decontaminate all of the "Main Plant" buildings that had formerly been used for uranium project work. Clean-up work was performed by Main Plant work crews under directions from Uranium Division Health Department monitors. Contamination was accumulated and delivered to AEC for disposal. Contaminated equipment was taken to Plant 6 where it was either put to use or transferred to AEC for disposal. Some equipment was delivered directly to USAEC at the Main Plant for disposal.

When the work was done to the satisfaction of the St. Louis Area AEC office, then monitoring personnel from USAEC NYOO surveyed the Main Plant facilities. After they were satisfied, the USAEC returned the facilities to Mallinckrodt for unrestricted use.

Detailed reports of that work including final surveys were prepared by Mallinckrodt and the USAEC. However, no copies have been located of either of these reports. (Further search of old MCW Uranium Division Health Department records or old USAEC NYOO H&S Division records might yield copies if that should become necessary).

Destrehan and Plant 4

In 1957 the USAEC discontinued production at St. Louis and transferred all of its work there to the new Weldon Spring Feed Materials site. Soon thereafter, USAEC entered into contracts with Arch Wrecking Co. to remove USAEC equipment or materials from the Destrehan and "Plant 4" sites and to decontaminate those properties so that they could be returned to Mallinckrodt for unrestricted use.

The Mallinckrodt Uranium Division, then at Weldon Spring, was directed by the USAEC to furnish it with radiological monitoring services for that work which was done. However, the monitoring services so provided did not entail decisions that anything could be released for restricted or unrestricted use. That decision rested solely with USAEC.

The Uranium Division performed a final decontamination survey of the Destrehan and Plant 4 properties for the USAEC during 1960-61 and furnished a report to the USAEC.

Appropriate officials for Mallinckrodt and USAEC then negotiated terms for transferring the property back to Mallinckrodt for unrestricted use.

The survey portion of that report for the Destrehan site was furnished to Mallinckrodt by ERDA in July, 1977. So far, no other part of the documentation of the close-out surveys and reports has been found.

APPENDIX C

REFERENCES

In the preparation of this summary, I have relied heavily on my personal first hand knowledge acquired as Manager of the Uranium Division Health Department from 1947 through 1966, and on personal notes, or copies of parts of various documents which I accumulated for my personal use during that era.

I have interviewed a number of former Uranium Division personnel to fill in voids of my personal recollections and to amend or strengthen them. The following is a partial list of those persons who have been especially helpful:

1. Dick Midlam
2. Bill McGrath
3. John Opie
4. Walter Bone
5. Matt Kuehn
6. Harry Ellington
7. Harold Hollenback
8. Orville Green
9. Vic Amantea
10. Barney Field
11. Harold Yeager
12. Earl Miller
13. George Brown
14. Ed Monaco
15. Frank Bognar

I have also reviewed a number of company records and documents including engineering drawings furnished by Noble Robinson, George Brown, and Garth Smith and the file of contracts and contract correspondence furnished by Roger Keller.

Documents in addition to the engineering drawings that have been especially helpful are:

1. Uranium Production Technology by Harrington & Ruehle D. Von Nostrand Co. 1959

2. Fuel For The Atomic Age - A completion report on St. Louis Area Uranium processing operations, 1942-1947. Prepared by Fleishman-Hilliard Inc. under MCW-UD sub-contract 25188-M of July 11, 1966. Under Contract No. W-14-108 Eng-8

3. Uranium Division News - June, 1962, Vol. 7, Nos. 3 & 4.

APPENDIX C

REFERENCES (Continued)

4. "Activity Levels. Final Radioactivity Survey, Destrehan Street Survey, Destrehan Street Facilities"

Report By: MCW UD Health & Safety Dept. 11/30/61
Associated with Disposal of Destrehan Street Facilities and Restoration of Site. AEC Contract AT-(23-2)-44, Project No. 224-6041. Copy furnished to N. Robinson by W. T. Thornton (ERDA), Transmitted July 22, 1977.

5. Files of W. L. Utnage from Main Plant records including: "Preliminary - Radioactive Contamination Survey", MCW - UD, Destrehan Plant, August 6, 1959.

6. "Disposition of Destrehan Street Facilities and Restoration of Site", Report of services provided by Mallinckrodt Chemical Works, Uranium Division, Health and Safety Department. (Copy of report furnished by D. Holt, former employee who assisted in the work and in preparing the report).

7. "Atomic Energy For Military Purposes", H. DeW. Smyth, Princeton University Press 1948.

8. "Annual Report, Fiscal Year 1950", Health and Safety Division, U. S. Atomic Energy Commission, New York Operations, November 13, 1950.

Note: I have only a copy of a section related to the Mallinckrodt operations. I have this as part of my personal files; I did not seek out the full report from old USAEC records.

9. "Health Hazards In NYOO Facilities Producing and Processing Uranium", (A status report - April 1, 1949) issued 18 April, 1949. U.S. Atomic Energy Commission, New York Operations Office, Prepared by the NYOO Medical Division.

Note: There has been no search of old files from Destrehan or Weldon Spring operations that may still be stored by ERDA at the Federal Record Center, Winnebago Street, St. Louis, or portions thereof which have been transferred to USAEC (ERDA) at Oak Ridge Operations, or of old files relating to Destrehan or Main Plant operations which may be in the former USAEC Archives for its New York Operations office. Some of those records are believed to still be available from the former HASC files which may still be in New York. That is the most likely place to find records relating to decontamination at the Main Plant because the NYOO AEC HASC group supervised and approved that clean up.

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