MALLINCKRODT CHEMICAL WORKS
(Mallinckrodt Inc.)
Bounded by Salisbury Street, Wharf Street,
Angelrodt Street and Second Street
St. Louis, Missouri

HABS No. MO-1929

HABS
MO
96-SALU,
134-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Buildings Survey
National Park Service
Great Plains Support Office
1709 Jackson Street
Omaha, Nebraska 61802-2571

HISTORIC AMERICAN BUILDINGS SURVEY

MALLINCKRODT CHEMICAL WORKS
(Mallinckrodt Inc.)

HABS No. MO-1929

Location: Bounded by Salisbury Street, Wharf Street, Angelrodt Street, and North Second Street, St. Louis, Missouri

USGS Granite City, Illinois-Missouri. Quadrangle (7.5'), Universal Transverse Mercator Coordinates:

744040 E	4282850 N
744190 E	4282500 N
744670 E	4283140 N
744760 E	4282760 N

Present Owner: Mallinckrodt Inc.

Present Use: Storage or vacant. Some buildings demolished in 1996-97.

Significance: The Mallinckrodt Chemical Works complex consists of 16 buildings associated with the Manhattan Engineer District/Atomic Energy Commission (MED/AEC)-sponsored program to process uranium for use in the development of atomic weapons. This work was part of a top-secret nationwide fabricating effort during World War II to develop an atomic bomb, and in the post-war era, to create atomic weapons as part of the U.S. Cold War policy of military supremacy over the Soviet Union. From 1942 to 1957 the company purified uranium oxide and produced uranium metal for the U.S. government. The property is significant for association with national defense strategies during World War II and the Cold War era.

I. PHYSICAL CONTEXT OF MALLINCKRODT CHEMICAL WORKS

Mallinckrodt Chemical Works (MCW), now Mallinckrodt Inc., is a large chemical company plant located at Mallinckrodt and North Second Streets in the North Broadway industrial section of St. Louis, Missouri, at the eastern edge of the city, 300 feet west of the Mississippi River. It is bordered by McKinley Iron Works on the north, the Mississippi River, a food processing plant and City of St. Louis land to the east, the Thomas and Proetz lumber company to the south, and North Broadway Street to the west. The Norfolk and Western Railroad, the Chicago, Burlington and Quincy Railroad, and the St. Louis Terminal Railroad Association tracks run in a north-south direction through the plant.

The 45-acre site encompasses 10 blocks, which are labeled as Plants No. 1 through No. 10. Covering the area from North Broadway to the railroad tracks at Wharf Street and from Salisbury Street to Angelrodt Street, the site contains approximately 85 buildings, dating from 1876 to 1995, that house the offices and chemical processing operations. The 16 Mallinckrodt Chemical Works buildings used for the uranium processing work carried out for the Manhattan Engineering District/Atomic Energy Commission from 1942 to 1958 are located in Plants 1, 2, 6, 6E, and 7.

II. PHYSICAL DESCRIPTION

The Mallinckrodt Inc. site, surrounded by a chain link fence and accessible through a security building, lies on flat land between North Broadway and the Mississippi River in an industrial section of St. Louis. The buildings are arranged by plants that occupy discrete blocks within the complex. The oldest section, Plant 1, located in the northeast section of the site, consists of a number of nineteenth century factory and office buildings ranging from one to seven stories. Plant 8, adjacent to Plant 1, contains a nineteenth-century industrial building formerly housing the dynamo for the St. Louis Transit Company trolleys. Plant 5 contains a number of brick buildings dating from the 1950s, unified by their similar architectural design. The uranium processing buildings, constructed in 1950 as Plants 6, 6E, and 7 in a cluster at the southwestern section of the complex, are also unified by their similar design. Buildings constructed more recently have infilled the older plants, being built where space was available. Parking lots for employees and visitors are located at Plants 3, 4, 8, and 10.

The oldest section of the company reflects nineteenth century spatial and design ideas. The brick industrial buildings are arranged in an orderly way and are designed as standard "boxes," capable of housing a variety of different manufacturing processes. The newest buildings reflect a different outlook. They are scattered throughout the site, and have no architectural unity, the design of each being based on the constraints of the specific manufacturing process to be conducted within it.

III. HISTORICAL CONTEXT OF THE SITE

A. DEVELOPMENT OF ST. LOUIS

St. Louis, founded in 1763 by the fur trader Pierre La Clede, developed as a small colonial outpost under the respective jurisdictions of France, then Spain, then the United States. The population consisted of French Creoles, African-Americans, and American settlers, engaged in either farming, fur trading, or servicing the few travelers on their way west.[1] After 1800, emigrants from the South and New England began to settle the area, as well, and the town became a more important trading center.

After 1830, the town developed rapidly. Situated as it was on a landing just across the Mississippi River, at the "gateway" to the West, it became the natural trading center for the hundreds of thousands migrating across the country as the frontier reached and then moved westward from Missouri. Settlers came from Germany as well, lured by the writings of Gottfried Duden who warned of an impending crisis of overpopulation in Germany and described the wonders of Missouri farmland. St. Louis, as the first large city west of the Mississippi River, handled freight and passengers, loading and off-loading them along the riverbanks onto wagons or other boats.[2]

Logging, shipping, pork packing, flour-milling, making of barrels, tobacco production, and beer making were the chief manufacturing interests before the Civil War.[3] After the war and as the Industrial Revolution developed, with its rise in machine production of goods formerly made by hand, and the concomitant expansion of the railroads, factories began to be built along the edge of the river, both north and south of the central business district.

St. Louis was well-situated both to make use of the natural resources found in the Midwest and to sell the finished products to that same market. With a ready supply of raw materials from the Midwest, as well as an excellent transportation system, first by riverboat and, after the 1850s, by the railroads, to carry finished goods both to the East and the Midwest, industry in St. Louis blossomed. Its extravagant growth in the post-Civil War era was fostered by the 1874 construction of the Eads Bridge, an impressive iron structure with immense stone piers, which was the first railway connection between Missouri and Illinois. Between 1880 and 1890, the number of industrial businesses in the city doubled. By 1900, the city was nationally known for the production of beer, shoes, packaged meat, stoves, bricks, chemicals, wagons and streetcars. The following businesses were also represented: planing mills, brick yards, architectural iron works, foundries, stamping mills, printing factories, confectioneries and bakeries.[4]

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1 Selwyn K. Troen and Glen E. Holt, *St. Louis* (New York: Franklin Watts, 1977), xviii.
2 *Ibid.*, 66-68.
3 William Hyde and Howard L. Conard, *Encyclopedia of the History of St. Louis* (St. Louis: The Southern History Company, 1899), 1351.
4 *Ibid.*, 1353-4.

Nine different industrial districts developed, largely in the flatlands along the river: specifically, North and South Broadway, Mill Creek, River des Peres, Oak Hill, Northwest by the Harlem River drainage basin, Carondelet, downtown St. Louis, and the East Side. With the exception of the downtown area, which contained light manufacturing companies, the other districts included such industries as lumber mills, chemical companies (Mallinckrodt, Monsanto), stockyards and meatpacking companies (Swift), grain elevators, railroad yards and terminals, tobacco companies (Liggett and Myers), foundries, brick works, steel smelters, breweries (Anheuser-Busch), and metal companies. The North Broadway District, in which the Mallinckrodt Chemical Company is located, included lumber mills, woodworking companies, the Mississippi Glass Company, The St. Louis Street Car Company, grain elevators, stockyards, meat packing plants, boiler works, machine shops, stove manufacturers, and railroad yards.[5]

Much of the handling of goods by the 1900s was done by the railroads, and the Wabash, St. Louis and Pacific, the Chicago, Burlington and Quincy, and the Merchants Terminal Railroads ran north and south between the Mississippi River and North Broadway, providing ample spur lines to every factory along this corridor. Immediately adjacent to the river were large lumber yards and planing mills, which still depended upon the river to bring white pine from northern Michigan forests. One and two blocks inland were large brick factories lining North Broadway.

By 1929, St. Louis ranked seventh nationally for its manufacturing industries, which included in order of importance, food products from meat packing and bakeries, chemicals and drugs, iron and steel products, clothing, boots and shoes, aluminum and zinc, electrical machinery and supplies, and printing and publishing products.[6] After World War II, a number of the industries moved west out of the city into the County of St. Louis, and today the once-booming North Broadway District has many vacant factory buildings.

B. DEVELOPMENT OF THE ATOMIC BOMB

The development of the atomic bomb was tied directly to World War II and the race between Germany and the United States to develop such a crucial weapon. Many of the physicists working on the development in the United States were foreigners who had fled Nazi Europe and were driven by a desire to create a bomb before Germany did. In 1939, uranium fission was discovered, and the U.S. government was apprised of its military importance. The following year, President Roosevelt established the National Defense Research Committee, with a Uranium Committee to study the requirements necessary to produce a nuclear chain reaction using uranium. This marked a first step toward production of a bomb. In 1942, the

5 James Neal Primm, *Lion of the Valley: St. Louis, Missouri* (Boulder, Colorado: Pruett Publishing Company, 1981), 464.
6 *Ibid.*, 462-464.

atomic project was centralized under the U.S. Army Corps of Engineers, and given the code name Manhattan project, or Manhattan Engineer District (MED).[7]

From 1940 to 1942, physicists at various American universities performed experiments with lattice piles of graphite and uranium oxide to see what the "optimum lattice" would be: i.e. the size, shape, and placing of uranium within the graphite to produce the desired fission. In 1942, these physicists gathered at the University of Chicago Metallurgical Laboratory, under the direction of Dr. Arthur Holly Compton, to work toward producing a chain reaction. The chief difficulty at the time was in procuring uranium oxide in sufficient quantities and of sufficient purity for the needs of the lattice. The raw material, hundreds of tons of black uranium oxide (U_3O_8), was bought from the Canadian Radium and Uranium Company but was not pure enough for the experiment with fission.[8]

Compton knew that uranium could be purified by ether extraction, and remembering his old friend Edward Mallinckrodt's experiments with ether and his company's safety record with working with the volatile material, he asked Mallinckrodt in April 1942 to tackle the important and potentially dangerous job of purifying 60 tons of uranium oxide (UO_2)in a matter of months. Mallinckrodt agreed, when other large companies had declined, and successfully produced the requisite amount of the material that was necessary for the fission experiment to succeed.[9] Leaving the Mallinckrodt Chemical Works as uranium dioxide, the material was then shipped to the Westinghouse Company, where it was turned into metal for placement in the lattice.[10] The first self-sustaining nuclear chain reaction occurred in a squash court under the west stands of Stagg Field at the University of Chicago on December 2, 1942.

Once it was proven that fission could occur, the MED pursued development of the atomic bomb. The first gaseous diffusion plant and nuclear reactor, at Oak Ridge, Tennessee, was built in the rural countryside in 1942 by MED as the field headquarters for the Manhattan Project, in order to separate uranium-235 and to produce plutonium for the atomic bomb. In 1943, a second more isolated plant was built at Hanford, Washington, with huge reactors to separate plutonium from uranium. The same year, an isolated laboratory was established at Los Alamos, New Mexico, under J.R. Oppenheimer.[11] Here the first atomic bomb was designed, constructed, and, in July 1945, exploded, leading to the bombing of Hiroshima and Nagasaki and the end of World War II. The Mallinckrodt Chemical Works continued to supply the Manhattan Project with purified uranium throughout this period.

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7 Gerard H. Clarfield and William M. Wiecek, *Nuclear America.: Military and Civilian Nuclear Power in the United States 1940-1980* (New York: Harper & Row, 1984), 27.
8 Henry DeWolf Smyth, *Atomic Energy for Military Purposes* (New Jersey: Princeton University Press, 1946), 45-74.
9 Arthur Holly Compton, *Atomic Quest* (New York: Oxford University Press, 1956), 94-95.
10 Smyth, *Atomic Energy for Military Purposes*, 88-94.
11 *Ibid.*, 222.

When Edward Mallinckrodt agreed to undertake the purification of uranium for the MED, he assigned an inorganic chemist, Dr. John R. Ruhoff, to direct the operation. The research project was entitled "Uranium Oxide S.L. 42-17." Although MCW knew that the project was secret, they chose the name deliberately to imply that the uranium compound was just one more in the company's line of standard luminescent (S.L.) chemicals, and therefore did not merit any special attention or curiosity. However, the name was later changed to the "Tube Alloy Dioxide Project" when government security officials indicated that the use of the word uranium was against security regulations.[12]

Additionally, MCW was required to give code names to the various metals that were processed as part of the uranium operations. Initially, uranium trioxide (UO_3) was called orange oxide, uranium dioxide (UO_2) was called brown oxide, uranium tetrafluoride (UF_4) was called green salt, and uranium metal was labeled biscuits. In 1947, these names were changed further and tended more toward food. Orange oxide became juice, brown oxide was called cocoa, green salt was called talcum, and high grade ore became oats.[13] Very few MCW workers knew what product they were working on. One worker, Matt Kuehn said "We knew we were working on something very important for the war effort. We knew it was uranium but didn't know just what part it was to play." Another operator commented, "I don't know what the stuff is but they tell me it's radioactive — so it must be for radios." [14]

Research was carried out in laboratories on the second floor of Building 25 and in the alleyway between Buildings K and 25, to discover how to convert black uranium oxide to uranium dioxide, the material needed by the government for its experiment with atomic fission. The original research and development team consisted of Donald Alnutt, James Boyd, Dr. Charles Conard, Dr. Charles D. Harrington, Louis Kaplan, Dr. Jack Kyger, John Lemp, Gerald Reid, William Rosenbaum, Samuel M. Tuthill, and Dr. Charles Winters, under the direction of H.V. Farr and Dr. John Ruhoff.[15] Quality control also took place on both the first and second floors of Building 25.[16] In April 1942, the "50 series" buildings in Plant 2 were taken over as the production site for the purification of the uranium oxide. These buildings consisted of five interconnected industrial warehouse buildings constructed between 1883 and 1941, that happened to be vacant when time came to construct the processing plant.[17]

The purification process took place in five stages: conversion of the uranium oxide to uranyl nitrate (which Mallinckrodt had sold for years as an analytical reagent), purification of the uranyl nitrate by ether extraction, recovery of the uranyl nitrate from the ether, conversion of

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12 John Ruhoff, "The First Fifty Critical Days," *Uranium Division News*, June 1962: 5; The History Factory, *Mallinckrodt 125th Year Anniversary* (Washington, D. C., 1992), 57.

13 Harold Schleuter, "20 Years of Plant Security Without a Serious Violation,: *Uranium Division News*, June 1962: 54-55.

14 Jeanelle Hoffert, "These Things I Remember . . ., " *Uranium Division News*, June 1962: 33.

15 The History Factory, *Mallinckrodt 125th Year Anniversary*, 42.

16 Mont G. Mason, "History and Background Relative to the Radiological Re-Monitoring of Mallinckrodt by the Energy Research and Development Administration" (St. Louis: Mallinckrodt, Inc. 1977), 8.

17 Ruhoff, "The First Fifty Critical Days," 8.

the uranyl nitrate to uranium trioxide, and, finally, the reduction of uranium trioxide to uranium dioxide. At the same time, research was conducted at the Mallinckrodt plant in Jersey City to experiment with a thermal decomposition process that the uranium project could use. When the experiment proved that the process could convert uranyl nitrate to uranium trioxide, the equipment (denitration pots) was sent by train to the Mallinckrodt Chemical Works in St. Louis and set up inside Building 51.[18]

By May 1942, purified uranium dioxide samples were found acceptable and work was undertaken to design a tonnage-scale process. This process was developed, and the equipment in Buildings 51 and 52 processed uranium dioxide 24 hours each day, seven days each week. Workdays were sometimes 14 or more hours, and holidays and vacations became non-existent.

Sixty tons of uranium oxide were delivered to the Manhattan Project within 90 days of the project's start. By July 1942, the company was shipping uranium oxide at the rate of 30 tons per month. Mallinckrodt continued to supply the Manhattan District with purified uranium through the duration of the war, ultimately providing approximately 4,400 tons of the material to the government. During these years the company also manufactured uranium tetrafluoride (green salt) and uranium metal.[19]

Henry D. Smyth, consulting physicist on the Manhattan Project, wrote in 1945 of the Mallinckrodt Chemical Works' purifying of uranium: "No higher degree of purity can be expected on a commercial scale. In fact it was a remarkable achievement to have developed and put into production on a scale of the order of one ton per day a process for transforming grossly impure commercial oxide to oxide of a purity seldom achieved even on a laboratory scale."[20] Arthur D. Compton, in charge of developing the bomb at the Metallurgic Laboratory in Chicago, wrote in 1956: ". . . the production of enough pure metallic uranium to do our task in time was a technological and industrial miracle."[21]

C. COLD-WAR DEVELOPMENT OF ATOMIC ENERGY FOR MILITARY PURPOSES

In the first few post-war years, the United States held a monopoly on atomic energy and the production of nuclear energy. After the war the Manhattan Engineer District was replaced with the Atomic Energy Commission (AEC), established by the Atomic Energy Act of 1946. Its directive was to develop both military and peacetime uses for the newly discovered nuclear energy. It was to be the owner of existing nuclear facilities and any fissionable material that would be produced in the future. Through the influence of Enrico Fermi, who had worked on the original bomb, the priority turned toward the development of uranium and other raw

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18 The History Factory, *Mallinckrodt 125th Year Anniversary*, 57-58.

19 *Ibid.*, 42; Mason, "History and Background Relative to the Radiological Re-Monitoring of Mallinckrodt by the Energy Research and Development Administration," 13; Hoffert, "These Things I Remember . . . ," 33.

20 Smyth, *Atomic Energy for Military Purposes*, 93.

21 Compton, *Atomic Quest*, 90.

materials for weapons production and the manufacture of bombs, rather than for peacetime applications.[22]

This trend toward military rather than peacetime uses of nuclear energy came about in part because of the change in the political climate from 1945 to 1950, at which time the stance of the United States toward the Soviet Union, its World War II ally, hardened into enmity. This translated into what became known as the Cold War. Through a series of events in the Soviet Union in 1948-49, such as the detonation of its first atomic bomb, its blockade of Berlin, and its growing influence in neighboring China, the United States came to believe that the Soviets were planning both to claim the world for communism and to eradicate the United States through a surprise nuclear attack.[23]

President Truman responded to the Soviet threat with a policy declaration (NSC-68) in 1950 that committed the United States to the arms race against the Soviet Union and approved the production of a hydrogen bomb and other nuclear weapons as the method for deterring Soviet attack. The AEC was directed to produce "more and bigger bombs," to build reactors to produce plutonium, and to develop uranium and other raw materials.[24] The AEC had retained the contractors from the Manhattan Project, and consequently was able to continue working with highly-trained civilians after the war.[25] Mallinckrodt Chemical Works was one of the private firms that continued to provide the AEC with purified uranium, which was sent to the Hanford reactor.[26]

In 1944, the U.S. government decided to build a new refinery for manufacturing UO_2 by extraction from pitchblende ore. Vacant MCW land to the east of the main plant in St. Louis was chosen as the location because of its proximity to the existing refinery buildings at Mallinckrodt, as well as the large amount of space available, enabling all administration, laboratory, maintenance, and warehousing activities to be housed at an independent facility. Security also was a factor in the selection of this location.[27] This new government-owned facility was constructed by the AEC in 1946 for $22 million. Built on Destrehan Street to the east of the existing buildings, it was known as Plant 6 or the Destrehan Street Plant. At this time, the production of uranium dioxide in the "50 series" buildings ceased and was transferred to Plant 6.

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22 Clarfield and Wiecek, *Nuclear America. Military and Civilian Nuclear Power in the United States 1940-1980*, 113, 121.

23 *Ibid.*, 144.

24 *Ibid.*, 122-34.

25 George T. Mazuzan and J. Samuel Walker, *Controlling the Atom: The Beginnings of Nuclear Regulation 1946-1962* (Berkeley: University of California Press, 1984), 7.

26 Richard G. Hewlett and Francis Duncan. *Atomic Shield: A History of the United States Atomic Energy Commission*, Vol. II (University Park: The Pennsylvania State University Press, 1962. Rep., Berkeley: University of California Press, 1990), 291-2.

27 Mason, "History and Background Relative to the Radiological Re-Monitoring of Mallinckrodt by the Energy Research and Development Administration," 17.

Plant 6 was designed specifically to process pitchblende ore from the Belgian Congo (Zaire), a new experience for Mallinckrodt. The facility consisted of approximately 23 buildings (all the buildings in Plant 6, with the exception of Building 100, have been demolished). Its engineering design was based on experimental pitchblende processing carried out during 1944 in Plant 1. Work with pitchblende ore required intensive health and safety precautions because, unlike the Canadian black oxide, it contained radium (Ra-226), a decay product of normal uranium (U-238). It was necessary to remove the radium from the uranium oxide before it could be processed further. Development work for this process was carried out in Building 25-2, and a pilot radium extraction plant was established in Building K-1-E.[28] A description of the processing at Plant 6 is as follows:

> Incoming pitchblende ore and ore concentrates arrived by rail and were stored in Building 110. The southwest yard area, which is the present-day location of the wastewater basins, was also used to store MED-AEC feed materials as well as contaminated equipment. The continuous process reactor, located in Building 104, was designed for pitchblende and included new operations to recover radium-bearing residues and raffinate cake and to concentrate and convert U_3O_8 to UO_2. The feed liquor was extracted with ether in a manner similar to that used in Plant 2, yielding pure uranyl nitrate hexahydrate (UNH). The UNH was denitrated to yield UO_3, and the UO_3 was reduced with hydrogen to yield UO_2. The UO_2 product was sent to Plant 4, Plant 7, or an off-site government facility for further processing.[29]

Building 117 was constructed in either 1949 or 1950 as the security and check-in building for workers, as well as providing lunchrooms, showers, change rooms, locker rooms, and a laundry for work clothes. Building 116, located in Plant 6E and connected to Building 117, was constructed in 1950 as a replacement for the uranium metal production area in Plant 4. It was designed to increase the capacity of uranium metal production, improve its quality, and reduce processing costs.[30] Plant 7, including buildings 703, 704, 705, 706, 707, and 708, was built in 1951 as a replacement for the green salt (UF_4) production area in Plant 4, in order to increase its capacity and quality. The plant used a continuous-process, stirred-bed reactor to produce the UF_4. Additionally, continuous processing equipment for converting UO_3 to UO_2 was added, allowing the production of UF_4 using the feed material UO_3. At this time the green salt production at Plant 4 ceased, although the plant continued to be used as a metallurgical pilot

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28 Mallinckrodt Inc., "Columbium-Tantalum Plant Characterization Plan" (St. Louis: Mallinckrodt Inc., 1993), A-3.
29 *Ibid.*, A-3.
30 *Ibid.*, A-3-4.

plant for processing uranium metal until 1956, when it was closed.[31] Building 700 was added in 1954 as a warehouse.[32]

The use of pitchblende as a feed ended in 1954. The Destrehan Street facilities continued operation until 1957, when the Mallinckrodt Uranium Division operations were transferred to the new Mallinckrodt facility, the Weldon Spring Feed Materials site. Decontamination operations began at Plants 1 and 2 in 1949 under the guidance of the Mallinckrodt Uranium Division and the AEC's New York office. Once cleanup was completed, the buildings were returned to Mallinckrodt for unrestricted use.[33] Buildings in Plants 4, 6, 6E, and 7 were decontaminated under the guidance of AEC. Arch Wrecking Company removed materials from the site. By 1960, the property was transferred back to Mallinckrodt. Since 1962, all the Plant 4 and Plant 6 buildings (with the exception of 100 and 117) have been demolished. In September 1996, the Building 50 series were torn down. Plans for Plants 6E and 7 also include demolition.

IV. HISTORY OF MALLINCKRODT CHEMICAL WORKS

The site of the Mallinckrodt Chemical Works in the early nineteenth century was wooded bottomland on the banks of the Mississippi River, with the Gingras Creek flowing through it. A number of Germans were attracted to the area by the writings of Gottfried Duden, a German who visited Missouri between 1823 and 1827, and wrote a report extolling the excellent farmland there as similar to the Rhineland. He promoted the area as a "second Fatherland." These German immigrants settled along Broadway, then called Bellefontaine Road or the Great Trail, and built farms, calling the region New Bremen after their homeland. In 1840, Emil Mallinckrodt, who had moved from Dortmund, Germany, to Missouri in 1831, bought 39 acres of land in Bremen. Four years later, with three other property owners, he commissioned a survey of Bremen and later incorporated the town. As a result four of the east-west streets are named for these men: Buchanan, Destrehan, Mallinckrodt, and Angelrodt.[34]

Emil Mallinckrodt's three sons, Gustav, Edward, and Otto, born in America, established the G. Mallinckrodt and Company, Manufacturing Chemists, in 1867 on a portion of their father's Bremen property, at the corner of Mallinckrodt and Second streets. The original plant consisted of a stone building, an acid house, and a wooden shed, in which they produced anhydrous ammonia, nitrous ether, acetic and carbolic acids, chloroform, and burnt alum.[35] The company grew rapidly. Between 1876 and 1896 the block now comprising Plant 1 became

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31 United States Department of Energy, "St. Louis Contamination Begins With Atomic Age" (Oak Ridge, Tennessee: Formerly Utilized Sites Remedial Action Program, 1993), 2-3.

32 Mason, "History and Background Relative to the Radiological Re-Monitoring of Mallinckrodt by the Energy Research and Development Administration," 18; Mallinckrodt, "Columbium-Tantalum Plant Characterization Plan," A-4.

33 Mason, "History and Background Relative to the Radiological Re-Monitoring of Mallinckrodt by the Energy Research and Development Administration," 19.

34 Robert Hannon, *St. Louis: Its Neighborhoods and Neighbors: Landmarks and Milestones* (St. Louis: Buxton and Skinner Printing Company, 1986), 64; The History Factory, *Mallinckrodt 125th Year Anniversary*, 8-9; Troen and Holt, *St. Louis*, 66-67.

35 The History Factory, *Mallinckrodt 125th Year Anniversary*, 9-11.

filled with approximately 50 brick buildings extending from one-story to seven-stories containing offices, factories, warehouses, and a laboratory.[36]

By 1877, two of the brothers had died, and Edward continued alone to develop the business. His company expanded into the fields of refrigeration through the production of anhydrous ammonia, used to produce ice, and the fledgling field of photography, through the manufacture of chemicals for producing dry plates. In the 1890s, the firm began to manufacture morphine, codeine, hydrogen peroxide, and tannic, gallic and pyrogallic acids. In 1882, the firm was incorporated as the Mallinckrodt Chemical Works. Several years later it expanded to the East Coast with an office in New York City and a manufacturing plant in Jersey City, New Jersey. In 1913, the company added the Mallinckrodt Chemical Works, Ltd., in Montreal.[37]

In 1901, Edward's son, Edward Jr., a Harvard graduate, joined the family business, adding his skill in chemical research to his father's entrepreneurial strengths. As a result of the younger Mallinckrodt's interest in research, such products as a pure and stable ether, analytical reagents used to test the purity of chemicals, iodeikon, the first x-ray contrast medium for viewing the gall bladder, and phenobarbitol were developed and manufactured by the company between 1914 and the 1920s. World War I effectively cut off the company from German chemicals, forcing it to develop substitutes and new chemicals.[38]

As the business grew, the company expanded into adjacent blocks, both vacant and developed, to the west and south. Plant 2, the former Buck's Stove and Range Company, founded in the 1880s, was bought by the Mallinckrodt Chemical Works in 1935. Between 1900 and 1920 several brick warehouses were built on the west side of Second Street to form Plant 3. Plant 4, now Plant 10, included the former St. Louis Sash and Door Works, constructed in 1906. Plant 5, developed between 1947 and the late 1950s, was built on the site of the nineteenth-century National Enamel and Stamping Company. In response to the AEC uranium processing needs, Plant No. 6 was constructed in 1946 on the site of the Boeckler Lumber Company. In 1950, Plant 6E and Plant 7 were built on vacant MCW land, also for uranium processing. Plant 8, purchased in 1946, was the former dynamo house for the St. Louis Transit Company trolleys.

In 1960, Harold Thayer, who became manager of the Uranium Division in 1943, became president of the company and reorganized it into Medicinal, Industrial Chemicals and Nuclear Divisions, and in 1962 established an International Division. Under Thayer's guidance, the company acquired a number of companies with similar products and expanded into the European market through a number of joint ventures. In 1974, the company's name was changed to Mallinckrodt, Inc., and three years later, the corporate headquarters moved northwest from downtown St. Louis to St. Louis County. In 1982, Mallinckrodt was acquired

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36 *Whipple's Fire Insurance Map of St. Louis, Missouri,* Vol. III (St. Louis: A. Whipple, 1897).
37 The History Factory, *Mallinckrodt 125th Year Anniversary,* 11, 14.
38 *Ibid.,* 18.

by Avon Products Inc. Four years later, the company was sold to International Minerals and Chemical Corporation (later IMCERA Group Inc.). In 1989, the company was decentralized through the formation of two independent companies in addition to Mallinckrodt, Inc.: Mallinckrodt Medical Inc. and Mallinckrodt Specialty Chemicals Company.

A number of new buildings have been added to the site in recent years. As new products were developed for manufacture at the Mallinckrodt Inc., plant, new buildings replaced older ones that were no longer economically viable. Consequently new buildings are found throughout Plants 1 through 10.

V. PROJECT INFORMATION

This HABS documentation project was undertaken as mitigative recordation required by Section 106 of the National Historic Preservation Act of 1966. The Department of Energy Former Sites Restoration Division has demolished the Building 50 series as part of site remediation and decontamination.

The documentation was prepared by Alexandra C. Cole, architectural historian at Science Applications International Corporation (SAIC), Santa Barbara, California in February 1997. Large-format photography was done by Bruce Harms of Louis Berger and Associates, Marion, Iowa, in August/September 1996. Measured floor plans and elevations were prepared under the supervision of Ohannes Armani and Michael Poligone of Bechtel National Incorporated (BNI), Oak Ridge, Tennessee, in September 1996 and January 1997.

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