Watervliet Arsenal
Large Caliber Gun Tube Manufacturing Building
(Building 135)
Gillespie Road south of Parker Road
Watervliet
Albany County
New York

HAER No. NY-1J

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
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HISTORIC AMERICAN ENGINEERING RECORD

WATERVLIET ARSENAL
LARGE CALIBER GUN TUBE MANUFACTURING BUILDING
(Building 135)
HAER No. NY-1J

Location:	Gillespie Road south of Parker Road, Watervliet Arsenal, Watervliet, Albany County, New York. UTM: 18.605440.4730000 Quad: Troy South
Date of Construction:	1942-1943.
Present Owner and Occupant:	U.S. Army
Present Use:	Manufacture of large caliber gun tubes
Significance:	The building is a major component of manufacturing facilities constructed at Watervliet Arsenal during World War II and is a building in which advanced technology was employed in the manufacture of large caliber guns. It is also a visual landmark at the arsenal because of its size, configuration, and the use of construction materials.
Historian:	Barbara E. Hightower, February 1985

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of erection: The building was constructed in 1942–1943 (original construction plans on file in the arsenal's Engineering Division).

2. Architect: The building was designed by the office of Marcus T. Reynolds of Albany, New York. Kelly, Syska, and Hennessey of New York City were the consulting engineers (original construction plans).

3. Original and subsequent owners: U.S. Army

4. Builder, contractor, suppliers: Not known.

5. Original plans and construction: A set of 66 original construction drawings dated 1942 are in the Engineering Division. The drawings include plans, elevations, sections, architectural detaila, plumbing, heating, and the building's steel structural system.

The Watervliet Arsenal Museum has a series of eight photographs taken during construction (see HAER Photo No. NY-1J-9 through HAER Photo No. NY-1J-11). The photographs include both exterior and interior views.

6. Alterations and additions: Except for upgrading and installing machinery and modernizing personnel facilities, the building appears to have undergone no alterations since its construction.

B. Historical Context:

To accommodate increased war-time production, the arsenal acquired a tract of land along its southern border in April 1942 for the construction of a shop to manufacture large caliber gun tubes. Containing 186,645 square feet, the structure, which was considered to be "the finest cannon factory in the world," cost $2,519,419 to erect (A History of Watervliet Arsenal, p. 126). The building's design was well suited for its purpose. Its immense size allowed consolidation in one building of equipment needed to turn a rough-bored piece of metal into a finished gun tube. The height of the building allowed for the movement of large gun tubes from one stage of production to another by overhead traveling cranes and for lowering the tubes vertically into the shrinkage pits under the high

bay at the south end. Although dark on the exterior, the large expanses of actinic corrugated wire glass lining the sides of the building, both cut glare and provided a considerable amount of light for interior work spaces. Large doors open on the west side of the building for rail lines that are connected to the Delaware and Hudson Railroad west of the arsenal boundary providing access for incoming and outgoing materials.

Upon completion, the building was outfitted with up-to-date gun production machinery, including lathes, borers, riflers, shrinkage pits, and a 10,000,000 pound coldworking press. The coldworking process increased the strength of gun tubes by placing stress on the metal through very high hydrostatic pressure (Ibid, pp. 126-127). Power to run the machinery was derived from two 50,000-pound boilers housed in Building 136. The boiler house, constructed adjacent to Building 135 on the west in 1943, was enlarged in 1955 when two 100,000-pound boilers were added (Ibid, p. 169).

During the last two years of the war, emphasis shifted to the manufacture of large caliber guns at Watervliet. Construction of the factory building enabled the arsenal to efficiently produce the most important of these weapons, the 155-mm. gun. The gun, which had been manufactured by private industry during the preceeding two years, could be easily transported by truck and could fire one round per minute at a range of approximately 14 miles. Known as the "Long Tom", it was credited by the Chief of Ordnance, General Levin H. Campbell, Jr., with "doing as much as any gun to drive the enemy out of Tunisia" (Ibid, p. 138). Also produced in the building were 8-inch guns, which fired either high-explosive or armor piercing shells for a range of 20 miles, and 6- and 16-inch guns. Another product of the shop was the highly accurate and destructuve 240-mm Howitzer, one of the largest pieces of mobile artillery used by American forces during the war (Ibid).

Intensification of combat in the spring of 1944 increased the demand for large caliber cannon. In response, the shop's production methods were improved resulting in a more than fifty percent reduction in the time and number of machines required. The improvements, which were essentially modifications of high-speed manufacturing methods used successfully in the mass production of smaller caliber cannon, included:

> Tungsten carbide-tipped cutting tools replaced steel cutting tools on the turning operations of exterior turning on the gun tubes. One very important improvement was button-type broaches for rifling in place of the older, slower, rifling heads. Grinding of recoil surfaces replaced the slow finish turning and

> draw filing previously used. The step threads on the 155-mm Guns and 8" Howitzers were machined on a special oscillating hydraulic machine instead of the conventional jump turning lathes. (Ibid, p. 139)

Following the war, many of the arsenal's manufacturing facilities, including the large caliber gun tube shop, were placed on standby and manufacturing activity was concentrated in Building 20. The shop went into production once again at the end of the decade and output continued to increase during the Korean and Vietnam Wars.

Between November 1948 and June 1949, induction heating equipment, manufactured by General Electric of Schenectady, was installed. With this process, gun tubes were placed inside a metallic coil. A high frequency alternating current was then passed through the coil, setting up a rapidly alternating magnetic field. The gun tube was in turn made a short curcuiting agent, which heated in one-eighth the time of conventional heating methods (Ibid, p. 154). Previous to the installation of induction heating equipment in the Watervliet shop, the process was being used successfully by private industry on a considerably smaller scale. Studies by firms using the method concluded that it was not practical for gun tube manufacture because of the immense size of the coil that would be needed to adequately heat large caliber tubes. Nevertheless, arsenal engineers were able to adapt the process for shrinking and unshrinking built-up tubes of 8-inch and 240-mm guns (Ibid).

A new process was developed by the arsenal's Benet Research and Engineering Laboratories and installed in the south end of the shop during the Vietnam War. Modifications in steel used for gun tubes to achieve greater range reduced the safe firing life of 175-mm guns from 1,200 rounds to 300. The firing life was expanded to 1,200 rounds and costs dramatically reduced through autofrettage, "a process whereby a permanent prestress is introduced into the gun tube during manufacturing...by applying internal pressures of approximately 100,000 pounds per square inch to the walls of the tube" (Ibid, p. 220).

Facilities, which vastly reduced the amount of time required for manufacturing gun tube forgings, were installed in the building in 1975-1977. Dr. Robert E. Weigle, director of the arsenal's Benet Research and Engineering Laboratories, described the rotary forge built by GFM Company of Steyr, Austria for $14,000,000:

> ...it was 195 feet long and weighed 935 tons, making it the largest of its kind. It was capable...of forging hollow cylinders (the shape of an artillery gun tube) from 6 inches to 18 inches in diameter and up to 33 feet in length and it

could do this so that the forging produced would be so close to the final shape of the gun that the savings in steel would be very great. The forge operated by beginning with raw material in the form of a short steel "preform." Gripped by chuck jaws mounted on a moving platform, the preform was fed through a central housing where, while being rotated by the gripping jaws, it was struck rapid blows (200 times a minute) by four opposing hammers with a force of 1,000 tons each. Shaped by the hammer blows, the red-hot steel preform rapidly began to assume the form of a gun tube, and gripped by a second set of jaws on the other side of the hammer housing, the new tube forging would emerge. For a 105mm tank gun forging the whole forging process took only about 10 minutes. One man in a sophisticated glassed-in control station complete with television monitors and a multitude of other electronic devices, directed the giant equipment with the help of only one floor observer. The properties of the steel in the forgings produced in this way were found to be excellent (Ibid, p. 235).

A continuous horizontal heat treating system was installed with the rotary forge. Forged gun tubes are moved through this system's cylindrical furnace along powered rollers, a process which takes about a quarter of the time required by conventional heat treating methods (A History of Watervliet Arsenal, p. 235).

The shop is currently producing large caliber weapons, the largest of which is the 8" gun (Interview with Kacharian). (For further documentation see HAER No. NY-1A.)

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character: One of the largest manufacturing facilities at the arsenal, the building is a tall one-story structure with a high bay on the south and a series of seven flat-roofed monitors at the center. Its configuration, size, and the use of large expanses of actinic corrugated wire glass set the building apart from other structures within the arsenal's boundaries.

2. Condition of fabric: The building is in good condition and is well maintained.

B. Description of Exterior:

1. Over-all dimensions: The tall one-story main section of the building is rectangular and measures approximately 260' wide by 575' long. A high bay rises at the south end of the section. A one-story wing, approximately 275' x 30', extends across the south. The one-story wing on the east measures approximately 520' x 25'.

2. Foundations: Reinforced concrete.

3. Walls: Walls at the northeast and northwest corners of the main section and the east and south wings are red brick laid in 5/1 common bond. Red brick in 5/1 common bond frames large expanses of dark actinic corrugated wire glass on the high bay, and low brick walls with concrete caps run along the west and north sides. Remaining walls are actinic corrugated wire glass.

4. Structural system, framing: The structural frame along the east and west sides of the building consists of two rows of heavy structural steel beams with x-braces every six bays (HAER Photo No. NY-1J-11). Diagonal steel beams in a M configuration are along the east and west sides of the monitors. Similar structural framing runs north-south dividing the interior into four aisles, and cranes run along each aisle on tracks supported by the lower row of the frame (HAER Photo No. NY-1J-15 and HAER Photo No. NY-1J-16). Bays along the north wall and the high bay are defined by a grid crossed with x-bracing (HAER Photo No. NY-1J-11 and HAER Photo No. NY-1J-18). The members are riveted to steel plates at the centers and corners. Steel A-frames, partially exposed on the exterior (HAER Photo No. NY-1J-7) buttress the high bay. The building's roof truss is composed of thin steel members.

5. Openings:

   a. Doorways and doors: The brick walls on the east and west sides at the north end are punctuated by large metal overhead doors providing access for rail lines which cross the interior. Rail lines also enter the high bay area through a metal overhead door on the north side of the high bay. Additional overhead doors are located on the north, east, and west sides of the building (see HAER Photo No. NY-1J-8). Personnel doors on the north, east, and west sides are metal, glazed metal, or glazed wood.

   b. Windows: Window openings along the west side of the main section contain metal louvers. Windows lining the south side

of the south wing and those on the east elevation at the south end of the east wing are corrugated glass sash with flat concrete lintels and concrete lug sills. Window openings at the north end of the east wing are filled with glass block or corrugated glass sash with flat concrete lintels and concrete lug sills.

6. Roof:

The roofs on the main section and high bay are flat with a wood deck above metal trusses. Seven flat-roofed monitors oriented east-west project above the roof at the center of the main secton. The east and south wings have flat built-up roofs.

C. Description of Interior:

1. Floor plans: The main section is divided into four open aisles running north-south, which contain a furnace, rotary forge and its control room, induction heating system, continuous heat treat facilities, high speed saw, lathes, straightening presses, riflers, overhead cranes, and open storage areas (HAER Photo No. NY-1J-13, HAER Photo No. NY-1J-14, and HAER Photo No. NY-1J-17). Stress relieving furnaces, overhead cranes, and autofrettage facilities are located in a fifth open aisle oriented east-west under the high bay. The south and east wings contain offices, locker rooms, and restrooms. Equipment for the manufacture of minor components is also situated in the east wing.

2. Flooring: Floors are end grain wood block except around production equipment where they are concrete or metal.

3. Wall and ceiling finish: Walls are exposed brick along the exterior sides. Interior partition walls are brick and glass or concrete block. Ceilings are formed by the wood deck of the roofs.

4. Openings:

a. Doorways and doors: Doors are modern wood or metal personnel.

b. Windows: Windows are set in metal frames in brick openings.

5. Mechanical equipment:

a. Heating, air conditioning: Partitioned areas are heated by ceiling units and cooled by window air conditioners.

b. Lighting: Lighting is provided by fluorescent and incandescent ceiling fixtures.

c. Plumbing: Plumbing fixtures are modern.

D. Site:

1. General setting and orientation: The building is located south of Parker Road on a site acquired by the arsenal in 1942. One of two manufacturing complexes constructed during World War I lies to the north, and the arsenal's central heating plant is to the west. A residential neighborhood outside the arsenal's boundary fence is situated east and south of the building.

2. Outbuildings: A flat-roofed, one-story, wood-frame structure (Building 133) adjoins the building on the north, partially obscuring the north elevation. Erected in 1944, the structure serves as a receiving and shipping and storage facility.

PART III. SOURCES OF INFORMATION

A. Original Architectural Drawings:

The original construction drawings consisting of 66 sheets, including elevations, plans, sections, foundation, structural system, and roof trusses, are on file in the arsenal's Engineering Division. The drawings are dated 1942. (See HAER Photo No. NY-1J-12)

B. Early Views:

The Watervliet Arsenal Museum has a series of eight photographs showing exterior and interior views taken during construction of the building. (See HAER Photo No. NY-1J-9 through HAER Photo No. NY-1J-11)

C. Interviews:

Interview with John Kacharian, the arsenal's historical consultant, conducted by Barbara E. Hightower on November 14, 1984. Provided information on machinery and production in the building.

D. Bibliography:

Secondary and published sources:

Building Technology, Inc. Historic Properties Report Watervliet Arsenal, Watervliet, New York and Rotterdam Family Housing Area,

Rotterdam, New York. January 1985. The report and inventory cards for the arsenal are filed as field records in the Prints and Photographs Division, Library of Congress under HAER No. NY-1A.

A History of Watervliet Arsenal, 1813 to Modernization 1982. Watervliet, New York: Watervliet Arsenal, n.d. Contains information on the construction, weapons produced, and technology employed in the building.

Prepared by: Barbara E. Hightower
Historian
MacDonald and Mack Partnership
February 1985

PART IV. PROJECT INFORMATION

This project was part of a program initiated through a memorandum of agreement between the National Park Service and the U.S. Department of the Army. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, and Dr. Robert J. Kapsch, Chief of the Historic American Buildings Survey/Historic American Engineering Record, were program directors. Sally Kress Tompkins of HABS/HAER was program manager, and Robie S. Lange of HABS/HAER was project manager. Under the direction of William A. Brenner, Building Technology Incorporated, Silver Spring, Maryland, acted as primary contractor, and MacDonald and Mack Partnership, Minneapolis, was a major subcontractor. The project included a survey of historic properties at Watervliet Arsenal, as well as preparation of an historic properties report and HABS/HAER documentation for 17 buildings. The survey, report, and documentation were completed by Barbara E. Hightower, historian, Minneapolis. The photographs were taken by Robert A. Ryan and J Ceronie of Dennett, Muessig, Ryan, and Associates, Ltd., Iowa City, Iowa. Drawings were produced by Cary M. Louris, Minneapolis.