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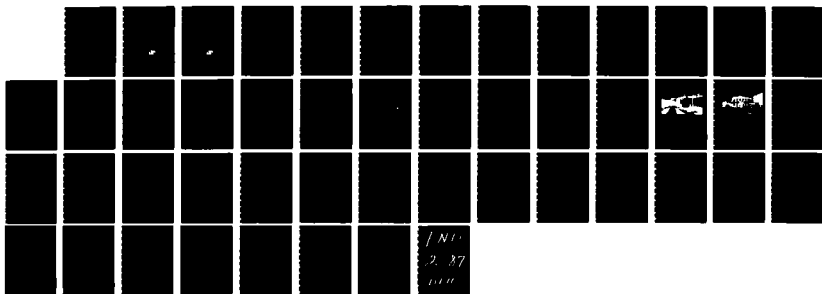
HISTORIC PROPERTIES REPORT: HAYS ARMY AMMUNITION PLANT 1/1  
PITTSBURGH PENNSYLVANIA(U) BUILDING TECHNOLOGY INC  
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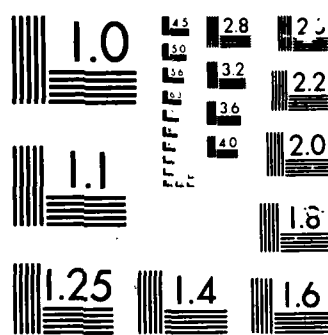
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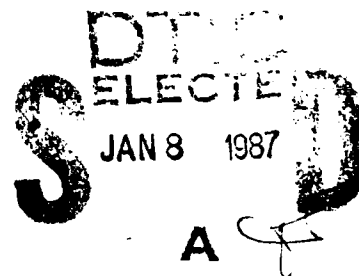
HISTORIC PROPERTIES REPORT

HAYS ARMY AMMUNITION PLANT

PITTSBURGH, PENNSYLVANIA

FINAL REPORT

AUGUST 1984



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This document was prepared by the MacDonald and Mack Partnership, Minneapolis, Minnesota, under Contract CX-0001-2-0033 between Building Technology Incorporated, Silver Spring, Maryland, and the Historic American Buildings Survey/Historic American Engineering Record, National Park Service, U.S. Department of the Interior.

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## EXECUTIVE SUMMARY

Hays Army Ammunition Plant (Hays AAP) is a government-owned, contractor-operated facility for the manufacture of 105-mm projectiles. A part of the Army's Armament, Munitions and Chemical Command (AMCCOM), Hays AAP is located in the metropolitan Pittsburgh, Pennsylvania, area, and is comprised of five buildings on a 7.9-acre site. The single production building and the adjoining administration building were built for the Navy in 1942 for the production of gun forgings. Subsequently, the plant was modified into a shell-production facility. At the time of the Korean War, new machinery was installed for production of shells by the cold-extrusion process, as distinguished from conventional hot-forging methods in use elsewhere. As of 1983, this machinery was substantially intact, but was neither historic nor particularly unique. Hays AAP contains no Category I, II, or III historic properties.



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## PREFACE

This report presents the results of an historic properties survey of the Hays Army Ammunition Plant (Hays AAP). Prepared for the United States Army Materiel Development and Readiness Command (DARCOM), the report is intended to assist the Army in bringing this installation into compliance with the National Historic Preservation Act of 1966 and its amendments, and related federal laws and regulations. To this end, the report focuses on the identification, evaluation, documentation, nomination, and preservation of historic properties at the Hays AAP. Chapter 1 sets forth the survey's scope and methodology; Chapter 2 presents an architectural, historical, and technological overview of the installation and its properties; and Chapter 3 identifies significant properties by Army category and sets forth preservation recommendations. Illustrations and an annotated bibliography supplement the text.

This report is part of a program initiated through a memorandum of agreement between the National Park Service, Department of the Interior, and the U.S. Department of the Army. The program covers 74 DARCOM installations and has two components: 1) a survey of historic properties (districts, buildings, structures, and objects), and 2) the development of archaeological overviews. Stanley H. Fried, Chief, Real Estate Branch of Headquarters DARCOM, directed the program for the Army, and Dr. Robert J. Kapsch, Chief of the Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) directed the program for the National Park Service. Sally Kress Tompkins was program manager, and Robie S. Lange was

project manager for the historic properties survey. Technical assistance was provided by Donald C. Jackson.

Building Technology Incorporated acted as primary contractor to HABS/HAER for the historic properties survey. William A. Brenner was BTI's principal-in-charge and Dr. Larry D. Lankton was the chief technical consultant. Major subcontractors were the MacDonald and Mack Partnership and Jeffrey A. Hess. The authors of this report were Robert Ferguson and Stuart E. MacDonald. The authors gratefully acknowledge the help of Mr. Robert J. Kasper, Plant Commander's Representative, and Mr. Steve Cindric, Plant Manager, Plant Facilities & Engineering, Inc.

The complete HABS/HAER documentation for this installation will be included in the HABS/HAER collections at the Library of Congress, Prints and Photographs Division, under the designation HAER No. PA-77.



## Chapter 1

### INTRODUCTION

#### SCOPE

This report is based on an historic properties survey conducted in 1983 of all Army-owned properties located within the official boundaries of the Hays Army Ammunition Plant (Hays AAP). The survey included the following tasks:

- . Completion of documentary research on the history of the installation and its properties.
- . Completion of a field inventory of all properties at the installation.
- . Preparation of a combined architectural, historical, and technological overview for the installation.
- . Evaluation of historic properties and development of recommendations for preservation of these properties.

Also completed as a part of the historic properties survey of the installation, but not included in this report, are HABS/HAER Inventory cards for two individual properties. These cards, which constitute HABS/HAER Documentation Level IV, will be provided to the Department of the Army. Archival copies of the cards, with their accompanying photographic

negatives, will be transmitted to the HABS/HAER collections at the Library of Congress.

The methodology used to complete these tasks is described in the following section of this report.

## METHODOLOGY

### 1. Documentary Research

The Hays Army Ammunition Plant (Hays AAP) was one of several government-owned, contractor-operated facilities constructed during 1940-1942 for the manufacture of metal ammunition parts. Since the plant was part of a larger manufacturing network, an evaluation of its historical and technological significance requires a general understanding of the wartime ammunition industry. To identify published documentary sources on American ammunition manufacturing during World War II, the Korean War, and the Vietnam War, research was conducted in standard bibliographies of military history, engineering, and the applied sciences. Unpublished sources were identified by researching the historical and technical archives of the U.S. Army Armament, Munitions and Chemical Command (AMCCOM) at Rock Island Arsenal.<sup>1</sup>

In addition to such industry-wide research, a concerted effort was made to locate published and unpublished sources dealing specifically with the history and technology of the Hays AAP. This site-specific

research was conducted primarily at the AMCCOM Historical Office at Rock Island Arsenal, the Carnegie Public Library in Pittsburgh, the Commonwealth of Pennsylvania State Historic Preservation Office in Harrisburg, and the Hays AAP.

On the basis of this literature search, a number of valuable sources were identified. These included an extensive collection of architectural and engineering drawings, including construction drawings prepared by the original contractor, and a detailed, unpublished, facility report prepared in 1955 by a private architectural and engineering consultant to the contractor. The State Historic Preservation Office had no pertinent information.

Army records used for the field inventory included current Real Property Inventory (RPI) printouts that listed all officially recorded buildings and structures by facility classification and date of construction; the installation's property record cards; base maps and photographs supplied by installation personnel; and installation master planning, archaeological, environmental assessment, and related reports and documents. A complete listing of this documentary material may be found in the bibliography.

## 2. Field Inventory

Architectural and technological field surveys were conducted in April, 1983 by Stuart MacDonald. Following general discussions and a tour of the production facilities conducted by Steve Cindric, Plant Manager,

the surveyor was permitted access to all exterior and interior areas without escort.

Field inventory procedures were based on the HABS/HAER Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures.<sup>2</sup> All areas and properties were visually surveyed.

Building locations and approximate dates of construction were noted from the installation's property records and field-verified. Interior surveys were made of the Administration Building and the Machine Shop to permit adequate evaluation of architectural features, building technology, and production equipment. In the Machine Shop, individual machine types were examined as well as overall industrial processes.

Field inventory forms were prepared for, and black and white 35 mm photographs taken of all buildings and structures through 1945 except basic utilitarian structures of no architectural, historical, or technological interest. Field inventory forms were also completed for representative post-1945 buildings and structures.<sup>3</sup> Information collected on the field forms was later evaluated, condensed, and transferred to HABS/HAER Inventory cards.

### 3. Historical Overview

A combined architectural, historical, and technological overview was prepared from information developed from the documentary research and the field inventory. It was written in two parts: 1) an introductory description of the installation, and 2) a history of the installation

by periods of development, beginning with pre-military land uses. Maps and photographs were selected to supplement the text as appropriate.

The objectives of the overview were to 1) establish the periods of major construction at the installation, 2) identify important events and individuals associated with specific historic properties, 3) describe patterns and locations of historic property types, and 4) analyze specific building and industrial technologies employed at the installation.

#### 4. Property Evaluation and Preservation Measures

Based on information developed in the historical overviews, properties were first evaluated for historical significance in accordance with the eligibility criteria for nomination to the National Register of Historic Places. These criteria require that eligible properties possess integrity of location, design, setting, materials, workmanship, feeling, and association, and that they meet one or more of the following:<sup>4</sup>

- A. Are associated with events that have made a significant contribution to the broad patterns of our history.
- B. Are associated with the lives of persons significant in the nation's past.

- C. Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction.
- D. Have yielded, or may be likely to yield, information important in pre-history or history.

Properties thus evaluated were further assessed for placement in one of five Army historic property categories as described in Army Regulation 420-40:<sup>5</sup>

- Category I Properties of major importance
- Category II Properties of importance
- Category III Properties of minor importance
- Category IV Properties of little or no importance
- Category V Properties detrimental to the significance of adjacent historic properties.

Based on an extensive review of the architectural, historical, and technological resources identified on DARCOM installations nationwide, four criteria were developed to help determine the appropriate categorization level for each Army property. These criteria were used to assess the importance not only of properties of traditional historical interest, but also of the vast number of standardized or prototypical buildings, structures and production processes that were

built and put into service during World War II, as well as of properties associated with many post-war technological achievements. The four criteria were often used in combination and are as follows:

- 1) Degree of importance as a work of architectural, engineering, or industrial design. This criterion took into account the qualitative factors by which design is normally judged: artistic merit, workmanship, appropriate use of materials, and functionality.
- 2) Degree of rarity as a remaining example of a once widely used architectural, engineering, or industrial design or process. This criterion was applied primarily to the many standardized or prototypical DARCOM buildings, structures, or industrial processes. The more widespread or influential the design or process, the greater the importance of the remaining examples of the design or process was considered to be. This criterion was also used for non-military structures such as farmhouses and other once prevalent building types.
- 3) Degree of integrity or completeness. This criterion compared the current condition, appearance, and function of a building, structure, architectural assemblage, or industrial process to its original or most historically important condition, appearance, and function. Those properties that were highly intact were generally considered of greater importance than those that were not.

- 4) Degree of association with an important person, program, or event. This criterion was used to examine the relationship of a property to a famous personage, wartime project, or similar factor that lent the property special importance.

The majority of DARCOM properties were built just prior to or during World War II, and special attention was given to their evaluation. Those that still remain do not often possess individual importance, but collectively they represent the remnants of a vast construction undertaking whose architectural, historical, and technological importance needed to be assessed before their numbers diminished further. This assessment centered on an extensive review of the military construction of the 1940-1945 period, and its contribution to the history of World War II and the post-war Army landscape.

Because technology has advanced so rapidly since the war, post-World War II properties were also given attention. These properties were evaluated in terms of the nation's more recent accomplishments in weaponry, rocketry, electronics, and related technological and scientific endeavors. Thus the traditional definition of "historic" as a property 50 or more years old was not germane in the assessment of either World War II or post-war DARCOM buildings and structures; rather, the historic importance of all properties was evaluated as completely as possible regardless of age.

Property designations by category are expected to be useful for



approximately ten years, after which all categorizations should be reviewed and updated.

Following this categorization procedure, Category I, II, and III historic properties were analyzed in terms of:

- . Current structural condition and state of repair. This information was taken from the field inventory forms and photographs, and was often supplemented by rechecking with facilities engineering personnel.
- . The nature of possible future adverse impacts to the property. This information was gathered from the installation's master planning documents and rechecked with facilities engineering personnel.

Based on the above considerations, the general preservation recommendations presented in Chapter 3 for Category I, II, and III historic properties were developed. Special preservation recommendations were created for individual properties as circumstances required.

## 5. Report Review

Prior to being completed in final form, this report was subjected to an in-house review by Building Technology Incorporated. It was then sent in draft to the subject installation for comment and clearance

and, with its associated historical materials, to HABS/HAER staff for technical review. When the installation cleared the report, additional draft copies were sent to DARCOM, the appropriate State Historic Preservation Officer, and, when requested, to the archaeological contractor performing parallel work at the installation. The report was revised based on all comments collected, then published in final form.

#### NOTES

1. The following bibliographies of published sources were consulted: Industrial Arts Index, 1938-1957; Applied Science and Technology Index, 1958-1980; Engineering Index, 1938-1983; Robin Higham, ed., A Guide to the Sources of United States Military History (Hamden, Conn.: Archon Books, 1975); John E. Jessup and Robert W. Coakley, A Guide to the Study and Use of Military History (Washington, D.C.: U.S. Government Printing Office, 1979); "Military Installations," Public Works History in the United States, eds., Suellen M. Hoy and Michael C. Robinson (Nashville: American Association for State and Local History, 1982), pp. 380-400. AMCCOM (formerly ARRCOM, or U.S. Army Armament Materiel Readiness Command) is the military agency responsible for supervising the operation of government-owned munitions plants; its headquarters are located at Rock Island Arsenal, Rock Island, Illinois. Although there is no comprehensive index to AMCCOM archival holdings, the agency's microfiche collection of unpublished reports is itemized in ARRCOM, Catalog of Common Sources, Fiscal Year 1983, 2 vols. (no pl.: Historical Office, ARRCOM, Rock Island Arsenal, n.d.).
2. Historic American Buildings Survey/Historic American Engineering Record, National Park Service, Guidelines for Inventories of Historic Buildings and Engineering and Industrial Structures (unpublished draft, 1982).
3. Representative post-World War II buildings and structures were defined as properties that were: (a) "representative" by virtue of construction type, architectural type, function, or a combination of these, (b) of obvious Category I, II, or III historic importance, or (c) prominent on the installation by virtue of size, location, or other distinctive feature.

4. National Park Service, How to Complete National Register Forms (Washington, D.C.: U.S. Government Printing Office, January 1977).
5. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).

## Chapter 2

### HISTORICAL OVERVIEW

#### BACKGROUND

Hays Army Ammunition Plant (Hays AAP) is a government-owned, contractor-operated installation located on a 7.9 acre site about seven miles southeast of the center of Pittsburgh, Pennsylvania (Figure 1). The plant consists of five buildings, of which the two largest, the Machine Shop and the Administration Building, occupy almost the entire site. They were built for the Navy in 1942 (Figure 2). The Mesta Machine Company first operated the plant, producing forgings for Navy 5" guns. Later, 16" projectiles for the Navy were produced at Hays by the Carnegie-Illinois Steel Corporation.

After World War II, the plant remained idle until the Korean War, at which time it was modified for cold extrusion process production of shells by the Mullins Manufacturing Company of Salem, Ohio. After the war, the plant was deactivated and held as a Naval Reserve Plant until transfer to the Army in 1966. The facilities were rehabilitated by the Levinson Steel Company, which manufactured 105-mm shells under several contracts until 1970, when the plant was laid away. It remains in layaway status as of 1983.

Hays AAP was the only Army ammunition plant using the "Kold-Flo" cold extrusion process, pioneered by the Mullins Co., whereby shell casings are formed from the raw steel billets at room temperature, without heating as in the usual forging operation. This process eliminates most rough and

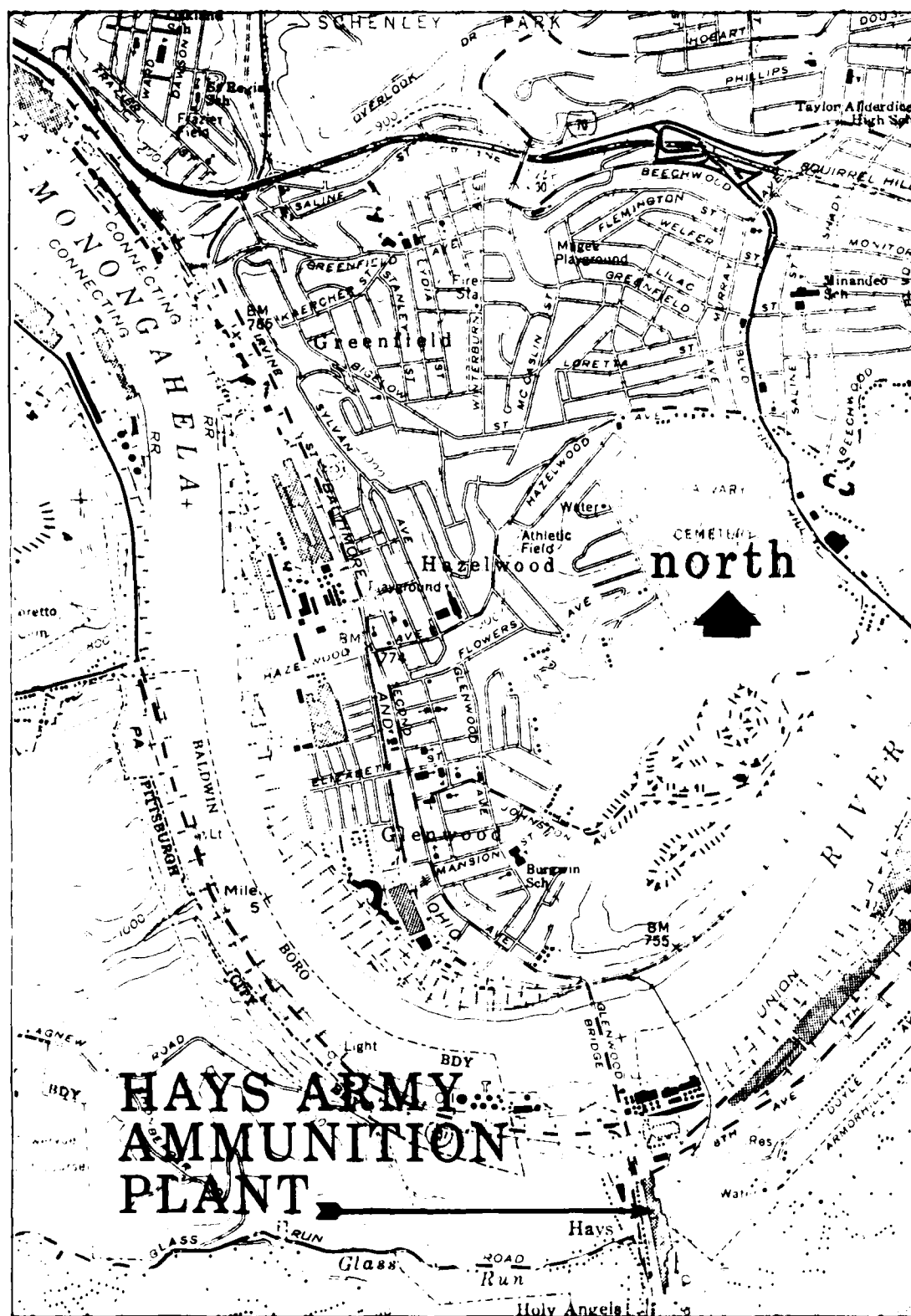


Figure 1: Hays Army Ammunition Plant. Location Map.  
(Source: USGS.)

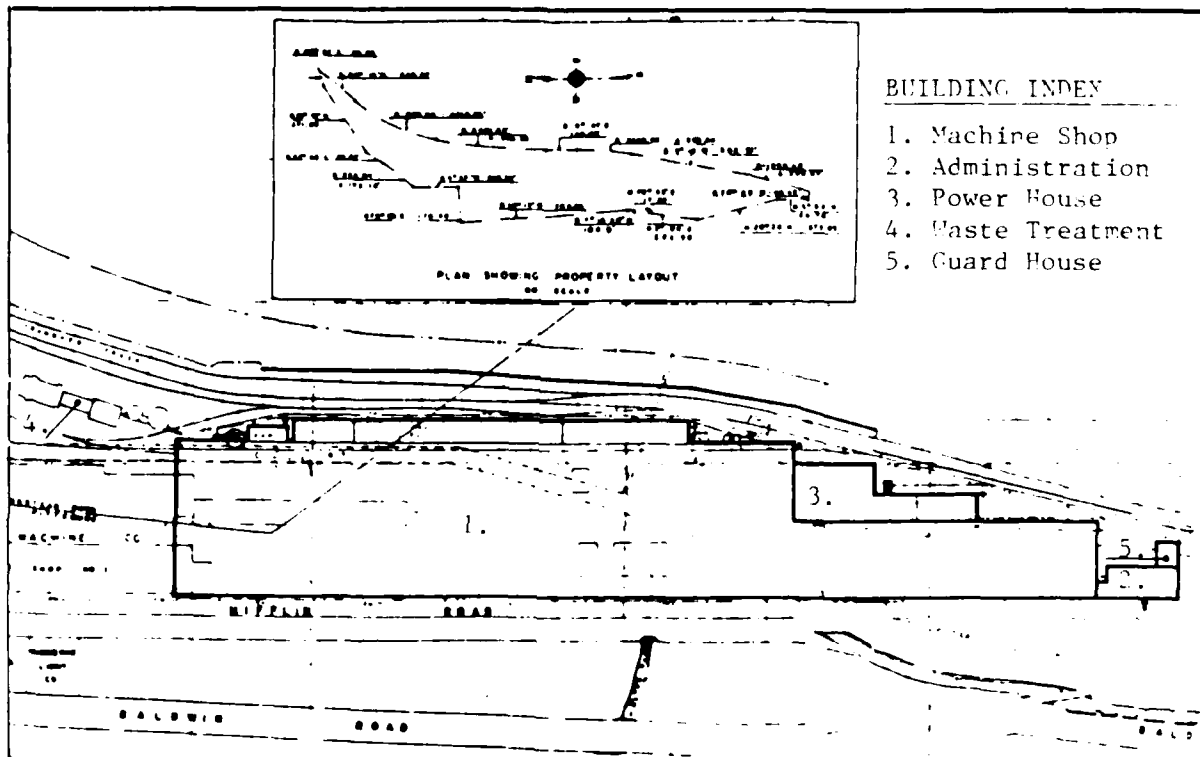


Figure 2: Hays Army Ammunition Plant. Site Plan.  
(Source: Hays AAP.)

finish machining and produced shells of precisely controllable weight with a minimum of waste material.<sup>1</sup>

## WORLD WAR II

During the late 1930s, as the German military showed increasing aggression in Europe, the United States responded by beginning to build up its own military forces. Major expansion of the Navy's ship and plane fleets was authorized by Congress as early as May 1938,<sup>2</sup> but the arrangements for industrial production to support this and further expansion were some time in the working out. Most of these arrangements eventually took some form of government support for expansion and operation of existing private industry. As Navy historians tell the story in Building the Navy's Bases in World War II,

Diversion of American industries from peacetime to war production began with Army and Navy contracts for materials which could be produced in existing private plant facilities. . . . When the Requirements. . . exceeded the capacity which the combined government and private plants could produce, specialized new plants had to be built.

As many of these facilities would have little peacetime conversion value the government underwrote their construction in various ways and placed private contractors in them. The objective was to get buildings up and machinery installed by the fastest means possible; it was attained by calling on the shipbuilders and manufacturers already engaged in producing armaments to help plan and design the new war plants. . . .

. . . The Congress first authorized the Navy to<sup>3</sup> undertake this industrial plant-expansion in June, 1940.

This expansion, called the Civil Works Program and placed under the jurisdiction of the Navy's Bureau of Yards and Docks in March 1942,

administered contracts "varying from complete government ownership to complete private ownership,"<sup>4</sup> and it was under this program that the Mesta Machine Company, of West Homestead, Pennsylvania, came to expand their shops in the Hays district, on the boundary between West Homestead and Pittsburgh proper, in 1942.

The Mesta Machine Company, long a manufacturer of steel milling equipment, began before 1941 to prepare for the manufacture of heavy forgings for military use.<sup>5</sup> Throughout World War II Mesta produced shafts and gear systems for electric power plants and for ships, and 155-mm and small guns and parts,<sup>6</sup> as well as large steel rollers, planers, borers, and presses, at several plants in and near Pittsburgh. The structures now comprising the Hays AAP were built in 1942, adjacent to other Mesta forge shops, under a "Navy-ownership" type of contract. Under such a contract, the type most widely used after mid-1941,<sup>7</sup> the operating contractor was reimbursed by the Navy for constructing facilities which were then owned by the Navy and used by the contractor for filling government production contracts.<sup>8</sup> The construction at Hays, to designs by Mesta's engineering department, was begun in August, 1942.<sup>9</sup>

Fifteen residential structures (thirteen single-family houses and two duplexes) were demolished at this time; no pre-1942 construction remains on the site.<sup>10</sup> Two streams, known as Streets Run and Glass Run, join on the site and run across it (the site is within a few hundred yards of the Monongahela River); at the time of construction they were enclosed in a heavily reinforced concrete culvert under the plant floor.



The main plant building (now called the Machine Shop, Figure 3), which covers most of the site, is a steel-framed building 1,120 feet long and varying in width between 100 and 218 feet; roof trusses are supported on steel columns 25 feet on center, and the roof is precast concrete decking covered by built-up roofing. Walls are covered with corrugated asbestos siding in most places; portions of the walls are brick veneer on concrete block. Along 745 feet of its length the building is divided longitudinally into two 90-foot bays. During World War II, the west bay contained machine tools and the east bay forging and heat treating furnaces.<sup>11</sup>

Other areas, including the boiler house and electric power substation, were built as lean-to's or other adjuncts to the main structure, only the administrative office building and the gas production/coke storage area being separate. The office building is a two-story brick structure with a hip roof, located at the extreme south end of the main building (Figure 4). The gas production and coke storage facilities were located immediately northeast of the main building, abutting a steep slope which occupies the only unbuilt portion of the site.

The Mesta Machine Company built the plant for the production of breech-block forgings for Navy 5" guns.<sup>12</sup> It was later taken over by the Carnegie-Illinois Steel Corporation, which produced 16" projectiles, also for the Navy. This change apparently resulted in little or no modification of the buildings.



Figure 3: Photograph taken in 1983 showing the Machine Shop. View from the northeast. (Source: field inventory photograph.)



Figure 4: Photograph taken in 1983 showing the Administration Building and Guard House, Machine Shop in the background. View from the southwest, showing the entrance.  
(Source: field inventory photograph.)

## KOREAN WAR

The Hays plant had been inactive for several years at the onset of the Korean War. In December of 1951, the Mullins Manufacturing Company of Salem, Ohio, undertook a cost study for conversion of the plant to manufacture several sizes of artillery shells for both the Navy and the Army. Over the next two years, most of the Mesta and Carnegie-Illinois machines were removed<sup>13</sup> and three lines for cold extrusion of projectiles were installed. Two "light" lines for production of 75-mm, 76-mm, 90-mm, and 3" ammunition, and a "medium" line for 105-mm, 120-mm, and 5" ammunition (the Army used millimeters; the Navy, inches) were designed.<sup>14</sup> Only the shells themselves were made at Hays. 105-mm ammunition, which which accounted for the majority of Hays' production from this point on, was assembled with a cartridge containing the propellant charge; but, as was usually the case with large-caliber ammunition, the shell, cartridge case, and fuse were manufactured at separate munitions works. The final assembly was the responsibility of specialized loading plants.

### Construction

The most dramatic alteration to the existing building was the demolition of the steam boiler plant, which had served only for building heating and was small even for that purpose, since residual heat from the furnaces in the east half of the building had made additional heating of that half unnecessary.<sup>15</sup> The new production process required more steam and produced far less heat; therefore, a new boiler plant of "much greater capacity"<sup>16</sup> was built in the same location. Various small mezzanines and enclosures

within the plant building were torn down and new ones, including new plant offices and an employee cafeteria, were built. Floors and roofs were repaired, and new toilet and locker room facilities provided, in one case beneath the floor, in an area formerly used as a scrap pit, owing to lack of other available space.<sup>17</sup>

The very tight spatial constraints of the site also dictated the location of the waste treatment facilities. For the Hays plant, the Sanitary Water Board of the Commonwealth of Pennsylvania required treatment of and waste waters containing oil and grease, or acids from the pickling and rinse operations, before discharge into the Streets Run culvert (and thence to the Monongahela River). The various mixing, settling, and concentration tanks, and the holding tank for the spent pickling liquors, which were trucked away for disposal elsewhere, were located northeast of the main building, on the site of the former gas production and coke storage facilities. This location was some distance from the source of the wastes, but was practically the only buildable space remaining within the property lines.<sup>18</sup>

A two-level enclosed passageway between the main building and the office building, and a new clock house adjoining the office building on the east, were also built at this time. The office building, which continued to serve the same purpose, was "adapted without major alterations"<sup>19</sup> to the needs of its new occupants. The total cost for conversion of the plant, including equipment, was estimated at the time of construction at \$15,509,000.<sup>20</sup>

## Technology

The nearly total changeover of equipment undertaken by Mullins at the Hays plant was due to their use of the relatively new cold extrusion process, instead of conventional hot forging methods, for metal parts production. In the conventional method, a very rough forging was produced in presses from metal which had been heated to increase its fluidity. The rough forging then went through a series of rough and finish machining operations to obtain the exact dimensions and surface quality required; several annealing and heat-treatment operations were usually needed to give the forged metal the proper metallurgical characteristics.

Research on cold extrusion was begun in Germany during World War II, in an effort to save steel and labor in the face of critical material and time shortages. It was discovered that, under high pressure, steel could be forced through dies to produce a nearly finished shape at room temperature, thus eliminating much of the labor and loss of material involved in hot forging and machining to shape.<sup>21</sup> The results of the German research were made available after the war by the American Industrial Intelligence Committee, and developed under Army Ordnance Corps contracts and supervision at the Heintz Manufacturing Company in Philadelphia.<sup>22</sup> Heintz's report, detailing the practical application of the process and pointing up the key role of lubricative coatings between the material and the die, was released to the Army, and subsequently to the industry at large, in 1947.<sup>23</sup>

It was at this time that Mullins, a large World War II shell producer, began to work with cold extrusion at their plant in Warren, Ohio.<sup>24</sup> The Mullins "Kold-Flo" process, in operation at Warren by 1953 and subsequently installed at Hays, produced 105-mm shells by the following steps:<sup>25</sup>

- (1) Five-inch diameter, hot-rolled steel bars were sawn into slugs on a circular cold sawing machine. Weight and length of the slugs, both of which were critical, were checked.
- (2) The slugs were washed, rinsed, pickled (an acid bath for cleaning), rinsed, "Bonderized" (a phosphate coating, developed from the original German "Bonder" solution, which provided a receptive surface for the lubricating soap coat), rinsed, soap coated, and dried. This sequence of operations was called "processing," and recurred several times.
- (3) The slug was "sized," i.e., pressed in a die for concentricity.
- (4) The first extrusion pressed the slug through a hardened-steel die into a cup shape. In this as in the other extrusions, the soap coating prevented any actual contact between the slug and the die, reducing friction and eliminating the possibility of metal-to-metal seizure and scoring. The extruded piece was examined for seams, which at this stage could be dressed with a file or grit wheel so as to be eliminated in the next extrusion.
- (5) The pieces were washed, dried, and annealed to reduce hardness developed in the extruding process.

- (6) The pieces were cooled, then "processed" again, in preparation for the next set of extrusions.
- (7) The second extrusion increased the length and began to thin the sidewalls.
- (8) The third extrusion continued this process and began to form the bottom of the internal cavity.
- (9) The piece was extruded to length. Sidewalls had their final thickness at this stage, and outside diameter was checked.
- (10) The "processing" was repeated, and the pieces allowed to cool. Although this process was called "cold" extrusion, and the metal was never heated to forging temperatures (about 2,150 degrees F), considerable heat was released in the extrusion process, due to the deformation of the steel. A piece that went into the press at room temperature came out at 500 degrees F; thus the cooling at this time.<sup>26</sup>
- (11) The piece was expanded in a press to form the Bourrelets, which center and guide the projectile in the gun barrel.
- (12) The nose operation, the final press operation, compressed the open end to form the ogive (the tapered nose of the projectile). An opening



was left in the end, the inside of which could be threaded to accept the fuse.

- (13) The shells were washed, dried, and stress relieved in a furnace to ensure uniform characteristics in the metal. The shells were then pickled to remove the scale developed in the furnace, rinsed, and dried.
- (14) The first of the relatively few and small-scale machining operations was the grinding of the Bourrelets to final size.
- (15) The nose was bored, faced and chamfered, and threaded.
- (16) A Groove was turned and knurled for the rotating band, which engages the riflings inside the gun to give the projectile the spin to stabilize its flight. The band was pressed into the groove and turned to size on a lathe.
- (17) A base plate was welded to the bottom of the shell, to seal off any invisible cracks which might cause the shell's premature detonation in the gun barrel.
- (18) The shells were inspected before the final washing, Bonderizing, and painting; final inspection and preparation for shipping followed.

Articles appearing in the trade journals at the time showed considerable enthusiasm for the economies possible with cold extrusion. D.I. Brown, an

editor of Iron Age, enumerated some advantages of the Mullins shell-production process in 1950:<sup>27</sup>

- (1) Practically no machining is done on the cold extruded product. In fact, it would be difficult to consistently machine to the close tolerances produced by cold working.
- (2) Because the final mechanical properties are achieved through cold working the metal, little or no alloy is needed [representing a significant saving, especially in manganese].
- (3) Much less metal per shell is required due to [elimination of] loss in machining, scaling in heat treatment, overfilling in forging, etc. Practically every ounce of the 26 lb. slug . . . used to make the 105-mm . . . shell ends up in the shell.
- (4) The glassy smooth surface of the extruded product . . . is a natural function of the process — not requiring any extra or subsequent operation of any kind.

Since dimension, weight, and surface finish are critical to the performance of artillery shells,<sup>28</sup> it can be understood that these advantages of the cold extrusion process were seen to justify the "relatively high die and setup costs,"<sup>29</sup> which were the main disadvantages apparent at the time. The conversion of the Hays plant took two years and cost \$15.5 million.

After the Korean War, the Hays plant was deactivated. It was held as a Naval Reserve Plant under the jurisdiction of the Department of the Navy, Bureau of Naval Weapons.<sup>30</sup>

#### VIETNAM WAR

On December 23, 1966, the Hays plant was transferred to the Army's Procurement and Supply Agency, although the Navy retained the title. A

contract for the production of 1,443,000 105-mm shells was awarded to the Levinson Steel Company as operating contractor. Levinson also signed at the same time a cost-reimbursement contract for "extensive rehabilitation" of the plant,<sup>31</sup> necessary because "poor layaway procedures"<sup>32</sup> had resulted in deterioration. The three steam boiler units, originally coal-fired with oil as a backup fuel, were converted, probably at this time, one to natural gas and two to oil, as a primary fuel.<sup>33</sup>

"Considerable modification and rehabilitation"<sup>34</sup> was also necessary on the 105-mm production line, although the production process used by Levinson can be seen to be virtually identical to the Mullins "Kold-Flo" process, with the exception of the elimination, apparently by Levinson, of the third extrusion.<sup>35</sup> The rehabilitated plant was estimated to be capable of producing 360,000 projectiles per month; actual production varied between 160,000 and 237,000 per month on the three contracts awarded to Levinson between 1966 and 1970.<sup>36</sup>

No significant modifications appear to have been made to the buildings during this period, and only six machines, none of them large presses or furnaces, were added.<sup>37</sup> Except for changes in the arrangement of the final Bonderizing, painting, and inspection lines, the Mullins machinery and layout can be seen to have been substantially intact in 1969.<sup>38</sup>

Contrary to the expectations of those who pioneered the process, cold extrusion, at least at Hays, "consistently proved to be the most expensive shell producing technique."<sup>39</sup> Aside from the setup expense already mentioned, it had been noticed by 1956<sup>40</sup> that the process had a serious

weakness in its dependence on a consistent supply of very "clean" steel -- steel with a very low content of phosphorus, sulphur, and "residuals" such as chromium, copper, and molybdenum. Any variation in the purity of the steel, from one batch or supplier to the next, necessitated adjustments in the operation, and an excess of impurities could cause cracking or excessive hardening during extrusion, resulting in a high rejection rate regardless of the speed of production.

On December 19, 1970, the Hays plant was laid away under contract with the Zell Brothers, Inc., of McKeesport, Pennsylvania. This firm was succeeded on September 30, 1976, by Plant Facilities and Engineering, Inc., of St. Louis, Missouri, who continue to maintain the plant in layaway as of April, 1983.<sup>41</sup>

#### NOTES

1. "DARCOM Installation and Activity Brochure," (unpublished brochure, prepared by the Hays Army Ammunition Plant, 30 June, 1982), pp. 1-2.
2. Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946, (Washington, D.C.: United States Printing Office, 1947), p. 3.
3. Building the Navy's Bases, p. 383.
4. Building the Navy's Bases, p. 384.
5. Information on Mesta's history and wartime activities can be found in the article "Mesta Machine Company" in Men and Women of Wartime Pittsburgh: A War-Production Epic (Pittsburgh: Frank C. Harper, 1945), pp. 256-259.
6. Mesta is not mentioned in Buford Rowland and William Boyd's U.S. Navy Bureau of Ordnance in World War II (Washington, D.C.: Bureau of Ordnance, Department of the Navy, n.d.), the standard work on the subject, possible because Mesta's contracts would have been administered through the Bureau of Yards and Docks. See Building the Navy's Bases, p. 385.

7. Building the Navy's Bases, p. 386.
8. Building the Navy's Bases, p. 385. Facilities so financed could also be used for private contracts, in which case the operator paid rent to the Navy.
9. Building the Navy's Bases, p. 393.
10. See "Plot Plan" drawings prepared by the Mesta Machine Company, sheets N10008, N10030, N10201, N10202; on file in the Administration Building, Hays AAP.
11. Gannett, Fleming, Corddry, and Carpenter, Inc., "Report for Naval Industrial Plant, Hays, Pennsylvania, for the Mullins Manufacturing Corporation, Salem, Ohio" (April, 1955), pp.8-9. This unpublished report, written after the modification of the plant by Mullins during the Korean War, is the main source for information on this plant up through that time. See also Mesta Machine Company's "Plot of Navy Plant" drawing, sheet N10030, on file at the Administration Building, Hays AAP.
12. "DARCOM Brochure," p. 1.
13. According to Gannett et al., an air compressor and "a group of general purpose machines" were retained. The Army's Semi-Annual Inventory RCS: DRC-828 (SP-38) for 1 Nov., 1982 shows a number of drills, lathes, grinding and milling machines, planers and shapers which date from 1941-1943. The Mesta/Carnegie-Illinois furnaces "were the property of the United States Navy and were removed by that branch of the service." (Gannett et al., p. 18.)
14. Gannett et al., p. 4. As of the date of this report, 1955, the lines were set up only for 3" and 105-mm projectiles. Space was left on the lines for additional machine tools, the only alteration necessary for manufacture of other sizes (p. 5).
15. Especially in summer.
16. Gannett et al., p. 17. The new boiler plant had a full production capacity of 164,000 pounds of steam per hour (p. 48), but no estimate of the capacity of the old plant is given.
17. Gannett et al., pp. 17-20.
18. Gannett et al., pp. 26-35.
19. Gannett et al., p. 9. See also p. 20.
20. Gannett et al., p. 56. Levinson Steel Company's production publication "Hays Army Ammunition Plant" (n.d., but between 1966 and 1970) reports the 1953 conversion cost at \$25,000,000.

21. Adolph Bregman, "Surface Treatment for Cold Extrusion," Metal Progress, 60 (Dec., 1951), 76. See also T.E. Lloyd and E.S. Kopecki, "Cold Extrusion of Steel," Iron Age, 164 (Aug. 4, 1949), 90-91.
22. Bregman, 76. See also Lloyd and Kopecki, 90-91; and "Cold Extrusion of Steel Sheels at Heintz Mfg. Co.," Metal Progress, 61 (May, 1952), 72-74.
23. Lloyd and Kopecki, p. 91.
24. D.I. Brown, "Cold Extrusion of 105-mm Shells Saves Steel," Iron Age, 166 (Oct. 19, 1950), 69.
25. This description of the 105-mm production process is based of descriptions in Brown, "105-mm Shells," 69-733; "General Description of Manufacture for 105-mm Projectile M1HE" (unpublished report, Hays AAP, n.d.); "Hays Army Ammunition Plant;" and Lloyd and Kopecki, 99-100. See also D.I. Brown, "Cold Extrusion Ready to Invade Metalworking Markets," Iron Age, 171 (April 23, 1953), 152-55, where the trade name "Kold-Flo" is used to refer to the Mullins process.
26. Lloyd and Kopecki, p. 95.
27. Brown, "105-mm Shells," p. 70.
28. Brown, "105-mm Shells," pp. 69-70; Lloyd and Kopecki, p. 92.
29. Lloyd and Kopecki, p. 90.
30. "DARCOM Brochure," p. 1.
31. "DARCOM Brochure," p. 1; R.J. Hammond, "Profile on Munitions, 1950-1977" (unpublished report, n.d., on microfiche, U.S. Army Armament, Munitions And Chemical Command (AMCCOM) Historical Office, Rock Island Arsenal, Rock Island, Illinois), p. 29.
32. Hammond, p. 30.
33. According to information gathered during a tour of the facility conducted by Steve Cindric, Plant Manager, on April 14, 1983.
34. Hammond, p. 29.
35. Indeed, Hays AAP publications continue to refer to the process as "Kold-Flo" (see "DARCOM Brochure," p. 2), and Mullins was known to license the process to other manufacturers (Brown, "Markets," p. 155). The best sources for comparison of the Mullins and Levinson processes are Brown, "105-mm Shells" for Mullins, and "Hays Army Ammunition Plant" and "General Description of Manufacture" for Levinson.
36. "DARCOM Brochure," pp. 1-2.

37. Army Inventory, 1 Nov. 82.
38. This statement is based on the Army's Inventory of 1 Nov., 1982, and on comparison of Levinson's layout after rehabilitation, in their drawing "1974 [sic] Modernization" (Jan. 14, 1969) with Mullins' layout in 1953, in their drawing "Plant Layout" (Nov. 11, 1953). Both drawings are on file at the Administration Building, Hays AAP.
39. Hammond, p. 32.
40. Disadvantages of cold extrusion are analyzed, and cold and hot processes compared, in Arthur F. MacConochie, "Shell Forming: Some Like It Hot, Some Like It Cold," Steel, 138 (Jan. 27, 1956), 128-132, on which this discussion is based.
41. "DARCOM Brochure," p.2. See "Army Ammunition Plant Profile: Hays AAP, 4th Quarter, F.Y. '82" (unpublished brochure, Rock Island Arsenal, Rock Island, Illinois: Headquarters, U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Single Manager for Conventional Ammunition), p. 16, for background on Plant Facilities & Engineering, Inc.

## Chapter 3

### PRESERVATION RECOMMENDATIONS

#### BACKGROUND

Army Regulation 420-40 requires that an historic preservation plan be developed as an integral part of each installation's planning and long-range maintenance and development scheduling.<sup>1</sup> The purpose of such a program is to:

- . Preserve historic properties to reflect the Army's role in history and its continuing concern for the protection of the nation's heritage.
- . Implement historic preservation projects as an integral part of the installation's maintenance and construction programs.
- . Find adaptive uses for historic properties in order to maintain them as actively used facilities on the installation.
- . Eliminate damage or destruction due to improper maintenance, repair, or use that may alter or destroy the significant elements of any property.
- . Enhance the most historically significant areas of the installation through appropriate landscaping and conservation.

To meet these overall preservation objectives, the general preservation recommendations set forth below have been developed:

#### Category I Historic Properties

All Category I historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for



nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category I historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category I historic properties should not be altered or demolished. All work on such properties shall be performed in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).
- b) An individual preservation plan should be developed and put into effect for each Category I historic property. This plan should delineate the appropriate restoration or preservation program to be carried out for the property. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulation. Until the historic preservation plan is put into effect, Category I historic properties should be maintained in accordance with the recommended approaches of the Secretary of Interior's Standards for Rehabilitation and

Revised Guidelines for Rehabilitating Historic Buildings<sup>2</sup> and in consultation with the State Historic Preservation Officer.

- c) Each Category I historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.<sup>3</sup> When no adequate architectural drawings exist for a Category I historic property, it should be documented in accordance with Documentation Level I of these standards. In cases where standard measured drawings are unable to record significant features of a property or technological process, interpretive drawings also should be prepared.

#### Category II Historic Properties

All Category II historic properties not currently listed on or nominated to the National Register of Historic Places are assumed to be eligible for nomination regardless of age. The following general preservation recommendations apply to these properties:

- a) Each Category II historic property should be treated as if it were on the National Register, whether listed or not. Properties not currently listed should be nominated. Category II historic properties should not be altered or demolished. All work on such properties shall be performed

in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation (ACHP) as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800).

- b) An individual preservation plan should be developed and put into effect for each Category II historic property. This plan should delineate the appropriate preservation or rehabilitation program to be carried out for the property or for those parts of the property which contribute to its historical, architectural, or technological importance. It should include a maintenance and repair schedule and estimated initial and annual costs. The preservation plan should be approved by the State Historic Preservation Officer and the Advisory Council in accordance with the above-referenced ACHP regulations. Until the historic preservation plan is put into effect, Category II historic properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings<sup>4</sup> and in consultation with the State Historic Preservation Officer.
- c) Each Category II historic property should be documented in accordance with Historic American Buildings Survey/Historic American Engineering Record (HABS/HAER) Documentation Level

II, and the documentation submitted for inclusion in the HABS/HAER collections in the Library of Congress.<sup>5</sup>

### Category III Historic Properties

The following preservation recommendations apply to Category III historic properties:

- a) Category III historic properties listed on or eligible for nomination to the National Register as part of a district or thematic group should be treated in accordance with Sections 106 and 110(f) of the National Historic Preservation Act as amended in 1980, and the regulations of the Advisory Council for Historic Preservation as outlined in the "Protection of Historic and Cultural Properties" (36 CFR 800). Such properties should not be demolished and their facades, or those parts of the property that contribute to the historical landscape, should be protected from major modifications. Preservation plans should be developed for groupings of Category III historic properties within a district or thematic group. The scope of these plans should be limited to those parts of each property that contribute to the district or group's importance. Until such plans are put into effect, these properties should be maintained in accordance with the recommended approaches in the Secretary of the Interior's Standards for Rehabilitation and Revised

Guidelines for Rehabilitating Historic Buildings<sup>6</sup> and in consultation with the State Historic Preservation Officer.

- b) Category III historic properties not listed on or eligible for nomination to the National Register as part of a district or thematic group should receive routine maintenance. Such properties should not be demolished, and their facades, or those parts of the property that contribute to the historical landscape, should be protected from modification. If the properties are unoccupied, they should, as a minimum, be maintained in stable condition and prevented from deteriorating.

HABS/HAER Documentation Level IV has been completed for all Category III historic properties, and no additional documentation is required as long as they are not endangered. Category III historic properties that are endangered for operational or other reasons should be documented in accordance with HABS/HAER Documentation Level III, and submitted for inclusion in the HABS/HAER collections in the Library of Congress.<sup>7</sup> Similar structures need only be documented once.

#### CATEGORY I HISTORIC PROPERTIES

There are no Category I historic properties at the Hays Army Ammunition Plant.

## CATEGORY II HISTORIC PROPERTIES

There are no Category II historic properties at the Hays Army Ammunition Plant.

## CATEGORY III HISTORIC PROPERTIES

There are no Category III historic properties at the Hays Army Ammunition Plant.

## NOTES

1. Army Regulation 420-40, Historic Preservation (Headquarters, U.S. Army: Washington, D.C., 15 April 1984).
2. National Park Service, Secretary of Interior's Standards for Rehabilitation and Revised Guidelines for Rehabilitating Historic Buildings, 1983 (Washington, D.C.: Preservation Assistance Division, National Park Service, 1983).
3. National Park Service, "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines," Federal Register, Part IV, 28 September 1983, pp. 44730-44734.
4. National Park Service, Secretary of the Interior's Standards.
5. National Park Service, "Archeology and Historic Preservation."
6. National Park Service, Secretary of the Interior's Standards.
7. National Park Service, "Archeology and Historic Preservation."

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