

Pine Bluff Arsenal  
Pine Bluff  
Jefferson County  
Arkansas

HAER No. AR-2

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WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record  
National Park Service  
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HISTORIC AMERICAN ENGINEERING RECORD

Pine Bluff Arsenal

AR-2

Location: In Jefferson County, Arkansas, about eight miles northwest of the City of Pine Bluff and thirty miles southeast of the City of Little Rock.

Date of Construction: Established in 1941.

Owner: Department of the Army

Significance: Pine Bluff Arsenal was established at the beginning of World War II to manufacture magnesium - and aluminum-based incendiary munitions, but its industrial function was soon expanded to include production facilities for war gases, smoke munitions, and napalm bombs.

Historical Report  
Prepared by: Jeffrey A. Hess, 1984.

Prepared for  
Transmittal by: Robie S. Lange, HABS/HAER, 1985.

## EXECUTIVE SUMMARY

Pine Bluff Arsenal (PBA) is part of the Army's Armament, Munitions and Chemical Command (AMCCOM). The arsenal is a government-owned-and-operated installation occupying 14,454 acres in Jefferson County, Arkansas, about eight miles northwest of the City of Pine Bluff and thirty miles southeast of the City of Little Rock. Constructed during 1941-1943, PBA was originally designed to manufacture magnesium- and aluminum-based incendiary munitions, but its industrial function was soon expanded to include production facilities for war gases, smoke munitions, and napalm bombs. After V-J Day, the installation was designated a standby facility, and its war-gas facilities were eventually dismantled. Reactivated for the manufacture of incendiary and smoke munitions during the Korean War, PBA has remained in limited production to the present time.

Currently, PBA comprises about 830 buildings, almost ninety percent of which date from the 1940s. The installation also contains a wood-frame farmhouse (Building T-12410), constructed about 1900, that was acquired with the site. Although this building contributes to a general understanding of the area's pre-military history, it is without specific architectural or historical significance. Technologically, PBA retains much of its original character. Despite the modernization of production lines, many basic procedures still conform to the semi-automated practices of the World-War-II period. In 1981, construction began on a manufacturing facility (Building 53220) designed to produce one chemical component of a binary nerve-agent munition. This facility is scheduled for completion in 1984. There are no Category I, Category II, or Category III historic properties at PBA.

CONTENTS

Executive Summary

PREFACE . . . . .	1
1. INTRODUCTION . . . . .	3
Scope . . . . .	3
Methodology . . . . .	4
2. HISTORICAL OVERVIEW . . . . .	14
Background . . . . .	14
World War II . . . . .	14
Korean War to the Present . . . . .	36
3. PRESERVATION RECOMMENDATIONS . . . . .	43
Background . . . . .	43
Category I Historic Properties . . . . .	48
Category II Historic Properties . . . . .	49
Category III Historic Properties . . . . .	49
BIBLIOGRAPHY . . . . .	50
Appendix . . . . .	52

## PREFACE

This report presents the results of an historic properties survey of the Pine Bluff Arsenal (PBA). 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 PBA. 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 author of this report was Jeffrey A. Hess. The author would like to thank the many employees at PBA who graciously assisted him in his research and field surveys. He especially acknowledges the help of James L. Bacon, Executive Assistant; Dewey C. Spencer, Public Affairs Officer; Clara Bucci, Public Affairs Editor/Writer; George R. Holt, Facilities Engineer Director; Harold B. Bray, Deputy Director of Industrial Operations; and Bennie D. Roberts, Real Properties Technician.

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. AR-2.

Chapter 1  
INTRODUCTION

SCOPE

This report is based on an historic properties survey conducted in January 1984 of all Army-owned properties located within the official boundaries of the Pine Bluff Arsenal (PBA). 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 33 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

PBA was constructed during 1941-1943 to manufacture incendiary and toxic munitions. Since the arsenal was one of four government-owned-and-operated installations involved in such activities during World War II, an evaluation of its historical significance requires a general understanding of the country's chemical-warfare manufacturing program. To identify relevant published sources, research on chemical munitions 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 sources dealing specifically with the history and technology of PBA. This site-specific research was conducted primarily at the AMCCOM Historical Office at Rock Island Arsenal; the Pine Bluff-Jefferson County Public Library in Pine Bluff, Arkansas;

and the government's administrative and engineering archives at PBA. The Arkansas State Historic Preservation Office (Department of Arkansas Natural and Cultural Heritage, Little Rock) was also contacted for information on the architecture, history, and technology of PBA, but had no pertinent data.

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 January 1984 by Jeffrey A. Hess. After informational interviews with Dewey C. Spencer, Public Affairs Officer; James L. Bacon, Executive Assistant; and George R. Holt, Facilities Engineer Director; the surveyor inspected major manufacturing facilities and completed a field inspection of the installation. Dewey C. Spencer served as escort. All arsenal areas and facilities were surveyed with the following exceptions, which were excluded for security reasons: eighty-six igloos (Buildings 62-150 through 63-000), Security Entry Control Building (Building 60-530) (see Appendix).

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 major facilities to permit adequate evaluation of architectural features, building technology, and production equipment.

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. When groups of similar ("prototypical") buildings were found, one field form was normally prepared to represent all buildings of that type. 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, AMCCOM, 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

Pine Bluff Arsenal (PBA) is a government-owned-and-operated installation occupying a 14,454-acre site in Jefferson County, Arkansas, about eight miles northwest of the City of Pine Bluff and thirty miles southeast of the City of Little Rock. Constructed during 1941-1943, the arsenal was originally designed to manufacture magnesium- and aluminum-based incendiary munitions, but its industrial function was soon expanded to include production facilities for war gases, smoke munitions, and napalm bombs. After V-J Day, PBA was designated a standby installation, and its war-gas facilities were eventually dismantled. Reactivated for the manufacture of incendiary and smoke munitions during the Korean War, PBA has remained in limited production to the present time. Architecturally and technologically, PBA retains much of its original character. Almost ninety percent of the arsenal's buildings date from the 1940s, and despite the modernization of production lines, many basic procedures conform to semi-automated, World War II practices. In 1981, construction began on a manufacturing facility (Building 53220) designed to produce one chemical component of a binary nerve-agent munition. This facility is scheduled for completion in 1984.

#### WORLD WAR II

In common parlance, the term "chemical warfare" is most closely associated

with the use of toxic substances, especially poison gases. By military definition, however, the term applies equally to the deployment of incendiary and smoke devices. During World War I, the United States produced all three types of chemical munitions at Edgewood Arsenal in Maryland, under the supervision of the newly created Chemical Warfare Service. Edgewood Arsenal remained the country's primary chemical-warfare installation until World War II, when Congress authorized the construction of three additional plants. PBA was the first to be designed and built.<sup>1</sup>

#### Site Selection and Former Land Use

PBA is located on the west bank of the Arkansas River in Jefferson County, Arkansas, about eight miles northwest of the City of Pine Bluff and thirty miles southeast of the City of Little Rock. The selection of the site was governed by the same basic criteria used in evaluating locations for all three chemical-warfare arsenals built during World War II. These considerations included:

- 1) a mid-continental location as a defense against enemy bombardment
- 2) proximity to main railroad lines
- 3) availability of an ample water supply and sufficient electrical power for processing purposes
- 4) availability of suitable labor<sup>2</sup>

The PBA site satisfied all selection criteria. The tract was within easy commuting distance of the City of Pine Bluff, a regional industrial and rail center with a population of over 20,000 people. The area's hydrology also assured an abundance of well and river water for industrial purposes. When the federal government took possession of the 15,000-acre, rectangular-shaped site in the fall of 1941, the installation was largely undeveloped, cutover timberland with a "few small areas . . . in cultivation."<sup>3</sup> Within the present boundaries of PBA, only one wood-frame, architecturally unassuming, farmhouse (T-12410), constructed about 1900, survives from the site's pre-military period.

### Construction

Originally designed to manufacture magnesium- and aluminum-based incendiary munitions, PBA was expanded within the first year of its operation to include production and storage facilities for war gases, smoke munitions, and napalm bombs. Construction commenced in December 1941, with Sanderson and Porter of New York City serving as chief architect, engineer, and construction contractor. When the last phase of construction was completed in the fall of 1943, the arsenal comprised approximately 750 buildings grouped into three main areas (Figures 1-4).<sup>4</sup> The largest area, occupying the northern half of the installation, contained a storage depot of 232 standard, earth-sheltered, "igloo," magazines (61000-, 62000-, 64000-, 83000-series buildings) (Figure 5) and a chemical manufacturing complex of about sixty buildings. Half of the chemical plant structures were stock-plan, clay-tile warehouses (50000-, 55000-series buildings) (Figure 6).<sup>5</sup> The other half were production facilities for two war gases, lewisite

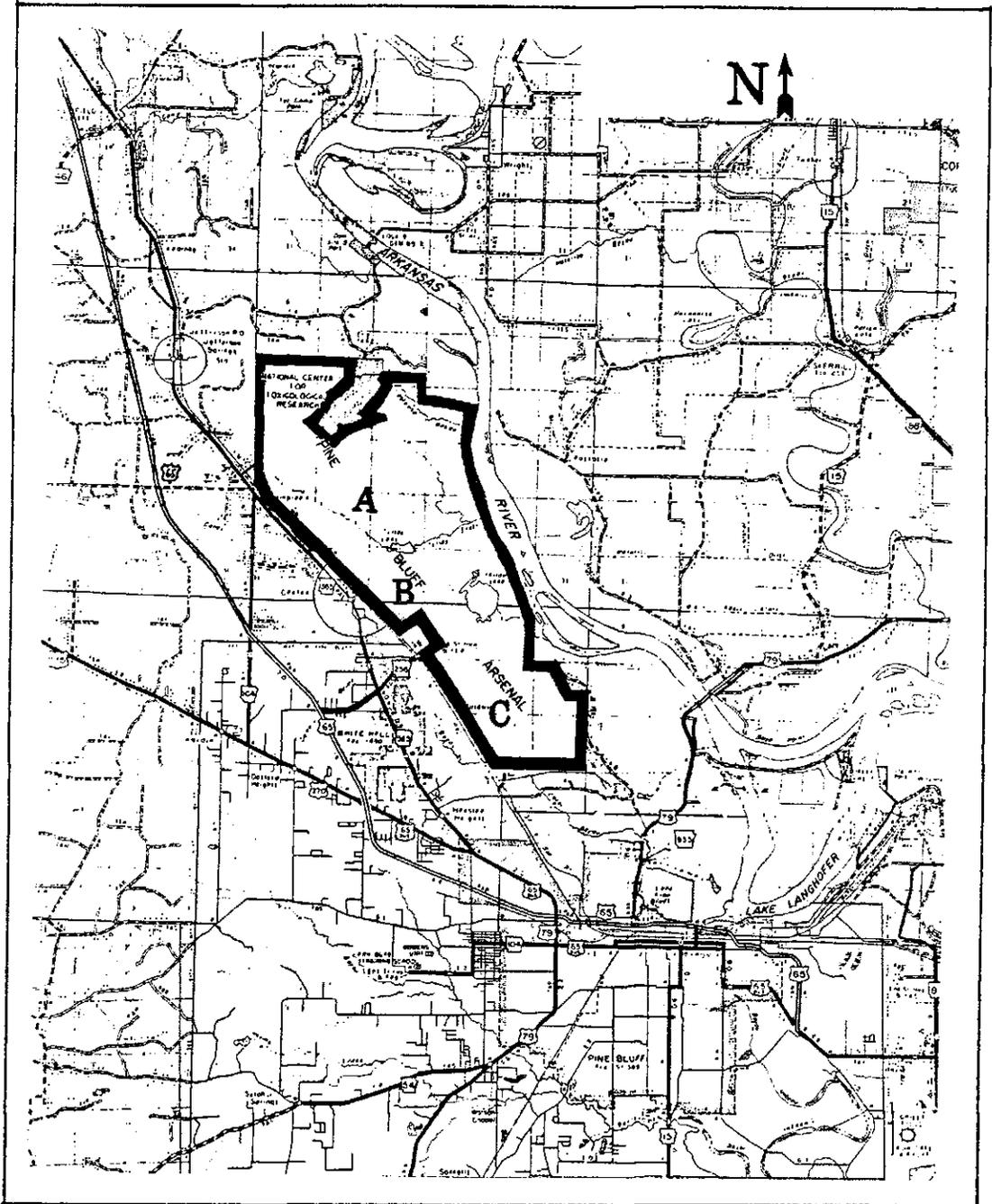


Figure 1: Location Map. (Source: "Information Booklet [on Pine Bluff Arsenal]," unpublished, 1983, PBA Public Affairs Office.)

- A. Former war-gas production and storage areas.
- B. Administration area.
- C. Incendiary and smoke production areas.

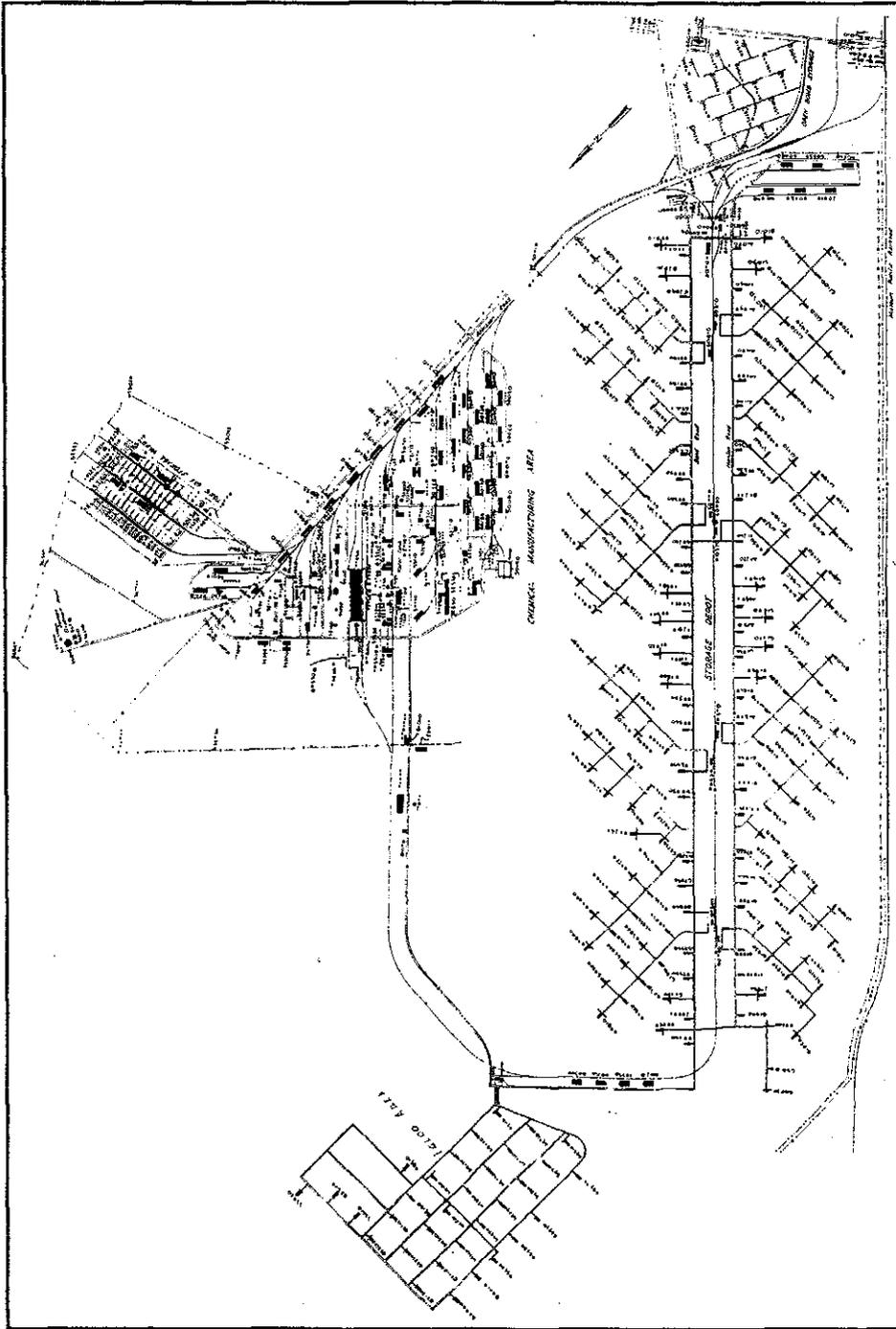


Figure 2: Site plan of war-gas production and storage areas. (Source: "Supplement No. 2 to the Industrial Facilities Inventory Report, Pine Bluff Arsenal," unpublished report prepared by U. S. Army Corps of Engineers, 1946, PBA Facilities Engineer's Office.)

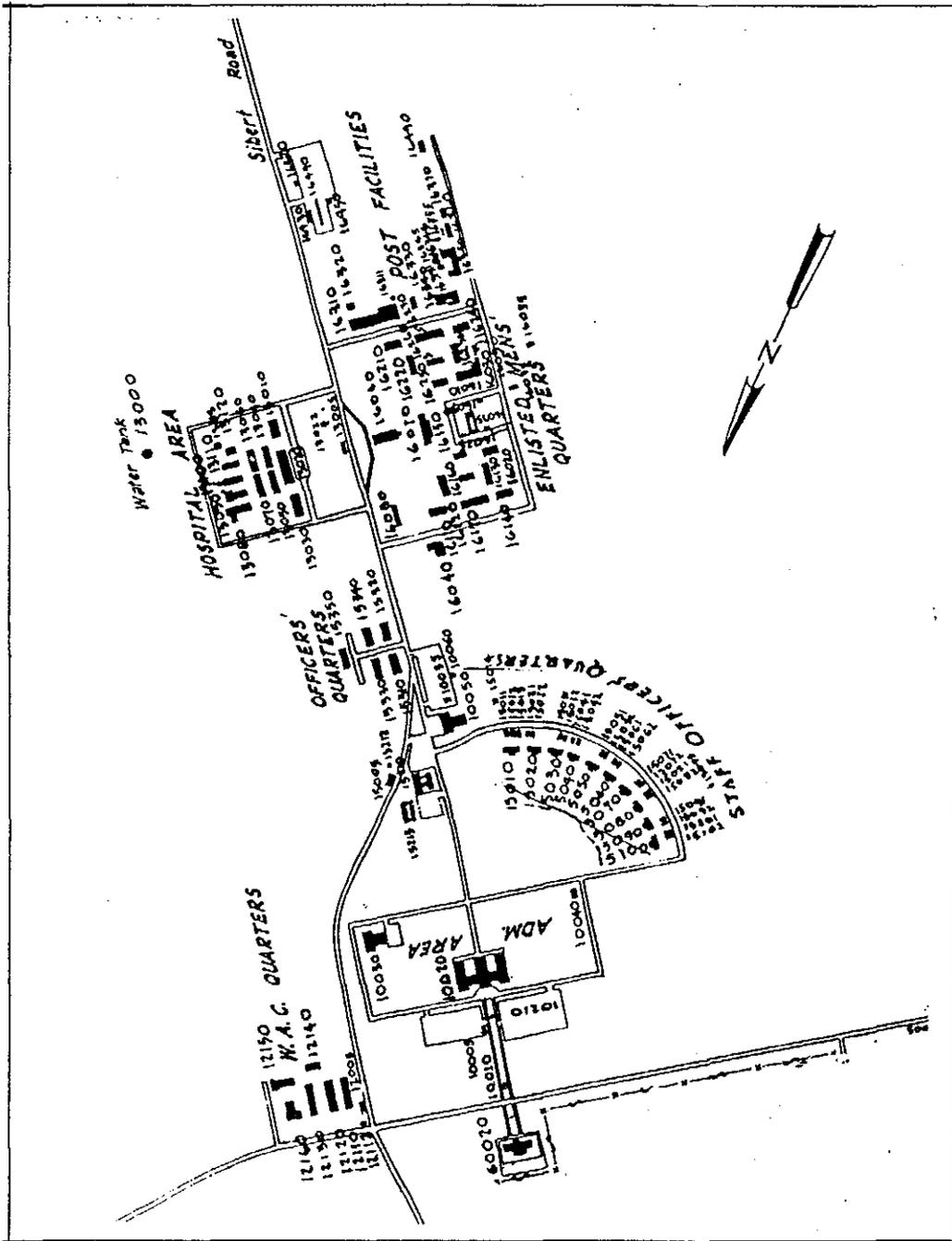


Figure 3: Site plan of administration area. (Source: "Supplement No. 2 to the Industrial Facilities Inventory Report, Pine Bluff Arsenal," unpublished report prepared by U. S. Army Corps of Engineers, 1946, PBA Facilities Engineer's Office.)

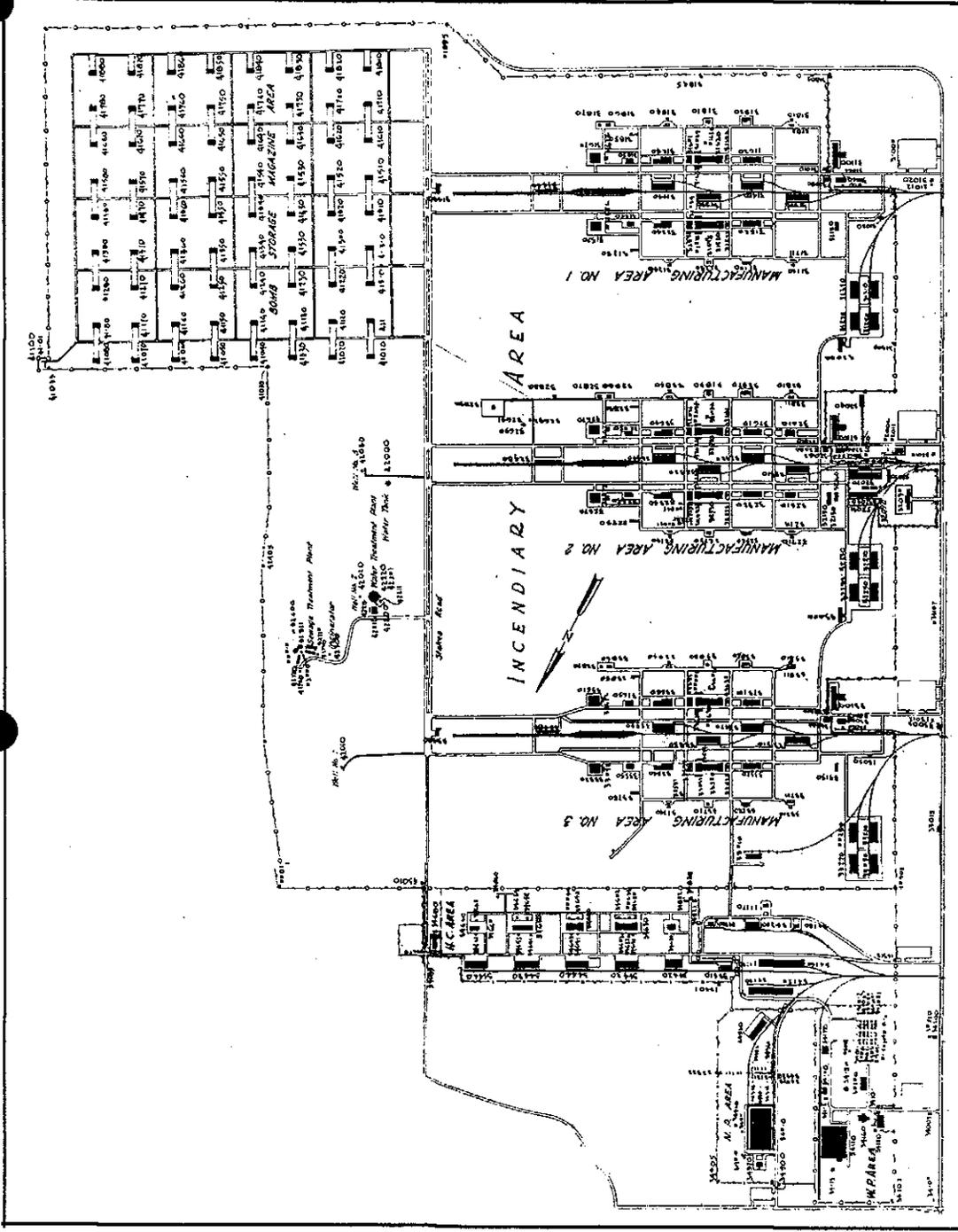


Figure 4: Site plan of incendiary and smoke production areas. "N. P." stands for napalm; "W. P." for white phosphorus; and "H. C." for hexachloroethane, a primary ingredient in certain smoke munitions. (Source: "Supplement No. 2 to the Industrial Facilities Inventory Report, Pine Bluff Arsenal," unpublished report prepared by U. S. Army Corps of Engineers, 1946, PRA Facilities Engineer's Office.)

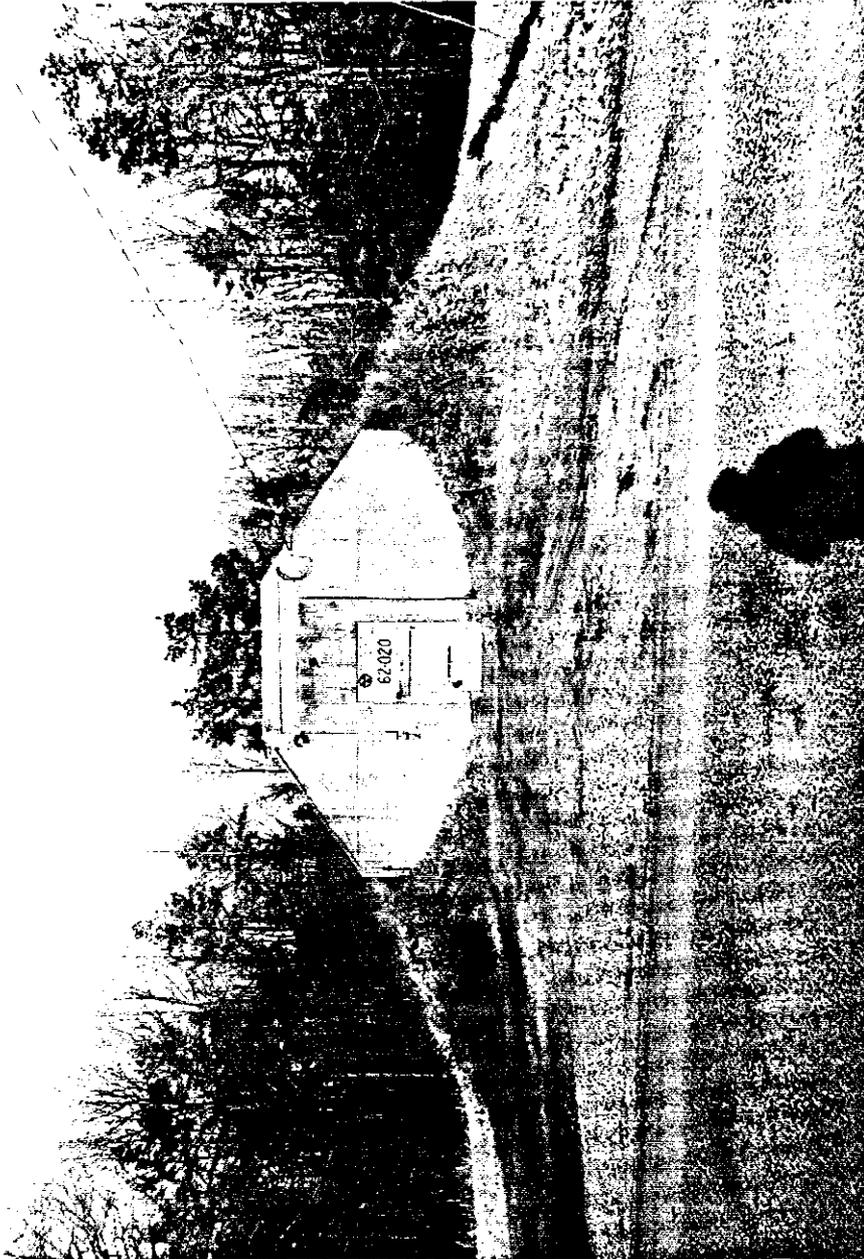


Figure 5: Building 62020 is representative of the arsenal's earth-sheltered igloo magazines. (Source: Field inventory photography, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

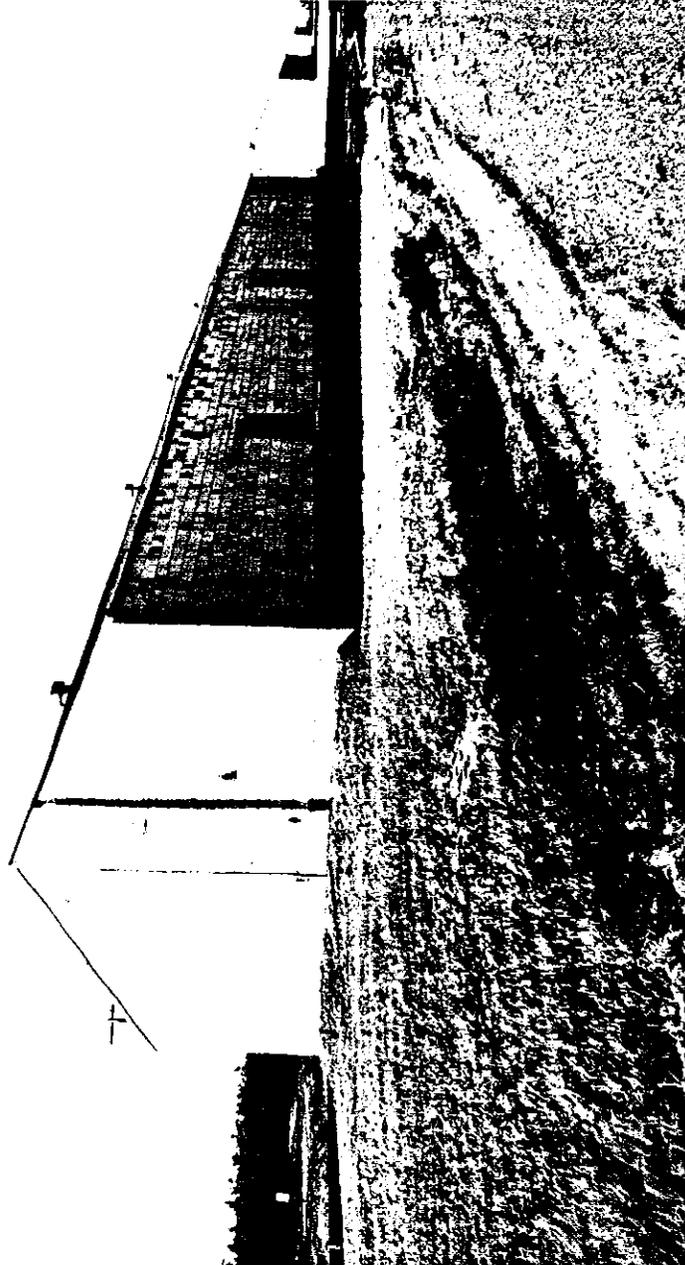


Figure 6: Building 50410 is typical of the arsenal's clay-tile warehouses and above-ground magazines. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

and mustard (53000-, 54000-series buildings). Although the warehouses still remain, almost all of the war-gas production buildings were either partially dismantled or completely demolished in the decades after World War II. Only the Mustard Filling Building (Building 53990) survives intact (Figures 7, 8).

The second main area of the arsenal was the centrally located administration compound, which contained approximately sixty wood-frame buildings. The most prominent were a Main Administration Building (Building 10020), Cafeteria (Building 10030), Guard Headquarters (Building 10050), Clinic (13000-series Buildings), single-family houses for staff officers (Buildings 15010 through 15100), and barracks for other military personnel (Buildings 12110 through 12130, 15310 through 15350, 16110 through 16140, 16210 through 16240) (Figures 9-11).

The southernmost part of the arsenal was given over to the production of incendiary and smoke munitions. This area housed six distinct filling-and-assembling plants: three for aluminum- and magnesium-based incendiaries (31000-, 32000-, 33000-series buildings), one for smoke devices (Buildings 34220 through 34685), one for white phosphorous munitions (Buildings 34100-series buildings), and one for napalm bombs (34900-series buildings). Most of the production buildings were of standard "blow-out" construction, featuring steel framing, clay-tile walls, transite roofing, and interior, reinforced-concrete blast walls (Figure 12).<sup>6</sup>



Figure 7: This former lewisite-manufacturing building (Building 54140) is one of four identical structures surviving at the chemical plant area. The other three buildings (Buildings 54240, 54340, 54440) have also been partially dismantled. (Source: Field inventory photograph, 1984, Jeffrey A. Hess MacDonald and Mack Partnership.)

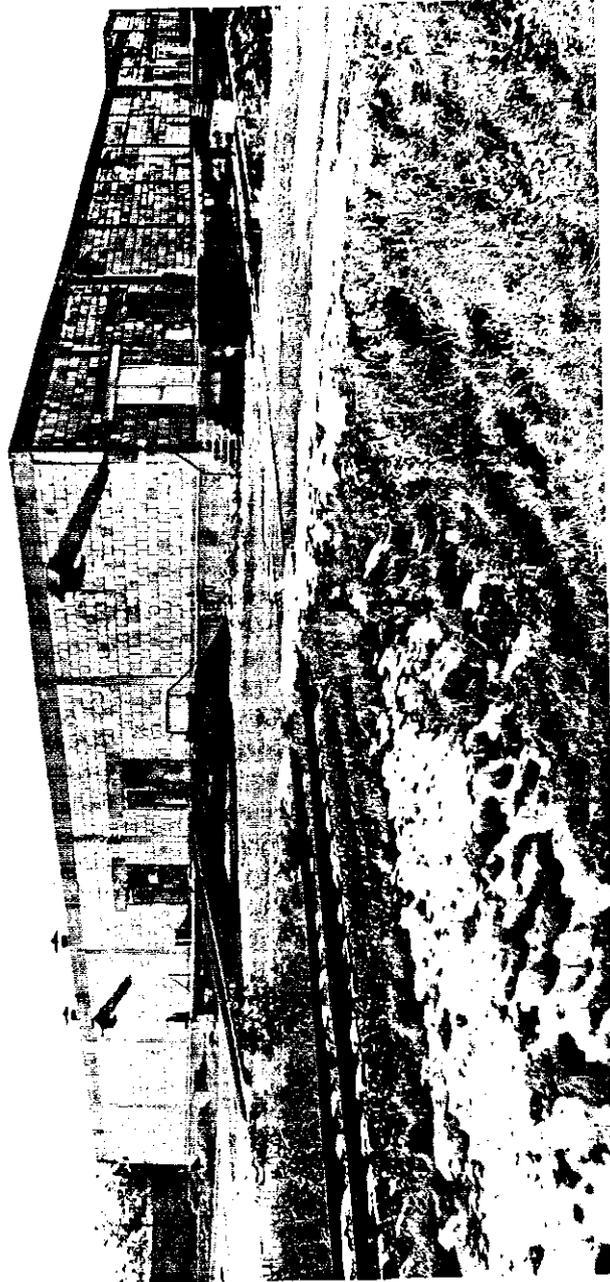


Figure 8: Currently a warehouse, Building 53990 was formerly used for filling munitions with mustard gas. It is the arsenal's sole war-gas production facility that has not been demolished, partially dismantled, or substantially remodeled. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

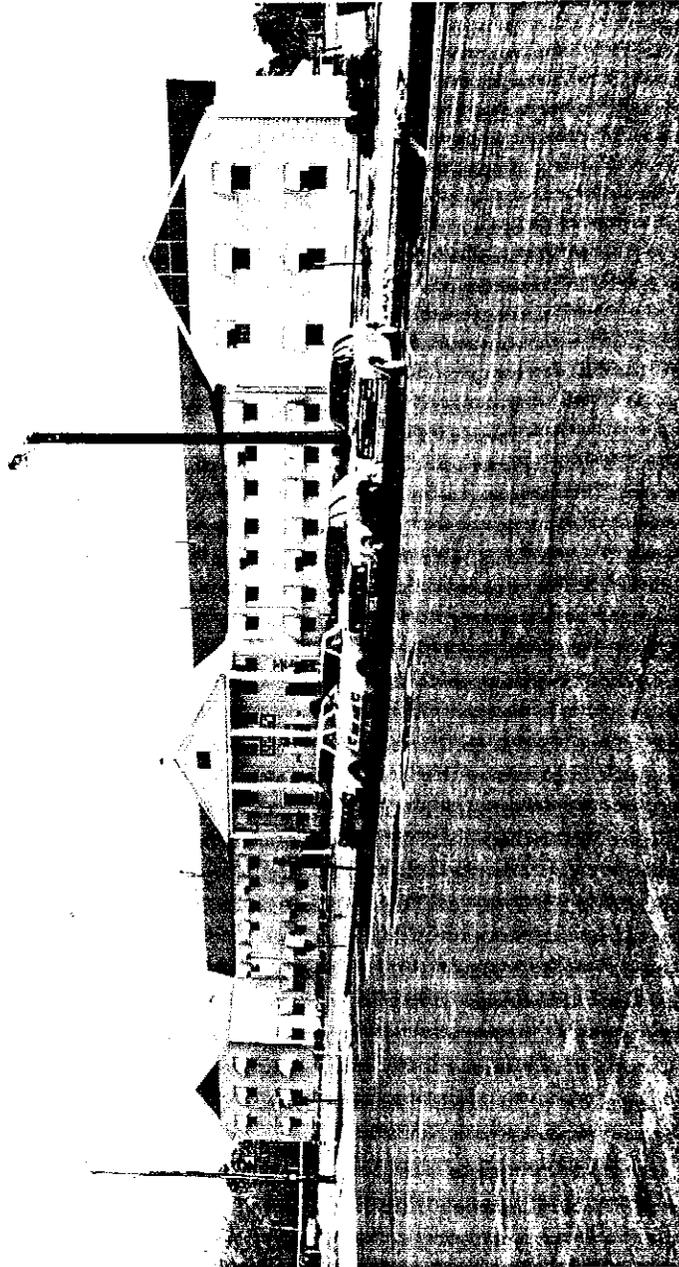


Figure 9: Administration Building (Building 10020), looking south. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

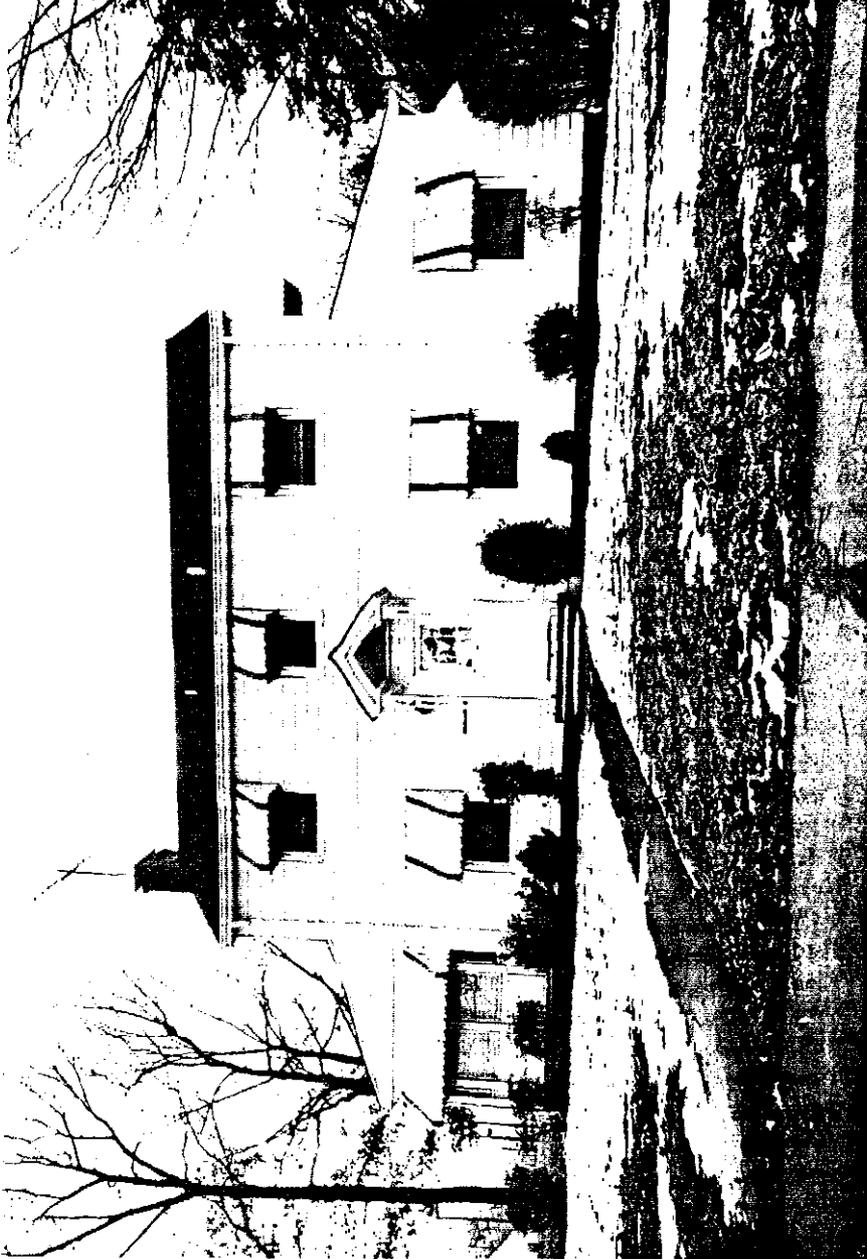


Figure 10: Building 15010 is representative of the ten single-family residences constructed during World War II for staff officers. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)



Figure 11: Building 15330 still serves its original function as a bachelor officers' barracks. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

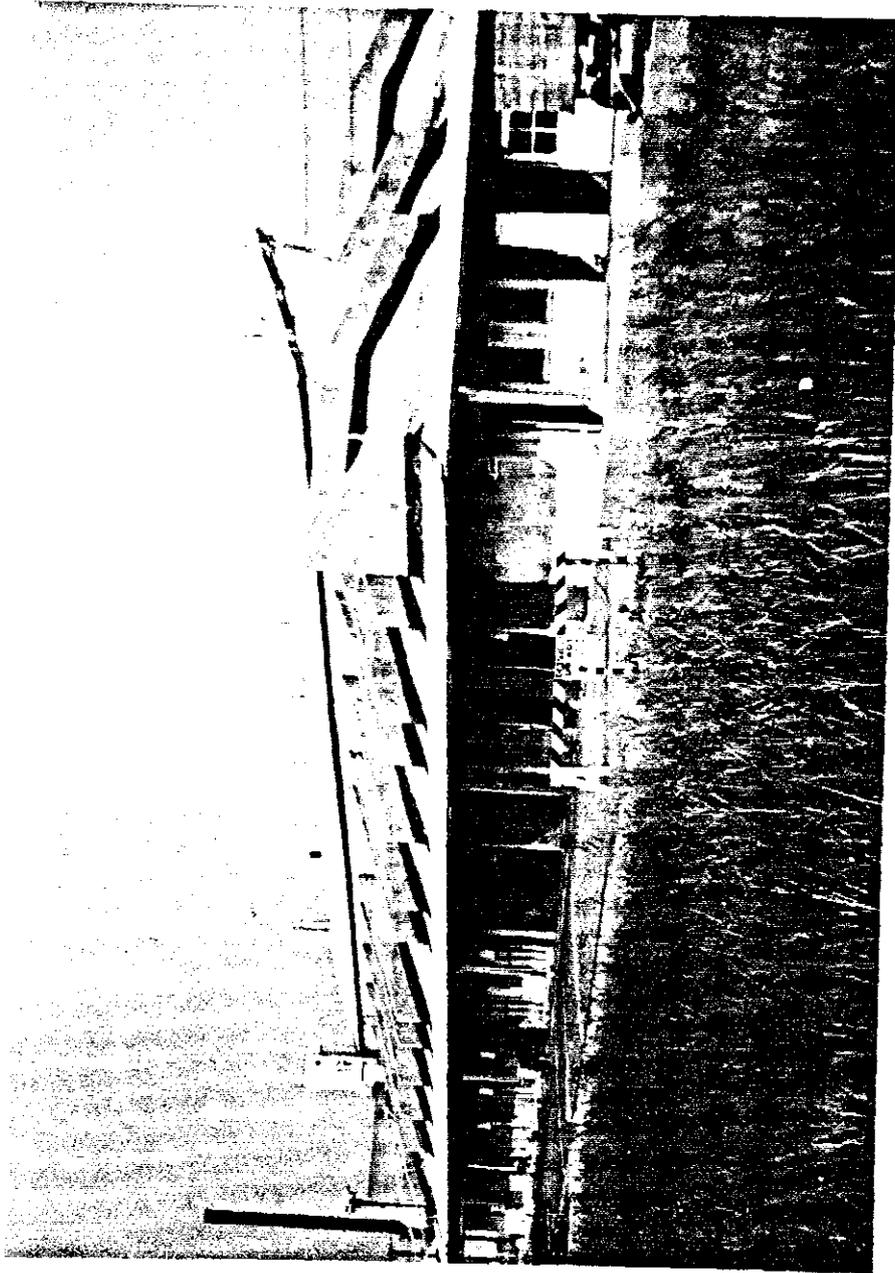


Figure 12: Divided into numerous mixing cubicles by reinforced-concrete blast walls, Building 33620 is typical of the production facilities in the incendiary-manufacturing areas. (Source: Undated photograph in PBA Administrative Archives.)

## Technology

Although none of the combatants used toxic gases on the battlefield in World War II, Allied and Axis powers alike manufactured and stockpiled gas munitions for retaliatory purposes. PBA was one of four American arsenals manufacturing lewisite (dichlor-2-chloro-vinyl-arsine) and mustard gas (dichloroethyl sulfide). Mustard was made by the well-established Leivinstein process, involving the reaction of ethylene gas and sulfur monochloride, with chlorine gas and caustic solution used for "neutralization and decontamination of spills, wild batches, and equipment." Lewisite was produced by a more recently developed English process that had been refined at Edgewood Arsenal. The procedure called for "the reaction between arsenic trichloride and gaseous acetylene in the presence of an aqueous hydrochloric acid solution of mercuric chloride [with] thionyl chloride . . . used for the completion of the reaction."<sup>7</sup> In terms of production machinery, the war-gas operation primarily employed "corrosion resistant reactors, pumps, storage tanks and stills," along with "semi-automatic and manually operated equipment" for filling the toxic substances into shells and shipping containers.<sup>8</sup> After World War II, all war-gas equipment was eventually dismantled and removed from the arsenal.

Most of the original machinery for producing incendiary and smoke munitions has also been removed from PBA. These items included tumbling barrels and blenders for mixing the chemical charge (Buildings 31520, 31620, 31720, 31820, 32520, 32620, 32720, 32820, 33520, 33620, 33720, 33820, 34640, 34660), and hydraulic consolidation presses for compacting it in the munition casing, which was loaded by hand filling (Buildings 31530, 31630,

32530, 32630, 33530, 33630). After casings had been filled with chemical mix to the proper height and density, operators hand inserted ignition devices to complete the pyrotechnic assembly. In the case of incendiary bombs, individual casings were also equipped with tail fins and strapped into clusters (Buildings 31540, 31640, 32540, 32640, 33540, 33640) (Figures 13-15).<sup>9</sup>

The preparation of white phosphorous munitions employed a somewhat different technology. Since white phosphorous spontaneously combusts in the presence of oxygen, the material could not safely be exposed to air during the case-filling process. To render the substance as manageable as possible, it was liquified in steam-heated tanks and then piped to the various work stations in the White Phosphorous Filling Building (Building 34110). Initially, case filling was accomplished by hand-actuated, pressurized nozzles with "quick opening valves."<sup>10</sup> This arrangement was soon superseded by the "dip filling method," which utilized a mechanized conveyor system that gravity filled the casings by immersing them in a tank of white phosphorous sealed from the air by a lighter layer of water (Figure 16). As one historian of the operation noted, "the adoption of the dip filling method for filling shells with WP [i.e., white phosphorous] increased the output of the WP Filling Plant on this type of munition by 100%."<sup>11</sup> The white phosphorous production area, along with all other manufacturing plants at PBA, ceased operation and assumed standby status immediately following V-J day. None of the original white phosphorous production equipment survives intact at the installation.

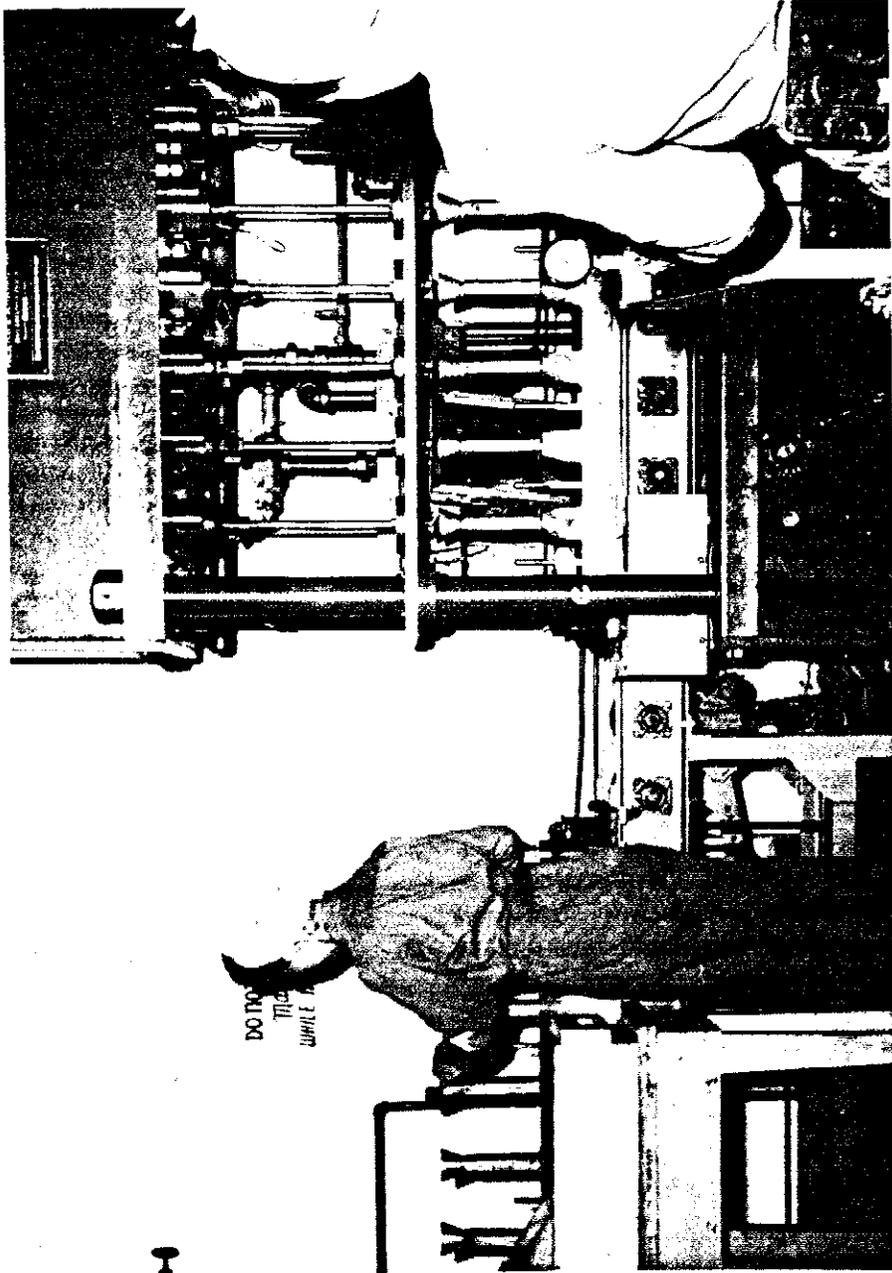


Figure 13: Operator (left) hand fills incendiary mix into bombs, which are then run through a consolidation press to compact chemical charge (right). This process was completed five times: once with "starter" mix, and four times with incendiary mix. Source: "Pine Bluff Arsenal History," vol. 2, unpublished report prepared by Chemical Warfare Service, 1945, PBA Administrative Archives.)



Figure 14: Operator inserts firing pin assembly into filled and pressed incendiary bomb. (Source: "Pine Bluff Arsenal History," vol. 2, unpublished report prepared by Chemical Warfare Service, 1945, PBA Administrative Archives.)

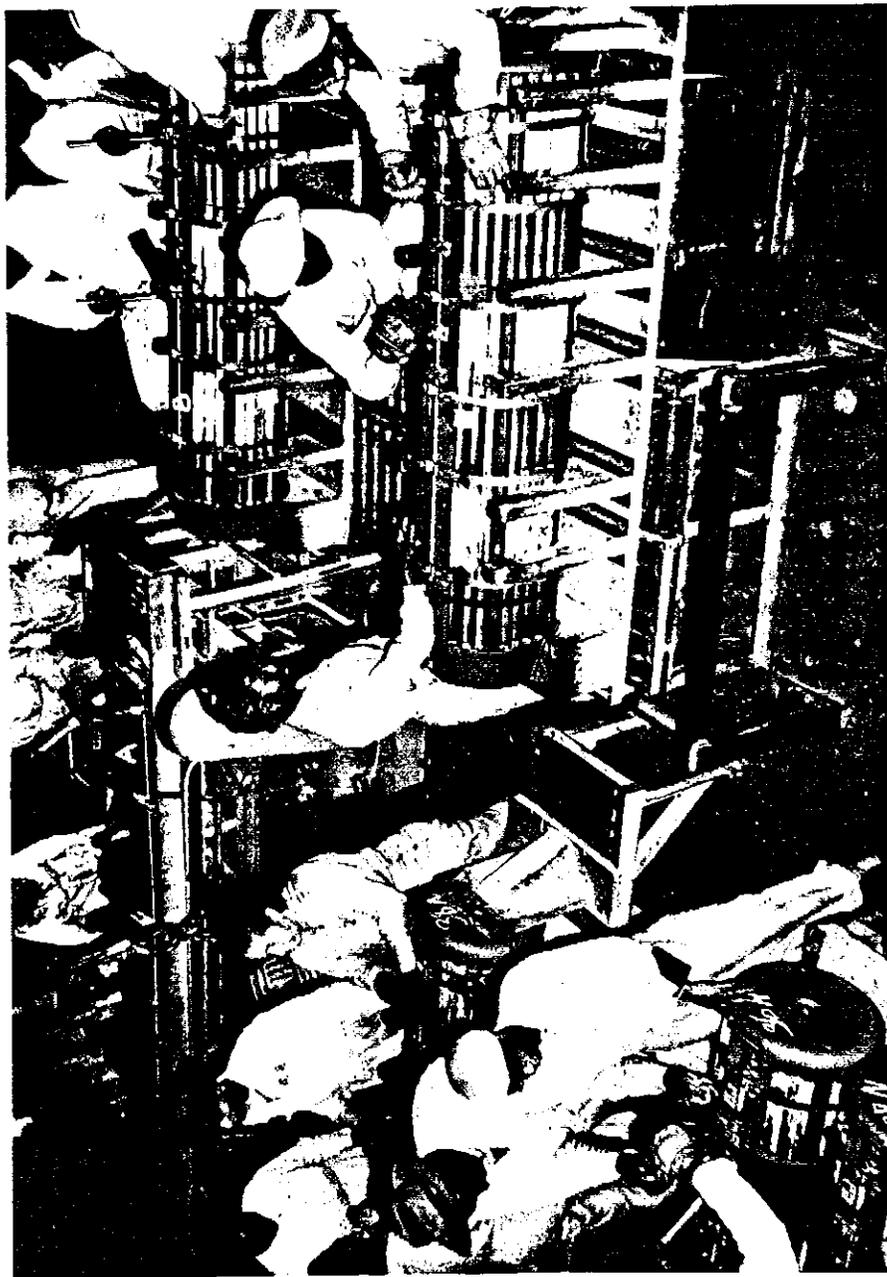


Figure 15: Operators assemble loaded and primed incendiary bombs into clusters.  
(Source: "Pine Bluff Arsenal History," vol. 2, unpublished report prepared by Chemical Warfare Service, 1945, PBA Administrative Archives.)



Figure 16: Dip filling 4.2 inch mortar shells with white phosphorous. (Source: "Pine Bluff Arsenal History, vol. 2, unpublished report prepared by Chemical Warfare Service, 1945, PBA Administrative Archives.")

KOREAN WAR TO THE PRESENT

Reactivated for the manufacture of incendiary and smoke munitions during the Korean War, PBA has remained in limited production to the present time. Although original lines have been modernized with more efficient mixing, filling, and consolidating apparatus, most manufacturing processes still resemble basic, World-War-II procedures (Figures 17, 18). The major technological improvement occurred in the white phosphorous operation during the mid-1960s, when conventional dip-filling lines were augmented by a newly developed "dry-filling" system (Building 34110). In this operation, casings were nozzle-fed and gravity-filled in an hermetic cabinet flooded with nitrogen.<sup>12</sup>

Architecturally, PBA still retains much of its original World-War-II character. Almost ninety percent of the arsenal's buildings date from the 1940s. The largest post-war construction program occurred in the early 1950s, with the completion of a biological-warfare center in the north-central section of the installation. Originally known as the Production Development Laboratories (later renamed the Directorate for Biological Operations), the center comprised about two dozen buildings for manufacturing and loading biologically active, toxic munitions. Following the Nixon Administration's repudiation of biological warfare in 1969, all manufacturing activities ceased; in 1972, the 500-acre complex was removed from PBA jurisdiction, renamed the National Center for Toxicological Research, and placed under the supervision of the Department of Health, Education, and Welfare.<sup>13</sup> Other significant new construction at PBA included a packing facility for white phosphorous munitions (Building

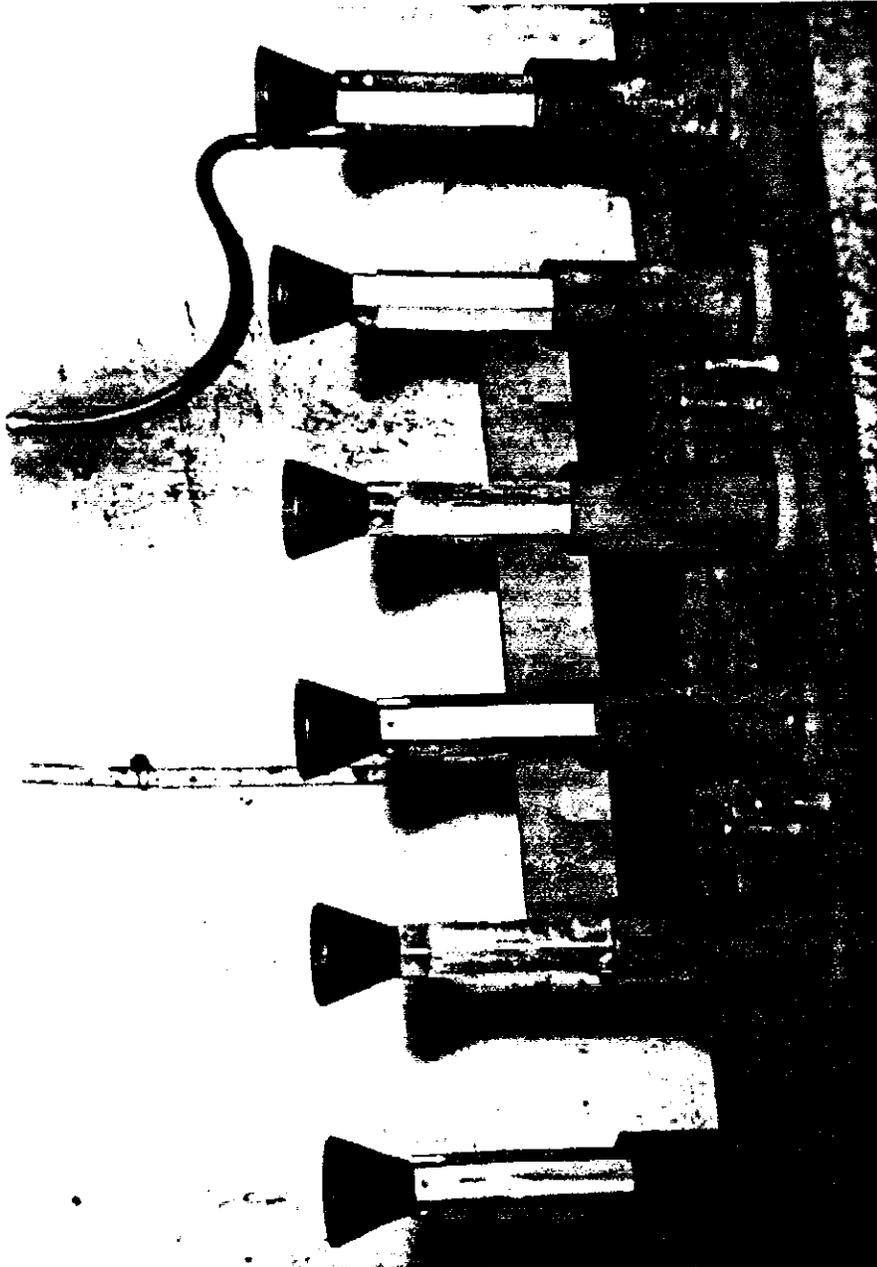


Figure 17: These hand-filled incendiary bombs are about to be run through a consolidation press during the Vietnam War production buildup. (Source: Undated photograph in PBA Administrative Archives.)



Figure 18: During the Vietnam War, arsenal workers inserted firing pin assemblies into incendiary bombs in the same manner used during World War II. (Source: Undated photograph in PBA Administrative Archives.)

44110) in 1971, and a manufacturing facility (Building 53220) (Figure 19) designed to produce one chemical component of a binary nerve-agent munition. Construction on this facility commenced in 1981 and is scheduled for completion in 1984.<sup>14</sup>



Figure 19: Building 53220 is designed to manufacture one chemical component of a binary nerve-agent munition. The one-story section of the building is new construction; the two-story section is a remodeled mustard-gas production building from World War II. (Source: Field inventory photograph, 1984, Jeffrey A. Hess, MacDonald and Mack Partnership.)

NOTES

1. The two other new plants were Huntsville Arsenal in Huntsville, Alabama, and Rocky Mountain Arsenal near Denver, Colorado. The standard study of American use of chemical munitions during World War II is Brooks E. Kleber and Dale Birdsell, The Chemical Warfare Service: Chemicals in Combat (Washington, D.C.: Office of the Chief of Military History, United States Army, 1966). On the role of Edgewood Arsenal and on the authorization of the three new installations, see Leo P. Brophy and George J. B. Fisher, The Chemical Warfare Service: Organizing for War (Washington, D.C.: Office of the Chief of Military History, Department of the Army, 1959), pp. 10-13, 31-32, 36-37, 120-122.
2. The site's merits are analyzed in "Memorandum on Engineering Features of Chemical Warfare Service Plant Site," Sept. 12, 1941, Exhibit 1, in "Pine Bluff Arsenal History, Exhibits 1-14," unpublished report prepared by Chemical Warfare Service, 1945, PBA Administrative Archives.
3. For the site's prior land use, see "Land Utilization and Management Plan, Pine Bluff Arsenal, Pine Bluff, Arkansas," n. d., p. 4, unpublished report, PBA Administrative Archives. Economic and demographic data on the City of Pine Bluff are furnished by Ethel Barker, "Pine Bluff -- City Guide," unpublished typescript, c. 1938, Pine Bluff-Jefferson County Public Library.
4. "One of the country's leading engineering firms," Sanderson and Porter had designed and built the Elwood Ordnance Plant in Illinois during 1940-1941. A senior partner in the firm, Francis Blossom, had been responsible for reviewing plant construction practices for the army after World War I, and he served as an engineering consultant for the government throughout World War II. See Lenore Fine and Jesse A. Remington, The Corps of Engineers: Construction in the United States (Washington, D.C.: Office of the Chief of Military History, United States Army, 1972), pp. 29, 125, 191. Sanderson and Porter apparently designed all of the facilities at PBA except for the chlorine plant (52000-series buildings), which was the work of H. K. Ferguson Co. of Cleveland, the designer of similar facilities at Edgewood and Rocky Mountain Arsenals; see "Supplement No. 2 to the Industrial Facilities Inventory Report, Pine Bluff Arsenal," n.p., unpublished report prepared by U. S. Army Corps of Engineers, Little Rock, Arkansas, Office, 1946, PBA Facilities Engineer's Office; Armed Service Forces, Chemical Warfare Service, "History of Rocky Mountain Arsenal," vol. 5, p. 1274, unpublished report, 1945, Rocky Mountain Arsenal Administrative Archives. For a listing of buildings at PBA, see "Industrial Facilities Inventory, Pine Bluff Arsenal, Pine Bluff, Arkansas," vol. 3, unpublished report prepared by U. S. Army Corps of Engineers, Little Rock, Arkansas Office, 1944, PBA Facilities Engineer's Office.
5. Brief descriptions of the standard igloo and clay-tile warehouse are found in E. E. MacMorland, "Ordnance Supply System," Mechanical Engineering, 67 (December 1945), 791-792.

6. See site plans in "Industrial Facilities Inventory," vol. 1; also descriptions of individual building construction in vol. 3.
7. The stockpiling of gas munitions in combat areas is discussed in Kleber and Birdsell, pp. 36-276. Process descriptions of the PBA war-gas plant do not seem to be available. The quoted passages are from a study of the gas operation at Rocky Mountain Arsenal, which apparently used the same basic methods as PBA; see "History of Rocky Mountain Arsenal," vol. 8, pp. 2510, 2592.
8. "Pine Bluff Arsenal History," vol. 2, n.p.
9. Detailed process descriptions of the incendiary operations are found in "Pine Bluff Arsenal History," vol. 2, n. p. Automated filling machines were tried and discarded: "The adoption of hand filling of magnesium incendiary bombs . . . improved . . . the quality of production through both an increase in the speed of operation and the reduction in down time resulting from the maintenance of filling machines and the elimination of fires in that equipment."
10. "Pine Bluff Arsenal History," vol. 4, n. p.
11. "Pine Bluff Arsenal History," vol. 2, n. p.
12. The description of dry filling is based on author's site inspection of the White Phosphorous Filling Building (Building 34110), escorted by Harold B. Bray, Deputy Directory of Industrial Operations, January 4, 1984.
13. "Pine Bluff Arsenal Profile," p. 6, unpublished report prepared by U. S. Army Materiel Readiness Command, 1983, PBA Administrative Archives. The biological warfare program at PBA is discussed in Seymour M. Hersh, Chemical & Biological Warfare: America's Hidden Arsenal (Garden City, N.Y.: Doubleday & Co., 1969), pp. 113-117.
14. "A binary munition is one which forms a lethal chemical agent from two non-lethal compounds by means of a chemical reaction which occurs during the flight of the munition to the target. The two chemicals are not assembled until ready to fire. The proposed facility [at PBA] would be designed to manufacture only difluoro (DF), one of the two components required in the 155mm binary munition. This DF component [i.e., methyl phosphonic difluoride] would be hermetically sealed in leakproof containers which would be [later] loaded into projectiles. A cardboard spacer would occupy the space for the second canister. The second canister which contains the second component (Isopropyl alcoholamine, or OPA), would be procured, filled, and packed by industry at another location. Only on the battlefield would this second canister be inserted into the round with the DF canister. Upon firing, the canisters rupture and the two chemicals react to manufacture the lethal chemical agent during flight to the target." From "Information Booklet [on the 155mm Binary Munition Facility,]" unpublished, n. d., PBA Administrative Archives.

## 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 PBA.

CATEGORY II HISTORIC PROPERTIES

There are no Category II historic properties at the PBA.

CATEGORY III HISTORIC PROPERTIES

There are no Category II historic properties at the PBA.

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."

BIBLIOGRAPHY

- Armed Service Forces, Chemical Warfare Service. "History of Pine Bluff Arsenal," vols. 5, 8. Unpublished report, 1945. Rocky Mountain Arsenal Administrative Archives, Commerce City, Colorado. Describes basic war-gas manufacturing operation used at PBA and other Chemical Warfare Service arsenals during World War II.
- Barker, Ethel. "Pine Bluff — City Guide." Unpublished typescript, c. 1938, Pine Bluff-Jefferson County Public Library.
- Brophy, Leo P., and Fisher, George J. B. The Chemical Warfare Service: Organizing for War. Washington, D. C.: Office of the Chief of Military History, Department of the Army, 1959. Standard administrative history of Chemical Warfare Service; contains brief discussion of arsenals.
- Fine, Lenore, and Remington, Jesse A. The Corps of Engineers: Construction in the United States. Washington, D. C.: Office of the Chief of Military History, United States Army, 1972. Standard study of military construction of ordnance plants during World War II.
- Hersh, Seymour M. Chemical & Biological Warfare: America's Hidden Arsenal. Garden City, N. Y.: Doubleday & Co., 1969. Expose style treatment of biological-warfare program at PBA. Higham, Robin, ed. A Guide to the Sources of United States Military History. Hamden, Conn.: Archon Books, 1975.
- 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.
- Hoy, Suelen M., and Robinson, Michael C., eds. Public Works History in the United States. Nashville: American Association for State and Local History, 1982.
- "Industrial Facilities Inventory, Pine Bluff Arsenal, Pine Bluff, Arkansas." Unpublished report prepared by U. S. Army Corps of Engineers, 1944. 5 vols. PBA Facilities Engineer's Office. Most detailed account of construction of PBA; contains descriptions of individual buildings and general site plans.
- "Information Booklet [on the 155mm Binary Munition Facility.]" Unpublished, n. d. PBA Administrative Archives.
- Jessup, John E., and Coakley, Robert W. A Guide to the Study and Use of Military History. Washington, D. C.: U. S. Government Printing Office, 1979.

- Kleber, Brooks E., and Birdsell, Dale. The Chemical Warfare Service: Chemicals in Combat. Washington, D. C.: Office of the Chief of Military History, United States Army, 1966. Standard study of American development and deployment of chemical munitions during World War II.
- "Land Utilization and Management Plan, Pine Bluff Arsenal, Pine Bluff, Arkansas." N. d. PBA Administrative Archives.
- MacMorland, E. E. "Ordnance Supply System." Mechanical Engineering, 67 (December 1945), 789-797. Good general overview of warehouse and magazine construction at ordnance depots and plants during World War II.
- National Park Service. "Archeology and Historic Preservation; Secretary of the Interior's Standards and Guidelines." Federal Register, Part IV (September 28, 1983), 44730-44734.
- \_\_\_\_\_. How to Complete National Register Forms. Washington, D. C.: U. S. Government Printing Office, 1977.
- \_\_\_\_\_. 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.
- Pine Bluff Arsenal General Site Plan. Unpublished drawing No. GL214, 1973, PBA Facilities Engineer's Office Archives.
- "Pine Bluff Arsenal History." Unpublished report prepared by Chemical Warfare Service, 1945. 4 vols. PBA Administrative Archives. Most detailed accounted of arsenal's operation during World War II.
- "Pine Bluff Arsenal Profile." Unpublished report prepared by U. S. Army Armament Materiel Readiness Command, 1983, PBA Administrative Archives.
- Pine Bluff Arsenal Real Property Inventory. Unpublished computer printout, March 1982. PBA Facilities Engineer's Office Archives.
- "Supplement No. 2 to the Industrial Facilities Inventory Report, Pine Bluff Arsenal." Unpublished report prepared by U. S. Army Corps of Engineers, 1946. PBA Facilities Engineer's Office Archives.
- United States Army Armament Materiel Readiness Command. Catalog of Common Sources, Fiscal Year 1983. No pl.: Historical Office, AMCCOM, Rock Island Arsenal, n.d. 2 vols.



DEPARTMENT OF THE ARMY  
PINE BLUFF ARSENAL  
PINE BLUFF, ARKANSAS 71611

Pine Bluff Arsenal  
HAER No. AR-2  
Page 55

January 5, 1984

SMCPB-IN

[APPENDIX]

Mr. Jeffrey A. Hess  
Historical Consultant  
MacDonald and Mack Partnership  
215 Grain Exchange Building  
Minneapolis, Minnesota 55415

Dear Mr. Hess:

This is to acknowledge that in your visit to the Pine Bluff Arsenal for the DARCOM Historic Review, the following areas, for security reasons, were excluded from the tour:

- a. Eighty-six igloos numbering from 62-150 through 63-000, and
- b. Security Entry Control Bldg. No. 60-530.

We were pleased to have you here for the historic survey and hope that your visit proved to be successful and enjoyable.

Sincerely,

A handwritten signature in cursive script that reads "Dewey C. Spencer".

Dewey C. Spencer  
Public Affairs Officer