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HISTORIC AMERICAN BUILDINGS SURVEY

DOCUMENTATION

OF PYROTECHNIC R&D LABORATORY

(BUILDING 1510) AND

GENERAL STORAGE BUILDING (BUILDING 1510B),

PICATINNY, MORRIS COUNTY, NEW JERSEY

Prepared for:

PARSONS INFRASTRUCTURE
901 NE Loop 410, Suite 610
San Antonio, Texas 78209-1305

Prepared by:

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October 2008

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OF PYROTECHNIC R&D LABORATORY (BUILDING 1510)

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PICATINNY, MORRIS COUNTY, NEW JERSEY

FINAL

Prepared for:

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Prepared by:

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Mark A. Steinback, M.A., Senior Historian/Technical Editor

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Management Summary

Panamerican Consultants, Inc. (Panamerican) was subcontracted by Parsons Infrastructure, San Antonio, TX, to prepare of documentation of two structures at Picatinny, Morris County, New Jersey. The Pyrotechnic R&D Laboratory, Building 1510, and the General Storage Building, Building 1510B, are contributing elements to the Rocket Test Area Historic District at Picatinny, which is eligible for listing to the National Register of Historic Places under Criteria A and C through Criterion Consideration G. The buildings are no longer required for the installation's mission, and they are to be demolished pertinent to the Base Realignment and Closure (BRAC) Act. Their mitigation is to be accomplished through their documentation to Historic American Buildings Survey (HABS) standards.

The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et. seq) through 2000 (which includes Section 106 compliance); the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 et. seq.); the Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historical Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-1 Environmental Protection and Enhancement.

In accordance with HABS Documentation Level II, each resource was documented through large-format photography and written historic data and description. One copy of this data is submitted on archival materials as a two stand-alone packets (one for each building). In addition, for the sake of organization and future storage, digital and non-archival copies of the documentation for each of the structures have been submitted as a single report with two sections.

The Panamerican project team included Ms. Kelly Nolte, M.A., Senior Architectural Historian and Principal Investigator; Mr. Mark Drumlevitch, Photographer; and Mr. Mark A. Steinback, Senior Historian/Technical Editor. Ms. Nolte conducted the fieldwork and historic research and wrote the majority of the report, and Mr. Drumlevitch was responsible for all the large-format photography. Mr. Steinback prepared portions of the historical background and edited the report. Dr. Michael A. Cinquino served as Panamerican's Project Director.

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Morris County
New Jersey

PHOTOGRAPHS

WRITTEN AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
National Park Service
Mid-Atlantic Region
Custom House
2nd & Chestnut Streets, Rm. 231
Philadelphia, PA 19106

October 2008

HISTORIC AMERICAN BUILDINGS SURVEY

PYROTECHNIC R&D LABRATORY
(Building 1510)

Location: Pyrotechnic R&D (Research and Development) Laboratory, Building 1510, is located on the south side of Hart Road, east of the intersection of Hart Road and Lake Denmark Road, in the Rocket Test Area Historic District, 1500 Area, Picatinny, Rockaway Township, Morris County, New Jersey.

UTM: 18.539520.4533570
Quad: Dover 1954 (1981)

Date of Construction: 1950 with a major addition in 1967

Engineer/Architect: Original, unknown. Addition, Rouse, Dubin & Ventura, Architect and Engineer, New York

Present Owner/ Occupant: United States Army, Picatinny Arsenal, New Jersey

Present Use: Not used, vacant

Significance: The Pyrotechnic R&D Laboratory, Building 1510, is a contributing element to the Rocket Test Area Historic District, Picatinny Arsenal, which is eligible for listing to the National Register of Historic Places under Criteria A and C through Criterion Consideration G. The Pyrotechnic R&D Laboratory is part of the storage and laboratory area within the Rocket Test Area Historic District. This building served as an engineering and pyrotechnic laboratory and administration center.

Kelly Nolte, Senior Architectural Historian/Director of Architectural History Division
Mark A. Steinback, Senior Historian

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October 2008

PART I. HISTORICAL INFORMATION

A. Physical History:

1. **Date of erection:** 1950 with a major addition in 1967.

2. **Architect/engineer:** Original plan, unknown. Addition, Rouse, Dubin & Ventura, Architect and Engineer, New York, New York. No information could be found on Rouse, Dubin & Ventura.

3. **Original and subsequent owners:** U.S. Army/Picatinny Arsenal, now just Picatinny, has been the only owner.

4. **Original and subsequent occupants:** The building was apparently constructed in 1950 as a Pyrotechnic Research and Development (R&D) Laboratory within the pyrotechnic laboratory and storage area of what was then the Rocket Test Area. According to a Record Drawing blueprint of the floor plan, the building was later used as office space as well (Picatinny 1963). In 1966, the building was used as a pyrotechnics laboratory. In 1967, a rear addition was made to the south side of the building, but its use is not known (Rouse, Durbin & Ventura 1967). In 1977, the entire building's floor plan was reworked to accommodate the interim location for the Flame/Incendiary & Props & Stability Location (Picatinny 1977). In 1987, the building was used by the Energetics Test Range, Propulsion Branch, Ammunition Engineering Directorate (AED), and included a Sewing Room, a Strain Gage Laboratory, and a Fabrication and Repair Shop, with Inert Storage and Assembly in the rear addition (Energetics Test Range 1987). The building is now vacant.

5. **Builder, Contractor, Suppliers:** Not known.

6. **Original plans and construction:** The original plans are not known. The building's size and a 1963 Record Drawing internal floor plan indicate that the building has not changed substantially through time. The major change is the rear (south) addition, which seems to have been divided into a number of configurations during its life. At present, the rear addition is one large open space, as it was originally (Picatinny 1963; Rouse, Dubin & Ventura 1967).

7. **Alterations and additions:** The only major change to the building is an addition completed in 1967 by the New York City firm, Rouse, Dubin &

Ventura, Architect and Engineer. The addition was reconfigured in a number of ways (Picatinny 1977), but is a large open space as it was originally configured. Although the roof line, cornice, and windows and their construction materials are the same as those on the original building, the addition's walls are painted concrete block as opposed to the original walls that are yellow, low gloss, glazed, hollow tile. The original building is longer than the addition, which makes the current building a roughly "L"–shaped configuration with more of the west end of the original building extending beyond the addition.

B. Historical Context:

1. Introduction: Picatinny Arsenal (referred to as Picatinny) is a government-owned, government-operated facility in the Green Pond Brook valley in the Highlands of northwestern New Jersey. The U.S. Army established the Dover Powder Depot on more than 900 acres in 1880. Originally constructed for storage of powder and other munitions, the Dover Powder Depot became Picatinny Arsenal in 1907 with the establishment of the first Army-owned smokeless powder factory. During the twentieth century, Picatinny Arsenal emerged as a leading facility for the research, development, engineering, and production of munitions. The installation was reenvisioned following a catastrophic explosion at the Navy's contiguous Lake Denmark Powder Depot that destroyed much of the Navy's facility. During World War II and the subsequent Cold War, Picatinny continued its leading role in the research, development, and engineering of munitions and weapons systems.

Picatinny has long been of historic and architectural interest and since the 1980s an abundance of architectural and historical reports have been prepared assessing the significance of Picatinny's buildings and structures and determining their eligibility for listing to the National Register of Historic Places (Thurber and Norman 1983; Ashby et al. 1984; Fitch and Glover 1990; Harrell 1993, 1994; Nolte 1998; Nolte et al. 1999a, 1999b, 1999c; Nolte and Steinback 2004a, 2004b; Nolte et al. 2007; U.S. Department of the Army nd).

A HABS/HAER Level IV was completed on more than 800 structures that were 50 years of age or older (Ashby et al. 1984). Many have since been demolished as a result of excessive contamination. Subsequently, a HAER was completed for Picatinny Arsenal that provided additional detail to document the historically significant structures related to various industrial processes at the facility (Thurber and Norman 1983). This documentation focused on five areas: 200 Area, Shell Component Loading; 400 Area, Gun Bag Loading; 500 Area, Powder Factory and Power House; 600 Area, Ordnance Test Area; and 800 Area, Complete Rounds/Melt Loading. Further, a draft Multiple Resource National Register Nomination was prepared for six Historic Districts at Picatinny Arsenal—the five areas listed above and a Picatinny Multiple Resources Area, a large area primarily of administrative structures that runs roughly down Farley Avenue including the Cannon Gates. The six districts were cited as being eligible under Criteria A, B, C, and D. The draft nomination was never finalized or submitted for consideration to the Department of the Interior (U.S. Department of the Army nd).

In 1993, 51 structures on the installation were evaluated as part of a catalog of building drawings (Harrell 1993). The structures surveyed included quarters, laboratories, industrial facilities, warehouses, support and utilities structures and one building from the now defunct Navy rocket program. This report recommended that all of the historic structures on Picatinny be surveyed so that future catalogs could include all components of an industrial line and patterns of construction and modernization could be defined. Such a report was prepared a year later (Harrell 1994). A total of 527 structures, all of which were 50 years old or older, were chosen from the HABS/HAER studies and then surveyed in some detail including an evaluation as to each structure's NRHP status. The opinion expressed in the document was that 500 buildings were eligible as contributing elements to a single historic district. This report did not place Picatinny's structures within a larger U.S. military architectural and historical context. In the Army's opinion there was not enough information to support the nomination of 500 structures.

A subsequent reevaluation of the data and the structures recommended that 51 buildings and structures were eligible for the NRHP as contributing elements to three historic districts (the Administration and Research District, the 600 Ordnance Test District, and the Naval Air Rocket Test Station [NARTS], Test Area E District), and two buildings (3250 and 3316) as being individually eligible (Nolte et al. 1999a; Nolte et al. 1999b, 1999c; Nolte 1998). The New Jersey Historic Preservation Office (HPO) concurred with these recommendations (Guzzo 1999). Picatinny also treats the Cannon Gates as NRHP eligible.

Panamerican later completed an Integrated Cultural Resources Management Plan (ICRMP) for the installation (Schieppati and Steinback 2001), and has completed a NRHP determination of eligibility for the Rocket Powder Propellant Plant (1400 Area), the Detonation Facility (1600 Area, "Little Picatinny"), and the NARTS, Area D (which is NRHP eligible) as well as the Haleite/HE Plant (1000 Area), the Nitroglycerine Plant (1300 Area), Pyrotechnic Testing Facility (640 Area), and the Ammunition Testing Facilities (630 Area) (Nolte and Steinback 2004a, 2004b; Guzzo 2004a, 2004b). Recently, Panamerican surveyed, photographed, and evaluated a total of 318 buildings scattered within the installation (Nolte et al. 2007). As a result of this investigation, the Rocket Test Area Historic District (Area 1500) was recommended as eligible under Criterion Consideration G and Criteria A and C. The recommended district located off Lake Denmark Road comprises 34 contributing buildings and seven non-contributing buildings.

2. History: Prior to the Army's residency in the area, settlement of the Highlands, including the project area, was associated with the iron industry. Mining is reputed to have occurred at both Mount Hope mine (adjacent to Picatinny) and Dickerson mine (west of Picatinny) as early as 1710, making these sites the oldest iron-mining operations in both New Jersey and the thirteen colonies (Rutsch and van Voorst 1991:13; Rogers 1931:2-3; Fitch and Glover 1990:B/145-146). By 1737, the northern portion of Hunterdon County (at that time consisting of the present counties of Morris, Warren and Sussex) had an approximate population of 1,750 whites and 70 African slaves (Pitney 1914:4). During the mid-eighteenth century, three forges were established either near or within what would become the Picatinny Arsenal reservation:

- Picatinny Forge, founded about 1749 and called Middle Forge after 1772;
- Mount Pleasant Forge, founded around 1750 and subsequently known as Lower Forge; and
- Burnt Meadow or Denmark Forge, founded in 1750 and known as Upper Forge.

Although there is little agreement about the structures that may have existed at these forges, Halsey inferred that these sites were "bloomary forges," where charcoal, ore, and limestone were shoveled into a furnace to create a "bloom" or semi-molten mass of metal and slag. While still hot, this mass was hammered to remove the slag and produce wrought iron (Halsey 1882:48-56; Rutsch 1999).

An important element to the successful operation of these establishments was that the necessary raw materials—iron ore, limestone, and charcoal—were found easily nearby. Mount Hope and Hibernia mines were located in the hills just east of these forges, while at least two limestone extraction pits were utilized within what is now Picatinny, and several charcoal kilns were adjacent to it (Rogers 1931:7; Fitch and Glover 1990:B-150; Sandy and Rutsch 1992:69; Rutsch et al. 1986:184-186).

The iron industry expanded into the Green Pond Brook valley when Jonathan Osborn (or Osbourne) erected a dam at the southern end of what is now Picatinny Lake and established one of the earliest forges in New Jersey in 1749. Within the boundaries of what is now Picatinny, Osborn's forge was called Picatinny Forge, but later became known as Middle Forge. The forge may have used ores from the nearby Mount Hope mine (Rogers 1931:7; Halsey 1882:41). Establishing his forge at the foot of Picatinny Peak near Green Pond Brook, Osborn created Picatinny Lake by damming the brook for his forge. Machinery and other implements from Middle Forge are on display at the installation museum (Rogers 1931:6; Myers 1984:7).

The following year (1750), Colonel Jacob Ford, Sr., who had purchased Mount Hope mine about the same time, established a forge at Mount Pleasant. Since this forge was south of Osborn's forge, it was sometimes referred to as the Lower Forge. Ford, a leader in the colonial iron-working industry in New Jersey, constructed a dam on Burnt Meadow Brook in 1750, creating Lake Denmark in the process, in order to erect another forge. Subsequently located near the southern end of Lake Denmark, this forge is referred to as the Upper Forge, or, later, as John Harriman's Iron Works or Burnt Meadow Forge. Jacob Ford, Jr., who would continue the family business of owning numerous iron operations in the Green Pond Brook valley, reacquired Middle Forge in 1772 (Fitch and Glover 1990:B-146; Rogers 1931:6-7; Halsey 1882:41).

Known as the Denmark Tract, Jacob Ford, Jr.'s tract contained approximately 6,231 acres and was located west of Mount Hope and east of Green Pond Mountain (in the middle of the Green Pond Brook valley). Sources reported that the property was "returned to Courtland Skinner and John Johnson" on June 21, 1774 (Halsey 1882:334; Rogers 1931:5).

Skinner and Johnson appeared to have purchased this tract for Ford, Jr. (Sandy and Rutsch 1992:43). The substantial tract included Mount Pleasant, Washington Forge, the Spicer properties, Middle Forge and Denmark lands, and portions of it remained in the Ford family until 1806, when it was purchased by Benjamin Holloway, who rebuilt the abandoned forge.

Ironmaster John Jacob Faesch, a Swiss formerly employed by the American Iron Company (also known as the London Company), began to dominate the valley's iron industry. Southeast of the future arsenal near the village of Dover, he established the Mount Hope Furnace in 1772. Also in 1772, Faesch purchased a large tract of land in the Green Pond Brook valley. After demolishing two standing mills (a gristmill and a hemp mill) to construct the Mount Hope furnace on the best location for waterpower, Faesch increased his holdings by renting contiguous properties from Jacob Ford, Jr. He purchased Middle Forge from the Ford heirs in 1778 as well as over 1,900 acres of forested land adjacent to his forges. Faesch, like the Fords, acquired other forges in the Green Pond Brook valley as well as the Mount Hope mine. Moreover, he operated his forges, including Middle Forge, in conjunction with Mount Hope mine until his death in 1799 (Rutsch et al. 1986:46-49; Fitch and Glover 1990:B-146, B-150; Rogers 1931:7; Halsey 1882:41, 53). The historical records are unclear regarding the relationship between Ford's Denmark Tract and Faesch's Tract, which, upon initial review, seem either to overlap or to be contiguous.

Faesch's various iron works played an important role in the Revolutionary War by providing the Continental Army with iron materiel, such as "cannon, shot, bar iron, shovels, axes and other iron implements" (Myers 1984:7). George Washington visited the ironworks at Mount Hope, and approved the transfer of a number of Hessian prisoners to Faesch in order to work at the facilities (Myers 1984:7; Fitch and Glover 1990:B-150; Rogers 1931:5; Rutsch et al. 1986:48). Within Picatinny's boundaries, the Walton Family Cemetery (known alternatively as the Walton Burial Ground or the Hessian Cemetery) lies near Picatinny's Mount Hope Gate and is reputed to contain graves of several of the Hessian prisoners. Since most of the graves in the cemetery are marked with fieldstones, following early custom, the Hessian connection is extrapolated from prisoner work at the local forge and those Hessians who remained in the area after the war. It is further alleged that three other Revolutionary War veterans, besides Peter Doland, are buried there, as well as a possible Civil War veteran, whose grave is unknown (U.S. Army Armament Research, Development, and Engineering Center [ARDEC] Historical Office nd:Item 19; Rutsch et al. 1986:55).

During the nineteenth century, the vicissitudes of the iron industry resulted in valley land changing hands often as the fires of forges burned less and less brightly (Sandy and Rutsch 1992:46-51; Halsey 1882:45, 334; Fitch and Glover 1990:B-150, B-154; Rogers 1931:5-6: Rutsch et al. 1986:59). Despite a depletion of forest timber (and subsequently charcoal), which began in the 1820s and contributed to the volatility of early nineteenth-century iron markets, Middle and Upper Forges continued to operate until the 1850s. Other factors reflecting the general volatility of the industry included frequent ownership changes and a continuous pattern of forge shutdowns and start-ups. On the other hand, providing new blood to the region's sclerotic economy, the Morris Canal was built between 1825 and 1831. Passing just south of Picatinny through Rockaway and Dover, the canal connected Jersey City on the Hudson River to Phillipsburg on the Delaware River by 1865. Constructed to carry cheap coal from Pennsylvania to the industrial centers developing along the New Jersey coast, the canal also provided coal to fuel the iron forges and furnaces in the Highlands, replacing the depleted timber supply. While anthracite coal traveled east, ore from the New Jersey Highlands was shipped westward in great quantities to newer furnaces constructed in Pennsylvania near the Delaware River (Rutsch et al. 1986:65-66; Halsey 1882:68-69; Fitch and Glover 1990:B/150-151).

By 1882, Denmark Forge was no longer in operation and was followed into inactivity five years later by the Denmark mine (Sandy and Rutsch 1992:53). As the profitability of the iron industry declined after 1880, the population of the region declined in tandem, to a low of 2,423 in 1940 (Rutsch et al. 1986:27-29, 35). By the beginning of the twentieth century, only 20 iron mines in the Highlands were in operation, including the Mount Hope mine, which had passed to the control of the Empire Steel & Iron Company. The decline of the iron industry continued through the twentieth century, and resulted in a continual ebbing of the region's population over the next forty years (Fitch and Glover 1990:B-155; Sandy and Rutsch 1992:37). While the Highlands' lakes continued to be popular as resorts and vacation spots, the area around Picatinny Arsenal became attractive to suburban development with improvements in the automobile and the region's transportation infrastructure. Population surged following World War II with the construction of Interstate 80 and 287, the development of suburban residential communities and ancillary commercial construction (Fitch and Glover 1990:B-155; Rutsch 1999).

Picatinny Arsenal. Established on September 6, 1880 as the Dover Powder Depot under the command of Major Francis H. Parker of the Ordnance Department, Picatinny's initial purpose was the storage of "powder, projectiles, and explosives, both for reserve supply and for issue; also for the preparation and issue of these stores" (Rogers 1931:53). A board of Ordnance Department officers chose the Green Pond Brook valley near Dover as the site of the depot based on several criteria: the site had to be a sparsely populated region near New York City, capable of storing a large amount of powder, and, accessible by train. Between 1880 and 1881, the government acquired 1,866.12 acres from various owners for a total of $62,750, or about $34 per acre. After Major Parker requested that the installation's name be changed, the new depot became Picatinny Powder Depot on September 10, 1880, with construction beginning six days later (Fitch and Glover 1990:B-160; Rogers 1931:10-11).

Between 1880 and 1890, construction activities focused on the erection of storage magazines, officer's quarters, and service facilities. The first powder-storage magazine was completed in 1881 with the storage capacity of 10,000 pounds of black powder. With four powder magazines completed by November 1886, the depot received its first shipment of powder (300,000 pounds) for storage later that month. To facilitate access to the installation and the general shipment of freight, the Morris County Railroad began building a rail line through the depot in 1886. In 1887, 23½ miles of track traversed the powder depot and connected it to the Delaware, Lackawanna & Western Railroad and the Dover Central Railroad of New Jersey at Wharton. A privately owned line called the Northern & Wharton Railroad also ran through the depot and maintained five associated stations. Seventy men were employed at the depot and 900,000 pounds of powder were stored at the facility by that time. From 1893 until 1907, the facility was known as the United States Powder Depot (Fitch and Glover 1990:B/164-166; Rogers 1931:53-54, 71; Rutsch 1999:19-21).

In June 1891, 315 acres of Picatinny Powder Depot land near Lake Denmark were ceded to the United States Navy for the establishment of a Navy powder depot. (This area is now part of Picatinny.) After vacating its powder magazine on Ellis Island in New York harbor, the Navy utilized the Lake Denmark facility as its primary depot on the East coast. Storing powder, ammunition, high explosives, and artillery shells, the Lake Denmark Powder Depot was enlarged when the Navy acquired more than 146 additional acres in two purchases in 1902. By 1892, a shell house, a storage magazine and three residential structures were completed (Rogers 1931:29-31; Fitch and Glover 1990:B/166-168; Harrell 1994:6).

Historical development within Picatinny has been concentrated in the areas south and east of Picatinny Lake, which included most of the areas initially purchased by the federal government in 1880-1881 (Rogers 1931:58-61, 77; Harrell 1994). Construction phases at the post dovetailed with the installation's manufacturing activities and changes in its mission over time. The initial phase of development covered the depot/storage period from 1880 until 1907. The depot's first phase of operation involved powder storage and increasing involvement in the assembly of cannon charges. In 1897, workers at the depot assembled powder charges that included manufacturing and filling the storage bags. Between 1902 and 1906 armor-piercing shells were assembled at the depot, where projectiles were filled with explosives, such as Maximite and Explosive "D" (Rogers 1931:54; Fitch and Glover 1990:B-168; Harrell 1994:6).

A major change in the installation's mission occurred in 1907 with the construction of the first Army-owned smokeless powder factory. This activity resulted in the redesignation of the depot as Picatinny Arsenal, and marked the beginning of the Picatinny's important manufacturing phase, which continued until the early years of World War II. Manufacturing increased gradually in the years before World War I as Congress approved continual expansion of the arsenal's production facilities. Picatinny maintained sole responsibility for the assembly of fixed ammunition over .50-caliber by 1909. By 1913, the arsenal was operating a plant for the manufacture of Explosive "D," which was used in armor-piercing projectiles. An Officer's Training School was established in late 1911 to provide training in chemistry, explosives, and ballistics, as well as ammunition manufacturing processes. When the United States entered World War I, Picatinny Arsenal saw a rapid development of its physical plant both around Picatinny Lake and Lake Denmark to meet the exigencies of preparing for war and to accentuate its storage capabilities. During this time, the development of the arsenal as a research and administrative installation also began as the Picatinny personnel provided technical assistance to the private sector producing explosives for the war effort. During the 1920s, munitions experimentation and training had replaced powder production as the arsenal's mission, foreshadowing the later expansion of the facility into a complete ammunition arsenal (Rogers 1931:54-56; Kaye 1978; Fitch and Glover 1990:B/168-170; Harrell 1994:7).

While the Ordnance Department was transforming Picatinny Arsenal into a center for explosives research and development through an extensive renovation and construction program, the Navy was constructing additional powder-storage magazines at its Lake Denmark installation. On Saturday afternoon, July 10, 1926, lightning struck the 461-acre Lake Denmark Powder Depot, causing a series of fires and sympathetic explosions throughout the southwest end of the depot. These explosions killed 19 people, including eleven Marines fighting the fires, and sent shock waves throughout the Green Pond Brook valley, destroying everything within a 3,000-foot radius of the epicenter. Beyond this radius many structures were severely damaged, both within the Navy depot and the adjacent arsenal as well as among the nearby non-military residences (Rogers 1931:Chapter IX; Fitch and Glover 1990:B/171-174).

Once the fires were extinguished, the Navy appointed a Court of Inquiry to investigate the incident. The results of the investigation led to changes in safety and ammunition-storage procedures and standards. Since Picatinny stored material similar to that stored by the Navy at Lake Denmark and had been damaged by the explosions, a board of Army officers also investigated the incident. This commission recommended that Picatinny Arsenal not only be reconstructed but also enlarged for the purpose of consolidating the Army's ordnance activities in northern New Jersey. Devised with the safe handling of explosives as a top priority, plans for rebuilding the arsenal called for the division of the arsenal into zones based on the function or activity occurring in that zone (Rogers 1931:94-96; Fitch and Glover 1990:B/174-176). These functional zones were:

- powder and explosives production and handling;
- powder and explosives storage;
- powder and explosives testing; and,
- non-hazardous manufacturing, and offices for administration and research (Rogers 1931:94).

Between 1927 and 1937 both the Navy Powder Depot and Picatinny Arsenal were completely rebuilt. With rehabilitation nearly complete in 1931, Picatinny became not only the major ammunition arsenal of the U.S.

Army, but was an important center of ammunition research, development, and manufacturing, which included operation of experimental and production plants for the development of a range of propellants and explosives. By the time the United States entered World War II, the arsenal contained 567 buildings and was producing smokeless powder, high explosives, fuzes and primers, assembled rounds of artillery ammunition, bombs and grenades, and pyrotechnics (e.g., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983:28-29; Fitch and Glover 1990:B/177-180; Harrell 1994). In addition, the arsenal was responsible for the standardization of new designs for artillery fuzes and for the development of nose and tail-bomb fuzes. Arsenal personnel also improved the design of artillery primers, trench mortars and rounds of chemical and tracer ammunition. The Research and Chemical Branch developed fuze powders, primer mixtures, pyrotechnic compositions, propellant compositions, and new high explosives. Picatinny's mission also called for the development of new munitions designs utilizing the latest technology and, in the event of a national emergency, to provide private industry with production plans and testing. For example, during the 1930s, researchers at DuPont and Picatinny developed flashless, non-hygroscopic (i.e., non-water absorbent) powders or FNH. DuPont developed M1 powder, and Picatinny developed M3 powder, both of which were tested for composition and specific weapons at the arsenal (Thurber and Norman 1983:29; Green et al. 1990; Kaye 1978).

During World War II, many important advances, new products or simplified methods of production were made at the arsenal in its newly constructed laboratories and testing facilities. As the importance of Picatinny's R&D activities grew, more emphasis was placed on this function, which it would retain after the war. In one year the job-training methods, research projects, and improved work developments originating at Picatinny and passed along to other plants saved the United States more than $30 million (Kaye 1978). While expanding production capabilities to meet the munitions requirements of fighting a two-front war, the arsenal continued to conduct research on tetryl manufacturing and nitrocellulose powder. It also provided explosives and powder production training to both civilian and military personnel.

The responsibility of the Mechanical Branch of the Technical Division was the development and design of ammunition and special bombs for specific jobs. During the war, a number of special components were designed and tested at Picatinny, including both aboveground and long-delay bomb fuzes. In addition, the Mechanical Branch created pyrotechnic devices, such as flares and signals (Thurber and Norman 1983:32-33; Kaye 1978; Fitch and Glover 1990:B/179-183). One of the most important bombs developed for a particular need was created to blow up the Ploesti oil fields in Romania, a vital source of oil for Nazi forces. The bombs created by Picatinny for this mission obliterated the Ploesti installations (Kaye 1978).

In addition to the development and evaluation of new explosives, the Chemical Engineering Section, part of the Technical Division, was responsible for improvements in the performance of regularly used, standard military explosives. The invention of haleite, named for Dr. George C. Hale, chief chemist at Picatinny, is regarded as its most significant accomplishment. Although just entering production at the end of the war, haleite (ethylenedinitramine or EDNA) could be press-loaded into small shells without a desensitizing agent and its derivative, ednatol, could be melt-loaded into large shells. Manufacturing problems, however, prevented haleite from being used in combat (Green et al. 1990; Thurber and Norman 1983:33). During research subsequent to the development of haleite, Picatinny's chemists created another explosive, PTX-2 (Picatinny Ternary Explosive), a combination of PETN (pentaerythritol tetranitrate), RDX ("Research Department Explosive") and TNT (trinitrotoluene). Preliminary firings at the arsenal revealed that it was adaptable to shaped-charged ammunition, although by the end of the war PTX-2 was still in the testing stage (Green et al. 1990).

During the war, Lake Denmark Powder Depot continued to operate as the Navy's propellant and projectile storage area (Fitch and Glover 1990:B/179-183). Several sources suggested that the 3400 Area of the Lake Denmark Depot was built to house prisoners-of-war, but no evidence has been located to document whether prisoners-of-war (POW) were ever held there (Thurber and Norman 1983; Fitch and Glover 1990:B-183) and it appears likely that no POW were ever held there.

The post-war years were marked by both the Cold War with the Soviet Union and hot wars in Asia and the Middle East. During this period, Picatinny continued as a center for R&D for new weapons systems and advances in production processes. Innovations in these areas and the development of new materials had occurred consistently at the arsenal over its history. These types of innovations increased after World War II and included development of photoflash cartridges and bombs, study of plastics and adhesives in the packaging of ammunition, research on warheads for the NIKE, HONEST JOHN, SERGEANT, and other nuclear and conventional missile programs, and production of a tank-piercing rocket for the 3.5-inch bazooka and an atomic shell for the 250-millimeter (mm) gun (Fitch and Glover 1990:B/182-184; Gaither 1997:94, 102).

After World War II, the Navy's Bureau of Aeronautics decided to establish a rocket-engine test center on the east coast, and initiated modifications to the existing facilities at Lake Denmark. On July 1, 1948, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established there. Less than two years later, the Naval Ammunition Depot was officially disestablished, and the NARL was redesignated the Naval Air Rocket Test Station (NARTS) on April 1, 1950. All physical facilities of the former Lake Denmark depot were made a part of NARTS. As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations and technical services, all of which were included in its mission "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" as assigned by the Chief of Naval Operations (U.S. Department of the Navy 1997a, 1997b; Nolte et al. 1999c).

Prior to 1950, the NARL had a number of temporary test stands at which the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1, and the LARK. It also had a large test stand for the development of the 20,000 lb-thrust Viking engine, the Consolidated-Vultee MX-774 (a preliminary Intercontinental Ballistic Missile [ICBM]), and for certain other tests on the SKYROCKET. By the 1950s, the station consisted of 760 acres and represented a multimillion-dollar investment.

The history of NARTS is intimately associated with the history of Reaction Motors, Inc. (RMI). RMI was formed in 1941 and was the first enterprise devoted to the commercialization of the rocket engine (Shesta 1978; Nolte et al. 1999c). By the middle of 1946, all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway. By 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (RMD). In 1956, RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15. The initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents. In 1960, the Navy decommissioned NARTS and the facilities became part of Picatinny Arsenal under the Ammunition Development Division of the Ammunition group at Picatinny. Renamed the Liquid Rocket Propulsion Laboratory, the entire facility was leased almost immediately to the Thiokol Chemical Corporation, RMD. As a result of changes in the rocket industry during the 1960s, RMD at Lake Denmark was shut down by 1972. The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since, except as backdrops for training exercises (Shesta 1978; Nolte et al. 1999c; U.S. Department of the Navy 1997c).

By 1977, most production of weapons and ammunition had ceased at the arsenal and its activities focused on R&D. At that time the Army established the U.S. Army Armament Research and Development Command (ARRADCOM), headquartered at Picatinny, to be responsible for developing new and improving old weapons and munitions. In 1983, ARRADCOM was disestablished and its mission was transferred to the Armament, Munitions and Chemical Command (AMCCOM), Rock Island Arsenal, Illinois. The munitions and weapons R&D activities remaining at Picatinny were renamed the U.S. Army Armament Research and Development Center (ARDC). In 1986, ARDC was renamed the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) with its headquarters at Picatinny. ARDEC was transferred from AMCCOM to the Tank-Automotive and Armaments Command (TACOM) in 1994. Representing the technical expertise of the U.S. government in guns and ammunition of all sizes, from pistols to howitzers, ARDEC played an essential role in developing items and technologies as diverse as warheads, gun fire control, mines, and smart ammunition, among other responsibilities (ARDEC 1995). In the mid-1990s, over 1,000 buildings were spread out over Picatinny's nearly 6,500 acres, making Picatinny "the largest Army installation devoted solely to research and development" (STV/Lyon Associates, Inc. 1994). In 2003, ARDEC was transferred from TACOM to the U.S. Army Research, Development and Engineering Command (RDECOM). As the Army's "Center of Lethality," ARDEC at Picatinny is "the Army's principal researcher, developer and sustainer of current and future armament and munitions systems" (ARDEC 2006).

3. The Army in Space: After World War II, the U.S. military became a leader in the development and use of space for weapons and communications. The U.S. Army played a significant role in the early stages of the U.S. space program developing rockets and satellites, many of which were transferred to the National Aeronautics and Space

Administration (NASA) after it was created in 1958. The first U.S. satellite was launched into orbit by an Army REDSTONE rocket (Space Division, HQ 1993). The first U.S. tactical nuclear weapon, the HONEST JOHN rocket, was developed by the Army (Redstone Arsenal 2000a), and world's first operational, guided, surface-to-air missile system, the NIKE AJAX, was deployed by the Army (Combat Air Museum 2007a). Picatinny played a role in all of these "firsts."

Although theoretical work had been laid down by others before them, primarily by Konstantin Eduardovich Tsiolkovsky, a Russian pioneer in rocket and space science development, and Robert Hutchings Goddard, father of U.S. rocketry, German scientists and engineers were the first to develop and use guided missiles. Throughout the 1920s and 1930s, Walter Hohmann, an engineer who defined the principles of rocket travel in space, guided the German rocket program, which launched its first successful liquid propellant rocket in the early 1930s (Space Division, HQ 1993).

In 1932, Dr. Wernher von Braun has hired by the German Army to develop liquid propellant rockets, which led to the creation of the Aggregate or "A" series of rockets that achieved an altitude of 1.5 miles. In 1937, von Braun and his colleagues moved to an area off the Baltic coast near the small town of Peenemünde in northern Germany to escalate their rocket work for war weaponry. Von Braun and his team created larger rockets and began working on the first A4 rocket (Space Division, HQ 1993).

In October 1942, after a number of failures, the first A4 rocket was successfully launched, flying a programmed trajectory and impacting 120 miles down range. This event is considered by some the beginning of the Space Age because the A4 is the ancestor of practically all U.S. and Soviet space launchers after World War II. The A4 was originally intended for use in attacks on the rear battlefield area beyond the range of conventional artillery, but it evolved into something entirely different. The A4 became the V-2 (*Vergeltungswaffe zwei*, "Vengeance Weapon 2"), a ballistic missile weapon that had a range of 200 miles and carried a one-ton explosive warhead (Space Division, HQ 1993).

In 1943, German Führer Adolf Hitler authorized the full-scale development of the V-2, with mass production of the weapon beginning later that year in an underground factory in the Harz Mountains. On September 7, 1944, the first V-2 was launched against England. Before the war was over, 4,300 V-2s were launched against Great Britain, Belgium and other Allied targets.

The Allies were powerless against the rockets since they did not have any weapons that were able to intercept them. The V-2 fell silently on its target at a maximum speed of about 5,200 feet per second (approximately 3,600 miles per hour); it was the most sophisticated and capable rocket that had ever been developed (Space Division, HQ 1993).

As the war was ending, von Braun and his team were in a small town near the Austrian border with elements of the advancing U.S. Seventh Army only a few miles away. Von Braun and his men surrendered to the U.S. Army. When the war in Europe ended on May 7, 1945, the U.S. Army began to collect all the V-2s, V-2 components, technical documents, and all German technical personnel they could in order to outflank the Russians. The Russians did manage to capture a considerable amount of V-2 hardware, including the actual Peenemünde launch complex and several remaining scientists and technicians (Space Division, HQ 1993).

During World War II, the U.S. military had not been standing still on the development of rockets and missiles. In 1943, the Army established the Ordnance Rocket Branch (ORB) to centrally manage the development of rockets. In 1944, the ORB contracted with the California Institute of Technology's (CIT) Jet Propulsion Laboratory (JPL) to study rocket propulsion and develop long-range surface-to-surface rockets (Project ORDCIT). A total of 24 solid propellant rockets were tested at Fort Irwin, California, under this program, leading to the development of the PRIVATE, CORPORAL, and BUMPER rockets. These development systems never reached operational testing (Space Division, HQ 1993).

Also in 1944, the Army developed White Sands Proving Ground (WSPG), New Mexico, north of Fort Bliss, Texas, to provide more area for longer range testing. Between 1945 and 1948, Fort Bliss was involved in "Operation PAPERCLIP," the relocation of 492 German and Austrian rocket scientists, their equipment, and documents to the United States. The Army received 177 of these individuals, including Wernher von Braun, and was responsible for another 38 working for the Commerce Department. Fort Bliss became the U.S. Army Ordnance Research and Development Rocket Sub Office (Space Division, HQ 1993; Hughes 1990).

After the war, military funding decreased dramatically and many in the War Department were reluctant to fund what they considered experimental programs, such as large rocket weapons. The need to modernize conventional weaponry, such as jet airplanes, tanks, and submarines, seemed to take precedence. Nevertheless, people within the military establishment continued to push for rocket development and extended space exploration. The concept of artificial synchronous communication satellites seized the imagination of the public, and some in the military viewed it as a virtual communications certainty for which they sought funding (Space Division, HQ 1993).

In January 1946, scientists at the Army Signal Corps at Fort Monmouth, New Jersey, bounced radio signals off the moon and received the reflected signals back, proving that radio transmissions could penetrate the atmosphere and return to earth. About the same time, studies and proposals were prepared urging the development of artificial satellites. Despite the potential utility of the project, development of a satellite was not immediately pursued (Space Division, HQ 1993).

On April 16, 1946, the Army launched its first reconstructed V-2 from WSPG, which carried instruments in the nosecone that were recovered after dropping by parachute. In January 1947, the Navy asked the Joint Aeronautical Research and Development Board, an oversight committee composed of the Navy and Army Air Forces personnel, for authority over American satellite development. In June of that year, the board asked the War Department for authority to fund studies related to satellites. However, in 1947, the National Security Act established the National Military Establishment (NME; the Department of Defense [DoD] was not created as such until August 1949), reorganizing the U.S. military establishment and creating the Air Force as a separate service with resources primarily from the Army Air Corps. In September, the NME assigned responsibility for the development and control of defense satellites to the Joint Aeronautical R&D Board (Space Division, HQ 1993; Hall 1992).

Nevertheless, by 1948, James V. Forrestal, the first Secretary of Defense, felt it necessary to specify the roles and missions of each of the services in relationship to rockets and space, especially during a period of limited budgetary expenditures. The Army could develop tactical and Intermediate Range Ballistic Missiles (IRBM), including responsibility for antiaircraft guided missiles and ground-launched, short-range, surface-to-surface guided missiles supporting or extending conventional artillery capabilities; the Air Force was responsible for ICBM; and the Navy would develop ship or Submarine Launched Ballistic Missiles (SLBM). The struggle among the services for funding was exacerbated when the Air Force claimed the rights to satellite development as an extension of strategic air power. The Navy dropped its claims for satellite oversight (Redstone Arsenal 2000b; Space Division, HQ 1993; Hall 1992).

Regardless of the funding and maneuvering ploys, the Army moved forward in its rocket program. On February 24, 1949, Bumper Round 5, fired at WSPG under the direction of von Braun, marked the first penetration of outer space by an American missile (Redstone Arsenal 2000b). In that same year, the Secretary of the Army transferred the Ordnance Research and Development Division Sub Office from Fort Bliss to Redstone Arsenal. Von Braun and his team moved to Huntsville, Alabama. In addition, safety restrictions at WSPG became a problem for testing large rockets and the testing range was relocated to an isolated place on the east coast of Florida, later developing into Cape Canaveral (Space Division, HQ 1993). More ominously, an American weather plane over the Pacific Ocean detected radioactive particles in the atmosphere in September 1949, indicating that Soviets had tested their own atomic bomb. This development set off an atomic weapons race that lasted almost 50 years, adding more chill to the Cold War.

During the early 1950s, the sharp-elbowed rivalry among the military services over their respective roles during the Cold War carried over into the efforts to develop rockets and missiles. Changing roles after World War II brought about by new technology (e.g., airplanes, atomic bomb) compounded by budgetary priorities raised the Air Force’s stature at the expense of the Army’s. This shift was enhanced by the policies of the administration of President Dwight Eisenhower, beginning in 1953. His “New Look” budget for the Army for Fiscal Year (FY) 1955 was barely half of its allocation in FY 1953, and it would receive the smallest allocations of the three services during the 1950s (Bacevich 1986:20). The intellectual environment of the period reinforced policy decisions that emphasized high-technology applications to military problems and was seasoned by reports published by RAND. These reports speculated on the use of commercial television technology for military satellites to gather intelligence and weather data (1951) and advocated Air Force use of imaging satellites to gather strategic intelligence (1954) (Space Division, HQ 1993).

To rebut the charges that conventional warfare was obsolete in the Atomic Age, Army policymakers emphasized their lead in missile development, and promoted its high-technology endeavors, such as the space program, to capture public imagination. In its efforts to assert control over the development of rockets and missiles, the Army supported three missile programs, each focused on a different problem: air-defense weapons, including surface-to-air missiles (SAMs); tactical surface-to-surface missiles (SSMs); and space exploration with the goal of orbiting a satellite. However, the Air Force and the Navy were also eager to obtain this technological responsibility (Bacevich 1986:16-21, 74-75; Gaither 1997:14, 23-24).

In its rivalry to develop SAMs, the Air Force argued that the Army was intruding into areas of Air Force responsibility, abrogating the 1948 Key West agreement, which outlined the functions of the armed services in the new NME. At that time, the Air Force was assigned the task of developing long-range missiles; however, the Army was allowed to continue its research on the SKYSWEEPER, a radar-directed automatic cannon. By the early 1950s, the Air Force was working with the private sector on the BOMARC missile and the Army was testing the NIKE AJAX. The NIKE won the bureaucratic battle over the BOMARC and was fielded in 1954, but its lack of range and firepower made it quickly obsolete. By 1956, the more nuclear-capable NIKE HERCULES was under development in competition with Air Force-Navy TALOS. To quell the debate, the DoD, in November 1956, assigned the Army jurisdiction of SAMs with range up to 100 miles. By 1960, the Army had two more missiles under development: the HAWK and NIKE ZEUS (Bacevich 1986:77-80; Gaither 1997:23-24; Combat Air Museum 2007a).

The Army’s work on SSMs led to the creation of the 280mm Atomic Cannon, which was developed at the arsenal, but its large size and lack of range made it obsolete immediately. Also in 1953, the Army fielded the CORPORAL missile, the first operational guided missile of the Army and the first guided missile approved for a nuclear warhead. It had a range of 75 miles. During the 1950s, the Army was developing the REDSTONE rocket as a tactical ballistic missile; the Navy was working on the VANGUARD rocket; and the Air Force was developing the ATLAS rocket as an ICBM (Combat Air Museum 2007b; Space Division, HQ 1993).

The development of rockets and missiles had dual implications; one path involved tactical weapons and focused on battlefield developments and defense against attacks, while the other involved more strategic goals of space exploration and research, communication and intelligence-gathering satellites. In 1950, the Army consolidated its rocket and missile development program, relocating von Braun's scientists and engineers from Fort Bliss to Redstone Arsenal. As a result, Redstone's mission was expanded to include "antiaircraft missiles, rocket launchers, and solid propellants, the latter two programs to be carried out in cooperation with Rock Island and Picatinny Arsenals" (Hughes ca. 1995). During the period between 1950 and 1958, Army personnel at Redstone Arsenal directed the REDSTONE, CORPORAL, NIKE, HAWK, LACROSSE, HONEST JOHN, SERGEANT, LITTLE JOHN, and REDEYE missile/rocket development programs. Arsenal scientists played a prominent role in the development of warhead sections (including the explosive payload, fuzing devices, and the arming and safety mechanisms) for all of these programs as well as the PERSHING, SAM-D, LANCE, and SAFEGUARD systems (Gaither 1997:94, 102; Kaye 1978).

The revelations that the Soviet Union had not only produced a hydrogen bomb in 1953 but were developing a ballistic-missile delivery system capable of reaching the United States enlivened the American effort to develop a ballistic missile. A 69-foot (ft) tall REDSTONE rocket was successfully launched from Cape Canaveral, Florida, in August 1953. The REDSTONE would serve initially as a space launcher and, by 1956, as a tactical ballistic missile (deployed in Germany). Despite the success of the REDSTONE, the president elevated development of the ATLAS ICBM project as the government's number one priority in 1955. (The ATLAS would not become operational until the late summer of 1959.) The Army Ballistic Missile Agency (ABMA) was established in 1956 at Redstone "to oversee the Army's ballistic missile program, the first agency devoted exclusively to the development of ballistic missiles" (Gaither 1997:24). The agency was responsible for the REDSTONE, JUPITER, and PERSHING (IRBM) missile programs (Hughes ca. 1995).

Closely related to the American missile-development program was its satellite-development program, since the rockets used to propel a warhead at an enemy were also the same ones that could be used to send a satellite into orbit. By the 1950s, manned reconnaissance over enemy territory was vulnerable to increasingly accurate air defense missiles, so development of reconnaissance satellites was essential to intelligence-gathering and monitoring activities in the Soviet interior. However, no international agreement had been negotiated on the right of free passage of satellites over another nation's territory. President Eisenhower advocated a policy of "Open Skies," which would permit the

United States and Soviet Union to conduct aerial reconnaissance flights over each other's territory to verify that the other was not preparing to attack. Cold War suspicions led Soviet General Secretary Nikita Khruschev to reject Eisenhower's proposal. President George H.W. Bush reintroduced this concept 34 years later, in 1989, as a means to build confidence and security between North Atlantic Treaty Organization (NATO) and Warsaw Pact countries (Space Division, HQ 1993; Hall 1992).

The inter-service rivalry that was characteristic of the period was also fierce in the field of launching satellites: the Army advocated the use of a modified REDSTONE rocket with a solid fuel upper stage; the Air Force proposed using an ATLAS ICBM, although it had yet to field one; and the Navy advanced its VANGUARD rocket, also in development. The administration, sensitive to the appearance that the launch of a military-sponsored satellite would destabilize the tense Cold War political environment, selected the Navy-National Science Foundation VANGUARD to launch the first U.S. satellite because it was more closely linked to the research community (Space Division, HQ 1993; Hughes 1990; Hall 1992).

Although the Air Force's ATLAS received high priority for development as an ICBM and the Navy's VANGUARD was chosen to launch the first American satellite, the Army was allowed to continue research on its JUPITER rocket for use as an IRBM. By September 1956, the Army realized that its modifications to the JUPITER's motor as well as the use of solid propellant could allow the placement of a small satellite in orbit by the end of 1956, ahead of VANGUARD. Despite the capability, the Army was ordered not to launch such a satellite.

Nevertheless, in 1956, the Soviets announced their intention to place a satellite in orbit as part of the International Geophysical Year 1957-1958. Almost as a precursor to the satellite launch, the Soviets successfully conducted a launch of their first ICBM in August 1957. Several months later, in October, the Soviets launched Sputnik, the first artificial satellite, and truly ushered in the Space Age. The administration viewed the launch of Sputnik as advancing the "Open Skies" concept, since the Soviets couldn't protest American surveillance satellites flying over other nations if the Soviets did it first (Begley 2007; Hall 1992).

Despite advanced warning and intelligence revealing Soviet intentions and its own ability to launch a satellite, administration critics and politicians, pandering to fears of the general public, played up the non-existent technology gap. With this launch, they argued, the Soviets demonstrated that they not only possessed nuclear weapons but also had the means to deliver them against targets in the continental United States for which the United States had no defense. On November 3, 1957, Soviet scientists launched Sputnik 2, which carried a live dog, named Laika. The Eisenhower Administration, unconcerned by the satellite launch, had miscalculated the blow to national pride and prestige. To counter the negative publicity after the launch of Sputnik 2, the VANGUARD program, which had endured delays and test failures, was accelerated and the Army was directed to orbit a satellite by March 1958. However, American technological prestige was wounded further when a Vanguard launch in December 1957 fell back to the pad and erupted in flames (Begley 2007; Space Division, HQ 1993; Hall 1992).

By the end of 1950s, the initial fragmentation of the American space program as a result of inter-service rivalries was replaced by a greater sense of organization with the creation of Advanced Research Projects Agency (ARPA) and NASA. Eisenhower created ARPA, a high-level DoD organization, to initially direct the U.S. space program and, in the summer of 1958, the National Aeronautics and Space Act was enacted which created the NASA. ARPA would maintain control of national defense space operations and focus on national defense R&D that would expand the frontiers of technology beyond the immediate and specific requirements of the military services, while NASA was responsible for non-military aeronautical and space research under civilian control. Initially, NASA's facilities came from the National Advisory Committee for Aeronautics (NACA), which was disbanded. The American space effort also began to achieve some success at this time when ABMA launched the first U.S. satellite—EXPLORER I—on January 31, 1958, using a JUPITER-C rocket (later, redesignated JUNO I). The data collected by this satellite led to the discovery of radiation belts in space around the Earth (i.e., the Van Allen belts). The successful satellite launch cemented the competence of Army missile developers in the American mind. A successful launch of a VANGUARD rocket finally occurred on March 17, 1958 (Space Division, HQ 1993; Hall 1992).

During this period, the Air Force continued development of ICBMs and the Navy continued its work on sea-launched rockets, although the Navy did transfer its VANGUARD project and part of the Naval Research Laboratory to NASA in November 1958. The Army continued research on IRBMs. Gradually, non-military, space-related missions were transitioned to NASA, while weapons-related missions were transitioned to the Army Ordnance Missile Command at Redstone, including development of the solid propellant for the PERSHING rocket and the NIKE ZEUS program. By October 1959, ABMA engineers and scientists were transferred to NASA, including the development program for the SATURN rocket, the EXPLORER satellite program, and the JPL in California. Nevertheless, final approval of the Army-NASA transfer enabled ABMA personnel to work on military weapons systems for the Army as well as independent space vehicle R&D for NASA (Hughes 1990, ca. 1995; Space Division, HQ 1993). NASA established the George C. Marshall Space Flight Center at Redstone Arsenal, Alabama, in the spring of 1960, and by July 1, with the transfer of ABMA responsibilities to the Marshall Space Flight Center, all of the Army's space missions passed to NASA (Hughes 1990). Subsequent to the Army reorganization in 1962, missile R&D was subsumed under the Army Missile Command (MICOM), a subordinate command of the U.S. Army Materiel Command.

ARPA's initial emphasis included space, ballistic missile defense, and nuclear test detection. In 1960, all of its civilian space programs were transferred to NASA and the military space programs to the individual services. This allowed ARPA to concentrate its efforts on the DEFENDER (defense against ballistic missiles), Project VELA (nuclear test detection), and AGILE (counterinsurgency R&D) Programs, and to begin work on computer processing, behavioral sciences, and materials sciences. The DEFENDER and AGILE Programs formed the foundation of ARPA sensor, surveillance, and directed energy R&D, particularly in the study of radars, infrared sensing, and x-ray/gamma ray detection (Space Division, HQ 1993). The Army satellite program was directed by Signal Research and Development Laboratory (SRDL) at Fort Monmouth, where ARPA was also located. SRDL developed the Signal Communications by Orbiting Relay Equipment (SCORE) satellite, which was launched in December 1958.

The Army's significant contributions to the U.S. space program during the last years of the 1950s included:

- successfully solving the problem of ballistic missile reentry (August 1957);

- placing four satellites into orbit between 1958 and 1960 (EXPLORER I, II, III, IV);
- launching the United States' first lunar probe (PIONEER III) and first solar satellite (PIONEER IV);
- launching three primates into space, although only two were recovered alive;
- beginning R&D for a 1.5-million-pound-thrust booster rocket for a lunar exploration vehicle (SATURN, an ARPA project); and
- initiating research on the launch vehicle that would carry the first men into space (Hughes 1990).

By the beginning of the 1960s, the NASA's manned space program had begun, which captured the public's imagination. As a precursor, Mercury 1, an unmanned capsule, was launched by a REDSTONE rocket on a suborbital flight on December 9, 1960. Despite advances in the U.S. space program and the success of hypersonic flight by American test pilots, Soviet cosmonaut Yuri Gagarin became the first man in space on April 12, 1961. Less than one month later, American astronaut Alan Shepard became the first American to make a suborbital flight on May 5, 1961. His Mercury 3 capsule called Freedom 7 was launched by a REDSTONE. On July 21, 1961, astronaut Virgil Grissom made another suborbital Mercury mission launched by the Army's REDSTONE. John Glenn became the first American to orbit the earth on February 20, 1962, in the Mercury 6 capsule launched on an ATLAS D rocket (Space Division, HQ 1993).

In the field of space probes and satellites, ABMA launched the PIONEER III lunar probe (December 6, 1958), which did not reach the moon, and EXPLORER VII for NASA (October 13, 1958) using an Army-developed JUNO II rocket (a SERGEANT missile as top stage on a JUPITOR first stage). The technology applied in the JUNO II rocket was important in the subsequent deep-space explorations by RANGER, MARINER, VIKING, and SURVEYOR spacecraft. Other Army satellites included VANGUARD 2 (launched February 17, 1959); DISCOVERER I, the first polar orbiting satellite (February 28, 1959); PIONEER IV, launched by JUNO II to orbit the sun; TIROS (Television Infrared Observation Satellite) I (April 1, 1960) and II (November 23, 1960); and COURIER 1B (October 4, 1960). In 1961, the DoD assigned the mission of managing and operating U.S. military space launch vehicles and satellites to the Air Force (Space Division, HQ 1993).

By the early 1960s, the Army's role as a developer of communication payloads in satellite systems was taken over by the Defense Communications Agency (DCA). And, in 1962, the U.S. Army Satellite Communications Agency was organized at Fort Monmouth, New Jersey, which was responsible for ground terminals and ground support for space systems (Space Division, HQ 1993).

4. Rocket Test Area Historic District, Picatinny Arsenal: This area, which has gone by a number of names including the Rocket Propellant Power Plant (late 1940s), the Liquid Rocket Propulsion Laboratory Test Area (early 1960s), and the 1500 Area (present), is a 20-acre site off Lake Denmark Road off the installation proper. The area is divided into two parts, the western Explosives Area and the eastern Pyrotechnics Area. The western area was constructed from the late 1940s through the 1960s and the eastern section from the early 1950s to the late 1950s. The 1500 Area is currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (Picatinny 2006).

Between 1948 and 1960 the U.S. Navy and Reaction Motors, Inc. (later Thiokol Chemical Corporation), the first commercial rocket company in the United Sates, were designing and testing rockets up to 350,000 lbs thrust as well as creating all types of gray literature (e.g., government reports) related to rocket design, chemical use, and standards for clothing, chemicals, equipment, etc., to be used in rocket work. All of this Navy rocket activity was taking place in the former NARTS, which was immediately north and east of the Army Rocket Area, less than one-half mile away. The interaction between the Army and the Navy is not known; however, in the early, heady days of rocket work, there were very few scientists and engineers with any expertise and it can be assumed that rocket information was shared in some way.

In the early years of Army rocket development, the numerous research activities and undertakings, such as component creation, modification, and testing or procurement, loading, and servicing, were farmed out to the Army installation that could best handle the required activity. This diversification was prominent for the other service branches as well. In the early years, a single rocket might actually represent the physical labor of several installations, such as Picatinny Arsenal, which might have developed the fragmentation device in the warhead, Frankford Arsenal, which might have created the fuzing device, and Aberdeen Proving

Ground, where a determination of the optimum shape of the warhead might have been made (Combat Air Museum 2007a). This division of labor often caused problems, but the need and lack of other resources necessitated the division.

Picatinny participated in the creation of the following rocket/missile systems (organized by first launch, first experimental firing, or first working date):

CORPORAL	1947
LOKI	1951*
SAGE	1951*
HONEST JOHN	1952*
REDSTONE	1953*
NIKE AJAX	1954*
LACROSSE	1954
SHILLELAGH	1958*
NIKE HERCULES	1958
HAWK	1960
PERSHING I	1960*
LITTLEJOHN	1961
SERGEANT	1962
LANCE	1970
PATRIOT	1976
PERSHING II	1977

*work known to have been conducted in the historic district

It is probable that Picatinny also worked on other rocket/missile systems that have not yet been identified.

Rocket/Missile Systems. As noted above, blueprints (Facilities Engineering Division nda) and Real Property files (Directorate of Public Works [DPW] nd) demonstrate that the 1500 Area was involved in the testing of various components related to numerous rocket systems. A brief explanation of the rocket/missile/system and the work performed in the 1500 Area provides an overview of the types of activities undertaken at the site.

<u>LOKI</u>. Beginning in 1946, the Army conducted research on anti-aircraft, free-flight, unguided, rocket systems based on the German *Taifun* rocket.

LOKI was first flown in 1951, but never saw service in its original role; instead, the Navy acquired them in 1955 and used them successfully as sounding rockets to measure high-altitude wind speed and direction until the mid-1960s (Bjork et al. 1957; Parsch 2005).

The solid-fuel rocket development and tests were overseen by many eyes including: Picatinny Arsenal, Redstone Arsenal, Frankford Arsenal, Watertown Arsenal, JPL, Fort Monmouth's Evans Signal Laboratory, Bendix Aviation Corporation, R. Hoe and Co., Inc., Grand Central Aircraft Cp., Thiokol Chemical Corporation, East Coast Aeronautics, Inc., Steuart-Harner Corporations, Horning-Cooper Corp., Westinghouse Electric Corp., American Machine and Foundry Co., Whitin Machine Works, the Dawns-Ratterson Corp., United Can Co., Chaffee Brothers, Philadelphia Ordnance District, Boston Ordnance District, and the New York Ordnance District (Bjork et al. 1957). Despite the number of organizations involved, Picatinny had a significant role in the development, testing and creation of LOKI.

Picatinny's first responsibility was for the technical supervision of LOKI fuze development, which was designed and developed by Eastman Kodak under Picatinny's supervision. The rocket motors also underwent extensive surveillance. Most importantly Picatinny was given the responsibility of loading and assembling the warhead with conventional high explosives. Because of production problems, Picatinny actually wound up loading and fully producing 30,000 LOKI rockets. Reports of the progress in the development of guided missiles, such as the HAWK and the NIKE AJAX, prompted the Ordnance Department to discontinue the LOKI program. It is not clear what happened to the 30,000 LOKI that had been loaded at Picatinny Arsenal (Bjork et al. 1957; Federation of American Scientists [FAS] 1999).

Despite the importance of the project, blueprints and Real Property records are not specific about which buildings were used for the LOKI project. In most cases, projects are mentioned casually, which is the case with LOKI. A notation written on Blueprint SK-5373 indicated that Building 1560 (1954), a former Assembling Building, was relocated from the LOKI area. Unfortunately, at the time of Panamerican's field investigation, the Technical Library at Picatinny had sent out all of its early historical records, such as monthly reports and gray literature (e.g., technical reports) to be digitized. It is not clear, however, that this literature would have been helpful in deciphering which activities were actually happening in particular buildings.

SAGE. The Semi-Automatic Ground Environment (SAGE) system began life in 1951 as the Lincoln Transition System, a U.S. Air Force project with the Massachusetts Institute of Technology (MIT). Completed in the early 1960s, it revolutionized air defense by integrating radar and computer technology in the aid of air defense and contributed to the development of civilian air traffic control systems. Under SAGE, incoming targets (i.e., long-range bombers, missiles) tracked by remote radar were displayed instantaneously at central SAGE command centers, along with the target's speed, direction and altitude. With this information, air defense commanders could efficiently allocate their fighters to engage enemy aircraft. The Air Force also intended to incorporate long-range, surface-to-air missiles into SAGE. The SAGE system was used to direct BOMARC missiles, which were direct competitors to the Army's NIKE program. The SAGE control centers would not be replaced until 1979 (Lonnquest and Winkler 1996).

Although blueprints mention the program within the context of the 1500 Area, it is unclear what Picatinny was doing with a rival service's missile-tracking system. It is true that in the early years of the space program all the "rocketeers" talked and shared research with each other. The field was new and workers were gleaned from many different disciplines, necessitating the transfer of ideas and knowledge. Perhaps Picatinny had expertise in an area that the Air Force needed. Nevertheless, it is not clear what buildings were involved in this activity only that it occurred in the historic district.

HONEST JOHN. A simple, free-flight rocket capable of delivering a nuclear warhead, the HONEST JOHN was a highly mobile system designed to be fired like conventional artillery in battlefield areas. The HONEST JOHN was the United States' first tactical nuclear weapon and was considered a vital part of the Army's Pentomic battlefield. The system was first deployed in 1954 and was classified obsolete in 1982 (Redstone Arsenal 2000a; Silber 1958; Combat Air Museum 2007c; Cagle 1964).

Picatinny played a significant role in the research and creation of the HONEST JOHN. The installation's primary responsibility was for the warhead and fuzing system, including the adaptation kit. The Army was optimistic that the nosecone of the HONEST JOHN could also be adapted to hold a chemical warhead, but Picatinny discounted the feasibility of a chemical warhead (Kobialka 1959; Silber 1958).

Photographs of the Rocket Test Area Historic District from 1953 showed an HONEST JOHN being moved and in test position in Static Firing Test Bay No. 2, Building 1505. The rocket was hand-carried down a covered walkway, a typical Army industrial area feature, from Building 1503, a Conditioning Building, to the static firing area. The rocket was strapped to the stand in Static Firing Test Bay No. 2, Building 1505, where it was test fired. The squares on the wall are one-foot cubes that were used in conjunction with high-speed film to determine velocity.

Building 1505 was still extant at the time of the investigation and is a Test Cell.

REDSTONE. The year 1953 proved to be a banner year for Soviet achievement in space. In August, the Soviets tested their first hydrogen bomb and, later, U.S. intelligence sources revealed that the Soviet ICBM program was well on its way to becoming a reality. The assessment was that the Soviets were well ahead of the United States in the space race, resulting in a major shift in American policy toward the development of long-range ballistic missiles. Based on the experience of the V-2 and other rockets, the Army developed the REDSTONE rocket as both a tactical ballistic missile and a space launcher. The first launch of the REDSTONE was August 20, 1953 at the Army's Cape Canaveral (Space Division, HQ 1993). After the creation of NASA, the Army REDSTONE was modified for the Mercury (MR-2 and MR-3) program and was used successfully to carry first a chimpanzee and then a man into space (Hughes 1990).

Picatinny Arsenal, Aberdeen Proving Ground, Frankford Arsenal, and Watertown Arsenal, all played a role in the development of the REDSTONE rocket. Picatinny's primary responsibilities were the development of the adaptation kit, the radio proximity fuze, and the safety and arming mechanisms. It delegated the responsibilities for developing the radio proximity fuze and safety and arming mechanisms to the Diamond Ordnance Facility (Bullard 1965). It is not clear what type of warhead Picatinny was adapting for the REDSTONE, but it could have run the gamut from nuclear to chemical to some type of exotic hybrid high explosive (HE). Although blueprints and Real Property files reveal that work on the REDSTONE was completed in the historic district, it is not clear which specific buildings were involved.

NIKE AJAX. Developed by the Army as the world's first surface-to-air missile (SAM), the NIKE AJAX was rushed into production and deployed in battery systems around key urban, military, and industrial locations in 1954. By 1958, the Army had deployed nearly 200 NIKE AJAX batteries in these locations. Soon after, they were deactivated and replaced with the next generation NIKE HERCULES missile, which had a longer range and was nuclear-capable (Combat Air Museum 2007a).

The key contractor for the NIKE AJAX project was Western Electric, but Picatinny played an essential role in its production. The arsenal was chosen to develop the HE fragmentation device that would be placed in the warhead. The warhead was actually three HE fragmentation warheads mounted in the nose, center and rear of the missile body. Although consideration was given to arming the NIKE AJAX with a nuclear warhead, this aspect of the project was canceled in favor of developing a new and improved missile, the NIKE HERCULES (Air Combat Museum 2007a; Bender 2004; Cagle 1973). The NIKE AJAX system is mentioned in the blueprints and Real Property files within the context of the Rocket Test Area Historic District, but not specifically related to any particular building.

SHILLELAGH*.* An antiarmor missile system, the SHILLELAGH evolved from a requirement in 1958 for the development of weapon systems for use in combat vehicles for the "Pentomic" and future armies. The complete, combat-vehicle weapon system consisted of a SHILLELAGH direct-fire guided missile, a 152mm gun/launcher, conventional ammunition, and guidance-fired control subsystems. The SHILLELAGH was the primary armament on the M551 Sheridan Armored Reconnaissance/Airborne Assault Vehicle and M60A2 Main Battle Tank. SHILLELAGH was first deployed in 1959 (Delong et al. 1984; Bacevich 1986).

This Pentomic weapon system included work by Picatinny Arsenal, Frankford Arsenal, Redstone Arsenal, the Ballistic Research Laboratories, Watervliet Arsenal, White Sands Missile Range, the Signal Corps, Ford Motor Company, Aeronautic Division, and Raytheon. Picatinny was responsible for the warhead and fuze-system development, motor propellant and igniter development, and gas generator propellant and igniter development.

Picatinny also was responsible for providing a propellant grain and igniter, which met the ballistic requirements for the missile within existing limitations and, most importantly, was compatible with the missile-guidance system. The guidance component required that the exhaust plume of the rocket motor not interfere with the transmission of infrared signals within the plume. These specifications posed severe limitations on propellant composition. After a thorough analysis of the types of solid propellants available, Picatinny selected a double-base type that was essentially smokeless at relatively low flame temperatures, which solved the problem (DeLong et al. 1984). Historical photographs reveal that various components of the SHILLELAGH were tested in the historic district. In particular, the SHILLELAGH's closed, breach-launch simulator was tested in Building 1505A, a Test Cell, which is extant and still used for testing.

PERSHING I. A solid-fuel, two-stage medium-range ballistic missile, the PERSHING I was designed and built by the Martin Marietta Company to replace the REDSTONE missile as the Army's primary theater-level weapon. It was named for General John J. Pershing and had its first test firing in 1960. The warhead could be a conventional explosive or a W50 nuclear warhead, yielding 400 kilotons of TNT. The PERSHING I firing platoon consisted of four M747 tracked-vehicles, while the REDSTONE needed twenty vehicles (Redstone Arsenal 2007).

The warhead for the PERSHING I was developed at Picatinny (Lonnquest and Winkler 1996) and components of the motor were tested there as well. In what is now Building 1505A (it was then identified as Static Firing Test Bay No. 4), the PERSHING underwent static spin testing. Building 1505A was extant at the time of the current investigation and was used for testing.

As noted, Picatinny also developed warheads for the CORPORAL, LACROSSE, NIKE HERCULES, HAWK, LITTLE JOHN, SERGEANT, PARTIOT, LANCE and PERSHING II missiles (Lonnquest and Winkler 1996). The LITTLE JOHN (also written as LITTLEJOHN) was the smallest nuclear-capable rocket the U.S. Army ever deployed. It was an air-transportable, unguided artillery rocket powered by an XM26 solid-fuel rocket motor and could be armed with either a conventional or nuclear warhead (Parsch 2002). The LANCE system was also a nuclear-capable system that could also be adapted with a conventional warhead. It was a field-mobile artillery missile system designed to attack key enemy targets beyond the range of cannon artillery and to reinforce the fire of other artillery units. The LANCE replaced the HONEST JOHN system. As can be surmised by the significant amount of nuclear work completed at Picatinny, the arsenal was considered a part of the U.S. Nuclear Weapons Complex (NWC) until well into the 1970s (Loeber 2002).

Activities occurring in the Rocket Test Area Historic District played a significant part of the United States' and the Army's initial forays into space. Picatinny served in key roles for some of the most important rocket programs and missile systems that were ever devised, including those programs that involved the adaptation of rockets to accommodate nuclear warheads. These rockets include the HONEST JOHN, REDSTONE, LITTLE JOHN and NIKE AJAX.

The construction dates of the buildings within the Rocket Test Area span a broad spectrum from 1946 to 1980, all of which fall within the Cold War period, 1946-1989. According to Army Cold War Guidelines (USACE, Fort Worth 1997) for deciding building/structure significance, the determination of significance is made only after a resource is shown to be important to one or more of the Army Cold War Themes. The Rocket Test Area meets two of the Army's broad themes—Technological Imperative, and Survival and Preparation for a Hot War. Specific Army themes that the area meets include: Mission Focus, Technology, and Militarization of Space.

These buildings were used to meet a perceived Soviet military threat and to influence Soviet objectives and policy through the development of rockets and missile systems that could and would militarize space or change the traditional battlefield into a nuclear one. The implied or actual use of nuclear war materiel is considered one of the most significant aspects of the Cold War (USACE, Fort Worth 1997). Certainly, the Rocket Test Area meets these criteria.

The Rocket Test Area Historic District, the 1500 Area, is eligible as a district for the National Register of Historic Places under Criterion A, contributing the broad patterns of history, and Criterion C, architectural/engineering features, as well as satisfying Criteria Consideration G, a property achieving significance within the past 50 years that is of exceptional importance. The buildings contributing to this district are:

1500 (1947)	Water Tower
1501 (1948)	Office
1502 (1948)	Ordnance Facility

1503 (1948/1956)	Conditioning Building
1504 (1956)	Storage
1504A (1948)	Conditioning Building
1505 (1948/1956)	Test Cell
1505A (1948)	Test Cell
1505B (1948)	Test Cell
1505C (1958)	Control House
1505D (1951	Test Cell
1505E (1966)	Control Spin Room
1505F (1959)	Storage
1505N (1948)	Open Blast Area
1506 (1954)	Loading Facility
1507 (1946)	HE Magazine
1507B (1959)	Storage
1508 (1955)	HE Magazine
1509 (1950)	Test Facility
1510 (1950/1967)	Pyrotechnic Building
1510A (1947)	Storage
1510B (1948)	General Storage
1511 (1952)	Neutralizing and Pump Station
1512 (1956)	Chemistry Laboratory
1512A (1958)	Flammable Material Storage
1513 (1968)	Pyrotechnic R&D Laboratories
1514 (1968)	Pyrotechnic R&D Laboratories
1515 (1961)	Physics Laboratory
1517 (1956)	High Altitude Test
1517A (1963)	Electric Equipment Facility
1519 (1956)	HE Magazine
1520 (1956)	HE Magazine
1521 (1960)	Component Propellant Building
1522 (1970)	Ordnance Facility

On the whole, these buildings have integrity and it is clear that they form testing/plant areas. The period of significance is 1946-1989, the Cold War.

Non-contributing buildings include:

1505J (1960)	Storage (truck trailer)
1505K (found on post)	Storage (truck trailer)
1518 (1958)	General Purpose Instrument Storage (derelict, has no integrity)

1527 (1960)	Barricade (derelict, has no integrity)
1528 (1963)	Barricade (derelict, has no integrity)
1529 (1964)	Warehouse
1530 (1990s)	Administration Building (constructed after period of significance)

5. Building 1510: Although the 1500 Area is traditionally divided into the eastern and the western sections, the area really consists of three distinct building groupings: Extreme Environment Testing Area, Testing Area, and the Storage and Laboratory Area. All of the 1500 Area, the Rocket Test Area Historic District, is enclosed within a chain-link fence. The Testing Area and portions of the Storage and Laboratory Area are also within chain-link fences.

The Storage and Laboratory Area is located off Hart Road and includes Building 1510, originally a Pyrotechnic R&D Laboratory. In fact, during the late 1950s and early 1960s, this area of the district was known as the Pyrotechnics Laboratory and is squarely into the eastern, Pyrotechnics Division. Picatinny had long been known for its pyrotechnics work with conventional weapons, so pyrotechnics related to rockets was a natural undertaking.

Building 1510 (Pyrotechnic R&D Laboratory), Building 1510B (General Storage Building), and 1501 (Office) are grouped together behind a chain-link fence that was erected in 1966 (DPW nd). Portions of the fence are now missing and blueprints are unclear as to why these specific buildings were grouped together behind one fence. Traditionally, Building 1501 is grouped with the Testing Area as its Administrative Office Space. Generally, when buildings are placed behind a fence, or “enclosed” as it is called at Picatinny, it is because the work conducted within them is dangerous or secret. Although the changes to the building are enumerated Part I, A 4, it is not known whether any of the projects occurring within the building were dangerous or secret or both. Certainly, the Cold War (1946-1989) and rocket activities during that period were most times classified, so it is possible that mission work conducted here was secret as well as dangerous.

The Pyrotechnic R&D Laboratory, Building 1510, is in the Army’s interpretation of the 1950s Contemporary Style. American and international architectural and engineering trends have influenced the construction of military buildings. The age of many military installations is readily apparent by the architectural styles (or lack thereof) found on them. Individuals designing for the military had received the same schooling as their civilian peers and were familiar with current design trends. Many of the Army's early engineers also served as architects incorporating engineering innovations into structures they designed. The Army's early buildings were grand piles incorporating the latest in materials and design even the most mundane structures featured fine details, such as corbelling, arched windows, and quoining.

The glory days of Army architecture did not last long. By the early twentieth century, the Army, always strapped for cash, began to entertain the idea of creating and using standardized building designs. Standardized designs would solve a multitude of problems. One individual could design a building for a certain activity, and decide the materials to be used and their precise measurements, thereby saving money in design, purchasing and construction phases. Moreover, a standardized look would be created for all Army installations, which would adhere to current regulations and doctrine. Individuality in design was not an important factor, getting the most bang for the least amount of buck was the overriding factor.

One of the first standardized buildings developed by the Army was the barracks, a fundamental part of most installations. The subsequent World War I barracks were part of what was known as the 600 series of standardized plans. By the mid-1930s, just in time for the mobilization period for World War II, the Army created the 700 series of standardized plans that included everything from barracks, to chapels, hospitals, athletic fields, warehouses, magazines, movie theaters, office spaces, and flag poles. These plans incorporated the Army's basic needs with modern innovations in order to recruit, and train vast numbers of soldiers. The 700 series included such innovations as indoor plumbing and heating but were sorely lacking in any real architectural details.

In the private sector the cost of building materials was not necessarily a prohibiting factor. The military, however, was always concerned about expenses and sought ways to keep costs down, employing less expensive materials that could be substituted for more expensive ones. Architectural design fell prey to cost cutting. A modern, efficient barracks did not need to have a classical design, in fact it needed no particular design since the maxim, form follows function, had been introduced into architectural language. The Army's World War II buildings were utilitarian to the extreme. Some more public structures, such as the headquarters or commanding-officer's quarters were created in what is now called the Stripped Classical Style. The basic classical architectural vocabulary was used but stripped of all unnecessary ornamentation, lending an austere, formal feeling to the buildings.

During the first period between World War I and the early 1930s, the Army had constructed some quite lovely vernacular buildings with pretensions to high style. A host of building materials, roof styles and materials, and designs were introduced onto Army posts. However, the constraints of the Depression and the specter of World War II undermined the Army's desire for anything but the most efficient and cost conscious buildings possible. The Army built thousands of these utilitarian buildings on every installation in the United States and in various overseas war theaters.

At the end of World War II, every military installation, not just the Army's, was awash in utilitarian structures. The *Sturm und Drang* of the World War II and the early Cold War period convinced the political establishment that a large standing force was necessary for the safety of the United States. While these buildings of World War II could continue to accommodate many aspects of military training and the standing force, more modern, efficient buildings needed to be constructed. The war had stimulated the creation of a host of new building materials and construction ideas that could be easily and cheaply adapted for military use. In addition, civilian architectural styles themselves had undergone great changes, seeking a more modern, clean look without the burden of a classical architectural vocabulary. The Modernist designs of the time became a symbol of the new political order (Rifkind 1998).

The United States took up this Modernist banner when it undertook a massive embassy-building program that incorporated the designs of Ralph Rapson, Eero Saarinen, and Edward Durrell Stone, masters of the Modernist idiom. However, at home, other public servants were more concerned with efficiency and economy than esthetics, and typically produced more cautious buildings that ranged from the truly utilitarian to cautiously Modernistic. American public schools were the buildings most reflective of the Modernist style. Most parents of the post-war decades saw these school designs as reflecting progress, while providing flexibility and economy (Rifkind 1998).

Although most Americans wanted a more traditional house design, many others abandoned traditional styles in favor of variations of the Modernistic Style. Minimal traditional, ranch, split-level, contemporary, and shed styles abounded. The Contemporary Style, a product of the 1950s that found favor into the early 1970s, eschewed traditional form and detail and was a particular favorite in architect-designed homes of the period (McAlester and McAlester 1984). These generally asymmetrical, flat-roofed houses with wide hanging eaves, contrasting wall material, and unusual window placements and sizes were for the more refined house buyer.

The Army standardized designs of the 1950s most closely resemble the Contemporary style. Since this style does not rely on traditional architectural forms and incorporates many cost-conscious construction techniques, it was particularity suitable for standardization by the Army. The design lends itself to asymmetry and flexibility, enabling Army architects to create buildings for almost any space imaginable. The 1950s Contemporary style resembled the International style in having flat roofs and no decorative detail, but lacked the stark, white stucco surfaces of the International, instead choosing combinations of wood, masonry and stone (McAlester and McAlester 1984). In the case of the Army, the building material of choice was the concrete block. Concrete block is cheap, has superior tensile strength, and provides great flexibility in its use. During World War II, the Army had been partial to hollow clay tiles, which had many of the same features as concrete block, which created a familiarity with hollow supporting units.

The majority of the buildings within the Rocket Test Area Historic District have Contemporary style touches—asymmetry, flat roofs, and wide overhanging eaves. Building 1510, however, is clearly in the Contemporary style.

<u>PART II. ARCHITECTURAL INFORMATION</u>

A. General Statement:

1. Architectural character: The Pyrotechnic R&D Laboratory, Building 1510, is an example of Army 1950s Contemporary style. It is the only building within the Rocket Test Area Historic District that has some pretension to style.

2. Condition of fabric: Poor. The hollow tiles on the front (north) side of the building have begun to spall in several places, especially on the eastern-most corner. The roof, particularly on the addition, leaks severely. The building is scheduled for demolition.

B. Description of Exterior:

1. Overall dimensions: The structure measures approximately 110’-0” x 65’-0”. It is one story without a basement. The main façade (north side) is on Hart Road within the 1500 Area, Rocket Test Area Historic District, Picatinny, New Jersey. In typical Contemporary style, the primary entry is offset on the western-most side of the front façade with a single ribbon-row of windows filling the remainder of the side.

2. Foundations: The foundations of both the original building and the addition are concrete.

3. Walls: The original walls are yellow, low gloss, glazed, hollow tile, which is a common building material at Picatinny and within the Army. The rear (south) addition is concrete block, also a common building material. The wide over-hanging fascia is covered in ripple-textured aluminum that retains its silver color. The soffit of the fascia is white stucco. The fascia and the soffit are the same around the addition.

4. Structural systems, framing: Walls are self-supporting hollow clay tile in the original building and self-supporting concrete block in the addition. The roof is wood framed with plywood sheets supporting a built-up gravel and tar barrier. The floor is concrete covered with asphalt tile.

5. Openings:

a. Doorways and doors: The Pyrotechnic R&D Laboratory, Building 1510, has five doors. On the front or north, there is one metal door with an upper opaque glass light. The door itself is located on the western-most end of the front façade. On the rear or south façade, there are no doors. On the east façade, there are two sets of doors. The first set is a pair of metal doors with upper off-set, opaque glass lights. These doors are situated on the northern-most end of the east façade. On the interior, these doors have screen doors. A second metal door is located on the eastern side, where the original building and the addition meet. This door is metal with an upper opaque glass light. The west façade is the site of the only vehicular door, a single, rolling metal garage door with two lozenge-shaped lights. This door is located toward the south end of the west side of the addition. A single, solid metal door is also found on the west side of the addition toward the south side, tucked under the roof overhang that serves as a type of protection.

b. Windows: The north (front), south (rear), and west facades of the building are marked by ribbon rows of windows. These continuous window banks share a common concrete sill and extend up to the edge of the roofline. The three-part vertical windows themselves are placed within brown metal panels and are sometimes grouped in threes, in twos or singly. From the outside, all of the bottom sections of the three-part windows have screens, which are brown to match the surrounding panels.

From the interior, the lower section of the window opens hopper style. The middle section of the window is fixed, and the upper section features sliding panels. The panels slide from the center of the window to each side. Small screens are mounted on the lower inside portion of the upper window so that the sliding panels may be opened without insect problems. The brown metal panels that surround the windows can also be seen from the interior.

6. Roof: The roof is built-up with gravel and tar with a very slight gable, less than 25 percent. The rear addition, which is also built-up gravel and tar, also has a slight gable, less than 25 percent. Where the edges of the original building's roof and the addition's roof meet, there is a slight valley that accounts for the meeting of the edges of each gable.

7. Gutters and drains: A built-in drain is in place where the original roof meets the addition roof in the valley formed by the two slopes. Today that gutter is filled with vegetation of all types. It is not clear how successful the drain was since the rear addition has a severe leak that runs the full width of the addition about two feet back from where the addition meets the original building. Placed along the front, north, and rear, south, fascia of the building are aluminum drains that feed into downspouts that open onto splash blocks.

C. Description of the Interior:

1. Floor plans: The original floor plans and the floor plans for the addition are included in the attached photographs. Initially, the building was divided into several different spaces with steel partitions. The only "permanent" spaces were men's and women's bathrooms and a large open space on the eastern end of the building. These spaces were created using hollow tile walls (Picatinny 1963). When the addition was made, it was one large room and appears to have been destined for offices (Rouse, Dubin & Ventura 1967). However, the addition was used for a number of activities, including a machine shop and a laboratory. At one time, the addition was divided into three rooms, and later two rooms (Picatinny 1977; Energetics Test Range 1987).

At the time of the investigation, the interior is like that of the original plan, even though several smaller rooms have been created in wallboard. There are three large open spaces, two in the original building—one on the western end that is filled with metal, fixed partitions for offices, and one on the eastern end that appears to have been used as a shop. The third open space is the addition; the south wall of which is now lined with tables that hold various types of outdated laboratory equipment.

The building has been abandoned and is full of old desks, paper, books, memo boards, and broken or outdated pieces of equipment.

2. Flooring: In the original building, the original asphalt tile is in place. In the addition, single unit, stick-in-place, tiles are scattered about, some of which are still stuck in place. It is not clear if the tiles are asphalt or vinyl.

3. Wall and ceiling finish: In the original building the walls are primarily hollow clay tile. The only walls that are not tile are those in the rooms that were enclosed later. The walls in the addition are concrete block. The ceiling is a combination of acoustic tile and plaster.

4. Mechanical Equipment: All of the buildings within the Rocket Test Area Historic District were originally tied to each other through an aboveground steam system that still exists. All buildings originally shared (and still do) water from the Area 1500 Water Tower, Building 1500, which is directly across the street, north, of Building 1510. Internal mechanical systems specifically for the building can be found in the large storage room/machine shop at the eastern end of the original building. There are a number of single-circuit electrical outlets throughout the building so that large pieces of equipment can be run on that single circuit. As is typical of military construction, electrical conduits, water and other piping is exposed along wall surfaces.

5. Light fixtures: The building is predominantly lighted by enormous banks of hanging florescent lights. The lighting does not seem to have a true reason for being because it was installed before the current building interior configuration and was never changed to accommodate it. There are some lights in explosion cages, particularly in the back storage areas, but, by and large, the fixtures are hanging fluorescents.

D. Site:

Pyrotechnic R&D Laboratory, Building 1510, is located on Hart Road in the Storage and Laboratory Area of the Rocket Test Area Historic District, the 1500 Area, the whole of which is enclosed by a chain-link fence. At one point, the building and several others were enclosed by an additional fence. Only a small portion of the original fence remains across the front (north) of the building.

A concrete sidewalk extends across the front or north side of the building and angles around the east side of the building. It is also connected to Building 1510B, a storage building on that same side. The sidewalk passes by, but is not connected to, a square concrete pad that lies between Building 1510 and Building 1510B. The sidewalk, which terminates at the front entry of Building 1510, begins to the east in a parking lot.

The properties surrounding Building 1510 include, on the west, a yard with trees and Building 1501, an office building, and, immediately to the east, Building 1510B, a square concrete pad with no number, and an open grassy expanse that terminates in a parking lot. To the north there is a sidewalk and a grassy front yard that terminates in Hart Road. Across the road are a parking lot and a Water Tower, Building 1500. To the north of the building lies a wooded area that separates it from a number of pyrotechnic magazines. The wooded area serves as a type of blast protection and helps delineate use areas within the 1500 Area.

The Rocket Test Area Historic District within which the building lies is a 20-acre site located off Lake Denmark Road and the installation proper. As noted, the area is divided into two parts, the western Explosives Area and the eastern Pyrotechnics Area. The western area was constructed from the late 1940s through the 1960s and the eastern section from the early 1950s to the late 1950s. Although the area is generally divided into two parts, there are actually three distinct groupings of buildings: Extreme Environment Testing Area, Testing Area, and the Storage and Laboratory Area. The 1500 Area is currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (Picatinny 2006).

The boundary of the 1500 Area, Rocket Test Area Historic District, begins at Lake Denmark Road on the west and extends easterly behind Buildings 1519 and 1520 to Building 1530 north of Hart Road. The boundary turns south and extends to encompass Buildings 1511, 1515 and 1513, east of Sage Place. From Building 1513, the boundary turns west and runs behind the buildings along the south side of Hart Road to the end of the chain-link fence, where the boundary turns north and extends to Hart Road. The boundary continues westerly along Hart Road to Lake Denmark Road (Nolte et al. 2007).

The area at the time of the investigation was mostly overgrown with vegetation and run down. Some of the buildings and structures are on the verge of being derelict. The majority of buildings/structures within the area were built in the 1950s and 1960s. Nevertheless, the whole area is still in an enclosure and still a work site for a number of scientists and pyrotechnicians.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings: The Directorate of Public Works (DPW), Picatinny, has a collection of blueprints related to Building 1510, a number of which are photographed and used in this document or are used as bibliographic references. These blueprints are easily accessed through the Picatinny Cultural Resource Manager and DPW.

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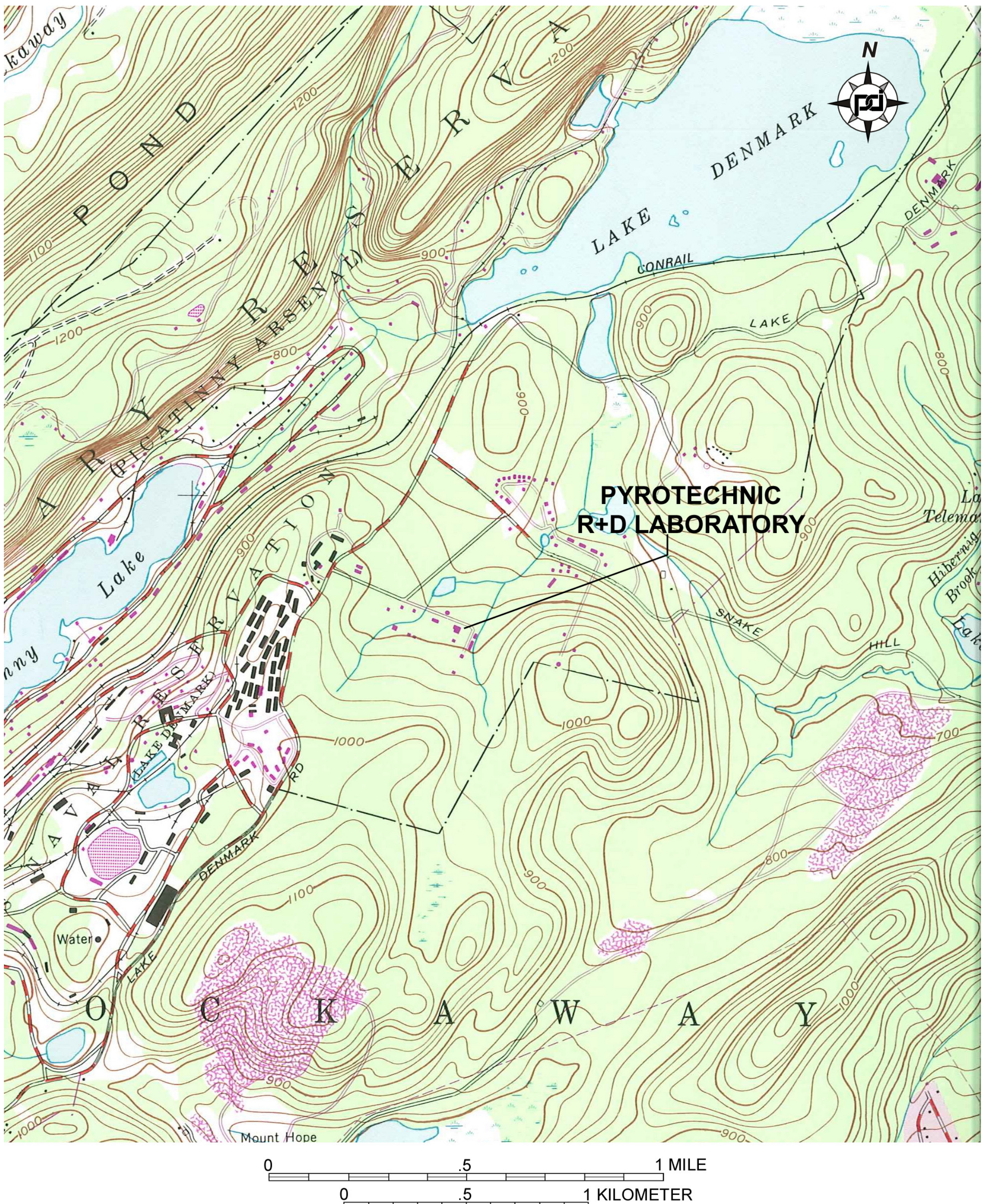
C. **Supplemental material:** Black-and-white 35mm photographs of exterior and interior views of Pyrotechnic R&D Laboratory, Building 1510, taken by Ms. Kelly Nolte, Director Architectural History Division, Panamerican Consultants, Inc.

PART IV. PROJECT INFORMATION

The Pyrotechnic R&D Laboratory, Building 1510, was recorded in August 2008 by Ms. Kelly Nolte, Director, Architectural History Division, Panamerican

Consultants, Inc., Mr. Mark Drumlevitch, Photographer, Panamerican, and Mr. Mark A. Steinback, Panamerican. Ms. Nolte conducted the field work, the historic research, and wrote the report. She also was responsible for the supplementary 35mm photography. Mr. Drumlevitch was responsible for all the large-format photography. Mr. Steinback also conducted historic research and wrote a portion of the report. The report was prepared under the supervision of Mr. Steinback. Dr. Michael A. Cinquino, Panamerican, was the Project Director.

The project could not have been completed without the help of many people at Picatinny. They include: Mr. Jason Huggan, Cultural Resources Manager; Mr. Jack Lyons, Real Property Specialist; Mr. Ken Klingamen, Test and Evaluation Engineer, 1500 Area; Mr. Russell Broad, Lead Technical Expert for Pyrotechnics, 1500 Area; Dr. Patrick Owens, Historian/Archivist; and a host of military police. Mr. Daniel Saunders at the New Jersey Historic Preservation Office, Trenton, was also helpful.



Location of the Pyrotechnic R&D Laboratory (Building 1510), shown on a topographic map (USGS 7.5' Quadrangle, Dover 1954 [photorevised 1981]).

HISTORIC AMERICAN BUILDINGS SURVEY

INDEX TO PHOTOGRAPHS

PYROTECHNIC R&D LABORATORY **HABS No. NJ-XXX**
(Building 1510)
South side of Hart Road, east of intersection
of Hart Road and Lake Denmark Road
Rocket Test Area Historic District
Area 1500
Picatinny
Morris County
New Jersey

Mark Drumlevitch, Panamerican Consultants, Inc, Photographer August 2008

NJ-XXX-1 VIEW OF EAST SIDE OF BUILDING 1510, LOOKING WEST. NOTE BUILDING 1510B IN THE PHOTOGRAPH.

NJ-XXX-2 OBLIQUE VIEW OF NORTH, FRONT, SIDE OF BUILDING 1510, LOOKING WEST. NOTE BUILDING 1501 IN THE RIGHT MIDDLE BACKGROUND.

NJ-XXX-3 OBLIQUE VIEW OF SOUTH, REAR, ADDITION TO BUILDING 1510, LOOKING NORTHEAST.

NJ-XXX-4 VIEW OF SOUTH, REAR, ORIGINAL WING OF BUILDING 1510 AND PORTION OF REAR ADDITION, LOOKING NORTHEAST.

NJ-XXX-5 OBLIQUE VIEW OF WEST SIDE OF 1510, LOOKING NORTHEAST. NOTE BUILDING 1530 IN THE RIGHT BACKGROUND.

NJ-XXX-6 OBLIQUE VIEW OF WEST SIDE OF 1510, LOOKING NORTHEAST.

NJ-XXX-7 VIEW OF LANDSCAPE CONTEXT FOR BUILDINGS 1510 AND 1510B, LOOKING NORTHWESTERLY. NOTE BUILDING 1501 IN THE BACKGROUND TO THE CENTER RIGHT OF BUILDING 1510, TREES THAT SERVE AS BLAST AND AREA BREAKS, SECURITY FENCING, AND ACCESS ROAD.

NJ-XXX-8 INTERIOR VIEW OF BUILDING 1510 SHOWING CUBICALS AND ROOMS, LOOKING EAST DOWN PRIMARY HALLWAY.

NJ-XXX-9 INTERIOR VIEW OF ADDITION ROOM IN REAR OF BUILDING 1510, WHICH IS NOW USED FOR STORAGE, LOOKING SOUTHWEST.

NJ-XXX-10 INTERIOR VIEW OF ORIGINAL STORAGE ROOM, BUILDING 1510, NOW USED FOR GENERAL STORAGE.

NJ-XXX-11 RECORD DRAWING, BUILDING NO. 1510, PYROTECHNICS LABORATORY FLOOR PLAN [BLUEPRINT], FEBRUARY 18, 1963, DIRECTORATE OF PUBLIC WORKS, PICATINNY ARSENAL, NEW JERSEY.

NJ-XXX-12 BUILDING NO. 1510, FLAME/INCENDIARY & PROPS & STABILITY – INTERIM LOCATION CONSTRUCTION PLAN [BLUEPRINT], OCTOBER 4, 1977, DIRECTORATE OF PUBLIC WORKS, PICATINNY ARSENAL, NEW JERSEY.

NJ-XXX-13 PICATINNY ARSENAL, PYROTECHNIC R&D LABORATORIES, BULDING 1510 – ALTERATION & ADDITION, PLANS, SECTIONS & ELEVATIONS, ARCHITECTURAL [BLUEPRINT], MAY 2, 1967, ROUSE, DUBIN & VENTURA, DIRECTORATE OF PUBLIC WORKS, PICATINNY ARSENAL, NEW JERSEY.

HISTORIC AMERICAN BUILDINGS SURVEY

INDEX TO SUPPLEMENTAL MATERIAL

PYROTECHNIC R&D LABORATORY **HABS No. NJ-XXX**

(Building 1510)
South side of Hart Road, east of intersection
of Hart Road and Lake Denmark Road
Rocket Test Area Historic District
Area 1500
Picatinny
Morris County
New Jersey

SUPPLEMENTAL MATERIAL
35mm Black-and-White Photographs

Kelly Nolte, Panamerican Consultants, Inc., Photographer August 2008

1. East side of Pyrotechnic R&D Laboratory looking southwest. Note aboveground steam pipe that feeds the entire Rocket Test Area Historic District.

2. Oblique view of front, north side, of Pyrotechnic R&D Laboratory, with east side in view, looking west. Note Building 1501, office, in the right middle background.

3. West side of the Pyrotechnic R&D Laboratory looking east, showing the original building and the addition. Note heavy tree growth to the south, rear, that separates the building from pyrotechnics magazines serving as blast wall.

4. Full view of west side of original Pyrotechnic R&D Laboratory, looking east.

5. West side of Pyrotechnic R&D Laboratory addition, looking northeast.

6. South, rear, of Pyrotechnic R&D Laboratory addition looking northeast. Note heavy tree growth that separates the building from pyrotechnics magazines serving as blast wall.

7. South, rear, of Pyrotechnic R&D Laboratory original building with portions of the addition showing looking north.

8. Interior view Pyrotechnic R&D Laboratory showing open space with metal fixed cubicles looking west down hall. Note the banks of florescent lights, exposed piping, the concrete block wall of the addition to the left and the room that has been created with wall board in the center background.

9. Interior view Pyrotechnic R&D Laboratory down hallway looking west, note the concrete block area to the right, which is the bathrooms, the tiled area to the left that opens into a large space which seems to have served as a machine/storage area, and the half-framed wall that was never finished. Note the many exposed pipes, wires, and electrical boxes.

10. Interior view of three-part window. Note the acoustical tile ceiling.

11. Small room created on the north side of the Pyrotechnic R&D Laboratory. Note that the wallboard does not perfectly divide the window. Also note the hanging banks of fluorescent lights, the smooth plastered ceiling, the exposed air duct, asphalt tile, and heaters. The equipment in the room appears to be junk.

12. Another view of the same small room showing the door and framing. Note the black boards on the wall. Many of the black boards were still filled with various formulas and information related to projects.

13. View into Room 4, Pyrotechnic R&D Laboratory. Some of the rooms were marked, but most were not. This room was so small it was virtually impossible to enter and take pictures.

14. Another small room looking west into the larger cubical filled room. Note the numerous metal lockers.

15. View into a small room that was originally created as a permanent space within the original Pyrotechnic R&D Laboratory. A sign left from the last occupation identifies the room as “Hazardous Storage Area.”

16. Men’s bathroom located on the north side of the building.

17. Men’s bathroom with shower stall.

18. Men’s bathroom with toilet stall.

19. Interior view of machine/storage room at eastern end of Pyrotechnic R&D Laboratory, looking northeast. Note double doors that open to the side of the building and the sprinkler heads in the ceiling.

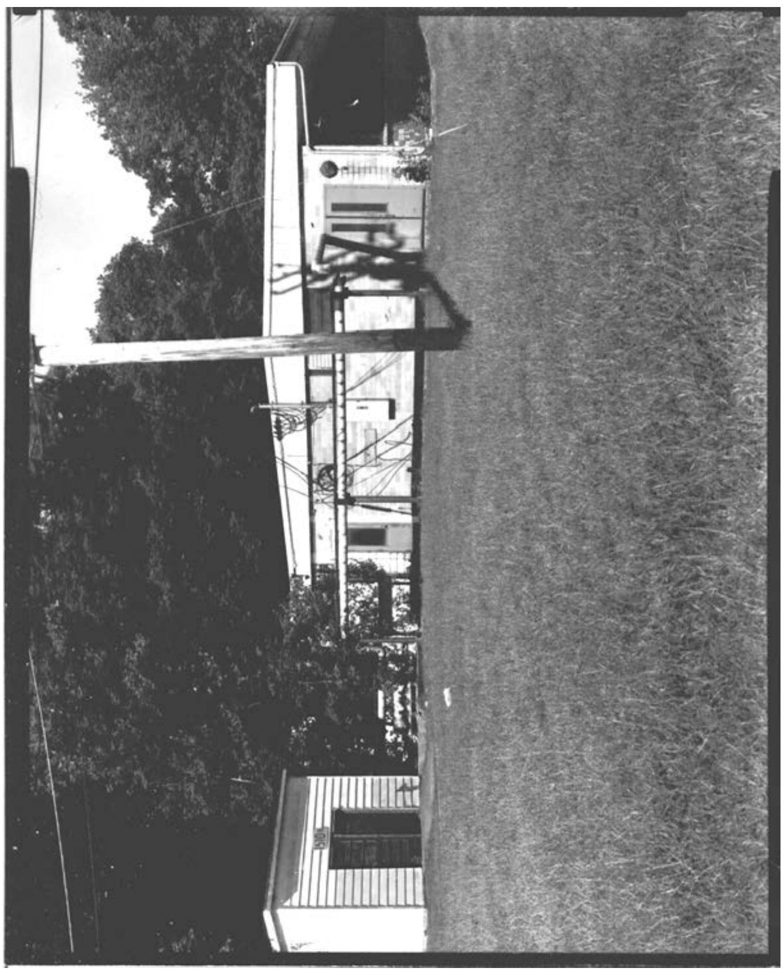
20. Interior view of machine/storage room at eastern end of Pyrotechnic R&D Laboratory, looking northeast. Note the upper wall mounted electrical heater, the exposed piping and the double doors have screens.

21. Interior view of east wall of addition, looking east. Note the large holes in the acoustical tile where the roof has leaked and the resulting problems on the floor. Also note the large blackboard on the east wall as well as the exit.

22. Interior view of the addition, looking west. Note the windows in the left of the photograph, the open ceiling tiles where the roof has leaked, and general mess of the room.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-1



HISTORIC AMERICAN BUILDINGS SURVEY
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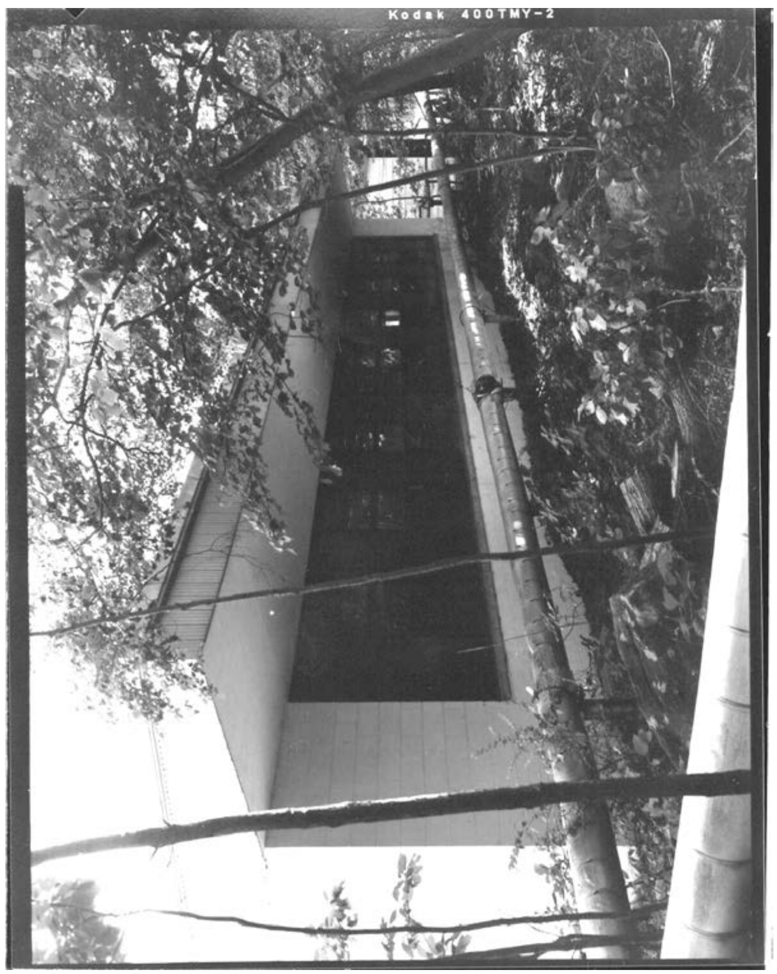
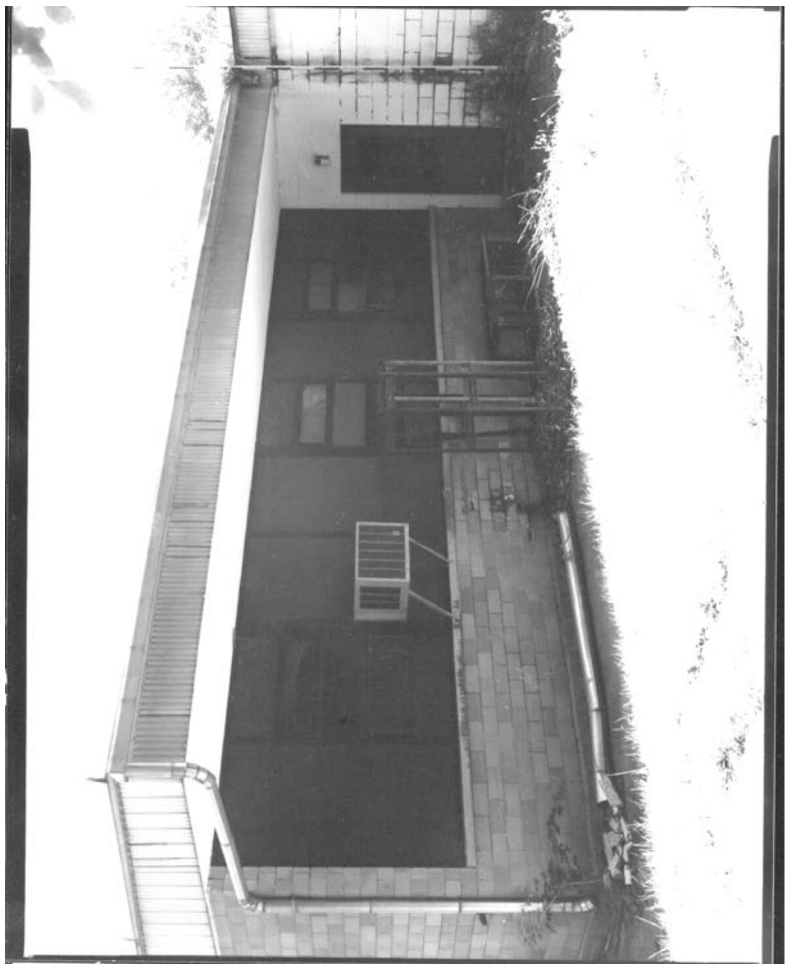
HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-3



HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-4



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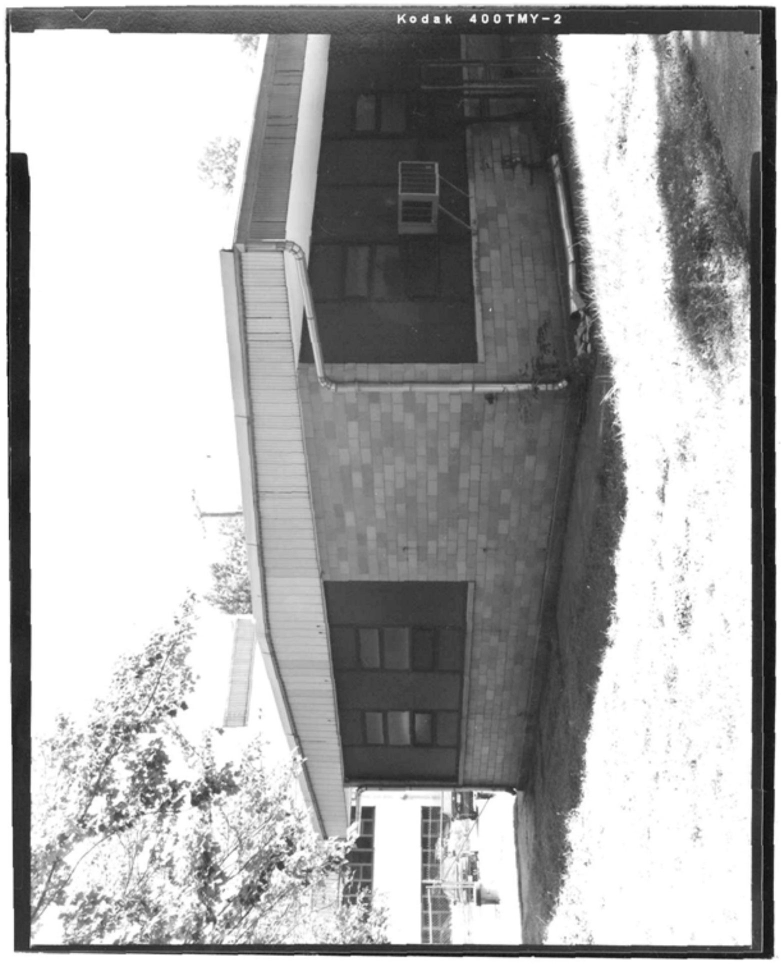

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

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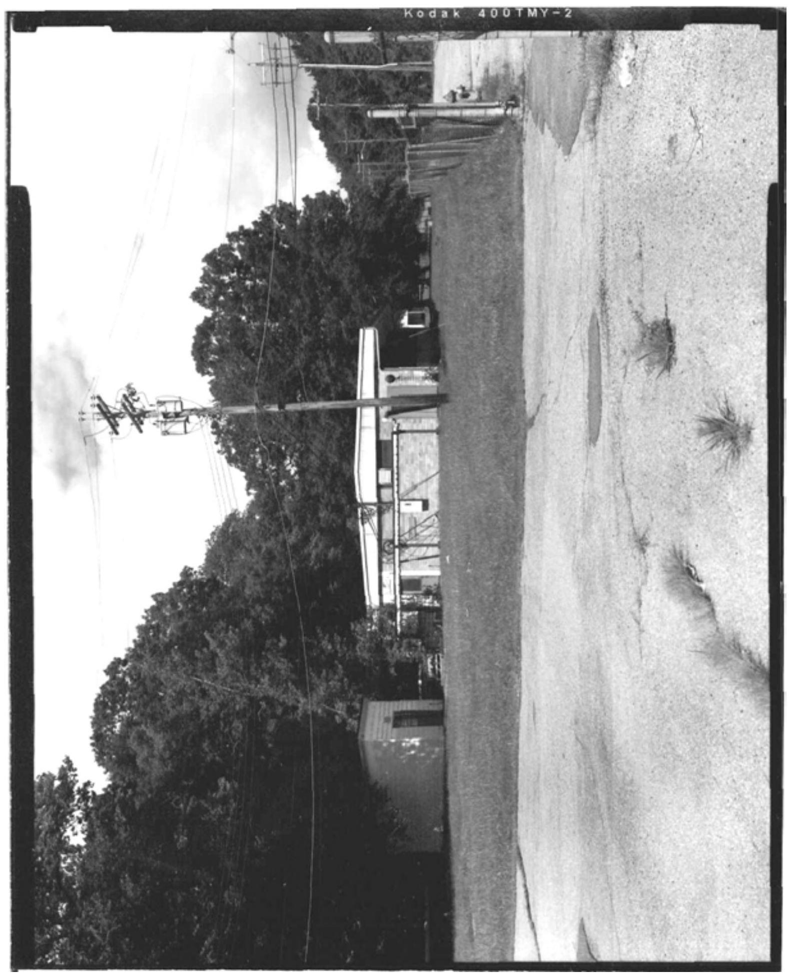

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HABS No. NJ-XXX-8

HISTORIC AMERICAN BUILDINGS SURVEY
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HABS No. NJ-XXX-9

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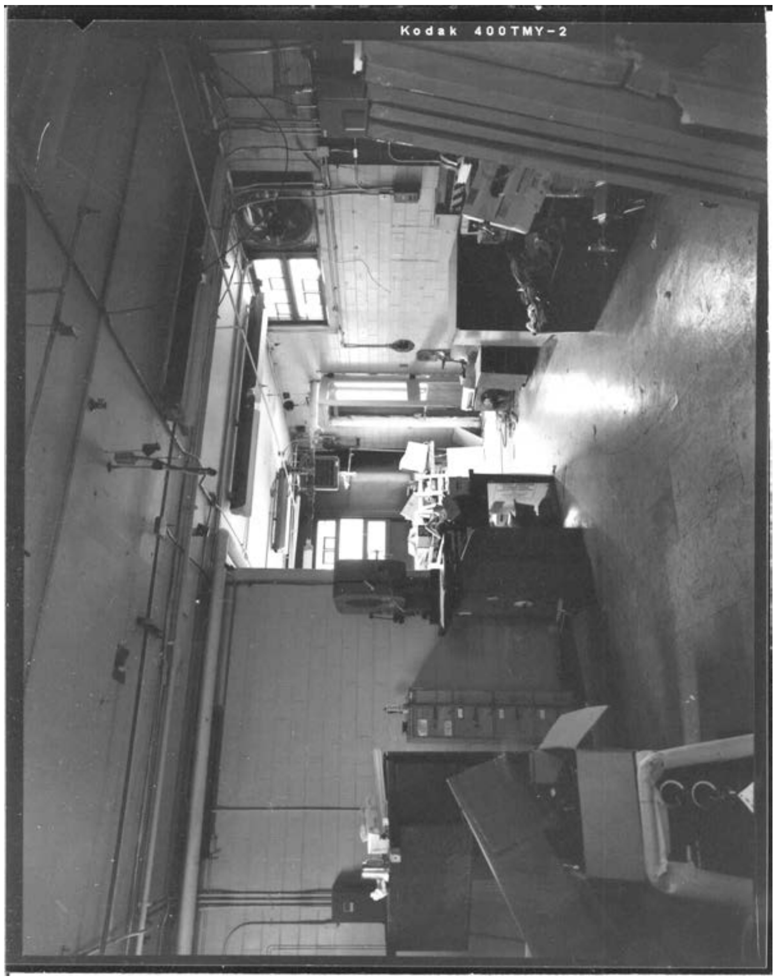

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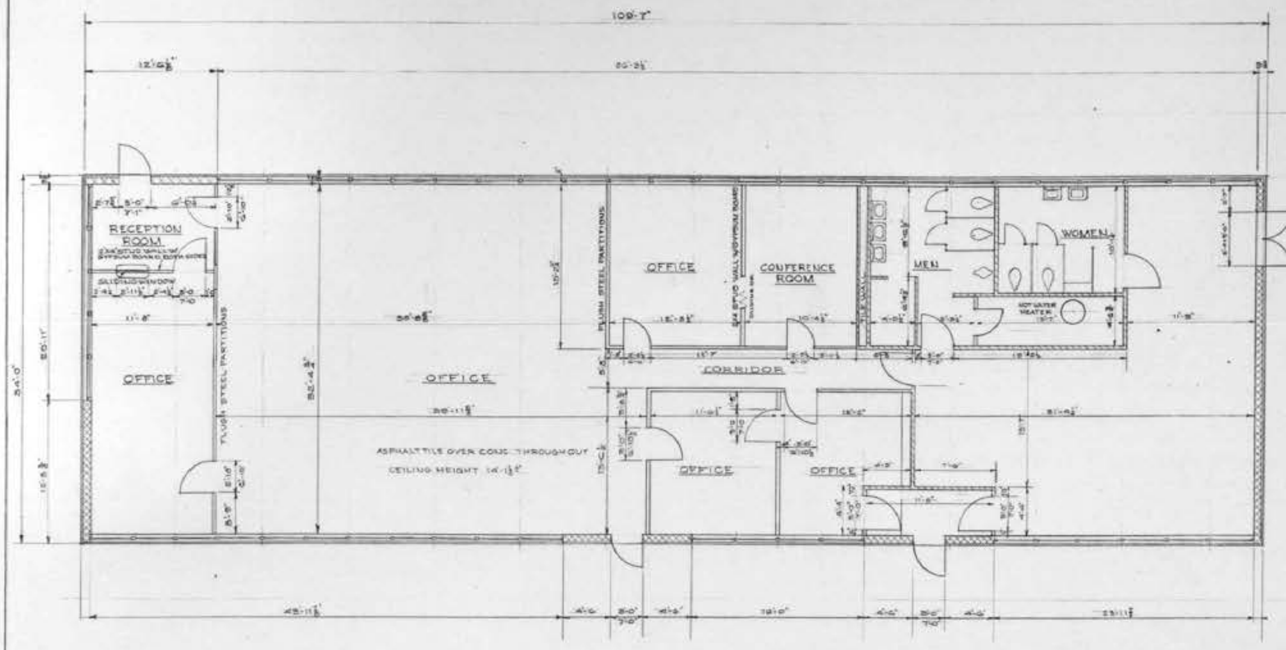
(SEE VERSO)



LOCATION PLAN
SCALE 1" = 200'-0"

FLOOR PLAN
SCALE ¼" = 1'-0"

REFERENCE DRAWINGS:
SEE SPECIAL FOLDER "LOK"

SYMBOLS
FLUSH STEEL PARTITIONS
2"X4" STUD WALL WITH GYPSUM BOARD ON BOTH SIDES
TILE BRICK WALLS

RECORD DRAWING

BUILDING Nº 1510
PYROTECHNICS LABORATORY
FLOOR PLAN

REVISION	1	2	3	4
NO				
DATE				
DRAFTSMAN				
ENGINEER				
CHIEF ENGR				
APPROVED				
SAFETY				
APPROVED				

DATE 18 FEBRUARY 1963

SUBMITTED: PLANT ENGINEERING & MAINTENANCE OFFICE
C. H. Richards
CHIEF ORD CORPS U.S.A.

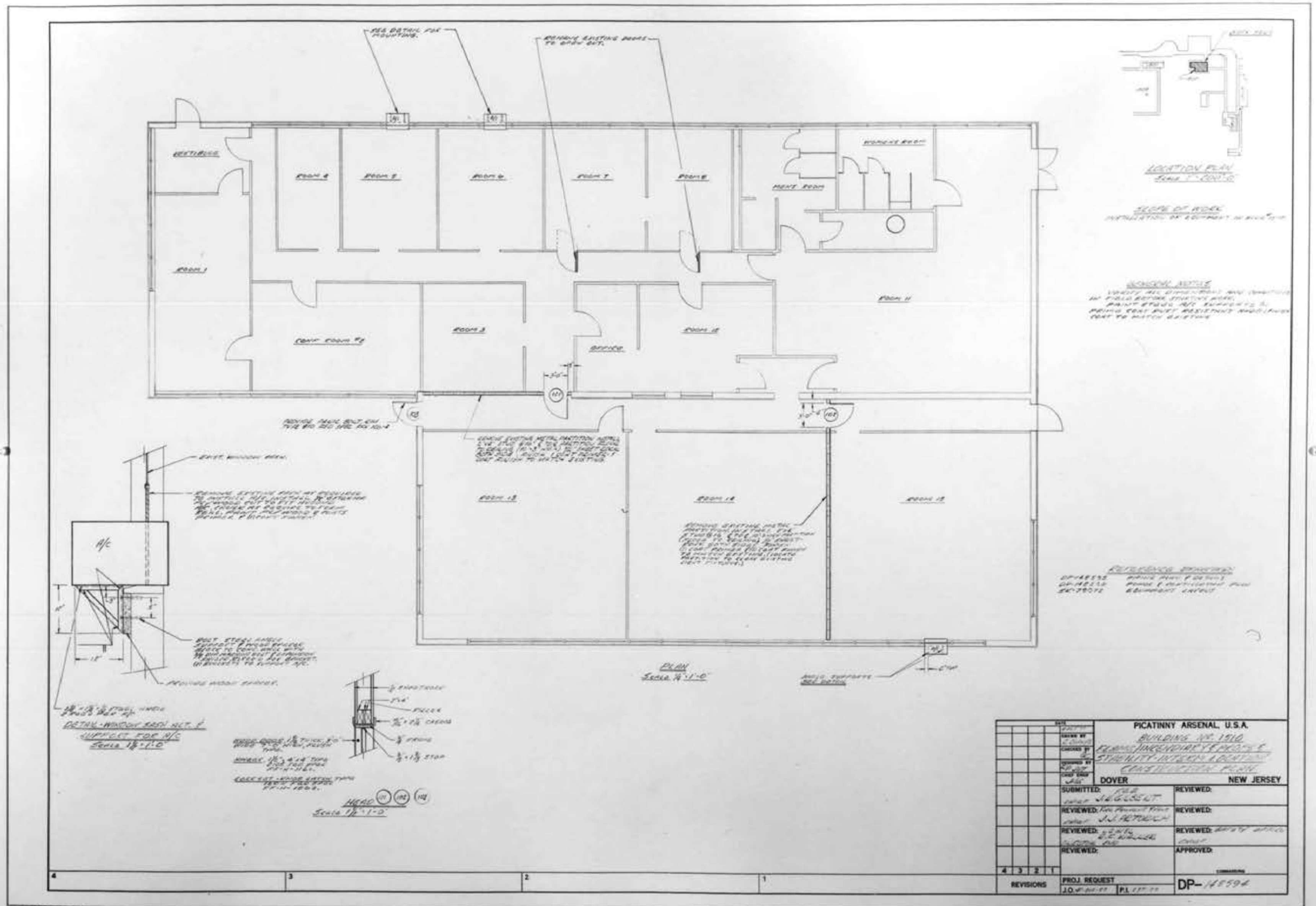
APPROVED:
SAFETY OFFICE
COLONEL ORD CORPS U.S.A. COMMANDING

DP-57511

PICATINNY ARSENAL U.S.A.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-12
(SEE VERSO)



PICATINNY ARSENAL, U.S.A.
BUILDING NO. 1510
DOVER
NEW JERSEY
SUBMITTED:
REVIEWED:
REVIEWED:
REVIEWED:
REVIEWED:
REVIEWED:
REVIEWED:
APPROVED:
REVISIONS
PROJ. REQUEST
DP-148594
VESTIBULE
ROOM 1
ROOM 4
ROOM 5
ROOM 6
ROOM 7
ROOM 8
ROOM 11
ROOM 12
ROOM 13
ROOM 14
ROOM 15
OFFICE
LOCATION PLAN
SCOPE OF WORK
GENERAL NOTES
REFERENCE DRAWINGS
PLAN
HEAD

HISTORIC AMERICAN BUILDINGS SURVEY
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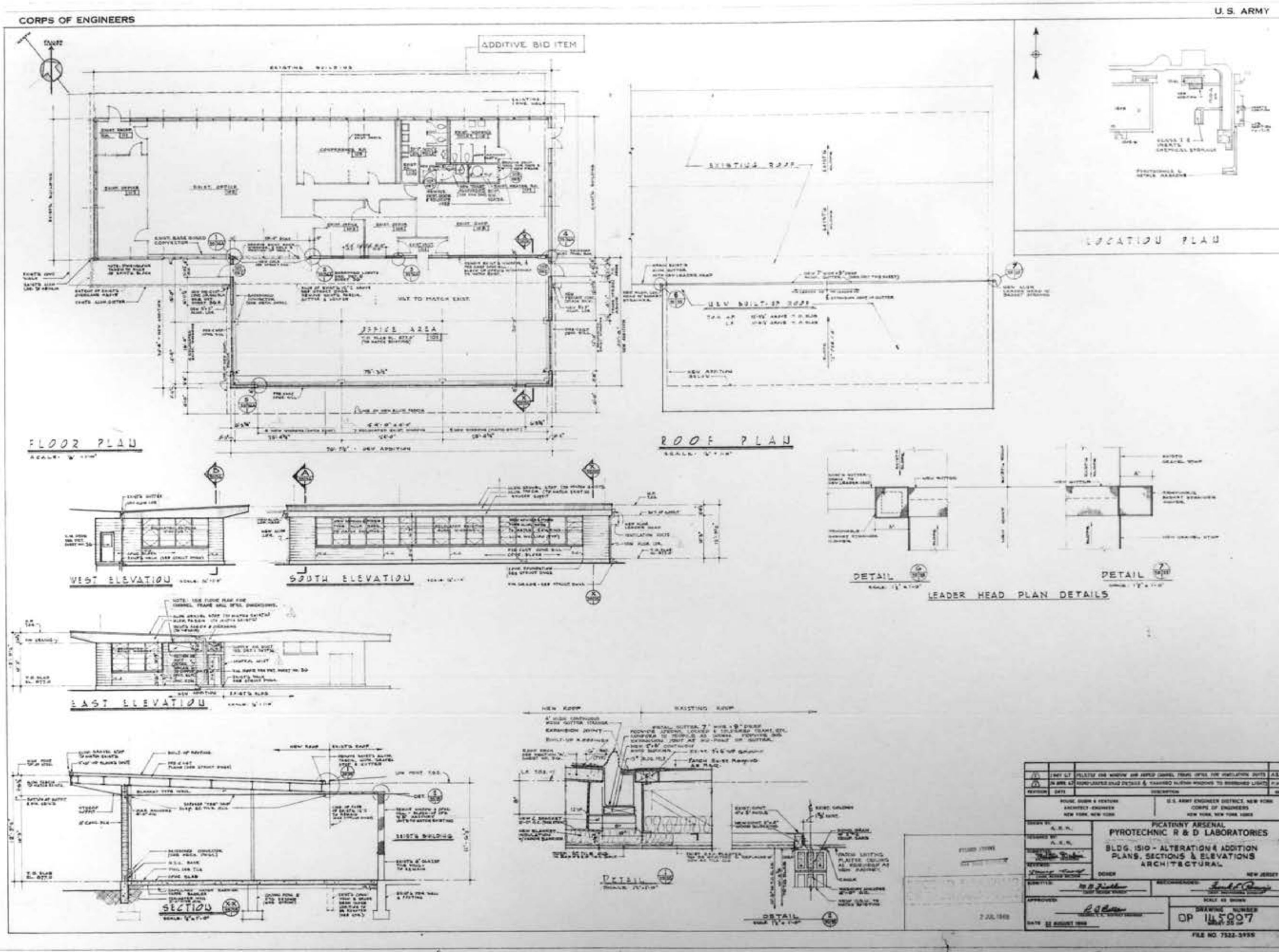
HABS No. NJ-XXX-13
(SEE VERSO)


CORPS OF ENGINEERS
U.S. ARMY
ADDITIVE BID ITEM
FLOOR PLAN
ROOF PLAN
LOCATION PLAN
OFFICE AREA
NEW BUILT-UP ROOF
EXISTING ROOF
WEST ELEVATION
SOUTH ELEVATION
EAST ELEVATION
SECTION
DETAIL
LEADER HEAD PLAN DETAILS
NEW ROOF
EXISTING ROOF
PICATINNY ARSENAL
PYROTECHNIC R & D LABORATORIES
BLDG. 1510 - ALTERATION & ADDITION
PLANS, SECTIONS & ELEVATIONS
ARCHITECTURAL
NEW JERSEY
DRAWING NUMBER
OP 115007
FILE NO. 7522-5955

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

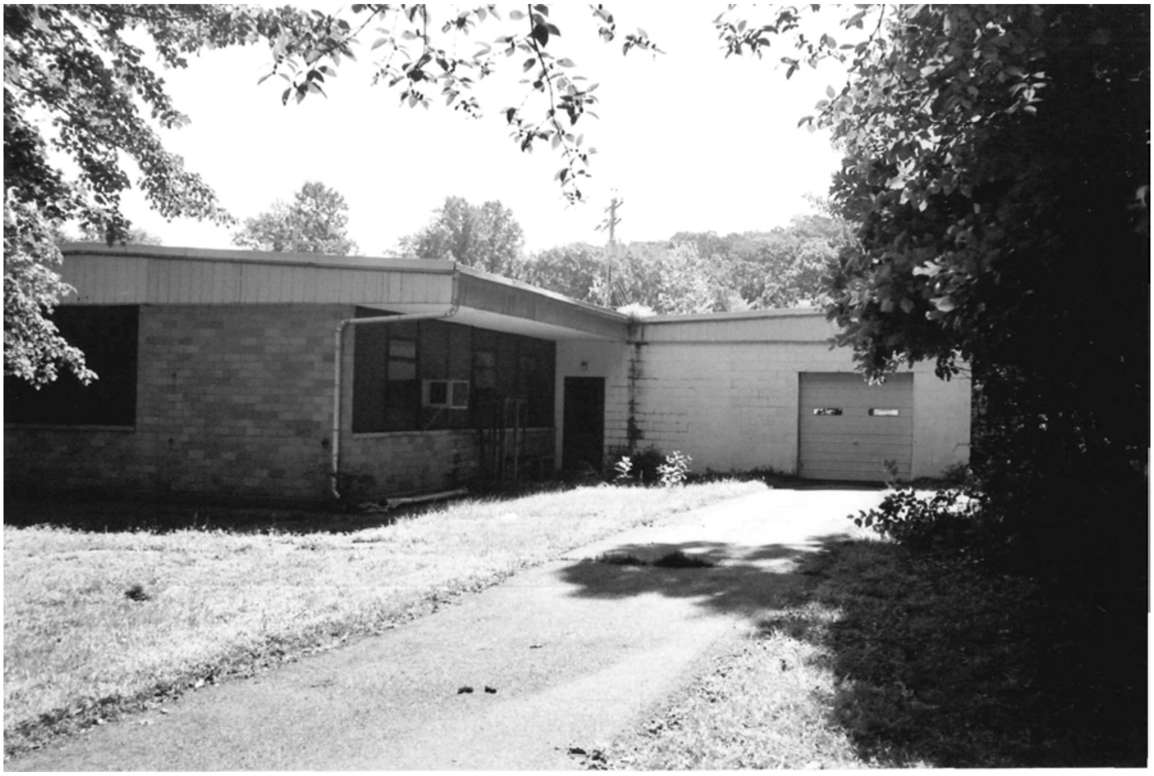
HABS No. NJ-XXX

Photograph 1.

Photograph 2.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

HABS No. NJ-XXX



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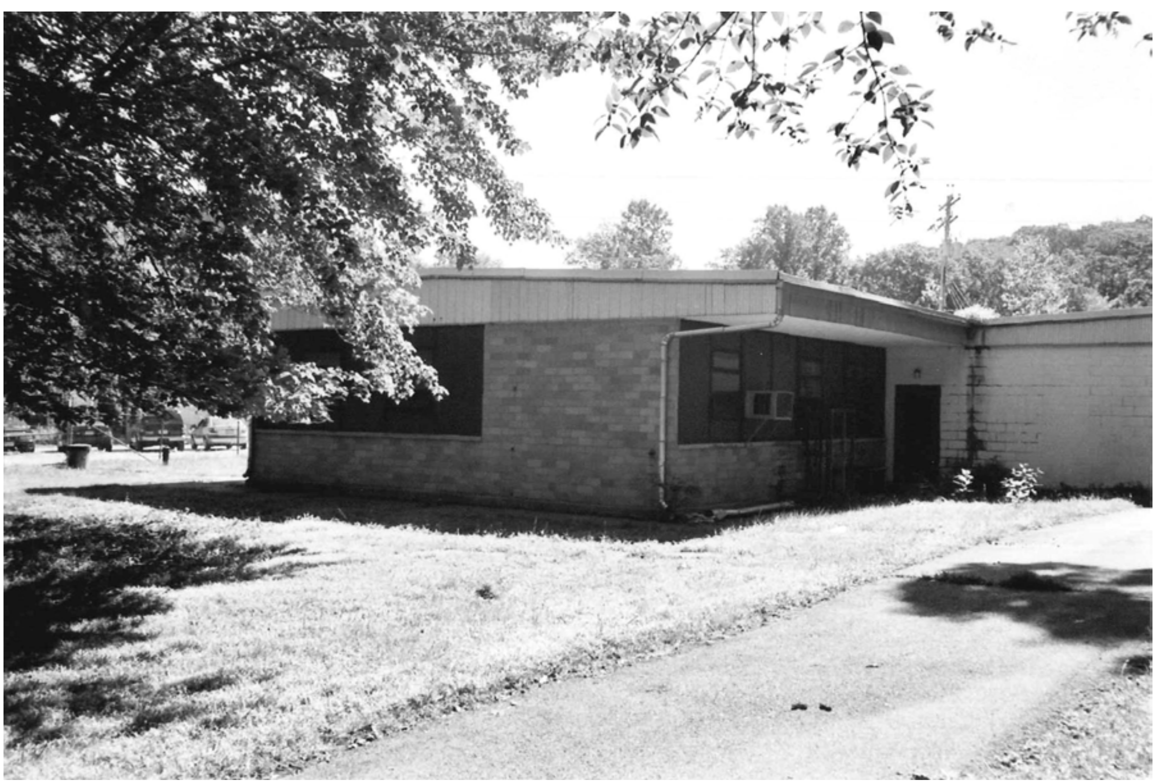


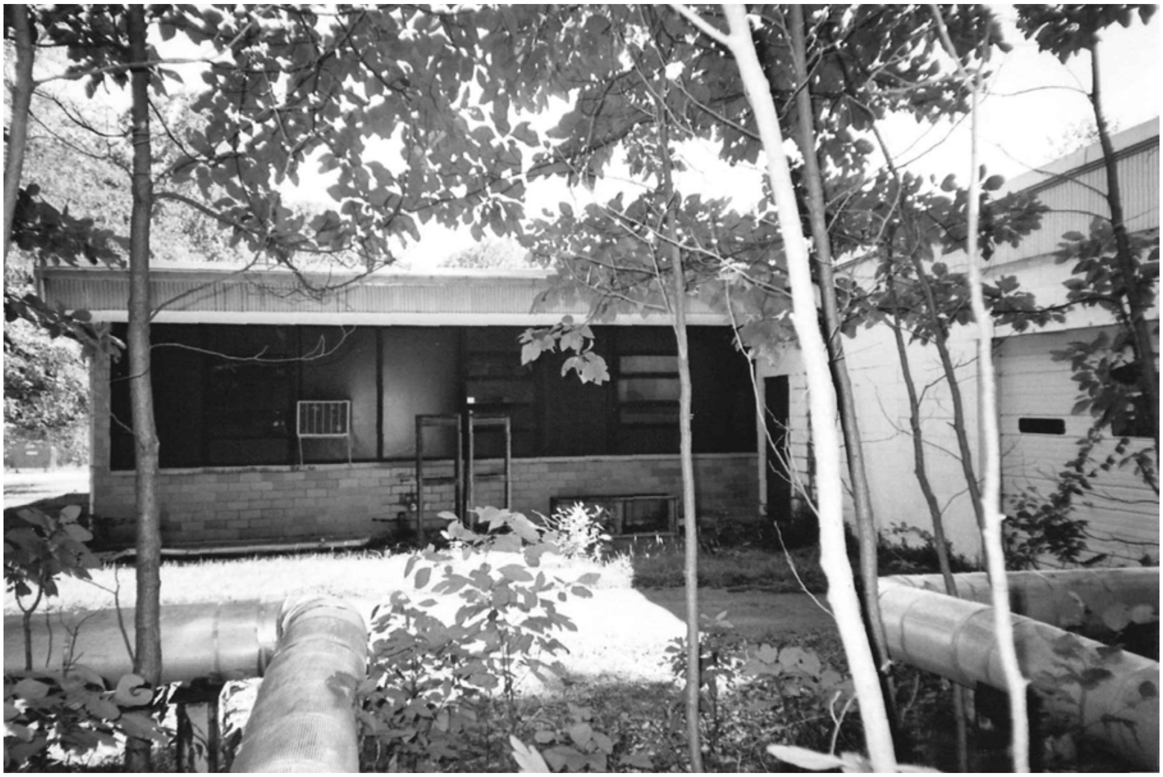
Photograph 4.

Photograph 5.

Photograph 6.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

HABS No. NJ-XXX

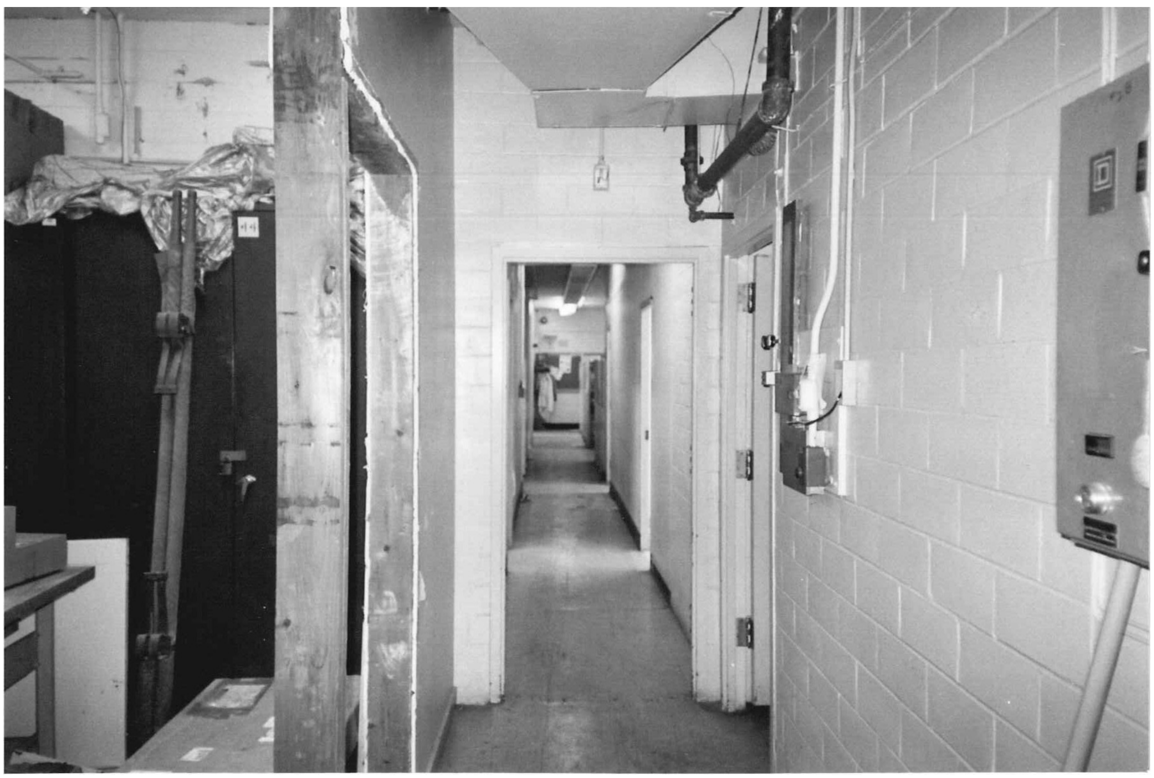


Photograph 7.

Photograph 8.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR
CAPTION

HABS No. NJ-XXX


Photograph 9.

HISTORIC AMERICAN BUILDINGS SURVEY
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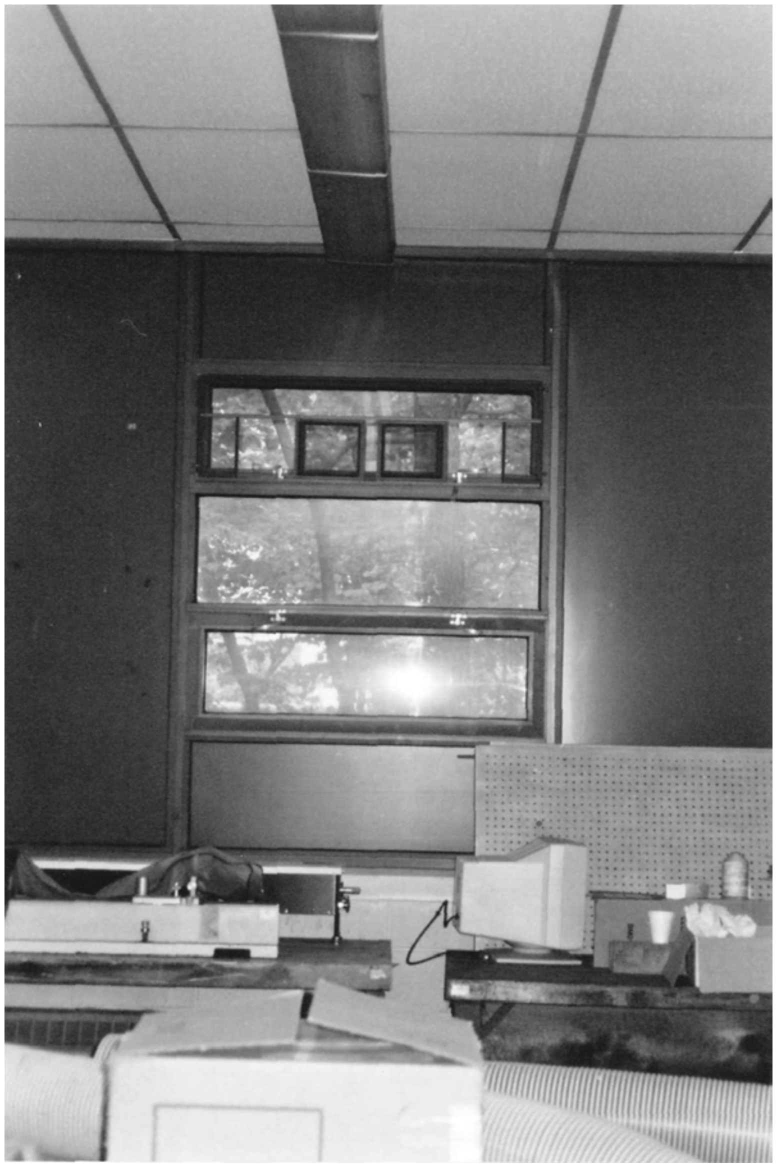
HABS No. NJ-XXX



Photograph 10.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

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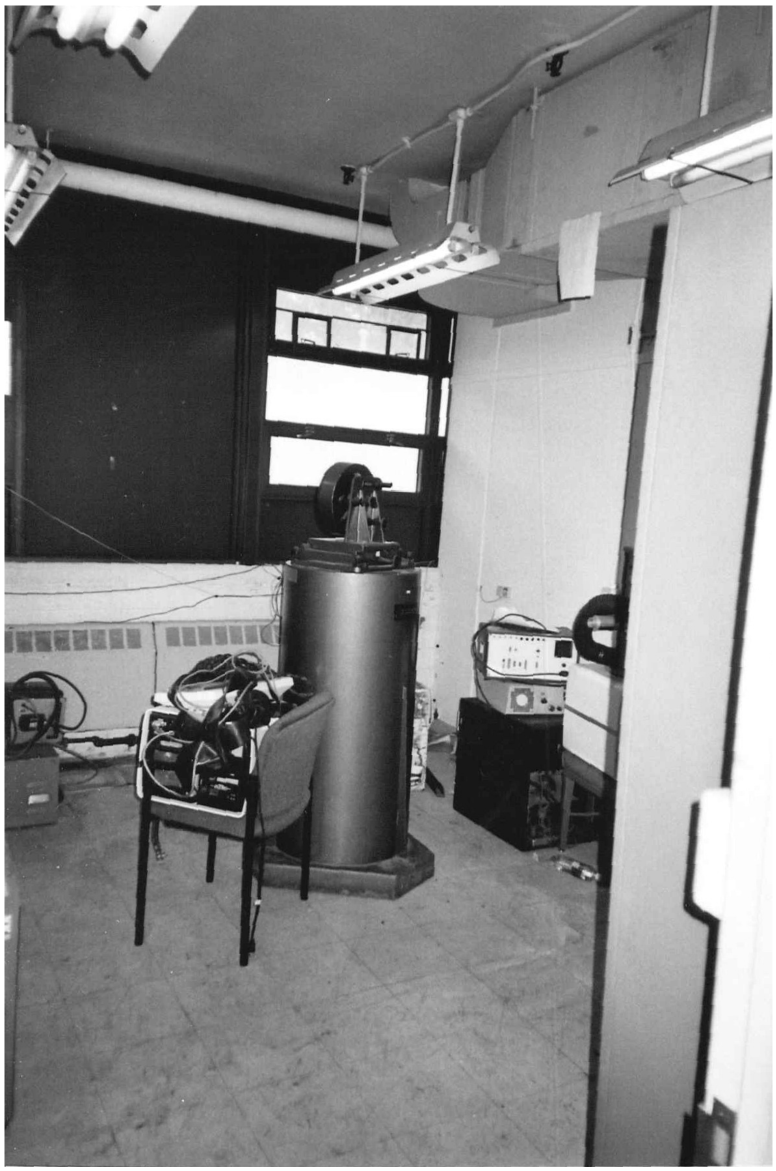

Photograph 11.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

HABS No. NJ-XXX

Photograph 12.

HISTORIC AMERICAN BUILDINGS SURVEY
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HABS No. NJ-XXX

Photograph 13.

Photograph 14.

HISTORIC AMERICAN BUILDINGS SURVEY
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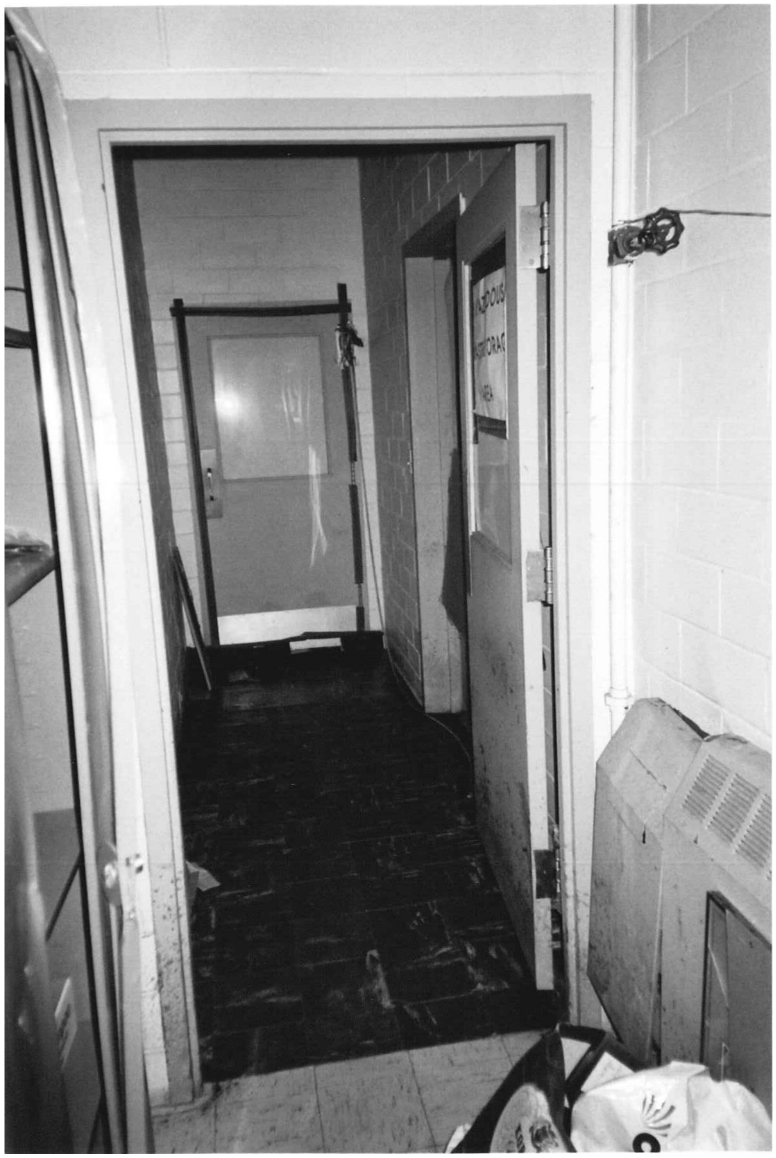
HABS No. NJ-XXX



Photograph 15.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

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Photograph 16.

HISTORIC AMERICAN BUILDINGS SURVEY
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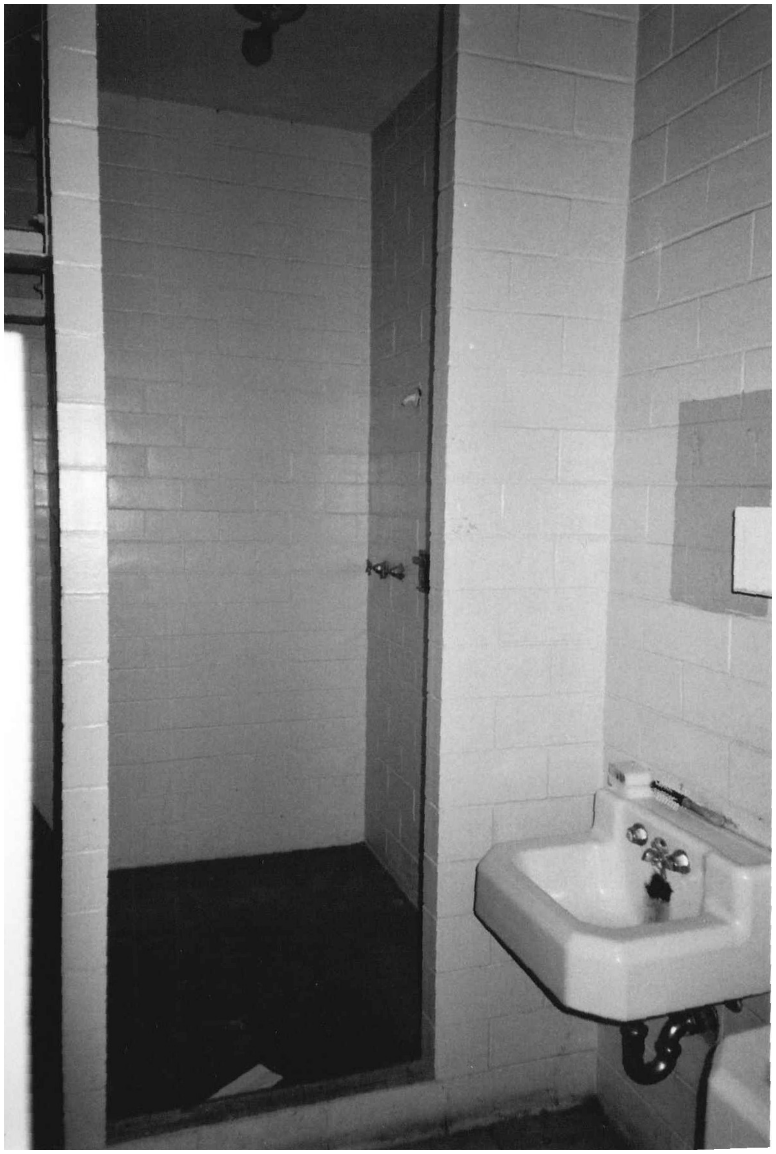

Photograph 17.

HISTORIC AMERICAN BUILDINGS SURVEY
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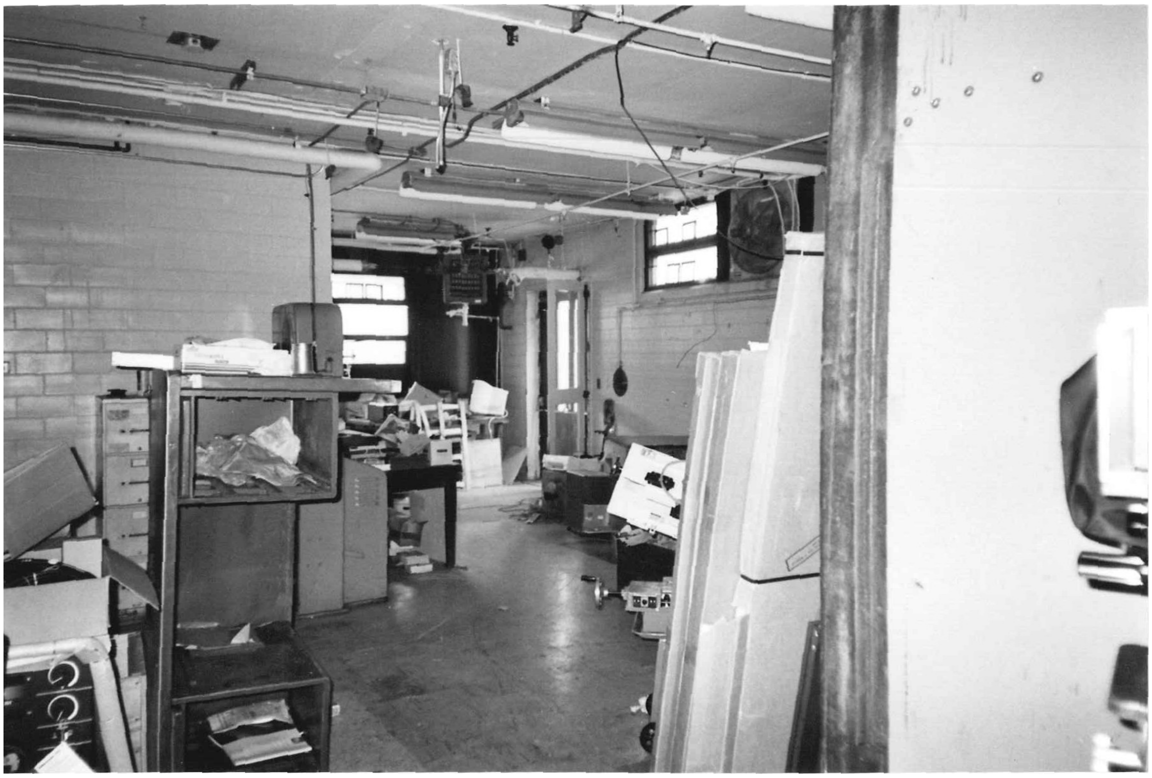
Photograph 18.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

HABS No. NJ-XXX



Photograph 19.

Photograph 20.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO SUPPLEMENTAL MATERIAL FOR CAPTION

HABS No. NJ-XXX

Photograph 21.

Photograph 22.

HISTORIC AMERICAN BUILDINGS SURVEY

DOCUMENTATION

OF PYROTECHNIC R&D LABORATORY (BUILDING 1510)

AND GENERAL STORAGE BUILDING (BUILDING 1510B),

PICATINNY, MORRIS COUNTY, NEW JERSEY

FINAL

Prepared for:

PARSONS INFRASTRUCTURE
901 NE Loop 410, Suite 610
San Antonio, Texas 78209-1305

Prepared by:

Kelly Nolte, M.A., Senior Architectural Historian

Mark A. Steinback, M.A., Senior Historian/Technical Editor

Mark Drumlevitch, B.A., Photographer

PANAMERICAN CONSULTANTS, INC.
Buffalo Branch
2390 Clinton Street
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(716) 821-1650

October 2008

Management Summary

Panamerican Consultants, Inc. (Panamerican) was subcontracted by Parsons Infrastructure, San Antonio, TX, to prepare of documentation of two structures at Picatinny, Morris County, New Jersey. The Pyrotechnic R&D Laboratory, Building 1510, and the General Storage Building, Building 1510B, are contributing elements to the Rocket Test Area Historic District at Picatinny, which is eligible for listing to the National Register of Historic Places under Criteria A and C through Criterion Consideration G. The buildings are no longer required for the installation's mission, and they are to be demolished pertinent to the Base Realignment and Closure (BRAC) Act. Their mitigation is to be accomplished through their documentation to Historic American Buildings Survey (HABS) standards.

The U.S. Army, as a federal agency, has management responsibilities concerning the protection and preservation of cultural resources on land it controls or uses. Federal statutes require the Army to identify and evaluate significant cultural resources on these properties, and include: the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470 et. seq) through 2000 (which includes Section 106 compliance); the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4371 et. seq.); the Historic Preservation Act of 1974 (16 U.S.C. 469-469c); the Advisory Council on Historical Preservation Guidelines for the Protection of Cultural and Historic Properties (36 CFR Part 800); as well as Army Regulation (AR) 200-1 Environmental Protection and Enhancement.

In accordance with HABS Documentation Level II, each resource was documented through large-format photography and written historic data and description. One copy of this data is submitted on archival materials as a two stand-alone packets (one for each building). In addition, for the sake of organization and future storage, digital and non-archival copies of the documentation for each of the structures have been submitted as a single report with two sections.

The Panamerican project team included Ms. Kelly Nolte, M.A., Senior Architectural Historian and Principal Investigator; Mr. Mark Drumlevitch, Photographer; and Mr. Mark A. Steinback, Senior Historian/Technical Editor. Ms. Nolte conducted the fieldwork and historic research and wrote the majority of the report, and Mr. Drumlevitch was responsible for all the large-format photography. Mr. Steinback prepared portions of the historical background and edited the report. Dr. Michael A. Cinquino served as Panamerican's Project Director.

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GENERAL STORAGE BUILDING HABS No. NJ- XXX
(Building 1510B)
South side of Hart Road, east of intersection
of Hart Road and Lake Denmark Road
Rocket Test Area Historic District
Area 1500
Picatinny
Morris County
New Jersey

PHOTOGRAPHS

WRITTEN AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
National Park Service
Mid-Atlantic Region
Custom House
2nd & Chestnut Streets, Rm. 231
Philadelphia, Pennsylvania 19106

October 2008

HISTORIC AMERICAN BUILDINGS SURVEY

GENERAL STORAGE BUILDING
(Building 1510B)

Location:	General Storage Building, Building 1510B, is located on the south side of Hart Road, east of the intersection of Hart Road and Lake Denmark Road, in the Rocket Test Area Historic District, 1500 Area, Picatinny, Rockaway Township, Morris County, New Jersey. UTM: 18.539550.4533560 Quad: Dover 1954 (1981)
Date of Construction:	1948
Engineer/Architect:	Unknown. The General Storage Building was probably constructed using standard building plans.
Present Owner/ Occupant:	United States Army, Picatinny, New Jersey.
Present Use:	Not used, vacant.
Significance:	The General Storage Building, Building 1510B, is a contributing element to the Rocket Test Area Historic District, Picatinny Arsenal, which is eligible for the National Register of Historic Places under Criteria A and C through Criterion Consideration G. The General Storage Building is part of the storage and laboratory area within the Rocket Test Area Historic District. This building served as a storage facility for the pyrotechnic center.

Kelly Nolte, Senior Architectural Historian/Director of
Architectural History Division
Mark A. Steinback, Senior Historian

Panamerican Consultants, Inc.
Buffalo Office
2390 Clinton Street
Buffalo, New York, 14227-1735

October 2008

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Date of Erection: 1948.

2. Architect: Unknown. The General Storage Building was probably constructed using standard building plans.

3. Original and subsequent owners: U.S. Army/Picatinny Arsenal, now just Picatinny, has been the only owner.

4. Original and subsequent occupants: The General Storage Building has probably been occupied by various groups within the 1500 Area. It has, however, always been a storage facility.

5. Builder, Contractor, Suppliers: Unknown.

6. Original plans and construction: There is no original plan for the structure, however, a plan from 1968 showed the basic floor plan of the building (Picatinny 1968). This blueprint is included in this documentation.

7. Alterations and additions: In 1968, the building was covered in aluminum siding, and the wooden eaves with wooden fascias and open soffits were extended out from the roofline. The aluminum was applied directly over the existing wooden walls. The existing wooden, double doors were taken down, repaired, and painted green (Picatinny 1968).

B. Historical Context:

1. Introduction: Picatinny Arsenal (referred to as Picatinny) is a government-owned, government-operated facility in the Green Pond Brook valley in the Highlands of northwestern New Jersey. The U.S. Army established the Dover Powder Depot on more than 900 acres in 1880. Originally constructed for storage of powder and other munitions, the Dover Powder Depot became Picatinny Arsenal in 1907 with the establishment of the first Army-owned smokeless powder factory. During the twentieth century, Picatinny Arsenal emerged as a leading facility for the research, development, engineering, and production of munitions. The installation was reenvisioned following a catastrophic explosion at the Navy's contiguous Lake Denmark Powder Depot that destroyed much of the Navy's facility. During World War II and the subsequent Cold War, Picatinny continued its leading role in the research, development, and engineering of munitions and weapons systems.

Picatinny has long been of historic and architectural interest and since the 1980s an abundance of architectural and historical reports have been prepared assessing the significance of Picatinny's buildings and structures and determining their eligibility for listing to the National Register of Historic Places (Thurber and Norman 1983; Ashby et al. 1984; Fitch and Glover 1990; Harrell 1993, 1994; Nolte 1998; Nolte et al. 1999a, 1999b, 1999c; Nolte and Steinback 2004a, 2004b; Nolte et al. 2007; U.S. Department of the Army nd).

A HABS/HAER Level IV was completed on more than 800 structures that were 50 years of age or older (Ashby et al. 1984). Many have since been demolished as a result of excessive contamination. Subsequently, a HAER was completed for Picatinny Arsenal that provided additional detail to document the historically significant structures related to various industrial processes at the facility (Thurber and Norman 1983). This documentation focused on five areas: 200 Area, Shell Component Loading; 400 Area, Gun Bag Loading; 500 Area, Powder Factory and Power House; 600 Area, Ordnance Test Area; and 800 Area, Complete Rounds/Melt Loading. Further, a draft Multiple Resource National Register Nomination was prepared for six Historic Districts at Picatinny Arsenal—the five areas listed above and a Picatinny Multiple Resources Area, a large area primarily of administrative structures that runs roughly down Farley Avenue including the Cannon Gates. The six districts were cited as being eligible under Criteria A, B, C, and D. The draft nomination was never finalized or submitted for consideration to the Department of the Interior (U.S. Department of the Army nd).

In 1993, 51 structures on the installation were evaluated as part of a catalog of building drawings (Harrell 1993). The structures surveyed included quarters, laboratories, industrial facilities, warehouses, support and utilities structures and one building from the now defunct Navy rocket program. This report recommended that all of the historic structures on Picatinny be surveyed so that future catalogs could include all components of an industrial line and patterns of construction and modernization could be defined. Such a report was prepared a year later (Harrell 1994). A total of 527 structures, all of which were 50 years old or older, were chosen from the HABS/HAER studies and then surveyed in some detail including an evaluation as to each structure's NRHP status. The opinion expressed in the document was that 500 buildings were eligible as contributing elements to a single historic district. This report did not place Picatinny's structures within a larger U.S. military architectural and historical context. In the Army's opinion there was not enough information to support the nomination of 500 structures.

A subsequent reevaluation of the data and the structures recommended that 51 buildings and structures were eligible for the NRHP as contributing elements to three historic districts (the Administration and Research District, the 600 Ordnance Test District, and the Naval Air Rocket Test Station [NARTS], Test Area E District), and two buildings (3250 and 3316) as being individually eligible (Nolte et al. 1999a; Nolte et al. 1999b, 1999c; Nolte 1998). The New Jersey Historic Preservation Office (HPO) concurred with these recommendations (Guzzo 1999). Picatinny also treats the Cannon Gates as NRHP eligible.

Panamerican later completed an Integrated Cultural Resources Management Plan (ICRMP) for the installation (Schieppati and Steinback 2001), and has completed a NRHP determination of eligibility for the Rocket Powder Propellant Plant (1400 Area), the Detonation Facility (1600 Area, "Little Picatinny"), and the NARTS, Area D (which is NRHP eligible) as well as the Haleite/HE Plant (1000 Area), the Nitroglycerine Plant (1300 Area), Pyrotechnic Testing Facility (640 Area), and the Ammunition Testing Facilities (630 Area) (Nolte and Steinback 2004a, 2004b; Guzzo 2004a, 2004b). Recently, Panamerican surveyed, photographed, and evaluated a total of 318 buildings scattered within the installation (Nolte et al. 2007). As a result of this investigation, the Rocket Test Area Historic District (Area 1500) was recommended as eligible under Criterion Consideration G and Criteria A and C. The recommended district located off Lake Denmark Road comprises 34 contributing buildings and seven non-contributing buildings.

2. History: Prior to the Army's residency in the area, settlement of the Highlands, including the project area, was associated with the iron industry. Mining is reputed to have occurred at both Mount Hope mine (adjacent to Picatinny) and Dickerson mine (west of Picatinny) as early as 1710, making these sites the oldest iron-mining operations in both New Jersey and the thirteen colonies (Rutsch and van Voorst 1991:13; Rogers 1931:2-3; Fitch and Glover 1990:B/145-146). By 1737, the northern portion of Hunterdon County (at that time consisting of the present counties of Morris, Warren and Sussex) had an approximate population of 1,750 whites and 70 slaves (Pitney 1914:4). During the mid-eighteenth century, three forges were established either near or within what would become the Picatinny Arsenal reservation:

- Picatinny Forge, founded about 1749 and called Middle Forge after 1772;
- Mount Pleasant Forge, founded around 1750 and subsequently known as Lower Forge; and
- Burnt Meadow or Denmark Forge, founded in 1750 and known as Upper Forge.

Although there is little agreement about the structures that may have existed at these forges, Halsey inferred that these sites were "bloomary forges," where charcoal, ore, and limestone were shoveled into a furnace to create a "bloom" or semi-molten mass of metal and slag. While still hot, this mass was hammered to remove the slag and produce wrought iron (Halsey 1882:48-56; Rutsch 1999).

An important element to the successful operation of these establishments was that the necessary raw materials—iron ore, limestone and charcoal—were found easily nearby. Mount Hope and Hibernia mines were located in the hills just east of these forges, while at least two limestone extraction pits were utilized within what is now Picatinny, and several charcoal kilns were adjacent to it (Rogers 1931:7; Fitch and Glover 1990:B-150; Sandy and Rutsch 1992:69; Rutsch et al. 1986:184-186).

The iron industry expanded into the Green Pond Brook valley when Jonathan Osborn (or Osbourne) erected a dam at the southern end of what is now Picatinny Lake and established one of the earliest forges in New Jersey in 1749. Within the boundaries of what is now Picatinny, Osborn's forge was called Picatinny Forge, but later became known as Middle Forge. The forge may have used ores from the nearby Mount Hope mine (Rogers 1931:7; Halsey 1882:41). Establishing his forge at the foot of Picatinny Peak near Green Pond Brook, Osborn created Picatinny Lake by damming the brook for his forge. Machinery and other implements from Middle Forge are on display at the arsenal museum (Rogers 1931:6; Myers 1984:7).

The following year (1750), Colonel Jacob Ford, Sr., who had purchased Mount Hope mine about the same time, established a forge at Mount Pleasant. Since this forge was south of Osborn's forge, it was sometimes referred to as the Lower Forge. Ford, a leader in the colonial iron-working industry in New Jersey, constructed a dam on Burnt Meadow Brook in 1750, creating Lake Denmark in the process, in order to erect another forge. Subsequently located near the southern end of Lake Denmark, this forge is referred to as the Upper Forge, or, later, as John Harriman's Iron Works or Burnt Meadow Forge. Jacob Ford, Jr., who would continue the family business of owning numerous iron operations in the Green Pond Brook valley, reacquired Middle Forge in 1772 (Fitch and Glover 1990:B-146; Rogers 1931:6-7; Halsey 1882:41).

Known as the Denmark Tract, Jacob Ford, Jr.'s tract contained approximately 6,231 acres and was located west of Mount Hope and east of Green Pond Mountain (in the middle of the Green Pond Brook valley). Sources reported that the property was "returned to Courtland Skinner and John Johnson" on June 21, 1774 (Halsey 1882:334; Rogers 1931:5). Skinner and Johnson appeared to have purchased this tract for Jacob Ford, Jr. (Sandy and Rutsch 1992:43). The substantial tract included Mount Pleasant, Washington Forge, the Spicer properties, Middle Forge and Denmark lands, and portions of it remained in the Ford family until 1806, when it was purchased by Benjamin Holloway, who rebuilt the abandoned forge.

Ironmaster John Jacob Faesch, a Swiss formerly employed by the American Iron Company (also known as the London Company), began to dominate the valley's iron industry. Southeast of the future arsenal near the village of Dover, he established the Mount Hope Furnace in 1772. Also in 1772, Faesch purchased a large tract of land in the Green Pond Brook valley. After demolishing two standing mills (a gristmill and a hemp mill) to construct the Mount Hope furnace on the best location for waterpower, Faesch increased his holdings by renting contiguous properties from Jacob Ford, Jr. He purchased Middle Forge from the Ford heirs in 1778 as well as over 1,900 acres of forested land adjacent to his forges. Faesch, like the Fords, acquired other forges in the Green Pond Brook valley as well as the Mount Hope mine. Moreover, he operated his forges, including Middle Forge, in conjunction with Mount Hope mine until his death in 1799 (Rutsch et al. 1986:46-49; Fitch and Glover 1990:B-146, B-150; Rogers 1931:7; Halsey 1882:41, 53). The historical records are unclear regarding the relationship between Ford's Denmark Tract and Faesch's Tract, which, upon initial review, seem either to overlap or to be contiguous.

Faesch's various iron works played an important role in the Revolutionary War by providing the Continental Army with iron materiel, such as "cannon, shot, bar iron, shovels, axes and other iron implements" (Myers 1984:7). George Washington visited the ironworks at Mount Hope, and approved the transfer of a number of Hessian prisoners to Faesch in order to work at the facilities (Myers 1984:7; Fitch and Glover 1990:B-150; Rogers 1931:5; Rutsch et al. 1986:48). Within Picatinny's boundaries, the Walton Family Cemetery (known alternatively as the Walton Burial Ground or the Hessian Cemetery) lies near Picatinny's Mount Hope Gate and is reputed to contain graves of several of the Hessian prisoners. Since most of the graves in the cemetery are marked with fieldstones, following early custom, the Hessian connection is extrapolated from prisoner work at the local forge and those Hessians who remained in the area after the war. It is further alleged that three other Revolutionary War veterans, besides Peter Doland, are buried there, as well as a possible Civil War veteran, whose grave is unknown (U.S. Army Armament Research, Development, and Engineering Center [ARDEC] Historical Office nd:Item 19; Rutsch et al. 1986:55).

During the nineteenth century, the vicissitudes of the iron industry resulted in valley land changing hands often as the fires of forges burned less and less brightly (Sandy and Rutsch 1992:46-51; Halsey 1882:45, 334; Fitch and Glover 1990:B-150, B-154; Rogers 1931:5-6: Rutsch et al. 1986:59). Despite a depletion of forest timber (and subsequently charcoal), which began in the 1820s and contributed to the volatility of early nineteenth-century iron markets, Middle and Upper Forges continued to operate until the 1850s. Other factors reflecting the general volatility of the industry included frequent ownership changes and a continuous pattern of forge shutdowns and start-ups. On the other hand, providing new blood to the region's sclerotic economy, the Morris Canal was built between 1825 and 1831. Passing just south of Picatinny through Rockaway and Dover, the canal connected Jersey City on the Hudson River to Phillipsburg on the Delaware River by 1865. Constructed to carry cheap coal from Pennsylvania to the industrial centers developing along the New Jersey coast, the canal also provided coal to fuel the iron forges and furnaces in the Highlands, replacing the depleted timber supply. While anthracite coal traveled east, ore from the New Jersey Highlands was shipped westward in great quantities to newer furnaces constructed in Pennsylvania near the Delaware River (Rutsch et al. 1986:65-66; Halsey 1882:68-69; Fitch and Glover 1990:B/150-151).

By 1882, Denmark Forge was no longer in operation and was followed into inactivity five years later by the Denmark mine (Sandy and Rutsch 1992:53). As the profitability of the iron industry declined after 1880, the population of the region declined in tandem, to a low of 2,423 in 1940 (Fitch and Glover 1990:B-155; Rutsch et al. 1986:27-29, 35). By the beginning of the twentieth century, only 20 iron mines in the Highlands were in operation, including the Mount Hope mine, which had passed to the control of the Empire Steel & Iron Company. The decline of the iron industry continued through the twentieth century, and resulted in a continual ebbing of the region's population over the next forty years (Fitch and Glover 1990:B-155; Sandy and Rutsch 1992:37). While the Highlands' lakes continued to be popular as resorts and vacation spots, the area around Picatinny Arsenal became attractive to suburban development with improvements in the automobile and the region's transportation infrastructure. Population surged following World War II with the construction of Interstate 80 and 287, the development of suburban residential communities and ancillary commercial construction (Fitch and Glover 1990:B-155; Rutsch 1999).

Picatinny Arsenal. Established on September 6, 1880, as the Dover Powder Depot under the command of Major Francis H. Parker of the Ordnance Department, Picatinny's initial purpose was the storage of "powder, projectiles, and explosives, both for reserve supply and for issue; also for the preparation and issue of these stores" (Rogers 1931:53). A board of Ordnance Department officers chose the Green Pond Brook valley near Dover as the site of the depot based on several criteria: the site had to be a sparsely populated region near New York City, capable of storing a large amount of powder, and, accessible by train. Between 1880 and 1881, the government acquired 1,866.12 acres from various owners for a total of $62,750, or almost $34 per acre. After Major Parker requested that the installation's name be changed, the new depot became Picatinny Powder Depot on September 10, 1880, with construction beginning six days later (Fitch and Glover 1990:B-160; Rogers 1931:10-11).

Between 1880 and 1890, construction activities focused on the erection of storage magazines, officer's quarters, and service facilities. The first powder-storage magazine was completed in 1881 with the storage capacity of 10,000 pounds of black powder. With four powder magazines completed by November 1886, the depot received its first shipment of powder (300,000 pounds) for storage later that month. To facilitate access to the installation and the general shipment of freight, the Morris County

Railroad began building a rail line through the depot in 1886. In 1887, 23½ miles of track traversed the powder depot and connected it to the Delaware, Lackawanna & Western Railroad and the Dover Central Railroad of New Jersey at Wharton. A privately owned line called the Northern & Wharton Railroad also ran through the arsenal and maintained five associated stations. Seventy men were employed at the depot and 900,000 pounds of powder were stored at the facility by that time. From 1893 until 1907, the facility was known as the United States Powder Depot (Fitch and Glover 1990:B/164-166; Rogers 1931:53-54, 71; Rutsch 1999:19-21).

In June 1891, 315 acres of Picatinny Powder Depot land near Lake Denmark were ceded to the United States Navy for the establishment of a Navy powder depot. (This area is now part of Picatinny.) After vacating its powder magazine on Ellis Island in New York harbor, the Navy utilized the Lake Denmark facility as its primary depot on the east coast. Storing powder, ammunition, high explosives, and artillery shells, the Lake Denmark Powder Depot was enlarged when the Navy acquired more than 146 additional acres in two purchases in 1902. By 1892, a shell house, a storage magazine and three residential structures were completed (Rogers 1931:29-31; Fitch and Glover 1990:B/166-168; Harrell 1994:6).

Historical development within Picatinny has been concentrated in the areas south and east of Picatinny Lake, which included most of the areas initially purchased by the federal government in 1880-1881 (Rogers 1931:58-61, 77; Harrell 1994). Construction phases at the arsenal dovetailed with the installation's manufacturing activities and changes in the arsenal's mission over time. The initial phase of development covered the depot/storage period from 1880 until 1907. The depot’s first phase of operation involved powder storage and increasing involvement in the assembly of cannon charges. In 1897, workers at the depot assembled powder charges that included manufacturing and filling the storage bags. Between 1902 and 1906 armor-piercing shells were assembled at the depot, where projectiles were filled with explosives, such as Maximite and Explosive "D" (Rogers 1931:54; Fitch and Glover 1990:B-168; Harrell 1994:6).

A major change in the installation's mission occurred in 1907 with the construction of the first Army-owned smokeless powder factory. This activity resulted in the redesignation of the depot as Picatinny Arsenal, and marked the beginning of the arsenal's important manufacturing phase, which continued until the early years of World War II. Manufacturing increased gradually in the years before World War I as Congress approved continual expansion of the arsenal's production facilities. Picatinny maintained sole responsibility for the assembly of fixed ammunition over .50-caliber by 1909. By 1913, the arsenal was operating a plant for the manufacture of Explosive "D," which was used in armor-piercing projectiles. An Officer's Training School was established in late 1911 to provide training in chemistry, explosives, and ballistics, as well as ammunition manufacturing processes. When the United States entered World War I, Picatinny Arsenal saw a rapid development of its physical plant both around Picatinny Lake and Lake Denmark to meet the exigencies of preparing for war and to accentuate its storage capabilities. During this time, the development of the arsenal as a research and administrative installation also began as the Picatinny personnel provided technical assistance to the private sector producing explosives for the war effort. During the 1920s, munitions experimentation and training had replaced powder production as the arsenal's mission, foreshadowing the later expansion of the facility into a complete ammunition arsenal (Rogers 1931:54-56; Kaye 1978; Fitch and Glover 1990:B/168-170; Harrell 1994:7).

While the Ordnance Department was transforming Picatinny Arsenal into a center for explosives research and development through an extensive renovation and construction program, the Navy was constructing additional powder storage magazines at its Lake Denmark installation. On Saturday afternoon, July 10, 1926, lightning struck the 461-acre Lake Denmark Powder Depot, causing a series of fires and sympathetic explosions throughout the southwest end of the depot. These explosions killed 19 people, including eleven Marines fighting the fires, and sent shock waves throughout the Green Pond Brook valley, destroying everything within a 3,000-foot radius of the epicenter. Beyond this radius many structures were severely damaged, both within the Navy depot and the adjacent arsenal and among the nearby non-military residences (Rogers 1931:Chapter IX; Fitch and Glover 1990:B/171-174).

Once the fires were extinguished, the Navy appointed a Court of Inquiry to investigate the incident. The results of the investigation led to changes in safety and ammunition storage procedures and standards. Since Picatinny stored material similar to that stored by the Navy at Lake Denmark and had been damaged by the explosions, a board of Army officers also investigated the incident. This commission recommended that Picatinny Arsenal not only be reconstructed but also enlarged for the purpose of consolidating the Army's ordnance activities in northern New Jersey.

Devised with the safe handling of explosives as a top priority, plans for rebuilding the arsenal called for the division of the arsenal into zones based on the function or activity occurring in that zone (Rogers 1931:94-96; Fitch and Glover 1990:B/174-176). These functional zones were:

- powder and explosives production and handling;
- powder and explosives storage;
- powder and explosives testing; and,
- non-hazardous manufacturing, and offices for administration and research (Rogers 1931:94).

Between 1927 and 1937 both the Navy Powder Depot and Picatinny Arsenal were completely rebuilt. With rehabilitation nearly complete in 1931, Picatinny became not only the major ammunition arsenal of the U.S. Army, but was an important center of ammunition research, development, and manufacturing, which included operation of experimental and production plants for the development of a range of propellants and explosives. By the time of the United States entered World War II, the arsenal contained 567 buildings and was producing smokeless powder, high explosives, fuzes and primers, assembled rounds of artillery ammunition, bombs and grenades, and pyrotechnics (e.g., airplane flares and signal smokes), all at experimental or peace-time levels (Thurber and Norman 1983:28-29; Fitch and Glover 1990:B/177-180; Harrell 1994). In addition, the arsenal was responsible for the standardization of new designs for artillery fuzes and for the development of nose and tail-bomb fuzes. Arsenal personnel also improved the design of artillery primers, trench mortars and rounds of chemical and tracer ammunition. The Research and Chemical Branch developed fuze powders, primer mixtures, pyrotechnic compositions, propellant compositions, and new high explosives. Picatinny's mission also called for the development of new munitions designs utilizing the latest technology and, in the event of a national emergency, to provide private industry with production plans and testing. For example, during the 1930s, researchers at DuPont and Picatinny developed flashless, non-hygroscopic (i.e., non-water absorbent) powders or FNH. DuPont developed M1 powder, and Picatinny developed M3 powder, both of which were tested for composition and specific weapons at the arsenal (Thurber and Norman 1983:29; Green et al. 1990; Kaye 1978).

During World War II, many important advances, new products or simplified methods of production were made at the arsenal in its newly constructed laboratories and testing facilities. As the importance of Picatinny's research and development (R&D) activities grew, more emphasis was placed on this function, which it would retain after the war. In one year the job-training methods, research projects, and improved work developments originating at Picatinny and passed along to other plants saved the United States more than $30 million (Kaye 1978). While expanding production capabilities to meet the munitions requirements of fighting a two-front war, the arsenal continued to conduct research on tetryl manufacturing and nitrocellulose powder. It also provided explosives and powder production training to both civilian and military personnel.

The responsibility of the Mechanical Branch of the Technical Division was the development and design of ammunition and special bombs for specific jobs. During the war, a number of special components were designed and tested at Picatinny, including both aboveground and long-delay bomb fuzes. In addition, the Mechanical Branch created pyrotechnic devices, such as flares and signals (Thurber and Norman 1983:32-33; Kaye 1978; Fitch and Glover 1990:B/179-183). One of the most important bombs developed for a particular need was created to blow up the Ploesti oil fields in Romania, a vital source of oil for Nazi forces. The bombs created by Picatinny for this mission obliterated the Ploesti installations (Kaye 1978).

In addition to the development and evaluation of new explosives, the Chemical Engineering Section, part of the Technical Division, was responsible for improvements in the performance of regularly used, standard military explosives. The invention of haleite, named for Dr. George C. Hale, chief chemist at Picatinny, is regarded as its most significant accomplishment. Although just entering production at the end of the war, haleite (ethylenedinitramine or EDNA) could be press-loaded into small shells without a desensitizing agent and its derivative, ednatol, could be melt-loaded into large shells. Manufacturing problems, however, prevented haleite from being used in combat (Green et al. 1990; Thurber and Norman 1983:33). During research subsequent to the development of haleite, Picatinny's chemists created another explosive, PTX-2 (Picatinny Ternary Explosive), a combination of PETN (pentaerythritol tetranitrate), RDX ("Research Department Explosive") and TNT (trinitrotoluene). Preliminary firings at the arsenal revealed that it was adaptable to shaped-charged ammunition, although by the end of the war PTX-2 was still in the testing stage (Green et al. 1990).

During the war, Lake Denmark Powder Depot continued to operate as the Navy's propellant and projectile storage area (Fitch and Glover 1990:B/179-183). Several sources suggested that the 3400 Area of the Lake Denmark Depot was built to house prisoners-of-war, but no evidence has been located to document whether prisoners-of-war (POW) were ever held there (Thurber and Norman 1983; Fitch and Glover 1990:B-183) and it appears likely that no POW were ever held there.

The post-war years were marked by both the Cold War with the Soviet Union and hot wars in Asia and the Middle East. During this period, Picatinny continued as a center for R&D for new weapons systems and advances in the production process. Innovations in production processes and the development of new materials had occurred consistently at the arsenal over its history. These types of innovations increased after World War II and included development of photoflash cartridges and bombs, study of plastics and adhesives in the packaging of ammunition, research on warheads for the NIKE, HONEST JOHN, SERGEANT, and other nuclear and conventional missile programs, and production of a tank-piercing rocket for the 3.5-inch bazooka and an atomic shell for the 250-millimeter (mm) gun (Fitch and Glover 1990:B/182-184; Gaither 1997:94, 102).

After World War II, the Navy's Bureau of Aeronautics decided to establish a rocket-engine test center on the east coast, and initiated modifications to the existing facilities at Lake Denmark. On July 1, 1948, the U.S. Naval Aeronautical Rocket Laboratory (NARL) was established there. Less than two years later, the Naval Ammunition Depot was officially disestablished and the NARL was redesignated the Naval Air Rocket Test Station (NARTS) on April 1, 1950. All physical facilities of the former Lake Denmark depot were made a part of NARTS. As it evolved, NARTS had three major work categories: qualification tests, preliminary investigations and technical services, all of which were included in its mission "to test, evaluate and conduct studies pertaining to rocket engines, their components and propellants" as assigned by the Chief of Naval Operations (U.S. Department of the Navy 1997a, 1997b; Nolte et al. 1999c).

Prior to 1950, the NARL had a number of temporary test stands at which the Navy had tested the rocket engines for the Douglas SKYROCKET, the Bell X-1, and the LARK. It also had a large test stand for the development of the 20,000 lb-thrust Viking engine, the Consolidated-Vultee MX-774 (a preliminary Intercontinental Ballistic Missile [ICBM]), and for certain other tests on the SKYROCKET. By the 1950s, the station consisted of 760 acres and represented a multimillion-dollar investment.

The history of NARTS is intimately associated with the history of Reaction Motors, Inc. (RMI). RMI was formed in 1941 and was the first enterprise devoted to the commercialization of the rocket engine (Shesta 1978; Nolte et al. 1999c). By the middle of 1946, all of RMI's activities had been transferred to Lake Denmark, where a construction program for rocket test stands was underway. By 1958, RMI and Thiokol Chemical Corporation merged and RMI became a division within the company (RMD). In 1956, RMI was awarded the contract to develop the XLR-99 liquid rocket engine for eventual use in the X-15. The initial testing, including test firings, of that engine was conducted at Lake Denmark, much to the displeasure of the local residents. In 1960, the Navy decommissioned NARTS and the facilities became part of Picatinny Arsenal under the Ammunition Development Division of the Ammunition group at Picatinny. Renamed the Liquid Rocket Propulsion Laboratory, the entire facility was leased almost immediately to the Thiokol Chemical Corporation, RMD. As a result of changes in the rocket industry during the 1960s, RMD at Lake Denmark was shut down by 1972. The rocket test areas of the Lake Denmark site were abandoned to the Army and have been largely unused since, except as backdrops for training exercises (Shesta 1978; Nolte et al. 1999c; U.S. Department of the Navy 1997c).

By 1977, most production of weapons and ammunition had ceased at the arsenal and its activities focused on R&D. At that time the Army established the U.S. Army Armament Research and Development Command (ARRADCOM), headquartered at Picatinny, to be responsible for developing new and improving old weapons and munitions. In 1983, ARRADCOM was disestablished and its mission was transferred to the Armament, Munitions and Chemical Command (AMCCOM), Rock Island Arsenal, Illinois. The munitions and weapons R&D activities remaining at Picatinny were renamed the U.S. Army Armament Research and Development Center (ARDC). In 1986, ARDC was renamed the U.S. Army Armament Research, Development, and Engineering Center (ARDEC) with its headquarters at Picatinny. ARDEC was transferred from AMCCOM to the Tank-Automotive and Armaments Command (TACOM) in 1994. Representing the technical expertise of the U.S. government in guns and ammunition of all sizes, from pistols to howitzers, ARDEC played an essential role in developing items and technologies as diverse as warheads, gun fire control, mines, and smart ammunition, among other responsibilities (ARDEC 1995). In the mid-1990s, over 1,000 buildings were spread out over Picatinny's nearly 6,500 acres, making Picatinny "the largest Army installation devoted solely to research and development" (STV/Lyon Associates, Inc. 1994). In 2003, ARDEC was transferred from TACOM to the U.S. Army Research, Development and Engineering Command (RDECOM). As the Army's "Center of Lethality," ARDEC at Picatinny is "the Army's principal researcher, developer and sustainer of current and future armament and munitions systems" (ARDEC 2006).

3. The Army in Space: After World War II, the U.S. military became a leader in the development and use of space for weapons and communications. The U.S. Army played a significant role in the early stages of the American space program developing rockets and satellites, many of which were transferred to the National Aeronautics and Space Administration (NASA) after it was created in 1958. The first U.S. satellite was launched into orbit by an Army REDSTONE rocket (Space Division, HQ 1993). The first U.S. tactical nuclear weapon, the HONEST JOHN rocket, was developed by the Army (Redstone Arsenal 2000a), and world's first operational, guided, surface-to-air missile system, the NIKE AJAX, was deployed by the Army (Combat Air Museum 2007a). Picatinny played a role in all of these "firsts."

Although theoretical work had been laid down by others before them, primarily by Konstantin Eduardovich Tsiolkovsky, a Russian pioneer in rocket and space science development, and Robert Hutchings Goddard, father of U.S. rocketry, German scientists and engineers were the first to develop and use guided missiles. Throughout the 1920s and 1930s, Walter Hohmann, an engineer who defined the principles of rocket travel in space, guided the German rocket program, which launched its first successful liquid propellant rocket in the early 1930s (Space Division, HQ 1993).

In 1932, Dr. Wernher von Braun has hired by the German Army to develop liquid propellant rockets, which led to the creation of the Aggregate or "A" series of rockets that achieved an altitude of 1.5 miles. In 1937, von Braun and his colleagues moved to an area off the Baltic coast near the small town of Peenemünde in northern Germany to escalate their rocket work for war weaponry. Von Braun and his team created larger rockets and began working on the first A4 rocket (Space Division, HQ 1993).

In October 1942, after a number of failures, the first A4 rocket was successfully launched, flying a programmed trajectory and impacting 120 miles down range. This event is considered by some the beginning of the Space Age because the A4 is the ancestor of practically all U.S. and Soviet space launchers after World War II. The A4 was originally intended for use in attacks on the rear battlefield area beyond the range of conventional artillery, but it evolved into something entirely different. The A4 became the V-2 (*Vergeltungswaffe zwei*, “Vengeance Weapon 2”), a ballistic missile weapon that had a range of 200 miles and carried a one-ton explosive warhead (Space Division, HQ 1993).

In 1943, German Führer Adolf Hitler authorized the full-scale development of the V-2, with mass production of the weapon beginning later that year in an underground factory in the Harz Mountains. On September 7, 1944, the first V-2 was launched against England. Before the war was over, 4,300 V-2s were launched against Great Britain, Belgium and other Allied targets. The Allies were powerless against the rockets since they did not have any weapons that were able to intercept them. The V-2 fell silently on its target at a maximum speed of about 5,200 feet per second (approximately 3,600 miles per hour); it was the most sophisticated and capable rocket that had ever been developed (Space Division, HQ 1993).

As the war was ending, von Braun and his team were in a small town near the Austrian border with elements of the advancing U.S. Seventh Army only a few miles away. Von Braun and his men surrendered to the U.S. Army. When the war in Europe ended on May 7, 1945, the Army began to collect all the V-2s, V-2 components, technical documents, and all German technical personnel they could in order to outflank the Russians. The Russians did manage to capture a considerable amount of V-2 hardware, including the actual Peenemünde launch complex and several remaining scientists and technicians (Space Division, HQ 1993).

During World War II, the U.S. military had not been standing still on the development of rockets and missiles. In 1943, the Army established the Ordnance Rocket Branch (ORB) to centrally manage the development of rockets. In 1944, the ORB contracted with the California Institute of Technology’s (CIT) Jet Propulsion Laboratory (JPL) to study rocket propulsion and develop long-range surface-to-surface rockets (Project ORDCIT). A total of 24 solid propellant rockets were tested at Fort Irwin, California, under this program, leading to the development of the

PRIVATE, CORPORAL, and BUMPER rockets. These development systems never reached operational testing (Space Division, HQ 1993).

Also in 1944, the Army developed White Sands Proving Ground (WSPG), New Mexico, north of Fort Bliss, Texas, to provide more area for longer range testing. Between 1945 and 1948, Fort Bliss was involved in "Operation PAPERCLIP," the relocation of 492 German and Austrian rocket scientists, their equipment, and documents to the United States. The Army received 177 of these individuals, including Wernher von Braun, and was responsible for another 38 working for the Commerce Department. Fort Bliss became the U.S. Army Ordnance Research and Development Rocket Sub Office (Space Division, HQ 1993; Hughes 1990).

After the war, military funding decreased dramatically and many in the War Department were reluctant to fund what they considered experimental programs, such as large rocket weapons. The need to modernize conventional weaponry, such as jet airplanes, tanks, and submarines, seemed to take precedence. Nevertheless, people within the military establishment continued to push for rocket development and extended space exploration. The concept of artificial synchronous communication satellites seized the imagination of the public, and some in the military viewed it as a virtual communications certainty for which they sought funding (Space Division, HQ 1993).

In January 1946, scientists at the Army Signal Corps at Fort Monmouth, New Jersey, bounced radio signals off the moon and received the reflected signals back, proving that radio transmissions could penetrate the atmosphere and return to earth. About the same time, studies and proposals were prepared urging the development of artificial satellites. Despite the potential utility of the project, development of a satellite was not immediately pursued (Space Division, HQ 1993).

On April 16, 1946, the Army launched its first reconstructed V-2 from WSPG, which carried instruments in the nosecone that were recovered after dropping by parachute. In January 1947, the Navy asked the Joint Aeronautical Research and Development Board, an oversight committee composed of the Navy and Army Air Forces personnel, for authority over American satellite development. In June of that year, the board asked the War Department for authority to fund studies related to satellites. However, in 1947, the National Security Act established the National Military Establishment (NME; the Department of Defense [DoD] was not created as such until August 1949), reorganizing the U.S. military establishment and creating the Air Force as a separate service with resources primarily from the Army Air Corps. In September, the NME assigned responsibility for the development and control of defense satellites to the Joint Aeronautical R&D Board (Space Division, HQ 1993; Hall 1992).

Nevertheless, by 1948, James V. Forrestal, the first Secretary of Defense, felt it necessary to specify the roles and missions of each of the services in relationship to rockets and space, especially during a period of limited budgetary expenditures. The Army could develop tactical and Intermediate Range Ballistic Missiles (IRBM), including responsibility for antiaircraft guided missiles and ground-launched, short-range, surface-to-surface guided missiles supporting or extending conventional artillery capabilities; the Air Force was responsible for ICBM; and the Navy would develop ship or Submarine Launched Ballistic Missiles (SLBM). The struggle among the services for funding was exacerbated when the Air Force claimed the rights to satellite development as an extension of strategic air power. The Navy dropped its claims for satellite oversight (Redstone Arsenal 2000b; Space Division, HQ 1993; Hall 1992).

Regardless of the funding and maneuvering ploys, the Army moved forward in its rocket program. On February 24, 1949, Bumper Round 5, fired at WSPG under the direction of von Braun, marked the first penetration of outer space by an American missile (Redstone Arsenal 2000b). In that same year, the Secretary of the Army transferred the Ordnance Research and Development Division Sub Office from Fort Bliss to Redstone Arsenal. Von Braun and his team moved to Huntsville, Alabama. In addition, safety restrictions at WSPG became a problem for testing large rockets and the testing range was relocated to an isolated place on the east coast of Florida, later developing into Cape Canaveral (Space Division, HQ 1993). More ominously, an American weather plane over the Pacific Ocean detected radioactive particles in the atmosphere in September 1949, indicating that Soviets had tested their own atomic bomb. This development set off an atomic weapons race that lasted almost 50 years, adding more chill to the Cold War.

During the early 1950s, the sharp-elbowed rivalry among the military services over their respective roles during the Cold War carried over into the efforts to develop rockets and missiles. Changing roles after World War II brought about by new technology (e.g., airplanes, atomic bomb) compounded by budgetary priorities raised the Air Force’s stature at the expense of the Army's. This shift was enhanced by the policies of the administration of President Dwight Eisenhower, beginning in 1953. His "New Look" budget for the Army for Fiscal Year (FY) 1955 was barely half of its allocation in FY 1953, and it would receive the smallest allocations of the three services during the 1950s (Bacevich 1986:20). The intellectual environment of the period reinforced policy decisions that emphasized high-technology applications to military problems and was seasoned by reports published by RAND. These reports speculated on the use of commercial television technology for military satellites to gather intelligence and weather data (1951) and advocated Air Force use of imaging satellites to gather strategic intelligence (1954) (Space Division, HQ 1993).

To rebut the charges that conventional warfare was obsolete in the Atomic Age, Army policymakers emphasized their lead in missile development, and promoted its high-technology endeavors, such as the space program, to capture public imagination. In its efforts to assert control over the development of rockets and missiles, the Army supported three missile programs, each focused on a different problem: air-defense weapons, including surface-to-air missiles (SAMs); tactical surface-to-surface missiles (SSMs); and space exploration with the goal of orbiting a satellite. However, the Air Force and the Navy were also eager to obtain this technological responsibility (Bacevich 1986:16-21, 74-75; Gaither 1997:14, 23-24).

In its rivalry to develop SAMs, the Air Force argued that the Army was intruding into areas of Air Force responsibility, abrogating the 1948 Key West agreement, which outlined the functions of the armed services in the new NME. At that time, the Air Force was assigned the task of developing long-range missiles; however, the Army was allowed to continue its research on the SKYSWEEPER, a radar-directed automatic cannon. By the early 1950s, the Air Force was working with the private sector on the BOMARC missile and the Army was testing the NIKE AJAX. The NIKE won the bureaucratic battle over the BOMARC and was fielded in 1954, but its lack of range and firepower made it quickly obsolete. By 1956, the more nuclear-capable NIKE HERCULES was under development in competition with Air Force-Navy TALOS. To quell the debate, the DoD, in November 1956, assigned the Army jurisdiction of SAMs with range up to 100 miles. By 1960, the Army had two more missiles under development: the HAWK and NIKE ZEUS (Bacevich 1986:77-80; Gaither 1997:23-24; Combat Air Museum 2007a).

The Army's work on SSMs led to the creation of the 280mm Atomic Cannon, which was developed at the arsenal, but its large size and lack of range made it obsolete immediately. Also in 1953, the Army fielded the CORPORAL missile, the first operational guided missile of the Army and the first guided missile approved for a nuclear warhead. It had a range of 75 miles. During the 1950s, the Army was developing the REDSTONE rocket as a tactical ballistic missile; the Navy was working on the VANGUARD rocket; and the Air Force was developing the ATLAS rocket as an ICBM (Combat Air Museum 2007b; Space Division, HQ 1993).

The development of rockets and missiles had dual implications; one path involved tactical weapons and focused on battlefield developments and defense against attacks, while the other involved more strategic goals of space exploration and research, communication and intelligence-gathering satellites. In 1950, the Army consolidated its rocket and missile development program, relocating von Braun's scientists and engineers from Fort Bliss to Redstone Arsenal. As a result, Redstone's mission was expanded to include "antiaircraft missiles, rocket launchers, and solid propellants, the latter two programs to be carried out in cooperation with Rock Island and Picatinny Arsenals" (Hughes ca. 1995). During the period between 1950 and 1958, Army personnel at Redstone Arsenal directed the REDSTONE, CORPORAL, NIKE, HAWK, LACROSSE, HONEST JOHN, SERGEANT, LITTLE JOHN, and REDEYE missile/rocket development programs. Arsenal scientists played a prominent role in the development of warhead sections (including the explosive payload, fuzing devices, and the arming and safety mechanisms) for all of these programs as well as the PERSHING, SAM-D, LANCE, and SAFEGUARD systems (Gaither 1997:94, 102; Kaye 1978).

The revelations that the Soviet Union had not only produced a hydrogen bomb in 1953 but were developing a ballistic-missile delivery system capable of reaching the United States enlivened the American effort to develop a ballistic missile. A 69-foot (ft) tall REDSTONE rocket was successfully launched from Cape Canaveral, Florida, in August 1953. The REDSTONE would serve initially as a space launcher and, by 1956, as a tactical ballistic missile (deployed in Germany). Despite the success of the REDSTONE, the president elevated development of the ATLAS ICBM project as the government's number one priority in 1955. (The ATLAS would not become operational until the late summer of 1959.) The Army Ballistic Missile Agency (ABMA) was established in 1956 at Redstone "to oversee the Army's ballistic missile program, the first agency devoted exclusively to the development of ballistic missiles" (Gaither 1997:24). The agency was responsible for the REDSTONE, JUPITER, and PERSHING (IRBM) missile programs (Hughes ca. 1995).

Closely related to the American missile-development program was its satellite-development program, since the rockets used to propel a warhead at an enemy were also the same ones that could be used to send a satellite into orbit. By the 1950s, manned reconnaissance over enemy territory was vulnerable to increasingly accurate air defense missiles, so development of reconnaissance satellites was essential to intelligence-gathering and monitoring activities in the Soviet interior. However, no international agreement had been negotiated on the right of free passage of satellites over another nation's territory. President Eisenhower advocated a policy of "Open Skies," which would permit the United States and Soviet Union to conduct aerial reconnaissance flights over each other's territory to verify that the other was not preparing to attack. Cold War suspicions led Soviet General Secretary Nikita Khruschev to reject Eisenhower's proposal. President George H.W. Bush reintroduced this concept 34 years later, in 1989, as a means to build confidence and security between North Atlantic Treaty Organization (NATO) and Warsaw Pact countries (Space Division, HQ 1993; Hall 1992).

The inter-service rivalry that was characteristic of the period was also fierce in the field of launching satellites: the Army advocated the use of a modified REDSTONE rocket with a solid fuel upper stage; the Air Force proposed using an ATLAS ICBM, although it had yet to field one; and the Navy advanced its VANGUARD rocket, also in development. The administration, sensitive to the appearance that the launch of a military-sponsored satellite would destabilize the tense Cold War political environment, selected the Navy-National Science Foundation VANGUARD to launch the first U.S. satellite because it was more closely linked to the research community (Space Division, HQ 1993; Hughes 1990; Hall 1992).

Although the Air Force's ATLAS received high priority for development as an ICBM and the Navy's VANGUARD was chosen to launch the first American satellite, the Army was allowed to continue research on its JUPITER rocket for use as an IRBM. By September 1956, the Army realized that its modifications to the JUPITER's motor as well as the use of solid propellant could allow the placement of a small satellite in orbit by the end of 1956, ahead of VANGUARD. Despite the capability, the Army was ordered not to launch such a satellite.

Nevertheless, in 1956, the Soviets announced their intention to place a satellite in orbit as part of the International Geophysical Year 1957-1958. Almost as a precursor to the satellite launch, the Soviets successfully conducted a launch of their first ICBM in August 1957. Several months later, in October, the Soviets launched Sputnik, the first artificial satellite, and truly ushered in the Space Age. The administration viewed the launch of Sputnik as advancing the "Open Skies" concept, since the Soviets couldn't protest American surveillance satellites flying over other nations if the Soviets did it first (Begley 2007; Hall 1992).

Despite advanced warning and intelligence revealing Soviet intentions and its own ability to launch a satellite, administration critics and politicians, pandering to fears of the general public, played up the non-existent technology gap. With this launch, they argued, the Soviets demonstrated that they not only possessed nuclear weapons but also had the means to deliver them against targets in the continental United States for which the United States had no defense. On November 3, 1957, Soviet scientists launched Sputnik 2, which carried a live dog, named Laika. The Eisenhower Administration, unconcerned by the satellite launch, had miscalculated the blow to national pride and prestige. To counter the negative publicity after the launch of Sputnik 2, the VANGUARD program, which had endured delays and test failures, was accelerated and the Army was directed to orbit a satellite by March 1958. However, American technological prestige was wounded further when a Vanguard launch in December 1957 fell back to the pad and erupted in flames (Begley 2007; Space Division, HQ 1993; Hall 1992).

By the end of 1950s, the initial fragmentation of the American space program as a result of inter-service rivalries was replaced by a greater sense of organization with the creation of Advanced Research Projects Agency (ARPA) and NASA. Eisenhower created ARPA, a high-level DoD organization, to initially direct the U.S. space program and, in the summer of 1958, the National Aeronautics and Space Act was enacted which created the NASA. ARPA would maintain control of national defense space operations and focus on national defense R&D that would expand the frontiers of technology beyond the immediate and specific requirements of the military services, while NASA was responsible for non-military aeronautical and space research under civilian control. Initially, NASA's facilities came from the National Advisory Committee for Aeronautics (NACA), which was disbanded. The American space effort also began to achieve some success at this time when ABMA launched the first U.S. satellite—EXPLORER I—on January 31, 1958, using a JUPITER-C rocket (later, redesignated JUNO I). The data collected by this satellite led to the discovery of radiation belts in space around the Earth (i.e., the Van Allen belts). The successful satellite launch cemented the competence of Army missile developers in the American mind. A successful launch of a VANGUARD rocket finally occurred on March 17, 1958 (Space Division, HQ 1993; Hall 1992).

During this period, the Air Force continued development of ICBMs and the Navy continued its work on sea-launched rockets, although the Navy did transfer its VANGUARD project and part of the Naval Research Laboratory to NASA in November 1958. The Army continued research on IRBMs. Gradually, non-military, space-related missions were transitioned to NASA, while weapons-related missions were transitioned to the Army Ordnance Missile Command at Redstone, including development of the solid propellant for the PERSHING rocket and the NIKE ZEUS program. By October 1959, ABMA engineers and scientists were transferred to NASA, including the development program for the SATURN rocket, the EXPLORER satellite program, and the JPL in California. Nevertheless, final approval of the Army-NASA transfer enabled ABMA personnel to work on military weapons systems for the Army as well as independent space vehicle R&D for NASA (Hughes 1990, ca. 1995; Space Division, HQ 1993). NASA established the George C. Marshall Space Flight Center at Redstone Arsenal, Alabama, in the spring of 1960, and by July 1, with the transfer of ABMA responsibilities to the Marshall Space Flight Center, all of the Army's space missions passed to NASA (Hughes 1990). Subsequent to the Army reorganization in 1962, missile R&D was subsumed under the Army Missile Command (MICOM), a subordinate command of the U.S. Army Materiel Command.

ARPA's initial emphasis included space, ballistic missile defense, and nuclear test detection. In 1960, all of its civilian space programs were transferred to NASA and the military space programs to the individual services. This allowed ARPA to concentrate its efforts on the DEFENDER (defense against ballistic missiles), Project VELA (nuclear test detection), and AGILE (counterinsurgency R&D) Programs, and to begin work on computer processing, behavioral sciences, and materials sciences. The

DEFENDER and AGILE Programs formed the foundation of ARPA sensor, surveillance, and directed energy R&D, particularly in the study of radars, infrared sensing, and x-ray/gamma ray detection (Space Division, HQ 1993). The Army satellite program was directed by Signal Research and Development Laboratory (SRDL) at Fort Monmouth, where ARPA was also located. SRDL developed the Signal Communications by Orbiting Relay Equipment (SCORE) satellite, which was launched in December 1958.

The Army's significant contributions to the U.S. space program during the last years of the 1950s included:

- successfully solving the problem of ballistic missile reentry (August 1957);
- placing four satellites into orbit between 1958 and 1960 (EXPLORER I, II, III, IV);
- launching the United States' first lunar probe (PIONEER III) and first solar satellite (PIONEER IV);
- launching three primates into space, although only two were recovered alive;
- beginning R&D for a 1.5-million-pound-thrust booster rocket for a lunar exploration vehicle (SATURN, an ARPA project); and
- initiating research on the launch vehicle that would carry the first men into space (Hughes 1990).

By the beginning of the 1960s, the NASA's manned space program had begun, which captured the public's imagination. As a precursor, Mercury 1, an unmanned capsule, was launched by a REDSTONE rocket on a suborbital flight on December 9, 1960. Despite advances in the U.S. space program and the success of hypersonic flight by American test pilots, Soviet cosmonaut Yuri Gagarin became the first man in space on April 12, 1961. Less than one month later, American astronaut Alan Shepard became the first American to make a suborbital flight on May 5, 1961. His Mercury 3 capsule called Freedom 7 was launched by a REDSTONE. On July 21, 1961, astronaut Virgil Grissom made another suborbital Mercury mission launched by the Army's REDSTONE. John Glenn became the first American to orbit the earth on February 20, 1962, in the Mercury 6 capsule launched on an ATLAS D rocket (Space Division, HQ 1993).

In the field of space probes and satellites, ABMA launched the PIONEER III lunar probe (December 6, 1958), which did not reach the moon, and EXPLORER VII for NASA (October 13, 1958) using an Army-developed JUNO II rocket (a SERGEANT missile as top stage on a JUPITOR first stage). The technology applied in the JUNO II rocket was important in the subsequent deep-space explorations by RANGER, MARINER, VIKING, and SURVEYOR spacecraft. Other Army satellites included VANGUARD 2 (launched February 17, 1959); DISCOVERER I, the first polar orbiting satellite (February 28, 1959); PIONEER IV, launched by JUNO II to orbit the sun; TIROS (Television Infrared Observation Satellite) I (April 1, 1960) and II (November 23, 1960); and COURIER 1B (October 4, 1960). In 1961, the DoD assigned the mission of managing and operating U.S. military space launch vehicles and satellites to the Air Force (Space Division, HQ 1993).

By the early 1960s, the Army's role as a developer of communication payloads in satellite systems was taken over by the Defense Communications Agency (DCA). And, in 1962, the U.S. Army Satellite Communications Agency was organized at Fort Monmouth, New Jersey, which was responsible for ground terminals and ground support for space systems (Space Division, HQ 1993).

4. Rocket Test Area Historic District, Picatinny Arsenal: This area, which has gone by a number of names including the Rocket Propellant Power Plant (late 1940s), the Liquid Rocket Propulsion Laboratory Test Area (early 1960s), and the 1500 Area (present), is a 20-acre site off Lake Denmark Road off the installation proper. The area is divided into two parts, the Western Explosives Area and the Eastern Pyrotechnics Area. The western area was constructed from the late 1940s through the 1960s and the eastern section from the early 1950s to the late 1950s. The 1500 Area is currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (Picatinny 2006).

Between 1948 and 1960 the U.S. Navy and Reaction Motors, Inc. (later Thiokol Chemical Corporation), the first commercial rocket company in the United Sates, were designing and testing rockets up to 350,000 lbs thrust as well as creating all types of “gray literature” (e.g., government reports) related to rocket design, chemical use, and standards for clothing, chemicals, equipment, etc., to be used in rocket work. All of this Navy rocket activity was taking place in the former NARTS, which was immediately north and east of the Army Rocket Area, less than one-half mile away. The interaction between the Army and the Navy is not known; however, in the early, heady days of rocket work, there were very few scientists and engineers with any expertise and it can be assumed that rocket information was shared in some way.

In the early years of Army rocket development, the numerous research activities and undertakings, such as component creation, modification, and testing or procurement, loading, and servicing, were farmed out to the Army installation that could best handle the required activity. This diversification was prominent for the other service branches as well. In the early years, a single rocket might actually represent the physical labor of several installations, such as Picatinny Arsenal, which might have developed the fragmentation device in the warhead, Frankford Arsenal, which might have created the fuzing device, and Aberdeen Proving Ground, where a determination of the optimum shape of the warhead might have been made (Combat Air Museum 2007a). This division of labor often caused problems, but the need and lack of other resources necessitated the division.

Picatinny participated in the creation of the following rocket/missile systems (organized by first launch, first experimental firing, or first working date):

CORPORAL	1947
LOKI	1951*
SAGE	1951*
HONEST JOHN	1952*
REDSTONE	1953*
NIKE AJAX	1954*
LACROSSE	1954
SHILLELAGH	1958*
NIKE HERCULES	1958
HAWK	1960
PERSHING I	1960*
LITTLEJOHN	1961
SERGEANT	1962
LANCE	1970
PATRIOT	1976
PERSHING II	1977

*work known to have been conducted in the historic district

It is probable that Picatinny also worked on other rocket/missile systems that have not yet been identified.

Rocket/Missile Systems. As noted above, blueprints (Facilities Engineering Division nda) and Real Property files (Directorate of Public Works [DPW] nd) demonstrate that the 1500 Area was involved in the testing of various components related to numerous rocket systems. A brief explanation of the rocket/missile/system and the work performed in the 1500 Area provides an overview of the types of activities undertaken at the site.

<u>LOKI</u>. Beginning in 1946, the Army conducted research on anti-aircraft, free-flight, unguided, rocket systems based on the German *Taifun* rocket. LOKI was first flown in 1951, but never saw service in its original role; instead, the Navy acquired them in 1955 and used them successfully as sounding rockets to measure high-altitude wind speed and direction until the mid-1960s (Bjork et al. 1957; Parsch 2005).

The solid-fuel rocket development and tests were overseen by many eyes including: Picatinny Arsenal, Redstone Arsenal, Frankford Arsenal, Watertown Arsenal, JPL, Fort Monmouth's Evans Signal Laboratory, Bendix Aviation Corporation, R. Hoe and Co., Inc., Grand Central Aircraft Cp., Thiokol Chemical Corporation, East Coast Aeronautics, Inc., Steuart-Harner Corporations, Horning-Cooper Corp., Westinghouse Electric Corp., American Machine and Foundry Co., Whitin Machine Works, the Dawns-Ratterson Corp., United Can Co., Chaffee Brothers, Philadelphia Ordnance District, Boston Ordnance District, and the New York Ordnance District (Bjork et al. 1957). Despite the number of organizations involved, Picatinny had a significant role in the development, testing and creation of LOKI.

Picatinny's first responsibility was for the technical supervision of LOKI fuze development, which was designed and developed by Eastman Kodak under Picatinny's supervision. The rocket motors also underwent extensive surveillance. Most importantly Picatinny was given the responsibility of loading and assembling the warhead with conventional high explosives. Because of production problems, Picatinny actually wound up loading and fully producing 30,000 LOKI rockets. Reports of the progress in the development of guided missiles, such as the HAWK and the NIKE AJAX, prompted the Ordnance Department to discontinue the

LOKI program. It is not clear what happened to the 30,000 LOKI that had been loaded at Picatinny Arsenal (Bjork et al. 1957; Federation of American Scientists [FAS] 1999).

Despite the importance of the project, blueprints and Real Property records are not specific about which buildings were used for the LOKI project. In most cases, projects are mentioned casually, which is the case with LOKI. A notation written on Blueprint SK-5373 indicated that Building 1560 (1954), a former Assembling Building, was relocated from the LOKI area. Unfortunately, at the time of Panamerican's field investigation, the Technical Library at Picatinny had sent out all of its early historical records, such as monthly reports and gray literature (e.g., technical reports) to be digitized. It is not clear, however, that this literature would have been helpful in deciphering which activities were actually happening in particular buildings.

SAGE*.* The Semi-Automatic Ground Environment (SAGE) system began life in 1951 as the Lincoln Transition System, a U.S. Air Force project with the Massachusetts Institute of Technology (MIT). Completed in the early 1960s, it revolutionized air defense by integrating radar and computer technology in the aid of air defense and contributed to the development of civilian air traffic control systems. Under SAGE, incoming targets (i.e., long-range bombers, missiles) tracked by remote radar were displayed instantaneously at central SAGE command centers, along with the target's speed, direction and altitude. With this information, air defense commanders could efficiently allocate their fighters to engage enemy aircraft. The Air Force also intended to incorporate long-range, surface-to-air missiles into SAGE. The SAGE system was used to direct BOMARC missiles, which were direct competitors to the Army's NIKE program. The SAGE control centers would not be replaced until 1979 (Lonnquest and Winkler 1996).

Although blueprints mention the program within the context of the 1500 Area, it is unclear what Picatinny was doing with a rival service's missile-tracking system. It is true that in the early years of the space program all the "rocketeers" talked and shared research with each other. The field was new and workers were gleaned from many different disciplines, necessitating the transfer of ideas and knowledge. Perhaps Picatinny had expertise in an area that the Air Force needed. Nevertheless, it is not clear what buildings were involved in this activity only that it occurred in the historic district.

HONEST JOHN. A simple, free-flight rocket capable of delivering a nuclear warhead, the HONEST JOHN was a highly mobile system designed to be fired like conventional artillery in battlefield areas. The HONEST JOHN was the United States' first tactical nuclear weapon and was considered a vital part of the Army's Pentomic battlefield. The system was first deployed in 1954 and was classified obsolete in 1982 (Redstone Arsenal 2000a; Silber 1958; Combat Air Museum 2007c; Cagle 1964).

Picatinny played a significant role in the research and creation of the HONEST JOHN. The installation's primary responsibility was for the warhead and fuzing system, including the adaptation kit. The Army was optimistic that the nosecone of the HONEST JOHN could also be adapted to hold a chemical warhead, but Picatinny discounted the feasibility of a chemical warhead (Kobialka 1959; Silber 1958).

Photographs of the Rocket Test Area Historic District from 1953 showed an HONEST JOHN being moved and in test position in Static Firing Test Bay No. 2, Building 1505. The rocket was hand-carried down a covered walkway, a typical Army industrial area feature, from Building 1503, a Conditioning Building, to the static firing area. The rocket was strapped to the stand in Static Firing Test Bay No. 2, Building 1505, where it was test fired. The squares on the wall are one-foot cubes that were used in conjunction with high-speed film to determine velocity.

Building 1505 was still extant at the time of the investigation and is a Test Cell.

REDSTONE. The year 1953 proved to be a banner year for Soviet achievement in space. In August, the Soviets tested their first hydrogen bomb and, later, U.S. intelligence sources revealed that the Soviet ICBM program was well on its way to becoming a reality. The assessment was that the Soviets were well ahead of the United States in the space race, resulting in a major shift in American policy toward the development of long-range ballistic missiles. Based on the experience of the V-2 and other rockets, the Army developed the REDSTONE rocket as both a tactical ballistic missile and a space launcher. The first launch of the REDSTONE was August 20, 1953 at the Army's Cape Canaveral (Space Division, HQ 1993). After the creation of NASA, the Army REDSTONE was modified for the Mercury (MR-2 and MR-3) program and was used successfully to carry first a chimpanzee and then a man into space (Hughes 1990).

Picatinny Arsenal, Aberdeen Proving Ground, Frankford Arsenal, and Watertown Arsenal, all played a role in the development of the REDSTONE rocket. Picatinny's primary responsibilities were the development of the adaptation kit, the radio proximity fuze, and the safety and arming mechanisms. It delegated the responsibilities for developing the radio proximity fuze and safety and arming mechanisms to the Diamond Ordnance Facility (Bullard 1965). It is not clear what type of warhead Picatinny was adapting for the REDSTONE, but it could have run the gamut from nuclear to chemical to some type of exotic hybrid high explosive (HE). Although blueprints and Real Property files reveal that work on the REDSTONE was completed in the historic district, it is not clear which specific buildings were involved.

NIKE AJAX. Developed by the Army as the world's first surface-to-air missile (SAM), the NIKE AJAX was rushed into production and deployed in battery systems around key urban, military, and industrial locations in 1954. By 1958, the Army had deployed nearly 200 NIKE AJAX batteries in these locations. Soon after, they were deactivated and replaced with the next generation NIKE HERCULES missile, which had a longer range and was nuclear-capable (Combat Air Museum 2007a).

The key contractor for the NIKE AJAX project was Western Electric, but Picatinny played an essential role in its production. The arsenal was chosen to develop the HE fragmentation device that would be placed in the warhead. The warhead was actually three HE fragmentation warheads mounted in the nose, center and rear of the missile body. Although consideration was given to arming the NIKE AJAX with a nuclear warhead, this aspect of the project was canceled in favor of developing a new and improved missile, the NIKE HERCULES (Air Combat Museum 2007a; Bender 2004; Cagle 1973). The NIKE AJAX system is mentioned in the blueprints and Real Property files within the context of the Rocket Test Area Historic District, but not specifically related to any particular building.

SHILLELAGH*.* An antiarmor missile system, the SHILLELAGH evolved from a requirement in 1958 for the development of weapon systems for use in combat vehicles for the "Pentomic" and future armies. The complete, combat-vehicle weapon system consisted of a SHILLELAGH direct-fire guided missile, a 152mm gun/launcher, conventional ammunition, and guidance-fired control subsystems. The SHILLELAGH was the primary armament on the M551 Sheridan Armored Reconnaissance/Airborne

Assault Vehicle and M60A2 Main Battle Tank. SHILLELAGH was first deployed in 1959 (Delong et al. 1984; Bacevich 1986).

This Pentomic weapon system included work by Picatinny Arsenal, Frankford Arsenal, Redstone Arsenal, the Ballistic Research Laboratories, Watervliet Arsenal, White Sands Missile Range, the Signal Corps, Ford Motor Company, Aeronautic Division, and Raytheon. Picatinny was responsible for the warhead and fuze-system development, motor propellant and igniter development, and gas generator propellant and igniter development.

Picatinny also was responsible for providing a propellant grain and igniter, which met the ballistic requirements for the missile within existing limitations and, most importantly, was compatible with the missile-guidance system. The guidance component required that the exhaust plume of the rocket motor not interfere with the transmission of infrared signals within the plume. These specifications posed severe limitations on propellant composition. After a thorough analysis of the types of solid propellants available, Picatinny selected a double-base type that was essentially smokeless at relatively low flame temperatures, which solved the problem (DeLong et al. 1984). Historical photographs reveal that various components of the SHILLELAGH were tested in the historic district. In particular, the SHILLELAGH's closed, breach-launch simulator was tested in Building 1505A, a Test Cell, which is extant and still used for testing.

<u>PERSHING I</u>. A solid-fuel, two-stage medium-range ballistic missile, the PERSHING I was designed and built by the Martin Marietta Company to replace the REDSTONE missile as the Army's primary theater-level weapon. It was named for General John J. Pershing and had its first test firing in 1960. The warhead could be a conventional explosive or a W50 nuclear warhead, yielding 400 kilotons of TNT. The PERSHING I firing platoon consisted of four M747 tracked-vehicles, while the REDSTONE needed twenty vehicles (Redstone Arsenal 2007).

The warhead for the PERSHING I was developed at Picatinny (Lonnquest and Winkler 1996) and components of the motor were tested there as well. In what is now Building 1505A (it was then identified as Static Firing Test Bay No. 4), the PERSHING underwent static spin testing. Building 1505A was extant at the time of the current investigation and was used for testing.

As noted, Picatinny also developed warheads for the CORPORAL, LACROSSE, NIKE HERCULES, HAWK, LITTLE JOHN, SERGEANT, PARTIOT, LANCE and PERSHING II missiles (Lonnquest and Winkler 1996). The LITTLE JOHN (also written as LITTLEJOHN) was the smallest nuclear-capable rocket the U.S. Army ever deployed. It was an air-transportable, unguided artillery rocket powered by an XM26 solid-fuel rocket motor and could be armed with either a conventional or nuclear warhead (Parsch 2002). The LANCE system was also a nuclear-capable system that could also be adapted with a conventional warhead. It was a field-mobile artillery missile system designed to attack key enemy targets beyond the range of cannon artillery and to reinforce the fire of other artillery units. The LANCE replaced the HONEST JOHN system. As can be surmised by the significant amount of nuclear work completed at Picatinny, the arsenal was considered a part of the U.S. Nuclear Weapons Complex (NWC) until well into the 1970s (Loeber 2002).

Activities occurring in the Rocket Test Area Historic District played a significant part of the United States' and the Army's initial forays into space. Picatinny served in key roles for some of the most important rocket programs and missile systems that were ever devised, including those programs that involved the adaptation of rockets to accommodate nuclear warheads. These rockets include the HONEST JOHN, REDSTONE, LITTLE JOHN and NIKE AJAX.

The construction dates of the buildings within the Rocket Test Area span a broad spectrum from 1946 to 1980, all of which fall within the Cold War period, 1946-1989. According to Army Cold War Guidelines (USACE, Fort Worth 1997) for deciding building/structure significance, the determination of significance is made only after a resource is shown to be important to one or more of the Army Cold War Themes. The Rocket Test Area meets two of the Army's broad themes—Technological Imperative, and Survival and Preparation for a Hot War. Specific Army themes that the area meets include: Mission Focus, Technology, and Militarization of Space.

These buildings were used to meet a perceived Soviet military threat and to influence Soviet objectives and policy through the development of rockets and missile systems that could and would militarize space or change the traditional battlefield into a nuclear one. The implied or actual use of nuclear war materiel is considered one of the most significant aspects of the Cold War (USACE, Fort Worth 1997). Certainly, the Rocket Test Area meets these criteria.

The Rocket Test Area Historic District, the 1500 Area, is eligible as a district for the National Register of Historic Places under Criterion A, contributing the broad patterns of history, and Criterion C, architectural/engineering features, as well as satisfying Criterion Consideration G, a property achieving significance within the past 50 years that is of exceptional importance. The buildings contributing to this district are:

1500 (1947)	Water Tower
1501 (1948)	Office
1502 (1948)	Ordnance Facility
1503 (1948/1956)	Conditioning Building
1504 (1956)	Storage
1504A (1948)	Conditioning Building
1505 (1948/1956)	Test Cell
1505A (1948)	Test Cell
1505B (1948)	Test Cell
1505C (1958)	Control House
1505D (1951	Test Cell
1505E (1966)	Control Spin Room
1505F (1959)	Storage
1505N (1948)	Open Blast Area
1506 (1954)	Loading Facility
1507 (1946)	HE Magazine
1507B (1959)	Storage
1508 (1955)	HE Magazine
1509 (1950)	Test Facility
1510 (1950/1967)	Pyrotechnic Building
1510A (1947)	Storage
1510B (1948)	General Storage
1511 (1952)	Neutralizing and Pump Station
1512 (1956)	Chemistry Laboratory
1512A (1958)	Flammable Material Storage
1513 (1968)	Pyrotechnic R&D Laboratories
1514 (1968)	Pyrotechnic R&D Laboratories
1515 (1961)	Physics Laboratory
1517 (1956)	High Altitude Test
1517A (1963)	Electric Equipment Facility
1519 (1956)	HE Magazine
1520 (1956)	HE Magazine
1521 (1960)	Component Propellant Building
1522 (1970)	Ordnance Facility

On the whole, these buildings have integrity and it is clear that they form testing/plant areas. The period of significance is 1946-1989, the Cold War.

Non-contributing buildings include:

1505J (1960)	Storage (truck trailer)
1505K (found on post)	Storage (truck trailer)
1518 (1958)	General Purpose Instrument Storage (derelict, has no integrity)
1527 (1960)	Barricade (derelict, has no integrity)
1528 (1963)	Barricade (derelict, has no integrity)
1529 (1964)	Warehouse
1530 (1990s)	Administration Building (constructed after period of significance)

5. Building 1510B: Although the 1500 Area is traditionally divided into the eastern and western sections, the area really consists of three distinct building groupings: Extreme Environment Testing Area, Testing Area, and the Storage and Laboratory Area. All of the 1500 Area, the Rocket Test Area Historic District, is enclosed within a chain-link fence. In addition, the Testing Area and portions of the Storage and Laboratory Area are also within chain-link fences. The Storage and Laboratory Area is located off Hart Road and includes Building 1510B, a general storage building.

Building 1510B, General Storage Building, Building 1510, Pyrotechnic R&D Laboratory, and Building 1501, an office, are grouped together behind a chain-link fence that was erected in 1966 (DPW nd). Portions of the fence are now missing and blueprints are unclear as to why these specific buildings were grouped together behind one fence. Traditionally, Building 1501 is grouped with the Testing Area as its Administrative Office Space. Generally, when buildings are placed behind a fence, or “enclosed” as it is called at Picatinny, it is because the work conducted or the items stored within them are dangerous or secret or both. Certainly, the Cold War (1946-1989) and rocket activities during that period were most times classified, so it is possible that mission work conducted here was secret as well as dangerous.

PART II. ARCHITECTURAL INFORMATION

A. General Statement:

1. Architectural character: Building 1510B, General Storage Building, has no particular architectural style. It is a simple, windowless building with a shed-style roof.

2. Condition of fabric: Deteriorated; the entire south, rear, wall of the building has fallen in.

B. Description of the Exterior:

1. Overall dimensions: The structure measures approximately 17'-3½" x 14'-2". The building has one story without a basement. It is a single-bay building that faces Hart Road.

2. Foundations: The foundation of the building is concrete.

3. Walls: The original walls were wood and covered in aluminum siding in 1968 (Picatinny 1968). The building has wooden eaves with wooden fascias and open soffits that slightly overhang the structure. The aluminum siding is white and the eave fascia is green.

4. Structural systems, framing: The building walls and roof are wood frame; the floor is concrete.

5. Openings:

a. Doorways: There is only one entry point for the General Storage Building: wooden double doors in the center of the front, north, façade. They have three upper light panels and three lower sunk panels. The doors, which were refurbished in 1968, are painted green and locked with a hasp and padlock.

b. Windows: The building does not have any windows.

6. Roof: The roof is flat, in the shed style, covered with rolled roofing material.

C. Description of Interior:

1. Floor plans: There are no original floor plans. However, a 1968 blueprint, which is included with this documentation, showed the floor plan as it was originally conceived (Picatinny 1968).

2. Flooring: The concrete foundation serves as the flooring.

3. Wall and ceiling finish: Neither the wall nor the ceiling are finished. The exposed framing can be seen for both.

4. Mechanical equipment: The building has no mechanical equipment. An aboveground, common steam pipe is routed to the building to provide heat. The building has electricity.

5. Lighting fixtures: The General Storage Building has two hanging metal light fixtures with flared covers typical of industrial lighting.

D. Site:

The General Storage Building, Building 1510B, is located on Hart Road in the Storage and Laboratory Area of the Rocket Test Area Historic District, the 1500 Area. The entirety of the 1500 Area is enclosed by a chain-link fence. At one point, the building and several others were enclosed by an additional fence. Only a small portion of the original fence remains across the front, north, of the building.

Across the front, north side, of the building runs a concrete sidewalk that is also connected to Building 1510, Pyrotechnic R&D Laboratory. The sidewalk passes by, but is not connected to, a square concrete pad that lies between Building 1510B and Building 1510. The General Storage Building, Building 1510B, is on a slight rise, so the broad entry to the building from the sidewalk is above grade. The sidewalk, which terminates at the front entry of Building 1510 to the west, begins to the east in a parking lot.

The properties surrounding Building 1510B include a square concrete pad with no number and Building 1510, Pyrotechnic R&D Laboratory on the west; an open, grassy lawn and a parking lot on the east; and a sidewalk and grassy front yard on the north that terminates at Hart Road. Across the road are a parking lot and a Water Tower, Building 1500. To the north of the building lies a wooded area that separates it from a number of pyrotechnic magazines. The wooded area serves as a type of blast protection and helps delineate use areas within the 1500 Area.

The Rocket Test Area Historic District within which the building lies is a 20-acre site off Lake Denmark Road and the installation proper. As noted, the area is divided into two parts, the western Explosives Area and the eastern Pyrotechnics Area. The western area was constructed from the late 1940s through the 1960s and the eastern section from the early 1950s to the late 1950s. Although the area is generally divided into two parts, there are actually three distinct groupings of buildings: the Extreme Environment Testing Area, the Testing Area, and the Storage and Laboratory Area. The 1500 Area is currently used for storage, assembly, research, development, and testing of high explosives, propellants, and projectiles (Picatinny 2006).

The boundary of the 1500 Area, Rocket Test Area Historic District begins at Lake Denmark Road at the west and extends easterly behind Buildings 1519 and 1520 to Building 1530 north of Hart Road. At Building 1530, it turns south and extends to encompass Buildings 1511, 1515, and 1513, east of Sage Place. From Building 1513, the boundary turns west and runs behind the buildings along the south side of Hart Road to the end of the chain-link fence, where the boundary turns north and extends to Hart Road. The boundary continues westerly along Hart Road to Lake Denmark Road (Nolte et al. 2007).

The area at the time of the investigation was mostly overgrown with vegetation and run down. Some of the buildings and structures are on the verge of being derelict. The majority of buildings/structures within the area were built in the 1950s and 1960s. Nevertheless, the whole area is still in an enclosure and is still a work site for a number of scientists and pyrotechnicians.

PART III. SOURCES OF INFORMATION

A. Architectural Drawings: The Directorate of Public Works (DPW), Picatinny, has a single blueprint related to Building 1510B, which was photographed and submitted as part of this document. It is easily accessed through the Picatinny Cultural Resource Manager and DPW.

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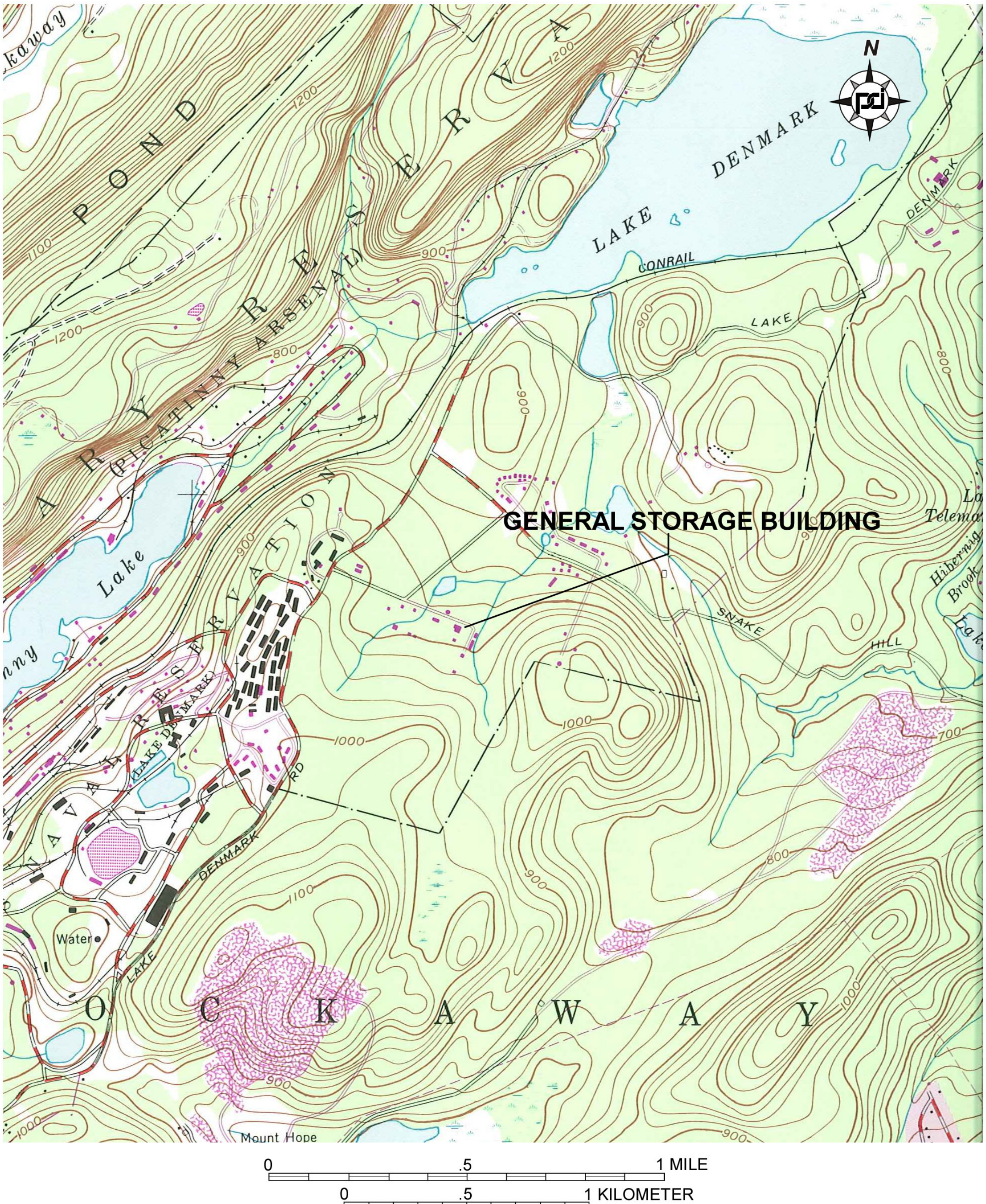
PART IV. PROJECT INFORMATION

The General Storage Building, Building 1510B, was recorded in August 2008 by Ms. Kelly Nolte, Director, Architectural History Division, Panamerican Consultants, Inc., Mr. Mark Drumlevitch, Photographer, Panamerican, and Mr. Mark A. Steinback, Panamerican. Ms. Nolte conducted the fieldwork, the historic research, and wrote the report. Mr. Drumlevitch was responsible for all the large-format photography. Mr. Steinback also conducted historic research and wrote a

portion of the report. The report was prepared under the supervision of Mr. Steinback. Dr. Michael A. Cinquino, Panamerican, was the Project Director.

The project could not have been completed without the help of many people at Picatinny. They include: Mr. Jason Huggan, Cultural Resources Manager; Mr. Jack Lyons, Real Property Specialist; Mr. Ken Klingamen, Test and Evaluation Engineer, 1500 Area; Mr. Russell Broad, Lead Technical Expert for Pyrotechnics, 1500 Area; Dr. Patrick Owens, Historian/Archivist; and a host of military police. Mr. Daniel Saunders at the New Jersey Historic Preservation Office, Trenton, was also helpful.



Location of the General Storage Building (Building 1510B), shown on a topographic map. Note: actual building not illustrated on map (USGS 7.5' Quadrangle, Dover 1954 [photorevised 1981]).

HISTORIC AMERICAN BUILDINGS SURVEY

INDEX TO PHOTOGRAPHS

GENERAL STORAGE BUILDING **HABS No. NJ-XXX**

Building 1510B
South side of Hart Road, east of intersection
of Hart Road and Lake Denmark Road
Rocket Test Area Historic District
Picatinny
Rockaway Township
Morris County
New Jersey

Mark Drumlevitch, Panamerican Consultants, Inc., Photographer August 2008

NJ-XXX-1 VIEW OF SOUTHEAST SIDE OF BUILDING 1510B, LOOKING NORTHWEST. NOTE BUILDING 1510 IN MIDDLE BACKGROUND.

NJ-XXX-2 VIEW OF NORTHEAST, FRONT, SIDE OF BUILDING 1510B, LOOKING SOUTHWEST. NOTE SQUARE CONCRETE PAD IN RIGHT MIDDLE GROUND.

NJ-XXX-3 OBLIQUE VIEW OF NORTH AND EAST SIDES OF BUILDING 1510B, LOOKING SOUTHWEST. NOTE SQUARE CONCRETE PAD IN RIGHT MIDDLE GROUND.

NJ-XXX-4 INTERIOR VIEW OF BUILDING 1510B SHOWING THE FALLEN REAR WALL, LOOKING SOUTHWEST.

NJ-XXX-5 VIEW OF SOUTH, REAR, WALL OF BUILDING 1510B, LOOKING NORTH.

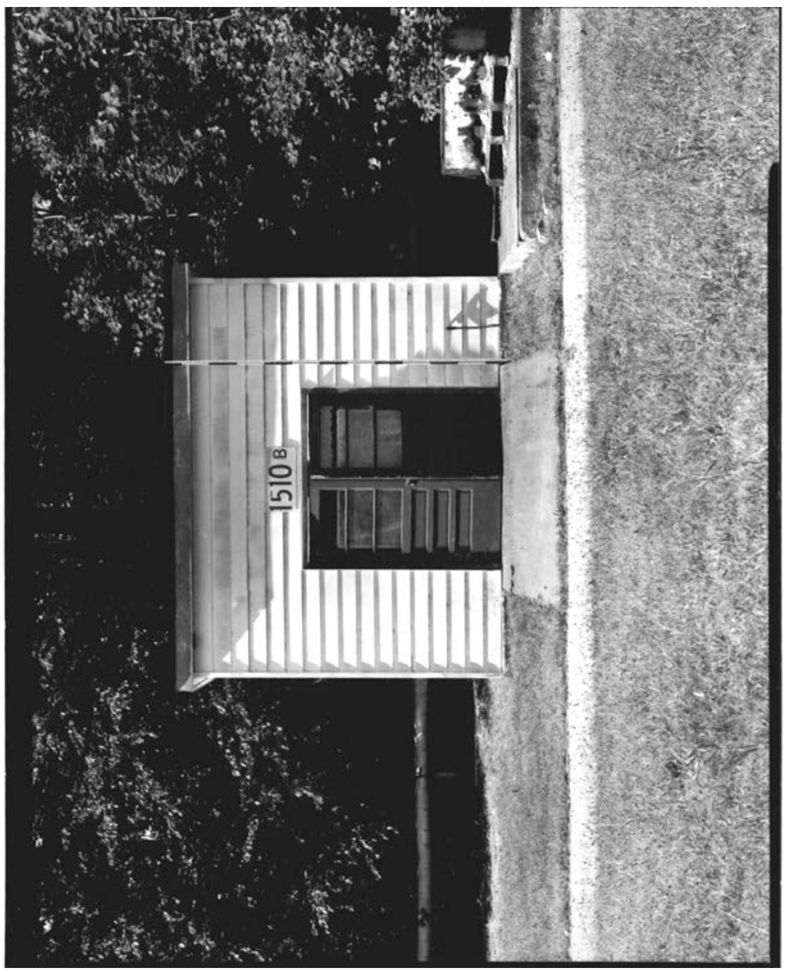
NJ-XXX-6 BUILDING 1510B, STORAGE, REPAIRS TO EXISTING STRUCTURE, PLAN AND DETAILS [BLUEPRINT], JUNE 28, 1968, DIRECTORATE OF PUBLIC WORKS, PICATINNY ARSENAL, NEW JERSEY.

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-1

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-2



HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

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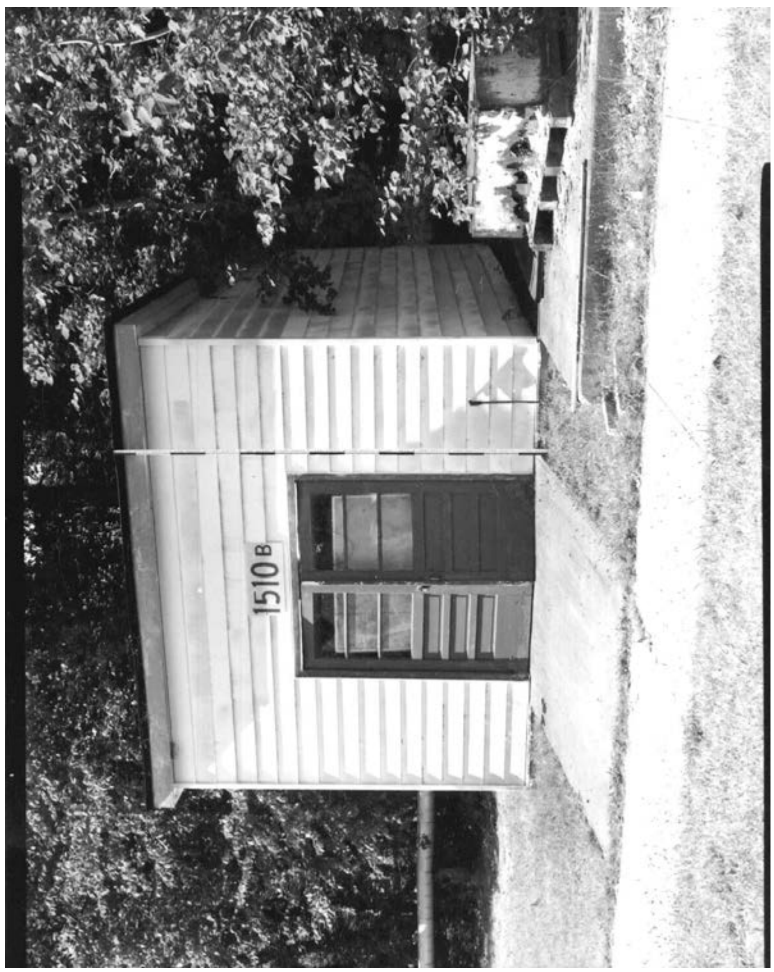


HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

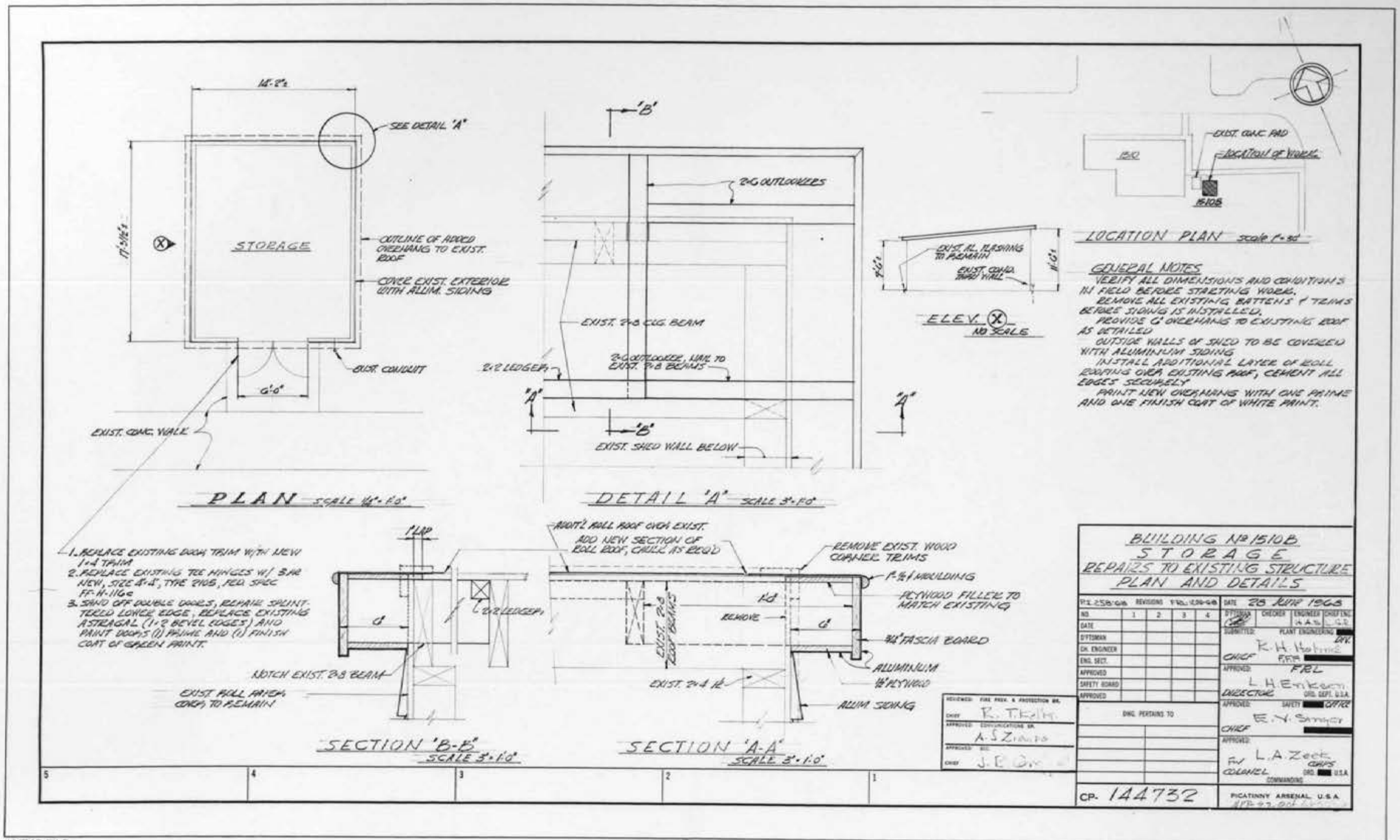
HABS No. NJ-XXX-4

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-5

HISTORIC AMERICAN BUILDINGS SURVEY
SEE INDEX TO PHOTOGRAPHS FOR CAPTION

HABS No. NJ-XXX-6
(SEE VERSO)


PLAN SCALE 1/4"=1'-0"
14'-2 1/2"
17'-3 1/2"
STORAGE
SEE DETAIL "A"
OUTLINE OF ADDED OVERHANG TO EXIST. ROOF
COVER EXIST. EXTERIOR WITH ALUM. SIDING
EXIST. CONDUIT
6'-0"
EXIST. CONC. WALK
1. REPLACE EXISTING DOOR TRIM WITH NEW 1×4 TRIM
2. REPLACE EXISTING TEE HINGES W/ 3 PR NEW, SIZE 4"×4", TYPE 2105, FED. SPEC FF-H-116c
3. SAND OFF DOUBLE DOORS, REPAIR SPLINTERED LOWER EDGE, REPLACE EXISTING ASTRAGAL (1×2 BEVEL EDGES) AND PAINT DOORS (1) PRIME AND (1) FINISH COAT OF GREEN PAINT.
DETAIL "A" SCALE 3"=1'-0"
2-6 OUTLOOKERS
EXIST. 2×8 CLG. BEAM
2×2 LEDGER
2-6 OUTLOOKER, NAIL TO EXIST. 2×8 BEAMS
EXIST. SHED WALL BELOW
"A"
"B"
ELEV. X NO SCALE
EXIST. AL. FLASHING TO REMAIN
EXIST. CONC. BASE WALL
LOCATION PLAN SCALE 1"=50'
EXIST. CONC. PAD
LOCATION OF WORK
1510
1510B
GENERAL NOTES
VERIFY ALL DIMENSIONS AND CONDITIONS IN FIELD BEFORE STARTING WORK.
REMOVE ALL EXISTING BATTENS & TRIMS BEFORE SIDING IS INSTALLED.
PROVIDE 6" OVERHANG TO EXISTING ROOF AS DETAILED
OUTSIDE WALLS OF SHED TO BE COVERED WITH ALUMINUM SIDING
INSTALL ADDITIONAL LAYER OF ROLL ROOFING OVER EXISTING ROOF, CEMENT ALL EDGES SECURELY
PAINT NEW OVERHANG WITH ONE PRIME AND ONE FINISH COAT OF WHITE PAINT.
SECTION "B-B" SCALE 3"=1'-0"
FLAP
2×2 LEDGER
NOTCH EXIST. 2×8 BEAM
EXIST. ROLL ROOF COVER TO REMAIN
SECTION "A-A" SCALE 3"=1'-0"
ADD'L ROLL ROOF OVER EXIST.
ADD NEW SECTION OF ROLL ROOF, CAULK AS REQ'D
REMOVE EXIST. WOOD CORNER TRIMS
1-5/8 MOULDING
PLYWOOD FILLER TO MATCH EXISTING
3/4" FASCIA BOARD
ALUMINUM
1/4" PLYWOOD
ALUM. SIDING
REMOVE
EXIST. 2×6 ROOF BEAMS
EXIST. 2×4
REVIEWED: FIRE PROT. & PROTECTION BR.
CHIEF R. T. Kelly
APPROVED: COMMUNICATIONS BR.
A. S. Zi...
APPROVED:
CHIEF J. E. ...
BUILDING № 1510B
STORAGE
REPAIRS TO EXISTING STRUCTURE
PLAN AND DETAILS
PI-258-68 REVISIONS FRL-120-68
NO. 1 2 3 4
DATE
D'FTSMAN
CH. ENGINEER
ENG. SECT.
APPROVED
SAFETY BOARD
APPROVED
DWG. PERTAINS TO
DATE 28 JUNE 1968
D'FTSMAN CHECKER ENGINEER CHIEF ENG.
SUBMITTED: PLANT ENGINEERING [redacted] DIV.
R. H. Holmes
CHIEF F.R.R. [redacted]
APPROVED: FRL
L. H. Eriksen
DIRECTOR ORD. DEPT. U.S.A.
APPROVED: SAFETY [redacted] OFFICE
E. V. Smyser
CHIEF [redacted]
APPROVED:
For L. A. Zeck
COLONEL CORPS ORD. [redacted] U.S.A.
COMMANDING
CP- 144732
PICATINNY ARSENAL, U.S.A.
5
4
3
2
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