ACKNOWLEDGMENTS

Many individuals at the Marshall Space Flight Center and the Redstone Arsenal contributed to the research and analysis presented here. The EDAW team especially wishes to thank Ralph Allen at Marshall for arranging access to buildings and structures, coordinating efforts among individual offices, and generally overseeing the project for the National Aeronautics and Space Administration (NASA). Mr. Allen’s provisions for a two-week pass to Marshall and Redstone greatly facilitated the team’s work, as did his special arrangement of weekend access to Marshall for outdoor photography. The NASA security office in Building 4312 provided the EDAW team members passes for their stay, also supporting their needs during the outdoor photography sessions after normal work hours. Preparation of the historic context, and assessment of buildings and structures against the significance criteria of the National Register of Historic Places (NRHP), would not have been possible without the involvement of the history offices at Marshall and Redstone. EDAW wishes to thank historians Mike Wright and Bob Jaques at the Marshall Space Flight Center History Office for opening their archive to the researchers, and for providing a work station for the research team. EDAW also wishes to thank historians Mike Baker and Dr. Kaylene Hughes at the Redstone Arsenal History Office for their parallel hospitality and professional assistance. Dr. Hughes additionally handled logistical issues such as sign-in access to the building housing their archive. Others at the Marshall Space Flight Center and Redstone Arsenal who helped make the project successful were Army cultural resource manager Carolene Wu, who graciously discussed the efforts of Redstone toward the assessment of arsenal historic properties, and who prepared materials for the EDAW team for comparison with their own analyses. In addition to research in the history offices and a review of comparable work completed for the Army, EDAW also thoroughly reviewed original drawings and site plans for buildings and structures at Marshall. To accomplish this lengthy task, team members worked in the civil engineering drawings vault of the Marshall Space Flight Center on a daily basis over two weeks, assisted there by vault manager Karen Francis. Above and beyond the call of duty, Ms. Francis came in over a weekend to allow the EDAW team to work a full extra day during their time at Marshall. In counterpoint, Reba Tyler in the civil engineering office at the Redstone Arsenal arranged access to drawings storage for the Army. Also essential to the assessment presented here was a review of the large collection of historic images archived in the Photographic Laboratory at Marshall. Freda M. Grant, and others at the laboratory, offered their very generous assistance. Both the Marshall Photographic Laboratory and the Redstone Arsenal History Office additionally made CDs of a sizable group of requested historic images for the EDAW researchers. For all others who assisted while the EDAW team worked at the Marshall Space Flight Center and the Redstone Arsenal, the researchers offer their sincere appreciation of efforts to make the work efficient, accurate, and enjoyable.

Document author Dr. Karen J. Weitze finally wishes to thank those individuals behind the scenes at EDAW San Diego, whose assistance made the project work well. These people include Beth Pittman, Judy Flint, Debbie Surrell, Marisa Fabrigas, and Dan Brady. Dr. Weitze also wishes to thank her San Diego EDAW team members Dr. James Cleland, Lori Lilburn, and Carrie Gregory. In the Huntsville EDAW office, Tuyet Bailey assisted in the logistical needs of the researchers, while Atlanta EDAW manager Ellen Heath served as a liaison for larger contract matters.
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<td>Army Ballistic Missile Agency</td>
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<td>ACC</td>
<td>Air Combat Command</td>
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<td>ACHP</td>
<td>Advisory Council on Historic Preservation</td>
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<td>AEDC</td>
<td>Arnold Engineering Development Center</td>
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<tr>
<td>AFCEE</td>
<td>Air Force Center for Environmental Excellence</td>
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<td>ARDC</td>
<td>Air Research and Development Command</td>
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<tr>
<td>ARPA</td>
<td>Advanced Research Projects Agency</td>
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<tr>
<td>AT</td>
<td>arsenic trichloride</td>
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<td>CFR</td>
<td>Code of Federal Regulations</td>
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<tr>
<td>CG</td>
<td>phosgene</td>
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<tr>
<td>CN</td>
<td>chloroacetophenone</td>
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<tr>
<td>CN-DM</td>
<td>chloroacetophenone-adamsite</td>
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<tr>
<td>DoD</td>
<td>Department of Defense</td>
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<tr>
<td>GOCO</td>
<td>government-owned, contractor-operated</td>
</tr>
<tr>
<td>GOGO</td>
<td>government-owned, government-operated</td>
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<td>HABS</td>
<td>Historic American Buildings Survey</td>
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<td>HE</td>
<td>high explosives</td>
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<td>HSL</td>
<td>Hardware Simulation Laboratory</td>
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<td>IBF</td>
<td>incendiary bomb filling</td>
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<td>ICBMs</td>
<td>intercontinental ballistic missiles</td>
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<tr>
<td>IRBM</td>
<td>intermediate range ballistic missile</td>
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<tr>
<td>L</td>
<td>lewisite</td>
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<tr>
<td>LAP</td>
<td>load, assemble and pack</td>
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<td>LOX</td>
<td>liquid oxygen</td>
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<td>MIT’s</td>
<td>Massachusetts Institute of Technology’s</td>
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<td>MOA</td>
<td>Memorandum of Agreement</td>
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<tr>
<td>MRBM</td>
<td>medium range ballistic missile</td>
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<td>MSFC</td>
<td>Marshall Space Flight Center</td>
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<td>NASA</td>
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<td>P&amp;E</td>
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<td>R&amp;D</td>
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<td>SAGE</td>
<td>Semi-Automatic Ground Environment</td>
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<td>SM</td>
<td>smoke munitions</td>
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<td>SSM</td>
<td>surface-to-surface guided missile</td>
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<tr>
<td>SSME</td>
<td>Space Shuttle Main Engine</td>
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<td>TVA</td>
<td>Tennessee Valley Authority</td>
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<tr>
<td>USACERL</td>
<td>U.S. Army Construction and Engineering Research Laboratory</td>
</tr>
<tr>
<td>USGS</td>
<td>United States Geological Survey</td>
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<tr>
<td>XSSM</td>
<td>[military shorthand for] experimental</td>
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This report presents a cultural resource assessment of the Marshall Space Flight Center (MSFC), which is operated by the National Aeronautics and Space Administration (NASA) at Huntsville, Alabama. Prepared by EDAW, Inc., the report focuses on the built environment at MSFC in recognition of the fact that an archaeological assessment was prepared recently for the Environmental Review Document, prepared by Foster Wheeler Environmental. The present report was commissioned in conjunction with the preparation of a facilities and land-use master plan by The Johnson-McAdams Firm. MSFC requested that the buildings and structures under its management be evaluated with regard to their eligibility for the National Register of Historic Places. To accomplish this, the current report provides (1) a historic context statement for the MSFC and (2) NRHP evaluations of 243 individual buildings and structures, which are organized into 238 properties inclusive of a proposed discontiguous historic district of six observation bunkers.

MFSC was established as a NASA facility in 1960. However, it is contained within the U.S. Army’s Redstone Arsenal and includes many buildings and structures that were formerly part of the Arsenal during the World War II and early Cold War eras. During the second world war, the Arsenal served as a center for the manufacture and storage of ordnance, with particular emphasis on chemical warfare. Following a period of demobilization, the Army selected Redstone in the early 1950s to become a research and development center for its guided missile program. A group of prominent rocket scientists under the overall direction of Dr. Wernher von Braun was relocated to Redstone as part of the Army Ballistic Missile Agency (ABMA). During this era, Redstone played a critical role in the development of the U.S. ballistic missile and space program.
After NASA was created in 1958, a major component of ABMA, inclusive of the von Braun group and related facilities, was transferred to NASA in 1960. MSFC was created at this time. During the 1960s, MSFC was critical in the development of rocket systems capable of space exploration, leading to the successful Gemini 11 moon landing in 1969. In the 1970s and 1980 MSFC continued to serve as an R&D facility with important roles in several key programs, including Space Lab, the Space Shuttle, and the Hubble Space Telescope.

The majority of the text of the current report is devoted to the contextual overview, which is critical to the NRHP assessment. The text also describes the methodology of the NRHP evaluations, indicating how issues of integrity and significance considerations were brought to bear in the analysis of the MSFC properties.

The assessment concludes that 28 properties are eligible for the NRHP, inclusive of the discontiguous historic district; that eight properties do not clearly meet the NRHP criteria at present but that these should be reevaluated in ten years, as they achieve the 50-year threshold; and that 13 properties require additional investigation prior to a clear conclusion on NRHP eligibility. The remaining properties are evaluated as not eligible for the NRHP, either because of loss of integrity or failure to meet any of the NRHP significance criteria. The 28 eligible properties are variously found to meet at least one of the NRHP criteria A, B and C. Eighteen of these had design dates of approximately 50 years ago or older, while the remaining 10 eligible properties are less than 50 years old but meet the exceptional significance Criteria G Consideration of the NRHP. The remainder of the properties, which were evaluated under all of the National Register criteria and criteria considerations, were evaluated as ineligible because of lack of integrity, diminished integrity, lack of distinctive historical associations, or lack of architectural distinction under those criteria. Numerous Cold War era properties failed to meet the “outstanding” significance consideration.

Supporting information for the evaluations are presented in the appendices as follows:

Appendix A – Current condition photographs of all structures and buildings included within the assessment.

Appendix B – Tabular data summary for 243 individual structures, including an NRHP evaluation of each.

Appendix C – Historic American Buildings Survey Level IV forms for each property that is evaluated as eligible for the NRHP.

Appendix D – An overview of historic cemeteries known to exist at MSFC.
PROJECT DESCRIPTION

During late autumn 2001, EDAW, Inc. (EDAW), was retained to conduct an assessment of cultural and historic resources at the Marshall Space Flight Center (MSFC), a National Aeronautics and Space Administration (NASA) facility located at Huntsville, Alabama (Figure 1). EDAW performed this investigation as a subcontractor to The Johnson-McAdams Firm, P.A., which is preparing a facilities and land-use master plan for MSFC. The original scope of work stated that the cultural and historic study should “address archeological and pre-Army acquisition resources, Army era resources and NASA era resources. The survey is to comply with (National Historic Preservation Act) NHPA Section 106 requirements.” This general goal was clarified and modified at the project kick-off meeting held November 7, 2001. At that meeting MFSC provided EDAW with a draft of the cultural resource section of Environmental Review Document (ERD) being prepared by Foster-Wheeler Environmental. Because this ERD contains a thorough review of the archaeological and pre-Army resources, MSFC staff requested that EDAW focus on the built-environment historic resources, reviewing buildings and structures at the center against the criteria of the National Register of Historic Places (NRHP). Additionally, MSFC staff requested that EDAW examine the historic record with regard to pre-Army cemeteries that still exist on land-managed by the center.

With the exception of two small family cemeteries, the potential resources are exclusively military and scientific in type. Periods of significance for the resources are World War II: 1941-1945, and, the Cold War: 1946-1991. The associated federal government agencies managing the resources over their lifetimes are the Army and NASA. In a number of instances, both the Army and NASA have managed particular buildings and structures. When this has occurred, the Army’s historic involvement is of three types: (1) arsenal ownership of 1941-1945; (2) transitional use post-World War II, 1946-1950; and, (3) early Cold War research and development (R&D) toward guided missiles and space vehicle boosters, 1951-1960. Layered over the Army’s historic uses for buildings and structures at MSFC is that of NASA. Today the space agency manages former Army buildings constructed during World War II, former Army buildings and structures built explicitly for early guided missile R&D, and buildings and structures erected post-1960. In all these cases, NASA has adapted former Army buildings for its mission.

The goals of the present cultural resource investigation are (1) to provide an overview context statement for the MSFC appropriate to its historic buildings and structures, and, (2) to make preliminary assessments of NRHP eligibility. Discussions with MSFC staff and subsequently with representatives of the Alabama State Historic Preservation Officer (SHPO) led to the decision that historic building inventory forms for each structure, regardless of significance, would not be necessary. Rather, EDAW was to compile tabular summaries and photos of all buildings and structures and to prepare inventory forms for those resources that appear to meet the NRHP criteria of significance. For the latter, it was decided that Historic American Buildings Survey (HABS) Level IV would be appropriate. Dr. James Cleland provided oversight for the project. Dr. Karen J. Weitze authored the document, inclusive of Appendices B and C. Lori Lilburn and Carrie Gregory assisted Dr. Weitze in the field work at the MSFC. Ms. Lilburn prepared Appendix A, while Ms. Gregory wrote Appendix D.
Figure 1
Vicinity Map
Marshall Space Flight Center, Huntsville, Alabama.

Courtesy of NASA
NASA-Army Real Property Issues

The Army’s Redstone Arsenal physically circumscribes the MSFC on all of its borders (Figure 2). NASA sustains use of its real property through a long-term land use agreement with the Army, while the Army maintains certain responsibilities for overall land use and generic infrastructure required by both agencies (such as electric substations). The NASA-Army physical and managerial relationship for real property at the MSFC and the Redstone Arsenal creates some unusual situations. For example, the Army maintains the secured entry gates to the property, with no separate or directed access for the MSFC. Also, Army buildings and structures are interspersed with those of the MSFC (usually small support facilities), or are on opposite sides of common streets (and thus, are not readily distinguishable from one agency to the other). As might be anticipated, jurisdictional issues also shift between the Army and NASA over time, with selected buildings (such as at the airfield) alternating in their management. The assessment of potential historic resources at the MSFC, included herein, only reviews those buildings and structures under NASA’s management at the time this study was undertaken (although an appropriate cross-referencing to related Army real property is included).

The interwoven physical and management nature of NASA and Army real property is most easily understood through several examples. In a few cases, buildings which were originally identical, such as Buildings 4722 and 4723, are respectively Army and NASA real property today (Plate 2). Historically these two buildings remain part of an unbroken linear cluster of warehouses along the western side of Rideout Road near Building 4207 (see Figures 2 and 4). Constructed in 1941, the two buildings were historically three warehouses. Two warehouses are today combined as Building 4722 (Army), while Building 4723 (NASA) approximates its original configuration. All three buildings are heavily altered, and—in this instance—the interpretation for NRHP eligibility is the same for both Army and NASA property: ineligible. In another case, however, the situation is much more complex. Buildings 4484 and 4488, Army property on the east side of Morris Road north of Martin Road, are surrounded on three sides by the MSFC (see Figure 2 and Plate 2). Buildings 4484 and 4488 were very important offices for early guided missile work at Redstone during the middle and late 1950s, as well as beyond that date, but are extremely altered today on both exterior and interior. The Army has evaluated both as eligible for the NRHP despite the integrity issues. The Army evaluation is inconsistent with those contained herein for similar NASA properties, which are evaluated as ineligible due to lack of integrity.

The NASA-Army real property situation at the MSFC and the Redstone Arsenal highlights the subjectivity of evaluations for NRHP eligibility and the differences between agencies and professional historians. Agencies typically proceed at different paces in their assessment of historic properties. The Redstone Arsenal has been undertaking a comprehensive review of its historic real property for over five years in a continuous stand-alone effort responding to Section 110 of the National Historic Preservation Act (NHPA). The MSFC is combining its historic preservation efforts with the current updating of its master plan. Interpretations of NRHP eligibility for the MSFC are also intended to assist NASA in its compliance with Sections 106 and 110 of the NHPA and to parallel the efforts of the Army for the Redstone Arsenal. The contextual overview and discussions of individual properties at the MSFC are also the first steps toward NASA’s achievement of a Programmatic Agreement (PA) addressing its management of its historic buildings and structures. Generally, the evaluations of NRHP eligibility that follow for MSFC-managed property take into account all of the NRHP criteria, including integrity, historical associations, architectural/engineering qualities, and special considerations such as exceptional significance for properties that are less than 50 years of age. Generally, a high degree of exterior integrity was expected for properties to meet the threshold of eligibility for the NRHP.
Figure 2
Location Map
Marshall Space Flight Center, Huntsville, Alabama

Major buildings identified by real property numbering.
Courtesy of NASA.
The few exceptions to this rule are focused on the high importance and intactness of interior equipment (such as wind tunnels in Building 4732) and/or the presence of exceptionally important self-contained units fully inside buildings which are altered on their exteriors (such as the Huntsville Operations Support Center of 1968 and the Spacelab Mission Operations Control Facility of 1990, inside Building 4663; the Neutral Buoyancy Simulator [tank] inside Building 4705; and, the two-story blockhouse simulating the first Saturn V launch control facility at Complex 39 at the Kennedy Space Center in Florida, inside Building 4708).

Additional Special Issues

Several specialty historic-resource issues are included herein, but are not intended to be comprehensive or conclusive. For example, included in the review of MSFC buildings and structures are test stands and their ancillary units in the east and west test areas of the MSFC. Within and neighboring the boundaries of the test areas are numbered and unnumbered observation bunkers. To the extent field personnel encountered these bunkers, these structures are discussed in the assessments that follow. The layering of specific test structures in the east and west test areas of the MSFC over time is very complex: some key earlier structures are now removed, but very important test fragments still exist. The contextual overview addresses this situation to the extent possible. The context also references the pre-existing presence of large contaminated acreage within and near the MSFC test areas, possibly derived from the Army’s land use during World War II. An interpretation of the potential for the presence of historic archaeological sites is not a part of this study, although an overview discussion of historic cemeteries within MSFC boundaries is included as Appendix D. The location of the Army’s German Prisoner of War (POW) camp is additionally verified on a primary-source Army land use map of October 1943 (see Figure 7) as within NASA jurisdiction today.
METHODOLOGY

NRHP Standards and Criteria

The NHPA of 1966, as amended in 1986 and 1992, mandates the Secretary of the Interior to maintain and augment the NRHP. The National Register is the United States’ honorary list of valued districts, sites, buildings, structures, and objects interpreted as significant in American history, culture, archaeology, architecture, and engineering at the national, state, and local levels (36 Code of Federal Regulations [CFR] 60.1). The National Park Service (NPS) administers the NRHP. NPS cultural resources managers and specialists have articulated two areas requiring analysis for NRHP consideration: historic integrity and significance. Varying within individual state jurisdictions—and again through agency and professional interpretations—districts, sites, buildings, structures, and objects must possess a physical integrity related to the proposed historic significance. That is, they must convey historic time and place. Most often, districts, sites, buildings, structures, and objects that retain sufficient integrity to be considered for the NRHP have been modified only in minor ways. In some instances, modifications to historic resources fall within the interpreted period of significance. For example, an engine test stand might be significant for R&D conducted over decades, and thus additions and changes of later years are subsumed within its original integrity.

Seven aspects of integrity help to refine its evaluation: integrity of location, setting, feeling, association, design, materials, and workmanship. Integrity of location most often indicates that buildings, structures, and objects have not been moved from one site to another. Buildings and structures resited more than 50 years ago are often interpreted as fully possessing integrity of (re-established) location. Setting, feeling, and association are always strongest when a minimum of unrelated properties have intruded within, or immediately adjacent to, the original physical boundaries of a potential resource. In simple terms, setting, feeling, and association are also affirmed when a continuity of function or purpose occurs—as at the MSFC. The final three aspects of NRHP integrity focus on the intactness of the physical fabric of the resource, again pertinent to the possible period of significance. Is the original design (through its stylistic rendering) or the original workmanship (through construction detailing) still visually readable (sometimes inclusive of additions)? Is a substantial percentage of the original materials present? Interpretation of the seven aspects of NRHP integrity varies widely across the United States. In some states, the emphasis for NRHP eligibility concentrates almost entirely on significance, with extreme latitude for introduced change over time. In other states, replacing window treatments alone might render the potential resource too altered for consideration to the National Register. Not surprisingly, interpretations of integrity have also varied radically during the 34-year life of the NRHP, making any reliance on a formulaic approach unwise.

Evaluations of potential historic significance for NRHP eligibility, in counterpoint, have been more consistent over the decades. To establish significance, NRHP guidelines suggest that a reviewer establish a thorough historic context for the resource(s). The presented district, site, building, structure, and/or object must meet at least one of four NRHP significance criteria. The criteria are defined as:

- **Criterion A**: an association with events significant to the broad patterns of history;
- **Criterion B**: an association with the lives of persons significant in the past;
- **Criterion C**: an embodiment of the characteristics of a type, period, or method of construction; a representation of the work of a master or one that
possesses highly artistic values; or a distinguishable entity with components individually undistinguished; and,
Criterion D: the ability to yield information important in prehistory or history.

At the MSFC, the most applicable NRHP criteria are Criteria A, B, and C, with an emphasis on Criterion A. The broad patterns of history represented are those associated with important munitions manufacture during World War II (in a few instances), and, critical guided missile and space booster research, development, test, and evaluation during the Cold War (in the majority of cases). The lives of persons significant in the past (Criterion B) are embodied in potential NRHP resources at the MSFC more vaguely, but include strong associations with both internationally prominent German rocket professionals during the 1950s and 1960s, and, their American colleagues. A sizable group of German scientists and engineers arrived in the United States during Project Paperclip recruitment after World War II (1945-1948), assigned to the American military and to military contractors. The Army’s group at Fort Bliss, Texas, and the White Sands Proving Ground, New Mexico (today, White Sands Missile Range) led by Dr. Wernher von Braun relocated to the Redstone Arsenal in 1951. Others working for the Navy and the Air Force later came to Redstone to reunite with von Braun’s group. The United States sponsored a second and third recruitment of German scientists under Project 63 in 1952 and again in the middle 1950s. Movement of the Paperclippers, as these extremely well educated and talented men were known, continued over the decades, with interwoven contributions across the Army, Air Force, Navy, and, after 1958, NASA (and supported through each agency’s contractors). Professional endeavors of the Paperclippers were many, with active leadership and participation in the American Rocket Society and international organizations. In selected cases, the MSFC also has buildings and structures eligible to the NRHP under Criterion C, the criterion focused on architecture and engineering significance. The prominent architectural-engineering firms undertaking the design of buildings and structures at the MSFC during the 1952-1965 period included Burns & Roe of New York, Maurice H. Connell & Associates of Miami, Giffels & Rossetti of Detroit, Holmes & Narver and Ralph M. Parsons (Parsons-Aerojet) of Los Angeles, Robert & Company of Atlanta, Stearns-Rogers Corporation of Denver, and Sverdrup & Parcel of St. Louis. All of these firms were also responsible for major innovative buildings and structures for the R&D command within the Air Force during the Cold War.

The NPS excludes some types of properties from potential NRHP listing or eligibility, including religious properties (Criteria Consideration A); moved properties (Criteria Consideration B); birthplaces or graves (Criteria Consideration C); cemeteries (Criteria Consideration D); reconstructed properties (Criteria Consideration E); commemorator properties (Criteria Consideration F); and, properties that have achieved significance within the past 50 years (Criteria Consideration G). Each of these criteria considerations has exceptions. For properties less than 50 years in age, and in particular for highly specialized military, industrial, and scientific properties, the 50-year age requirement increasingly has been found to be inadequate. The NPS publication National Register Bulletin No. 22: Guidelines for Evaluating and Nominating Properties that have Achieved Significance within the Last Fifty Years (1991) provides general references for establishing whether or not a property possesses the exceptional significance required if it is less than 50 years in age. A second publication, published by the Advisory Council on Historic Preservation (ACHP), complements the guidance of NPS: Balancing Historic Preservation Needs with the Operation of Highly Technical or Scientific Facilities (1991).

In addition, both the Air Force and the Army have developed formal guidance for the assessment of Cold War properties based on the existing NRHP criteria, again focused on the need to evaluate and establish exceptional significance. The Interim Guidance Treatment of Cold War Historic Properties for U.S. Air Force Installations of June 1993 supplements both the available
NPS and ACHP guidance. Written by Dr. Paul Green, Cultural Resource Manager for Headquarters Air Combat Command (ACC) at Langley Air Force Base in Virginia, the Air Force Interim Guidance remains one of the primary military guidance documents for evaluating Cold War buildings and structures nationwide. ACC plans to update and finalize the Air Force guidance for evaluating Cold War properties during 2002-2004. In 1998, the U.S. Army Environmental Center at the Aberdeen Proving Ground in Maryland also published guidance for assessing Cold War historic resources: Thematic Study and Guidelines: Identification and Evaluation of U.S. Army Cold War Era Military-Industrial Historic Properties. The Army guidance provides both a context for the agency during the Cold War and a discussion of primary Cold War property types within the agency. Many of the Air Force and Army Cold War facilities for research, development, test, and evaluation are parallel in type to those of NASA for the late 1950s through the end of the war. Examples pertinent to the MSFC include antenna ranges, static and dynamic test stands, launch control buildings (blockhouses), missile and component assembly structures (typically, high-bay), accelerators, laboratories, clean rooms, wind tunnels, computerized command and communication posts, specialized test structures, and unusual transportation facilities. The Army emphasizes that historic resources eligible for the NRHP that are less than 50 years old must be assessed against the most detailed context possible, inclusive of a consideration of resources of parallel type located at multiple sites, and, must be important at a national (rather than state or local) level.

Between 1991 and today, a large, and increasingly sophisticated, body of historic structures inventories and detailed historic contexts support the decisions of the Air Force and Army. During the middle 1990s, late into the decade, the agencies undertook multiple studies as a part of the Legacy Resource Management Program funded through Congress. A Department of Defense (DoD) special cultural resources newsletter, In from the Cold, has abstracted a number of the Cold War inventories, assessments, and contextual histories in its six issues of 1996-1998. Headquarters ACC at Langley; the Office of Air Force History at Bolling Air Force Base in Washington, D.C.; the Air Force Center for Environmental Excellence (AFCEE) at Brooks Air Force Base in San Antonio; the Army Environmental Center at Aberdeen; the U.S. Army Construction and Engineering Research Laboratory (USACERL) in Champaign, Illinois; and, the U.S. Army Corps of Engineers, Fort Worth District, continue to be involved in assessing Cold War material culture against NRHP criteria and standards. These agencies have posted key studies on their internet web sites.

At the MSFC, the assessment of potential historic buildings and structures includes 238 individual properties. Of these, 36 are 50 years or older—with the greatest proportion of this group from World War II and highly altered. Another 42 buildings and structures are within five years of meeting the 50-year threshold (that is, have a design date of 1953-1957). These resources are considered as functionally at the 50-year mark, in order to allow an appropriate process of review. The remaining 160 properties are evaluated under Criteria Consideration G, applicable to properties less than 50 years in age. As presented in the results section of this report, a total of 33 buildings and structures are evaluated as eligible for the NRHP, inclusive of 27 non-bunker structures that have been assigned building numbers by NASA and six bunkers (two numbered and four non-numbered). Of the 33 buildings and structures interpreted as eligible for the NRHP through this study, 23 date to 1941-1957, and are considered as 50 years old, without the requirement to meet exceptional significance. The remaining ten NRHP-eligible structures are less than 50 years of age and are evaluated as meeting the exceptional significance consideration. Eight additional structures are recommended for reevaluation in ten years, either because they could meet the NRHP criteria at that point in time or because their associations are so recent that the current researchers do not feel that a sufficient period of time has elapsed to evaluate their relative contributions and significance. There are 13 properties at MSFC where
additional research is necessary before an NRHP-eligibility evaluation can be made. In order to aid the reader in understanding the history of the development of the built environment at MSFC, Figure 3 color-codes each structure for the period in which it was built. Additionally, Figure 4 color-codes structures for their NRHP eligibility as evaluated herein.

Field Assessments and Research

The assessment of potential historic resources at the MSFC represented through this document is part of overall efforts toward the creation of an updated master plan for the MSFC. The master plan is the responsibility of the architectural firm Johnson-McAdams of Memphis, Tennessee. EDAW offices in Atlanta, Huntsville, and San Diego have each contributed to the evaluation of potential historic resources at MSFC, with management undertaken by personnel in Atlanta and Huntsville, and with the assessment itself handled by San Diego. Key members of the San Diego EDAW team were Dr. James Cleland, Lori Lilburn, and Carrie Gregory. The San Diego team also included Dr. Karen J. Weitze, an independent architectural-engineering historian with established expertise in Cold War resources evaluations and military contexts. Dr. Cleland managed the effort and provided project oversight and quality control. Both Drs. Cleland and Weitze met with staff at the MSFC and the Alabama Office of Historic Preservation in pre-field work of November and December 2001. NASA planner Ralph Allen coordinated these initial efforts, also serving as NASA oversight for the research and field work to follow.

Dr. Weitze directed the field research team of Ms. Lilburn and Ms. Gregory during two weeks of effort at the MSFC in January 2002. The three-person team photographed all of the 238 buildings and structures under assessment. Dr. Weitze and Ms. Gregory conducted research in the two history offices of NASA and the Army, with Dr. Weitze directing all efforts. Ms. Lilburn comprehensively reviewed construction drawings and as-builts in the NASA civil engineering drawings vault, recording data for the project. Dr. Weitze also worked in the drawings vault with Ms. Lilburn. Together, Dr. Weitze and Ms. Lilburn additionally reviewed drawings held in the Army civil engineering vault, at a less thorough level. Ms. Lilburn selectively supplemented information gleaned from the drawings vaults through copies of NASA real property records. Ms. Lilburn and Ms. Gregory further augmented the research through a thorough check of historic photographs held at the NASA Photographic Laboratory. The Army History Office and the NASA Photographic Laboratory provided high-resolution tagged image files (tif) of requested historic photographs appropriate to the project. Ms. Lilburn and Ms. Gregory concluded research efforts at the Huntsville Public Library, there addressing available cemetery records pertinent to land use at the MSFC before government ownership.

Both the NASA and Army History Offices, at the MSFC and the Redstone Arsenal respectively, maintain archives that directly assist in evaluating NASA buildings and structures against the NRHP. In 1999, NASA published *Power to Explore: A History of Marshall Space Flight Center 1960-1990*. Authors Andrew J. Dunar and Stephen P. Waring, professors of history at the University of Alabama at Huntsville, include a bibliographic essay in their volume describing available primary sources pertinent to MSFC history. As they note, documentary collections for the MSFC are somewhat inconsistent over time. NASA did not support a History Office between 1975 and 1986, a gap during which many records dispersed. The EDAW research team decided to rely on the analysis of primary-source materials presented in *Power to Explore*, with two major exceptions. The team carefully reviewed the collection of master plans and drawings held at the NASA History Office, and Ms. Gregory compiled a large group of articles in the NASA newspaper, the *Marshall Star*, for the 1960 to 1968 period. The *Marshall Star* contains many references to buildings and test structures, inclusive of photographs. Dr. Weitze correlated the
Figure 3
Historic Periods for Buildings and Structures

Source: August 1999, Courtesy of NASA
excerpted material from the *Marshall Star* with other research, and in most cases was able to assign discussed buildings and structures their appropriate real property number. A recent NASA History Office publication, *A Chronology of the Marshall Space Flight Center—1960 – 2000: Milestones in Space Exploration*, was also helpful for linking historic properties with major agency missions and achievements.

At the Army History Office, Dr. Weitze and Ms. Gregory researched the pre-NASA history of buildings and structures first utilized by the Army and subsequently transferred to NASA. They also addressed major missions and personnel for the Army’s presence during World War II and the early years of R&D for the Army’s guided missiles program. Key primary sources in the Army History Office included unit histories for the Huntsville Arsenal, 1941-1946; the Redstone Arsenal, 1950-1959; and, the Army Ballistic Missile Agency, 1956-1960. Of note, the *Supplement to the Redstone Arsenal Historical Summary of July – December 1957* contains a “Building Number Index” prepared by the Post Engineer which correlates the old and new building numbers at the arsenal. The change occurred in mid-1957. Original numbering is needed to accurately correlate buildings’ use before that date, and vice versa. A building number index also exists for January 1959. A multi-page World War II Huntsville Arsenal plot plan of late 1943, with War Department foldout sheets, is contained in *History of Huntsville Arsenal July 1941 – August 1945*. This source provides detailed information on numbered buildings, inclusive of use and physical fabric (foundations, walls, roof, etc.) Review of selected special subject files, as well as facilities briefings and reports, concluded analysis of primary resources in the Army History Office. Dr. Weitze also referred to several major secondary sources in the Army’s collections. Written by Army historians of U.S. Army Missile Command, the pertinent studies were *The Redstone Arsenal Complex in the Pre-Missile Era: A History of Huntsville Arsenal, Gulf Chemical Warfare Depot, and Redstone Arsenal 1941-1949* (1966); *The Redstone Arsenal Complex in its Second Decade, 1950-1960* (1969); and, *History of the Redstone Missile System* (1965). Two complementary, brief overviews prepared by the current Army History Office include *Redstone Arsenal Yesterday and Today* (1993) and *Redstone Arsenal’s Pioneering Efforts in Space* (1992). Also important for more background on the World War II buildings and structures now a part of the MSFC were several published histories in the Army Technical Series, including *The Corps of Engineers: Construction in the United States* (1972), *The Chemical Warfare Service: From Laboratory to Field* (1988), and *The Chemical Warfare Service: Organizing for War* (1989).

**Existing and Concurrent Buildings Assessments at the Redstone Arsenal**

Finally, in an effort to coordinate the assessment of historic resources at the MSFC with the work previously (and concurrently) undertaken by the Army at the Redstone Arsenal, Dr. Weitze met with Cultural Resources Manager Carolene Wu. Past studies of Army buildings and structures, including ones with references to the MSFC, are multiple, sometimes confusing, and ongoing.

(1) The first analysis of historic properties at the Redstone Arsenal was a short Historic Properties Report compiled by Building Technology Incorporated, Silver Spring, Maryland, in 1984. This document, *Historic Properties Report Redstone Arsenal, Alabama, with the George C. Marshall Space Flight Center*, included both the Army and NASA facilities in its assessment, from World War II forward. “Cold War” buildings and structures evaluations, *per se*, did not occur before about 1991 with reference to the criteria of the NRHP. The threshold of exceptional significance for properties less than 50 years old, however, did exist. The 1984 study addressed potential NRHP eligibility for buildings and structures into the 1960s, using Army historic property categories listed in Army Regulation 420-40. Within these constraints, the Historic Properties Report concluded that Category I and II resources
were eligible for the NRHP. Buildings and structures at the MSFC interpreted as eligible were Buildings 4540, 4550, 4572, 4619, 4665, 4670, 4705, and 4775, with references to the associated blockhouses and gantries (Buildings 4541, 4573, 4574, and 4674). Four of these selected properties became National Historic Landmarks (NHLs) in 1986: Buildings 4550, 4572, 4665, and 4705. The NHLs were among a total of 22 buildings and structures listed nationwide in Alabama, California, Maryland, Mississippi, New Mexico, Ohio, Texas, and Virginia, as representative of “Man in Space.” The eight MSFC properties interpreted as eligible for the NRHP were never formalized in their eligibility, and remained recommendations only.

(2) The second analysis of historic properties at the Redstone Arsenal began in 1995 and remains active in 2002. These studies do not address historic resources at the MSFC, with one exception.

In 1995, the Army resubmitted the Historic Properties Report of 1984 to the Alabama State Historic Preservation Office, seeking to finalize the document’s recommendations for NRHP eligibility. During the intervening decade, assessments of NRHP eligibility had become more sophisticated and the properties under evaluation had become older. The Legacy program of DoD, addressing Cold War historic buildings and structures in particular, was also underway. The State Historic Preservation Office requested that the Army undertake a more detailed inventory and context for the Redstone Arsenal. In response, the Army hired Panamerican Consultants, Inc., of Tuscaloosa, Alabama, to conduct the needed study. Panamerican submitted two reports in 1996: Preliminary Architectural Assessment of the World War II Military and Civilian Works on and around Lines 1, 2, 3, 4, and 5 of the Former Redstone Ordnance Plant (1941-1945) Now the Thiokol Corporation Lease, U.S. Army Missile Command, Redstone Arsenal, Madison County, Alabama, and, Architectural Assessment of the World War II Military and Civilian Works, U.S. Army Missile Command, Redstone Arsenal, Madison County, Alabama. The Panamerican effort concluded with a Final Report (Amended), Architectural Assessment of the World War II Military and Civilian Works, U.S. Army Aviation and Missile Command, Redstone Arsenal, Madison County, Alabama, in January 1998. The Army and Alabama State Historic Preservation Office decided to consider these documents as “draft only.” The Panamerican effort looked exclusively at World War II resources, with the Cold War period still requiring a thorough assessment.

The Army next hired TRC Mariah, Inc., of Austin, Texas, who submitted Architectural and Historic Inventory of Buildings and Structures Dating to the Cold War Era (1946-1989) at Redstone Arsenal, Alabama, in 1997. This effort also aborted.

Currently, the Army is also working with the U.S. Army Corps of Engineers, Seattle District, on a Historic American Buildings Survey (HABS)-like document that is recording the World War II buildings and structures at the Redstone Arsenal on individual forms. The working title of this study is *To Defend and Deter: Weapons Production at Redstone Arsenal in World War II*. The Corps project was at the draft stage in January 2002.
The contextual history of the built-environment at MFSC is discussed below within six time-successive themes: Planning toward Army Land Use; World War II Operations; Interregnum: Demobilization to 1952; The Guided Missile Mission: 1952 to 1958; The Later 1950s and Transition to NASA; The Saturn Program and the 1960s; and, Programs and Accomplishments of the 1970s and 1980s. A brief pre-Army history is included within the first contextual period with particular reference to the extant family cemeteries.

Planning toward Army Land Use at the Marshall Space Flight Center

The Chemical Warfare Service

Just prior to American entry into World War II, the U.S. Army had begun to seriously expand its installations in the continental United States. Efforts included specialized facilities to support chemical warfare. Up until this expansion, the Army’s Chemical Warfare Service maintained only a single site, that of the Edgewood Arsenal in Maryland (Baker 1993: 1). The Edgewood post, at that time including today’s adjacent Aberdeen Proving Ground, served both as a manufacturing location and as a proving range for important tests and evaluations of chemical munitions. The Chemical Warfare Service dated to 1918, as did its Edgewood site (first known as Gunpowder Neck Reservation). Private companies directly supported the Army’s work at Edgewood, with a number of manufacturing sites, pilot plants, and small corporate proving grounds situated across the country from California to the Atlantic seaboard (Weitze 1996: 1-19). To expand its chemical warfare operations during the early 1940s, the Army added new facilities at the Edgewood Arsenal and at selected inland locations. The latter posts were typically virgin, predominantly of an isolated, rural character. The availability of cheap and willing labor was also a factor in the decision process for chemical munitions manufacturing plants, as was ready access to electric power and appropriate transportation networks. Congress approved construction for three chemical production plants, in addition to the expansion at Edgewood. New chemical warfare Army installations included a major chemical warfare R&D post at the Dugway Proving Ground in central Utah (established in 1942); testing of chemical munitions at the Jefferson Proving Ground in Indiana (established in 1941); and, a group of arsenals and depots for chemical munitions manufacture and storage. The latter posts were those of the Rocky Mountain Arsenal in Colorado (established in 1942); the Deseret Chemical Warfare Depot in Utah, near the Dugway Proving Ground (established in 1942); the Pine Bluff Arsenal in Arkansas (established in 1941); the Midwest Chemical Warfare Depot, sited with Pine Bluff (established in 1942); the Blue Grass Army Depot in Kentucky (established in 1942); and, the triplet of the Huntsville Arsenal, Redstone Ordnance Plant (the Redstone Arsenal as of early 1943), and Gulf Chemical Warfare Depot in Alabama (established during 1941-1942) (U.S. Army Environmental Center 1998: 122-158). The three chemical munitions manufacturing plants were those at the Pine Bluff, Huntsville, and Rocky Mountain Arsenals (Gaither 1997: 74-90). The Army additionally set up schools and training centers for chemical warfare at several locations, and availed itself of the large ranges at Eglin Field in the Florida panhandle. At Eglin, the Army proof tested chemical and incendiary bombs on Range 52, also conducting some incendiary tests using unoccupied farm buildings at the Huntsville Arsenal as of Spring 1942 (Weitze 1996: 13; Weitze 2001: 56-77). The arsenals and depot in the vicinity of Huntsville markedly changed land use for the area.

Construction for the Huntsville Arsenal began during August 1941. The name proposed by the Chemical Warfare Service was that of Sibert Arsenal, honoring Major General William L. Sibert. Major General Sibert had served as the first chief of the Chemical Warfare Service between
mid-1918 and early 1920. (A Quartermaster General land acquisition map for the Huntsville Arsenal of September 1941 is titled the “Siebert [sic] Arsenal Project.”) During the period between World War I and World War II, the Chemical Warfare Service had planned for one new arsenal removed from its Edgewood post, which would become three. Huntsville Arsenal was the first of the chemical production plants underway. Supervised by personnel transferred from Edgewood, the physical design of the Huntsville Arsenal derived from late 1930s plans for a new chemical arsenal. (Design for a new phosgene plant at Edgewood was complete as of 1939, with that plant operational in mid-1941. The Edgewood phosgene plant served as a direct model for a 30-ton capacity phosgene plant at the Huntsville Arsenal [Brophey, Miles and Cochrane 1988: 52].) War Plans Division engineers at the Edgewood Arsenal had worked with the Baltimore firm of Whitman, Requardt & Smith in developing this model chemical plant facility. As of early August 1940, Whitman, Requardt & Smith received the third fixed-fee contract for architect-engineer services granted through the Construction Division of the Army’s Quartermaster Corps nationwide—for services at Edgewood (Fine and Remington 1972: 147). Government arsenal engineers involved in the design for Huntsville were E.C. Thompson and L.W. Greene. In mid-July 1941, the Army awarded Whitman, Requardt & Smith a contract for detailed architectural and engineering services toward the Huntsville Arsenal. Construction contracts for the arsenal went to C.G. Kershaw Contracting Company of Birmingham, Engineers Limited of San Francisco, and Walter Butler Company of St. Paul. As first planned, the Huntsville Arsenal was to include “four chemical loading plants, a chemical warfare depot, plant storage, laboratories, shops, offices, hospitals, fire and police protection installations, paved roads, and railroads” (Brophey, Miles and Cochrane: 1988: 256-257).

The Army’s chemical munitions program also generated an immediate need for new storage space and two additional arsenals. In September 1941 construction began for the Gulf Chemical Warfare Depot, occupying 7,700 acres that were physically reserved for this purpose. (The Army initially named the installation the Huntsville Chemical Warfare Depot, changing its name in late 1943 to reduce confusion with the Huntsville Arsenal.) Land for the depot was immediately adjacent to the Tennessee River at the southern extreme of the overall Army acreage. Capacity for the storage of toxic gas, as well as that for the storage of four-pound incendiary bombs, transferred from Edgewood to Gulf Chemical. The Chemical Warfare Service next decided upon an arsenal focused on the manufacture of incendiaries, with a pilot plant built at Edgewood. This second chemical munitions arsenal, that of Pine Bluff, was underway as of the autumn of 1941. Its storage depot, Midwest, was under construction the next year. The Chemical Warfare Service engineers responsible for the design of the Huntsville Arsenal—presumably including efforts by Whitman, Requardt & Smith—directly supported the planning for Pine Bluff and executed the drawings for its buildings and structures. Construction at Pine Bluff began in December 1941. As of 1942, work began on the Rocky Mountain Arsenal. Whitman, Requardt & Smith again received an architectural-engineering contract for design there (Brophey, Miles and Cochrane: 1988: 277).

Land Use Before the U.S. Army

The acreage that comprised the Huntsville Arsenal, the Redstone Ordnance Plant, and the Gulf Chemical Warfare Depot occupied land that formerly had been farms and small communities. The Chemical Warfare Service had sought a 30,000-acre tract for the arsenal, conducting site surveys in Alabama, Arkansas, Missouri, Ohio, Tennessee, and West Virginia before deciding on the Huntsville area. The Huntsville site included 32,244 acres, buffered on the south by 6,400 acres owned by the Tennessee Valley Authority (TVA) along area waterways including Indian and Huntsville Creeks. The Chemical Warfare Service considered the TVA land as “an access and insulation area” (History of Huntsville Arsenal July 1941 to August 1945, volume I: 3-4).
Internal to the 33,000-acre tract were two distinct areas that featured level sites, each about two miles square. Two railroads bordered the north and east edges of the selected location, with the Tennessee River along the southern edge offering future docks. The TVA was in place to provide electric power, with plans to extend existing transmission lines from Wheeler and Guntersville Dams. (As of the late 1940s, proximity to the TVA water and power system in the area was also a major factor in the selection of the Camp Forrest locale to the northeast in Tennessee for the Air Force’s Arnold Engineering Development Center.) The TVA had established labor agreements with the region’s unions, a controlling factor that benefited the Army as well. Four cotton mill villages in the immediate Huntsville area, those of Lincoln, Dallas, Marrimac, and West Huntsville, offered poorly educated white labor willing to work for low wages (History of Huntsville Arsenal July 1941 to August 1945, volume I: 4-7). The Army added another 4,000 acres for the Redstone Ordnance Plant. (See Figure 6.)

While an official Army history noted the general area population as about 20% black in 1941 (History of Huntsville Arsenal July 1941 to August 1945, volume I: 13), several sources indicate that the percentage of the people who occupied the Madison County land that became the Huntsville Arsenal, Redstone Ordnance Plant, and Gulf Chemical Warfare Depot were between 70% and 76% black (Huntsville Times August 17 and 21, 1941: 3 and 1; Hughes 1991: 53). First historic settlers for Madison County were Cherokee and Chickasaw, with the prehistoric Native American culture that of the Copenas. Sometime immediately before the federal government removed the Cherokee and Chickasaw from Madison County lands in the early 19th century, plantation settlement of the area began. Two “Indian” lines ran through the area near Huntsville, denoting large land purchases from the two tribes. The government delineated the original Chickasaw Line from northwest to southeast, through what would become today’s Redstone Arsenal, to the near east of the MSFC. The Cherokee line ran from southwest to northeast, southeast of Huntsville and east of the greater arsenal. Extensions and redefinitions of the two tribal boundaries occurred in 1818, 1819, 1826, 1836, 1841, and 1887, encouraging an expansion of non-Native American settlement (G.W. Jones & Sons undated: map). Landowners for the area, up through the Civil War period, were slaveholders. Beginning in 1941, the Army removed about 6,000 individuals from acreage needed for the arsenal comprised of 550 to 1000 families (Huntsville Times August 21, 1941: 1; Hughes 1991: 54). Although tenant farmers were among the group, many families owned and worked their own tracts, with a total of 81 tracts bought by the Army (Huntsville Times January 26, 1942: 3). As of the early 20th century, farming communities included Pond Beat, Mullins Flat, Union Hill, Elko, Cave Hill, Hickory Grove, Horton’s Ford, Bettle Slash, Cedar Grove, Silver Hill, and Center Grove (Hughes 1991: 52). The earliest mapped communities immediate to arsenal lands appear to have been sited at its southern edge, near the Tennessee River, and included Green Grove and Triana (with Triana the largest, just outside arsenal lands to the south/southwest). Also mapped before 1818 was Cedar Grove, although without the appellation of a formal name (G.W. Jones ca.1804: map).

Documented as present prior to the Army’s arrival were “more than” 500 dwellings, as well as 12 churches, three to five schools, and several lodges (Huntsville Times August 17, 1941: 3). Lodges included Masonic Lodge #63 and the Brothers and Sisters of Honor. The Army mapped five school parcels in 1941, four that were two acres in size and one a single acre. (Quartermaster General September 5, 1941: map). The majority of the public buildings supported black community life. Antebellum plantations included those of the Chaney and Lee families. The Harris family was also present as of the earlier 19th century, near the Lees, on today’s Buxton Road. To the south/southeast of the MSFC, the community of Cedar Grove, in the vicinity of Patton and Buxton Roads, featured a Methodist church pre-dating the Civil War—among the oldest documented buildings standing at the time of the Army’s land acquisition (Hughes 1991: 52-56). Within the MSFC, the oldest cluster of community buildings appears to have been that of
Center Grove, approximately sited along both sides of Martin Road from Rideout Road to west of Gemini Road. The transportation corridor that later became Martin Road appears to have been long-established from west of today’s Rideout Road to beyond the western edge of the MSFC and onto the Redstone Arsenal (G.W. Jones ca.1804: map). In addition to being mapped very early in the 19th century, Center Grove continued to become bigger. Two churches (Pine Tree and Centre) and a dispersed linear cluster of six buildings along Martin toward Dodd Road appeared on a map of 1911. Other buildings are mapped along the extant roadway corridors of that year, with settlement within today’s MSFC heaviest near Center Grove and along Dodd Road between Martin and Saturn Roads. Although unnamed on the 1911 map, a cluster of buildings near what was known as Silver Hill School suggests that a community of Silver Hill existed in the vicinity of Building 4665, on both sides of Dodd Road, and extending south and southwesterly (US Department of Agriculture 1911: map). Buildings for the Silver Hill area increased in 1936 and 1937, while a road appears to approximate the corridor of Rideout Road today (north of Martin)—again with settlement along it. Maps suggest that area growth increased during the 1920s and 1930s. A 1937 Alabama State Highway Department map denotes buildings very clearly, and presumably offers a basis for a structures’ count and location, immediately prior to Army purchase in 1941 (Alabama State Highway Department 1937: map). A 1936 United States Geological Survey (USGS) map includes a less permanent road (convened by dotted lines) running north-south, parallel to Dodd to the east, as well as one running east-west to the west of Dodd today, between about Building 4666 and Building 4670 (USGS 1936: map).

After purchase during 1941-1942, the Army used the vacant buildings left on its land primarily for storage, office, and housing, although it did choose some farm structures to test the effectiveness of incendiary bombs (thus largely destroying these structures during test episodes). Gunpowder Neck, the Chemical Warfare Service proving ground area associated with the Edgewood Arsenal in Maryland, had also included very old black and Caucasian settlements, dating from the 17th to the 19th centuries, and had used empty buildings for destructive testing (Weitze 1996: 13). In 1946, the Huntsville Arsenal listed one barn and eight “old farm house”(s), to which the installation had assigned numbers (History of the Huntsville Arsenal July – December 1946: 113). An oversized map of the Redstone Arsenal of mid-October 1943 locates the barn (then Building 465 / T-465), as well as five other buildings in the immediate vicinity of today’s east test area. The barn appears to have been located immediately north of Building 4566, on the east side of Dodd Road (Proposed Enlargement of Redstone Arsenal 14 October 1943: map). Although the numbering is not clearly legible on the copy of the map made for this study, the cluster of buildings near today’s Building 4670 appears to have been in the group listed in a “Tabulation of Building Data” of 1943: in use for truck and vehicle repair, grease storage, welding, a paint and sign shop, and a fabrication shop. The barn is explicitly listed as a wash and grease rack (as Building T-465) (War Department 14 October 1943, in History of Huntsville Arsenal July 1941 to August 1945).

The number of family cemeteries on land purchased by the Army in 1941 for the arsenal, plant, and storage depot is not verifiable by an exact count. (See Appendix D.) On the eve of arsenal construction in August 1941, the Huntsville Times reported 31 known cemeteries within arsenal boundaries: of these, 24 were black family cemeteries and seven, Caucasian. A slightly later article reported 34 family cemeteries. The Army planned to reinter between 2,357 and 2,500 bodies to accommodate construction, but the outcome of Army intentions is unknown. The Huntsville Times noted in 1941 that the Army considered combining the small individual family cemeteries at a single location, with discussions of sites in both the northeast and northwest corners of Army lands (Huntsville Times September 3, 1941 and January 26, 1942: 1, 4 and 3). This idea did not come to fruition. In 1959, as a part of the master planning process of that year, compilers of an analysis of existing facilities at the Redstone Arsenal noted that the arsenal
included 38,781 acres, inclusive of 6,990 acres obtained through a use permit from the TVA. Of this acreage, the analysis concluded that 12,960 acres were unusable. The analysis defined 10,000 acres as swamp, 2,800 acres as mountainous terrain, 150 acres as contaminated (see below), and 10 acres as containing 60 family cemeteries. No mapping or descriptive detail accompanied the reference to “60 cemeteries” (Analysis of Existing Facilities June 30, 1959: 1, 6) The next known numbering of cemeteries on arsenal lands appears as hand-notations on a multisheet document used as a baseline for the General Site Map of the Master Plan Basic Information Maps of 1 January 1967. The ca.1967 cemetery count for the Redstone Arsenal was 43, with 22 of the cemeteries having markers and 26 named. The official Army cemetery counts of 1959 and ca.1967, at 60 and 43 respectively, suggest that the agency did not move graves in large numbers during its initial construction for the Chemical Warfare Service during World War II. The drop in the number of cemeteries from 60 to 43, between the two counts, may further indicate that the Army and NASA may have (1) relocated some cemeteries within arsenal and MSFC grounds during this period for new construction; (2) reintered bodies off the government lands at this time; and/or (3) lost track of cemeteries still present within the Redstone Arsenal and the MSFC due to lack of headstones and receding oral history.

On Army land that is now within the MSFC, were at least two family cemeteries, Moore and Jordan. (See Appendix D.) In addition, a Horton family cemetery must have been located near or in MSFC acreage at one time. The Moore (Moore/Landman) and Jordan Cemeteries remain today, and were both likely black family cemeteries. A Horton cemetery is of unknown siting, but may be partially conflated with what is known today as the Moore Cemetery and/or may be Unnamed Cemetery 46-3 just outside MSFC boundaries to the south of Building 4680 (Figure 5). The Moore Cemetery is in the vicinity of the historic locations of the Centre and Pine Tree churches. The 1911 map includes these buildings, with a cluster of others, but does not indicate a cemetery. In 1936, a map of the area does show the cemetery. In 1941, the cemetery—immediate to Center Grove and today south of Centaur Street to the rear (south) of Building 4648—is again left off of an Army land acquisition map. Nearby Center Grove was probably a black community as suggested by the map notation of a Colored Baptist Church there. All Center Grove buildings were no longer mapped by 1950, suggesting their relocation or demolition by the Army (USGS 1950: map). The cemetery today contains one recent marker with four listings of the Burns family, placed by descendents. Death dates vary from 1898 to 1928, with Charles V. Burns noted as coordinating the genealogy effort. Birth dates range from 1845 to 1855. The Moore Cemetery is annotated on the ca.1967 Master Plan Basic Information Map, identified as the Moore/Landman Cemetery. The Moore Cemetery sits south of the Chickasaw Line. At the time of the early G.W. Jones mapping for the area, land ownership for acreage in the vicinity of today’s Moore Cemetery showed multiple names: Sam Arnett, J.E. Williams, A. Cowan, and J. Klaus & Co. By 1936-1941, the large tract of land containing the Moore Cemetery is delineated without individual ownership, by the late 1930s presumably part of TVA acreage along Indian Creek. Center Grove is mapped very early, ca.1804, and may have derived from a slave community that became a black freedman’s settlement following the Civil War.

A further understanding of the Moore Cemetery connects it to the Horton family. Printed references to a Horton family cemetery suggests that it is related to the Moore Cemetery. According to family descendents, a Horton cemetery sat on an original 900 acres of family land, land that also included the Horton’s farm house, the Silver Hill School, a pear orchard, a well, and a wash hole. Horton property is mapped in scattered tracts in 1941, existing both within current MSFC lands, and to the northeast and south on Army acreage. The family, which had sold 100 acres of their land to the TVA in the late 1930s, was required to sell the remaining 800 acres to the Army in 1941. Some part of the property—possibly that near or on the Huntsville Spring
Branch of Indian Creek—is likely also the source for the community name, Horton’s Ford. Horton parcels sat on and near the Indian and Huntsville Creeks, as shown in the early 19th century (G.W. Jones ca.1804: map). Both a Horton farm house and the Silver Hill school stood on test stand sites, those for Buildings 4670 and 4665, respectively. As mapped by the Quartermaster General’s Real Estate office in autumn 1941, Horton surname parcels accounted for 1,127 acres in nine distinct tracts. The largest tracts were those of the Everett Horton Estate (in two tracts of 443 and 102 acres: C-106 and C-140). The larger of the two Everett Horton tracts existed on Army land to the east of the MSFC (north and east of the Jordan Cemetery)—property that G.W. Jones mapped in ca.1804 as part of large tracts then owned by Llewelyn Jordan and M.H. Lanier. Several small notations for an “E. Horton” also appeared, adjacent to much larger Llewelyn Jordan holdings. These Horton-Lanier parcels sat to the near south/southeast of MSFC’s west test stand area, on Redstone Arsenal lands today. The smaller of the two Everett Horton tracts in 1941 was west / southwest of Building 4665 and is the probable location of the Everett Horton farmhouse. The Silver Hill School is mapped in 1936 and 1941, in the latter instance identified on two-acre parcel C-132 as “School District #27.” A Yancy Horton held a small amount of land near this site in ca.1805-1818, as mapped by G.W. Jones, also holding a small tract to the northeast of Green Grove within lands that became the Gulf Chemical Warfare Depot. The Yancy Horton tract at the latter site appears to have been at or near today’s Horton/Jones Cemetery 87-1. A Huntsville genealogist, Dorothy Scott Johnson, maps the Horton/Jones Cemetery as the “Horton-Joiner” cemetery in 1971, presumably referencing a William Joiner who owned acreage nearby during the early 19th century (Johnson 1971: 269).

Members of the Horton family returned to the MSFC in June 1962, when Building 4670 was under construction. These family members were Ovey and Celeste R. Horton (son and mother) and Charles W. Burns and Cebelle Wilkins (son and mother). Celeste Horton is assumed to be the same person as “Celestine Horton,” who is mapped as the owner of a 40-acre tract (C-119) very near the 443-acre Everett Horton tract in 1941. Charles Burns and Cebelle Wilkins were cousin and aunt to Ovey Horton. Charles “W.” Burns may be the same person as Charles “V.” Burns associated with the Moore Cemetery. Charles Burns and Cebelle Wilkins lived in Chicago in 1962, returning to Huntsville to visit. A photograph of the four family members appears in the *Marshall Star* during the visit to the west test area in June: Charles Burns appears to be black, with the two older women appearing to be black with possible Native American in genetic heritage. The original Yancy Horton parcel sat east of today’s Dodd Road, with the Silver Hill School across the road at the location of Building 4665. A photograph of the Silver Hill School shows five black female children standing in front of the schoolhouse, with a caption noting that Ovey Horton attended school there (*Marshall Star* June 20, 1962: 3).

The fate of the Everett and Yancy Horton family cemeteries is not known, but several possibilities suggest themselves. The Everett cemetery is likely that south/southwest of the MSFC west test area, Unnamed Cemetery 46-3. This cemetery is sited immediately northeast of the Lanier Cemetery 46-2, with the two cemeteries labeled as Lanier and Lanier Colored by Johnson in 1971. The M.H. Lanier family owned multiple large tracts of land mapped near the E. Horton holdings in ca.1804. The involvement of Charles Burns in placing headstones in the Moore Cemetery for early members of the Burns family—who in turn appear to be related to the Horton family—suggests that possibly the Burns’ graves in the Moore Cemetery also link the Horton family to that location. Whether the Horton family that returned to the MSFC during construction of Building 4670 descended from the Everett Horton or Yancy Horton family line is not researched here. The existence of a small Yancy Horton parcel to the south of the MSFC below Buxton Road, as well as that of the Horton/Jones or Horton/Joiner family cemetery, also suggests some Horton family burial at that location. Cemetery burials within and near the MSFC are complex, and appear to be tied to antebellum and late 19th century black settlement.
The Jordan Cemetery, the second of the two cemeteries today confirmed as existing within the MSFC, is the final known family cemetery with strong ties to MSFC lands. The Army’s map locating 43 cemeteries on arsenal grounds in ca.1967 does not include the Jordan family cemetery, although it does show an unnamed cemetery immediately north of Building 4531 between two roads in the upper portion of the east test area. While today’s Jordan cemetery does not appear on any known maps before ca.1967, an unimproved road is shown on the USGS map of 1950 in the immediate vicinity. The road’s terminus circled what was likely cemetery land (USGS 1950: map). The Army’s land acquisition map of 1941 denotes the 327-acre tract which includes today’s cemetery site as owned by Moses Love. This tract was split between Llewelyn Jordan and M.H. Lanier in ca.1804-1820, with smaller tracts owned by Celia Love and Yancy Horton to the neighboring south (G.W. Jones ca.1804:map). The corridor of today’s Martin Road bordered the two quarter-sections on the north, with Dodd Road the border on the west. The Love family of the early 19th century owned several small tracts of land in the vicinity, mapped with the names of W.A. Love and Celia Love. A single remaining set of head- and footstones in the cemetery read “Beulah Love” and “B L,” respectively, with birth and death dates of 1880 and 1925. The death date in the 1920s is very similar to those present in the Moore Cemetery off Centaur Street, while the surname Love is likely linked to the land owner in 1941, Moses Love. Moses Love is assumed to have been a descendant of Celia Love. The Love family was likely also black. The name “Jordan” does not appear associated with this cemetery until Johnson’s map of 1971, and must reference the large landholder of the early 19th century, Llewelyn Jordan. Elucidating the interrelationships among the landowners, tenants and other pre-Army residents of MSFC is beyond the scope of the present effort. It is worth noting, however, that the historical records examined to date suggest that some of the land may have been in black ownership prior to the Civil War. The black families represented by the MSFC’s cemeteries are posited to be members of the very long-standing black community of Center Grove.

World War II Operations

The Huntsville Facilities and the Army Ordnance Department

The Huntsville Arsenal, Redstone Ordnance Plant, and Gulf (originally, “Huntsville”) Chemical Warfare Depot represented an important contribution to American military mobilization during World War II, and were an equally important expansion of the specialized capabilities of the Chemical Warfare Service. Construction of buildings for ammunition manufacture and storage began in August 1941, with land purchase occurring simultaneously into early 1942. As the project unfolded, the utilized acreage included TVA lands and consumed between 39,000 and 40,000 total acres. The Huntsville Arsenal included manufacturing and chemical loading plants, as well as the required support infrastructure of offices, laboratories, shops, medical facilities, and a housing cantonment. The Redstone Ordnance Plant, adjacent to the Huntsville Arsenal at the southeast, featured similar types of basic infrastructure, but focused on ammunition assembly. The very large storage area of the Gulf Chemical Warfare Depot to the south of today’s MSFC included its own munitions branch, with its primary architecture that of multiple warehouses, igloos, magazines, and outdoor storage sites, as well as a toxic gas yard. The three Chemical Warfare Service posts worked together. Employees of the Huntsville Arsenal produced a variety of chemical agents and materiel at the arsenal’s manufacturing plants, focused on mustard gas, phosgene, lewisite, white phosphorous, tear gas, incendiaries, and colored smoke. Yet more workers prepared the agents and chemical materiel as munitions or munitions components. In the latter step, arsenal employees stationed along loading lines packed chemical materiel into various sizes of cluster bombs, medium and major caliber chemical artillery shells, demolition blocks, and rifle grenades. Employees at the Redstone Ordnance Plant then added fuzes, boosters,
propellant charges, and primers to assemble 75mm and 135mm chemical ammunition, as well as 30- and 100-pound chemical bombs. Employees at the plant also manufactured all bursters. As of early 1943, the plant became the Redstone Arsenal, the single government-owned, government-operated (GOGO) industrial facility established under the Army’s Ordnance Department during the war. The finished munitions went to the Gulf Chemical Warfare Depot for storage and later shipment. Also stored at the depot were bulk chemicals, decontaminating and protective equipment, and associated items, such as gas masks. Transportation systems supporting the operations of all three Chemical Warfare Service posts at Huntsville included miles of road and rail, augmented by dock facilities on the Tennessee River to the south of the conjoined arsenal, plant, and depot lands. (Reed 2000: passim; Baker 1993: 1-5; Hughes 1991: 56-58; Wright 2000: 13-15).

The Huntsville Arsenal functioned as a “works” facility, producing basic materials required in munitions production, while the Redstone Ordnance Plant operated as a “plant.” The Army’s Ordnance Department, the forerunner of today’s Army Materiel Command, supplied ordnance to the United States Army Ground Forces, the Navy, the Coast Guard, and the Marine Corps, as well as to 43 foreign countries during World War II. In addition its one GOGO plant, the Redstone Ordnance Plant, and its GOGO works, such as the Huntsville Arsenal, the Ordnance Department set up 76 government-owned, contractor-operated (GOCO) plants and works to support the war effort. (The Army first contracted the Redstone Ordnance Plant as a GOCO, but shifted management of the industrial facility to that of a GOGO.) The number of ordnance plants was somewhat greater (41) than ordnance works (35). In Alabama, GOGO ordnance plants and works were those of the Huntsville Arsenal and Redstone Ordnance Plant, while the state’s GOCO facilities were those of the Gadsden Ordnance Plant, the Coosa River Ordnance Plant, and the Alabama Ordnance Works (at Sylacauga). Army Ordnance Department plants and works did not extend westwards further than Utah, with only two of the GOCOs west of Texas. In the southern region comprised of East Texas, Louisiana, Arkansas, Mississippi, Alabama, and Tennessee, the Ordnance Department established 20 GOCO ordnance plants and works, more than 25% of the total such GOCO facilities nationwide. GOGOs and GOCOs for the Ordnance Department were of nine basic types: load, assemble and pack (LAP) plants such as Redstone and Coosa River in Alabama; propellant and explosive (P&E) works such as the Alabama Ordnance Works; chemical works (which included the Huntsville Arsenal in the GOGO category); small arms ammunition plants; case cup plants; gun tube plants; incendiary (magnesium metal power) works (chemical manufacture at Huntsville-Redstone did not include efforts toward the magnesium-type incendiary); tank plants; and, plants for the metal components of small arms (such as at the Gadsden Ordnance Works).

LAP plants and chemical works paralleling those of the Redstone Ordnance Plant and the Huntsville Arsenal, built outside Alabama but within the Ordnance Department’s southern region include seven LAPs: the Arkansas Ordnance Plant, the Bluebonnet and Lone Star Ordnance Plants in Texas, the Gulf Ordnance and Mississippi Ordnance Plants in Mississippi, the Louisiana Ordnance Plant in Louisiana, and the Wolf Creek Ordnance Plant in Tennessee; and, four chemical works: the Baytown Ordnance Works in Texas, the Dixie Ordnance Works in Louisiana, the East Tennessee Ordnance Works in Tennessee, and the Ozark Ordnance Works in Arkansas. These 11 industrial plants and works offer a regional context for the Redstone Ordnance Plant and Huntsville Arsenal (today’s Redstone Arsenal) of World War II. Operation order for the 14 total LAP plants and chemical works in the Ordnance Department’s southern region was: Baytown and Wolf Creek (September 1941); Coosa River (January 1942); Redstone (February 1942); Arkansas, Huntsville, and Louisiana (March 1942); Lone Star (May 1942); East Tennessee (July 1942); Bluebonnet (October 1942); Gulf (November 1942); Dixie (April 1943); Ozark (May 1943); and, Mississippi (May 1945). Not only were the Huntsville Arsenal and
Redstone Ordnance Plant the first such facilities planned by the Chemical Warfare Service, they were among the very first LAPs and chemical works activated in their contextual Southern group. Of the 14 plants and works, the Army deactivated or declared excess the Arkansas, Baytown, Bluebonnet, Dixie, East Tennessee, and Gulf plants and works, with those of Mississippi and Ozark ending activities shortly after World War II. The remaining six Ordnance Department plants and works considered in the group—Coosa River, Lone Star, Louisiana, Redstone, Huntsville, and Wolf Creek—continued as major Army facilities, after a period of stand-by and other use during the late 1940s and sometimes during the 1950s. Three of these plants and works were in Alabama (Kane 1995: 7-18, 45,57-63).

Architectural-Engineering Design for the Chemical Warfare Service

The role and involvement of architectural-engineering firms in the planning, design, and engineering required for the Ordnance Department plants and works of the early 1940s varied between GOGO and GOCO facilities. The Huntsville Arsenal was one of three World War II GOGO chemical works built in the United States, including those of Pine Bluff in Arkansas and Rocky Mountain in Colorado (see discussion above). Its design was first nationwide, and conceived within the Army’s Quartermaster Corps during the late 1930s as assisted by the Baltimore firm of Whitman, Requardt & Smith. While the Army initially contracted the operation of the Redstone Ordnance Plant to the Concan Ordnance Company, a subsidiary of the Continental Can Company, the agency canceled this contract before it went into effect (Kane 1995: 62). Whitman, Requardt & Smith were responsible for the design of the Redstone Ordnance Plant in tandem with their work on the Huntsville Arsenal, also undertaking the design of the Pine Bluff and Rocky Mountain chemical works facilities. This situation was significantly different from that for the 76 Ordnance Department GOCO plants and works built across the country. Architectural-engineering firms contracting for these facilities varied by region, but included a premier group that would reappear numerous times throughout the 1950s and into the early 1960s as responsible for the design of specialized military research, development, test, and evaluation buildings and structures. Architectural-engineering firms that designed Ordnance Department GOCO plants and works during World War II, and subsequently designed at the Redstone Arsenal and the MSFC during the Cold War included: Bechtel (as Bechtel McCone) and Parsons Corporation of Los Angeles; and, Giffels & Vallet (later becoming Giffels & Rossetti) and Smith, Hinchman & Grylls of Detroit (Kane 1995: 71-78). (Also, see Appendix B.)

The Chemical Warfare Service, and the Army and Navy generally, turned to very well known industrial architects and engineers for its design needs during World War II—sometimes also involving major architects and engineers who had immigrated to the United States between the first world war and the early 1940s. For very heavy construction, or the specialized needs tied to plant construction, the Army focused on firms in the Chicago, Detroit, Cleveland, New York, Baltimore-Washington, Boston, and Los Angeles areas (Fine and Remington 1972: 191; Weitze 2002: in draft). For the Huntsville Arsenal, the Quartermaster Corps and Whitman, Requardt & Smith designed three separate plants areas. The layout further segregated the plants areas from the arsenal headquarters by several miles. The Quartermaster Corps and Whitman, Requardt & Smith designed two of the plants areas, within the Huntsville Arsenal, as duplicating each other “on the theory that an enemy air attack was entirely feasible and that if one area were knocked out there was a chance that the other area might be saved.” Creating a literal “duplex” arrangement for high-priority military systems was a strategy that would continue strongly into the first two decades of the Cold War (Figure 6). The third plants area was different from Plants Area 1 and 2.
This area manufactured and filled smoke munitions and incendiary weapons, with groupings of buildings separated from one another due to the explosive nature of Plants Area 3’s mission (Reed 2000: 41ff). Each of the three areas had its own administrative units for engineering, personnel, property, storage, and transportation. The redundant layout for the Huntsville Arsenal, however, was cumbersome and expensive, leading the Army to make both the Pine Bluff and Rocky Mountain chemical works much more compact, without a duplication in administrative support units (Brophey and Fisher 1989: 121). In this regard, the designed layout of the Huntsville Arsenal is uniquely representative of the very earliest design concepts of the Ordnance Department and the Chemical Warfare Service at the outset of World War II.

Design of the buildings and structures for the Army’s ordnance plants and works were similar between the GOCO facilities handled across a number of key industrial architectural-engineering firms, and the GOGO chemical arsenals of Huntsville, Pine Bluff, and Rocky Mountain. An extremely functional design was a priority at all installations. The major differences in design among the nine categories of ordnance plants and works were linked directly to the differences in facilities’ functions. LAP plants were very similar to one another, as were P&E works—and, for the Chemical Warfare Service, as were chemical works. Explicit function also determined the presence of sub-areas within facilities. Buildings housed a predetermined grouping of machinery, equipment, and production lines, with these items and their placement designed first. Other factors also affected the appearance of Ordnance Department facilities. As GOCO plants and works went to construction, the Army’s Chief of Ordnance faced high cost overruns. As of January 1941, he stipulated that in all possible cases the Quartermaster Corps insist upon temporary, rather than permanent, construction. This change meant some plants and works were primarily light wood-frame construction. Where masonry buildings went forward, they were typically not brick, nor more than one story in height. Finishing features were all aborted (such as air conditioning). Lower-cost alternatives were the norm—cheaper roof systems, floorings, and so on. As of 1942, material shortages also focused the design of most plants and works in this direction. Substitutions, if more economical for a particular item, were the result. Steel, for example, was needed in other war arenas first, even as American steel manufacturers increased their production capacity. For buildings and structures, steel architectural features defaulted to other materials: brick or concrete smokestacks replaced steel smokestacks; wood or concrete substituted for steel in water tanks; industrial roof trusses, wall-framing, and doors, previously steel, became wood; asbestos-cement and concrete pipe replaced former steel pipe. In other less obvious ways, Army industrial buildings were also different during the war: hot water tanks became smaller to allow the use of sheet-steel; cast-iron downspouts replaced plate-steel ones, soon disappearing altogether along with gutters; concrete slabs replaced more complex foundation systems; warehouse sprinkler systems remained uninstalled. Changes driven by materials’ availability and construction costs also appeared in utility lines and supporting infrastructure systems of all kinds. However, where structural steel was a necessity, Ordnance and Chemical Warfare Service jobs sustained a priority status (Fine and Remington 1972: 534-536; Kane 1995: 84-87).

At the Huntsville Arsenal and Redstone Ordnance Plant, the materials issues of World War II Army construction are clearly reflected in the installations’ buildings and structures, inclusive of those buildings originally part of the Huntsville Arsenal that are now within the MSFC. Across the three Huntsville Arsenal plants areas and the headquarters administration area, individual buildings fell into seven umbrella use categories: manufacturing, storage, maintenance, administration and laboratories, cantonment support, and housing. Whitman, Requardt & Smith designed the industrial plant buildings at the Huntsville Arsenal and the Redstone Ordnance Plant predominantly as steel-frame structures supporting steel roof decking and trusswork, with hollow-tile attached equipment rooms where appropriate. Use of precious structural steel partially
reveals how early in the World War II mobilization effort the Huntsville buildings actually are, and in addition points to the priority granted to the Chemical Warfare Service. Foundations are generally spread footings with concrete flooring, rather than concrete slab, another indication that the design and construction occurred before major changes—as is the use of steel, rather than wood, doors and stairs. Economic materials, although functionally fireproof and adequate, are seen in the corrugated asbestos metal cladding for exterior walls and roofs, and in the substitution of hollow tile masonry for brick. In addition, all window treatment is extremely minimal, as built. An example of this kind of design is present with only minor exterior alterations in Building 4313 at the MSFC, designed by Whitman, Requardt & Smith in 1941 as an ethylene generator plant (War Department October 14, 1943: Building Data; Whitman, Requardt & Smith October 23, 1941: drawing). (See Appendices A and C.) In contrast, examples illustrating the shift stipulated by the Quartermaster Corps as of early 1941 do appear in the building campaign at the Huntsville Arsenal and Redstone Ordnance Plant as of 1942. Building 4485, now within the MSFC, is indicative. The framing and roof trusswork for this building, designed by Whitman, Requardt & Smith as a 4.2 [-inch chemical mortar shell] assembly building in October 1942, is wood, not steel. Walls are hollow-tile, not brick. Roof sheathing is of a rolled type, not corrugated asbestos. Doors and stairs are wood. The character of the activities inside the building demanded that it be fireproof (hence hollow-tile walls rather than horizontal wood siding). To support the equipment and load lines within the building, foundations remained reinforced concrete flooring on spread footings (War Department October 14, 1943: Building Data; Whitman, Requardt & Smith October 31, 1942: drawing) (Plate 3). Most storage structures at the plants (warehouses) were wood-frame, clad in corrugated asbestos siding, and generally reflecting the economizing of mobilization construction. Administration (such as offices) and cantonment support buildings (such as fire stations) were typically hollow-tile and wood, dependent on use. Very large cantonment support buildings, such as boiler houses (Building 4725) were among the few erected as reinforced concrete construction. (Plants Area 3 also featured hollow tile and reinforced concrete structures [Reed 2000: 10-12]). (See Appendix A.) Original housing relied on theater-of-operations buildings, the most temporary of standardized wood-frame Army structures available (History of Huntsville Arsenal July 1941 – August 1945, volume I: 24).

Specific Activities at Huntsville Arsenal

The Huntsville Arsenal (within today’s Redstone Arsenal and the MSFC) featured distinct physical areas set distances apart from one another. A headquarters administrative area included the arsenal headquarters, staff quarters, administration, communications and medical buildings, fire and pump station, and a boiler house. A small airport supported proof testing for incendiary bombs over a bombing mat sited near the western boundaries of the reservation. Plants Areas 1 and 2, the redundant configurations of the Huntsville Arsenal, are today primarily split between NASA (Plants Area 1) and Army (Plants Area 2) management jurisdictions. Plants Area 3 focused on incendiaries, smoke munitions filling, and chloroacetophenone-adamsite (CN-DM) production (under Army jurisdiction today). The Chemical Warfare Service manufactured no actual chemicals in Plants Area 3 (Reed 2000: 41-52), instead focused on munitions filling tasks (Joiner 1966: 5). For these facilities, the Quartermaster General’s Office first authorized four smoke munitions (SM) plants (inclusive of an arsenic trichloride [AT] plant), four mustard (H or HS) plants, two lewisite (L) plants, one chlorine plant, two mustard filling plants, one WP (white phosphorous) plant, one incendiary bomb filling (IBF) plant, two administration buildings, 10 warehouses, 55 magazines, one dock, a 150' by 5000' runway and a toxic gas storage yard as of mid-July 1941. Ancillary buildings were to include a structure for clothing renovation, a control laboratory, a maintenance shop, a 60-bed hospital, a steam and electric plant, and guard houses.
By January 1942, plans for what would become the Gulf Chemical Warfare Depot included 200 concrete igloos, three storage magazines, a fire station, maintenance shop, and guard houses, expanded by another 150 igloos, six warehouses, and a toxic gas yard as of March. That same month, the Army issued directives for expansion of the Huntsville Arsenal and the addition of the Redstone Ordnance Plant.

Expansion of plans occurred again in June 1942, to include a fifth smoke munitions plant, two additional lewisite plants, one phosgene (CG) manufacturing plant, one chloroacetophenone (CN) [tear gas] manufacturing plant, two additional administrative buildings, another hospital, three cafeterias, an additional control laboratory, nine additional warehouses including a specialized chemical warfare warehouse, nine fuel oil and alcohol storage tanks, another toxic gas yard, and a steam plant. The original planned construction, combined with the sequential expansions, became the basis for the redundant Plants Area 1 and Plants Area 2. More structures for the Gulf Chemical Warfare Depot were also authorized, in July 1942, to include 20 added concrete igloos, and a packing, shipping, and receiving building. Predictably, yet more expansions continued during late 1942 (such as a thionyl chloride plant adjacent to Chlorine Plant No. 2 and a carbonyl iron plant sited nearby) with conversion of some manufacturing facilities to new tasks, befitting the particular chemical munitions assigned to the installation. The Army’s contract with Whitman, Requardt & Smith for “the preparation of necessary reports, designs, drawings, specifications, and other documents, as well as technical supervision for the construction of Huntsville Arsenal”

Work at the Huntsville Arsenal, Redstone Ordnance Plant, and Gulf Chemical Warfare Depot was both demanding and dangerous (Joiner 1966: 27-41). The first product made at the arsenal was colored smoke, with semi-permanent dyes in yellow, red, violet, and green that tinted the munitions, and workers’ skin and clothing (Hughes 1991: 56-57). Toxic gas agents manufactured at the Huntsville Arsenal included mustard gas, lewisite, phosgene, and tear gas. Gas production required specific plant facilities within one of the plants areas at the arsenal, and provided the material for partial munitions manufacture adjacent. For example, six plants at Huntsville handled mustard gas, four in Plants Area 1 (primarily within the MSFC today) and two in Plants Area 2 (within the Redstone Arsenal today). Each mustard plant featured a sulphur monochloride building, an ethylene generator building, a mustard reactor building, two gas holders, a tail gas scrubber building, a disposal reactor, a lunch room, and several ancillary structures (History of Huntsville Arsenal July 1941 – August 1945, volume I: 325). Two mustard munitions filling plants, today’s Building 4471 and Building 4481 at the MSFC, complemented the chemical works for the agent. The individual areas of the Huntsville Arsenal occupied concentrations within the majority of the acreage used by the Chemical Warfare Service. The Redstone Ordnance Plant discretely sat at the southeast, while the Army situated the Gulf Chemical Warfare Depot at the far south of the entire government reservation. Within the Huntsville Arsenal, Whitman, Requardt & Smith were responsible for the design and engineering of all of the buildings except those for the chlorine plants (Chlorine Plants No. 1 and No. 2, and the thionyl chloride plant), the carbonyl iron plant, the oleum thaw house, and, the bomb target and mat (History of Huntsville Arsenal July 1941 – August 1945, volume I: Appendix A, Section II). Each of these facilities was a specialized, multi-building heavy industrial task, subcontracted to H.K. Ferguson of Cleveland (Joiner 1966: 33). The Chemical Warfare Service used chlorine in the production of mustard gas. Running at capacity, the two chlorine plants at the Huntsville Arsenal manufactured 50 tons of gaseous chlorine, or 45 tons of liquid chlorine and 56 tons of caustic soda, per day. Caustic fusion plants (including Building 4241) produced up to 75 tons of solid caustic per day (Joiner 1966: 27). In addition to the facilities at Huntsville, H.K. Ferguson also executed the design and engineering for at least one, and possibly two, complete ordnance plants for the Army: those of the Wolf Creek shell loading plant near Milan, Tennessee, and that of the Gulf Ordnance Plant in Mississippi (another LAP plant) (Kane 1995: 75). In the case of the Wolf Creek plant, the Construction Division of the Quartermaster Corps had turned to the selected GOCO plant operator, Proctor & Gamble, to take their recommendation for the architect-engineer best advised for the job (Fine and Remington 1972: 191).

The total number of buildings remaining today at the MSFC from World War II is 28, today configured as 26 individually numbered structures (see Appendices A, B and C). These buildings primarily sit within what was Plants Area 1, with a few located in the general Service Area for Plants Area 1 and Plants Area 2 (immediately west of Dodd Road). (See Figure 3.) Included are:

- Building 4241, a caustic-fusion facility at Chlorine Plant No. 1 (a distinct facility within Plants Area 1);
- Building 4306, of unknown original use, but functioning as a canteen/cafeteria as of the early 1950s;
- Building 4313, an ethylene generator plant;
- Building 4319, bulk fuel oil, alcohol storage, and distribution;
Building 4353, an ethylene generator plant;
Building 4471, an HS [mustard] munitions filling plant;
Building 4479, a bulk oil platform;
Building 4481, a second mustard munitions filling plant;
Building 4485, a 4.2 assembly facility;
Building 4491, an inert materials warehouse;
Building 4492, an inert materials warehouse;
Building 4493, an inert materials warehouse;
Building 4494, an inert materials warehouse;
Building 4495, a Signal Corps warehouse;
Building 4632, a fuel tank;
Building 4633, a fuel tank;
Building 4711, a white phosphorous filling and storage facility;
Building 4712, a white phosphorous locker and office;
Building 4714, a compressor for white phosphorous filling and storage;
Building 4715, a 4.2 assembly facility;
Building 4716, a fuze and propellant magazine;
Building 4723, an LCL warehouse for inert materials;
Building 4727, a machine shop;
Building 4728, an inert materials warehouse;
Building 4732, a clothing renovating facility; and,
Building 4746, originally three separate buildings that functioned as an engineering service office, a production operations office, and a drafting annex.

The German Prisoner of War (POW) Camp

The Huntsville Arsenal also supported a German POW camp on its grounds. Information on the location of the POW camp and its size is scanty, and, as assessed to date, sometimes in conflict from one analysis to the next. Discussion in the *History of Huntsville Arsenal July 1941 – August 1945*, volume I, noted that the Army Corps of Engineers built an “original camp for 250 Prisoners of War.” The presentation implies that the Army expanded the camp at its site (the “remainder of the Camp”) to house 655 men, with a total cost of just over $30,500. The Post Engineer at the arsenal oversaw the enlargement of the POW camp, and used POW labor to achieve the added construction (*History of Huntsville Arsenal July 1941 – August 1945*, volume I: 34). In the *History of Huntsville Arsenal July – December 1946*, Army historians commented briefly that the POW camp “with all buildings and compound” was still standing on the arsenal, numbered as Buildings T-401 and T-402 (*History of Huntsville Arsenal July – December 1946*: 113). Although the War Department Buildings Data report of 14 October 1943 does not include any buildings designated as either 401 and 402 (or, T-401 and T-402), a land use map prepared by the U.S. Engineer (Army Corps) Office in Mobile of identical date clearly maps and labels the POW camp. The camp featured a rectangular fenced area, with a stockade in one corner. Two buildings sit immediately outside the fencing. The Army located the POW camp to the near east of Dodd Road, immediately south of the Service Area for the arsenal (U.S. Engineer Office October 14, 1943: map). In June 1982, one of the prisoners held at the Huntsville Arsenal POW camp, Karl Spitzenpfeil, returned to Huntsville. The *Huntsville Times* interviewed Mr. Spitzenpfeil, who described the compound as arranged as “tent-like structures housing six men each…in rows within that fence.” The Army confined Mr. Spitzenpfeil at the Huntsville Arsenal POW camp for 14 months between August 1944 and September 1945 (*Huntsville Times* June 17, 1982). As a part of the visit by Mr. Spitzenpfeil, the Redstone Rocket also reported on the event, noting that “Camp Huntsville was situated just east of Dodd Road. The site is today grown up in
pines and is behind the NASA fence.” The arsenal took Mr. Spitzenpfeil to the top “of the big test
tower,” assumed to be Building 4550. From that vantage point, the former POW indicated that he
could look down on the camp’s site to the north and could see the dirt road leading to the camp.
Mr. Spitzenpfeil stated that one of the buildings immediately outside the fenced compound had
functioned as the arsenal carpenter shop. He noted, in this interview, that the six-man tents were
of canvas with screens and had sat in four rows (Redstone Rocket June 23, 1982). Mr. Spitzenpfeil’s description of the tents is a standard delineation of military huts of the
period.

The actual number of German POWs at the Huntsville Arsenal is not solidly confirmed.
Mr. Spitzenpfeil discussed the camp as housing 250 men, while the Army history of 1945
indicates an expansion up to 655 men. Communications between the Edgewood and Redstone
History Offices, as recorded in a typescript on file at the Redstone Arsenal History Office today,
suggests that the correct number of men was about 250 up into early 1945, and that this increased
to about 500 men by mid-year. The typescript noted that POWs worked in the motor
maintenance shops, in carpenter and machine shops, and as warehousemen, box makers, and
mosquito controlmen. (The Huntsville Arsenal is situated on land that was under a malaria
control program during World War II, in part due to the large amount of surface water created in
the immediate area by the TVA as of the late 1930s. The TVA had a pre-existing program in
place that had included adding screens for most houses in the area [Joiner 1966: 17; Huntsville
Times August 17, 1941: 3].) The typescript refers to one of the two buildings at the compound as
a mess hall (Undated memo on file at the Redstone Arsenal History Office). A telephone
interview of February 1980, conducted by the Redstone Arsenal History Office, mentioned an
even higher number of men, 1,100—although this figure is unsubstantiated and unlikely. The
interviewee, a former Army employee at the arsenal during World War II, noted that a small
number of the POWs worked in the post motor pool across Dodd Road, as well as at the sawmill,
a limestone quarry (on Neal Road), and at the rock crusher. A few also worked at the officers
club as cooks (Cagle February 29, 1980). The site of the German POW camp at the Huntsville
Arsenal is within the MSFC today, verified through correlation of Army maps of October 1943
and August 1953, and current maps, as to the near-south of the unpaved extension of the NASA-
Army boundary road east of Dodd Road. The site is east/southeast of Building 4657 (Figures
6-7). (See also, Plate 9.)

Interregnum: Demobilization to 1952

With the end of World War II in 1945, the Chemical Warfare Service arsenal, ordnance plant, and
storage depot near Huntsville each began demobilization. After victory in Europe, production
activities changed and the Army placed some plants on standby status. Following victory in
Japan, efforts turned largely to inventory of existing surplus, supplies, and equipment; complete
shutdown of manufacturing; property disposal; and, receipt of termination inventories from
selected Chemical Warfare Service plants and contracted facilities. Some unusual situations
occurred, such as the selling of large numbers of empty wooden boxes formerly made to ship
M54 white phosphorous incendiary bombs. The immediate post-war lumber shortage fostered a
demand for these crates, and house builders in Huntsville reused the boards from many boxes to
floor and sheet new construction in Huntsville. While the regional populace desired the return of
arsenal, ordnance plant, and depot acreage to private use, the Army decided that the whole of the
acreage occupied by the Chemical Warfare Service during the war should stay in the hands of the
federal government to produce smoke materiel and be available for emergency manufacture of
some chemical agents. Land not needed for these peacetime purposes was open to lease, as were
certain mothballed buildings and structures. In contrast, Army activity at the Gulf Chemical
Warfare Depot continued briefly post-war. The Chemical Warfare Service decided to fully inactivate the Indianapolis Chemical Warfare Depot in October 1945, shifting its mission to the depot at Huntsville and transferring its stock there. As of mid-January 1947, the Huntsville Arsenal formally absorbed the Gulf Chemical Warfare Depot, with the two becoming a single installation (Joiner 1966: 49-65). Late- and post-war activities at the Redstone Ordnance Plant (Arsenal as of 1943) also reflected new needs of the Chemical Warfare Service as of mid-1944. The Redstone Arsenal thereafter functioned as the Service’s center for screening and renovating chemical munitions returned from overseas and other depots in the U.S. Production increases very late in the war led to an upgrading and automation of production lines at the Redstone Arsenal. The Army selected Maurice H. Connell & Associates of Miami as the architect-engineers for the project. Maurice H. Connell & Associates would design and engineer key test stands, terminal buildings, observation bunkers, support and research facilities for the missile and space booster program at the Redstone Arsenal and at the MSFC, between 1957 and 1963—culminating in the Advanced Saturn Dynamic Test Stand (Building 4550). (See Appendices A, B, and C.) After victory in Japan, however, production schedules at the Redstone Arsenal stopped. The Redstone Arsenal renovated and salvaged materiel into early 1947, placed in standby status between February 1947 and June 1949 (Joiner 1966: 119, 122-123, 132).

From 1946 into 1948, activities at the Huntsville and Redstone Arsenals were minimal. Many buildings and structures at the Huntsville Arsenal became storage warehouses for Army production equipment set aside as war reserve, inclusive of large, specialized buildings originally used as manufacturing plants. Although not anticipated, building modification also began in 1946 following an extremely severe hail storm that damaged 4,000 windows and the roofs of 700 buildings. The first major leasing of former chemical works facilities came in autumn 1946, when the Solvay Process Division of the Allied Chemical and Dye Corporation of Solvay, New York, leased Chlorine Plants No. 1 and 2 for a five-year period. Solvay initiated its operations at the Huntsville Arsenal in May 1947. After the repair of buildings following the 1946 hail storm, the Army planned to prepare most other buildings and structures at the Huntsville Arsenal for extended standby. Anti-corrosion and –weathering efforts occurred for Plants Area 3, but remained unachieved for Plants Areas 1 and 2. In August 1947, the Army leased Building 4481 within the MSFC to Keller Motors Corporation (earlier named the Dixie Motor Car Corporation) under a 15-year contract (Joiner 1966:74). Keller Motors Corporation planned to assemble automobiles at the site. Other companies leasing buildings from the Army at this time were Calabama Chemical Company and Fine Organics, Inc. These contracts not withstanding, Army Chemical Corps uses for the Huntsville Arsenal post-war were insufficient to prevent a declaration of surplus for the post in late September 1947, with full deactivation intended by mid-1949. Surplus status further required decontamination of many manufacturing plants and some acreage. Procedurally, the War Assets Administration was to assume jurisdiction from the Army of the nearly 1,150 buildings at the Huntsville Arsenal. In late April 1948 the War Assets Administration refused to accept the arsenal due to contamination issues and property administration stayed with the Army. The agency continued to lease property, and to demilitarize and decontaminate. In 1948, the Army leased Buildings 413, 414, and 415 to Bryant-Harper & Company to recover white phosphorous from filled munitions. (Two of these structures survive today within the MSFC: Building 4714 and 4715. See Appendix A.) As of the end of 1948, the federal government changed the status of the Huntsville Arsenal from surplus to austerity standby for up to 10 years. By this date, both the newly formed Air Force of mid-1947 and non-Chemical Corps units within the Army had indicated that they might want to take over the Huntsville Arsenal for new uses. The number of total buildings on the installation had dropped by about 160 over 1948, with 58 leased to private companies (Joiner 1966: 66, 68-71, 74-84).
As of July 1949, plans shifted again, and the Huntsville Arsenal was formally for sale. Equipment salvage continued, as did decontamination. However, while activities at the Huntsville Arsenal remained at a low ebb, those at the adjacent Redstone Arsenal had taken on renewed life. During 1948, the Army had designated the Redstone Arsenal for rocket R&D. In June 1949, the Ordnance Department reactivated the Redstone Arsenal for the emerging Cold War mission of rocketry. Nearly simultaneously, the Army made Redstone Arsenal responsible for the buildings and acreage of the dormant Huntsville Arsenal. At this date, the total Army landscape between the two arsenals approached 40,000 acres. In early 1949, the Army initiated planning toward physically moving the Guided Missile Research and Development Center from Fort Bliss, Texas, to the Redstone Arsenal. Pre-1950, 132 German rocket scientists and engineers were working at Fort Bliss and the nearby White Sands Proving Ground in New Mexico on the earliest post-war guided missile research and testing. Led by Dr. Wernher von Braun, these men had arrived in the U.S. via Project Paperclip between autumn 1945 and 1948. The majority of the group—120 men—accompanied von Braun to the Redstone Arsenal in April 1950, while a nucleus stayed behind under Dr. Ernst Steinhoff at Air Force’s guided missile development center at Holloman Air Force Base in Alamogordo, New Mexico (Weitze 1997: 24, 172). In August 1949, a planning group of Army officers and several of the Fort Bliss German scientists inspected the Redstone Arsenal, suggesting the first changes to existing facilities:

The Post Engineer furnished the group with complete sets of drawings of the existing facilities considered for alterations to meet their requirements. These drawings were carried back to Fort Bliss for further study and used as a guide for the development of design criteria to be submitted to the Post Engineer for preparation of final drawings and specifications pertinent to facility requirements for Missile Research and Development.

In January 1950, the Post Engineer initiated action for employing engineers and draftsmen necessary to design and prepare drawings for converting existing facilities for use in Research and Development of Guided Missiles and during February and March 1950, engineering progressed rapidly for the first phase of the project (Redstone Arsenal Historical Summary V-J Day to 31 December 1950: 25).

The government fully deactivated the Huntsville Arsenal as of April 1950, consolidating its acreage and buildings with the Redstone Arsenal toward the Army’s Guided Missile and Rocket Research Center (inclusive of the Ordnance Rocket Center and the Ordnance Guided Missile Center). In 1950, too, Congress appropriated funding for new construction at the emerging Redstone Arsenal of the Cold War (Joiner 1966: 132-134).

The rocketry mission of the Redstone Arsenal included not only R&D for the missiles themselves, but also aerodynamics research, component and systems development, guidance and control, propulsion, assembly, transport, testing, and launch responsibilities. Additional related guided missiles and rocket ordnance missions evolved as the early 1950s unfolded. The arsenal continued to sustain an ordnance reserve depot mission, using the facilities formerly part of the Gulf Chemical Warfare Depot of World War II, as well as a chemical ammunition mission initially focused on shell renovation. With American entry into the Korean War in mid-1950, the Redstone Arsenal returned to the production of chemical ammunition and its components. Manufacturing resumed at the Redstone Arsenal between mid-1951 and mid-1956, when all such production ceased permanently (Joiner and Jolliff 1969: 6-16). In preparation for the guided missile and Korean War production missions, the Army began making physical changes to some of the vacant buildings that had formerly comprised the Huntsville Arsenal, Redstone Ordnance Plant, and Gulf Chemical Warfare Depot. Within today’s MSFC, World War II buildings
undergoing remodeling for new roles included: Building 4306, as an updated cafeteria (1950); Building 4312, as a vulcanizing pilot plant (1950) with a carbon black room (1951); Building 4313, for storage (1950) and subsequently for a structural test laboratory with an attached steel missile tower (1951); Building 4481, as a pilot production building and missile assembly shop (1952); Building 4485, as a property office for the Guided Missile Center (1950); Building 4711, as a guided missile development shop (1950); Building 4712, as the office for Building 4711 (1950); Building 4714, as a high pressure test laboratory (1951); Building 4715, as a missile fuel test shop (1950); Building 4716, as missile fuel test cells (1950); Building 4723, as a material test laboratory (1950) and subsequently as an x-ray laboratory (1951); Building 4727, as a production shop (1950); Building 4728, as a test section workshop (1950); Building 4732, as an air flow test stand (1950) with important wind tunnel equipment (1951); and, Building 4746, renovated from three individual buildings of 1941-1942 into a single flow rate laboratory (1951) and subsequently as a test measuring laboratory (1952) (Plates 4-7). (Also, see Plates 2-3.) Within this group were former chemical plant buildings leased by the Keller Motor Company in 1947 (including Building 4481). The Army canceled Keller’s contract as of late 1950, curtailing the auto-making enterprise to a three-year run (Redstone Arsenal Historical Summary V-J Day to 31 December 1950: 23). By the end of 1951, the Post Engineer had overseen the completed conversion of six World War II buildings for the guided missile program, as well as the expansion of facilities in Building 4732—a critical initial structure. The Guided Missile Development Group had also shipped “the press building” from Fort Bliss to Redstone, where personnel had erected it (site and details unknown) (Historical Summary Redstone Arsenal July – December 1951: 3).

Complementing the renovation of these 17 buildings (and others no longer standing today), the Army began commissioning new structures and erecting the first test stand complex. Within the MSFC, existing buildings in this category include: Building 4665, a static test stand (1952); Building 4704, a hydraulic press building and pressure test facility (1951); Building 4705, a missile assembly shop (1952) (see Plate 5); Building 4733, an air flow test stand tank farm (1950); Building 4734, a vacuum pump house (1950); Building 4735, a dryer house (1950); Building 4736, a dry air storage tank (1951); Building 4737, a second dry air storage tank (1951); Building 4747, a high pressure compressor station (1950) (see Plate 7); and, Building 4751, a combustion test stand high pressure battery pit (1950). (See Appendices A and B.) The very first of these new buildings added by the Army were Buildings 4747 (earlier numbered 435) and 4750 (earlier numbered 430 and now demolished), along with a previous Building 4748 (a liquid propellant test stand, now demolished) (Plate 8) (Redstone Arsenal Historical Summary V-J Day to 31 December 1950: 23). Within today’s MSFC, a total of 27 buildings were under remodel, or in design and construction, between 1950 and 1952 (with 25 buildings resultant). This real property represents approximately 10% of NASA’s current buildings and structures at the installation. For existing MSFC buildings, many changes were interior, preparatory to the guided missiles mission. (The renovation of Building 4312, as a vulcanizing pilot plant, may have been part of the resumed chemical munitions mission during the Korean War. Vulcanizing used large amounts of sulphur and high heat to harden rubber, and by 1954 Building 4312 was known as a rubber laboratory). Other building modifications were external, however, and focused on adding fenestration to many structures that had been nearly windowless during World War II, or replacing earlier smaller openings with newer window treatment (MSFC 1950-1952: drawings). The Army upgraded both steel- and wood-frame buildings that were clad in corrugated asbestos, and, hollow-tile structures. Examples within the MSFC today include Buildings 4313 and 4481, both originally steel-frame with asbestos corrugated sheathing and windowless. Added fenestration was of industrial steel-sash type, and of several varieties. Another example is Building 4485, a hollow-tile structure built with a only few small windows as a 4.2 chemical
Plate 5. Aerial view of Buildings 4725 (lower left), 4712 and 4711 (lower middle left), 4704 and 4702 (lower middle center), 4707 (middle left), 4705 (middle right), and 4708 with test cell addition at left (background). 2 June 1964. NASA Photograph Laboratory.

Plate 7. Aerial view of Building 4732 complex, with Building 4728 background left. Building 4741, the beryllium facility (demolished), immediately south of Building 4732. Building 4744 west/northwest of Building 4741 (center). 6 October 1966. NASA Photograph Laboratory.
mortar shell assembly plant. To transform this building into a property office for the guided missile center, the Army added a full and regular patterning of CECO commercial windows on all but the west end façade—the only face of the original building having noticeable fenestration as built. (The south façade also had one small existing window.)

Today, a number of the former arsenal and ordnance plant buildings renovated for the guided missile center and rocket R&D in the early 1950s are under Army management as a part of the Redstone Arsenal. The majority of these buildings are located in two parts of the arsenal far removed from the MSFC, and include groups of buildings in the 100- and 7000-series (with the latter area within the Redstone Ordnance Plant of World War II and including a number of buildings reused for rocket motor and propellant research, as well as major new infrastructure) (Figure 8). The complete number of World War II buildings renovated for the guided missile mission, as well as for Korean War chemical production within the former Chemical Warfare Service installations at Huntsville, is not researched here. New construction of this period throughout the Redstone Arsenal is also not reviewed in detail. A partial catalog and discussion of existing Redstone Arsenal buildings with Cold War history notes that the most important early guided missiles work occurred in a cluster of buildings in the headquarters administration area of the original Huntsville Arsenal (Buildings 110-117) and in Plants Area 1 (today, within MSFC). Redstone Arsenal histories of the period also directly support this:

In May 1950 work orders were written to reactivate certain buildings, structures, equipment, machinery, etc., in Plants Area 1 and the former Huntsville Arsenal Headquarters Area to provide facilities for the movement of Guided Missile activities from Ft. Bliss, Texas, to this arsenal (Redstone Arsenal Historical Summary V-J Day to 31 December 1950: 21-22).

Dr. von Braun’s initial office was in Building 111, remaining there until the middle 1950s when the headquarters for the Army Ballistic Missile Agency (ABMA) moved into the new Buildings 4484 and 4488 (after a temporary period in Building 4722) (see Plate 2). The Army also converted Building 112 for office and laboratory space. Within the arsenal, the Army also designated Ranges 1, 2, and 3, constructing a thrust stand at Range 1 (site today, unresearched) (Redstone Arsenal Historical Summary V-J Day to 31 December 1950: 23).

Today the Plants Area 1 of the Huntsville Arsenal contains both NASA and Army buildings, in many ways evocative of the interwoven contributions of the two agencies toward the missile and space programs as they unfolded (see Figure 6). Construction and renovation of the 1950-1952 period for the guided missile mission in Plants Area 1 occurred not only for properties now under MSFC jurisdiction, but also for ones currently under Army control. The Army also remodeled Building 4722, originally a World War II warehouse, to serve as headquarters for the Guided Missile Development Division and the Mechanics Laboratory of the Ordnance Missile Laboratories after 1952. Other pre-existing buildings of Plants Area 1, outside the boundaries of the MSFC to the near east, were also under the management of the Ordnance Missile Laboratories by 1954 (Wright 2000: 68-72, Appendix I). A large part of Plants Area 1 served as a laboratory and test area for the guided missile mission in the early 1950s. As of August 1952, planning toward architectural-engineering needs at the Redstone Arsenal became more integrated with work toward the first missiles systems. The arsenal also set up a field unit in Los Angeles pertinent to the guided missiles mission: the Redstone Ordnance Office. This office, far distant from Huntsville geographically, was to handle R&D, production, and engineering services needed from aerospace contractors in Southern California. The Army’s establishment of the Redstone
In Redstone Arsenal, Alabama, Building Number Index.

Redstone Arsenal Numbering System

Figure 8
Ordnance Office directly foreshadowed offices set up by the Air Force in Los Angeles in 1954. Air Research and Development Command (ARDC) established its Western Development Division there, with Air Materiel Command setting up its Special Aircrafts Projects Office simultaneously. These two Air Force offices handled the same kinds of contracting issues as the Redstone Ordnance Office, only focused on ballistic missiles. In both cases, a significant group of Los Angeles architectural-engineering firms emerged from 1952-1954 forward that would be responsible for missile launch and test complexes, with marked overlap between the Army and the Air Force (Weitze 2002: draft).

The Guided Missiles Mission: 1952 to 1958

That part of the Redstone Arsenal missiles and rocket missions that would evolve into the space missions of NASA at the MSFC originated within the Guided Missile Development Group under the Technical and Engineering Division at the Redstone Arsenal in late 1951. (The Ordnance Guided Missile Center became the Guided Missile Development Group in 1951.) The other focused group under the Technical and Engineering Division at the outset of the 1950s, that of the Rocket Development Group (evolved directly from the Ordnance Rocket Center), began work on Army programs such as anti-tank and anti-aircraft missiles, inclusive of related research toward solid propellants. The Army redesignated both groups as divisions in 1952. In Texas and New Mexico, the Paperclippers had concentrated on research and test for missiles derived from the World War II German programs at Peenemünde, in addition using V-2s shipped to the U.S. for Army Air Forces and Army (and after mid-1947, Army and Air Force) experimentation. Both groups included German scientists and engineers from Fort Bliss brought to the U.S. under Project Paperclip, and each evolved toward multiple, increasingly sophisticated missions during the years ahead. At the Redstone Arsenal the Paperclippers and follow-on recruitments of scientists and engineers from Germany (see discussion below) formed the core intellectual leadership for training and developing the talents of young American military and civilian engineers. On multiple occasions, the Redstone Arsenal sought this type of talent directly from college campuses and the offices of its supporting military contractors (Dunar and Waring 1999: 16-18). The following discussion focuses on the history of the guided missiles group that would be absorbed within NASA at the end of the decade, with the Army’s half of the Redstone Arsenal story during the early years of the Cold War presented elsewhere. (See Helen Brents Joiner, The Redstone Arsenal Complex in its Second Decade, 1950-1960 [1969] and Kip Wright, Rocket Science: A Historic Context and Assessment of U.S. Army Cold War Properties 1946-1989 Redstone Arsenal, Alabama [2000].)

Major changes in the organization of the guided missiles group at the Redstone Arsenal accrued several times during the 1950s. At the end of 1951, the Guided Missile Development Group included nine branches and a laboratory (Historical Summary Redstone Arsenal July – December 1951: 1):

- the Design Branch
- the Aeroballistics Branch
- the Launching and Handling Branch
- the Guidance and Control Branch
- the Test Branch
- the Propulsion and Fuels Branch
- the Development Fabrication Branch
- the Experimental Missile Firing Branch
- the Development Inspection Branch
Each of these units would see its tasking grow over time. Names for the branches and laboratories at the Redstone Arsenal and the MSFC also changed as the years passed. The core contributions and internal working dynamics of these groups, however, remained steady. Most became associated with specific clusters of buildings and structures within that portion of the Redstone Arsenal that would be redefined as the MSFC in 1960.

Undertaking the Redstone Missile Mission

As of August 1950, the Army had formally established the need for a guided missile characterized by a 500-mile range. This first key program for the Guided Missile Development Group at the Redstone Arsenal was known as Project Hermes C-1, renamed Project Major at its transfer from the Rochester Ordnance District in New York to Huntsville. Other early nomenclature for the Redstone included Ursa, XSSM-G-14 and XSSM-A-14. (The acronym XSSM is a military shorthand for experimental [X] surface-to-surface guided missile [SSM].) By Spring 1952, Project Major had become the Redstone missile, essentially a weapons system developed out of the German V-2 of World War II. The first Redstone featured a rocket 63 feet long, combined with a warhead of a little over 25 feet. The guided missile was 70 inches in diameter in late 1951. Initial flight distance was 155 nautical miles. The Development Fabrication Branch of the Guided Missile Development Group was directly responsible for fabricating and assembling the first 12 Redstones from industry-supplied components (Joiner and Jolliff 1969: 40; Historical Summary Redstone Arsenal July – December 1951: 22). This activity for the Redstone occurred in Buildings 4711 and 4481. Men put together the three main sub-assemblies in Building 4711, transporting them to Building 4481 for final assembly (Marshall Star May 23, 1962: 6). The interior configuration of Building 4481, one of two mustard gas filling plants in the Plants Area 1 of the early 1940s, was a main reason that the Army converted the structure converted to a “Pilot Production Building / Missile Assembly Shop” in 1952. Also contributing was its active use by the Keller Motor Company between late 1947 and late 1950. The sister mustard gas filling plant adjacent, Building 4471, was functioning as a storage structure at the time that the von Braun group was assessing which buildings could be converted in a timely manner to suit guided missile R&D needs. Building 4471 remained a storage warehouse post-World War II until 1960. (Ironically, Building 4481 is heavily altered today, and is visually only poorly representative of its lives as a mustard gas filling plant, an assembly line for an experimental car post-World War II, or a fabrication and assembly shop for the Redstone missile [Marshall Star July 6, 1966: 1]. Building 4471, in contrast, retains much of its exterior visual credentials as an important Army chemical manufacturing plant of the early 1940s.)

Building 4705, in design and construction during 1952, augmented Building 4481 as a major missile assembly shop upon its completion (see Plate 5). Robert & Company, an architectural-engineering firm in Atlanta that had designed the very large climatic hangar at Eglin Air Force Base in Florida in the immediate years after World War II, received the commission for Building 4705 (Weitze 2001: 87-97). As of 1953, Building 4481 was in use by the Fabrication Laboratory, and in 1956, by the Launching and Handling Laboratory (with a guided missile library). (See Appendix B.) In the cases of both Buildings 4481 and 4705, the role of the Redstone Arsenal was tied to R&D throughout the “manufacturing” process, with fabrication and assembly of missiles shifted to a private industrial contractor once the Army had completed production of the first 12 missiles. As the situation unfolded, the Guided Missile Development Division also had assembly responsibility for a partial number of missiles in the second lot, missiles 17 through 29, due to difficulties in establishing a plant within private industry. Chrysler, in Detroit, won the manufacturing contract for the Redstone in late 1952. The Army had decided to use either an
automotive or rail, rather than aircraft, manufacturer for fabrication and assembly of the Redstone. Most missile components subcontracted through Chrysler were fabricated by aerospace companies. Beginning in 1956, Chrysler manufactured Redstone developmental missiles 13 through 17, and 30 through 75, in a former Navy jet-engine GOCO plant from World War II, a facility just north of Detroit in Warren, Michigan. The delivery capability of the Guided Missile Development Division was one Redstone per month, a rate that Chrysler initially only matched in its Detroit plant (but one that Chrysler increased to two per month as of September 1956). The Detroit area facility had been a Naval Industrial Reserve Aircraft Plant post-war. The Army flight-tested 50 of the Redstone developmental missiles for R&D purposes at the Atlantic Missile Range in Florida (Cape Canaveral), inclusive of efforts for the Jupiter and satellite programs (see below). The agency fired the remaining 25 for tactical training purposes, primarily at the White Sands Missile Range in New Mexico, but with a small number fired in Florida. First launch of a Redstone missile occurred at the Atlantic Missile Range in August 1953 (Bullard 1965: 44-47, 55-57, 75-78, 82-88; Bullard 1965: 88, 92-93, 162-173).

The other branches of the Guided Missile Development Group also had tasks of parallel seminal importance at the Redstone Arsenal during the early 1950s. The Design Branch worked with structural and mechanical components of the Redstone missile, while the Development Inspection Branch assured that missile parts met specifications. The Design Branch chose an existing power-plant, a North American Aviation product for the Navajo missile project, which team members modified for the Redstone. North American Aviation is an excellent example of a Southern California aerospace contractor channeled through the Redstone Ordnance Office in Los Angeles. The key power-plant research for the guided missiles program at the arsenal fell to the Propulsion and Fuels Branch. The Aeroballistics Branch of this initial period conducted theoretical studies applicable to the design, development, and test of guided missiles. Pertinent to the Redstone, the branch looked at design and performance characteristics such as thrust duration, missile caliber, warhead separation, and weights. The Aeroballistics Branch employed wind tunnel tests in their work, one of the branches strongly tied to important tests run in Building 4732 (see Plates 7-8). The Test Branch was responsible for configuring the wind tunnels at the Redstone Arsenal. This branch additionally planned, engineered, designed, constructed, operated, and maintained both primary and secondary test facilities for the guided missiles, inclusive of their power plants and components. By late 1951, the Test Branch had installed two supersonic wind tunnels in Building 4732, with a third supersonic wind tunnel acquired from the Army’s Ballistic Research Laboratory at the Aberdeen Proving Ground in Maryland and nearly set up. (See Appendices B and C.) The Launching and Handling Branch focused on the final assembly of the Redstone, including the missile’s transportation from the assembly shop to the launch site, as well as erection, tests, fueling, and preparations for firing. In the early 1950s, the Redstone was a very large missile, presenting challenges in its appropriate transport, and, in set up and servicing at the launch complex. The branch addressed items from portable gantry cranes, to the modification of railway flat cars, to propellant handling. The Guidance and Control Branch initially addressed problems of aerodynamic stability and control, of the missile before warhead separation and of the warhead during final target trajectory. The Guided Missile Development Group established the Experimental Missile Firing Branch among the last branches in its organization, in early 1952. The Experimental Missile Firing Branch supervised missile launches, at this time with plans for the experimental Redstone. While Army missile firings had previously been exclusively at the White Sands Proving Ground in New Mexico, from this point forward the guided missile program at the Redstone Arsenal turned to the over-water test range of the Air Force Missile Test Center, an Air Force R&D center managed under ARDC, at Patrick Air Force Base in Florida (Historical Summary Redstone Arsenal July – December 1951: 23-35). The space launch facilities of Cape Canaveral would evolve at this location.
The Design of Test Facilities into the Middle 1950s

The Static Test Stand Area and Expansion in Plants Area 1

As of early 1952, the Experimental Missile Firing Branch coordinated with the Air Force Missile Test Center in Florida for the construction of test stands, blockhouses, and associated ancillary structures needed there for the Redstone program, simultaneously initiating plans for a static test area south of Plants Area 1 at the Redstone Arsenal. The Army hired Parsons-Aerojet Company to prepare preliminary design criteria and specifications for the facilities at both locations. The Parsons-Aerojet team combined the firms of Ralph M. Parsons and Aerojet, both of Los Angeles. (The choice of the engineering firm Ralph M. Parsons is assumed directly linked to the physical location of the Redstone Ordnance Office in Los Angeles at this same time.) As of at least 1948, Ralph M. Parsons was handling architectural-engineering contracts for complex and unusual military R&D structures—among the very earliest such work by any firm. A major accomplishment of Parsons in 1948 was the design of technical facilities for the development of atomic (and later, thermonuclear) weapons at Los Alamos, New Mexico. In 1952, Air Materiel Command, within the Air Force, hired the firm to evaluate possible hot-agent test facilities for biological warfare munitions. Parsons recommended a program of specialized structures at Eglin Air Force Base in Florida, inclusive of a munitions assembly shop, a laboratory, and temperature-controlled storage. The firm’s next major Cold War military commission may be that of the test stand and affiliated buildings at the Redstone Arsenal, with the first drawings dating to 1953. Nearly simultaneously, Ralph M. Parsons designed and engineered a high-thrust rocket test stand at Edwards Air Force Base in Southern California, with those facilities featuring test stands, control stations, instrumentation, propellant storage, handling equipment, hazardous waste disposal systems, laboratories, and shops. By mid-decade, Ralph M. Parsons had assumed a leadership position within the architectural-engineering industry with regards to aviation and missile structures, in particular. Parsons participated in the Air Force and Navy nuclear-powered aircraft program; in the intermediate range ballistic missile (IRBM) program; high energy fuel development; and, nuclear reactor design. Examples of Ralph M. Parsons designs before 1957 included test facilities for nuclear engineering development at the National Reactor Test Station in Idaho; a nuclear reactor and engineering facilities at Wright-Patterson Air Force Base in Ohio; and, underground bulk fuel storage facilities for Strategic Air Command worldwide (Stone October 8, 1956: 64). At the close of the 1950s into the middle 1960s, Ralph M. Parsons participated in the design of launch silos and underground control centers for the Titan I and II intercontinental ballistic missiles (ICBMs), as well as for the Minuteman I and II. A later Cold War key test facility designed by the firm was the Missile X (MX/Peacekeeper) buried trench test project on the Luke Bombing and Gunnery Range in Arizona at the close of the 1970s (Weitze 2002: draft).

Phase I of the Ralph M. Parsons contract for test facilities at the Redstone Arsenal included “a static firing stand to accommodate complete missiles, a cold calibration stand for tests of the propulsion system, a test laboratory, and a blockhouse.” Phase II referenced buildings and structures required for the future, but was non-specific as to type (Historical Summary Redstone Arsenal January – June 1952: 35). The first Ralph M. Parsons buildings and structures for the Redstone Arsenal, documented through their original drawings remaining at the MSFC and the Redstone Arsenal today, included: a static test stand (Building 4572), gantry (Building 4573), a blockhouse (Building 4570), a booster pump station and steam plant (Building 4567), a nitrogen booster battery (Building 4581), and a nitrogen booster station (Building 4582), each of 1953; and, a guided missile test engineering facility (Building 4566), components test laboratory, with catch tank pit and substation (Buildings 4583, 4584, and 4587), a cold calibration test stand (originally with multiple ancillary structures) (Building 4588), a horizontal test stand (today gone,
Building 4665 came to be known as the Interim [Ignition] Test Stand(s), and later, as the Redstone Test Stand(s) (although should not be confused with the static test stand designed by Ralph M. Parsons, Building 4572, for the missile). This cobbled together temporary static test facility was the first “test stand in the United States to accommodate the entire launch vehicle for static tests.” Earlier static test stands were for rocket engine test only (Butowsky 1984: National Historic Landmark nomination). Static rocket engine tests prior to testing at the Redstone Arsenal, outside of tests at contractor test sites in Southern California, concentrated at Edwards Air Force Base (the Muroc Flight Test Base of World War II). Although static rocket engine tests
Plate 9. Aerial view of the west propellant storage area and east test area. 8 August 1961, NASA Photograph Laboratory.


had gone forward from 1945 into 1951 at Edwards, it was not until the Parsons-Aerojet Experimental Rocket Test Station on Leuhman Ridge that this test installation began to feature very large test stands toward IRBM and ICBM development. The first permanent test stands on Leuhman Ridge were operational in 1953, with a hot run as of July 1952. These test stands would directly parallel construction of the Ralph M. Parsons static test stand at the Redstone Arsenal, Building 4572, in both their sheer size and in their support of much more sophisticated missiles tests (Weitze 2002 volume II: draft).

In researching the history of the static test area, the EDAW team found information relevant to identifying areas of previous major ground disturbance. This information might be useful in helping to establish the appropriate scope of future cultural resource efforts. The static test area sat just north of the Wheeler Reservoir (which the TVA had engineered from Huntsville [Spring Branch] Creek in the pre-1930s), south of Plants Area 1 and to the near south of the interim test stand site. Land parcels of the 1950s static test area (east) show almost no buildings during the 19th and early 20th centuries. (Farm buildings were concentrated along Dodd Road leading to the test area. A second cluster ran in a southwest- and westerly pattern from the Silver Hill School site toward Huntsville Creek, with the location of this grouping overlapping the sites of Buildings 4666 and 4665 through on acreage within today’s west test area.) Large contaminated areas from the World War II period surrounded the ground initially chosen for the static test area both east and west of Dodd Road. Today’s Buildings 4666, 4667, 4668, and 4669 all sit within what was a fenced rectangular contaminated area in 1953-1954, while a very large contaminated area appears to have occupied land between the current Saturn and Dodd Roads just southeast of the west test area. A third sizable contaminated area lay at the south/southeastern edge of the site for Building
4572, the static test stand. During the early 1940s, the Huntsville Arsenal used an eight-acre area on “the right bank” of Huntsville Spring Creek as a decontamination area known as the “boneyard.” While not verified, it is possible that this boneyard corresponds to the land between Saturn and Dodd Roads, historically extending west and including a portion of land south of Saturn Road within the west test area. This small area is still called the boneyard today, the recipient of miscellaneous scrapped items from the MSFC. The boneyard at the Huntsville Arsenal first housed “metal articles contaminated with mustard gas,” decontaminated on site in wood and oil fires. After late 1943, the Army also decontaminated rejected phosphorous-filled munitions components at the boneyard (by fire) (Joiner 1966: 7, 32-33). A comparison of two Parsons-Aerojet site maps of 1953 and 1954 indicates that the Army decontaminated a portion of the area between Saturn and Dodd Roads during this period, this may have resulted in major ground disturbance and the destruction of any cultural resources located there. It appears that today’s boneyard is in this section (Parsons-Aerojet August 1953 and May 1954: maps).

Site planning and construction for the Ralph M. Parsons static test stand, cold calibration test stand, blockhouse, and components test laboratory resumed during 1953 and 1954 (Plate 15). Construction of Building 4572, with its gantry Building 4573, occurred in stages throughout 1953, with the blockhouse Building 4570 and other key buildings in the test area finished as noted above. Building 4573 was actually a revolving gantry crane manufactured by the Washington Iron Works of Seattle, Washington, in 1942, shipped to the Redstone Arsenal and modified for its Cold War function there (Plates 16-17) (Washington Iron Works June 10, 1942: drawing; “Revolving Crane” October 1953: drawing). (See Appendices B and C.) As the work went forward, Parsons-Aerojet made some noteworthy alterations to its plans for the Guided Missile Test Facilities at the Redstone Arsenal between late summer 1953 and summer 1954. Those buildings not constructed during 1953 all have drawings of May 1954. Drawings for Building 4588 delineate not only the cold calibration test stand, but also an observation bunker and preparation annex connected to the test stand via an underground tunnel. Directly beneath the test stand were three levels including terminal and instrumentation rooms, and with the lowest level partially below ground. The tunnel connected this level of the tower to a small structure that featured a second terminal room (underground) and an observation bunker (aboveground). Originally numbered as Building 4589, this annex for the cold calibration test stand is assumed to be incorporated into Building 4554 today (Plate 18) (Parsons-Aerojet May 1954: drawings; History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan). The May 1954 building program also featured other new particulars. Parsons-Aerojet first planned the site of Building 4583, the components test laboratory, to the near northwest of Building 4588 (the cold calibration test stand) at the approximate site of the later Building 4550 (the Saturn test stand). As actually erected, Building 4583 sits to east/northeast of Building 4588 (Plate 19). In addition, by May 1954, the immediate area between Buildings 4588 and 4583 is more precisely defined than during the year before. New Parsons-Aerojet structures at this location included the liquid waste reservoir, holding pond, electrical substation, and oxidizer, nitrogen, and fuel ready storage units discussed previously (Buildings 4579, 4584, 4587, 4596, 4597, and 4598) (see Figure 9). The test engineering office on Dodd Road, Building 4566, also dates to 1954 (Plate 20).

Also augmenting test facilities, and of major significance, was a horizontal test stand, sited to the immediate west of the nitrogen battery and booster station (Buildings 4581 and 4582). The Redstone Arsenal numbered the horizontal test stand as Building 4564. This test stand no longer exists, mapped as “to be removed” on a MSFC master plan of 1980 (NASA 1980: master plan). The horizontal test stand sat immediately north/northeast of today’s Building 4515 (a facility of 1987), and is distinct from the current Building 4564, a solid rocket motor refurbishment facility,
Plate 15. Direct overhead view of the east test area. Observation bunkers, Buildings 4560 and 4571 (today demolished), highlighted. 8 August 1961. NASA Photograph Laboratory.
Plate 16. Buildings 4573 (left) and 4572 (right). In Army Ordnance Missile 
Command, Facilities Briefing, 7 March 1961. Redstone Arsenal 
History Office.

Plate 17. Building 4570. In Army Ordnance Missile Command, Facilities 
Briefing, 7 March 1961. Redstone Arsenal History Office.
Plate 18. View of Buildings 4551, 4550, 4557 (demolished), 4558, 4554, 4588, and 4548, left to right, middleground to foreground, looking northwest. 11 November 1964. NASA Photograph Laboratory.

also of 1987 (Parsons-Aerojet August 1953 and May 1954: maps). In late 1956, the Army converted the horizontal test stand to a vertical power plant test stand (Plate 21) (History of Army Ballistic Missile Agency February – June 1956: unnumbered Status Report). The H-1 Power Plant Test Stand of 1957 for continued Redstone testing toward Jupiter featured two vertical static firing positions and stood 110 feet high (NASA 1968: master plan). (See Plates 9 and 15.) The refigured test stand faced substantial challenges however. As early as September 1958, fire so severely damaged the test stand that further static firing of Jupiter rocket engines was rendered impossible until the Army completely rehabilitated the facility. The urgency of the Jupiter test program accelerated an approval for the needed funding to restore the test stand, and as of December 1958 it was again operational (History of Army Ballistic Missile Agency July – December 1958: 18-19). An improved observation bunker, Building 4560, had been in design by Maurice H. Connell & Associates as of March 1958 for the test stand. The catastrophic fire at the former Building 4564 demonstrated the need for a new type of protective construction in this period’s observation bunkers. Both Building 4560 and a now-removed Building 4571 (an added bunker for the static test stand Building 4572) featured a small bunker that could accommodate three to four people, with viewing ports shielded by heavy glass. These bunkers rested atop tall cones of bermed earth, with Building 4560 the first of its type at the arsenal (see Plate 15) (also see, further discussion below).

The earliest test stands for guided missile development at the Redstone Arsenal, those of the interim test stand (Building 4665), the static Redstone test stand (Building 4572), the cold calibration test stand (Building 4588), and the horizontal test stand (the former Building 4564, now gone), numbered four and dated to 1952-1954. Each of these test stands appears to have had observation bunkers, with one for Building 4588 today assumed incorporated into Building 4554 (facing east). Several, if not all, of these bunkers survive today and represent a very rare look at this first period of missile test and evaluation. For Building 4665, the observation bunker also functioned as a true blockhouse. This bunker, constructed from three large chemical tanks salvaged from the Huntsville Arsenal, is the most sophisticated of the group (see Plates 12-14). Other, small observation bunkers remaining from this era include an earthen-bermed bunker south of Building 4588, an unbermed bunker immediately southwest of Building 4560 (the next-generation bunker at the site), and a partially bermed bunker now attached to Building 4596. These structures are all unnumbered today, and do not appear to have had numbering historically. Each features a rounded steel tank, very likely also salvaged from former chemical tanks used at the Huntsville Arsenal during World War II. The bunkers were one- or two-person units. That standing south of the cold calibration test stand (Building 4588) must have functioned as a protected viewing station for the stand (see Plate 19). The bunker behind Building 4560 was a viewing station for the horizontal test stand, and today is pristine in its evocation of the early 1950s. This bunker could have held one chair and a seated observer, looking out through a horizontal slit cut (Plate 22). As was true for the interim test stand of 1952, oral history credits German engineer Fritz A. Vandersee with its construction (Samaneigo to Allen January 14, 2002). (Building 4560 now blocks the original bunker’s view of the horizontal test stand.) The third small observation bunker, attached to the southwest corner of Building 4596, is assumed to have been placed for viewing of tests on Building 4557, (now removed—immediate to today’s Building 4558), and is likely relocated from an earlier position at an unknown date. The most probable earlier location is to the near northwest of the cold calibration test stand (Building 4588), now a site in the parking area or roadway north of Building 4554. This spot is mapped as an observation bunker in 1959, then numbered Building 4595 (History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan). (See Appendices A, B, and C.) A few other small bunkers, wooden and steel, also exist for the added test stands of the 1950s and early 1960s. Buildings 4574 (pre-1957) and 4697 (1965, for viewing of Saturn testing on Building 4550) are examples of wooden observation bunkers, with Building 4574 possibly modified since its initial construction. (See Appendices A and B.) In addition, several small, and one large, observation bunker(s) are now removed from the test stand areas (see below).
Second Phase Expansion during 1956-1957

New construction for the static test area and expansion of the Plants Area 1 facilities occupied much of the period between 1953 and 1958. During the concentrated building campaign, the Guided Missiles Development Division continued R&D, with the beginnings of testing for the Redstone and associated missile systems development. In addition to the buildings designed by Ralph M. Parsons for the guided missiles mission, several other major facilities went up. These included Building 4487, the guidance control research and development facility, likely designed by the Atlas Engineering Group of Knoxville, Tennessee, in 1954 (for which Ralph M. Parsons executed an extension in 1957) (Plates 23-24), and, Building 4707, the structural fabrication laboratory, by Robert & Company of Atlanta (who were also responsible for Building 4705 in 1952) (see Plate 5). The next major building campaign followed nearly immediately, beginning with a second group of designs by Ralph M. Parsons in 1956. (See Appendix B.) These Phase II buildings featured the major office, laboratory, and test structures that enlarged the Plants Area 1 of World War II, south- and westwards. The second Parsons building program included:

- Building 4610, a structures and mechanics facility;
- Building 4612, a second structures and mechanics facility;
- Building 4613, a compressor structure;
- Building 4616, a shop (Butler prefabricated building);
- Building 4617, flammable storage;
- Building 4619, a third structures and mechanics facility;
- Building 4620, a vacuum and compressor structure;
- Building 4650, a guided missile test shop;
- Building 4651, shop (Quonset prefabricated building);
- Building 4663, the computation laboratory; and
- Building 4708, a missile assembly and inspection hangar.

Ralph M. Parsons also designed a major extension of Building 4566, the engineering facility directly associated with the static test area, at this same time. Building 4566 housed missile test personnel and stored test results, serving to directly support activities in the static test area (and later both expanded and linked to an added structure, Building 4666 across Dodd Road).

Design of the second-phase Parsons group of buildings took on the character of a collegiate plan, with multi-structure clusters—such as Buildings 4610, 4612, 4613, 4617, 4619, and 4620—a functionally cohesive unit. The full middle 1950s complex of guided missile offices and laboratories at the Redstone Arsenal occupied a roughly square area between Rideout Road (west), Titan Street (north), Dodd Road (east), and Fowler Road (south), immediately south of Plants Area 1 (Plate 25). Four individual clusters of buildings, each designed with parallel wings (sometimes linked by smaller wings at right angles), reflected the idea of the collegiate plan. Each cluster defined a quadrant of the overall square. This type of formal architectural site planning for scientific laboratories and technical facilities was particularly prominent in the U.S. industrial and military community of the late 1940s into the middle 1950s. The best example, from its rigorous planning to its execution, was that for the Cambridge Research Center at Hanscom Air Force Base northwest of Boston. The Air Force Cambridge Research Center of ARDC focused on R&D for electronics and radar. A second collegiate laboratory complex adjacent to that of the Cambridge Research Center was the Lincoln Laboratories, the Massachusetts Institute of Technology’s (MIT’s) highly important scientific center for Air Force air defense research. The collegiate groupings at Hanscom dated to 1948 in their earliest efforts. Characteristics of individual buildings were an interior flexibility (to allow for reallocating laboratory space to meet scientific needs); well controlled natural light (usually obtained through glass curtain walls); careful heating and air-conditioning; attention to such spaces as technical libraries, conference rooms, and cafeterias; and, an emphasis on modular units intended to accommodate future expansion. For the collegiate laboratory groupings at Hanscom, ARDC personnel had compiled a detailed bibliography of professional articles on the subject, with a number of laboratory campuses built for private industry beginning after the war (such as Saarinen & Swanson’s General Motors Technical Center on a 350-acre site near Detroit). Drawings for the Cambridge Research Center, inclusive of MIT’s Lincoln Laboratories, dated to 1951-1956. At the time of the planning and execution of the collegiate-plan clusters at the Redstone Arsenal, this center for Air Force R&D was a known model, both in Air Force and architectural-engineering professional circles (Weitzel volume I 2002: draft).

Miscellaneous questions about the planning of the middle 1950s collegiate grouping at the Redstone Arsenal remain, however. The first two clusters designed in the group were those of Building 4487 (1954) and Buildings 4484 and 4488 (ca.1954-1955) (Plate 26; see also, Plates 23-24). The architectural-engineering firm(s) responsible for Buildings 4484 and 4488 is not included in existing Army analysis of its historic structures, and the author did not check Army drawings to obtain this information. While the firm that designed these buildings may be Ralph M. Parsons, this is not yet verified (or certain). For Building 4487, the responsible design firm appears to be Atlas Engineering Corporation of Knoxville, although Parsons execution of an immediate addition in 1957 suggests that perhaps Atlas Engineering was a firm subcontracted for a subordinate task and that a second review of the original drawings would determine that Ralph M. Parsons was the firm primarily in charge of designing the building. The Army completed Buildings 4487 and 4488 in 1956 (Redstone Arsenal Historical Summary January – June 1956 volume I: 86). The other two clusters in the overall collegiate plan, those of the Building 4610-4620 group and the Building 4663 and 4650 pair, are documented as the work of Ralph M. Parsons (Plates 27-29). This missing information bears review. If Ralph M. Parsons was


responsible for all four of the buildings clusters within the area bounded by Rideout, Titan, Dodd, and Fowler, then the statement made toward a high-level scientific college campus for military R&D is much stronger, in keeping with the cutting edge for such design nationwide during this period. Of interesting note, however, is how the four-cluster collegiate area at the arsenal (and later, as a part of the MSFC) evolved after its initial construction. Almost immediately, the Army (again, continued by NASA) augmented individual buildings through additions. These successive changes whittled away at the cohesive design of the middle 1950s, as did expansions south of Fowler Road. Split jurisdiction of the grouping (with the Army occupying Buildings 4484 and 4488) only increased the tendencies of the area to become ever more reflective of a generic manufacturing enterprise rather than a college campus setting. Today, original design intentions and achievements are often missed (Dunar and Waring 1999: 40).

The other major cluster of buildings at the MSFC evolving during the middle 1950s for guided missile work was in the 4700 area, immediately west of the line of World War II structures along Rideout Road. In contrast to the articulation of the collegiate-plan area south of Titan Street, buildings here sit in no particular arrangement, either as linked by function or as juxtaposed to one another. In part, the post-World War II 4700 area was pragmatic, with the Army adding buildings steadily between 1951 into the present. From the 1950s through some undetermined point in later decades, the 4700 area also split into two halves: a fabrication and assembly area north of today’s Tiros Street, and an industrialized test area for the Test and Aeroballistics Laboratories bordered by Gemini Road, Tiros Street, Rideout Road, and Martin Road. The southern area was additionally divided into west (Test) and east (Aeroballistics) portions by Thor Avenue (Figure 10). The overall area was generically industrial as well, with its air flow test stand tank farm, dryer house, dry air storage tanks, and vacuum pump station of the early 1950s supportive of wind tunnel operations in Building 4732. Architectural and engineering firms known to have been responsible for structures in the 4700 area are not cohesive, although Robert & Company of Atlanta (Buildings 4705, 4707, 4752, and 4755) (see Plate 5), Ralph M. Parsons (Building 4708) (Plates 30-31) and Aerojet (Building 4760) do sustain major commissions there between 1952 and 1964. Maurice H. Connell & Associates of Miami, a key architectural-engineering firm working on buildings and structures within the MSFC during 1957-1964 (see below), is also responsible for a building in the 4700 area, Building 4744, a gas storage facility of ca.1957. Maurice H. Connell had previously upgraded production lines at the Redstone Arsenal late in World War II. A full understanding of the industrial test area south of Tiros Street is difficult, in part, due to its highly changed character today. In 1957, two clusters of test structures were present between Gemini, Tiros, Thor, and Martin. In this quadrant, only Building 4751 remains from the test clusters of that period—with the area largely empty. Gone are a north cluster of structures that included a high altitude test cell, two combustion test blocks, propellant storage, and a high pressure air battery (see Plate 8), and, a south cluster that featured two test cells (A and C) and a liquid propellant test stand. Also substantially gone is a beryllium facility for making guidance components; four of its five buildings are demolished today. This cluster was likely the work of Maurice H. Connell & Associates, verified as responsible for Building 4744—the sole remnant of the five-building grouping. Its key building sat immediately south of Building 4732, along Rideout Road (see Plate 7) (Construction 1950s Fact Book; History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan). Miscellaneous buildings from 1957 in the 4700 area extant today are Buildings 4738 and 4739, a sub-storage facility for the Fabrication Laboratory and an office for the Systems Analysis Laboratory, respectively (see Appendices A and B).

The Guided Missile Program: Men and Achievements

At the beginning of November 1955, the Guided Missile Development Division of the Ordnance Missile Laboratories at the Redstone Arsenal became the ABMA, temporarily occupying offices in Building 4722 (today, Army real property) (see Plate 2). The ABMA began the shift to its permanent headquarters in Building 4488 as of February 1956 (History of the Army Ballistic Missile Agency February – June 1956: 56-57). Of the 120 Project Paperclip German scientists and engineers who had accompanied Dr. von Braun from Fort Bliss to the Redstone Arsenal, the number who remained as of mid-decade appears to have lessened only slightly. The majority, although not all, worked within the Guided Missile Development Division (and subsequently, the ABMA). As of mid-decade, the majority of the men had become U.S. citizens. Forty-one Redstone Arsenal scientists and engineers had achieved citizenship by mid-November 1954. In April 1955, another 103 Redstone Arsenal German-born scientists, technicians, and their family members took their oaths of citizenship at Huntsville High School. Thereafter, while some men began to retire and others transferred from the Redstone Arsenal to the Air Force and Navy, or hired with military aerospace contractors, a sizable group worked for decades at the Redstone Arsenal and at the MSFC. (A second American recruitment of German scientists and engineers in 1952 through Project 63, an Air Force effort that continued Project Paperclip, added new German personnel at the arsenal, as was the case across the military.) As of 1957 the numbers of Paperclip and Project 63 recruits remaining at the ABMA did begin to drop, as men moved into private industry or retired. The American Rocket Society listed only 47 German scientists and engineers working for the ABMA in 1957. This number jumped back the next year, to 82, possibly due in part to a final middle 1950s recruitment in Germany and some inter-agency moves by German scientists and engineers already in the U.S. (Weitze 1997: 169). The last recruitment in Germany of 1955 had included a staff member of the Guided Missile Development Division of the Redstone Arsenal on the interview team, who had questioned 93 German scientists in November that year. As of 1956, the ABMA had decided that 20 to 30 of the men interviewed were excellent candidates for needs at the Redstone Arsenal, with a planned second round of interviews in Germany set for June (History of the Army Ballistic Missile Agency February – June 1956: 78). Even into 1958, the agency noted a pressing need for a related expertise, German and Russian translators to assign to the arsenal’s Technical Library (U.S. Army Rocket & Guided Missile Agency April – June 1958: 101). In late 1963, about 70 of the Paperclippers and men hired through the sequential recruitments continued to work at the MSFC (Marshall Star November 13, 1963: 2). The men who continued in the guided missile program at the arsenal during the 1950s included prominent and important figures, many of whom were heads and deputys of the organizational units within the ABMA in the immediate pre-NASA years.

The years of 1955 and 1956 serve as an illustration of the noteworthy roles of the well-educated and experienced Paperclippers. In April 1955, key German scientists and engineers working within the Guided Missile Development Division included: Dr. Wernher von Braun (Chief), Dr. Eberhard Rees (Deputy Chief), Dr. Ernst D. Geissler (head of the Aeroballistics Laboratory [later, renamed the Aero-Astrodynamics Laboratory]), Dr. Helmut Hoelzer (head of the Computation Laboratory), Mr. Hans H. Maus (head of the Fabrication Laboratory), Mr. Friedrich Graf von Saurma (head of the Field Test Office), Dr. Walter Hauessermann (head of the Guidance and Control Laboratory [later, renamed the Astrionics Laboratory]), Mr. Hans Heuter (head of the Launch and Handling Equipment Laboratory), Dr. Kurt H. Debus (head of the Missile Firing Laboratory), Mr. Walter Wiesman (head of the Operations Office), Dr. Wilhelm Raithel (head of the Structures and Mechanics Laboratory [later, renamed the Propulsion and Vehicle Engineering Laboratory]), Mr. Erich W. Neubert (head of the Systems Analysis and Reliability Laboratory), and Mr. Karl L. Heimburg (head of the Test Laboratory) (Redstone Arsenal Historical Summary...
January – June 1955 volume I: 21-22, organization chart). As of September 1956, the ABMA reconfigured this organization as three operating divisions (Industrial, Development, and Support) with a Technical Liaison Group and a Research Projects Office, and, nine laboratories (Aeroballistics, Computation, Fabrication, Guidance and Control, Launching and Handling, Missile Firing, Structures and Mechanics, Systems Analysis and Reliability, and Test). Dr. von Braun headed Development Operations, with Mr. Rees his Deputy and Mr. von Saurma his Assistant Director. Dr. Arthur Rudolph filled the role of Technical Director within the group. Mr. Konrad K. Dannenberg served as Director of the Technical Liaison Group, while Dr. Ernst Stuhlinger filled the parallel position for the Research Projects Office. Directors of the laboratories remained as in 1955, with the addition of Dr. William A. Mrazek heading Structures and Mechanics. Deputy Directors for the laboratories were Dr. Rudolf F. Hoelker (Aeroballistics), Dr. Oswald H. Lange (Computation), Mr. F. Mueller (Guidance and Control), Mr. T.A. Poppel (Launching and Handling), Dr. H.F. Gruene (Missile Firing), Mr. H.K. Weidner (Structures and Mechanics), and Mr. B.R. Tessman (Test). (The AFMA had not yet filled several deputy director positions for the laboratories in 1956) (History of the Army Ballistic Missile Agency February – June 1956: organization chart, 48-55).

The 30 men occupying key positions for the offices and laboratories of the Guided Missile Development Division / ABMA represented fully a quarter of the number of original Paperclippers (inclusive of some additions and deletions) who had come to the Redstone Arsenal to work with Dr. von Braun. Other German scientists and engineers within the Paperclip (1945-1948) and Project 63 (1952-1954) recruitment were also prominent specialists in their fields. During the middle 1950s, a final recruitment in Germany had occurred (1955-1958). While the German government did not authorize, or favor, continued American recruitment, the U.S. Army maintained an office in Bad Homburg, near Frankfurt, to find potential employees. Recruitment stationary still used the designation Paperclip on its letterhead. By this date, recruits were often a generation younger than those from Peenemünde (Weitze 1997: 176-177). Across the recruitments, these men had highly distinguished backgrounds, and even as late as the transfer of their mission to NASA in 1960 a sizable core group of these men continued their work at the Huntsville facility. In 1959, the ABMA’s Development Operations Division directors and deputies posed for a photograph in front of Building 4488. Included, left to right, were Ernst Stuhlinger, Helmut Hoelzer, Karl Heimberg, Ernst Geissler, E.W. Neubert, Walter Haeussermann, Wernher von Braun, William Mrazek, Hans Huetter, Eberhard Rees, Kurt Debus, and Hans Maus (Plate 32). Among the group at the MSFC as of the early 1960s were at least 20 of the original Paperclippers, eight Project 63 recruits, and two late recruits of the middle 1950s (Marshall Star 1960-1967: passim; see bibliography). The list given below is incomplete, based solely on biographies appearing in the Marshall Star.

Mr. Helmut F. Bauer: chief of the Flutter and Vibration Section in the Aeroballistics Division at the MSFC in 1961

Konrad K. Dannenberg: deputy director of the MSFC Saturn Systems Office in 1961

Dr. Kurt H. Debus: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde; chief of the Missile Firing Laboratory of ABMA in 1951; first assignment at Cape Canaveral in 1952; head of the Launch Operations Directorate at Cape Canaveral

Dr. Ernst D. Geissler: Project Paperclip recruit who arrived at Fort Bliss in ca.1946, transferring to the Redstone Arsenal in 1950; expert on missile stability and control; director of the Aeroballistics Division at the MSFC in 1960
Mr. Werner Gengelbach: Project Paperclip recruit who arrived at Fort Bliss in 1945; in 1949 worked for the Air Force, remaining at the Missile Development Center under ARDC at Holloman Air Force Base in New Mexico until 1957; worked in private industry in Southern California; joined the MSFC in 1962 as the representative engineer for NASA at the Jet Propulsion Laboratory, an 80-acre facility near Pasadena; resident manager for the Saturn S-II for the MSFC at North American Aviation’s Space and Information Office in Los Angeles.

Mr. Dieter Grau: Project Paperclip recruit who arrived at Fort Bliss in 1946, transferring to the Redstone Arsenal in 1950; chief of the Electrical Network and Power Supply Section of the Guidance and Control Laboratory at the Redstone Arsenal; director of the Quality Division of the MSFC in 1960.

Dr. Walter Haeussermann: Project Paperclip recruit who arrived at Fort Bliss in 1948, transferring to the Redstone Arsenal in 1950; worked for the U.S. Army on R&D for analog computers in Germany during 1946-1947; formerly at Peenemünde; by 1966 known for R&D in the guidance and control for the Jupiter IRBM, the Pershing missile, and earth satellites.
Mr. Karl L. Heimburg: Project Paperclip recruit who arrived at Fort Bliss in ca.1946, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde; director of the Test Division for MSFC

Mr. Gerhard Heller: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; expert in rocket motor development and thermodynamics; deputy director of the Research Projects Division and chief of its Space Thermodynamics Branch at the MSFC in 1961

Mr. Curt P. Herold: Project 63 recruit who arrived at the Redstone Arsenal in 1954; engineering director for development of V-2 components at Peenemünde; deputy chief of the Launch Operations Center, Launch Equipment Branch, at the MSFC, 1962

Mr. Adolf L. Herrmann: Project 63 recruit who arrived in the U.S. in 1953 to work with the Army; joined the MSFC in 1960; electrical engineer for control systems

Dr. Rudolf F. Hoelker: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde

Dr. Helmut Hoelzer: Project Paperclip recruit who arrived at Fort Bliss in 1946, transferring to the Redstone Arsenal in 1950; pioneered the development of analog computers in guided missiles for Germany

Mr. Hans H. Hueter: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; chief test engineer at Peenemünde; manager of the Agena and Centaur Systems Office at the MSFC in 1960

Dr. Heinz Hermann Koelle: middle 1950s recruit who arrived at the Redstone Arsenal in 1955; responsible for the analysis, planning, and design of advanced space vehicles and space transportation systems for ABMA and NASA

Mr. Arthur J. Kroeger: Project Paperclip recruit who arrived at Fort Bliss in 1946, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde; technical assistant in the Propulsion and Vehicle Engineering Laboratory

Dr. Joachim P. Kuettner: Project Paperclip recruit who arrived in the U.S. in 1948 at the Air Force Cambridge Research Center at Hanscom Air Force Base in Massachusetts and at the ABMA in 1958; meteorologist and aeronautical research scientist; manager of the Mercury-Redstone program for the MSFC in 1960

Dr. Oswald H. Lange: Project 63 recruit who arrived in the U.S. to work for Glenn L. Martin in Baltimore ca.1954; at Peenemünde during World War II; principal scientific officer at the Royal Aircraft Establishment in England, 1947 into the early 1950s; director of the Saturn Systems Office for MSFC

Mr. Hermann Ludewig: Project 63 recruit who arrived at the Redstone Arsenal in 1953; a member of the Peenemünde rocketry group as of 1937

Mr. Hans H. Maus: Project Paperclip recruit who arrived at Fort Bliss in ca.1946, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde; expert in missile manufacturing methods development, process automation, assembly, and tooling concept development
Mr. Walter Medenica: Project 63 recruit who arrived in the U.S. in 1952 and at the ABMA in 1959; engineer in the Test Division at the MSFC

Dr. William A. Mrazek: Project Paperclip recruit who arrived at Fort Bliss in 1946, transferring to the Redstone Arsenal in 1950; responsible for rocket structure design and engine development projects, including ones for Redstone, Jupiter, Juno II, Jupiter C, Mercury Redstone, and Pershing; chief Saturn engineer

Dr. Eberhard Rees: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; technical plant manager at Peenemünde

Dr. Arthur Rudolph: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; formerly at Peenemünde; technical director of the Redstone and Pershing missile systems at the Redstone Arsenal; head of the Saturn V program office, with oversight for MSFC Apollo activities

Dr. Harry O. Ruppe: Middle 1950s recruit who arrived in the U.S. in 1957; special assistant to the director of the Future Projects Office at MSFC by 1963

Mr. Heinrich A. Schulze: Project 63 recruit who arrived at the Redstone Arsenal in 1953; at Peenemünde and chief of the Guided Missile Training School in Germany during World War II; chief of the Reliability Office for MSFC as of 1961

Dr. Ernst Stuhlinger: Project Paperclip recruit who arrived at Fort Bliss in 1946, transferring to the Redstone Arsenal in 1950; major feasibility and design studies for electrical propulsion systems for space vehicles; key contributor to the Pegasus meteoroid detection satellite program of the middle 1960s

Georg von Tiesenhausen: Project 63 recruit who arrived at the Redstone Arsenal in 1953; missile testing at Peenemünde as of 1943; chief of the Launch Operations Center, Future Studies Branch, at the MSFC in 1962

Dr. Arthur Urbanski: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; formerly at the Kummersdorf testing range and Peenemünde; retired from NASA as the Chief of the Analytical Operations Division of the Quality and Reliability Assurance Laboratory in 1964

Mr. Fritz A. Vandersee: Project Paperclip recruit at Fort Bliss; formerly at Peenemünde; head of the space vehicle Test Support Shop at the MSFC by 1962; the Test Support Shop (in Building 4650 as of the late 1950s) built a number of test stand items, including the interim test stand (Building 4565), the steel observation bunker behind Building 4560, and the flame deflector added to the east side of Building 4572—for which Mr. Vandersee was the lead designer

Dr. Wernher von Braun: Project Paperclip recruit who arrived at Fort Bliss in 1945, transferring to the Redstone Arsenal in 1950; technical director at Peenemünde; director of the MSFC in 1960

Mr. Friedrich Graf von Saurma: Project 63 recruit who arrived in the U.S. in 1953 for the Department of Defense and at the Redstone Arsenal in 1954; worked within the German Air Ministry during World War II; prior to transferring to the MSFC, headed the Weapons Systems Information Office for the ABMA
In 1956, the core of the newly formatted ABMA was the Development Operations Division, headed by Dr. von Braun and deputy directed by Dr. Rees. The mission of the division was to research and develop controlled ballistic missiles. The Research Projects Office supporting the Development Operations Division collected, analyzed, and evaluated scientific and technical information, also coordinating R&D projects not assigned to a single laboratory. The Technical Liaison Group served as an intermediary between the guided missile team at the ABMA and private sector contractors. The nine laboratories also each had specific duties (that generally carried forward into the NASA years under a revised organization). For example, that of Aeroballistics ran wind tunnel tests to gather experimental data, as well as multiple types of developmental investigations and simulator studies. The Computation Laboratory concentrated on improving electronic and analog computers for direct missile guidance and control, while the Guidance and Control Laboratory handled design and development of missile navigational instrumentation for inertial guidance systems. The Fabrication Laboratory focused on the fabrication and assembly of the missile airframe through components and subcomponents testing. In related work, the Structures and Mechanics Laboratory managed the overall development of a guided missile system, including review of missile drawings and specifications for the ABMA. The Structures and Mechanics Laboratory also had responsibility for the development, design, and test of missile airframes, as well as mechanical and propulsion systems. The Missile Firing Laboratory operated at Cape Canaveral as a part of the ABMA, responsible for all of the agency’s proving ground facilities and many of its activities there. The Systems Analysis and Reliability Laboratory set up and maintained inspection procedures and handbooks, simulated flight operations, conducted and evaluated tests on completed missiles, and was involved in pilot production. Finally, the Test Laboratory conducted static firings of complete missiles; static firings and cold calibration tests of power plants; and, other types of calibration and components tests (History of the Army Ballistic Missile Agency February – June 1956: 48-55).

As the ABMA solidified into a sophisticated missile development group at the Redstone Arsenal, inclusive of its expanding physical facilities and highly talented staff, the first major missions and accomplishments went forward. The Guided Missile Development Division / ABMA was responsible for key programs during late 1955-1958, including the Army’s Jupiter IRBM effort paralleling Air Force work on the Thor. The Department of Defense deployed both the Jupiter and the Thor at overseas bases. These priority missile programs for a 1,500-mile ballistic missile helped to staunch a missile gap between the U.S. and the U.S.S.R. while the Air Force Atlas ICBM completed development and test. (During a six-month period between late 1955 and early 1956, the U.S.S.R. test-fired a 900-mile guided ballistic missile multiple times, indicative of the achievement of a developmental phase for the weapons system [Anderton March 5, 1956: 98].) The Jupiter evolved directly from the Redstone, with the Jupiter A adapting a Redstone to flight test Jupiter components. The Jupiter C employed a modified Redstone first stage booster and clustered, scaled-down Sergeant rockets as second and third stages (Joiner and Jolliff 1969: 77). By 1956, planning toward scientific satellites was moving forward with the ABMA’s involvement (although shortly would become the domain of the Navy for American participation in the International Geophysical Year of July 1957 to December 1958). In August 1956, construction crews completed enhancements to the Parsons-Aerojet static test stand at the Redstone Arsenal (Building 4572), then the largest such stand in the continental U.S. for testing rocket motors. The test stand could accommodate two static run-ups simultaneously (east and west sides of the stand) (Aviation Week February 27, 1956). More modifications (of the east side of the stand) would occur in 1958-1959 by Maurice H. Connell & Associates for the Juno V and Saturn programs (see below). By 1961, the west side of Building 4572 could static test boosters up to 500,000 pounds of thrust, while the east side of the stand could accommodate 1,500,000
pounds of thrust (Plate 33) (Army Ordnance Missile Command March 7, 1961: 3). Major missions of the ABMA through 1958 were:

- directing, coordinating, and evaluating the Redstone missile program (developed both as a space booster and a tactical 175-mile missile;
- work toward a 500-mile medium range ballistic missile (MRBM);
- undertaking an Army IRBM (that would become the Jupiter in early 1956, a joint Army-Navy program into late that year);
- studies toward Project Orbiter, the joint Army-Navy scientific satellite program (with Army involvement terminated at the close of 1955 and the Navy moving forward with Project Vanguard);
- reinvolve of the ABMA in a manned satellite program following the launch of Sputnik I by the U.S.S.R. (with the successful launch of the first U.S. unmanned satellite, Explorer I, atop a modified Jupiter C [Juno I]) in January 1958; and,
- assignment of the Pershing missile program in early 1958, planned as a solid-propellant replacement of Redstone.

In June 1958, the U.S. Army added the Redstone tactical missile to the Shield Forces of the North American Treaty Organization (NATO) overseas (Joiner and Jolliff 1969: 118). As of August, the Advanced Research Projects Agency (ARPA) initiated the Saturn project, with assignment to Army Ordnance Missile Command. The ABMA began work on Saturn booster development, with a first-stage booster created from the Jupiter and the Redstone. In October 1958, NASA activated, with Project Mercury nearly simultaneously organized to place a manned capsule in space orbit. Mercury would use a Redstone booster. The Redstone launched the first U.S. astronaut, Alan Shepard, into space in a Mercury capsule on 5 May 1961 (A Chronology of the MSFC—1960-2000: 9). In December, the Army agreed that the ABMA would support NASA’s needs, although NASA’s request to have all of the ABMA’s space activities transferred to itself remained deferred. The ABMA continued its work toward space conquest, with a first lunar probe firing at Cape Canaveral (Pioneer III atop Juno II) (Chronology of the Army Ballistic Missile Agency February 1956 – December 1960: 1-55; Wright 2000: 27-44). The Juno V program of 1958-1959 led directly to the Saturn booster (Plate 34) (History of the Army Ballistic Missile Agency 1 January – 30 June 1959: 50).

The Later 1950s and Transition to the National Aeronautics and Space Administration

Facilities

With the activation of NASA in 1958, another major phase of buildings and structures design began for the (east) test area, inclusive of a dynamic test stand (in addition to static facilities). For this era of construction, which primarily would support the Jupiter and the earliest work toward the Saturn-booster, new architectural-engineering firms become active at the Redstone Arsenal. While Ralph M. Parsons (Parsons-Aerojet) dominated the first era of design and engineering for testing of the Redstone, from this point forward the situation changes. Buildings from 1958-1960 include several structures scattered among existing facilities outside the test area: Building 4318, a liquid oxygen (LOX) storage shed; Building 4472, a packing and preserving structure; Building 4478, an isolation enclosure for test equipment; Building 4482, an operations support structure; Building 4483, a vehicle maintenance shop; Buildings 4498 and 4499, Quonset huts; Building 4623, an accelerator and test cell (Plate 35); a test cell addition to Building 4708 (see Plate 5); Building 4731, a storage shed; and Building 4744, a compressed air unit for the Aeroballistics Laboratory. Among these buildings, four were part of a coordinated building campaign tied to architectural-engineering work going forward in the test area:

- Building 4482 (1958);
- Building 4623 (1958);
- the high-pressure test cell added to Building 4708 (1960); and,
- Building 4744 (ca.1957-1959).

The firm responsible for their design and engineering was Maurice H. Connell & Associates of Miami, Florida. While little is researched here about the details of missions associated with these structures, the implied range of these missions suggests that Maurice H. Connell was working under a larger, comprehensive buildings’ contract to meet ABMA needs at the arsenal. Building 4482 is presumed to be relatively generic (as an operations support structure constructed in the midst of the mustard filling plant [Building 4481] cluster of World War II), while the other three are evocative of highly specialized missions. Buildings 4623 and 4708 both focused on test cells, with Building 4623 also featuring a Vandegraff accelerator. The test cells for Building 4623 were for hazardous materials testing, and included LOX impact test cells and an ion accelerator as of 1965 and radiation shielding in 1981. Today, the MSFC’s Environmental Engineering Department denotes a circular high-pressure blast-hazard area around Building 4623, also delineating a similar blast-hazard area around Building 4628, a nearby low-temperature test facility of the early 1960s (see Plate 35) (NASA March 2, 2000: map). Maurice H. Connell’s design for Building 4744 was also technically sophisticated and is assumed related to a small group of buildings on site that are now removed. This cluster included a structure, the former Building 4741, where a crew of five workers cut, drilled, and shaped raw stock beryllium into guidance components (primarily gyroscopes) (see Plate 7). Beryllium particles and shavings cause severe respiratory problems and skin disease. As of the early 1960s, the beryllium facility operated through the Pilot Manufacturing Development Branch of the Astrionics Division. Its employees, “experimental machinists,” took decontamination showers at the end of each work day, with work clothing laundered daily as well. The facility required a special air filtration system. The machinists also weighed in every two weeks to measure possible weight loss, a sign of accruing respiratory problems. The beryllium facility at the Redstone Arsenal began operations in May 1958, with the next closest such facility located in Sarasota, Florida (Marshall Star August 8, 1962: 6).
Plate 35. Buildings 4623, 4622, and 4628, middleground to background. Foreground building today replaced by Building 4605. 2 June 1964. NASA Photograph Laboratory.
In the test area, Maurice H. Connell & Associates designed and engineered several important structures, and would continue their work through the design of major test stands and support facilities into the middle 1960s. In addition, the Redstone Arsenal commissioned increased ancillary infrastructure for the test area, beginning in the late 1950s (for which Maurice H. Connell & Associates may, or may not, be responsible). Verified buildings executed by Maurice H. Connell & Associates extant in the test area from 1958-1960 are:

- Building 4560, an elaborate observation bunker for viewing tests at the former Building 4564, of 1958 (Plate 15)—Parson’s horizontal test stand of 1954, modified as a vertical power plant test stand in late 1956 (assumed for the Jupiter program);
- Building 4561, a support service structure and hardstand (the small easternmost unit of today’s building only) of 1958; and,
- Building 4594, a fuel storage facility of 1959.

Also possibly designed by the firm, or, by DeLaureal & Moses of Pensacola, are:

- Building 4549, a booster pump station (1960);
- Building 4552, a booster pump station reservoir (1960);
- Building 4559, a vacuum pump house for the components test facility (1958); and,
- Building 4562, a booster pump station reservoir (1959), documented as the work of DeLaureal & Moses.

Of equivalent importance in the test area were two buildings of 1959-1960, now removed. These structures, a dynamic test stand, and a second elaborate observation bunker, are both very likely the work of Maurice H. Connell & Associates. The observation bunker, former Building 4571, is so verified through its original drawings of January 1959. The bunker replaced use of a small observation bunker to the near west, immediately south of Building 4572 (Plate 36). (Both of these bunkers are gone today.) The dynamic test stand, the former Building 4557, stood to the immediate east of today’s Building 4558 (see Plate 18)—its control structure (small blockhouse). Design of Building 4558 dates to 1960, and is assumed simultaneous with that for the now removed test stand, the former Building 4557. (This dynamic test stand was still standing as of the master plan for the MSFC of 1980; its removal date is unresearched here.) The more comprehensive design and engineering work of Maurice H. Connell & Associates is unexplored here, but is most likely tied to parallel types of buildings and structures under their simultaneous effort at Cape Canaveral.

Missions

Throughout the 1958 to 1960 period, ABMA’s research, development, test, and evaluation at the Redstone Arsenal focused on the Jupiter program, work toward satellites, and early efforts tied to Saturn. Building 4572 (the static test stand built for Redstone) and Building 4573 (its gantry) supported tests of Jupiter engines (see Plate 33). ABMA personnel also tested the Juno space booster for adaptation to satellite launches, with static firings at Building 4572 (see Plate 34). In early October 1958 immediately after its activation, NASA officials met with ABMA at the Redstone Arsenal to explore the idea of a NASA manned space capsule launched atop ballistic missile packages (Project Mercury), with a first-stage booster developed from the Redstone and the Jupiter. First plans were for test firings of 10 (subsequently reduced to eight) Redstones and three Jupiters. Simultaneous with this discussion of NASA-ABMA collaboration, NASA also requested that its agency formally acquire ABMA’s scientists and engineers, along with those of
the Jet Propulsion Laboratory in Southern California. A first decision in December 1958 transferred the Jet Propulsion Laboratory group to NASA, but left the ABMA team within the Army. At this time, Dr. von Braun’s “space team” within the ABMA included a total of 2,100 personnel. To appease NASA, President Eisenhower stipulated that a portion of the ABMA’s work would support NASA’s space program, inclusive of eight satellite launches planned for 1959 (History of Army Ballistic Missile Agency July – December 1958: 49-52). Satellite launches from Cape Canaveral featured Juno boosters with instrumentation payloads. Following upon ARPA’s Order 14-59 for the development of a large space booster (1.5 million pounds of thrust, as compared with 78,000 pounds of thrust for the Redstone and 150,000 pounds of thrust for the Jupiter) using a cluster of rocket engines (Redstone and Jupiter engines configured as the Saturn booster), the ABMA also began studies toward a stipulated static firing of the booster by the end of 1959. The planned booster was to be capable of lifting a multi-stage vehicle and an astronaut-manned capsule. NASA titled the three-stage vehicle program Saturn. By mid-1959, the ABMA had completed many of the facilities preparations required to accommodate testing of the Saturn space booster. The Army hired Maurice H. Connell & Associates to modify the east side of the static test stand, Building 4572, with successive additional changes to the stand in 1962 and 1966. Testing of the Redstone H-1 engine on the power plant test stand (the former Building 4564) also applied to the Saturn program. The ABMA interpreted Rocketdyne’s (North American Aviation) H-1 engine as well suited for the job due to its operational simplicity and proven reliability, inclusive of the engine’s thoroughly tested components. The Saturn first-stage booster featured eight H-1 improved-Redstone engines clustered around a Jupiter propellant tank. The Saturn second-stage was a modified Titan ICBM, while its third stage was the Centaur space vehicle. Work toward the Saturn first-stage booster began to dominate efforts at the ABMA as of June 1959 (History of Army Ballistic Missile Agency January – June 1959: 46-55). The first static test of all eight Redstone engines of the Saturn first-stage booster fired on Building 4572 in an eight-second test at the end of April 1960. Static testing of increased duration and thrust continued thereafter (Chronology of the Army Ballistic Missile Agency February 1956-December 1960: passim).

As work went forward toward the three-stage Saturn booster and Project Mercury, President Eisenhower announced the planned transfer of part of the ABMA to NASA, inclusive of critical personnel and facilities, in October 1959. Through this action, NASA assumed total responsibility for the development of the Saturn booster. Army personnel, buildings, structures, equipment, and technical documents shifting to NASA at the Redstone Arsenal concentrated within the ABMA’s Development Operations Division. Appropriate parties signed the Army-NASA Transfer Plan in mid-December 1959, with assets formally shifted 1 July 1960. Buildings and structures allocated to the MSFC numbered about 150. The transfer agreement focused on a desire to create a self-sufficient MSFC, yet avoid duplication of support services. The agreement further recognized the Army’s need to retain a compliment of personnel (up to 350 employees) to maintain an uninterrupted weapons systems capability. The Army was to continue to provide what were termed “station-wide services,” inclusive of its foundry; electric, steam, and water; and maintenance of perimeter security. No military personnel within ABMA’s Development Operations Division transferred to NASA, but were instead phased out to configure a fully civilian organization. The buildings and structures shifted to NASA included most of the facilities then occupied or used by the Division. Major exceptions were Buildings 4484 and 4488. The four wings of the Building 4484-4488 cluster included the headquarters of the ABMA (the three wings of Building 4488) and a contractors’ engineering facility (the single wing of Building 4484). NASA planned for a new MSFC headquarters grouping (today’s Buildings 4200, 4201, and 4202). While design and construction for this complex went forward, those NASA employees within the Development Operations Division whose offices were in Building 4488 (such as Dr. von Braun) would remain in Buildings 4484 and 4488, concentrated in
Building 4488. Shared NASA-Army use of Building 4663, the Computation Laboratory, was another major dilemma for the two agencies. Approximately 35 percent of the total digital computer time in the laboratory supported NASA-ARPA programs (such as for Saturn), with the Army using the remainder on other weapons systems projects. Both NASA and the Army anticipated major increases in their needed computation capacities. The solution was to cede the building to NASA, but for NASA to provide the Army sustained scientific and data processing services on a reimbursable basis until the Army could construct a new computation laboratory for itself elsewhere at the arsenal (History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan). In addition, NASA renovated Building 4491, an inert materials warehouse of World War II, to serve as a second computer center for the MSFC’s technical support and business needs—with scientific computer applications remaining in Building 4663 (Marshall Star December 7, 1960: 1, 8).

The area of the Redstone Arsenal mapped for transfer to NASA in December 1959 is smaller than the acreage of the MSFC. At the center of the NASA area, the northernmost boundary ran parallel to today’s Digney Road approximately through the linear axis of Building 4315. This choice excluded the facilities of the U.S. Industrial Chemical Company, a resident leasee operating buildings and structures originally configured as the World War II Chlorine Plant No. 1 (today’s Building 4241-4250 area), and also did not include the land that would become the site of the NASA 4200 headquarters office complex. The eastern edge for the MSFC, south of this area, did align closely with today’s boundary, as did the southernmost edge. Along the western edge, however, the planned MSFC followed the loop through the propellant storage area west of Dodd Road (through today’s west test area), moving north in stepped increments that aligned immediately west of Buildings 4623 and 4708. Within the 1959 boundaries of the MSFC remained the major Army utility systems including railroad tracks, Building 4490 (railroad scales), Building 4468 (an electrical substation), unnumbered electrical substations, Buildings 4725 and 4726 (the steam plant and its auxiliary structure), Building 4636 (the sewage lift station), Building 4424 (the fire station), and Building 4565 (a moveable range tower, planned for relocation. (History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan; Master Plan Analysis of Existing Facilities June 30, 1959). Expansion of the test area (to east and west areas), as well as enlargement of the industrial 4700 area, added acreage to the MSFC in the years following. The contractual mechanism between the Army and NASA was a “long-term, non-revocable, and renewable use permit for the agreed upon Redstone Arsenal land and facilities” (History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan).

Buildings and structures planned for transfer from the Army to NASA as of mid-December 1959, given with their assigned uses in the transfer document, were:

- Building 4306 (cafeteria)
- Building 4309 (engine buildup) [demolished today]
- Building 4311 (administration and supply) [demolished today]
- Building 4312 (security)
- Building 4313 (Rocketdyne service center)
- Building 4319 (oil pump station)
- Building 4331 (missile systems engineering) [demolished today]
- Building 4332 (environmental test for the Systems Analysis and Reliability Laboratory) [today demolished]
- Building 4334 (environmental test for the Systems Analysis and Reliability Laboratory) [today demolished]
- Building 4335 (centrifuge) [today demolished]
Building 4336 (environmental test) [today demolished]
Building 4350 (fuel test stand) [today demolished]
Building 4351 (field support training) [today demolished]
Building 4352 (nitrogen manufacturing plant) [today demolished]
Building 4353 (field support training)
Building 4354 (nitrogen storage tank) [today demolished]
Building 4355 (nitrogen storage tank) [today demolished]
Building 4371 (shake table, office and shop) [today demolished]
Building 4372 (receiving unit) [replaced by another structure in 1972]
Building 4373 (ground support equipment laboratory) [today demolished]
Building 4435 (motor pool complex) [today demolished]
Building 4469 (semi-permanent storage for the Post Engineer) [today demolished]
Building 4471 (office and storage for the TME Laboratory)
Building 4472 (packing facility for the TME Laboratory)
Building 4479 (storage shed for the TME Laboratory)
Building 4481 (offices and laboratory for the SSE Laboratory)
Building 4482 (woodwork shop)
Building 4485 (network electronics)
Building 4487 (office and laboratory)
Building 4491 (computer building)
Building 4492 (network system electronics)
Building 4493 (machine shop)
Building 4494 (storage for the TME Laboratory)
Building 4495 (maintenance shop and storage for the Post Engineer)
Building 4559 (vacuum pump)
Building 4560 (observation bunker for the power plant test stand)
Building 4561 (propellant shop support)
Building 4562 (industrial water storage)
Building 4564 (power plant test stand) [today demolished]
Building 4566 (engineering offices for the SSE Laboratory)
Building 4567 (test stand area boiler house)
Building 4569 (guard house) [today demolished]
Building 4570 (blockhouse)
Building 4571 (observation bunker for static test tower) [today demolished]
Building 4572 (static test tower)
Building 4573 (gantry crane for static test tower)
Building 4574 (fuel disposal pit) [replaced by wooden observation bunker]
Building 4575 (oxidizer for static test area) [today demolished]
Building 4576 (liquid waste disposal tank) [today demolished or unnumbered in situ]
Building 4577 (liquid waste sand filter) [today demolished or unnumbered in situ]
Building 4578 (liquid waste U.G. disposal) [today demolished or unnumbered in situ]
Building 4579 (liquid waste reservoir)
Building 4580 (liquid waste disposal mixing chamber) [today demolished]
Building 4581 (nitrogen booster battery)
Building 4582 (nitrogen booster battery compressor)
Building 4583 (components test laboratory)
Building 4584 (tank pit for the components test laboratory)
Building 4585 (holding pond for the components test laboratory) [today demolished, incorporated with Building 4584, or unnumbered in situ]
Building 4586 (holding pond for the components test laboratory) [today demolished, incorporated with Building 4584, or unnumbered in situ]
Building 4588 (cold calibration test stand)
Building 4589 (observation building for cold calibration test stand) [today presumed incorporated with Building 4554]
Building 4590 (pit) [today demolished or unnumbered in situ]
Building 4591 (oxidizer disposal for the cold calibration test stand) [today demolished or unnumbered in situ]
Building 4592 (fuel disposal for the cold calibration test stand) [today demolished or unnumbered in situ]
Building 4593 (holding pond) [today demolished or unnumbered in situ]
Building 4594 (fuel storage)
Building 4595 (observation bunker) [today likely the bunker incorporated in Building 4596]
Building 4596 (oxidizer ready storage)
Building 4597 (fuel ready storage)
Building 4598 (nitrogen ready storage)
Building 4610 (engineering office)
Building 4612 (engineering development)
Building 4613 (compressor building)
Building 4616 (shop)
Building 4617 (flammable storage)
Building 4619 (test unit)
Building 4620 (vacuum and compressor)
Building 4623 (accelerator and test cell)
Building 4624 (hydrogen peroxide storage) [replaced with warehouse in 1992]
Building 4630 (gas pump building) [today replaced with structural-thermal test facility in 1971]
Building 4631 (gasoline tank) [today demolished or unnumbered in situ]
Building 4632 (gasoline tank)
Building 4633 (gasoline tank)
Building 4634 (diesel pump building) [replaced by a portable storage structure in 1961]
Building 4635 (diesel storage) [replaced by chemical waste storage facility in 1987]
Building 4650 (guided missile test shop)
Building 4658 (guard house) [replaced by blower facility in 1977]
Building 4659 (mosquito oil tank) [replaced by HP GN2 facility in 1964; may remain unnumbered in situ]
Building 4663 (computer building)
Building 4665 (interim test stand)
Building 4670 (hydrogen peroxide tank)
Building 4681 (hydrogen peroxide transfer pump) [today demolished]
Building 4682 (hydrogen peroxide unloading dock) [replaced by a portable storage structure in 1990]
Building 4683 (hydrogen peroxide disposal) [today demolished or unnumbered in situ]
Building 4684 (nitric acid drum storage) [today demolished or unnumbered in situ]
Building 4685 (nitric acid disposal) [today demolished or unnumbered in situ]
Building 4686 (liquid oxygen tank pit) [today demolished or unnumbered in situ]
Building 4687 (tool shelter) [today demolished]
Building 4688 (aniline furfuryl drum storage)
Building 4689 (aniline furfuryl disposal) [today demolished or unnumbered in situ]
Building 4690 (ethyl alcohol tank) [today demolished or unnumbered in situ]
Building 4691 (ethyl alcohol transfer pump) [today demolished]
Building 4692 (ethyl alcohol disposal) [today demolished or unnumbered in situ]
Building 4693  (hydrocarbon storage)
Building 4694  (hydrocarbon storage tool shelter)
Building 4702  (high pressure test)
Building 4703  (chemical cleaning)
Building 4704  (hydraulic press and heat treatment facility)
Building 4705  (missile assembly building)
Building 4706  (missile assembly hangar) [today combined with Building 4705]
Building 4707  (structural fabrication facility)
Building 4708  (missile assembly and inspection hangar)
Building 4709  (semi-permanent lunch room) [today demolished]
Building 4710  (test cell C) [today demolished]
Building 4711  (development shop)
Building 4712  (engineering building)
Building 4713  (storage) [today demolished]
Building 4714  (cleaning and treatment shop)
Building 4715  (expenditures and production)
Building 4716  (pipe fitting)
Building 4717  (propellant storage) [today demolished]
Building 4718  (oil storage) [replaced by x-ray calibration facility in 1989]
Building 4720  (safety office) [replaced by refrigeration storage in 1994]
Building 4723  (electrical and graphic engineering)
Building 4727  (supply materials and equipment)
Building 4728  (research and development shop)
Building 4730  (dry air shed) [today demolished]
Building 4732  (wind tunnel and laboratory)
Building 4733  (vacuum pump)
Building 4734  (vacuum pump house)
Building 4735  (air dryer)
Building 4736  (dry air storage tank)
Building 4737  (dry air storage tank)
Building 4738  (substorage for TME Laboratory)
Building 4739  (instrumentation shop)
Building 4741  (beryllium and printed “circ”) [today demolished]
Building 4742  (temporary storage for guidance and control) [today demolished]
Building 4743  (gas cylinder storage) [replaced by picnic pavilion in 1993]
Building 4744  (compressed air)
Building 4746  (instrumentation development)
Building 4747  (air compressor)
Building 4748  (liquid propellant test stand) [replaced by shower and dressing room in 1989]
Building 4749  (test cell A) [replaced by restroom facility in 1985]
Building 4750  (high altitude test facility) [replaced by barbecue area in 1975]
Building 4751  (high pressure air battery)
Building 4753  (combustion test block #1) [today demolished]
Building 4754  (VG water storage) [replaced by high bay shop in 1990]
Building 4755  (combustion test block #2) [replaced by vehicle components hangar in 1966]
Building 4760  (surface treatment plant)
Among the above 149 buildings and structures, approximately 83 exist today. Many of those buildings were replaced at a later date by structures having the same real property number now, are sited at entirely different locations. The removed buildings and structures of pre-1960 fall into four groups. About 17 were within the 4300 and 4400 areas, largely comprised of buildings from the World War II Plants Area 1. Another 16 were within the 4700 area, and were primarily industrial test clusters now gone. Six buildings were sited between Fowler Road and the test area. The majority of the removed buildings and structures were within the test area: 27 (History of Army Ballistic Missile Agency January – June 1960 volume II: Army-NASA Transfer Plan). In the last category are a number of toxic propellant facilities and disposal areas, which may either be fully gone today or may remain on or under the ground (with numbering). President Eisenhower dedicated the new MSFC, as the largest NASA facility in the U.S., 8 September 1960. The transfer from the Army to NASA included management across 1,200 acres of land and the realignment of 4,670 people (Dunar and Waring 1999: 30).

*The Saturn Program and the 1960s*

**Comprehensive Building Campaign**

The MSFC assumed responsibility for the Saturn as of its activation in July 1960. The Saturn test program at the MSFC stimulated a very large building campaign in the existing (east) test area and an expansion creating today’s west test area. For the west test area, and even more generally, the west area at the southern end of Dodd Road within the MSFC, NASA removed the then-existing crescent of six propellant storage facilities and four disposal ponds (see Plate 9), as well as the rail trackage running through the cluster. The west test area also overlapped with a 135-acre zone of older contaminated acreage, where the Army had buried mustard and other blistering gases since 1946. To test for residual contamination, an Army Chemical Corps team from the Edgewood Arsenal in Maryland removed two feet of surface dirt over a three-acre area to accommodate construction of Saturn static test facilities (*Marshall Star* September 16, 1961: 4). Today’s crescent-shaped road through the west test area, Saturn Road, follows the original layout of the propellant-storage corridor of the 1950s. NASA added a test engineering office, Building 4666 on the west side of Dodd Road at Saturn Road (connected by a tunnel under Dodd Road to the pre-existing test engineering office Building 4566), with two sequential expansions; an industrial water facility comprised of two reservoirs (Buildings 4668 and 4669) and a high-pressure pump station (Building 4667) (Plate 37); two major test stands for the Saturn program (Building 4670 and 4696); a west test area blockhouse (Building 4674) (Plate 38); specialty test facilities; and, propellant and other necessary support infrastructure. Extant in 2002 are at least 16 buildings and structures from the 1961-1966 redevelopment of the west test area. In addition, NASA built a new headquarters office building cluster for its headquarters on Rideout Road and augmented many buildings from the 1950s with additions and important interior modifications. New technical complexes, with specific purposes for the Saturn program, also went in place. One example of this phenomenon for the MSFC was the grouping for ground support test, inclusive of Buildings 4646 (a blockhouse), a checkout and assembly building (original site undiscovered; assumed demolished today), five support structures (Buildings 4638-4642), and “various swing arm test positions” (Plate 39) (*Marshall Star* April 3, 1963: 1,5).

For these building campaigns, Maurice H. Connell & Associates continued to play a major role at the outset of the decade, but does not appear thereafter. (Maurice H. Connell & Associates was of primary importance as an architectural-engineering firm designing structures for the ABMA/MSFC during 1957-1963.) However, during the 1960s other nationally important architectural-engineering firms also worked at the MSFC. Beginning in the 1950s, these firms
Plate 37. Buildings 4566, 4567, 4562, 4552, and 4549, foreground left to right. Buildings 4666 (with additions), 4667, 4668, 4669, and 4665 (right edge), middleground left to right. Buildings 4670, 4674, and 4696, background left to right (test stands and blockhouse only). 6 October 1966. NASA Photograph Laboratory.
simultaneously worked for the Air Force on missile launch complexes; on highly sophisticated air defense command and control facilities for Air Defense Command; and, on technical R&D and munitions complexes for ARDC. Included in this group were Holmes & Narver and Bechtel of Los Angeles; Burns & Roe of New York; Sverdrup & Parcel of St. Louis; Giffels & Rossetti of Detroit; and, Stearns-Rogers Corporation of Denver. Each had a national presence, although not all are detailed here (Weitze 2002: volume II draft). For example:

- Holmes & Narver:

Holmes & Narver existed by 1945, with critically important work for Los Alamos, the Sandia Laboratory, and the Department of Defense. Early that year the firm had designed the Salt Wells Pilot Plant at the Naval Ordnance Test Station at Inyokern (China Lake), California, to manufacture chemical high explosives (HE) that featured the exacting detonation wave characteristics required for the development of implosion atomic weapons (Bilderback and Binder May 1999: 28). The firm had handled the structures and instrumentation program for Operation Greenhouse, an elaborate nuclear test in the Marshall Islands during the first half of 1951. The final shot for Greenhouse was the first successful thermonuclear explosion in the world. Greenhouse had required 900 electrical recording and 500 self-recording gauges. At mid-decade, Holmes & Narver had worked for the Air Force, conducting a major site study at Holloman Air Force Base in New Mexico for ARDC’s Missile Development Center. Their planning document for Holloman ultimately contributed to the final choice for an Air Force western ICBM test range, at Vandenberg Air Force Base in California. Holmes & Narver designed and engineered the Atlas launch complexes at Vandenberg during the late 1950s. Later Cold War work by the firm featured parts of ground support complexes for the MX ICBM, hardened aircraft shelters, recabling for the Sandia Laboratories, and ground facilities for satellite communications.

- Burns & Roe:

Burns & Roe had started out as an important designer of power plants, established in 1932 and evolving toward pioneering engineering for nuclear power plants, facilities for advanced energy technologies, and aerospace projects. The firm is also known for its design of uranium ore processing facilities and for engineering linked to the handling of military chemical munitions. For the Department of Defense, Burns & Roe has designed computer centers, communications and electronic networks, radar systems, missile support and testing facilities, vacuum chambers, wind tunnels, and specialized R&D sites. A major example of the firm’s work during the middle 1950s into the early 1960s included the design and engineering for the national Air Force network of 23 Combat and Direction Centers for Air Defense Command, better known as the Semi-Automatic Ground Environment (SAGE), and operational into the early 1980s. Immediately prior to its work for the MSFC, Burns & Roe completed the design for the structure housing the Mark I Aerospace Systems Environmental Chamber at the Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee. The AEDC was another of the R&D test centers under ARDC and its successor commands, an industrial complex with facilities not unlike those at the MSFC. The Mark I simulated high-altitude space environments, and included a large vacuum chamber capable of creating the environmental conditions of space pressure, temperature, solar radiation, and vibration for the testing of full-scale satellite vehicles.
• Sverdrup & Parcel

Sverdrup & Parcel, an engineering firm founded in 1928, had forged important and enduring ties to the American military during World War II. Both partners began their careers as bridge engineers. Leif Johan Sverdrup served as a Colonel in the Army Corps of Engineers at the request of General Douglas MacArthur as of 1942, overseeing the engineering and design of airfields in the Pacific theater. Dr. Ira Parcel was a specialist in statically indeterminate structures. He designed two pioneering wind tunnels for Air Technical Service Command at Wright Field in 1945. As of 1946, the Army Air Forces hired Sverdrup & Parcel to design the AEDC in Tullahoma (a project encompassing the full test installation and under construction during the 1950s). The firm maintained its key role at the AEDC through the J-series of large rocket test cells and the hypersonic ballistics Range G test facility of the 1960s. At Vandenberg Air Force Base, Sverdrup & Parcel designed the space shuttle launch complex of the late 1970s and the Rail Garrison test compound for the Peacekeeper ICBM at the conclusion of the Cold War.

• Giffels & Rossetti

The founding of Giffels & Rossetti also dates to the 1920s, under the name Giffels & Vallet by World War II. During the war, the engineering firm Giffels & Vallet, in association with the architect L. Rossetti, handled multiple commissions for the Army, including a number of large industrial manufacturing plants. The firm was also responsible for the design of the standard Army munitions igloo built at many installations across the U.S. Immediately after World War II, Giffels & Vallet, working with L. Rossetti, designed Electronics Park for General Electric, a major electronics R&D facility in Syracuse, New York. (In 1949, Air Materiel Command set up a Test Operations Building at Electronics Park for Air Force research toward the improvement of air defense command posts.) During the 1950s, the firm continued significant assignments for the Air Force, including definitive drawings for standard buildings and structures at the headquarters level. By late in the decade, as Giffels & Rossetti, the firm designed the composite structures for SAC’s tenant alert missions, and developed the Air Force manual on radioactive fallout for bases agencywide.

Bechtel’s work at the MSFC during the 1960s is also of major note, but is not detailed for this study. Bechtel began as the W.A. Bechtel Company constructing railroad beds in the Oklahoma Territory in 1898, and by 1931 had participated in the Six Companies joint venture for the building of Hoover Dam. C.F. Braun & Company of Los Angeles is another important firm in this specialized design and engineering arena, about whom no research is presented here. (The firm operated an established engineering campus-style company in Alhambra, east of Los Angeles, and is no longer in business today.) Although not responsible for as many commissions during the 1960s expansion for the Saturn program as had been true during the 1950s, Aerojet also continued to work at the installation. Finally, Robert & Company was responsible for isolated commissions, as had been true the previous decade.

Continued work of the early 1960s at the MSFC by Maurice H. Connell & Associates, extant today, included:

• Building 4550, the advanced Saturn dynamic test stand (1963) (Plate 40);
• Building 4551, the terminal building for the advanced Saturn dynamic test stand (1963);
Plate 40. Building 4550, center right. 2 June 1964. NASA Photograph Laboratory.
By Aerojet:

- Building 4655, F-1 test facility preparation building (1963) (Plate 41);
- Building 4670, Saturn static test stand (1961) (Plate 42);
- Building 4671, Saturn static test stand support building (1962) (see Plate 42);
- Building 4674, Saturn static test stand blockhouse (1961) (Plate 43);
- Building 4676, helium system building (1962);
- Building 4696, F-1 engine test stand (1962) (Plate 44);

By Robert & Company (Plate 45):

- Building 4752, a components and sub-assembly acceptance building (1963);
- Building 4755, a vehicle components hangar (1964);

By Holmes & Narver (see Plate 39):

- Building 4638, support building (1963);
- Building 4639, support building (1963);
- Building 4640, support building (1963);
- Building 4641, support building (1963);
- Building 4642, support building (1963);
- Building 4646, advanced Saturn ground support equipment test facility (blockhouse) (1963);

By Bechtel:

- Building 4514, a liquid hydrogen test facility (1962);
- Building 4516, a liquid oxygen storage facility (1962);
- Building 4517, a liquid hydrogen storage facility (1962);
- Building 4518, a hydrogen transfer control house (1962);
- Building 4519, a liquid oxygen transfer control house (1962);
- Building 4522, Saturn components testing facilities (1964) (Plate 46);
- Building 4525, a liquid oxygen transfer control house (ca.1964);
- Building 4526, a liquid hydrogen transfer control house (ca.1964);
- Building 4527, a liquid hydrogen storage tank (ca.1964) (see Plate 46);
- Building 4530, Test Facility 300 (1964) (see Plate 46);
- Building 4531, Saturn components testing facilities (1964);
- Building 4553, the terminal building for the liquid hydrogen test stand (1962);
- Building 4561, large blockhouse addition (1964);
- Building 4570, large blockhouse addition (1963);
- Building 4583, major addition (1963-1964) (Plate 47);

By Burns & Roe:

- Building 4647, air compressor structure (1965);
- Building 4648, tail service mast test facility (1965) (see Plate 39);
Plate 41. Buildings 4656, 4653, and 4655, left to right. 29 September 1975. NASA Photograph Laboratory.

Plate 42. Building 4670 and 4671 (foreground). 6 October 1966. NASA Photograph Laboratory.

Plate 44. Building 4696. 6 October 1966. NASA Photograph Laboratory.
Plate 45. Buildings 4752 (foreground) and 4755 (center). 17 March 1969. NASA Photograph Laboratory.

Plate 47. Building 4583, center 2 June 1964. NASA Photograph Laboratory.
By Sverdrup & Parcel:

- Building 4476, an acceleration and environmental test facility (1963) (Plate 48);
- Building 4487, major addition (1962-1963) (see Plate 24);
- Building 4708, major addition (1961) (see Plate 5);

By Giffels & Rossetti:

- Building 4605, a non-destructive testing laboratory (1965) (Plate 35);

By Stearns-Rogers Corporation:

- Building 4475, a hazardous operations building and radiation measuring laboratory (1963) (see Plate 48);
- Building 4628, a low temperature test facility (1963) (see Plate 35);

And by C.F. Braun (see Plate 19):

- Building 4539, a preparation building (1964);
- Building 4540, acoustic model test facility (1964);
- Building 4541, control building for Building 4540 (1964).

An equivalently large number of buildings and structures constructed at the MSFC during the 1960s are of unverified provenance, and could include additional work by the above architectural-engineering firms. The MSFC commissioned about 50 buildings and structures of this type between 1961 and 1967 (extant today). Some of these facilities were to enhance overall generic support at the MSFC, while others were highly technical in type. Also, included in this group are buildings and structures designed by regional architectural-engineering firms, or by the MSFC itself. (See Appendices A and B.) In all, the MSFC commissioned approximately 100 new facilities, exclusive of major additions and augmentations, during the 1960s—concentrated in the first half of the decade.

The expansion of the MSFC during its first years approximately doubled the size of the center in terms of its real property, inclusive of those buildings and structures demolished to make way for the west test area and needed new facilities scattered throughout the installation. Quite appropriately, one of the earliest planned augmentations was that for a NASA headquarters office grouping, today’s Buildings 4200, 4201, 4202, and 4203. (Within this group, Building 4203 is a relatively recent addition, in 1991.) The first of the offices in design was that of Building 4200, in 1961 (Plate 49). Building 4201 followed immediately in 1962, with Building 4202 not in design until 1964. The architectural-engineering firm of Wyatt C. Hedrick of Fort Worth, Texas, had received the commission for a central office and laboratory complex of three connected units in November 1960. As envisioned, the grouping would include an office tower with adjoining auditorium and cafeteria. Design work was scheduled for completion in Spring 1961, with construction started by mid-year. NASA selected the Hedrick firm from among about 25 competitors. Anticipated cost of the MSFC headquarters complex was nearly $4.5 million. As actually designed, the main NASA office was a nine-story curtain-wall structure in a steel-and-glass aesthetic derived from the International Style that featured ground and first floors with seven tower levels. An auditorium connected off the lobby on the north façade, and a cafeteria for the building’s 1200 employees sat beneath it on the ground level below. In 1962, the MSFC
Plate 48. Buildings 4436 (foreground center) and 4476 (center). Building 4476 with 120-foot acceleration test tower. Building 4475, lower left. 29 September 1975. NASA Photograph Laboratory.
Plate 49. Building 4200. 26 April 1963. NASA Photograph Laboratory.
announced the addition of a second six-story building at the site, Building 4201 (for 650 employees from Industrial Operations). This structure functioned as the Engineering and Administration Building, complementing the Central Laboratory and Office (Building 4200) (Plate 50). As January 1963, the MSFC also planned for a possible third building similar to Building 4201. Wyatt C. Hendrik designed both Buildings 4200 and 4201, but a new firm—Hudgins, Thompson, Ball & Associates of Oklahoma City—won the commission for Building 4202. NASA began to occupy the first of the three-building group in June 1963, opening up badly needed space in Buildings 4484 and 4488 for return to Army use. Hudgins, Thompson, Ball & Associates designed Building 4202 in a style similar to the earlier offices of the complex, with drawings dating to 1964. (Like Building 4201, Building 4202 was six stories high, built for 650 employees.) Hudgins, Thompson & Ball had worked for the Air Force during the early 1950s, designing an important modular concrete warehouse at Tinker Air Force Base for Air Materiel Command. The Tinker warehouse became the prototype for a rigid-frame warehouse refined by a Baltimore architectural-engineering firm for construction in multiples across the nation. As of May 1964, NASA employees were moving into Building 4201 and Building 4202 was under construction with its occupation scheduled for mid-1965 (Plate 51) (Marshall Star: see bibliography; Weitze 2002: volume II draft).

Barges and Docks

One other building program occurred to support the establishment of the MSFC and its Saturn test facilities at the outset of the 1960s. The very large Saturn booster required transport from the MSFC at Huntsville to launch facilities for the Atlantic Missile Range at Cape Canaveral in Florida. The MSFC first constructed a single-berth dock on the Tennessee River to connect via the Ohio River to the Mississippi River and the Gulf of Mexico (Plate 52). As of 1964-1966, NASA expanded dock facilities (Plate 53). The Huntsville-to-Canaveral water route was approximately 2,000 miles long, and required 18-22 days of transport time to get the Saturn booster from one location to the other. In March 1960, NASA had awarded a $345,000 contract for a 180-foot barge to carry the Saturn to Canaveral (Chronology of the Army Ballistic Missile Agency February 1956 – December 1960: 83). This first Saturn barge was a unique structure. Named for the Greek sea god Palaemon, the vessel accommodated the Saturn’s 82-foot length and 21.5-foot diameter. The Army Transportation Research Command at Fort Eustis, Virginia, designed the barge for the MSFC, while the Todd Shipyards Corporation in Houston, Texas, built it. The barge was 118 feet long, 30 feet wide, and 32 feet high, and featured a special controlled-atmosphere compartment for the booster (see Plate 53) (Marshall Star November 1960: 2). The shakedown cruise for the Palaemon occurred in March 1961 (Marshall Star March 22, 1961: 1-2). In July 1961, the MSFC added a second barge to transport the Saturn booster from Huntsville to Florida, a retrofitted Navy YFNB-33 dry-cargo vessel named the Compromise. NASA acquired the surplus Compromise from the Atlantic Reserve Fleet Station at Green Cove Springs, Florida (Marshall Star June 21, 1961: 3). Damage at the Wheeler Lock on the Tennessee River in early June had made that water juncture temporarily impassable to the Palaemon, with the Compromise the interim solution for transport (Marshall Star August 9, 1961: 3). After modification of the barge, NASA renamed the Compromise as the Promise (see Plate 53). NASA used the two barges together to move the Saturn booster from the MSFC to Canaveral. For the very first movement of the Saturn from the MSFC to Cape Canaveral during 1961-1962, the Palaemon transported the booster, two inert upper stages, and vehicle payload from the MSFC dock to the Wheeler Lock, where men transferred the cargo overland around the lock to the Promise for the remainder of the water trip to Canaveral (Marshall Star August 9, 1961: 1-3, and, February 21, 1962: 1, 7). NASA launched the first and second test Satums, the SA-1 and SA-2, on October 27, 1961, and April 25, 1962, respectively (Marshall Star September 12, 1962: 2).
Plate 50. Buildings 4200 and 4201, left to right. 2 June 1964. NASA Photograph Laboratory.

Plate 51. Buildings 4201, 4200, and 4202, left to right, looking west. 6 October 1966. NASA Photograph Laboratory.
NASA continued to improve its barge transportation system for the Saturn. As of May 1962, both the Palaemon and the Promise were in service for the trip between the MSFC dock and Florida (Marshall Star May 30, 1962: 6). The barges also transported upper stages for the Saturn space vehicle from their manufacturing sites to the MSFC, inclusive of shipment via ship from Southern California through the Panama Canal to New Orleans and thence to the MSFC for months of tests (Marshall Star November 21, 1962: 6). By 1964, NASA transferred the Palaemon to its operations plant at Michoud, Louisiana (near New Orleans). Michoud became the manufacturing site for Saturn boosters as of the SA-8, as well as the location for manufacture of the first stages of the Saturn I, IB, and V. NASA had converted the Michoud facility in late 1961 from a pre-existing World War II manufacturing plant for plywood cargo planes. With the exception of a brief period between 1951 and 1954 when the plant produced Sherman and Patton tanks, the government had mothballed the facility (Marshall Star July 11, 1962: 6). The Michoud dock became the home port for the Palaemon, with the Promise also moored there when appropriate (Marshall Star January 1, 1964: 10, and, March 18, 1964). (The Palaemon continued to transport Saturn stages to the MSFC for testing.) In 1964 too, the MSFC expanded its dock facilities on the Tennessee River. NASA’s new dock featured a 54' by 40' reinforced concrete dock and a 25' by 10' reinforced concrete boat deck, with an enlargement and deepening of the existing basin (Marshall Star April 29, 1964: 4, and, October 28, 1964: 11). The MSFC acquired a third and final barge, the Poseidon, as of October 1965, once more a modified former Navy vessel. The Poseidon was the largest of the three special barges for the Saturn, at 190 feet long, 44 feet wide, and 41+ feet high (Marshall Star October 13, 1965: 1, 10).
Mission and Accomplishments

While the massive building campaign at the MSFC during the 1960s occurred partially to transform the former Army guided missile center at the Redstone Arsenal into a major installation for NASA, the primary driver for the rapidity (and sheer expense) of new construction was the man-in-space program—inclusive of President Kennedy’s strong desire to land an American on the moon by decade’s end. The German scientist and engineer group transferred from the Army to NASA also brought to the MSFC a continued micromanagement of phased R&D, test, and evaluation. This approach meant that the laboratories and shops, as well as test engineering units, desired to control efforts in-house from early design to successful launch at Canaveral rather than supervise the tasks of major contractors (Dunar and Waring 1999: 39ff). The key program undertaken at the MSFC during the 1960s focused on Saturn launch vehicles, advancing through increasingly sophisticated models. As summarized in *Power to Explore*:

The Saturn I, originally called the Juno V and Saturn C-1, was a two-stage booster used to test multi-engine clusters, to qualify Apollo spacecraft, and to launch the Highwater and Pegasus experiments. The Saturn IB, also called the C-1B and Uprated Saturn, had more advanced upper-stage engines than the Saturn I. NASA used it to continue propulsion and spacecraft testing, and to launch the Earth orbital missions in the Apollo and Skylab programs. By far the most powerful was the Saturn V, also known as the Saturn C-5. It was NASA’s largest launch system, and its three stages propelled the Apollo lunar missions and the Skylab workshop (Dunar and Waring 1999: 83).

Development of the S-1, the initial stage of the Saturn I, had occurred largely within the ABMA at the Redstone Arsenal during the late 1950s. The Army had conducted the first static tests for the Saturn I booster at Building 4572 in March 1960. The S-1B followed the S-1, as the first stage of the Saturn IB. The Saturn I and IB functioned as test beds for the more advanced Saturn V, the vehicle that would take Apollo 11 to the moon on 20 July 1969. The two-stage Saturn 1B featured a first stage, the S-1B, and a second stage, the S-IVB. First launch of the Saturn 1B occurred at Cape Canaveral in February 1966. Engineers at the MSFC concentrated on propulsion using liquid-fuel, rather than solid-rocket, engines for the boosters. Engineers could shut down liquid-fuel engines once ignited, whereas solid-rocket boosters would continue burning. Liquid hydrogen engines evolved through the RL-10 of Pratt and Whitney, to the J-2 of Rocketdyne. The first stage of the Saturn V, Boeing’s S-IC, was physically the largest of the boosters, incorporating four Rocketdyne F-1 engines and using RP-1 kerosene and LOX fuel. (First static firing of the S-IC took place at Building 4670 in February 1966.) Design toward the S-II upper stage had begun in late 1959, again with liquid-hydrogen engine propulsion. Clustered liquid-hydrogen engines accommodated increased payload weight (*A Chronology of the Marshall Space Flight Center 1960-2000*: 11-13; Dunar and Waring 1999: 79-100).

Test facilities built directly for development of the Saturn included:

- Building 4436, a vehicle and ground support equipment systems automation checkout facility designed in 1962;
- Building 4467, a laying and alignment station for Saturn V, of 1965;
- Building 4476, an acceleration and environmental test facility of 1963 for Saturn V instrument testing, with a 120-foot acceleration test tower, large centrifuge, and acoustical chamber added in 1967 to test noise levels equal to those generated by the Saturn V on the launch pad (*Marshall Star* March 4, 1964: 1, 12);
• Building 4516, a LOX storage facility of 1962;
• Building 4517, a liquid-hydrogen storage facility of 1962;
• Building 4518, a hydrogen transfer control house of 1962;
• Building 4519, a LOX transfer control house of 1962;
• Building 4522, Test Stand 500 (TF-500) for Saturn components testing of 1964;
• Building 4525, a LOX transfer control house of ca.1964;
• Building 4526, a liquid-hydrogen transfer control house of ca.1964;
• Building 4527, a liquid-hydrogen storage tank of ca.1964;
• Building 4530, TF-300 for Saturn components testing of 1964;
• Building 4531, Saturn components testing facilities, 1964;
• Building 4548, the F-1 turbo pump test facility of 1963;
• Building 4550, the Advanced Saturn dynamic test stand for the C-5 of 1963;
• Building 4551, the terminal building for Building 4550 of 1963;
• Building 4553, the terminal building for Building 4514 of 1962;
• Building 4554, the cold calibration and dynamic test facility of 1962;
• Building 4558, the control building for Building 4557 of 1960 (a Saturn dynamic test stand, today gone *[Marshall Star* October 26, 1960: 7, April 19, 1961: 1, and, June 21, 1961: 2]);
• Building 4622, a liquid hydrogen test pad (now gone) of 1961 *(Marshall Star* October 4, 1961: 5);
• Buildings 4639-4642, support facilities for Building 4646 of 1963;
• Building 4646, the Advanced Saturn ground support equipment test facility of 1963;
• Building 4655, the F-1 test facility preparation facility of 1963;
• Building 4670, the Saturn V S-1C static test stand of 1961;
• Building 4671, a support building for Building 4670 of 1962;
• Building 4674, the blockhouse for Buildings 4670 and 4696 of 1961;
• Building 4696, the single-position F-1 test stand of 1962;
• Building 4697, an observation bunker for Building 4670 of 1965;
• Building 4699, the S-II aft section assembly facility of 1967;
• Building 4752, the Saturn components and sub-assembly acceptance facility of 1963; and,
• Building 4755, the Saturn vehicle components hangar of 1964.

A number of significant, special additions to existing buildings also supported the Saturn program, as did the placement of more generic aerospace infrastructure. An example of the latter included a very large industrial water system (Buildings 4667, 4668, and 4669), with 13 oversized exterior mufflers to suppress the sound of the diesel pumps (see Plate 37). The added water system connected to the two major test stands in the west area (Buildings 4670 and 4696) via 1,200 and 500 feet of 96-inch and 72-inch steel pipe to create the deluge required for the stands’ flame buckets *(Marshall Star* April 3, 1963: 2, and, July 1, 1964: 1). An example of unusual specialized facilities included the acoustic model test facility (Building 4540) used to static test scale models of the F-1, H-1, and J-2 engines. Building 4540, of 1964—also known as TF-116—featured its test stand and a large fan-shaped apron, along with its control facility
(Building 4541). The test stand included 51 acoustic measurement points, with another 148 points on the apron (see Plate 19) (*Marshall Star* April 26, 1967: 2).

The accomplishments of the Saturn program, leading to the Apollo missions late in the decade, reached their first plateau in 1967, with many changes thereafter. That year one of the Apollo launches, Apollo 204, suffered from fire that took the lives of three astronauts. Before 1967 closed, NASA in counterpoint successfully launched the first Saturn V for the Apollo 4 space mission. At the MSFC, NASA nearly simultaneously imposed a 700-person reduction-in-force for the center’s employees. Yet the MSFC continued to move forward with very important new missions, inclusive of work toward a manned space station (with fabrication of a neutral buoyancy simulator in Building 4705 during 1968) and a lunar roving vehicle (design, development, and test responsibilities as of 1969). Building 4705 had originally been built as a missile assembly shop in 1952, one more instance at the MSFC of a major adaptation of an existing facility for new and unusual mission support. The neutral buoyancy simulator featured a 1.5 million-gallon water tank, 75' in diameter and 40' deep, that simulated the weightless conditions found in space (Plate 54). As 1970 arrived, more major change for the MSFC was at hand. Dr. von Braun left the center for NASA headquarters in Washington, D.C., as of January 1970, with reorganization and more reductions-in-force in his wake (Dunar and Waring 1999: *passim*).

Plate 54. Undated test in the neutral buoyancy simulator, Building 4705. NASA Photograph Laboratory.
Programs and Accomplishments of the 1970s and 1980s

Programs, accomplishments, and added facilities of the 1970s and 1980s at the MSFC are only broadly sketched herein. As time moves forward, a closer look at particular test complexes of this final era of the Cold War should be undertaken, to assess both their importance against key missions and to evaluate roles in scientific and technical achievements not yet the domain of historic analysis.

Missions of the final two decades of the Cold War focused on an increasing role in space research and exploration. During these same years too, organization, management, and personnel changes internal to NASA affected the MSFC, for the first time truly distinguishing the MSFC from the ABMA before it. Soon, the number of Paperclippers and German follow-on recruits would significantly diminish. The Apollo 11 moon landing of July 1969 was the apex of the Saturn efforts at the center, and was also a high point in national interest and federal government motivation. While the 1960s had witnessed huge expenditures to support the man-in-space program, this began to seriously reverse after Apollo 11. NASA top management in Washington, D.C., shifted. Rivalry between the MSFC and the Johnson Space Center in Houston increased. Dr. von Braun left for NASA headquarters in March 1970, with some hopes at the MSFC that he could sell a manned Mars mission to Congress. Von Braun’s deputy for technical and scientific affairs, Dr. Eberhard Rees, became the director for the MSFC. Paperclipper Rees carried on in the von Braun manner, but faced extreme challenges in budget cuts. At the outset of the 1970s, the MSFC worked on human spacecraft engineering, efforts begun through a National Science Foundation grant in 1966 that had taken Drs. von Braun and Stuhlinger to Antarctica to experience an extremely hostile environment and assess a scientific installation under such conditions. Work toward a manned space station led to the Skylab project, an endeavor that in its magnitude replaced the Saturn-Apollo mission of the previous decade. Skylab also exacerbated competition between the MSFC and the Johnson Spaceflight Center. Some of what occurred was at its most reduced level the need for a new, major mission to garner funding and support the centers. The MSFC increased its work in space science, generally, as of this period. Projects at the MSFC included the High Energy Astronomy Observatory, the Apollo Telescope Mount for Skylab, the Large Space Telescope, continued lunar rover studies, lunar science activities, and satellite work. At the MSFC, astronomy became a new specialty at this time. While these changes went forward, the center faced successive manpower reductions—by 1972, four in five years. At the close of 1972, Dr. Rees announced his retirement as of January 1973. The new director of the MSFC, Dr. Rocco A. Petrone, perhaps best reflected the end of the Paperclipper and “Army” era. Dr. Petrone had worked at launch operations at Cape Canaveral. He was considered an outsider and was not a choice amenable to either Dr. von Braun or Dr. Rees. Assigned by NASA headquarters, Dr. Petrone brought severe change (Dunar and Waring 1999: 137-138, 152-162).

The 1970s continued on a path of financial austerity for the MSFC. As of 1974, reductions-in-force numbered six since their initiation in 1967. The role of the German scientists and engineers drastically lessened at the MSFC, and even at NASA headquarters Dr. von Braun found himself sidelined. Dr. von Braun left NASA for private industry in 1972. Many of the remaining Paperclippers retired or left the MSFC at this time. Dr. Petrone also reorganized the center in 1974, characterized bluntly in Power to Explore: “By reforming the laboratories, the Petrone reorganization undercut part of the old German and ABMA engineering system….Lab directors, rather than being the leaders as they had been in ABMA days, shared authority with project officers.” During the second half of the 1970s, two studies went forward to fully close the MSFC, in 1975 and 1977. As of 1978, the total number of employees at the MSFC was less than half of what it had been in 1966, reduced to 3,760. The director position at the MSFC had shifted
once more in 1974, with the appointment of Dr. William Lucas—who had functioned as a head of the Program Development Office under von Braun in the late 1960s, and who moved the center toward diversification in its scientific missions. From this point on, the MSFC reconfigured itself from an installation focused on one “very big engineering project” [the Saturn launch system] to a center submitting competitive bids for projects for which its personnel offered the appropriate expertise. Work continued on Skylab, Spacelab, and the Space Station; the Large Space Telescope and the Hubble Space Telescope; on satellites and scientific probes; high-energy astronomy, geophysics, and astrophysics, including work involving laser, x-ray, and gamma-ray technologies; solar energy technology; and, the space shuttle (Dunar and Waring 1999: 161-167, 179ff; A Chronology of the Marshall Space Flight Center 1960-2000: 17-38).

Facilities at the MSFC for Late-Era Missions

Buildings and structures, both new and modified for missions of the 1970s and 1980s, are numerous at the MSFC. Several facilities discussed below also date to the 1960s, but feature missions most evocative of the following decades. Also listed are mission-specific buildings of the early 1990s. Technical buildings modified for later-era missions were typically those first erected for the Saturn program, and much less often included buildings of the original World War II chemical munitions plant. (Offices and more generic laboratories of all periods continue to change with their new assignments, typical of their real property type.)

New infrastructure built for the more diversified missions of the 1970s and 1980s included:

- a communications test complex, including Buildings 4184 and 4185, transmitter and receiver towers (coupled with an existing radio frequency altitude test chamber [Building 4189], a microwave anechoic chamber [Building 4190], and two radio frequency measurement laboratories [Buildings 4191 and 4194] of the 1960s (Plate 55);
- Building 4347, a solar magnetograph facility of ca.1963 (possibly later);
- Building 4372, millimeter wavelength facility of 1972;
- Building 4464, a microbiology laboratory of 1993;
- Building 4466, a staging building of 1991;
- Building 4477, an audio reverberant facility of 1989;
- Building 4520, a solid propulsion test bed of 1988;
- Building 4523, a seal bearing test facility of 1979;
- Building 4524, a test support building of 1987;
- Building 4532, a test support building of 1983;
- Building 4564, a solid rocket motor refurbishment facility of 1987;
- Building 4604, a space station environmental test storage facility of 1996;
- Building 4625, space shuttle hardware storage facility of 1992;
- Building 4626, a liquid hydrogen cold flow facility of 1990;
- Building 4629, a space station support facility of 1990;
- Building 4630, a structural-thermal test facility of 1971;
- Building 4657, a liquid hydrogen vaporization facility of 1974;
- Building 4718, an x-ray calibration facility of ca.1975 first used to test instruments for the High Energy Astronomy Observatory, improved in 1989 to evaluate the mirrors for the Advanced X-Ray Astrophysics Facility (Plate 56);
- Building 4765, a space station coating facility of 1993;
- Building 4775, a high Reynolds number wind tunnel facility of 1967; and,
- Building 4777, a space shuttle main engine dynamic fluid flow facility of 1984.
In counterpoint, existing buildings and structures modified for key missions of the 1970s and 1980s included:

- Building 4436, originally erected for Saturn in 1962, and modified as the Space Shuttle Main Engine (SSME) – Hardware Simulation Laboratory (HSL) Block II facility;
- Building 4467, originally erected for Saturn in 1965, and modified as the Celestial Sensors facility in 1969 (today, the Lidar facility);
- Building 4476, originally erected for Saturn in 1963, and modified several times during the 1970s and 1980s—functioning as a hardware simulator laboratory in the late 1980s and today as an optical vertical test facility;
- Building 4481, originally erected as a munitions filling plant from World War II, and modified as a space sciences laboratory in the late 1960s and as the Cosmic Ray Emulsion Laboratory in 1990;
- Building 4493, originally erected as an inert materials warehouse from World War II, and modified as a microgravity development center by 1990;
- Building 4554, a portion built in 1954 with an addition in 1962 for cold calibration tests, modified as a hot gas facility in 1975 to evaluate solid rocket booster and external tank thermal protection system materials;
- Building 4572, originally erected for static testing of the Redstone, and modified successively over time inclusive of changes to accommodate testing of a solid rocket booster for the space shuttle program;
- Building 4605, a non-destructive testing laboratory of 1965, today used as a space environmental effects facility;
- Building 4612, originally erected as the structures and mechanics building in 1956, and modified to provide a simulated environment for training Spacelab crews in 1979;
- Building 4643, originally erected as a high pressure chemical reaction test cell in 1965, and modified as a tribology test facility today;
- Building 4663, originally erected as the computation laboratory for the ABMA in 1956, with two floors modified as the Spacelab Mission Operations Control Facility in 1990—replacing the payload operations control center previously at the Johnson Spaceflight Center in Houston;
- Building 4755, originally erected for Saturn in 1964, and modified as a space station development laboratory in the middle 1990s; and,
- Building 4776, originally erected as a thermal acoustic jet (bisonic wind tunnel) facility in 1965, and used as the space shuttle main engine water facility by 1984.

The importance of buildings and structures to major missions of this period is only minimally analyzed, as noted above. Generally, the responsible architectural-engineering firm also remains unidentified.
Based upon the information presented in the contextual history, and supported in Appendices B and C, buildings and structures at the MSFC fall into three groups with reference to the NRHP. For those buildings and structures evaluated as eligible for the NRHP, eligibility is suggested under Criterion A, for association with key missions at the MSFC, and, in multiple cases, also under Criterion C, for association with leading aerospace architectural-engineering firms of the early Cold War years. In some cases, research and analysis will also support eligibility under Criterion B, for association with the important professional contributions of particular German scientists and engineers recruited to the Redstone Arsenal through Project Paperclip and its follow-ons of the early and middle 1950s. Research to this level is not uniformly included herein, although the context does offer associations between laboratory and program directors, and particular buildings.

The categories of NRHP assessment at the MSFC defined through this study are (1) eligible for the NRHP; (2) suggested as requiring a second review for NRHP eligibility in 10 years; (3) lacking sufficient information to render a professional judgment on potential NRHP status. In all instances, only exterior NRHP integrity is addressed. The remaining properties studied are evaluated as not eligible for the NRHP (see Appendix B for details).

**Eligible for the NRHP:**

Twenty-eight properties are interpreted as eligible for the NRHP (with the group of observation bunkers, inclusive of Building 4560, counted as a single property). A number of the properties that are less than 50 years old are quickly approaching that threshold.

**Buildings 4200, 4201, and 4202:** As the original headquarters office grouping for the MSFC, of 1961-1964. Building 4200 is interpreted as independently eligible, while Buildings 4201 and 4202 are interpreted as contributing to a small NRHP district defined by the three buildings. Buildings 4200, 4201, and 4203 were considered under Criterion C, but were not found to be eligible under that criterion. The buildings are of standard international style and lack architectural distinction. They do not represent the works of a master. Eligible under Criteria A and B. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

**Building 4313:**

As representative of the chemical munitions plant of World War II, and, as an early (1951) structural test laboratory for guided missiles work. Eligible under Criteria A and C. Exterior window modifications of the early 1950s, but highly representative of the World War II era. Rare in its intactness as a remaining building from the chemical munitions plant within the MSFC today. At the local level of significance.

**Building 4471:**

As representative of the chemical munitions plant of World War II. One of the key structures of the Plants Area 1 facilities. Eligible under Criteria A and C.
Needs additional assessment of integrity. At the local level of significance.

Building 4476:
As representative of the Saturn program of the early 1960s, and including a 120-foot acceleration test tower and other specialized additions of 1967. Representative of the major work of Sverdrup & Parcel. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Needs further assessment of integrity. At the national level of significance.

Building 4550:
As representative of the Saturn program of the early 1960s. Representative of the major work of Maurice H. Connell & Associates. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. A National Historic Landmark. Integrity excellent. At the national level of significance.

Building 4551:
Paired with Building 4550, as the control building for the test stand. Eligible under Criteria A and C. Should be added to the National Historic Landmark. Integrity good. As coupled with Building 4550, at the national level of significance.

Building 4560:
As representative of Redstone-Mercury program, and follow-on testing for the Saturn-Apollo program. Also, the sole remaining example of a type of elaborate observation bunker of the late 1950s at the MSFC. Bunker eligible as a part of a discontiguous district of 1950s bunkers remaining in the east test area. (See final item, below.) Representative of the major work of Maurice H. Connell & Associates. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance (rarity).

Buildings 4566 and 4666:
As representative of the test area engineers achievements across programs at the Redstone Arsenal and the MSFC, from the middle 1950s through 1970. Paired and physically connected to Building 4666 via a tunnel under Dodd Road. Representative of the work of Ralph M. Parsons. Eligible under Criteria A, B, and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

Building 4570:
As representative of the Redstone and Saturn programs, 1953-1970. Excellent example of large early 1950s blockhouse, with addition of 1963. Built for east area test stands: Buildings 4564 (today, gone), 4572, and 4588. Representative of the major work of Ralph M. Parsons (Parsons-Aerojet, with Bechtel addition). Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for
Building 4572: As representative of the Redstone, Jupiter, Mercury, and Saturn, and space shuttle programs, inclusive of modifications. Representative of the major work of Ralph M. Parsons (Parsons-Aerojet). Eligible under Criteria A, B, and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. A National Historic Landmark. At the national level of significance.

Building 4573: Gantry crane paired with Building 4572. Fabricated in 1942 and adapted for use at Building 4572. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

Building 4583: As representative of the Redstone through the space shuttle programs. One of the original key buildings in the east test area, erected simultaneously with three test stands: Building 4564 (today, gone), 4572, and 4588. Representative of the major work of Ralph M. Parsons (Parsons-Aerojet). Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity good. At the national level of significance.

Building 4588: As representative of the Redstone through Saturn programs. One of the original key buildings in the east test area, erected simultaneously with a components test laboratory (Building 4583) and two other test stands (Building 4564 [today, gone] and Building 4572). Originally connected via underground tunnel to an observation building and preparation annex (Building 4589), now incorporated into Building 4554. Representative of the major work of Ralph M. Parsons (Parsons-Aerojet). Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent generally; unassessed for the underground tunnel and annex. At the national level of significance.

Building 4596: With respect to the attached observation bunker ONLY. Bunker eligible as a part of a discontiguous district of 1950s bunkers remaining in the east test area. (See final item, below.) Assumed designed and fabricated under the direction of Fritz A. Vandersee. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance (rarity).

Buildings 4610, 4612, and 4619: As representative of the contributions of the Structures and Mechanics Laboratory (later, renamed the
Propulsion and Vehicle Engineering Laboratory) under Dr. Wilhelm Raithel and Dr. William A. Mrazek in the middle 1950s. Representative of the work of Ralph M. Parsons. Eligible under Criteria A, B, and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent, inclusive of additions. At the national level of significance.

Building 4663: As representative of the technical advancements at the MSFC facilitated through high-speed computers. Consider for interior components only: the Huntsville Operations Support Center linking the MSFC to the Kennedy Space Center to monitor Apollo real-time mission data (1968) and the Spacelab Mission Operations Control Facility that replaced the unit formerly at the Houston Spaceflight Center (1990). Representative of the work of Ralph M. Parsons. Possibly eligible under Criterion A. Needs assessment of interior integrity. Substantially modified exterior. Unassessed level of significance.

Building 4665: As representative of the first static test stand at the Redstone Arsenal for the Redstone of 1952. Coupled with a blockhouse fabricated from World War II chemical tanks. Designed and fabricated under the direction of Fritz A. Vandersee. Eligible under Criteria A, B, and C. Integrity excellent. A National Historic Landmark. At the national level of significance.

Building 4670: As representative of the Saturn program and as modified for space shuttle testing. Linked to the blockhouse, Building 4674. Representative of the major work of Aerojet. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. A National Historic Landmark. At the national level of significance.

Building 4674: Blockhouse for the west test area, representative of the Saturn program. Linked to two Saturn test stands: Buildings 4670 and 4696. Representative of the major work of Aerojet. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

Building 4696: As representative of the Saturn program. Linked to the blockhouse, Building 4674. Representative of the major work of Aerojet. Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

significance under Criteria Consideration G, for properties less than 50 years old. Integrity of the neutral buoyancy simulator unassessed. A National Historic Landmark. At the national level of significance.


Building 4718: As representative of the High Energy Astronomy Observatory program of the 1970s and as enhanced in 1989 for advanced x-ray astrophysics studies. At the time of its construction, the facility was one-of-a-kind. (See Appendix C.) Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance.

Building 4732: For possible interior equipment ONLY. As representative of wind tunnel studies required for early missiles testing. Existence of World War II and early 1950s wind tunnels is unverified. Addition of later wind tunnels is also unassessed. Needs interior assessments. Equipment is possibly eligible under Criteria A and C. Integrity and level of significance, unassessed.

Observation Bunkers: A discontiguous district of six observation bunkers: five unnumbered and Building 4560. Two bunkers discussed above, under Building 4560 and 4596. Others are of steel type, from the 1950s. (See Appendix C.) Eligible under Criteria A and C. Sustains exceptional significance under Criteria Consideration G, for properties less than 50 years old. Integrity excellent. At the national level of significance (rarity).

Suggested for Reconsideration of NRHP eligibility in 10 Years:

Eight buildings fall into this category. See discussion in Appendix B.

- Building 4522, TF-500, of 1964;
- Building 4530, TF-300, of 1964;
- Building 4540, TF-116 (the acoustic model engine test facility), of 1964;
- Building 4541, blockhouse for TF-116, of 1964;
- Building 4548, F-1 turbo pump test facility, of 1963;
- Building 4561, Saturn components testing blockhouse, of 1964 (added to small pre-existing structure of 1958);
- Building 4564, the solid rocket motor test facility of 1987; and,
- Building 4707, for the added hydrostatic test tower added in 1962.
Insufficient Information for NRHP Assessment:

Thirteen buildings fall into this final category. Generally, these buildings represent (or appear to feature) specialty technologies that are unresearched in this study. In a few cases, the buildings require an interior assessment and/or are behind locked gates. See discussion in Appendix B.

- Building 4347, a solar magnetograph facility, of ca.1963 or later;
- Building 4372, a millimeter wavelength facility, of 1972;
- Building 4436, the space shuttle main engine hardware simulation laboratory designed to test avionics, software, control systems, and mathematical models for the space shuttle main engine, modified in 1974 for this purpose;
- Building 4467, the Lidar facility, of 1965;
- Building 4477, an audio reverberant facility, of 1989;
- Building 4554, the hot gas facility designed to simulate space flight vehicle environments inclusive of heating rates, pressures, shear and other factors, modified in 1975 for this purpose;
- Building 4605, a non-destructive testing laboratory modified as a space environmental effects facility, of 1965;
- Building 4628, a cryogenic test facility designed by Stearns-Rogers Corporation, of 1963;
- Building 4643, a high pressure chemical reaction test cell modified as a tribology test facility, of 1965;
- Building 4646, a blockhouse for testing Saturn ground support equipment designed by Holmes & Narver, of 1965;
- Building 4699, a cryogenic test facility, of 1967;
- Building 4775, a high Reynolds number facility, of 1967; and,
- Building 4776, a bisonic wind tunnel facility, of 1965.
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Redstone Arsenal History Office. Information File on the German Prisoner of War Camp. Contains articles from the *Huntsville Times.* History Office, Redstone Arsenal.


*The Marshall Star*

“Acoustic Study Facility to be Built at MSFC.” [Buildings 4540 and 4541.] 3 June 1964: 11.


“Compressor Facility Furnishes All High Pressure Air to Divisions.” [Building 4747.] 19 June 1963: 3.


“‘Crescent City’ Port – Palaemon.” 1 January 1964: 10.


“Dr. Haeussermann Named to Auburn Graduate Faculty.” 6 April 1966: 2.


- 128 -
“Dr. Koelle Named to University Post in Berlin.” 9 June 1965: 5.

“Dr. Kuettner Will Manage Saturn-Apollo at MSFC.” 10 January 1962: 3.


“Dr. Wernher von Braun, Marshall Center Director.” 28 September 1960: 5.


“Funeral Services for von Saurma held on Friday.” 20 December 1961: 1, 6.


“Hedrick Firm to Design Center’s Office Complex.” [Building 4200.] 30 November 1960: 3.


“In the Offing.” [Buildings 4557 (former) and 4558.] 26 October 1960: 7.


“Instrument Lab is in Operation.” [Building 4650.] 2 December 1964: 3.


“Karl Heimburg Heads Center’s Test Division.” 30 November 1960: 2.

“Kroeger Retires After 22 Years with Teammates.” 28 August 1963: 1, 3.


<table>
<thead>
<tr>
<th>Title</th>
<th>Date</th>
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<tbody>
<tr>
<td>“Navy Guns Plus Ingenuity Make Hypersonic Tunnel.”</td>
<td>2 January 1963</td>
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<tr>
<td>[Former Building 4311.]</td>
<td></td>
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<tr>
<td>“Nears Completion.”</td>
<td>13 December 1961</td>
</tr>
<tr>
<td>[Building 4663.]</td>
<td></td>
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<tr>
<td>“New Computer is Delivered.”</td>
<td>17 April 1963</td>
</tr>
<tr>
<td>[Building 4663.]</td>
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<tr>
<td>“New Device Will Simulate S-1C Tests.”</td>
<td>22 January 1964</td>
</tr>
<tr>
<td>[Tests in Building 4670.]</td>
<td></td>
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<tr>
<td>“New Facilities Opened By Computation Division.”</td>
<td>7 December 1960</td>
</tr>
<tr>
<td>[Buildings 4491 and 4663.]</td>
<td>1, 8</td>
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<tr>
<td>“New Pressure Test Cell.”</td>
<td>2 August 1961</td>
</tr>
<tr>
<td>[Building 4708.]</td>
<td></td>
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<tr>
<td>“New Test Tower, Centrifuge to be Built Here.”</td>
<td>29 January 1964</td>
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<tr>
<td>[Building 4476.]</td>
<td>1-2</td>
</tr>
<tr>
<td>[Building 4200.]</td>
<td>3</td>
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<tr>
<td>“New Saturn Test Area Certified for Use.”</td>
<td>16 September 1961</td>
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<tr>
<td>[Building 4670.]</td>
<td>[Discusses site contamination issues.] 4</td>
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<tr>
<td>“New Stand Rises.”</td>
<td>1 January 1964</td>
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<tr>
<td>[Buildings 4550 and 4557 (former).]</td>
<td>1</td>
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<tr>
<td>“9 Floors in New MSFC Building.”</td>
<td>12 April 1961</td>
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<tr>
<td>[Building 4200.]</td>
<td>1</td>
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<tr>
<td>“Orbital Workshop Mockup.”</td>
<td>17 May 1967</td>
</tr>
<tr>
<td>[Building 4755.]</td>
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<tr>
<td>“Oswald Lange Directs Saturn Systems Office.”</td>
<td>11 January 1961</td>
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<td></td>
<td>8</td>
</tr>
<tr>
<td>“P&amp;VE Additions.”</td>
<td>24 November 1965</td>
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<tr>
<td>[Building 4612.]</td>
<td>8</td>
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<tr>
<td>“P&amp;VE’s New Look.”</td>
<td>11 November 1964</td>
</tr>
<tr>
<td>[Building 4610.]</td>
<td>11</td>
</tr>
<tr>
<td>“Palaemon Arrives.”</td>
<td>30 November 1960</td>
</tr>
<tr>
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<tr>
<td>“Palaemon Departs for Canaveral.”</td>
<td>19 April 1961</td>
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<td></td>
<td>1, 8</td>
</tr>
<tr>
<td>“Palaemon, Promise in Dock.”</td>
<td>18 March 1964</td>
</tr>
<tr>
<td>[At Michoud.]</td>
<td>2</td>
</tr>
<tr>
<td>“‘Promise’ Kept It.”</td>
<td>7 March 1962</td>
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<tr>
<td></td>
<td>2</td>
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<tr>
<td>“Proposed F-1 Static Stand.”</td>
<td>7 November 1962</td>
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<tr>
<td>[Building 4670.]</td>
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<tr>
<td>“Quality Division Director Became Citizen in 1954.”</td>
<td>17 December 1960</td>
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<td>[Dieter Grau.]</td>
<td>6</td>
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<tr>
<td>“Quality Lab Facility Completed.”</td>
<td>26 August 1964</td>
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<tr>
<td>[Building 4752.]</td>
<td>1, 10</td>
</tr>
<tr>
<td>“Quality Moves Into New Lab, Office Annex.”</td>
<td>9 January 1963</td>
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<tr>
<td>[Building 4708.]</td>
<td>7</td>
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<tr>
<td>“Research Projects Head is Dr. Ernst Stuhlinger.”</td>
<td>16 November 1960</td>
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<tr>
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</tbody>
</table>


“Saturn Static Test Stand is to be Enlarged.” [Building 4572.] 2 May 1962: 8.


“Urbanski Retires After 30 Years on Rocket Team.” 7 October 1964: 9.


“Werner Gengelbach is S-II Resident Manager at S&ID.” 7 April 1965: 5.


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Master Plans, Drawings, and Real Property Records

Master Plans


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Real Property Records


Appendix A

Photographs for MSFC Buildings and Structures
Legend

Unevaluated – Properties that require additional investigation prior to a clear conclusion on National Register of Historic Places eligibility.

Ineligible – Properties evaluated as not eligible for the National Register of Historic Places, either because of loss of integrity or failure to meet any of the National Register of Historic Places significance criteria.

Eligible – Properties evaluated as eligible for the National Register of Historic Places.

Reevaluate – Properties that do not clearly meet the National Register of Historic Places criteria at present, but that should be reevaluated in ten years, as they achieve the 50-year threshold.


Plate A4 Building 4190: Ineligible for the NRHP. Looking northeast. 17 January 2002. C. Gregory
Plate A5 Building 4191: Ineligible for the NRHP. Building 4194: Ineligible for the NRHP. Looking northwest. 17 January 2002. C. Gregory

Plate A6 Building 4200: Eligible for the NRHP. Looking northeast. 7 March 2002. J. Zielinski
Plate A7 Building 4201: Eligible for the NRHP. Looking southeast. 11 March 2002. J. Zielinski

Plate A8 Building 4202: Eligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski
Plate A9 Building 4203: Ineligible for the NRHP. Looking northeast.
7 March 2002. J. Zielinski

Plate A10 Building 4207: Ineligible for the NRHP. Looking northeast.
16 January 2002. C. Gregory


Plate A17 Building 4306: Ineligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory

Plate A19 Building 4313: Eligible for the NRHP. Looking northwest. 7 March 2002. J. Zielinski

Plate A20 Building 4313: Eligible for the NRHP. Looking southeast. 7 March 2002. J. Zielinski
Plate A21 Building 4315: Ineligible for the NRHP. Looking northwest.
7 March 2002. J. Zielinski

Plate A22 Building 4319: Ineligible for the NRHP. Looking east.
15 January 2002. C. Gregory
14 January 2002. C. Gregory

Plate A24 Building 4348: Ineligible for the NRHP. Looking northeast.
15 January 2002. C. Gregory
Plate A25 Building 4353: Ineligible for the NRHP. Looking north/northwest.
15 January 2002. C. Gregory

Plate A26 Building 4372: Unevaluated. Looking northeast.
7 November 2003. R. Allen
Plate A27 Building 4391: Ineligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski

Plate A29 Building 4464: Ineligible for the NRHP. Looking east/southeast. 15 January 2002. C. Gregory

Plate A30 Building 4465: Ineligible for the NRHP. Looking south/southeast. 16 January 2002. C. Gregory
Plate A31 Building 4466: Ineligible for the NRHP. Looking south/southeast. 16 January 2002. C. Gregory

Plate A33 Building 4470: Ineligible for the NRHP. Looking northwest.
16 January 2002. C. Gregory

Plate A34 Building 4471: Eligible for the NRHP. Looking northeast.
16 January 2002. C. Gregory
Plate A35 Building 4472: Ineligible for the NRHP. Looking southeast.  
7 March 2002. J. Zielinski

Plate A36 Building 4473: Ineligible for the NRHP. Looking east/northeast.  
13 January 2002. C. Gregory
Plate A37 Small unnumbered observatory in vicinity of Building 4473, looking southeast. Unevaluated. 13 January 2002. C. Gregory

Plate A38 Building 4475: Ineligible for the NRHP. Looking northeast. 13 January 2002. C. Gregory
Plate A39 Building 4476: Eligible for the NRHP. Looking southeast. 13 January 2002. C. Gregory

Plate A41 Building 4478: Ineligible for the NRHP. Looking east.
6 November 2003. R. Allen

Plate A42 Building 4479: Ineligible for the NRHP. Looking southwest [left].
16 January 2002. C. Gregory
Plate A43 Building 4480: Ineligible for the NRHP. Looking northeast.
7 March 2002. J. Zielinski

Plate A44 Building 4480: Ineligible for the NRHP. Looking southeast.
11 March 2002. J. Zielinski
Plate A45 Building 4481: Ineligible for the NRHP. Looking northwest.
11 March 2002. J. Zielinski

Plate A46 Building 4481: Ineligible for the NRHP. Looking northeast.
11 March 2002. J. Zielinski
Plate A47 Building 4481: Ineligible for the NRHP. Looking northeast. 11 March 2002. J. Zielinski

Plate A48 Building 4482: Ineligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski
Plate A49 Building 4483: Ineligible for the NRHP. Looking east/southeast.  
16 January 2002. C. Gregory

Plate A50 Building 4485: Ineligible for the NRHP. Looking west/northwest.  
16 January 2002. C. Gregory
Plate A51 Building 4487: Ineligible for the NRHP. Looking northeast.
13 January 2002. C. Gregory

Plate A52 Building 4487: Ineligible for the NRHP. Looking east/southeast.
13 January 2002. C. Gregory
Plate A53 Building 4490: Ineligible for the NRHP. Looking northwest.  
29 October 2003. R. Allen

Plate A54 Building 4491: Ineligible for the NRHP. Looking west/southwest.  
16 January 2002. C. Gregory
Plate A55 Building 4492: Ineligible for the NRHP. Looking northeast.
16 January 2002. C. Gregory

Plate A56 Building 4493: Ineligible for the NRHP. Looking southeast.
11 March 2002. J. Zielinski
Plate A57 Building 4493: Ineligible for the NRHP. Looking west.  
11 March 2002. J. Zielinski

Plate A58 Building 4493: Ineligible for the NRHP. Looking southwest.  
11 March 2002. J. Zielinski
Plate A59 Building 4494: Ineligible for the NRHP. Looking southeast.
7 March 2002. J. Zielinski

Plate A60 Building 4495: Ineligible for the NRHP. Looking southeast.
7 March 2002. J. Zielinski
Plate A61 Building 4495: Ineligible for the NRHP. Looking northeast. 7 March 2002. J. Zielinski


Plate A65 Building 4515: Ineligible for the NRHP. Looking southwest. 11 January 2002. K. Weitze

Plate A66 Building 4515: Ineligible for the NRHP. Looking northwest. 11 January 2002. K. Weitze
Plate A67 Building 4516: Ineligible for the NRHP. Looking west.
11 January 2002. K. Weitze

Plate A68 Building 4517: Ineligible for the NRHP. Looking east/northeast.
11 January 2002. K. Weitze
Plate A69 Building 4518: Ineligible for the NRHP. Looking north. 29 October 2003. R. Allen

Plate A70 Building 4519: Ineligible for the NRHP. Looking west. 11 January 2002. K. Weitze
Plate A71 Building 4520: Ineligible for the NRHP. Looking east.
11 January 2002. K. Weitze

Plate A72 Burn pond to the near northeast, looking southeast.
11 January 2002. K. Weitze
Plate A73 Building 4520: Ineligible for the NRHP. Group view, looking northwest. 11 January 2002. K. Weitze

Plate A74 Building 4522: Reevaluate in 10 years. Looking west/northwest [left of center; Buildings 4526 and 4527 on right]. 16 January 2002. K. Weitze
Plates A75 Unnumbered bunker to the near west/southwest of Building 4523, looking north/northeast and southwest. Eligible for the NRHP. 16 January 2002. K. Weitze
Plate A76 Building 4523: Ineligible for the NRHP. Looking northeast. 16 January 2002. K. Weitze


Plate A80 Building 4527: Ineligible for the NRHP. Looking southwest.

Plate A81 Building 4530: Reevaluate in 10 years. Looking north.
Plate A82 Building 4530: Reevaluate in 10 years. Looking southwest. 16 January 2002. K. Weitze

Plate A84 Building 4531: Ineligible for the NRHP. Looking east/southeast.

Plate A85 Building 4531: Ineligible for the NRHP. Looking west.
Plate A86 Building 4532: Ineligible for the NRHP. Looking northeast.  
29 October 2003. R. Allen

Plate A87 Building 4539: Ineligible for the NRHP. Looking east/southeast.  
Plate A88 Building 4540: Reevaluate in 10 years. Looking west.

Plate A89 Building 4541: Reevaluate in 10 years. Looking southwest.

Plate A91 Building 4548: Reevaluate in 10 years. Looking east/southeast. 11 January 2002. K. Weitze

Plate A93 Building 4549: Ineligible for the NRHP. Looking southeast [Building 4550, background left]. 7 March 2002. J. Zielinski
Plate A94 Building 4550: Eligible for the NRHP. Looking north/northwest.
11 January 2002. K. Weitze

Plate A95 Building 4550: Eligible for the NRHP. Looking northwest.
11 January 2002. K. Weitze
Plate A96 Building 4550: Eligible for the NRHP. Looking southwest.  

Plate A97 Building 4551: Eligible for the NRHP. Looking northwest.  
11 January 2002. K. Weitze

Plate A99 Building 4553: Ineligible for the NRHP. Looking northwest. 6 November 2003. R. Allen


Plate A103 Building 4559: Ineligible for the NRHP. Looking east [right; Building 4587 on left]. 16 January 2002. K. Weitze
Plate A104 Building 4560: Eligible for the NRHP. Looking northeast.

Plate A105 Building 4560: Eligible for the NRHP. Looking west/northwest.
11 January 2002. K. Weitze
Plates A106 Building 4560: Eligible for the NRHP. Details of Building 4560.
11 January 2002. K. Weitze
Plates A107 Unnumbered observation bunker to the near southwest of Building 4560, looking southwest and northeast. Eligible for the NRHP. 11 January 2002. K. Weitze


Plate A113 Building 4564: Reevaluate in 10 years. Looking northeast. 11 January 2002. K. Weitze
Plate A114 Building 4564: Reevaluate in 10 years. Looking north.  
11 January 2002. K. Weitze


Plate A117 Building 4570: Eligible for the NRHP. Looking southeast. 11 January 2002. K. Weitze
Plate A118 Building 4570: Eligible for the NRHP. Looking north.  
11 January 2002. K. Weitze

Plate A119 Building 4571 [site only]: Foot-bridge and path to site, looking southeast. 16 January 2002. K. Weitze
Plate A120 Building 4571 [site only]: Leveled site, looking northeast.  

Plate A121 Building 4572: Eligible for the NRHP. Looking southeast.  
11 January 2002. K. Weitze
Plate A122 Building 4572: Eligible for the NRHP. Looking northeast.  
11 January 2002. K. Weitze

Plate A123 Building 4572: Eligible for the NRHP. Looking west/northwest.  
11 January 2002. K. Weitze
Plate A124 Building 4573: Eligible for the NRHP. Looking southeast. 11 January 2002. K. Weitze

Plate A125 Building 4574: Ineligible for the NRHP. Looking northeast [Building 4541 middleground left]. 7 March 2002. J. Zielinski

Plate A128 Building 4583: Eligible for the NRHP. Looking west.  

Plate A129 Building 4583-A: Eligible for the NRHP. Looking east/northeast.  

Plate A132 Building 4584: Ineligible for the NRHP. Looking east.  
29 October 2003. R. Allen

Plate A133 Building 4585: Ineligible for the NRHP. Looking northwest.  
29 October 2003. R. Allen
Plate A134 Building 4587: Ineligible for the NRHP. Looking east. 29 October 2003. R. Allen

Plate A135 Building 4588: Eligible for the NRHP. Looking east/southeast. 11 January 2002. K. Weitze
Plate A136 Building 4588: Eligible for the NRHP. Looking south/southeast.
11 January 2002. K. Weitze

Plate A137 Building 4594: Ineligible for the NRHP. Looking southeast.
11 January 2002. K. Weitze
Plate A138 Building 4596: Ineligible for the NRHP. Looking southeast.

Plate A139 Unnumbered observation bunker immediate to the south/ southwest corner of Building 4596, looking south/southeast. Eligible for the NRHP.
Plate A140 Building 4597: Ineligible for the NRHP. Looking east/southeast. 11 January 2002. K. Weitze

Plate A142 Building 4604: Ineligible for the NRHP. Looking northeast.
29 October 2003. R. Allen

Plate A143 Building 4605: Unevaluated. Looking southeast.
12 January 2002. K. Weitze

Plate A146 Building 4609: Ineligible for the NRHP. Looking east.
7 March 2002. J. Zielinski

Plate A147 Building 4610: Eligible for the NRHP. Looking northwest.
13 January 2002. C. Gregory
Plate A148 Building 4610: Eligible for the NRHP. Looking southeast.  
13 January 2002. C. Gregory

Plate A149 Building 4611: Ineligible for the NRHP. Looking northeast.  
12 January 2002. K. Weitze
Plate A150 Building 4612: Eligible for the NRHP. Looking southwest.
13 January 2002. C. Gregory

Plate A151 Building 4612: Eligible for the NRHP. Looking west.
13 January 2002. C. Gregory
Plate A152 Building 4612: Eligible for the NRHP. Looking north/northeast.
13 January 2002. C. Gregory

Plate A153 Building 4613: Ineligible for the NRHP. Looking southeast.
6 November 2003. R. Allen
Plate A154 Building 4614: Ineligible for the NRHP. Looking southeast. 7 March 2002. J. Zielinski

Plate A155 Building 4614: Ineligible for the NRHP. Looking northwest. 7 March 2002. J. Zielinski
Plate A156 Building 4616: Ineligible for the NRHP. Looking northeast.
12 January 2002. K. Weitze

Plate A157 Building 4617: Ineligible for the NRHP. Looking west.
6 November 2003. R. Allen

Plate A160 Building 4619: Eligible for the NRHP. Looking northeast.
12 January 2002. K. Weitze


Plate A164 Building 4622: Ineligible for the NRHP. Looking southeast.
12 January 2002. K. Weitze

Plate A165 Building 4623: Ineligible for the NRHP. Looking southeast.
12 January 2002. K. Weitze


Plate A172 Building 4630: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen

Plate A174 Building 4634: Ineligible for the NRHP. Looking northeast. 
29 October 2003. R. Allen

Plate A175 Building 4635-1: Ineligible for the NRHP. Looking northwest. 
29 October 2003. R. Allen
Plate A176 Building 4635-2: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen

Plate A177 Building 4635-3: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen
Plate A178 Building 4635-4: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen

Plate A180 Building 4640: Ineligible for the NRHP. Looking southwest.
6 November 2003. R. Allen

Plate A181 Building 4641: Ineligible for the NRHP. Looking northeast.
29 October 2003. R. Allen
Plate A182 Building 4642: Ineligible for the NRHP. Looking north.  
6 November 2003. R. Allen

12 January 2002. C. Gregory
Plate A184 Building 4645: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen

Plate A186 Building 4647: Ineligible for the NRHP. Looking southwest. 12 January 2002. C. Gregory

Plate A187 Building 4648: Ineligible for the NRHP. Looking northeast. 29 October 2003. R. Allen
Plate A188 Building 4649: Ineligible for the NRHP. Looking northwest. 12 January 2002. C. Gregory
Plates A189 Building 4650: Ineligible for the NRHP. Looking northwest.  
13 January 2002. C. Gregory

Plate A192 Building 4654: Ineligible for the NRHP. Looking southeast.
12 January 2002. K. Weitze

Plate A193 Building 4655: Ineligible for the NRHP. Looking southeast.
12 January 2002. K. Weitze
Plate A194 Building 4656: Ineligible for the NRHP. Looking southeast.  
12 January 2002.  K. Weitze

Plate A195 Building 4657: Ineligible for the NRHP. Looking northwest.  
3 November 2003.  R. Allen
Plate A196 Building 4658: Ineligible for the NRHP. Looking north/northeast [on right; Army Building 4683 on left]. 11 January 2002. K. Weitze

Plate A198 Building 4660: Ineligible for the NRHP. Looking northwest.
29 October 2003. R. Allen

Plate A199 Building 4661: Ineligible for the NRHP. Looking northwest.
29 October 2003. R. Allen

Plate A201 Building 4663: Eligible for the NRHP. Looking north/northwest. 13 January 2002. C. Gregory
Plate A202 Building 4663: Eligible for the NRHP. Looking north/northeast.  
13 January 2002. C. Gregory

Plate A203 Building 4663: Eligible for the NRHP. Looking northeast.  
13 January 2002. C. Gregory
Plate A204 Building 4663: Eligible for the NRHP. Looking east/northeast.
13 January 2002. C. Gregory

Plate A205 Building 4663: Eligible for the NRHP. Looking southeast.
13 January 2002. C. Gregory
Plate A206 Building 4665: Eligible for the NRHP. Interim Redstone test stands, looking northwest. 12 January 2002. C. Gregory

Plate A207 Building 4665: Eligible for the NRHP. Interim Redstone test stand (right), looking west/northwest. 12 January 2002. C. Gregory
Plate A208 Building 4665: Eligible for the NRHP. Interim Redstone test stand (left), looking west/northwest. 12 January 2002. C. Gregory


Plate A214 Building 4670: Eligible for the NRHP. Looking east.
11 January 2002. K. Weitze

Plate A215 Building 4670: Eligible for the NRHP. Looking northeast.
11 January 2002. K. Weitze

Plate A218 Control/sentry booth immediately east of LOX tanks, northeast of Building 4670, looking northeast. 11 January 2002. K. Weitze

Plate A220 Building 4672: Ineligible for the NRHP. Looking east/southeast. 
11 January 2002. K. Weitze

Plate A221 Building 4672: Ineligible for the NRHP. Looking northeast. 
11 January 2002. K. Weitze
Plate A222 Building 4673: Ineligible for the NRHP. Looking south [one of two berm-and dike-protected fuel tanks, with fuel lines; Building 4671 background center; Building 4670 background right]. 11 January 2002. K. Weitze

Plate A223 Building 4673: Ineligible for the NRHP. Fuel line and dike system for tanks, looking southeast. 11 January 2002. K. Weitze

Plate A225 Building 4673: Ineligible for the NRHP. Looking northeast [one of two tanks with fuel lines; Building 4696 background middle]. 11 January 2002. K. Weitze
Plate A226 Building 4674: Eligible for the NRHP. Looking northwest.
11 January 2002. K. Weitze

Plate A227 Building 4674: Eligible for the NRHP. Looking north.
11 January 2002. K. Weitze
Plate A228 Building 4675: Ineligible for the NRHP. Looking south/southwest. 11 January 2002. K. Weitze

Plate A229 Building 4676: Ineligible for the NRHP. Looking east/southeast. 11 January 2002. K. Weitze


Plate A233 Building 4680: Ineligible for the NRHP. Looking southwest. 11 January 2002. K. Weitze

Plate A235 Building 4688: Ineligible for the NRHP. Looking northwest. 7 March 2002. J. Zielinski
Plate A236 Building 4694: Ineligible for the NRHP. 11 January 2002. K. Weitze

Plate A238 Building 4696: Eligible for the NRHP. Looking north [left to right: equipment stand, warning light, flame bucket, blast deflector, control/sentry booth]. 11 January 2002. K. Weitze

Plate A239 Building 4696: Eligible for the NRHP. Closeup of flame bucket looking east. 11 January 2002. K. Weitze
Plate A240 Building 4696: Eligible for the NRHP. Looking east/southeast. 11 January 2002. K. Weitze


Plate A244 Building 4698: Ineligible for the NRHP. Looking east/northeast. 16 January 2002. K. Weitze


Plate A249 Building 4700: Ineligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory
Plate A250 Building 4702: Ineligible for the NRHP. Looking northeast. 16 January 2002. C. Gregory

Plate A251 Building 4703: Ineligible for the NRHP. Looking southwest. 16 January 2002. C. Gregory

Plate A253 Building 4705: Eligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory
Plate A254 Building 4705: Eligible for the NRHP. Looking northeast.  
16 January 2002. C. Gregory

Plate A255 Building 4707: Reevaluate in 10 years. Looking northeast.  
16 January 2002. C. Gregory

Plate A257 Building 4708: Eligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory

Plate A259 Building 4711: Ineligible for the NRHP. Looking northeast. 16 January 2002. C. Gregory
Plate A260 Building 4712: Ineligible for the NRHP. Looking northeast.  
16 January 2002. C. Gregory

Plate A261 Building 4712: Ineligible for the NRHP. Looking northwest.  
16 January 2002. C. Gregory
Plate A262 Building 4714: Ineligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory

Plate A263 Building 4715: Ineligible for the NRHP. Looking southeast. 16 January 2002. C. Gregory
Plate A264 Building 4716: Ineligible for the NRHP. Looking south. 16 January 2002. C. Gregory

Plate A265 Building 4718-1: Eligible for the NRHP. Looking north/northwest. 13 January 2002. C. Gregory
Plate A266 Building 4718-2: Eligible for the NRHP. Looking northeast. 13 January 2002. C. Gregory

Plate A267 Building 4718-1, 4718-2 and 4718-3: Eligible for the NRHP. Looking east. 13 January 2002. C. Gregory
Plate A268 Building 4718-3: Eligible for the NRHP. Looking north/northeast. 13 January 2002. C. Gregory

Plate A269 Building 4718: Eligible for the NRHP. Looking west. 16 January 2002. C. Gregory

Plate A271 Building 4723: Ineligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski
Plate A272 Building 4727: Ineligible for the NRHP. Looking southwest.
11 March 2002. J. Zielinski

Plate A273 Building 4728: Ineligible for the NRHP. Looking northwest.
16 January 2002. C. Gregory
Plate A274 Building 4731: Ineligible for the NRHP. Looking north. 11 March 2002. J. Zielinski

Plate A275 Building 4732: Eligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski
Plate A276 Building 4732: Eligible for the NRHP. Looking northeast. 11 March 2002. J. Zielinski

Plate A277 Building 4733: Ineligible for the NRHP. Looking southeast. 16 January 2002. C. Gregory
Plate A278 Building 4734: Ineligible for the NRHP. Looking southeast.
16 January 2002. C. Gregory


Plate A282 Building 4739: Ineligible for the NRHP. Looking northwest.  
29 October 2003. R. Allen

Plate A283 Building 4743: Ineligible for the NRHP. Looking north.  
29 October 2003. R. Allen
Plate A284 Building 4744: Ineligible for the NRHP. Looking northeast.
16 January 2002. C. Gregory

Plate A285 Building 4745: Ineligible for the NRHP. Looking south.
29 October 2003. R. Allen
Plate A286 Building 4745-1: Ineligible for the NRHP. Looking south. 29 October 2003. R. Allen

Plate A287 Building 4746: Ineligible for the NRHP. Looking southwest. 11 March 2002. J. Zielinski
Plate A288 Building 4746: Ineligible for the NRHP. Looking northwest. 11 March 2002. J. Zielinski

Plate A289 Building 4747: Ineligible for the NRHP. Looking west/northwest. 13 January 2002. C. Gregory
Plate A290 Building 4748: Ineligible for the NRHP. Looking west. 
13 January 2002. C. Gregory

Plate A291 Building 4749: Ineligible for the NRHP. Looking north. 
13 January 2002. C. Gregory
Plate A292 Building 4750: Ineligible for the NRHP. Looking northwest. 29 October 2003. R. Allen

Plate A293 Building 4751: Ineligible for the NRHP. Looking northeast. 16 January 2002. C. Gregory
Plate A294 Building 4752: Ineligible for the NRHP. Looking east/southeast.
13 January 2002. C. Gregory

Plate A295 Building 4754: Ineligible for the NRHP. Looking southeast.
6 November 2003. R. Allen
Plate A296 Building 4755: Ineligible for the NRHP. Looking northwest. 7 March 2002. J. Zielinski

Plate A297 Building 4756: Ineligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory
Plate A298 Building 4757: Ineligible for the NRHP. Looking west/northwest. 13 January 2002. C. Gregory

Plate A299 Sheds in vicinity of Building 4757, looking northeast. 13 January 2002. C. Gregory
Plate A300 Building 4758: Ineligible for the NRHP. Looking southwest. 16 January 2002. C. Gregory

Plate A301 Building 4759: Ineligible for the NRHP. Looking east. 16 January 2002. C. Gregory

Plate A303 Building 4760: Ineligible for the NRHP. Looking northeast. 16 January 2002. C. Gregory
Plate A304 Building 4761: Ineligible for the NRHP. Looking east.  
13 January 2002.  C. Gregory

Plate A305 Building 4764: Ineligible for the NRHP. Looking southeast.  
16 January 2002.  C. Gregory

Plate A308 Building 4774: Ineligible for the NRHP. Looking northwest. 16 January 2002. C. Gregory


Plate A312 Building 4777: Ineligible for the NRHP. Looking southwest. 16 January 2002. C. Gregory

Plate A313 Ancillary facility in vicinity of Building 4777. Looking northwest. 16 January 2002. C. Gregory
Plate A314 Overview of Sam Moore Cemetery:  Looking southwest.
7 March 2002.  J. Zielinski

Plate A315 Sam Moore Cemetery grave stone:  Looking northwest.
7 March 2002.  J. Zielinski
Appendix B

Buildings and Structures Historic Data Summary
<table>
<thead>
<tr>
<th>Real Property Number</th>
<th>Current Name</th>
<th>Historic Name(s)</th>
<th>Architectural-Engineering Firm(s)</th>
<th>Date Designed</th>
<th>NRHP Assessment and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4184</td>
<td>Antenna Test Tower (Transmitter)</td>
<td></td>
<td></td>
<td>1976</td>
<td>Ineligible for the NRHP. Tower is paired with Building 4185, and as built was part of a Half-Mile Antenna Range for far-field antenna radiation pattern measurements. The Army had first erected a remote transmitter and receiver set (50-foot towers), with control building, on Ward Mountain at the Redstone Arsenal in late 1956. This tower set accommodated communications. By 1958, the Army established test Air Defense Laboratories at Redstone for the investigation and evaluation of microwave antennas and other microwave components requiring similar environmental conditions” (U.S. Army Rocket Guided Missile Agency Historical Summary April-June 1958). The Army’s Air Defense Laboratories planned for an outdoor long-range antenna testing facility focused on microwave equipment.</td>
</tr>
<tr>
<td>4185</td>
<td>Antenna Test Tower (Target)</td>
<td>Model Tower</td>
<td></td>
<td>1976</td>
<td>Ineligible for the NRHP. Tower is paired with Building 4184, and as built was part of a Half-Mile Antenna Range for far-field antenna radiation pattern measurements.</td>
</tr>
<tr>
<td>4189</td>
<td>Radio Frequency (RF) Vacuum Test Facility</td>
<td>Altitude Test Chamber</td>
<td></td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4190</td>
<td>Microwave Anechoic Chamber</td>
<td></td>
<td>BF Goodrich (manufacturer)</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4191</td>
<td>RF Measurement Laboratory</td>
<td></td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: a 100-foot Microwave Relay Tower of 1964. The earlier tower, also known as the Launch Information Exchange Facility (1964) and as the Antenna Building (1966), was responsible for information transmission between Marshall and Cape Canaveral, inclusive of the transmission of rocket drawings between the two centers and real-time launch data from Canaveral to Marshall via television. Coupled with the older Building 4151 was Building T-4192, an Air-Inflated Envelope Building. Before the close of 1958, the Army had also begun construction of a Microwave Tower and Facilities Building (designed by Southern Bell Telephone) for long-distance communications from Redstone. The 1958-1959 facilities appear to have included a microwave tower (height unknown)—subsequently replaced by the 100-foot microwave tower (old Building 4191)—and Building 4194. Detailed information from the Marshall Star: see bibliography.</td>
</tr>
<tr>
<td>4200</td>
<td>Office Building</td>
<td>Central Laboratory and Office Building</td>
<td>Wyatt C. Hedrick, Fort Worth</td>
<td>1961</td>
<td>Eligible for the NRHP. Independently eligible and contributing to a district with Buildings 4201 and 4202. See Appendix C: HABS Level IV Forms.</td>
</tr>
<tr>
<td>4201</td>
<td>Office Building</td>
<td>Engineering and Administration Building</td>
<td>Wyatt C. Hedrick, Fort Worth</td>
<td>1962</td>
<td>Eligible for the NRHP. Not independently eligible; contributing to a district with Buildings 4200 and 4202. See Appendix C: HABS Level IV Forms.</td>
</tr>
<tr>
<td>4202</td>
<td>Office Building</td>
<td>Project Engineer Office Building</td>
<td>Hudsons, Thompson, Ball &amp; Associates, Oklahoma City</td>
<td>1964</td>
<td>Eligible for the NRHP. Not independently eligible; contributing to a district with Buildings 4200 and 4201. See Appendix C: HABS Level IV Forms.</td>
</tr>
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</tr>
<tr>
<td>4203</td>
<td>Office Building</td>
<td>Project Engineering Facility</td>
<td>Pan Am World Services, Inc., Engineering Division, Cape Canaveral</td>
<td>1991</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4207</td>
<td>Communications Facility</td>
<td>Central Communications Facility</td>
<td>Grady Harmon, Design Branch, Technical Services Office, Marshall Space Flight Center</td>
<td>1962</td>
<td>Ineligible for the NRHP. Addition of 1965. As built, included teletype communications with 21 states in the southern and central United States. Teletype links to NASA headquarters, Cape Canaveral, the Western Operations Office in California, the Goddard Space Center in Maryland, the Manned Spacecraft Center in Houston, and Michoud Operations in New Orleans. Also originally included radio communications facilities connecting Marshall to the Saturn barges while in transit between Alabama and Canaveral. Detailed information from the Marshall Star; see bibliography.</td>
</tr>
<tr>
<td>4249</td>
<td>Medical Center and Office Building</td>
<td></td>
<td>Sherlock, Smith &amp; Adams, Inc., Montgomery</td>
<td>1962</td>
<td>Ineligible for the NRHP. As built, included administrative space and shops for painting, carpentry, air conditioning, electrical and instrument repair; and sheet metal, millwright, welding, and machine work. Paired with Building 4251. Detailed information from the Marshall Star; see bibliography.</td>
</tr>
<tr>
<td>4250</td>
<td>Office Building</td>
<td>Technical Services Operations Facility</td>
<td>Sherlock, Smith &amp; Adams, Inc., Montgomery</td>
<td>1962</td>
<td>Ineligible for the NRHP. As built, included administrative space and shops for painting, carpentry, air conditioning, electrical and instrument repair; and sheet metal, millwright, welding, and machine work. Paired with Building 4250. Detailed information from the Marshall Star; see bibliography.</td>
</tr>
<tr>
<td>4251</td>
<td>Office and Storage Building</td>
<td>Technical Services Operations Facility</td>
<td>Sherlock, Smith &amp; Adams, Inc., Montgomery</td>
<td>1962</td>
<td>Ineligible for the NRHP. As built, included administrative space and shops for painting, carpentry, air conditioning, electrical and instrument repair; and sheet metal, millwright, welding, and machine work. Paired with Building 4250. Detailed information from the Marshall Star; see bibliography.</td>
</tr>
<tr>
<td>4252</td>
<td>Steam Cleaning Facility</td>
<td></td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
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<tr>
<td>4315</td>
<td>Wellness Center</td>
<td></td>
<td></td>
<td>2001</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4348</td>
<td>Storage Building</td>
<td>LOX Shed (1966)</td>
<td></td>
<td>ca.1958</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4391</td>
<td>Compactor Facility</td>
<td></td>
<td></td>
<td>1999</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4436</td>
<td>SSME (Space Shuttle Main Engine)– HSL (Hardware Simulation Laboratory) Block II Facility</td>
<td>Automation Checkout Building (1966) Vehicle and Ground Support Equipment Systems Automation Checkout Building (1962)</td>
<td></td>
<td>1962</td>
<td>Needs further research before any NRHP assessment is possible. SSME HSL function for Building 4436 dates to about 1974, and an assessment of interior features against NRHP criteria is needed.</td>
</tr>
<tr>
<td>4464</td>
<td>Microbiology Laboratory</td>
<td></td>
<td></td>
<td>1993</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4465</td>
<td>Storage Building</td>
<td></td>
<td></td>
<td>1992</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4466</td>
<td>Staging Building</td>
<td></td>
<td></td>
<td>1991</td>
<td>Ineligible for the NRHP.</td>
</tr>
</tbody>
</table>

*Note: All buildings are located at the NASA Marshall Space Flight Center (MSFC).*
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<tr>
<td>4477</td>
<td>Audio Reverberant Facility</td>
<td>Reverberant Audio Facility</td>
<td></td>
<td>1989</td>
<td>Needs further research before any NRHP assessment is possible. Previously existing with identical building number: Booster Station, Chemical Distribution (Building 477: by late 1943).</td>
</tr>
<tr>
<td>4480</td>
<td>Paint Shop</td>
<td>Vehicle Paint Shop</td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
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<tr>
<td>4484</td>
<td>Office Building</td>
<td></td>
<td>Whitman, Requardt &amp; Smith, Baltimore</td>
<td>1942</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4490</td>
<td>Storage Shed</td>
<td></td>
<td>Whitman, Requardt &amp; Smith, Baltimore</td>
<td>1941</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4492</td>
<td>Office Building</td>
<td></td>
<td>Electrical System(s) Laboratory (1969)</td>
<td>1949</td>
<td>Ineligible for the NRHP.</td>
</tr>
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</tr>
<tr>
<td>4499</td>
<td>Storage Building</td>
<td>Quonset Hut (1960, 1966)</td>
<td>Prefabricated unit</td>
<td>Purchased 1960</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4515</td>
<td>Transient Pressure Test Facility</td>
<td></td>
<td></td>
<td>1987</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4516</td>
<td>LOX Storage Facility</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles) (attributed)</td>
<td>1962</td>
<td>Ineligible for the NRHP. Ancillary structure for Building 4514. Related structures include Buildings 4517, 4518, 4519, and 4553.</td>
</tr>
<tr>
<td>4517</td>
<td>LH2 Storage Facility</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles) (attributed)</td>
<td>1962</td>
<td>Ineligible for the NRHP. Ancillary structure for Building 4514. Related structures include Buildings 4516, 4518, 4519, and 4553.</td>
</tr>
<tr>
<td>4518</td>
<td>Hydrogen Transfer Control House</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles) (attributed)</td>
<td>1962</td>
<td>Ineligible for the NRHP. Ancillary structure for Building 4514. Related structures include Buildings 4516, 4517, 4519, and 4553.</td>
</tr>
<tr>
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</tr>
<tr>
<td>4519</td>
<td>LOX Transfer Control House</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles) (attributed)</td>
<td>1962</td>
<td>Ineligible for the NRHP. Ancillary structure for Building 4514. Related structures include Buildings 4516, 4517, 4518, and 4553.</td>
</tr>
<tr>
<td>4525</td>
<td>LOX Transfer Control House</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles) (attributed)</td>
<td>ca.1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4526</td>
<td>LH2 Transfer Control House</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles)</td>
<td>ca.1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4527</td>
<td>LH2 Storage Tank (100,000 gallons)</td>
<td></td>
<td>Bechtel Corporation, Vernon (Los Angeles)</td>
<td>ca.1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4530</td>
<td>Test Facility 300 (TF-300)</td>
<td>Saturn Components Testing Facilities (1964)</td>
<td>Bechtel Corporation, Vernon (Los Angeles)</td>
<td>1964</td>
<td>Reconsider for potential NRHP eligibility in 10 years. Associated with Building 4561, the control blockhouse, and a second test stand, Building 4522.</td>
</tr>
<tr>
<td>4532</td>
<td>Test Support Building</td>
<td></td>
<td></td>
<td>1983</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>Real Property Number</td>
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</tr>
<tr>
<td>4539</td>
<td>Test Stand Support Building</td>
<td>Preparation Building</td>
<td>C.F. Braun &amp; Company, Alhambra, California (attributed)</td>
<td>1964</td>
<td>Ineligible for the NRHP. Associated with Buildings 4540 and 4541.</td>
</tr>
<tr>
<td>4542</td>
<td>Test Support Building</td>
<td></td>
<td></td>
<td>1992</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4548</td>
<td>Turbo Pump / High Volume Flow Facility</td>
<td>F-1 Turbo Test Facility</td>
<td></td>
<td>1963</td>
<td>Reconsider for potential NRHP eligibility in 10 years.</td>
</tr>
<tr>
<td>4552</td>
<td>Water Reservoir</td>
<td>Booster Pump Station Reservoir</td>
<td></td>
<td>1960</td>
<td>Ineligible for the NRHP. Paired with second reservoir constructed a year earlier, Building 4582. As built, included a pumphouse, Building 4549.</td>
</tr>
<tr>
<td>Real Property Number</td>
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<tr>
<td>4558</td>
<td>Structural Test Facility Terminal Building</td>
<td>Dynamic Test Facility Control Building</td>
<td>Maurice H. Connell &amp; Associates, Miami</td>
<td>1960</td>
<td>Ineligible for the NRHP. Constructed for the (Saturn) Dynamic Test Stand, Building 4557, now removed. Also formerly associated were two observation bunkers, Buildings 4555 and 4556. Building 4595, today subsumed within Building 4596, is a third observation bunker oriented toward the site.</td>
</tr>
<tr>
<td>4559</td>
<td>Shear Shop</td>
<td>Vacuum Pump House for Components Test Facility</td>
<td></td>
<td>1958</td>
<td>Ineligible for the NRHP. Transferred from the Army to NASA in 1960.</td>
</tr>
<tr>
<td>4560</td>
<td>Propulsion System Test Observation Bunker</td>
<td></td>
<td>Maurice H. Connell &amp; Associates, Inc., Miami (attributed)</td>
<td>1958</td>
<td>Eligible for the NRHP. Erected for the no longer extant Horizontal Test Stand, Building 4564, of 1954. Unnumbered early observation bunker immediately nearby, likely the first observation post erected for Building 4564, is also eligible to the NRHP as contributing to a thematic grouping of early observation bunkers. The unnumbered bunker likely dates to 1954. Transferred from the Army to NASA in 1960. See entry, &quot;Unnumbered Bunkers.&quot;</td>
</tr>
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<tr>
<td>4570</td>
<td>Advanced Propulsion Research Facility</td>
<td>Blockhouse and Cable Tunnel (1957, 1959, 1966)</td>
<td>Parsons-Aerojet Company, Los Angeles; Bechtel Corporation, Vernon (Los Angeles)</td>
<td>1953, 1963</td>
<td>Eligible for the NRHP. Instrumentation and control center for the static test stand (Building 4572 of 1953), the horizontal test stand (Building 4564 of 1954, converted to a vertical power plant test stand in the middle 1950s and removed in the 1980s), and the cold calibration test stand (Building 4588 of 1964). Numbered as Building 270 before mid-1957. Doubled in size through addition of 1963. The Test and Evaluation Branch of the Rocket Development Group at the Redstone Arsenal planned for two static test stands (Buildings 4564 and 4572) and a control building (Building 4570) in late 1951, with Parsons designing the three structures together in 1953-1954. Efforts toward a cold calibration test stand (Building 4588) were also underway before the close of 1951, with Parsons also handling that structure. Transferred from the Army to NASA in 1960.</td>
</tr>
<tr>
<td>4574</td>
<td>Observation Bunker</td>
<td>Observation Bunker (Wooden) (1968)</td>
<td></td>
<td>1957</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: STT Fuel Disposal Pit (1957-1959). STT Fuel Disposal Pit numbered as Building 271-B before mid-1957. A wooden observation bunker, Building T-4574 of 1957, existed to the north of Building 4583 and is mapped at that location at least into 1955. Today’s Building 4574 is not mapped at its current site during this same period (up through at least 1985). It is likely that NASA moved Building 4574 to its existing location after 1985, and that Building T-4574 was distinct from Building 4574 of the late 1950s.</td>
</tr>
<tr>
<td>4579</td>
<td>Liquid Waste Disposal (LWD) Reservoir</td>
<td></td>
<td>Parsons-Aerojet Company, Los Angeles</td>
<td>1954, 1959</td>
<td>Ineligible for the NRHP. Numbered as Building 271-G before mid-1957. Buildings 4576, 4577, and 4578 were first numbered as Buildings 271-D, 271-E, and 271-F. Expanded, late 1953. Other structures are subsumed within Building 4579. These were originally numbered as Building 4576 (LWD Collection Tank), Building 4577 (LWD Sand Filter), and Building 4578 (LWD Underground Tanks). Transferred from the Army to NASA in 1960.</td>
</tr>
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<tr>
<td>4585</td>
<td>Test Support Building</td>
<td></td>
<td></td>
<td>1993</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Components Test Laboratory Concrete Holding Pond (ca.1954: Building 273-B). (Also no longer extant is Building 4586 [Building 273-C], the Components Test Laboratory Earthen Holding Pond.)</td>
</tr>
<tr>
<td>4588</td>
<td>Cold Calibration Test Stand</td>
<td></td>
<td>Parsons-Aerojet Company, Los Angeles</td>
<td>1954</td>
<td>Eligible for the NRHP. Numbered as Building 274 before mid-1957. As built in 1954, the test stand cluster also included Buildings 274-A – 274-F, Building 4589, the Cold Calibration Test Stand Observation Building; Building 4590, the Cold Calibration Test Stand Catch Tank Pit; Building 4591, the Cold Calibration Test Stand Oxidizer Disposal Pit; Building 4592, the Cold Calibration Test Stand Fuel Disposal Pit; Building 4593, the Cold Calibration Test Stand Earthen Holding Pond; and, Building 4594, the Cold Calibration Test Stand Sub-Station. Building 4588 was built as a two-position test stand for performing cold flow tests of guided missile propulsion systems. An underground tunnel connects the test stand to Building 4554, within which is incorporated the earlier Building 4589. Blockhouse for Building 4588 is Building 4570. Transferred from the Army to NASA in 1960.</td>
</tr>
<tr>
<td>4596</td>
<td>Test Area Maintenance Shop</td>
<td>Oxidizer Ready Storage (1954, 1957, 1959, 1966)</td>
<td>Parsons-Aerojet Company, Los Angeles</td>
<td>1954</td>
<td>Building 4596 is ineligible for the NRHP. Intermediate (&quot;ready&quot;) storage for three to four propellants (1956). The structure was numbered Building 275 before mid-1957, and included three ancillaries: Buildings 4597 (275-A), Fuel Ready Storage; 4598 (275-B), a Nitrogen Gas Ready Station Battery; and, 4599 (275-C), a Sub-Station for the Ready Staging Area [now removed]. Transferred from the Army to NASA in 1960. Of note, an attached unnumbered observation bunker is eligible as contributing to a thematic grouping of test stand area bunkers. The test stand for which the Army erected the bunker is likely Building 4588 or 1954, with the bunker previously sited immediately north of Building 4554 (and numbered on some maps as Building 4595). NASA appears to have incorporated the bunker into Building 4596 during construction of 4557, a dynamic test stand for Saturn, of 1960 (today removed). As of that time, the bunker functioned for observation of Building 4557 tests. Construction date of the unnumbered bunker attached to Building 4596 is interpreted as 1954. See entry, &quot;Unnumbered Bunkers.&quot;</td>
</tr>
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<tr>
<td>4604</td>
<td>SSETS Storage Facility</td>
<td>Parsons-Aerojet Company, Los Angeles (attributed)</td>
<td>1996</td>
<td>Needs further research before any NRHP assessment is possible.</td>
<td></td>
</tr>
<tr>
<td>4606</td>
<td>Air Compressor Building</td>
<td>Giffels &amp; Roses, El Segundo</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4607</td>
<td>Pistol Range Storage</td>
<td>Parsons-Aerojet Company, Los Angeles (attributed)</td>
<td>1993</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4608</td>
<td>Softball Field House</td>
<td>Parsons-Aerojet Company, Los Angeles (attributed)</td>
<td>1992</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4610</td>
<td>Automotive Fuel Facility</td>
<td>Ralph M. Parsons Company, Los Angeles (attributed)</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4611</td>
<td>Air Conditioning Equipment Building</td>
<td>Ralph M. Parsons Company, Los Angeles</td>
<td>1965</td>
<td>Ineligible for the NRHP. Rawinsonde facility (Radiosonde balloon and receiving/telemetry equipment used to obtain weather and wind information).</td>
<td></td>
</tr>
<tr>
<td>4612</td>
<td>Materials and Processes Laboratory</td>
<td>Ralph M. Parsons Company, Los Angeles</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4613</td>
<td>Atmospheric Research Building</td>
<td>Ralph M. Parsons Company, Los Angeles</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
<td></td>
</tr>
<tr>
<td>4614</td>
<td>Aerodynamic Wind Tunnel</td>
<td>Ralph M. Parsons Company, Los Angeles</td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
<td></td>
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</tbody>
</table>

*NRHP*: National Register of Historic Places.
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<tr>
<td>4616</td>
<td>Storage Building</td>
<td>Shop Unit (1966) Shop (1957, 1959)</td>
<td>Butler Manufacturing, Kansas City (attributed)</td>
<td>ca.1957</td>
<td>Ineligible for the NRHP. Building 4616 is a prefabricated structure that appears to have been moved at least twice in the vicinity of the Buildings 4610-4620 cluster. Between 1957 and at least 1964, Building 4616 sat between Building 4619 and the center wing of Building 4612, on the site of the addition to Building 4612 of the middle 1960s. The most recent repositioning dates to 1989-1991. Transferred from the Army to NASA in 1960.</td>
</tr>
<tr>
<td>4618</td>
<td>Heat Treatment Facility</td>
<td>Hydraulic Test Facility</td>
<td></td>
<td>1963</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4621</td>
<td>Storage Building</td>
<td>Substore No. 84 (1966) [for Chemical Storage] Sub-Storage Facility (1962)</td>
<td>Butler Manufacturing Company, Kansas City</td>
<td>1962</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Sub-Station (1957, 1959)</td>
</tr>
<tr>
<td>4625</td>
<td>Shuttle Hardware Storage</td>
<td>SRB Tooling Equipment Warehouse</td>
<td></td>
<td>1992</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4626</td>
<td>LH2 Cold Flow Facility</td>
<td>LH2 High Flow Facility</td>
<td></td>
<td>1990</td>
<td>Ineligible for the NRHP.</td>
</tr>
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</tr>
<tr>
<td>4634</td>
<td>Storage Building</td>
<td>Portable Building</td>
<td></td>
<td>1961</td>
<td>Ineligible for the NRHP. Prefabricated structure.</td>
</tr>
<tr>
<td>4635</td>
<td>Chemical Waste Storage</td>
<td></td>
<td>Williams-Russell &amp; Johnson, Inc., Huntsville</td>
<td>1987</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4638</td>
<td>Support Building</td>
<td>Support Building No. 1</td>
<td>Holmes &amp; Narver, Inc., Los Angeles</td>
<td>1963</td>
<td>Ineligible for the NRHP. Erected as a part of a group, Buildings 4638, 4639, 4640, 4641, and 4642. All originally numbered as semi-permanent (S-4638, etc.).</td>
</tr>
<tr>
<td>4639</td>
<td>Battery Storage Facility</td>
<td>Support Building No. 2</td>
<td>Holmes &amp; Narver, Inc., Los Angeles</td>
<td>1963</td>
<td>Ineligible for the NRHP. Erected as a part of a group, Buildings 4638, 4639, 4640, 4641, and 4642. All originally numbered as semi-permanent (S-4638, etc.).</td>
</tr>
<tr>
<td>4640</td>
<td>Hazardous Waste Facility</td>
<td>Support Building No. 3</td>
<td>Holmes &amp; Narver, Inc., Los Angeles</td>
<td>1966</td>
<td>Ineligible for the NRHP. Erected as a part of a group, Buildings 4638, 4639, 4640, 4641, and 4642. All originally numbered as semi-permanent (S-4638, etc.).</td>
</tr>
<tr>
<td>4641</td>
<td>Center Activities Building</td>
<td>Support Building No. 4</td>
<td>Holmes &amp; Narver, Inc., Los Angeles</td>
<td>1963</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Carpenter Shop (by 1943: Building T-4641; originally, Building T-441). Erected as a part of a group, Buildings 4638, 4639, 4640, 4641, and 4642. All originally numbered as semi-permanent (S-4638, etc.).</td>
</tr>
<tr>
<td>4642</td>
<td>Center Activities Building</td>
<td>Support Building No. 5</td>
<td>Holmes &amp; Narver, Inc., Los Angeles</td>
<td>1963</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Maintenance Work Shop (1957) / Sheet Metal Shop (1943) (Building T-4642; originally, Building T-442). Erected as a part of a group, Buildings 4638, 4639, 4640, 4641, and 4642. All originally numbered as semi-permanent (S-4638, etc.).</td>
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<tr>
<td>4647</td>
<td>Air Compressor Building</td>
<td></td>
<td>Burns &amp; Roe, New York</td>
<td>1965</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Change House (1957) / Grease Storage Building (1943) (Building T-4647; originally, Building T-447).</td>
</tr>
<tr>
<td>4656</td>
<td>Hydraulic Equipment Development Facility</td>
<td>Assembly Building</td>
<td></td>
<td>1965</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Supply Storage (1957) / Warehouse (1943) (Building T-4656; originally, Building T-456).</td>
</tr>
<tr>
<td>4657</td>
<td>LH2 Vaporization Facility</td>
<td></td>
<td></td>
<td>1974</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Supplies and Equipment Storage (1957) / Fabrication Shop (1943) (Building T-4657; originally, Building T-447).</td>
</tr>
<tr>
<td>4659</td>
<td>HP GN2 Facility</td>
<td></td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Mosquito Oil Tank (1957, 1959) / Waste Oil Storage for Permanent Motor Pool Area (1942) (Building T-4659; originally, Building T-459).</td>
</tr>
<tr>
<td>4660</td>
<td>Boiler House</td>
<td></td>
<td></td>
<td>1966</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Ice House (1957) (Building T-4660; originally, Building 460).</td>
</tr>
<tr>
<td>4661</td>
<td>Scale House</td>
<td></td>
<td></td>
<td>1966</td>
<td>Ineligible for the NRHP. Previously existing with identical building number: Sub-Station, Guided Missile Test Facility (1957, 1959).</td>
</tr>
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<tr>
<td>4663</td>
<td>Computer Facility</td>
<td>Computation Laboratory</td>
<td>Ralph M. Parsons, Los Angeles; Smith, Hinchman &amp; Grylls, Detroit</td>
<td>1956; 1963</td>
<td>Eligible for the NRHP, contingent upon the integrity of two interior portions of the Building: the Huntsville Operations Support Center (1968) linking Marshall engineers directly to the Kennedy Space Center during the Apollo missions to monitor real-time data; and, the Spacelab Mission Operations Control Facility (1990) which replaced the Payload Operations Control Center at the Johnson Space Center in Houston for the control of Spacelab missions. Featured two IBM 7090 computers in October 1960. Second-story addition to the connecting corridor between wings, 1961. Other major additions (1963) and modifications. Detailed information from the <em>Marshall Star</em>: see bibliography.</td>
</tr>
<tr>
<td>4667</td>
<td>Pump House</td>
<td>High Pressure Industrial Water System</td>
<td>A.M. Kinney, Inc., Cincinnati</td>
<td>1962</td>
<td>Ineligible for the NRHP. Water supplied to test stands. Lined on the exterior with 30-foot high mufflers to control the noise of interior diesel pumps.</td>
</tr>
<tr>
<td>4670</td>
<td>Advanced Engine Test Facility</td>
<td>S-1C Static Test Complex (1966) Saturn V S-1C Static Test Stand (1965) Saturn V Booster Test Stand (1965) Saturn Static Test Stand (1961, 1966)</td>
<td>Aetron / Aerjet, Covina (Los Angeles)</td>
<td>1961</td>
<td>Eligible for the NRHP. Site of the Horton family farm, pre-1941. Nearby area included house, pear orchard, well, and school. School on site of Building 4665, pre-1941. Also, as of 1946, a 135-acre area in the immediate vicinity served as a burial zone for mustard and other warfare gases from World War II. In 1961, a unit from the Army Chemical Center at the Edgewood Arsenal, Maryland, removed two feet of dirt from three acres at the Building 4670 site, checking for contamination.</td>
</tr>
<tr>
<td>4672</td>
<td>West Test Area LH2 Storage Facility</td>
<td>Liquid Oxygen Tank (1966)</td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4673</td>
<td>Fuel Tanks</td>
<td>R.P. Fuel Tank (1966)</td>
<td></td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
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<tr>
<td>4674</td>
<td>Control Facility</td>
<td>Control Center Building (1966) Saturn Static Test Facility Control Center (1961)</td>
<td>Aetron / Aerojet, Covina (Los Angeles)</td>
<td>1961</td>
<td>Eligible for the NRHP. Blockhouse for Saturn static test stand, Building 4670, and, F-1 engine static test stand, Building 4696. 750 feet of underground cable raceway connect the blockhouse to the two test stands, with more than 1,000 channels of instrumentation in 1966.</td>
</tr>
<tr>
<td>4675</td>
<td>Boiler House</td>
<td></td>
<td></td>
<td></td>
<td>Ineligible for the NRHP. Prefabricated structure. Included in the contract for Building 4674.</td>
</tr>
<tr>
<td>4676</td>
<td>Helium Compressor Building</td>
<td>Helium System Building</td>
<td>Aetron / Aerojet, Covina (Los Angeles)</td>
<td>1962</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4677</td>
<td>Test Cell</td>
<td>Hydrogen Cell Building</td>
<td></td>
<td></td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4678</td>
<td>Shop Building</td>
<td></td>
<td></td>
<td>1966</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4679</td>
<td>Electrical Equipment Building</td>
<td></td>
<td></td>
<td>1965</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4696</td>
<td>Hydrogen Engine Test Facility</td>
<td>F-1 Engine Test Stand (1965: Marshall Star, 1966) F-1 Test Facility (1962)</td>
<td>Aetron / Aerojet, Covina (Los Angeles)</td>
<td>1962</td>
<td>Eligible for the NRHP. Replaced two prefabricated buildings on site, with the salvaged components of these two structures reused as a single structure about a mile distant (building number unknown). The Aerojet contract included the test stand, a preparations building, propellant systems, a high pressure gas system, instrumentation and controls systems, an instrument tunnel, and an observation bunker (Building 4696-1. Detailed information from the Marshall Star: see bibliography.</td>
</tr>
<tr>
<td>4697</td>
<td>Observation Bunker</td>
<td>Saturn Static Test Viewing Facility</td>
<td></td>
<td>1965</td>
<td>Ineligible for the NRHP. Similar to other wooden observation bunkers present for the test stand areas, now removed. Detailed information from the Marshall Star: see bibliography.</td>
</tr>
<tr>
<td>4698</td>
<td>Cable Storage Building</td>
<td></td>
<td></td>
<td>1991</td>
<td>Ineligible for the NRHP.</td>
</tr>
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<tr>
<td>4699</td>
<td>Cryogenic Structural Test Facility</td>
<td>Structural-Thermal Test Facility (1971)S-II Aft Section Test Assembly (1967)</td>
<td></td>
<td>1967</td>
<td>Needs further research before any NRHP assessment is possible.</td>
</tr>
<tr>
<td>4700</td>
<td>Deionized Water Facility</td>
<td></td>
<td></td>
<td>1994</td>
<td>Ineligible for the NRHP.</td>
</tr>
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<td></td>
<td></td>
<td>Manufacturing Engineering Division / Laboratory (area) (1962, 1963)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Guided Missile Center Machine Shop (1952)</td>
<td></td>
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<td></td>
<td></td>
<td>Development Shop (1950)</td>
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<td></td>
<td></td>
<td>White Phosphorous Filling and Storage Building (1941)</td>
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<td></td>
<td></td>
<td>Propulsion and Vehicle Engineering Laboratory [complex] (1967)</td>
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<td></td>
<td></td>
<td>Field Office Building (1966)</td>
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<td></td>
<td></td>
<td>Manufacturing Engineering Division / Laboratory (area) (1962, 1963)</td>
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<td></td>
<td></td>
<td>Field Office, Engineer (1957, 1959)</td>
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<td></td>
<td></td>
<td>Fabrication Laboratory (1957)</td>
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<td></td>
<td>Development Shop Office (1950)</td>
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<td></td>
<td></td>
<td>White Phosphorous Locker and Office Building (1941)</td>
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<td></td>
<td>High Pressure Test Laboratory (1951)</td>
<td></td>
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<td></td>
<td></td>
<td>Compressor Building, White Phosphorous Filling and Storage Group (1941)</td>
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<td></td>
<td></td>
<td>Electric Shop (1957, 1959)</td>
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<td></td>
<td></td>
<td>Fuel Test Shop (1950)</td>
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<td></td>
<td>4.2 Assembly Building (1941)</td>
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<td></td>
<td></td>
<td>Fuel Test Cells (1950)</td>
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<td></td>
<td>Fuse and Propellant Storage / Magazine (1941)</td>
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<td></td>
<td>X-Ray Laboratory (1951)</td>
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<td></td>
<td>Material Test Laboratory (1950)</td>
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<td></td>
<td>L.C.L. Warehouse, Inert Materials (1941)</td>
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<td></td>
<td></td>
<td>Machine Shop (1957, 1959)</td>
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<td></td>
<td>Production Shop II (1950)</td>
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<td></td>
<td></td>
<td>Machine Shop (1941)</td>
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<td>Real Property Number</td>
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<td>NRHP Assessment and Comments</td>
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</tr>
</tbody>
</table>
| 4728                 | Shop and Storage Building | Equipment Test Shop (1959, 1966)  
Machine Shop (1957)  
Test Section Workshops (1950)  
| 4731                 | Storage Building | Chemical Storage Facility (1981)  
Storage Shed (1958, 1959, 1966) | | 1958 | Ineligible for the NRHP. |
| 4732                 | Office and Wind Tunnel Facility | Aerophysics Building (1993)  
High Reynolds Number Wind Tunnel Facility (1964)  
Wind Tunnel Facility (1957, 1959, 1966)  
Air Flow Test Stand (1950)  
Clothing Renovating [Renovation] Building (1941) | Whitman, Requardt & Smith, Baltimore | 1941, 1950-1951 (interior) | Needs interior assessment for NRHP-eligible equipment; heavily altered on exterior. Possibly contains NRHP-eligible wind tunnels on its interior. Examples of very early equipment include three supersonic wind tunnels for key early guided missile work in 1951-1952; a 2” by 3” structure operating at Mach 2.0 to 3.6; a 18cm by 18cm structure operating at Mach 1.37 to 4.6; and, a 15” by 20” structure operating at Mach 1.37 to 4.6—the latter wind tunnel shipped from the Ballistic Research Laboratory at the Army's Aberdeen Proving Ground in Maryland. Expansion of the Air Flow Test Stand was one of the earliest key efforts of the Guided Missile Development Group in 1951. Numbered as Building 429 before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group in 1950. |
Vacuum Tank Facility (1957, 1959)  
Air Flow Test Stand Tank Farm (1950) | | 1950 | Ineligible for the NRHP. Numbered as Building 429-A before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group. |
| 4734                 | Vacuum Pump House | | | 1950 | Ineligible for the NRHP. Numbered as Building 429-B before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group. |
| 4735                 | Air Dryer House | Dryer House | | 1950 | Ineligible for the NRHP. Numbered as Building 429-C before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group. |
| 4736                 | Dry Air Storage Tank | | | 1951 | Ineligible for the NRHP. Numbered as Building 429-D before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group. |
| 4737                 | Dry Air Storage Tank | | | 1951 | Ineligible for the NRHP. Numbered as Building 429-E before mid-1957. Buildings 4732, 4733, 4734, 4735, 4736, and 4737 functioned as a group. |
| 4738                 | Plasma Burn Shed and Storage Building | Sub-Storage for Fabrication Laboratory | | 1957 | Ineligible for the NRHP. |
| 4739                 | SOFI Formulation Facility | Foam Formulation Building (1989)  
Model Shop Building (1963)  
<table>
<thead>
<tr>
<th>Real Property Number</th>
<th>Current Name</th>
<th>Historic Name(s)</th>
<th>Architectural-Engineering Firm(s)</th>
<th>Date Designed</th>
<th>NRHP Assessment and Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>4744</td>
<td>Compressed Air Facility</td>
<td>Gas Cylinder Storage (1966)</td>
<td>Maurice H. Connell &amp; Associates, Inc., Miami</td>
<td>1959</td>
<td>Ineligible for the NRHP. Construction date may be inaccurate. Previously existing with identical building number: Hydrogen Peroxide Storage (1952, 1957, 1959: Building 431-C before mid-1957). Building 4744 may be a renovation of the original structure for hydrogen peroxide storage on site. The early 1950s Building 4744 was part of a four-structure cluster, including Buildings 4741, 4742, 4743, 4744, and 4745. The earliest structures in the group dated to World War II (Buildings 4741 and 4742—historically, Buildings 431 and 431-A), and functioned as an Analytical Laboratory and its Decontamination Building. The other three structures in the group are present by mid-1957 as Gas Cylinder Storage, Hydrogen Peroxide Storage, and an Air Compressor Building, respectively. As of 1958 the key structure, Building 4741, served as a Beryllium Facility where workers cut, drilled, and shaped raw stock beryllium into guidance components (primarily gyroscopes). Beryllium particles and shavings cause severe respiratory problems and skin disease. Toxicity of the surrounding site is unknown. Detailed information from the Marshall Star: see bibliography.</td>
</tr>
<tr>
<td>4746</td>
<td>Office Building</td>
<td>Office Test Laboratory (1957, 1959, 1966)</td>
<td>Whitman, Requardt &amp; Smith, Baltimore</td>
<td>1941-1942</td>
<td>Ineligible for the NRHP; heavily altered. Combined from three individual buildings during 1956-1957: the Engineering Service Office (1941: Building 432), the Production Operations Office (1942: Building 433), and the Drafting Annex (1942: Building 434). In 1956, before remodeling: Building 432 served as administrative and operational offices for the Test Laboratory; Building 433 designed and developed new instruments for the guided missile program; and, Building 434 operated measuring instrumentation for test facilities and planned, prepared, and established design criteria for guided missile test stands.</td>
</tr>
<tr>
<td>4750</td>
<td>Barbecue Facility</td>
<td></td>
<td></td>
<td>1975</td>
<td>Ineligible for the NRHP. Two other structures exist in the records with an identical number. Drawings for a Building 4750, an Industrial Wastewater Treatment Facility, date to 1977. Between at least mid-1957 and 1966, Army records and a master plan list Building 4750 as a High Altitude Test Facility that simulated conditions up to 100,000 feet. The earliest Building 4750, located near today’s Building 4751, dates to 1950 as Building 430, erected with Buildings 4747 [Building 435] and 4748 [Building 403].</td>
</tr>
<tr>
<td>4751</td>
<td>High Pressure Air Storage</td>
<td>High Pressure Air Battery (1951, 1957, 1959, 1966)</td>
<td></td>
<td>1950-1951</td>
<td>Ineligible for the NRHP. Numbered as Building 430-A before mid-1957. NOTE: 1950s functions for Buildings 4750, 4751, 4752, 4753, 4754, and 4755 (Buildings 430 and 430A, A2, B, C, and D) suggest that the overall site may have been historically toxic.</td>
</tr>
<tr>
<td>Real Property Number</td>
<td>Current Name</td>
<td>Historic Name(s)</td>
<td>Architectural-Engineering Firm(s)</td>
<td>Date Designed</td>
<td>NRHP Assessment and Comments</td>
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<tr>
<td>4760</td>
<td>Surface Treatment Facility</td>
<td></td>
<td>Aerojet-General Corporation, Covina (Los Angeles)</td>
<td>1957</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4761</td>
<td>Waste Water Treatment Facility</td>
<td></td>
<td></td>
<td>1991</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4764</td>
<td>Chemical Storage Building</td>
<td></td>
<td></td>
<td>1961</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>4765</td>
<td>Space Station Coating Facility</td>
<td></td>
<td></td>
<td>1993</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>Real Property Number</td>
<td>Current Name</td>
<td>Historic Name(s)</td>
<td>Architectural-Engineering Firm(s)</td>
<td>Date Designed</td>
<td>NRHP Assessment and Comments</td>
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<tr>
<td>4767</td>
<td>Inert Propellant Casting Facility</td>
<td>Drum Storage Facility (1999)</td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP.</td>
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<tr>
<td></td>
<td></td>
<td>Silicone Spray Facility (1980)</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td>Instrumentation Bunker (1964)</td>
<td></td>
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<tr>
<td>4775</td>
<td>High Reynolds Number Facility</td>
<td>Multi-Purpose Experimental Test Building</td>
<td></td>
<td>1967</td>
<td>Needs further research before any NRHP assessment is possible.</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>50-foot diameter receiver sphere, 1975.</td>
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<tr>
<td></td>
<td></td>
<td>Bisonic Wind Tunnel Facility (1980)</td>
<td></td>
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<td></td>
<td></td>
<td>Thermal Acoustic Jet Facility (1971)</td>
<td></td>
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<tr>
<td>4777</td>
<td>Engine Dynamic Fluid Flow Facility</td>
<td>Space Shuttle Main Engine (SSME) Dynamic Fluid Flow Facility</td>
<td></td>
<td>1984</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>8037</td>
<td>Barge Docks</td>
<td>Ashburn &amp; Gray, Inc., Huntsville</td>
<td></td>
<td>1964</td>
<td>Ineligible for the NRHP.</td>
</tr>
<tr>
<td>Unnumbered Observation Bunkers</td>
<td>Observation Bunkers</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1953-1958</td>
<td>Eligible for the NRHP. Includes six known observation bunkers: the steel and earthen bunker for Building 4665; an earthen-mounded bunker south of Buildings 4548 and 4588 (test stands); a steel bunker immediately southwest of Building 4560; Building 4560; a steel bunker attached to Building 4598; and a steel bunker to the near west of the Building 4524 cluster. The site of another major bunker (Building 4571)—similar in design to Building 4560—exists to the southeast of Building 4572. This bunker is now completely removed.</td>
</tr>
</tbody>
</table>
Appendix C

HABS Level IV Inventory
NAME(S) OF STRUCTURE: Buildings 4200, 4201, and 4202

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1961, 1962, and 1964

ARCHITECT/ENGINEER: Wyatt C. Hedrick

USE (ORIGINAL/CURRENT): Offices
Central Laboratory and Office (Building 4200)
Engineering and Administration (Building 4201)
Project Engineer Office (Building 4202)

NRHP ASSESSMENT: Building 4200 is independently eligible under Criteria A and B. Buildings 4201 and 4202 are contributing to a three-building district.

INTEGRITY: Excellent

DESCRIPTION: Building 4200 is a nine-story, steel-frame office tower showcasing curtain wall construction. The ground floor features a center lobby, utilities core, auditorium, library, and offices. Eight upper floors are uniformly designed around a utilities core and conference room, wrapped by offices. A penthouse includes two conference rooms, each with individual projection room attached, an observation area, and roof deck access. Footprint for Building 4200 is T-shaped, 216'4" by 92'5" on the facade axis and 183'5" by 92'5" on cross axis. Buildings 4201 and 4202 complement Building 4200, designed to be nearly identical and erected sequentially. Each is a six-story office tower, with basement. Mechanical equipment occupies the basement level, with storage areas. Ground and upper floors feature offices wrapping around a center utility core and small conference room. Footprints for Buildings 4201 and 4202 are rectangular, with placement parallel to one another behind Building 4200. Dimensions are 218' by 70'. A fourth office tower, Building 4203, completed the site in the early 1990s, and is non-contributing to the original group.

HISTORICAL DATA: Building 4200 is the first headquarters office designed for NASA at the Marshall Space Flight Center. As planned, the tower was initially a stand-alone design by Fort Worth architects Wyatt C. Hedrick. NASA quickly decided to add the second office tower, with intentions of a final three-tower design as of 1962. Wyatt C. Hedrick designed the second tower, Building 4201, but the third tower, Building 4202, was the work of an Oklahoma City firm Hudgins, Thompson, Ball & Associates. Buildings 4201 and 4202 are nearly identical, nonetheless.

SIGNIFICANCE: Buildings 4200, 4201, and 4202 contained the offices of the division chiefs at the Marshall Space Flight Center. During the 1960s into the middle 1970s, this group included a number of the German scientists and engineers who had come to the Redstone Arsenal with Dr. Wernher von Braun in 1950. Many of these men had worked together at Peenemünde during World War II and at Fort Bliss, Texas, under Project Paperclip after the war. The group at the Redstone Arsenal included added German professionals from two successive recruitments of the 1950s. Only after a major reorganization beginning in 1973, did the German character of upper management at the center seriously change. Buildings 4200, 4201, and 4202 are strongly associated with the space careers of an internationally renowned group of men, and complement similar associations between the Army Ballistic Missile Agency and Building 4488.

PHOTOGRAPHS: Building 4200: JZ Roll 2, Frame 10, NE, 3/07/02; Building 4201: JZ Roll 4, Frame 15, SE, 3/11/02; Building 4202: JZ Roll 4, Frame 23, NW, 3/11/02

Building 4200: Looking northeast. 7 March 2002. J. Zielinski

Building 4201: Looking southeast. 11 March 2002. J. Zielinski
Building 4202: Looking northwest. 11 March 2002. J. Zielinski

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
Name(s) of Structure: Building 4313

Location: Marshall Space Flight Center
          Huntsville, Alabama

Date(s) of Design: 1941

Architect/Engineer: Whitman, Requardt & Smith

Use (Original/Current):
- Ethylene Generator Plant (1941)
- Storage (1950)
- Structural Testing Laboratory (1951-1959)
- Rocketdyne Service Center (1960)
- Structural Testing Laboratory Storage (1966)
- Storage (2001)

NRHP Assessment: Eligible under Criteria A and C.

Integrity: Good. Window additions as of the early 1950s. Later exterior changes in keeping with original design and construction.

Description:
Building 4313 is a steel-framed structure, with steel roof truss, sheathed and roofed in corrugated asbestos metal siding. Foundation is spread concrete footings. As designed and built, Building 4313 had only minor fenestration. Footprint for Building 4313 is L-shaped, 127'6" by 83'2".

Historical Data:
Building 4313 one of four ethylene generator plants erected for Plants Areas 1 and 2 at the Huntsville Arsenal in 1941. The structure is part of a comprehensive design for the arsenal (and for the Redstone Ordnance Plant) completed by the Baltimore architectural-engineering firm Whitman, Requardt & Smith. The Huntsville Arsenal was one of three government-owned, government-operated (GOGO) chemical works in the United States, including those of Pine Bluff in Arkansas and Rocky Mountain in Colorado. Whitman, Requardt & Smith designed all three, having previously worked with the U.S. Army Chemical Warfare Service at the Edgewood Arsenal in Maryland toward a pilot arsenal design in the late 1930s. The Huntsville Arsenal was a “works” facility, producing basic materials required in munitions production.

Significance:
Building 4313 is a rare, nearly intact representative of the chemical munitions manufacturing mission of the Huntsville Arsenal, present within the acreage of the Marshall Space Flight Center today. While other buildings and structures from the World War II arsenal remain at the center, almost all are highly altered on both their exteriors and interiors. Building 4313 is also associated with a very early Cold War mission, adapted as a structural test laboratory in 1951 through the addition of an exterior corner steel missile tower, 50' tall and 12' square, on an angled 20' base (today removed). Drawings label the tower as a facility for missile vibration testing.

Photographs:
Building 4313: JZ Roll 2, Frame 23, NW, 3/07/02 (See Appendix A for additional photographs)

Inventoryed By:
Building 4313: Looking northwest. 7 March 2002. J. Zielinski

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4471

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1941 ARCHITECT/ENGINEER: Whitman, Requaardt & Smith

USE (ORIGINAL/CURRENT): Mustard Munitions Filling Plant (1941)
Storage (ca.1946-1960)
Saturn Systems Office (early 1960s)
Marshall Center Space Museum / Orientation Center (1962-1963)
Storage and Office (2001)

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Initial assessment: good. Additional refinement of integrity assessment is recommended.

DESCRIPTION:
Building 4471 is a steel-framed structure, with steel roof truss, originally sheathed and roofed in corrugated asbestos metal siding. Foundation is spread concrete footings. As designed and built, Building 4471 had only minor fenestration. Footprint for Building 4471 is rectangular, 72'11" by 147'9". In mid-1958, the Army added a small wood-frame room addition to Building 4471, also placing several windows on the south façade of the structure. NASA modified Building 4471 during 1961-1964 for office space and use as a calibration laboratory. These changes appear to be primarily interior to the structure. Building 4471 served as general storage for the Army during the 1950s.

HISTORICAL DATA: Building 4471 is one of two mustard munitions filling plants erected for Plants Area 1 at the Huntsville Arsenal in 1941. The structure sits immediately near the second mustard munitions filling plant, Building 4481. Building 4471 is part of a comprehensive design for the arsenal (and for the Redstone Ordnance Plant) completed by the Baltimore architectural-engineering firm Whitman, Requaardt & Smith. The Huntsville Arsenal was one of three government-owned, government-operated (GOGO) chemical works in the United States, including those of Pine Bluff in Arkansas and Rocky Mountain in Colorado. Whitman, Requaardt & Smith designed all three, having previously worked with the U.S. Army Chemical Warfare Service at the Edgewood Arsenal in Maryland toward a pilot arsenal design in the late 1930s. The Huntsville Arsenal was a "works" facility, producing basic materials required in munitions production. In the early 1960s, NASA set up a group of rockets in front of Building 4471, complementing its function as a museum. By July 1963 the display included a Hermes, V-2, Jupiter, Juno II, Redstone, Jupiter C, Mercury-Redstone, and Saturn I first stage.

SIGNIFICANCE: Building 4471 is one of two World War II mustard munitions filling plants at Plants Area 1. Paired with Building 4481, the structure both anchored and defined the center of this plants area for the Huntsville Arsenal. Buildings 4471 and 4481 are the largest manufacturing structures in Plants Area 1, with all surrounding facilities visually subordinate. While Building 4481 contributes to the general feeling and association of the World War II Plants Area 1, this structure is highly altered today. Building 4471, then, remains the sole example of its specific chemical warfare mission at the Huntsville Arsenal that retains an exterior integrity appropriate to the National Register. While the two mustard munitions filling plants were redundant in specific mission as a military precaution, the overall duplexed design of Plants Areas 1 and 2 did not include mustard munitions filling plants at each location.

PHOTOGRAPHS: Building 4471: CG Roll 8, Frame 18, NE, 1/16/02

Building 4471: Looking southeast. 7 March 2002. J. Zielinski

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4476

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1963
ARCHITECT/ENGINEER: Sverdrup & Parcel

USE (ORIGINAL/CURRENT):
- Acceleration and Environmental Test Facility (1963)
- Acceleration, Test and Calibration Facility (1964)
- Saturn V Instrument Test Facility (1964)
- Marshall Avionics System Test (MAST) Beds Facility / FSL Simulation Facility (1965)
- Hardware Simulator Laboratory (1987)
- Optical Vertical Test Facility (2001)

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Initial assessment: excellent. Refinement of assessment, to include interior equipment, is recommended.

DESCRIPTION: Building 4476 is a specialized test structure including 14,000 square feet of laboratory space, a 120-foot tall tower for acceleration testing, a large centrifuge, and an acoustical chamber for noise experiments. Footprint for Building 4476 is an irregular rectangle, with general dimensions of 256'6" by 95'7", exclusive of offsets on the north façade. A tunnel system exists beneath Building 4476, running the length of the structure and featuring several short perpendicular corridors. Two tunnel corridors access the test tower on the north and a circular chamber on the south. The test tower is 26'6" by 26'7" in footprint. Building 4476 is predominantly a single story in height, although does include a limited second floor. Two large control rooms on the south façade are high-bay in type, open to the second story. Mechanical equipment, generators, and batteries occupy the west end of Building 4476, with vibration equipment, power supply, and test units sit at the east terminus. Laboratory space, inclusive of a computer room, defines the center, first-floor section.

HISTORICAL DATA: The St. Louis engineering firm Sverdrup & Parcel designed Building 4476 for use by the Astrionics Laboratory at Marshall. The facility accommodated tests of the guidance instruments for Saturn V. Building 4476 simulated spins and shakes that Marshall engineers anticipated Saturn V would encounter in space. The centrifuge combined vibration and spinning features, while the test tower allowed engineers to shoot working components of Saturn V up and down to test different effects of intense acceleration. In the acoustical chamber, engineers subjected instruments to noise levels predicted during launch. Building 4476 sits immediately to the east of the Astrionics Laboratory (Building 4487).

SIGNIFICANCE: Building 4476 is a key test facility for the Astrionics Laboratory (earlier known as the Guidance and Control Laboratory). The test tower, as well as the centrifuge and noise chamber, offered specialized experimental conditions for research, development, test, and evaluation of guidance instrumentation on the Saturn V. Saturn V represented the culmination of the Saturn program. This large and powerful booster was critical to the achievement of landing a man on the moon. The first stage of the Saturn V incorporated four F-1 engines, and used RP-1 kerosene and LOX fuel for propulsion. The upper two stages of the Saturn V accommodated increased payload weights. The Saturn V launch system defined the Apollo mission, also making possible Skylab.

PHOTOGRAPHS: Building 4476: CG Roll 4, Frame 13, SE, 1/13/02


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Buildings 4550 and 4551

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1963 ARCHITECT/ENGINEER: Maurice H. Connell & Associates

USE (ORIGINAL/CURRENT): Advanced Saturn Dynamic Test Facility (1963)
Space Shuttle Mated Ground Vibration Test Facility (1975)
Microgravity Drop Tower (Heritage) (2001)

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION: Building 4550 is a dynamic test stand for the Saturn V. The main steel framing of the tower is 360' tall, with the height of the structure increased by another 115' when the topmost 200-ton derrick is fully extended. Building 4550 is 122' (north/south elevations) by 98' (east/west elevations) in footprint, although engineers originally planned for a structure 98' square. Maximum center bay size is 74' by 74'. A reinforced concrete base of the tower measures 125'3" by 101'2". Corrugated metal siding sheathes the test stand. Two small hoist houses sit at the base of Building 4550 on its east and west facades. Hoist houses contain derrick hoist machinery and air compressors. Other features of the test stand include a drop tube running the height of the steel framing on the north facade, two loading deck levels at 120' and 216' with movable side beams, landings for the 16 levels of the stand, a 175-ton derrick at level nine on the east facade, an elevator, two heated and air-conditioned instrumentation and control shelters, and two reinforced concrete tunnels for connective cables. A one-story, reinforced concrete terminal structure, Building 4551, stands immediately adjacent at the west base of the test stand and contains instrumentation and controls. NASA also enhanced facilities for extending high pressure air and nitrogen piping, as well as industrial and potable water systems to the stand.

HISTORICAL DATA: The Miami architectural-engineering firm of Maurice H. Connell & Associates designed Buildings 4550 and 4551, with the latter structure an ancillary unit for the test stand. Maurice H. Connell had worked at the Redstone Arsenal upgrading load lines late in World War II, and was a prominent firm working in the east test area and elsewhere at the arsenal between 1957 and 1963. The mission of the Saturn V vehicle was to launch the Apollo three-man spacecraft to the moon. The vehicle was also critical to the Skylab program. Engineers suspended the Saturn V in Building 4550, subjecting the vehicle to electrical and mechanical vibration tests to simulate free flight conditions. Hydrodynamic supports allow up to six degrees of movement, with loads “induced in the pitch, yaw, or longitudinal axis to obtain resonance frequencies and bending modes” (Butowsky May 15, 1984).

SIGNIFICANCE: Buildings 4550 and 4551, together, are a major test facility of the Saturn program at the Marshall Space Flight Center. Engineers modified Building 4550 after Saturn V testing to accommodate testing for the Space Shuttle. In 1984, Building 4550 became a National Historic Landmark. At that time, NASA was retaining the test facility on a standby basis.

PHOTOGRAPHS: Building 4550: KW Roll 4, Frame 34A, NW, 1/11/02; Building 4551: KW Roll 5, Frame 8, NW, 1/11/02 (See Appendix A for additional photographs)

Building 4551: Looking northwest on the left, at the base of Building 4550. 11 January 2002. K. Weitze

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4560
1950s Observation Bunkers in the East Test Area

LOCATION: Marshall Space Flight Center
Huntsville, Alabama


USE (ORIGINAL/CURRENT): Observation Bunker

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION: Building 4560 is an unusual observation bunker, erected in the east test area with an orientation toward a now-removed test stand (former Building 4564, not to be confused with today’s Building 4564). Building 4560 is of undetermined height from the existing grade. A flight of concrete stairs 7'2” wide climbs a length of 40' to an 8’ tunnel into the bunker. Sitting on a circular 3'-thick reinforced concrete platform 26' in diameter, the bunker is 10' in diameter and 13'3” high at its apex. Steel reinforcing infilled with gunnite comprise its shell, with six individual thick-glass viewing ports. The viewing port of the bunker faces northeast. A 3' by 7' by 1.75' hollow steel blast door accesses Building 4560. Steps rises 43” to a steel-grated platform inside. A conical earthen berm approximately 60’ in diameter at its base surrounds the bunker, inclusive of an original 5’ gravel walkway along the eastern side of the structure connecting to the former Building 4564. The earthen berm encases the bunker to a height of 8’3”, leaving only the upper domed 5’ of the structure exposed. Electrical conduits connected Building 4560 to the former Building 4564. The Army had erected Building 4564 as one of the original test stands (horizontal) in the east test area in 1954. In 1956, engineers converted the former Building 4564 to a 110’ vertical power plant test stand for the H-1 with two static firing positions.

HISTORICAL DATA: The Miami architectural-engineering firm of Maurice H. Connell & Associates designed Building 4560. Building 4560 replaced a small steel ca.1954 bunker that remains to the near southwest. The original bunker (unnumbered) is likely the design of German engineer Fritz A. Vandersee, who was also responsible for the design and fabrication of the test stands and bunker for Building 4665 in 1952. Maurice H. Connell also designed a second nearly identical large observation bunker in the east test area in January 1959. This structure, the former Building 4571, stood to the southeast of Building 4572. Today, nothing remains of Building 4571 at its site. Building 4571 appears to have been even taller than Building 4560, although is also of undetermined height. Its access stairs were 45’6” long, leading to a 22’ entry tunnel. The bunker for Building 4571 was otherwise identical to that of Building 4560 in size, shape and materials, but featured two viewing positions to the northwest (clustered as three and six individual viewing ports) to accommodate the two static firing positions on Building 4572.

SIGNIFICANCE: Building 4560 is one of six known remaining bunkers from the 1950s in the east test area, with the site of Building 4571 reflective of a seventh. Building 4560 is unique at Marshall, and may also be unique nationwide. The other early bunkers include four steel bunkers: one behind Building 4560, one south of Building 4588, one northwest of Building 4522, one today incorporated into Building 4596, and, one part of Building 4665. The unnumbered bunker collocated with Building 4560 is highly evocative of the very earliest days of guided missiles testing, and is strongly complemented by the addition of the next-era bunker, Building 4560.

PHOTOGRAPHS: Building 4560: KW Roll 9, Frame 19A, NE, 1/16/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Buildings 4566 and 4666

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1954-1965
ARCHITECT/ENGINEER: Ralph M. Parsons; others

USE (ORIGINAL/CURRENT): Test Division Engineering Complex

NRHP ASSESSMENT: Eligible under Criteria A, B, and C.

INTEGRITY: Excellent

DESCRIPTION: Buildings 4566 and 4666 have functioned as an office and laboratory complex for the Test Engineering Division from the construction of the first facilities on site through today. The office grouping accrued as a series of expansions. Both buildings began as small structures, and both underwent two sequential major additions. Building 4566 contains the original office on site, designed in 1954. Its additions date to 1956 and 1965. NASA added Building 4666 at the location in 1961, with additions in 1963 and 1965. A 200' tunnel under Dodd Road connects the two offices as a single complex. Building 4566 is a one-story, L-shaped structure as completed in 1966. The earliest part of Building 4566 sits back from Dodd Road, with its original entrance facing north—today, in the easternmost portion of the building. The first Building 4566 was rectangular in plan, 125'4" by 44', and of concrete block construction. In 1956, an L-shaped addition to Building 4566 expanded the offices toward and along Dodd Road. The façade along the east side of Dodd Road became the primary one for Building 4566 as of this date. The middle 1950s Building 4566 featured a north-south wing 356' by 50', and an east-west wing 175'4" by 44'. In 1965, a final expansion wrapped around the original structure to the east, added another 76' to the east-west wing and increasing the wing’s depth by 24' for the length of 155'. The earliest portion of Building 4666 sits at the southernmost end of the structure today. The rectangular, two-story reinforced concrete building is approximately 218' by 41' in footprint. Its lower story is substantially below ground, with the connecting tunnel to Building 4566 part of its construction. The first addition to Building 4666 extended the office to the north. This two-story section is 124' by 121'2", with a center open courtyard and no basement. A 36' vestibule connects the addition to earlier parts of the building. The final north addition is also two stories, 225' by 40'11", again connected to its predecessor via a 24'6" vestibule. Design of the entire complex is cohesive.

HISTORICAL DATA: The architectural-engineering firm Ralph M. Parsons of Los Angeles designed the 1954 and 1956 (majority) of Building 4566, while regional architectural firms handled the successive designs of Building 4666. Test engineers for projects in the east and west test areas worked in the complex, with classified records facilities included on site.

SIGNIFICANCE: Buildings 4566 and 4666 are associated with the careers of prominent engineers working for the Army Ballistic Missile Agency and NASA, inclusive of a number of the original German professionals associated with the Redstone, Mercury-Redstone, Jupiter, Juno, and Saturn programs. Building 4566 originally sat behind an L-shaped earthen berm to shield the structure from testing planned in the east test area. Expansion of Building 4566 is primarily associated with the Army’s testing for Mercury-Redstone, Jupiter, and Juno, while the addition of Building 4666 is illustrative of the priority of NASA’s Saturn mission. The steadily increasing size of the Buildings 4566 and 4666 is reflective of the important role played by the complex. The first Building 4566 is part of the comprehensive Parsons-Aerojet design for missiles test at the Redstone Arsenal.

PHOTOGRAPHS: Building 4566: CG Roll 1, Frame 10, S/SE, 1/12/02; Building 4666: KW Roll 5, Frame 15, SW, 1/12/02


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4570

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1953, 1963
ARCHITECT/ENGINEER: Parsons-Aerojet; Bechtel

USE (ORIGINAL/CURRENT): Blockhouse

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION: Building 4570 is the blockhouse for the east test area. As designed, the blockhouse connected via cableways to three test stands of the early and middle 1950s: Buildings 4564 (former), 4572, and 4588. As the east test area expanded, the blockhouse also became the control center for tests run on added stands of the early 1960s. These facilities paired with ancillary terminal buildings (Buildings 4550 and 4551; Buildings 4557 [today removed] and 4558; and, Buildings 4514 and 4553). The original Building 4570 is a reinforced concrete structure of combined one- and two-story height, with basement, configured as the eastern half of the blockhouse today. Approximate footprint dimensions were 109'5" by 50'+, oriented on a northwest/southeast axis. The south façade features 11 viewing ports on both the first- and second-floor levels, facing Building 4572. The upper floor of the east façade includes another five viewing ports. A major addition of 1963 more than doubled the square footage of Building 4570. A two-story addition, with basement, to the west, and a small one-story addition, without basement, to the east, comprised the expansion. The lengthened south face of Building 4570 continued the patterning of viewing ports facing Building 4572 (eight on each of the two levels), while the new west façade included three viewing ports on the first floor and five on the second (clustered at the corner). The original Building 4570 included three basement cable tunnels, oriented north, south, and west as they exited the structure. After the addition of the early 1960s, a new cable tunnel exited the basement at the southeast corner, and paralleling the original north tunnel. These cableways connected to Buildings 4551 and 4558, terminal buildings for the Saturn V and Saturn I dynamic test stands, and, to Building 4553, terminal building for the liquid hydrogen facility used for testing the J-2 rocket engine. As modified, the cableway to the former Building 4564 passed through Building 4553 enroute.

HISTORICAL DATA: The Los Angeles engineering firms of Parsons-Aerojet and Bechtel designed Building 4570, with the work of Bechtel directly continuing the first efforts of Parsons in exterior appearance and materials. Building 4570 is the major control facility for the east test area, and is one of the first major structures on site (including Buildings 4572 and 4573).

SIGNIFICANCE: Building 4570 is one of three large blockhouses in the east and west test areas today. The east half of Building 4570 is the earliest permanent blockhouse erected for guided missiles testing at the Redstone Arsenal, dating to 1953. Its single predecessor is the blockhouse and observation bunker for Building 4665, a structure designed and fabricated in 1952 from three World War II chemical tanks remaining at the arsenal. Plans for Building 4570 and three major test stands of the east area date to 1951, but were put on hold due to a hiatus in funding—which had necessitated construction of Building 4665 as an interim measure. The two later blockhouses for the east and west test areas are also of note: Building 4674 designed by Aerojet in 1961, and, a major expansion of Building 4561 by Bechtel in 1964. Building 4570 is of greatest significance as the blockhouse for Redstone, Jupiter, Juno, and Saturn testing on Building 4572.

PHOTOGRAPHS: Building 4570: KW Roll 3, Frame 13, SE, 1/12/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Buildings 4572 and 4573

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1953
1958
1962
(Building 4573) 1942

ARCHITECT/ENGINEER: Parsons-Aerojet; Maurice H. Connell

USE (ORIGINAL/CURRENT): Static Test Stand and Gantry Crane

NRHP ASSESSMENT: Building 4572 is eligible under Criteria A, B, and C. Building 4573 is eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION: Buildings 4572 and 4573 are functionally a single static test complex comprised of a test stand and its gantry crane. Building 4572 stands 175' high, with an irregular footprint. The test stand incorporates a terminal room, shop and equipment rooms, offices, and storage in an L-shaped structure extending from the rear. The attached multi-purpose structure includes a small basement connected via a cable tunnel to Building 4570, a full first floor, and a stepped configuration of second and third floors. Overall footprint of tower base and its attached structure is 65'7" by 67'6". Building 4572 is a T-stand, featuring two test positions (east and west). Upper steel T trusswork extends approximately 460' east-west at the top of the test stand. Building 4573 is a 45-ton revolving gantry crane of 1942, adapted for inclusion at the test stand in 1953. Moving on tracks from east to west 431'4" along the north face of the test stand, Building 4573 features a rotating, enclosed cab with a crane that extends 110'. Its main hook-and-pulley has a capacity of 40 tons at a 40' radius, as designed and engineered, while a whip hook-and-pulley at the end of the crane has a capacity of 10 tons at any radius. Building 4573 is 60'1.25" from tracks to cab platform. The cab and upper counterweight stand another 36'5.75". A second 100-ton overhead crane also augments the facility. The Army and NASA improved the static testing capacity of Building 4572 multiple times, augmenting the test positions to accommodate increased pounds of thrust. By 1961, the west position could test articles up to 500,000 pounds of thrust, while engineers had enhanced the east position to 1.5 million pounds of thrust.

HISTORICAL DATA: The Los Angeles engineering firm of Parsons-Aerojet designed Building 4572. The revolving gantry crane, Building 4573, appears to be a feature added by the Redstone Arsenal. Original drawings for the test stand date to August 1953, with the test stand mapped as completed by August 1954. (The Corps of Engineers signed off on the drawings in 1955, with a final as-built acceptance date of 1957—these dates have led to confusion about the design date of the test stand.) The Washington Iron Works of Seattle manufactured the revolving crane. Drawings for the crane date to June 1942, with adaptation for the Redstone Arsenal in October 1953. Use of a World War II stock piece of equipment to augment Building 4572 is in keeping with the frugality and creativity manifested at the Redstone Arsenal by the German scientists and engineers developing the guided missiles program during the early 1950s. A full set of drawings for the crane, before its adaptation as Building 4573, exist in the NASA History Office flat files in a hard-cover portfolio annotated with the name “Weidner.” In 1956, Mr. H.K. Weidner was the Deputy Director of the Structures and Mechanics Laboratory, working under Directors Dr. Wilhelm Raithel (1955 and earlier) and Mr. William A. Mrazek (as of 1956). These men were all Project Paperclip recruits who had accompanied Wernher von Braun to the Redstone Arsenal from Peenemünde, via Fort Bliss. Building 4573 is illustrative of the hands-on involvement of the Paperclippers in the early design of testing facilities, paralleling their ad hoc construction of Building 4665. First-use date for Building 4572 is unverified and confused in documentary sources. Aviation Week illustrates Buildings 4572 and 4573 as of February 1956, inclusive of a Redstone missile emplaced in the west test position. An Army history of 1961 notes a construction completion date of August 1956. Most probable are shake-down tests using Buildings 4572 and 4573 as of late 1954. Maurice H. Connell & Associates of Miami augmented the east position of the test stand in 1958-1959, inclusive of the 100-ton attached crane, loading and moveable
platforms, a flame bucket, added fuel storage and value pits, and a tall, earthen-bermed observation bunker (the former Building 4571) to the south. By late 1958, the Army was testing the Jupiter in the west test position, and the Juno V in the east position. The Juno V, renamed, became the Saturn booster vehicle. As of mid-1961, NASA had made plans to augment the west position to 1.5 million pounds of thrust, to create a double-position static test stand for the Saturn I vehicle. Maurice H. Connell handled this modification in 1962. After completion of the Saturn program at Marshall, engineers again modified the west position of Building 4572 for testing of a solid rocket booster for the Space Shuttle program.

SIGNIFICANCE: Buildings 4572 and 4573 are a highly significant test complex in the east test area. Building 4572 is the first permanent test stand designed for the Redstone Arsenal, following upon the interim facilities of Building 4665. The tentative circumstances of the early missile and space program—as well as the limited funding for such efforts during the Korean War—are also evoked in the use of a World War II revolving crane to create the gantry on site, Building 4573. The Army and NASA tested the Redstone, Mercury-Redstone, Jupiter, Juno, Saturn, and solid rocket booster for the Space Shuttle in the two positions of the stand. Building 4572 is a National Historic Landmark. As appropriate, the National Park Service is recommended to amend the landmark nomination to include Building 4573 as an integrated ancillary structure servicing the test stand.

PHOTOGRAPHS: Buildings 4572 and 4573: KW Roll 4, Frame 1A, SE, 1/11/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4583

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1954, 1963-1964 ARCHITECT/ENGINEER: Parsons-Aerojet; Bechtel

USE (ORIGINAL/CURRENT): Guided Missile Components Test Laboratory (1954)
Test Stand 115 (1964)

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Good (inclusive of additions)

DESCRIPTION:
Building 4583 is the major missile components test laboratory constructed as a part of the original Parsons design for the east test area. The reinforced concrete and concrete-block structure is two stories in height, with basement. Footprint is irregular, with ground level overall dimensions of 199'1" by 177'2". The first floor is windowless, while the second floor features two small clusters of recessed blockhouse-type viewing ports (fenestration) at the corners of the south façade. The interior of Building 4583 includes seven small test cells along the east face of the first story, with four larger test cells on the east and north faces adjoining. Also a part of Building 4583 is Test Stand 115 (Test Cell 115), located approximately 80' in front of the west elevation as a free-standing unit. Test Stand 115 features a first-story bay 14' tall, with a vertical test chamber of 40' height above. Vertically opening doors run the full 40' of the test stand on its west face. An 8000-gallon water tank sits immediately adjacent to the test stand, with trench beneath the stand itself. An altitude test chamber completes the specialized test facilities, at the northeast corner. The recording facility for the test stand is connected by underground cableway to Building 4561, a structure expanded by Bechtel as a blockhouse at the same time as the addition of Test Stand 115.

HISTORICAL DATA: The Los Angeles engineering firm of Parsons-Aerojet designed Building 4583 as a roughly square structure, inclusive of its 11 interior test cells. Bechtel Corporation, also of Los Angeles, added Test Stand 115 and its recording facility attached at the southwest corner in 1964. The altitude chamber is another addition of later date. Engineers at the Redstone Arsenal, and subsequently the MSFC, used the combustion test cells in Building 4583 to test liquid rocket engine components. Engineers tests scale models of engines to refine data toward the design of flame deflectors for both static testing facilities and launch sites. Men tested the RL-10, H-1, F-1, and J-2 in Building 4583 test cells using 1:20 scale models, also testing the F-1 as a 1:56 scale model. Test cells further accommodated tests of the H-1 and S-3D engines at full scale. NASA modified on of the test cells in the late 1980s for solid rocket testing.

SIGNIFICANCE: Building 4583 is a key structure in the original 1953-1954 Parsons design for the east test area, and is one of the earliest facilities planned and erected for guided missiles testing at the Redstone Arsenal. Parsons first planned to locate Building 4583 to the northeast of Building 4570 (approximately at today’s Building 4550 site), connecting it by cableway to that blockhouse. By 1954, siting had changed (with presumed cableway connections via the cold calibration test stand, Building 4588, to Building 4570). To accommodate expanded tests for the Saturn program, NASA added Test Stand 115, connecting its terminal room addition in Building 4583 to the blockhouse expansion of Building 4561. Building 4583 is of major significance as a test facility for scale-model liquid propulsion engines of the Redstone, Jupiter, Juno, and Saturn, and for scale-model testing of the solid rocket booster of the Space Shuttle.

PHOTOGRAPHS: Building 4583: KW Roll 7, Frame 24, W, 1/16/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4588

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1954

ARCHITECT/ENGINEER: Parsons-Aerojet

USE (ORIGINAL/CURRENT): Cold Calibration Test Stand

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent (test stand); unassessed (tunnel and observation building/preparation annex).

DESCRIPTION:
Building 4588 is a steel test stand of unidentified height. The facility features a small, reinforced concrete tri-level structure beneath the stand, 28'6" by 24' in footprint. The structure beneath the tower includes an upper terminal room, middle instrumentation room, and lower, partially below-ground room, each accessed by vertical steel ladder. The lowest level of the terminal and instrumentation units connects via an underground reinforced concrete tunnel to an observation building and preparation annex. The tunnel measures approximately 52' in length, and is of 6' width and 8' height, with 1'-to-2'-thick walls. Originally numbered as Building 4589, the observation building and preparation annex is assumed to exist today incorporated into Building 4554 along this structure’s north façade (per current footprint outline). The observation building (former Building 4589) is irregular in footprint and features two levels. At the end of the tunnel is a below-ground terminal room, pentagonal in shape and 24' by 21' in its longest dimensions. A 4' diameter steel spiral staircase connects to an aboveground observation room, 22' by 10'6". The observation room features an east-facing façade with two viewing ports deep set in a reinforced concrete wall 1'6" thick. Two 45-degree wing walls at the northeast and southeast corners, each 11' long and 1'6" thick, further protect the observation room from the test stand. On the roof, two periscopes extend upwards 3'4.5", set 7' behind the east façade, 4'3" from the north and south observation room walls. Viewing ports from the periscopes face east, toward the test stand. Behind the terminal and observation building sits a preparation annex, 36' by 23'10". Set on a concrete slab, the annex is a one-story structure, sheathed and roofed in corrugated metal siding.

HISTORICAL DATA: The Los Angeles engineering firm of Parsons-Aerojet designed Building 4588 as one of the three original test stands erected for the Redstone program in the east test area. These first facilities included Buildings 4572 and the former 4564. Engineers cold-flow tested the Redstone’s engine and its hardware at Building 4588, using a single test position. The Army added a second test position in 1957 for the S-3D engine, modifying the stand again in 1959 for the H-I engine. Also in the late 1950s, the Army further altered the stand on its north façade for cold-flow testing tied to the Saturn I. NASA modified Building 4588 again during the 1980s for work on the Space Shuttle program.

SIGNIFICANCE: Building 4583 is a key structure in the original 1953-1954 Parsons design for the east test area, and is one of the earliest facilities planned and erected for guided missiles testing at the Redstone Arsenal. Although unverified, it is assumed that a cableway connects Building 4588 to Building 4570, the original blockhouse for the east test area. Blockhouse plans show remnants of an exiting cableway from its north basement façade, replaced by a new parallel cableway with the addition of the early 1960s. More complete information on the original observation building and annex is needed. Building 4588 is associated with cold-flow testing of engines for the Redstone, Jupiter, Juno, and Saturn, and the Space Shuttle.

PHOTOGRAPHS: Building 4588: KW Roll 5, Frame 2, S/SE, 1/11/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Buildings 4610, 4612, and 4619

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1956, 1959-1966
ARCHITECT/ENGINEER: Ralph M. Parsons

USE (ORIGINAL/CURRENT):
Structures and Mechanics Buildings
Propulsion and Vehicle Engineering Laboratory (Building 4610)
Materials Laboratory (Building 4612)
Structures and Mechanics Building (Building 4612)
Vibration and Static Test Tests (Building 4619, added function, 1959)
Altitude Chamber (Building 4619, added function, 1959)
Load Test Annex (Building 4619, added function, 1962)

NRHP ASSESSMENT: Eligible under Criteria A, B, and C.

INTEGRITY: Excellent

DESCRIPTION:
Buildings 4610, 4612, and 4619 comprise the primary units of the Structures and Mechanics Laboratory (later renamed the Propulsion and Vehicle Engineering Laboratory). Each of these buildings is large, with additions into the middle 1960s. Two wings, east and west, comprise Building 4610. The three-story, concrete-block west wing is the original portion of Building 4610, and is 423' by 51' in footprint. The five-story east wing is an addition of 1961, and is L-shaped. Its primary wing, 293' by 606", includes two partial basement areas. The L-shaped short wing to the immediate south of the east addition is a one-story cafeteria. The west wing is configured as laboratories and offices facing north and south, separated by a central corridor on each floor. The east wing is similar, but includes a center area of larger rooms, inclusive of conference and computer facilities. Building 4612 is comprised of four parallel east-west wings, connected by a perpendicular wing at its western edge. As originally constructed, Building 4612 was F-shaped, with two reinforced concrete and concrete-block east-west wings each 335'8" by 50' and a north-south wing 352'8" by 50'. A free-standing structure, then numbered Building 4616, stood to the north of the base of the F. In 1965, three additions to Building 4612 changed the overall footprint of the structure to one nearing that of today. The final configuration includes an added short east-west wing between the original east-west wings, an east extension of the southernmost original east-west wing, and an infilling between the base of the original F and the former Building 4616 (today absorbed into Building 4612 and not to be confused with a contemporary Building 4616 that is a part of the overall complex). A final extension of the southernmost wing occurred to the east at an undetermined date. Building 4619, a reinforced concrete and steel structure with substantial sections sheathed in corrugated metal, is the most complex structure of the group. Again, its western portion is original, 715'9" by 161' in footprint. Today's interior configuration of the original Building 4619 includes a high-bay area, laboratory, a test cell room, clean room, open and covered pits, and two lines of shops along the north and south. In 1959-1960, the Army added vibration and static test towers, a vacuum and compressor building, an altitude chamber, and a vibration exciter facility to Building 4619, interior to then-existing square footage. In 1962, NASA expanded Building 4619 to the east, with the addition of the load test annex. The annex features a 140' steel tower with moveable crosshead platform. NASA immediately further expanded Building 4619 to the east with a second high-bay space completed by 1966 (an extension of the load test annex facility). The double high-bay addition to the east, like the original west portion of Building 4619, is 715'9" in length and measures 248' wide (irregular).

HISTORICAL DATA:
The Los Angeles engineering firm of Ralph M. Parsons designed the original sections of Buildings 4610, 4612, and 4619. Ralph M. Parsons also handled the vibration and static test towers internal to the west portion of Building 4619 in 1959. A regional firm executed the east wing of Building 4610, while the Miami firm Maurice H. Connell & Associates was responsible for the three additions to Building 4612 of 1965. The load test annex for Building 4619, a structure essentially built around its special interior test tower, is the work of Vitro Engineering of New York. (Vitro had originated as Kellex
Corporation, a firm dating to the middle 1940s and known for its work at Oak Ridge, Tennessee, on atomic weapons manufacturing infrastructure, and, for the instrumentation and master plan design of the early 1950s ranges at Eglin Air Force Base.) Engineers worked in the Building 4610-4619 cluster to develop and test materials and structures suitable for space flight. In mid-1962, the Marshall Star described researchers in Building 4612 as “doing anything from taking X-ray pictures of a piece of aluminum to running salt-water spray tests on a material that has to take the Florida air.” As of April 1965, engineers were ready to test a Saturn V booster (the S-IC) in the load test annex of Building 4619. This was the first such structural test series for the Saturn V in the annex and included a tie-down simulation of a single F-1 firing at full thrust; force applications from all five engine positions to simulate 7.5 million pounds of thrust without gimballing the engines; a five-engine, full gimbal simulation; and, a simulation of sudden engine cut-off.

SIGNIFICANCE: Buildings 4610, 4612, and 4619 functioned together as an extremely important complex of test facilities at the MSFC. With initial structures designed by Ralph M. Parsons in the middle 1950s, the grouping is part of a four-quadrant collegiate-plan of laboratories at the Redstone Arsenal. Known as the Structures and Mechanics Laboratory (and next as the Propulsion and Vehicle Engineering Laboratory), the cluster is also associated with a number of prominent scientists and engineers originally recruited for the Army under Project Paperclip following World War II. In 1955, Dr. Wilhelm Raithel headed the laboratory, followed by Dr. William A. Mrazek in 1956. Buildings 4610, 4612, and 4619 are integral to test programs at the MSFC throughout the Cold War period, inclusive of ones for the Redstone, Jupiter, Juno, and Saturn, and the Space Shuttle.

PHOTOGRAPHS: Building 4610: CG Roll 2, Frame 20, NW, 1/13/02; Building 4612: CG Roll 2, Frame 32, N/NE, 1/13/02; Building 4619: CG Roll 6, Frame 9, NW, 1/12/02 (See Appendix A for additional photographs)


Building 4619: Looking northwest at right center. 12 January 2002. C. Gregory

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4663

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1956, 1963  ARCHITECT/ENGINEER: Ralph M. Parsons

USE (ORIGINAL/CURRENT): Computation Laboratory

NRHP ASSESSMENT: Eligible (contingent upon interior evaluations of specific facilities) under Criterion A.

INTEGRITY: Heavily altered in plan; assumed altered on exterior; interior needs assessment.

DESCRIPTION: As originally designed, Building 4663 is a two-story, concrete-block structure erected as three east-west wings connected to an east perpendicular wing. The E-shaped building also included partial basements. Original footprint is estimated at 317'10" by 192'. During 1958-1960, the Army enclosed the areas between wings as courtyards through the addition of a one-story west façade. By late 1961, NASA had added a second story to the connecting corridors. NASA also undertook an addition of 1961-1962 that extended the east-west wings to the west approximately 100' each. Later changes include a further east extension of the northernmost wing, an addition to the north-south wing at the northeast corner, and a remodeling of the east façade main entry.

HISTORICAL DATA: The Los Angeles engineering firm of Ralph M. Parsons designed Building 4663 as part of the four-quadrant collegiate grouping of guided missile laboratories at the Redstone Arsenal. Smith, Hinchman & Grylls handled the expansion of 1961. The long-established Detroit firm had previously undertaken major buildings for the Army’s Detroit Arsenal (for automotive and tank testing), and were working on an expansion of the aeromedical laboratory complex at Brooks Air Force Base in San Antonio in the early 1960s. Agreement between the Army and NASA ceded Building 4663 to NASA, while the Army built a fully new computer laboratory for weapons R&D at the Redstone Arsenal. In late 1960, immediately after NASA’s occupancy of Building 4663, the computation laboratory featured two IBM 7090 computers. These large scientific mainframes were state-of-the-art for military high-speed applications such as nuclear weapons research and missile detection/tracking. For example, IBM 7090s were also found in the fixed-fence early warning radar network, the Ballistic Missile Early Warning System (BMEWS), erected to track possible Soviet launching of intercontinental ballistic missiles (ICBMs). The three primary radars of BMEWS, those at Thule, Greenland (1960), Fylingdales Moor, Britain (1961), and Clear, Alaska (1963) all featured duplexed IBM 7090s (Weitze 1999: 28-31). As of April 1963, NASA added a Burroughs B-5000 to the computers in Building 4663. Data acquisition equipment fed these computers information from tracking and telemetry equipment used in static and live missile and space-launch firings in a data reduction process. By 1968, the Huntsville Operations Support Center operated inside Building 4663, linking MSFC engineers directly to the Kennedy Space Center during Apollo missions to monitor real-time data and advise as situations arose. In 1990, the Spacelab Mission Operations Control Facility in Building 4663 replaced the Payload Operations Control Center at the Johnson Space Center in Houston for the control of Spacelab missions.

SIGNIFICANCE: The interior Huntsville Operations Support Center of the late 1960s forward and the Spacelab Missions Operations Control Facility of 1990 should be assessed for possible significance pertinent to the National Register. Associated programs are those of Saturn/Apollo, Skylab, Spacelab, and the Space Shuttle.

PHOTOGRAPHS: Building 4663: CG Roll 2, Frame 12, N/NW, 1/13/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4665

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1952-1953
ARCHITECT/ENGINEER: Fritz A. Vandersee

USE (ORIGINAL/CURRENT): Redstone Test Stands and Blockhouse
(formally known as the Interim Ignition Test Stand Site)

NRHP ASSESSMENT: Listed

INTEGRITY: Excellent

DESCRIPTION:
Building 4665 is a grouping of three distinct structures today: two test stands and a blockhouse. Historically, the cluster first included two static test stands for the Redstone and the blockhouse, each constructed as interim facilities pending the funding and erection of the initial permanent test stands (Buildings 4572/4573, the former Building 4564, and Building 4588) and blockhouse (Building 4570) in the east test area. The first of the two test stands appears to be the south test stand on site, built from salvaged scrap metal and constructed for one ignition firing only. As originally erected in 1952, this test stand included a single lower platform near the base of the mounted Redstone, and a small upper platform near the top of the missile (without payload) (Marshall Star 26 July 1961: 6). This test stand is approximately 75' tall, on a 20' by 20' base. Construction of the north test stand, that most commonly referenced as the original Redstone interim test stand, appears to date to late 1952 or early 1953. The steel static test stand is also 75' tall, with a rectangular base 33' by 22'. The stand features two working platforms and four lower levels. An elbow-shaped flame bucket (deflector) directly beneath the test stand channels water into an earthen flame trench aligned northwards. The blockhouse for the two test stands is comprised of three reused chemical tanks from the World War II arsenal, equipped with instrumentation and control devices and connected east-west via an underground cableway to the test stand. An earthen berm protects the blockhouse, with the control center sited to the near east of the test stands. Two small viewing ports face the test stands on its west façade, with two doors added to the first and third tanks on the rear (east) façade. Front and rear stairs also access an open platform atop the blockhouse. Viewing ports are distinctively angled toward the south and north test stands, with that for the south stand somewhat obscured by berming for that for the north. In ca.1955, the Army apparently modified the south test stand through the addition of multiple platforms, or replaced it with a subsequent structure, for the Jupiter. The Army used the reconfigured/replaced test stand additionally as a sound suppression test facility in 1963 (Marshall Star 29 May 1963: 8). Prior to mid-1963, this test stand (today’s southernmost stand on site) was a dry run-up facility, without a deluge system. (The north test stand had included a simple flame bucket with small holes for channeling water as a cooling system during tests.) NASA added a 520', 42" diameter water line to the south stand to convert it for sound suppression tests (for an as yet unidentified test vehicle/engine). Buildings 4667, 4668, and 4669 supplied the added deluge system to the south test stand. In 1956, the Army had also attached a load cell apparatus to the north (Redstone) test stand. Configured as a tower on the south side of the (north) test stand, the load cell apparatus featured hydraulic tanks in a small upper structure sheathed and roofed in corrugated metal panels. A second small structure stands at the base of the load cell apparatus, housing the terminal boards (i.e., is the terminal building for the test stand). Engineers used the added load cell apparatus to measure engine thrust. Also on site were a number of temporary structures including nitrogen and helium trailers, and, a shop area built using modified railroad cars. Today, all temporary structures are no longer extant.

HISTORICAL DATA: German engineer Fritz A. Vandersee, a Paperclip recruit who had worked at Peenemünde with the von Braun group during World War II, designed the test stands and blockhouse. By 1962, Mr. Vandersee was head of the Test Support Shop (in Building 4650), responsible for devising and making many test devices needed by the Army and NASA for guided missiles work at the Redstone Arsenal and the MSFC. The 1952-1953 test stands and blockhouse were the very first missile test facilities built at the
arsenal. In June 1961 the last test of a Mercury-Redstone occurred at Building 4665, culminating 361 static firings on the site since April 1953.

**SIGNIFICANCE:** Building 4665 is listed on the National Register of Historic Places (1976); is an Alabama Historic Engineering Landmark (1979); and, is a National Historic Landmark (1984).

**PHOTOGRAPHS:** Building 4665: CG Roll 1, Frame 16, NW, 1/12/02; KW Roll 5, Frame 27, NW, 1/12/02; KW Roll 5, Frame 30, NE, 1/12/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4670

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1961

ARCHITECT/ENGINEER: Aetron/Aerojet

USE (ORIGINAL/CURRENT): Saturn Static Test Stand
Space Shuttle Components Tests
Advanced Engine Test (as of 1986)

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION:
Building 4670 is a static test stand designed and engineered for the Saturn V booster, and is alternately known as the S-1C Test Stand. The static test stand is approximately 405' tall, inclusive of 138'6" of extension for its upper loading crane. The base of the test stand is 164' by 164' in footprint. Base and foundation of the test stand is reinforced concrete construction, as are the four pylons rising at the corners of the stand. The tower substructure is 32' deep, 190' by 165' in dimension, with foundation walls set into bedrock 40' below ground. Pylon height is 144'. A four-room partial basement exists beneath the west façade of the tower, configured as two shops and electrical/mechanical equipment rooms. The terminal room for the test stand is also placed under the test stand. Four one-story individual “buildings” sit inside the hollow pylons, each approximately 48' square in footprint and 30' square at the top. These spaces contain additional work areas. Pylon walls are 4' thick. Two enclosed shafts sheathed in corrugated metal bracket the interior face of the steel framework of the upper 122'6" of the test stand on the east façade. Trussed framework includes work levels every 10' above the pylon base. Flame bucket (deflector) for the test stand is on the west façade, and measures 85' high, 68' wide, and 110' long. Buildings 4667, 4668, and 4669 provide water and pump capacity for the deluge system required in the flame bucket. About 320,000 gallons of water per minute flowed through the flame bucket in testing of the late 1960s. Building 4670 additionally features an engine removal platform at 93'4", a loading platform at 144', a 150-ton crane on the north façade for the platform work, and the top-mounted crane (south side) with two hooks for tasks up to 200 and 20 tons respectively. An underground 450' cableway tunnel connects Building 4670 to Building 4674 (the west area blockhouse), featuring more than 1,000 instrumentation channels in 1966. In 1974, NASA added liquid hydrogen capacity to Building 4670 for testing the external tanks of the Space Shuttle. Further modifications occurred in 1986 for advanced engine testing derived from the shuttle.

HISTORICAL DATA: Aetron, a division of Aerojet of Los Angeles, designed Building 4670 in 1961, with a contract awarded for the excavation of the foundation of the test stand as of late June that same year. Engineers used the test stand to captive-fire the Saturn V (C-5) booster, the largest rocket then in development, at 7.5 million pounds thrust. Building 4670 accommodated up to 12 million pounds of thrust, as designed. Tower handling equipment and thrust restraint accommodated test vehicles up to 178' in length and 48' in diameter. While the test stand was under construction, the Saturn V booster was also in the early stages of development. In mid-1962, engineers anticipated that the Saturn V would be a vehicle approximately 140' long and 33' in diameter. As of early 1964, NASA engineers had designed an S-1C simulator, a circular, hollow steel-truss structure the length and diameter of the Saturn V booster, with concrete blocks placed on its interior for weight, to run shake tests for Saturn V test facilities at the MSFC, Michoud, Stennis, and Canaveral, inclusive of Building 4670. As of April 1965, NASA engineers ran short single-engine firings of the Saturn V at Building 4670. The S-1C booster featured five F-1 engines, with a full run-up test of all five engines at Building 4670 as of May. Tests started as 15-16 seconds in duration, increased slowly to a full length firing time of 2.5 minutes. Following Saturn testing at Building 4670, the stand accommodated Space Shuttle and advanced engine testing. The engineering firm of Sverdrup & Parcel of Saint Louis modified Building 4670 in 1986 as the Advanced Technology Engine Test Stand.
SIGNIFICANCE: Building 4670 is the first NASA-era test stand built at the MSFC, and inaugurated the west test area. The static test stand is a major engineering achievement. Designed for the Saturn V booster, the stand was in design before completion of vehicle it was to test. The Saturn V booster launched the Apollo capsule, and is associated with putting a man on the moon in 1969. The three-stage Saturn V also was the vehicle for Skylab. NASA continued to use Building 4670 for R&D tied to the Space Shuttle.

PHOTOGRAPHS: Building 4670: KW Roll 2, Frame 26, E, 1/11/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4674

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1961

ARCHITECT/ENGINEER: Aetron/Aerojet

USE (ORIGINAL/CURRENT): Blockhouse

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION:
Building 4674 is the blockhouse for the west test area. The two-story, reinforced concrete structure is 128' by 107' in footprint. Building 4674 is about 44' high. A partial basement includes a main 450' cableway tunnel exiting its west façade and two cableway tunnels of smaller diameter exiting the north and south facades. (The Facilities Databook for the MSFC denotes the smaller tunnels as “future cable tunnels,” but with respect to at least the north tunnel this appears to be an error. The north cable tunnel should be active and connecting to Building 4696, a test stand for the F-1 engine.) Both first and second floors of Building 4674 feature viewing ports across the width of the west façade. Exterior corners of the blockhouse are angled at the northwest and southwest, and include single viewing ports on the first and second stories. Viewing ports continue on the north façade, clustered near the northwest corner. These ports are configured as thee on the first floor and seven on the second story (facing Building 4696). On the south façade, each floor features two viewing ports, closely clustered at the southwest corner of the blockhouse. Massive vertical buttresses (exterior piers) additionally articulate the exterior of Building 4674. The blockhouse is the control facility for two major

HISTORICAL DATA: Aetron, a division of Aerojet of Los Angeles, designed Building 4674 in 1961, simultaneously with its efforts for Building 4670 (the Saturn V static test stand). The blockhouse is the control facility for two major test stands constructed for the Saturn program, Buildings 4670 and 4696. Basement cableway tunnels suggest that NASA originally planned to erect three test stands, with the third positioned to the south of Building 4674, west of the intersection of Saturn and Lem Roads. Building 4674 housed instrumentation, control, and communications equipment, providing a safe area for engineers and test personnel during static firings on Buildings 4670 and 4696.

SIGNIFICANCE: Building 4674 is one of three major blockhouses in the east and west test areas at the MSFC. The earliest blockhouse, that for the east test area, is Building 4570, designed by Parsons-Aerojet in 1953 primarily to accommodate testing at Building 4572. Building 4674 is the second-generation blockhouse, for the west test area, and is also designed by Aerojet. (The third blockhouse, Building 4561, dates to 1964, and is a Bechtel expansion of an existing structure to provide a major control facility for Bechtel test stands added in the east test area during the middle 1960s.) Building 4674 is strongly associated with Saturn testing in the west test area; is paired with Building 4670 in particular; and, is an excellent example of major blockhouse design and engineering for the space program nationwide.

PHOTOGRAPHS: Building 4674: KW Roll 1, Frame 6, NW, 1/11/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4696

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1962
ARCHITECT/ENGINEER: Aetron/Aerojet

USE (ORIGINAL/CURRENT): F-1 Engine Test Stand
Hydrogen Engine Test Facility

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION:
Building 4696 is the second major static test stand designed and constructed in the west test area for the Saturn program. The test stand is of unidentified height, with a base footprint of 102' by 87'2". Foundation and substructure are reinforced concrete, as is the lower portion of the stand. The aboveground reinforced concrete base is configured as four hollow piers, each approximately 18' by 16' in footprint. On the east façade of Building 4696, a two-level rectangular structure measuring 102' by 30' in footprint, contains mechanical and electric equipment rooms and the terminal room in the basement, and, a mechanical shop and control and instrumentation areas on the first floor. The terminal room directly connects to an underground cableway tunnel, estimated at 300', that connects to the west test area blockhouse, Building 4674. The southeast and northeast towers contain stairs that climb 12 levels to a work platform atop the reinforced concrete base of the test stand. The northeast tower continues six and a half additional levels as a steel-frame shaft sheathed in corrugated metal. The northwest and southwest towers contain storage and shop space on several lower levels (with no basement), with stairs climbing seven levels. In addition to the work platform on the 12th level, a rolling deck platform on the 5th level and a loading platform on the 7th level, provide work areas on the test stand. The upper portion of Building 4696 is a steel truss structure, featuring six additional levels that begin one-half level above the work platform. The flame bucket (deflector) for Building 4696 faces southwest (on the west façade). Two cranes, of unidentified ton capacity, complete Building 4696, mounted at the work platform level and atop the test stand. Extant ancillary structures at the test stand include a small earth-bermed observation bunker, Building 4696-1 to the near northwest, and unnumbered sentry booth, blast deflector wall, and warning light post at the southwest corner.

HISTORICAL DATA: Aetron, a division of Aerojet of Los Angeles, designed Building 4696 in 1962, immediately following the firm's efforts for Buildings 4670 (the Saturn V static test stand) and 4674 (the west test area blockhouse). Building 4696 is a run-up test stand for the F-1 engine. The F-1 used liquid hydrogen and kerosene propellants, and operated at 1.5 million pounds thrust. Five F-1 engines powered the Saturn V booster vehicle that launched the three-man Apollo capsule to place a man on the moon. The Rocketdyne Division of North American Aviation, of Los Angeles, designed and engineered the F-1. (Known as the F-1 Engine Test Stand, the F-1 Test Facility, and the Hydrogen Engine Test Facility [by 1963], Building 4696 should not be confused with Building 4548, the F-1 Turbo Pump Test Facility of 1963.)

SIGNIFICANCE: Building 4696 is the second major NASA-era test stand designed for the MSFC. Designed in conjunction with Buildings 4670 and 4674 for static testing critical to the Saturn program. Aerojet designed and engineered Buildings 4696, 4670, and 4674 together during 1961-1962, predating final design and engineering of the Saturn V itself.

PHOTOGRAPHS: Building 4696: KW Roll 1, Frame 16, S, 1/11/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4705

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1952
ARCHITECT/ENGINEER: Robert & Company
1961-1968

USE (ORIGINAL/CURRENT): Missile Assembly Shop
Missile Assembly Shop and Hangar (Buildings 4705/4706, combined)
Neutral Buoyancy Simulator

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Building 4705 has absorbed Building 4706, with the two now a single structure.

DESCRIPTION: Today Building 4705 is one large structure that incorporates the former Buildings 4705 and 4706, with multiple additions and infilling between the two. The original Building 4705 was 296' long, 224' wide, and 52' tall through the center of the high bay. North and south end facades featured the center high bay of 102' width, bracketed by two side bays approximately 34' high (with roofs sloped slightly from the center outwards). The steel-framed shop is designed as a large missile assembly space. Corrugated cement-asbestos siding sheathed Building 4705 as first built. Five warehouse doors accented both the north and south facades of the original shop, with center roll-up door of double proportions. Two levels of north-south fenestration on the east and west facades were of fixed steel industrial sash type. The original Building 4706 was a missile assembly hangar of unidentified original date, but likely also of the early 1950s. Building 4706 was present on site by mid-1957, configured perpendicular to Building 4705 to the near north. Original footprint dimensions of Building 4706 are approximately 236'8" by 89'6". By this date, the Army had added another side shop bay to the west façade of Building 4705, 35'6" wide running the north-south length of the structure with a perpendicular offset of 119'4" by 41'10" in footprint. (These additions appear further altered today.) Also to the near northwest of Building 4705 in mid-1957 were three small semi-permanent structures, numbered as S-4709 (an inspection office), S-4738 (sub-storage for the Fabrication Laboratory), and S-4739 (a Systems Analysis Laboratory office). As of late summer 1961, NASA had construction underway to join Buildings 4705 and 4706. This effort included the north extension of Building 4705 to meet Building 4706, as well as an added offset to the further north of the original Building 4706. By 1962, NASA had removed Building S-4739 from the site, to accommodate the single missile assembly shop and hangar created from Buildings 4705 and 4706. During FY1964, NASA added yet another structure on site, numbered as S-4706. This steel-frame structure, clad in corrugated siding, measured 122'1" by 102'4" in footprint, erected as a mock-up shelter for the Saturn V booster (the C-5 Mock-up Shelter). In 1968, NASA adapted the C-5 Mockup Shelter as the Neutral Buoyancy Simulator, adding a large water tank on the interior. The tank, 75' in diameter and 40' deep, simulated a zero-gravity environment. The infill addition between Building S-4706 and Building 4705 occurred at an unidentified date, but by 1986 contained support facilities for the Neutral Buoyancy Simulator.

HISTORICAL DATA: Robert & Company, an architectural-engineering firm of Atlanta, designed the original Building 4705. The firm had previously designed the very large climatic hangar at Eglin Air Force Base in the 1944-1946 period. (The climatic hangar is a one-of-a-kind facility, and when built was capable of fully housing a B-36 bomber for Arctic testing.) The original Buildings 4705 and 4706 functioned as large shop spaces for the Redstone and Jupiter, joined together for assembly and alignment operations with the upper stages of the advanced Saturn configurations. The Neutral Buoyancy Simulator of 1968 accommodated four astronauts at a time and was also used for testing hardware in a simulated zero-gravity environment. Test specialists monitored neutral buoyancy, an achieved condition of neither rising nor sinking, through port holes on four observation levels, further supported through television and physiological display equipment. Tank water was filtered, temperature-controlled, and continuously recirculated. The facility also included underwater audio and video, and capabilities for emergency rescue.
SIGNIFICANCE: Building 4705 is a complex structure today, derived from two large original buildings of the early 1950s. While important for its role in assembly of missiles at the Redstone Arsenal, and subsequently for the MSFC in the Saturn program, Building 4705 achieved its most noteworthy significance with the addition of the Neutral Buoyancy Simulator in 1968. The simulator provided a unique test environment for zero-gravity conditions and their effects, built to support not only the astronaut program generally but the Skylab (space station) program of the 1970s in particular. Building 4705 became a National Historic Landmark in 1984, designated for its Neutral Buoyancy Simulator as one of 22 facilities nationwide illustrative of the man-in-space theme.

PHOTOGRAPHS: Building 4705: CG Roll 7, Frame 14, NE, 1/16/02 (See Appendix A for additional photographs)

NAME(S) OF STRUCTURE:  Building 4708

LOCATION:  Marshall Space Flight Center
            Huntsville, Alabama

DATE(S) OF DESIGN:  1956; 1960-64  ARCHITECT/ENGINEER:  Ralph M. Parsons; others

USE (ORIGINAL/CURRENT):  Missile Assembly and Inspection Hangar
                          Interior Blockhouse

NRHP ASSESSMENT:  Eligible (pending assessment of interior blockhouse) under Criteria A and C.

INTEGRITY:  Unassessed, needed for interior blockhouse.

DESCRIPTION:
Building 4708 is large missile assembly hangar configured as a center high bay flanked by two lower side bays. Original footprint dimensions of the structure were 278.4' by 231'8". Cement asbestos panels sheathed the steel-frame hangar. During 1960-1961, NASA doubled the size of the hangar through a 200' extension on the west and added a pressure test cell on the south. While construction of the two major additions to Building 4708 overlapped, that for the pressure test cell dated to 1960 and that for the extension to 1961 (design). The test cell is configured as a rectangular addition, 233'10" by 65'. The pressure cell featured a 35' clear height, with a remote control room. The special facility could create pressures up to 3,000 pounds per square inch above normal atmospheric pressure. The test cell is partially integrated into the original Building 4708 to the north. Today the cell features three large clean rooms, two computer rooms, and an airlock on the first floor. Two of the clean rooms are in situated in the cell’s high-bay space. The west extension of Building 4708 lengthened the assembly hangar to a footprint of 505' by 231'8". Flanking bays are two-stories in height, with shops, offices, and laboratories. The enlarged Building 4708 also includes a full basement. The west extension of Building 4708 featured a center-opening hangar door 92'11" wide, approaching the 50'10" height of the high bay. Five feet below its basement floor is a 10'-square grid of copper cable to ground all laboratories in the structure, as well as grounding the steel frame of the building itself. The copper grid reduced electromagnetic interference in the vehicle checkout area. In early 1964, NASA remodeled the interior of Building 4708 to include a two-story structure that housed integrated checkout and weighing equipment for the Saturn V S-IC stages. The checkout facility was computer automated, and occupied about one-quarter of Building 4708's interior. The same year, NASA describes a two-story “blockhouse” internal to Building 4708, used to electrically simulate the first launch of the Saturn V at Launch Complex 39 at Cape Canaveral. Previously, in late 1960, NASA had built an earlier Saturn checkout station inside Building 4708, the Saturn Telemetering Ground Station Complex. Locations, and/or survival, of these checkout facilities—particularly that of the two-story structure of 1964, is unassessed.

HISTORICAL DATA:  Ralph M. Parsons, an architectural-engineering firm of Los Angeles, designed the original Building 4705. Maurice H. Connell & Associates, of Miami, was responsible for the pressure cell addition of 1960, while Sverdrup & Parcel of St. Louis, designed the major extension of 1961. As first constructed, Building 4705 accommodated assembly and inspection of the Redstone and Jupiter missiles. NASA modifications of the facility during the early 1960s supported the Saturn program, with major enhancements for the Saturn V.

SIGNIFICANCE:  Building 4708 requires further assessment of its interior two-story checkout facility of 1964, particularly its ties to Launch Complex 39 at the Kennedy Space Center.

PHOTOGRAPhS:  Building 4708: CG Roll 8, Frame 1, NW, 1/16/02.


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4718

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: ca.1975, 1989
ARCHITECT/ENGINEER: Unidentified

USE (ORIGINAL/CURRENT): X-Ray Calibration Facility

NRHP ASSESSMENT: Eligible under Criteria A and C.

INTEGRITY: Excellent

DESCRIPTION:
Today's Building 4718 is large x-ray test facility configured as four individual structures, Buildings 4718, 4718-1, 4718-2, 4718-3, and 4718-4. Building 4718 is a three-story structure with partial basement, 329' by 100'11" in footprint and substantially designed as a high-bay space. Basement space sits at the west end of the structure, arranged as two large plenum rooms. First floor interior is configured as three mechanical rooms, two high-bay clean rooms, a small cluster of offices, and the x-ray instrument chamber set in a high-bay space. Second floor interior features two mechanical rooms, control room, conference room and office, and vessel platform around the x-ray chamber. The vessel platform connects to the x-ray guide tube on the second floor, west façade. The third floor contains only two rooms, along the south façade: a mechanical room and an experimental control and operations room. A stainless steel x-ray guide tube, of undetermined diameter, extends west from Building 4718. The tube passes through three ancillary structures, Buildings 4718-1, 4718-2, and 4718-3, aligned from west to east toward Building 4718. Tube length is approximated as 1,900' (gross estimate), based on the known east-west footprint dimension of adjacent Building 4708. Building 4718-1 is 41'8" by 22' in footprint, two stories in height. Lower floor contains a mechanical room, while the upper floor is configured as a clean room and terminus for the x-ray guide tube. Also two stories in height, Building 4718-2 is 25'6" by 14' in footprint, identically laid out on its interior. Building 4718-3 is the largest ancillary structure, sited nearest to the primary structure, Building 4718. Building 4718-3 is 55'8" by 39'8" in footprint. Its two stories contain the x-ray source chamber on the first floor, with a mechanical room. Second floor of Building 4718-3 is channels the source chamber from below.

HISTORICAL DATA: Information on the Building 4718 is incomplete. Power to Explore notes that NASA built an “original” x-ray test facility in the middle 1970s. The presentation in Power to Explore implies that this x-ray test facility is today’s Building 4718, substantially modified in 1989 to become the current test complex. The 1970s x-ray test facility featured a 1,000' x-ray tube, 3' in diameter. Possibly the current Building 4718 is an extension of the test facility of ca.1975. Also possible is the earlier presence of two of the three ancillary structures, Buildings 4718-2 and 4718-3. Scientists used the original facility to conduct x-ray verification testing and calibration of x-ray mirrors, telescope systems, and instrumentation. This facility was part of the High Energy Astronomy Observatory (HEAO) program. The main x-ray chamber of the original test facility was 20' in diameter. This dimension is not yet compared with the specifics of the present test chamber in Building 4718. Today’s Building 4718 complex is noted as an improved x-ray calibration facility, used by NASA as its advanced x-ray astrophysics program.

SIGNIFICANCE: Building 4718 requires further assessment of historic lineage. Both the original x-ray test facility of the 1970s and today’s advanced facility are important and unique test structures key to later Cold War scientific missions at the MSFC following upon the Saturn program.

PHOTOGRAPHS: Building 4718: CG Roll 3, Frame 6, E, 1/13/02 (See Appendix A for additional photographs)


Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
NAME(S) OF STRUCTURE: Building 4732

LOCATION: Marshall Space Flight Center
Huntsville, Alabama

DATE(S) OF DESIGN: 1941
ARCHITECT/ENGINEER: Whitman, Requardt & Smith

USE (ORIGINAL/CURRENT): Clothing Renovation (for chemical munitions manufacturing in WWII)
Wind Tunnel Facility (1950-2002)

NRHP ASSESSMENT: Eligible (for wind tunnel equipment) under Criteria A and C.

INTEGRITY: Unassessed (for wind tunnel equipment)

DESCRIPTION:
Today’s Building 4732 derives from a World War II structure constructed for “clothing renovation,” a task of preparing and refurbishing flame-resistant clothing, clothing chemically impregnated for protection against mustard gas, and accessories such as goggles, gloves, and shoe guards. The original building is a small one-story structure of 4,911 square-foot size, rectangular in plan with its longer axis running north-south. This core unit of today’s Building 4732 corresponds to a center portion of the complex along Rideout Road near the intersection at Titan Street, surrounded on its west, north, and south facades by additions. The north-south axis of this 1941 section of the building is approximately 76.8’ long, with the east-west axis about 57.6’. Structural frame of this core unit is reinforced concrete, with hollow tile walls. Foundation is spread footings, with reinforced concrete flooring featuring a 1,000-pounds-per-square-inch loading and originally finished in cement. Roof deck of the original Building 4732 is also reinforced concrete. Interior clear height, is 11’. In 1950, the Army added a rectangular extension to the west, converting Building 4732 as a wind tunnel facility (alternately known as an air flow test stand). The addition was also one story in height and made Building 4732 L-shaped in footprint, although nearly rectangular (with a section cutaway at the northwest corner). Only part of this addition survives today, as a section of the east-west wing measuring about 48’ by 33.6’ in footprint. Sometime between 1955 and July 1957, the Army removed a northern portion of the 1950 wing and lengthened it to the west. Modifications continued into 1959, with a north-south addition at the far west, measuring approximately 75’8” by 36’. In 1962, NASA next added a north-south wing along Rideout Road, 96’ by 30’6” in footprint. Subsequent changes included the addition of a second floor in 1964, followed by miscellaneous modifications into 1992. In 1993, NASA added a final addition, the north-south wing along Rideout Road to the south of the original center core, further renovating the complex at mid-decade.

HISTORICAL DATA: Evolution of Building 4732 dates to several major periods: 1941, 1950-1951, 1958-1964, and the early 1990s. During World War II, the core structure sat somewhat isolated along Rideout Road, with no north neighboring buildings and with a single other structure (then numbered as Building 431) to the near south (later numbered as Building 4741 and today gone). (Building 431/4741 functioned as an analytical laboratory during World War II and as a propeller laboratory in the middle 1950s). Building 4732’s function for “clothing renovation” is assumed to have included the originating preparation of protective garments for chemical munitions workers in Plants Area 1, as well as the cleaning of garments after daily use (and their disposal as appropriate). Low vapor concentrations of mustard gas caused eye irritation, respiratory distress, and, with skin exposure, blistering similar to second degree burns. The Army required workers to bathe and change clothing before leaving the plant each day. In 1950, the Army adapted Building 4732 as a critical wind tunnel facility. Complementing the remodeling and expansion of Building 4732 that year, the Army also erected a cluster of ancillary structures nearby to support wind tunnel testing. Designed and constructed during 1950-1951, these structures included Buildings 4733 (an air flow test stand tank farm: vacuum tanks for wind tunnel testing), 4734 (a vacuum pump house), 4735 (an air dryer house), 4736 (a dry air storage tank), and, 4737 (a second dry air storage tank). By late 1951, the Test Branch of the Redstone Arsenal had installed two supersonic wind tunnels in Building 4732, with a third supersonic wind tunnel acquired from the Army’s Ballistic Research laboratory at the Aberdeen Proving Ground in Maryland. These wind tunnels, all very early equipment used for advancing aerospace R&D dated to sometime before 1951. The equipment may German in origin and of World War II vintage,
part of such equipment dismantled near the end of the war and shipped to the United States for the continued development of guided missiles. Similar wind tunnels were parceled out to Air Force and Navy R&D test installations, such as the Arnold Engineering Development Center (Air Force) in Tullahoma, Tennessee. Epre-1951 equipment in Building 4732 included a 2” by 3” tunnel that operated in the Mach 2.0 to 3.6 range; a 18-centimeter by 18-centimeter tunnel in the Mach 1.37 to 4.6 range; and, the 15” by 20” tunnel in the Mach 1.37 to 4.6 range from Aberdeen. Survival of these wind tunnels today is unknown. Wind tunnel equipment housed in Building 4732 “tested a model of virtually every large rocket ever built here [at the Redstone Arsenal / MSFC] by NASA or the Army [since 1951]” (Marshall Star August 15, 1962: 6). In 1962, coincident with the NASA physical expansion of Building 4732, NASA added the “Big Bertha” super wind tunnel for testing models at hypersonic velocities. A compressor shot air down a 130’ shock tunnel, with the capability of achieving Mach 20. As of August 1962, while Big Bertha was under construction, Building 4732 featured two major working wind tunnels: one 14” in diameter and the other of undetermined dimension. NASA also maintained three launch aerodynamic test facilities outside Building 4732 where engineers placed model rockets on miniature launch pads and blasted them with air to simulate launch conditions at Cape Canaveral. These facilities were alternately named the “launch deflector facility.” Engineers ran 100 to 150 tests in the 14” wind tunnel weekly, at subsonic, trans-sonic, and supersonic speeds, while they used the outdoor launch deflector facility for about 50 tests per day. Another important piece of equipment in use during 1962 was a vacuum chamber that simulated altitude. In this facility engineers tested a six-foot balloon model similar to the design of the Echo 1 communication satellite of 1960. Later equipment added to Building 4732 is unidentified. Building 4732 should not be confused with Building 4775, a High Reynolds Number wind tunnel facility of 1967.

SIGNIFICANCE: Building 4732 requires further assessment of its surviving wind tunnels and specialized test equipment. Although the structure is highly altered on its exterior, its equipment has a high probability of major significance, from as early as ca.1944 into the late Cold War period.

PHOTOGRAPHS: Building 4732: JZ Roll 3, Frame 34, 3/11/02 (See Appendix A for additional photographs)

Building 4732: Looking northwest. 11 March 2002. J. Zielinski

Source: Redstone Arsenal, Alabama, Master Plan Basic Information Maps. Courtesy of Master Planning Office, NASA.
Appendix D

Historic Cemeteries Overview
OVERVIEW OF HISTORIC CEMETERIES KNOWN TO HAVE BEEN AT MSFC

Description

EDAW identified two cemeteries within the Marshall Space Flight Center (MSFC) boundaries during the most recent fieldwork: the Moore/Landman Cemetery and the Jordan Cemetery. Both appear to be historic cemeteries, predating the purchase of the land by the United States Government in 1941. The Moore/Landman Cemetery is located in the southwest quarter of Section 5, Township 5 South and Range 1 West. Situated just south of Centaur Street, the cemetery site is behind Building 4628. A barbed wire fence encompasses the approximately ½-acre site. The Jordan Cemetery is located in the northwest quarter of Section 31, Township 4 South and Range 1 West. The cemetery is located just north of Building 4531 and south of Mariner Road. Surrounded by a rusting wire fence, it measures approximately ¼-acre.

The most complete record of all the cemeteries known to be within the boundaries of the MSFC is red pencil notations located on Basic Information Maps used to create the 1967 edition of the Redstone Arsenal Master Plan, as the boundaries of Marshall are within the boundaries of the larger Redstone Arsenal. These notations identify 43 cemeteries on the Redstone Arsenal, providing names for 26 of the 43. In addition, notes state whether markers exist at each site, referencing the presence of at least one marker at 22 of the 43 cemeteries. Two of these cemeteries are within the MSFC boundaries: the ‘Moore’ Cemetery and the ‘Jordan’ Cemetery. Marshall planners refer to the ‘Moore’ Cemetery as the Moore/Landman Cemetery.

Background

The Bureau of Land Management (BLM) issued land grants in the surrounding townships of Madison County between 1825 and 1913, although the BLM has no land grants recorded in the two sections containing these cemeteries (BLM 2002). Settlement of the surrounding area began around 1804, just before the United States Government purchased it from the Cherokee and Chickasaw Indians (Owen 1921). Although Alabama did not achieve statehood until 1819, territory officials established Madison County in 1808, with Huntsville officially named as the County Seat in 1811 (Turner 1993:22; Shogren et al. 1989:229-230). Most of the original County land sales in the southwestern portion of Madison County occurred in 1809 (Shogren et al. 1989:229-230). Land sales waned from 1810-1815, but increased after the 1818 land survey (Shogren et al. 1989:230). Research conducted by the University of Alabama indicates that the majority of original landowners in the area were slaveholders, buying large tracts for plantations (Shogren et al. 1989:230-231).

Huntsville Arsenal and the Redstone Ordnance Plant

The Army acquired approximately 57 square miles in 1941 to build the Huntsville Arsenal and the Redstone Ordnance Plant. The area purchased by the government comprised some of the most fertile land in Madison County. Major crops included cotton, corn, peanuts, and hay, in addition to various fruits and vegetables (Hughes 1991). The purchased land was comprised of a large farming community, of which 76-percent of the residents was African-American. The rural community of 1941, which consisted of 550 families (about 6,000 residents), lacked telephones, electricity, and indoor plumbing. The character of the land, as well as the members of the community, underwent a dramatic transition after the United States Army purchased the land. Dr. Kaylene Hughes, Redstone Arsenal Historian, states (1991):
Some of the families were tenant farmers, but many, black and white, were landowners who had worked the fertile soil of the region for several decades. White or black, tenant or landowner, all of them were forced to leave their farms when the Army came to Huntsville. Understandably, there was much concern at first among the area’s residents about when they had to leave and where they could go. … By the middle of January 1942, all of the area’s former residents were gone. … In addition to more than 500 houses and other assorted buildings, there were 3 schools for blacks; 1 church for whites and 11 churches for blacks; 31 known cemeteries; and several black lodges.

The local newspapers followed the actions of the military during the transitional period very closely. The following excerpts are from the *Huntsville Times*, concerning the disposition of recently purchased gravesites.

An article dated 20 July 1941, entitled “Will Move 2,300 Graves in County: Land Appraiser Recounts Obstacles in Acquiring Arsenal Land,” stated that,

> Bodies of more than 2,300 persons buried in Madison county on land to be purchased by the government for the huge war chemical plant will have to be removed to other locations, according to M. K. Williamson, land appraiser for the War department.

On 21 August 1941, an article entitled “Progress Seen upon Barracks in Plant Area: Sites for Main Buildings Known, but Withheld,” remarked that,

> There are 31 known cemeteries, seven for whites and 24 for colored, within the area. These cemeteries contain 2,357 graves, according to the report of the appraisers. Just what disposition is to be made of the graves has not been determined, it was unofficially announced today.

An article entitled “Men Required to Join Union to Land Jobs: Admission of Policy on Arsenal Made by Personnel Head,” dated 3 September 1941, stated that,

> The commission adopted a resolution approving the removal by the War department of approximately 2,500 graves in 34 cemeteries in the arsenal area. Lieutenant Munn said Commander R. C. Ditto, commanding officer of the arsenal, and his staff, are working a plan whereby descendants of persons buried in the area may have the graves moved elsewhere but at no additional cost to the government.

Much of the information on the cemeteries within the Arsenals’ boundaries comes from a personal communication made during previous investigations by Ms. Perroni, University of Alabama Division of Archaeology. The following is a summary of the information gathered from Mr. Bill Driver (Shogren et al. 1989:3):

> Mr. Driver was responsible for the location, identification and fencing of all cemeteries on Redstone Arsenal property in 1941. Mr. Driver hired a man named “Shorty” (he could not recall his last name) to help locate the cemeteries on the proposed Arsenal grounds. Shorty was seventy-nine years old in 1941 and knew the location of most of the graveyards on the Arsenal property that are presently protected. … According to Ms. Perroni, Mr. Driver researched archives and sponsored newspaper stories in 1941.

Very little information is available on the disposition and possible relocation of the remains within the identified cemeteries on the Redstone Arsenal. The Army made their construction plans for the arsenal
public, until it became a security risk to do so. Plans were most likely implemented in 1941, and possibly interrupted by the bombing of Pearl Harbor. With the beginning thrusts of World War II, public access to the arsenal decreased, and the Army did not provide further information about the reinterment activities (Hughes 1991). An analysis of existing facilities in the 1959 Master Plan states that 60 cemeteries comprise a total of 10 unusable acres within the arsenal boundaries (Redstone Arsenal 1959:6). Unfortunately, the analysis does not list the individual cemeteries. Although information regarding the Army’s disposition of graves is minimal, it does not appear that either the Moore/Landman Cemetery or the Jordan Cemetery has been disturbed.

Research

Preliminary research into land ownership of the cemetery sites did not associate any owners to the cemeteries. According to their land patent database, the BLM did not issue any patents for land in either Section 5 or Section 31. In addition, the records show that of the land patents issued in Madison County: 14 are in the surname of Jordan, 33 are in the surname of Moore, and zero are in the surname of Landman (BLM 2002). The 1850 census for Madison County includes listings for the surnames of Jordan, Moore, and Landman, but does not provide home addresses (AGW 2002). Historic maps provided an insight into the land use of the surrounding area, as well as a tool for relative dating of the sites, although a thorough map review did not provide cemetery specific data.

Findings

Moore/Landman Cemetery

An early parcel map, compiled and drafted by G. W. Jones, Civil Engineer, does not identify the Moore/Landman Cemetery, but shows that the area lies south of the Indian Line, within a region labeled Chickasaw Purchase, in the McDonnell (no. 47) area. T. J. Young owned the parcel that eventually included the Moore/Landman Cemetery. A road, roughly running east to west, passes just north of the Moore/Landman Cemetery location. Due north of the cemetery, two buildings are plotted on the north side of the road (Jones n.d.).

A 1911 map shows a small complex of buildings about ¼-section north of the Moore/Landman Cemetery location (USDA). Labels identify two of these buildings as churches: Centre Church is located just north of the road, and Pine Tree Church is plotted just south of the road (USDA). The Moore/Landman Cemetery does not appear on a map until 1936, labeled as the Moore Cemetery (USGS). The 1936 map also shows a single church, the Center Grove Church, on the north side of the road (USGS). Maps from 1937 and 1948 show two churches north of the road, with the westerly one labeled as the Center Grove Church on the 1948 map (1937 ASHD; 1948 ASHD).

The 1941 Siebert Arsenal Land Acquisition Map does not identify the Moore/Landman Cemetery (OQG). According to this map, the location of the cemetery lies within a large un-owned tract, about ¼-section south of the Center Grove Community (USGS 1936). The 1941 map shows that the community consists of a Lodge and three churches, including a Primitive (sic) Baptist Church and a Colored Baptist Church (OQG). By 1950, the USGS map does not show any existing structures in the area of Center Grove, but it still includes the boundaries of the Moore Cemetery.

Jordan Cemetery

The early parcel map, compiled and drafted by G. W. Jones, Civil Engineer, does not identify the Jordan Cemetery, but shows that M. H. Lanier owned the parcel where the Jordan Cemetery is now located (Jones n.d.). The 1941 Siebert Arsenal Land Acquisition Map does not identify the Jordan Cemetery.
The location of the Jordan Cemetery is within a 327-acre parcel owned by Moses Love (OQG 1941). None of the reviewed maps showed buildings or structures within proximity of the Jordan Cemetery plotted location. The Jordan Cemetery does not appear on a map until 1964, as an unlabeled cemetery (USGS).

Discussion

Archival investigation of the Moore/Landman Cemetery and the Jordan Cemetery, possibly African-American cemeteries in the Huntsville area of Madison County, did not yield in much new information. The associations between landowners and the cemeteries were not established directly through archival research, although land records do indicate that residents with the surnames of Moore, Landman, and Jordan resided within Madison County. The Moore/Landman Cemetery does not appear on a map until 1936, with the Jordan Cemetery appearing by 1964. A 1971 Madison County map is the first map to plot and name both cemeteries (MCC 1971).

In the Cemeteries of Madison County, Alabama, Volume I, the Jordan Cemetery is identified as a ‘Colored’ Cemetery, while the Moore Cemetery appears to have the same attribute, but without the label, and is recorded as having no gravestones (Johnson 1971:269). Ms. Johnson’s book did not provide any details for each of the ‘Colored’ cemeteries as, “the advisability of listing the Negro cemeteries in a separate work seemed prudent (1971).” According to the Librarian in the Huntsville Public Library Heritage Room, this work was never completed.

The task of identification of those buried in small rural cemeteries has moved into the public domain. Volunteers across the country are transcribing markers at local cemeteries, posting lists of names on genealogy sites across the Internet. Max C. Bennett, a United States Army Warrant Officer assigned to the Redstone Arsenal, has taken on the task of identifying the arsenal cemeteries and those buried in them. Mr. Bennett, college graduate and genealogist, is transcribing and researching the histories of Redstone Arsenal cemeteries. He states, “I have no family who lived on Redstone Arsenal and I have no ties to these lands except as a researcher and data collector. All my data is collected with no preconceived notions regarding who may or may not have lived here.” He has completed work on six of 49 cemeteries to date (2002).
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