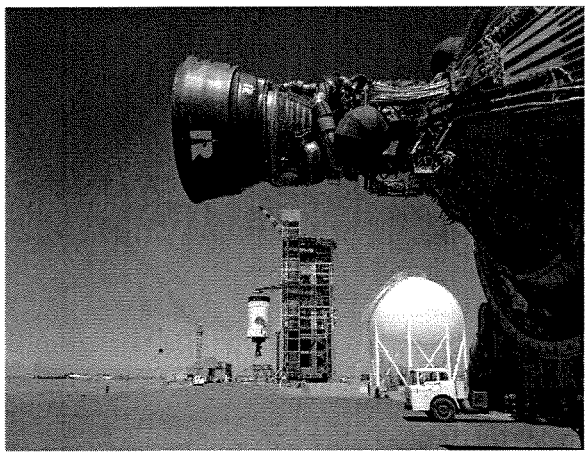
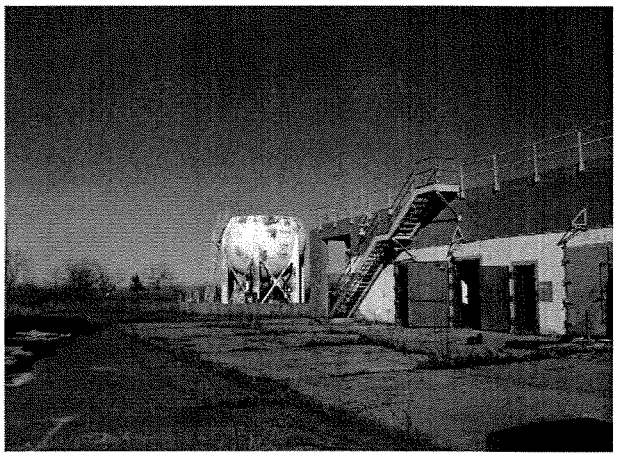
APPENDIX G

DRAFT HISTORIC BUILDING AND STRUCTURES INVENTORY

Draft

Historic Buildings and Structures Inventory
Douglas Missile Test Facility
Rio del Oro Specific Plan Project





Prepared for:

City of Rancho Cordova
and
U.S. Army Corps of Engineers,
Sacramento District

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Karen J. Weitze, PhD
Weitze Research

July 20, 2005

EDAW

P 3T089.01

HISTORIC BUILDINGS AND STRUCTURES INVENTORY
DOUGLAS MISSILE TEST FACILITY

Rancho Cordova
California

Prepared for:

City of Rancho Cordova
and
U.S. Army Corps of Engineers,
Sacramento District

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2022 J Street
Sacramento, California 95814

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June 2005

June 2005

Historic Buildings and Structures Inventory
Douglas Missile Test Facility

Rancho Cordova, California

DRAFT

EDAW, Inc.

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Acknowledgments

The author wishes to thank several individuals for their assistance during the historic architectural inventory at the former Douglas Missile Test Facility at Rancho Cordova, California. Aerojet environmental manager Rodney A. Fricke coordinated two day-long visits to the site during April and May 2005. Mr. Fricke also made Aerojet's collection of historic architectural-engineering drawings, maps, and plans available to support the inventory. Two missile and booster-vehicle test reports from 1962-1966 were accessible to the author at Aerojet's archives, as were environmental documents summarizing previous interpretations of the former Douglas Missile Test Facility during 1996-2004. The National Aeronautics and Space Administration's (NASA's) Marshall Space Flight Center in Huntsville, Alabama, graciously offered the author copies of the agency's 1966-1968 master plans for the former Douglas Missile Test Facility (then named the NASA S-IVB Stage Test Facility), and made tif images of more than 30 historic photographs of the Rancho Cordova site. The author especially thanks landscape architect and cultural resource manager Ralph Allen at Marshall for his time and effort. A website maintained by the Marshall Space Flight Center history office was additionally useful for selecting rare images of 1960-1968 test activities at the former Douglas Missile Test Facility. The author acknowledges her gratitude to the Marshall Image Exchange (MIX) website, and to NASA historian Mike Wright. EDAW project manager Charlane Gross oversaw the author's work, and provided much appreciated assistance in making arrangements with Aerojet.

List of Acronyms

ABM	antiballistic missile
ACC	Air Combat Command
ACHP	Advisory Council on Historic Preservation
AFCEE	Air Force Center for Environmental Excellence
AFP	Air Force Plant
ASSET	Aero-thermodynamic Elastic Structural Systems Environmental Tests
ASV	aero-thermodynamic structural test vehicle
BP	boilerplate
CFR	Code of Federal Regulations
DM	defense missile
DoD	Department of Defense
EES	Engineering Evaluation Site
GALCIT	Guggenheim Aeronautical Laboratory at the California Institute of Technology
GOCO	government-owned, contractor-operated [industrial plant / site]
GOGO	government-owned, government-operated [industrial plant / site]
ICBM	intercontinental ballistic missile
IM	interceptor missile
IRBM	intermediate range ballistic missile
JPL	Jet Propulsion Laboratory [at the California Institute of Technology]
LN2	liquid nitrogen
LOX	liquid oxygen
MIX	Marshall Image Exchange
NASA	National Aeronautics and Space Administration
NPS	National Park Service
NRHP	National Register of Historic Places
RATO	Rocket-Assisted Take-Off
R&D	research and development
USACERL	United States Army Construction and Engineering Research Laboratory

ABSTRACT

EDAW, Inc., contracted with Weitze Research to conduct a historic architectural inventory of buildings and structures within the boundaries of the former Douglas Missile Test Facility at Rancho Cordova, California. The inventory included six test areas of 1956-1969: the Solid Propellant Assembly Area, the Sigma Test Area, the Alpha Test Complex, the Beta Test Complex, the Gamma Test Area, and the Kappa Test Area. Weitze Research inventoried 62 properties at these locations. Field work included building assessments, digital photography, and records review. Subsumed within the inventory are preliminary National Register of Historic Places (NRHP) evaluations for the former Douglas Missile Test Facility properties.

The Solid Propellant Assembly Area (6 inventoried properties)

Four of the buildings and structures in the Solid Propellant Assembly Area, including their surrounding earthworks, define the assembly site for the developmental Nike Hercules and Nike Zeus missiles of 1956-1962. These properties are little altered and are interpreted as potentially eligible for the NRHP as a district under criteria A and C.

The Sigma Test Area

Four of the buildings and structures in the Sigma Test Area, including their surrounding earthworks, define the test complex for the developmental Nike Hercules and Nike Zeus missiles of 1956-1962. These properties are little altered and are interpreted as potentially eligible for the NRHP as a district under criteria A and C.

The Alpha and Beta Test Complexes (39 inventoried properties)

The test stands of the Alpha Test Complex (two) and the Beta Test Complex (two) no longer have their multi-story, steel superstructure (captive-firing towers), and remain on their sites only as one-story, reinforced concrete remnants. The test control centers (blockhouses) for the complexes are derelict today, with all control equipment removed. The test stands and blockhouses are character-defining for the Alpha and Beta Test Complexes. No support structures within the Alpha and Beta Test Complexes are interpreted as sufficiently significant for individual consideration to the NRHP.

The Gamma and Kappa Test Areas (9 inventoried properties)

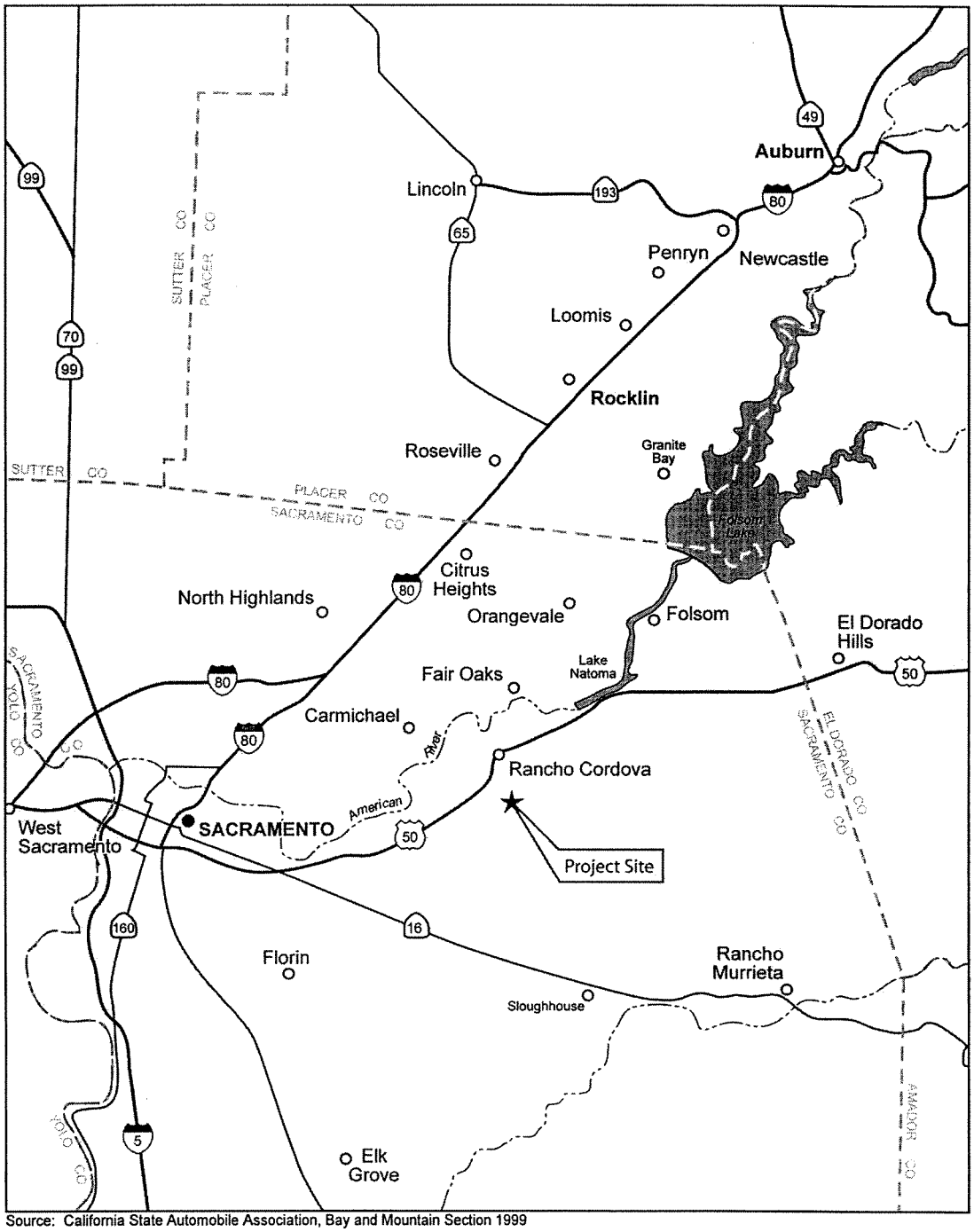
The test structures and test cells in the Gamma Test Area (one) and the Kappa Test Area (six) exist in a varied state of intactness. The three-bay test structure in the Gamma Test Area is the key building for the site. Only one of its captive-firing stands is intact. In the Kappa Test Area, one of six test cells is intact. Three others remain as remnants or are gone, while two are partially collapsed. The Gamma and Kappa Test Areas were component test locations, essentially adjunct sites for the Alpha and Beta Test Complexes. No support structures within the Gamma and Kappa Test Areas are interpreted as sufficiently significant for individual consideration to the NRHP.

METHODOLOGY

Field Assessment and Real Property Research

At the request of EDAW, Inc., Weitze Research conducted an inventory and National Register of Historic Places (NRHP) evaluation of the former Douglas Missile Test Facility in Rancho Cordova, California (Figures 1-2). Dr. Karen J. Weitze served as the principal investigator for the effort. On 11 April and 31 May 2005, Dr. Weitze conducted field analysis at the former test facility and a review of drawings and documents held by the facility's owner Aerojet. Drawings and documents' review occurred at Aerojet's Rancho Cordova location. She inspected 62 extant buildings, structures, and structure remnants during her analysis, taking digital photographs of all accessible real property at the site. In the inventory document, Dr. Weitze includes historic photographs and maps of the former Douglas Missile Test Facility, and supports discussion with a brief contextual history of similar aerospace test sites in California. She also provides a broad overview of the industrial plant program established for the United States military services, referencing the government-owned, contractor-operated (GOCO) plants, government-owned, government-operated (GOGO) plants, and privately owned and operated sites. Plants conducted research, testing, and production activities for the American government. The Douglas Missile Test Facility was a privately owned and operated site, located on property in the Folsom-Rancho Cordova area. In 1956, the Douglas Aircraft Company leased 1,700 acres from the Aerojet General Corporation for its first facilities at the location. Aerojet General operated Air Force Plants (AFPs) 70 and 71 adjacent, both established during 1956-1957. In 1961, the Douglas Missile & Space Division bought the property from Aerojet, expanding the size of it operations to about 4,000 acres. Within this acreage, about 2,800 acres housed the test complexes and administration area—the Douglas Missile Test Facility—with 1,100 acres remaining unused for aerospace facilities. Douglas immediately began using portions of the test facility to support the Saturn program of the National Aeronautics and Space Administration (NASA). NASA continued to oversee activities at the former Douglas Missile Test Facility until 1969. The former Douglas Missile Test Facility became dormant during 1969-1972, and subsequently deactivated during 1973-1977. The Douglas Missile Test Facility lost a substantial portion of its integrity as a potential NRHP resource in the late 1970s, due to the dismantlement of test stand superstructure. In 1977, McDonnell Douglas developed the Administration Area as an industrial park (Security Park), selling and leasing parcels in the southeastern corner of the former test facility. In the middle 1980s, Aerojet repurchased its original property from McDonnell Douglas. Security Park was not included in the sale.

The inventory and NRHP evaluations of the former Douglas Missile Test Facility are focused on six individual test areas: the Solid Propellant Assembly Area, the Sigma Test Area, the Alpha Test Complex, the Beta Test Complex, the Gamma Test Area, and the Kappa Test Area. White Rock Road and Aerojet border the former the Douglas Missile Test Facility on the north; Aerojet, on the east; Douglas Road, on the south; and, the former Mather Air Force Base and gold dredgings, on the west. The Administrative Area, in the southeast corner of the former Douglas Missile Test Facility, is not included



Source: California State Automobile Association, Bay and Mountain Section 1999

Regional Location

Figure 1

Rio del Oro Specific Plan Project DEIR/DEIS
City of Rancho Cordova and USACE
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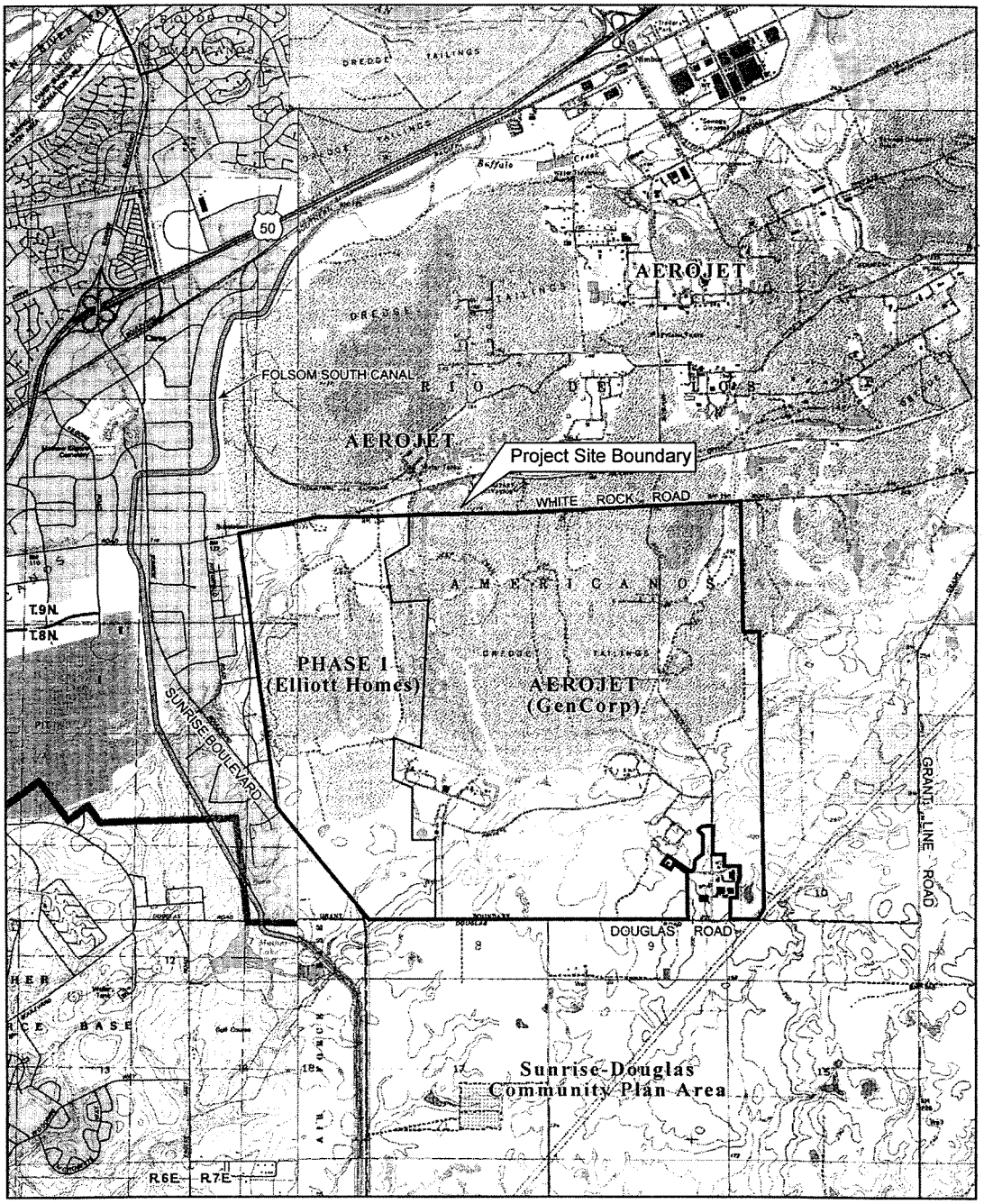
Figure 1: Vicinity Map, former Douglas Missile Test Facility, Rancho Cordova, California.



Source: USGS Citrus Heights/Carmichael Quads 1992, USGS Folsom/Buffalo Creek Quads 1980

Project Location

EXHIBIT 2

Rio del Oro Specific Plan Project DEIR/DEIS
City of Rancho Cordova and USACE
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Figure 2: Location Map, former Douglas Missile Test Facility, Rancho Cordova, California.

in the inventory or NRHP evaluations, but is discussed in the contextual history section of the document (see below). The inventory and NRHP evaluations are restricted to the individual test areas that remain in Aerojet ownership in 2005. Also not included in the inventory and NRHP evaluations are isolated ancillary sites within the boundaries of the former Douglas Missile Test Facility. The omitted ancillary sites were primarily small land-use areas that did not contain infrastructure.

Approximately 50% of the original Units 1-152 of the former Douglas Missile Test Facility exist today, with about 1% of these properties no longer in Aerojet ownership.

Criteria of the National Register of Historic Places (NRHP)

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, a missile test stand might be significant for research, development, test, and evaluation conducted over decades, and thus additions and changes of later years are subsumed within its original integrity. In counterpoint, follow-on property use might have necessitated that the majority of a test stand be dismantled. In the second instance, NRHP integrity would likely have been severely compromised or lost.

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 throughout the lifetime of a property. 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 comparison with architectural-engineering drawings) 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. Not surprisingly, interpretations of integrity have also changed from time to time during the life of the NRHP. An assessment of NRHP integrity is flexible, rather than formulaic.

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 the 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 former Douglas Missile Test Facility, the 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 missile and space booster research, development, test, and evaluation during the first half of the Cold War. The lives of persons significant in the past are embodied in potential NRHP resources at the former Douglas Missile Test Facility only indirectly. Two of the test complexes, Alpha and Beta, are the work of architectural-engineering firms important in Cold War aerospace-military structures design. These firms are Aerojet General Corporation (for the design and engineering of the Alpha Test Complex) and Ralph M. Parsons (for the design and engineering of the Beta Test Complex). The two firms often worked together during the 1950s and 1960s as Parsons-Aerojet of Los Angeles. A third key Cold War architectural-engineering firm renowned for its innovative aerospace-military structures also designed an assembly building in the Administrative Area at the former Douglas Missile Test Facility: Holmes & Narver of Los Angeles. These three firms were also responsible for major buildings and structures for the United States Army and 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); commemorative 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. 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. Not surprisingly, Air Force and Army Cold War facilities for missile and rocket booster research, development, test, and evaluation are parallel in type to those at the former Douglas Missile Test Facility. Examples pertinent to this study include static test stands, test control centers (blockhouses), missile and component assembly structures (typically, high-bay), specialized laboratories, and test cells. 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. Potential resources that are truly unique (one of a kind) can be clearly identified—not always an easy task for aerospace-military infrastructure.

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.

Within the boundaries of the former Douglas Missile Test Facility (excluding the Administrative Area no longer part of the property), the assessment of potential historic buildings and structures includes 62 individual properties (Figure 3). Of these, none are 50 years or older—although 27 buildings and structures are within five years of meeting the 50-year threshold (that is, have a design date of 1956-1960). These resources are considered as functionally at the 50-year mark, in order to allow an appropriate process of review. Of the 10 buildings and structures interpreted as eligible for the NRHP through this study (as two small districts), all date to 1956, and are considered as 50 years old, without the requirement to meet exceptional significance. The buildings and structures (and structure remnants) inventoried in 2005 at the former Douglas Missile Test Facility are summarized as:

- 1956-1957: 25 properties

  in the Solid Propellant Assembly Area (1956)

  in the Sigma Test Area (1956)

  in the Alpha Test Complex (1956-1957)

- 1959: 2 properties

  in the Kappa Test Area, originating as the Initial Operational Capability (IOC) Site 2 for the Thor missile (1959)

- 1961-1962: 3 properties

  in the Sigma Test Area (1961)

  in the Kappa Test Area (1962)

- 1964-1966: 32 properties

  in the Solid Propellant Assembly Area (1966)

  in the Sigma Test Area (1964)

  in the Beta Test Complex (1963-1964)

  in the Gamma Test Area (1964)

  in the Kappa Test Area (1964)

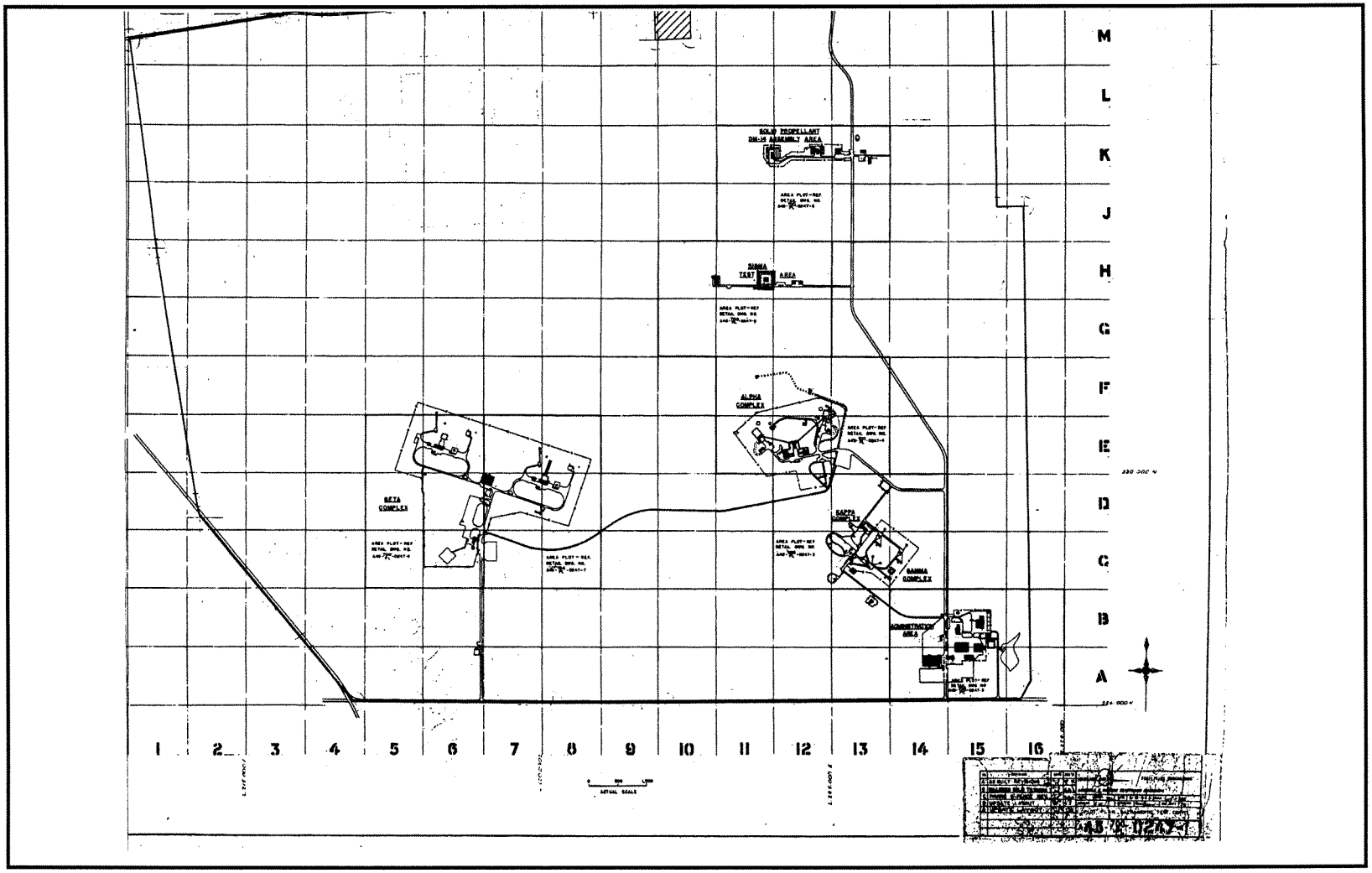

Figure 3: Douglas Facilities Engineering, Solid Propellant Assembly Area, Sigma Test Area, Alpha Test Complex, Beta Test Complex, Gamma Test Area, Kappa Test Area, and Administrative Area, Douglas Missile Test Facility, Rancho Cordova, California, 1964.

EXECUTIVE SUMMARY OF INVENTORIED STRUCTURES

Lineage of the Douglas Missile Test Facility

Initial activities at the Douglas Missile Test Facility are interpreted as supporting tests of solid-propellant rocket booster engines for the Nike Hercules interceptor missile at the Solid Propellant Assembly Area and the Sigma Test Area, and captive firings of the Thor intermediate range ballistic missile (IRBM) on the test stands in the Alpha Test Complex. The developmental Nike Hercules was the DM-14; the developmental Thor, the DM-18.

The 1956-1958 configuration of the Douglas Missile Test Facility included:

- the west half of the Solid Propellant Assembly Area (known as the DM-14 area);
- the Sigma Test Area;
- the Alpha Test Complex; and,
- the Administration Area (today, in private ownership).

By the late 1950s, Douglas had expanded its test areas to include:

- the Engineering Evaluation Site (EES), part of the later Kappa Test Area; and,
- a large missile maintenance and checkout facility in the Administration Area.

Between mid-1958 and 1960, the Douglas Missile Test Facility also included Thor Initial Operational Capability (IOC) Sites (1 and 2). These locations coexisted within the Alpha Test Complex (IOC 1) and the EES of the subsequent Kappa Test Area (IOC 2). In 1961, Douglas adapted the Solid Propellant Assembly Area for tests supporting the Nike Zeus (DM-15) program. Douglas added tests for the Skybolt (DM-20) at the location in 1962.

A second era of expansion occurred during 1963-1965. At this time, the Douglas Missile Test Facility became known as the National Aeronautics and Space Administration (NASA) S-IVB Stage Test Facility. Douglas added several large test areas for NASA, also augmenting facilities at existing sites. Ralph M. Parsons is interpreted as the master architectural-engineering firm for the dedicated NASA facility. Added for NASA in the early and middle 1960s were:

- the east half of the Solid Propellant Assembly Area (the DM-14 area);
- expanded facilities in the Sigma Test Area;
- the Beta Test Complex;
- the Gamma Test Area;
- expanded facilities in the Kappa Test Area; and,
- expanded facilities in the Administration Area.

The last static test of a NASA upper-stage booster occurred at the NASA S-IVB Stage Test Facility (the Douglas Missile Test Facility) in 1969. Between 1969 and late 1972, McDonnell Douglas maintained the site in a readiness state for NASA. During the following five years, the NASA S-IVB Stage Test Facility (the Douglas Missile Test

Facility) deactivated. By 1977, personnel had removed the multi-story, steel superstructure of the large test stands in the Alpha and Beta Test Complexes. The Douglas Missile Test Facility lost a substantial portion of its integrity as a potential National Register of Historic Places (NRHP) resource between 1972 and 1977. In 1977, McDonnell Douglas developed the Administration Area of its former test facility into an industrial park (Security Park), selling and leasing parcels within this section. Final changes in the real estate lineage of the Douglas Missile Test Facility occurred in the middle 1980s. In 1984, Aerojet repurchased its original property from McDonnell Douglas. The only exceptions in the reverse transfer were those parcels already sold to other parties in Security Park (the former Administration Area).

Buildings, Structures, and Major Site Remnants

No building (real property) numbers are available for the structures at the Douglas Missile Test Facility. During 1963-1964, when the Douglas Missile Test Facility became the NASA S-IVB Stage Test Facility, Douglas produced master plans for each test area within the facility. On these plans, individual buildings and structures are assigned numbers: Units 1-152. Many small ancillary structures remained unnumbered. The summary assessments of the buildings and structures standing within the Solid Propellant Assembly Area, Sigma Test Area, Alpha Test Complex, Beta Test Complex, Gamma Test Area, and Kappa Test Area are provided below, inclusive of their middle-1960s assigned unit number. Buildings within the Administration Area, no longer owned by Aerojet, are not listed. With the exception of the Kappa Test Area, properties are listed west to east.

Solid Propellant Assembly Area

Six buildings and structures remain in the Solid Propellant Assembly Area in May 2005:

Motor Storage Building (Unit 104):	Metal prefabricated structure of 1956. Associated with development of the Nike Hercules. Minor alterations.
Assembly Building (Unit 103):	Metal prefabricated structure of 1956. Associated with development of the Nike Hercules. Nearly unaltered.
Paint Shed (Unit 109):	Metal prefabricated structure of 1956. Associated with development of the Nike Hercules. Exterior unaltered.
Storage Building (Unit 102):	Metal prefabricated structure of 1956. Associated with development of the Nike Hercules. Unaltered.
A.S.V. Building (Unit 106):	Steel-arch structure of 1966. Storage facility for a NASA aero-thermodynamic structural test vehicle (ASV). Unaltered.
Quonset Hut (Unit 105):	Quonset hut placed on site in ca.1964 as a storage structure. Unaltered.

NRHP Evaluation Summary:	The four buildings of 1956, Units 102, 103, 104, and 109, are interpreted as eligible for the NRHP as a district under criteria A and C for their association with the developmental Nike Hercules missile. The distinctive earthen bermwork surrounding Units 103 and 104 is included as a contributing feature of the property. Complements a second developmental Nike Hercules test site, the Sigma Test Area.

Sigma Test Area

Parts of eight buildings and structures remain in the Sigma Test Area in May 2005:

Support Building (Unit 95):	Structure remnants and test pad of 1956. First associated with development of the Nike Hercules.
Destruct Pad (unnumbered):	Reinforced concrete pad, 31 by 20 feet, with four pairs of embedded rail segments. Added in 1961. Associated with tests of Nike Zeus and Skybolt.
Concrete Pad (unnumbered):	Small reinforced concrete pad of ca.1963-1964. Unidentified historic use.
Personnel Bunker (unnumbered):	Small reinforced concrete structure of 1956. First associated with development of the Nike Hercules. Adapted for storage of high-explosives. Unaltered, but moved a short distance.
Test Control Center (Unit 94):	Windowless reinforced concrete blockhouse of 1956. First associated with development of the Nike Hercules. Unaltered, with vacant interior.
Assembly Building (Unit 93):	Metal prefabricated structure of 1956. Associated with development of the Nike Hercules. Unaltered exterior, with interior derelict.
Conditioning Chamber (Unit 92):	Metal-paneled conditioning chamber of 1964. Constructed for hot-conditioning of solid-propellant motors, prior to static-test firing. Unaltered.
Conditioning Chamber (Unit 91):	Metal-paneled conditioning chamber of 1964. Constructed for cold-conditioning of solid-propellant motors, prior to static-test firing. Collapsed in place.
NRHP Evaluation Summary:	The four buildings of 1956, Units 93, 94, 95, and an unnumbered personnel bunker, are interpreted as eligible for the NRHP as a district under criteria A and C for their association with the developmental Nike Hercules missile. The distinctive earthen bermwork surrounding Unit 93 is included as a contributing feature of the property. Complements

a second developmental Nike Hercules test site, the Solid Propellant Assembly Area.

Alpha Test Complex

Seventeen buildings and large structural remnants stood in the Alpha Test Complex in May 2005:

LOX Tanks (Units 82-83):	Reinforced concrete barricade wall of 1956-1957. Constructed to support Test Stand No.2.
Steam Accumulators (Units 84-85):	Reinforced concrete pedestal foundations of 1956-1957. Constructed to support Test Stand No.2 .
Test Stand No.2 (Unit 80):	Reinforced concrete base (terminal and power rooms) and deluge pit intact, with derelict interior. Multi-story steel superstructure and flame deflector completely removed. Constructed in 1956-1957 as a dual-position test stand for Thor static firings.
Observation Shelter No.2 (Unit 88):	Three-sided, reinforced concrete shelter of 1956-1957. Observation post for static firings at Test Stand No.2. Unaltered.
Helium Storage Area (Unit 68):	Reinforced concrete barricade wall of 1956-1957. Constructed to support Test Stands No.1 and No.2.
LN2 Tank (Unit 67):	Reinforced concrete pedestal foundations of 1956-1957. Built to support Test Stands No.1 and No.2.
Generator & Compressor (Unit 62):	Metal prefabricated structure of 1956-1957. Housed generators and compressors for the Alpha Test Complex. Unaltered exterior. Interior derelict.
Control Center (Unit 61):	Windowless, reinforced concrete blockhouse for Test Stands No. 1 and No.2, constructed in 1956-1957. Instrumentation tunnels to test stands. Unaltered exterior. Interior derelict.
Pump House (Unit 63):	Metal prefabricated structure of 1956-1957. Housed pump equipment for the Alpha Test Complex.
Water Tank (Unit 65):	Steel storage tank for the Alpha Test Complex. Constructed in 1956-1957 to support static (deluge) firings on Alpha Test Stands No.1 and No.2.
Observation Shelter No.1 (Unit 79):	Three-sided, reinforced concrete shelter of 1956-1957. Observation post for static firings at Test Stand No.1. Unaltered.
Test Stand No.1 (Unit 72):	Reinforced concrete base (terminal and power rooms) and deluge pit intact, with derelict interior. Multi-story steel superstructure and flame deflector completely removed. Constructed in 1956-1957 as a single-position test stand for Thor static firings.

LOX Tanks (Units 74-75): Reinforced concrete barricade of 1956-1957. Constructed to support Test Stand No.1.

Test Cell (Unit 60): Three-sided, metal-framed test cell of 1956-1957. Interior paneling likely asbestos. Unaltered.

NRHP Evaluation Summary: No buildings and structures in the Alpha Test Complex are interpreted as eligible to the NRHP, either individually or as a district.

Beta Test Complex

Twenty-two buildings and large structural remnants stood in the Beta Test Complex in May 2005:

Observation Shelter No.3 (Unit 152): Reinforced concrete shelter of 1963-1964. Observation post for static firings at Beta Test Stand No.3. Unaltered.

LOX Tank (Unit 134): Steel tank of 1963-1964. Constructed to support Beta Test Stand No.3. Unaltered, with cap adjacent.

Fan Room (Unit 137): Small underground structure accessed by surface-level turn valve. Constructed in 1963-1964 to support Beta Test Stand No.3. Unaltered.

Observation Shelter No.4 (Unit 135): Reinforced concrete shelter of 1963-1964. Observation post for static firings at Beta Test Stand No.3. Unaltered.

Terminal Equipment Rm (Unit 132): Reinforced concrete terminal and power rooms for Beta Test Stand No.3, constructed in 1963-1964. Unaltered, with derelict interior.

Test Stand No.3 (Unit 131): Reinforced concrete base and deluge pit intact. Multi-story steel superstructure and flame deflector completely removed. Constructed in 1963-1964 for static firings of NASA's S-IVB.

Shop Building (Unit 133): Steel-frame structure of 1963-1964. Constructed to support Beta Test Stand No.3. Unaltered, with derelict interior.

Liquid Hydrogen Tank (Unit 136): Concrete perimeter wall and footings of 1963-1964. Constructed to support Beta Test Stand No.3.

Test Control Center (Unit 121): Windowless, reinforced concrete blockhouse of 1963-1964. Constructed for Beta Test Stands No.1 and No.3. Instrumentation tunnels to test stands. Unaltered exterior, with derelict interior.

Liquid Hydrogen Tank (Unit 147): Concrete perimeter wall and footings of 1963-1964. Constructed to support the Beta Test Complex.

Facilities Shop (Unit 145): Metal prefabricated structure of 1963-1964. Constructed to support the Beta Test Complex. Unaltered, with derelict interior.

Beta Support Office No.2 (Unit 141): Metal prefabricated structure of 1963-1964. Constructed as a calibration tower for the Beta Test Complex. Unaltered.

Beta Support Office No.1 (Unit 141): Metal prefabricated structure of 1963-1964. Constructed to support the Beta Test Complex. Unaltered, with derelict interior.

Pump House (Unit 143): Reinforced concrete structure of 1963-1964. Constructed to support the Beta Test Complex. Unaltered, with derelict interior.

Water Tank (Unit 144): Steel storage tank for the Beta Test Complex. Constructed in 1963-1964 to support static (deluge) firings on Beta Test Stands No.1 and No.3.

Guard Post No.7 (Unit 148): Wood-frame guard station of 1963-1964. Beta Test Complex. Unaltered.

Fan Room (Unit 127): Small underground structure accessed by surface-level turn valve. Constructed in 1963-1964 to support Beta Test Stand No.1. Unaltered.

Observation Shelter No.1 (Unit 126): Reinforced concrete shelter of 1963-1964. Observation post for static firings at Beta Test Stand No.1. Unaltered.

Terminal Equipment Rm (Unit 123): Reinforced concrete terminal and power rooms for Beta Test Stand No.1, constructed in 1963-1964. Unaltered exterior. Interior inaccessible.

Test Stand No.1 (Unit 122): Reinforced concrete base and deluge pit intact. Multi-story steel superstructure and flame deflector completely removed. Constructed in 1963-1964 for static firings of NASA's S-IVB.

Shop Building (Unit 124): Steel-frame structure of 1963-1964. Constructed to support Beta Test Stand No.3. Unaltered, with derelict interior.

Liquid Hydrogen Tank (Unit 128): Steel tank of 1963-1964. Constructed to support Beta Test Stand No.3. Unaltered, with cap nearby.

NRHP Evaluation Summary: No buildings and structures in the Beta Test Complex are interpreted as eligible to the NRHP, either individually or as a district.

Gamma Test Area

Four buildings and large structural remnants stood in the Gamma Test Area in May 2005. The maintenance and assembly building for the Gamma Test Area is located outside the security fence to the southwest. West to east, buildings and structures are:

Instrumentation Center (Unit 34): Windowless, reinforced concrete building of 1964-1965. Raised cable tray to the test control center.

	Constructed to support the Test Structure (Unit 32). Exterior unaltered. Interior inaccessible.
Test Control Center (Unit 31):	Reinforced concrete building of 1964-1965, with viewports. Raised cable tray to the instrumentation center. Constructed to support the Test Structure (Unit 32). Exterior unaltered. Interior inaccessible.
Test Structure (Unit 32):	Reinforced concrete and steel, three-bay test structure of 1964-1965. Used for static tests of NASA subsystems. One test stand intact.
Maintenance & Assembly (Unit 37):	Metal prefabricated building of 1964-1965. Constructed to support the Gamma Test Area. No longer in Aerojet ownership.
NRHP Evaluation Summary:	No buildings and structures in the Gamma Test Area are interpreted as eligible to the NRHP, either individually or as a district.

Kappa Test Area

Five buildings and large structural remnants stood in the Kappa Test Area in May 2005:

Test Cell B:	Three-sided, wood-framed test cell of 1962. Used for NASA subsystem development and testing. Partially collapsed.
Test Cell C:	Three-sided, steel-framed and -paneled test cell of 1962. Used for NASA subsystem development and testing. Unaltered.
Test Area D:	Interpreted as the center location of IOC 2, 1959. Supported engineering evaluation tests for Thor. Remnants extant.
Test Area E:	Raised reinforced concrete pad, connected to deluge channel. Interpreted as the west location of IOC 2, 1959. Remnants extant.
Cryostat Laboratory (Unit 42):	Concrete-block building with viewports facing a test area. Constructed in 1964. Used for NASA subsystem development and testing. Exterior unaltered. Interior inaccessible.
NRHP Evaluation Summary:	No buildings and structures in the Kappa Test Area are interpreted as eligible to the NRHP, either individually or as a district.

CONTEXTUAL HISTORY

Aerojet General purchased acreage at the Folsom-Rancho Cordova location during the early 1950s. Still only a young company, Aerojet had grown into a major manufacturer for the developing American guided missile program. Aerojet had originated during World War II as a research firm affiliated with Dr. Theodore von Karman and the Guggenheim Aeronautical Laboratory (GALCIT) at the California Institute of Technology (Cal Tech) in Pasadena. Hungarian by birth and educated in Germany, Dr. von Karman had immigrated to the United States in 1929, invited to become the director at GALCIT. In 1940, GALCIT constructed its first captive-firing rocket engine test stands in the Arroyo Seco near the Cal Tech campus. In 1942, Dr. von Karman and his students organized the Aerojet Engineering Corporation to fabricate liquid-and solid-fueled small rocket engines. By 1944, Dr. von Karman had garnered an Army contract for GALCIT to develop tactical ballistic missiles. The rocket science laboratory at Cal Tech rapidly emerged as an important military research and development (R&D) facility, and after 1944 became known as the Jet Propulsion Laboratory (JPL). JPL and Aerojet erected more elaborate test stands in 1945 at a larger, isolated location at Muroc Army Air Field (the later Edwards Air Force Base). Static rocket tests at Muroc were among the earliest in the United States, complementing those undertaken by the group of captured German rocket scientists led by Werner von Braun at the White Sands Proving Ground in New Mexico. The first Army-Aerojet facilities at Muroc covered about 40 acres at JPL's test site. In mid-1947, the newly formed United States Air Force selected Leuhman Ridge at Muroc as the location for a new group of captive-firing test stands required to develop the Atlas intercontinental ballistic missile (ICBM). Air Materiel Command chose Aerojet Engineering to build and operate the test stands on Leuhman Ridge. In July 1952, Aerojet conducted the first static test on the ridge, with two test stands fully operational in 1953. During 1954-1955, the Air Force added more test stands at the rocket R&D station (Plate 1). By the middle 1950s, the stands were jointly designed by Aerojet and Ralph M. Parsons, a Los Angeles engineering firm that rose rapidly in prominence after World War II and often worked on the design of aerospace technical facilities with Aerojet. Ralph M. Parsons, for example, was the architectural-engineering firm responsible for the major early captive-firing test stands and blockhouses at the Redstone Arsenal in Huntsville, Alabama (Weitze, Cleland, Gregory, and Lilburn 2003). Redstone was the forerunner of today's Marshall Space Flight Center of the National Aeronautics and Space Administration (NASA). The static test stands at Redstone (Plate 2) were contemporary with those on Leuhman Ridge in southern California (1952-1956). At an unidentified date, Ralph M. Parsons became formally affiliated with Aerojet for selected commissions (Weitze 2003). Parsons-Aerojet won the contract for the Naval Air Missile Test Center at Point Mugu by 1954 (Coughlin 1954).

By early 1954, Aerojet operated a liquid propellant production plant on 8,400 acres at the Rancho Cordova site. Aerojet produced Rocket-Assisted Take-Off (RATO) units at its northern California plant for several Navy aircraft of the period, including the P2V and the B-45. The RATO units used liquid and solid propellants, and were small, recoverable rocket boosters (Coughlin 1954). During 1956-1957, Aerojet transitioned some of its operations to become Air Force Plants (AFPs) 70 and 71. Aerojet had announced a $2.1-

Plate 1: Atlas ICBM in Test Stand 1-A, Leuhman Ridge, Edwards Air Force Base, California, 1 August 1957. Courtesy of the History Office, Edwards Air Force Base.

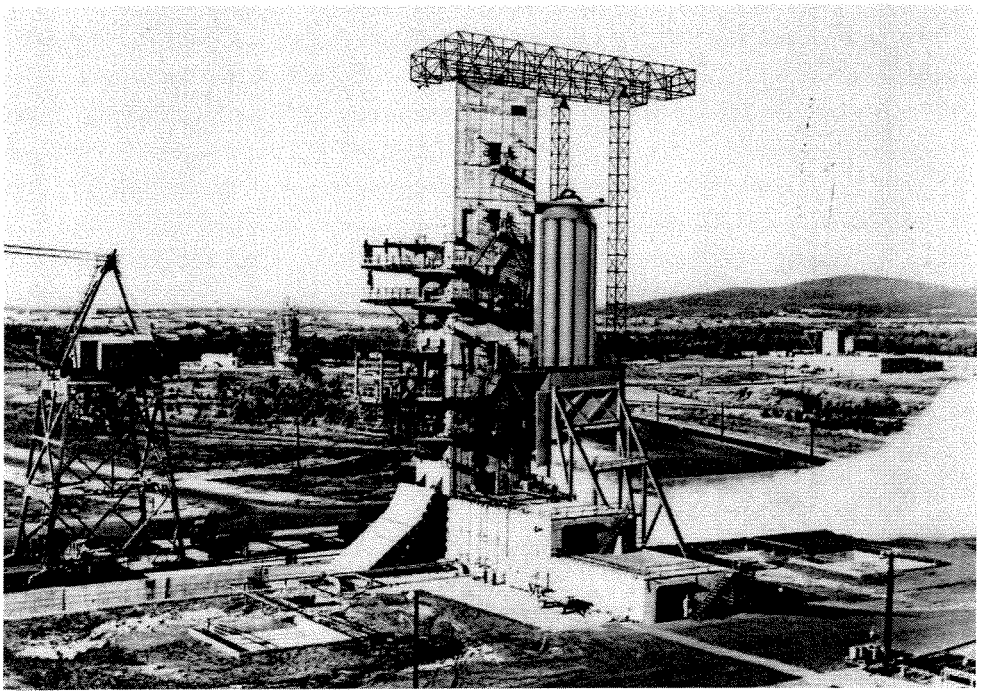

Plate 2: Juno V booster in the dual-position static test stand, Redstone Arsenal, Huntsville, Alabama, 8 October 1958. Courtesy of the History Office, Redstone Arsenal.

million expansion at the Folsom-Rancho Cordova site in February 1954. Financed by the Federal government, the expansion of the Aerojet facilities supported the manufacture of engines and boosters for Nike and Regulus missiles—Army and Navy weapons, respectively. When constructed, AFPs 70 and 71 were liquid-fuel, rocket engine production sites. In early 1956, Aerojet announced a second major expansion of its Folsom-Rancho Cordova facilities. At that time, the size of the Aerojet test and manufacturing site approached 14,000 acres, with a $9-million liquid propellant plant producing RATO units. The 1956 augmentation of the site featured a $35-million solid propellant plant (*Aviation Week* 1956).

The Aerojet General Corporation bought the acreage that would become the Douglas Missile Test Facility in 1956, as part of an expansion of its property in the Folsom-Rancho Cordova area. Prior to its acquisition by Aerojet, the parcel had been owned by the Natomas Company and had supported gold dredging activities between 1915 and 1956. Shortly after the purchase of the property, Aerojet leased a portion of the acreage to the Douglas Aircraft Company. Douglas built selected buildings in the Solid Propellant Test Area before October 1956, following with construction at the Sigma Test Area to its immediate south. By the close of the year, both the Alpha Test Complex and the Administration Area were also under construction. The first four areas of the Douglas Missile Test Facility are interpreted as designed by Aerojet, as noted in existing drawings for the Alpha Test Complex. The internal Douglas name for the facility was Site A-45. Alternate early names for the location were the Sacramento Missile Field Station and the Douglas Sacramento Test Center.

AFPs 70 and 71, and the Douglas Missile Test Facility, were part of the industrial plant and test site program of the United States Air Force. During World War II, the Army sponsored two types of industrial facilities in the United States that linked the military closely to private industry: the government-owned, government-operated (GOGO) plant and the government-owned, contractor-operated (GOCO) plant. The GOCO was the key paradigm for the "Army aircraft plant." These plants included a huge government investment in their infrastructure. By the end of the war, Army and Navy government-funded aircraft plants totaled 350. After the surrender of Japan in September 1945, the aircraft and weapons systems procurement mission abruptly changed, with most contracts cancelled and plant production mothballed. The federal government first sought to transition to a peacetime economy by offering the plants for sale to their wartime users, but such plant conversion was typically not cost-effective. In 1946, with the Cold War unfolding, the War Department foresaw a need for sustained future industrial preparedness and a reserve of standby plants. That year, the Army Air Forces had jurisdiction over just nine industrial plants—each an aircraft or aircraft-components manufacturing site held on standby. Headquarters Air Materiel Command managed the emerging program. Industrial mobilization and plant management planning continued in the late 1940s in the Air Force, Army, and Navy, with a projection of 159 GOCOs for the Air Force alone. The Air Force GOCO program included plants for the manufacture of aircraft, missiles, weapons systems, and all types of component parts. The National Industrial Reserve Act of 1948 simultaneously formalized a National Industrial Reserve, with particular use restrictions for some GOCOs managed by all service arms.

Complementing the industrial manufacturing plants, such as Aerojet's AFPs 70 and 71 at Folsom, were the closely related test sites of aerospace companies such as Douglas. These facilities were not government owned or operated, but did directly support research, development, test, and evaluations required during the manufacturing process. Corporate test sites, such as the Douglas Missile Test Facility, existed across the United States. California examples of rocket-engine, missile, and space booster corporate test facilities of the middle and late 1950s include a North American Aviation (NAA) site in Santa Susana Canyon near Los Angeles, where the company captive-fired Atlas engines in 1955 (Plate 3); a Convair test-stand complex for Atlas at Point Loma near San Diego, of 1957 (Plate 4); and, the Aerojet rocket-engine static test complex associated with AFP 70 near the Douglas Missile Test Facility, of 1956 (Plates 5-6). At some of these locations, including the NAA site at Santa Susana Canyon and the Douglas Missile Test Facility, NASA followed the Air Force as the true user of the test facilities (Weitze 2003; NASA 1966). (Among NASA test managers, the NAA site became known as Santa Sue.)

Initial activities at the Douglas Missile Test Facility are interpreted as supporting tests of solid-propellant rocket booster engines for the Nike Hercules interceptor missile at the Solid Propellant Assembly Area and the Sigma Test Area, and captive firings of early production-line Thor intermediate range ballistic missiles (IRBMs) and Thor engines on the test stands in the Alpha Test Complex. Components tests for the Thor also took place at two smaller sites at the Douglas Missile Test Facility: Initial Operational Capability (IOC) Site 1, collocated at the Alpha Test Complex, and IOC Site 2, the genesis of the later Kappa Test Area. The developmental Nike Hercules was Defense Missile (DM)-14; the developmental Thor, the DM-18.

Nike Hercules

The Nike Hercules was the second-generation Nike surface-to-air missile. The Hercules was 41 feet long, 31.5 inches in diameter, used solid rocket fuel, and had a range of 75 miles up to altitudes of 150,000 feet. The missile was a two-stage weapons system. Its predecessor, the Nike Ajax, was also a two-stage missile, but was smaller than the Hercules and used liquid propellant. The Nike Ajax deployed during 1954-1958, and was the first operational guided, surface-to-air missile in the world. The prime subcontractor for the Nike Ajax was Douglas Aircraft, who manufactured 13,714 large airframes for the missile at its plant in Santa Monica, California, and at the Army Ordnance Missile Plant in Charlotte, North Carolina. The Army established nearly 200 Nike Ajax batteries ringing the continental United States by 1958. A single Nike rocket engine powered the Ajax, while a cluster of four Nike engines powered the Hercules. The Army initiated development of the Nike Hercules in 1953, with deployment of the missile underway in 1958. Douglas was also the prime subcontractor for the Hercules, a nuclear-capable missile. The Army deployed 145 Nike Hercules batteries (110 of these converted from pre-existing Nike Ajax installations). Nike Ajax / Nike Hercules batteries in California were located around Los Angeles (16) and San Francisco (16). The Nike Hercules ceased to be an operational missile in the United States by 1975, although was still deployed internationally thereafter (Lonnquest and Winkler 1996).

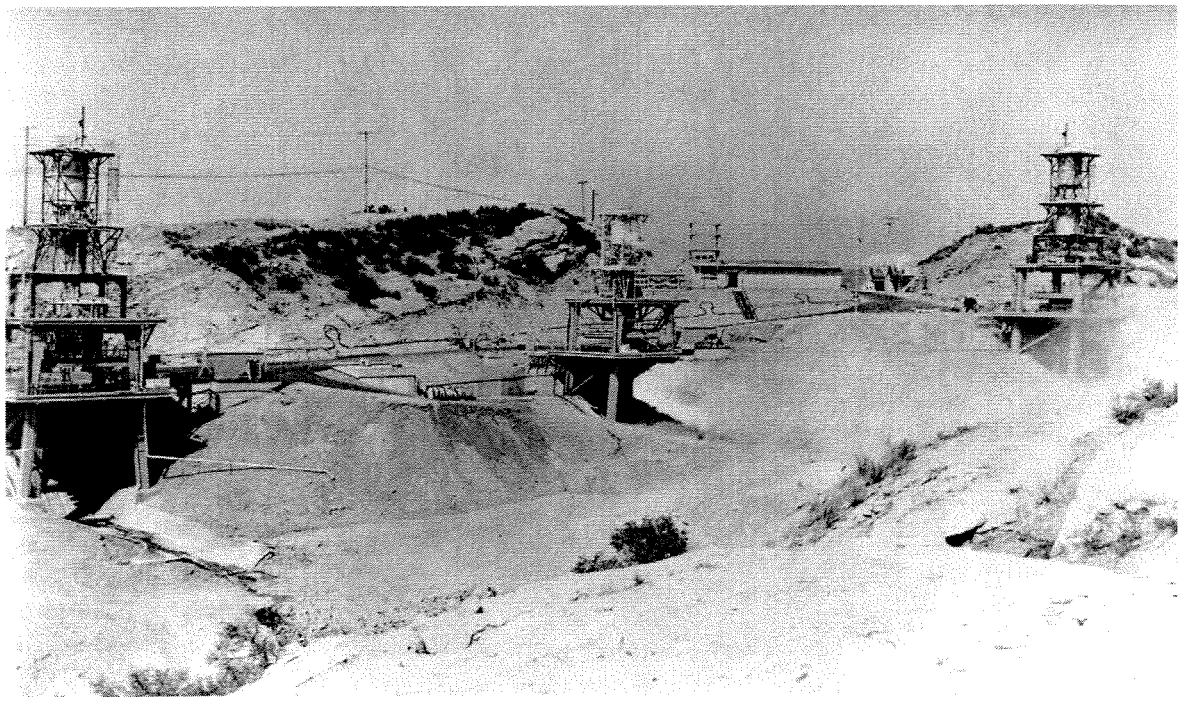

Plate 3: NAA Test Site, Santa Susana Canyon, California. Firing of an Atlas single booster engine. In *History of Air Research and Development Command July-December 1955.*

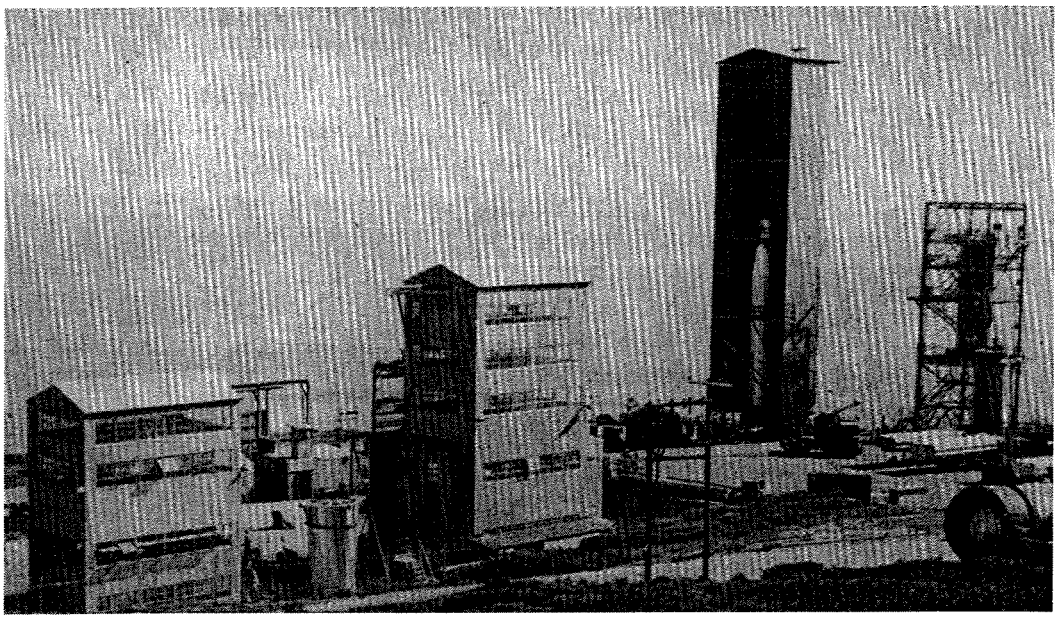

Plate 4: Convair Test Site, Point Loma, California. Atlas in test stand. In *Aviation Week*, 9 December 1957.

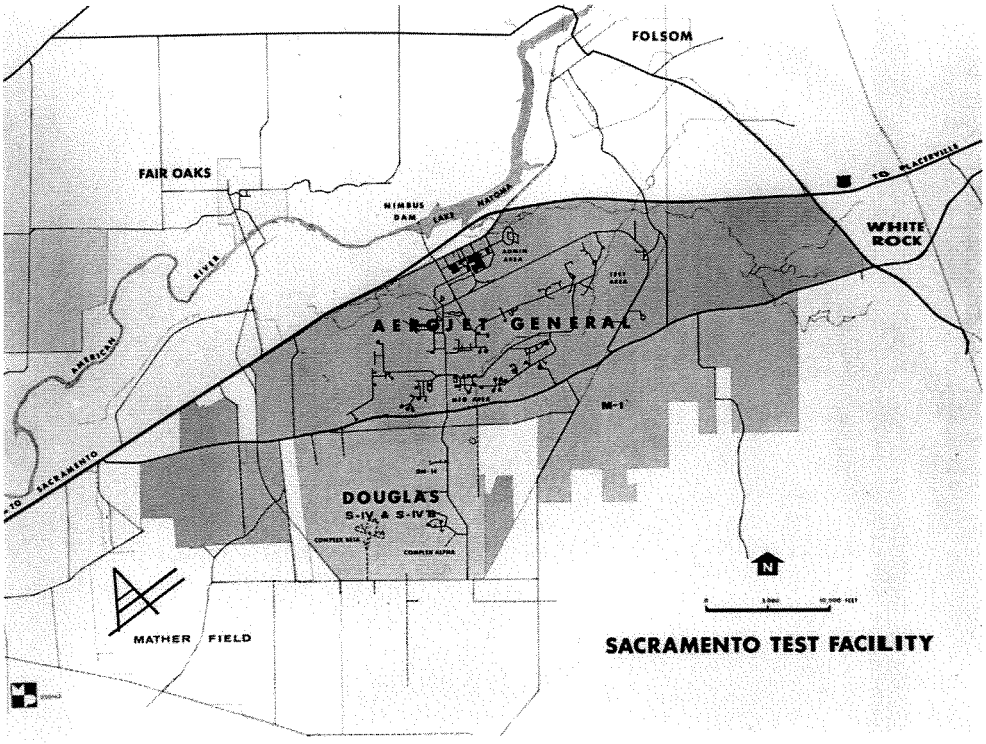

Plate 5: Aerojet General M-1 Test Complex and Douglas Missile Test Facility, ca.1964. Courtesy of NASA.

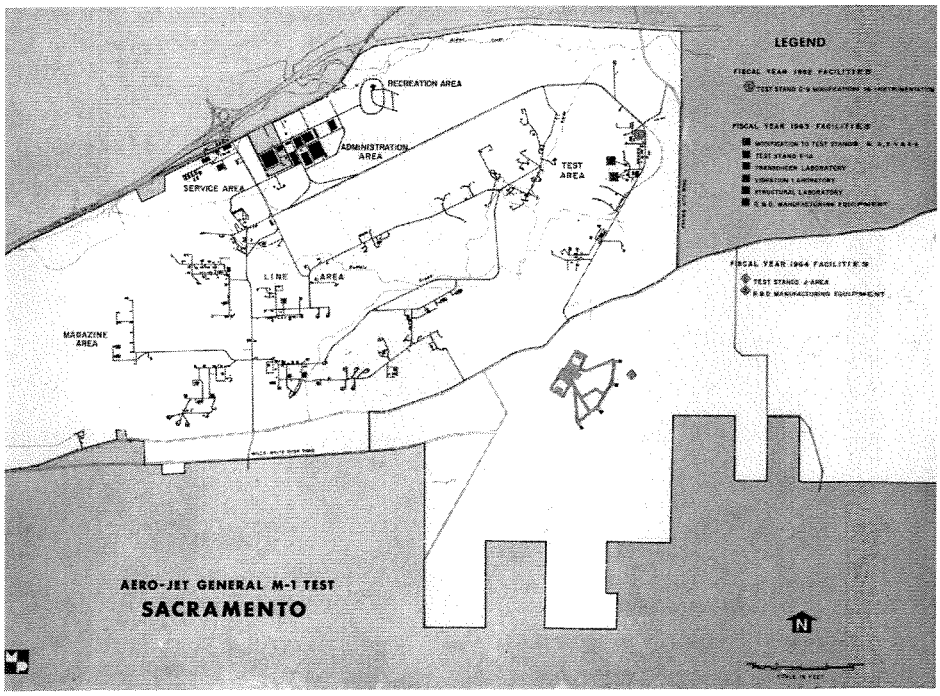

Plate 6: Aerojet General M-1 Test Complex, ca.1964. Courtesy of NASA.

Note: An oral tradition exists that the Solid Propellant Assembly Area accommodated tests of the MB-1 Genie, a nuclear-tipped air-to-air missile contracted to Douglas Aircraft for development in 1954. Douglas delivered the first inventories of the Genie to the Air Force in January 1957—with the weapons system placed at Hamilton Air Force Base near San Francisco and Wurtsmith Air Force Base near Detroit (Schaffel 1991). The Kansas City architectural-engineering firm Black & Veatch designed the special munitions igloo for the Genie in mid-1956, with its buildout matching deployment of the Genie during 1957-1958 at selected Air Defense Command fighter-interceptor alert compounds across the nation (Weitze 2003). If work on the Genie occurred at the Solid Propellant Assembly Area and/or the Sigma Test Area, such activity was confined to 1957, and preceded a full shift to work on the Nike Hercules by 1958. The likelihood of work on the Genie at a contractor site, *after* its deployment to Air Force installations as an operational weapons system, is unlikely. One possibility is that a portion of the Solid Propellant Test Area was operational very quickly in 1956, as is indicated by existing drawings of the site, and that for a brief period supported Douglas' work on the Genie in the assembly building at that location. (See the discussion for Unit 109, in the inventory for the Solid Propellant Test Area.)

Thor

Thor was an Air Force IRBM, developed to complement the Army's Redstone shorter-range ballistic missile, the Redstone. While the Redstone had a range of 500 miles, the Thor and its complementary Army IRBM, the Jupiter, could it deliver their payloads 1,500 miles. The Department of Defense desired a truly long-range ballistic-missile capability, and planned toward the Atlas and Titan ICBMs. The Atlas I and Titan I each had a range of more than 6,300 miles. Military engineers calculated that an IRBM would be easier to bring to operational status than would an ICBM. The Thor and the Jupiter were also rushed through development and test to counterbalance similar IRBM programs thought to be in progress in the Soviet Union. Douglas Aircraft was the manufacturer of the Thor IRBM. The Thor was a stop-gap ballistic missile, deployed as four, 15-missile squadrons in Britain during 1959-1960. Thor was 65 feet long, and unlike the Nike Hercules was a liquid-propellant weapons system. Aerojet engineers designed the Alpha Test Complex on the Douglas Missile Test Facility in 1956-1957 for early Thor evaluation testing. Thor was also in test for the Air Force in the captive-firing stands on Leuhman Ridge at Edwards Air Force Base in southern California, a facility managed by Aerojet. In mid-1960, after two years of tests at Douglas Missile Test Facility and on Leuhman Ridge, the Air Force moved the final process of Thor IOC testing to Vandenberg Air Force Base near Santa Barbara. The training of British personnel for the Thor occurred at Vandenberg. The three Thor launch complexes constructed for Thor at Vandenberg retained potential operational capability during the early 1960s (Lonnquest and Winkler 1996; Weitze 1991).

Douglas operated its test site at Rancho Cordova-Folsom as a sequence of expanding activities. The work on the developmental Nike Hercules at the Solid Propellant Assembly Area and the Sigma Test Area was likely underway by 1957, and is interpreted as including significant Aerojet participation. Captive firings of the Thor at the Alpha

Test Complex began in January 1958, with activation of IOC Site 1 in July 1958 and IOC Site 2 in July 1959. In 1960, Douglas completed Thor tests at its test facility, and began supporting the Aerojet second-stage engine test program for the Titan ICBM on one of the test stands in the Alpha Test Complex. Douglas also initiated tests of the developmental DSV-IV Saturn booster for NASA at IOC Site 2 (with the location renamed the Component Test Site). Beginning in 1961, Douglas increased its contracting to NASA, although continued to support tests of the Titan second-stage engine. In 1961, Douglas conducted more developmental tests for the Nike weapons system at the Solid Propellant Test Area and at the Sigma Test Area. As of this year, tests were for the third-generation Nike, the Nike Zeus (DM-15). During 1962, Douglas continued tests of the Nike Zeus at the two locations, and also added tests for the Skybolt air-launched ICBM (DM-20). For NASA, tests for the DSV-IV Program continued at the Alpha Test Complex, with the addition of static firings of RL 10 A-1 and RL 10 A-3 engines configured in the battleship S-IV (Douglas 1958-1962). The battleship launch vehicle was a non-flight test version, fabricated from stainless steel for heavy, repeated usage.

Nike Zeus

The Army developed the Nike Zeus as an anti-missile missile, a weapon planned for an antiballistic missile (ABM) system and one that included a nuclear warhead. The first contract for the Nike Zeus occurred in early 1957. Douglas was again the prime subcontractor for the missile's large airframe. Although the Army lobbied Congress for funding of the Nike Zeus as a full-blown ABM weapon, the Nike Zeus received only sufficient monies to carry the missile through R&D during 1959-1962. Douglas conducted activities for the Nike Zeus in the Solid Propellant Assembly Area and in the Sigma Test Area of its missile test facility at Rancho Cordova during 1961-1962—possibly running tests for the Nike Zeus at the locations before this date, after transitioning from work on the Nike Hercules (Douglas 1958-1962). In July 1962, the Army fired a Nike Zeus (with a dummy warhead) from launch facilities on the Kwajalein Atoll in the Marshall Islands at an Atlas ICBM fired from Vandenberg Air Force Base. The Army counted the test mission a success, although the Nike Zeus warhead missed the inbound Atlas by two kilometers. In a second test, a Nike Zeus fired from Kwajalein came within 22 meters of the Atlas launched from Vandenberg. Despite the prominence of the Nike Zeus tests and their positive receipt, the Department of Defense decided not to deploy the Nike Zeus as an ABM, and instead shifted toward a more sophisticated defense missile first named the Nike X. The Nike X was the first step toward the later Safeguard ABM system developed during 1964-1975 (Lonnquest and Winkler 1996).

Skybolt

Douglas Aircraft was also responsible for development of the Skybolt ballistic missile, with early development of the weapon beginning in 1959. The Skybolt was an air-to-surface missile nearly 40 feet long, planned for launch from a B-52. The weapon was the first ballistic missile to be fired from a bomber, and had a target distance of 950 nautical miles. The Skybolt, like both the Nike Hercules and Nike Zeus, had a nuclear warhead. Strategic Air Command (SAC) planned to deploy the Skybolt to selected of its alert

facilities in 1961 as a follow-on weapon to the Hound Dog, a nuclear-tipped cruise missile of the late 1950s. Program goals were 1,000 Skybolt missiles, equipping 22 squadrons at SAC bases. Douglas fabricated full-scale dummy Skybolt missiles, which the Air Force used in drop tests from both American and British aircraft, but never went into production for the weapons system. The Air Force cancelled the Skybolt program in December 1962 (Weitze 2003).

Note: Each of the identified missiles associated with tests in the Solid Propellant Assembly Area and the Sigma Test Area during 1956/1957-1962 were Douglas-developed and –manufactured weapons systems with nuclear warheads: the Nike Hercules, Nike Zeus, and Skybolt (and also, the MB-1 Genie, if tested at the locations). In 1962, Douglas also conducted a "Special Test Series 'A'" in the Solids Area. The Special Test Series "A" were a classified test series that included an igniter test and three propellant evaluation tests (Douglas 1958-1962). The Special Test Series "A" likely also involved tests related to a weapons system with a nuclear warhead. The significance of the focus on nuclear-warhead weapons in the Solid Propellant Assembly Area and the Sigma Test Area remains undetermined.

During 1960-1962, even as the company supported tests of the Nike Zeus and Skybolt, Douglas moved toward a dedicated use of its missile test facilities at Rancho Cordova for NASA's S-IVB program. Initially, Douglas tested the S-IV in the Alpha Test Complex. By 1966, NASA had redesignated the Douglas site the NASA S-IVB Stage Test Facility—a name that replaced that of the Douglas Missile Test Facility. Ralph M. Parsons designed the Beta Test Complex for tests of the S-IVB in 1963, with construction of the complex during 1964. Douglas also expanded its facilities at the IOC Site 2 (Component Test Site / Engineering Services Site) to support the needs of the S-IVB test program. The IOC Site 2 evolved into the Kappa Test Area, with the Gamma Test Area added adjacent. Douglas conducted battleship tests for the S-IVB in the Beta Test Area, subsequently running acceptance tests of S-IVBs and of its power-plant, the J-2 engine.

Saturn S-IV and S-IVB Boosters

The S-IV and S-IVB were second-stage boosters for the Saturn I and Saturn IB, NASA's launch platforms for placing man in space. The Saturn launch vehicles advanced through increasingly sophisticated models (Plate 7). The Saturn I was a two-stage launch vehicle (first called the Juno V—see Plate 2) used to qualify Apollo spacecraft. The Saturn IB was also a two-stage launch vehicle, but featured improved upper-stage engines. NASA used the Saturn IB for earth-orbital missions, including Apollo and Skylab. The first-stage booster of the Saturn I was the S-I, developed within the Army Ballistic Missile Agency at the Redstone Arsenal during the late 1950s. The second-stage booster of the Saturn I was the S-IV. The configuration of the Saturn IB included an S-1B as the first-stage booster, and the S-IVB as the second-stage booster. NASA engineers developed the propulsion systems for the Saturn I and the Saturn IB using liquid-fuel engines, rather than solid-rocket engines. Engineers could shut down liquid-fuel engines after ignition, whereas solid-rocket boosters would continue burning. Liquid-fuel engines for the Saturn I were eight H-1 engines in the S-I (first stage booster), and six RL 10 engines in

the S-IV (second stage). As true for the Saturn I, propulsion for the first stage of the Saturn IB was also eight H-1 engines. For the second-stage S-IVB booster, however, NASA turned to a single J-2 engine (Weitze, Cleland, Gregory, and Lilburn 2003). In the final version of the Saturn, the Saturn V, NASA configured the launch vehicle as three stages: a first-stage S-IC (with five F-1 engines), a second-stage S-II (with five J-2 engines), and a third-stage S-IVB (with one J-2 engine). McDonnell Douglas manufactured the S-IV and S-IVB for NASA. The S-IVB was 58 feet long and 21.5 feet in diameter. The J-2 engine had a 200,000-pound thrust, with a restart capability (NASA 2005).

NASA conducted tests of the RL 10 and the J-2 engines in battleship configurations of the S-IV and S-IVB boosters on captive-firing stands in the Alpha Test Complex (the RL 10) and in the Beta Test Complex (the J-2) during 1962-1968 (Plates 8-14). Tests of the RL 10 focused on very early versions of the engine during 1962. Tests of the J-2 at Rancho Cordova illustrate the important interactive relationships between corporate test facilities and those maintained by NASA to develop a new engine for a launch vehicle. Rocketdyne contracted to manufacture 55 J-2 engines for NASA by August 1965, and delivered the first production J-2 engine in April 1964. Rocketdyne, a division of NAA, ran an intensive test program for the J-2 engine at the Santa Susana test site (see Plate 1). NASA followed with qualification tests of the J-2 engine at its Marshall Space Flight Center in Huntsville, Alabama, during 1965-1966. NASA conducted acceptance tests of the J-2 engine in the battleship S-IVB at the Beta Test Complex in Rancho Cordova during 196_. In mid-1966, NASA increased its contract for J-2 to 155 engines, including an uprated version (Weitze 2004). Douglas ran acceptance tests of the J-2 engine, including its uprated version, at the S-IVB Stage Test Facility in Rancho Cordova from mid-decade into about 1968. After acceptance tests, NASA transported the individual J-2 engines from California to Cape Canaveral for installation on second- or third-stage S-IVB boosters configured in the Saturn IB and Saturn V.

McDonnell Douglas ceased using its facilities at the Rancho Cordova site in 1969, thereafter maintaining the S-IVB Stage Test Facility in a state of readiness for NASA until late 1972. Between 1973 and 1977, McDonnell Douglas dismantled the majority of the steel superstructure on the four test stands in the Alpha Test Complex (two stands) and in the Beta Test Complex (two stands). The company sold the steel as scrap. In 1977, McDonnell Douglas also initiated sales of parcels and buildings in the Administration Area of the former Douglas Missile Test Facility / S-IVB Stage Test Facility. The divested real estate became part of an industrial park (Security Park). Final changes took place in the middle 1980s. In 1984, Aerojet bought back its original property from McDonnell Douglas. The only exceptions in the sale was real estate in third-party ownership located in Security Park (the former Administration Area). The lineage of AFP 70 and AFP 71, neighboring the Douglas property, also went through major changes. The Air Force sold AFP 71 in 1969. AFP 70, owned jointly by Aerojet and the Air Force, became fully Aerojet-owned in 1999. (The majority of AFP 70 was Aerojet-owned from its beginnings, but with direct oversight and record-keeping by the Air Force.)

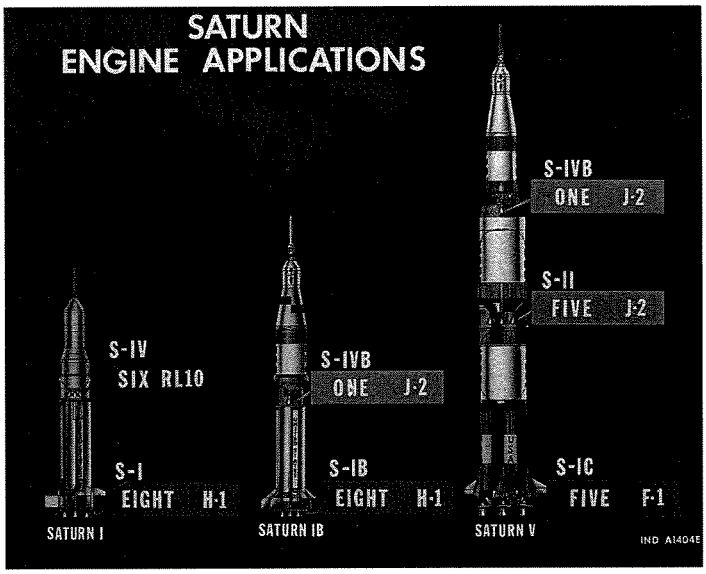

Plate 7: First-, second-, and third-stage booster configurations for the Saturn I, Saturn IB, and Saturn V. Courtesy of NASA, Marshall Space Flight Center MIX Archives.

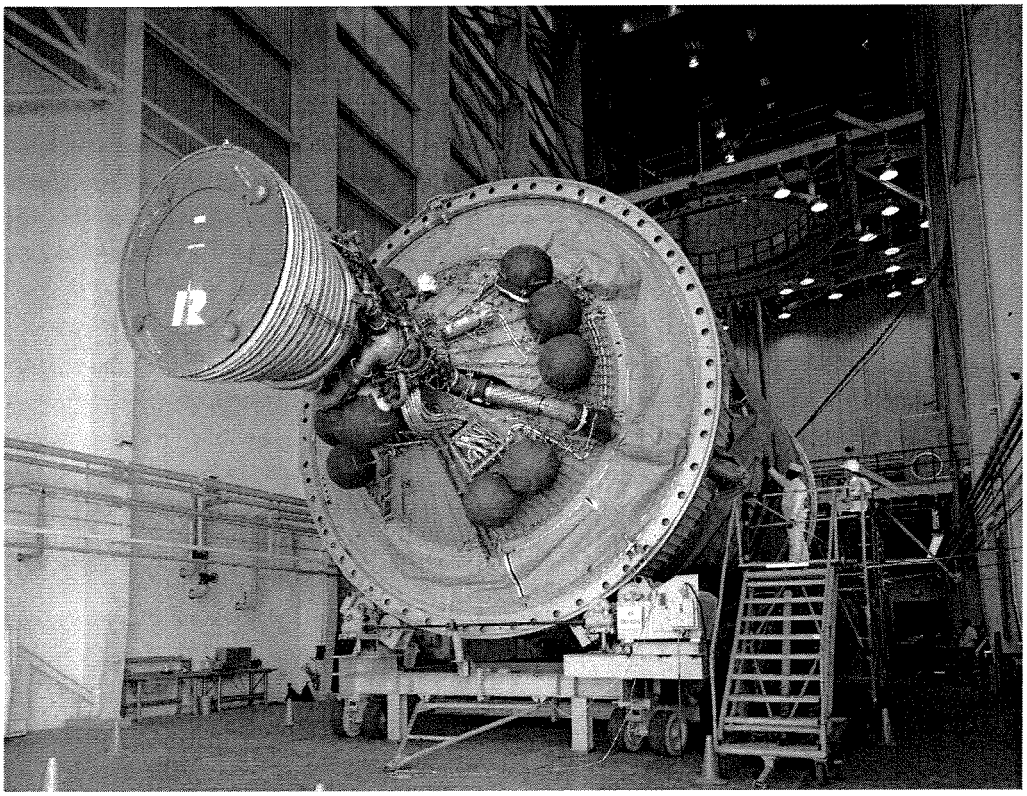

Plate 8: Fully assembled S-IVB, third-stage booster for the Saturn V (AS-503). Used in the Apollo 8 mission. In the Vehicle Checkout Laboratory, Administration Area, S-IVB Stage Test Facility (Douglas Missile Test Facility), January 1967. Marshall Space Flight Center MIX Archives.

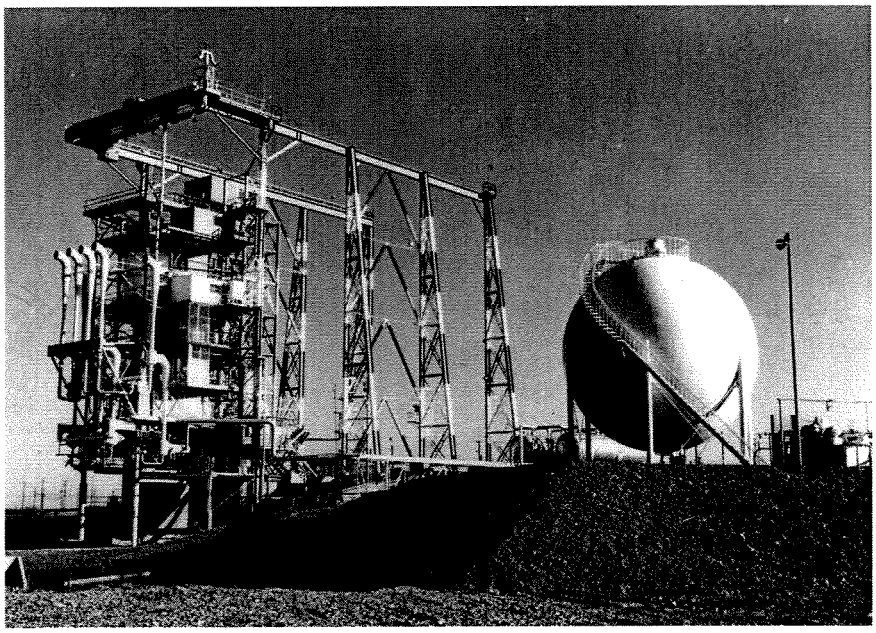

Plate 9: Battleship S-IV, in Test Stand No. 1, Alpha Test Complex, Douglas Missile Test Facility, ca.1961-1962. Bank of six steam ejectors visible left edge of the test stand. Steam ejectors and accumulators supported altitude simulation capabilities at Test Stands No. 1 and No. 2, Alpha Test Complex. Courtesy of NASA.

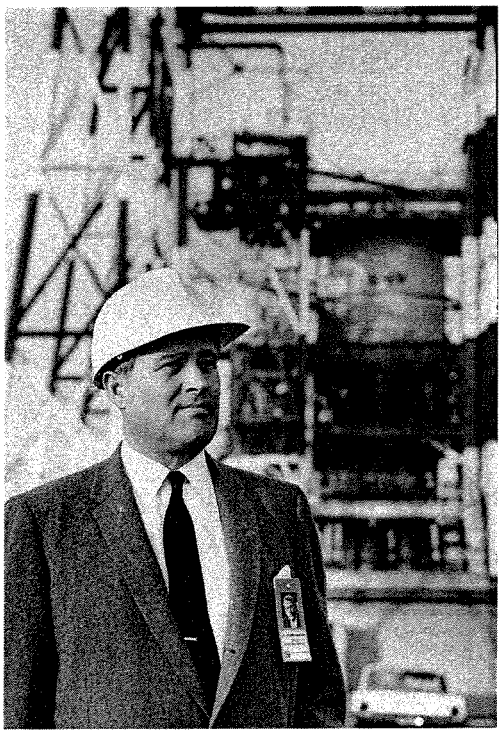

Plate 10: Werhner von Braun, visiting Test Stand No. 1, Alpha Test Complex, Douglas Missile Test Facility, early 1960s. Marshall Space Flight Center MIX Archives.

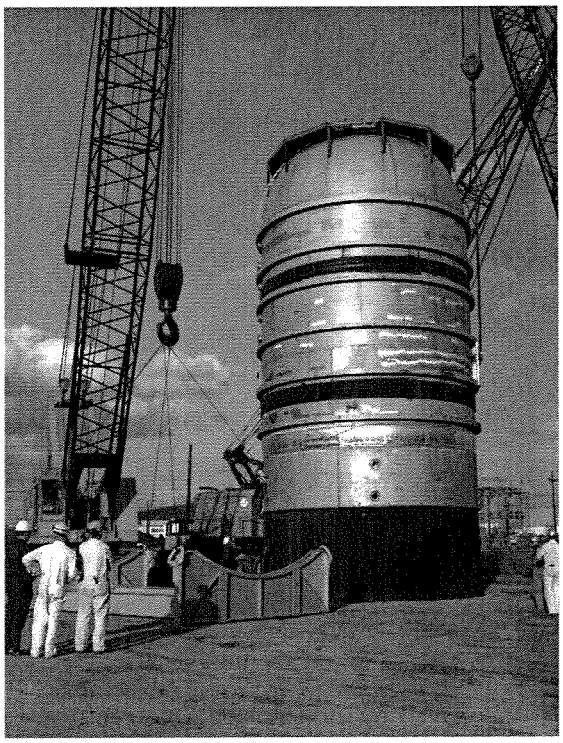

Plate 11: Battleship S-IVB at the S-IVB Stage Test Facility (Douglas Missile Test Facility), 1 February 1965. Marshall Space Flight Center MIX Archives.

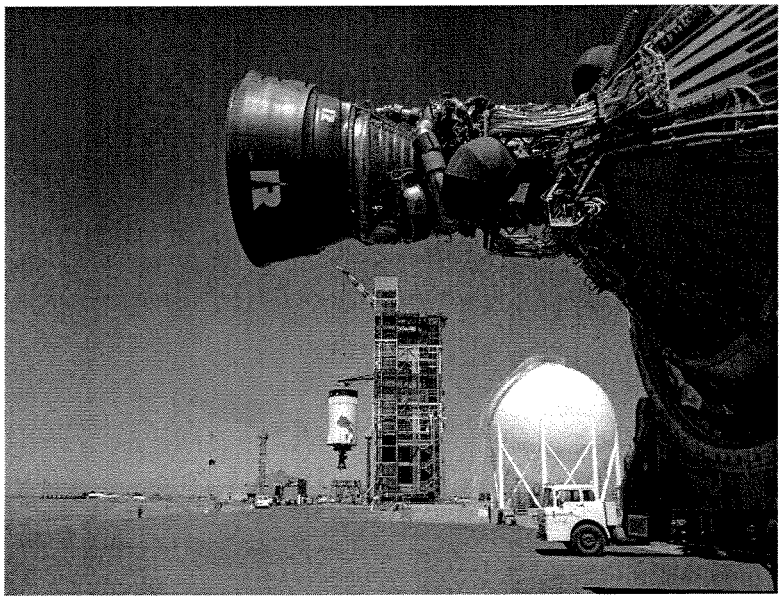

Plate 12: Saturn V S-IVB (AS-209), on transporter in foreground, with S-IVB for the Apollo 9 mission being installed in Test Stand No. 1, Beta Test Complex, S-IVB Stage Test Facility (Douglas Missile Test Facility), 1 January 1967. Marshall Space Flight Center MIX Archives.

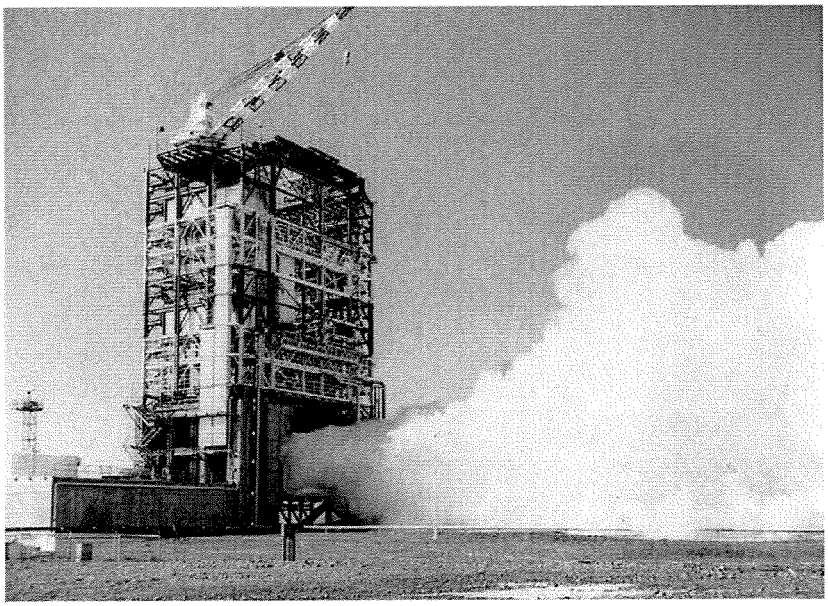

Plate 13: Acceptance test for a J-2 engine, in a third-stage S-IVB configuration for Saturn V, Test Stand No. 1, Beta Test Complex, S-IVB Stage Test Facility (Douglas Missile Test Facility),undated (ca.1967-1968). Marshall Space Flight Center MIX Archives.

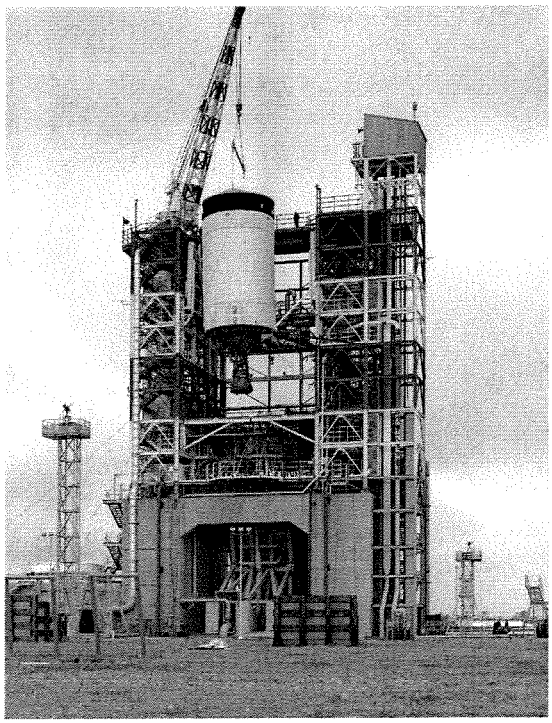

Plate 14: Acceptance test for Saturn V S-IVB, Apollo 10 mission. Test Stand No. 1, Beta Test Complex, S-IVB Stage Test Facility (Douglas Missile Test Facility), 1 January 1968. Marshall Space Flight Center MIX Archives.

INVENTORY ASSESSMENT

Weitze Research inventoried buildings, structures, and site remnants in six historic test complexes of the Douglas Missile Test Facility. The Administration Area for the Douglas Missile Test Facility (today's Security Park) is a seventh historic location, but is outside the project area. The contextual history above addresses the relationship of the Administration Area to the six inventoried test complexes.

Solid Propellant Assembly Area

The Solid Propellant Assembly Area is a small, partially fenced compound laid out east-west along a single road in the northern part of the overall historic Douglas test site (Figure 4). The area includes two distinct clusters of buildings that bracket a larger north-south road. The western cluster of buildings lies within a security fence, while those east of the road have open access. The fenced western building group dates to 1956. The unfenced eastern building group dates to 1964-1966. Reviewed materials indicate that McDonnell Douglas constructed the western half of the Solid Propellant Assembly Area to support its early development work on the Nike Hercules interceptor missile, the IM-14. Also known as Site DM-14 (which stands for Defense Missile 14), the Solid Propellant Assembly Area may have acquired this alternate name from its early association with the Nike Hercules. McDonnell Douglas added the eastern cluster of buildings as a part of an expansion of facilities during the early 1960s for NASA.

Aerojet manufactured the liquid-fueled sustainer engine and the solid-fueled rocket booster for the Nike Ajax during the late 1940s and early 1950s. The experimental Nike Hercules program was underway in late 1953, with test firings beginning at the White Sands Proving Ground in New Mexico by 1955. The developmental Nike Hercules of the middle 1950s reused the existing Nike Ajax propulsion system. Design engineers quadrupled the engine components, using four solid-rocket boosters to lift the missile into its initial flight. Four liquid-rocket boosters fired next to propel the Nike Hercules to its target. A serious test firing accident at White Sands in late September 1955 led design engineers to replace the liquid-fueled rocket booster with a solid-fueled sustainer engine for the Nike Hercules. Nike Hercules development work conducted in the western half of the Solid Propellant Assembly Area is interpreted to have included only solid-propellant rocket engines.

Minor ancillary structures that are no longer standing within the assembly area include the following:

- a small water tank at the southwestern corner of the assembly building;
- a clock station (Unit 108) at the entrance gate to the fenced group of buildings west of the north-south road;
- a guard station (Unit 101) coupled with the clock station;
- a pair of storage sheds south of the ASV building and west of the Quonset hut;
- a large storage shed; and,
- an impound storage facility immediately east of the Quonset hut.

A discussion of the existing components of the solid propellant assembly area is presented below.

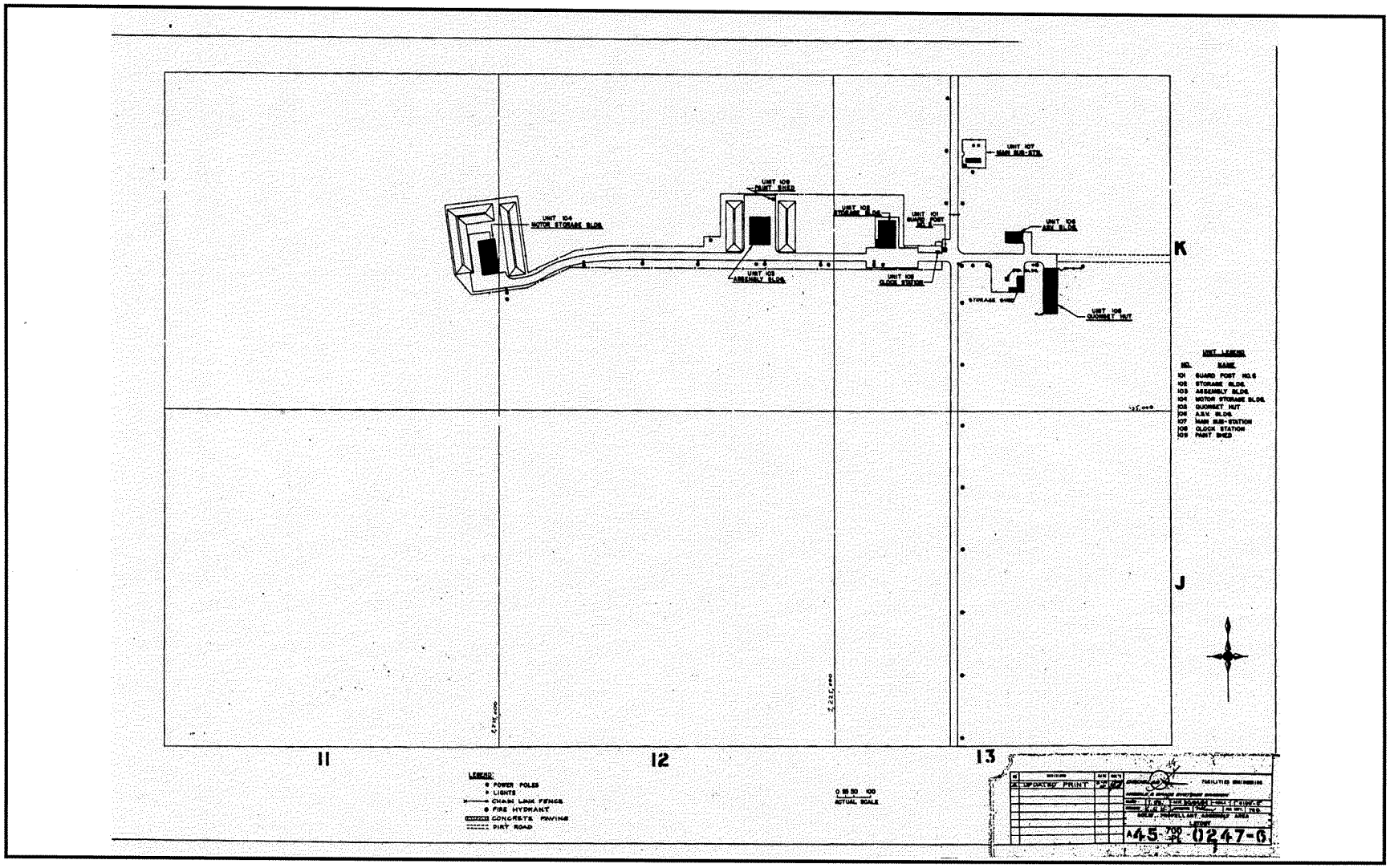

Figure 4: Douglas Facilities Engineering, Solid Propellant Assembly Area, Douglas Missile Test Facility, Rancho Cordova, California, 1964.

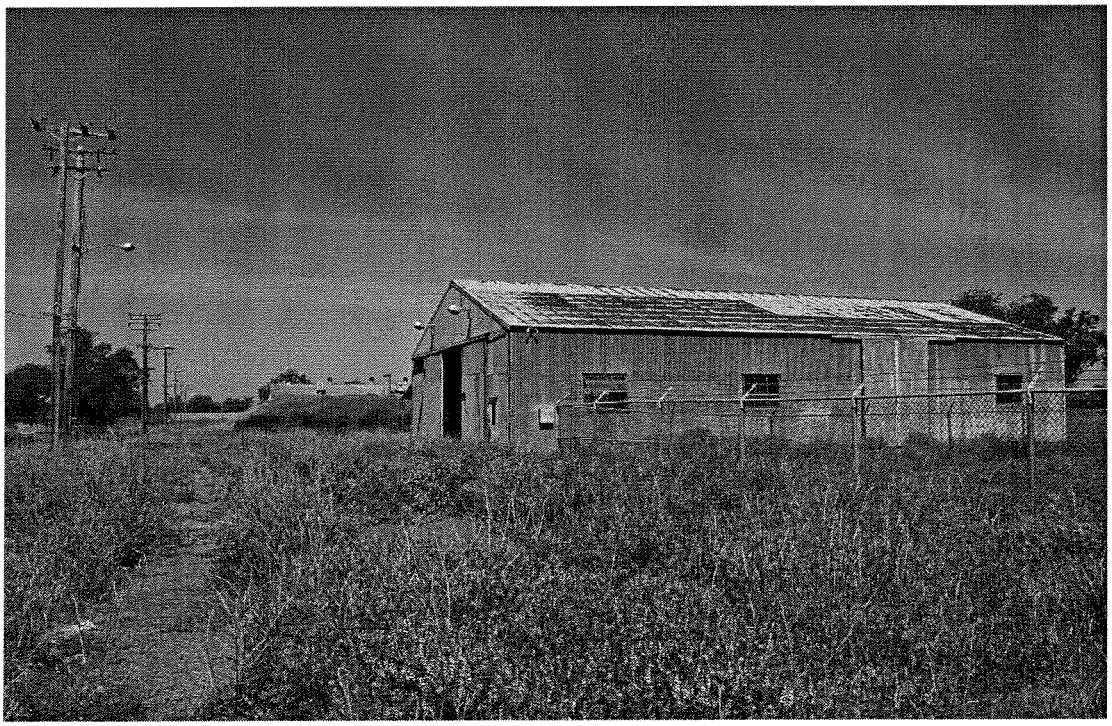

Plate 15: Storage Building (Unit 102), Assembly Building (Unit 103), and Motor Storage Building (Unit 104), Solid Propellant Assembly Area, 1956. East to west overview. Looking west. View of May 2005.

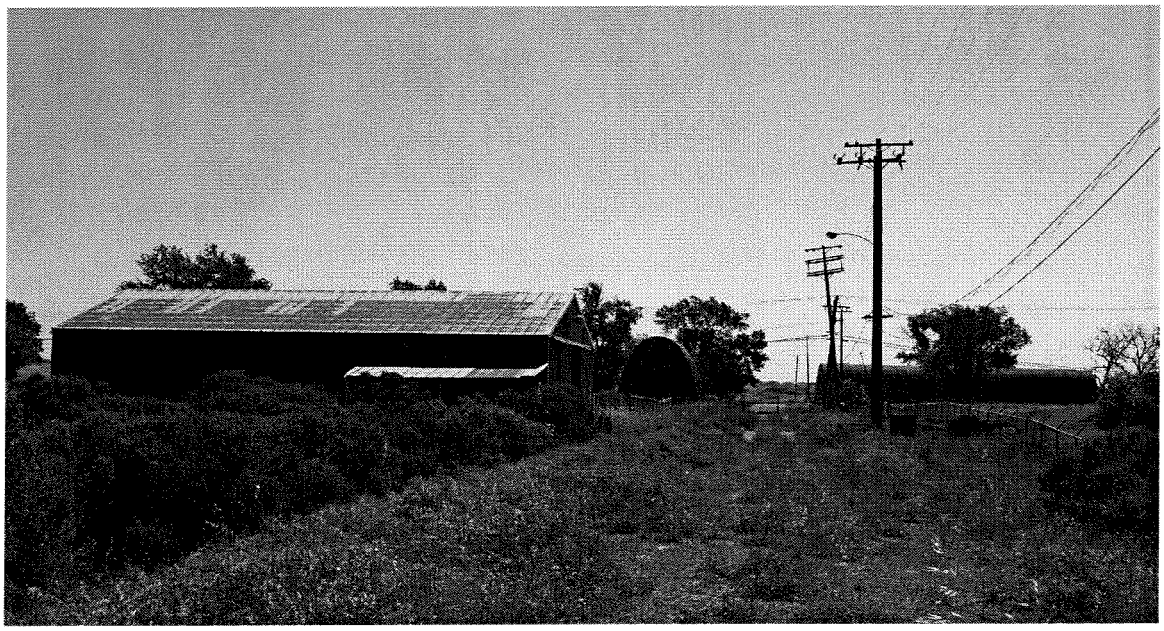

Plate 16: Storage Building (Unit 102), ASV Building (Unit 106), and Quonset Hut (Unit 105), Solid Propellant Assembly Area, 1956. West to east overview. Looking east. View of May 2005.

Motor Storage Building

Also known as Unit 104, the motor storage building is a one-story, prefabricated metal structure erected in the Solid Propellant Assembly Area in October 1956. The motor storage building is rigid-frame construction, sheathed in corrugated siding. Windowless, the building features center-opening, track-mounted front and rear doors and a gable roof. Several rooms now augment the interior of the motor storage building, configured primarily along the west side. The interior of the motor storage building was likely open when built. A large earthen berm buffers the two sides and rear of the motor storage building from its surroundings. The berm is rock-stabilized, presently overgrown with grass. The earthen berm is an original feature of the building.

Douglas added the motor storage building to the Solid Propellant Assembly Area after construction of the assembly building (Unit 103) to the east. The Solid Propellant Assembly Area, alternately known as the DM-14 Site, first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for Special Test Series "A." The special series tests were classified. (Douglas 1958-1962.) The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south.

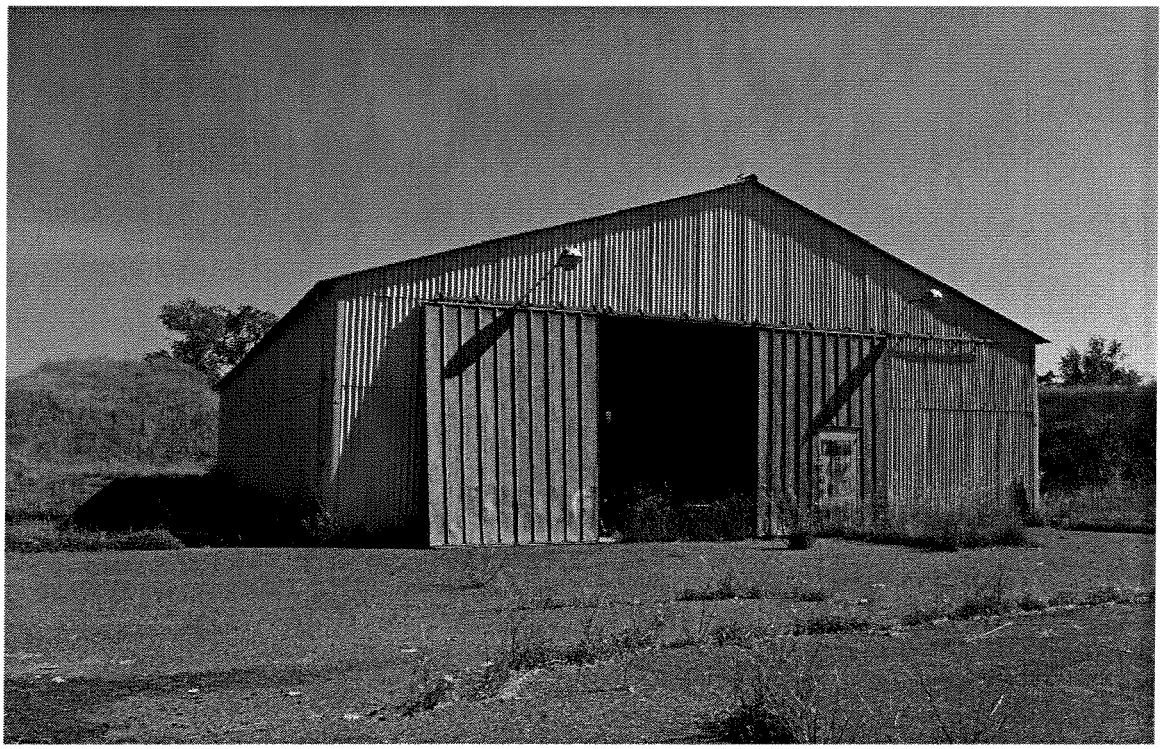

Plate 17: Motor Storage Building (Unit 104), Solid Propellant Assembly Area, 1956. Looking north/northeast. View of May 2005.

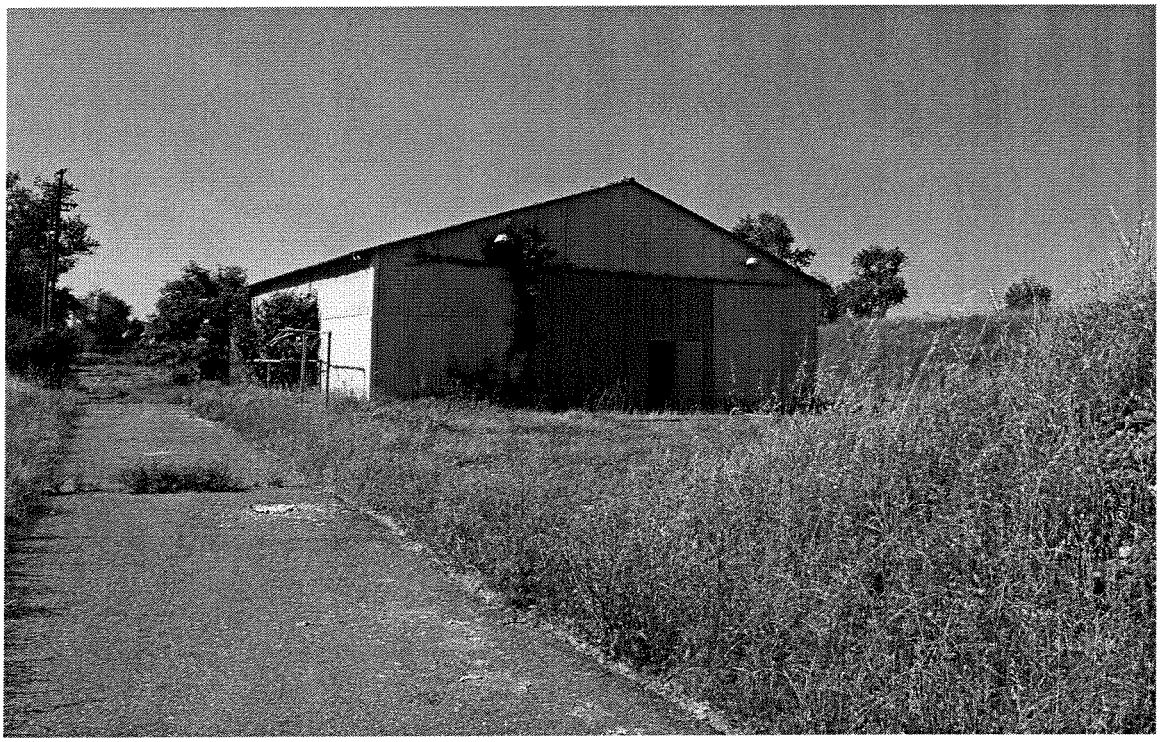

Plate 18: Motor Storage Building (Unit 104), Solid Propellant Assembly Area, 1956. Looking south/southwest. View of May 2005.

Plate 19: Motor Storage Building (Unit 104), Solid Propellant Assembly Area, 1956. Interior, looking north. View of May 2005.

Assembly Building

Also known as Unit 103, the assembly building is a one-story, prefabricated metal structure erected in the Solid Propellant Assembly Area before October 1956. The assembly building is rigid-frame construction, sheathed in corrugated siding. Windowless, the building features center-opening, track-mounted front and rear doors and a gable roof. Shed-roof rooms line the west façade, as built. A corner office and boiler equipment augment the interior of the assembly building, and are also likely original. Doors on the east façade are non-historic. A large earthen berm buffers the two sides of the assembly building from its surroundings. The berm is rock-stabilized, presently overgrown with grass. The earthen berm is an original feature of the building. A paint shed stands behind the building on the northeastern corner of the property.

Douglas constructed the assembly building as the primary facility for in the Solid Propellant Assembly Area. Alternately known as the DM-14 Site, the Solid Propellant Assembly Area first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for Special Test Series "A." The special series tests were classified. (Douglas 1958-1962.) The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south.

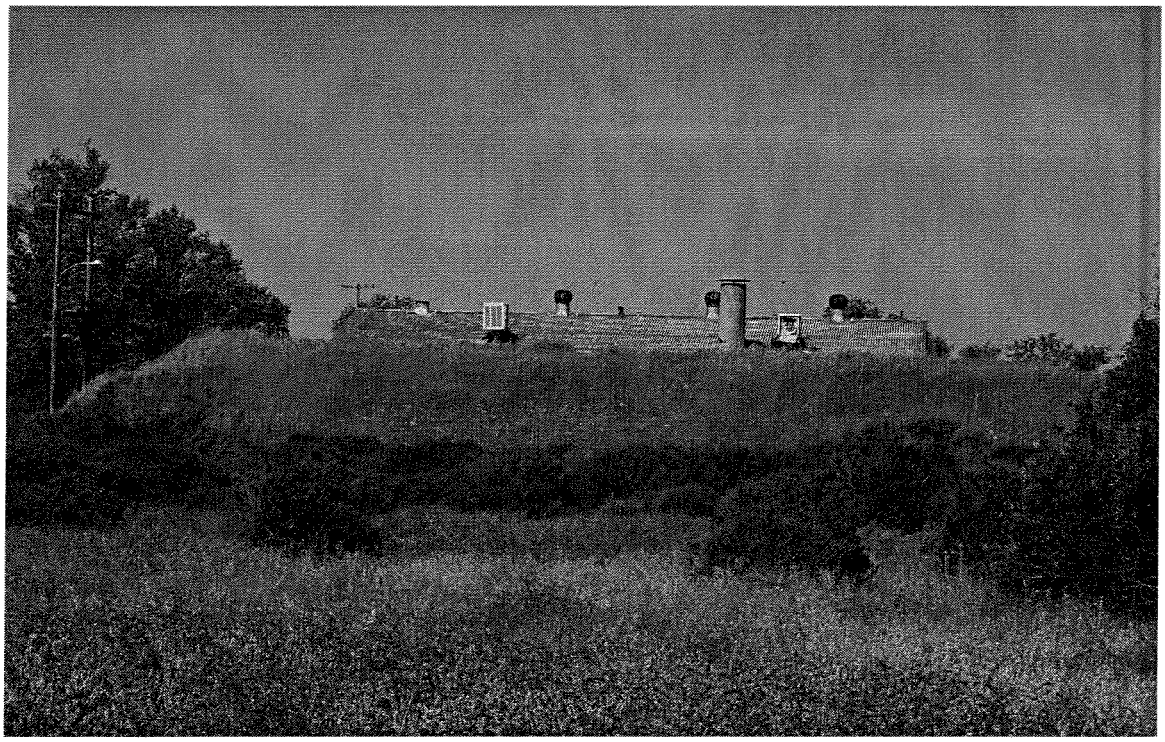

Plate 20: Assembly Building (Unit 103), Solid Propellant Assembly Area, 1956. Bermwork. Looking west. View of May 2005.

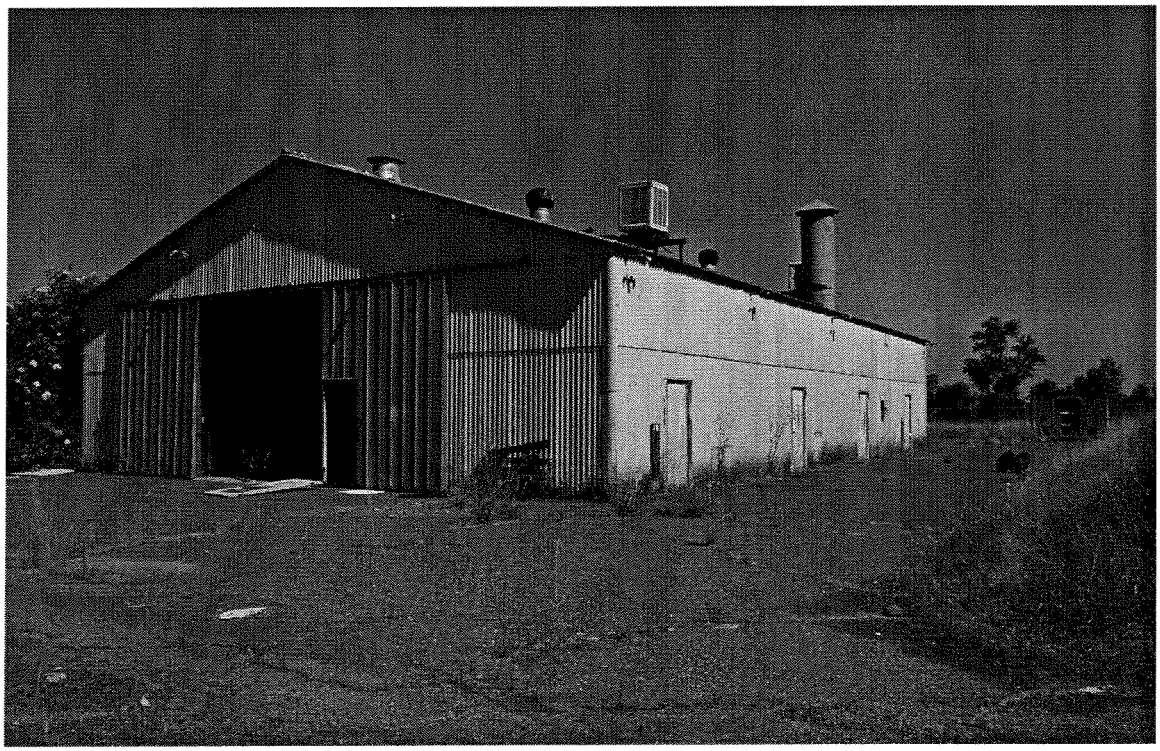

Plate 21: Assembly Building (Unit 103), Solid Propellant Assembly Area, 1956. Looking northwest. View of May 2005.

Plate 22: Assembly Building (Unit 103), Solid Propellant Assembly Area, 1956. Looking south/southeast. View of May 2005.

Plate 23: Assembly Building (Unit 103), Solid Propellant Assembly Area, 1956. Interior, looking southwest. View of May 2005.

Plate 24: Assembly Building (Unit 103), Solid Propellant Assembly Area, 1956. Interior, looking northeast. View of May 2005.

Paint Shed

Also known as Unit 109, the paint shed is a small, one-story prefabricated metal structure erected in the Solid Propellant Assembly Area in 1956. The paint shed is sheathed in corrugated siding. Windowless, the building features a single door bracketed by low wall vents and a clipped-eave shed roof. The paint shed is unaltered on its exterior. The small shed stands behind the assembly building on the northeastern corner of the property.

Douglas constructed the paint shed as an ancillary structure for the assembly building in the Solid Propellant Assembly Area. Alternately known as the DM-14 Site, the Solid Propellant Assembly Area first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for Special Test Series "A." The special series tests were classified. (Douglas 1958-1962.) The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south.

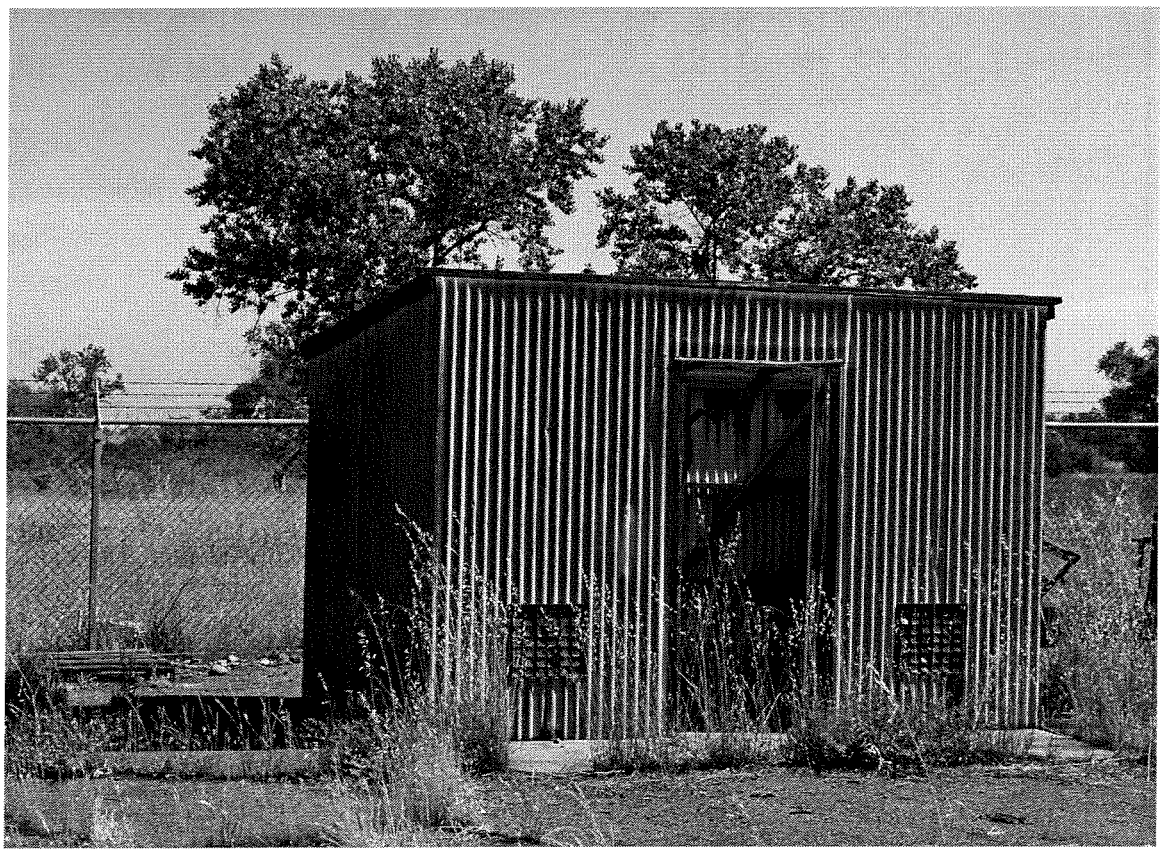

Plate 25: Paint Shed (Unit 109), located to the rear of the Assembly Building, Solid Propellant Assembly Area, 1956. Looking north/northeast. View of May 2005.

Storage Building

Also known as Unit 102, the storage building is a one-story, prefabricated metal structure erected in the Solid Propellant Assembly Area in 1956. The storage building is rigid-frame construction, sheathed in corrugated siding. Sparsely articulated by 6/3 factory windows, the building features center-opening, track-mounted front and side doors, and a gable roof. A shed-roof addition augments the east façade, interpreted as original construction. The interior of the storage building includes a small corner office, also original. No earthen berm surrounds the storage building.

Douglas likely constructed the storage building in the Solid Propellant Assembly Area simultaneously with the assembly building (Unit 103) to the west. Exterior mounted security lights are identical for both the assembly and storage buildings. The Solid Propellant Assembly Area, alternately known as the DM-14 Site, first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for Special Test Series "A." The special series tests were classified. (Douglas 1958-1962.) The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south.

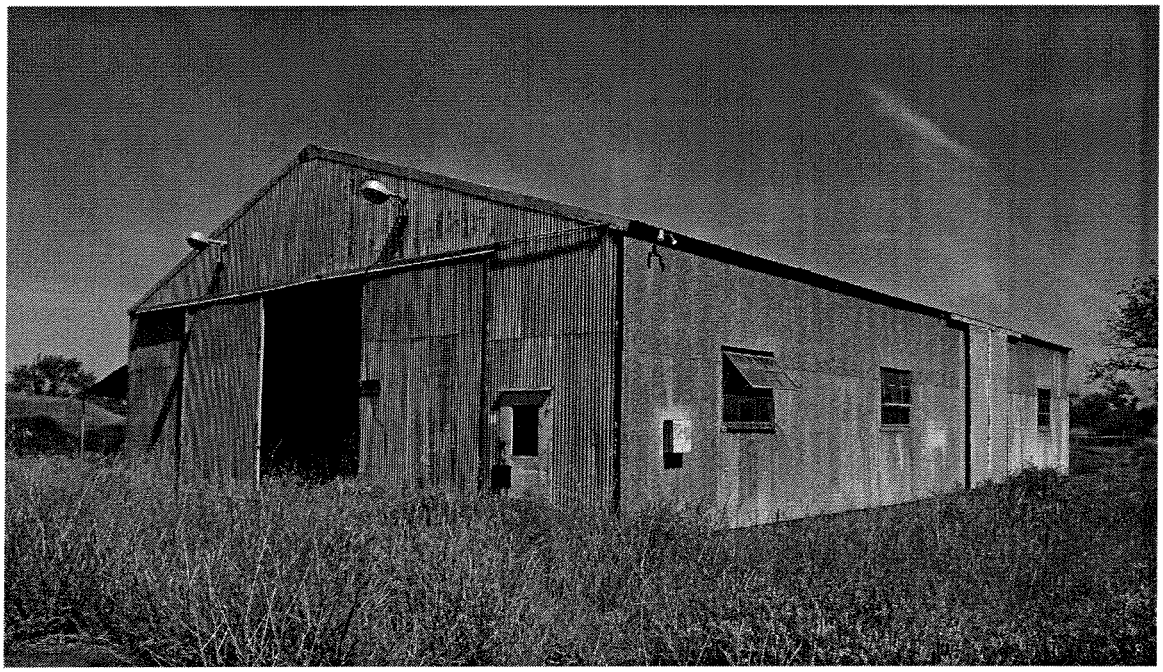

Plate 26: Storage Building (Unit 102), Solid Propellant Assembly Area, 1956. Looking northwest. View of May 2005.

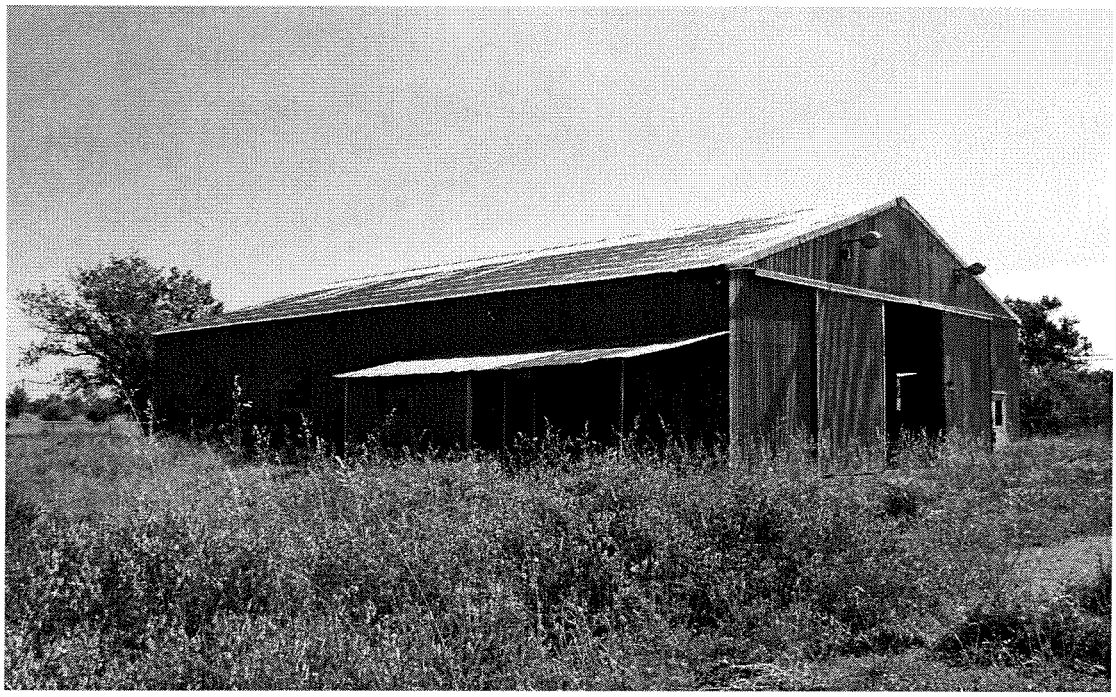

Plate 27: Storage Building (Unit 102), Solid Propellant Assembly Area, 1956. Looking northeast. View of May 2005.

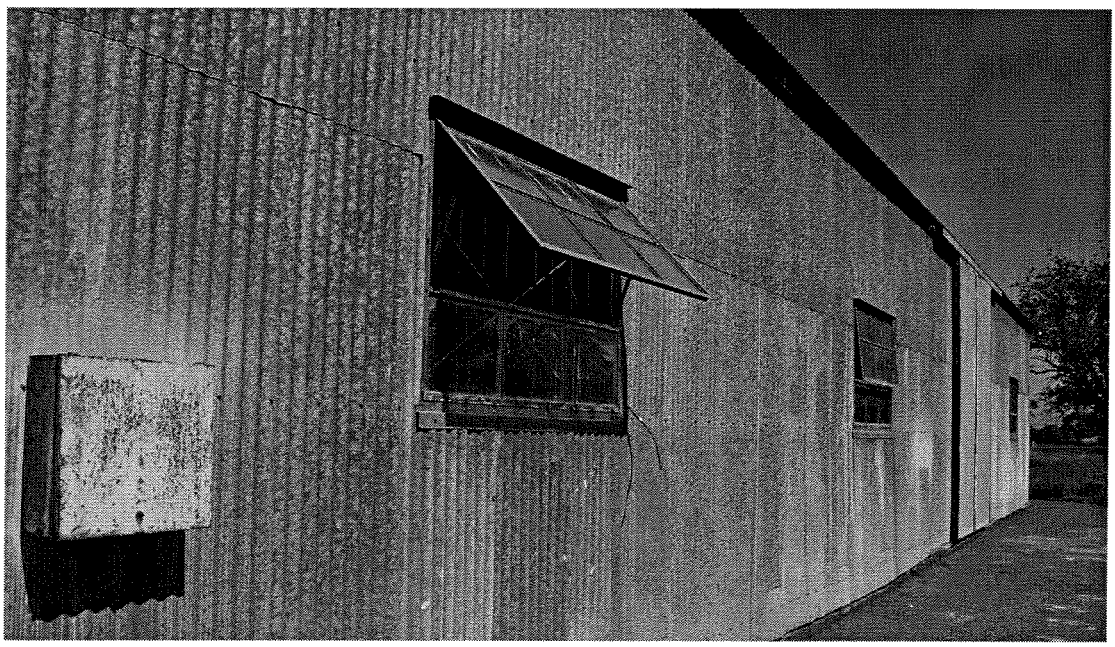

Plate 28: Storage Building (Unit 102), Solid Propellant Assembly Area, 1956. Window details. Looking north/northwest. View of May 2005.

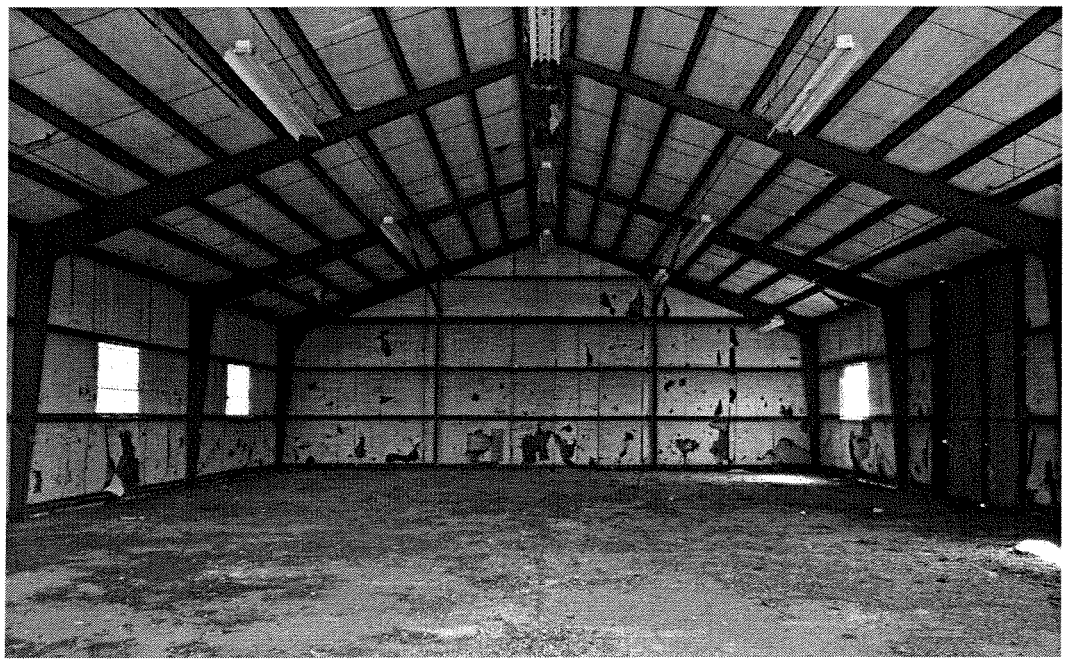

Plate 29: Storage Building (Unit 102), Solid Propellant Assembly Area, 1956. Interior, looking north. View of May 2005.

Plate 30: Storage Building (Unit 102), Solid Propellant Assembly Area, 1956. Interior, looking southeast. View of May 2005.

A.S.V. Building

Erected as storage for NASA's Aero-Thermodynamic Structural Test Vehicle in 1966, the ASV Building was alternately known as Unit 106 and the "Wonder Building" (Douglas 1966). The ASV Building is a self-supporting, steel-arch structure manufactured by the Wonder Trussless Building Company of Chicago. Peter S. Pederson had purchased the building's patent in 1949, and had founded the Wonder Company in 1950 to prefabricate the arched structure. Wonder Buildings complemented other prefabricated structures sold in the United States such as those manufactured by Butler, IDECO, and ARMCO. In widespread use for storing agricultural equipment, harvested crops, and livestock, Wonder Buildings were also desirable as high-load structures. The Air Force, NASA, and the aerospace contractors turned to Wonder Buildings for special uses during the 1960s. Military and aerospace engineering firms adapted Wonder Buildings for earth-covered bomb shelters and hardened aircraft shelters (Arch Technology Corporation 2001). The ASV Building features a parabolic profile, steel arches, and standing-seam steel siding. The structure is windowless, with a center-opening door on its east façade.

The Solid Propellant Assembly Area, alternately known as the DM-14 Site, first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for Special Test Series "A." The special series tests were classified. (Douglas 1958-1962.) The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south.

Douglas added the clustered storage structures east of the original solid propellant area during 1964-1966. The north-south access road through the Douglas Missile Test Facility separated the storage area from the primary compound of the Solid Propellant Assembly Area. Beginning in 1960, Douglas used portions of its missile test facilities at Rancho Cordova to support NASA. The company adapted the Kappa Test Complex for components testing of the developmental Saturn (the DSV-IV Saturn), conducting related tests for the program on Test Stand 1 in the Alpha Test Complex in 1961. Simultaneously, NASA initiated its Aero-thermodynamic Elastic Structural Systems Environmental Tests (ASSET) program. ASVs were test vehicles for manned units. The vehicles were similar to the command modules of the Apollo program, and were in test throughout the 1960s. NASA engineers evaluated materials required for the manned space program through the ASSET program. Heat-shield tests were among the experiments run within ASSET. Surplus Thor missiles became the launch vehicles for ASVs fired during ASSET (Astronautix 2005). The ASV Building is interpreted as a storage structure for one or more test ASVs—either of boilerplate (numbered BP) or battleship type. ASVs were scaled test units, fabricated as nose cones (Weitze 2004).

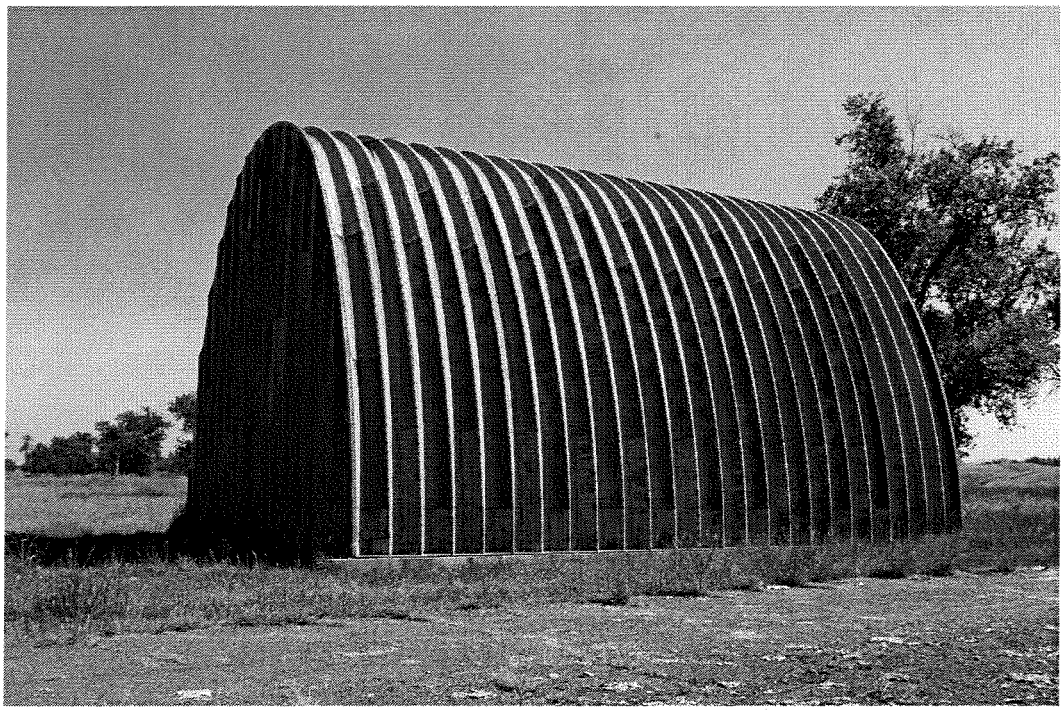

Plate 31: ASV Building (Unit 106), Solid Propellant Assembly Area, 1966. Looking north/northeast. View of May 2005.

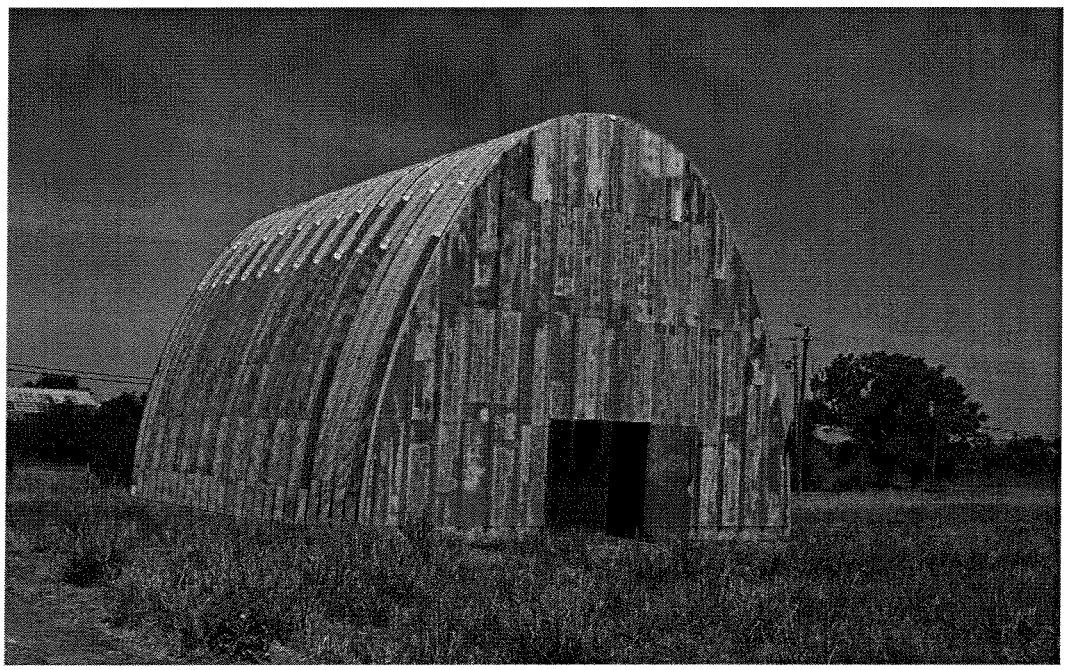

Plate 32: ASV Building (Unit 106), Solid Propellant Assembly Area, 1966. Looking west/northwest. View of May 2005.

Plate 33: ASV Building (Unit 106), Solid Propellant Assembly Area, 1966. Detail of sheathing. Looking west. View of May 2005.

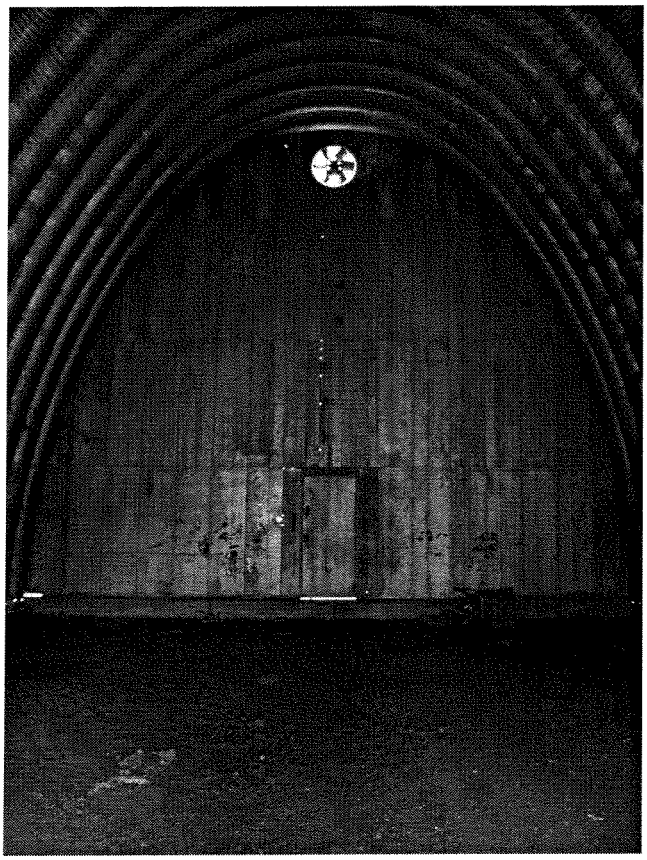

Plate 34: ASV Building (Unit 106), Solid Propellant Assembly Area, 1966. Interior. Looking west. View of May 2005.

Quonset Hut

Also known as Unit 105, the Quonset Hut is a prefabricated metal storage structure erected on site in ca.1964. Derived from the wood-and-metal Nissan Bow Hut of World War I, the Quonset Hut was a portable, arched metal building designed in early World War II by George A. Fuller & Company for the Army Signal Corps. The stock structure acquired the name "Quonset Hut" from its first place of manufacture, the Davisville Construction Battalion Center at Quonset Point Naval Air Station, North Kingston, Rhode Island (Garner 1993). The Quonset Hut in the storage compound of the Solid Propellant Assembly Area features the steel framing and curved, corrugated sheet-metal sheathing typical of the building type. A small, plywood office in the northwest corner of the Quonset Hut is of undetermined date, but may have been added when Douglas placed the structure at its present location in the early 1960s.

The Solid Propellant Assembly Area, alternately known as the DM-14 Site, first accommodated assembly of solid-rocket boosters for the developmental Nike Hercules (DM-14). During 1960, Douglas used the location for assembly of the follow-on Nike Zeus (DM-15). Work supporting the Nike Zeus continued during 1962 in the Solid Propellant Assembly Area. In addition, Douglas used the area for assembly of the developmental Skybolt (DM-20), as well a support compound for classified Special Test Series "A" (Douglas 1958-1962). The Solid Propellant Assembly Area completed the Sigma Test Area (first known as the Solid Test Area) to the south. Douglas added the clustered storage structures east of the original solid propellant area during 1964-1966, locating the group across the north-south access road through the test facilities.

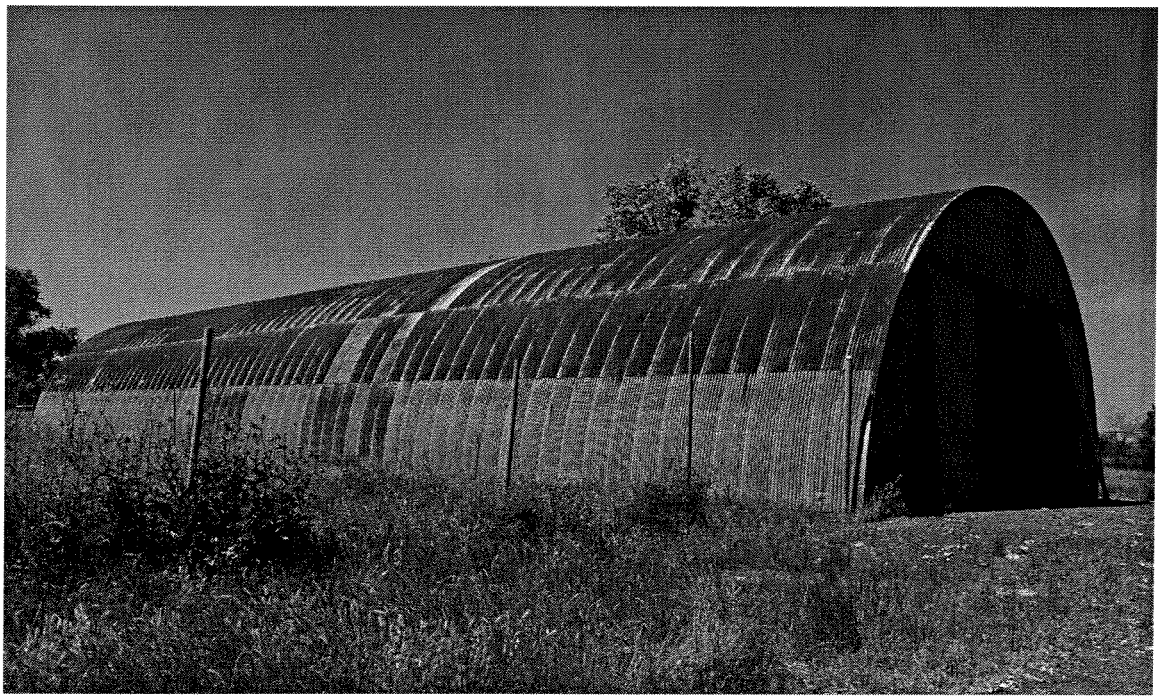

Plate 35: Quonset Hut (Unit 105), Solid Propellant Assembly Area, ca.1964. Looking southwest. View of May 2005.

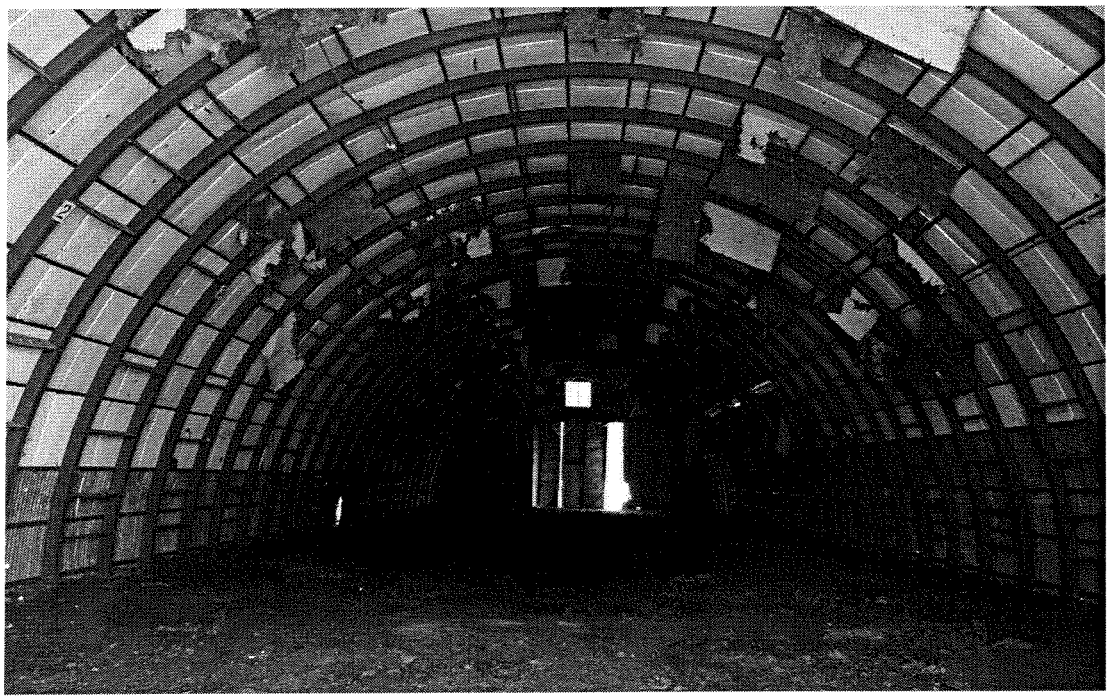

Plate 36: Quonset Hut (Unit 105), Solid Propellant Assembly Area, ca.1964. Interior. Looking south. View of May 2005.

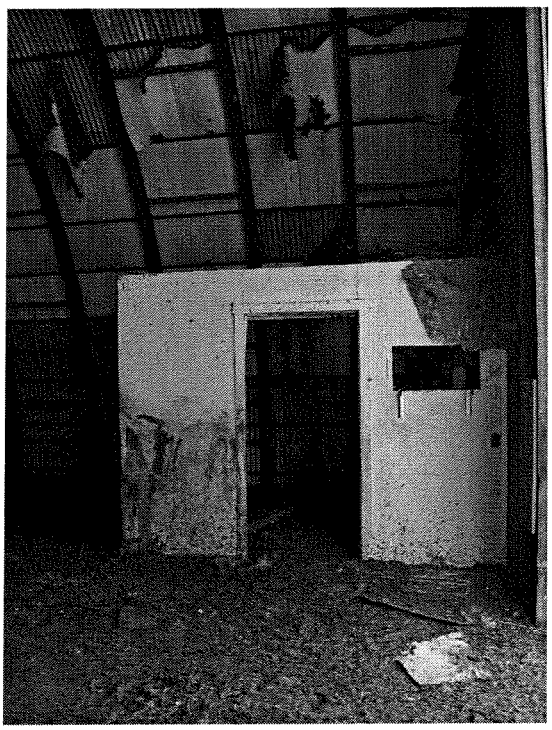

Plate 37: Quonset Hut (Unit 105), Solid Propellant Assembly Area, ca.1964. Interior. Corner Office. Looking west. View of May 2005.

Sigma Test Area

The Sigma Test Area is a small compound laid out east-west, approximately one-half mile south of the Solid Propellant Assembly west of the north-south road (Figure 5). The area is open access, with a security fence surrounding the assembly building. The western half of the Sigma Test Area dates to 1956. In mid-1961, Douglas added a destruct pad at the western end of the group of structures (Douglas 1963). In about 1964, site managers added two environmental test chambers east of the original assembly building. A map made prior to the construction of the test chambers labels the site "Existing Nike Test Area" (Ralph M. Parsons 1963). The Sigma Test Area is interpreted as complementing the Solid Propellant Assembly Area, first in use for developmental testing of the Nike Hercules solid-rocket boosters. In April 1965, Douglas changed the official name of the area from Solid Test Area to Sigma Test Area (Douglas 1965). From about 1961 into 1964, the Sigma Test Area supported tests of the developmental Skybolt and Nike Zeus. Douglas was the primary military contractor for both missile systems.

The following two minor ancillary structures are no longer standing within the Sigma Test Area:

- a small storage building (Unit 96) northwest of the test control center, west of the assembly building; and,
- an unnumbered water tank and well north of the test control center, located between the storage structure and the assembly building.

Existing components of the Sigma Test area are discussed below.

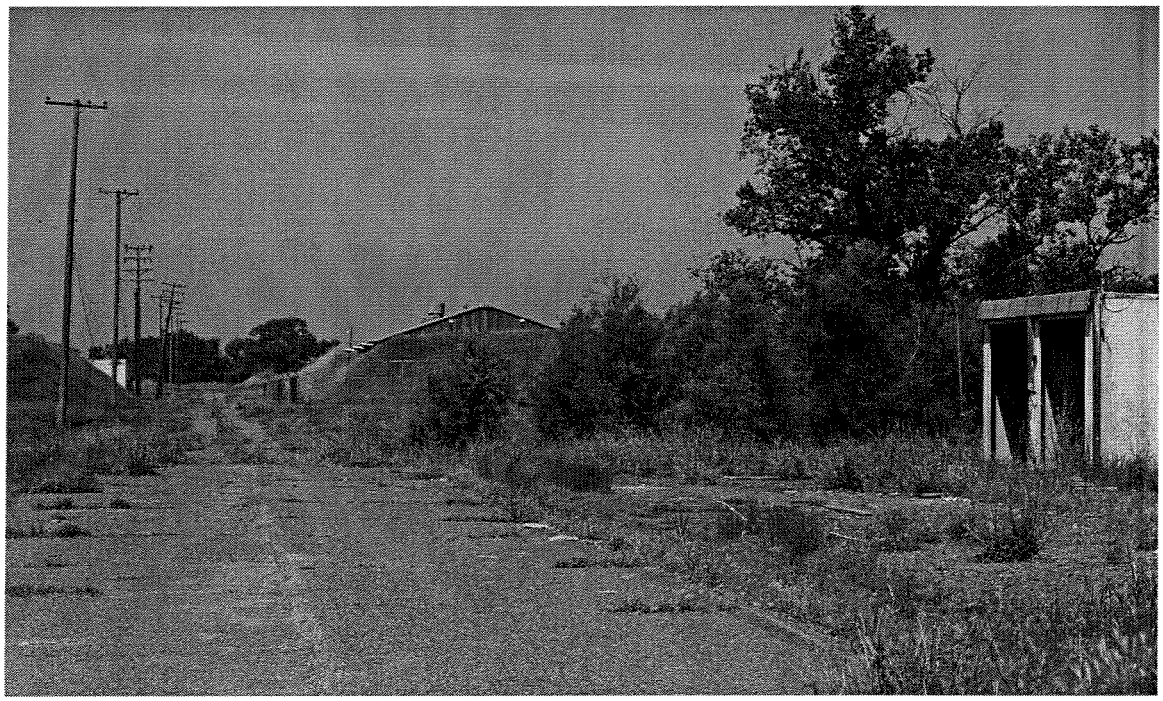

Plate 38: Hot Conditioning Chamber (Unit 92), Assembly Building (Unit 93), Test Control Center (Unit 94), and Test Area (Support Building/Unit 95 and Destruct Pad), Sigma Test Area, 1956-1965. East to west overview. Looking west. View of May 2005.

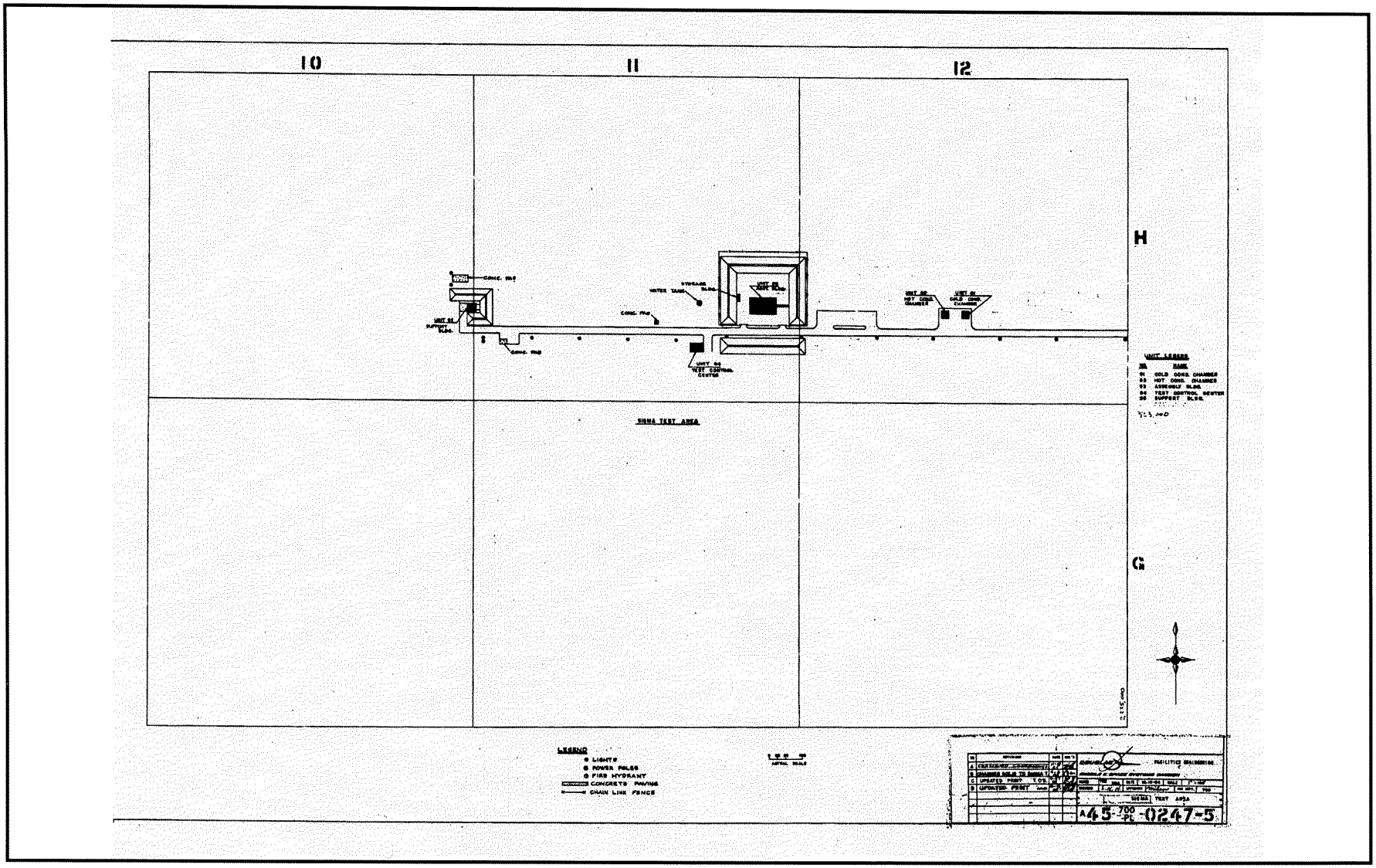

Figure 5: Douglas Facilities Engineering, Sigma Test Area, Douglas Missile Test Facility, Rancho Cordova, California, 1964.

Test Area and Support Building

Douglas configured the test area and support building at the western terminus of the Sigma Test Area in 1956 and 1961 for Nike Hercules (DM-14) and Nike Zeus (DM-15) testing. The support building, also known as Unit 95, was a small rectangular structure surrounded on three sides by an earthen berm. Today, it remains undetermined if the support building is intact, or exists only as a remnant. Standing on the site is a reinforced concrete wall, bracketed by shed-roofed wings. Two wooden utility poles, mounted with lights and wiring, further frame the support building. The debris from a wooden staircase exists on the exterior face of the southern arm of the surrounding berm. The earthen berm itself is unaltered, although was constructed in two phases. As originally mapped, the earthen berm featured northern and southern arms of equal length, each connected to a longer western arm. The protective structure first shielded the western end of an open test area. A small structure, interpreted as a personnel bunker, sat to the immediate south of the test area and is now relocated a short distance to the southeast (see below). In 1961, Douglas constructed a destructive pad (see below) to the immediate north of the original Nike Hercules test area. To accommodate tests on the pad, Douglas simultaneously extended the northern arm of the earthen berm to the west.

After construction of the destruct pad in 1961, Douglas used the area to run 46 tests for Nike Zeus. The next year, the company expanded work at the location to support the Skybolt (DM-20), also conducting a series of classified tests ("Series A"). Engineered as a bomber-launched ICBM with a nuclear warhead, Skybolt was in test until cancellation of the program in December 1962. Nike tests included a full-scale firing of a third-stage manifold of the Nike Zeus; firings of the third-stage swivel nozzle, swivel elbow, and blast tube; and firings of a sub-scale second-stage and its nozzle. Later in the 1960s, Douglas modified the test area to remove "aged, spent, or unburned solid propellant from rocket casings." Personnel reamed out rocket boosters with high-pressure water (known as "hogout" operations) toward a catchment pond west of the Sigma Test Area.

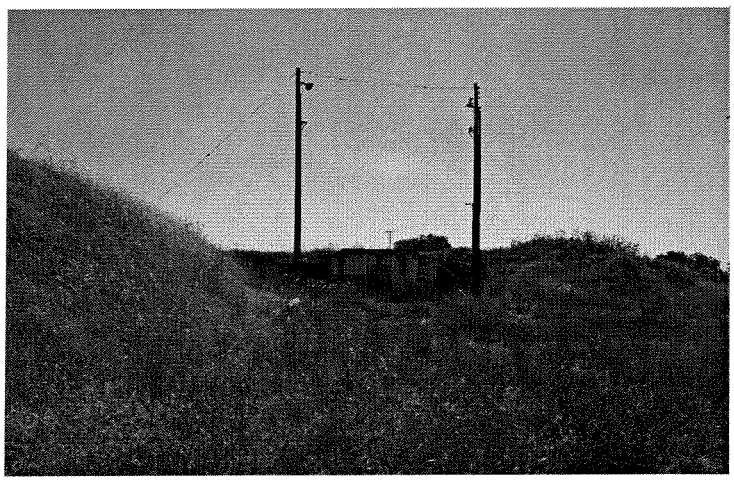

Plate 39: Test Area and Support Building (Unit 95), surrounded by earthen berm, Sigma Test Area, 1956-1961. Looking east. View of May 2005.

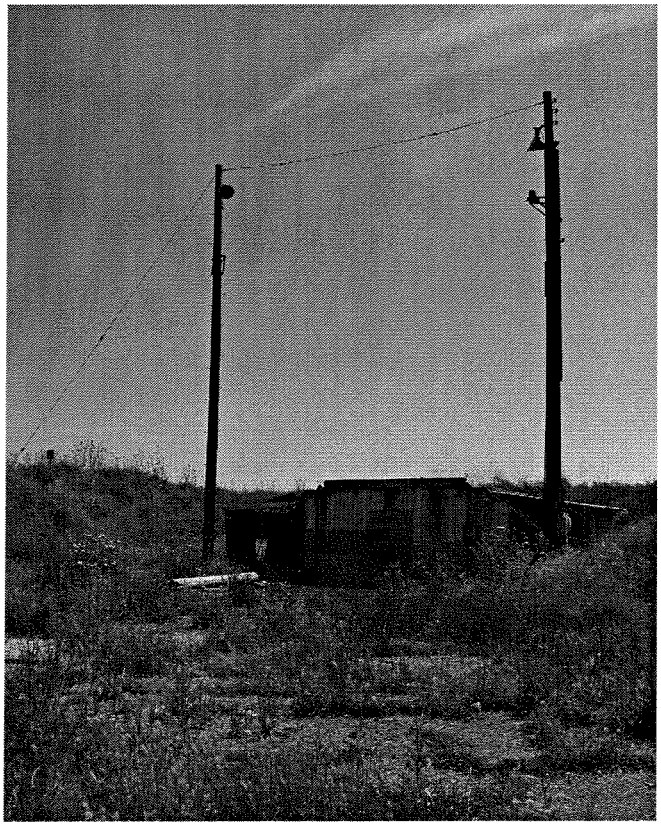

Plate 40: Support Building (Unit 95), Sigma Test Area, 1956-1961. Looking east. View of May 2005.

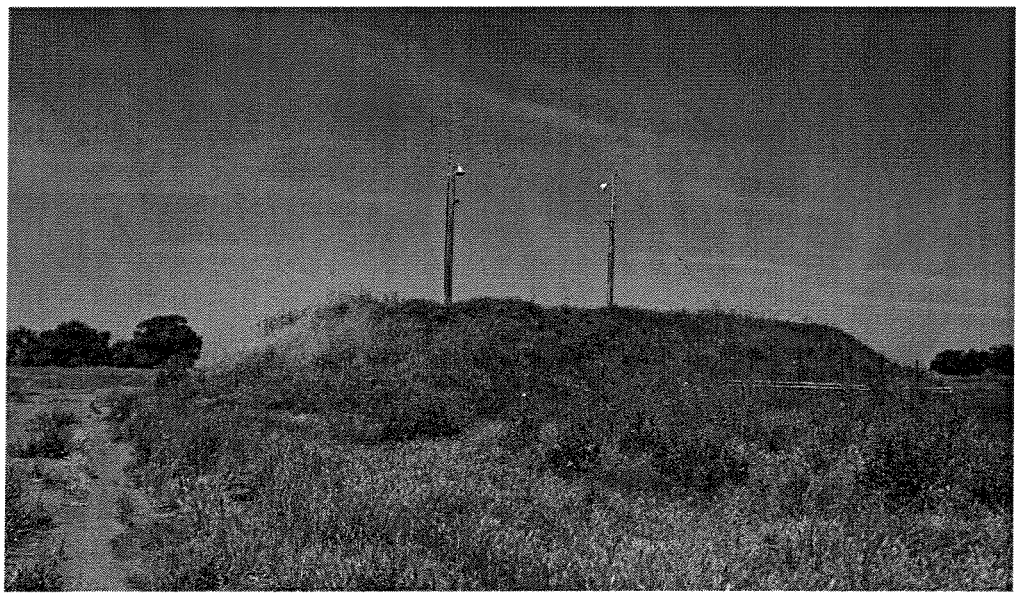

Plate 41: Test Area and Support Building (Unit 95), surrounded by earthen berm, Sigma Test Area, 1956-1961. Looking west. View of May 2005.

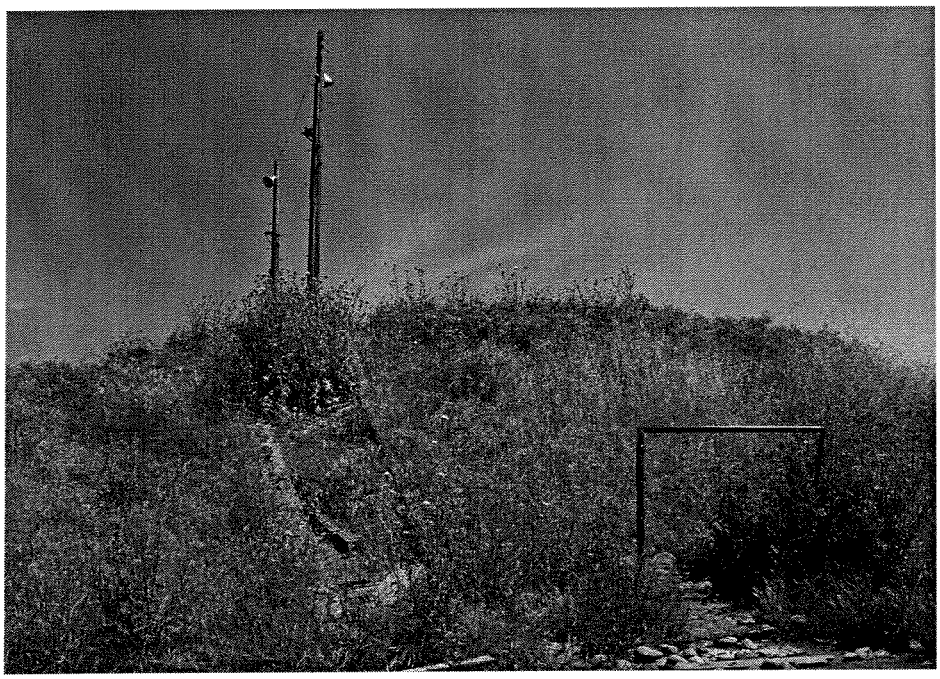

Plate 42: Test Area and Support Building (Unit 95), surrounded by earthen berm, Sigma Test Area, 1956-1961. Looking north. View of May 2005.

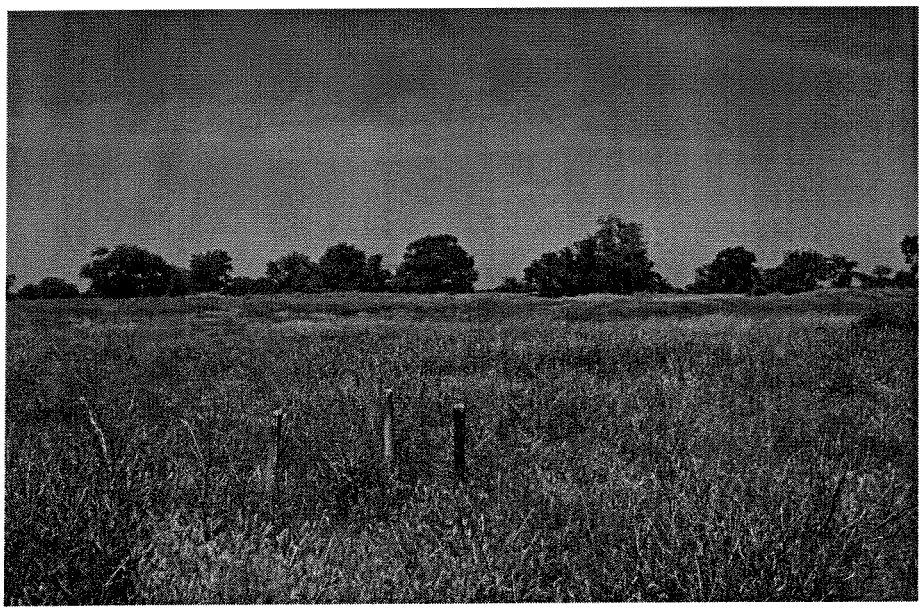

Plate 43: Catchment Pond west of Test Area and Support Building (Unit 95), Sigma Test Area, 1960s. Looking north. View of May 2005.

Destruct Pad

Douglas constructed a destruct pad immediately north of the original test pad in the Sigma Test Area in mid-1961. Dimensions of the reinforced concrete pad were approximately 31 by 20 feet, as built. A 17- by 10.75-foot section of the pad was 3.5 feet thick, tapered to about 1 foot along the outer edges and at one end. The center section featured four pairs of embedded steel rails, placed at right angles to one another. Rail pairs were 3, 4, and 6 feet long, respectively, with two pairs of the 6-foot segments (Douglas 1961). The destruct pad lay to the north of the northern arm of the earthen berm surrounding the Nike Hercules test area of 1956.

After construction of the destruct pad in 1961, Douglas used the area to run 46 tests for Nike Zeus. The next year, the company expanded work at the location to support the Skybolt (DM-20), also conducting a series of classified tests ("Series A"). Engineered as a bomber-launched ICBM with a nuclear warhead, Skybolt was in test until cancellation of the program in December 1962. Nike tests included a full-scale firing of a third-stage manifold of the Nike Zeus, firings of the third-stage swivel nozzle, swivel elbow, and blast tube, and firings of a sub-scale second-stage and its nozzle. Later in the 1960s, Douglas modified the test area to remove "aged, spent, or unburned solid propellant from rocket casings." Personnel reamed out rocket boosters with high-pressure water ("hogout"), directing the material toward a catchment pond west of the Sigma Test Area.

Plate 44: Destruct Pad, bracketed to the south by the earthen berm of the original test site, Sigma Test Area, 1961. Looking east/southeast. View of May 2005.

Concrete Pad

A small, reinforced concrete pad, of rectangular footprint, exists to the southeast of the test area and support building. Not mapped in early 1963, but present by late 1964, the pad is interpreted as one of the final features added to the Sigma Test Area. The pad is of undetermined historic use.

The concrete pad post-dates tests of Nike Hercules and Nike Zeus solid-rocket boosters at the Sigma Test Area. The pad also is unrelated to tests run for the Skybolt ICBM, or the classified Series A tests. During the 1960s, Douglas modified the Sigma Test Area to remove "aged, spent, or unburned solid propellant from rocket casings." The pad is likely a support facility for this mission. Personnel reamed out rocket boosters with high-pressure water ("hogout"), directing the material toward a catchment pond west of the Sigma Test Area.

Plate 45: Concrete Pad, southeast of the original test site, Sigma Test Area, ca.1963-1964. Looking southeast. View of May 2005.

Personnel Bunker

A small, reinforced concrete structure currently sits to the south/southeast of the concrete pad. The structure is windowless, and has painted signage indicating its use to store high-explosives. Unnumbered, the structure is not mapped at its current site on any available documentation of 1956-1966. The structure strongly resembles a "launch barricade," a type of protective personnel bunker found on the armament test ranges at Eglin Air Force Base in Florida during 1952-1956. The launch barricade functioned as shelter for personnel during rail-launched small missile tests. Personnel retreated to the launch barricade as a safety precaution. A separate, larger building functioned as the blockhouse for the test area—a function of the test control center in the Sigma Test Area (see below). The small, reinforced concrete structure in the Sigma Test Area is interpreted as a personnel bunker of launch-barricade type. A map of early 1963 shows a structure of its size and footprint immediately south of the southern arm of the earthen barricade around the test area. Douglas may have moved the structure to its present location for a subsequent use storing explosives. (The launch barricades at Eglin were moveable units.)

The small, reinforced concrete structure is interpreted as supporting tests of the Nike Hercules, Nike Zeus, and Skybolt during 1956-1963, with a secondary use as a storage facility for high-explosives.

Plate 46: Personnel bunker, south/southeast of the original test site, Sigma Test Area, 1956. Looking southwest. View of May 2005.

Assembly Building

Also known as Unit 93, the assembly building is a one-story, prefabricated metal structure erected in the Solid Propellant Assembly Area before October 1956. The assembly building is rigid-frame construction, sheathed in corrugated siding. The building features center-opening, track-mounted east- and west-façade doors and a gable roof. Several small, shed-roof rooms line the north (rear) façade, as built. The east, west, and south facades include pairs of wood-frame personnel doors, set near the building's corners and each articulated with a window. Distinctive outdoor security lights are mounted at the roofline on all sides of the building. The interior of the assembly building is open. A large earthen berm buffers all four sides of the assembly building from its surroundings. The berm is rock-stabilized, presently overgrown with grass. On three sides of the assembly building the berm is continuous. On the south side of the building, the berm is free-standing and sits across the access road through the Sigma Test Area. The earthen berm is an original feature of the building. Although derelict today, the assembly building is unaltered.

Douglas configured the Sigma Test Area in 1956, pairing it with the Solid Propellant Assembly Area one-half mile to the north. In early 1963, the Sigma Test Area was alternately named the Nike Test Area, and during 1963-1964 as the Solid Test Area. The assembly building was one of three original structures mapped for the area. The structure first supported developmental work on the Nike Hercules, followed by similar efforts for the Nike Zeus and Skybolt. In late 1964, Douglas added two temperature conditioning chambers at the eastern end of the Sigma Test Area to support NASA, the follow-on user of the location.

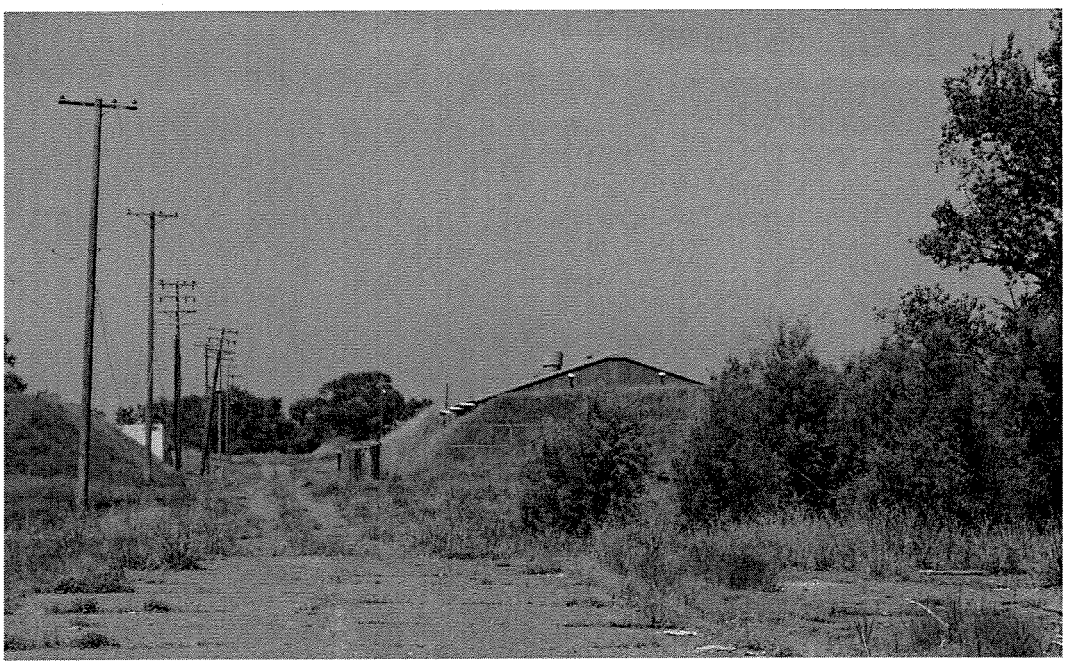

Plate 50: Assembly Building (Unit 93) surrounded by earthen berms, Sigma Test Area, 1956. Test control center left. Looking southeast. View of May 2005.

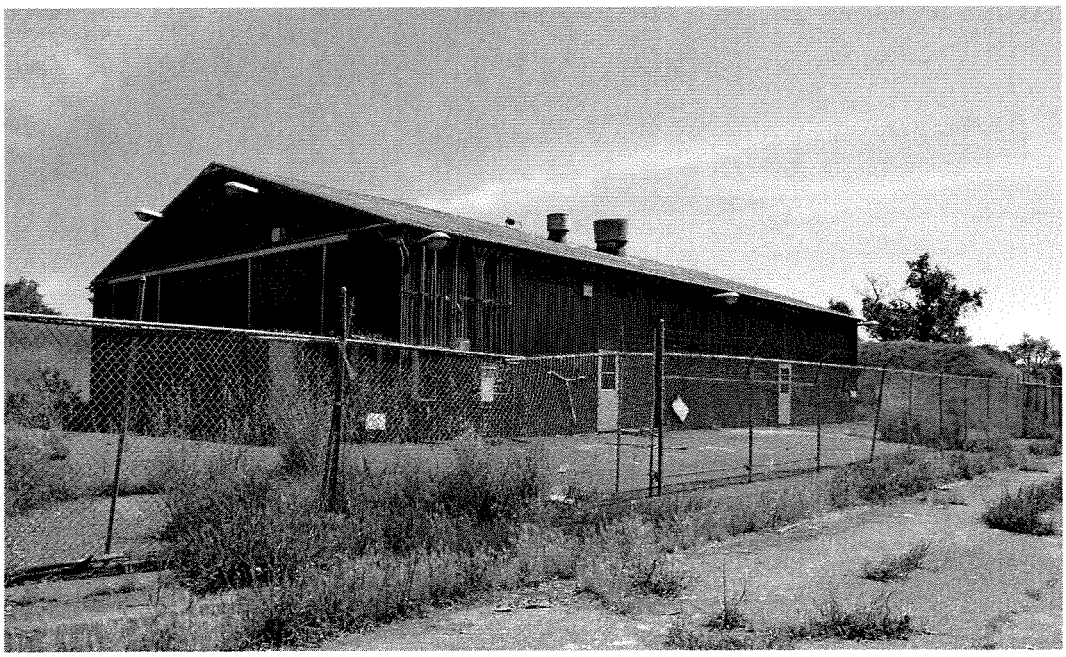

Plate 51: Assembly Building (Unit 93), Sigma Test Area, 1956. Looking northeast. View of May 2005.

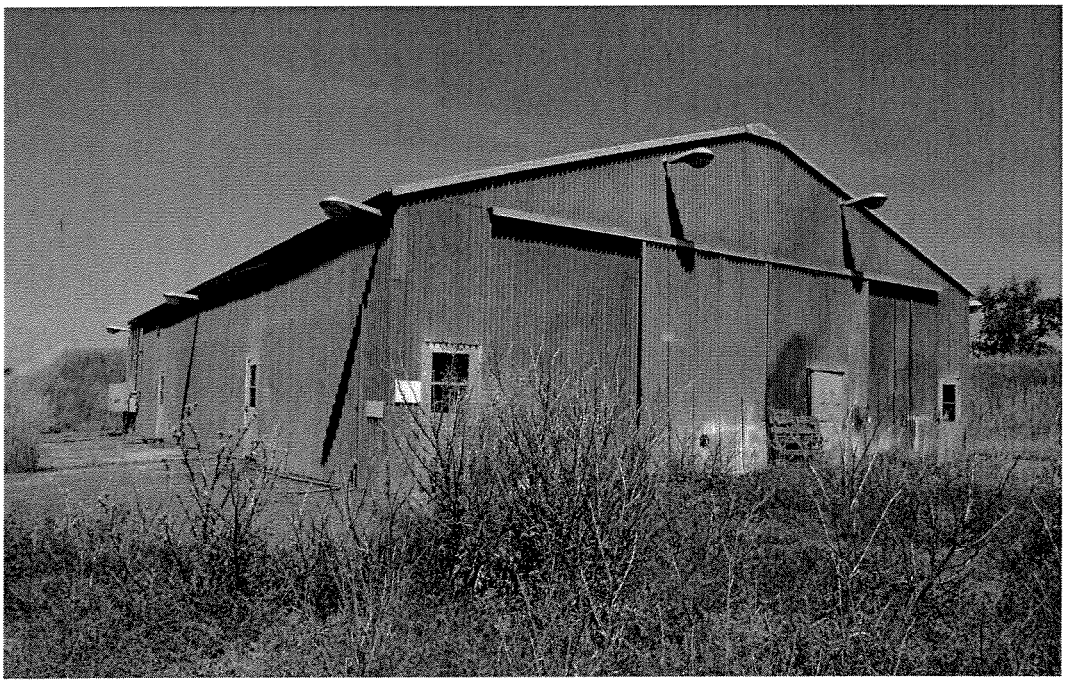

Plate 52: Assembly Building (Unit 93), Sigma Test Area, 1956. Looking northwest. View of May 2005.

Plate 53: Assembly Building (Unit 93), rear façade, Sigma Test Area, 1956. Looking southwest. View of May 2005.

Plate 54: Assembly Building (Unit 93), interior, Sigma Test Area, 1956. Looking east. View of May 2005.

Hot Conditioning Chamber

Also known as Unit 92, the hot conditioning chamber is a two-bay, steel-frame structure sheathed in metal paneling. The chambers are open on their south façade today, but originally featured metal doors. At least one of the doors lies on the ground adjacent to the chamber. The hot conditioning chamber supported high-temperature environmental conditioning for solid-rocket motors in test by NASA during the middle and late 1960s. Motors went through a period of conditioning before being static-fired in the Alpha, Beta, and Gamma Test Complexes. Immediately west of the hot conditioning chamber, a second similar facility accommodated cold conditioning of motors. The aerospace and armaments industries, as well as military test centers located throughout the United States, used environmental test chambers of all types and sizes to condition armament, space vehicles, and component parts during the research, development, test, and evaluation phases of systems selection and acquisition.

Douglas originally configured the Sigma Test Area in 1956, pairing it with the Solid Propellant Assembly Area one-half mile to the north. In early 1963, the Sigma Test Area was alternately named the Nike Test Area, and during 1963-1964 as the Solid Test Area. In late 1964, Douglas added the two temperature conditioning chambers at the eastern end of the Sigma Test Area to support NASA, the follow-on user of the location.

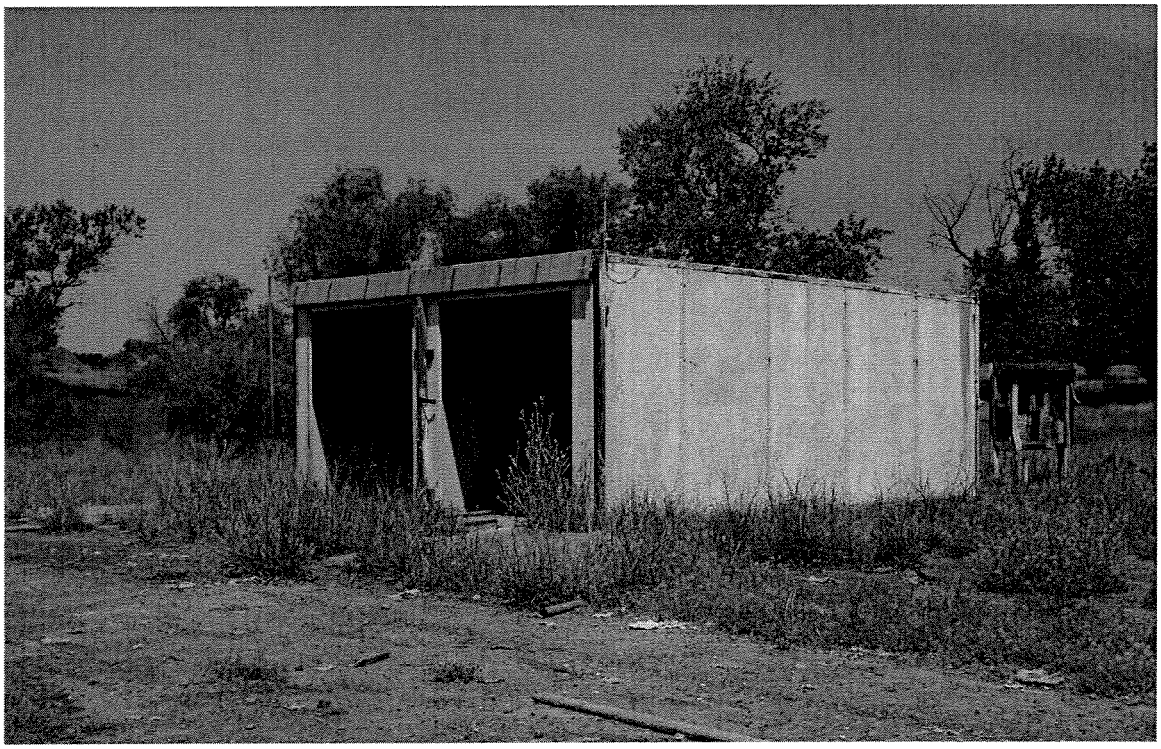

Plate 55: Hot Conditioning Chamber (Unit 92), Sigma Test Area, 1956. Looking northwest. View of May 2005.

Cold Conditioning Chamber

Also known as Unit 91, the cold conditioning chamber was a two-bay, steel-frame structure sheathed in metal paneling, interpreted as similar in design to the hot conditioning chamber to the immediate west. The cold conditioning chamber is collapsed in place today. The hot and cold conditioning chambers supported environmental conditioning for solid-rocket motors in test by NASA during the middle and late 1960s. Motors went through a period of conditioning before being static-fired in the Alpha, Beta, and Gamma Test Complexes. The aerospace and armaments industries, as well as military test centers located throughout the United States, used environmental test chambers of all types and sizes to condition armament, space vehicles, and component parts during the research, development, test, and evaluation phases of systems selection and acquisition.

Douglas originally configured the Sigma Test Area in 1956, pairing it with the Solid Propellant Assembly Area one-half mile to the north. In early 1963, the Sigma Test Area was alternately named the Nike Test Area, and during 1963-1964 as the Solid Test Area. In late 1964, Douglas added the two temperature conditioning chambers at the eastern end of the Sigma Test Area to support NASA, the follow-on user of the location.

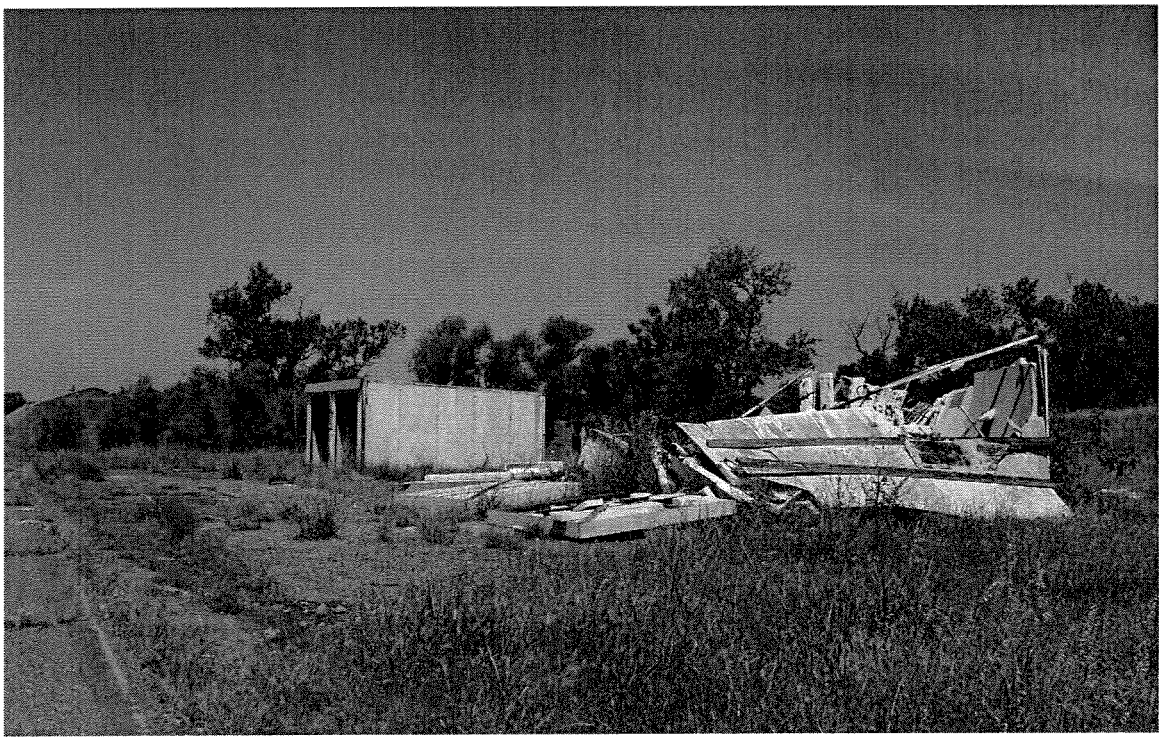

Plate 56: Cold Conditioning Chamber (Unit 91) (right), Sigma Test Area, 1956. Hot conditioning chamber adjacent (left). Looking northwest. View of May 2005.

Alpha Test Complex

The Alpha Test Complex is a large, fenced compound laid out south of the Sigma Test Area. The complex includes a central blockhouse and the remains of two static test stands. Originally configured with 31 numbered structures and several unnumbered support units and pads, the Alpha Test Complex exists as 14 buildings, structures, and structural remnants in 2005 (Figure 6). The character-defining components within the complex are its blockhouse and test stands. Underground instrumentation tunnels connect the blockhouse to the terminal control rooms beneath both test stands. Test Stand No. 1 is a single-position structure, while Test Stand No. 2 is a dual-position structure. Ancillary buildings and structures vary from the larger secondary support facilities such as the generator-compressor building, test stand shops, and the pumphouse, to the critical, but smaller equipment units and test observation shelters. Equipment, sometimes with permanent raised foundations, included liquid hydrogen tanks, liquid oxygen (LOX) tanks, central water and fuel tanks, a liquid nitrogen tank, storage areas for helium tanks and for hydrogen gas tanks, steam accumulators, and a boiler. Also on the site were a small power substation, weather station, time clock, and guard post at the entrance to the complex. Two observation shelters are separately located along an access road north of the Alpha Test Complex. The shelters overlook the two test stands. In the southeast corner of the Alpha Test Complex a large tee-shaped set of reinforced concrete foundations is interpreted as Initial Operational Capability (IOC) Site No. 1. IOC No. 1 was the location of individual tests that supported development of the full missile systems in test at the complex.

The Alpha Test Complex featured the first large-scale test stands erected for the Douglas Missile Test Facility at Rancho Cordova. The engineers of Aerojet General designed the facilities within the Alpha Test Complex in 1956, with construction underway in 1957. Douglas initiated static firings at the Alpha Test Complex in January 1958. In this period, the overall test facility was known as the Sacramento Missile Field Station of the Douglas corporate enterprise. The first missile in test was the Thor IRBM. Both test stands in the Alpha Test Complex were captive firing stands, and both used deluge systems. Douglas used Test Stand No. 1 to static-fire early production line Thor missiles selected from those manufactured in the company's Santa Monica facilities. Test Stand No. 2 included two positions, Test Stand No. 2A and Test Stand No. 2B. Douglas fired battleship versions of Rocketdyne's Thor engines on Test Stand No. 2A. (A "battleship missile" is a developmental model partially made of less expensive, robust materials for repeated captive tests—sometimes alternately called the "boilerplate" version of a missile in early test. Components of the missile in actual test are real, while much of the missile is fabricated as a type of placeholder.) Douglas completed its research-and-development tests of Thor at the Alpha Test Complex in December 1959, and in mid-1960 full-scale IOC testing of Thor moved to Vandenberg Air Force Base in southern California. Douglas next used Test Stand No. 2A for battleship tests of the Aerojet Titan ICBM second-stage engine. In 1960 also, Douglas initiated activities for NASA at its Rancho Cordova location, beginning with tests for a developmental Saturn booster, the DSV-IV, on Test Stand No. 1. By 1962, activities conducted on Test Stand No. 1 were also focused on the Saturn DSV-IV, and included static firings of the A-1 and A-3 versions of

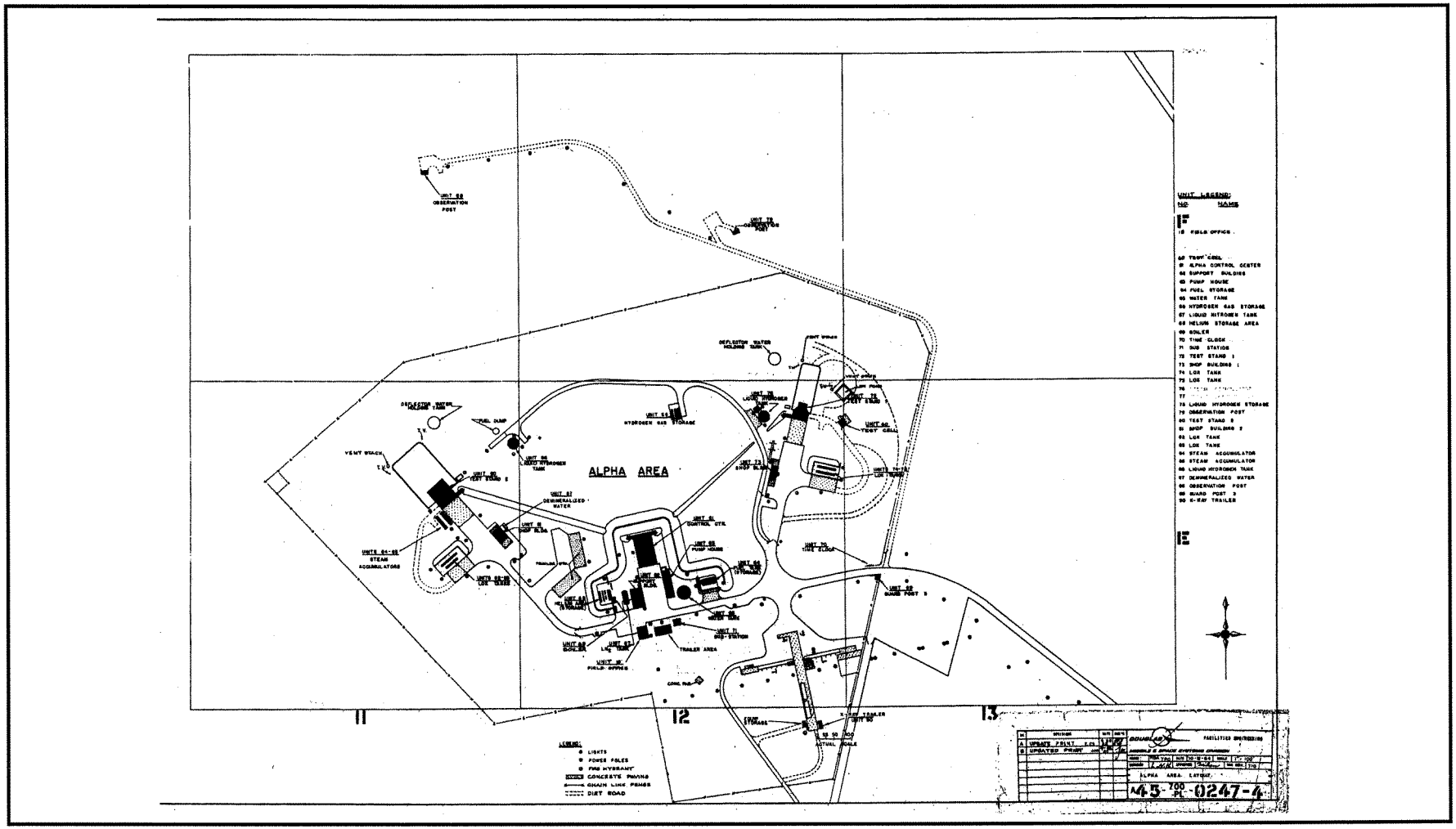

Figure 6: Douglas Facilities Engineering, Alpha Test Complex, Douglas Missile Test Facilities, Rancho Cordova, California, 1964.

the RL-10 liquid hydrogen engine placed in a battleship version of the booster (Douglas: 1958-1962). During the 1965-1968 years, Douglas conducted acceptance testing of Saturn S-IV boosters on Test Stand No. 2B for NASA. The company shipped S-IV boosters from its plant in Santa Monica for check-out, firing, and post-firing checks at the missile test facility in Rancho Cordova. After completion of the acceptance testing, Douglas shipped the Saturn S-IV boosters by air to NASA's facilities at Cape Kennedy in Florida for "mating with the Saturn S-I booster for exploratory 'Man on the Moon' feasibility studies" (NASA 1965). All static testing ended in 1969, although Douglas maintained the test stands in the complex in a state of readiness into late 1972. After deactivation of the Alpha Test Complex, Douglas dismantled the superstructure of the test stands later in the decade (ENSR Consulting and Engineering 1993).

Ancillary structures no longer standing within the Alpha Test Complex include:

- a large fuel tank (Unit 64) immediately east of the water tank;
- the hydrogen gas storage area (Unit 66) west of Test Stand No. 1;
- a boiler (Unit 69) immediately west of the generator-compressor building;
- a time clock (the first Unit 70) near the entrance to the test area;
- a weather station (the second Unit 70) south of the pumphouse;
- a power substation (Unit 71) south of the pumphouse;
- two shop buildings, one at each test stand (Units 73 and 81);
- two steam accumulators (Units 76-77) southwest of Test Stand No. 1;
- a liquid hydrogen tank (Unit 78) immediately west of Test Stand No. 1;
- a liquid hydrogen tank (Unit 86) immediately northeast of Test Stand No. 2;
- a demineralized water facility (Unit 87) near the shop at Test Stand No. 2; and,
- the guard post (Unit 89) at the entrance to the area.

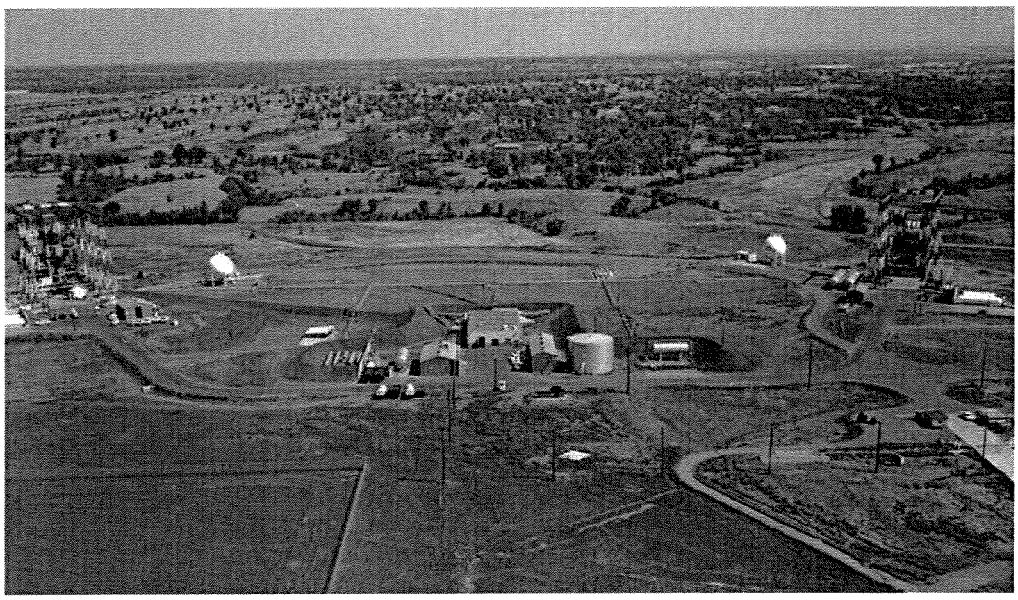

Plate 57: Alpha Test Complex, ca.1965. Blockhouse with generator-compressor building and pumphouse, center. Test Stand No. 2, left. Test Stand No. 1, right. NASA.

LOX Tanks for Test Stand No. 2

Also known as Units 82 and 83, the two LOX tanks for Test Stand No. 2 sat within a protected area to the near southwest of the test stand. Today, the reinforced, ell-shaped barricade wall, surrounding earthen berm, and the raised pedestal foundations for the tanks remain at the site. Placed at the location in 1956-1957, the LOX tanks are no longer present.

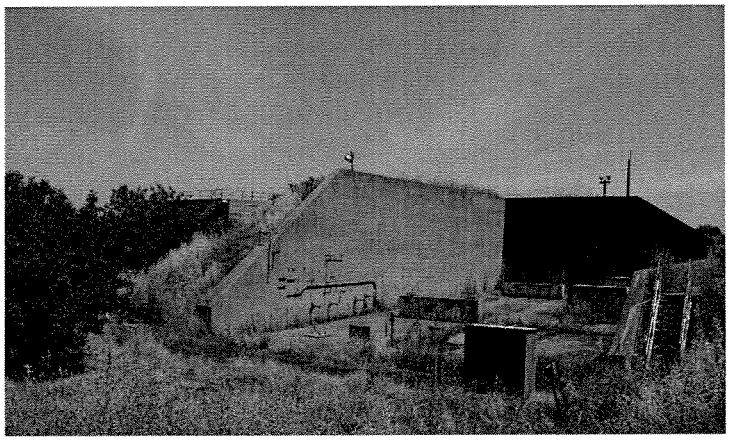

Plate 58: LOX Tank Area (Units 82 and 83), Test Stand No. 2, Alpha Test Complex, 1956-1957. Looking north/northeast. View of May 2005.

Steam Accumulators for Test Stand No. 2

Also known as Units 84 and 85, the two steam accumulators for Test Stand No. 2 sat to the immediate southwest of the test stand. Today, the reinforced concrete, raised pedestal foundations for the accumulators remain at the site. Placed at the site in 1956-1957, the steam accumulator equipment is no longer present. The accumulators supported the altitude simulation system engineering for the test stand.

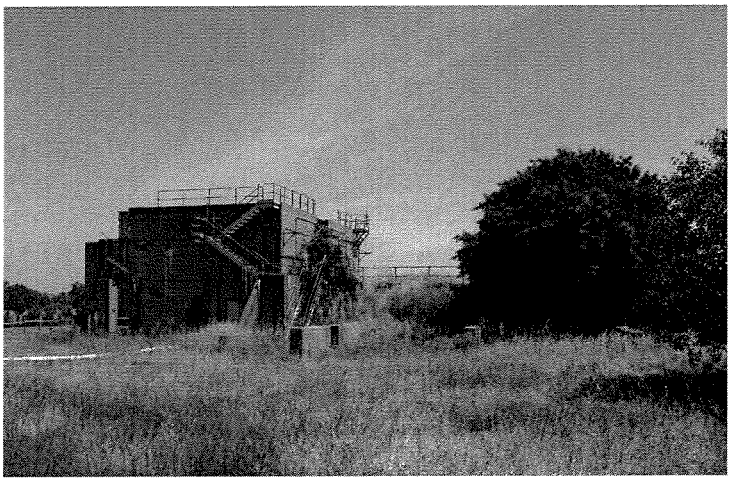

Plate 59: Raised pedestal foundations for steam accumulators (Units 84 and 85), Test Stand No. 2, Alpha Test Complex. Foundations present in the middleground, center to right edge of the photograph. Looking northeast. View of May 2005.

Test Stand No. 2

Also known as Unit 80, Test Stand No. 2 featured a steel-beam tower with two side captive-firing positions, a north-facing flame deflector, and a ground-level, reinforced concrete terminal room. The terminal room also functioned as the base of the test stand. Test Stand No. 2 is 700 feet from the blockhouse for the Alpha Test Complex. An underground instrumentation tunnel connects Test Stand No. 2 to the blockhouse, in a layout identical to the tunnelworks for Test Stand No. 1. The steel superstructure of Test Stand No. 2A accommodated a test item 63 feet long and 8 feet in diameter. Douglas initially operated Test Stand No. 2A p to run static firing tests on liquid-propellant engines for the Thor IRBM and the Titan ICBM during 1958-1960. Test Stand No. 2B accommodated a larger test item, initially a full-scale Thor missile. Dimensions for a test item placed on Test Stand No. 2B were 40 by 19 feet (length and diameter). Test Stand No. 2 could withstand up to a 300,000-pound thrust during captive firings. A deluge system flooded the flame deflector (bucket) in a standard configuration for static tests. Test Stand No. 2 also included a 10-ton crane used to position test items in the two captive-firing positions (Douglas 1966).

Aerojet General designed Test Stand No. 2 during 1956-1957 as a major component of its overall engineering for the Alpha Test Complex. Today, only the reinforced concrete terminal room at the base of the test stand remains at the site. Douglas removed the steel superstructure of the tower and of the flame deflector in 1977. All equipment formerly in the terminal room is also no longer extant, with the rooms partially open to the elements. The terminal room is in derelict condition in 2005. The instrumentation tunnel to the Alpha Test Complex blockhouse is intact, with electric cables removed. The reinforced concrete catchment basin at the base of the flame deflector is present, overgrown in weeds. Miscellaneous camera and light stands sit at the periphery of the test stand.

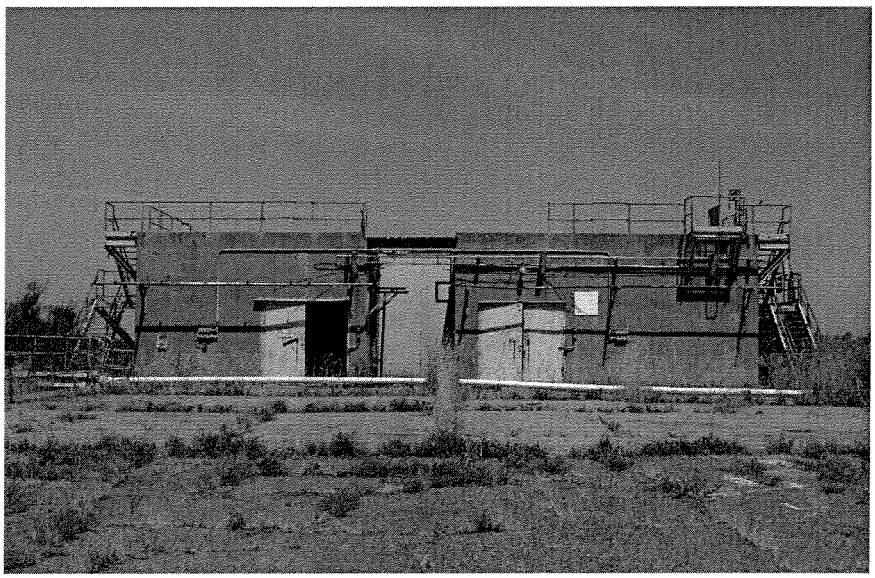

Plate 60: Test Stand No. 2, Alpha Test Complex, 1956-1957. Looking northwest. View of May 2005.

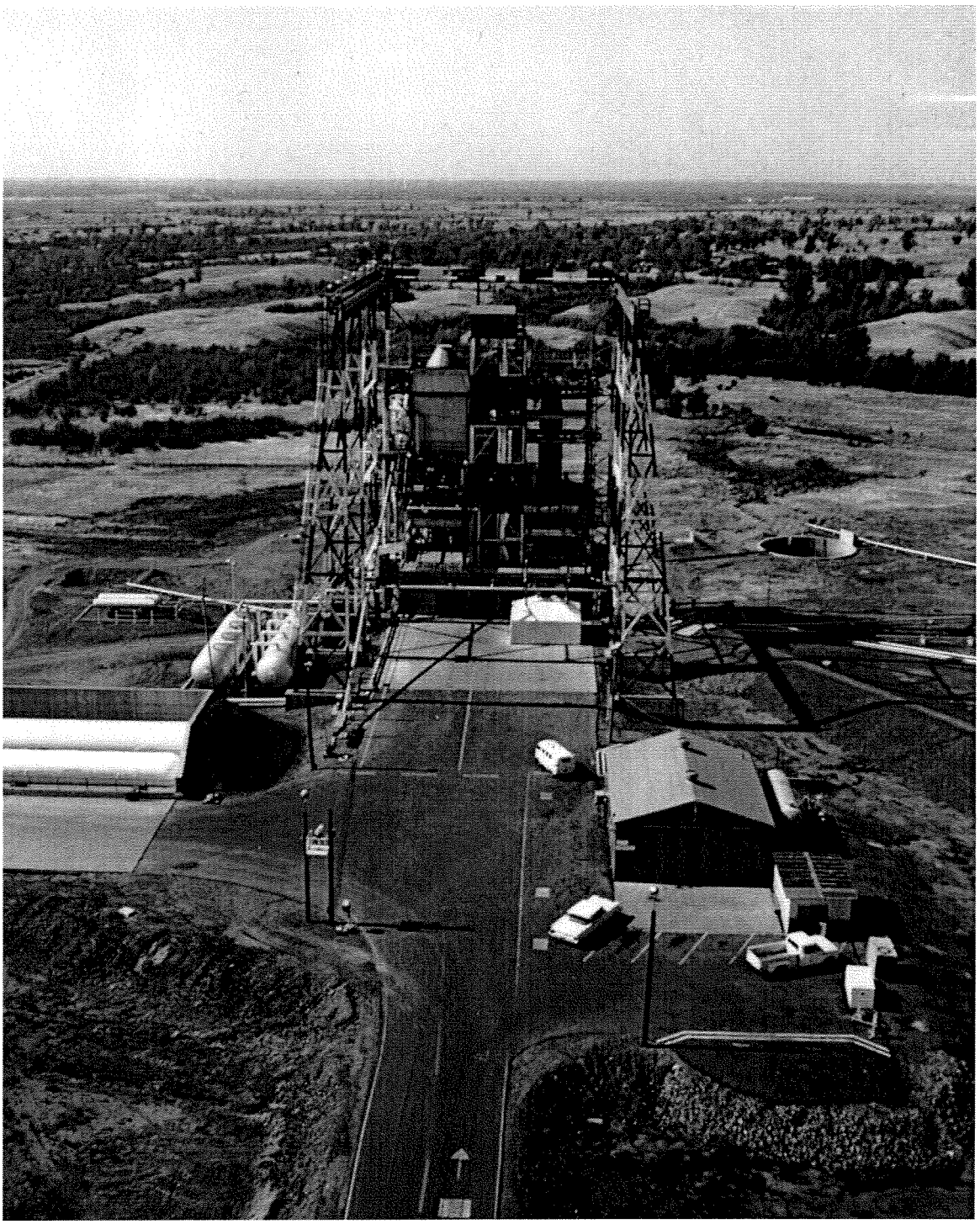

Plate 61: Test Stand No. 2, Alpha Test Complex, 1956-1957. Left to right in photograph: LOX tanks with barricade wall, steam accumulator tanks, test stand, shop (foreground), and deflector-water containment tank (background). Looking northwest. View of ca.1965. Courtesy of NASA.

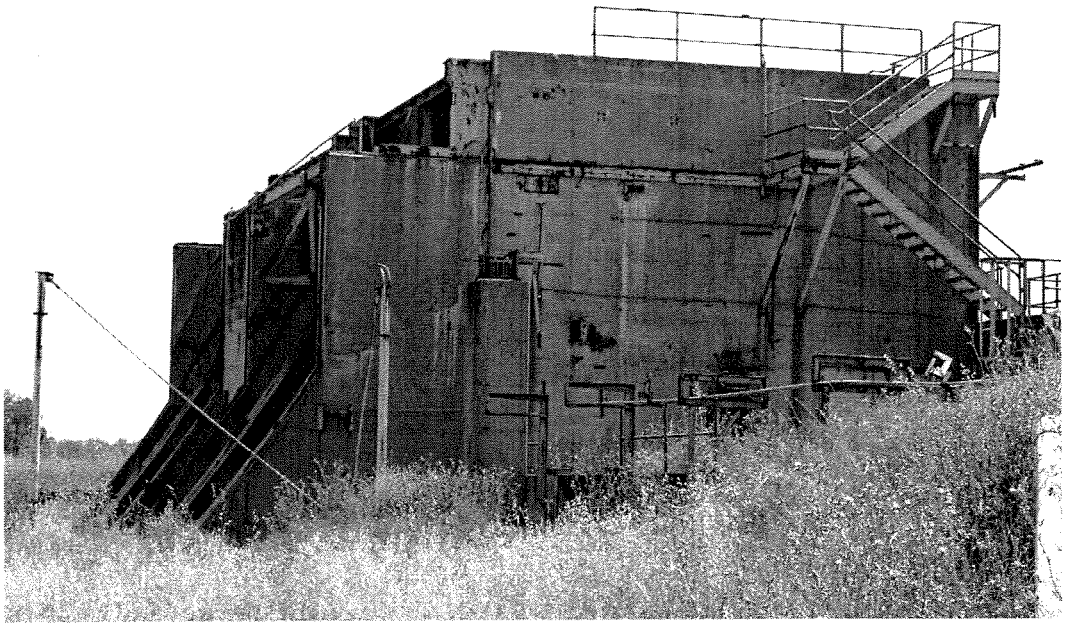

Plate 62: Test Stand No. 2, Alpha Test Complex, 1956-1957. Looking east. View of May 2005.

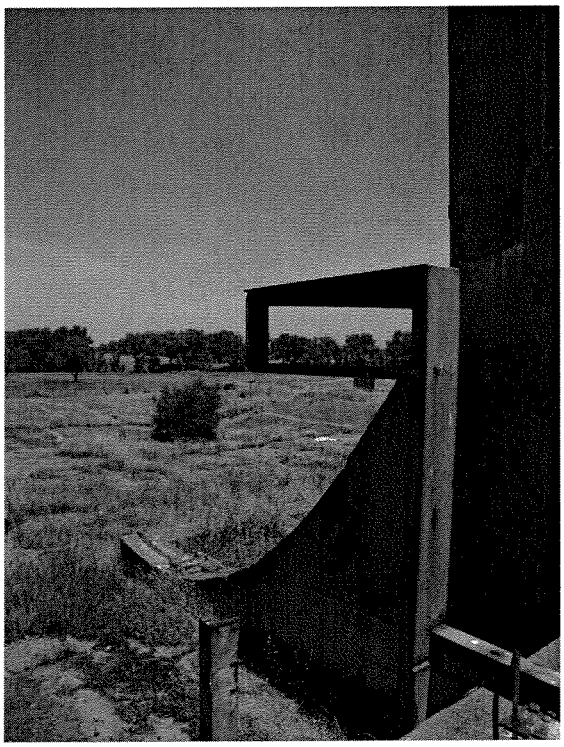

Plate 63: Test Stand No. 2, Alpha Test Complex, 1956-1957. Flame deflector catchment area. Looking north. View of May 2005.

Plate 64: Test Stand No. 2, Alpha Test Complex, 1956-1957. Terminal room. Looking north. View of May 2005.

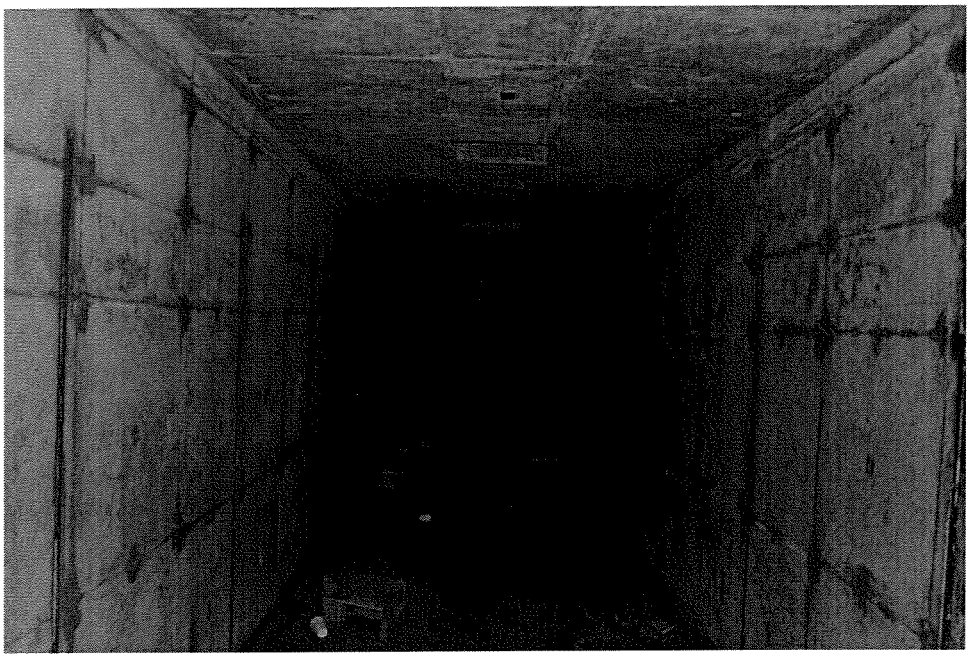

Plate 65: Test Stand No. 2, Alpha Test Complex, 1956-1957. Instrumentation tunnel. Looking northwest. View of May 2005.

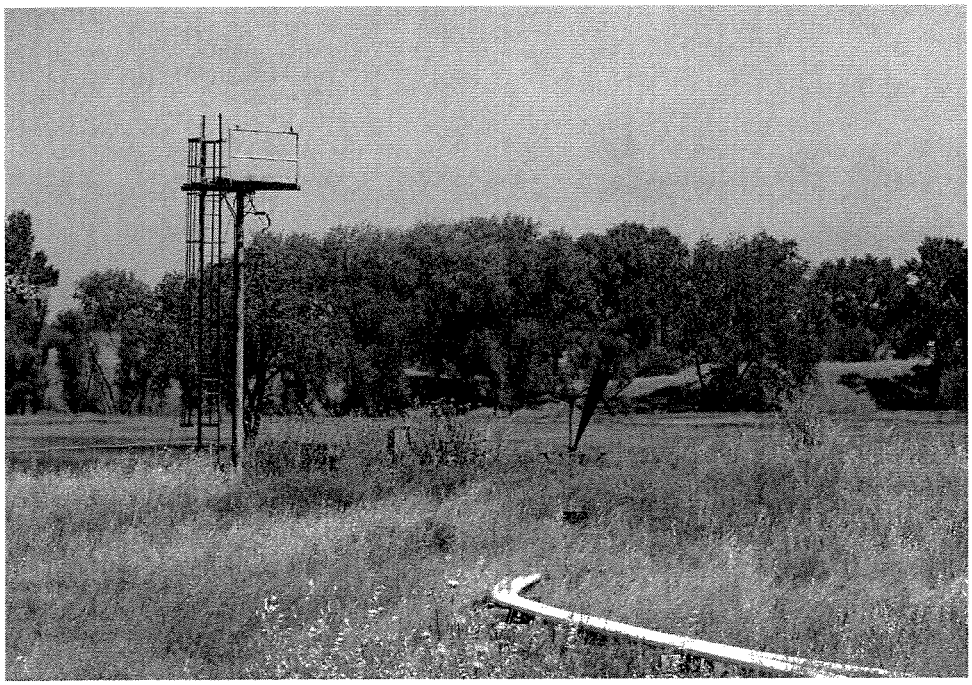

Plate 66: Test Stand No. 2, Alpha Test Complex, 1956-1957. TV camera stand, northwest corner of flame deflector basin. Looking northwest. View of May 2005.

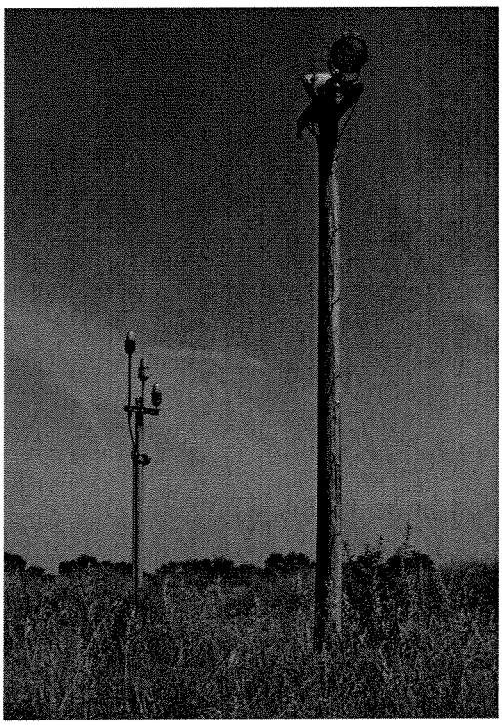

Plate 67: Test Stand No. 2, Alpha Test Complex, 1956-1957. Test-in-progress light (left) and floodlight (right). Looking north. View of May 2005.

Observation Shelter No. 2

Also known as Unit 88, the observation shelter for captive firings at Test Stand No. 2 is located north of the test stand at the end of an access road. The shelter is a small, flat-roofed, reinforced concrete structure, open on its rear face. The shelter features a bank of six viewing windows, each with thick, inset glass panes. The fenestration is typical of that found in blockhouses and observation posts at missile test facilities and launch sites. A chimney-like element sits on the roof of the shelter in its southeast corner. The historic function of this element remains undetermined.

Designed by Aerojet General and constructed in 1956-1957, the observation shelter is one of two shelters on the access road. Observation Shelter No. 2 is unaltered today.

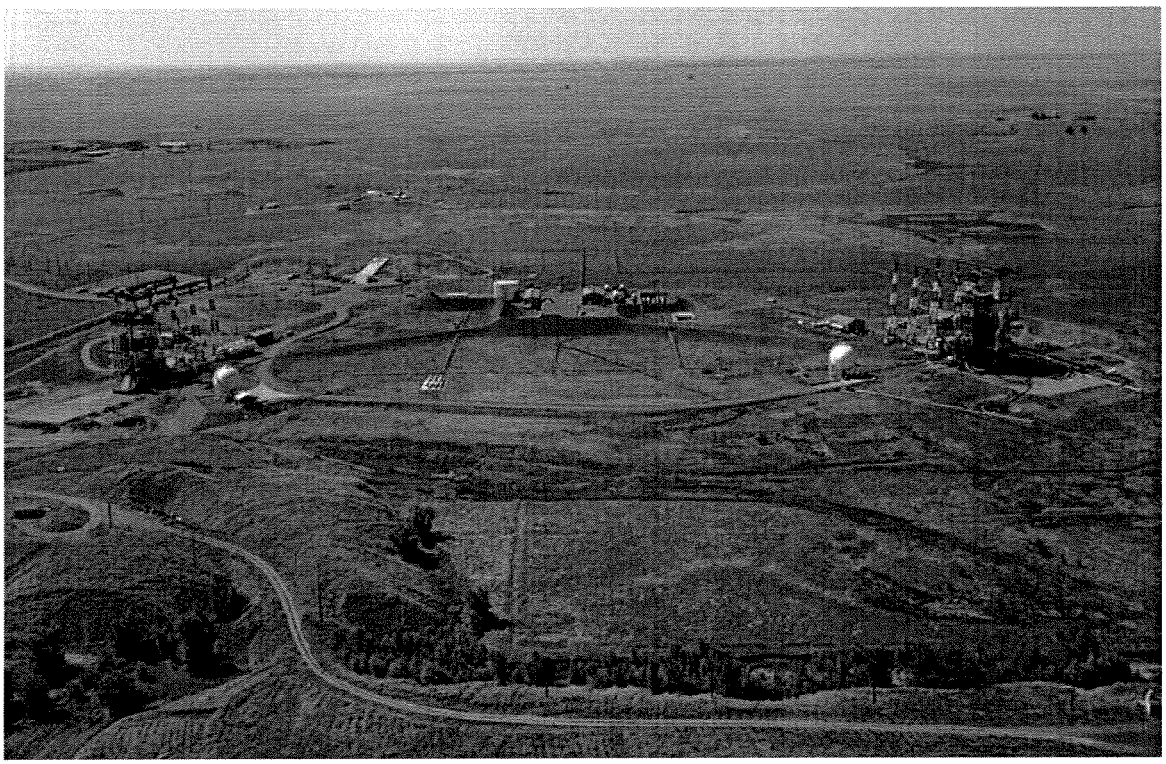

Plate 68: Alpha Test Complex, ca.1965. Observation Shelter No. 2, lower right corner of the photograph. Observation Shelter No. 1, left edge of the photograph. Blockhouse with generator-compressor building and pumphouse, center, surrounded by large earthen berm. Test Stand No. 2, right. Test Stand No. 1, left. Looking south. Courtesy of NASA.

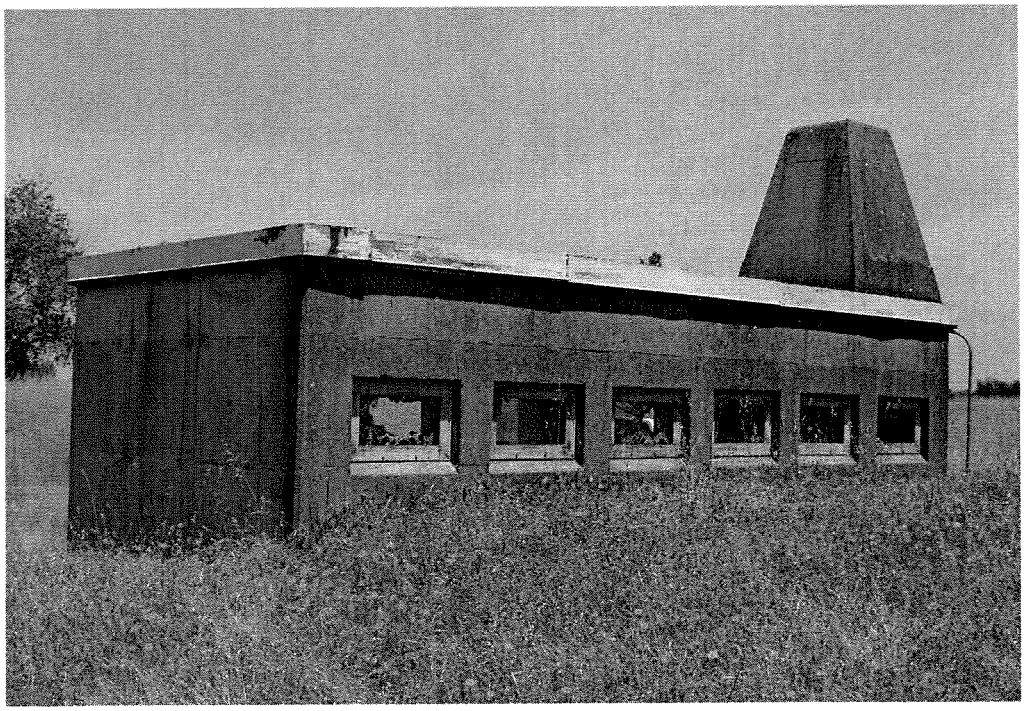

Plate 69: Observation Shelter No. 2, Alpha Test Complex, 1956-1957. Looking northeast. View of May 2005.

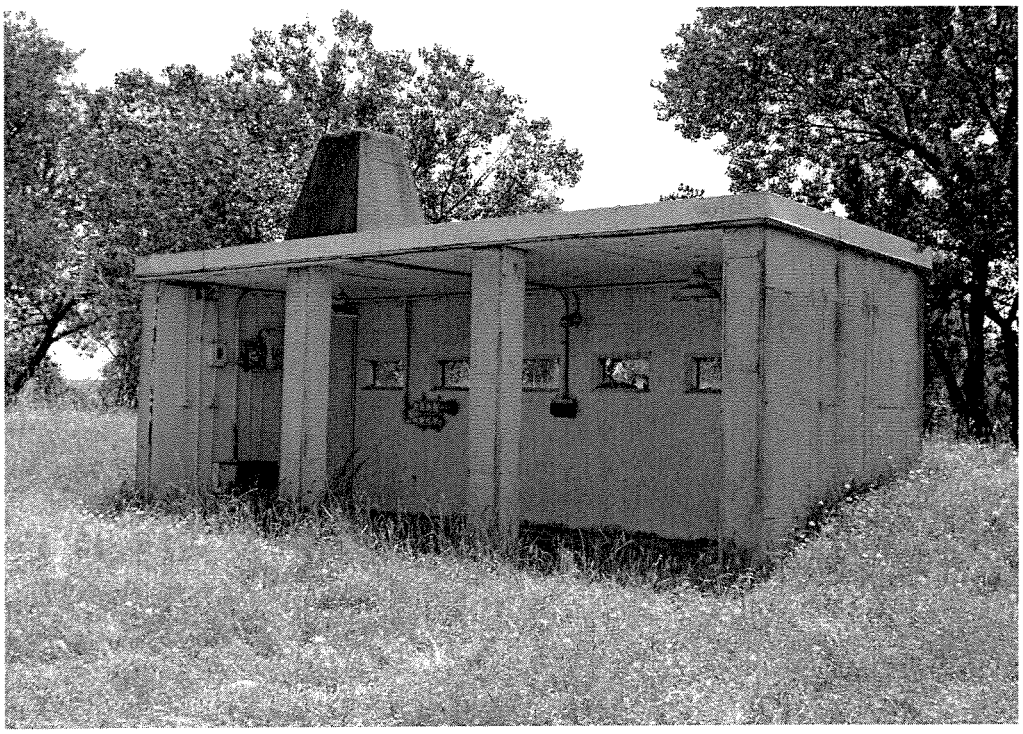

Plate 70: Observation Shelter No. 2, Alpha Test Complex, 1956-1957. Looking southeast. View of May 2005.

Helium Storage Area

Also known as Unit 68, the storage area for helium tanks is located to the immediate west of the generator-compressor building. The paved area featured a reinforced concrete barricade wall on its eastern periphery, placed between the stored tanks and a boiler. The helium storage area historically contained three large tanks and two small tanks of helium gas. A large earthen berm buffered the north, west, and south sides of the storage area. The bermworks were part of a larger protective earthen unit that surrounded the central blockhouse area of the Alpha Test Complex.

Aerojet General designed the helium storage area during 1956-1957 as a component of its overall engineering for the Alpha Test Complex. Today, only the reinforced barricade wall remains on the site. Douglas constructed the helium storage area to support static firings at Test Stands No. 1 and No. 2.

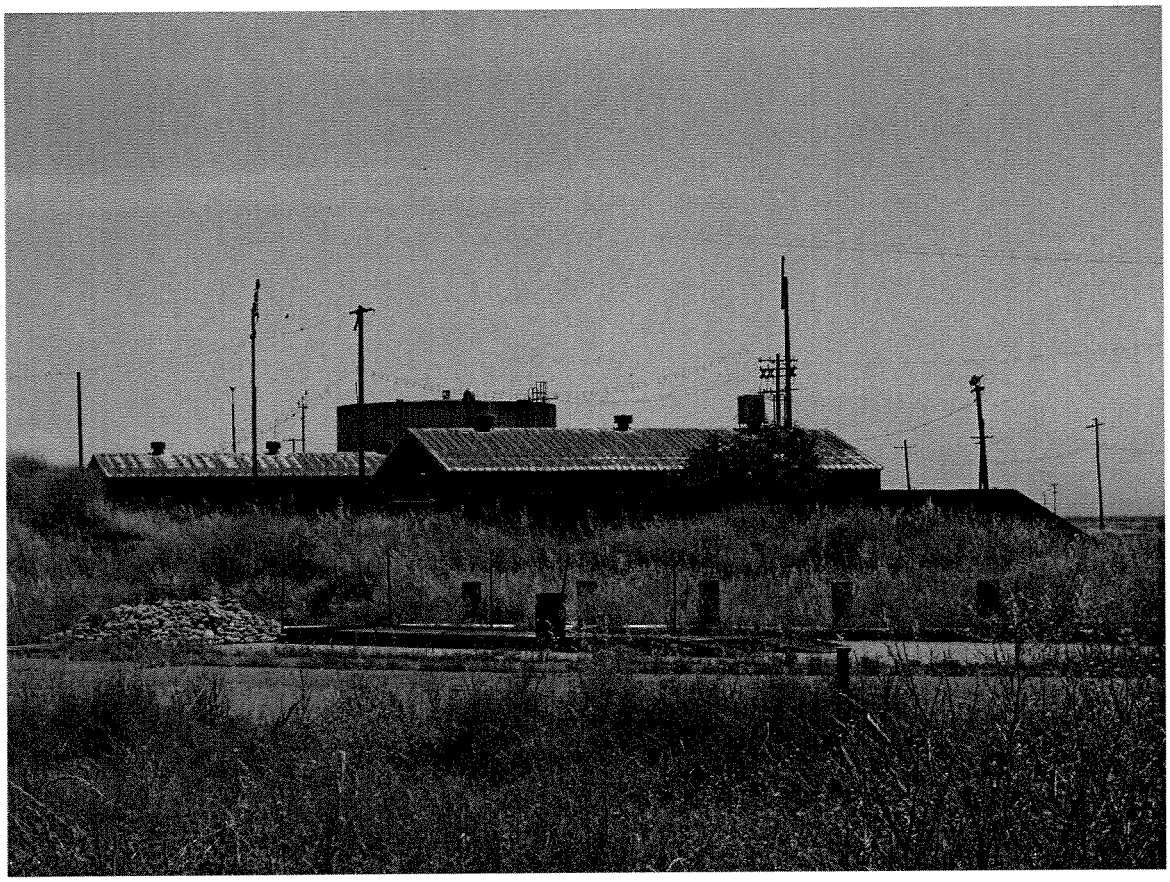

Plate 71: Helium Storage Area, Alpha Test Complex, 1956-1957. Barricade wall in middleground, with the generator-compressor building, pumphouse, and water tank in the background. Former equipment trailer parking area in the foreground. Looking east. View of May 2005.

Liquid Nitrogen (LN2) Tank

Also known as Unit 67, the LN2 tank sat west of the generator-compressor building in the Alpha Test Complex. When placed on site in 1957, raised concrete pedestals supported a cylindrical LN2 tank. Only the pedestal mounts remain today.

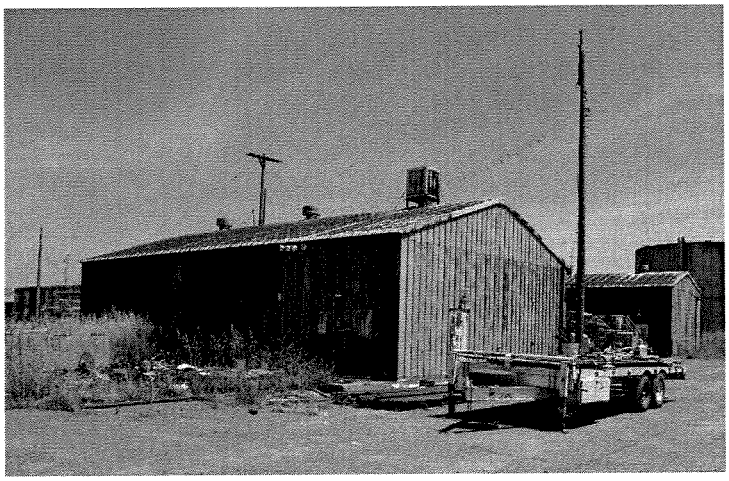

Plate 72: Generator-Compressor Building, with the foundation of the LN2 tank (Unit 67) (left), Alpha Test Complex, 1956-1957. Looking northeast. View of May 2005.

Generator and Compressor Building

Also known as Unit 62, the generator-compressor building is a one-story, prefabricated metal structure erected in center of the Alpha Test Complex in 1957. The windowless building features corrugated metal sheathing and a gable roof. Two center-opening shop doors articulate the east façade. The interior of the generator- compressor building is divided into several rooms, and is in an altered, derelict condition today.

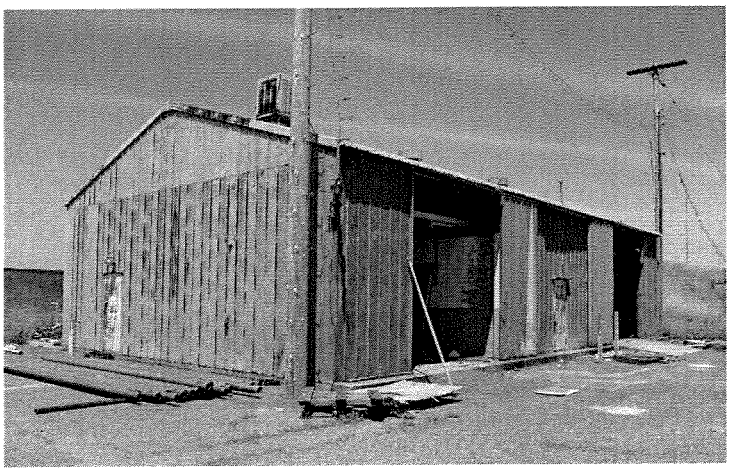

Plate 73: Generator-Compressor Building, Alpha Test Complex, 1956-1957. Looking northwest. View of May 2005.

Plate 74: Generator-Compressor Building (Unit 62), Alpha Test Complex, 1956-1957. Interior. View of May 2005.

Plate 75: Generator-Compressor Building (Unit 62), Alpha Test Complex, 1956-1957. Interior. View of May 2005.

Control Center

Also known as Unit 61, the control center for the Alpha Test Complex is a one-story, reinforced concrete structure. Operational as the blockhouse for Test Stands No. 1 and No. 2, the control center is windowless. Rectangular, louvered vents articulate several facades of the building. The control center features steel doors and is flat-roofed. Underground instrumentation tunnels connect the control center to the test stands.

Aerojet General designed the control center during 1956-1957 as a key component of its overall engineering for the Alpha Test Complex. Today, the control center remains unaltered on its exterior. Interior rooms are open to the elements, and are in a derelict condition. Historically, a large earthen berm buffered the control center and its surrounding buildings at the center of the Alpha Test Complex. Only sections of the berm are extant in 2005. (See Plates 57 and 68.)

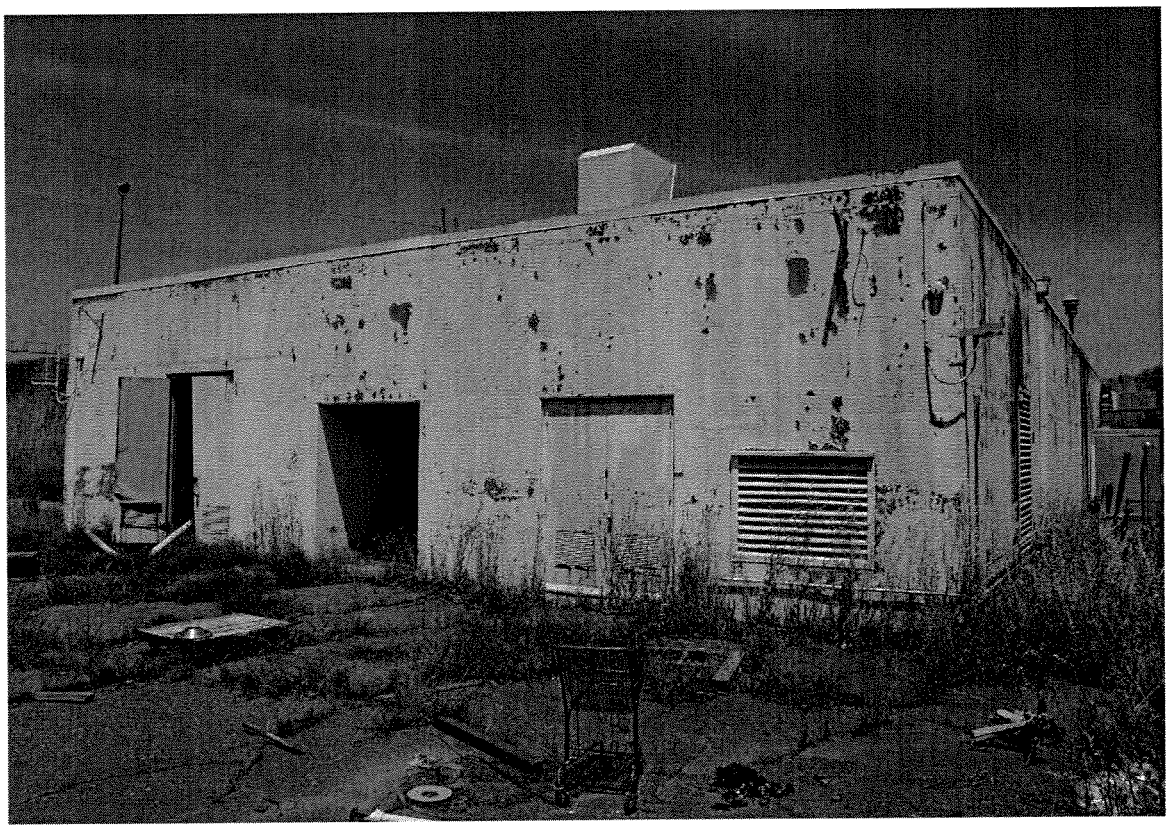

Plate 76: Control Center (Unit 61), Alpha Test Complex, 1956-1957. Looking northwest. View of May 2005.

Plate 77: Control Center (Unit 61), Alpha Test Complex, 1956-1957. Interior of operations room. View of May 2005.

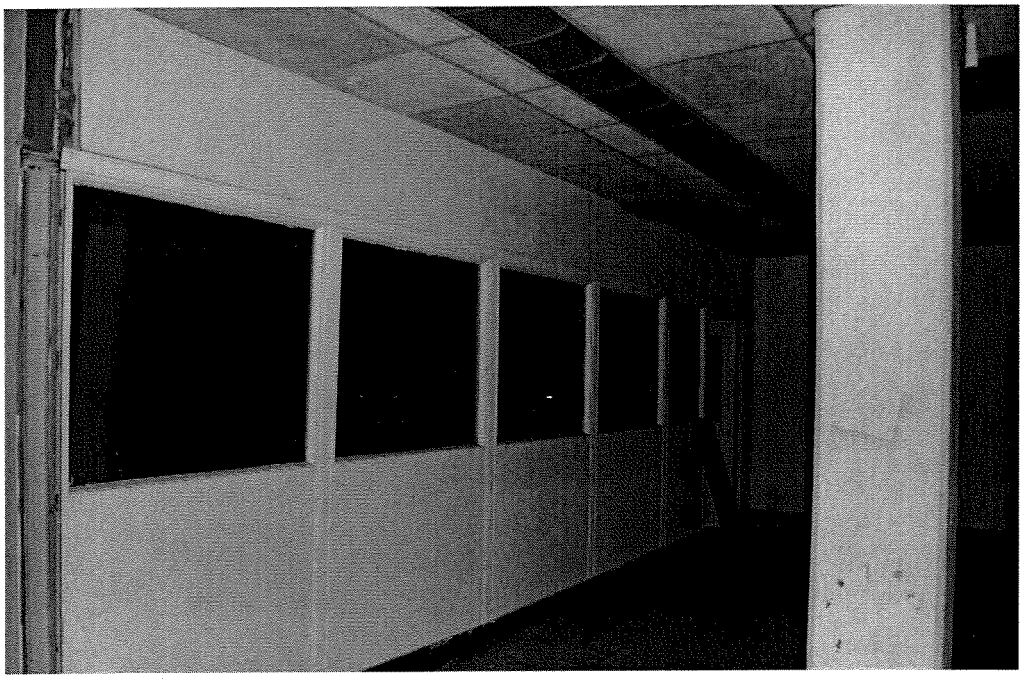

Plate 78: Control Center (Unit 61), Alpha Test Complex, 1956-1957. Interior of operations room, looking toward observation room. View of May 2005.

Pump House

Also known as Unit 63, the pump house is a one-story, prefabricated metal structure erected in center of the Alpha Test Complex in 1957. The building features rigid-frame construction, standing-seam metal sheathing, 6/3 factory windows, and a gable roof. A single entrance articulates the west façade. The interior of the pump house is a single room, and is in derelict condition today.

Historically, a large earthen berm buffered the pump house, control center, and generator-compressor building, with their ancillary water, fuel, helium, and liquid nitrogen tanks, at the center of the Alpha Test Complex. Only sections of the berm are extant in 2005. (See Plates 57 and 68.)

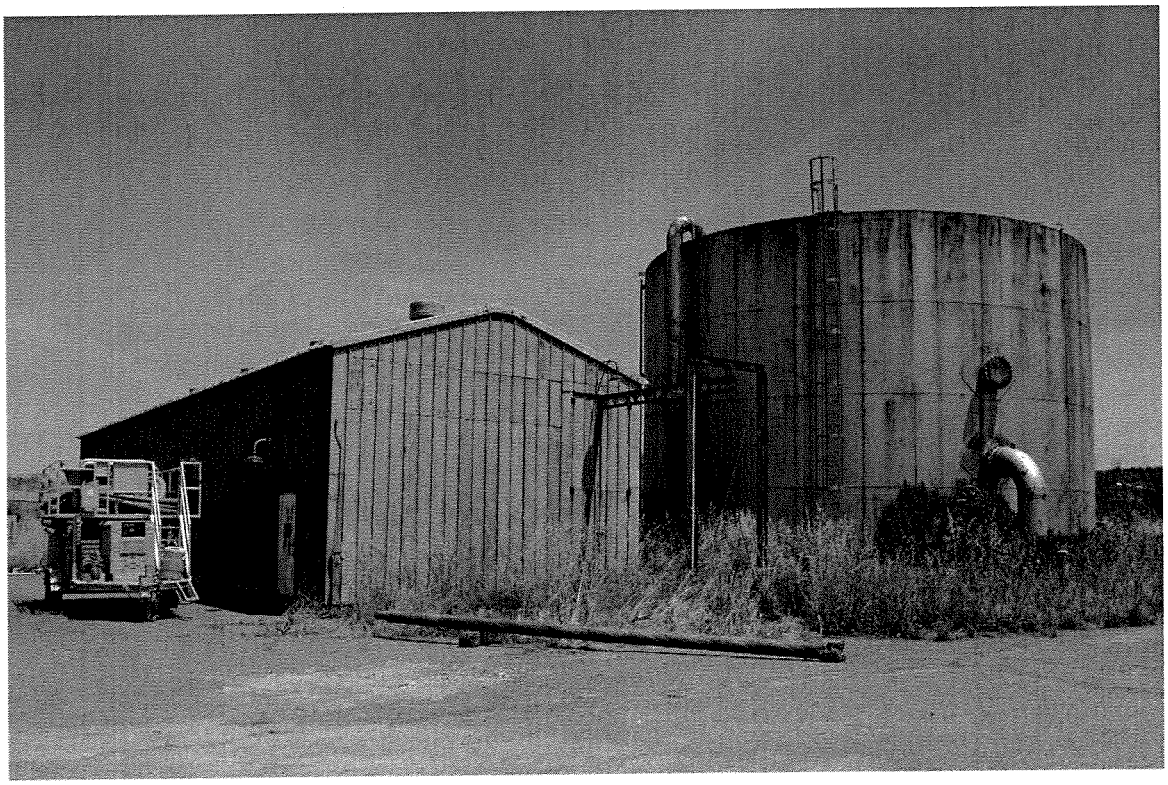

Plate 79: Pump House (Unit 63), Alpha Test Complex, 1956-1957. Water tank adjacent. Looking northeast. View of May 2005.

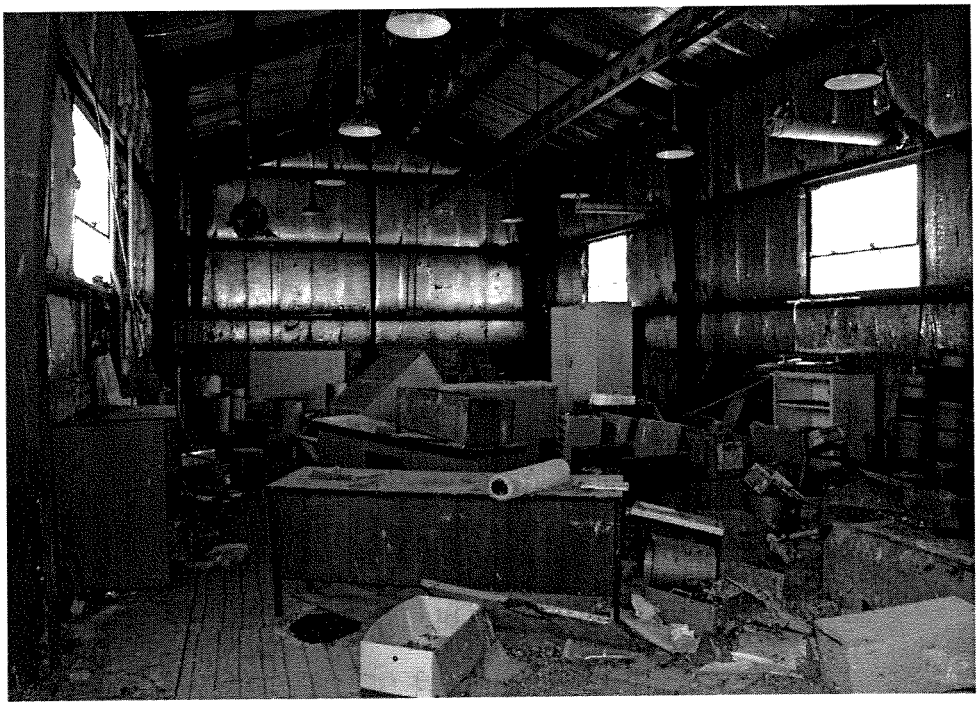

Plate 80: Pump House (Unit 63), Alpha Test Complex, 1956-1957. Interior, looking north. View of May 2005.

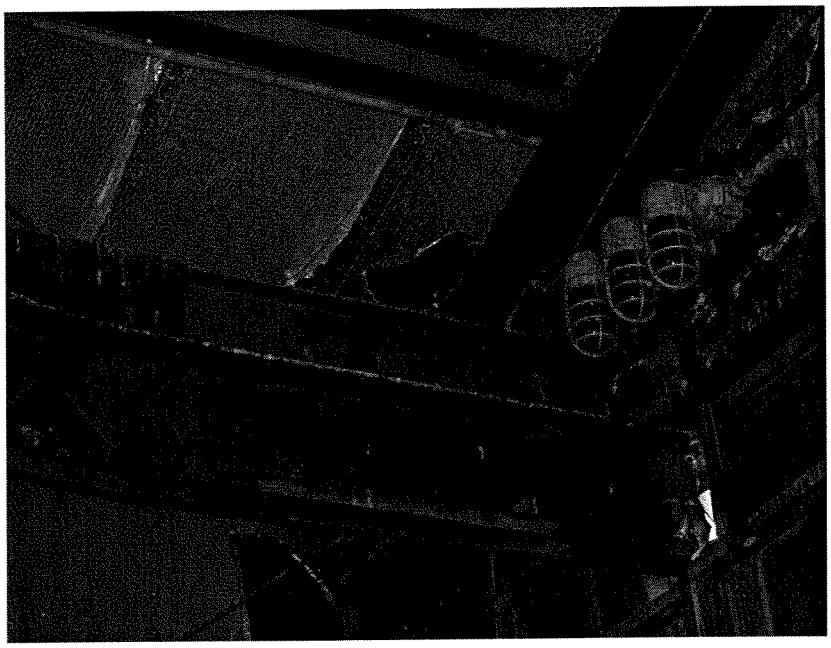

Plate 81: Pump House (Unit 63), Alpha Test Complex, 1956-1957. Interior, upper southeast corner: test-status light fixture. View of May 2005.

Water Tank

Also known as Unit 65, the water storage tank for the Alpha Test Complex is located at the southeastern corner of the pump house. The tank is a large steel structure fabricated from riveted panels. The water tank and pump house worked as a unit to provide the deluge system for the Alpha Test Complex. Large amounts of water were required for captive missile and missile-engine firings on Test Stands No. 1 and No. 2.

Aerojet General designed the deluge system during 1956-1957 as a major component of its overall engineering for the Alpha Test Complex. Today, the water tank remains unaltered on its exterior. Historically, a large earthen berm buffered the water tank, pump house, control center, and generator-compressor building at the center of the Alpha Test Complex. Only sections of the berm are present at the site in 2005. (See Plates 57 and 68.) When the test complex was operational, a large cylindrical fuel tank stood to the near east of the water tank. The fuel tank is no longer extant.

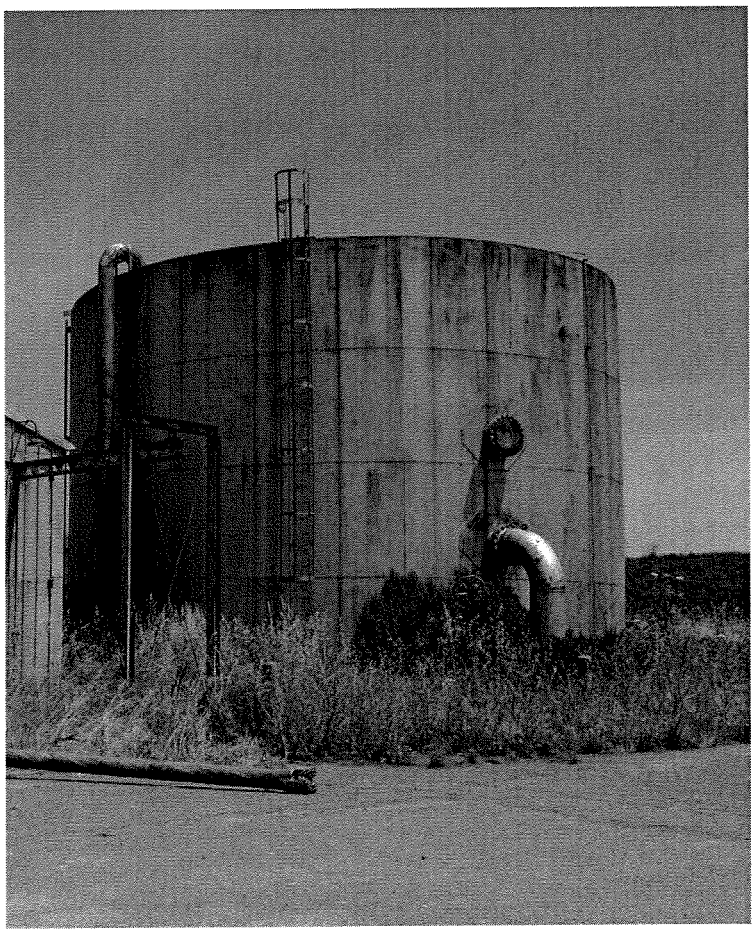

Plate 82: Water Tank (Unit 65), Alpha Test Complex, 1956-1957. Looking northeast. View of May 2005.

Observation Shelter No. 1

Also known as Unit 79, the observation shelter for captive firings at Test Stand No. 1 is located northwest of the test stand at the midpoint of its access road. The shelter is a small, flat-roofed, reinforced concrete structure, open on its rear face. The shelter features a bank of six viewing windows, each with thick, inset glass panes. The fenestration is typical of that found in blockhouses and observation posts at missile test facilities and launch sites. Constructed in 1956-1957, the observation shelter is one of two shelters on the access road. Observation Shelter No. 1 is unaltered today.

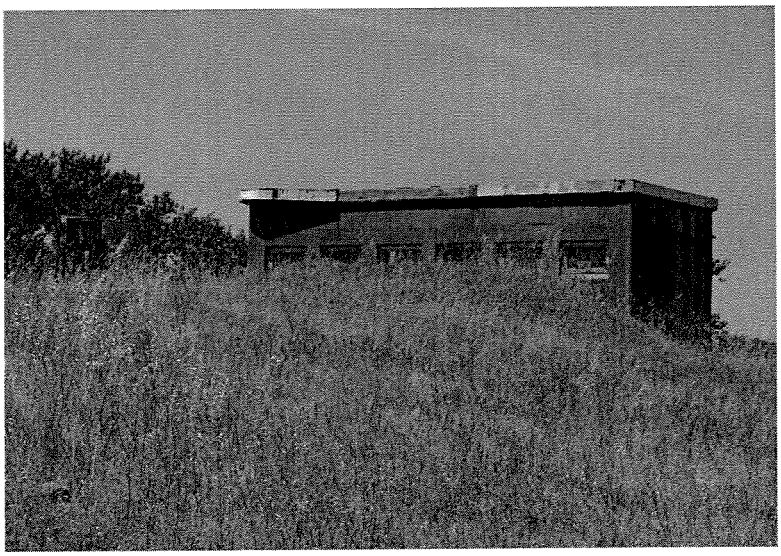

Plate 83: Observation Shelter No. 1, Alpha Test Complex, 1956-1957. Looking northwest. View of May 2005.

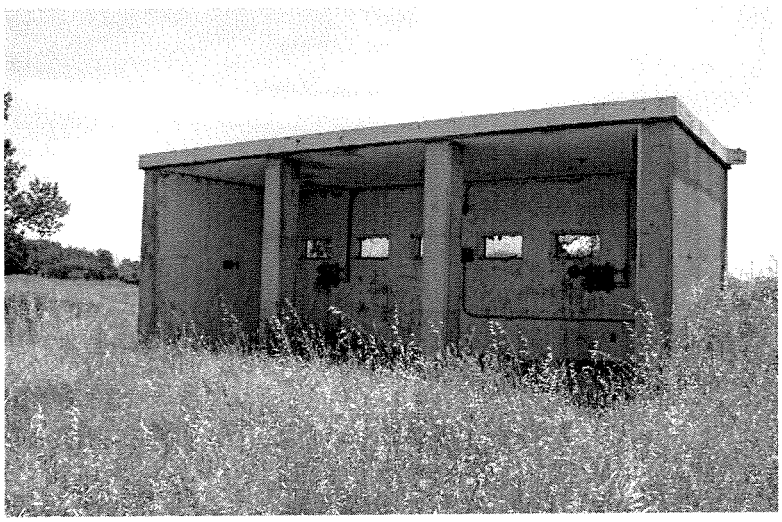

Plate 84: Observation Shelter No. 1, Alpha Test Complex, 1956-1957. Looking southeast. View of May 2005.

Test Stand No. 1

Also known as Unit 72, Test Stand No. 1 featured a steel-beam tower with a single captive-firing position, a north-facing flame deflector, and a ground-level, reinforced concrete terminal room. The terminal room also functioned as the base of the test stand. Test Stand No. 1 is 700 feet from the blockhouse for the Alpha Test Complex. An underground instrumentation tunnel connects Test Stand No. 1 to the blockhouse, in a layout identical to the tunnelworks for Test Stand No. 2. The steel superstructure of Test Stand No. 1 accommodated a test item 40 feet long and 19 feet in diameter. Douglas initially operated Test Stand No. 1 p to run static firing acceptance tests on the Thor IRBM during 1958-1960. The captive-firing position in Test Stand No. 1 was identical in its dimensions to that of Test Stand No. 2B. Test Stand No. 1 could withstand up to a 300,000-pound thrust during captive firings. A deluge system flooded the flame deflector (bucket) in a standard configuration for static tests. Test Stand No. 1 also included a 10-ton crane used to position test items (Douglas 1966).

Aerojet General designed Test Stand No. 1 during 1956-1957 as a major component of its overall engineering for the Alpha Test Complex. Today, only the reinforced concrete terminal room at the base of the test stand remains at the site. Douglas removed the steel superstructure of the tower and of the flame deflector in 1977. All equipment formerly in the terminal room is also no longer extant, with the rooms partially open to the elements. The terminal room is in derelict condition in 2005. A car, visually identical to one shown in a photograph of Wernher von Braun's visit to the site in the early 1960s, is currently stored in the base of the test stand (see Plate 10). The instrumentation tunnel to the Alpha Test Complex blockhouse is intact, with electric cables removed. The reinforced concrete catchment basin at the base of the flame deflector is present, as is the test stand's large, circular deflector water-holding tank. The deflector water-holding tank is a surface pond facility. Miscellaneous camera and light stands sit at the periphery of the test stand.

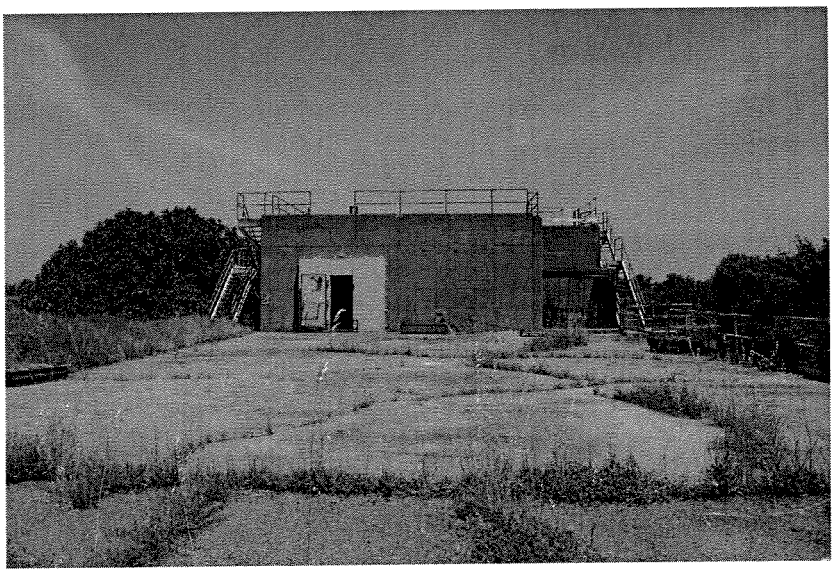

Plate 85: Test Stand No. 1, Alpha Test Complex, 1956-1957. Looking northeast. View of May 2005.

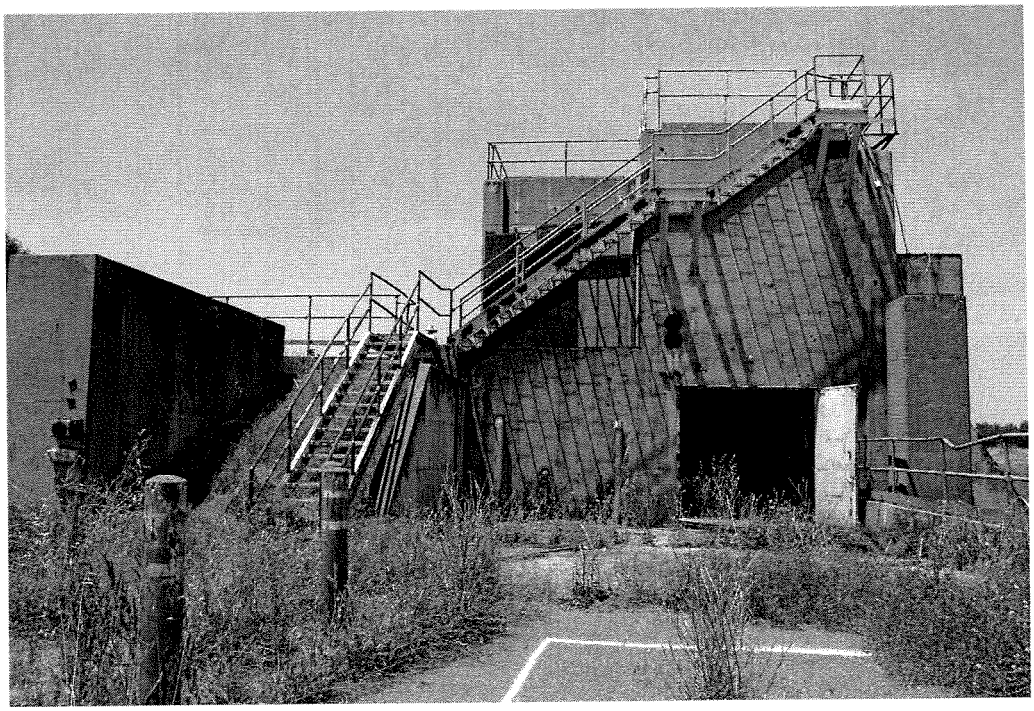

Plate 86: Test Stand No. 1, Alpha Test Complex, 1956-1957. Looking west. View of May 2005.

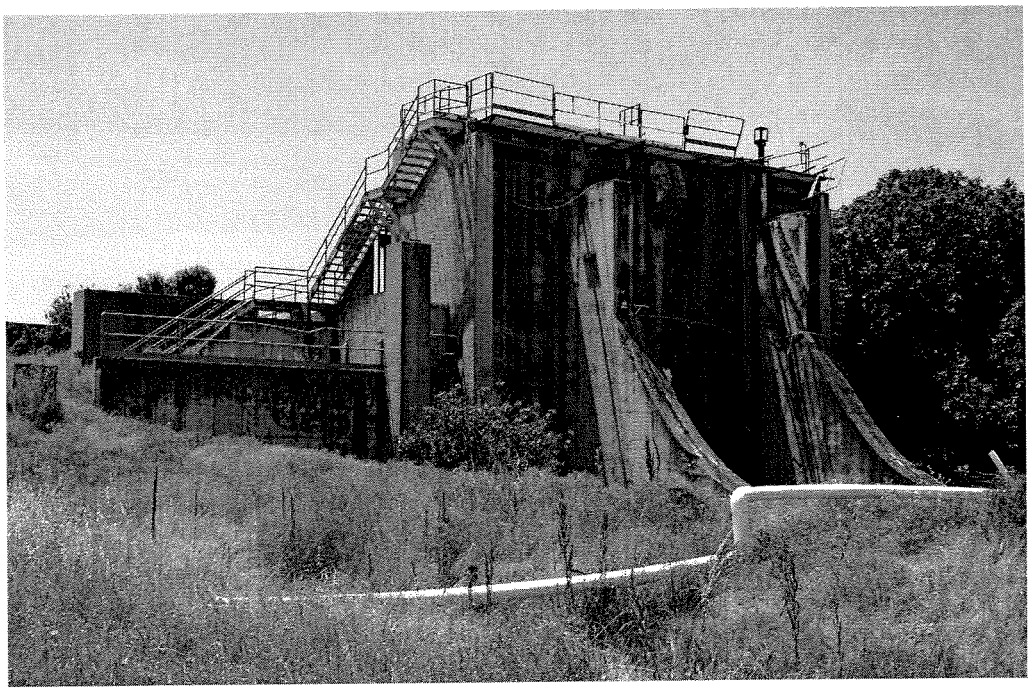

Plate 87: Test Stand No. 1, Alpha Test Complex, 1956-1957. Looking southwest. View of May 2005.

Plate 88: Test Stand No. 1, Alpha Test Complex, 1956-1957. Terminal room. Looking west/southwest. View of May 2005.

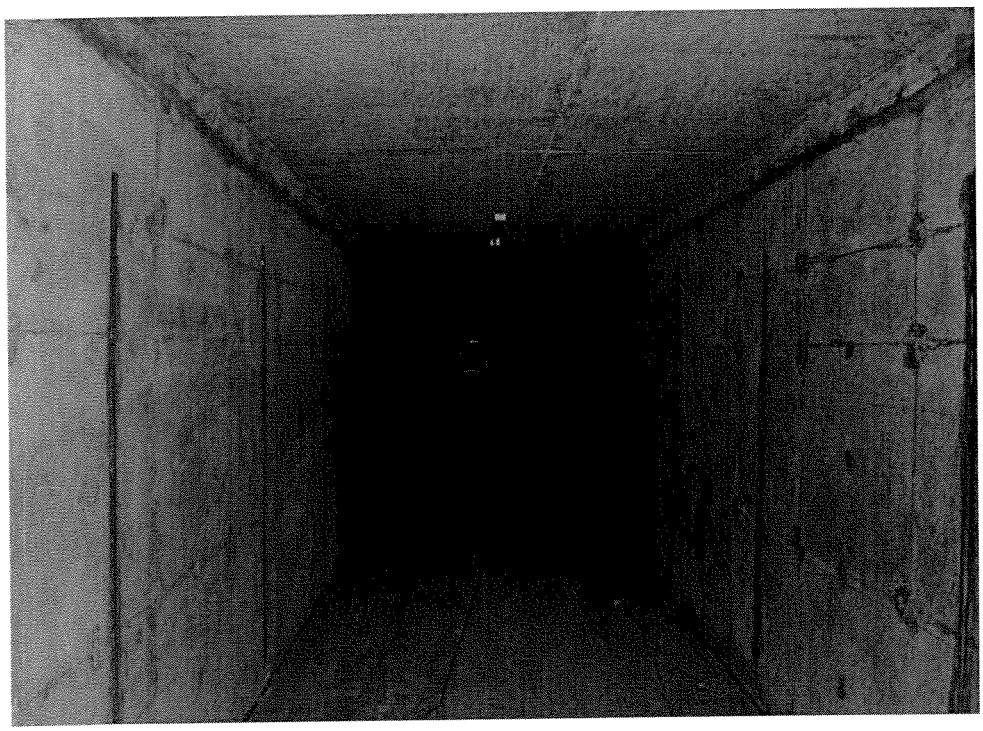

Plate 89: Test Stand No.1, Alpha Test Complex, 1956-1957. Instrumentation tunnel. Looking southwest. View of May 2005.

Plate 90: Vehicle stored inside base of Test Stand No.1, Alpha Test Complex. View of May 2005.

Plate 91: Vehicle stored inside base of Test Stand No.1, Alpha Test Complex. View of May 2005.

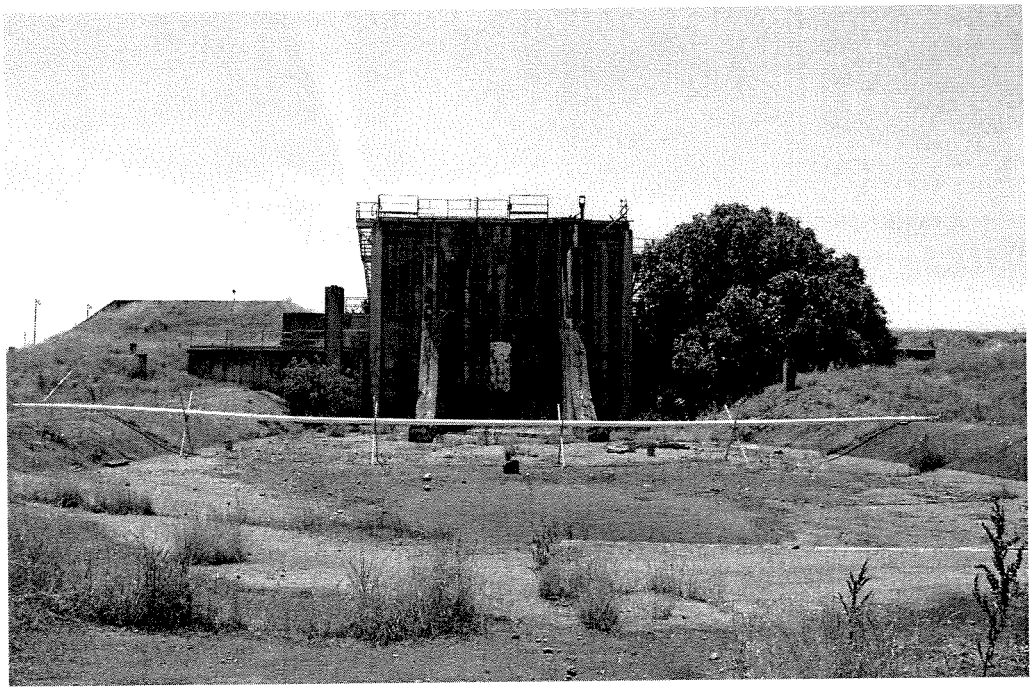

Plate 92: Test Stand No. 1, Alpha Test Complex, 1956-1957. Flame deflector catchment area. Looking south/southwest. View of May 2005.

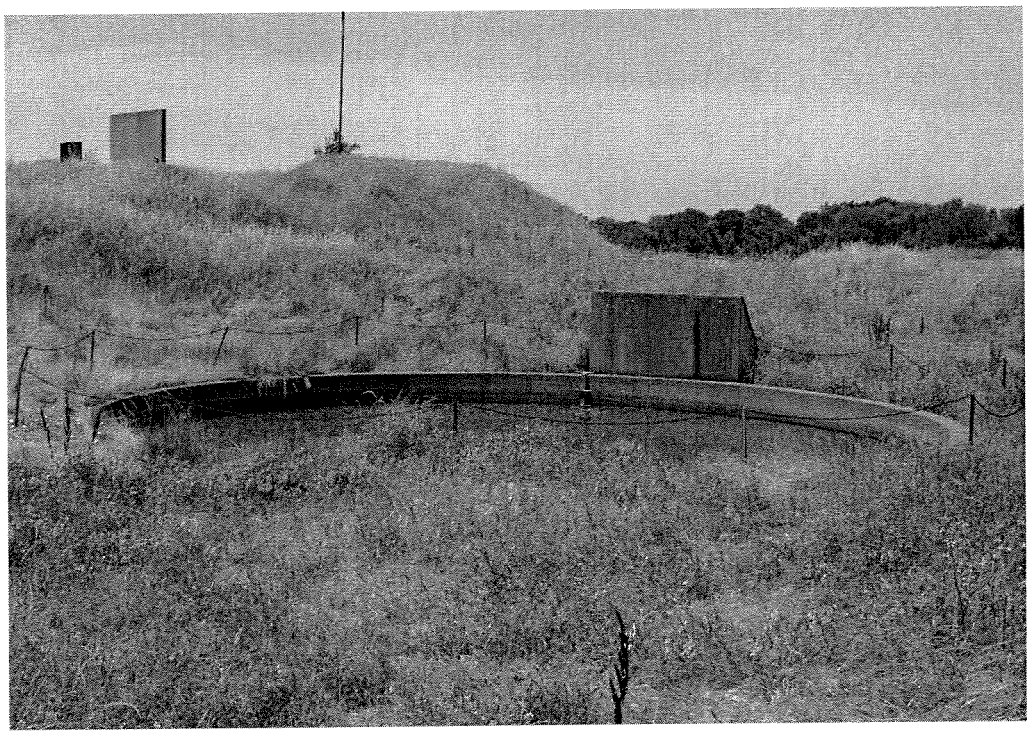

Plate 93: Test Stand No. 1, Alpha Test Complex, 1956-1957. Flame deflector water-containment tank. Looking southwest. View of May 2005.

LOX Tanks for Test Stand No. 1

Also known as Units 74 and 75, the two LOX tanks for Test Stand No. 1 sat within a protected area to the near southeast of the test stand. Today, a reinforced, ell-shaped barricade wall and surrounding earthen berm remain at the site. Placed at the location in 1956-1957, the LOX tanks are no longer present. (See Plates 57 and 68.)

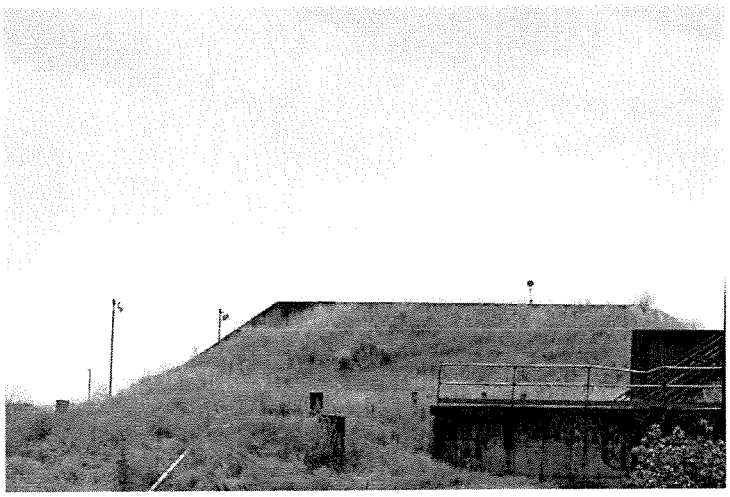

Plate 94: LOX Tank Area (Units 74 and 75), Test Stand No. 1, Alpha Test Complex, 1956-1957. Looking south/southwest. View of May 2005.

Test Cell

Also known as Unit 60, the test cell located to the near southeast of Test Stand No. 1 is a three-sided, flat-roofed, steel-frame structure placed on site in 1957. The inside face of the test cell is paneled, possibly with asbestos. Historic use of the test cell is undetermined.

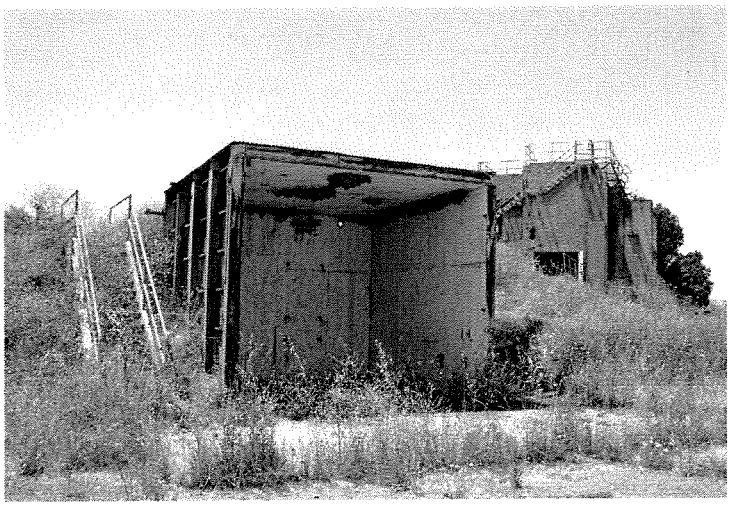

Plate 95: Test Cell (Unit 60), Test Stand No. 1, Alpha Test Complex, 1956-1957. Looking west. View of May 2005.

Beta Test Complex

The Beta Test Complex is a large, fenced compound laid out west of the Alpha Test Complex. The irregularly-shaped complex includes a central blockhouse and the remains of two static test stands. Originally configured with 30 numbered structures and several unnumbered support units and pads, the Beta Test Complex exists as 22 buildings, structures, and structural remnants in 2005 (Figures 7-8). The character-defining components within the complex are its blockhouse and test stands. Underground instrumentation tunnels connect the blockhouse to the terminal control rooms beneath both test stands. NASA planned three test stands for the Beta Test Complex, but constructed only two. Both Test Stand No. 1 and Test Stand No. 3 are single-position structures. NASA planned the unbuilt facility, Test Stand No. 2, to be located between Test Stands No. 1 and No. 3, in a triangular configuration. Ancillary buildings and structures varied from the larger secondary support facilities such as the facilities shop, test stand shops, calibration tower, pumphouse, power substation, and warehouse, to the critical, but smaller equipment units and test observation shelters. Equipment, sometimes with permanent raised foundations, included a liquid nitrogen tank, liquid hydrogen tanks, liquid oxygen (LOX) tanks, and a central water tank. Also on the site was a guard post at the entrance to the complex. Four observation shelters are separately sited north and south of the two test stands. Two fan rooms, constructed below ground north of two of the observation shelters, are unusual features of undetermined historic purpose. Also at the Beta Test Complex were hydrogen burn ponds and LOX dump pits, located north of each test stand.

The Beta Test Complex featured the final group of large-scale test stands erected for the Douglas Missile Test Facility at Rancho Cordova. Ralph M. Parsons designed the facilities within the Beta Test Complex in 1963. NASA had initiated activities at the Douglas test facility in late 1961, using the Alpha Test Complex for its Battleship Test Program for the Saturn S-IV. NASA leased the test site from Douglas. The Beta Test Complex expanded NASA's test capabilities for the Saturn S-IVB booster. The S-IVB was a second- and third-stage booster used in the Saturn IB and the Saturn V. Test Stand No. 1 in the Beta Test Complex accommodated battleship tests of the S-IVB, while Test Stand No. 3 in the complex was the location for acceptance tests and checkout verification of the booster (NASA 1966). During the 1965-1968 years, Douglas conducted acceptance testing of Saturn S-IVB boosters for NASA. The company shipped S-IVB boosters from its plant in Santa Monica for check-out, firing, and post-firing checks at the missile test facility in Rancho Cordova. After completion of the acceptance testing, Douglas shipped the Saturn S-IV boosters by air to NASA's facilities at Cape Kennedy in Florida for "mating with the Saturn S-I booster for exploratory 'Man on the Moon' feasibility studies" (NASA 1965). All static testing ended in 1969, although Douglas maintained the test stands in the complex in a state of readiness into late 1972. After deactivation of the Beta Test Complex, Douglas dismantled the superstructure of the test stands later in the decade (ENSR Consulting and Engineering 1993).

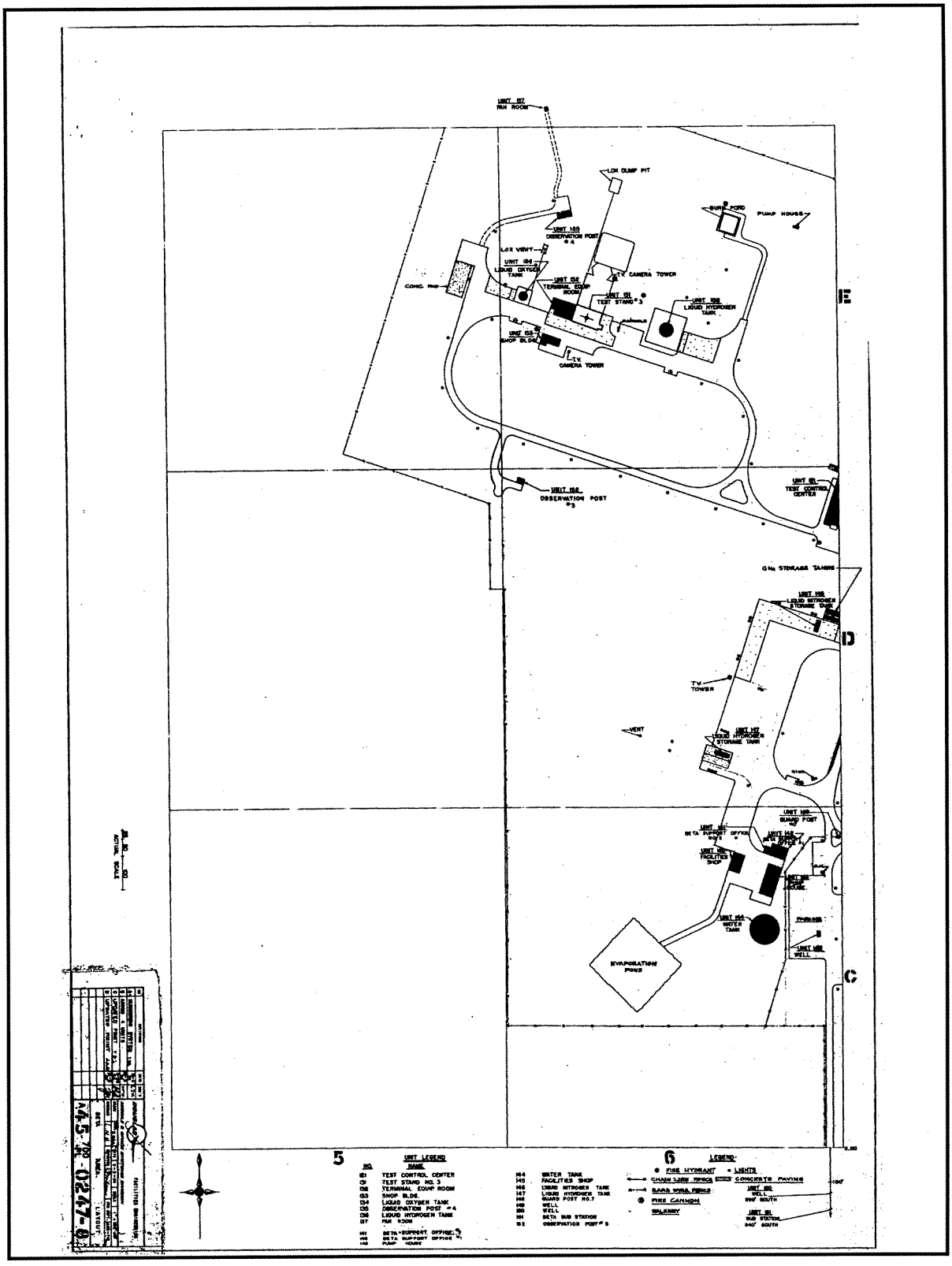

Figure 7: Douglas Facilities Engineering, Beta Test Complex (western half), Douglas Missile Test Facilities, 1964.

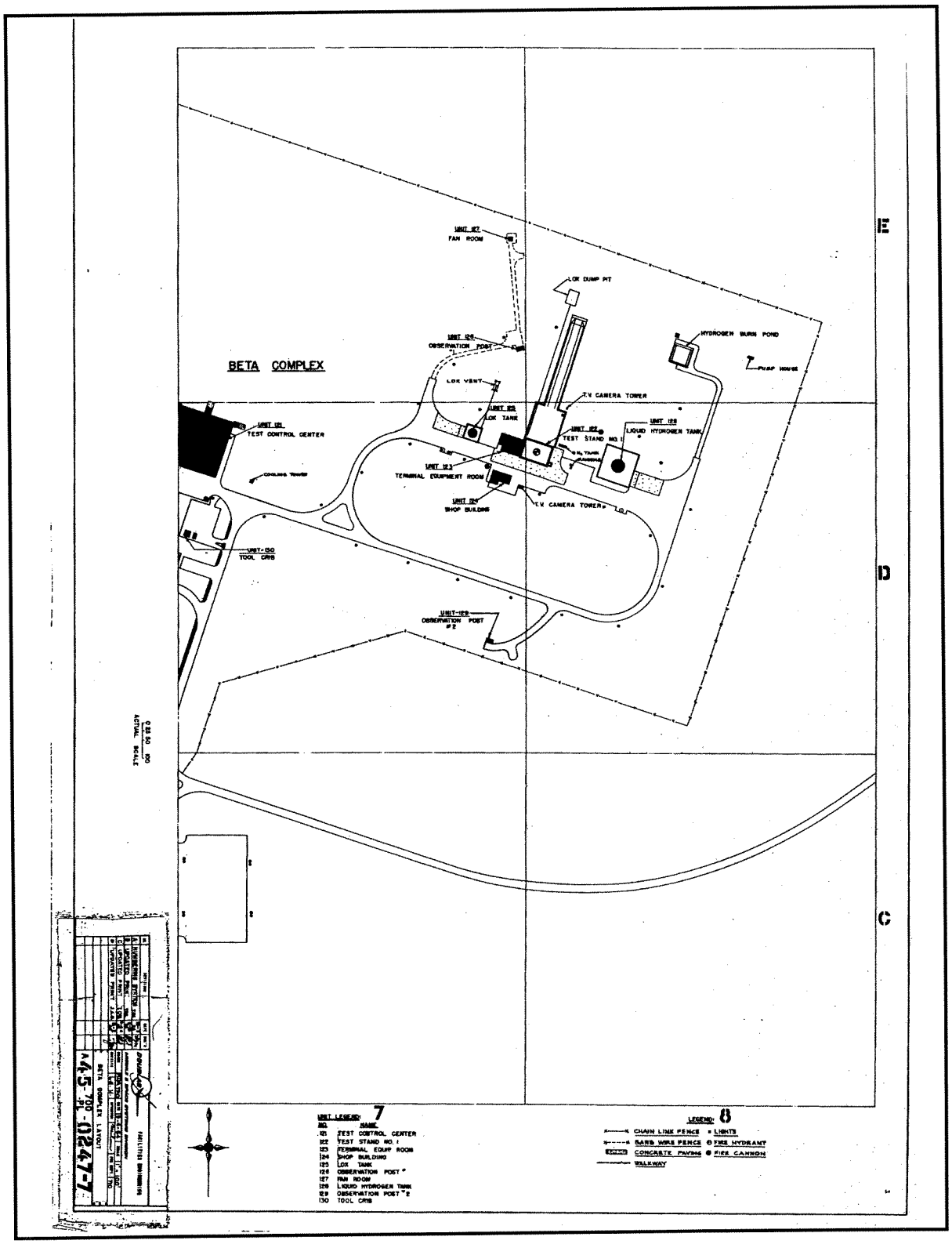

Figure 8: Douglas Facilities Engineering, Beta Test Complex (eastern half), Douglas Missile Test Facilities, 1964.

Ancillary structures interpreted as no longer standing within the Beta Test Complex include:

- a LOX tank (Unit 125) immediately west of Test Stand No. 1;
- an observation shelter (Unit 129) south of Test Stand No. 1;
- a tool crib (Unit 130) south of the test control center;
- a warehouse (Unit 138) west of Test Stand No. 3;
- a liquid nitrogen tank (Unit 146) south of the test control center;
- two wells (Units 149-150); and,
- a power substation (Unit 151) outside the security fencing, south of the complex.

The two wells (Units 149-150) and the substation (Unit 151) were placed outside the security fence of the Beta Test Complex, along the north-south road east of the southernmost area with the complex. These features were not field checked. Also not field checked were the unnumbered LOX dump pits and hydrogen burn ponds established for each test stand. A paired LOX dump pit and hydrogen burn pond existed north/northeast of Test Stand No. 3 and north/northwest of Test Stand No. 1.

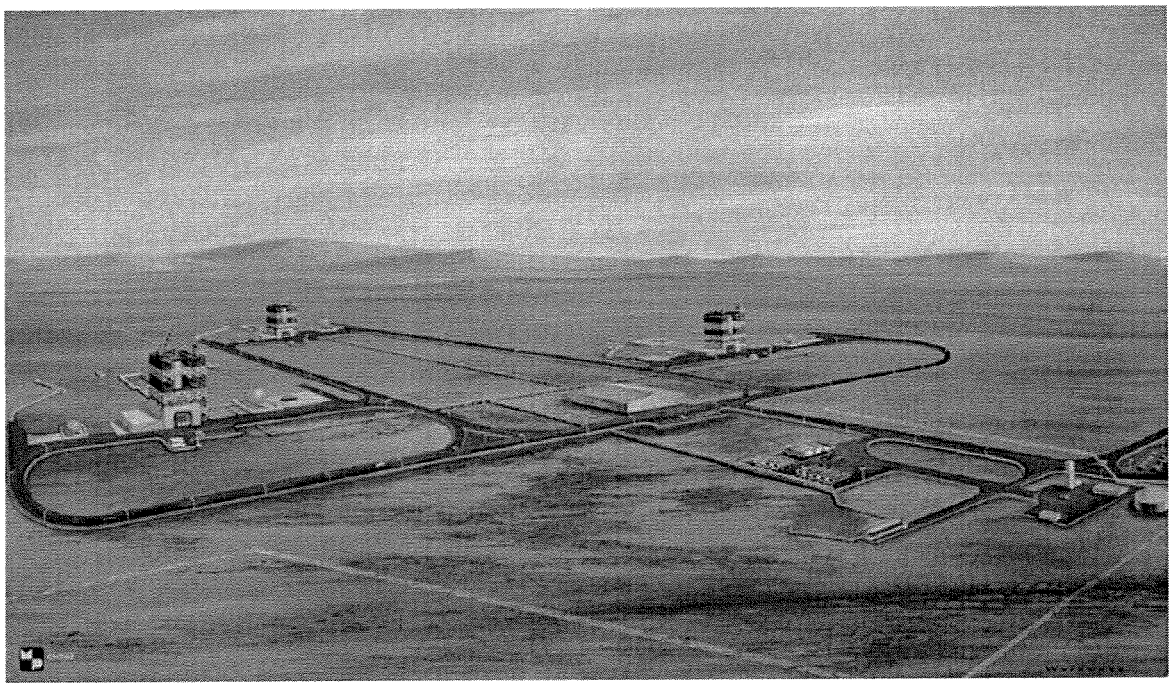

Plate 96: Beta Test Complex, as planned for three test stands, ca.1962-1963. Test control center (blockhouse), center. Test Stand No. 3, left. Test Stand No. 1, right. Facilities shop, calibration tower, pump house, and water tank, right foreground. Courtesy of NASA.

Observation Shelter No. 3

Also known as Unit 152, Observation Shelter No. 3 is one of two personnel stations erected for viewing captive firings at Test Stand No. 3 in the Beta Test Complex. Observation Shelter No. 3 is located south of the test stand at the end of a short access road. The shelter is a small, flat-roofed, reinforced concrete structure. The shelter features a bank of three viewing windows, each with thick, inset glass panes. A steel blast door on the rear façade provides entry to the shelter. The fenestration is typical of that found in blockhouses and observation posts at missile test facilities and launch sites. Constructed in 1963-1964, Observation Shelter No. 3 is unaltered today.

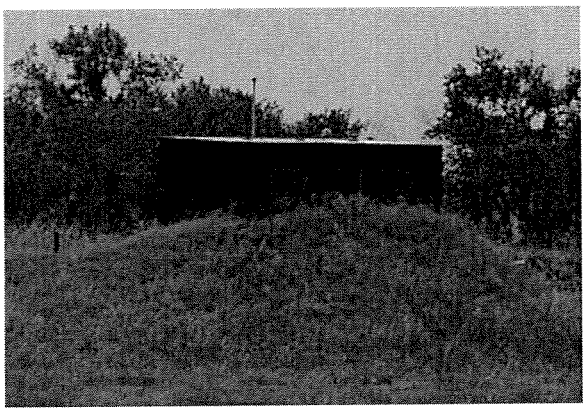

Plate 97: Observation Shelter No. 3 (Unit 152), Beta Test Complex, 1963-1964. Looking southwest. View of May 2005.

LOX Tank for Test Stand No. 3

Also known as Unit 134, the LOX tank for Test Stand No. 3 is located to the near west of the test stand. Constructed in 1963-1964, the tank is a large spherical chamber on raised footings. Today, the tank cap lies on the ground adjacent.

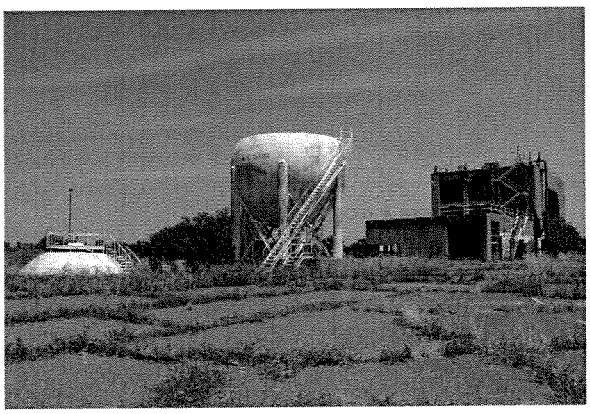

Plate 98: LOX Tank (Unit 134), Beta Test Complex, 1963-1964. Looking east/northeast. View of May 2005.

Fan Room for Test Stand No. 3

Also known as Unit 137, the fan room for Test Stand No. 3 is a small, underground structure accessed through a heavy steel, circular hatch cover. The hatch cover is imprinted with the words "42 TUBE TURN" and "WCB." The number "279," or "27" with a degree mark, is also included on the hatch. The historic origins of the hatch cover, likely a recycled item, are unknown. The historic usage of the fan room at the Beta Test Complex remains undetermined.

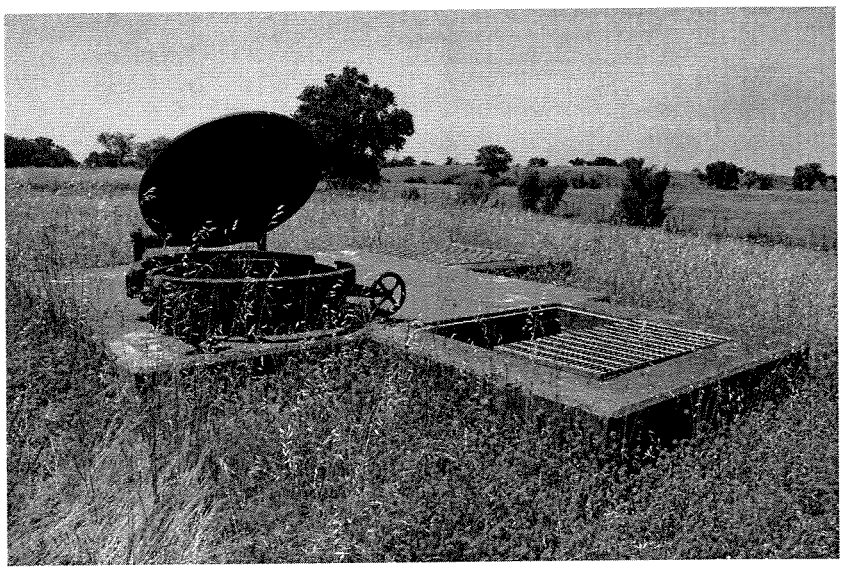

Plate 99: Fan Room for Test Stand No. 3 (Unit 137), Beta Test Complex, 1963-1964. Looking northwest. View of May 2005.

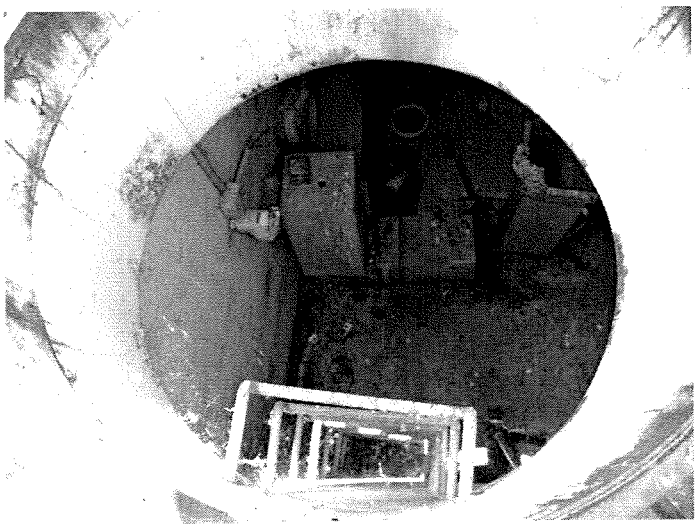

Plate 100: Fan Room for Test Stand No. 3 (Unit 137), Beta Test Complex, 1963-1964. Looking into the structure, with the access hatch up. View of May 2005.

Observation Shelter No. 4

Also known as Unit 135, Observation Shelter No. 3 is one of two personnel stations erected for viewing captive firings at Test Stand No. 3 in the Beta Test Complex. Observation Shelter No. 4 is located north of the test stand at the bend in the access road to the fan room for Test Stand No. 3. The shelter is a small, flat-roofed, reinforced concrete structure. Observation Shelter No. 4 features a bank of three viewing windows, each with thick, inset glass panes. A steel blast door on the rear façade provides entry to the shelter. The fenestration is typical of that found in blockhouses and observation posts at missile test facilities and launch sites. Constructed in 1963-1964, Observation Shelter No. 4 is unaltered today.

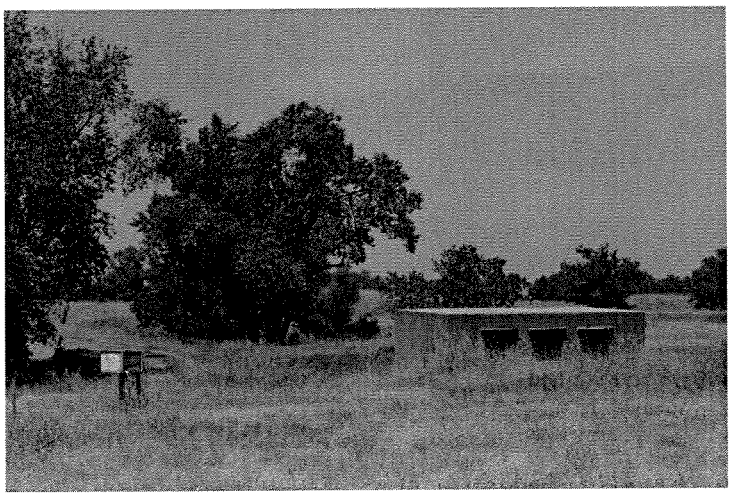

Plate 101: Observation Shelter No. 4 (Unit 135), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

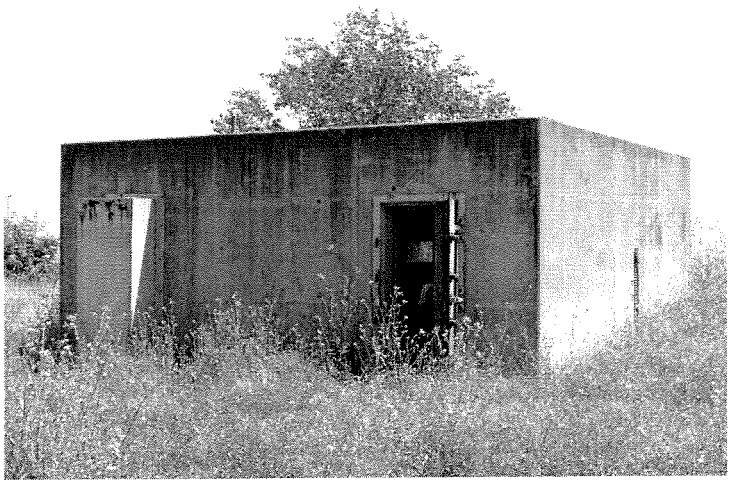

Plate 102: Observation Shelter No. 4 (Unit 135), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

Terminal Equipment Room for Test Stand No. 3

Also known as Unit 132, the terminal equipment room for Test Stand No. 3 is a one-story, reinforced concrete structure that abuts the western face of the base of Test Stand No. 3. The instrumentation tunnel from Test Stand No. 3 to the Beta Test Complex test control center (blockhouse) exits from the lower level of the terminal equipment room. (Douglas numbered the terminal equipment room and the superstructure of the test stand as separate units in the Beta Test Complex, differing from the company's numbering the two units as a single structure in the Alpha Test Complex. In the Alpha Test Complex, the terminal equipment rooms function as the base of the test stands, rather than as adjunct units.)

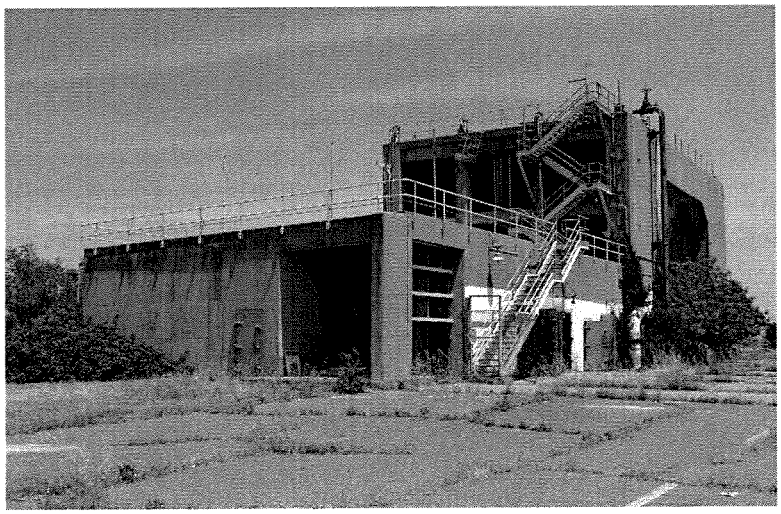

Plate 103: Terminal Equipment Room Test Stand No. 3 (Unit 132), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

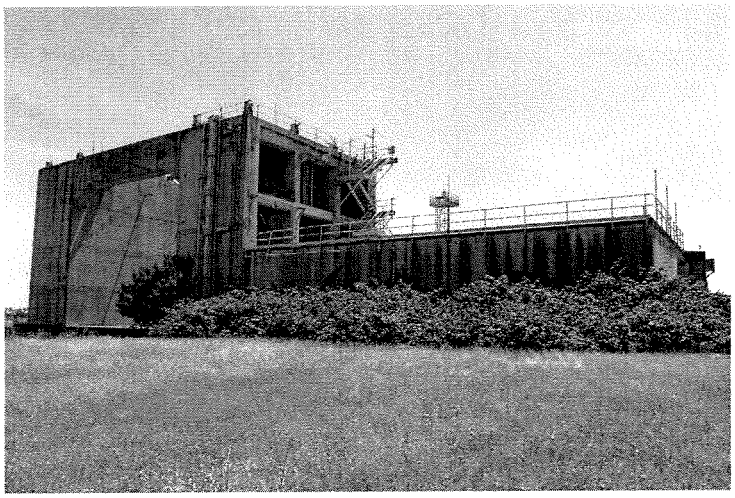

Plate 104: Terminal Equipment Room Test Stand No. 3 (Unit 132), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

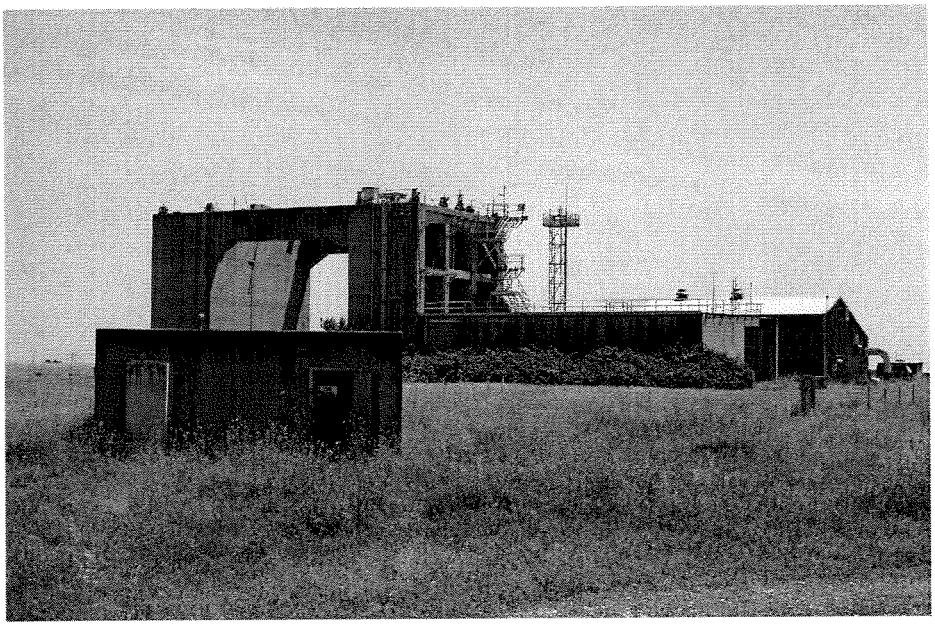

Plate 105: Terminal Equipment Room Test Stand No. 3 (Unit 132), Beta Test Complex, 1963-1964, middleground right. Base of Test Stand No. 3, middleground left. Observation Shelter No. 4, foreground left. Shop, background right. Looking southeast. View of May 2005.

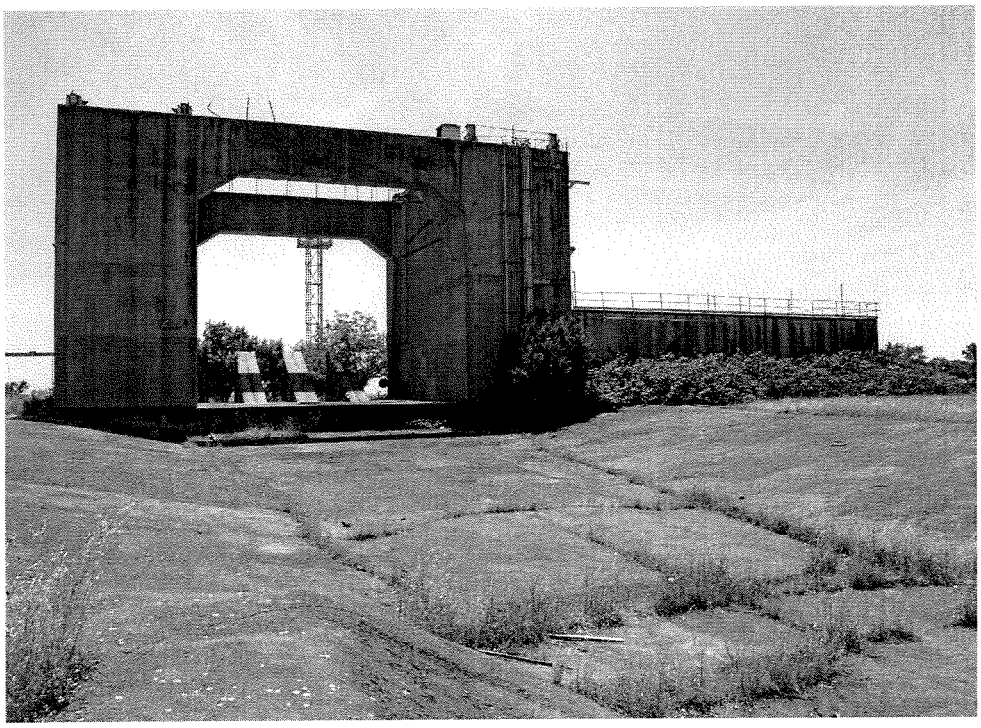

Plate 106: Terminal Equipment Room Test Stand No. 3 (Unit 132), Beta Test Complex, 1963-1964. Base of Test Stand No. 3, left, and flame deflector catchment basin, foreground. Looking southwest. View of May 2005.

Test Stand No. 3

Also known as Unit 131, Test Stand No. 3 featured a steel-beam tower atop a reinforced concrete base. Test Stand No. 3 included one captive-firing position and a north-facing flame deflector. The ground-level terminal room (Unit 132) for the facility abuts Test Stand No. 3 to the west. Test Stand No. 3 is 1,000 feet from the blockhouse for the Beta Test Complex. An underground instrumentation tunnel connects Test Stand No. 3, from its adjacent terminal control room, to the blockhouse, in a layout identical to the tunnelworks for Test Stand No. 1. The steel superstructure of Test Stand No. 3 accommodated a test item 60 feet long and 22 feet in diameter. NASA operated Test Stand No. 3 p to run acceptance and checkout tests for the Saturn S-IVB booster during 1965-1969. Test Stand No. 3 could withstand up to a 1,000,000-pound thrust during captive firings. A deluge system flooded the flame deflector (bucket) in a standard configuration for static tests. Test Stand No. 3 also included a 15-ton crane used to position test items in the captive-firing position (Douglas 1966).

Ralph M. Parsons designed Test Stand No. 3 during 1963 as a major component of its overall engineering for the Beta Test Complex. Today, only the reinforced concrete base of the test stand remains at the site. Douglas removed the steel superstructure of the tower and of the flame deflector in 1977. The reinforced concrete catchment basin at the base of the flame deflector is present, partially overgrown in weeds. Miscellaneous camera and light stands sit at the periphery of the test stand.

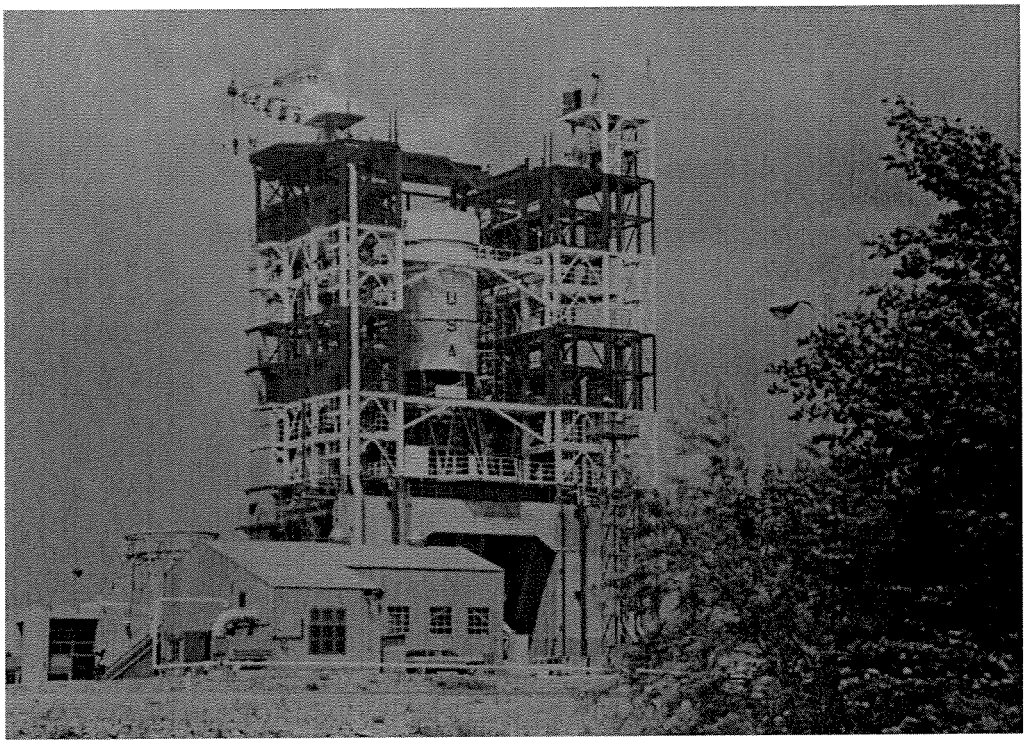

Plate 107: Test Stand No. 3 (Unit 131), Beta Test Complex, 1963-1964. With S-IVB booster undergoing checkout, ca.1966. Looking northeast. Courtesy of NASA.

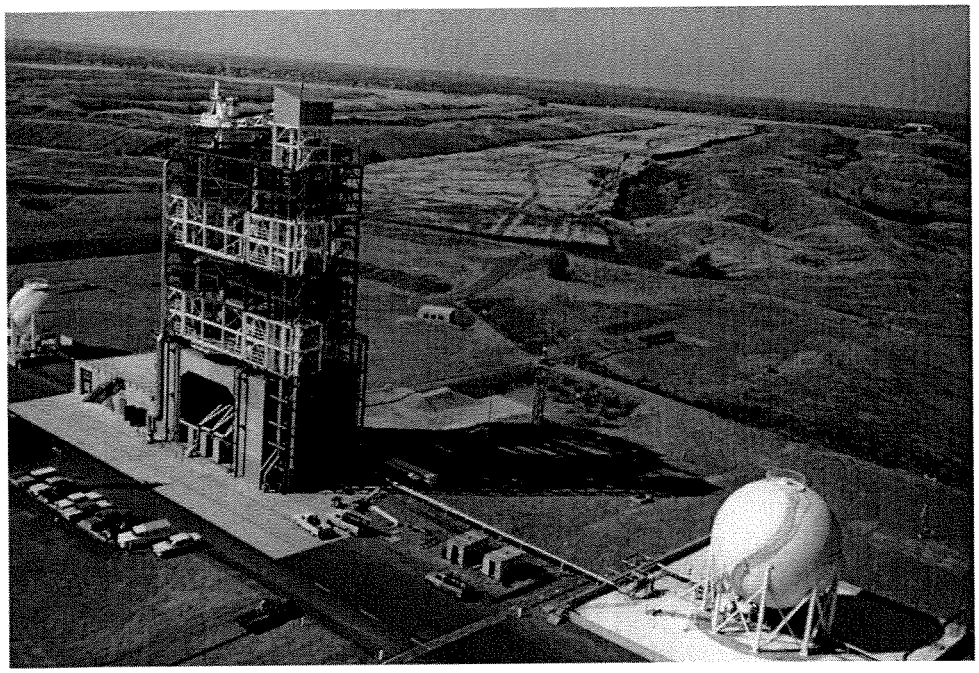

Plate 108: Test Stand No. 3 (Unit 131), Beta Test Complex, 1963-1964. Left to right: LOX tank, terminal room, test stand, north observation shelter, LOX dump pit, and liquid hydrogen tank. Looking northwest. Undated view. Courtesy of NASA.

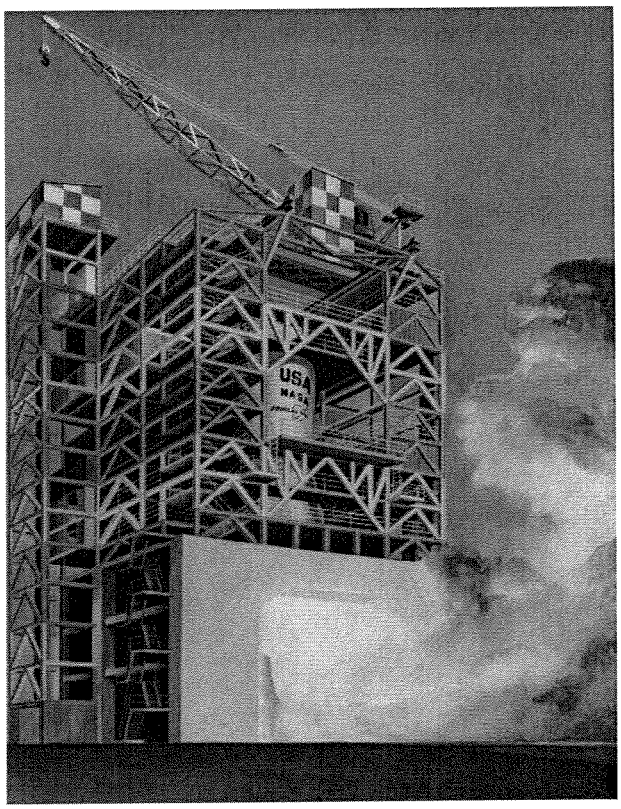

Plate 109: Beta Test Complex, drawing of planned test stand, ca.1962-1963. NASA.

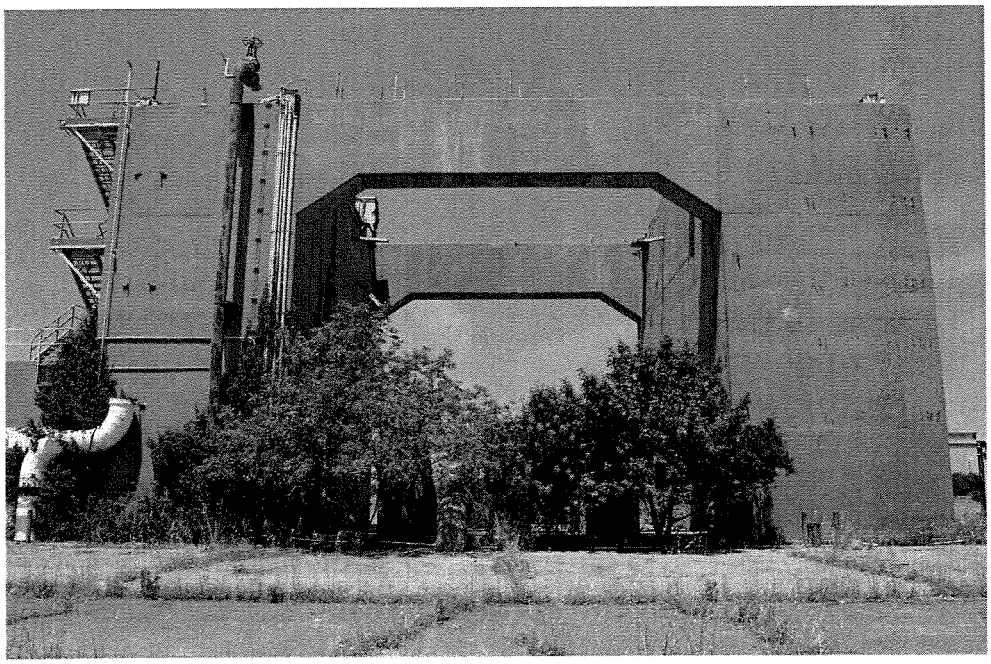

Plate 110: Test Stand No. 3 (Unit 131), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

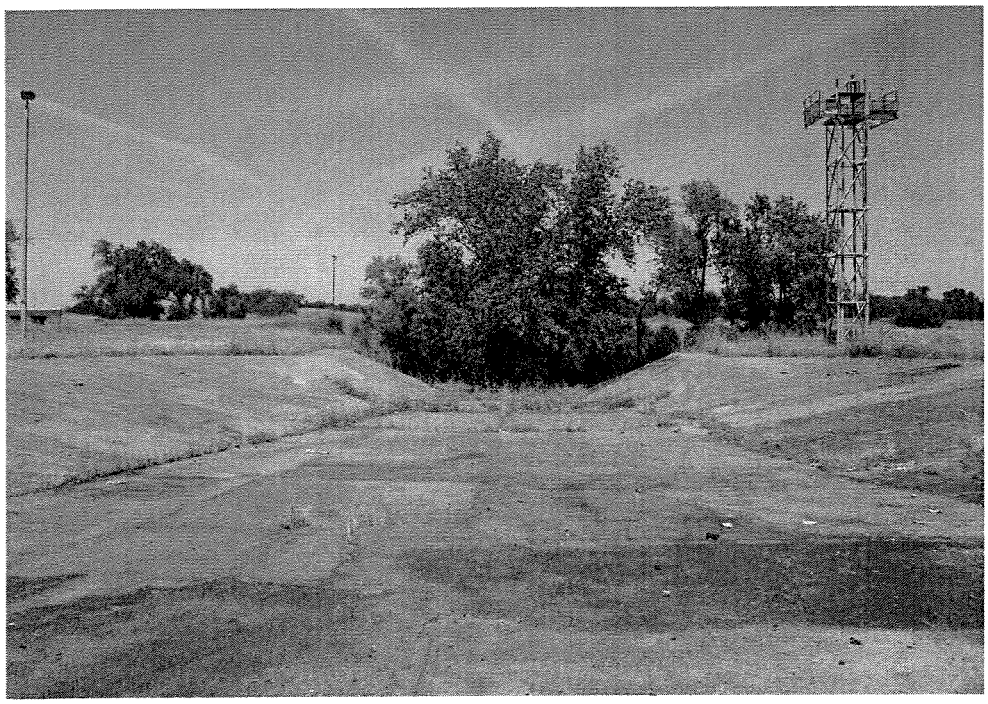

Plate 111: Flame deflector catchment basin at Test Stand No. 3 (Unit 131), Beta Test Complex, 1963-1964. TV camera stand, upper right. Looking northeast. View of May 2005.

Shop Building for Test Stand No. 3

Also known as Unit 133, the shop building for Test Stand No. 3 is a one-story, steel-frame structure erected in the Beta Test Complex in 1964. The shop building features steel I-beam construction with a light truss roof frame. Sheathed in corrugated siding, the shop building also includes a center-opening, track-mounted door on the east façade and a steel blast door on the west facade, with a simple entry on the north. Fenestration is 6/3 factory windows on the east façade and 3/6/3 factory windows on the north and south facades. The shop building has a combination gable roof, with a shed extension in the southwest corner. The interior of the structure is open, with rooms and an upper work space configured at its west end.

Plate 112: Shop for Test Stand No. 3 (Unit 133), Beta Test Complex, 1963-1964. TV camera stand, background left. Looking southeast. View of May 2005.

Plate 113: Shop for Test Stand No. 3 (Unit 133), Beta Test Complex, 1963-1964. Interior. Looking west. View of May 2005.

Liquid Hydrogen Tank for Test Stand No. 3

Also known as Unit 136, the liquid hydrogen tank for Test Stand No. 3 was a large, spherical structure on raised footings, as built. In 2005, only sections of the tank footings, the site's concrete perimeter wall, and access stairs remain.

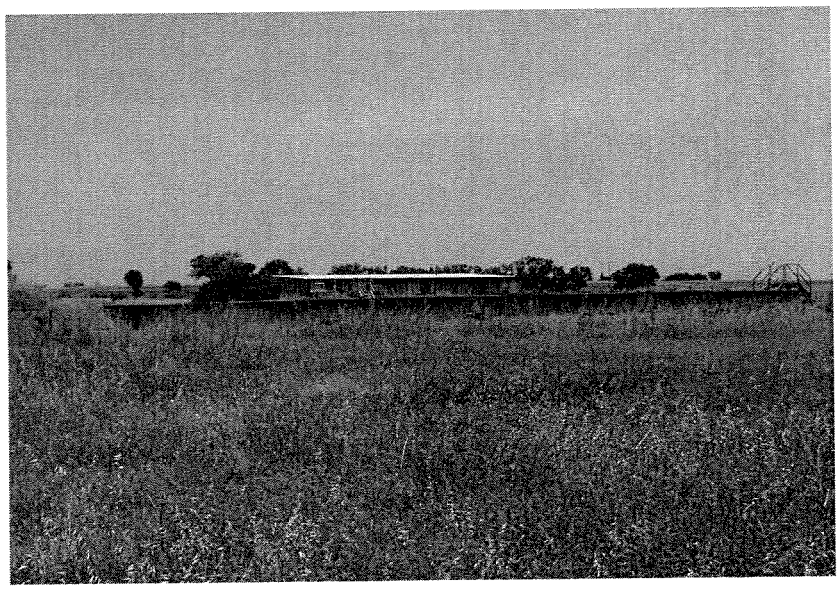

Plate 114: Liquid Hydrogen Tank at Test Stand No. 3 (Unit 136), foundation remnants, Beta Test Complex, 1963-1964. Test control center in background. Looking southeast. View of May 2005.

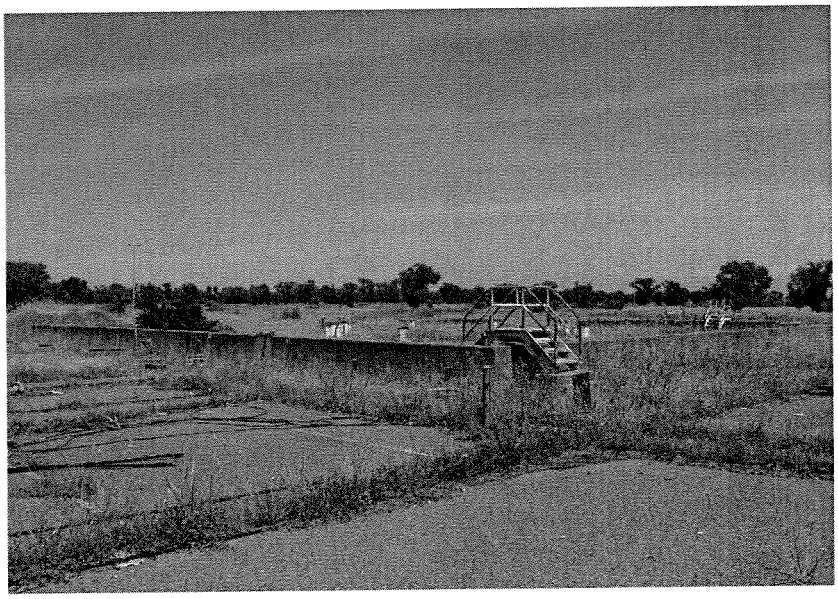

Plate 115: Liquid Hydrogen Tank at Test Stand No. 3 (Unit 136), foundation remnants, Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

Test Control Center

Also known as Unit 121, the test control center (blockhouse) for the Beta Test Complex is a one-story, windowless reinforced concrete structure. The test control center is flat-roofed, and features entrances on the building's east, west, and south facades. Center-opening, double sets of steel blast doors distinguish all entrances. Single inset view ports, additionally shielded by concrete overhangs on the building's exterior, sparsely articulate the east, west, and south facades. The interior of the test control center is configured with a large control room in the northern part of the building, overlooked by an observation room. The instrumentation tunnels from the terminal buildings at Test Stand No. 1 and Test Stand No. 3 enter the test control center through two extensions at the northeast and northwest corners of the blockhouse. Smaller work areas define the layout in the southern part of the building. The test control center sits between Test Stands No. 1 and No. 3 in the Beta Test Complex. As planned, a third captive-firing test stand (Test Stand No. 2) was to be constructed north of the test control center. Test Stand No. 2 was never built. Although derelict today, the test control center is unaltered.

Ralph M. Parsons designed the test control center during 1963 as a major component of its overall engineering for the Beta Test Complex.

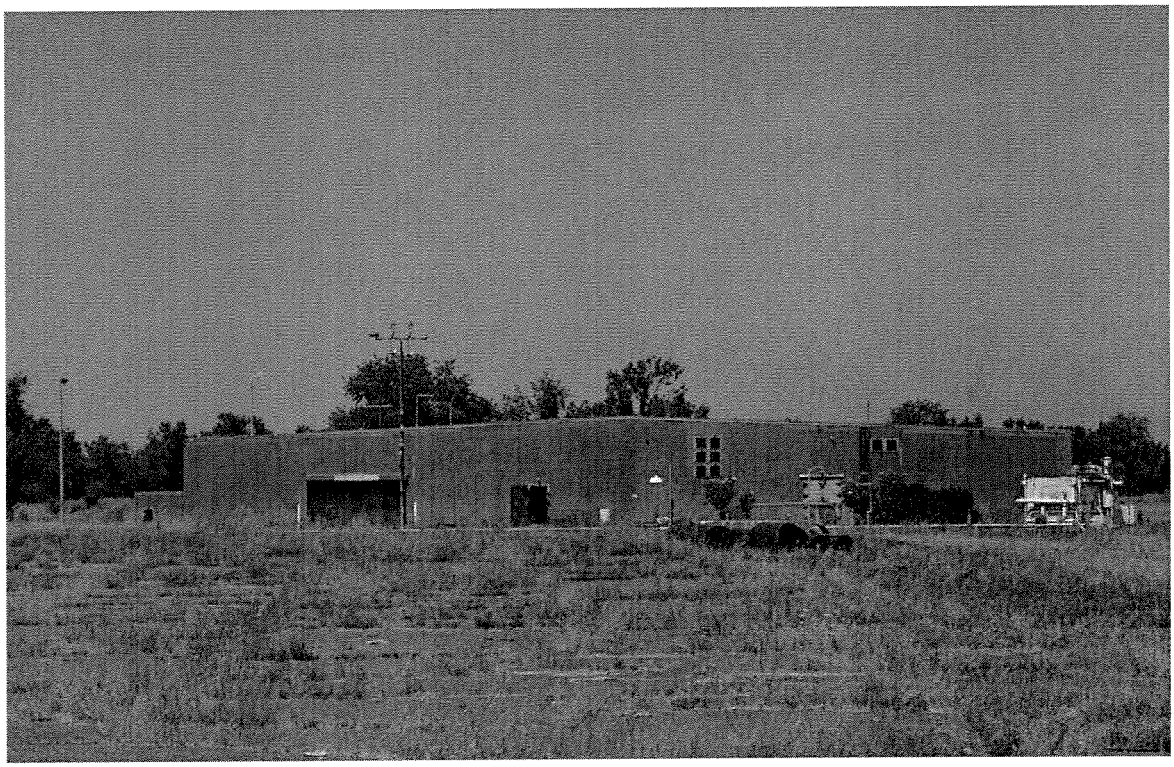

Plate 116: Test Control Center (Unit 121), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

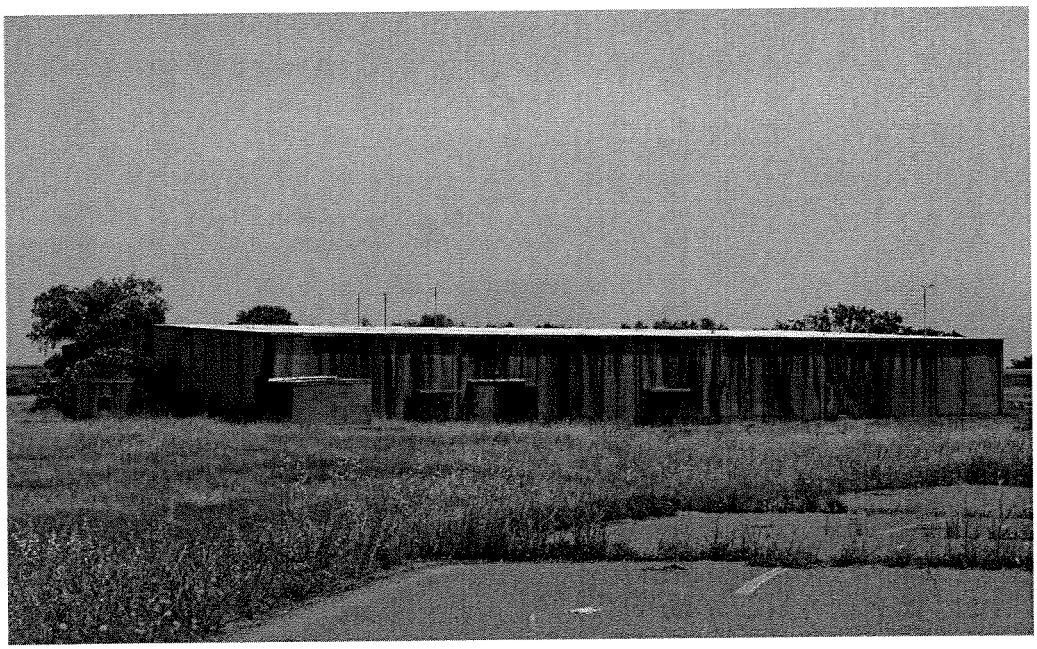

Plate 117: Test Control Center (Unit 121), Beta Test Complex, 1963-1964. Entrance to the instrumentation tunnel to Test Stand No. 3, projecting from northwest corner. Looking southeast. View of May 2005.

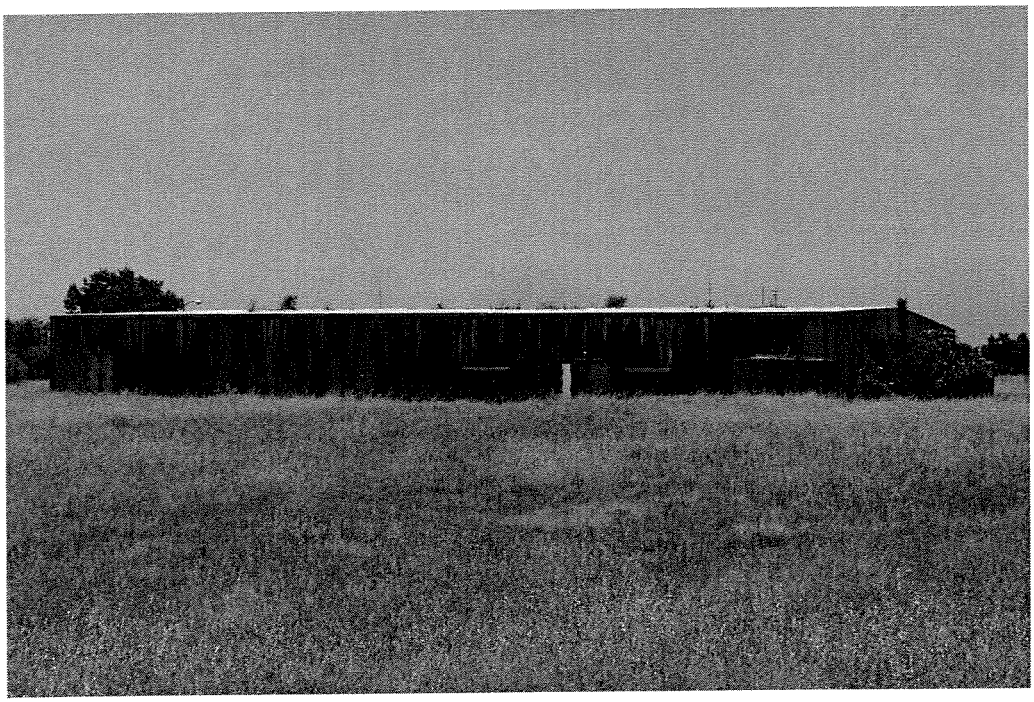

Plate 118: Test Control Center (Unit 121), Beta Test Complex, 1963-1964. Entrance to the instrumentation tunnel to Test Stand No. 1, projecting from northeast corner. Looking southwest. View of May 2005.

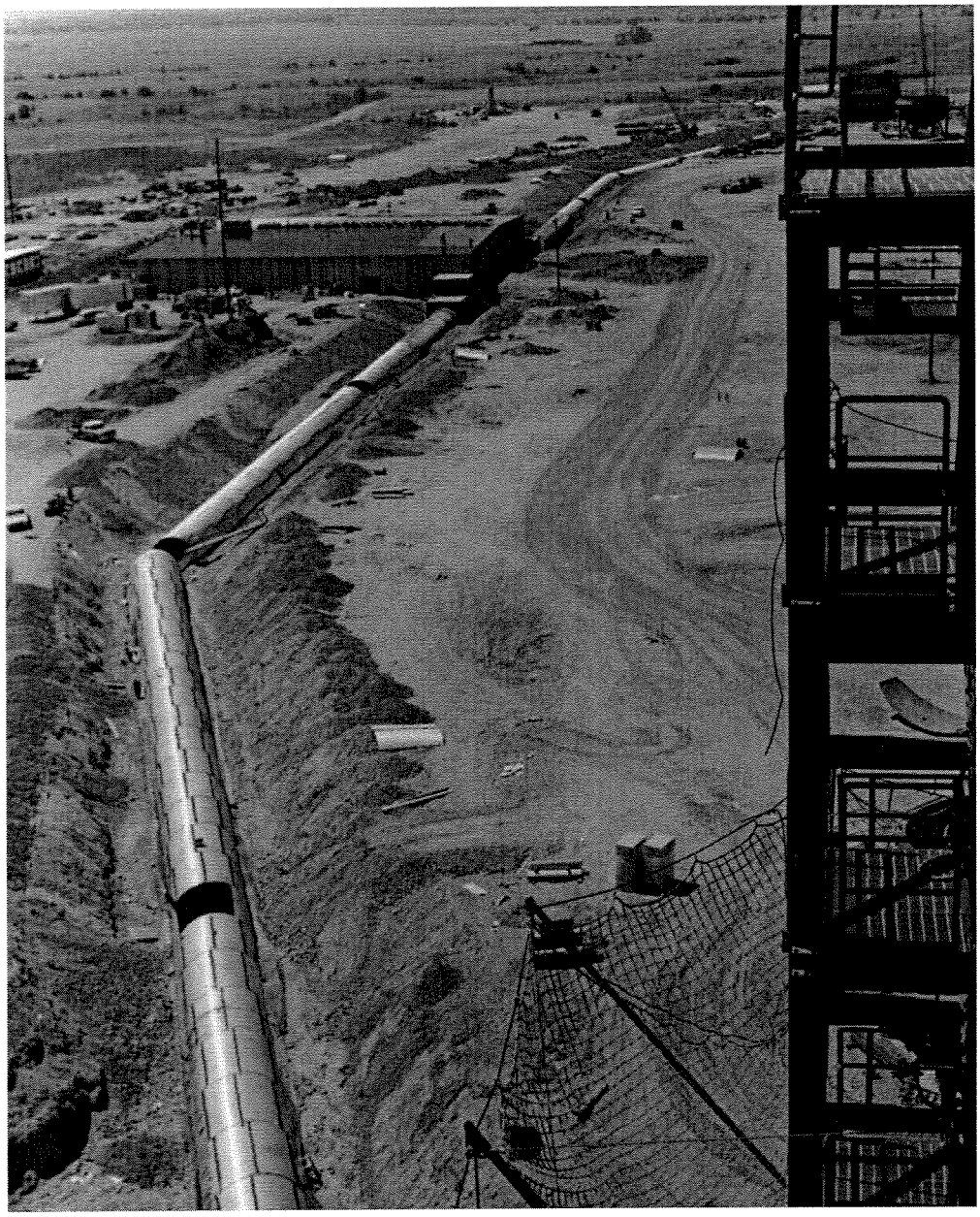

Plate 119: Test Control Center (Unit 121) and construction of the instrumentation tunnels to Test Stand No. 1 and Test Stand No. 3, Beta Test Complex, ca.1964. With Test Stand No. 1 in the foreground (right). Looking west. Courtesy of NASA.

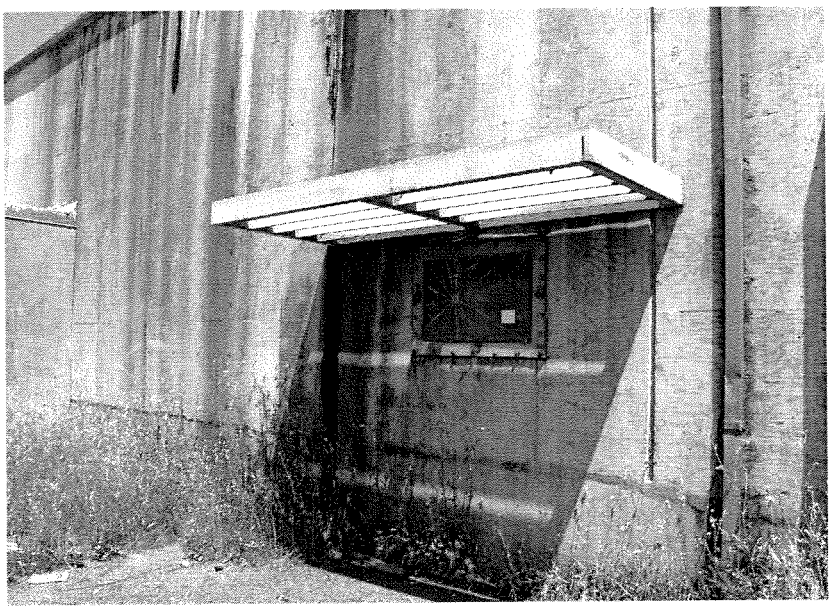

Plate 120: Test Control Center (Unit 121), Beta Test Complex, 1963-1964. Viewing port on west façade near northwest corner. Looking northeast. View of May 2005.

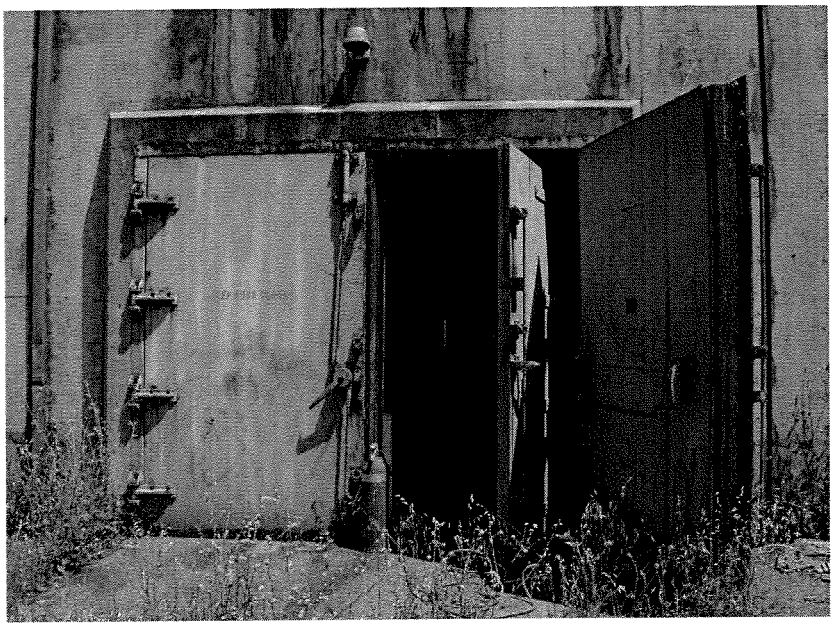

Plate 121: Test Control Center (Unit 121), Beta Test Complex, 1963-1964. Set of double blast doors on the west facade. Looking east. View of May 2005.

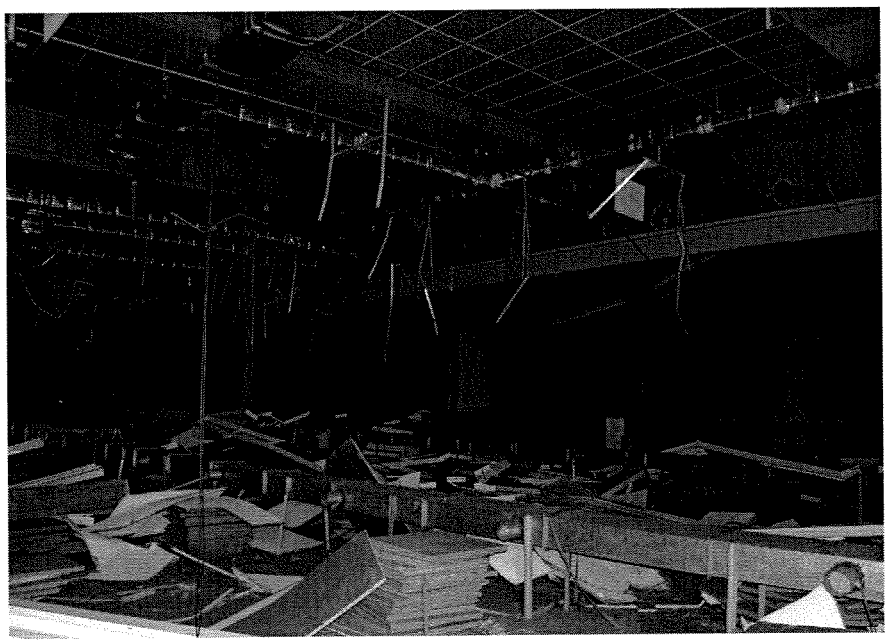

Plate 122: Test Control Center (Unit 121), Beta Test Complex, 1963-1964.
Interior of main control room. Looking southeast. View of May 2005.

Plate 123: Test Control Center (Unit 121), Beta Test Complex, 1963-1964.
Interior of main control room. Looking east/southeast. View of May 2005.

Liquid Hydrogen Tank

Also known as Unit 147, the liquid hydrogen tank northwest of the pump house was cylindrical and sat on concrete pedestal footings, as built. In 2005, only sections of the pedestal footings, vent pipes, the site's concrete perimeter wall, and access stairs remain.

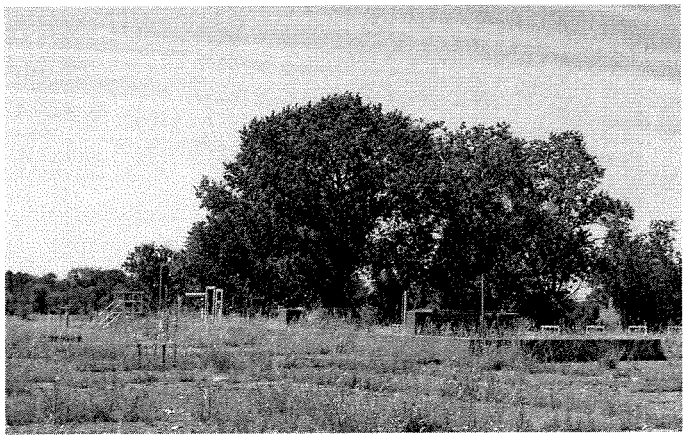

Plate 124: Liquid Hydrogen Tank at Test Stand No. 3 (Unit 147), Beta Test Complex, 1963-1964. Looking northwest. View of May 2005.

Facilities Shop

Also known as Unit 145, the facilities shop for the Beta Test Complex is a one-story, prefabricated metal structure erected in 1964. The facilities shop is rigid-frame construction, sheathed in double-seam corrugated siding. The building features a center-opening, track-mounted door on the north facade and a gable roof. Factory windows, 3/6/3 and 6/3 in type, articulate the east and west facades of the building. The interior of the facilities shop is open. The shop is unaltered.

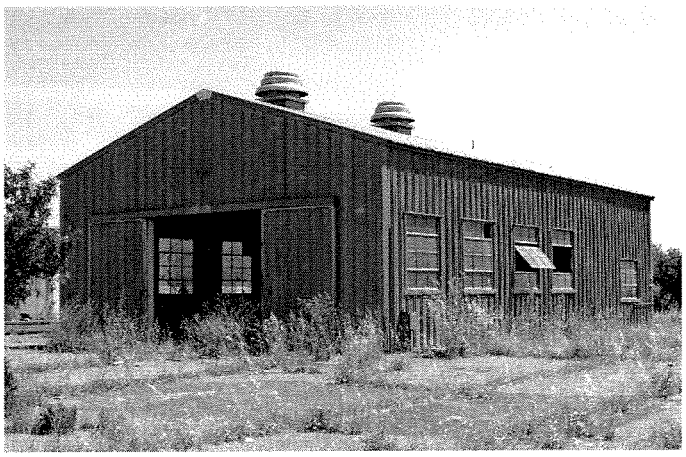

Plate 125: Facilities Shop (Unit 145), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

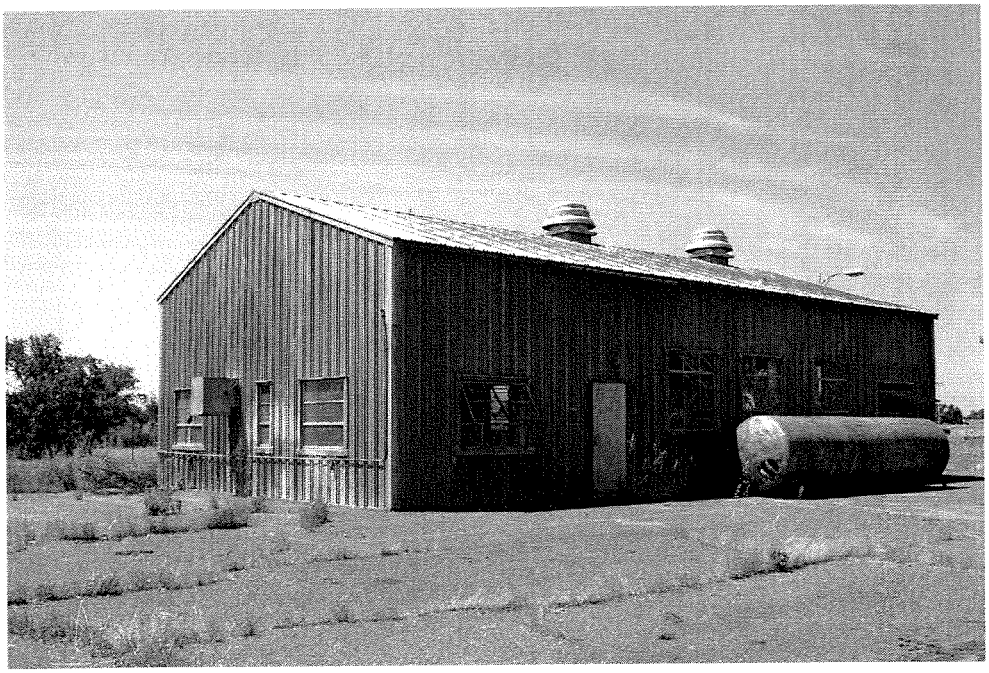

Plate 126: Facilities Shop (Unit 145), Beta Test Complex, 1963-1964. Looking northwest. View of May 2005.

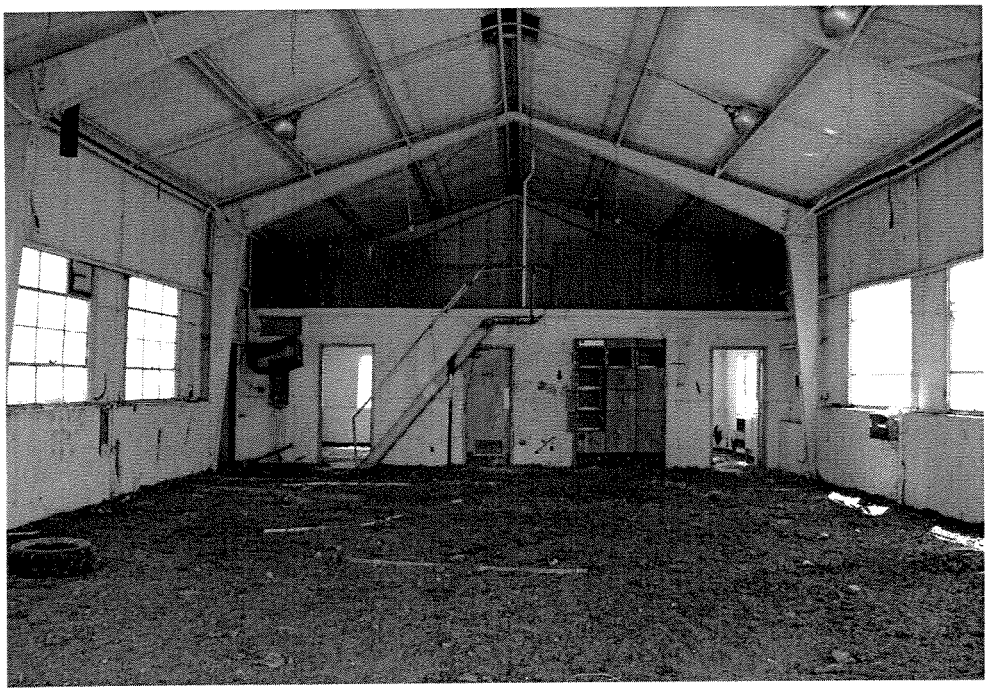

Plate 127: Facilities Shop (Unit 145), Beta Test Complex, 1963-1964. Looking southwest. View of May 2005.

Beta Support Offices No. 1 and No. 2

Also known as Units 142 and 141, Beta Support Offices No. 1 and No. 2 are abutting steel-frame structures sheathed in corrugated metal siding. Beta Support Office No. 1, the easternmost building of the pair, is a one-story structure featuring a flat roof. The interior of Beta Support Office No. 1 is open to the elements today, in use as a cattle shelter. Beta Support Office No. 2 first functioned as a calibration tower for the test complex. The lower two stories of Beta Support Office No. 2 are sheathed in siding, while the upper two stories are open steel I-beam framework. Beta Support Offices No. 1 and No. 2 are located immediately north of the Beta Test Complex pump facilities.

Ralph M. Parsons included Beta Support Offices No. 1 and No. 2 as components of its overall engineering design for the Beta Test Complex of 1963-1964.

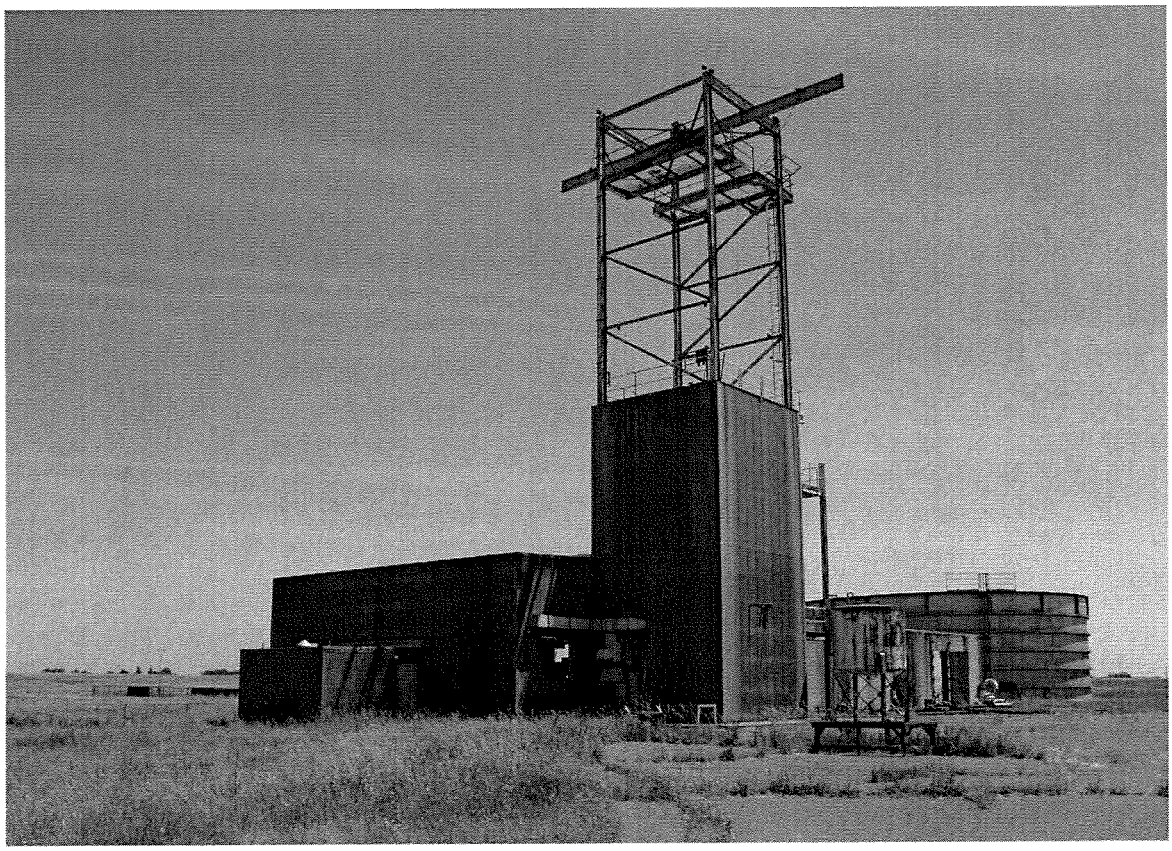

Plate 128: Beta Support Offices No. 1 (left) and No. 2 (right) (Units 142 and 141), Beta Test Complex, 1963-1964. Pump house and water tank, right. Looking southeast. View of May 2005.

Plate 129: Beta Support Office No. 1 (Unit 142), Beta Test Complex, 1963-1964. Interior. Looking northeast. View of May 2005.

Plate 130: Beta Support Office No. 2 (Unit 141), Beta Test Complex, 1963-1964. Interior. Looking northeast. View of May 2005.

Pump House

Also known as Unit 143, the pump house for the Beta Test Complex is a one-story, reinforced concrete structure erected in 1964. The building features fixed ventilation panels on its north and south facades, and is windowless. A single entrance articulates the west façade. The interior of the pump house is a single room, and is in derelict condition today.

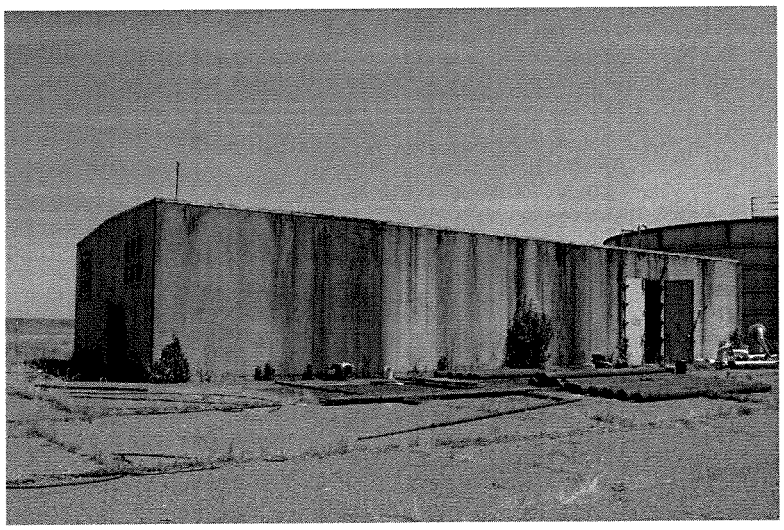

Plate 131: Pump House (Unit 143), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

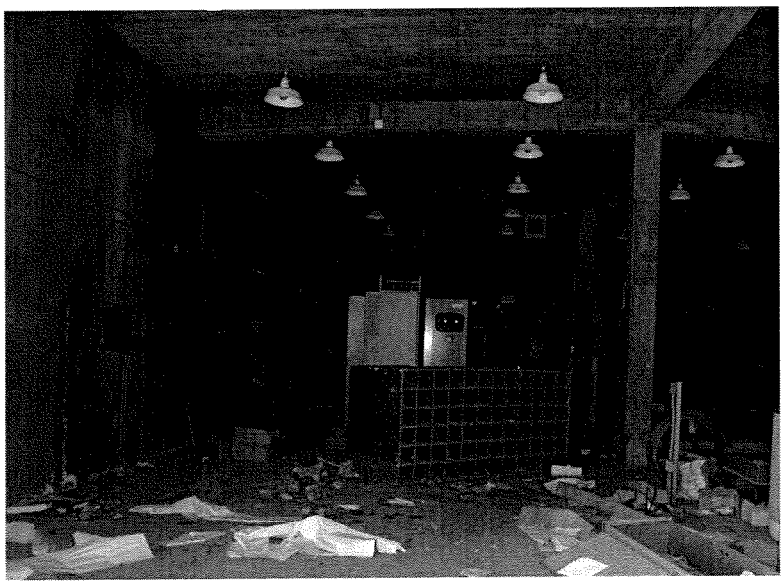

Plate 132: Pump House (Unit 143), Beta Test Complex, 1963-1964. Interior with debris. Looking north. View of May 2005.

Water Tank

Also known as Unit 144, the water storage tank for the Beta Test Complex is located at the southeastern corner of the pump house. The tank is a large steel structure fabricated in 1964. The water tank and pump house worked as a unit to provide the deluge system for the Beta Test Complex. Large amounts of water were required for captive missile and missile-engine firings on Test Stands No. 1 and No. 3.

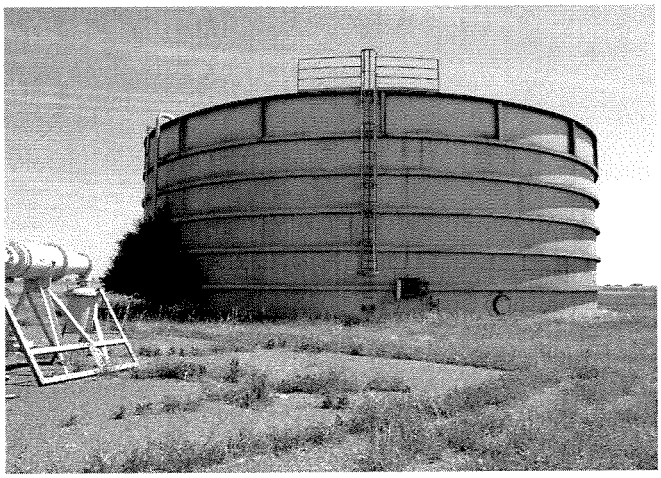

Plate 133: Water Tank (Unit 144), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

Guard Post No. 7

Also known as Unit 148, Guard Post No. 7 is the surviving security gate on the Douglas Missile Test Facility. The post is a small one-story, wood-frame structure, banded on all facades with plate-glass windows. Erected in 1963-1964, Guard Post No. 7 is unaltered.

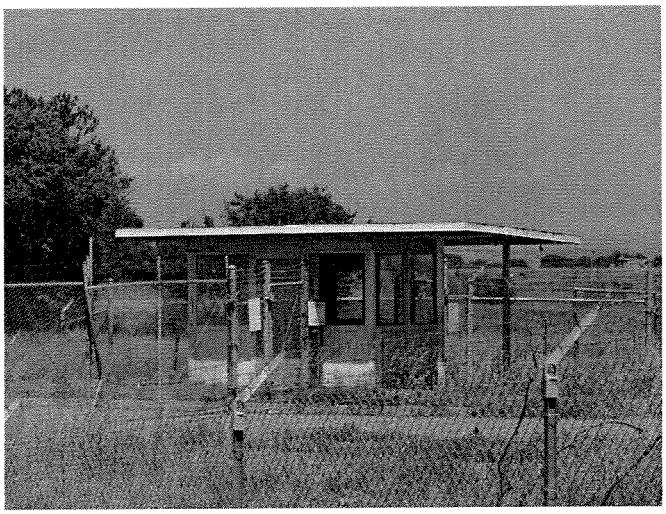

Plate 134: Guard Post No. 7 (Unit 148), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

Fan Room for Test Stand No. 1

Also known as Unit 127, the fan room for Test Stand No. 1 is a small, underground structure accessed through a heavy steel, circular hatch cover. The hatch cover is imprinted with the words "42 TUBE TURN" and "WCB." The number "279," or "27" with a degree mark, is also included on the hatch. The historic origins of the hatch cover, likely a recycled item, are unknown. The historic usage of the fan room at the Beta Test Complex remains undetermined.

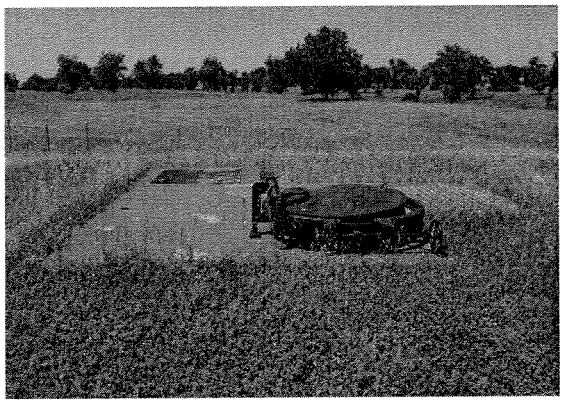

Plate 135: Fan Room for Test Stand No. 1 (Unit 127), Beta Test Complex, 1963-1964. Looking north. View of May 2005.

Observation Shelter No. 1

Also known as Unit 126, Observation Shelter No. 1 is the remaining viewing station at Test Stand No. 1 in the Beta Test Complex. Observation Shelter No. 1 is located north of the test stand, at the bend in the access road to the fan room. The shelter is a small, flat-roofed, reinforced concrete structure, and features a bank of three viewing windows, each with thick, inset glass panes. A steel blast door on the rear façade provides entry to the shelter. Constructed in 1963-1964, Observation Shelter No. 1 is unaltered today.

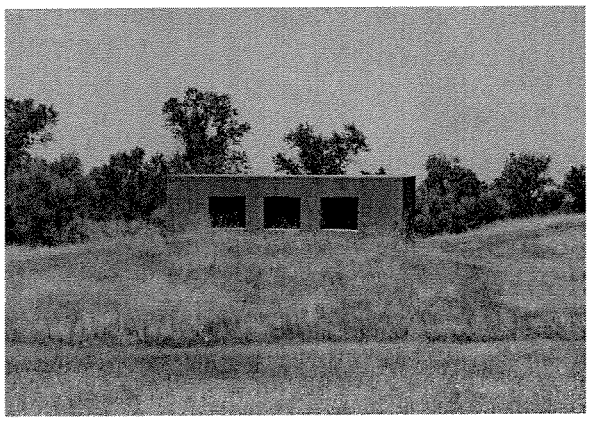

Plate 136: Observation Shelter No. 1 (Unit 126), Beta Test Complex, 1963-1964. Looking southwest. View of May 2005.

Terminal Equipment Room for Test Stand No. 1

Also known as Unit 123 and constructed in 1964, the terminal equipment room for Test Stand No. 1 is a one-story, reinforced concrete structure that abuts the western face of the base of Test Stand No. 1. The instrumentation tunnel from Test Stand No. 1 to the Beta Test Complex test control center (blockhouse) exits from the lower level of the terminal equipment room.

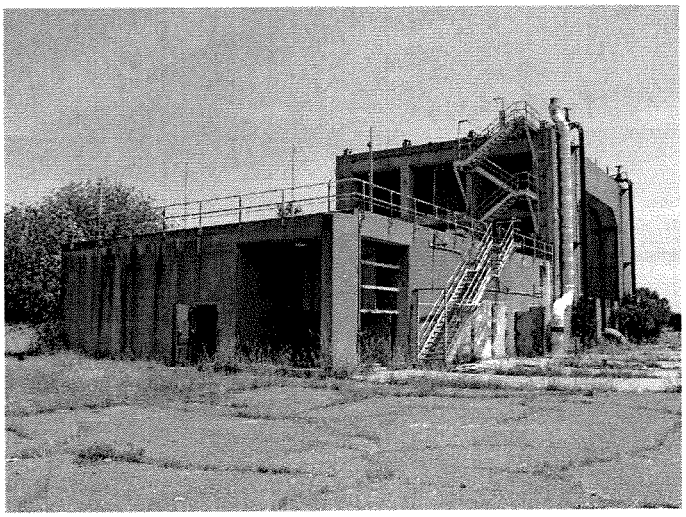

Plate 137: Terminal Equipment Room Test Stand No. 1 (Unit 123), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

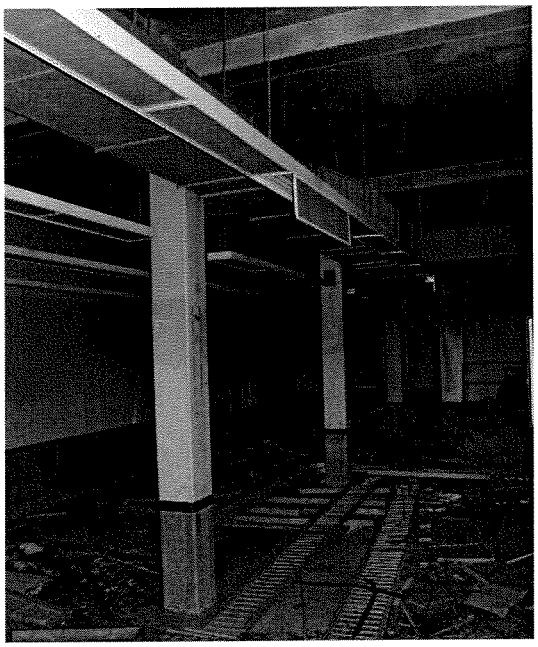

Plate 138: Terminal Equipment Room Test Stand No. 1 (Unit 123), Beta Test Complex, 1963-1964. Interior. Looking east. View of May 2005.

Test Stand No. 1

Also known as Unit 122, Test Stand No. 1 featured a steel-beam tower atop a reinforced concrete base. Test Stand No. 1 included one captive-firing position and a north-facing flame deflector. The ground-level terminal room (Unit 123) for the facility abuts Test Stand No. 1 to the west. Test Stand No. 1 is 1,000 feet from the blockhouse for the Beta Test Complex. An underground instrumentation tunnel connects Test Stand No. 1, from its adjacent terminal control room, to the blockhouse, in a layout identical to the tunnelworks for Test Stand No. 3. The steel superstructure of Test Stand No. 1 accommodated a test item 60 feet long and 22 feet in diameter. NASA operated Test Stand No. 1 p to run battleship tests for the Saturn S-IVB booster during 1965-1969. Test Stand No. 1 could withstand up to a 1,000,000-pound thrust during captive firings. A deluge system flooded the flame deflector (bucket) in a standard configuration for static tests. Test Stand No. 1 also included a 15-ton crane used to position test items in the captive-firing position (Douglas 1966).

Ralph M. Parsons designed Test Stand No. 1 during 1963 as a major component of its overall engineering for the Beta Test Complex. Today, only the reinforced concrete base of the test stand remains at the site. Douglas removed the steel superstructure of the tower and of the flame deflector in 1977. The reinforced concrete catchment basin at the base of the flame deflector is present, partially overgrown in weeds. Miscellaneous camera and light stands sit at the periphery of the test stand.

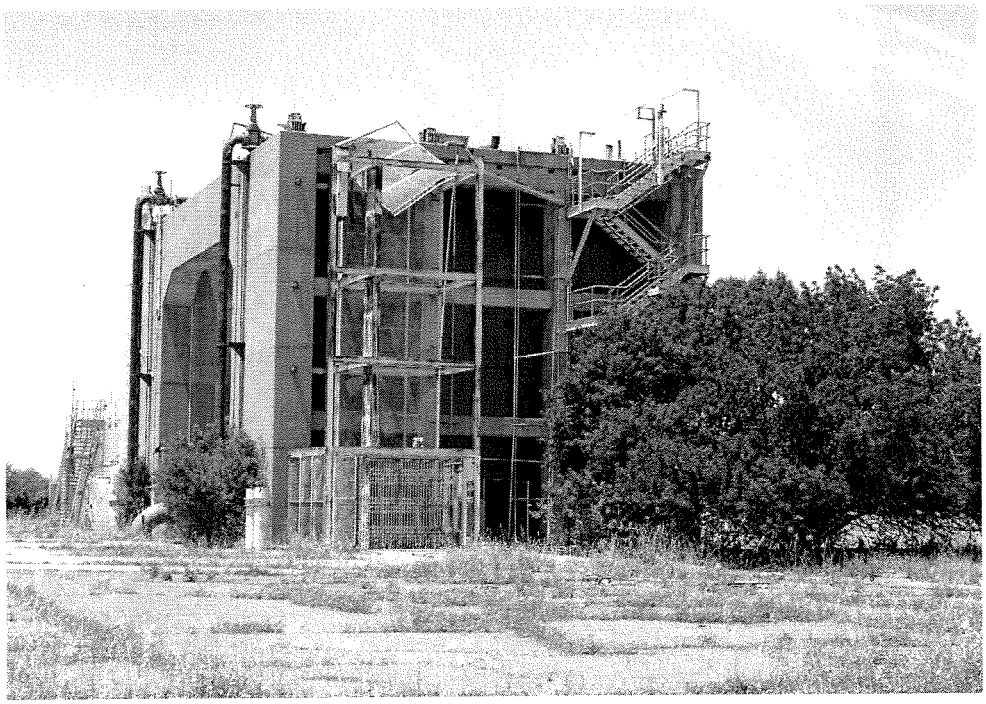

Plate 139: Test Stand No. 1 (Unit 122), Beta Test Complex, 1963-1964. Looking northwest. View of May 2005.

Plate 140: Test Stand No. 1 (Unit 122), Beta Test Complex, 1963-1964. Looking southeast. View of May 2005.

Plate 141: Test Stand No. 1 (Unit 122), flame deflector catchment basin, Beta Test Complex, 1963-1964. Looking northwest. View of May 2005.

Shop Building for Test Stand No. 1

Also known as Unit 124, the shop building for Test Stand No. 1 is a one-story, steel-frame structure erected in the Beta Test Complex in 1964. The shop building features steel I-beam construction with a light truss roof frame. Sheathed in corrugated siding, the shop building also includes a center-opening, track-mounted door on the east façade and a steel blast door on the west facade, with a simple entry on the north. Fenestration is 6/3 factory windows on the east façade and 3/6/3 factory windows on the north and south facades. The shop building has a combination gable roof, with a shed extension in the southwest corner. The interior of the structure is open, with rooms and an upper work space configured at its west end.

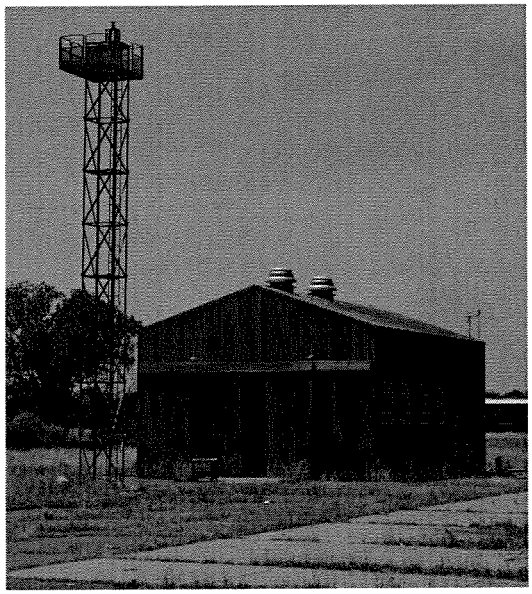

Plate 142: Shop for Test Stand No. 1 (Unit 124), Beta Test Complex, 1963-1964. TV camera stand, foreground left. Looking southwest. View of May 2005.

Plate 143: Shop for Test Stand No. 1 (Unit 124), Beta Test Complex, 1963-1964. Interior. Looking northwest. View of May 2005.

Liquid Hydrogen Tank for Test Stand No. 1

Also known as Unit 128, the liquid hydrogen tank for Test Stand No. 1 is a large, spherical structure on raised footings, constructed in 1964 to support Test Stand No. 1. Today, the tank cap lies on the ground adjacent.

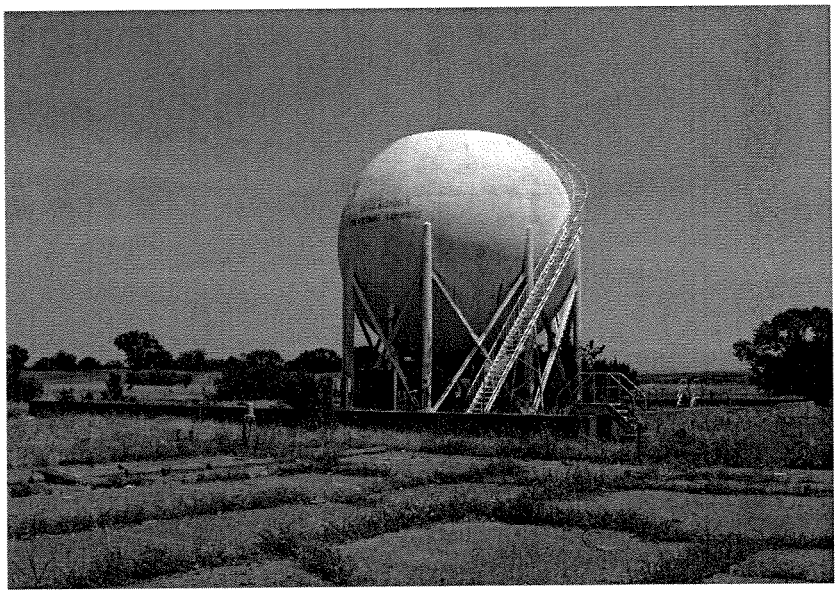

Plate 144: Liquid Hydrogen Tank at Test Stand No. 1 (Unit 128), Beta Test Complex, 1963-1964. Looking northeast. View of May 2005.

Plate 145: Liquid Hydrogen Tank at Test Stand No. 1 (Unit 128), cap, Beta Test Complex, 1963-1964. Looking southwest. View of May 2005.

Gamma Test Area

The Gamma Test Area is a small, fenced compound laid out between the Alpha Test Complex and the Administration Area in the southeast corner of the Douglas Missile Test Facility (Figure 9). The compound abuts the Kappa Test Area on its western edge. When established in 1964, the Gamma Test Area was laid out in a square configuration with dispersed buildings and structural elements. The first test sites in the neighboring Kappa Test Area predated the Gamma Test Area at the location, in place by ca.1957-1958. NASA set up the Gamma Test Area to develop and test the Saturn S-IVB attitude control motors and the handling of hypergolic propellants. While in planning, the site's name was the Attitude Control Area. Hypergolic rocket propellants are those that ignite spontaneously when mixed. The Gamma Test Area featured three test cells (in a single test structure), a test control center (blockhouse), and an instrumentation center (connected to the blockhouse by raised cable trays). Also part of the compound were propellant and gas storage facilities, transfer capabilities, a power substation, collection basins, and retention ponds. A maintenance and assembly building complemented the secured part of the compound, and sits to the near south/southeast of the Gamma Test Area. Historically, the maintenance and assembly building was a component of the test area, but today is no longer part of the former Douglas Missile Test Facility acreage.

NASA assigned property numbers to seven buildings and structures in the Gamma Test Area in 1964, with five additional unnumbered collection basins and retention ponds also within the fenced boundaries of the site. The character-defining components of the Gamma Test Area are the three-cell test structure, test control center, instrumentation center, and maintenance and assembly building.

Ancillary structures and site components no longer standing within the Gamma Test Area, or no longer readily visible/accessible for field inventory, include:

- a power substation (Unit 33) immediately northeast of the instrumentation center;
- a fuel storage shelter (Unit 35) in the northeast corner of the test area;
- an oxidizer shelter (Unit 36) in the northwest corner of the test area;
- a circular propellant collection basin (unnumbered) southeast of the oxidizer shelter;
- a circular propellant collection basin (unnumbered) southeast of the fuel storage shelter;
- a large, square retention pond (unnumbered) in the southeast quadrant of the test area;
- a small, rectangular collection basin for the test structure (unnumbered) in the southeastern corner of the test area; and,
- a large, square retention pond (unnumbered) in the southwestern corner of the test area.

The maintenance and assembly building (Unit 37), a metal, prefabricated structure, is outside the boundaries of the inventory, and is included in the descriptions and assessments below only photographically.

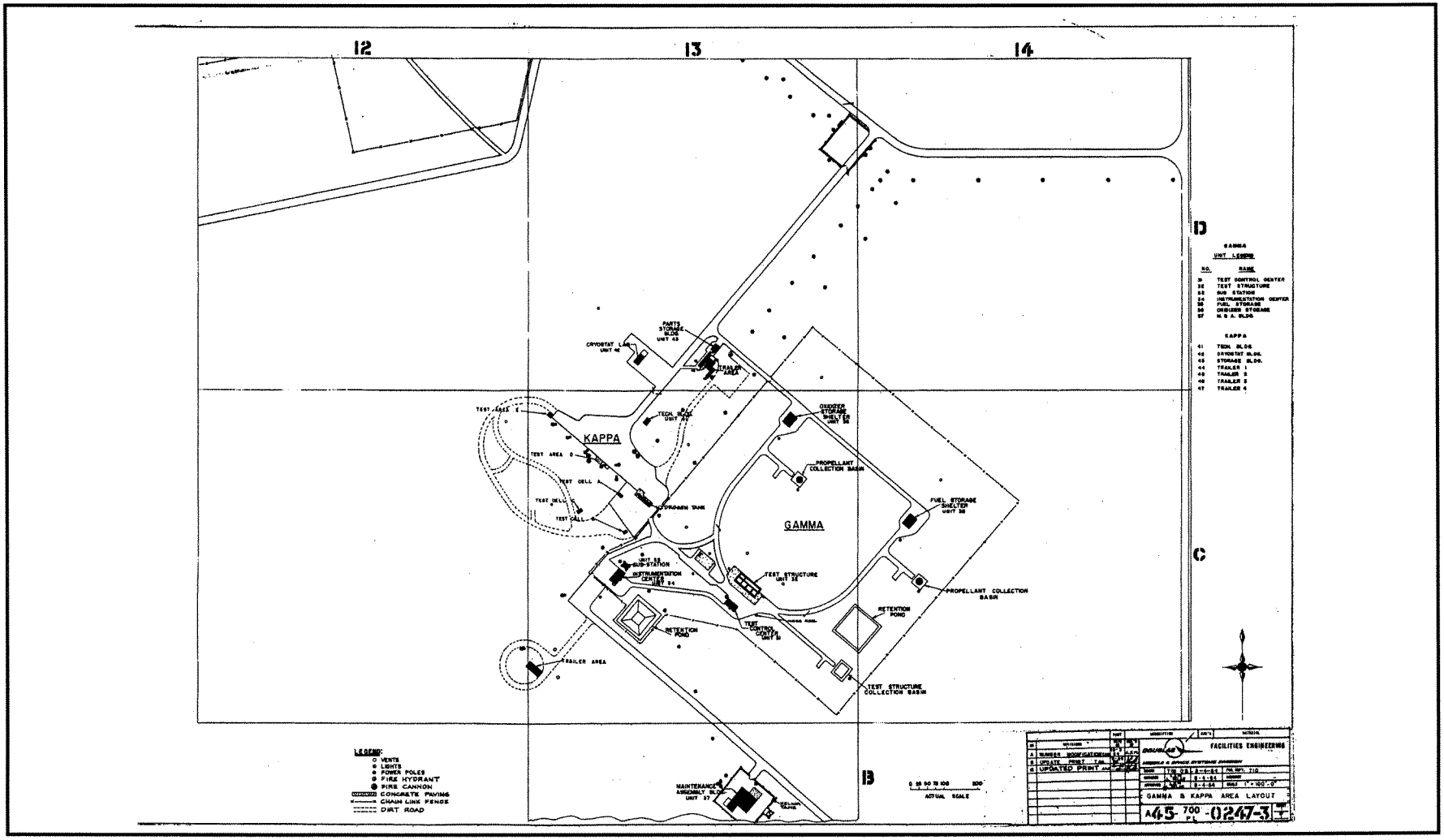

Figure 9: Douglas Facilities Engineering, Gamma/Kappa Test Areas, Douglas Missile Test Facilities, Rancho Cordova, California, 1964.

Instrumentation Center

Also known as Unit 34, the instrumentation center is a one-story, windowless reinforced concrete structure located in the southwestern corner of the Gamma Test Area. Constructed for NASA in 1964, the instrumentation center features a flat roof, steel blast doors on the east, west, and south facades, and an exterior-mounted, test-in-progress light system. A raised cable tray runs from the northeastern corner of the instrumentation center to the test control center (blockhouse). The instrumentation center is unaltered on its exterior. The interior of the center was inaccessible for inventory.

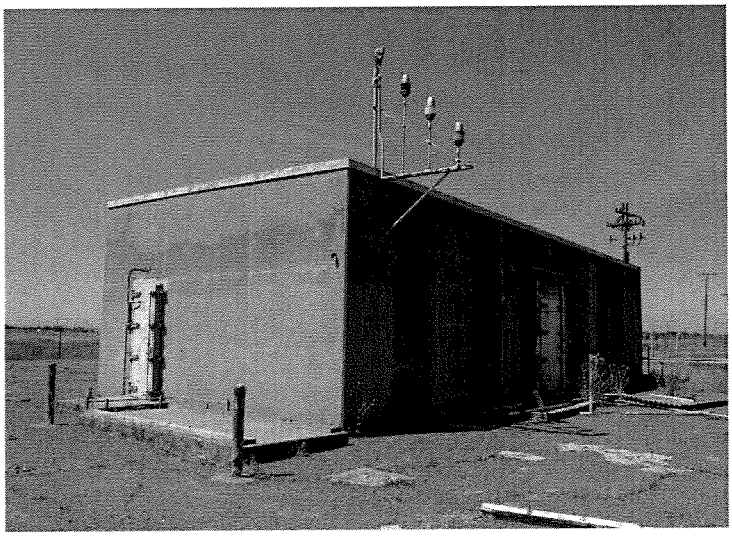

Plate 146: Instrumentation Center (Unit 34), Gamma Test Area, 1964. Looking north. View of May 2005.

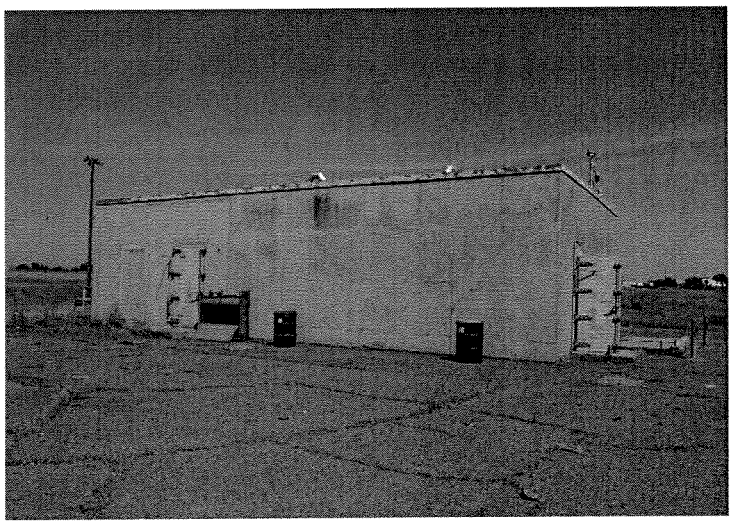

Plate 147: Instrumentation Center (Unit 34), Gamma Test Area, 1964. Looking east. View of May 2005.

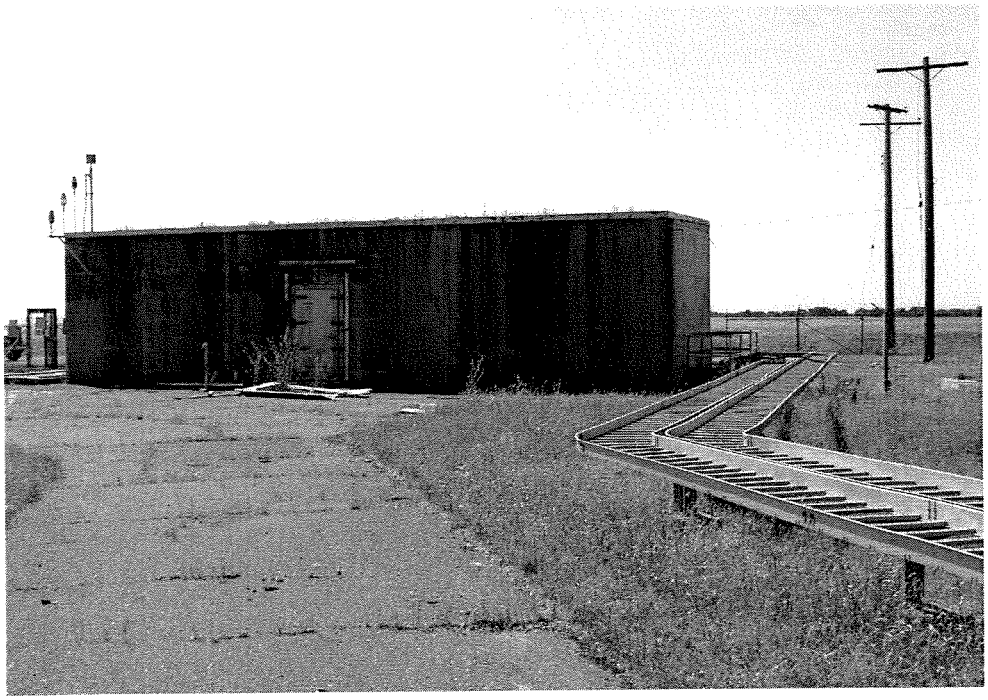

Plate 148: Instrumentation Center (Unit 34), Gamma Test Area, 1964. Looking west. View of May 2005.

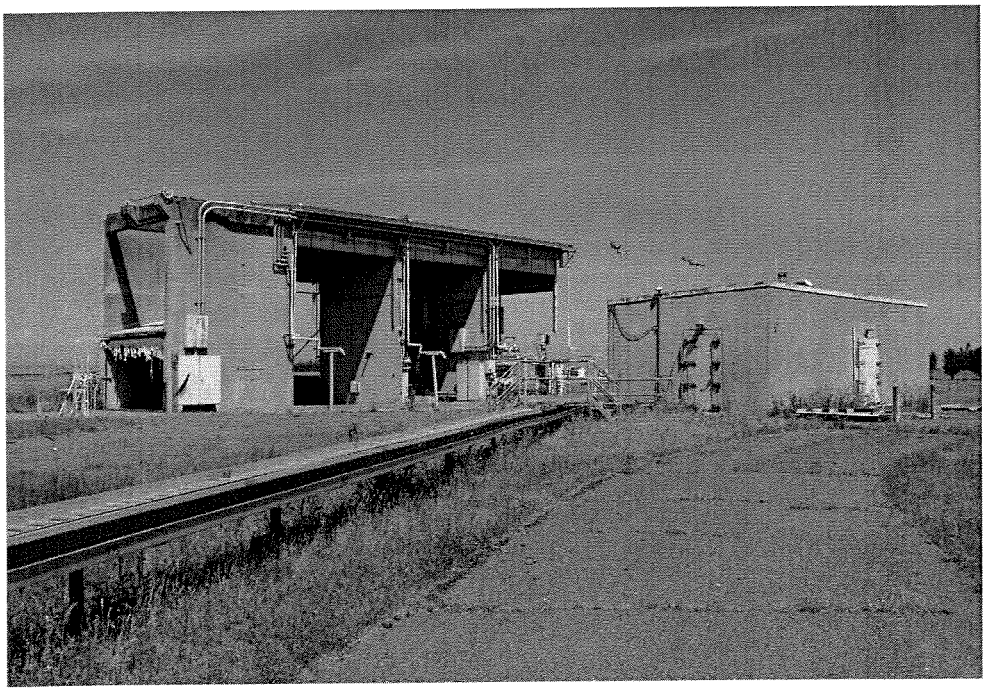

Plate 149: Cable tray from the Instrumentation Center (Unit 34) to the test control center, Gamma Test Area, 1964. Looking north. View of May 2005.

Test Control Center

Also known as Unit 31, the test control center (blockhouse) is a one-story, reinforced concrete structure located east of the instrumentation center, south/southwest of the test structure. Constructed for the Gamma Test Area in 1964, the test control center features a flat roof, steel blast doors on the southeast, southwest, and northwest facades, and three viewing ports on the northeast facade. The test control center faces the test structure. A raised cable tray runs from the northeastern corner of the instrumentation center to the northwest façade of the test control center. The instrumentation center is unaltered on its exterior. The interior of the center was inaccessible for inventory.

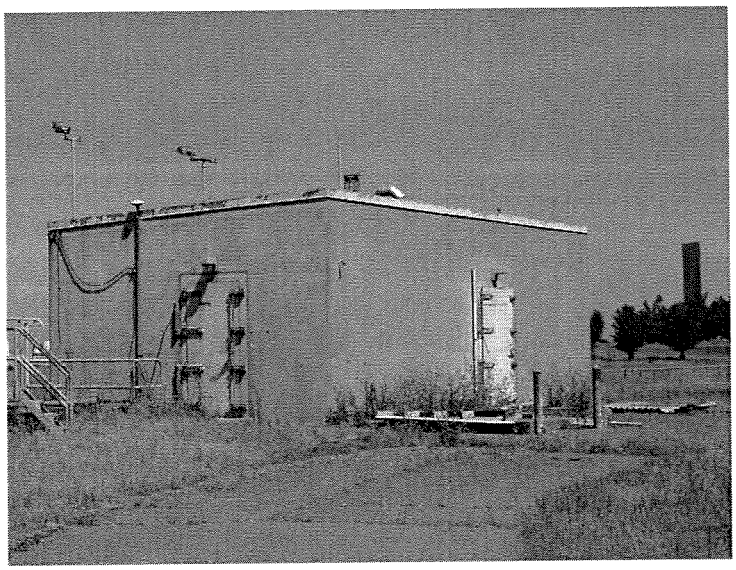

Plate 150: Test Control Center (Unit 31), Gamma Test Area, 1964. Looking east. View of May 2005.

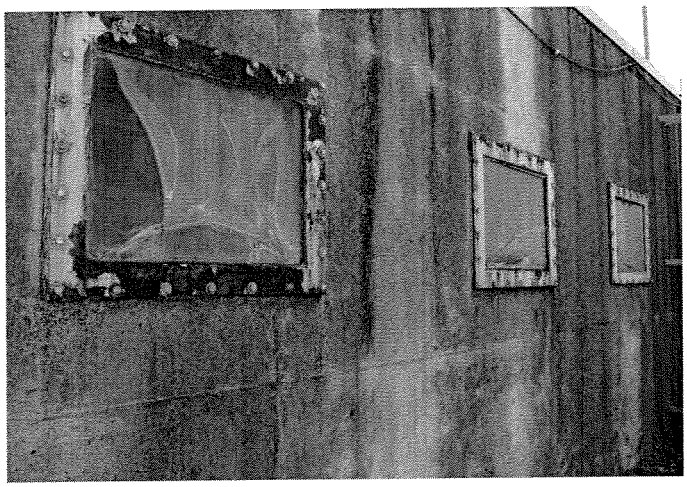

Plate 151: Test Control Center (Unit 31), Gamma Test Area, 1964. Viewing ports, eastern corner of northeast façade. Looking east. View of May 2005.

Test Structure

Also known as Unit 32, the test structure is three-bay, reinforced concrete and steel structure constructed in 1964 for the Gamma Test Area. The bays contained test cells, and are open on their northeast and southwest facades. The middle and east test cells included scaled-down captive test stands, inclusive of scaled flame deflectors (flame buckets). The eastern captive test stand remains intact in 2005, while the middle test stand exists only as a remnant structure. The west test cell is an open chamber, and is interpreted to never have been configured with a test stand. Heavy canvas curtains provided temporary walls for all open sides of the individual test cells: for the three bays on their northeast and southwest facades, as well as for the southeast and northwest facades of the overall test structure. A small, half-sized test cell also existed on the northwest end of the test structure, enclosable by a canvas curtain wall. Remnants of the canvas curtains are present today.

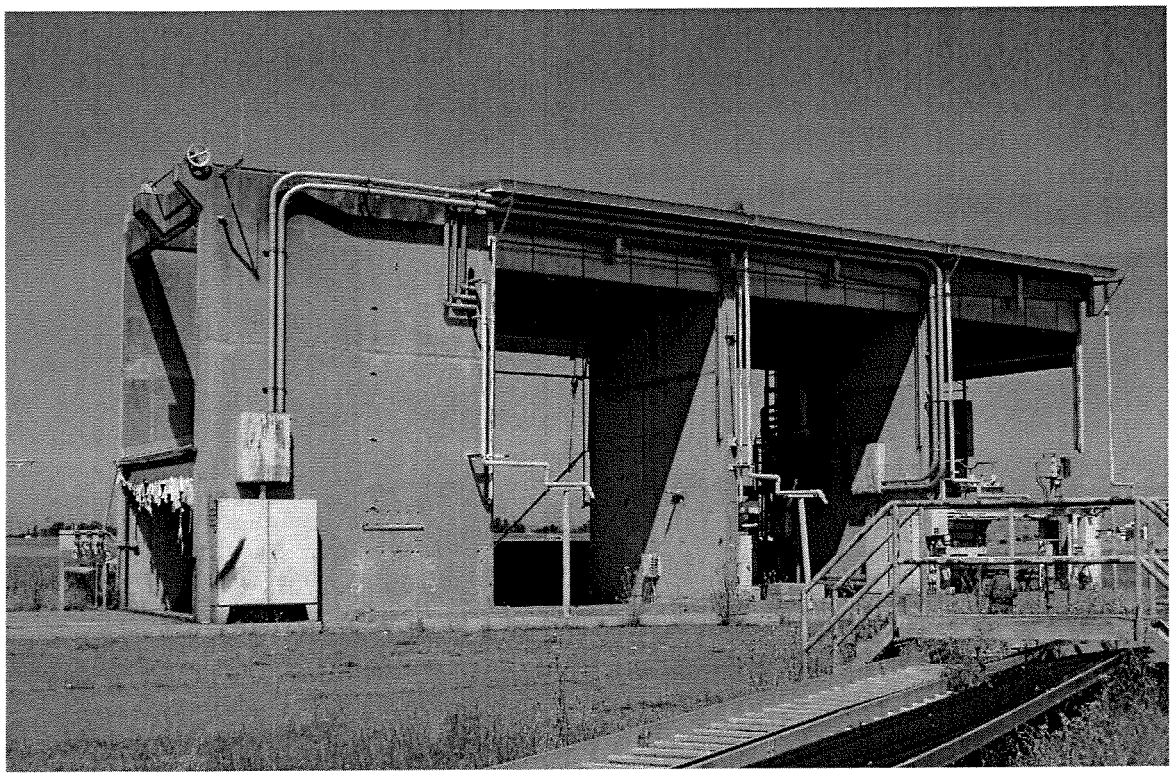

Plate 152: Test Structure (Unit 32), Gamma Test Area, 1964. Cable tray from the instrumentation center to the test control center, foreground right. Looking northeast. View of May 2005.

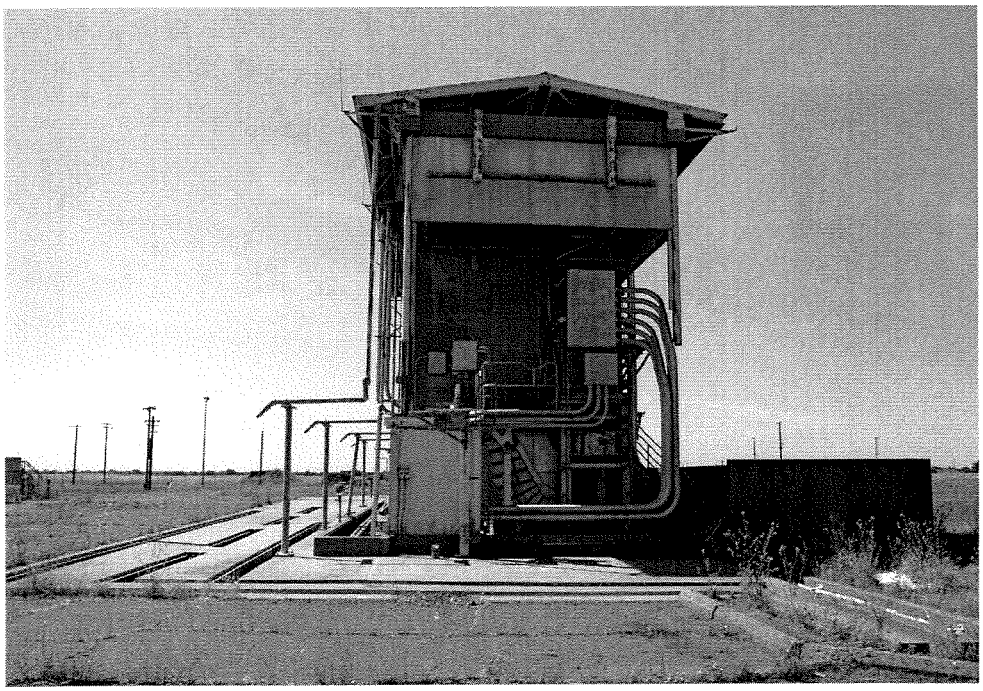

Plate 153: Test Structure (Unit 32), Gamma Test Area, 1964. With deluge channeling at the base of the structure, exiting at the lower right toward the collection basin for the test structure. Looking northwest. View of May 2005.

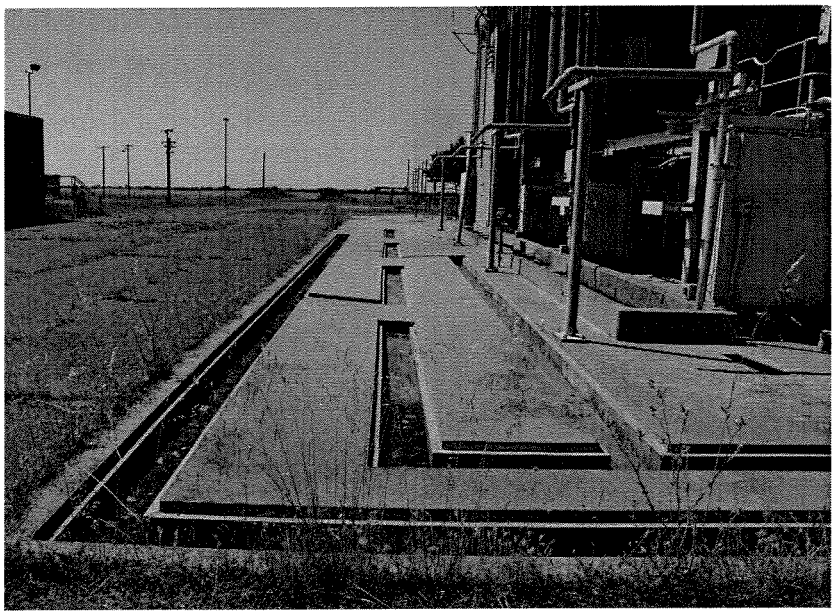

Plate 154: Test Structure (Unit 32), Gamma Test Area, 1964. Detail of the deluge channeling at the base of the structure. Test control center, background left. Looking northwest. View of May 2005.

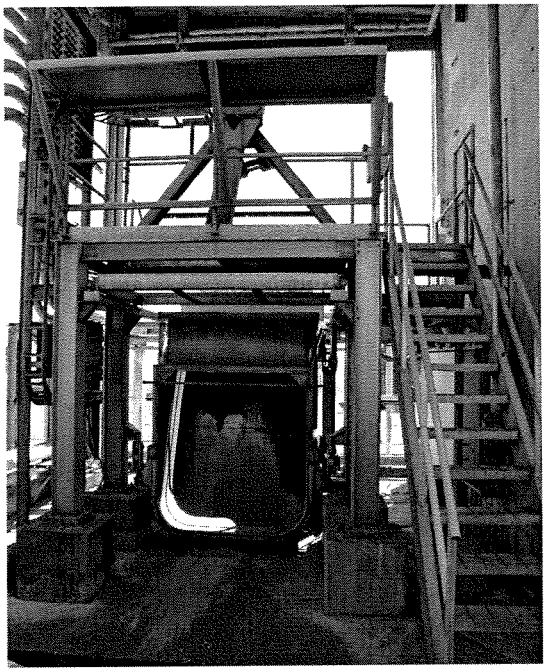

Plate 155: Test Structure (Unit 32), Gamma Test Area, 1964. East test cell, with scaled captive firing stand intact. Looking northwest. View of May 2005.

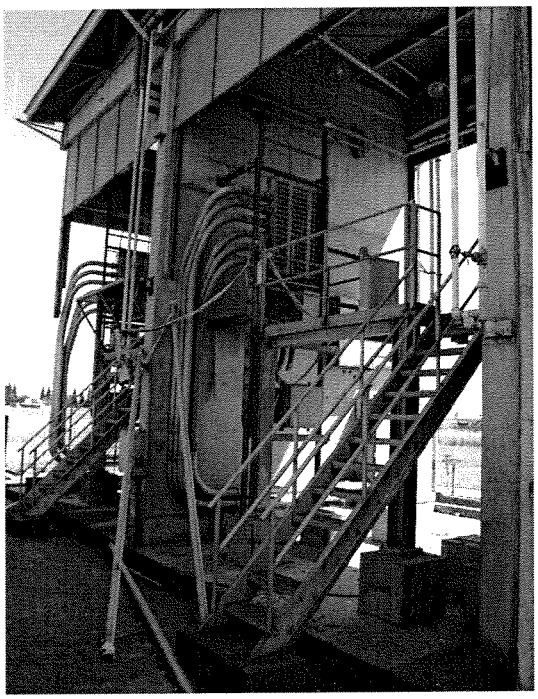

Plate 156: Test Structure (Unit 32), Gamma Test Area, 1964. Middle test cell, remnant. East test cell, background left. Looking northwest. View of May 2005.

Maintenance and Assembly Building

Also known as Unit 37, the maintenance and assembly building is outside the project area, sitting south/southwest of the secured portion of the Gamma Test Area. The Administration Area for the former Douglas Missile Test Facility sits to the southeast. The maintenance and assembly building was originally part of the Gamma Test Area.

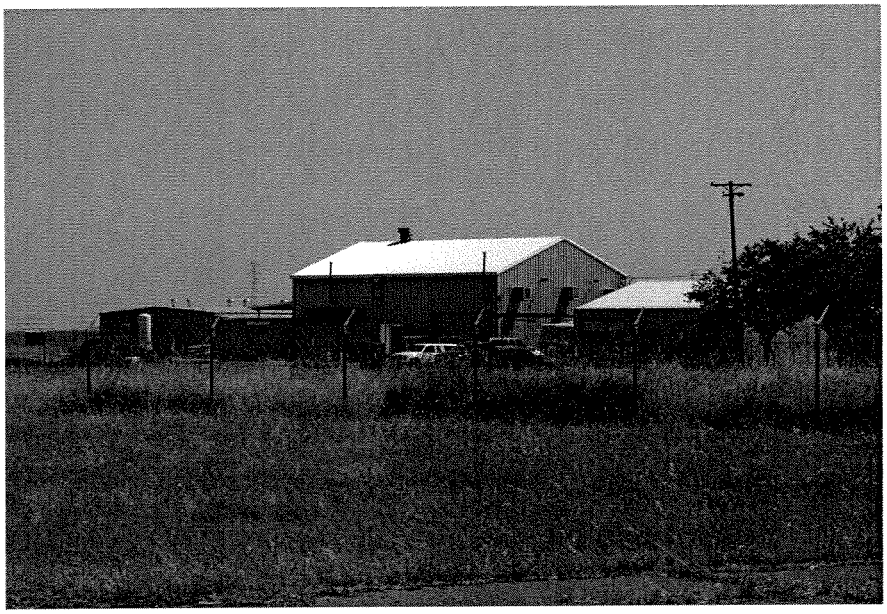

Plate 157: Maintenance and Assembly Building (Unit 37), Gamma Test Area, 1964. Augmented by other structures. Looking south. View of May 2005.

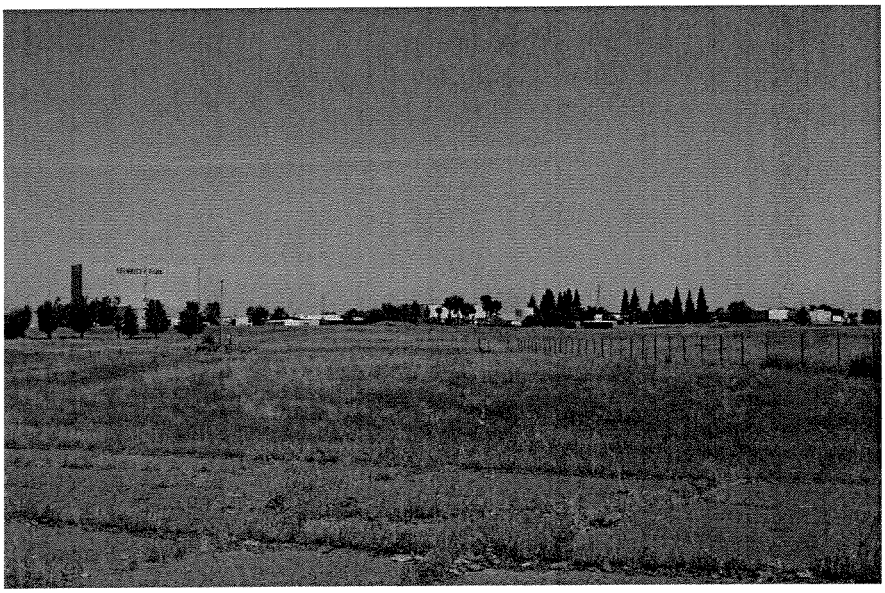

Plate 158: Administration Area, 1964. Southeast of the Gamma Test Area. Looking southeast. View of May 2005.

Kappa Test Area

The Kappa Test Area is a dispersed compound of individual test cells adjacent to the Gamma Test Area in the southeast corner of the Douglas Missile Test Facility (see Figure 9). The compound abuts the Gamma Test Area along its eastern edge. The Kappa Test Area originated in July 1959 as Initial Operational Capability (IOC) Site 2 for the developmental Thor (DM-18) IRBM. IOC Site 2 was a "propellant utilization pad." Douglas first used the location to conduct primary testing for "weights information and propellant density data" related to Thor (Douglas 1958-1962). During January through May 1960, Douglas continued to operate IOC 2 for the Thor In-Service Engineering Program. When IOC testing of Thor moved from the Douglas Missile Test Facility to Vandenberg Air Force Base in southern California at mid-year, IOC Site 2 became known as the Component Test Site. Douglas next used the Component Test Site to conduct early tests of NASA's Saturn DSV-IV (the developmental Saturn S-IV booster). The test programs of 1960 focused on subjecting the DSV-IV to a "liquid hydrogen environment" and on the "feasibility of transferring liquid hydrogen at high flow rates into a flight-type-vehicle tankage" (Douglas 1958-1962). Douglas ran 205 tests at the Component Test Site during the second half of the year, running an additional 548 tests at the Component Test Site in 1961.

The lineage of the Kappa Test Area transitioned again in 1962. Douglas renamed the location the Engineering Evaluation Site (EES). The EES was a very small test area aligned southeast to northwest. Personnel reached the EES from an access road that wyed southwards from the access road to the Alpha Test Complex. The EES included three components, southeast to northwest, that became the core of the sequentially developed Kappa Test Area: a hydrogen storage tank, Test Area D, and Test Area E (Ralph M. Parsons 1963). Douglas ran 337 tests in the EES to support the DSV-IV program during 1962. Personnel conducted 320 of these tests in Test Area E to develop the helium heater for the booster. The tests in Test Area E included 263 single injector firings at simulated altitudes, 28 helium heater integrated systems firings, 7 LOX-liquid hydrogen cold flow tests, and 4 cold helium system checkouts. By late 1962, Douglas had also augmented the complex of test cells with Test Cells A, B, and C. During 1962, personnel used Test Cell A for tests involving liquid hydrogen; Test Cell B, for testing insulations, bonding agents, and sealing resins; and, Test Area D for 24 tests to evaluate "tank insulation characteristics" during the transfer of liquid hydrogen into a scaled DSV-IV tank (Douglas 1958-1962).

In late 1964, the former IOC Site 2 and follow-on EES, expanded a third and final time into the Kappa Test Area. The Kappa Test Area included the five test cells/areas (A-E), the hydrogen tank, a test control center (in a trailer), instrumentation center (also in a trailer), a technical building, a parts storage building, two additional trailers, and a cryostat laboratory. NASA assigned property numbers to seven buildings and structures in the Kappa Test Area, with the five alpha-named test cells and hydrogen tank remaining unnumbered. The character-defining components of the Kappa Test Area are Test Cells A-C, Test Areas D-E, and the cryostat laboratory. The laboratory functioned as NASA's sixth test cell on site, with viewports to an outdoor test area. Also found within the

Kappa Test Area are multiple lights and power poles, two pair of water cannons bracketing Test Area D, and two large concrete pads with sections of rail trackage. From 1965 through 1969, NASA conducted cryogenic tests of "vehicle tank insulation, sealant and bonding compounds, and thermocouple probes, as well as test of scale tanks, helium heaters, and igniters" (NASA 1966). Control panels for the test cells existed in the trailer functioning as the test control center (blockhouse). NASA similarly installed instrumentation recording equipment in the trailer used as the test instrumentation center (NASA 1966).

Ancillary structures and site components no longer standing within the Kappa Test Area, or no longer readily visible/accessible for field inventory, include:

- the technical building (Unit 41) in the center of the test area;
- the parts storage building (Unit 43) at the north entrance to the test area;
- Trailer No. 1 (Unit 44) at the north entrance to the test area;
- Trailer No. 2 (Unit 45) at the north entrance to the test area;
- Trailer No. 3 (Unit 46) at the north entrance to the test area;
- Trailer No. 4 (Unit 47) at the north entrance to the test area;
- the hydrogen tank (unnumbered) at the eastern terminus of the core complex; and,
- Test Cell A (unnumbered) west of the hydrogen tank.

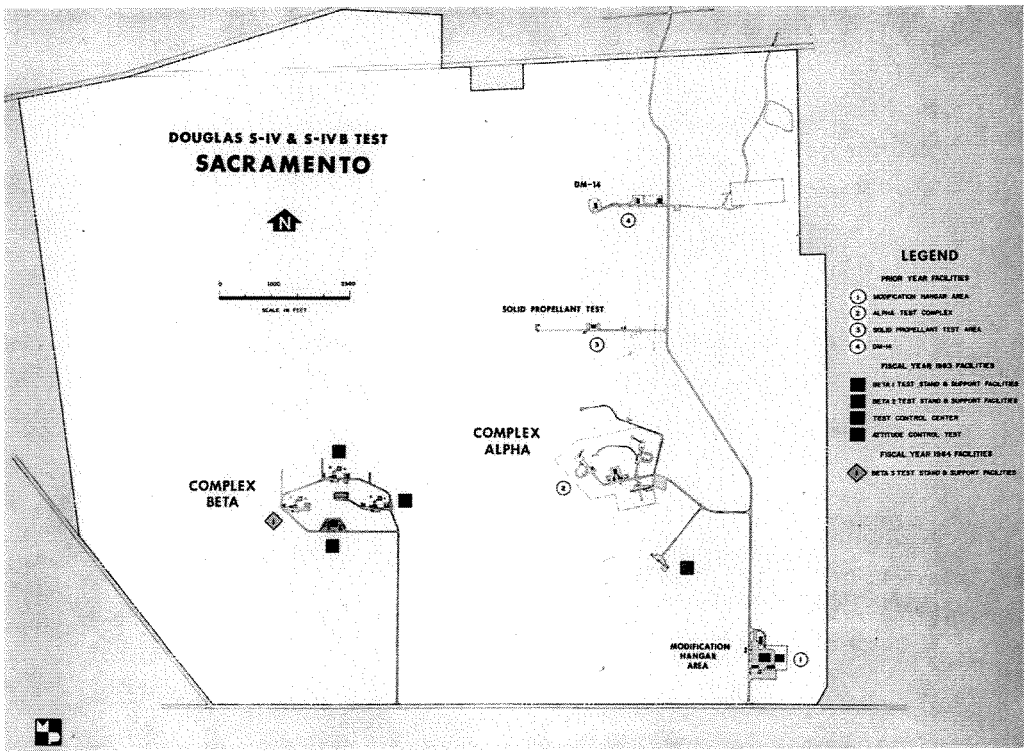

Plate 159: EES, 1963. Mapped immediately west of the planned Attitude Control Test Area (Gamma Test Area) in the southeastern corner the Douglas Missile Test Facility. Courtesy of NASA.

Test Cell B

Test Cell B is a three-sided, wood-frame structure added to location during its transition from the Component Test Site to the EES in 1962. Douglas used Test Cell B to conduct dome-plate experiments for insulations, bonding agents, and sealing resins. Douglas also ran thermal shock tests in the structure (Douglas 1958-1962). Test Cell B is deteriorated in place. The remains of an earthen berm exist behind the test cell. NASA was using Test Cell B in 1966 for experiments requiring liquid hydrogen and helium (Douglas 1966).

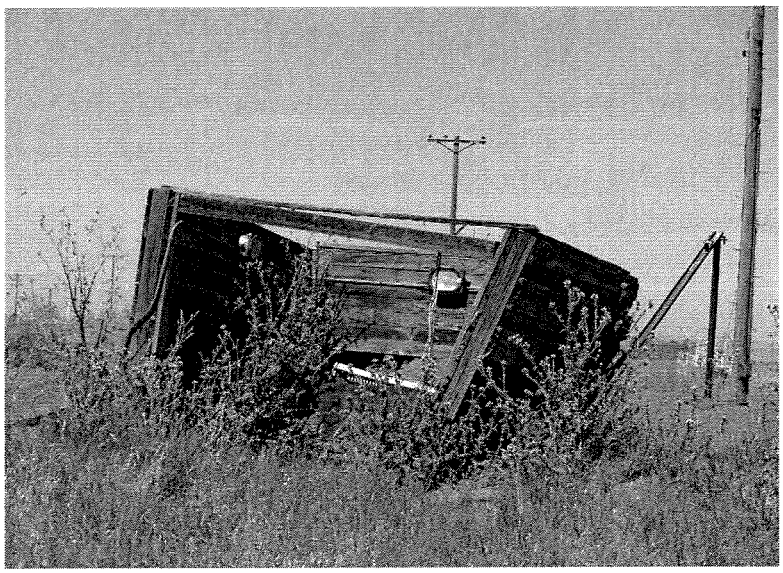

Plate 160: Test Cell B, Kappa Test Area, 1964. Looking north. View of May 2005.

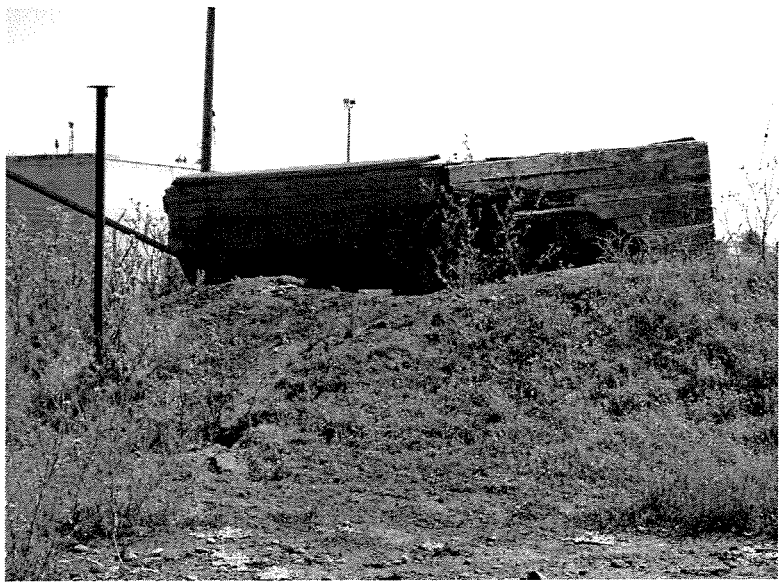

Plate 161: Test Cell B, Kappa Test Area, 1964. Looking north. View of May 2005.

Test Cell C

Test Cell C is the most elaborate test cell in the Kappa Test Area. The cell is a three-sided, blast-resistant steel structure added to location during its transition from the Component Test Site to the EES in 1962. An earthen berm surrounds the sides and rear of the cell. Early experiments in Test Cell C are undetermined. In 1966, Douglas used Test Cell C to "safely test liquid hydrogen components to failure in liquid hydrogen at pressures to 15,000 psi" (Douglas 1966). Test Cell C is unaltered and intact in 2005.

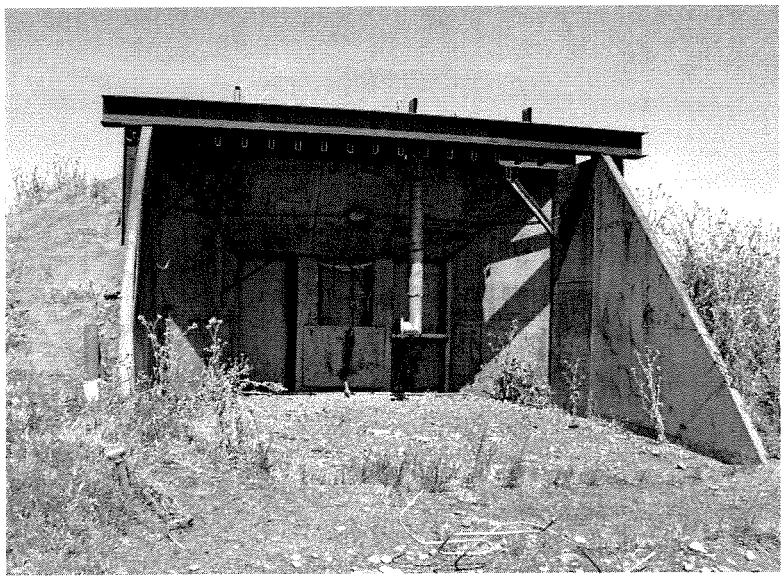

Plate 162: Test Cell C, Kappa Test Area, 1964. Looking northeast. View of May 2005.

Plate 163: Test Cell C, Kappa Test Area, 1964. Looking west. View of May 2005.

Test Area D

Test Area D is interpreted as part of the original IOC Site 2 that Douglas configured for Thor propellant tests in mid-1959. Only remnants of Test Area D exist in 2005. The major element at the location today is a piece of hydrogen test equipment carrying a dated metal stamped identification tag. Pairs of water cannons bracket Test Area D to the east and west. The cannons historically provided a deluge protection system for the area. In 1962, Douglas conducted 24 tests of the insulation for a scaled-down Saturn DSV-IV tank during the flow of liquid hydrogen (Douglas 1958-1962). The side was not in use in 1966 (Douglas 1966).

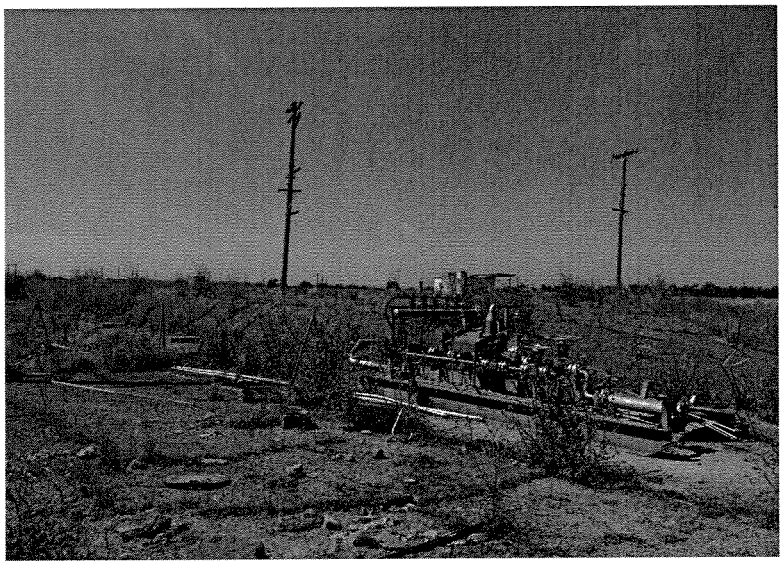

Plate 164: Test Area D, Kappa Test Area, 1964. Looking northeast. View of May 2005.

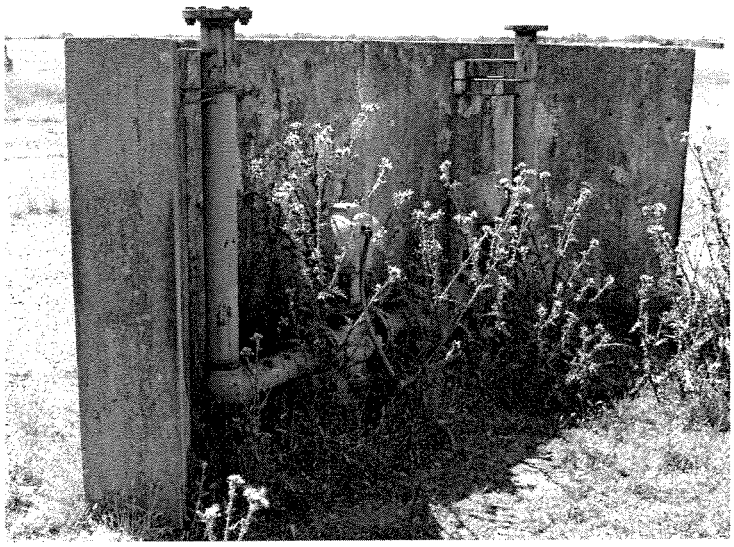

Plate 165: Test Area D, pair of water cannons, Kappa Test Area, 1964. Looking northwest. View of May 2005.

Test Area E

Test Area E is interpreted as part of the original IOC Site 2 that Douglas configured for Thor propellant tests in mid-1959. The location includes a reinforced concrete pad with an in-ground, concrete catchment channel. Steel plates covered the channel historically and remain partially extant. In 1962, Test Area E was the primary test site for the EES. Douglas conducted 320 tests in Test Area E focused on the development of the helium heater for the Saturn DSV-IV. Experiments included LOX and liquid hydrogen cold-flow tests, as well as cold helium checkout. In 1966, NASA used Test Area E for tests requiring liquid hydrogen (Douglas 1966) and had placed gaseous nitrogen tube trailers, a hydro-pneumatic trailer, a gaseous helium trailer, a liquid hydrogen run tank, an ullage (remnant fuel) storage tank, and two surge tanks at the site (NASA 1966).

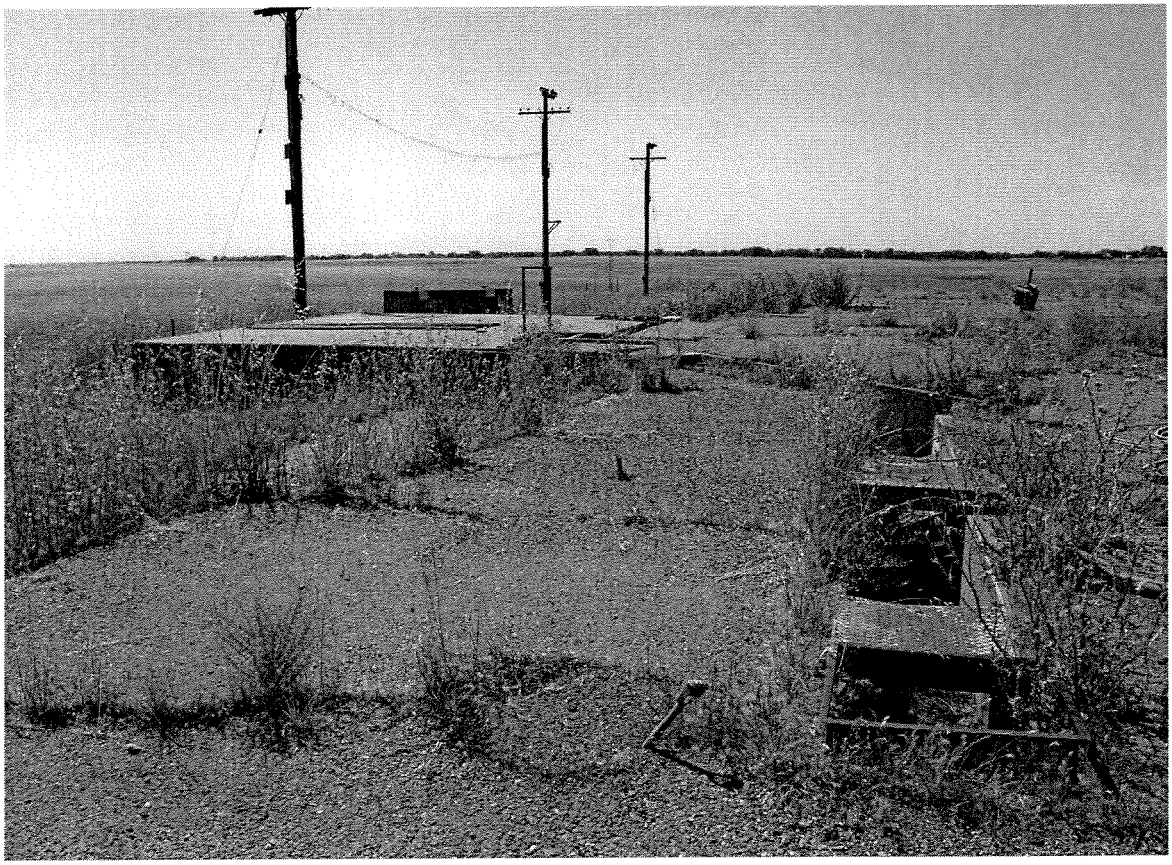

Plate 166: Test Area E, Kappa Test Area, 1964. Looking west. View of May 2005.

Cryostat Laboratory

Also known as Unit 42, the cryostat laboratory is a one-story, concrete block structure located in the northeastern section of the Kappa Test Area. The laboratory includes a covered, open test cell off its northeast façade. Two viewing ports and an equipment panel face the test cell. The cryostat laboratory features a flat roof and a single entrance on the southeast façade. A pair of long reinforced concrete pads, with imbedded steel rail trackage sit to the east of the laboratory, and are of undetermined historic purpose. In 1966, NASA used the cryostat laboratory to calibrate and verify temperature transducers. Personnel could calibrate instruments between temperatures of -423 degrees and 1,600 degrees Fahrenheit. A pressure tank holding cryogenic liquids provided the cold-temperature facility in the laboratory, while personnel achieved high temperatures in a hot oil bath (up to 500 degrees Fahrenheit) or a controlled-heat oven (above 500 degrees). The laboratory also accommodated the use of liquid hydrogen, liquid argon, and liquid nitrogen (Douglas 1966). The exterior of the cryostat laboratory is unaltered in 2005. The interior was inaccessible for inventory. The laboratory derives its name from the ultra-low temperature studies historically conducted on site.

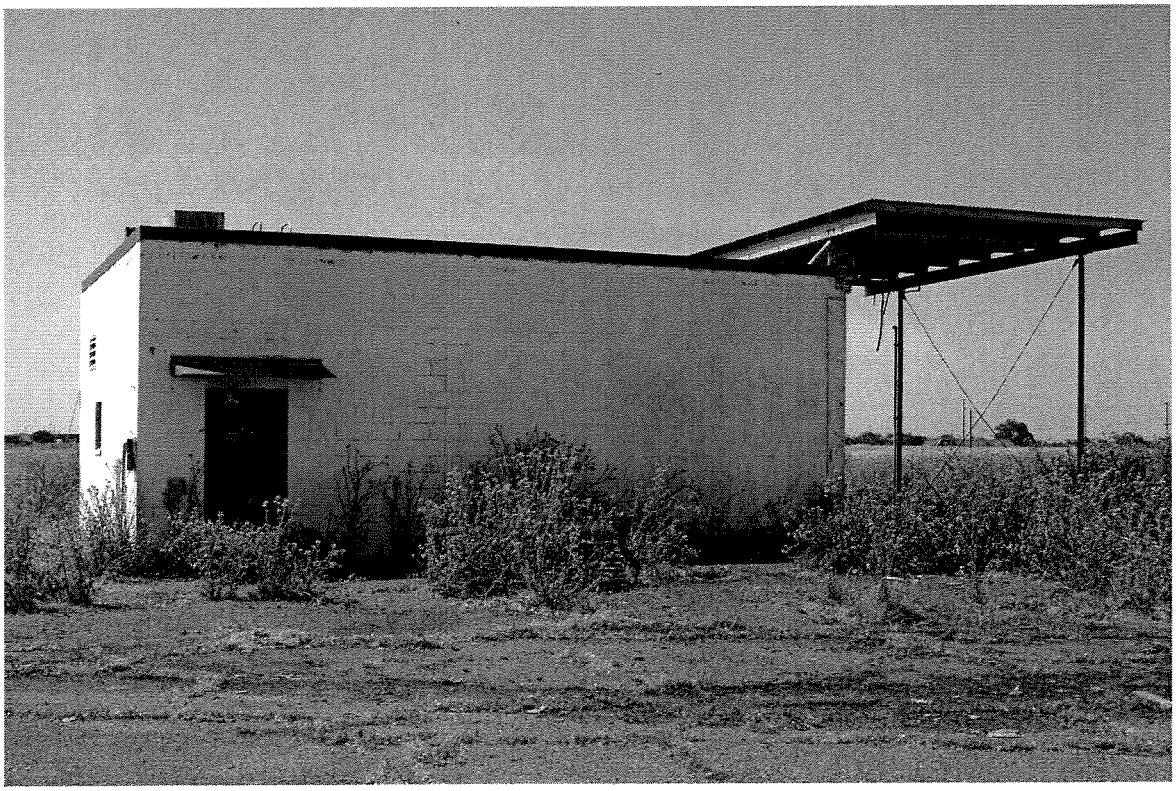

Plate 167: Cryostat Laboratory (Unit 42), Kappa Test Area, 1964. Covered open test cell, right. Looking west. View of May 2005.

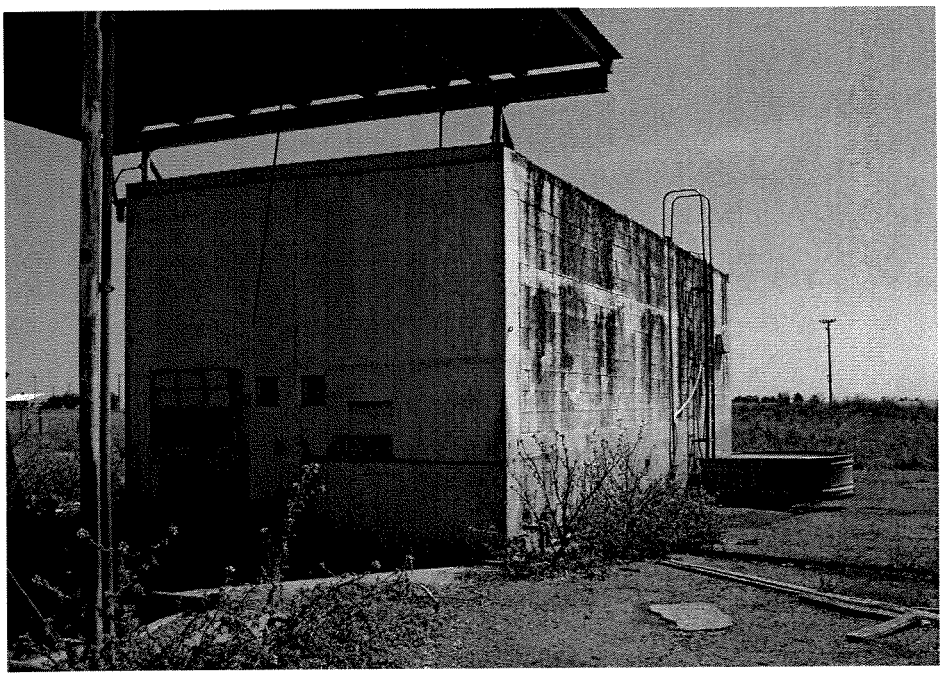

Plate 168: Cryostat Laboratory (Unit 42), Kappa Test Area, 1964. Covered open test cell, left. Viewing ports and equipment panel (with steel cover up), on the northeast façade facing the test cell Looking west. View of May 2005.

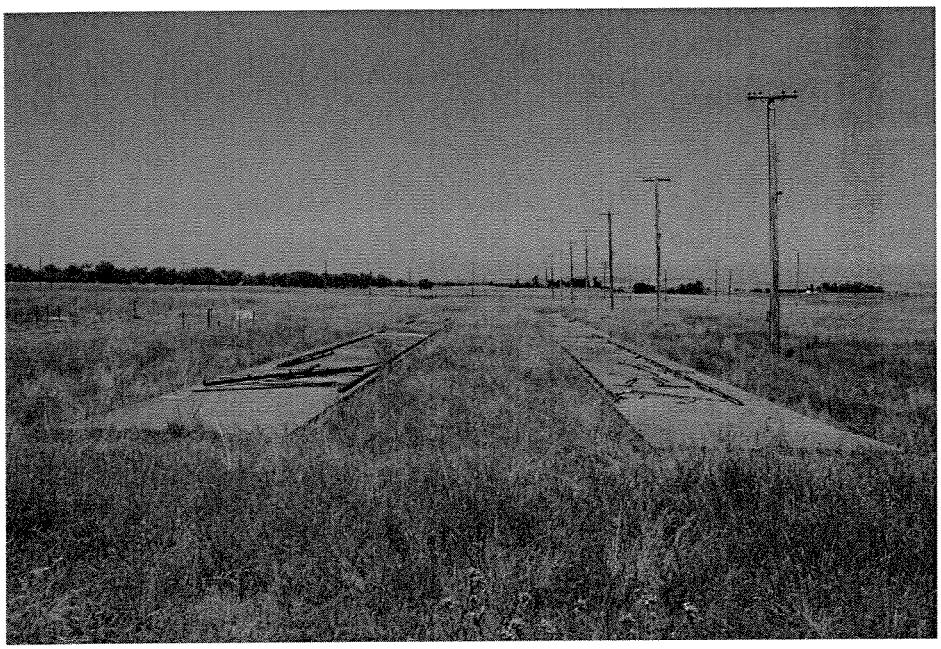

Plate 169: Test tracks on concrete pads west of the cryostat laboratory, Kappa Test Area, undetermined date of construction. Looking northeast. View of May 2005.

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