CAPE CANAVERAL AIR FORCE STATION, HAER NO. FL-8-11-S-1
LAUNCH COMPLEX 39,
SOLID ROCKET BOOSTER DISASSEMBLY & REFURBISHMENT COMPLEX
HANGAR AF
(Hangar AF Complex-Hangar AF)
(John F. Kennedy Space Center)
Cape Canaveral
Brevard County
Florida

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Department of Interior
100 Alabama St., SW
Atlanta, Georgia 30303

HISTORIC AMERICAN ENGINEERING RECORD

CAPE CANAVERAL AIR FORCE STATION, LAUNCH COMPLEX 39, SOLID ROCKET BOOSTER DISASSEMBLY & REFURBISHMENT COMPLEX HANGAR AF
(Hangar AF Complex – Hangar AF)

HAER No. FL-8-11-S-1

Location: Cape Canaveral Air Force Station, Cape Canaveral, Brevard County, Florida.

USGS Orsino, Florida, Quadrangle, Universal Transverse Mercator Coordinates: E 540465.24 N 3151325.46 Zone 17, NAD 1983.

Date of Construction: 1963

Present Owner: National Aeronautics and Space Administration (NASA)

Present Use: Solid Rocket Booster Disassembly & Refurbishment

Significance: The Solid Rocket Booster (SRB) Disassembly & Refurbishment Complex (Hangar AF Complex) contains Hangar AF and eight other facilities that played an essential role in the re-usability of the SRBs in the Space Shuttle Program (SSP). The complex was originally designed or modified to process SRBs, from pre-launch manufacture and assembly to post-launch recovery, disassembly, cleaning, and refurbishment. Hangar AF was determined to be eligible for the National Register of Historic Places (NRHP) as a contributing resource to the Hangar AF Complex Historic District. The complex was determined to be a historic district in the context of the SSP (1969-2011) under Criterion A, for Space Exploration, and Criterion Consideration G, as a facility that has achieved significance within the past fifty years.

Report Prepared by: New South Associates, Stone Mountain, Georgia

Date: October 16, 2012

PART I. HISTORICAL INFORMATION

A. INTRODUCTION

Hangar AF (Building 66250) at the SRB Disassembly and Refurbishment Complex is located on Hangar Road in the Industrial Area of the Cape Canaveral Air Force Station (CCAFS). The complex's boundaries are defined as the edges of the concrete hardscape that surround Hangar AF. The complex contains nine contributing historic resources, including Hangar AF (8BR2001). The remaining eight contributing resources are the High Pressure Gas Building (8BR2002), the High Pressure Wash Building (8BR2003), the First Wash Building (8BR2004), the SRB Recovery Slip (8BR2005), the SRB Paint Building (8BR2006), the Robot Wash Building (8BR2007), the Thrust Vector Control Deservicing Building (8BR2008), and the Multi-Media Blast Facility (8BR2009).

The complex is a significant historic property for its association with the Space Transportation System (STS), commonly known as the "space shuttle." The STS was a unique breakthrough in the history of the U.S. Space Program, because it was based on a design that made most of its major components re-usable, a model that decreased program costs, and helped make orbital space flight a routine endeavor. Along with the orbiter spacecraft, the SRBs were two of the shuttle's primary re-usable elements, while the external tank (ET) was not re-used. The SRBs' re-usability was made possible by a number of facilities at Kennedy Space Center (KSC) and CCAFS, including the SRB Disassembly and Refurbishment Complex. The complex is the first place to which the SRBs were brought after their recovery from sea and where they were disassembled,

cleaned, and processed before they were moved to other KSC facilities for buildup and assembly.

B. HISTORICAL CONTEXT

A full historical context for the SRB Disassembly and Refurbishment Complex, as well as a summary of the entire disassembly and refurbishment process, can be found in HAER NO. FL-8-11-S (Hangar AF Complex). A detailed explanation for the portions of that process that occurred in this resource is located in Section III of this document.

C. PHYSICAL HISTORY

1. Date of Construction:

The Hangar AF Complex was built in three phases from the 1960s through the 1990s. The first phase of construction included Hangar AF and the High Pressure Gas Facility in 1963. The facility was designed by Bail, Horton & Associates of Fort Myers, Florida, and used for staff headquarters and administrative support offices of the Saturn IB and Saturn V rockets during the Apollo program.[1]

The hangar site was located on Hangar Road in the CCAFS Industrial Area, which included almost two dozen hangars and other buildings, only four of which were used by NASA, with the rest belonging to the Air Force. Another of these NASA buildings is Hangar S, which is adjacent to Hangar AF. Hangar AF was designed to house 66,170 square feet of workspace with a reinforced concrete foundation and a concrete block and aluminum sheeting exterior.

[1] Bail, Horton & Associates, "Hangar 'AF'" Construction drawings (KSC, Florida) 1962; KSC, *Technical Facilities Resume: Hangar AF*, Facility No. 10-00-22-00 (KSC, Florida, 1966), 43-44. On file at the KSC Archive.

The advent of the SSP in the 1970s initiated the second phase in the construction history of the Hangar AF Complex. Under the SSP, NASA planned to use Hangar AF for the disassembly and refurbishment of the shuttle's re-usable SRBs. The hangar location on the Banana River made it ideal for receiving the boosters from specially-designed ships that towed them in from sea. Hangar AF remained largely unchanged for the Shuttle Program, but its surrounding site received extensive modifications from 1977-1979, including new paving and infrastructure, the construction of the SRB Recovery Slip, the railways, the First Wash Building, and the High Pressure Wash Building.[2]

Bids for the Hangar AF modifications were accepted in October 1977, with the contract awarded to Holloway Construction at a cost of $3,227,300. The site's new features were scheduled for completion by 1979 and represented the first phase in the SRB disassembly and refurbishment operations at the hangar.[3]

A 1978 aerial photograph of the Hangar AF site shows the condition of Hangar AF and the High Pressure Gas Building at the beginning of the site grading and other preparations.[4] The photograph shows the first construction phase of the SRB Recovery Slip and foundation preparations for the First Wash Building. A subsequent aerial from 1983 shows the condition of the site after the SRB Recovery Slip and First Wash Building were completed, but before the

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[2] Sverdrup & Parcel and Associates, "Solid Rocket Booster Recovery & Disassembly Facility, Hangar AF, CCAFS, Industrial Area" (KSC, Florida). Construction drawings, 1977.

[3] Joseph Andrew Brown, "Bid Cost of Shuttle Facilities, Construction Bidding Cost of KSC's Space Shuttle Facilities," Proceedings from the 23rd Annual American Association of Cost Engineers Meeting, Cincinnati, Ohio, July 15-18, 1979, KSC Facilities Engineering Division, KSC, Florida. On file at KSC Archives.

[4] KSC photograph negative number 108-KSC-378C-203/3, dated March 29, 1978. On file at KSC Archives.

later construction of the SRB Paint Building, the TVC Deservicing Building, the Robot Wash Building (1985), and the Multi-Media Blast Facility (MMBF)[5]

The third and final phase of major construction in the complex occurred from the mid-1980s through 1991, when Hangar AF's capabilities were expanded with the construction of four new buildings: the SRB Paint Building (1983), the TVC Deservicing Building (1984), the Robot Wash Building (1985), and the Multi-Media Blast Facility (1991). Previous to the 1984 completion of the TVC Deservicing Facility, the TVC system was tested and assembled in the low bay of the VAB.[6]

The SRB Paint Building included a bay for applying alodine, a corrosion inhibitor, to the bare aluminum surface of SRB components, as well as two booths for applying primer and top coats of paint. The building also had a blast bay that used ground walnut shells to remove all the paint from the SRB components without damaging or etching their surfaces. This blast bay was later replaced by the larger and better-equipped MMBF. The TVC Deservicing Building was completed to remove and clean the boosters' TVC systems. The Robot Wash Building was completed with a mechanical robot that was used to spray high-pressure jets of water onto the booster sections to remove the TPS and paint applied to their surfaces. More detailed discussions of the operations and processes of these buildings are included in Part III of this report.

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[5] KSC photograph negative number 109-KSC-81PC-459, dated May 4, 1983. On file at KSC Archives.

[6] Kay Grinter, "Assembly and Refurbishment Facility Finishes Shuttle Duties," *Spaceport News* (October 1, 2010): 7.

2. Architects/Engineers:

a. Hangar AF and the High Pressure Gas Building (1962): Bail, Horton & Associates, Architects & Engineers, Fort Myers, Bradenton, Florida.

Hangar AF and the High Pressure Gas Building were designed in 1961 by Bail, Horton & Associates of Fort Myers, Florida. The principal partner in this firm was George Hamlin Bail, who grew up in Fort Myers and worked in the architectural office of his father, Frank W. Bail. Bail received his A.B. degree from Princeton University in 1943 and then served in the U.S. Army Field Artillery during World War II from 1943 to 1946. After the war, Bail returned to Princeton where he earned a M.F.A degree in Architecture in 1948. Following his graduate work, Bail returned to his father's firm in Fort Myers and worked there for sixteen years. While working for his father, Bail designed projects throughout Florida, including a master plan for Florida State University, projects for the military, the U.S. Army Corps of Engineers, and NASA. He founded Bail, Horton & Associates in 1955 before joining W.R. Frizzell Architects in 1966. Bail became president of this firm after Frizzell died and retired as president in 1987.[7]

b. Hangar AF site modifications, First Wash Building, High Pressure Wash Building, and SRB Recovery Slip (1977): Sverdrup & Parcel and Associates, Inc., Jacksonville, Florida.

[7] Thomas J. McQade, Donna A. McQuade, and George Bail AIA, "George H. Bail AIA" (Fort Myers: American Institute of Architects FLASW and The Southwest Florida Museum of History, 2011), 1. http://mcmo-swfl.com/bio/Bail-%20George%20H%20-%20Narrative.pdf. Accessed November 17, 2011.

The 1977 modifications to the Hangar AF site, including grading and paving, railways, the construction of the SRB Recovery Slip, First Wash Building, and High Pressure Wash Building were designed by Sverdrup & Parcel and Associates, Inc. Sverdrup & Parcel was the engineering, architectural, and planning services branch of the larger Sverdrup Corporation, a broad-based engineering firm that worked throughout the United States and internationally.[8]

The company was founded as Sverdrup and Parcel in 1928 by Norwegian engineer Leif J. Sverdrup and John Ira Parcel, a professor at the University of Minnesota. Together, the men specialized in bridge design and construction and became one of the most respected bridge firms in the country by the 1940s. During World War II, the firm broadened its scope of services to include work for the U.S. Corps of Engineers in the Pacific theater, including a chain of airfields in the South Pacific leading to the Philippines.[9]

Domestically, Sverdrup and Parcel continued to concentrate on somewhat routine bridge, railroad, and highway construction. In the late 1940s, however, the firm expanded into the design of military and aviation test facilities for the U.S. Government, including architectural and engineering services at the new Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee, and the Air Force's Joint Long-

[8] *Sverdrup Corporation: Company History*, http://www.fundinguniverse.com/company-histories/Sverdrup-Corporation-Company-History.html. Accessed November 17, 2011.
[9] International Directory of Company Histories, *Sverdrup Corporation: Company History* (Farmington Hills, MI: St. James Press, 1996), http://www.fundinguniverse.com/company-histories/Sverdrup-Corporation-Company-History.html. Accessed November 17, 2011.

Range Proving Ground at Cape Canaveral, Florida. The work at Cape Canaveral opened the door for the firm to work in the 1960s with NASA and the Air Force, first in the development of rocket test stands, and then in 1977 with modifications to Hangar AF.[10]

c. Hangar AF site paving, grading, and drainage work (1991): Reynolds, Smith and Hills, Architects and Engineers, Merritt Island, Florida.

Reynolds, Smith and Hills is a construction and engineering firm based in Jacksonville, Florida, that provides infrastructure services for aerospace, defense, aviation, commercial, and transportation clients. The company was founded in 1941 and has additional offices throughout Florida and the nation.

3. Builder/Contractor/Supplier:

Hangar AF and the High Pressure Gas Building were built in 1962 by Douglass Aircraft Co., Boeing Aircraft Co., and Bendix Corporation, Inc.[11] The 1977 modifications were completed by Holloway Construction for $3,227,300.[12] The contractors involved in the subsequent construction projects at Hangar AF are not known.

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[10] International Directory of Company Histories, *Sverdrup Corporation: Company History* http://www.fundinguniverse.com/company-histories/Sverdrup-Corporation-Company-History.html. Accessed November 17, 2011.
[11] KSC, *Technical Facilities Resume: Hangar AF*, Facility No. 10-00-22-00 (KSC, Florida, 1966), 43-44. On file at the KSC Archives.
[12] Brown, Joseph Andrew, *Bid Cost of Shuttle Facilities, Construction Bidding Cost of KSC's Space Shuttle Facilities*, Proceedings from the 23rd Annual American Association of Cost Engineers Meeting, Cincinnati, Ohio, July 15-18, 1979, 14. On file at the KSC Archives.

4. Original Plans and Construction:

Hangar AF and the High Pressure Gas Building were originally built in 1963 for NASA's Apollo Program. According to technical reports, they were used for Saturn IB and Saturn V Staff Headquarters and Administrative Support Offices.[13] The buildings' site was a previously undeveloped corner of the CCAFS's Industrial Area immediately southwest of Hangar S. The site was the Industrial Area's closest access point to the Banana River, providing a place for ships to deliver Saturn rocket components. The site's configuration included Hangar AF (called "Special Assembly Building AF" on the original drawings) and the High Pressure Gas Building, as well as a parking area, access roads, and a wood Sentry House that was later demolished.[14]

Hangar AF was accessed via Hangar Road and a paved parking area to its southeast (where the SRB Paint and High Pressure Wash buildings are today). The Sentry House was located between the hangar and parking area. Two paved access roads led from the hangar to a concrete loading dock on the Banana River. The first led from the hangar's northwest doors, an area later paved in 1977 in preparation for the SSP. The second road remains in place along the southwest edge of the facility. At the waters' edge was a concrete pad labeled "Saturn Unloading Facility." This pad remains intact and was used to unload SRB frustums and parachute reels from the ships, *Liberty Star* and *Freedom Star*.[15]

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[13] KSC, *Technical Facilities Resume: Hangar AF*, 43-44.
[14] Cape Canaveral Air Force Station Master Plan (CCAFSMP) and Building Schedule (Department of the Air Force, Air Force Systems Command, Cape Canaveral, Florida, 1963), 26.
[15] CCAFSMP, 26.

An examination of the building's 71-page set of original as-built drawings and historic photographs show that Hangar AF retains its original appearance, including its corrugated aluminum roof and siding on the upper levels, and the concrete block exterior of the two-story wings (called "lean-tos" on the plans) on the southwest and northeast elevations. The hangar also retains its original steel high-bay doors.

4. Alterations and Additions:

As described in Section 1, Hangar AF's setting was altered considerably in the late 1970s with new infrastructure and buildings as it was modified for use in the SSP. In 1977, the firm of Sverdrup & Parcel and Associates, Inc. was selected to complete the site modifications. The firm's original set of construction drawings includes 71 pages of plans for site work (grading, paving, fencing, utilities, drainage, and railways), the construction of new buildings, and mechanical and electrical upgrades throughout the site. The Hangar AF area remained largely unchanged until the mid-1980s, when four new buildings were added: the SRB Paint Building in 1983, the TVC Deservicing Building in 1984, and the Robot Wash Facility in 1985. The Multi-Media Blast Facility was added in 1991.

Alterations and additions to individual buildings in the Hangar AF Complex have been minimal over the years. There have been no substantial alterations to the exterior of Hangar AF, although a comparison of the building's original 1962 and 1977 as-built drawings shows changes to the first floor plans of the north and south "lean-to" sections. The 1962 drawings show an arrangement of rooms separated by wood wall partitions that is slightly different from the 1977 drawings, which represent the present floor plan. All

of the building's original 1962 masonry wall partitions remain intact.

The SRB Recovery Slip received repairs and improvements in 1995 to stabilize the structure's seawall and bulkhead to improve drainage capabilities. The Hangar AF Complex's remaining buildings are largely in original condition. Alterations to individual buildings in the complex are discussed in Part II, Section B - "Building Descriptions."

PART II. STRUCTURAL/DESIGN/EQUIPMENT INFORMATION

A. GENERAL STATEMENT:

1. Character:

The Hangar AF Complex contains nine contributing industrial buildings that were designed to receive, disassemble, and refurbish the space shuttle SRBs. The centerpiece of the complex in terms of size and function is Hangar AF.

Transportation to and through the complex occurs via paved roads and parking areas, including a main entrance driveway at its east end that passes from Hangar Road through a grassy shoulder area into the complex's main visitor parking lot. An additional secondary entrance is provided by Industrial By-Pass Road, on the south side of the complex between the main Hangar AF area and the MMBF. This road leads from Hangar Road directly out to the SRB Recovery Slip area.

Paved roads also lead from the east visitor parking area around the north and south sides of Hangar AF. The north road leads between the hangar and the chain-link fence that separates Hangar AF from the neighboring Hangar S. The south road leads between Hangar AF and the Robot Wash and

High Pressure Gas Buildings. Automobiles can drive around Hangar AF on either of these roads to reach the extensive paved SRB recovery/inspection area lying between the SRB Recovery Slip and Hangar AF. An additional access road that is perpendicular to the above roads leads south to the MMBF, which is separated from the main portion of the complex by a ground support equipment (GSE) warehouse. Another perpendicular road is the driveway to the TVC Deservicing Building on the north side of the complex.

There are three GSE storage areas in the Hangar AF Complex. These areas are used to store various large metal objects like SRB work stands, rail car components, parachute reels, etc. The first GSE storage area is in the eastern corner of the complex on the north side of the visitor parking lot. The second is adjacent to the western corner of Hangar AF. The third is located just west of the First Wash Building, on the south side of the paved SRB recovery/inspection area.

Immediately north of the First Wash Building is the facility's wastewater reclamation storage and settling tank area. All of the water used in the First Wash Building is collected, filtered, and stored for another use in this area.

The complex is bordered on the west by undeveloped green space on the edge of the Banana River. The complex also contains small, irregularly shaped grassy areas that collect surface water runoff, including those around the eastern, southern, and western boundaries.

The building designs and materials used at Hangar AF were conventional and commonly found in the twentieth-century industrial and manufacturing sites. The complex's buildings are characterized by utilitarian designs that

feature aluminum and/or concrete block exteriors with a variety of built-up roof types, including flat, pitched, and shed. The complex contains one structure, the SRB Slip, which is composed of cast-in-place reinforced concrete.

The complex is historically significant for its association with the SSP and the technical processes that its industrial buildings and structures encompassed, rather than their architectural or engineering merit. Taken individually, these buildings do not communicate architectural or engineering significance. When viewed as a complex, however, they represent one of NASA's essential space shuttle manufacturing locations that enabled the re-usability of the SRBs.

The physical arrangement, or site layout, of the complex's resources is a key distinguishing characteristic, as it reveals the workflow of the various steps involved in the disassembly and refurbishment process. The L-shaped complex is long, narrow, and oriented at a northwest-southeast angle. The site workflow generally proceeded from northwest to southeast. The SRBs were delivered via the ships, *Liberty Star* and *Freedom Star,* to the SRB Recovery Slip on the northwestern edge of the complex. From there, they were removed from the water and moved to the southeast for the various steps of inspection, hydrolase wash, disassembly, and preparation for the refurbishment process.

2. Condition of Fabric:

The condition of the Hangar AF Complex's fabric is excellent. The buildings and structures of the complex were regularly maintained throughout their life spans and do not exhibit any major signs of neglect or deterioration.

B. BUILDING DESCRIPTION:

Exterior:

Hangar AF (1963) is the centerpiece of the complex and features a typical aeronautic hangar design that is similar to the other hangars in the CCAFS Industrial Area. The building has three primary sections, including the central hangar bay with an aluminum gable roof and two-story "lean-to" sections on the hangar's north and south elevations. The hangar bay contains the building's open SRB disassembly area, and the "lean-to" sections contain the small parts processing area, storage rooms, offices, and other support spaces. The overall dimensions of the building are 75′-8″ (H) x 250′-0″ (L) x 185′-8″ (W).

The building's foundation is composed of regularly spaced reinforced concrete footers set at a depth of 5′-0″. The footers are spaced 20′ apart on center. In the hangar bay, the footers under each column measure 13′-0″ x 9′-0″ x 2′-0″. In the north and south "lean-to" sections, the footers under each column measure 5′-0″ x 5′-0″ x 2′-0″.

The exterior of the hangar bay is clad in 4″ ribbed embossed aluminum siding. The north and south "lean-to" sections have concrete block exteriors. The sliding hangar doors on the east and west elevations are made of 1/4″ steel plates with translucent ribbed plastic sheets used as window lights.

The hangar bay has a load-bearing steel truss wall structure with a steel truss gable roof structure. The two-story "lean-to" sections have load-bearing concrete block walls with steel-truss shed roof structures.

Hangar AF has four horizontal sliding bay doors on the west and east sides of the building. Each door has two moving sections that roll on rubber drive wheels to collapse into concrete block pocket structures on either side of the bay. When closed, the doors are 45′ tall and 101′-8″ wide. They feature a steel frame structure with translucent ribbed plastic cover sheets in a pastel green color. Within each bay door is a standard size pedestrian entrance door for worker access.

There are secondary exterior pedestrian entrance doors on the north and south elevations of the hangar. The north elevation has two sets of pedestrian double-doors on its west end, one over the other, with stairs that lead to the second-story entrance. An additional set of ground-floor pedestrian double-doors is roughly offset from the middle of the north elevation and provides access to the interior staff office area. The south elevation has two sets of pedestrian double-doors in a similar configuration to the north elevation.

The hangar bay has clerestory windows along the north and south elevations. The windows are arranged in eleven bays, each of which contains eighteen fixed lights. There are additional secondary one-over-one double-hung windows along the exterior ground floor of the “lean-to” sections, with two square one-over-one windows in the stair corridors.

The Hangar AF bay has an aluminum gable roof with a steel truss structure. This roof structure provides a clear, uninterrupted workspace in the bay and room for the building’s bridge crane to move back and forth along the bay, as needed. The “lean-to” sections of the hangar have built-up roof systems on an aluminum base. Hangar AF has no cornice. It has aluminum boxed eaves with aluminum gutters.

Interior:

The interior of Hangar AF is composed of the main assembly area found in the hangar bay, which is flanked on the north and south by two-story "lean-to" sections that contain offices, storage rooms, the small parts processing area, and other work areas. The concrete slab floor of the hangar includes a grid system of covered trenches that contain electrical cables, mechanical lines, compressed air, and grounding cables that serve the building's various equipment and work stations. There are also stairwells leading to the second floor at each of the building's four corners. Refer to the as-built drawings included with this HAER package for a detailed representation of the building's floor plan.

The first floor of the south "lean-to" primarily contains the small parts processing area. From west to east, this area includes a logistics room, small parts/coveralls storage room, quality inspection area, blasting room, paint shop, and wash room with detergent and alodine dip tanks. The bathroom is located at the far west end of the building.

The small parts processing area contains tools, furniture, and specialized equipment used in the refurbishment process. One machine that extends throughout the area is an overhead monorail track system used to transport the SRB's small, but heavy aluminum parts from the storage area in the west to the process areas on the east.

The logistics room on the west end of the area contains tools that were checked out to individual workers and then returned at the end of the day. The adjacent storage area contains racks for storing worker coverall uniforms, as well as numbered racks holding unfinished small parts such

as splice plates, cable support brackets, mounting brackets, and other fitting assemblies.

The quality inspection area is located along the open corridor that connects the east and west ends of the small parts processing area. It contains four inspection tables that have been modified with specially padded tops to protect the finished parts. Above these tables is a bank of wall-mounted storage cabinets.

South of the quality inspection area is the small parts blasting room. It contains three “Blast-It-All” brand blasting machines, which use glass-bead media to remove the small parts’ finish materials down to bare aluminum. The room also contains workstation desks on the south wall and small parts storage racks on the north wall.

North of the quality inspection area is the alodine tank area, where the stripped small parts are rinsed and dipped in alodine surface preparation solution.

East of the quality inspection area is the lead area, where metal lead connectors were attached and soldering occurred. The lead area included a main work area and four work tables.

On the eastern end of the small parts processing area are the paint booth, an accelerated cure oven for curing painted parts, and a standard cure area where parts were hung in the open to cure. Also at this end is the closeout area where finished small parts were sorted and stored before transported out of Hangar AF for buildup and assembly.
The first floor of the north “lean-to” contains a variety of room types. From west to east, this area includes the bathroom, staff break room and lunchroom, staff offices,

machine shop, and tool crib. At the east end of the building is the electrical repair shop and the scuba shop, where scuba gear and the EDOP are stored.

The second floors of both the north and south "lean-to" sections are composed of staff office and meeting spaces. There are approximately thirty offices in the south and twenty-four offices in the north.

Finish materials on the interior of Hangar AF include cast-in-place concrete flooring throughout the building, as well as walls of aluminum, steel, concrete block, and drywall. The interior of the hangar bay is unfinished; the walls and ceiling are composed of the building's exposed steel truss structure and the concrete block walls of the north and south "lean-to" sections. Both "lean-to" sections feature painted concrete block on exterior walls with painted drywall finished interior walls. Ceilings throughout the "lean-to" areas are finished with suspended acoustical tile.

The first floor of the hangar features a mixture of double and single metal doors, most of which contain single fixed lights at eye level.

Both the south and north "lean-to" sections were designed with full HVAC systems, which remain intact, but no such system treats air in the hangar bay. The original air conditioner in the north "lean-to" had a 123-ton cooling load and in the south side a 125-ton cooling load.[16] Both the north and south sections had HVAC equipment rooms that contained a chiller-compressor, air compressor, and pumps that forced air throughout the building.

[16] KSC, *Technical Facilities Resume: Hangar AF*, Facility No. 10-00-22-00 (KSC, Florida, 1966), 43-44. On file at the KSC Archives.

Hangar AF is lit by an exterior and an interior lighting system that includes a number of fixture types. The complex lighting system was upgraded during the 1977 modifications. Refer to the as-built drawings from that year for a specific schedule of lighting fixtures used in the complex's various buildings. The outdoor lighting system consists of floodlights attached to telephone poles. The interior of the hangar bay is lit with a combination of seventy-two ceiling floodlights, and another twelve floodlights mounted approximately 20' above the floor. Interior lighting in the "lean-to" sections is provided by fluorescent fixtures installed in the suspended acoustic tile ceiling.

The original Hangar AF plumbing system served just the hangar itself. The system included four bathrooms (one on each floor of the north and south "lean-to" sections), as well as floor drains, a fire hose system, and a fire sprinkler system on the first and second floors of the north and south sections. This basic plumbing system was upgraded throughout the site in 1977 to accommodate the new First Wash Building and High Pressure Wash Building, which included a deionized water system, potable water system, surfactant system, and drainage/treatment systems for runoff at these facilities.

Notable machinery in Hangar AF includes the building's bridge crane, the decoupling rings, and the two EDOP devices. The bridge crane has a 40-ton lift capacity with a 10-ton auxiliary outrigger hoist. Power supplies and compressed air lines are arrayed along the north and south walls of the hangar's interior.

The crane was used to maneuver the six different decoupling rings into place, as well as to move SRB segments and other heavy equipment. The decoupling rings are hydraulic clamps

placed over the SRB segment joints, one on either side of each joint, and used to disassemble the boosters in a process called "segment demate."

The EDOPs are used in the SRB marine recovery process. While the boosters are floating upright in the ocean after splashdown, divers maneuver the EDOPs into the nozzle end of the boosters. Each EDOP creates an airtight seal in the end of the booster allowing air to be pumped into it and seawater to flow out. As the booster fills with air, it rises out of the water and eventually falls to a horizontal position on the ocean surface.

PART III: OPERATIONS AND PROCESS

A. INTRODUCTION

The primary operations at Hangar AF involved separating all of the SRB segments, removing their electronic and mechanical components, and preparing them for buildup and assembly at the ARF. The other buildings and structures at the Hangar AF complex processed the aft skirts, forward skirts, frustums, TPS systems, TVC systems, MPSS, and ETA ring. The boosters' four SRMs were separated and cleaned at Hangar AF and then shipped to their manufacturer for full refurbishment. Typically, the number of people working at the hangar during the space shuttle era was approximately 150 people. It took these workers from two to three weeks to fully process the SRB components from the time of their arrival.

B. SRB ARRIVAL, INSPECTION, AND SAFING

The Hangar AF refurbishment process began at the SRB Recovery Slip on the west end of the complex, where the

SRBs were towed by the *Freedom Star* and *Liberty Star* ships. The SRBs were then floated, one at a time, into the slip. A mobile 200-ton capacity gantry crane then lifted the SRBs out of the slip and placed them onto specially-designed rail cars, or dollies, which moved along tracks embedded in the paved surface of the complex. The dollies resemble flat-bed rail cars, each of which is equipped with a series of eight semi-circle "cradles" that hold the SRBs. The cradles all have belts and rollers along their inside surface that allow workers to rotate the SRBs into correct position using control panels mounted on the sides of the dollies.

The two sets of dolly rail tracks extend all the way from the slip area through the wash bays of the First Wash Building and then into Hangar AF where both SRBs were processed at the same time. The SRBs weighed approximately 190,000 pounds at the beginning of the refurbishment process.

After the SRBs were removed from the slip, the booster frustums and parachutes were offloaded from the ships, placed on transport trailers, and taken to Hangar AF for processing.

Once loaded onto the rail cars at the head of the slip area, the pair of SRBs underwent an open assessment to inspect for damage or wear to their structures. After the open assessment, the SRBs were "safed" by removing several components from the forward skirt, including all remaining batteries and ordnance, the Range Safety System (RSS), Safe and Arm (S&A), the Solid State Video Recorders (SSVR), and the Data Acquisition System (DAS).

C. INITIAL HYDROLASING – REMOVAL OF TPS

The SRBs were then moved on the rail cars into the First Wash Building for a high-pressure hydrolase water wash at 20,000 pounds of pressure per square inch. The boosters were hydrolased with both overhead spray bars and by manual hydrolase guns, which removed approximately 90 percent of their TPS. The waste water is collected in a series of drains, sumps, and filters before it is cleaned and stored in an adjacent above-ground tank for future use.

While in the First Wash Building, the boosters' exit cones were removed and inspected. The exit cones were then shipped back to their manufacturer, a defense and aerospace company in Utah, called ATK, for refurbishment.

D. DISASSEMBLY AT HANGAR AF

After hydrolasing in the First Wash Building, the boosters were moved into Hangar AF for disassembly. SRB segment disassembly is accomplished with the use of the hangar's decoupling ring, which was used to separate or "demate" the segments. The decoupling ring was moved into position over the booster with the use of the hangar's two original 1963 cranes manufactured by Manning, Maxwell & Moore. The cranes each have a 40-ton lift capacity, as well as 10-ton auxiliary hoists. Once demated, the cranes were used to lift the segments up and onto mobile transport platforms.

The first segments demated were the aft skirts, which required clearing all non-essential personnel from the facility due to residual hydrazine in the still-intact TVC fuel systems. With the aft skirts removed, personnel then disconnected the booster nozzles, which were shipped back to ATK for further disassembly and inspection.

The next segments demated were the forward skirts. With the forward skirts removed, the crew could then reach the SRB igniter inside the top SRM segment. The igniter was removed, inspected, and partially disassembled for further inspection. It was then shipped to ATK for further disassembly and inspection.

With the forward and aft skirts removed, the disassembly crew moved on to demating the SRM segments. Crews first inspected the condition of the SRM insulation, casings, and joint conditions. Notes were taken on any propellant that remained unburned and any corrosion found, which was addressed immediately to protect the high-value reusable cases. The four SRM segments were then separated with the decoupling ring. Propellant debris was removed from their interior with a manual high-pressure wash. The end openings of each SRM were covered with "handling rings," large caps that protected their interiors during shipping. The SRM segments were then moved from the rail dollies onto truck trailers via the hangar's overhead crane. The segments were then transferred to the NASA railhead, loaded onto rail cars, covered, and shipped by rail to ATK in Utah for further processing.

Once all of the SRB segments were disassembled, the frustums, aft skirts, and forward skirts underwent the remainder of the refurbishment process in other buildings at the Hangar AF Complex. The frustums were first rinsed and their parachute components were removed. Inside the hangar, the BSMs were inspected and removed for further disassembly and inspection. The frustums were then verified "safe" by inspecting and removing the confined detonating fuses (CDF) used to fire their separation during the booster's descent. All of the remaining frustum components were removed and readied for refurbishment, including their flotation blocks that kept them buoyant at

sea and the MPSS that supports the boosters' main parachutes.

E. SMALL PARTS PROCESSING

Each of the SRB segments contained a number of small but heavy aluminum parts that were individually removed for refurbishment in Hangar AF's Small Parts Processing area after each flight. Examples of these parts included the IEA box fittings, cable support brackets and lugs, tunnel covers, and ETA ring splice plates. Each of these and other small parts were first disassembled and inspected for repair and modification. They were then transferred to the Small Parts Processing area where residual TPS, protective finish, and corrosion were removed via media blasting in the area's three manual blast booths. Once cleaned and blasted, the parts were inspected for quality control and then coated with an alodine protective finish, a coat of paint primer, and a top coat of hypalon paint. Parts also received any necessary mechanical assembly or rework of nut plates, rivets, and other fasteners.

PART IV. SOURCES OF INFORMATION

A. ENGINEERING DRAWINGS AND PLANS

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Sverdrup & Parcel and Associates. "Solid Rocket Booster Recovery & Disassembly Facility, Hangar AF, CCAFS, Industrial Area." Kennedy Space Center, Florida. Construction drawings, 1977.

B. EARLY VIEWS

Kennedy Space Center. Photograph negative number 108-KSC-378C-203/3, dated March 29, 1978. On file at Kennedy Space Center Archives.

Kennedy Space Center. Photograph negative number 109-KSC-81PC-459, dated May 4, 1983. On file at Kennedy Space Center Archives.

C. INTERVIEWS

Christy, Howard, RPSF Manager, Personal Communication, February 24, 2010.

Morales, Art. George C. Marshall Space Flight Center Office of the Director Shuttle - ARES Transition Office. Interview with author. September 27, 2011.

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Sverdrup Corporation: Company History. http://www.fundinguniverse.com/company-histories/Sverdrup-Corporation-Company-History.html. Accessed November 17, 2011.

United Space Alliance

"Marine Operations, Revision J." (John F. Kennedy Space Center, n.d.), MO-1.

"Structures Assembly Buildup Operations, Revision J" (John F. Kennedy Space Center, n.d.).

McQade, Thomas J., Donna A. McQuade, and George Bail. "George H. Bail AIA" (Fort Myers, FL: American Institute of Architects FLASW and The Southwest Florida Museum of History, 2011), 1. http://mcmo-swfl.com/bio/Bail-%20George%20H%20-%20Narrative.pdf. Accessed November 17, 2011.

F. LIKELY SOURCES NOT YET INVESTIGATED

Research was conducted at KSC using primary and secondary sources. Sources that were not investigated that may contain secondary information include NASA Headquarters and at the

offices of the various architects and contractors that constructed the buildings of the Hangar AF Complex.

Additional oral history interviews with other engineers and technicians could also prove useful.

V. PROJECT INFORMATION

NASA determined that the SRB Disassembly & Refurbishment Complex was eligible to the NRHP as a historic district under Criterion A in the area of Space Exploration. Hangar AF was considered a contributing resource to that district. This determination was made by NASA's "Shuttle Transition Historic Preservation Working Group" or HPWG, which looked at 335 facilities at thirteen NASA Centers.[17] As a result of this work, seventy properties were identified as either listed, determined eligible, or were potentially eligible to the National Register. Out of twelve property types identified for NASA's SSP, the SRB Disassembly and Refurbishment Complex was identified as Type 2, which includes Resources Associated with Vehicle Processing Facilities.[18] NASA completed this evaluation as the SSP was scheduled for termination in 2011.

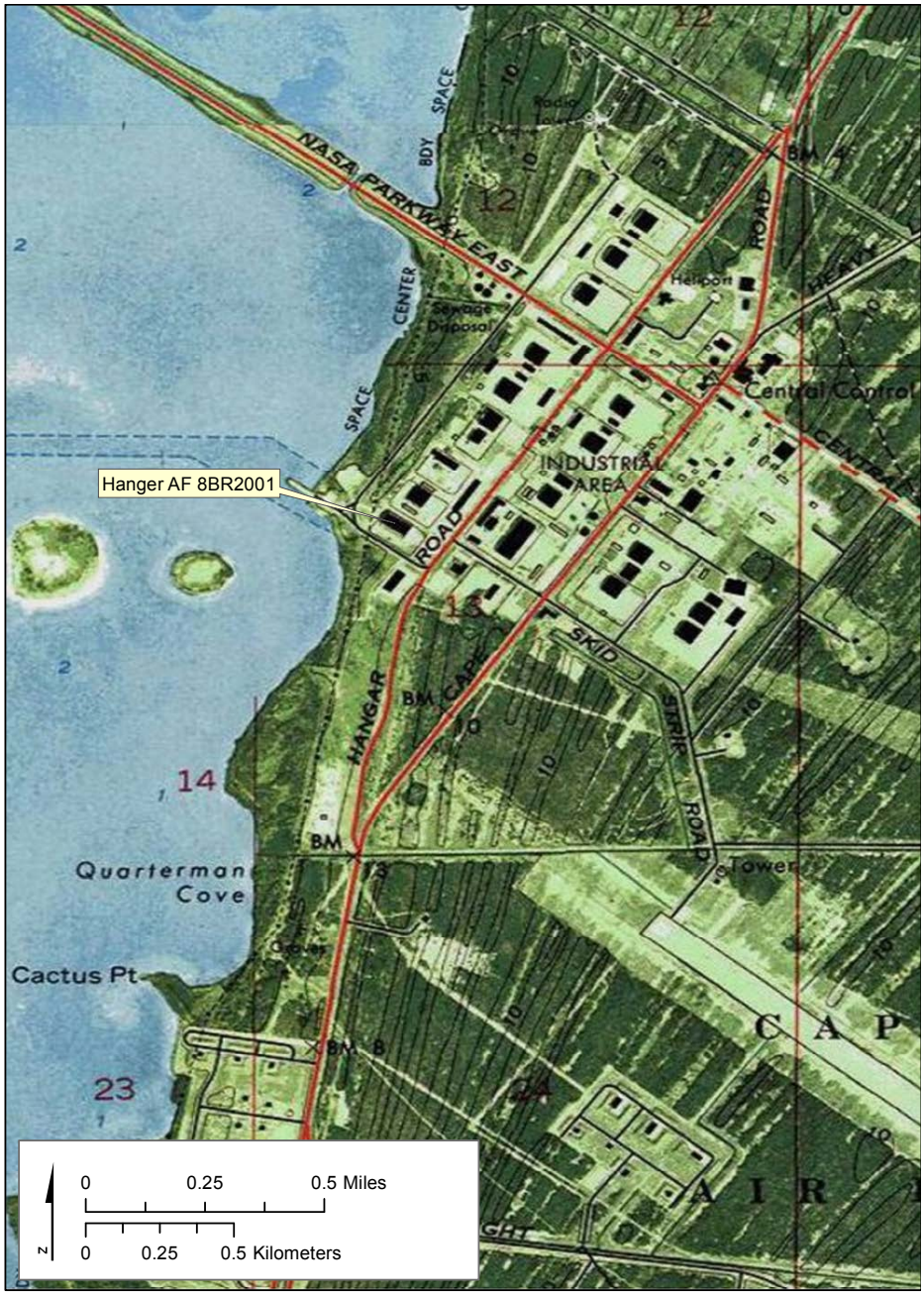
A Programmatic Agreement (PA) was developed to document the identified eligible resources and streamline the Section 106 consultation process. Per Section V.A of the PA between NASA, the Advisory Council on Historic Preservation (ACHP), and the Florida State Historic Preservation Officer (SHPO), dated May 2009, and the Statement of Work provided to New South Associates by KSC/InoMedic Health Applications (IHA), as part of the Task Order Contract, dated August 2011, the

[17] Deming and Slovinac, *Evaluation of Historic Facilities, Space Shuttle Program*, 5.11.
[18] Deming and Slovinac, *Evaluation of Historic Facilities, Space Shuttle Program*, 5.11.

documentation package for the SRB Disassembly & Refurbishment Complex includes the following items: a written narrative; a series of photographs showing both exterior and interior views using large format negatives; and a selection of existing drawings, which were photographed with large format negatives. This HAER documentation fulfills the recordation requirements of the PA for the district.

New South Associates, under contract with IHA, a subcontractor to NASA, conducted the HAER documentation and historic research for this project in September and October 2011. Therefore, NASA is completing HAER documentation of the complex and other KSC properties to record these as they appear and as they existed during the SSP. David Diener served as the project photographer. Julie Coco served as Principal Investigator, while David L. Price served as Project Historian.

In order to complete the project, New South Associates personnel were allowed full access to the facility, under the supervision of Barbara Naylor, KSC Historic Preservation Officer, and Nancy English, Cultural Resources Specialist. Photographs were taken of each building's interior, exterior, and context. David L. Price conducted a limited number of oral interviews and otherwise compiled the historic documentation required for the project. The following people were interviewed for this project: David Price, Hangar AF Facility Manager, United Space Alliance; Art Morales, George C. Marshall Space Flight Center, Office of the Director Shuttle - ARES Transition Office; and Dave Pappalardo, United Space Alliance, TVC Technician. Elaine Liston, KSC Archivist, provided a wealth of information from her office in the KSC Headquarters Building.



Source: USGS 7.5 Minute Topographic Quadrangle Map, Orsino, FL (1976)

Figure 1. USGS Map Showing the Location of the SRB Disassembly & Refurbishment Complex, Hangar AF.

Source: ESRI Resource Data, Imagery Layer

Figure 2. Aerial Photograph Showing the Location of the SRB Disassembly & Refurbishment Complex, Hangar AF.

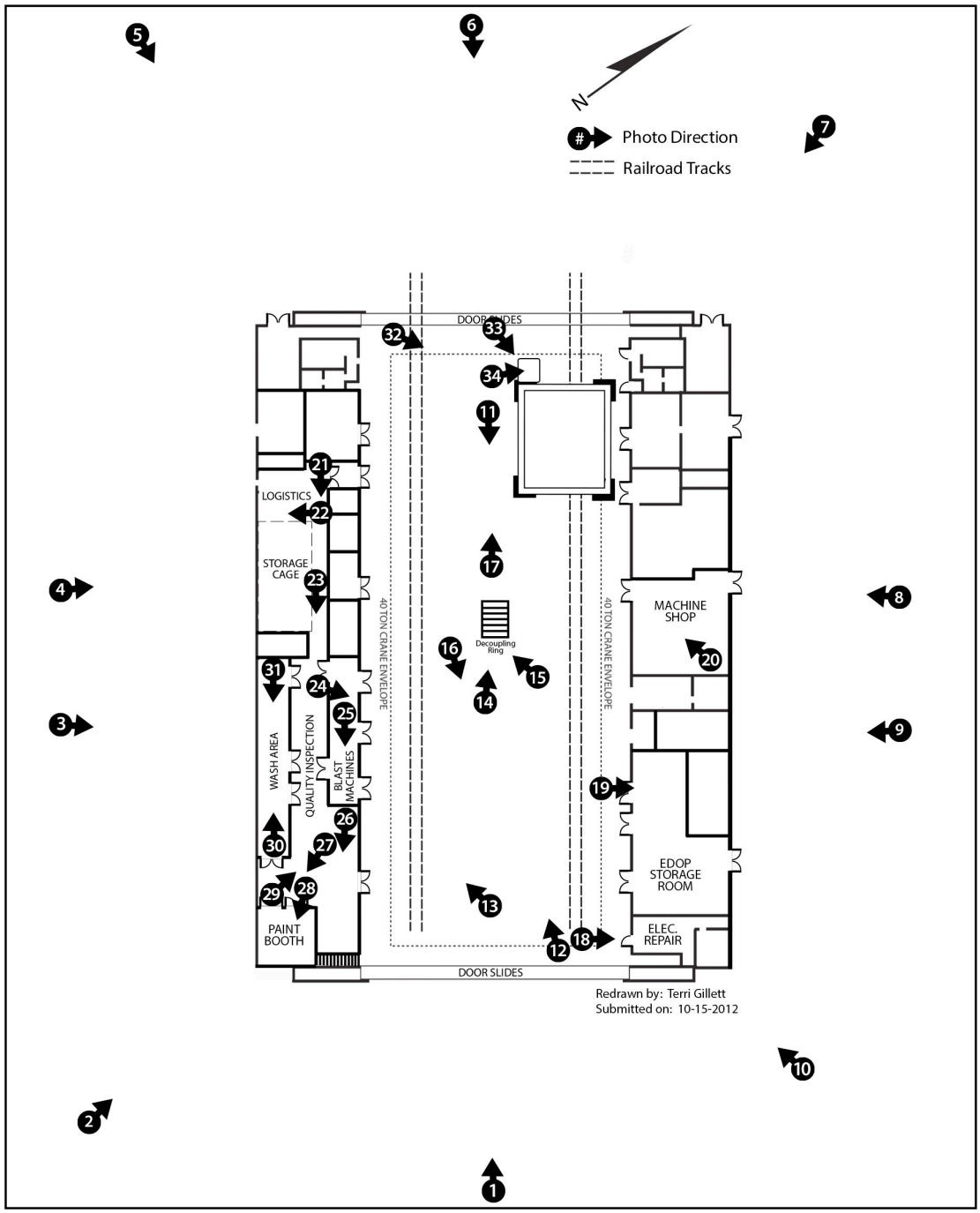


Figure 3. Photograph key for HAER NO. FL-8-11-S-1.