CAPE CANAVERAL AIR FORCE STATION,
LAUNCH COMPLEX 39, NASA KSC
RAILROAD SYSTEM HISTORIC DISTRICT
(John F. Kennedy Space Center)
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-A

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
U.S. Department of the Interior
100 Alabama Street, SW
Atlanta, GA 30303

HISTORIC AMERICAN ENGINEERING RECORD

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Location: John F. Kennedy Space Center (KSC)
Cape Canaveral
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The National Aeronautics and Space Administration (NASA) KSC Railroad System Historic District (Figure A-2) extends from the Jay Jay Yard, adjacent to the Florida East Coast Railway (FEC) mainline, near Titusville, Florida, located at latitude: 28.651050, longitude: -80.818562, east to the Wilson's Corner area, located at latitude: 28.645051, longitude: -80.697245. From there it extends south to the southern end of the Locomotive Maintenance Facility (LMF), ending at latitude: 28.561522, longitude: -80.654170. There is a small branch that extends west to the Suspect Siding Yard near the Shuttle Landing Facility (SLF), which ends at latitude: 28.631946, longitude: -80.696033, and another small branch that extends east to the Rotation, Processing, and Surge Facility (RPSF), ending at latitude: 28.590937, longitude: -80.653876. The Jay Jay Railroad Draw Bridge (Jay Jay Bridge) is located at latitude: 28.650673, longitude: -80.806844; these coordinates represent the center of the main span. The three locomotives and two aft skirt railcars are parked at the LMF. These coordinates were obtained on December 11, 2012, through Google Earth™. The coordinates datum are North American Datum 1983.

Present Owner/
Occupant: National Aeronautics and Space Administration
Kennedy Space Center, FL 32899-0001

Present Use: Transportation facility

Significance: The NASA KSC Railroad System Historic District is considered eligible for inclusion in the National Register of Historic Places in the context of the U.S. Space Shuttle Program (ca. 1969 - 2011) under Criterion A for its significant historical associations in the areas of Space Exploration and Transportation. Because it has achieved exceptional national significance in the last fifty years, Criteria Consideration G applies. The district includes roughly 19 miles of track, the Jay Jay Bridge, three locomotives (Locomotive Nos. 1, 2, and 3), and two solid rocket booster (SRB) aft skirt railcars (NLAX 170 and NLAX 171). Its period of significance

extends from 1978, when the first flight-ready solid rocket motor (SRM) segments arrived at KSC, to 2010, when the final set of SRM segments arrived at the Center. The railroad track, including the bridge, was used throughout the Space Shuttle Program (SSP) to carry fueled and spent SRM segments between KSC facilities and the Jay Jay Yard by one of the three locomotives. In addition, the railroad supported the delivery of SRB aft skirts, forward skirts, and frustums from California to KSC, via the NLAX 170 and NLAX 171 railcars.

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March 2013

Project Information: The documentation of the Cape Canaveral Air Force Station (CCAFS), Launch Complex 39, NASA KSC Railroad System Historic District was conducted in 2012-2013 for KSC by ACI, under contract to InoMedic Health Applications (IHA), and in accordance with KSC's Programmatic Agreement Regarding Management of Historic Properties, dated May 18, 2009. The field team consisted of architectural historian, Patricia Slovinac (ACI), and independent photographer, Penny Rogo Bailes. Assistance in the field was provided by Barbara Naylor, KSC Historic Preservation Officer, Nancy English, KSC Cultural Resource Specialist, and John Thiers, KSC Railroad Manager/Logistics Management Specialist. The written narrative was prepared by Ms. Slovinac; it was edited by Joan Deming, ACI Project Manager; Elaine Liston, KSC Archivist; Ms. Naylor and Ms. English of KSC; and Jane Provancha, Environmental Projects-Manager, IHA. The photographs and negatives were processed by Zebra Color, Inc., an independent photography/processing studio.

The Scope of Services for the project, which was written based on the Programmatic Agreement, specifies a documentation effort following HAER Level II Standards. Information for the written narrative was primarily gathered through informal interviews with current NASA and contractor personnel and research materials housed at the KSC Archives Department and the KSC Transportation Office. Selected drawings were provided by KSC's Engineering Documentation Center, which serves as the repository for all facility drawings. For the Railroad System, this

included some of the original as-built drawings. It should also be noted that KSC does not periodically produce drawings of their facilities to show current existing conditions.

LIST OF ACRONYMS

ACI	Archaeological Consultants, Inc.
ACOE	Army Corps of Engineers
CCAFS	Cape Canaveral Air Force Station
ET	External Tank
FEC	Florida East Coast Railway
GSE	Ground Support Equipment
IHA	InoMedic Health Applications
ISS	International Space Station
JSC	Johnson Space Center
KSC	Kennedy Space Center
LC	Launch Complex
LMF	Locomotive Maintenance Facility
MSFC	Marshall Space Flight Center
NASA	National Aeronautics and Space Administration
OV	Orbiter Vehicle
RPSF	Rotation, Processing and Surge Facility
SLF	Shuttle Landing Facility
SRB	Solid Rocket Booster
SRM	Solid Rocket Motor
SSP	Space Shuttle Program
STS	Space Transportation System
U.S.	United States
VAB	Vehicle Assembly Building

Part I. Historical Information

A. Physical History:

1. **Date of construction:** The original lengths of railroad track were installed between 1963 and 1965, and the Jay Jay Bridge was constructed circa 1963 (Figure No. A-1; Figure No. A-2 denotes those portions of the railroad track that are considered to be contributing to the historic district).[1] Locomotive No. 1 was built in 1968, and Locomotive Nos. 2 and 3 were built in 1970. The two aft skirt rail cars, NLAX 170 and NLAX 171, were fabricated in 1985.[2]

2. **Engineers:** The engineers for the railroad track included the U.S. Army Corps of Engineers (ACOE), Jacksonville District and Maurice H. Connell & Associates, Miami, Florida. The engineers for the Jay Jay Bridge included Maurice H. Connell & Associates, and Nashville Bridge Company and L. O. Hopkins & Sons, Inc., the latter two of Nashville, Tennessee.[3] General Motors designed the locomotives; Nelson Associates of Springfield, Virginia, was the design engineer for NLAX 170 and NLAX 171.[4]

3. **Builder:** The FEC constructed the portion of the railroad track between the Jay Jay Yard and Wilson's Corner; the joint venture of B. B. McCormick and Bailes-Sey, both of Jacksonville, Florida, constructed the remainder of the track (Figure No. A-2). General

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[1] At the time of construction, the 7.5-mile section of railroad track between the Jay Jay Yard and Wilson's Corner, which included the Jay Jay Bridge, was owned and operated by the FEC; the remaining track was owned by NASA KSC and operated by the FEC. NASA KSC, *The NASA Railroad*, NASA Facts (Florida: Kennedy Space Center, 2007), http://www.nasa.gov/centers/kennedy/pdf/192935main_RRtrain08.pdf. Of the roughly 38 miles of track within the NASA KSC Railroad System, only the approximately 19 miles used to support the transport of SRB components are considered contributing to the Historic District. ACI, "Historical Survey and Evaluation of the Jay Jay Bridge, Railroad System, and Locomotives, John F. Kennedy Space Center, Brevard County, Florida," (Survey report, NASA KSC, 2012); Robert F. Bendus (Florida State Historic Preservation Officer), "DHR Project File Number: 2012-4670" (response letter to survey report, KSC, October 2012), on file, Florida Division of Historical Resources, Tallahassee, FL.

[2] Folder "Locomotive 1, 2/68, Formerly TP&W [Toledo, Peoria and Western Railroad] 303," KSC Transportation Office, Florida; Folder "6670-5-170," KSC Transportation Office, Florida; Folder "6670-5-171," KSC Transportation Office, Florida.

[3] Maurice H. Connell & Associates, Miami, "Railroad Trackage Construction" (architectural drawings, FEC, June 1963), on file, KSC Engineering Documentation Center, Florida; Maurice H. Connell & Associates, Miami, "New Line to Merritt Island, Bridge Across Indian River" (architectural drawings, FEC, May 1963), on file, KSC Engineering Documentation Center, Florida; Nashville Bridge Company, Nashville, "Hopkins Trunnion Bascule Bridge" (architectural drawings, FEC, July 1963), on file, KSC Engineering Documentation Center, Florida; L. O. Hopkins & Sons, Nashville, "Single Track Railway Bascule" (architectural drawings, FEC, June 1963), on file, KSC Engineering Documentation Center, Florida.

[4] Folder "Locomotive 1, 2/68;" Folder "6670-5-170;" Folder "6670-5-171."

Motors built the locomotives, and the Davidson-Kennedy Company of Atlanta, Georgia, built NLAX 170 and NLAX 171. Research did not indicate the builder of the Jay Jay Bridge.[5]

4. **Original plans and construction:** At the time of documentation, the railroad track and Jay Jay Bridge maintained their original alignment. As originally constructed, the track was 100- or 112-pound jointed steel rail with wood crossties and limestone ballast. The Jay Jay Bridge retained the majority of its original construction materials, including the concrete foundation and bridge pit, steel bascule, and machinery. Likewise, the three locomotives and two rail cars retained their original form and materials.

5. **Alterations and additions:** In 1974, a railroad spur, about 1 mile long, was constructed to the SLF, and in 1977, a spur was constructed into the two west high bays of the Vehicle Assembly Building (VAB) for the delivery of SRB motor segments; the VAB spur was removed circa 2000 as part of the 'safe haven' project.[6] Between 1982 and 1984, a 115-ton railroad track was constructed through the RPSF.[7] Between 1983 and 1986, NASA replaced the original track with 132-pound continuous-welded rail and a combination of concrete and wood crossties. Around the same time, the original limestone ballast was replaced with granite.[8] Some of the Jay Jay Bridge's steel girders have been replaced because of deterioration, and the walkway along the north has been replaced multiple

[5] "MILA RR Bids Announced; Water Contract Awarded," *Spaceport News*, June 27, 1963: 1; "Merritt Island Railroad nears Completion Date," *Spaceport News*, November 27, 1963: 3; NASA KSC, *The NASA Railroad*; Folder "Locomotive 1, 2/68;" Folder "6670-5-170;" Folder "6670-5-171."

[6] The "safe haven" project included the restoration of the original Crawlerway segment into the VAB's southwest High Bay during hurricane season. If sustained winds were 69 miles per hour or greater, a stacked vehicle at the launch pad could be returned to the southwest high bay (High Bay No. 2) in the VAB, leaving the northeast and southeast high bays (High Bay Nos. 3 and 1, respectively) open for vehicle stacking operations. See Patricia Slovinac, "Cape Canaveral Air Force Station, Launch Complex 39, Vehicle Assembly Building (John F. Kennedy Space Center)," HAER No. FL-8-11-B. Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, July 2009, 14 and Patricia Slovinac, "Cape Canaveral Air Force Station, Launch Complex 39, Crawlerway (John F. Kennedy Space Center)," HAER No. FL-8-11-P. Historic American Engineering Record (HAER), National Park Service, U.S. Department of the Interior, September 2012, 9.

[7] ACI, "Survey and Evaluation of NASA-owned Historic Facilities and Properties in the Context of the U.S. Space Shuttle Program, John F. Kennedy Space Center (KSC), Brevard County, Florida," (Survey report, NASA KSC, 2007); KSC Railroad Information, Box 3, Folder "6670-2-1982," Kennedy Space Center Archives Department Collection, Florida.

[8] KSC Railroad Information, Box 3, Folder "6670-2-1983," Kennedy Space Center Archives Department Collection, Florida.

times.[9] In 2004, Locomotive No. 1 received a new, custom-built lube system, and in 2008, Locomotive No. 3 was repainted.[10]

B. Historical Context:

Following the launch of Sputnik I and Sputnik II, which placed Soviet satellites into Earth's orbit in 1957, the attention of the American public turned to space exploration. President Dwight D. Eisenhower initially assigned responsibility for the U.S. Space Program to the Department of Defense. The Development Operations Division of the Army Ballistic Missile Agency, led by Dr. Wernher von Braun, began to focus on the use of missiles to propel payloads, or even a man, into space. The United States successfully entered the space race with the launch of the Army's scientific satellite Explorer I on January 31, 1958, using a modified Jupiter missile named Juno I.[11]

With the realization that the military's involvement in the space program could jeopardize the use of space for peaceful purposes, President Eisenhower formed NASA on October 1, 1958, as a civilian agency with the mission of carrying out scientific aeronautical and space exploration, both manned and unmanned. Initially working with NASA as part of a cooperative agreement, President Eisenhower officially transferred to NASA a large portion of the Army's Development Operations Division, including the group of scientists led by Dr. von Braun, and the Saturn rocket program.[12]

NASA became a resident of Cape Canaveral in 1958 when the Army Missile Firing Laboratory, then working on the Saturn rocket project under the direction of Dr. Kurt H. Debus, was transferred to the agency. Several Army facilities at CCAFS were given to NASA, including various offices and hangars, as well as launch complexes (LCs) 5, 6, and 26. The Missile Firing Laboratory was renamed Launch Operations Directorate and became a branch office of Marshall Space Flight Center (MSFC). As the American space program evolved, the responsibilities of the Launch Operations Directorate grew, and NASA Headquarters separated the Directorate from MSFC, officially designating it an independent field installation called the Launch Operations Center.[13]

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[9] Frank Washburn (KSC Bridge Engineer), personal communication (informal interview) with Patricia Slovinac and Christopher Berger (ACI), January 26, 2012, notes on file, ACI, Sarasota, Florida.
[10] George Diller, "Railroad Crew gets Locomotive Back on Track," *Spaceport News*, March 26, 2004: 3; "Scene Around Kennedy Space Center," *Spaceport News*, November 28, 2008: 5.
[11] Charles D. Benson and William B. Faherty, *Gateway to the Moon. Building the Kennedy Space Center Launch Complex* (Gainesville: University Press of Florida, 2001), 1-2.
[12] Benson and Faherty, *Gateway*, 15.
[13] Benson and Faherty, *Gateway*, 136.

During a speech in May 1961, President John F. Kennedy set a goal to land a man on the Moon by the end of the 1960s. Upon NASA's decision to use the powerful Saturn V launch vehicle, it was apparent that a new launch complex was required, and CCAFS, already with twenty-two launch complexes, did not have available land for new rocket facilities. Merritt Island, an undeveloped area west and north of the Cape, was investigated along with eight other sites in Florida, Georgia, Texas, the Bahamas, Hawaii, and New Mexico. The Merritt Island site won this competition and in 1961, the Merritt Island Launch Area was established. Eventually, the Merritt Island Launch Area incorporated the Launch Operations Center as part of its jurisdiction; the entirety was renamed the John F. Kennedy Space Center in November 1963 following the death of the President.[14]

With the ACOE acting as purchasing agent, NASA began gaining title to the land in late 1962, taking over 83,903.9 acres by outright purchase. Included in this purchase were several small towns, such as Orsino, Wilson, Heath, and Audubon, in addition to farms, citrus groves, and several fish camps. Negotiations with the State of Florida provided submerged lands, resulting in the acquisition of property identified on the original Deed of Dedication. Much of the State-provided land was located south of the old Haulover Canal and north of the barge canal. With the newly purchased land, NASA designed a "Spaceport," formulated around the requirements of the Apollo Program. The original master plan for the Center depicted a railroad system (Figure No. A-3), to be used as a means "to provide railroad car delivery of construction supplies," and later for "delivery of operations and maintenance supplies and equipment in connection with [Apollo] launches."[15]

Circa 1962, NASA and the ACOE reached an agreement with the FEC for the construction and operations of a railroad system within KSC.[16] Per the agreement, the FEC would construct an approximately 7.5 mile long railroad extension from their track at the Titusville/Cape Canaveral Junction on the west shore of the Indian River to Wilson's Corner, located near the intersection of Kennedy Parkway North and State Road 402. The FEC also was contracted to build a seven-track yard, the Jay Jay Yard, at the Titusville/Cape Canaveral Junction, and a second, seven-track yard, the Wilson Yard, just west of Wilson's Corner.[17] All construction materials except for the

[14] Benson and Faherty, *Gateway*, 65-68, 96-98, 105, 133-137, 146-48.
[15] "MILA RR Track Bids to be Opened Soon," *Spaceport News*, May 29, 1963: 2.
[16] The FEC began on December 31, 1885, when Henry M. Flagler purchased the Jacksonville, St. Augustine & Halifax River Railway, a 38-mile line that ran from Jacksonville to St. Augustine. Over the next few years, Flagler expanded his holdings along Florida's East Coast through the acquisition of existing lines and the construction of new lines, extending all the way to Key West by 1912. The FEC was still operational at the time of this documentation effort. Seth Bramson, *Speedway to Sunshine* (Ontario, Canada: The Boston Mills Press, 1984); Sidney Johnston and Barbara Mattick, *Multiple Property Documentation Form: Florida's Historic Railroad Resources* (Tallahassee, FL: Florida Division of Historical Resources, 2001); George W. Pettengill, Jr., "The Story of the Florida Railroads, 1834-1903," *Railway and Locomotive Historical Society* 86 (July 1952): 1-132.
[17] NASA KSC, *The NASA Railroad*.

ballast were materials the FEC salvaged when it removed its mainline double track ca. 1961.[18]

Also included in the agreement between NASA and the FEC was the construction of the Jay Jay Bridge, a single-leaf, bascule bridge, that would carry the railroad track across the Indian River (Figure No. A-4). The approach spans for the bridge were designed by Maurice H. Connell and Associates; the bascule main span was designed by the Nashville Bridge Company and L. O. Hopkins. The as-built drawings indicate that fill was dredged from the bottom of the Indian River to create an approximately 1,500'-long peninsula on the west side of the river and an approximately 2,000'-long peninsula on the east.[19]

While the FEC controlled construction of the track between Titusville and Wilson's Corner, the ACOE maintained responsibility for the construction of an approximately 28-mile rail system in what would become the approximate 3,800-acre restricted area of KSC. This portion of the system consisted of two tracks, which split just east of Wilson's Corner (Figure Nos. A-2, A-3, A-5). One track, known as the east branch, extended eastward toward the Atlantic Ocean/Playalinda Beach, before turning southeast to pass by LC 39, Pads A and B and extending to the boundary between KSC and CCAFS. There it connected to 22 miles of track at the CCAFS Titan Launch Complex.[20] The second track, known as the west branch, traveled south from Wilson's Corner, past the VAB Area, and into the Industrial Area of KSC.[21] Like the FEC portion of the railroad, the sections within the KSC restricted area were 100- or 112-pound jointed rail with wood crossties and limestone ballast. The ACOE, however, paid for all new materials, although it was later discovered that the contractors used salvaged materials.[22]

On June 20, 1963, the ACOE opened bids for the construction of its portion of the KSC railroad system (Figure No. A-6). The lowest bid of roughly $2.4 million was submitted by A. S. Wickstrom, Inc., of Skaneateles, New York. However, the contract was awarded to the joint venture of B. B. McCormick and Bailes-Sey at a cost of around $2.5 million. The contract called for completion within 180 calendar days (about January 1964), which coincided with the

[18] Dave Hoffman (retired NASA KSC Railroad Manager), personal communication (telephone interview) with Patricia Slovinac (ACI), February 2, 2012, notes on file, ACI, Sarasota, Florida.
[19] Maurice H. Connell and Associates, "Bridge Across Indian River."
[20] "We've Been Working on the Railroad," *Spaceport News*, October 26, 1984: 6-7. This portion of the track is not considered contributing to the Historic District because it did not directly support the movement of SRB components (see Footnote No. 1).
[21] "MILA RR Track Bids to be Opened Soon," *Spaceport News*, May 29, 1963: 2. The portion extending south past the LMF is not considered contributing to the Historic District because it did not directly support the movement of SRB components (see Footnote No. 1).
[22] Hoffman, personal communication, February 2, 2012.

scheduled delivery of large quantities of steel for the VAB.[23] However, because of a FEC labor strike, the NASA KSC railroad was not completed in its entirety until 1965.[24]

At the outset of construction, NASA, as well as the Air Force, projected 300,000 carloads of materials to be delivered to KSC by the railroad over the first five years, including the river rock for the Crawlerway. Based on this figure, the FEC agreed to supply the money for the construction, operation, and maintenance of their 7.5-mile section, as well as the operation and maintenance of the 28-mile portion built by NASA/ACOE; the funds were to come from a "modest switching charge" for the shipment of the loaded railcars. By 1969, the actual traffic over the railroad amounted to only around 10 percent of the projected totals, most of which was along the west branch.[25] This led the FEC to file a lawsuit against NASA over lost revenue; the lawsuit would not be settled until 1983.[26]

The railroad remained as originally designed and constructed until 1974, when a railroad spur, about 1 mile long, was constructed from the west branch of the track to the SLF. The tracks were used by the SLF contractors to bring rough aggregate and cement into KSC for the construction of the SLF Runway (Figure No. A-7). Railroad cars hauled an estimated 500,000 barrels of cement for the 15,000'-long, 300'-wide landing strip.[27]

The advent of the SSP also "renewed interest in rail transportation as the most practical method of shipping the SRB segments."[28] Each Space Shuttle carried twin SRBs, each comprised of one SRM and several non-motor elements. The SRM consisted of four motor segments, which contained the fuel to power the SRBs. The SRMs were manufactured by the Thiokol Company in Utah; Thiokol also refurbished the SRMs and reloaded them with propellant following launch and recovery. The major non-motor segments included the nose cap, frustum, and forward and aft skirts. These structural components contained the electronics to guide the SRBs during liftoff, ascent, and external tank (ET)/SRB separation, and also housed the parachutes, which slowed the descent of the reusable boosters into the Atlantic Ocean after their jettison from the spacecraft.

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[23] "MILA RR Bids Announced; Water Contract Awarded," *Spaceport News*, June 27, 1963: 1; "Merritt Island Railroad nears Completion Date," *Spaceport News*, November 27, 1963: 3.
[24] "Transportation Office Releases 1965 Report," *Spaceport News*, December 31, 1964: 4. On January 23, 1963, FEC employees began a strike over management's refusal to honor an industry-wide pay raise. For almost nine years, court battles, negotiations, political pressures, regulatory rulings, and acts of sabotage clouded FEC's daily operations, until December 1971, when FEC finally reached an agreement with its workers. Bramson, *Speedway to Sunshine*; David P. Morgan, "Where did the railroad go that once went to sea?" *Trains* (Waukesha, WI: Kalmbach Publishing Company, 1975).
[25] Dave Hoffman, "KSC Assessment of Railroad Maintenance 1983-1990," April 26, 1983, Sweetsir Collection, Railroad Information, Box 3, Folder No. 6670-2-1983, Kennedy Space Center Archives Department, Florida.
[26] See Page 12. Folder No. Railroad Info., KSC Transportation Office, Florida; Hoffman, February 2, 2012.
[27] "Work on Shuttle Runway Begins," *Spaceport News*, April 4, 1974: 5.
[28] "Working on the Railroad."

Because of the size of the SRM segments (12'-diameter and approximately 150 tons each), and hazardous nature, shipment by rail between Utah and KSC was the only practical means of transportation.[29] Thus, in 1977, a spur was constructed from the west branch of the railroad into the two western VAB high bays for the delivery of the SRM segments (Figure Nos. A-8, A-9). The subcontractor for the work was a private firm called Kennedy Railroad of Harrisburg, Pennsylvania; ironically, the president of the company was John Kennedy. The spur was ready for use in 1978.[30]

To support the railroad operations, in January 1976, NASA KSC acquired two Alco S-2 diesel locomotives for $111,870 from the Defense Property Disposal Office, Seneca Army Depot in New York (Figure No. A-10). The 115-ton capacity locomotives were designed for heavy-duty road and switching service.[31] Following purchase, the locomotives were overhauled in June 1978 by Johnson Railway Service, Inc. at their shop in Cornelia, Georgia. The locomotives were painted black and white prior to their delivery to KSC in July 1978.[32] In conjunction with the purchase of the locomotives, KSC's Design Engineering Branch developed the layout for the LMF, which was constructed south of the VAB along Contractor Road. As part of the effort, in 1978, KSC purchased an old Army Signal Corps car (U.S. Army 87325) for use as an office/tool room.[33]

In the early 1980s, railroad operations increased to the point that almost daily round trips to the Jay Jay Yard were necessary to pick up and deliver cars from/to FEC's mainline connection. In many instances, there were simultaneous runs of two locomotives and dual train crews, as the trains were typically ten and twenty cars long.[34] Around the same time, KSC technicians made the decision to move SRB operations from the VAB to a separate facility, what would become the RPSF, located to the north of the VAB. The RPSF was a complex of three buildings, one of which, the Rotation/Processing Building, was specifically constructed for rotating the SRM segments from horizontal, as delivered, to vertical, for stacking. Construction of the RPSF occurred between 1982 and 1984. To assist in the delivery of the SRM segments, a 115-ton

[29] Anna Heiney, "NASA KSC Railroad Played Vital Role in Shuttle Booster Haul," *Spaceport News*, February 11, 2011: 6.
[30] "Photo Caption-Working on the Railroad," *Spaceport News*, May 27, 1977: 1. The VAB served as the processing area for the SRB/SRMs until the completion of the RPSF in 1984.
[31] The locomotives were manufactured in 1942 by the American Locomotive Company and used by the U.S. Army before they were purchased by NASA.
[32] Folder "Locomotive 1, 2/68."
[33] This car was constructed during World War II as a hospital car and remodeled in 1950 as the "Presidential Communications Car" that accompanied the "Ferdinand Magellan" armored Presidential Pullman whenever the U.S. President travelled by train. U.S. Army 87325, which became NLAX 150 upon its purchase by NASA, was retrofitted for duty by the newly hired railroad crew, which became part of the new Transportation Operations team within KSC. "KSC to Start Rail Operations," *Spaceport News*, March 17, 1978: 1-3.
[34] "Working on the Railroad."

railroad track was constructed through the RPSF, allowing KSC locomotives to transport segments directly to the facility (Figure Nos. A-11, A-12).[35]

In June 1983, as a result of the FEC's 1969 lawsuit, NASA purchased the 7.5-mile spur west of Wilson's Corner and undertook the complete operation and maintenance of the railroad, including the tracks, the Jay Jay Bridge, and crossings. Unfortunately, portions of the railroad were in poor condition after over fifteen years of exposure to the salty air and moist climate. Many of the wood cross ties were rotting, rust had eaten away much of the hardware, and the rail required strengthening to safely handle the hazardous loads. At that point, a three-year railroad repair project was implemented.[36]

The first step was hiring the Railroad Track Construction Corporation, a subsidiary of the FEC, to repair the tracks, bridge, and crossing signals. This included the replacement of more than 6 miles of track along the Atlantic Ocean that had succumbed to rust.[37] When originally constructed, the rail segments were bolted together. During the repairs, 1,000' segments of continuous welded rail replaced the original track segments that had been bolted together. Between 1984 and 1986, over 35,000 new, lower maintenance concrete cross ties were installed, principally in the west branch, which carried the SRM segments; this amounted to approximately one-third of the total ties. Wood cross ties were left at all track switches due to the flexibility of the material.[38] The work also included the repair of all road crossings associated with the railroad. When possible, workers used preassembled sections of track and cross ties to expedite the process. Most of the work occurred on the weekends, under the supervision of David Hoffman, then the NASA KSC Railroad Manager.[39]

At the same time, the Jay Jay Bridge underwent needed repairs. The channel lights and deteriorated bridge fenders were repaired in early 1985 by Inter-Bay Marine Construction, of Largo, Florida, and later that year the electrical system was rewired. The bridge was closed for seven days in early 1987 as a subcontractor, Ivey's Steel Erectors, of Merritt Island, Florida, replaced a deteriorated span.[40] In mid-1989, EG&G workers sandblasted and painted the bridge, work that limited boat passage to every hour and half-hour during the workday, and by August of

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[35] ACI, "Kennedy Space Center;" KSC Railroad Information, Box 3, Folder "6670-2-1982."
[36] Hoffman, "Railroad Maintenance;" KSC Railroad Information, Box 3, Folder "6670-2-1981," Kennedy Space Center Archives Department Collection, Florida; KSC Railroad Information, Box 3, Folder "6670-2-1983;" "Working on the Railroad;" Heiney, "Railroad Played Vital Role."
[37] This portion of track is not considered contributing to the Historic District (see Footnote Nos. 1 and 19).
[38] Bruce Chesson (KSC Transportation Officer, Alternative Fuel Vehicle Program), personal communication (informal interview) with Patricia Slovinac and Christopher Berger (ACI), January 24, 2012, notes on file, ACI, Sarasota, Florida; KSC Railroad Information, Box 3, Folder "6670-2-1983."
[39] "Working on the Railroad;" "Crossings to be Repaired," *Spaceport News*, September 28, 1984: 5; "Railroad Crossings undergo Overhaul," *Spaceport News*, January 18, 1985: 5.
[40] "Railroad Bridge Repairs Avoid Schedule Boggles," *Spaceport News*, March 27, 1987: 7.

that year, seven spans received additional reinforcement.[41] In 1993, the electrical system was reconfigured, and it has been updated since then. The exterior shell of the Control House was replaced in March 2008. Several more repairs have been made to the bridge over the years, including the installation of pile jackets; replacement of the track, ties, railing, walkways, piles, and fender system; and corrosion control and repainting.[42]

On July 22, 1983, NASA awarded a contract to the Davidson-Kennedy Company for the fabrication of two railcars (NLAX 170 and NLAX 171) to carry SRB non-motor components, including one frustum, one forward skirt, and two aft skirts, across the country (Figure Nos. A-13, A-14); design work for the car body was subcontracted to Nelson Associates. Each car cost $84,571 and arrived at KSC on April 19, 1985. The only two of their kind in the world, the NASA KSC railroad crew referred to them as "Carnival Cars" because of their unique appearance. For the remainder of the SSP, these two railcars carried SRB non-motor components between KSC, MSFC, and their manufacturing site in Los Angeles, California.[43]

On July 24, 1984, NASA acquired three used, as-is, multi-purpose switching locomotives (designated Locomotive Nos. 1, 2, and 3), made by General Motors' Electro-Motive Division, and powered by the Division's 645 engine (Figure No. A-15).[44] These SW-1500 locomotives contained most of the same parts as the FEC's newest locomotives, ensuring the availability of spare parts and maintenance assistance from the FEC. Once purchased, the locomotives were scheduled for minor repairs and a tune-up by the railroad crew, staffed by EG&G under the KSC Base Operations contract; the work included painting the locomotives in the NASA KSC railroad red, black, and gray color scheme (Figure No. A-16).[45] With this purchase, the two older Alco S-2 units were declared surplus and discarded.

In 2004, Locomotive No. 1 received a custom-built lube system designed by the railroad crew, due to a lubrication failure preventing the crankshaft and bearings from receiving oil. Because the vehicle had to be disassembled down to the engine block, other major maintenance was completed at the same time. In 2008, Locomotive 3 was painted black, blue, and white with red stripes as a result of a 15-month corrosion repair project (Figure No. A-17).[46]

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[41] "Drawbridge Painting Limits Boat Traffic," *Spaceport News*, April 21, 1989: 8.
[42] Washburn, personal communication, January 26, 2012; Frank Washburn, personal communication (telephone interview) with Christopher Berger (ACI), March 13, 2012, notes on file, ACI, Sarasota, Florida.
[43] Folder "6670-5-170," KSC Transportation Office, Florida; Folder "6670-5-171," KSC Transportation Office, Florida.
[44] These model SW-1500 diesel locomotives were built in 1968 (Locomotive 1) and 1970 (Locomotives 2 and 3), and originally were owned by the Toledo, Peoria and Western Railroad as numbers 303, 305, and 306, respectively.
[45] "Working on the Railroad."
[46] Diller, "Locomotive Back on Track;" "Scene Around Kennedy Space Center."

NASA's Early Manned Space Programs

Initially, NASA's space program was organized into three phases: Projects Mercury, Gemini, and Apollo. Project Mercury, initiated in 1958, was executed in less than five years. Begun in 1964, Project Gemini was the intermediate step toward achieving a manned lunar landing, bridging the gap between the short-duration Mercury flights and the long-duration missions proposed for the Apollo Program. Apollo, the largest and most ambitious of the manned space programs, had as its goal the landing of astronauts on the Moon and their safe return to Earth. Providing the muscle to launch the spacecraft was the Saturn family of heavy vehicles. Saturn IB rockets were used to launch the early unmanned Apollo test flights and the first manned flight, Apollo 7, which carried astronauts on a ten-day Earth orbital mission.[47]

Three different launch vehicles were used for Apollo: Saturn I, Saturn IB and Saturn V; and three different launch complexes were involved: LC 34 and LC 37 on CCAFS, and LC 39 on KSC.[48] Altogether, thirty-two Saturn flights occurred (seven from LC 34, eight from LC 37, and seventeen from LC 39 Pad A [twelve] and Pad B [five], including Skylab and the Apollo-Soyuz Test Project) during the Apollo era. Of the total thirty-two, fifteen were manned, and of the seven attempted lunar landing missions, six were successful. No major launch vehicle failures of either Saturn IB or Saturn V occurred. There were two major command/service module failures, one on the ground (Apollo 1) and one on the way to the Moon (Apollo 13).[49]

The unmanned Apollo 4 mission, which lifted off on November 9, 1967, was the first Saturn V launch and the first launch from LC 39 (Pad A) at KSC. The next launch from LC 39 (Pad A) was Apollo 6, on July 14, 1967. Beginning with the launch of Apollo 8 on August 14, 1968, all manned missions have launched from LC 39.[50] On July 20, 1969, the goal of landing a man on the Moon was achieved when Apollo 11 astronauts Neil A. Armstrong, Edwin E. "Buzz" Aldrin, Jr., and Michael Collins successfully executed history's first lunar landing. Armstrong and Aldrin walked on the surface of the Moon for two hours and thirty-one minutes, and collected 21 kilograms of lunar material. Apollo 17 served as the first night launch in December 1972. An estimated 500,000 people viewed the liftoff from LC 39 Pad A, which was the final launch of the Apollo Program.[51]

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[47] Harry A Butowsky, *Reconnaissance Survey: Man in Space* (Washington, DC: National Park Service, 1981), 5; Benson and Faherty, *Gateway*, 5.
[48] LC 39 is comprised of two launch pads, Pad A and Pad B. Unless otherwise noted, the term LC 39 refers to both launch pads.
[49] NASA, *Facts: John F. Kennedy Space Center* (1994), 82.
[50] Apollo 5 launched from CCAFS's LC 37B; Apollo 7 launched from LC 34 at KSC. Charles D. Benson and William B. Faherty, *Moon Launch! A History of the Saturn-Apollo Launch Operations* (Gainesville, FL: University Press of Florida, 2001), 532.
[51] NASA, *Facts*, 86-90.

Skylab, an Earth-orbiting mission that was a follow-on to the Apollo Program, served as an early type of space station. With 12,700 cubic feet of work and living space, it was the largest habitable structure ever placed in orbit at the time. The station achieved several objectives: scientific investigations in Earth orbit (astronomical, space physics, and biological experiments); applications in Earth orbit (Earth resources surveys); and long-duration spaceflight. Skylab 1 orbital workshop was inhabited in succession by three crews launched in modified Apollo command/service modules (Skylab 2, 3 and 4). Actively used until February 1974, Skylab 1 remained in orbit until July 11, 1979, when it re-entered Earth's atmosphere over the Indian Ocean and Western Australia after completing 34,181 orbits.[52]

The Apollo-Soyuz Test Project of July 1975, the final application of the Apollo Program, marked the first international rendezvous and docking in space, and was the first major cooperation between the only two nations engaged in manned space flight, the U.S. and Russia. As the first meeting of two manned spacecraft of different nations in space, and the first docking and visits by astronauts and cosmonauts into the others' spacecraft, the event was highly significant. The Apollo-Soyuz Test Project established workable joint docking mechanisms, taking the first steps toward mutual rescue capability of both Russian and American manned missions in space.[53]

The Space Shuttle Program

On January 5, 1972, President Richard M. Nixon delivered a speech in which he outlined the end of the Apollo era and the future of a reusable space flight vehicle, the Space Shuttle, which would provide "routine access to space." By commencing work at this time, Nixon added, "we can have the Shuttle in manned flight by 1978, and operational a short time after that."[54] The Space Task Group, previously established by President Nixon in February 1969, recommended three choices of long-range space plans. All included an Earth–orbiting space station, a space shuttle, and a manned Mars expedition.[55] Although none of the original programs presented was eventually selected, NASA implemented a program, shaped by the politics and economic realities of its time that served as a first step toward any future plans for implementing a space station.[56]

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[52] NASA, *Facts*, 91.
[53] NASA, *Facts*, 96.
[54] Marcus Lindroos, ed., "President Nixon's 1972 Announcement on the Space Shuttle," updated April 14, 2000, http://history.nasa.gov/stsnixon.htm.
[55] NASA, "Report of the Space Task Group, 1969," (Washington, DC: NASA Headquarters, 1969), http://www.hq.nasa.gov/office/pao/History/taskgrp.html.
[56] Dennis R. Jenkins, *Space Shuttle, The History of the National Space Transportation System. The First 100 Missions* (Cape Canaveral, Florida: Specialty Press, 2001), 99.

During this speech, President Nixon instructed NASA to proceed with the design and building of a partially reusable Space Transportation System (STS; commonly referred to as the Space Shuttle) consisting of a reusable orbiter, three reusable main engines, two reusable SRBs, and one non-reusable ET. NASA's administrators vowed that the Space Shuttle would fly at least fifty times a year, making space travel economical and safe. NASA gave responsibility for developing the Space Shuttle's orbiter vehicle and overall management of the SSP to the Manned Spacecraft Center (now known as the Johnson Space Center [JSC]) in Houston, Texas, based on the Center's experience. MSFC in Huntsville, Alabama, was responsible for development of the space shuttle main engine, the SRBs, the ET, and for all propulsion-related tasks. Engineering design support continued at JSC, MSFC, and NASA's Langley Research Center in Virginia, and engine tests were to be performed at NASA's National Space Technology Laboratories (later named Stennis Space Center) in south Mississippi, and at the Air Force's Rocket Propulsion Laboratory in California, which later became the Santa Susana Field Laboratory.[57] NASA selected KSC as the primary launch and landing site for the SSP. KSC, responsible for designing the launch and recovery facilities, was to develop methods for shuttle assembly, checkout, and launch operations.[58]

On September 17, 1976, the full-scale Orbiter Vehicle (OV) prototype *Enterprise* (OV- 101) was completed. Designed for test purposes only and never intended for space flight, structural assembly of OV-101 had started more than two years earlier in June 1974 at Air Force Plant 42 in Palmdale, California. Although the *Enterprise* was an aluminum shell prototype incapable of space flight, it reflected the overall design of the orbiter. As such, it served successfully in 1977 as the test article during the Approach and Landing Tests aimed at checking out both the mating with the Boeing 747 Shuttle Carrier Aircraft for ferry operations, as well as the orbiter's unpowered landing capabilities.

The first orbiter intended for spaceflight, *Columbia* (OV-102*)*, arrived at KSC from Air Force Plant 42 in March 1979. Originally scheduled for liftoff in late 1979, the launch date was delayed by problems with both the main engine components as well as the thermal protection system. *Columbia* spent 610 days in the Orbiter Processing Facility, another thirty-five days in the VAB and 105 days on LC 39A before lifting off on April 12, 1981. STS-1, the first orbital test flight and first SSP mission, ended with a landing on April 14, 1981, at Edwards Air Force Base in California. This launch demonstrated *Columbia's* ability to fly into orbit, conduct on-orbit

[57] Jenkins, *Space Shuttle*, 122.
[58] Linda Neuman Ezell, *NASA Historical Databook Volume III Programs and Projects 1969-1978*, The NASA History Series (Washington, DC: NASA History Office, 1988), 121-24, table 2-57; Ray A. Williamson, "Developing the Space Shuttle," in *Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program, Volume IV: Accessing Space*, ed. John M. Logsdon (Washington, DC: U.S. Printing Office, 1999), 172-174.

operations, and return safely.[59] *Columbia* flew three additional test flights in 1981 and 1982, all with a crew of two. The Orbital Test Flight Program ended in July 1982 with 95 percent of its objectives accomplished. After the end of the fourth mission, President Ronald W. Reagan declared that with the next flight the Shuttle would be "fully operational."

During the SSP, a total of 135 missions were launched from KSC. From April 1981 until the *Challenger* accident in January 1986, between two and nine missions were flown yearly, with an average of four to five per year. The milestone year was 1985, when nine flights were successfully completed. The years between 1992 and 1997 were the most productive, with seven or eight yearly missions. Since 1995, in addition to its unique responsibility as the Space Shuttle launch site, KSC also became the preferred landing site.

Over the past three decades, the SSP has launched a number of planetary and astronomy missions including the Hubble Space Telescope, the Galileo probe to Jupiter, Magellan to Venus, and the Upper Atmospheric Research Satellite. In addition to astronomy and military satellites, a series of Spacelab research missions were flown, which carried dozens of international experiments in disciplines ranging from materials science to plant biology. Spacelab was a manned, reusable, microgravity laboratory flown into space in the Space Shuttle cargo bay. It was developed on a modular basis allowing assembly in a dozen arrangements depending on the specific mission requirements.[60] The first Spacelab mission, carried aboard *Columbia* (STS-9), began on November 28, 1983. Four Spacelab missions were flown between 1983 and 1985. Following a stand-down in the aftermath of the *Challenger* disaster, the next Spacelab mission was not launched until 1990. In total, twenty-four Space Shuttle missions carried Spacelab hardware before the program was decommissioned in 1998.[61]

In 1995, a joint U.S./Russian Shuttle-*Mir* Program was initiated as a precursor to construction of the International Space Station (ISS). *Mir* was launched in February 1986 and remained in orbit until March 2001.[62] The first approach and fly around of *Mir* (STS-63) took place on February 3, 1995, and the first *Mir* docking (STS-71) was in June 1995. During the three-year Shuttle-*Mir* Program (June 27, 1995 to June 2, 1998), the Space Shuttle docked with *Mir* nine times. The Orbiter *Atlantis* flew all but the last two of these docking missions. In 1995, Dr. Norman Thagard was the first American to live aboard the Russian space station. Over the next three years, six more U.S. astronauts served tours on *Mir*. The Space Shuttle served as a means of

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[59] Jenkins, *Space Shuttle*, 268.
[60] NASA, *NSTS 1988 News Reference Manual* (Florida: Kennedy Space Center, 1988), http://science.ksc.nasa.gov/shuttle/technology/sts-newsref/.
[61] STS-90, which landed on May 3, 1998, was the final Spacelab mission. NASA KSC, "Shuttle Payloads and Related Information," *KSC Factoids* (Florida: Kennedy Space Center, 2002), http://www-pao.ksc.nasa.gov/kscpao/factoids/relinfo2.htm.
[62] Tony Reichhardt, ed., *Space Shuttle, The First 20 Years* (Washington, DC: Smithsonian Institution, 2002), 85.

transporting supplies, equipment, and water to the space station in addition to performing a variety of other mission tasks, many of which involved Earth science experiments. It returned experiment results and unneeded equipment to Earth. The Shuttle-*Mir* Program served to acclimate the astronauts to living and working in space. Many of the activities carried out were types they would perform on the ISS.[63]

On December 4, 1998, *Endeavour* (STS-88) launched the first U.S. component of the ISS into orbit. This event marked, "at long last the start of the Space Shuttle's use for which it was primarily designed – transport to and from a permanently inhabited orbital space station."[64] STS-96, *Discovery*, launched on May 27, 1999, marked the first mission to dock with the ISS. Since that time, most Space Shuttle missions supported the assembly of the space station. The last major component of the ISS was delivered in May 2011, during the final flight of *Endeavour* (STS-134).

The SSP suffered two major setbacks with the tragic losses of the *Challenger* and *Columbia* on January 28, 1986, and February 1, 2003, respectively. Following the *Challenger* accident, the program was suspended, and President Reagan formed a thirteen-member commission to identify the cause of the disaster. The Rogers Commission report, issued on June 6, 1986, which also included a review of the SSP, concluded "that the drive to declare the Space Shuttle operational had put enormous pressures on the system and stretched its resources to the limit."[65] In addition to mechanical failure, the Commission noted a number of NASA management failures that contributed to the catastrophe. As a result, among the tangible actions taken were extensive redesign of the SRBs; upgrading of the Space Shuttle tires, brakes, and nose wheel steering mechanisms; the addition of a drag chute to help reduce speed upon landing; the addition of a crew escape system; and the requirement for astronauts to wear pressurized flight safety suits during launch and landing operations. Other changes involved reorganization and decentralization of the SSP. NASA moved the management of the program from JSC to NASA Headquarters (Washington, DC), with the aim of preventing communication deficiencies.[66] Experienced astronauts were placed in key NASA management positions, all documented waivers to existing flight safety criteria were revoked and forbidden, and a policy of open reviews was implemented.[67] In addition, NASA adopted a Space Shuttle flight schedule with a reduced average number of launches and discontinued the long-term practice of launching

[63] Judy A. Rumerman, with Stephen J. Garber, *Chronology of Space Shuttle Flights 1981-2000* (Washington, DC: NASA History Division, 2000), 3.
[64] Williamson, "Developing," 191.
[65] Columbia Accident Investigation Board, *Report, Volume I*, (Washington, DC: U.S. Government Printing Office, 2003), 25, http://history.nasa.gov/columbia/CAIB_reportindex.html.
[66] Columbia Accident Investigation Board, *Report, Volume I*, 101.
[67] Cliff Lethbridge, "History of the Space Shuttle Program," 2001, http://spaceline.org/rocketsum/shuttle-program.html.

commercial and military payloads.[68] The launch of *Discovery* (STS-26) from LC 39B on September 29, 1988, marked a Return-to-Flight after a thirty-two-month stand-down in manned space flight following the *Challenger* accident.

In the aftermath of the 2003 *Columbia* accident, a seven-month investigation ensued, concluding with the findings of the Columbia Accident Investigation Board, which determined that both technical and management conditions accounted for the loss of the orbiter and crew. According to the Board's Report, the physical cause of the accident was a breach in the thermal protection system on the leading edge of the left wing, caused by a piece of insulating foam, which separated from the ET after launch and struck the wing.[69] NASA spent more than two years researching and implementing safety improvements for the orbiters, SRBs and ET. Following a two-year stand-down, the launch of STS-114 on July 26, 2005, marked the first Return-to-Flight since the loss of *Columbia*.

On January 14, 2004, President George W. Bush outlined a new space exploration initiative in a speech given at NASA Headquarters.

> *Today I announce a new plan to explore space and extend a human presence across our solar system . . . Our first goal is to complete the International Space Station by 2010 . . . The Shuttle's chief purpose over the next several years will be to help finish assembly of the International Space Station. In 2010, the Space Shuttle – after nearly 30 years of duty – will be retired from service. . .*[70]

Following the President's speech, NASA released *The Vision for Space Exploration*, which outlined the Agency's approach to the new direction in space exploration.[71] As part of this initiative, NASA decided that the Space Shuttle would not be upgraded to serve beyond the completion of the ISS; in 2011, after the last Space Shuttle Mission, STS-135, the SSP was officially retired.

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[68] Lethbridge, "History."
[69] Columbia Accident Investigation Board, *Report, Volume I*, 9.
[70] Weekly Comp. Pres. Docs., Remarks at the National Aeronautics and Space Administration, Vol. 40, Issue 3 (January 19, 2004), http://www.gpo.gov/fdsys/pkg/WCPD-2004-01-19/content-detail.html.
[71] NASA, *The Vision for Space Exploration* (Washington, DC: NASA Headquarters, 2004), http://www.nasa.gov/pdf/55583main_vision_space_exploration2.pdf.

Part II. Structural/Design Information

A. General Statement:

1. Character: The NASA KSC Railroad System Historic District is comprised of 19 miles of railroad track, the Jay Jay Bridge, three locomotives, and two railcars (Figure No. A-2). The railroad track is a standard gauge (4'-8.5") industrial short line, comprised of a single track; it has an approximate total width of 16' including the ballast. The Jay Jay Bridge is a roughly 2,058'-long, steel single-leaf bascule bridge, which carries the railroad track over the Indian River. At the bascule, the bridge has an approximate width of 33'; the remainder is roughly 14' wide. The three locomotives (Locomotive Nos. 1, 2, and 3) are standard General Motors' EMD SW1500 switching locomotives; the railcars (NLAX 170 and NLAX 171) are uniquely designed cars, based on a flatcar layout.

The NASA KSC Railroad System Historic District supported the SSP for three decades by transporting fueled SRM segments from the FEC mainline Titusville/Cape Canaveral Junction to several facilities within KSC, and returning the spent SRM segments from KSC to the FEC mainline.[72] In addition, NLAX 170 and NLAX 171 each carried four SRB non-motor components, one frustum, one forward skirt, and two aft skirts, between their manufacturing site in Los Angeles, California, and NASA's MSFC and KSC.

2. Condition of fabric: At the time of documentation, the railroad track, Jay Jay Bridge, Locomotive Nos. 1 and 3, and NLAX 170 and NLAX 171 were in good condition due to periodic maintenance. Locomotive No. 2 was in a deteriorated condition.

B. Description:

1. Railroad Track: The NASA KSC Railroad Track is comprised of 132-pound continuous-welded steel rail and a combination of concrete and wood crossties; the entirety is supported by granite ballast (Photo No. 8). The west boundary of the NASA KSC Railroad Track is the point where the track meets the FEC mainline at its Titusville/Cape Canaveral junction. Just to the east of this junction is the four-track Jay Jay Yard (Photo Nos. 1-3).[73] From Jay Jay Yard, the NASA KSC railroad crosses the Indian River via the Jay Jay Bridge (Photo No. 4), and then extends east for approximately 7 miles to Wilson's Corner (roughly the intersection of State Highway 402 and Kennedy Parkway North). Along the way, there are two yards, the

[72] The SRM segments were carried on railcars owned by Thiokol, as opposed to NASA.
[73] The Jay Jay Yard was reduced from its original seven-track to four tracks ca. 1986. KSC Railroad Information, Box 3, Folder "6670-2-1986," Kennedy Space Center Archives Department Collection, Florida.

West Wilson Yard (Photo No. 5), which consists of two tracks, and the Wilson Yard (Photo Nos. 6, 7), which consists of four tracks.

At Wilson's Corner, the railroad track splits into two branches: an east branch and a west branch (Figure Nos. A-1, A-2). The east branch, with a length of about 9 miles, extends eastward to Playalinda Beach, passes LC 39, Pads A and B, and ends at the boundary between KSC and CCAFS.[74] The west branch of the railroad, with a total length of approximately 11 miles, extends from Wilson's Corner to the KSC Industrial Area. Just over one-half mile from Wilson's Corner, there is a roughly 0.5-mile spur west toward the SLF; this spur ends at the Suspect Siding Yard (Photo No. 9). Approximately 4.5 miles south of Wilson's Corner, at the north end of the VAB Area, there is a roughly 1.7-mile spur that extends east toward the RPSF (Photo Nos. 10, 11). Just prior to reaching the RPSF, the spur splits into two, with one branch going into the facility, and the second continuing approximately 1.07 miles to the Compression/Converter Facility. Approximately 1 mile south of the RPSF spur is the roughly 0.83 mile-long, four-track LMF; the historic district ends at the south end of the LMF (Photo No. 12). The LMF contains various structures constructed between 1978 and 2010 to support maintenance operations for the railroad and railcars (Photo Nos. 13, 14). None of the structures is considered contributing to the historic district. From the LMF, the track continues roughly 3 miles south to the KSC Industrial Area.[75]

Within the Historic District boundaries, there are sixteen road crossings and forty-six switches. The crossings are all the same, and are typical of industrial short lines. Each features an at-grade intersection-the rail crosses through the asphalt so that the top of the track is even with the top of the road surface. On either side of the road, facing the direction of approaching traffic, is a crossbuck railroad sign with two flashing red lights (Photo No. 15). Likewise, all of the switches are the same. Each is a single slip switch manually operated by a railroad technician (Photo No. 16).

2. Jay Jay Railroad Draw Bridge: The Jay Jay Bridge is a 2,058' (approximately 0.5 miles) long, single-leaf bascule bridge that carries the railroad track over the Indian River (Photo Nos. 17, 18). It is comprised of seventy-five spans, which includes one main span and seventy-four approach spans. Thirty of the approach spans are situated to the west of the bascule, and forty-four are to the east of the bascule.

[74] This branch of the railroad is not considered contributing to the Historic District. See Footnote No. 1.
[75] As noted in Footnote No. 1, approximately 19 of the roughly 38 miles of track within the NASA KSC Railroad System were used to support the transport of SRB components and are considered contributing to the Historic District. This includes the track from the Jay Jay Yard to Wilson's Corner, and the track between Wilson's Corner and the southern terminus of the LMF, as well as the spur to the SLF, and the spur ending at the RPSF.

The main span is a 157' x 24' steel, Hopkins Frame-mounted, single leaf, through-girder bascule (Photo Nos. 19-21). Across the bascule span, the railroad track is mounted to two girders, which are supported by six beams with cross bracing in between (Photo No. 22). The bascule features sidewalls, approximately 10' in height, that are curved at the trunnions. The trunnions, which are situated on the west end of the bascule, raise and lower the bascule with the assistance of a counterweight mechanism (Photo Nos. 23-26).[76]

The bascule is supported by two piers, Pier No. 1 at the west end and Pier No. 2 at the east end. Pier 1 is an irregularly shaped, partially submerged reinforced concrete pit, which measures approximately 53' in length, 42'-3' in width, and stands 34'-2" in height; its foundation is a 14'-thick steel reinforced concrete slab. Pier No. 1 houses the bascule's machinery (Photo No. 24), as well as the trunnions and counterweight mechanism when the bascule is in the raised position. Access to the pit is provided by two vertical ladders on the south side of the pier; the pier's floor is kept dry by a sump pump. Pier 2 is an irregularly shaped reinforced concrete wall along the east side of the channel that has overall dimensions of 33' in length, 8'-8" in width, and 24'-7" in depth. The bascule span rests on Pier 2 when lowered; it is locked in place through two span locks, one on each side.[77]

The bascule crosses a 90' channel, on either side of which is an approximately 186'-long fender comprised of concrete piles faced with horizontal timber wales (Photo Nos. 19, 21); the purpose of the fenders is to protect the bridge from boats passing through the channel. Catwalks with wooden decks and metal rails have been built on top of the fender piles. Clusters consisting of seven wooden piles have been placed at the northwest, northeast, southeast, and southwest corners of the channel to further protect the fenders.[78]

The seventy-four approach spans are fixed open deck steel girders, each of which measures 24'-8" in length and 14' in width. Each span has a superstructure that consists of two girders, three beams, and four diagonal braces. The girders rest on steel plates that sit on top of the concrete bent caps and separate the substructure and superstructure. The girders are 24'-8" in length and 2'-9.25" in height, the beams are 5'-8" in length, and the cross braces are 7' in length.[79] The concrete substructure for the approach spans is comprised of seventy-two bents and two abutments. Of the seventy-two bents, sixty-two are single bents with three piles and

[76] Nashville Bridge Company, "Hopkins Trunnion Bascule Bridge;" L. O. Hopkins & Sons, "Single Track Railway Bascule."
[77] Nashville Bridge Company, "Hopkins Trunnion Bascule Bridge;" L. O. Hopkins & Sons, "Single Track Railway Bascule."
[78] Nashville Bridge Company, "Hopkins Trunnion Bascule Bridge;" L. O. Hopkins & Sons, "Single Track Railway Bascule."
[79] Nashville Bridge Company, "Hopkins Trunnion Bascule Bridge;" L. O. Hopkins & Sons, "Single Track Railway Bascule."

ten are double bents with six piles (Photo Nos. 29, 30). Each reinforced concrete pile has a cross section of 20" x 20", either rounded or squared corners, and extends about 3'-6" above the waterline. Additionally, each bent has a 3'-6"-high concrete cap. The two reinforced concrete abutments are protected by a concrete seawall reinforced by steel rods, packed earth, and riprap slope protection (Photo No. 31).[80]

Across the fixed spans of the bridge, steel plates are used to separate the girders and wooden railroad ties. The railroad ties have a cross section of 8" x 8" and are either 9' or 14' in length. Three 9' ties are laid for every 14' tie; the 14' ties extend to the north side of the tracks to support a wooden walkway. The walkway consists of four rows of planks placed end to end and contains a braced wooden railing along the outer edge (Photo No. 19).

A Control House is located to the south of the west end of the bascule; it is reached via the same concrete platform that contains the hatch that leads down to the Pier No. 1 pit. The Control House rests on a concrete platform supported by four concrete piles; its metal exterior shell was replaced in 2008. The building has a gable roof, and entry is through a metal door on the north elevation. Six-over-six independent metal sash windows are located on the west and south elevations. Internally, the room is divided into two sections: the larger main room (to the east) contains the equipment that operates the bridge (Photo No. 28), and a smaller room to the west is used for storage.

3. Locomotives: Locomotive Nos. 1, 2, and 3 (Photo Nos. 32-35) are General Motors' model EMD SW1500 switching locomotives. Each measures approximately 44'-8" in length, 10'-3" in width, and stands 11'-9" tall at the engine hood and 15' ft at the top of the cab. Each weighs 248,000 tons and sits on two, four-wheel trucks; the wheel diameter is 40". The engine is at the front of the locomotive; it is a 1,500 horsepower, V-12 diesel engine capable of reaching speeds up to 65 mph.[81] A walkway surrounds the engine and is accessible either from a door on the left half of the front side of the cab or from the steps at the front. The cab, which sits at the rear, features a seat and controls for the engineer on the right side, and a second passenger seat on the left side (Photo Nos. 36, 37). There are windows on all four sides of the cab, and a swing door on the back wall, which is accessed by steps at the back. At the time of documentation, Locomotive Nos. 1 and 2 featured a paint scheme of black, red, and gray with white stripes; Locomotive No. 3 was painted blue and white with red stripes.

[80] Transystems, *Biennial Inspection and Evaluation of Bridges at Kennedy Space Center, FL*, 2011, document provided to ACI by Frank Washburn, KSC Bridge Engineer; Nashville Bridge Company, "Hopkins Trunnion Bascule Bridge;" L. O. Hopkins & Sons, "Single Track Railway Bascule."
[81] Jean-Denis Bachand, "EMD SW1500 Data Sheet," 2006, http://thedieselshop.us/Data%20EMD%20SW1500.html.

4. NLAX 170 and NLAX 171 Railcars: NLAX 170 and NLAX 171 are 70-ton railroad flatcars that measure 66' in length and 12' in width overall (Photo Nos. 38-41). The cars are made of steel and feature a unique, double-well arrangement divided into four compartments, each designed to carry a SRB frustum or forward skirt in the end compartments, and aft skirts in the inner compartments, which were fitted with special attachment hardware designed around the shape of the aft skirt. At each end of the car are two steel collision posts, approximately 12' in height. These posts are coated with reflective paint. Each car also rests on four axles, and has a braking control at one end.

C. Operation: The FEC delivered fueled SRM segments to the Jay Jay Yard, where NASA KSC officially took control of the segments. Prior to moving the segments, railroad technicians thoroughly examined the railcars to ensure they were in good condition and that there was no debris to cause any hazardous situations. Once the inspection was completed, the technicians used the assigned locomotive to move the SRM cars across the four tracks so spacer cars could be installed between the segment cars; the spacer cars evenly distributed the weight of the train across the Jay Jay Bridge. If the locomotives were to transport NLAX 170 and/or NLAX 171, the spacer cars were not required, and only the assigned locomotive was attached to the load.[82]

When all locomotive/railcar maneuvering operations were completed, the train began its journey across the Jay Jay Bridge. The Control House for the bridge is typically not manned, so the bascule is usually in its raised position with green lights flashing to indicate that water vessels are free to pass through the channel. As such, when the train neared the bascule, it stopped, and one of the technicians exited the locomotive and pressed a button to lower and lock the bascule. Once the train was completely across the bascule, it stopped again so the technician could press a button to raise the bascule.[83]

If the load was comprised of fueled SRM segments, the locomotive carried the train from the bridge to the Wilson Yard, where railroad technicians removed the spacer cars. From there, the segments were transported to the Suspect Siding Yard, an isolated staging area on the northeast side of the SLF. Here, the individual segments were examined and stored until the RPSF technicians were ready for them. At that time, the KSC railroad crew drove a locomotive to the yard, attached it to the cars, and then carried the segments to the RPSF.[84] If NLAX 170 and NLAX 171 were being transported, the train typically did not stop at Wilson Yard; rather, it carried the cars to the designated drop-off location for the components.

[82] Heiney, "Railroad Played Vital Role."
[83] Washburn, personal communication, January 26, 2012.
[84] Heiney, "Railroad Played Vital Role."

When the locomotives hauled SRM segments, or NLAX 170 and/or NLAX 171, from a KSC facility to the Jay Jay Yard, the procedures described above were reversed. The only difference was that spacer cars were not required between the segment cars because the weight of the empty segments did not exceed the bridge's capacity.

D. Site Information: The NASA KSC Railroad System was originally intended to provide an inexpensive means for the transportation of construction materials, hazardous fuels and oxidizers, and other freight from the FEC mainline to various locations throughout the Center.[85] Although no specific information regarding the layout of the system was located during the research KSC-generated layouts, historic aerials, and U.S. quadrangle maps show that the railroad, for the most part, parallels roadways that had been existing prior to its construction (Figure A-1). Spurs were constructed from the main branches to different facilities, such as the Compressor/Converter Facility, LC 39 Pads A and B, and later the SLF and VAB areas for deliveries. The NASA KSC Railroad System crosses a river and extends through a variety of terrains, including marshes and sand dunes; no information was located to reveal how the land was built up to support the railroad.

[85] Pan American World Airways, Guided Missiles Range Division, *Analytical Report for NASA Merritt Island Launch Area Master Plan, Volume III* (Cape Canaveral, FL: Pan American World Airways, 1965), Sweetsir Collection, File No. ARCH00017252, Kennedy Space Center Archives Department, Florida.

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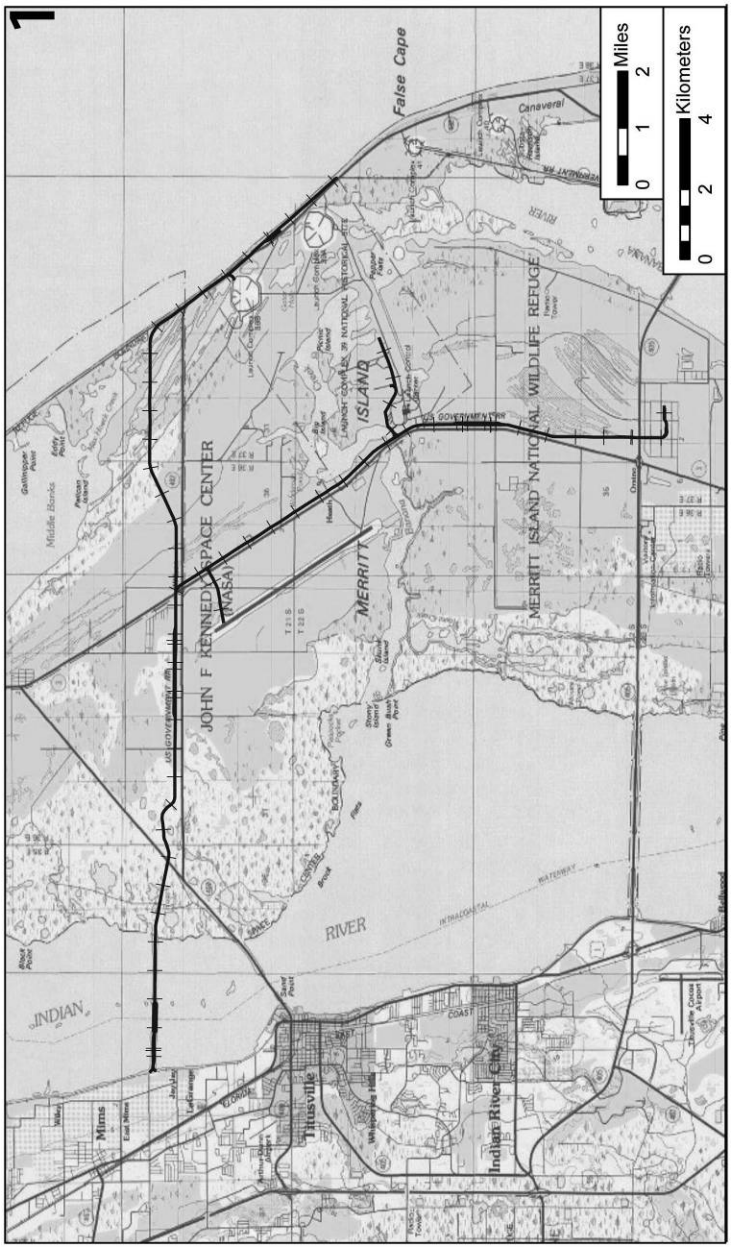

Figure A-1. Map of the NASA KSC Railroad System.
Source: USGS 7.5' Series Quad Maps: False Cape, Fla; Mims, Fla; Orsino, Fla; Wilson, Fla.

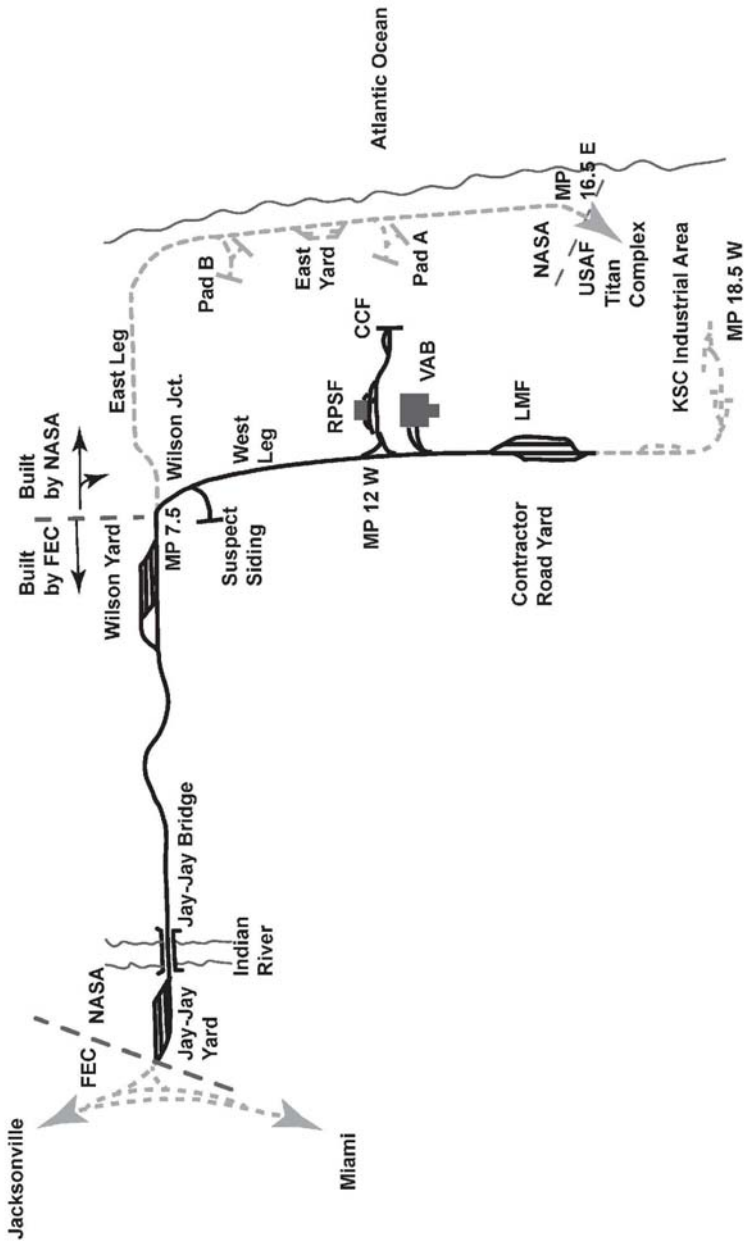

Figure A-2. Map of the NASA KSC Railroad System.
Black lines indicate those portions that are considered contributing to the historic district; dashed gray lines indicate those portions that are considered noncontributing.
Source of base map: John F. Kennedy Space Center Transportation Office, no folder.

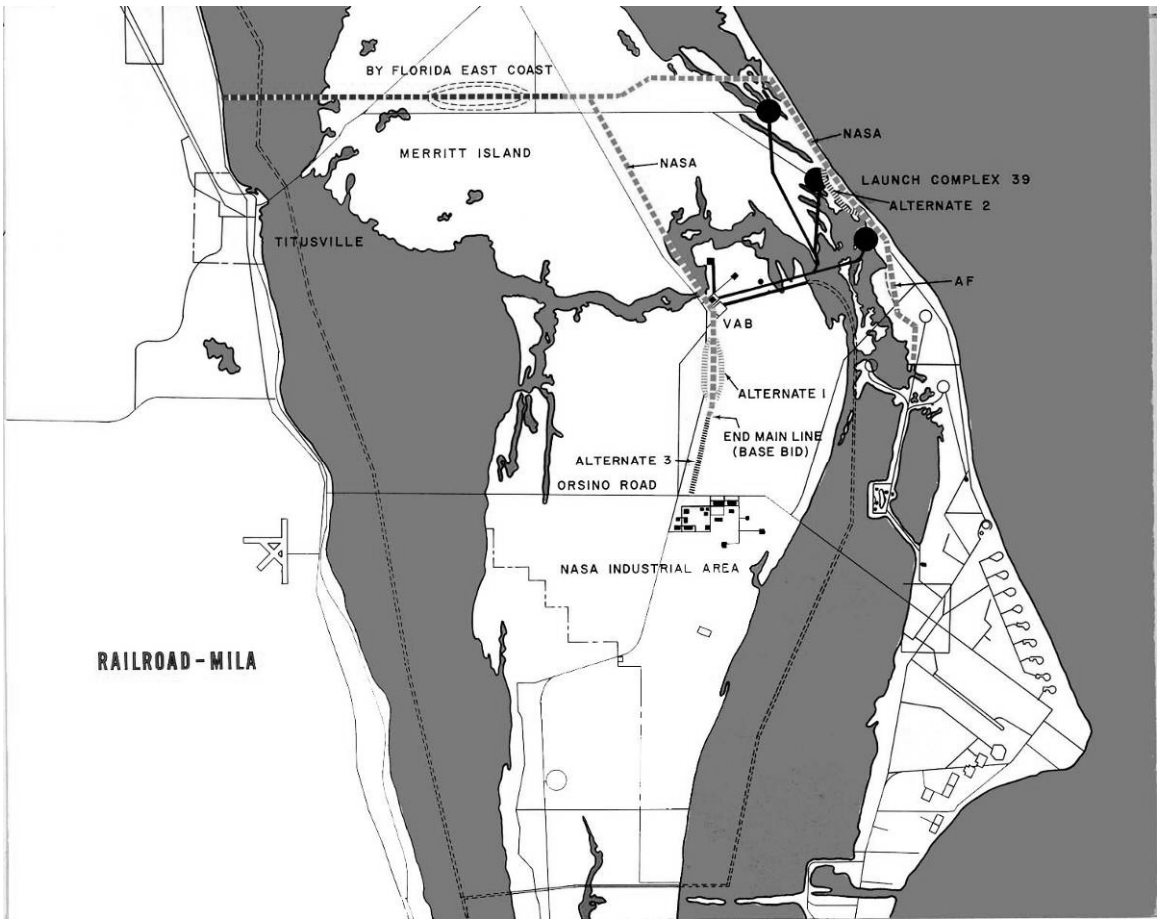

Figure A-3. Chart showing initial plan of the railroad system, August 21, 1963.
Source: Kennedy Institutional Image Facility, KSC-63C-2574.

Figure A-4. Construction of the Jay Jay Bridge, 1963.
Source: John F. Kennedy Space Center Archives, LOC-63-8518.

Figure A-5. Photograph of the railroad split east of Wilson's Corner, January 30, 2012. The portion that continues straight is the noncontributing east branch; the line that curves to the right is the contributing west branch.
Source: Archaeological Consultants, Inc.

Figure A-6. Construction of the railroad within the KSC Industrial Area, April 22, 1965.
Source: John F. Kennedy Space Center Archives, 100-KSC-65-7729.

Figure A-7. Delivery of construction materials for the SLF runway via the railroad, August 4, 1975.
Source: John F. Kennedy Space Center Archives, 108-KSC-375C-10046.8.

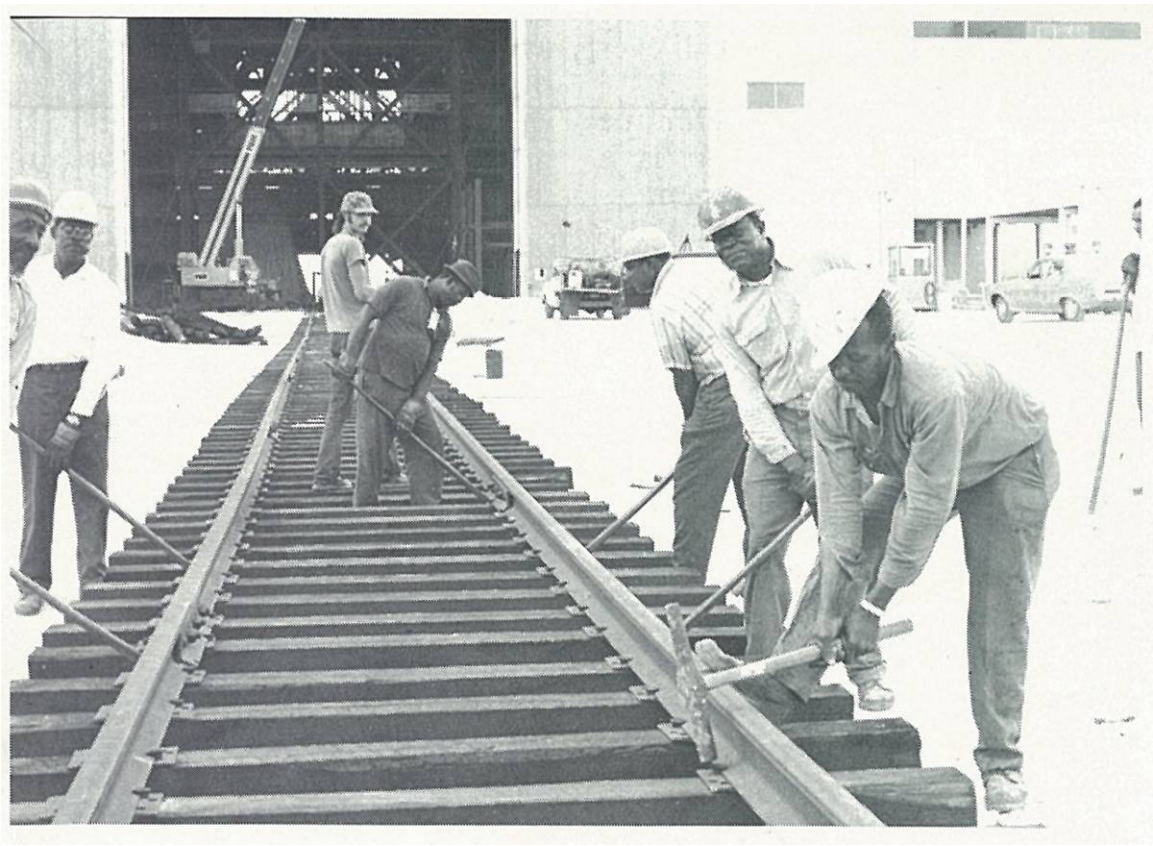

Figure A-8. Construction of the railroad spur in the VAB, May 1977.
Source: *Spaceport News*, May 27, 1977, page 1.

Figure A-9. Fueled SRM segments being offloaded in VAB High Bay No. 4, November 29, 1979.
Source: John F. Kennedy Space Center Archives, 108-KSC-79P-382.

Figure A-10. Alco locomotive hauling SRM segments, October 21, 1982.
Source: John F. Kennedy Space Center Transportation Office, 108-KSC-382C-3683.4.

Figure A-11. Aerial of RPSF showing railroad spur, March 9, 1984.
Source: John F. Kennedy Space Center Archives, 108-KSC-384C-1134_7.

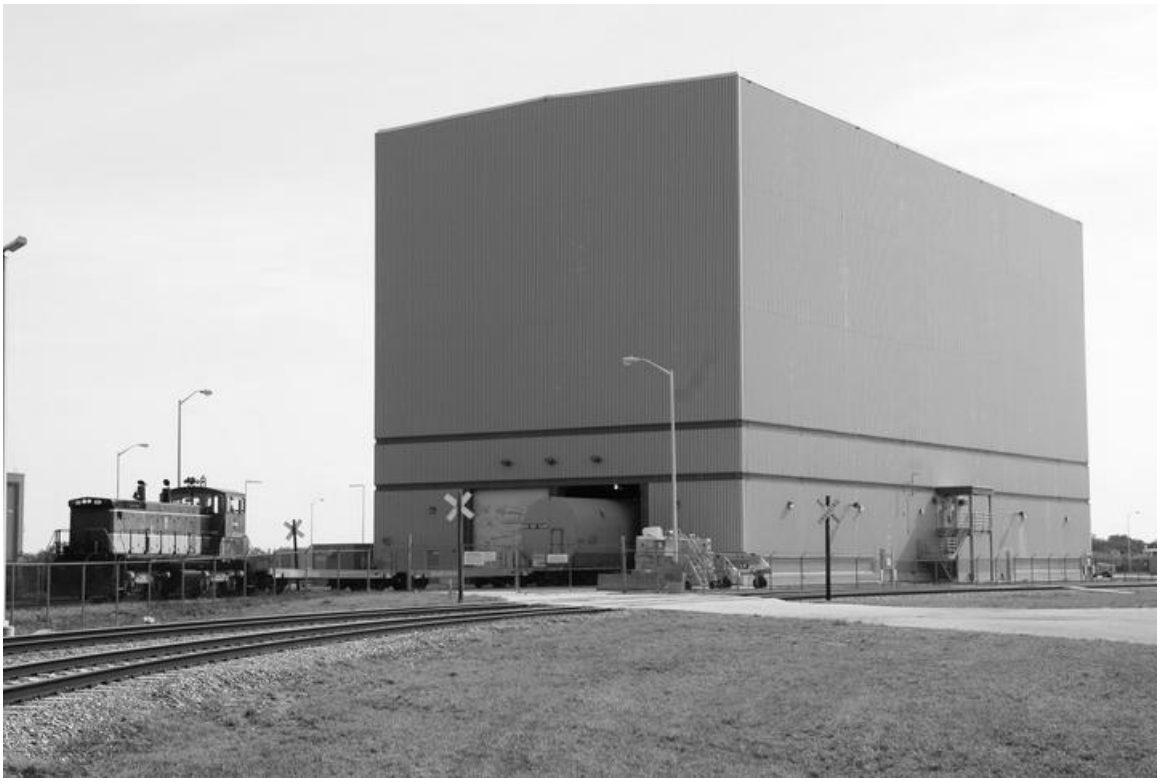

Figure A-12. Locomotive No. 1 delivering fueled SRM segments to the RPSF, May 15, 2007. Source: John F. Kennedy Space Center, KSC-07PD-1211, accessed via http://mediaarchive.ksc.nasa.gov/search.cfm.

Figure A-13. NLAX 171 approximately one year after construction, April 10, 1986.
Source: John F. Kennedy Space Center Transportation Office, 116-KSC-386C-2319_5.

Figure A-14. View of NLAX 171 with a SRB aft skirt, September 2012.
Source: John F. Kennedy Space Center Transportation Office, File No. NLAX171.

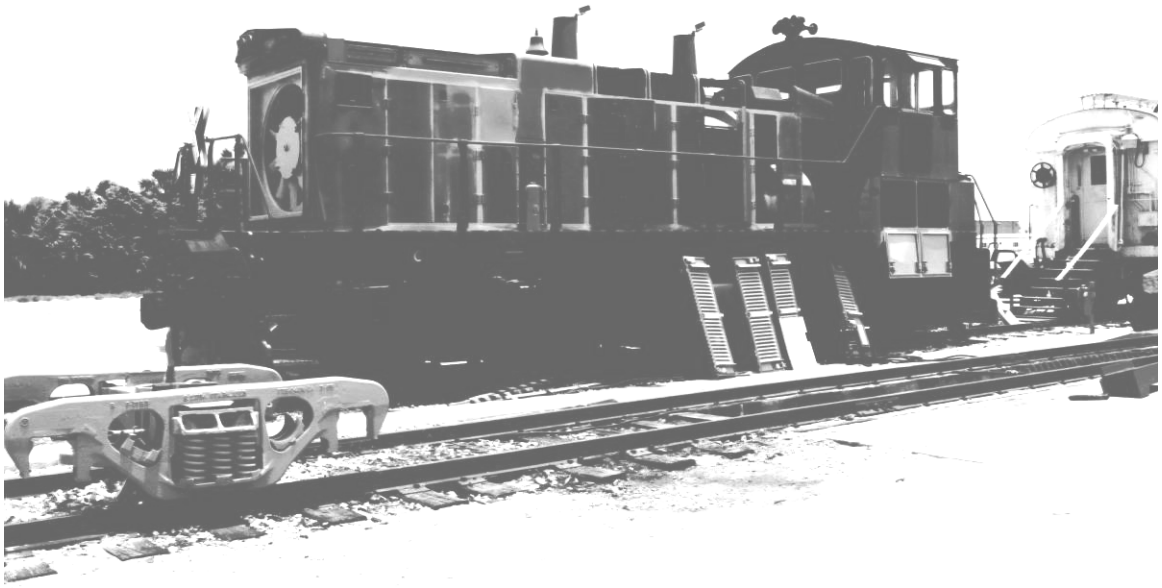

Figure A-15. View of one of the General Motors locomotives as purchased in July 1984. Source: John F. Kennedy Space Center Transportation Office, 114-KSC-385C-2658.7.

Figure A-16. Locomotive No. 1 carrying spent SRM segments to the Jay Jay Yard, March 5, 2008.
Source: John F. Kennedy Space Center, KSC-08PD-0638, accessed via http://mediaarchive.ksc.nasa.gov/search.cfm.

Figure A-17. Locomotive No. 3 carrying fueled SRM segments across the Jay Jay Bridge, March 20, 2009.
Note spacer cars in between the segments.
Source: John F. Kennedy Space Center, KSC-2009-2227.

HISTORIC AMERICAN ENGINEERING RECORD

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(John F. Kennedy Space Center)
Cape Canaveral
Brevard County
Florida

HAER No. FL-8-A

Penny Rogo Bailes, Photographer; June 2012
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FL-8-A-1 OVERALL VIEW OF JAY JAY YARD FROM ITS CENTER, FACING WEST.

FL-8-A-2 OVERALL VIEW OF JAY JAY YARD FROM ITS CENTER, FACING EAST.

FL-8-A-3 OVERALL VIEW OF JAY JAY YARD FROM THE WEST END OF THE JAY JAY BRIDGE, FACING WEST.

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FL-8-A-41 DETAIL VIEW OF THE TOP OF NLAX 171, FACING NORTH.

Photograph Nos. FL-8-A-42 through FL-8-A-56 are photocopies of engineering drawings, and are 8" x 10" enlargements from 4" x 5" negatives. Original drawings are located at the Engineering Documentation Office, NASA KSC.

FL-8-A-42 Photocopy of drawing
RAILWAY TRACKAGE CONSTRUCTION
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, June, 1963
VICINITY PLAN
Sheet 1 of 24

FL-8-A-43 Photocopy of drawing
RAILWAY TRACKAGE CONSTRUCTION
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, June, 1963
INDIAN RIVER YARD [now Jay Jay Yard]
Sheet 3 of 24

FL-8-A-44 Photocopy of drawing
RAILWAY TRACKAGE CONSTRUCTION
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, June, 1963
WILSON YARD
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FL-8-A-45 Photocopy of drawing
RAILWAY TRACKAGE CONSTRUCTION
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, June, 1963
TYPICAL SECTIONS
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FL-8-A-46 Photocopy of drawing
NEW LINE TO MERRITT ISLAND, BRIDGE ACROSS INDIAN RIVER
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, May, 1963
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FL-8-A-47 Photocopy of drawing
NEW LINE TO MERRITT ISLAND, BRIDGE ACROSS INDIAN RIVER, BULKHEAD
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Maurice H. Connell & Associates, September, 1963
PLAN & SECTIONS
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FL-8-A-48 Photocopy of drawing
HOPKINS TRUNNION BASCULE BRIDGE
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Nashville Bridge Company, July, 1963
SECTIONS
Sheet E4

FL-8-A-49 Photocopy of drawing
HOPKINS TRUNNION BASCULE BRIDGE
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Nashville Bridge Company, July, 1963
MACHINERY ERECTION
No sheet number available

FL-8-A-50 Photocopy of drawing
SINGLE TRACK RAILWAY BASCULE, INDIAN RIVER-MERRITT ISLAND
Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, L. O. Hopkins & Sons, May, 1963
PIER NO. 1
Sheet 2

FL-8-A-51 Photocopy of drawing
SINGLE TRACK RAILWAY BASCULE, INDIAN RIVER-MERRITT ISLAND
Florida East Coast Railway Company, St. Augustine, Florida
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Florida East Coast Railway Company, St. Augustine, Florida
Drawing VEN5722, Florida East Coast Railway, June, 1963
Sheet 151.5-2

FL-8-A-55 Photocopy of drawing
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NASA, John F. Kennedy Space Center, Florida
Drawing 79K36245, Reynolds, Smith and Hills, January, 2005
EXISTING BRIDGE PLAN AND ELEVATION
Sheet 3

FL-8-A-56 Photocopy of drawing
REFURBISH NASA JAY-JAY RAILROAD BRIDGE OVER INDIAN RIVER
NASA, John F. Kennedy Space Center, Florida
Drawing 79K36245, Reynolds, Smith and Hills, January, 2005
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Sheet 14