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NAT. REGISTER OF HISTORIC PLACES
NATIONAL PARK SERVICE

71

United States Department of the Interior
National Park Service

National Register of Historic Places Registration Form

This form is for use in nominating or requesting determinations of eligibility for individual properties or districts. See instructions in *How to Complete the National Register of Historic Places Registration Form* (National Register Bulletin 16A). Complete each item by marking "x" in the appropriate box or by entering the information requested. If an item does not apply to the property being documented, enter "N/A" for "not applicable." For functions, architectural classification, materials and areas of significance, enter only categories and subcategories listed in the instructions. Place additional entries and narrative items on continuation sheets (NPS Form 10-900a). Use a typewriter, word processor, or computer, to complete all items.

1. Name of Property

historic name Space Shuttle *Enterprise*

other names/site number Orbiter Vehicle-101; OV-101

2. Location

street & number Pier 86, W 46th St and 12th Ave ☐ not for publication

city or town Manhattan ☐ vicinity

state New York code NY county New York code 061 zip code 10036

3. State/Federal Agency Certification

As the designated authority under the National Historic Preservation Act, as amended, I certify that this [X] nomination ☐ request for determination of eligibility meets the documentation standards for registering properties in the National Register of Historic Places and meets the procedural and professional requirements set forth in 36 CFR Part 60. In my opinion, the property [X] meets ☐ does not meet the National Register criteria. I recommend that this property be considered significant [X] nationally ☐ statewide ☐ locally. [X] See continuation sheet for additional comments.

Ruth A Pierpont DSHPO 1/18/13

Signature of certifying official/Title Date

State or Federal agency and bureau

In my opinion, the property [X] meets ☐ does not meet the National Register criteria. ☐ See continuation sheet for additional comments.

Signature of certifying official/Title Date

State or Federal agency and bureau

4. National Park Service Certification

I hereby certify that this property is:

[X] entered in the National Register.
☐ See continuation sheet.

☐ determined eligible for the National Register.
☐ See continuation sheet.

☐ determined not eligible for the National Register.

☐ removed from the National Register.

☐ other, (explain:)

Signature of the Keeper Date of Action

Alexis Abernathy 3/13/13

5. Classification

Ownership of Property
(Check as many boxes as apply)

- [X] private
- [ ] public-local
- [ ] public-State
- [ ] public-Federal

Category of Property
(Check only one box)

- [ ] building(s)
- [ ] district
- [ ] site
- [X] structure
- [ ] object

Number of Resources within Property
(Do not include previously listed resources in the count.)

Contributing	Noncontributing	
0	0	buildings
0	0	sites
1	0	structures
0	0	objects
1	0	Total

Name of related multiple property listing
(Enter "N/A" if property is not part of a multiple property listing.)

N/A

Number of contributing resources previously listed in the National Register

0

6. Function or Use

Historic Functions
(Enter categories from instructions)

TRANSPORTATION/air-related: space related

Current Functions
(Enter categories from instructions)

EDUCATION

7. Description

Architectural Classification
(Enter categories from instructions)

N/A

Materials
(Enter categories from instructions)

foundation
walls
roof
other aluminum

Narrative Description
(Describe the historic and current condition of the property on one or more continuation sheets.)

Description:

Enterprise (Orbital Vehicle-101 or OV-101) is located on the flight deck of the *Essex*-class aircraft carrier the former USS *Intrepid*, which is moored at Pier 86, 700 West 46th Street, immediately west of the intersection of 12th Avenue and W 46th Street, on the west side of Manhattan, New York County. Until October 2012, *Enterprise* was displayed inside an environmentally controlled air-supported structure built to house the orbiter after it was moved to the *Intrepid* in 2102 for display to the public. Inside the structure, the shuttle was the centerpiece and was surrounded by information kiosks, video screens, and an elevated walkway around the forward fuselage. At the end of October, during Hurricane Sandy, the superstructure was destroyed and the shuttle was slightly damaged. Repairs are nearly complete and a new structure is being built to protect it. This nomination includes only *Enterprise* itself. The *Intrepid*, which has no historic relationship to the shuttle, was previously designated a National Historic Landmark.

Enterprise is one of six orbiters built between 1974 and 1990.[1] The other five are *Challenger* (OV-099), *Columbia* (OV-102), *Discovery* (OV-103), *Atlantis* (OV-104), and *Endeavor* (OV-105). *Challenger* and *Columbia* were destroyed during flight missions in 1986 and 2003, respectively. *Enterprise*, the only full-scale prototype, was not capable of space flight and was used for atmospheric flight and landing tests. In addition to the official space shuttle orbiters, there are a number of full and partial replicas on display at various facilities and museums. Some of these were test pieces used by NASA, while some were commissioned by private organizations. Some of the test pieces and structures have official designations from NASA but none of them are as complete or functional as *Enterprise* (NASA 2000a, 2000b, 2000c; WonderWorks 2011; Pearlman 2012).

Exterior:

In its design *Enterprise* exhibits a form similar to a conventional airplane in that it has a cockpit, two wings, a main tube-like body, and a vertical stabilizing tail. It is largely constructed from aluminum and has an exterior skin comprised of polyurethane foam and fiberglass to simulate the advanced thermal protection system used on the other orbiters. From a horizontal perspective *Enterprise* is 122 ft long, has a wingspan of 78 feet, and is 57 feet tall. The payload bay is 60 feet long and 15 feet in diameter. The orbiter exhibits a delta wing

[1] "Orbiter" is the term used to describe the airplane-like component of the space shuttle. It is separate from the large External Tank and the two supplemental Solid Rocket Boosters.

design – a wing similar in shape to a right triangle where the legs of the triangle are relatively equivalent. *Enterprise*'s weight has been calculated differently at different times. During the Approach and Landing Tests (ALT) its weight was noted as 144,000 lbs (NASA 2010). The tail cone weighs approximately 8,500 lbs. The weight of *Enterprise* was determined to be 156,620 lbs (including the tail cone) just before its flight to New York City from Washington, DC in 2012 (Dennis Jenkins, pers. comm.) *Enterprise* has various ballast compartments which can also affect the weight, depending on how much is onboard at any given time (Jenkins 2001).

One of the iconic components of the orbiters is the Thermal Protection System (TPS). For the space-capable orbiters, this system is designed to protect the spacecraft during reentry into Earth's atmosphere and to shield it from the extreme temperatures of space (NASA 2010). The majority of *Enterprise*'s exterior consists of simulated thermal tiles and insulation systems, although there are patches of authentic tiles (Jenkins 2001). The black and white tiles are made of polyurethane foam, while the nosecap and the wing edges are made of fiberglass. Most of these systems were simulated on *Enterprise* to reduce costs but maintain similar aerodynamics. As *Enterprise* was not capable of orbital flight, it would not be exposed to the extreme temperatures of the other orbiters and therefore did not need the same level of protection.

In preparation for its 1983 international tour *Enterprise* received an updated paint job that was designed to make *Enterprise* more closely resemble *Columbia.* Black areas were added to the vertical stabilizer (tail), along the wing edges, around the main cabin windows, across the nose, and around the main hatch (National Air and Space Museum 2011).

In 1998 the space-capable orbiters received updated paint schemes.[2] The new paint scheme utilized a different logo design from what was currently emblazoned on the orbiters. Other changes were made, including the placement of the name and flag on the wings. *Enterprise* did not receive these changes because, as of 1985, it was the property of the Smithsonian Air and Space Museum and no longer under the jurisdiction of NASA (NASA 2000c). *Enterprise* is the only extant orbiter to still feature the first livery of the space shuttle fleet

[2] The updated paint scheme replaced the so-called "worm" logo, a serpentine typeface design in use from 1972 to 1992, with the so-called "meatball" logo. The meatball logo, used from 1959 to 1982 and 1992 to the present, displayed the word "NASA" over a round, blue star field with a red chevron displayed diagonally and a small white craft orbiting the chevron.

(Jenkins 2001). Overall, the changes are relatively minor and simply represent different configurations of logos, names, and symbols.

The typeface used on all of the space shuttle orbiters is Helvetica, a Swiss-designed typeface developed in 1957. On *Enterprise* the name is displayed just aft of the cockpit on the cargo bay doors. An American flag is painted on the top of the port wing, while NASA's so-called "worm" logo (referring to its serpentine shape) and the name "*Enterprise*" are painted on the top of the starboard wing. A smaller "worm" logo is painted on the cargo bay doors on both the port and starboard sides near the hinge with the fuselage. Below this on both sides of the fuselage are the words "United States" and an American flag. Smaller informational signs and warnings can be found at various locations around the craft. For example, one sign indicates where rescue crew should cut on the exterior of the cockpit should they need to evacuate astronauts or crew from an orbiter.

Interior:

The internal structure of the orbiter is mainly aluminum (NASA 2010). The fuselage or main body of an orbiter can be broken down into three sections: the forward, mid, and aft fuselage. The forward fuselage contains the crew cabin. The mid fuselage contains the payload bay. The aft fuselage consists of the vertical stabilizer (tail), main engine, and the Orbital Maneuvering System Pods, which are the white bulbous structures nestled between the payload bay and the three black nozzles of the main engine at the rear of the vessel. On *Enterprise*, the Orbital Maneuvering System Pods are simulated and non-functional (NASA 2010).

The crew cabin is the forward portion of the fuselage and consists of three levels: the flight deck, the mid deck, and the utility area. The flight deck can accommodate four individuals: the commander, the co-pilot, and two mission specialists. The mid deck can accommodate three additional astronauts. The mid deck also contains the galley, toilet, sleep locations, storage lockers, and an airlock (NASA 2010).

Although *Enterprise* is very similar to the other orbiters, it did lack a number of key crew support systems, which weren't required for its missions. An airlock, mid-deck lockers, toilet, galley, and shower were not installed. Many of the control systems related to space flight and control of the External Tank and Solid Rocket Boosters were absent. Additional instrumentation unique to *Enterprise* for the nose air data test boom was installed as well as cameras to observe pilot actions. Ejection seats from Lockheed's SR-71 Blackbird program were installed (Jenkins 2001). Two panels were installed above the pilots for ejection during flight or

manual escape while on the ground. This escape system was not present in the other orbiters. "The cockpit we had in ALT was just only the switches that applied. All the other systems now had to be put in" (Fullerton 2002). After ALT the flight deck was stripped of the controls and computers and the seats were returned to Lockheed (Jenkins 2001). The overhead windows and windows looking into the payload bay were not necessary for the flight tests and were instead covered with aluminum panels. Aluminum braces were installed where the mid-deck airlock would have been. The landing gear system was lowered by explosive bolts and gravity. *Enterprise* did not have a hydraulic retraction mechanism like the other shuttles (Jenkins 2001). The process of landing gear retraction is performed by ground crew (NASA 200d).

Enterprise is the product of 1970s aerospace engineering. Its construction was divvied up amongst a number of different private contractors. Rockwell International was the main contractor which subsequently subcontracted portions of the shuttle construction to over 250 subcontractors. Rockwell International built the lower forward fuselage, crew compartment, forward reaction control system, and aft fuselage in Downey, California. The mid fuselage was constructed by General Dynamics in San Diego, California. The orbiter wings were constructed by Grumman in Bethpage, NY. The tail was manufactured by Fairchild Republic in Farmingdale, NY. The payload bay doors were manufactured by a separate Rockwell division in Tulsa, Oklahoma. The body flap (rear flap located below the engine cones) was constructed by Rockwell's Columbus, Ohio facility (NASA 2000d).

Integrity

Changes made to *Enterprise,* after its initial construction and usage, were the product of its function as a prototype used for testing and experimentation and thus significant. Changes since 2004 mainly represent its reconfiguration for public display. Prior to being handed over to the Smithsonian National Air and Space Museum in 1985, a number of components were removed from *Enterprise.* Some of these components included the seats, much of the cockpit controls and instrumentation, and the boom installed on the nose of the vehicle. Parts that could be reused were kept as replacements. Some parts were returned to their manufacturers. The cockpit seats were borrowed from the Lockheed SR-71 Blackbird program and were thus returned (Jenkins 2001). In place of the seats a ballast system was installed to help balance the orbiter during ferry flights aboard

the **SCA.** The instrument panels and general layout of the cockpit remains intact though the electronics have largely been removed.

Enterprise is in very good condition structurally. In 1996, twenty years after construction, *Enterprise* exhibited some signs of corrosion due to standing water within the vehicle, three years of exposure, and more than ten years in a hangar that wasn't environmentally controlled. Overall, *Enterprise* was considered to be in good condition. In 2004, after its arrival at the Stephen F. Udvar-Hazy Center in Washington DC, *Enterprise* received preservation treatment. Some areas were simply cleaned while other areas along the fuselage had to be scraped, sanded and repainted due to marring of the paint during previous NASA-related tests (National Air and Space Museum 2011).

In 2012, *Enterprise* was transported to the Intrepid Sea, Air & Space Museum, where it now rests on a flight deck and is used for interpretive purposes. In its current location, in Manhattan and on the deck of an aircraft carrier, the *Enterprise* no longer retains integrity of location and setting. While important, neither location nor setting is crucial to an understanding of the significance of the resource. In addition, after the shuttle was decommissioned by NASA, relocation was necessary to ensure its preservation. And finally, as the first and only full-scale prototype of the orbiter fleet, the *Enterprise* is the only resource of its kind. Because of the resource's exceptional significance and extreme rarity, its lack of integrity of location and setting do not compromise its significance.

During the barge trip from JFK a gust of wind caused *Enterprise* and its barge to shift course and strike the abutment of a bridge. The strike occurred along the starboard wing's rear corner edge. Some of the exterior foam was scraped away exposing the interior metal structure. Eric Boehm, curator of aviation and aircraft restoration at the Intrepid Sea, Air & Space Museum, described the damage as superficial. He indicated that the museum undertook repairs that met with approval from NASA. The repairs returned the wing to pre-damage conditions (Eric Boehm, pers. comm.). Later in 2012, during Hurricane Sandy, the Intrepid Museum lost power, causing the air supported structure over *Enterprise* to collapse and causing minor damage to the tip of the vertical stabilizer. Repairs will be completed in early 2013 and a new structure will be constructed to shelter the shuttle (Eric Boehm, pers. comm.).

There haven't been any major alterations during preparation for museum display other than the prior removal of electronics and cockpit components, the removal of the flight test boom on the nose, the

refurbishment of the exterior paint, and the restoration of the minor wing damage during the barge trip from JFK. A device securing a series of barbell weights was installed where the cockpit seats used to be to add ballast to the front of the vehicle for transportation aboard the SCA. Additionally, a narrow plywood walkway was installed in the cargo bay interior. *Enterprise* is largely intact, has undergone little modification, and contains many of the materials of its original construction. *Enterprise*, while similar to the other orbiters, is a one of a kind design. As a prototype, *Enterprise* was designed for specific tasks and its form and plan reflect those requirements. *Enterprise* has undergone few alterations and therefore still adheres to the design of an orbiter prototype.

8 Statement of Significance

Applicable National Register Criteria
(Mark "x" in one or more boxes for the criteria qualifying the property for National Register listing.)

[X] **A** Property is associated with events that have made a significant contribution to the broad patterns of our history.

[ ] **B** Property is associated with the lives of persons significant in our past.

[X] **C** Property embodies the distinctive characteristics of a type, period or method of construction or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components lack individual distinction.

[ ] **D** Property has yielded, or is likely to yield, information important in prehistory or history.

Criteria considerations
(mark "x" in all the boxes that apply.)

Property is:

[ ] **A** owned by a religious institution or used for religious purposes.

[ ] **B** removed from its original location.

[ ] **C** a birthplace or grave.

[ ] **D** a cemetery.

[ ] **E** a reconstructed building, object or structure.

[ ] **F** a commemorative property.

[X] **G** less than 50 years of age or achieved significance within the past 50 years.

Areas of Significance
(Enter categories from instructions)

OTHER/space exploration
TRANSPORTATION
ENGINEERING

Period of Significance
1976-2003

Significant Dates
September 17, 1976; August 12, 1977; November 18, 1977; May 2003

Significant Person
(Complete if Criterion B is marked above)

N/A

Cultural Affiliation
N/A

Architect/Builder
Rockwell International

Narrative Statement of Significance
(Explain the significance of the property on one or more continuation sheets.)

9. Major Bibliographical References

Bibliography
(cite the books, articles, and other sources used in preparing this form on one or more continuation sheets.)

Previous documentation on file (NPS):

[ ] preliminary determination of individual listing (36 CFR 67) has been requested
[ ] previously listed in the National Register
[ ] previously determined eligible by the National Register
[ ] designated a National Historic Landmark
[ ] recorded by Historic American Buildings Survey # _____
[ ] recorded by Historic American Engineering Record # _____

Primary location of additional data

[X] State Historic Preservation Office
[ ] Other State agency
[ ] Federal agency
[ ] Local government
[ ] University
[ ] Other

Name of repository:

Summary

The Orbiter *Enterprise*, OV-101, is eligible for listing on the National Register of Historic Places in the context of the U.S. Space Shuttle Program (1969-2011) under Criterion A in the areas of Space Exploration and Transportation and under Criterion C in the area of Engineering. As *Enterprise* has achieved exceptional significance within the past 50 years, Criteria Consideration G applies.

Under Criterion A, *Enterprise* is exceptionally significant because of its role in major events of the Space Shuttle Program. *Enterprise*, the first and only full-scale prototype of the orbiter fleet, was first used during the Approach and Landing Tests, one of the earliest missions of the Space Shuttle Program. Additional tests involving *Enterprise* prepared Cape Canaveral for the first of 135 space shuttle launches. As part of the Approach and Landing Tests program *Enterprise* was the first orbiter to fly in Earth's atmosphere, doing so thirteen times, five of which saw it separate from the Shuttle Carrier Aircraft in order to fly and land unaided. Additionally, *Enterprise* was used in the investigations and procedural revisions following the *Challenger* and *Columbia* accidents. Following the *Challenger* accident in 1986, *Enterprise* aided in crew escape tests. Following the *Columbia* accident in 2003, one of *Enterprise*'s wing edges and a landing gear door were borrowed for tests related to foam chunks striking an orbiter during launch. Although the loss of two space shuttle orbiters was devastating to NASA and the United States, *Enterprise* helped the program return to flight and continue its mission. *Enterprise* significantly advanced the United States' ability to explore outer space, and allowed the other five orbiters to make significant advancements in a range of scientific and technological fields.

Under Criterion C, *Enterprise* is exceptionally significant for its role in the practical application and testing of orbiter designs and features. *Enterprise* was of paramount importance in testing the feasibility of the Shuttle Carrier Aircraft – a modified 747 that transported the orbiters. *Enterprise* was indispensible in proving the flightworthiness of the space shuttle orbiter and the continued testing and modification of the orbiter fleet throughout the space shuttle program. The information gathered during the Approach and Landing Tests led to alterations in materials used for certain components (such as titanium instead of aluminum) and modifications in orbiter design. Leroy Chiao, NASA astronaut on STS-65 (1994), STS-72 (1996), and STS-92 (2000), as well as commander and science officer on International Space Station Expedition 10 (2004-2005), stated that "[The] shuttle, to me, represents a triumph and remains to this day a technological marvel. We learned so much from

the program, not only in the advancement of science and international relations, but also from what works and what doesn't on a reusable vehicle. The lessons learned from shuttle will make future US spacecraft more reliable, safer, and cost effective."

Unlike typical aviation advancement, the space shuttle was a major technological leap forward. While airplanes tend to slowly evolve over time through constant adjustments based on testing and performance, the systems and design of the orbiter was unprecedented. Space flight capabilities went from disposable rockets and capsules to a reusable cargo space plane in only twenty years; there was no transitional design. As a prototype, *Enterprise* was largely responsible for making sure these new technologies and concepts worked properly to ensure the safety of the astronauts that would fly aboard the other orbiters. *Enterprise* was also of paramount importance in planning and preparation at the shuttle facilities. In the early days of the space shuttle program, *Enterprise* was the only completed orbiter and was therefore the only vehicle capable of ensuring that the facilities were prepared and ready for the first launch. *Enterprise* is also rare as it is the first and only completed prototype and the first orbiter to be constructed. Although similar in size and shape to its extant sister ships (*Discovery*, *Endeavor*, and *Atlantis)*, *Enterprise* exhibits structural and design differences that make it a unique example of the type. *Enterprise* is the only completed vehicle that represents the performance testing phase of the space shuttle program.

Context

Enterprise represents the culmination of years of research, design, and experimentation. While the space shuttle program didn't officially start until January 5, 1972, planning for it began in 1968, ten months before Apollo 11 landed on the Moon (NASA 2010). Space exploration, a product of the mid-twentieth century, began to be realized with Sir Isaac Newton's treatise *The Mathematical Principles of Natural Philosophy* (1729, originally 1687). In it he describes the Laws of Motion that would eventually form the basis of physics – a crucial field of scientific understanding for rocketry. However, the practical application of scientific theories to space travel did not occur for more than three centuries. In the early twentieth century a number of scientific papers were written regarding rockets and manned space exploration that established the field as a legitimate field of modern science. These papers were written by individuals such as Konstantin Tsiolkovsky, an Imperial Russian and Soviet astronautic theorist; (Tsiolkovsky 1903); Robert Goddard, an

American physicist (Goddard 1919); Hermann Oberth, an Austro-Hungarian-born German physicist and engineer (Oberth 1923); and Yuri Kondratyuk, a Ukrainian theorist (Kondratyuk 1929).

Major advancements occurred in 1931, with the German rocket program's development of the V2 rocket and the work of Wernher von Braun. The USSR was also testing rocket designs, but in 1942 the Germans were the first to cross the boundary of space. After World War II, von Braun and other prominent German scientists were covertly brought to the United States, where they aided the United States in advancing its rocket program. The next monumental advancement occurred on October 4, 1957, when the Soviets successfully launched Sputnik 1 into Earth's orbit. The United States government responded by establishing the National Aeronautics and Space Administration on July 29, 1958. Over the next few years a number of firsts were achieved (the first communication satellite, the first Polar orbit satellite, and the first meteorological satellite) by both the USA and USSR, proving that the space race had begun. These flights marked the beginning of the golden age of space exploration, and during these early years the USSR dominated by putting an object on the Moon (Luna 2), taking the first photos of the far side of the Moon (Luna 3), and placing the first man and woman into space (Yuri Gagarin in 1961 and Valentina Tereshkova in 1963, respectively). In 1962, President John F. Kennedy made one of the most well known speeches of his presidency, proclaiming that the United States would send a man to the Moon and return him safely to the Earth before the decade was out.. Inspired by Kennedy's leadership and unwilling to let the Soviets dominate the new frontier of space, the United States began to devote a significantly larger amount of the federal budget to NASA. For most of NASA's history its percentage of the federal budget has been around 1 percent or less, but during the 1960s this increased, peaking in 1966 at 4.41 percent (Rogers 2010). During this period the United States began to pull ahead and mark many firsts of its own: first Mars flyby (1965), first orbital docking (1966), and the first humans to orbit another celestial body.[3] (Furniss 2003)

The Luna program, started in 1959 by the Soviet Union, was an unmanned space exploration program with the mission goal of exploring Earth's Moon. Although a number of the probes failed to achieve their intended goals, the program is considered a success because Luna led to a number of major discoveries and firsts including the return of regolith (soil-like) samples, photos of the far side of the Moon, panoramic photos of its surface, and achieving lunar orbit by a satellite. Unmanned robotic rovers were also sent to the Moon

[3] Frank Borman, James Lovell, and William Anders in 1968 for the Apollo 8 mission.

during the Luna program and were able to explore the lunar surface. A number of lunar attributes were researched, including temperature variations, gravity, chemical composition, and radiation levels (Furniss 2003). This data gave valuable insight into the environment and surface characteristics of the Moon, a largely theoretical field of study at the time.

Project Mercury, the first manned space missions undertaken by the United States, turned seven airplane test pilots (known as the "Mercury Seven") into national heroes overnight and helped pave the way for the Apollo missions. The main goal of Mercury was to place a man into orbit, a goal that was achieved in 1962 after testing and development of new spacecraft and rockets. The program ran from 1959 to 1963 and consisted of six manned flights and 20 unmanned flights (Furniss 2003, NASA 2007). Gemini, the second United States' manned spaceflight program, continued to improve on human spaceflight capabilities. Through Gemini's two unmanned and ten manned missions, a human's ability to work and function for longer periods of time in space was tested and improved upon. The first rendezvous and dockings in space were completed under Gemini, which ran from 1962 to 1966 (Furniss 2003, NASA 2004a). Mercury and Gemini set the stage for the Apollo program. The main goal of Apollo was to place American astronauts on the surface of the Moon and return them to Earth (NASA 2009a). The United States achieved that goal at 4:17 PM EDT, July 20, 1969, when Neil Armstrong and Buzz Aldrin became the first human beings to set foot on the lunar surface. The Apollo program consisted of twenty-two unmanned missions and twelve manned missions. Of the twelve manned missions, three traveled to the Moon but did not land (Apollo 8, 10, and 13), while six missions achieved successful landing on the lunar surface (Apollo 11, 12, 14, 15, 16, and 17). Those six missions allowed twelve Americans to walk on the Moon and conduct scientific research and exploration. The Apollo program, which ran from 1961 to 1972, was a major symbolic victory for the United States, signifying its dominance in the space race. Waning interest and high program costs associated with lunar exploration led to the cancellation of the final three Apollo missions. The materials and equipment were incorporated into other programs, such as the Skylab space station, which was launched in 1973.

A number of historic preservation and Cold War historians have argued that the United States space program of the mid 20th century, specifically the Apollo program, was a component of the Cold War conflict between the United States and the Soviet Union (Schefter 2000; Gibson 2001; Gorman 2005; O'Leary 2006; Spennemann 2007). Space was seen as a new frontier which could be used as a tool for political and militaristic

domination. Neither the USA nor the USSR wanted the other to take the lead in outer space, so a "space race," or technological competition, began, prompting both countries to focus their resources on developing space programs. As the closest tangible entity to Earth, the Moon was viewed as a logical destination. Although the United States successfully landed on the Moon first, achieving the desired Cold War advantage, the landing came to be viewed in the much larger context of science, engineering, and exploration of the unknown. These achievements and the heroic actions in space eclipsed the militaristic, nationalist and colonial ambitions of space-faring nations (Bryld and Lykke 2000). The significance of the early space program's relation to the Cold War should not be ignored, but it is important to recognize that the significance of the event had implications that reached far beyond that conflict. The Moon landing came to be viewed by many as a human accomplishment as opposed to only an American accomplishment (Kohler 1970). Even Neil Armstrong noted that it was a major accomplishment for mankind, without referencing the United States at all in his first public words from Tranquility Base. The Cold War, while a major socio-political clash of the mid 20th century, had a clear and distinct end when the Soviet Union collapsed. Space exploration, on the other hand, still continues.

The Space Shuttle Program[4]

Before the United States had even landed on the Moon, planning had begun on a new space vehicle. The intent was to develop a reusable and affordable vehicle that could travel to and from space routinely and easily. The Space Task Group, formed in early 1969 by President Nixon, was created to research the next step for American space exploration. The group recommended three different alternative plans, but each option included a manned mission to Mars, a space station that would orbit the Earth, and a space shuttle. The space shuttle was the first objective to be dealt with and completed. Nixon announced the program in a speech on January 5, 1972. He declared that the next generation of space flight would allow "routine access to space." Nixon presented an optimistic time table, indicating that the shuttle could be flying by 1978; however, the first launch didn't occur until 1981.

[4] History of "The Space Shuttle Program" section has been drawn from the draft Historic American Engineering Report for the Space Transportation System (HAER TX-116) prepared by Archaeology Consultants, Inc. on behalf of NASA (Deming 2012) unless otherwise indicated

Dr. Eugen Sänger, an Austrian aerospace engineer, could be considered the father of the modern reusable space vehicle. As early as 1929 he outlined a plan for such a system using a large aircraft to boost the space vehicle into low-Earth orbit. The idea of this dual system for launching a vehicle into orbit was tested by the Bell Aircraft Company in the 1940s under the Dornberger Project. The idea was further refined by individuals such as von Braun.

The X-20 Dynamic Soaring (Dyna-Soar) project represented the next iteration of a reusable space vehicle. The Dyna-Soar was a joint venture between the Department of Defense (DoD) and the United States Air Force (USAF). The intended goal of the Dyna-Soar was to create a delta-winged glider that could achieve orbit via a launch missile, deliver a single pilot into orbit, and allow for a mission to be completed. The Dyna-Soar would then land like a conventional airplane. Due to limited funding and competing priorities the program was cancelled in 1963.

The next step in this evolution occurred in the 1960s, when NASA and the DoD refined their objectives and requirements to focus on a system capable of transporting more than 20,000 pounds into orbit. McDonnell Douglas was chosen as a contractor to assist with the research and development. Some of the efforts proved to be fruitless, but the idea of an unpowered aerodynamic vehicle capable of a horizontal landing intrigued the involved parties because of its operational flexibility and cross-range capability, allowing the vehicle increased maneuverability to either side of the flight path. Meanwhile, the United States Air Force was developing its own program, referred to as START (Spacecraft Technology and Advanced Reentry Tests). START examined systems for lifting material into orbit and returning the lift vehicle to Earth. A number of different body designs were investigated and researched.

Even before Neil Armstrong had landed on the Moon, NASA knew that its previous approach to space flight was not sustainable. The organization pushed for a new approach that would make space accessible, affordable, and routine. George Mueller, head of NASA's Office of Manned Space Flight, supported this view. He believed that the next mission for NASA would be a space station paired with support vehicles. Mueller went on to say in a speech to the British Interplanetary Society that:

> Essential to the continuous operation of the space shuttle will be the capability to resupply expendables as well as to change and/or augment crews and laboratory equipment . . . Our studies show that using today's hardware, the resupply cost for a

> year equals the original cost of the space station. . . Therefore, there is a real requirement for an efficient earth-to-orbit transportation system - an economical space shuttle . . . The shuttle ideally would be able to operate in a mode similar to that of large commercial air transports and be compatible with the environment at major airports. (Deming 2012:16).

Two events likely precipitated the decision to use a rocket/space plane system for the shuttle: the advent of thermal insulation tiles by Lockheed, which made it affordable and convenient to insulate an airplane-like design, and the order by Congress that the next space transportation design must meet not only the requirements of NASA but also of the USAF. One of the biggest requirements of the USAF was the ability to land at Vandenberg Air Force Base after just one polar orbit so that classified missions could be completed quickly and efficiently. After testing it was determined that a delta wing design would be more stable and would allow for the necessary maneuverability at high speeds that a conventional wing design wouldn't allow.

The formal design of the shuttle solidified between 1969 and 1972, as various contractors were hired and different iterations and configurations were explored. A wide range of technical issues were debated.[5] The ever changing requirements of the shuttle caused the development process to be delayed and contracts extended. Many different alternatives were considered but the final configuration of the space shuttle was announced on March 15, 1972. The simple but elegant concept of a space plane launched using a disposable liquid fuel tank and two reusable booster rockets was chosen because it represented a lower development cost ($5.15 billion) and lower risk financially and technically.

The Space Shuttle Prototype

With a design chose, the next step was to build a prototype of the orbiter. The prototype would be used to verify the readiness of the various facilities involved with the launch of the space shuttle, to test the atmospheric flight capabilities of the orbiter, to test the flight capabilities and characteristics of the orbiter-SCA combination, and to verify that the orbiter could land safely. Construction of the prototype began on June 4, 1974 in Palmdale, California, at Air Force Plant 42 by Rockwell International (NASA. "Orbiter Vehicles:

[5] Including the "merits of straight versus delta wings; internal versus external propellant tanks; manned versus unmanned boosters; liquid versus solid propellant boosters; and sequential burn versus parallel burn solid rocket motors, among others" (Deming 2012:17).

Enterprise). NASA suggested that the first space shuttle orbiter be named *Constitution* and the agency even planned to unveil it on September 17 - Constitution Day. As NASA's plans became publicly known, thousands of *Star Trek* fans began a write-in campaign to the White House urging President Ford to name the orbiter *Enterprise* (NASA 2000c) in honor of the fictional starship from the science fiction television show.[6] "I'm a little partial to the name *Enterprise*" said Gerald Ford, noting that he had served in the Pacific aboard a Navy ship that serviced an aircraft carrier of that name (Lewine 1976). The write-in campaign apparently influenced Ford and the fans are generally credited as being the driving force behind the name change. (NASA 2000c, 2010). In addition, the name "*Constitution*" might not have pleased the international partners involved in the development of the space shuttle. Canada, for example, provided the remote assistance arm known as Canadarm (though this robotic arm was not installed in *Enterprise*). *Enterprise* was completed on March 12, 1975 and rolled out on September 17, 1976. S*tar Trek* cast and crew including Leonard Nimoy, George Takei, Nichelle Nichols, DeForest Kelly, James Doohan, and Gene Roddenberry were in attendance.

Approach and Landing Tests (ALT)

An orbiter by itself (without the assistance of the External Tank (ET) or Solid Rocket Boosters (SRBs)) is an unpowered vehicle. The ET and SRBs allow the space-capable orbiters to reach orbit and are then discarded. On their return from space the orbiters land as unpowered gliders. Although they were capable of landing at many locations around the world, orbiters could only launch from Kennedy Space Center (KSC) in Florida, as only KSC was equipped with the necessary launch infrastructure. The main requirement of a landing site is a runway of sufficient length. Since the orbiters are unpowered, they are not able to take off like a conventional airplane. Thus, transporting the orbiters required an additional vehicle – a modified 747 known as the Shuttle Carrier Aircraft (SCA). The orbiters would be attached to the top of the SCAs and ferried from one location to another (NASA 2010). *Enterprise* was used to test the SCA system and determine if it was a feasible means of transporting the orbiters when necessary. These tests were performed during the Approach and Landing Tests (ALT) (Jenkins 2001, NASA 2010).

[6] The exact origin of this very effective campaign is not known.

ALT allowed NASA to test the interaction between a full scale orbiter and the Shuttle Carrier Aircraft as well as the landing characteristics of the orbiter. The ALT program consisted of three phases: taxi tests, captive flights, and free flights. (NASA 2000c, 2010; Jenkins 2001). The taxi tests consisted of *Enterprise* being securely attached to the top of the SCA. The taxi tests were performed at Edwards Air Force Base (EAFB) (Jenkins 2001). These tests determined the taxiing characteristics while on the ground (NASA 2010). For this portion of the test *Enterprise* only needed to be mated with the SCA and was not powered up or manned. Three taxi tests were performed on February 15, 1977 (NASA 2000c; Jenkins 2001).

The captive flights were the next phase of the ALT and consisted of actual flights by the SCA with *Enterprise* mated to determine the flight handling, maneuverability, and general characteristics of the mated system while in flight (Jenkins, NASA 1998). Five inert, or unmanned and unpowered, flights were performed with *Enterprise* attached to the SCA. Three active flights were then performed with *Enterprise* remaining mated for the duration of the flight but powered and crewed (NASA 2000c; Jenkins 2001). Two alternating crews were used for the manned portion of the ALT mission. Crew 1 consisted of Fred Haise and C. Gordon Fullerton. Haise was a member of the Apollo 13 crew and Fullerton served on the support crew for Apollo 14, 15, 16, and 17. Crew 2 consisted of Joe Engle and Richard Truly. Engle served as a test pilot for the X-15 rocket airplane and as a crew backup for Apollo 14 and 17, while Truly was a member of the astronaut support crew and capsule communicator during the Skylab and Apollo-Soyuz missions. Finally, free flights were performed beginning on August 12, 1977. After being brought to a sufficient altitude *Enterprise* detached from the SCA via explosive bolts and then glided and landed successfully at Edwards Air Force Base. Although *Enterprise* was not returning from Earth orbit it did successfully simulate a return flight (Jenkins 2001). After the first free flight Haise said he was "...very happy. Everything went super slick. It went better than I had hoped for." Fullerton added that the flight was "just as much fun as it looked like it would be." (Rossister Jr, 1977).

The free flights were especially important regarding the taxiing of the orbiter itself. In normal aircraft testing the taxi tests occur first and eventually a speed is reached allowing for the vehicle to take off and move on to flight testing. For *Enterprise* the taxi and flight tests were done in reverse. Because the orbiter is unpowered, the only way to test its taxiing abilities and ground maneuverability was after landing but before it came to a full stop. In an oral history for NASA, C. Gordon Fullerton said "For ALT and then subsequently on

the *Columbia*, we were clearly test pilots because we were doing stuff that there wasn't a procedure for. We were writing the procedure and then flying it for the first time" (Fullerton 2002).

Three of the five free flights had *Enterprise* outfitted with a vertical stabilizer cone. This cone normally covers the rear engine bells and provides a more streamlined shape that aids in flight aerodynamics. This cone was used during transport of all the orbiters but not during a launch. For the final two free flights the vertical stabilizer cone was removed to simulate the return of an orbiter from Earth orbit (Jenkins 2001). These five flights represent the only time that *Enterprise* flew unaided. It is also the only time that an orbiter has flown without first returning from Earth orbit. Fred Haise also participated in NASA's oral history project. He stated that "It turned out the Shuttle, in my view, was a perfect vehicle. If you get set up with the right sync rate, coasting along, you can literally almost go hands-off, and it'll settle on and land itself very nicely" (Haise 1999). In 2004, shuttle commander Joe Engle attested to the minimal difference between *Enterprise* and the other orbiters: "I was very, very pushed to find any difference between *Enterprise* and the two orbital vehicles, *Columbia* and *Discovery*, other than the fact that *Enterprise* was much lighter weight and, therefore, performance-wise you had to fly a steeper profile and the air speed bled off quicker in the approach and landing" (Engle 2004).

Mated Vertical Ground Vibration Test (MGVT)

Upon completion of the ALT mission, *Enterprise* was ferried to Alabama for a rigorous series of vibration tests called the Mated Vertical Ground Vibration Test. For this, *Enterprise* was attached to an inert, un-fueled ET and SRBs. This configuration mirrors the launch assembly and is referred to as the "stack." During these tests *Enterprise* was outfitted with a series of vibration units that would subject the orbiter to the vibrations experienced during a launch and ensure that the orbiter was capable of handling this type of activity (Jenkins 2001).

***Enterprise* remains a prototype**

In 1977 the decision was made to turn STA-099 (a partially constructed orbiter test piece) into a complete space-capable space shuttle orbiter. A number of design changes had been implemented after *Enterprise* was completed, including enhancements to the wings and mid-fuselage for strength as well as some

aluminum components being replaced with titanium. To incorporate these changes into *Enterprise* would have required that it be disassembled and the various components returned to their respective manufacturers, which were scattered across the country. As STA-099 was only partially completed and had some of these alterations already incorporated into its design, it was decided that *Enterprise* would remain a prototype and STA-099 would receive the final modifications necessary to become part of the fleet. STA-099 received its new designation of OV-099 and its new name: *Challenger* (Jenkins 2001; NASA 2010).

Preparation for STS-1

Although *Enterprise* would never fly in space, its job was not yet complete. In April 1979, *Enterprise* was ferried to Kennedy Space Center to assist with fit checks involved with the other shuttle components such as the ET and SRBs as well as the launch pad/tower (Jenkins 2001). Following the fit checks performed at Kennedy Space Center, *Enterprise* was ferried to California. At this point, certain components and systems were removed (such as controls, computer hardware and avionics equipment) from *Enterprise* for use in the other orbiters and it received an updated paint scheme (Jenkins 2001).

The first orbital flight (STS-1) of the space shuttle program took place on April 12, 1981 with space shuttle *Columbia*. "At 27 seconds before launch, Crippen realized that they were actually going to fly. His heart raced to 130 beats per minute while Young's heart, that of a veteran commander, stayed at a calm 85 beats. Young later joked 'I was excited too. I just couldn't get my heart to beat any faster.'" John Young and Robert Crippen launched into orbit at precisely 7 AM EST (NASA 2010:12).

The fit checks, vibration tests, atmospheric flights and landings, and various other development tasks performed on *Enterprise* enabled *Columbia* to launch successfully during STS-1. Further, the groundwork laid with the development and testing of *Enterprise* enabled the five space-capable orbiters to achieve 135 flights in thirty years, making important contributions to science, technology, and exploration.

Retirement

In 1983, *Enterprise* began its role as an ambassador and educational tool. *Enterprise* was first ferried to Paris, France for the Paris Air Show. The international tour continued on with stops in England, Germany, Italy, and Canada. This tour represents the only time an orbiter has travelled internationally. Upon returning

home *Enterprise* was showcased at the World's Fair in New Orleans, Louisiana (NASA 2000c; Jenkins 2001). With Enterprise's national and international tours complete it headed to Vandenberg Air Force Base near Lompoc, California. Vandenberg was originally planned as an alternate launch site for the space shuttle. Although these plans were later scrapped, *Enterprise* was used for fit checks and testing at Vandenberg in much the same way as it was used at Kennedy Space Center to make sure that facility was prepared for a launch (NASA 2000c). On November 18, 1985 *Enterprise* became the property of the Smithsonian National Air and Space Museum (NASA 2000c); however, the shuttle was not put on public display for nineteen years.

Challenger Accident

On January 28, 1986 space shuttle *Challenger* launched at 11:39 AM EST as part of mission STS-51-L. The mission was highly publicized as Christa McAuliffe, the first participant in NASA's "Teacher in Space Project," was onboard. Seventy-three seconds into the launch, *Challenger* suffered a catastrophic malfunction in one of the SRBs, which led to the vehicle breaking apart. All seven astronauts aboard died and all subsequent shuttle flights were immediately suspended until the accident could be fully investigated. In the wake of the *Challenger* accident, NASA considered converting *Enterprise* into a space-capable orbiter. Ultimately, NASA chose to use spare parts from the construction of *Discovery* and *Atlantis* to build *Endeavor* as a replacement. The shuttle fleet was grounded for two and a half years and did not return to flight until *Discovery* launched on September 28, 1988.

Enterprise Continues Its Mission

In June 1987 *Enterprise* was used for testing landing barriers. The landing barrier is essentially a large net stretched across the runway that helps the orbiter reduce speed when landing. The tests were successful and the landing barriers were installed at three Transoceanic Abort Landing sites (Moron and Zaragota, Spain, and Banjul, Gambia). Later that year *Enterprise* was involved in tests related to crew extraction methods in response to the *Challenger* accident. Although retired, *Enterprise* continued to aid NASA throughout the 1990s and 2000s to test new systems and technology. Proposals had been made to convert *Enterprise* into an unmanned space-capable orbiter, so in 1996 it was physically inspected to assess current structural integrity and condition. Although some areas of corrosion and deterioration were identified, it was determined that it was in

good condition in light of its exposure to the elements over the years (Jenkins 2001; pers. comm.). Cost was the most likely reason that the proposal did not move forward (Jenkins pers. comm.).

Columbia Accident

At 8:59 AM EST, on February 1, 2003, Space Shuttle *Columbia* broke up during reentry into Earth's atmosphere during mission STS-107, and the seven astronauts aboard died. In May 2003, during the investigation by the Columbia Accident Investigation Board, tests were conducted using wing panels from *Enterprise*. A section of the wing was removed and attached to a stationary position and an air gun was used to shoot a foam block at the wing. Although the wing didn't break, it was deformed and seals were damaged. While *Enterprise* has a fiberglass wing, *Columbia*'s was made of reinforced carbon-carbon, a composite of carbon fiber in a graphite matrix which is well suited for high temperatures but exhibits less structural stability. Similar tests were performed on one of *Enterprise*'s landing gear doors. It was determined, based on these tests, that the foam strike during launch was most likely responsible for the Thermal Protection System being compromised and ultimately for the loss of *Columbia* upon reentering Earth's atmosphere. (Columbia Accident Investigation Board 2003). Upon completion of these tests the wing panel and landing gear door were returned to *Enterprise*. Visible evidence of these tests still exists on the components that were used for testing.

Public Display

Although *Enterprise* had been gifted to the National Air and Space Museum in the mid 1980s it wasn't put on public display until 2004 at the Stephen F. Udvar-Hazy Center in Washington, DC, a satellite facility designed to showcase the larger air and space vehicles the museum had acquired but was unable to display at its main location in Washington, D.C. *Enterprise* was on display at the Udvar-Hazy center until 2012, when it was ferried by the Shuttle Carrier Aircraft to New York City. After circling the city for photo opportunities with the Statue of Liberty and the Manhattan skyline, *Enterprise* arrived at John F. Kennedy International Airport. After a brief stay, the orbiter was placed on a barge and delivered to its final home: the Intrepid Sea, Air & Space Museum.

Technological History

The space shuttle was a radical step forward in space flight design and implemented new technologies and concepts. *Enterprise* was largely responsible for making sure these advancements worked properly to ensure the safety of the astronauts that would fly aboard the other orbiters. *Enterprise* was also of paramount importance in planning and preparation at the shuttle facilities. In the early days of the space shuttle program, *Enterprise* was the only completed orbiter and was therefore the only vehicle capable of ensuring that the facilities were prepared and ready for the first launch.

Enterprise paved the way for the other five orbiters to make their own marks on history. The space-capable orbiters are responsible for releasing some of the most significant orbiting telescopes, such as the Hubble Space Telescope, the Compton Gamma Ray Observatory, and the Chandra X-ray Observatory. They also released many groundbreaking probes and space craft, such as the Galileo probe, which explored Jupiter, the Magellan probe, which helped map Venus, and the Ulysses probe, which conducted the first systematic survey of the environment of the Sun.

The biggest achievement of the space shuttle program's achievements is the construction of the International Space Station (ISS). Astronaut Michael Finke noted that "[The shuttle] has such a great, historic, amazing record, it built the space station. This is the hugest, biggest piece of space hardware that human beings have ever built, and we couldn't have done it without the space shuttle – even the Russians admit that." The main purpose of the ISS is to serve as an orbiting laboratory. The station has advanced science and technology in areas ranging from biology and medicine to astronomy and physics. Hundreds of experiments have been conducted in orbit aboard the shuttle and the ISS. Some of them are long term and more publicized, such as the effects of microgravity on the human body. John Glenn returned to space in 1998 at the age of 77 as part of an experiment to better understand the effects of microgravity on the elderly (NASA 2010). Other experiments are much smaller in scope, such as determining if fish can swim upright and observing seed growth in microgravity (NASA 2009b). Enterprise was the first step towards the realization of this massive technological achievement.

Cold War

Much like the events of the early space race, the development of the space shuttle also played a role in the Cold War. The Soviet Union saw the space shuttle as a major threat, especially when a launch facility at

Vandenberg Air Force Base was announced. In response, the USSR developed *Buran,* a Soviet clone of the shuttle intended to limit the U.S.'s perceived tactical advantage. After one unmanned mission consisting of two orbits, *Buran* landed successfully and the program was discontinued. Although the Soviets didn't continue to use *Buran*, they did demonstrate that they could develop and implement a space shuttle program of their own. Perhaps more significant, James Moltz, professor of national security at the Naval Postgraduate School, noted that the astronomical costs associated with developing *Buran* "did more to destabilize the Soviet economy than any response to the Reagan administration's efforts in the 1980's." (NASA 2010:51).

Social History

The space shuttle program was also the first American space program to reflect NASA's adoption of culturally diverse hiring practices. In the late 1970s NASA became more progressive regarding its astronaut selection process. Test pilots and military personnel were no longer the only recruitment avenue for astronauts. The agency began focusing on scientists and engineers as well as women and minority groups. The space shuttle program provided a platform for NASA's shift in culture and allowing space to become accessible for everyone in a way that hadn't previously existed. The first American woman[7], first African American[8], and first African American woman[9] flew in space aboard the space shuttle. In addition, many non-US citizens have flow aboard the shuttle, representing a diverse group of people and a high level of cooperation. NASA brought multiculturalism to space exploration via the space shuttle.

The shuttle has given humanity an amazing opportunity for self reflection. Astronaut Sandra Magnus commented on her experience in orbit:

> Our planet is our spaceship, it looks very fragile from here, and it's very easy to take it for granted when we're living on it, when it seems so big and so massive. But it's not. It's very small and very fragile. When you look out the window, you notice how incredibly thin our atmosphere is, how such a fragile shell of air we have that surrounds our planet and makes it habitable and you can read that in a book, but until you see it it doesn't strike home.

[7] Sally Ride in 1983
[8] Guion Bluford in 1983
[9] Mae Jemison in 1992

Magnus went on to say that when a person gazes at the Earth, there is a sense that humanity and all life as we know it are completely dependent on a single planet and its thin atmosphere. "It makes you think about our planet as a whole system. We're all there together living together as human beings and other organisms and we have to take care of each other." (Malik 2009).

Cultural History

Certain physical objects become icons of their time. Popular sentiment transmutes shape, form, and outline into a mythic embodiment of the era so that abstracted symbols evoke even the hopes and aspirations of the day. These icons are instantly recognizable even by the merest suggestion of their shape: a certain wasp-shaped soft drink bottle epitomizes America of the 1950s; the outline of a gothic cathedral evokes the Middle Ages of Europe; the outline of a steam locomotive memorializes the American expansion westward on the late 19th century; a clipper ship under full sail idealizes global trade in an earlier part of that century. America's Space Shuttle has become such an icon, symbolizing American ingenuity and leadership at the turn of the 21st century. The outline of the delta-winged orbiter has permeated the public consciousness. (NASA 1998:2). "Its image exemplifies American's scientific and economic power and encourages dreamers." (NASA 2010:460).

The space shuttle is not only a dominant symbol of science, technology, and exploration but also a major cultural symbol; the space shuttles and their respective facilities have become major tourist attractions. Kennedy Space Center has an entire tourist destination mainly dedicated to the Apollo and space shuttle programs. The National Air and Space Museum showcased *Enterprise* at its satellite facility, the Steven F. Udvar-Hazy Center at Washington Dulles International Airport, until 2012 and now displays *Discovery*. U.S. Space Camp, a private organization, offers an astronaut training simulation experience where children and adults can participate in various types of astronaut training.

The space shuttle program was mandated for retirement in 2010 by George W. Bush, as outlined in his "Vision for Space Exploration" (NASA 2004b). The final launch occurred with *Atlantis* as part of mission STS-135 on July 8, 2011. Once the conclusion of the space shuttle program was announced, many museums attempted to obtain an orbiter for display. Some candidate cities went so far as to begin construction of facilities before they had been selected as shuttle recipients (KOMO 2011). Additionally, the locations chosen were so hotly contested that some Congressional leaders attempted to impede the decisions made by NASA (CNN 2011). The space shuttle is iconic - instantly recognizable, it was emblazoned on the Texas license plate in 2000 (Texas DMV 2012) and the Florida state quarter in 2004 (US Mint no date). Space shuttle merchandise can be found in most museum gift shops.

The importance of *Enterprise* and the space shuttle program is widespread and touches not just Americans but people around the world. In a July 2011 interview with *Air and Space Magazine,* NASA Administrator and space shuttle astronaut Charles Bolden commented on the significance of the shuttle:

> [The shuttle] will definitely be remembered for being the vehicle that enabled us to get the International Space Station successfully assembled on orbit, but it depends on what your favorite thing is. If you're a scientist or an astronomer, it will always be remembered as the vehicle that delivered the Hubble Space Telescope, then flew four successful servicing missions capped off by one of the most spectacular flights in the history of the shuttle program, STS-125, when we did five back-to-back-to-back-to-back-to-back space walks and carried out every objective of that flight when no one thought we would be able to finish everything.
>
> You look at other satellites that it deployed: Magellan, Ulysses. You look at the space laboratory that was flown on it, or the space habitation module. The people that it took to space. We now see, when you look at an astronaut crew, it's usually a rainbow of people—all races, all genders, all nationalities...There are countless things that the space shuttle will mean, just depending on who you are and where you sit. (Bolden, 2011).

Enterprise was the first step of a thirty-year journey into outer space. Its first flights and continued supporting role over the decades assisted *Atlantis, Challenger, Columbia, Discovery, and Endeavor* in transporting 355 people (306 men and 49 women) to and from orbit to undertake unprecedented scientific and technological missions. The space shuttle is "a cathedral of technology and achievement for future generations to regard with wonder." (NASA 2010:9).

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Space Shuttle *Enterprise*
Name of Property

New York County, New York
County and State

10. Geographical Data

Acreage of property Less than one acre

UTM References
(Place additional UTM references on a continuation sheet.)

	Zone	Easting	Northing		Zone	Easting	Northing
1	18	584238	4513167	3			
2				4			

☐ See continuation sheet

Verbal Boundary Description
(Describe the boundaries of the property on a continuation sheet.)

Boundary Justification
(Explain why the boundaries were selected on a continuation sheet.)

11. Form Prepared By

name/title Daniel A. Bagrow, Historic Preservation Specialist

organization New York State Historic Preservation Office date September 2012

street & number Peebles Island State Park, Box 189 telephone 518-237-8643 x 3254

city or town Waterford state New York zip code 12188

Additional Documentation

Submit the following items with the completed form:

Continuation Sheets

Maps

A **USGS map** (7.5 or 15 minute series) indicating the property's location.

A **Sketch map** for historic districts and properties having large acreage or numerous resources.

Photographs

Representative **black and white photographs** of the property.

Additional items
(Check with the SHPO or FPO for any additional items)

Property Owner

(Complete this item at the request of the SHPO or FPO.)

name Intrepid Sea, Air & Space Museum

street & number Pier 86, W 46th St and 12th Ave telephone 212-245-0072

city or town New York state NY zip code 10036-4103

Paperwork Reduction Act Statement: This information is being collected for applications to the National Register of Historic Places to nominate properties for listing or determine eligibility for listing, to list properties and to amend existing listings. Response to this request is required to obtain a benefit in accordance with the National Historic Preservation Act, as amended (16 U.S.C.470 *et seq.*)

Estimated Burden Statement: Public reporting burden for this form is estimated to average 18.1 hours per response including time for reviewing instructions, gathering and maintaining data and completing and reviewing the form. Direct comments regarding this burden estimate or any aspect of this from to the Chief, Administrative Services Division, National Park Service, P.O. Box 37127, Washington, DC 20013-7127; and the Office of Management and Budget, Paperwork Reductions Projects (1024-0018), Washington, DC 20503.

Verbal Boundary Description
The boundary includes only the historic shuttle itself.

Boundary Justification
Because the *Enterprise*'s integrity of location and setting has been lost and because neither of those two qualities is essential to understanding the significance or function of the shuttle, which is an aviation resource that was housed in different locations during the historic period, the boundary was drawn to include only the historic shuttle itself. Although now in a museum setting, the shuttle's ability to convey its historic character is undiminished.

Additional Information
PHOTO LIST

Ben Cooper (launchphotography.com), photos taken July 2012

0001. Space Shuttle *Enterprise*, forward port side, inside the exhibit space on the flight deck of the former USS *Intrepid.*

0002. Space Shuttle *Enterprise*, forward starboard side, inside the exhibit space on the flight deck of the former USS *Intrepid.*

0003. Space Shuttle *Enterprise*, aft starboard side, inside the exhibit space on the flight deck of the former USS *Intrepid.*

Eric Boehm (The Intrepid Sea, Air, & Space Museum), photos taken July 2012

0004. Space Shuttle *Enterprise*, interior cargo bay looking forward toward A-frame ballast racks and plywood catwalk.

0005. Space Shuttle *Enterprise*, interior engine compartment looking aft showing engine mounting structures. No engines are installed.

0006. Space Shuttle *Enterprise*, interior crew module lower deck looking aft through access passageway to cargo bay.

0007. Space Shuttle *Enterprise*, interior flight deck looking forward at instrument panels. Most instrumentation previously removed by NASA.

Daniel Bagrow (New York State Office of Parks, Recreation and Historic Preservation), photos taken May 2012

0008. Space Shuttle *Enterprise*, exterior close up showing the main crew hatch on the forward port side

0009. Space Shuttle *Enterprise*, exterior close up showing intentional damage sustained during testing related to the *Columbia* accident. The tiles in this section are actual high-temperature reusable surface insulation as opposed to polyurethane simulated tiles.

Figures

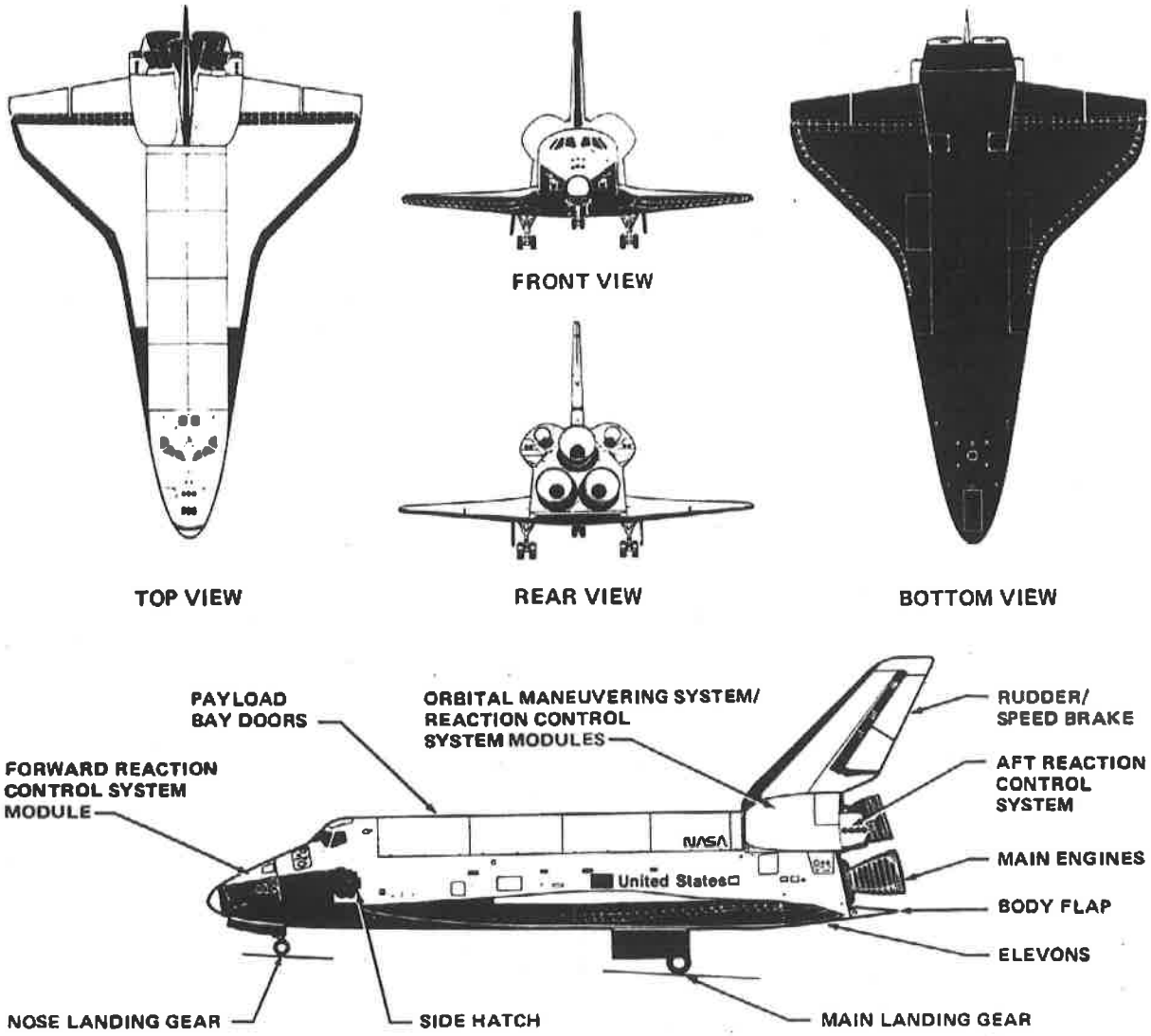
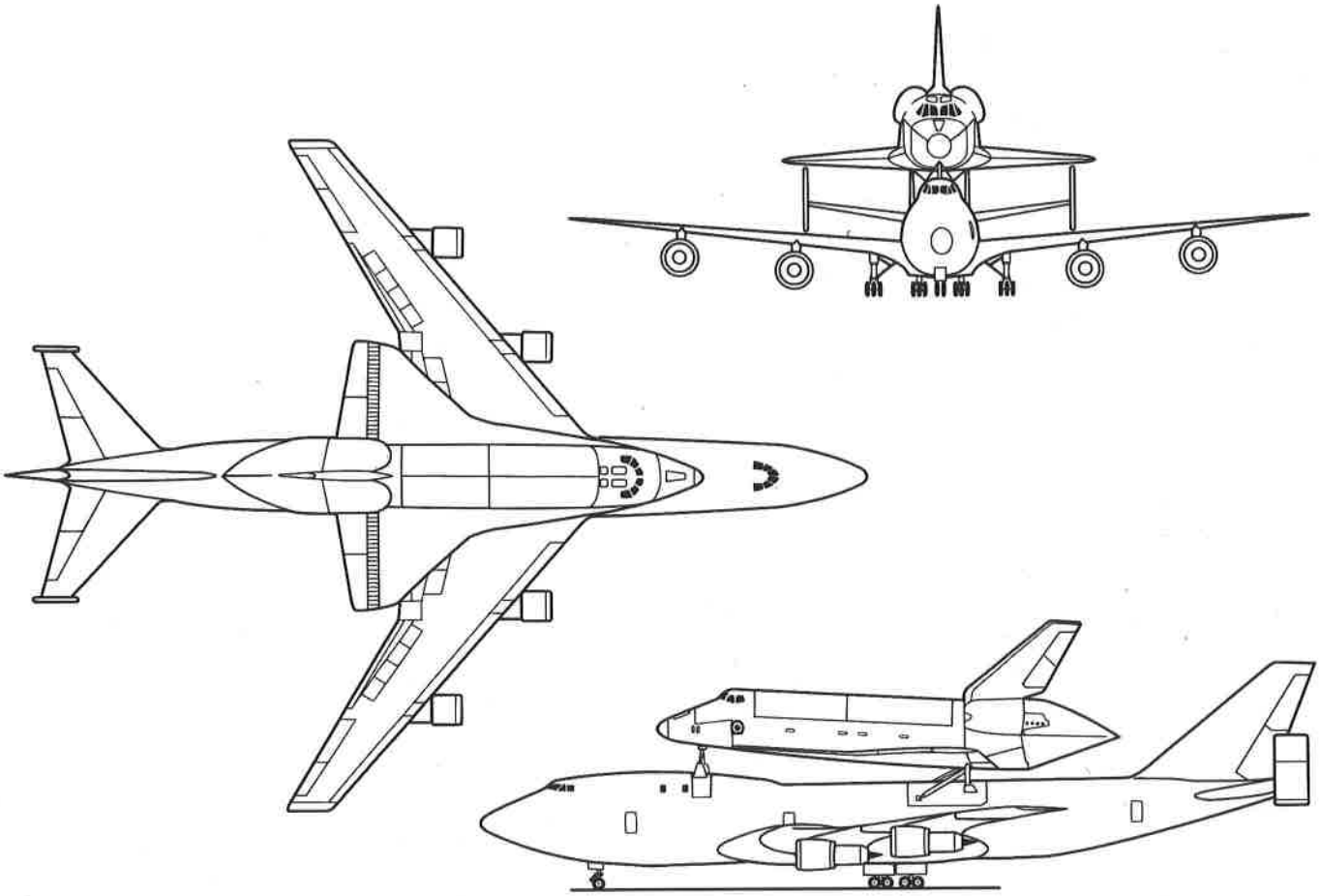


Diagram of a typical space shuttle orbiter.

Image credit: NASA/NSTS 1988 News Reference Manual

Emblem for the Approach and Landing Test

Image credit: NASA



Dryden Flight Research Center February 1998
Space Shuttle mated to 747 Shuttle Carrier Aircraft (SCA) 3-view

Diagram showing an orbiter and Shuttle Carrier Aircraft configuration.

Image credit: NASA.

Historic Photographs

The two crews for the Space Shuttle Approach and Landing Tests are photographed at the Rockwell International Space Division's Orbiter assembly facility at Palmdale, California on the day of the rollout of *Enterprise*. From left to right: Astronauts C. Gordon Fullerton, pilot of the first crew; Fred W. Haise Jr., commander of the first crew; Joe H. Engle, commander of the second crew; and Richard H. Truly, pilot of the second crew.

September 17, 1976

Photo credit: NASA

Enterprise rolls out of the Palmdale manufacturing facilities with Star Trek television cast members in attendance. From left to right: Dr. James D. Fletcher, NASA Administrator, DeForest Kelley, George Takei, James Doohan, Nichelle Nichols, Leonard Nimoy, Gene Roddenberry, unidentified NASA representative, and Walter Koenig.

September 17, 1976

Photo credit: NASA

Enterprise rides atop a Shuttle Carrier Aircraft during the first of the Approach and Landing Tests at the Dryden Flight Research Center, Edwards, California.

February 1977

Photo credit: NASA

An overall view of Mission Control Operations in the Mission Control Center, bldg 30, at Johnson Space Center, during the first free flight of the Shuttle Approach and Landing Tests at the Dryden Flight Research Center in Southern California. This view is looking across the console of flight director Donald R. Puddy. The television monitor in the background shows the *Enterprise* landing following its five minute 23-second unpowered free flight.

August 12, 1977

Photo credit: NASA

Enterprise soars above the Shuttle Carrier Aircraft during the second free flight of the Approach and Landing Tests at Dryden Flight Research Center in Southern California. Astronauts Joe H. Engle, and Richard H. Truly were the crew of this flight.

September 13, 1977

Photo credit: NASA

Enterprise stirs up a cloud of desert sand and dust as it lands at Edwards Air Force Base to conclude a five-minute, 28-second unpowered flight during the second free-flight of the Shuttle Approach and Landing Tests. To *Enterprise's* right a T-38 chase plane comes in for a landing. Astronauts Joe H. Engle, commander, and Richard H. Truly, pilot, were the crewmen for the flight.

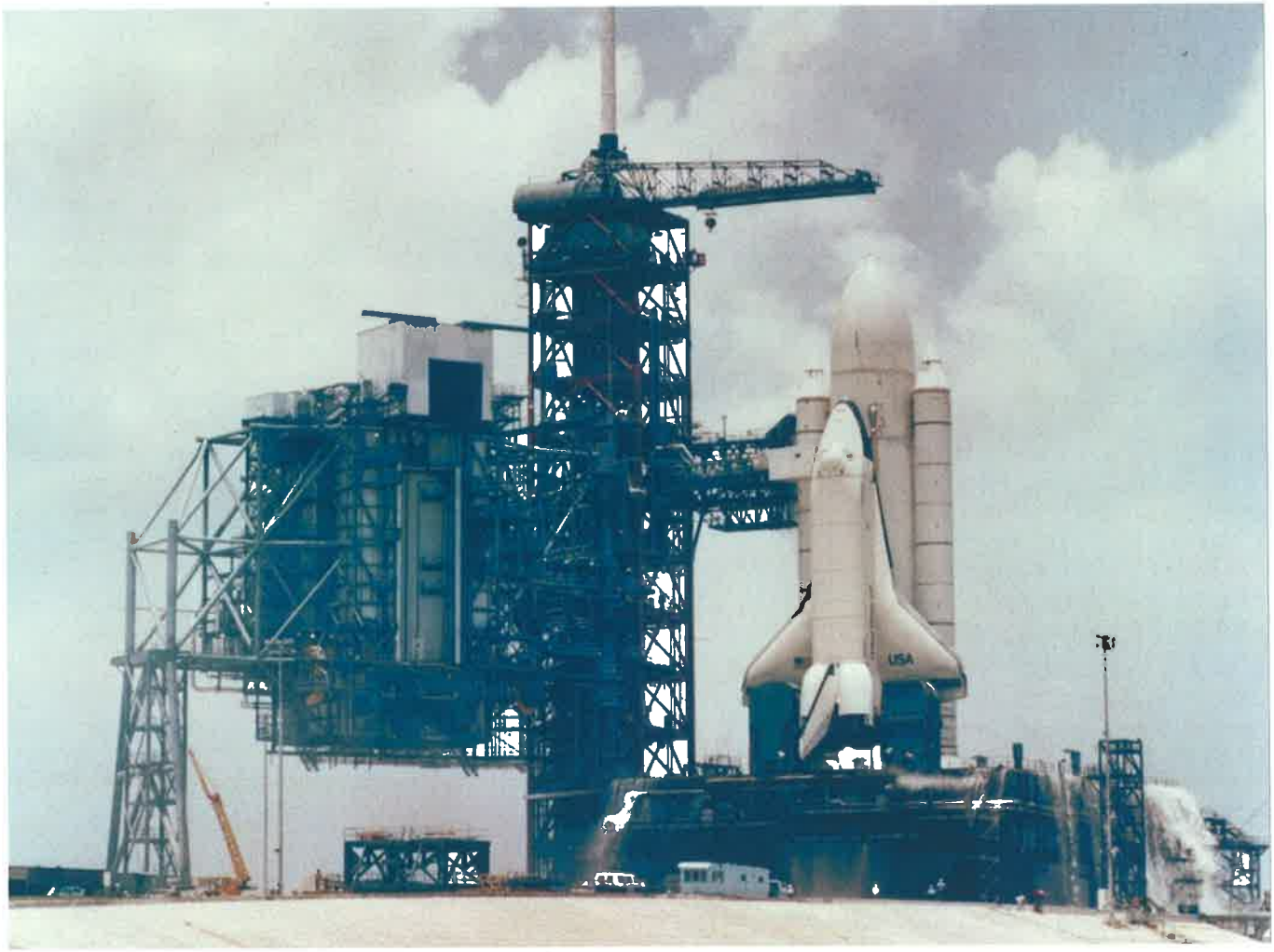
September 13, 1977

Photo credit: NASA

Enterprise flies free after being released from Shuttle Carrier Aircraft during one of five free flights carried out at the Dryden Flight Research Center, Edwards, California as part of the Approach and Landing Tests.

September 26, 1977

Photo Credit: NASA



Space shuttle *Enterprise* goes through a fit check at Kennedy Space Center's Launch Pad 39A.

February 6, 1980

Photo credit: NASA

Low angle view of gantry and Space Shuttle *Enterprise* in launch position on the Vandenberg Air Force Base's Space Launch Complex 6 in California, during verification of launch procedures.

February 1985

Photo credit: U.S. Air Force/TSgt. James R Pearson

Enterprise, mounted atop a Shuttle Carrier Aircraft, is seen as it flies near the Manhattan skyline before landing at John F. Kennedy International Airport. The Intrepid Sea, Air & Space Museum is located at the bottom-center of the image.

April 27, 2012

Photo Credit: NASA/Robert Markowitz

Enterprise, mounted atop a Shuttle Carrier Aircraft, is seen as it flies near the Manhattan skyline before landing at John F. Kennedy International Airport.

April 27, 2012

Photo credit: NASA/Robert Markowitz

Enterprise, mounted atop a Shuttle Carrier Aircraft, is seen as it flies near the Manhattan skyline before landing at John F. Kennedy International Airport.

April 27, 2012

Photo credit: NASA/Robert Markowitz

Enterprise, mounted atop a NASA 747 Shuttle Carrier Aircraft (SCA), is seen as it flies over John F. Kennedy Airport.

April 27, 2012

Photo credit: NASA/Paul E. Alers

Enterprise at John F. Kennedy International Airport shortly before being barged up the Hudson River to the Intrepid Sea, Air & Space Museum

July 2012

Photo credit: New York State Office of Parks, Recreation and Historic Preservation/Daniel Bagrow

Photographs

Photo 001

Photo 002

Photo 003

Photo 004

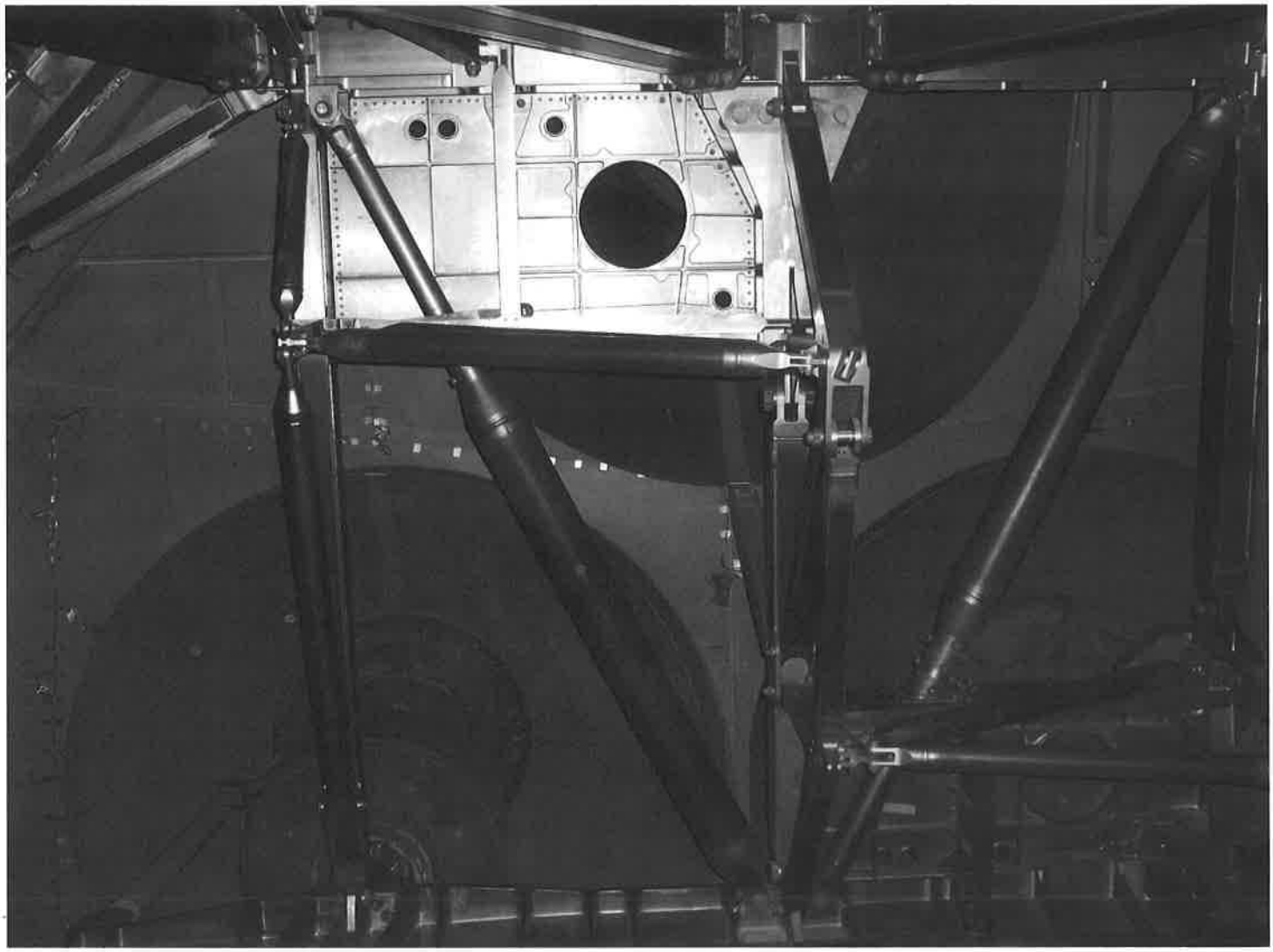


Photo 005

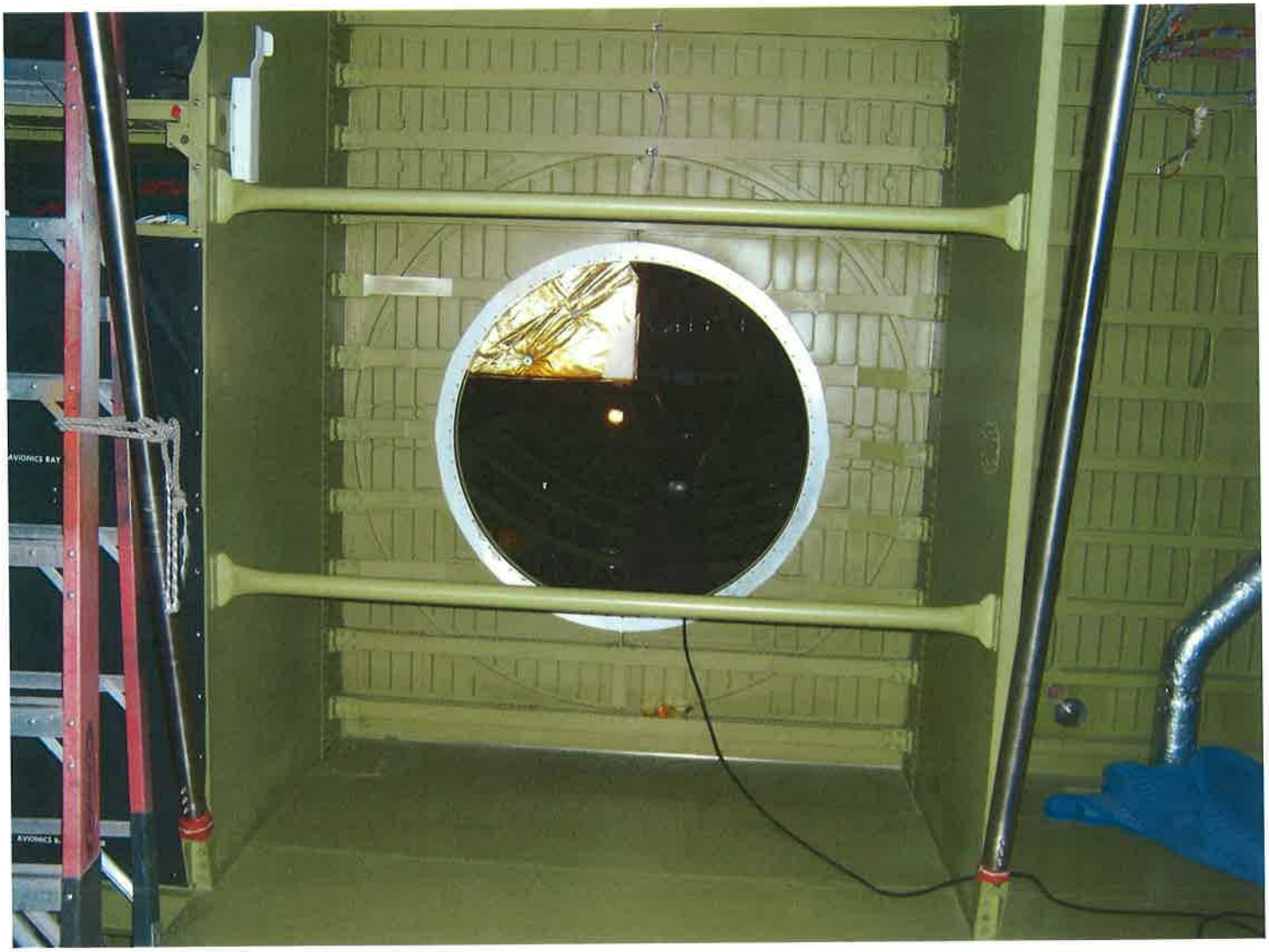


Photo 006

Photo 007

RESCUE
RESCUE
UPPER EJECTION PANELS
EMERGENCY ENTRANCE
CONTROL ON OTHER SIDE

Photo 008

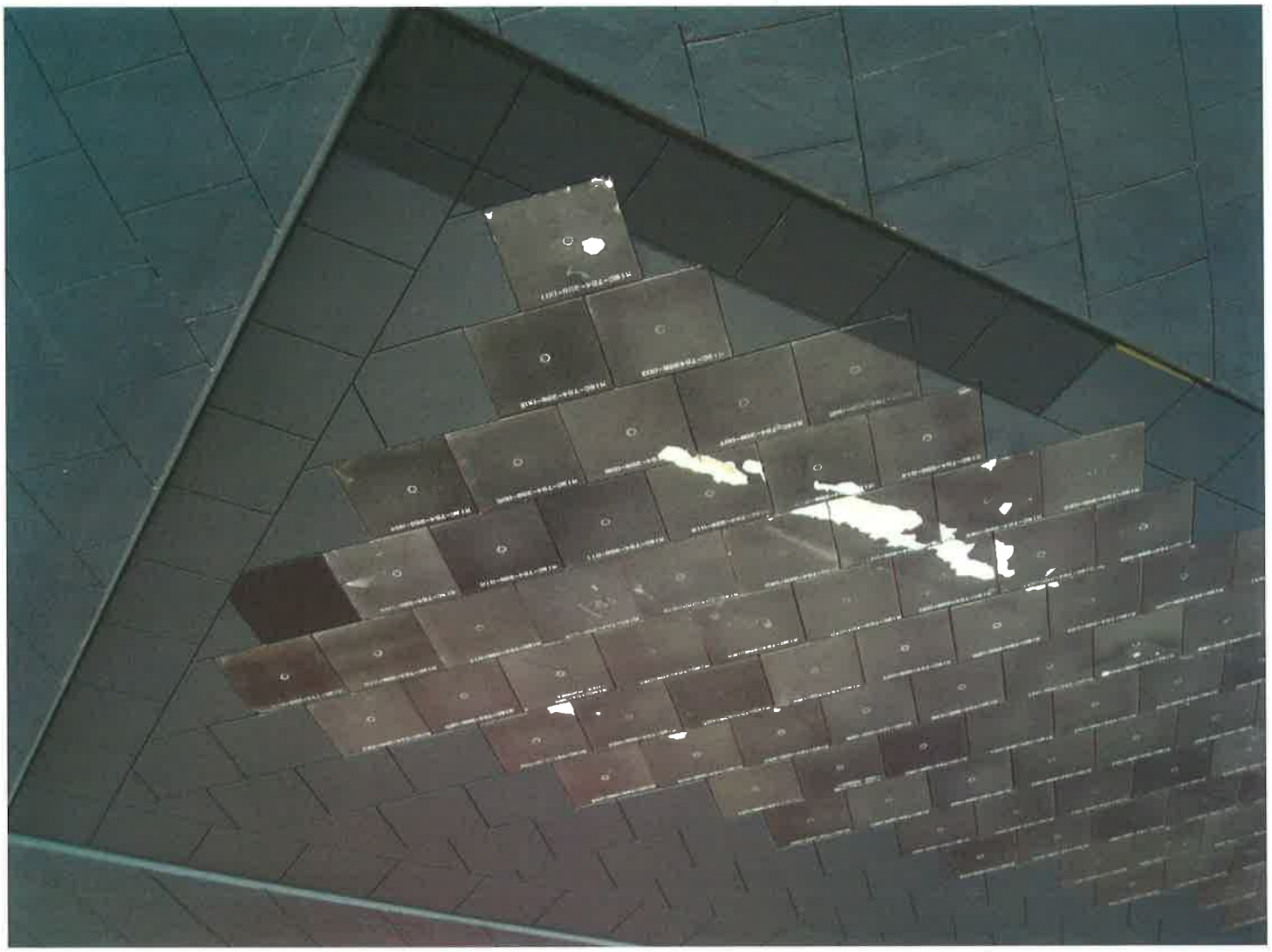
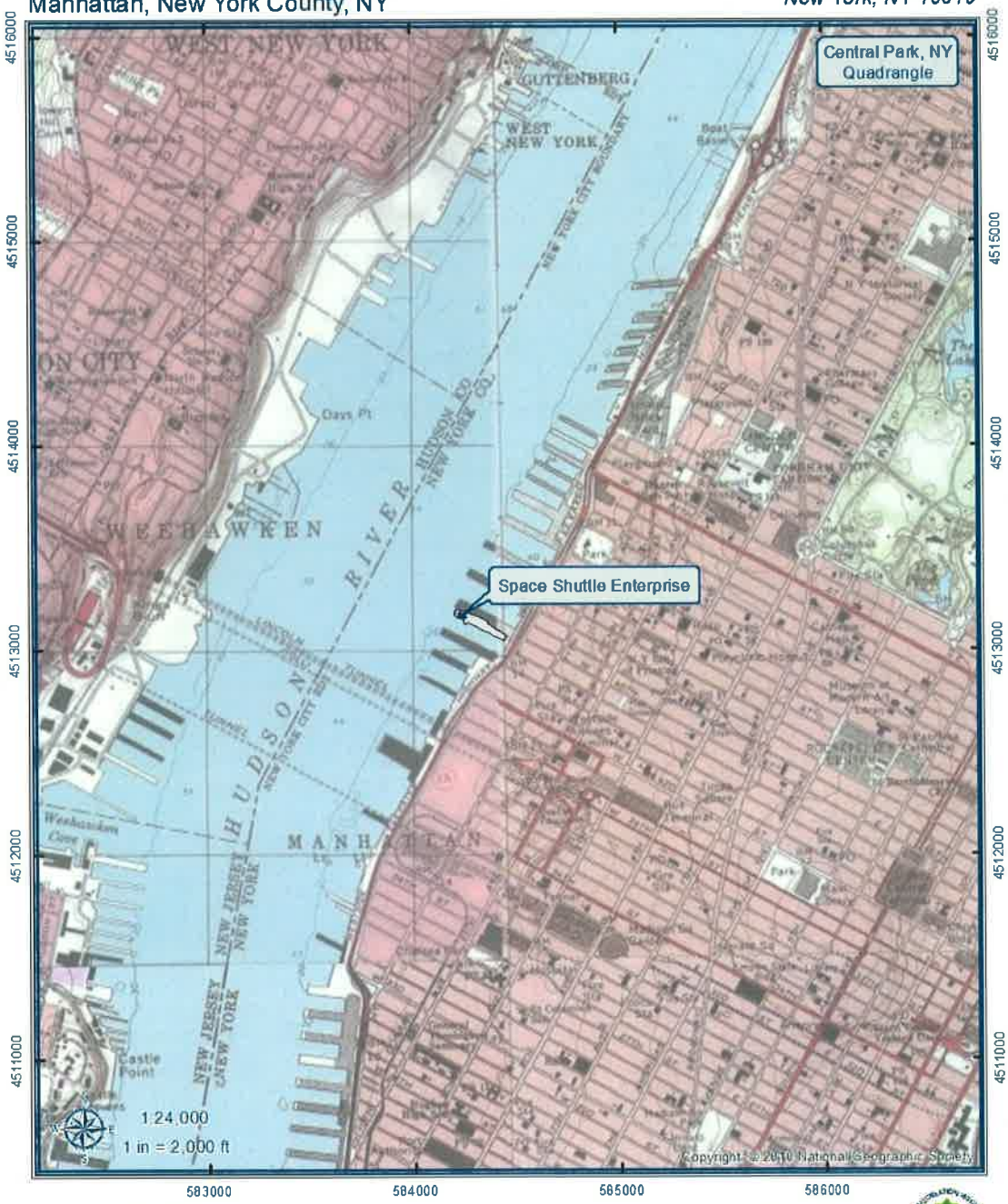


Photo 009

Space Shuttle Enterprise
Manhattan, New York County, NY

Pier 86- West 46th St. & 12th Ave.
New York, NY 10019



Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter

0 650 1,300 2,600 Feet

Shuttle Enterprise

Tax Parcel Data:
New York Co. RPS
http://gis.nyc.gov/doitt/nycitymap

Space Shuttle Enterprise
Manhattan, New York County, NY

Pier 86- West 46th St. & 12th Ave.
New York, NY 10019

Coordinate System: NAD 1983 UTM Zone 18N
Projection: Transverse Mercator
Datum: North American 1983
Units: Meter

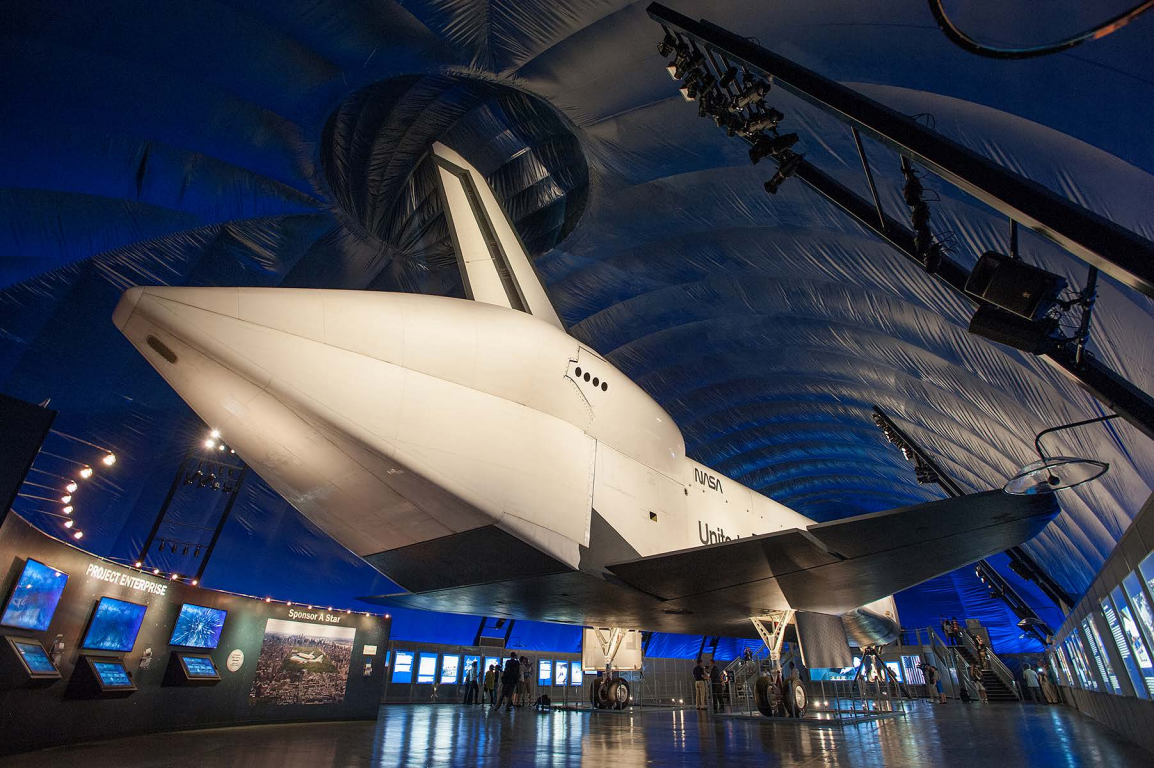
Feet
0 85 170 340

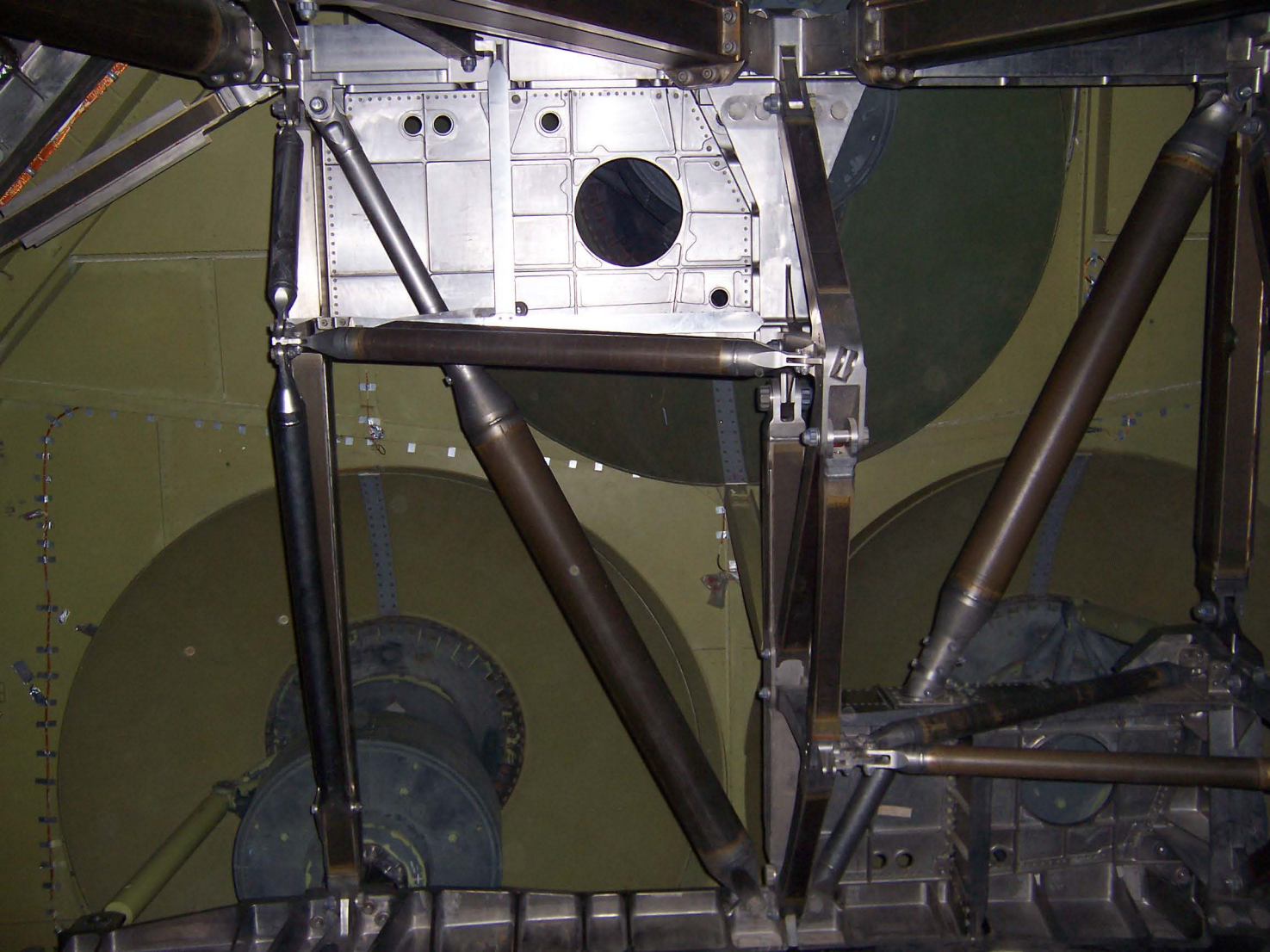
Shuttle Enterprise

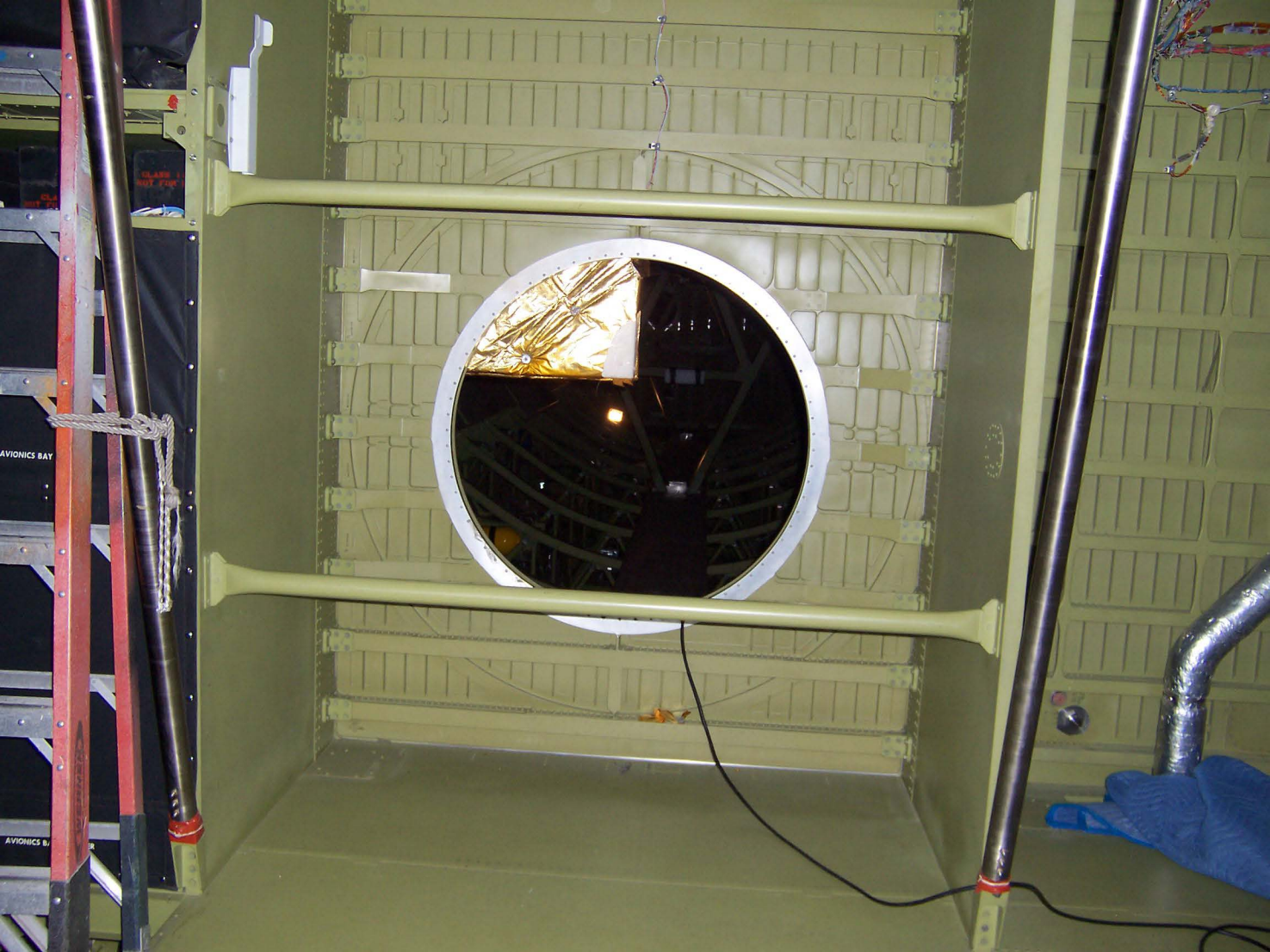
Tax Parcel Data:
New York Co. RPS
http://gis.nyc.gov/doitt/nycitymap

Enterprise
United States

Endeavour


PROJECT ENTERPRISE
Sponsor A Star
NASA




AVIONICS BAY

CLASS III
NOT FOR FLIGHT

1 INSERT TOOL-UNLOCK
2 ROTATE TO VENT DETENT
3 WAIT 2 SECONDS
4 ROTATE TO HARD STOP
UNLATCH
RESCUE
RESCUE
UPPER EJECTION PANELS
EMERGENCY ENTRANCE
CONTROL ON OTHER SIDE