As a result of the trend to replace some tiles with Flexible Insulation Blankets (FIBs), while the earlier orbiters used as many as 34,000 tiles, the last addition to the orbiter fleet, *Endeavour*, was protected by approximately 26,000 tiles. Beginning in 1996, AFRSI blankets were replaced by the lighter FRSI tiles to reduce weight in preparation for flights to the ISS. During major modification periods, the FRSI tiles were added to the shuttle midfuselage and aft fuselage, payload bay doors, and upper wing surfaces.[283]

The wing leading edge RCC upper panels were designed to withstand up to 1"-long penetrations and still block plasma flow. However, some of the lower panels could not suffer any damage without letting heat from the plasma flow reach the leading attach fittings and front spar in the wings. Starting in 1998, during major modifications, insulation was added to the lower panels.[284]

The *Columbia* accident demonstrated that the shuttle's TPS design was vulnerable to impact damage from the existing debris environment. As a result, NASA initiated a program to harden the orbiter against impacts.[285] In 2003, spar sneak flow protection was added to the wing leading edges to prevent hot gas flow from potentially reaching the RCC tiles. In addition, the horse collar gap fillers were redesigned to prevent hot gas from passing into the wing leading edges in case a tile broke off.[286] Beginning with STS-121 in July 2006, NASA replaced the existing FRCI belly tiles with the more impact-resistant Boeing Rigid Insulation (BRI) tiles around the main landing gear door, nose landing gear door, ET umbilical doors, wing leading edge carrier panels, and windows. These changes were made during orbiter processing between flights.[287]

ID. Shuttle Carrier Aircraft

Two NASA-owned SCAs, N905NA and N911NA, supported the SSP. These aircraft were modified four-engine intercontinental range Boeing 747 jetliners, originally manufactured for commercial use (Figure Nos. A-34, A-35).

Historical Overview

In 1973, early in the SSP, NASA considered both the C-5A cargo aircraft, manufactured by Lockheed,[288] and the Boeing 747 "jumbo jet" as potential vehicles to ferry the orbiter cross country. In August and October 1973, contracts were awarded to Boeing and Lockheed, respectively, to conduct preliminary feasibility studies to evaluate whether the orbiter could

[283] Jenkins, *Space Shuttle*, 398-401.
[284] Jenkins, *Space Shuttle*, 398-401.
[285] NASA, *NASA's Implementation Plan for Space Shuttle Return to Flight and Beyond*, vol. 1 (Washington, DC: NASA Headquarters, 2007), 1-21.
[286] Boeing, *Atlantis OV-104, Volume II*, 74.
[287] NASA, *NASA's Implementation Plan*, 1-25.
[288] The original version of the C-5A was manufactured by Lockheed between 1968 and 1973. This large military transport aircraft, which featured a heavy airlift capacity, was used primarily by the US Air Force.

separate from the back of the carrier aircraft. NASA's DFRC awarded a $56,000 contract to Boeing to study the feasibility of using a large aircraft to ferry the orbiter. The contract was the result of an unsolicited proposal submitted by Boeing. The objective of the 60-day study was to define operational requirements, performance, cost, schedules and preliminary systems design for such a carrier aircraft.[289] The Lockheed contract covered wind tunnel tests simulating the use of a C-5A as a ferry aircraft. The tests of a scale model of the orbiter mounted atop a scale model of the C-5A were conducted in Lockheed's Low Speed Tunnel in Burbank, California. The objectives were to determine if the plan was technically feasible, and if so, to determine the optimum location for positioning the orbiter on the C-5A.[290]

Test results demonstrated that the 747 had several advantages over the C-5A. The 747 was shown to be safer, and to be capable of a nonstop transcontinental flight without the need for refueling. Additionally, it could use shorter runways, and had a longer structural life. As a result, by June 1974, NASA replaced its earlier plans to install six air-breathing engines on the orbiter for ferry flights in favor of using a Boeing 747 to transport the orbiter. Following the request of authorization made by Christopher Kraft, director of NASA's JSC, in June 1974, NASA's Space Shuttle Program Office approved the purchase of a Boeing 747 airplane for use as the SCA.[291]

On July 18, 1974, NASA purchased a used Boeing 747-123 jetliner from American Airlines for approximately $15.6 million. At the time of purchase, the aircraft had logged about 9,000 flight hours. It was given the registration number N905NA.[292] Before being modified, the aircraft was initially used as part of a DFRC study of trailing wake vortices; this research was not directly connected to the SSP.[293] Subsequently, the Boeing 747 was used in a shuttle program-related simulated separation maneuver test. On August 2, 1976, modifications were started by Boeing at their production facilities near Everett, Washington. Work under this $30 million contract was completed in December. Under a separate contract, four Pratt and Whitney JT9D-3A engines were altered for use on the SCA.[294] In January 1977, the modified aircraft was flown to Edwards AFB for use with the *Enterprise* during the ALT Program. The tests were a success and demonstrated the flightworthiness of the aircraft-orbiter combination.[295]

N905NA was the only SCA until November 1990. In the wake of the 1986 *Challenger* accident, the Rogers Commission recommended that increasing the ferry capacity would enhance

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[289] "Boeing Gets Contract For Shuttle Ferry," *X-Press*, August 3, 1973, 2.
[290] "Shuttle Ferry Wind Tunnel Tests Slated," *X-Press*, October 26, 1973, 4.
[291] "747 To Be Used For Orbiter Transport," *X-Press*, June 21, 1974, 2.
[292] Heppenheimer, *Development of the Space Shuttle,* 94.
[293] Jenkins, *Space Shuttle*, 196.
[294] Jenkins, *Space Shuttle*, 197. The Pratt & Whitney JT9D engine was a large commercial turbo fan engine initially used on Boeing's 747-100.
[295] T.A. Heppenheimer, *Development of the Space Shuttle,* 121.

reliability of ferry operations and would eliminate a "single point failure from the program."[296] In accordance, in February 1988, NASA announced plans to acquire a second 747 to serve as backup to N905NA.[297] A surplus Japan Air Lines domestic passenger aircraft (747-100SR) with about 32,000 hours of flight time was acquired for NASA by Boeing in April 1988. Boeing began modifications to the aircraft in 1988, at the Boeing Military Airplanes manufacturing facility in Wichita, Kansas, under a $55 million contract, which included the cost of purchase.[298] After the structural work was completed, the aircraft was delivered to Chrysler Technologies in Waco, Texas, for painting.[299] SCA N911NA was added to the NASA fleet on November 20, 1990.[300] It was first used in May 1991, to deliver the new orbiter *Endeavour* (OV-105) to KSC.

Structural modifications to N905NA and N911NA to support ferry operations included stripping each airplane down to the "skin;" adding bracing for structural support; adding two vertical stabilizers, one on each end of the standard horizontal stabilizer; and adding three mounting struts, one forward and two aft, for attachment of the orbiter. Also, extra layers of aluminum skin were added to various stress points throughout the airplane.[301] Inside, aft of the forward doors, all of the standard internal furnishings, seats, overhead bins, etc. were removed (Figure A-35). A few seats were retained for transport of support personnel. Redundant power supplies and cabling were added, primarily to power orbiter fluid system heaters and water coolant loop pumps during ferry operations.[302] New controls and displays for the cockpit were added to monitor these devices. Modifications increased the basic weight of the aircraft by about 2,800 pounds.[303] Some modifications were reversible, including the support struts, the horizontal tip fans, and associated cabling and umbilicals.[304] Improvements also were made to the Pratt and Whitney JT-9D engines to provide more power. In late 1995, the NASA worm logo on the vertical stabilizer of N911NA was repainted with a new stylized tail logo. A few months later, the old logo was replaced on N905NA.

The two SCAs are nearly identical. Each aircraft measures approximately 231'-10" in length, with a wing span of 195'-8". The height to the top of the cockpit area is 32'-1", and 63'-5" to the

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[296] Barbara Schwartz, "NASA Announces Delivery of Second Shuttle Carrier Aircraft," NASA News Release, November 16, 1990, http://www.nasa.gov/centers/johnson/pdf/83142main_1990.pdf; Jeff Carr, "Ferry fleet doubles in size," *Space News Roundup*, November 16, 1990, 1 and 4.
[297] Jenkins, *Space Shuttle*, 198.
[298] Jeffrey E. Carr, "NASA Buys Second Shuttle Carrier Aircraft," NASA News Release, August 10, 1988, http://www.nasa.gov/centers/johnson/pdf/83140main_1988.pdf.
[299] Schwartz, "Second Shuttle Carrier Aircraft."
[300] Jenkins, *Space Shuttle*, 198.
[301] Taylor, interview, 29.
[302] Donald L. McCormack, interview by Jennifer Ross-Nazzal, *NASA STS Recordation Oral History Project*, March 24, 2011, http://www.jsc.nasa.gov/history/oral_histories/STS-R/McCormackDL/McCormackDL_3-24-11.htm. The SCA provided power to the orbiter during the ferry mission. If the orbiter lost power, some of the circulation systems and coolant loops became affected, Taylor, interview, 9.
[303] Marty Curry, ed., "Shuttle Carrier Aircraft," NASA Fact Sheets, July 21, 2006, http://www.nasa.gov/centers/dryden/news/FactSheets/FS-013-DFRC.html.
[304] NASA, *NSTS Shuttle Reference Manual*, "Shuttle Carrier Aircraft," August 31, 2000.

top of the vertical stabilizer. Each has a maximum gross taxi weight of 713,000 pounds. SCA N905NA has a basic weight of 318,053 pounds; N911NA weighs 323,034 pounds.[305] N911NA has five upper-deck windows on each side and N905NA has only two. To balance the SCA when it was carrying the orbiter, nearly 2 tons of pig iron and 3.5 tons of pea gravel were used as ballast. The pig iron is secured up front in the former first class section; the pea gravel is contained in cargo containers in the lower forward cargo bay.[306]

Ferry Flights

The two SCAs transported all five orbiters from California to KSC following their assembly at Palmdale. Cross-country ferry flights also were made following post-mission landings at Edwards AFB, as well as for orbiter maintenance and modifications in Palmdale (prior to September 2002).

Between March 1979, when SCA N905NA delivered *Columbia* to KSC, and September 2009, when SCA N911NA returned *Discovery* after mission STS-128, the two SCAs completed a total of seventy-six ferry flights comprised of 238 legs.[307] Almost three-quarters of the ferry flights were made by SCA N905NA, which actively served the SSP between 1979 and 2007.[308] SCA N911NA completed twenty ferry flights during its eighteen years of service (1991 through 2009), which began with the initial delivery of *Endeavour* to KSC in May 1991.

Tabulation of Ferry Flights and Flight Legs, by SCA and Flight Purpose

SCA	Initial Delivery No. Flights/No. Legs	Post-Mission No. Flights/No. Legs	OMM/OMDP No. Flights/No. Legs	Totals No. Flights/No. Legs
N905NA	4/11	42/126	10/29	56/166
N911NA	1/6	13/47	6/19	20/72
Totals	5/17	55/173	16/48	76/238
Average No. Legs	3.4	3.2	3.0	3.1

With the exception of *Endeavour*, the newly assembled orbiters were towed from Palmdale to Edwards AFB and mated to SCA N905NA using the MDD at DFRC. *Endeavour* was the only new orbiter delivered by SCA N911NA, and the only one to be mated to the SCA at Palmdale using the OLF.

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305 Curry, "Shuttle Carrier Aircraft."
306 Gray Creech, "Gravel Haulers: NASA's 747 Shuttle Carriers," August 22, 2003, http://www.nasa.gov/news/special/747_Shuttle_Carriers_prt.htm.; Pete Seidl, interview by Joan Deming and Patricia Slovinac, September 18, 2006.
307 A leg was the distance traveled between stops for fueling or other purposes.
308 In 1977, SCA N905NA was used in NASA's ALT Program. It also carried the orbiter prototype *Enterprise* to KSC for various fit checks and facility tests. The last post-mission (STS-128) landing of a SCA at Edwards AFB was on September 11, 2009. The final seven missions of the SSP ended with landings at KSC.

Early in the SSP, Edwards AFB was the preferred post-mission landing site because of more stable weather conditions as well as a choice of concrete and dry lake beds. However, KSC later became the primary landing site because it saved processing time to prepare for the next mission. The first landing at KSC was at the end of mission STS-41B, on February 11, 1984. Overall, approximately 74 percent of the first fifty missions, between 1981 and 1992, ended with a landing in California, resulting in thirty-seven ferry flights to return the orbiter to KSC. Of these, all but four of the thirty-seven used SCA N905NA. The first mission-related use of SCA N911NA was in support of STS-40 in June 1991. For the next fifty shuttle flights, between 1992 and 2000, only ten (25 percent) of the landings were made at Edwards AFB. The SCAs were placed into service equally, with five ferry flights each. In total, throughout the SSP, fifty-five post-mission ferry flights were made between California and Florida. SCA N905NA carried the orbiters forty-two times and SCA N911NA was used for thirteen flights. *Discovery* was the fleet leader, with a total of fifteen ferry flights, followed by *Columbia* and *Atlantis*, with thirteen each; *Challenger* and *Endeavour* rode atop the SCA seven times each.

Tabulation of Post-Mission Ferry Flights, by Orbiter and SCA

SCA	**OV-099** ***Challenger***	**OV-102** ***Columbia***	**OV-103** ***Discovery***	**OV-104** ***Atlantis***	**OV-105** ***Endeavour***	**Totals**
N905NA	7	12	12	9	2	42
N911NA	0	1	3	4	5	13
Totals	7	13	15	13	7	55

Post-mission ferry flights averaged three legs per flight. All but four ferry flights were made in two to four legs. *Columbia*, *Discovery*, and *Atlantis* each had a single five-leg ferry flight following missions STS-35, STS-42, and STS-76, respectively. The initial delivery of *Endeavour* entailed a six-leg journey.

In addition to initial delivery and mission-related flights, between 1985 and 2001, the SCAs were used to transport the orbiters between KSC and Palmdale, sixteen times in support of eight vehicle maintenance and major modifications.[309] Ten flights were made by SCA N905NA and six by SCA N911NA. On *Columbia's* first trip back to Palmdale, it was demated and mated at the DFRC MDD and towed to and from Palmdale. After the *Challenger* accident, the OLF was assembled at Palmdale and used to mate and demate the orbiter from the SCA. For cost-saving reasons, beginning in September 2002, NASA relocated the orbiter overhaul and upgrade operations from Palmdale to KSC. Thus, since late 2002, the SCAs have provided ferry flight service only in situations where bad weather requires a landing in California. A list of SSP ferry flights follows.

Notably, in 2001, a unique event in the history of the SSP took place in the form of simultaneous dual ferry missions. As related by Donald McCormack, *Columbia* was at Palmdale for maintenance, and scheduled to be ferried back to KSC in late February using SCA N905NA. On

[309] *Columbia* made four trips to Palmdale, *Atlantis* two, and *Discovery* and *Endeavour*, one trip each.

February 20, 2001, *Atlantis* concluded the STS-98 mission with a landing at Edwards AFB; turnaround processing began immediately. Since *Atlantis* would be flown again sooner than *Columbia*, NASA decided that the *Columbia* ferry mission could not interfere with the *Atlantis* ferry. Also, neither could interfere with the launch of the STS-102 (*Discovery*) mission, scheduled for March 8. Subsequently, two independent ferry missions were accomplished, with *Atlantis* using SCA N911NA. *Columbia* was prepared first, but the ferry mission was delayed by rain. By this time, *Atlantis* was also ready. Therefore, on March 1, 2001, *Columbia* was flown to Dyess AFB in Abilene, Texas, and *Atlantis* was flown to Altus AFB near Altus, Oklahoma, on the first leg of their respective ferry flight. Both *Atlantis* and *Columbia* arrived at KSC on March 4. *Atlantis* went to the KSC SLF and *Columbia* went to the skid strip at Cape Canaveral Air Force Station (CCAFS). Following the demating of *Atlantis*, *Columbia* was moved to the SLF on March 5.[310]

Space Shuttle Ferry Flights (exclusive of OV-101)

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
1	Delivery to KSC	OV-102	905	4	EDW-BIF/Mar. 20, 1979 BIF-SKF/ Mar. 22, 1979 SKF-VPS/ Mar. 23, 1979 VPS-X68/ Mar. 24, 1979	X		
2	STS-1	OV-102	905	2	EDW-TIK/ Apr. 27, 1981 TIK-X68/ Apr. 28, 1981		X	
3	STS-2	OV-102	905	2	EDW-BSM/Nov. 24, 1981 BSM-X68/Nov. 25, 1981		X	
4	STS-3	OV-102	905	2	SNG-BAD/Apr. 6, 1982 BAD-X68/Apr. 6, 1982		X	
5	Delivery to KSC	OV-099	905	2	EDW-EFD/July 4, 1982 EFD-X68/July 5, 1982	X		
6	STS-4	OV-102	905	2	EDW-DYS/July 14, 1982 DYS-X68/July 15, 1982		X	
7	STS-5	OV-102	905	2	EDW-SKF/Nov. 21, 1982 SKF-X68/ Nov. 22, 1982		X	
8	STS-6	OV-099	905	2	EDW-SKF/Apr. 14, 1983 SKF-X68/Apr. 14, 1983		X	
9	STS-7	OV-099	905	2	EDW-SKF/June 28, 1983 SKF-X68/June 29, 1983		X	
10	STS-8	OV-099	905	2	EDW-SPS/Sept. 9, 1983 SPS-X68/Sept. 9, 1983		X	
11	Delivery to KSC	OV-103	905	3	EDW-VBG/Nov. 6, 1983 VBG-FWH/Nov. 8, 1983 FWH-X68/9 Nov. 9, 1983	X		

[310] McCormack, interview, 19-20.

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
12	STS-9	OV-102	905	4	EDW-BIF/Dec. 14, 1983 BIF-SKF/Dec. 14, 1983 SKF-VPS/Dec. 15, 1983 VPS-X68/Dec. 15, 1983		X	
13	Mods	OV-102	905	2	X68-SKF/Jan. 26, 1984 SKF-EDW/Jan. 27, 1984			X
14	STS-41C	OV-099	905	2	EDW-SKF/Apr. 17, 1984 SKF-X68/Apr. 18, 1984		X	
15	STS-41D	OV-103	905	2	EDW-LTS/Sept. 9, 1984 LTS-X68/Sept. 10, 1984		X	
16	Delivery to KSC	OV-104	905	2	EDW-EFD/Apr. 12, 1985 EFD-X68/Apr. 13, 1985	X		
17	STS-51B	OV-099	905	2	EDW-SKF/May 10, 1985 SKF-X68/May 11, 1985		X	
18	STS-51G	OV-103	905	2	EDW-BSM/June 28, 1985 BSM-X68/June 28, 1985		X	
19	Mods	OV-102	905	2	EDW-OFF/July 14, 1985 OFF-X68/July 14, 1985			X
20	STS-51F	OV-099	905	4	EDW-DMA/Aug. 10, 1985 DMA-SKF/Aug. 10, 1985 SKF-VPS/Aug. 11, 1985 VPS-X68/Aug. 11, 1985		X	
21	STS-51I	OV-103	905	2	EDW-SKF Sept. 7, 1985 SKF-X68/Sept. 8, 1985		X	
22	STS-51J	OV-104	905	2	EDW-SKF/Oct. 11, 1985 SKF-X68/Oct. 11, 1985		X	
23	STS-61A	OV-099	905	4	EDW-DMA/Nov. 10, 1985 DMA-SKF/Nov. 10, 1985 SKF-VPS/Nov. 11, 1985 VPS-X68/Nov. 11, 1985		X	
24	STS-61B	OV-104	905	2	EDW-SKF/Dec. 7, 1985 SKF-X68/Dec. 7, 1985		X	
25	STS-61C	OV-102	905	4	EDW-DMA/Jan. 22, 1986 DMA-SKF/Jan. 22, 1986 SKF-VPS/Jan. 23, 1986 VPS-X68/Jan . 23, 1986		X	
26	STS-26	OV-103	905	2	EDW-SKF/Oct. 8, 1988 SKF-X68/Oct. 8, 1988		X	
27	STS-27	OV-104	905	3	EDW-DMA/Dec. 11, 1988 DMA-SKF/Dec. 12, 1988 SKF- -X68/Dec. 13, 1988		X	
28	STS-29	OV-103	905	2	EDW-SKF/Mar. 23, 1989 SKF-X68/Mar. 24, 1989		X	

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
29	STS-30	OV-104	905	4	EDW-BIF/May 13, 1989 BIF-DFW/May 15, 1989 DFW-WRB/May 15, 1989 WRB-X68/May 15, 1989		X	
30	STS-28	OV-102	905	4	EDW-EDW/Aug. 18, 1989 EDW-SPS/Aug. 20, 1989 SPS-WRB/Aug. 20, 1989 WRB-X68/Aug. 21, 1989		X	
31	STS-34	OV-104	905	3	EDW-BIF/Oct. 28, 1989 BIF-CBM/Oct. 28, 1989 CBM-X68/Oct. 29, 1989		X	
32	STS-33	OV-103	905	4	EDW-EDW/Dec. 2, 1989 EDW-SKF/Dec. 3, 1989 SKF-VPS/Dec. 3, 1989 VPS-X68/Dec. 4, 1989		X	
33	STS-32	OV-102	905	3	EDW-DMA/Jan. 25, 1990 DMA-SKF/Jan. 25, 1990 SKF-X68/Jan. 26, 1990		X	
34	STS-36	OV-104	905	4	EDW-EDW/Mar. 10, 1990 EDW-BIF/Mar. 11, 1990 BIF-CBM/Mar. 13, 1990 CBM-X68/Mar. 13, 1990		X	
35	STS-31	OV-103	905	3	EDW-SPS/May 5, 1990 SPS-WRB/ May 6, 1990 WRB-X68/ May 7, 1990		X	
36	STS-41	OV-103	905	3	EDW-SPS/Oct. 15, 1990 SPS-VPS/Oct. 15, 1990 VPS-X68/Oct. 16, 1990		X	
37	STS-35	OV-102	905	5	EDW-EDW/Dec. 16, 1990 EDW-BIF/Dec. 18, 1990 BIF-SKF/Dec. 18, 1990 SKF-BAD/Dec. 19, 1990 BAD-X68/Dec. 21, 1990		X	
38	STS-37	OV-104	905	4	EDW-SKF/Apr. 16, 1991 SKF-CBM/Apr. 16, 1991 CBM-MCF/Apr. 17, 1991 MCF-X68/Apr. 18, 1991		X	
39	Delivery to KSC	OV-105	911	6	PMD-PMD/May 2, 1991 PMD-BIF/ May 3, 1991 BIF-SKF/May 5, 1991 SKF-EFD/May 6, 1991 EFD-CBM/May ‘6, 1991 CBM-X68/ May 7, 1991	X		

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
40	STS-40	OV-102	905	4	EDW-BIF/June 19, 1991 BIF-SKF/June 20, 1991 SKF-CBM/June 20, 1991 CBM-X68/June 21, 1991		X	
41	OMDP	OV-102	911	4	X68-X-68/Aug. 9, 1991 X68-MCF/Aug. 10, 1991 MCF-SKF/Aug. 12, 1991 SKF-PMD/Aug. 13, 1991			X
42	STS-48	OV-103	911	4	EDW-BIF/Sept. 24, 1991 BIF-TIK/ Sept. 24, 1991 TIK-CBM/Sept. 25, 1991 CBM-X68/Sept. 26, 1991		X	
43	STS-44	OV-104	911	2	EDW-SPS/Dec. 7, 1991 SPS-X68/Dec. 8, 1991		X	
44	OMDP	OV-102	905	3	PMD-PMD/Feb. 7, 1992 PMD-SKF/Feb. 9, 1992 SKF-X68/Feb. 9, 1992			X
45	STS-42	OV-103	905	5	EDW-EDW/Feb. 11, 1992 EDW-BIF/Feb. 14, 1992 BIF-CBM/Feb. 15, 1992 SKF-CBM/Feb. 16, 1992 CBM-X68/Feb. 16, 192		X	
46	STS-49	OV-105	911	4	EDW-EDW/May 21, 1992 EDW-BIF/May 27, 1992 BIF-SKF/May 29, 1992 SKF-X68/May 30, 1992		X	
47	OMDP	OV-104	911	3	X68-GGG/Oct. 18, 1992 GGG-BIF/Oct. 18, 1992 BIF-PMD/Oct. 18, 1992			X
48	STS-53	OV-103	911	3	EDW-SKF/Dec. 15, 1992 SKF-VPS/Dec. 18, 1992 VPS-X68/Dec. 18, 1992		X	
49	STS-55	OV-102	905	4	EDW-BIF/May 11, 1993 BIF-SKF/May 12, 1993 SKF-CBM/May 12, 1993 CBM-X68/May 14, 1993		X	
50	STS-58	OV-102	911	4	EDW-BIF/Nov. 7, 1993 BIF-SKF/ Nov. 7, 1993 SKF-CBM/ Nov. 7, 1993 CBM-X68/Nov. 8, 1993		X	
51	STS-59	OV-105	911	4	EDW-EDW/Apr. 26, 1994 EDW-ELP/Apr. 30, 1994 ELP-LRF/May 1, 1994 LRF-X68/May 3, 1994		X	

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
52	OMDP	OV-104	911	4	PMD-BIF/May 27, 1994 BIF-CBM/ May 28, 1994 CBM-WRB/May 28, 1994 WRB-X68/May 29, 1994			X
53	STS-64	OV-103	905	2	EDW-SKF/Sept. 26, 1994 SKF-X68/Sept. 27, 1994		X	
54	OMDP	OV-102	905	4	X68-HSV/Oct. 8, 1994 HSV-EFD/Oct. 10, 1994 EFD-BIF/Oct. 11, 1994 BIF-PMD/Oct. 11, 1994			X
55	STS-68	OV-105	911	4	EDW-BIF/Oct. 19, 1994 BIF-DYS/Oct. 19, 1994 DYS-VPS/Oct. 20, 1994 VPS-X68/Oct. 20, 1994		X	
56	STS-66	OV-104	911	3	EDW-SKF/Nov. 21, 1994 SKF-VPS/Nov. 21, 1994 VPS-X68/Nov. 22, 1994		X	
57	STS-67	OV-105	905	3	EDW-DYS/Mar. 26, 1995 DYS-CBM/Mar. 27, 1995 CBM-X68/Mar. 27, 1995		X	
58	OMDP	OV-102	905	2	PMD-EFD/Apr. 11, 1995 EFD-X68/Apr. 14, 1995			X
59	OMDP	OV-103	905	3	X-68-NFW/Sept. 27, 1995 NFW-SLC/Sept. 27, 1995 SLC-PMD/Sept. 28, 1995			X
60	STS-76	OV-104	905	5	EDW-EDW/Apr. 6, 1996 EDW-DMA/Apr. 11, 1996 DMA-DYS/Apr. 11, 1996 DYS-VPS/Apr. 12, 1996 VPS-X68/Apr. 12, 1996		X	
61	OMDP	OV-103	911	4	PMD-PMD/June 25, 1996 PMD-LTS/June 28, 1996 LTS-WRB/June 28, 1996 WRB-X68/June 29, 1996			X
62	OMDP	OV-105	911	2	X68-SKF/July 30, 1996 SKF-PMD/July 30, 1996			X
63	OMDP	OV-105	905	4	PMD-PMD/Mar. 25, 1997 PMD-NFW/Mar. 26, 1997 NFW-WRB/Mar. 26, 1997 WRB-X68/Mar. 27, 1997			X
64	OMDP	OV-104	911	2	X-68-TIK/ Nov. 11, 1997 TIK-PMD/Nov. 14, 1997			X
65	OMDP	OV-104	905	4	PMD-PMD/Sept. 22, 1998 PMD-GRK/Sept. 23, 1998 GRK-HOP/Sept. 23, 1998 HOP/X68/ Sept. 27, 1998			X

Seq. No.	Flight	Orbiter	SCA	Flight Legs	Flight Route/Date	Initial Delivery	Post-Mission	OMM/ OMDP
66	OMM	OV-102	905	2	X68-SZL/Sept. 24, 1999 SZL-PMD/Sept. 25, 1999			X
67	STS-9	OV-103	905	3	EDW-LTS/Nov. 2, 2000 LTS-SZL/Nov. 2, 2000 SZL-X68/Nov. 3, 2000		X	
68	OMM	OV-102	905	3	PMD-DYS/Mar. 1, 2001 DYS-CCAS/Mar. 4, 2001 CCAS-X68/Mar. 5, 2001			X
69	STS-98	OV-104	911	4	EDW-LTS/Mar. 1, 2001 LTS-BAD/Mar. 3, 2001 BAD/VPS/Mar. 3, 2001 VPS-X68/Mar. 4, 2001		X	
70	STS-100	OV-105	905	3	EDW-LTS/May 8, 2001 LTS-LRF/May 8, 2001 LRF-X68/May 9, 2001		X	
71	STS-111	OV-105	911	3	EDW-LTS/June 28, 2002 LTS-SZL/June 28, 2002 SZL-X68/June 29, 2002		X	
72	STS-114	OV-103	905	3	EDW-LTS/Aug. 19, 2005 LTS-BAD/Aug. 19, 2005 BAD-X68/Aug. 21, 2005		X	
73	STS-117	OV-104	905	4	EDW-AMA/July 1, 2007 AMA-OFF/July 1, 2007 OFF-HOP/July 2, 2007 HOP-X68/July 3, 2007		X	
74	STS-126	OV-105	911	4	EDW-BIF/Dec. 10, 2008 BIF-NFW/Dec. 10, 2008 NFW-BAD/Dec. 11, 2008 BAD-X68/Dec. 12, 2008		X	
75	STS-125	OV-104	911	4	EDW-BIF/June 1, 2009 BIF-SKF/June 2, 2009 SKF-CBM/June 2, 2009 CBM-X68/June 2, 2009		X	
76	STS-128	OV-103	911	4	EDW-AMA/Sept. 20, 2009 AMA-NFW/Sept. 20, 2009 NFW-BAD/Sept. 20, 2009 BAD-X68/Sept. 21, 2009		X	

SCA Ferry Flight Stops

Identifier	Airfield	Identifier	Airfield
ATL	Atlanta Intl., GA	IAD	Dulles Intl., VA
AMA	Rick Husband Amarillo Intl., TX	LRF	Little Rock AFB, AR
BAD	Barksdale AFB, LA	LTS	Altus AFB, OK
BFM	Mobile Downtown Airport, AL	PMD	Palmdale Plant, CA
BIF	Biggs Army Airfield/Ft. Bliss, TX	MCF	MacDill AFB, FL
BSM	Bergstrom AFB, TX	NFW	NAS Fort Worth, TX*
CBM	Columbus AFB, MS	OFF	Offutt AFB, NE
CCAS	Cape Canaveral AFS, FL	MCI	Kansas City Intl, MO
DEN	Denver Intl., CO	SKF	Kelly AFB/Kelly Field Annex, TX
DMA	Davis-Monthan AFB, AZ	SLC	Salt Lake City Intl., UT
DYS	Dyess AFB, TX	SNG	Northrop Strip, NM
EDW	Edwards AFB, CA	SPS	Sheppard AFB, TX
EFD	Ellington Field, TX	SZL	Whiteman AFB, MO
FWH	Carswell AFB, TX	STL	St. Louis Intl., MO.
GGG	Gregg County Airport, TX	TUL	Tulsa Intl., OK
GRK	Robert Gray Army Airfield/Ft. Hood, TX	VBG	Vandenberg AFB, CA
HIF	Hill AFB, UT	VPS	Eglin AFB, FL
HOP	Fort Campbell Army Airfield, KY	WRB	Warner/ Robbins AFB, GA
HSV	Huntsville Intl., AL	X68	KSC Shuttle Landing Facility, FL

*Formerly FWH