STS-93

LAUNCH REPORT

204:07:00 G.m.t.

The STS-93 Space Shuttle vehicle was launched at 204:04:31:00 G.m.t. (12:31:00 a.m. e.d.t. on July 23, 1999) after a satisfactory countdown.

The initial launch attempt of the STS-93 vehicle, scheduled for 12:36 a.m. e.d.t. on July 20, 1999, was scrubbed when the hazardous gas sample reading in the aft compartment indicated a hydrogen concentration of 640 ppm. Ignition of the three Space Shuttle main engines (SSMEs) was manually inhibited at approximately T-6 seconds in the final countdown. As a result, detanking of the External Tank was performed, and the launch was rescheduled for 48 hours later on July 22, 1999.

The second launch attempt was made for a launch at 12:28 a.m. e.d.t. on July 22, 1999, and was scrubbed because of unfavorable weather in the launch area. Lightning was present within the 20-mile LCC limit throughout the launch window. The launch was rescheduled for 12:24 a.m. e.d.t. on July 23, 1999.

During the countdown, a communications problem occurred that resulted in the loss of the forward link with the vehicle. The problem was corrected at the Merritt Island Launch Area (*MILA) ground facility and communications were restored. As a result of this problem, the time of the planned launch was slipped seven minutes to 12:31 a.m. e.d.t. on July 23, 1999.

Following the liftoff of the vehicle, a short of approximately 0.5-second duration occurred on phase A of AC bus 1. Data evaluation and analysis are in progress of determine if this condition will impact the completion of the planned mission.

The OMS-1 maneuver was not required. The OMS-2 maneuver was performed at 204:054:12:06.97 G.m.t. (00:00:41:07 MET). The maneuver was 135.8 seconds in duration and a differential velocity (ΔV) of 201.3 ft/sec was imparted to the vehicle. The resulting orbit was 144.7 by 153.7 nmi.

The payload bay doors were opened at 204:06:08:35 G.m.t. (00:01:37:35 MET). Dual motor times were recorded during the opening operations.

/s/ Kenneth L. Brown 204:06:44:20 G.m.t.

Don L. McCormack
STS-93 Lead MER Manager

STS-93

FIRST DAILY REPORT

205:12:00 G.m.t.

The STS-93 mission is progressing satisfactorily, with no in-flight anomalies identified in the Orbiter subsystems. Vehicle performance throughout this reporting period has been nominal.

Data evaluation and analysis of the AC 1 phase A short that was discussed in the Launch Plus 4 Hour Report is still in progress. A meeting is scheduled July 24, 1999, to review the findings for the action items assigned during the initial meeting on the short. It has been concluded that there are no restrictions on the usage of AC 1.

The Chandra X-Ray Observatory was successfully deployed at 204:11:47:01 G.m.t. (00:07:16:01MET). At 204:11:48:25 G.m.t. (00:07:17:26 MET), an Orbiter –X axis maneuver was initiated to separate from Chandra. This was accomplished with two firings on reaction control subsystem (RCS) thrusters F2F and F3F. The first pulse was 0.540 second in duration, and the second was 6,700 seconds in duration. The separation firing was performed nominally with no requirement for an additional trim firing.

At 204:12:02:25 G.m.t. (00:07:31:26 MET), a 34.0-second left orbital maneuvering subsystem (OMS) maneuver was performed. The resultant orbit was 153 by 163 nmi. The maneuver delivered a differential velocity (ΔV) of 30.2 ft/sec to the vehicle.

At 204:05:03:15 G.m.t. (000:00:33:15 MET), the backup flight system (BFS) annunciated a cathode ray tube (CRT) BITE 3 message. The BFS was polling the display electronics unit (DEU) at the time, with the BFC/CRT select switch in the 3+1 position. The BITE status words indicated a DEU central processing unit (CPU) memory parity error. The crew performed the malfunction procedure and verified the memory parity error. CRT 3 was recovered and will remain selected and powered for the remaining of the mission.

At 205:01:42:05.17 G.m.t. (00:21:11:06 MET), a 15.4 second OMS-4 maneuver was performed with the right OMS engine. The resultant orbit was 153 by 155 nmi. The delivered a ΔV of 13.8 ft/sec to the vehicle.

At 205:03:14:00 G.m.t. (00:22:43:01 MET), a series of three +X axis thruster pulses were executed. Thruster L1A and R1A were fired (for the first time this mission) for 1.64, 8.92, and 1.64 seconds. The orbit was changed from 155.0 by 152.9 to 153.3 by 152.8 nmi. The maneuver delivered a ΔV of 8.8 ft/sec to the vehicle.

/s/ Don L. McCormack 205:11:40 G.m.t.

Don L. McCormack
STS-93 Lead MER Manager

STS-93

SECOND DAILY REPORT

206:12:00 G.m.t.

The STS-93 mission is progressing satisfactorily and vehicle performance throughout this reporting period has been nominal.

Data evaluation and analysis of the AC 1 hase A short is still in progress. During flight day 3, the crew reported that the AC1 phase A circuit breaker for the center engine controller A is open. This circuit breaker was originally reported as closed.

A Midcourse Space Experiment (MSX) maneuver consisted of a 9.9-second two-thruster (F2F and F3F) –X translation firing, followed by a 10-second coasting period that was followed by a 9.9-second two thruster (L1A and R1A) +X translation. The –X firing was initiated at 205:10:29:54.8 G.m.t. (01:05:58:55.8 MET), and the +X firing was initiated at 205:10:30:14.8 G.m.t. (01:05:59:15.8 MET).

At 205:11:05:56.17 G.m.t. (01:06:34:57 MET), a dual-engine orbital maneuvering subsystem (OMS) 5.2-second maneuver for the Shuttle Ionosphere Modification with Pulsed Local Exhaust (SIMPLEX) payload was performed. The orbit was changed from 153.3 by 147.6 to 158.2 by 148.0 nmi. The delivered differential velocity (ΔV) was 8.7 ft/sec.

At 206:05:49:01.37 G.m.t. (02:01:18:01.37 MET), a 9.80-second MS-7 maneuver was performed with the left OMS engine. The delivered ΔV was 8.8 ft/sec and the orbit was changed to 157.4 by 142.8 nmi.

At 206:07:09:31.17 G.m.t. (02:02:38:32.17 MET), a 10.0-second OMS-8 maneuver was performed with the right OMS engine. The delivered ΔV was 8.7 ft/sec and the orbit was changed to 158.2 by 147.0 nmi.

/s/ Don L. McCormack 206:12:27 G.m.t.

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Don L. McCormack
STS-93 Lead MER Manager

STS-93

THIRD DAILY REPORT

207:12:00 G.m.t.

The STS-93 mission is progressing satisfactorily and vehicle performance throughout this reporting period has been nominal.

A Midcourse Space Experiment (MSX) maneuver was performed that consisted of a 10.0-second left orbital maneuvering subsystem (OMS) engine firing. This OMS-9 firing occurred at 206:10:32:16.17 G.m.t. (02:06:01:16.17 MET) with a delivered differential velocity (ΔV) of 8.8 ft/sec. The orbit was changed from 147.0 by 158.9 nmi. To 146.2 by 158.9 nmi. A two thruster (L1A and R1A) +X-axis reaction control subsystem (RCS) firing was performed following the OMS-9 maneuver. The RCS firing was a 9.8-second translational pulse.

At 207:07:09:34.17 G.m.t. (03:02:38:34.17 MET), a right OMS engine 9.80-second maneuver (OMS-10) for the Shuttle Ionosphere Modification with Pulsed Local Exhaust (SIMPLEX) payload was performed. The resultant orbit was 141.7 by 157.7 nmi., and the delivered ΔV was 8.7 ft/sec.

The crew has experienced a tape jam on one of the camcorders, and they were able to clear the jam. However, a problem still existed when trying to record with the camcorder, but the camcorder operated nominally as a camera. A second jam was reported that initially could not be cleared, and the camcorder no longer functioned as a camera. Later the crew reported that the normal camcorder operation had been recovered.

/s/ Don L. McCormack 207:11:24 G.m.t.

Don L. McCormack
STS-93 Lead MER Manager

STS-93

FOURTH DAILY REPORT

208:12::00 G.m.t.

The STS-93 mission is progressing satisfactorily and vehicle performance throughout this reporting period has been nominal.

Throughout the mission following firings of reaction control subsystem (RCS) primary thruster F2D, the fuel injector temperature dropped, indicating a small volume leak from the fuel valve. The temperature has remained above the redundancy management (RM) leak detection limit of 20 °F for the fuel injector temperature. This performance is not expected to impact the mission, and the thruster will be used as planned. All of the primary RCS thrusters will be removed from the vehicle and sent to the White Sands Test Facility (WSTF) for Orbiter Maintenance Down Period (OMDP) processing.

A Midcourse space Experiment (MSX) part 1 maneuver of 9.8 seconds was performed with the right orbital maneuvering subsystem (OMS) engine. This OMS-11 firing occurred at 207:10:34:15.39 G.m.t. (03:06:05:15.39 MET) with a delivered differential velocity (ΔV) of 8.8 ft/sec. The orbit was changed from 141.7 by 157.7 nmi. To 144.3 by 159.6 nmi. The MSX part II RCS maneuver was performed 10 seconds after the cutoff of OMS-11 and it consisted of a 9.5-second two-thruster (F2F and F3F) –X axis translation followed by a 13-second coast period after which an 8.0-second RCS two-thruster (L1A and R1A) +X axis translation was executed. The -X axis maneuver was initiated at 207:10:34:36.52 G.m.t. (03:06:04:36.52 MET), and the +X axis was initiated at 207:10:34:59 G.m.t. (03:06:04:59 MET).

The flight control system (FCS) checkout was performed using auxiliary power unit (APU) system 1 at 208:01:27:06 G.m.t. (03:20:57:06 MET). The data showed performance was nominal. The checkout lasted for 5 minutes 49 seconds and 18 lb of fuel were consumed. Because of the short run-time of the APU, water spray boiler (WSB) cooling was not required as the lubrication oil temperature only reached 219 °F.

The RCS hot-fire began at 208:02:19:07 G.m.t. (03:21:49:07 MET) and was completed by 208:02:24:41 G.m.t. (03:21:54:41 MET). Sixteen thrusters were fired for the first time during the hot-fire. Also during the hot-fire, the primary- thruster F2D fuel-injector temperature exhibited the same dribbling signature seen throughout the mission. The fuel injector temperature reached a new low for this mission of 29 °F. As stated previously, the RM deselection limit is 20 °F.

At 208:03:08:02 G.m.t. (03:22:38:02 MET), a series of three +X-axis thruster (L1A and R1A) firings were performed. The thrusters were fired for 1.68, 15.81, and 1.64 seconds. The resultant orbit was 160.2 by 145.9 nmi. Thruster performance was nominal.

The OMS-12 maneuver was performed with the right OMS engine at 208:04:48:59.172 G.m.t. (4:00:17:58.188 MET). The firing duration was 10.0 seconds with a delivered ΔV of 8.7 ft/sec. Performance was nominal.

Ku-band antenna stowage was accomplished at about 208:07:05 G.m.t. (04:02:35 MET)

with dual motor run times.

/s/ Don L. McCormack 208:12:07 G.m.t.

Don L. McCormack
STS-93 Lead MER Manager

STS-93

LANDING REPORT

208:05:00 G.m.t.

The STS-93 Space Shuttle vehicle was launched at 204:04:30:59.984 G.m.t. (12:31:00 a.m. e.d.t. on July 23, 1999) after a satisfactory countdown.

The initial launch attempt of the STS-93 vehicle, scheduled for 12:36 a.m. e.d.t. on July 20, 1999, was scrubbed when the hazardous gas sample reading in the Orbiter aft compartment indicated a hydrogen concentration of 640 ppm, which exceeded the Launch commit Criteria (LCC) limit of 600 ppm. Ignition of the three Space Shuttle main engines (SSMEs) was manually inhibited at approximately T-6 seconds in the final countdown. As a result of the scrub, detanking of the External Tank was performed,

The cause of the indicated increase in the aft compartment hydrogen concentration was understood to be a problem in the hazardous gas detection system. No Orbiter corrective actions were required and the launch was rescheduled for July 22, 1999.

The second STS-93 launch attempt was made for a launch at 12:28 a.m. e.d.t. on July 22, 1999, and was scrubbed because of unfavorable weather in the launch area. Lightning was present within the 20-mile LCC limit throughout the launch window. The launch was rescheduled for 12:24 a.m. e.d.t. on July 23, 1999.

During the countdown for the launch on July 23, 1999, a communications problem occurred that resulted in the loss of the forward link with the vehicle. The problem was corrected at the Merritt Island Launch Area (*MILA) ground facility and communications were restored. As a result of this problem, the time of the planned launch was slipped seven minutes to 12:31 a.m. e.d.t. on July 23, 1999.

Approximately 5 seconds after the liftoff of the vehicle, an electrical short of approximately 0.5-second duration occurred on AC bus 1. Coincident with the short, the SSME 1 (center engine) controller A and the SSME 3 (right engine) controller B were disqualified. Post ascent, the crew was asked to check the SSME controller circuit breakers on panel L4 and they reported that none had opened.

Data evaluation indicated that the short had occurred on phase A of AC bus 1. An extensive review of the Orbiter components that were being powered by AC bus 1 during the event was performed. This review showed that there were effects of the resulting AC bus 1 undervoltage caused by the short, but all of the Orbiter equipment operating at the time of the short operated nominally following the short. One of the effects seen was the high pH indication received by fuel cell 1 when the sensor performed a self test that was initiated by the undervoltage transient. The data evaluation concluded that AC bus 1 was good for unrestricted use.

During flight day 3, the crew reported that the AC bus 1 phase A circuit breaker for SSME 1 controller A was actually open and transmitted photographs of the circuit breaker to the ground. With this data, the source of the short could be isolated to a point downstream of the circuit breaker, either in the Orbiter aft compartment wiring or the SSME 1 controller/wiring. The AC 1 phase B and C circuit breakers for SSME 1

controller A were opened for entry to protect against an inadvertent powering of the controller. A postflight troubleshooting plan has been developed.

Also during ascent, there was a low-level oxygen cutoff of the three SSMEs, resulting in a 15 ft/sec underspeed at Main Engine cutoff (MECO). A significant contributor to this cutoff is believed to be a hydrogen leak from the SSME 3 nozzle that was observed in postlaunch photography. The hydrogen leak caused low engine performance, which in turn caused a compensating increase in the flow of oxygen, which resulted in the low-level oxygen cutoff. A preliminary nozzle inspection plan to be performed on the landing strip and in the Orbiter Processing Facility (OPF) has been developed.

The orbital maneuvering subsystem (OMS) –1 maneuver was not required. The OMS-2 maneuver was performed at 204:054:12:06.97 G.m.t. (00:00:41:07 MET). The maneuver was 135.8 seconds in duration and a differential velocity (ΔV) of 201.3 ft/sec was imparted to the vehicle. The resulting orbit was 144.7 by 153.7 nmi.

During ascent, the flash evaporator system (FES) high-load inboard duct temperature dropped to 124 °F at 204:04:46 G.m.t. (approximately 15 minutes MET). The temperature normally remains above 190 °F with only one heater activated. Throughout the occurrence, the evaporator outlet temperatures were stable. The FES performed nominally during entry. The high-load FES on OV-102 has a history of water carryover resulting in off-nominal FES duct temperatures. This unit will be removed from the vehicle and returned to the vendor for refurbishment.

The payload bay doors were opened at 204:06:08:35 G.m.t. (00:07:45:00 MET) and the initial self-test failed due to a known and expected condition. After the initialization was complete, the system was switched to the communications mode and operated nominally throughout the flight.

The Chandra X-Ray Observatory was successfully deployed at 204:11:47:01 G.m.t. (00:07:16:01MET). At 204:11:48:25 G.m.t. (00:07:17:26 MET), an Orbiter –X axis maneuver was initiated to separate from Chandra. This was accomplished with two firings on reaction control subsystem (RCS) thrusters F2F and F3F. The first pulse was 0.54 second in duration, and the second was 6,700 seconds in duration. The separation firing was performed nominally with no requirement for an additional trim firing.

At 204:12:02:25 G.m.t. (00:07:31:26 MET), a 34.0-second firing of the left OMS engine was performed. The resultant orbit was 153 by 163 nmi. The maneuver delivered a ΔV of 30.2 ft/sec to the vehicle.

At 204:05:03:15 G.m.t. (00:00:33:15 MET), the backup flight system (BFS) annunciated a cathode ray tube (CRT) BITE 3 message. The BFS was polling the display electronics unit (DEU) at the time, with the BFC/CRT select switch in the 3+1 position. The BITE status words indicated a DEU central processing unit (CPU) memory parity error. The crew performed the malfunction procedure and verified the memory parity error. CRT 3 was recovered and will remain selected and powered for the remaining of the mission. All of the CRTs and DEUs will be removed from OV-102 following the mission prior to ferrying the vehicle to Palmdale for Orbiter Maintenance Down Period (OMDP).

At 205:01:42:05.17 G.m.t. (00:21:11:06 MET), a 15.4 second OMS-4 maneuver was performed with the right OMS engine. The resultant orbit was 153 by 155 nmi. The

maneuver delivered a ΔV of 13.8 ft/sec to the vehicle.

At 205:03:14:00 G.m.t. (00:22:43:01 MET), a series of RCS +X axis thruster pulses were executed. Thruster L1A and R1A were fired for 1.64, 8.92, and 1.64 seconds. The orbit was changed from 153 by 155 to 152.8 by 153.3 nmi. The maneuver delivered a ΔV of 3.1 ft/sec to the vehicle.

At 205:04:31 G.m.t. (01:00:00 MET), pressure control system (PCS) 1 oxygen flow sensor failed to indicate flow during several periods when oxygen flow was selected. However, this sensor did indicate flow earlier in the mission (between 6 and 10 hours MET) and briefly indicated flow at approximately 208:14:07 G.m.t. (04:09:30 MET).

At 205:07:09:35.17 G.m.t. (01:02:38:36.17 MET), a 10.2 second OMS-5 maneuver was performed with the left OMS engine. The orbit was changed from 153 by 153.5 to 147.9 by 153.5 nmi. The maneuver delivered a ΔV of 8.8 ft/sec to the vehicle.

A Midcourse Space Experiment (MSX) maneuver consisted of a 9.9-second RCS two-thruster (F2F and F3F) –X axis translation firing, followed by a 10-second coasting period that was followed by a 9.9-second two thruster (L1A and R1A) +X axis translation. The –X firing was initiated at 205:10:29:54.8 G.m.t. (01:05:58:55.8 MET), and the +X firing was initiated at 205:10:30:14.8 G.m.t. (01:05:59:15.8 MET).

At 205:11:05:56.17 G.m.t. (01:06:34:57 MET), a two-engine OMS-6 maneuver OF 5.2-second duration was performed for the Shuttle Ionosphere Modification with Pulsed Local Exhaust (SIMPLEX) payload. The orbit was changed from 147.6 by 153.3 to 148.0 by 158.2 nmi. The delivered ΔV was 8.7 ft/sec.

At 206:05:49:01.37 G.m.t. (02:01:18:01.37 MET), a 9.80-second MS-7 maneuver was performed with the left OMS engine. The delivered ΔV was 8.8 ft/sec and the orbit was changed to 142.8 by 157.4 nmi.

At 206:07:09:31.17 G.m.t. (02:02:38:32.17 MET), a 10.0-second OMS-8 maneuver was performed with the right OMS engine. The delivered ΔV was 8.7 ft/sec, and the orbit was changed to 147.0 by 158.2 nmi.

An MSX maneuver was performed that consisted of a 10.0-second left OMS engine firing. This OMS-9 firing occurred at 206:10:32:16.17 G.m.t. (02:06:01:16.17 MET) with a delivered ΔV of 8.8 ft/sec. The orbit was changed from 146.2 by 158.9 nmi. A two thruster (L1A and R1A) +X-axis RCS firing was performed following the OMS-9 maneuver. The RCS firing was a 9.8-second translational pulse.

At 207:07:09:34.17 G.m.t. (03:02:38:34.17 MET), a right OMS engine 9.80-second maneuver (OMS-10) was performed for (SIMPLEX) payload. The resultant orbit was 141.7 by 157.7 nmi., and the delivered ΔV was 8.7 ft/sec.

The crew experienced a tape jamming problem on one of the camcorders. Following an initial jam, which was cleared, the camcorder operated nominally as a camera but would not record. A second jam was reported that initially could not be cleared, and the camcorder no longer functioned as a camera. Later the crew reported that the normal camcorder operation had been recovered. However, this camcorder was not used during PAO events for the remainder of the mission.

Throughout the mission following firings of reaction control subsystem (RCS) primary thruster F2D, the fuel injector temperature dropped, indicating a small volume leak from the fuel valve. The temperature remained above the redundancy management (RM) leak detection limit of 20 °F for the fuel injector temperature. This performance did not impact the mission, and the thruster will be used as planned. All of the primary RCS thrusters will be removed from the vehicle and sent to the White Sands Test Facility (WSTF) for OMDP processing.

An MSX part 1 maneuver of 9.8 seconds was performed with the right OMS engine. This OMS-11 firing occurred at 207:10:34:15.39 G.m.t. (03:06:05:15.39 MET) with a delivered a ΔV of 8.8 ft/sec. The orbit was changed from 141.7 by 157.7 nmi. To 144.3 by 159.6 nmi. The MSX part II RCS maneuver was performed 10 seconds after the cutoff of OMS-11 and it consisted of a 9.5-second two-thruster (F2F and F3F) –X axis translation followed by a 13-second coast period after which an 8.0-second RCS two-thruster (L1A and R1A) +X axis translation was executed. The -X axis maneuver was initiated at 207:10:34:36.52 G.m.t. (03:06:04:36.52 MET), and the +X axis was initiated at 207:10:34:59 G.m.t. (03:06:04:59 MET).

The flight control system (FCS) checkout was performed using auxiliary power unit (APU) 1 at 208:01:27:06 G.m.t. (03:20:57:06 MET). The data showed performance was nominal. The checkout lasted for 5 minutes 49 seconds and 18 lb of fuel were consumed. Because of the short run-time of the APU, water spray boiler (WSB) 1 cooling was not required as the APU 1 lubrication oil temperature only reached 219 °F.

The RCS hot-fire began at 208:02:19:07 G.m.t. (03:21:49:07 MET) and was completed by 208:02:24:41 G.m.t. (03:21:54:41 MET). Sixteen thrusters were fired for the first time during the hot-fire. Also during the hot-fire, the primary- thruster F2D fuel-injector temperature exhibited the same dribbling signature seen throughout the mission. The fuel injector temperature dropped to 29 °F. As stated previously, the RM deselection limit is 20 °F.

At 208:03:08:02 G.m.t. (03:22:38:02 MET), a series of three +X-axis thruster (L1A and R1A) firings were performed. The thrusters were fired for 1.68, 15.81, and 1.64 seconds. The resultant orbit was 160.2 by 145.9 nmi. Thruster performance was nominal.

The OMS-12 maneuver was performed with the right OMS engine at 208:04:48:59.172 G.m.t. (4:00:17:58.188 MET). The firing duration was 10.0 seconds with a delivered ΔV of 8.7 ft/sec. Performance was nominal.

Ku-band antenna stowage was accomplished at about 208:07:05 G.m.t. (04:02:35 MET) with dual motor run times.

At 208:08:21:52.1 G.m.t. (04:03:40:52.1 MET) a 69.6-second forward RS firing was performed. The delivered ΔV was 19.3 ft/sec, and the orbit was changed from 144.7 by 156.1 nmi. To 138.6 by 151.1 nmi. Performance of the RCS was nominal.

The pressure control system (PCS) 1 oxygen (O_2) flow sensor failed to indicate flow during several periods when O_2 flow was selected. The flow sensor indicated flow during one period early in the mission (6 to 10 hours MET) and briefly indicated flow at around 208:14:07 G.m.t. (04:09:30 MET).

During deorbit preparations at 209:01:55 G.m.t. (04:21:24:47 MET), the right vent door 3 close 1 microswitch initially responded correctly. Approximately 5 seconds later, the microswitch transferred off where it remained for approximately one minute 30 seconds. Following that period, the microswitch transferred back on and remained in that position. Data indicate that the door closed in dual motor time.

The payload bay doors were closed and latched for landing at 208:23:40:36 G.m.t. (04:19:09:36 MET). The dual-engine deorbit maneuver for the first landing opportunity at the Kennedy Space Center (KSC) Shuttle Landing Facility) was performed on orbit 79 at 209:02:19:00.1 G.m.t. (04:21:48:00.1 MET). The maneuver was 133.34 seconds in duration with a ΔV of 103.6 ft/sec.

Entry interface occurred at 209:02:48:47.7 G.m.t. (04:22:17:47.7 MET). Entry was completed satisfactorily, and main landing gear touchdown occurred on SLF concrete runway 33 at 209:03:20:37 G.m.t. (04:22:49:37 MET) on July 27, 1999. The nose gear touchdown occurred at 209:03:20:43.8 G.m.t. The drag chute was deployed at 209:03:20:48 G.m.t. and jettisoned at 209:03:21:08 G.m.t. Wheels stop occurred at 209:03:21:22 G.m.t. The rollout was normal in all respects. The flight duration was day 22 hours 49 minutes 37 seconds. The APUs were shut down 16 minutes 3 seconds after landing.

/s/ Kenneth L. Brown 209:05:01 G.m.t.

Don L. McCormack
STS-103 Lead MER Manager