Section 2 - Program Description

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2.1. Description of the *Mir*-Shuttle and *Mir*-NASA Programs

The *Mir* Space Station program for 1994–98 was established by taking into account the following contents of the *Mir*-Shuttle and *Mir*-NASA programs:

2.1.1. Contents of the *Mir* Shuttle and *Mir*-NASA Programs

2.1.1.1. The *Mir*-Shuttle program included:

- Two independent flights (without docking with the *Mir* Space Station) of Russian cosmonauts on the Space Shuttle (STS-60 and STS-63).
- The flight of an American astronaut on the Soyuz-TM-21 vehicle (№ 70), his working on the *Mir* Space Station for three months, and his return on the Space Shuttle (STS-71)–NASA-1 increment.
- An American astronaut's operations on American science equipment that was delivered on the Spektr module.
- The flight of two Russian cosmonauts on the Space Shuttle (STS-71) in order to replace those flying on the *Mir* Space Station.
- The return from the *Mir* Space Station to Earth of two Russian cosmonauts on the Space Shuttle (STS-71).
- Execution of a short-term American mission on the *Mir* Space Station (STS-71).

2.1.1.2. The scope of the *Mir*-NASA program included the following:

- Eight dockings of the Space Shuttle with the *Mir* Space Station.
- Six long-duration missions of American astronauts on the *Mir* Space Station (with a period of residence on the *Mir* Space Station of 123 to 184 days and with an aggregate period of residence on the *Mir* Space Station of 831 days or 2.28 years).
- Eight short-term missions of American astronauts on the *Mir* Space Station (3 - 6 days).
- Development by the Russian side of a special docking module and the delivery thereof via the Space Shuttle to the *Mir* Space Station (STS-74) in order to preclude the movement of the Kristall module from the lateral assembly on the axial before every docking of the Space Shuttle.

- Delivery of American science equipment on the Spektr and Priroda modules.

- Installation of additional solar arrays on the Spektr module in order to provide for the power to be consumed by the American science equipment.

- Delivery by the Space Shuttle (STS-74) of two additional solar arrays for the Kvant module, one of which was furnished with American photoelectric converters.

- Operations on extending the service life of the *Mir* Space Station's onboard systems.

2.1.2. Basic Principles in Building the *Mir*-Shuttle and *Mir*-NASA Nominal Programs

When the *Mir* Space Station's nominal flight program was established for 1994–98, the following basic principles were taken into account:

2.1.2.1. All equipment and components of the life support system which are required for the flight of an American astronaut as per the *Mir*-Shuttle program (the astronaut for the first long-duration mission) shall be delivered to the *Mir* Space Station via Progress-M vehicles.

2.1.2.2. The American equipment that is to be initially installed on the *Mir* Space Station, and which supports the operations on the programs, shall be delivered on Spektr and Priroda modules and Progress vehicles.

2.1.2.3. As per the *Mir*-NASA program, the life support system's equipment and components shall be delivered by Space Shuttles in order to support the long-duration flight of American astronauts NASA 2-NASA 7.

2.1.2.4. According to the *Mir*-NASA program, the main Russian crews shall be rotated via Soyuz-TM vehicles.

2.1.2.5. The American astronauts shall be rotated via Space Shuttles.

2.1.2.6. Equipment and hardware intended to extend the *Mir* Space Station's service life and to maintain its viability, shall be delivered by Space Shuttles and Progress vehicles.

2.1.2.7. Worn-out American science equipment and hardware as well as Russian equipment and hardware shall be returned from the *Mir* Space Station by Space Shuttles.

2.1.2.8. Waste shall be removed from the *Mir* Space Station by Progress vehicles.

2.1.3. Measures That Support the Implementation of the Programs in the Event of Off-Nominal Situations

The *Mir* Space Station's flight program for 1994-98 provided for the following measures:

2.1.3.1. If there is a delay before the launch of a Space Shuttle, in order to ensure that one can recover from an off-nominal situation, provisions have been made for the necessary supply of consumable components for the *Mir* Space Station's onboard systems, propulsion systems and life support system supply to support flight for up to 40 days.

2.1.3.2. If there is a significant delay in launches of Soyuz-TM or Progress-M vehicles or Space Shuttles, or if there is docking failure with Spektr or Priroda modules, plans have been made for a reexamination of the *Mir*-Shuttle and *Mir*-NASA programs.

2.1.3.3. In the event that a launch is canceled or it is impossible for the Space Shuttle to dock (STS-71), the astronaut shall be returned to Earth together with the main crew on a Soyuz-TM vehicle. On subsequent flights, the astronaut can remain on board the *Mir* Space Station until the next docking with the Space Shuttle. Progress vehicles according to a separate contract shall provide life support system components for the American astronaut in this case.

2.1.3.4. If the Space Shuttle fails to dock within the scheduled time, a reserve of time has been provided to allow for an additional attempt at approach and docking. The docking time can be moved back by as much as two days.

2.1.3.5. If a Soyuz-TM vehicle fails to dock, termination of the manned flight program is possible.

2.1.3.6. An off-nominal situation on the Space Shuttle which could lead to loss of the vehicle's capability to return its crew from orbit to Earth or an off-nominal situation during which it would not be possible to separate the vehicle from the station is not deemed to be credible.

2.1.3.7. In the event that it is not possible to maintain the service life of a Soyuz-TM vehicle that is part of the *Mir* Space Station, the astronaut shall be returned to Earth on the Soyuz-TM together with the Russian crew.

2.1.3.8. With a view to using favorable flight conditions in mated configuration in order to increase the time for carrying out joint operations and counteracting off-nominal situations, one to two reserve flight days in the *Mir*-Shuttle mated configuration have been planned for in the flight program and provisions have been made for backup reserves of consumables.

2.1.3.9. If it is impossible to control the *Mir*-Shuttle mated configuration by the Space Shuttle, the *Mir* Space Station shall provide orientation for the mated configuration. When this happens, the duration of the joint flight may be reduced, depending upon the fuel supply on the station.

2.1.3.10. In order to counteract an off-nominal situation on board the *Mir* Space Station which results from the breakdown of equipment or hardware and which thereby places the station's functioning at risk, the capability exists to load a Space Shuttle in an emergency at the launch site within 40 hours before the launch with large-sized cargo having a mass of up to 120 kg.

2.1.4. Implementation of the *Mir*-Shuttle and *Mir*-NASA Programs

2.1.4.1. The implementation of the *Mir*-Shuttle program was carried out for two years from February 1994 through July 1995.

2.1.4.2. The implementation of the *Mir*-NASA program was carried out for three years from November 1995 through June 1998.

2.1.4.3. The specific time frames for vehicle flights and also the time frames for the Russian and American crew operations are given in the *Mir* Space Station's Flight Program (Section 2.2).

2.2. The *Mir* Space Station's Flight Program in 1994 - 98

The following designation has been adopted in the *Mir*/NASA Integrated Flight Schedules in Figure 2.1:

- The long rectangles show the residence in orbit of Soyuz-TM and Progress-M vehicles.
- The two-digit numbers in the rectangles show the numbers assigned to Soyuz-TM vehicles.
- The three-digit numbers in the rectangles show the numbers assigned to Progress-M vehicles.

- The two-digit numbers near the beginning and ending of the rectangles show the dates of launch and landing of Soyuz-TM vehicles respectively. For Progress-M vehicles, only the launch dates are given. The dates are given in Moscow time.

- The letter "E" in the circle shows extravehicular activity (EVA).

- The *Mir*-number shows the number of a Russian mission to the *Mir* Space Station, and the number in parentheses shows the period of residence of the mission's crew members on orbit in days.

- The NASA-number shows the number of the long-duration American mission to the *Mir* Space Station, and the number in parentheses shows the period of residence of the astronaut on orbit in days.

- CC means crew commander.

- FE means flight engineer.

- MS means mission specialist.

- The long lines show the residence of the crew members on orbit.

- The bold arrows pointing up or down show the launch or landing of Space Shuttles respectively. The numbers near the arrows show the dates of launch and landing according to Moscow time. The numbers in parentheses show the dates according to Houston time.

- The doubled diamonds show the docking and undocking of Space Shuttles. The numbers near the diamonds show the dates of docking and undocking respectively.

- The bold arrows pointing up, with the bold square on the side, show the launch and mating with the *Mir* Space Station of the Spektr and Priroda modules. The numbers near the arrows and the square show the dates of launch and mating of the modules respectively.

2.3. Phase 1 Joint Mission Information

Operation Schedules and Crew Members NASA 1 - NASA 7.

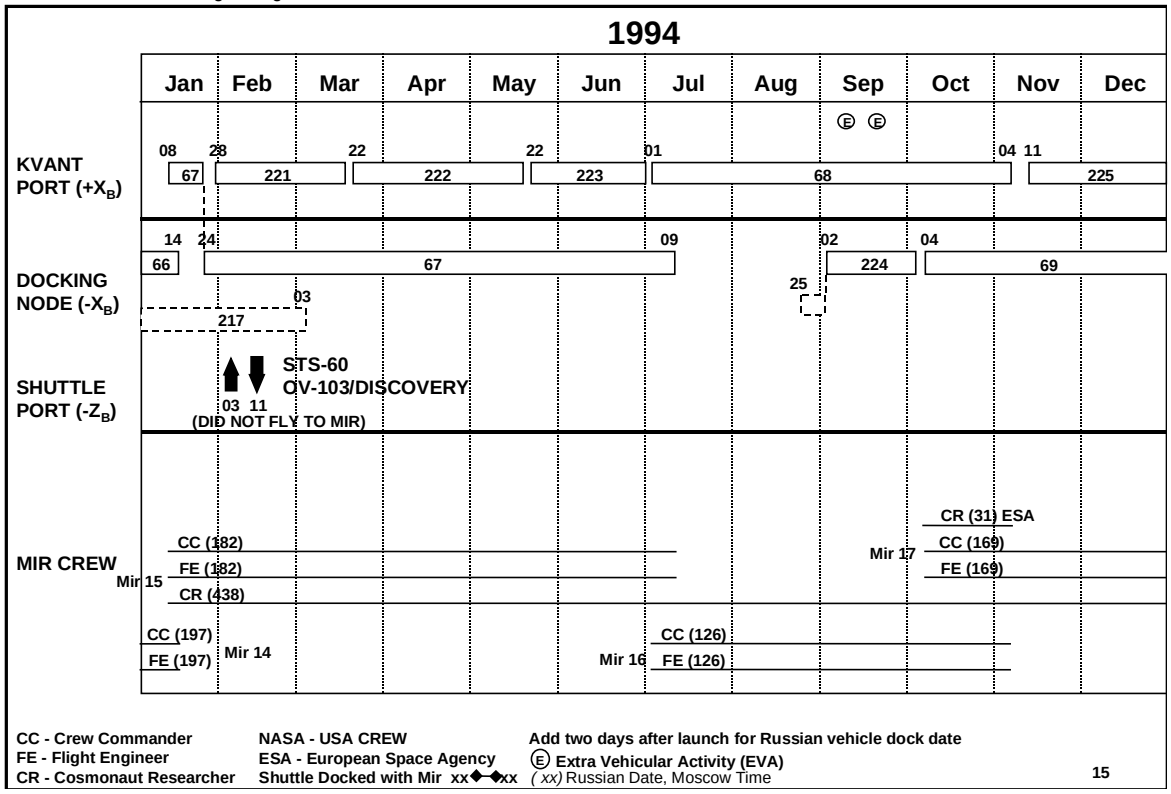
The dates and complement of U.S. long-duration missions on board *Mir* within the framework of *Mir*-Shuttle and *Mir*-NASA Programs as well as the dates of the U.S. crew's joint operations with the primary Russian expedition members are given in the Tables 2.2 and 2.3.

MIR/NASA INTEGRATED FLIGHT SCHEDULE

Figure 2.1

JSC/MT3 Manifest and Flight Integration Office

AUGUST 3, 1998

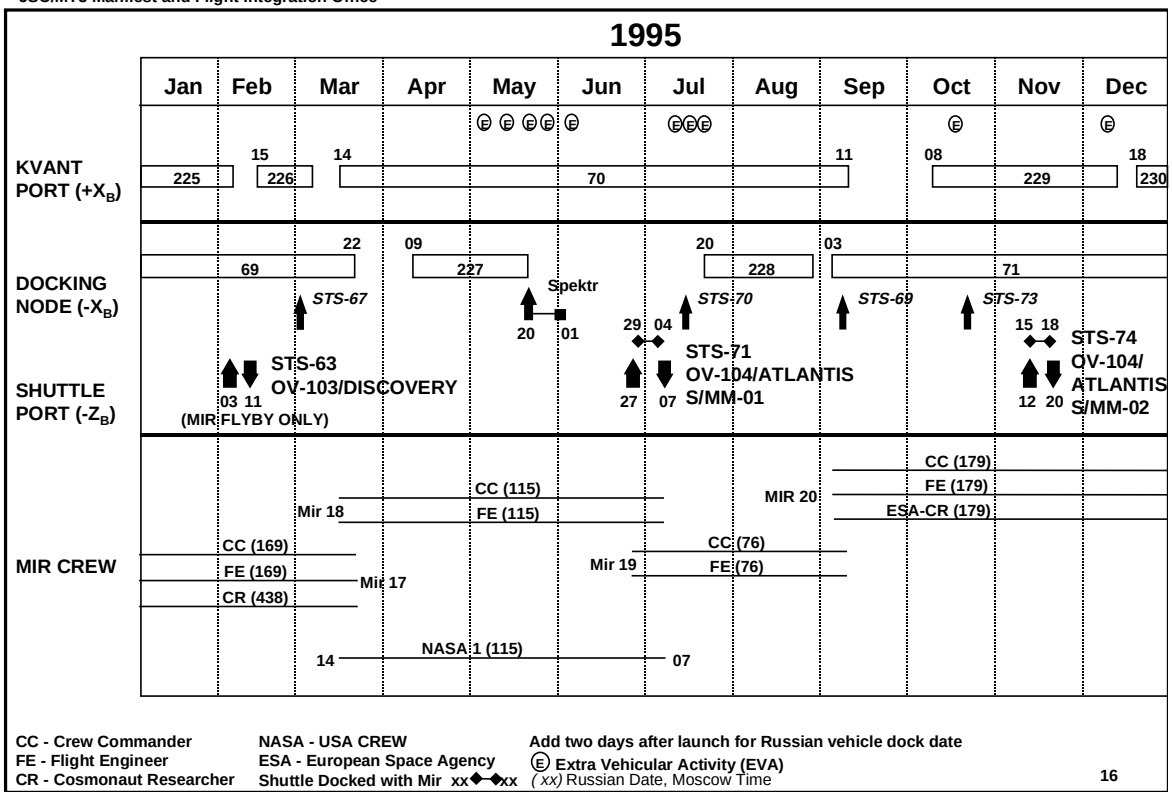


MIR/NASA INTEGRATED FLIGHT SCHEDULE

Figure 2.1 Cont.

JSC/MT3 Manifest and Flight Integration Office

AUGUST 3, 1998



CC - Crew Commander
FE - Flight Engineer
CR - Cosmonaut Researcher

NASA - USA CREW
ESA - European Space Agency
Shuttle Docked with Mir xx◆–◆xx

Add two days after launch for Russian vehicle dock date
Ⓔ Extra Vehicular Activity (EVA)
(xx) Russian Date, Moscow Time

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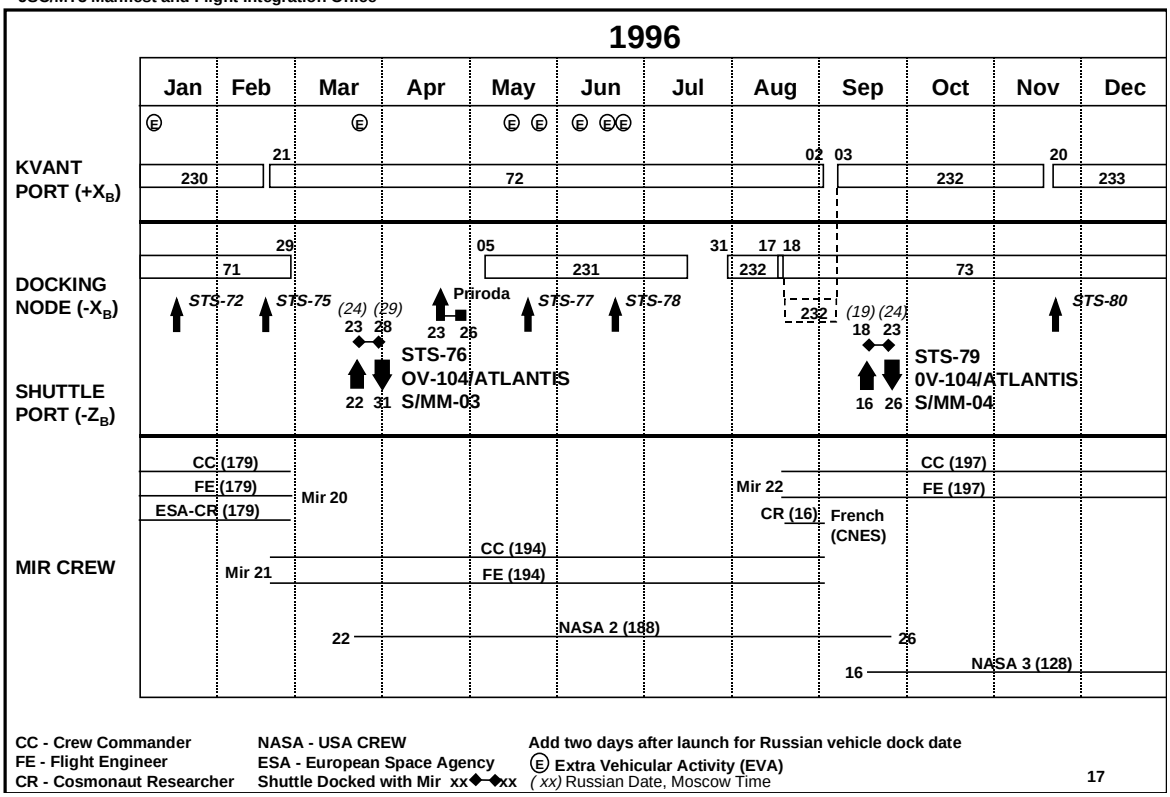
MIR/NASA INTEGRATED FLIGHT SCHEDULE

Figure 2.1 Cont.

JSC/MT3 Manifest and Flight Integration Office

AUGUST 3, 1998



CC - Crew Commander
FE - Flight Engineer
CR - Cosmonaut Researcher

NASA - USA CREW
ESA - European Space Agency
Shuttle Docked with Mir xx◆—◆xx

Add two days after launch for Russian vehicle dock date
Ⓔ Extra Vehicular Activity (EVA)
(xx) Russian Date, Moscow Time

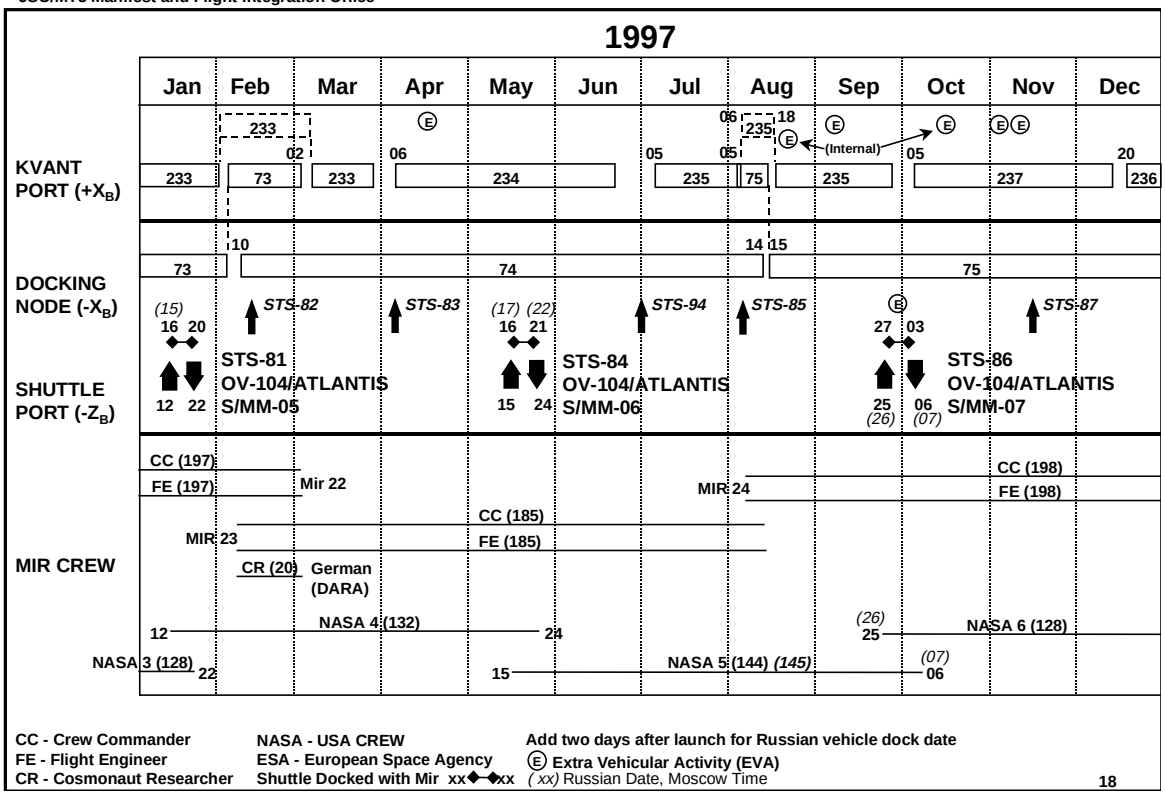
17

MIR/NASA INTEGRATED FLIGHT SCHEDULE

Figure 2.1 Cont.

JSC/MT3 Manifest and Flight Integration Office

AUGUST 3, 1998



CC - Crew Commander
FE - Flight Engineer
CR - Cosmonaut Researcher

NASA - USA CREW
ESA - European Space Agency
Shuttle Docked with Mir xx◆◆xx

Add two days after launch for Russian vehicle dock date
Ⓔ Extra Vehicular Activity (EVA)
(xx) Russian Date, Moscow Time

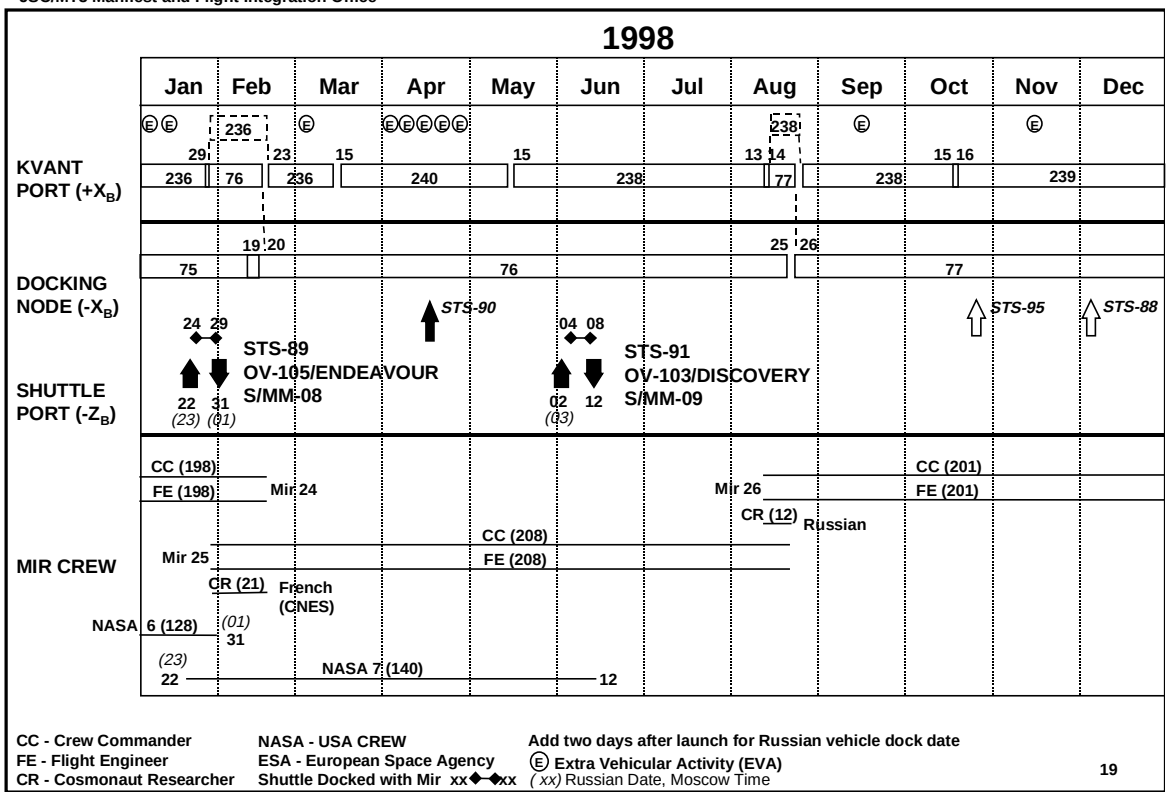
18

MIR/NASA INTEGRATED FLIGHT SCHEDULE

Figure 2.1 Cont.

JSC/MT3 Manifest and Flight Integration Office

AUGUST 3, 1998



CC - Crew Commander
FE - Flight Engineer
CR - Cosmonaut Researcher

NASA - USA CREW
ESA - European Space Agency
Shuttle Docked with Mir xx◆—◆xx

Add two days after launch for Russian vehicle dock date
Ⓔ Extra Vehicular Activity (EVA)
(xx) Russian Date, Moscow Time

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Dates and complement of U.S. long-duration missions on board *Mir*

Table 2.2

NASA mission №., astronaut	Delivery vehicle for *Mir*, launch date	Return vehicle, landing date	Days in orbit, Days on *Mir*	Russian primary missions and crews	Dates of joint operations between the primary mission and NASA on *Mir*
NASA 1 Norman Thagard	Soyuz-70 03/14/95	STS-71 07/07/95	115 111	*Mir*-18 V.N. Dezhurov G.M. Strekalov	03/16/95- 07/04/95
NASA 2 Shannon Lucid	STS-76 03/22/96	STS-79 09/26/96	188 184	*Mir*-21 U.N. Onufrienko U.V. Usachev *Mir*-22 V.G. Korzun A.Yu. Kaleri CNES: Claudie Deshays	03/24/96- 08/19/96 08/19/96- 09/19/96 08/19/91- 09/02/91
NASA 3 John Blaha	STS-79 09/16/96	STS-81 01/22/97	128 123	*Mir*-22 V.G. Korzun A.Yu. Kaleri	09/19/96- 01/15/97
NASA 4 Jerry Linenger	STS-81 01/12/97	STS-84 05/24/97	132 127	*Mir*-22 V.G. Korzun A.Yu. Kaleri *Mir*-23 V.V. Tsibliev A.I. Lazutkin DARA: Rienhold Ewald	01/15/97- 02/12/97 02/12/97- 05/17/97 02/12/97- 03/02/97
NASA 5 Michael Foale	STS-84 05/15/97	STS-86 10/07/97	144 138	*Mir*-23 V.V. Tsibliev A.I. Lazutkin *Mir*-24 A.Ya. Solovyev P.V. Vinogradov	05/17/97- 08/07/97 08/07/97- 09/27/97
NASA 6 Dave Wolf	STS-86 09/26/97	STS-89 02/01/98	128 124	*Mir*-24 A.Ya. Solovyev P.V. Vinogradov	09/27/97- 01/24/98
NASA 7 Andrew Thomas	STS-89 01/23/98	STS-91 06/12/98	140 135	*Mir*-24 A.Ya. Solovyev P.V. Vinogradov *Mir*-25 T.A. Musabaev N.M. Budarin CNES: Leopold Eyherts	01/24/98- 01/31/98 01/31/98- 06/08/98 01/31/98- 02/19/98

$\sum$ = 975 days = 2.67 years (Astronaut time spent in orbit from time of launch to landing date)

$\sum$ = 831 days = 2.28 years (Astronaut time spent on *Mir*)

Dates and Complements of Phase 1 Missions

Table 2.3

MISSION	MISSION START EVENT	MISSION END EVENT	CREW	MISSION INFORMATION
STS-60	STS-60 Launch: 2/3/94	STS-60 Landing: 2/11/94	Cmdr: Charlie Bolden Pilot: Ken Reightler MS: Franklin Chang-Diaz MS: Jan Davis MS: Ron Sega MS: Sergei Krikalev	Krikalev is first cosmonaut on Shuttle
STS-63	STS-63 Launch: 2/3/95	STS-63 Landing: 2/11/95	Cmdr: Jim Wetherbee Pilot: Eileen Collins MS: Janice Voss MS: Bernard Harris MS: Mike Foale MS: Vladimir Titov	Rendezvous w/*Mir*, Cosmonaut Titov on Shuttle
Mir 18/NASA 1	Soyuz 70 Launch: 3/14/95	STS-71 Landing: 7/7/95	Cmdr: Vladimir Dezhurov Eng: Gennady Strekalov NASA 1: Norman Thagard	First U.S. Astronaut to launch on Russian Soyuz; First U.S. Astronaut on *Mir*
Spektr	Spektr Launch 5/20/95	N/A	Unmanned	Carries U.S. Research Hardware
STS-71	STS-71 Launch: 6/27/95	STS-71 Landing: 7/7/95	Cmdr: Robert "Hoot" Gibson Pilot: Charlie Precourt MS: Ellen Baker MS: Greg Harbaugh MS: Bonnie Dunbar MS: Norman Thagard Cosmonaut: Anatoly Solovyev Cosmonaut:: Nikolai Budarin Cosmonaut: Vladimir Dezhurov Cosmonaut: Gennadiy Strekalov	First Shuttle-*Mir* Docking; *Mir* 19 cosmonauts delivered to *Mir*; *Mir* 18 cosmonauts returned to earth; Spacelab Mission, Thagard, Dezhurov, Strekalov return to earth. Solovyev, Budarin remain on *Mir*.
Mir 19	STS-71 Launch: 6/27/95	Soyuz 70 Landing: 9/11/95	Cmdr: Anatoly Solovyev Eng: Nikolai Budarin	

Table 2.3 Cont.

MISSION	MISSION START EVENT	MISSION END EVENT	CREW	MISSION INFORMATION
STS-74	STS-74 Launch 11/12/95	STS-74 Landing: 11/20/95	Cmdr: Kenneth Cameron Pilot: James Halsell MS: Jerry Ross MS: William McArthur MS: Chris Hadfield	Second Shuttle-*Mir* Docking; Delivers Docking Module and Cooperative Solar Array
STS-76	STS-76 Launch: 3/22/96	STS-76 Landing: 3/31/96	Cmdr: Kevin Chilton Pilot: Richard Searfoss MS: Rich Clifford MS: Linda Godwin MS: Shannon Lucid MS: Ron Sega	Third Shuttle-*Mir* Docking; First EVA During Docked Operations; Lucid Delivered to *Mir*; First Spacehab Mission to *Mir*
NASA 2	STS-76 Launch: 3/22/96	STS-79 Landing: 9/26/96	NASA 2: Shannon Lucid	Stay lengthened approx 6 weeks due to launch slip
Priroda	Priroda Launch: 4/23/96	N/A	Unmanned	Carries 1000 kg U.S. research hardware
STS-79	STS-79 Launch: 9/16/96	STS-79 Landing: 9/26/96	Cmdr: Bill Readdy Pilot: Terrence Wilcutt MS: Tom Akers MS: Jay Apt MS: Carl Walz MS: John Blaha MS: Shannon Lucid	Blaha delivered to *Mir*; Lucid returned to Earth; First Double Spacehab Module

Table 2.3 Cont.

MISSION	MISSION START EVENT	MISSION END EVENT	CREW	MISSION INFORMATION
NASA 3	STS-79 Launch: 9/16/96	STS-81 Landing: 1/22/97	NASA 3: John Blaha	
STS-81	STS-81 Launch: 1/12/97	STS-81 Landing: 1/22/97	Cmdr: Mike Baker Pilot: Brent Jett MS: John Grunsfeld MS: Marsha Ivins MS: Peter "Jeff" Wisoff MS: Jerry Linenger MS: John Blaha	Linenger delivered to *Mir*; Blaha returned to Earth; Double Spacehab Module and SAREX II
NASA 4	STS-81 Launch: 1/12/97	STS-84 Landing: 5/25/97	NASA 4: Jerry Linenger	Linenger EVA in Russian Suit
STS-84	STS-84 Launch: 5/15/97	STS-84 Landing: 5/24/97	Cmdr: Charlie Precourt Pilot: Eileen Collins MS: Carlos Noriega MS: Edward Lu MS: Mike Foale MS: Jerry Linenger MS: Elena Kondakova ESA: Jean-Francois Clervoy	Foale delivered to *Mir*; Linenger returned to Earth; Cosmonaut (Kondakova) on Shuttle; Double Spacehab Module; SAREX II-21
NASA 5	STS-84 Launch: 5/15/97	STS-86 Landing: 10/6/97	NASA 5: Mike Foale	Foale EVA in Russian Suit
STS-86	STS-86 Launch: 9/25/97*	STS-86 Landing: 10/6/97*	Cmdr: James Wetherbee Pilot: Mike Bloomfield MS: Wendy Lawrence MS: Scott Parazynski MS: Mike Foale MS: David Wolf Cosmonaut: Vladimir Titov CNES: Jean Loup Chretien	Wolf delivered to *Mir*; Foale returned to Earth; U.S. EVA; Cosmonaut (Titov) on Shuttle; Double Spacehab Module
NASA 6	STS-86 Launch: 9/25/97	STS-89 Landing: 1/31/98	NASA 6: David Wolf	Wolf EVA in Russian Suit

Table 2.3 Cont.

MISSION	MISSION START EVENT	MISSION END EVENT	CREW	MISSION INFORMATION
STS-89	STS-89 Launch: 1/22/98*	STS-89 Landing: 1/31/98*	Cmdr: Terrence Wilcutt Pilot: Joe Frank Edwards, Jr. MS: Bonnie Dunbar MS: Michael Anderson MS: James Reilly MS: David Wolf MS: Andy Thomas Cosmonaut: Salizan Sharipov	Thomas delivered to *Mir*, Wolf Return to Earth Double Spacehab Module, OV-105
NASA 7	STS-89 Launch: 1/22/98	STS-91 Landing: 1/31/98	NASA 7: Andy Thomas	
STS-91	STS-91 Launch: 6/2/98*	STS-91 Landing: 6/12/98	Cmdr: Charlie Precourt Pilot: Dominic Pudwill Gorie MS: Wendy Lawrence MS: Franklin Chang-Diaz MS: Janet Kavandi MS: Andy Thomas Cosmonaut: Valeriy Ryumin	Thomas return to Earth; Single Spacehab Module, OV-103; Alpha Magnetic Spectrometer Payload

* Dates are Eastern Time (Kennedy Space Center Time)

2.3.1 Primary Mission Objectives of the *Mir*-Shuttle Program

2.3.1.1 Mission STS-60 (*Discovery*)

- Studying U.S. astronaut preflight training methods
- Flight operation training for the first Russian astronaut as a member of the Shuttle crew
- Carrying out the scientific experiments

2.3.1.2 Mission STS-63 (*Discovery*)

- Launching the Shuttle into orbit at an inclination of 51.6°
- Shuttle rendezvous with *Mir* (without docking)
- Checking voice communication between the Shuttle and *Mir* crews
- Coordinating operations of the Mission Control Centers
- Studying U.S. astronaut training methods
- Carrying out the scientific experiments

2.3.1.3 Mission Soyuz TM-21 (№ 70)

- Learning methods for training Russian cosmonauts
- Sending the first U.S. astronaut to *Mir* on the Russian vehicle Soyuz TM
- Flight operation training for the U.S. astronaut on the vehicle Soyuz TM and on *Mir* during a long mission
- Carrying out the joint scientific program

2.3.1.4 Spektr Scientific Module Mission and Deliveries as part of this module

- American scientific equipment for the *Mir*-Shuttle and *Mir*-NASA programs
- Russian scientific equipment
- Additional solar arrays

2.3.1.5 Mission STS-71 (*Atlantis*)

- Docking and undocking of the Shuttle with the *Mir* module Kristall, located on the axial node of the core module
- Exchanging the Russian *Mir*-18 and *Mir*-19 crews and returning the U.S. NASA 1 astronaut on the Shuttle
- Coordinating operations of Mission Control Centers
- Carrying out the scientific program
- Delivering Russian cargo
- Delivering technical water
- Returning experiment results, experimental equipment with an expired operational life, and orbital station equipment which has malfunctioned for analysis and reuse

2.3.2 Primary Mission Objectives of the *Mir*-NASA Program

2.3.2.1 Mission STS-74 (*Atlantis*)

- Docking the docking module on the Shuttle with the *Mir* Kristall module installed on the lateral node of the core module
- Delivering and mounting the docking compartment on *Mir* so that subsequent Shuttle dockings can occur without redocking of the Kristall module
- Delivering solar arrays to replace solar arrays on the Kvant module
- Delivering consumables and experimental equipment
- Returning the results of experiments, experimental equipment with an expired operational life, and orbital station equipment which has malfunctioned for analysis and reuse

2.3.2.2 Mission STS-76 (*Atlantis*)

- Docking the Shuttle to the docking module mounted on the Kristall module during flight STS-74
- Delivering astronaut NASA 2 to *Mir*
- Delivering consumables and experimental equipment, and returning the results of experiments
- Carrying the joint science program
- EVA— spacewalk of the American astronauts to mount the scientific equipment on the docking module (First U.S. astronaut EVA on the *Mir* surface)

2.3.2.3 Priroda Scientific Module Mission and Deliveries as part of this module

- U.S. scientific equipment for the *Mir*-NASA program
- Russian scientific equipment

2.3.2.4 Mission STS-79 (*Atlantis*)

- First U.S. astronaut handover between NASA 2 and 3
- Delivering consumables and replaceable equipment
- Emergency delivery of two vacuum valve units and a nitrogen purge unit
- Carrying the joint scientific program
- Returning the results of experiments and replaceable equipment with an expired operational life
- Dynamic testing of the *Mir*-Shuttle stack for *Mir*

2.3.2.5 Mission STS-81 (*Atlantis*)

- Crew exchange of NASA 3 and NASA 4
- Providing logistics, delivering life-support systems for the NASA and *Mir* crews, and scientific equipment
- Carrying out the joint scientific program
- Returning the results of experiments and replaceable equipment with an expired operational life and for reuse

2.3.2.6 Mission STS-84 (*Atlantis*)

- Crew exchange of NASA 4 and NASA 5
- Providing logistics, delivering life-support systems for the NASA and *Mir* crews, and scientific equipment
- Emergency delivery of Elektron system equipment
- Carrying out the joint scientific program
- Returning the results of the experiments, equipment with an expired operational life, and *Mir* equipment that has malfunctioned. (the mission which returned the most Russian cargo)

2.3.2.7 Mission STS-86 (*Atlantis*)

- Crew exchange of NASA 5 and NASA 6
- Providing logistics, delivering life-support systems for the NASA and *Mir* crews, and scientific equipment (the mission which delivered the most Russian cargo)
- Emergency delivery of equipment for repairing the Spektr module, the portable air pressurization unit and the Salyut-5 computer
- Carrying out the joint scientific program
- Returning the results of experiments, equipment with an expired operational life, and equipment for analysis and reuse
- EVA, first joint EVA performed from Shuttle; retrieving scientific equipment installed during Mission STS-76, and mounting the pressurization assembly on the docking module to repair the Spektr module

2.3.2.8 Mission STS-89 (*Endeavour*)

- Crew exchange of NASA 6 and NASA 7
- Providing logistics, delivering life-support systems for the crews and scientific equipment
- Emergency delivery of the air conditioning unit, compressor assembly, and the Salyut-5 computer to restore the *Mir* system

- Carrying out the joint scientific program
- Returning the results of experiments, equipment with an expired operational life, and *Mir* equipment that has malfunctioned

2.3.2.9 Mission STS-91 (*Discovery*)

- Returning astronaut NASA 7
- Providing logistics, delivering life-support systems for the *Mir* and scientific equipment
- Carrying out the joint scientific program
- Returning the results of experiments, equipment with an expired operational life, and *Mir* equipment that has malfunctioned

2.3.2.10 Transport-cargo Progress vehicle missions № 224, 226-238, 240

- Providing logistics and technical servicing of *Mir*, delivering life-support systems for the crew and scientific equipment
- Removing waste from *Mir*.

2.4 Shuttle Mission Preparation Joint Milestones

Joint Working Group activities to prepare for each Shuttle mission were jointly coordinated according to the "Joint Milestones" specified in WG-0/RSC-E/NASA/0002, as shown in Table 2.4. Beginning with the STS-81 mission, joint milestones were presented as diagrams with specific deadlines and responsible parties.

0002 JOINT MILESTONE TEMPLATE

LONG-DURATION MISSIONS

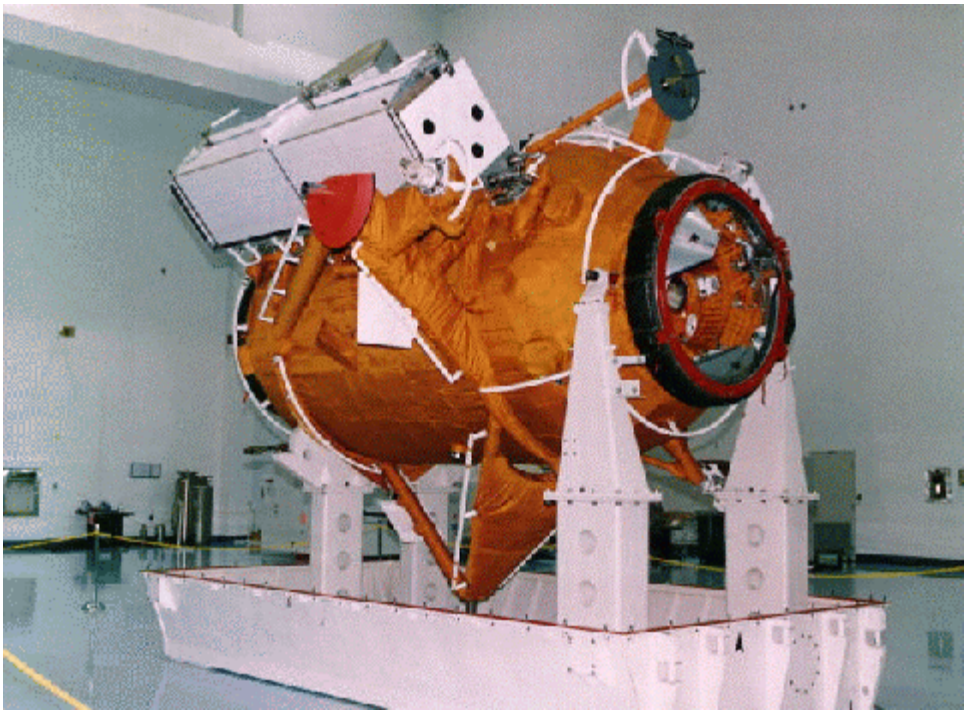
Table 2.4

Activity Owner	Template	Activity
1. Joint	L-12 Months	Define in 0002 Joint Mission operations and in-flight responsibilities of both sides /In English and Russian/.
2. US	L-11 Months	Draft DIDs for Non-Standard US H/W /In English/.
3. US (WG-6)	L-11 Months 7wks before US1 Trng	If necessary, deliver U.S. Experiment Procedures to RSC-E for new U.S. experiments (for US1 Training) /In English and Russian/.
4. Russia	L-10 Months 3 wks before US1 Trng	If necessary, deliver draft operating procedures to NASA for U.S. hardware /In Russian/.
5. Russia	L- 10 Months	Define in Document 0005 logistics that must be hard mounted (during ascent and return) /In English and Russian/.
6. Joint	L-9 Months	Start US1 Training.
7. US	L-9 Months	Deliver draft IPRD (Integrated Payload Requirements Document) to RSC-E and GCTC /In English and Russian/.
8. US	L-9 Months	Deliver Basic Configuration Information (DID) for Non-Standard U.S. equipment /In English/.
9. Joint	L-8 Months	Baseline SPACEHAB ICD for hard mounted logistics (In English and Russian).
10. US	L-8 Months	Delivery of training h/w to GCTC for crew training.
11. Joint	L-8 Months	Deliver Preliminary version of joint system integration documents (In English and Russian).
12. US	L-8 Months	Deliver 004 Baseline to RSC-E (Launch and Return Manifests)/In English/.
13. US	L-8 Months	Update Document 0005 with the preliminary list of all U.S. hardware listed in 004 /In English and Russian/.
14. Joint (WG-3)	L-7 Months	Baseline Preliminary version of joint flight operations (In English and Russian).
15. US (WG-6)	L-7 Months	Deliver 100 Series, EID, and Sketches /In English/.
16. Russia	L-7 Months	Beginning of Crew Training at GCTC.
17. Russia	L-7 to 6 Months	Define in 0005 Russian cargoes stowed in soft packages (In English and Russian).
18. US (WG-6)	L-6 Months	Deliver Preliminary (Basic) ORD /In English/.
19. US (WG-6)	L-6 Months	Deliver 004 Rev 1 (Launch, Return, On-Orbit Manifests)/In English/.
20. Russia	L-6 Months	Deliver ROP-2D Operations Document (Basic) (Preliminary Program, Service OPS timeline) /In Russian/.
21. Russia	L-6 Months	Define in 0007 Overall configuration of Nonstandard Experiment H/W /In English/.
22. US	L-6 Months (7 wks before US2 Trng)	Deliver U.S. Experiment Procedures for new U.S. Experiment to RSC-E (for US2 Training) /In English and Russian/.
23. Russia	L-6 Months	Preliminary Version of detailed EVA task and equipment list (Rev. 02) /In English and Russian/.
24. Joint	L-6 Months	Sign Preliminary 0005 list on transfer equipment (In English and Russian).
25. Russia	L-5 Months 3 wks prior to US2 Trng	RSC-E will deliver to NASA Onboard Instructions /In English/.
26. Russia	L-5 Months	Update of EVA procedures at GCTC /In English and Russian/.
27. US	L-4 wks before AT Approx. 5.5 Mos.	Deliver series 100 Documents to RSC-E (In English and Russian)
28. Russian	L-4 Months	Feasibility certificate for experiment program (In English and Russian).
29. US (WG-6)	L-4 Months	Deliver LDM Timeline input to RSC-E /In English/.
30. Joint (RSC-E/ WG-6)	L-4 Months	Start US2 Training.

Table 2.4 Cont.

Activity Owner	Template	Activity
31. US (WG-6)	L-3 Months	Deliver Final version of ORD (In English and Russian).
32. Joint	L-6 to L-3	Flight Hardware Acceptance Testing in U.S.
33. Joint	L - 3-4 Months	Baseline SPACEHAB ICD for Russian cargoes requiring only passive stowage and Attachment A (In English and Russian).
34. Joint	L-3 Months	Sign final version of Document 0005 for deliverable cargo to *Mir* (In English and Russian).
35. Russia	L-4-3 Months	Delivery by Russian side of hard mounted cargo.
36. US	L-3 Months	Deliver Final Redlines to Onboard Instructions (In English and Russian).
37. US	L-3 Months	Deliver Final 004 list of all scientific equipment (In English).
38. US	L-3 Months	Sign Final IPRD (Integrated Payload Requirements Document) (In English and Russian).
39. Joint	L-3 Months	Sign Final version of Joint Flight Operations Document (In English and Russian).
40. Joint	L-3 Months	Sign Final version of Detailed objectives of EVA description (Rev-02) (in English and Russian).
41. Russia	L-2.5 Months	Deliver by Russian side Soft Stowage Items.
42. Russian	L-2 Months	Define in document 0005 Russian Logistics: Final definition of Return Items in 0005 (In English and Russian).
43. Russian	L-2 Months	Delivery to U.S. side of safety certificates for Russian equipment to be transported on the shuttle (In Russian, category 2 certificates also in English)
44. US	L-2 Months	Delivery to Russian side of safety certificates for NASA equipment to be used on the *Mir* or transported on Russian cargo vehicles (In English, category 2 certificates also in Russian).
45. US (WG-6)	L-2 Months	Deliver Hazardous Materials Tables (In English).
46. US	L-2 Months	Deliver Final 004 (requires *Mir* Inventory at L-3 Months) (In English).
47. Russia	L-2 Months	Deliver ROP-2D (Final Timeline, Final Service Operations) (In Russian).
48. Russia	L-2 Months	Deliver Final Onboard Instructions (In Russian).
49. Joint	L-1.5-1 Months	All Joint Working Groups Sign certificates of flight readiness (in English and Russian).
50. Russia	L-1 Month	Delivery by Russian side of passively Stowage cargoes.
51. Russia	L-1 Month	Delivery to U.S. side of safety certificates for personal effects and packages for crew (cosmonauts) (In Russian, category 2 certificates also in English).
52. US	L-1 Month	Delivery to Russian side of safety certificates for personal effects and packages for crew (astronauts). /In English, category 2 certificates also in Russian/.
53. US	L-1 Month	Deliver Final version of all Spacehab ICDs, flight configuration mockup of Russian Cargoes (In English and Russian).
54. US	L-1 Month	Approval by NASA of Russian non-personal safety certs.
55. Russia	L-1 month	Approval by RSC-E of US non-personal safety certs.
56. US	L-2 Weeks	Delivery of DCNs for final changes to Document 0005 (in English and Russian).
57. Russia	L-2 Weeks	Approval by RSC-E of safety certificates for personal effects and packages for crew (astronauts).
58. Joint	L-2 Weeks	Incoming inspection of American equipment for *Mir* before installation on Shuttle.
59. US	L-2 Weeks	Approval by NASA of safety certificates for personal effects and packages for crew (astronauts) /In English and Russian/.
60. US	2 Weeks after flight	Handover to Russia side identified per document 0005 of urgently returnable cargoes as stated in Attachment A.
61. US	4 Weeks after flight	Handover to Russia side identified per document 0005 of remaining returnable cargoes.
62. Joint	1 month after flight	Issuance of joint summary report on transport of Russian cargoes.

Cosmonaut Valeriy Ryumin and astronaut Franklin Chang-Diaz during a training session



The docking module, which was attached to the *Mir* during STS-74