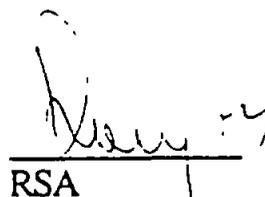


Approved by:

  
NASA

  
RSA

June 11, 1996

## PROTOCOL

### INCLUDING TERMS, CONDITIONS AND ASSUMPTIONS, SUMMARY BALANCE OF CONTRIBUTIONS AND OBLIGATIONS TO INTERNATIONAL SPACE STATION (ISS) AND RESULTING RIGHTS OF NASA AND RSA TO ISS UTILIZATION ACCOMMODATIONS AND RESOURCES, AND FLIGHT OPPORTUNITIES

1. The National Aeronautics and Space Administration (NASA) and the Russian Space Agency (RSA), ("the Parties") will begin to implement the understandings outlined in this Protocol ("the Protocol") regarding the balance of the Parties' contributions and obligations immediately upon the written approval by the respective agencies. The terms, conditions and assumptions specified in this Protocol will be summarized and incorporated in and subject to the conclusion of the NASA/RSA Memorandum of Understanding ("NASA/RSA MOU"). Upon entry into force of the NASA/RSA MOU, the MOU will take precedence over this Protocol and this Protocol will constitute an implementing arrangement under the Space Station Intergovernmental Agreement (IGA) and the NASA/RSA MOU. The Parties recognize that the understandings documented in this Protocol exist within the framework of a single integrated Space Station. The Parties assume and intend that the terms of this Protocol are consistent with NASA's bilateral MOUs with the other ISS partners. These understandings will be implemented through the management mechanisms defined in the NASA/RSA MOU under the lead integration role of NASA. For the purposes of this Protocol, the ISS vehicle consists of two segments: the Russian Segment and the American Segment. The Russian Segment contains the Russian elements and the NASA-provided FGB, while the American Segment includes the remaining NASA-provided elements and the elements provided by all ISS international partners other than RSA.
2. This Protocol, except as otherwise specifically indicated, will not nullify or void any previous agreements reached by the technical teams or those agreements already contained in program documentation. In the case of conflict between such previous agreements and this Protocol, this Protocol will take precedence.

3. This Protocol, together with the IGA, the NASA/RSA MOU, and existing and any future contractual and cooperative arrangements, represents the complete arrangement between NASA and RSA regarding the balance of the Parties' respective contributions and obligations to the Program, and the sharing of responsibilities associated with each Party's participation in the Program. If it is necessary in the future to adjust the Parties' contributions and obligations, and those adjustments have cost implications, any issues arising from the adjustments will be resolved, if the Parties agree, through barter and will not require renegotiation of the terms of this Protocol or additional discussion to quantify the cost impact. NASA's and RSA's responsibilities for performance of common system operations (as defined in Article 9.3 of the existing Memoranda of Understanding between NASA and the European Space Agency (ESA), NASA and the Government of Japan (GOJ) and NASA and the Canadian Space Agency (CSA), and the draft NASA/RSA MOU), have been taken into account in the Protocol and are included in the resulting balance of the Parties' contributions and obligations. RSA will not claim further compensation for the performance of common systems operations. NASA will not claim further compensation from RSA for its performance of common system operations.

4. The Parties will each be responsible for support of their own elements unless otherwise specified in the Protocol. For example, the Parties will each be responsible for the launch of their own elements, spares, logistics, sustaining engineering and utilization costs absent a specific agreement to the contrary. The FGB and SPP are examples of "specific agreements to the contrary" and are discussed in paragraphs 19 and 20. The Parties' overall responsibilities with regard to their own elements will be set forth in the NASA/RSA MOU. The Parties will each retain the use and benefits of the elements and systems they each provide, except as otherwise specifically agreed. For example, RSA will retain full use of its research modules and the electrical power generated by the Russian Segment (RS), absent agreement to the contrary, and will not have utilization rights in the American Segment (AS), again unless otherwise specifically agreed. Similarly, NASA will retain full use of the laboratories and electrical power generated by the AS, and will not have utilization rights in the RS unless otherwise specifically agreed. The basis for the evaluation of the Parties' contributions reflected in this Protocol is that the Parties each "keep what they bring". Understandings on currently known exceptions to this approach are also documented in this Protocol. Nothing in this Protocol precludes the Parties from reaching mutually agreeable barter in the future.

5. The reference configuration for the ISS vehicle is the Preliminary ISS Assembly Sequence, Revision B, as of March 1, 1996 (Appendix 1).

6. For purposes of cost sharing and assessing the Parties' relative contributions, the capabilities of the Parties' transportation vehicles have been used. Specific flight rates, crew and cargo loads and vehicles used for transportation to the Space Station will be determined through the agreed upon Program management mechanisms and operations planning functions.

7. The Parties agree that NASA, the lead integrator, with support of RSA, will perform ISS systems engineering and integration, ISS operations integration, and ISS utilization integration as specified in Appendix 2. These integration activities include utilization planning, integration and coordination for the Space Station as a whole, as well as activities identified in the attached balance of contributions. RSA will provide data and personnel to support this overall program integration effort and participate in the integrated operations and utilization planning for the strategic, tactical and execution phases. NASA and RSA will additionally each perform integration tasks for their own elements and segments, although these activities were not considered services provided for one Party by another. Both Parties agree to minimize operations costs and exchange of funds.

8. NASA's utilization integration contribution consists of the station-level analyses and efforts, with support of RSA, required to incorporate the integrated payload complement of the RS into the ISS. RSA will integrate RS payloads up to the segment level. By agreeing on NASA's leading station-level payload integration role, the Parties do not intend to imply that RSA has an allocation of AS utilization accommodations or resources, or vice versa for NASA. In the event that NASA or other partners conclude other cooperative science agreements or barter arrangements with RSA which bestow AS utilization accommodations or resources on RSA, any payload integration costs NASA incurs for such cooperative activities will be negotiated on a case by case basis as part of the barter arrangement. The same is true in the reverse instance where cooperative science agreements or barter arrangements bestow RS utilization accommodations or resources on NASA. In that case, any payload integration costs RSA incurs for such cooperative activities will be negotiated on a case by case basis as part of the barter arrangement.

9. The Parties agree that the planning for implementation of any transfer of Space Station resources, i.e. electrical power, between the Parties will be addressed through ISS Program integrated operations and utilization planning processes (strategic Consolidated Operations and Utilization Plan (COUP) development, tactical Increment Definition and Requirements Documents (IDRDs) development, execution-level integrated engineering assessments and the short term plan development, etc.). It will be necessary for RSA to participate in the Program's integrated planning forums, (i.e. Space Station Control Board, Systems Operations Panel, User Operations Panel, Multilateral Operations and Utilization Analysis and Integration Team (AIT), integrated tactical operations organization and, if resources are to be transferred, the Payload Operations Integration Center (POIC), etc.).

10. It was assumed that the Space Station will have a crew of 3 during assembly and a crew of 7 after assembly complete. The NASA/RSA MOU will set forth the general process for allocating flight opportunities and crew time, but paragraphs 11 and 12, below, describe the Parties' specific assumptions for the purpose of determining the overall balance of the Parties' contributions and obligations in this Protocol. Allocation of crew time and flight opportunities to the other Space Station partners will be in accordance with the terms of NASA's bilateral Memoranda of Understanding (MOUs) with those partners. This Protocol will only address the understanding between the Parties.

11.a. Crew During Assembly (through flight 19A): NASA and RSA will each have the right to an average of 50% of the 3 available crew flight opportunities. Each crew should include at least one representative from NASA and at least one representative from RSA. The Parties will each bear the responsibility for transporting and supporting on-orbit 50% of the 3-person crew. While the Parties will each receive 50% of the flight opportunities, this is an average balance over the entire assembly time frame and the Parties may not have equal shares at any given time. Detailed operational plans for allocating individual flight opportunities will be developed through normal operations planning processes. Crew time will first be devoted to systems operations and maintenance required to perform assembly tasks and Space Station operations and maintenance. Any time remaining will be devoted to utilization. Of crew time available for utilization, from first element launch up to the time when the GOJ accrues rights to on-orbit crew time, 50% of available time will be used to perform utilization on RS payloads and the remaining 50% will be used to perform utilization on AS payloads. After the GOJ accrues rights to on-orbit crew time, through flight 19A, its allocation of on-orbit utilization crew time will be drawn equally from the AS on-orbit crew time allocation and the RS on-orbit crew time allocation. It is assumed that no other partner will have rights to

on-orbit crew time through the completion of the assembly phase. In the event that the Parties end assembly with flight opportunities to their credit, those opportunities will be exercised in the assembly complete phase. If any other partner ends assembly with flight opportunities to their credit, those opportunities will be exercised in the assembly complete phase and drawn from the AS flight allocation. Each Party has a right to visiting crew. If the Parties have visiting crew, each Party will provide for the transport (including rescue), support (supplies and life support/habitation) and all expenses on Earth for those visiting crews. As a result, the visiting crews will not count as use of a Party's allocation of flight opportunities or crew time on-orbit rights. Plans for visiting crews will be coordinated through the standard ISS operations planning processes. As is the case for all utilization accommodations and resources, the Parties may receive additional rights to flight opportunities or crew time through barter.

11.b. Crew Post Assembly (after flight 19A): Following the completion of assembly of the Space Station and initial operational verification of the U.S.-provided crew rescue vehicle that allows an increase in the crew complement to 7, RSA will have the rights to the flight opportunities and on-orbit crew time of 3 crew to perform RS systems operations and utilization activities. NASA and the remaining Space Station partners will share the remaining four flight opportunities for their nationals and the time of the equivalent of four remaining crew to perform AS systems operations and utilization activities. In the event the crew rescue vehicle provided by the U.S. is not available immediately after flight 19A, and the ISS has crew complement of 6 and not 7, the Parties will meet to discuss appropriate action.

12. Crewmembers will work together as a single team. Regardless of nationality and tasks assigned to any individual crew person, the entire crew will train together and perform duties on-orbit as a single integrated international crew with one ISS Commander. Each Party will assign a crewmember to have primary responsibility for its segment. The ISS Crew Operations Board will further define the details of the integrated crew concept.

13. The Parties agree that RSA provides the capability to return the entire international crew (up to three) in off-nominal situations through the completion of assembly (flight 19A in June 2002). Since the entire vehicle capability of the Soyuz TM is assumed in determining RSA's cost credit for crew rotation and unplanned crew return, the seats required on the Soyuz (up to three) will remain available for use by the ISS crew. NASA will provide crew rescue capability following the completion of assembly. In the event the NASA crew rescue capability becomes available later than is currently planned (flight 19A in June 2002), RSA agrees to continue to provide the capability to rescue the entire international crew using the Soyuz for agreed upon compensation from NASA.

14. For purposes of determining the balance of the Parties' contributions, 6 Shuttle flights and 11 Soyuz flights rotating 51 crewmembers have been assumed for the assembly phase (after assembly complete, crew rotation was assumed to be provided by each Party proportional to its share of the crew, thus not requiring any exchange of compensation/contribution credit). Additional Shuttle flights (currently estimated at 5) during assembly might be used, upon mutual agreement of the Parties, when necessary to provide flexibility in the crew rotation model. NASA recognizes potential impacts to RSA if the use of additional Shuttle flights results in a Soyuz rotating less than three crew and these potential impacts have been taken into account in determining the balance of the Parties' contributions. NASA recognizes that Soyuz must fly with a minimum of two crew, but, as in the case of Shuttle-rotated crew, the mission tasks and required training will determine the details of crew rotation. NASA is not claiming contribution credit or compensation from RSA for the additional Shuttle crew rotation flights. The Parties agree to continue to work together on the optimum number and interval of Shuttle crew rotation flights and to resolve the issues of partial or full rotation of the crew.

15. Training expenses: Top level agreements regarding Space Station crew will be addressed in the context of the NASA/RSA MOU negotiations. Details of the crew training curriculum and process, including the curriculum and sites for advanced and increment-specific training for Space Station crew, will be defined as part of normal operations planning processes. For the purposes of the Protocol, it is understood that each Party is financially responsible for all compensation (salary and per diem), travel, personal interpreters, medical expenses, lodging and other living costs on Earth for Space Station crew which it provides. However, it is further agreed that the training of the U.S. and Russian crew shall be provided by the host country free of charge. RSA will not be charged training costs for crew training in the United States and NASA will not be charged training costs for crew training in Russia. Crew training includes instruction, training materials and equipment, access to all necessary facilities and all costs for activities in the jointly agreed training plan and curriculum. This reciprocal bilateral waiver of training fees is intended to include cases where, pursuant to a cooperative agreement for example, someone other than a U.S. national is tendered for training in Russia as part of NASA's flight opportunity allocation or vice versa. NASA agrees to discuss adoption of a similar approach for all ISS partners during the course of its bilateral MOU negotiations with ESA, GOJ and CSA.

16. Each Party will be responsible for providing food, supplies and personal items for its astronauts and cosmonauts who serve as Space Station crew. Launch of these items has been taken into account in determining the balance of the Parties contributions during the assembly phase. After assembly complete, it is assumed each Party will supply and deliver these items for its own crew or arrange for launch at its own expense.

17. With regard to propellant delivery, the Parties based their arrangement on the assumption that the total propellant required for the life of the station is 112 MT (this estimate does not include the propellant required for off-nominal situations, such as abnormal solar cycles). Of that total, 71% is attributable to the AS (80 MT) and 29% is attributable to the RS (32 MT). NASA will deliver 24 MT after assembly complete. RSA will deliver the remaining 56 MT to ISS for the AS. Total RSA propellant delivery obligation over the life of the station is 88 MT (56 MT for the AS and 32 MT for the RS). At the conclusion of the assembly phase (or earlier if required), the Parties will review the actual use of propellant during assembly and consider whether propellant requirements for the remaining life of ISS should be reviewed and revised. In the event of revisions, the Parties will reach a mutually acceptable arrangement for the adjustment of their obligations. Barter at the technical level will be the primary goal, although other arrangements may be substituted in the event an acceptable barter is not feasible.

18. The Parties agree to continue efforts to improve operations efficiencies onboard the ISS, including common and interoperable systems and interfaces to crew.

19. The FGB is a U.S. element, technically integrated into the Russian Segment. For purposes of establishing the balance of the Parties' contributions, the FGB is considered NASA's responsibility, except as specifically otherwise agreed. This means for example that the FGB mass was attributed to the AS for purposes of assessing the relative shares of propellant required by both segments and NASA will have exclusive rights to the FGB's dry cargo stowage capability. The AS owns the interior stowage volume of the FGB. RSA is responsible for maintenance of the FGB and manufacture/delivery of FGB spares. The AS will provide the on-orbit stowage volume for FGB spares. RSA agrees the on-orbit stowage requirements for FGB spares will comply with requirements for AS stowage volume specified in ICD 42121 (PMA to FGB). The Parties have agreed to their respective responsibilities with regard to the FGB in the February 5, 1995 Protocol between RSA and NASA (the FGB protocol) and continue to honor those commitments. RSA has assumed the costs associated

with launching the FGB on Proton. This has been taken into account as a RSA contribution in the balance of contributions, along with all of RSA's other obligations referenced in the FGB Protocol.

20. NASA agrees to launch the SPP on the Shuttle and to deliver the SPP to the ISS. NASA further agrees to assemble the SPP on orbit with the cooperation and technical support of RSA. The technical tasks required to transfer and assemble the SPP have been defined and agreed to in Appendix 3. Funding responsibilities for the technical tasks have also been agreed to and identified in Appendix 3. As stated under section 4.1 of Appendix 3, NASA and RSA are jointly responsible for the certification of the SPP transfer and berthing operation. NASA assumes no liability for the operation or overall performance of the SPP. RSA is ultimately responsible for the certification of the SPP and its subsystems. RSA and NASA agree that the Non-Standard Shuttle Services referenced under section 6 of Appendix 3 are based on initial design requirements identified in March, 1996. Costs for additional Non-Standard Shuttle Services beyond those listed in Appendix 3 resulting from subsequent SPP design changes/modifications are not included in this agreement. Separate negotiations will be conducted between NASA and RSA to specify funding responsibility if any additional Non-Standard Shuttle Services are required.

21. In assessing the Parties' relative contributions for the ISS configuration referenced in paragraph 5, current or future losses or gains of efficiency caused by a change in inclination, altitude, launch delays or inability to utilize the full capability of a transportation system, etc. will not be considered a contribution unless otherwise specifically agreed. Loss of efficiency or cost impacts caused by changes from previous design configurations to the current baseline configuration will likewise not be considered a contribution. Financial and other impacts from any loss of efficiency or previous design changes will be the sole responsibility of the Party claiming the loss of efficiency or cost impact. Further, any modifications and upgrades carried out by NASA and RSA in collaboration with other Partners to transition from the Mir-2 Program (Service Module modifications, LTV development, etc.) and Freedom Program (Shuttle modifications, etc.) to the ISS Program have been considered and accepted as balanced.

22. For purposes of the Protocol, the hardware, software and data which the Parties exchange pursuant to the NASA/RSA Bilateral Hardware, Software and Data Exchange Agreements, are now and will continue to be upon completion, considered balanced and such agreed trades will require no additional exchange of goods, services or funds.

23. The Parties agree that the main operations language for activities under this Agreement will be the English language, and data and information generated or provided under this Agreement will be in the English language, unless otherwise agreed. For example, joint program meetings and telecons will be conducted in English. The Crew Operations Panel (under the Space Station Multilateral Coordination Board) will determine the language used for crew training. Therefore, the Parties will implement this understanding to the extent possible and documentation between NASA and the Russian side will be exchanged in English. However, in recognition of the need for a transition period for the Russian participants to undergo English language training, Program activities may be conducted in English through use of interpretation and translation services, and NASA and RSA will work on a reciprocal basis to provide appropriate and reasonable levels of interpretation and translation support for the technical and managerial meetings they host through the completion of the assembly and initial operational verification of the Space Station.

24. RSA will make available, arrange for availability or continue to provide for NASA use office space at the following facilities: RSA, RSC Energia, Khrunichev, TsUP, and Gagarin Cosmonaut Training Center. NASA will continue to make available office space at the Johnson Space Center for RSA's use. In the case of established offices, the Parties will continue to provide the scope of office space and support currently provided. In the case of offices yet to be established, the Parties will work together to reach mutually satisfactory arrangements, recognizing that the cost of the Parties' provision of such office space and support have been taken into account and are considered balanced from a financial perspective. NASA will continue to staff and operate the NASA Moscow Liaison Office within the US Embassy in Moscow at its own expense.

25. Once the funding identified in contract NAS 1510110 for Russian personnel travel is depleted, each Party will bear the costs incurred by its personnel (civil servants and contractors) traveling to participate in the Space Station Program activities.

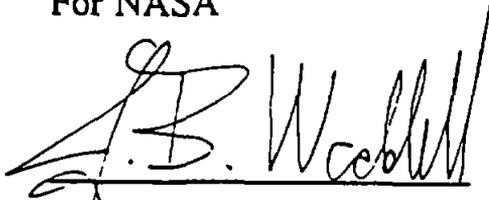
26. The efforts of the Parties to monitor and provide warning on/ response to space debris have been considered and require no further compensation.

27. Except as otherwise specifically agreed in the Protocol, the Parties' provision of backup data transmission capability and backup command and control to each other for contingency purposes has been considered and deemed balanced.

28. The attached Appendix 2 further specifies the balance of goods and services which each Party contributes.

Done in Moscow, in duplicate, this 11th day of June, 1996, in English and Russian languages, each text being equally authentic.

For NASA

A handwritten signature in black ink, appearing to read 'J. B. Waddell', written over a horizontal line.

J. B. Waddell

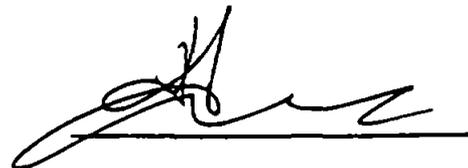
For RSA

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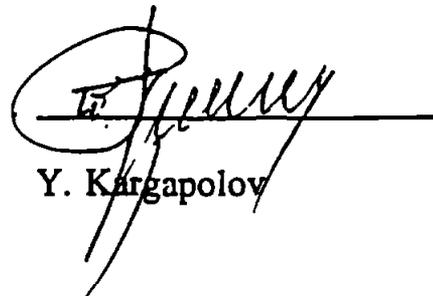
M. Sinetschikov

A handwritten signature in black ink, appearing to read 'A. Krasnov', written over a horizontal line.

A. Krasnov

A handwritten signature in black ink, appearing to read 'A. Derechin', written over a horizontal line.

A. Derechin

A handwritten signature in black ink, appearing to read 'Y. Kargapolov', written over a horizontal line.

Y. Kargapolov

# Preliminary ISS Assembly Sequence Rev B as of 1 March 1996

Planned Launch Date	Flight	Delivered Elements
11/97	1A/R	FGB (Launched on PROTON launcher)
12/97	2A	Node 1 (1 Storage racks), PMA1, PMA2
4/98	1R	Service Module
5/98	2R	Soyuz
7/98	3A	Z1 truss, CMGs, Ku-band, S-band Equipment, PMA3, EVAS (Spacelab Pallet)
11/98	4A	P6, PV Array (4 battery sets) / EATCS radiators, S-band Equipment
12/98	5A	Lab (4 Lab Sys racks)
12/98	4R	Docking Compartment (DC)
1/99	6A	7 Lab Sys racks (on MPLM), UHF, SSRMS (on Spacelab Pallet)
3/99	UF-1	ISPRs, 1 Storage rack (on MPLM), 2 PV battery sets (Spacelab Pallet)
4/99	7A	Airlock, HP gas (3 O2, 1 N2) (on Spacelab Pallet)
<b>Phase 2 Complete</b>		
6/99	8A	S0, MT, GPS, Umbilicals, A/L Spur
8/99	UF-2	ISPRs, 2 Storage Racks (on MPLM), MBS
9/99	9A	S1 (3 rads), TCS, CETA (1), S-band
11/99	9A 1	Science Power Platform w/4 solar arrays
1/00	11A	P1 (3 rads), TCS, CETA (1), UHF
2/00	12A	P3/4, PV Array (4 battery sets), 2 ULCAS
3/00	10A	Node 2 (4 DDCU racks), P5 w/radiator OSE
4/00	3R	Universal Docking Module (UDM)
6/00	1J/A	JEM ELM PS (5 JEM Sys, 2 ISPR, 1 Storage racks), SPDMM, ULC w/HP Gas (1 O2, 1 N2)
8/00	13A	S3/4, PV Array (4 battery sets), 4 PAS
11/00	1J	JEM PM (3 JEM Sys racks), JEM RMS
12/00	UF-3	ISPRs, 1 Storage Rack (on MPLM)
1/01	UF-4	2 ULCs with attached payloads, ATA, NTA, 1 O2 tank
5/01	2J/A	JEM EF, ELM-ES, 4 PV battery sets (on ULC)
5/01	8R	Research Module #1 (RM-1)
6/01	UF-5	S5, Cupola (on mini-ULC), Port Rails, Attached payloads (on ULC)
9/01	14A	Centrifuge
11/01	2E	2 U.S. Storage, 7 JEM racks, 7 ISPRs (on MPLM)
12/01	15A	S6, PV Array (4 battery sets), Stbd MT/CETA rails
12/96	10R	Research Module #2 (RM-2)
2/02	16A	Hab (6 Hab racks)
2/96	11R	Life Support Module (LSM)
4/96	13R	Research Module #3 (RM-3)
4/02	UF-6	ISPRs, 1 Storage Rack (on MPLM)
5/02	17A	1 Lab Sys, 1 Storage, 8 Hab Sys racks (on MPLM), ULC w/1 O2 tank, 2 PV battery sets
6/02	18A	CTV #1 (Launch Vehicle TBD) [referred to as CRV in protocol]
6/02	19A	3 Hab Sys, 11 U.S. Storage racks (on MPLM)
<b>U.S. Assembly Complete</b>		
early 2003	1E	Columbus Orbital Facility

June 11, 1996

**International Space Station  
NASA/RSA Contributions and Services which Cross the Interface  
DURING ASSEMBLY (through flight 19A)**

**NASA PROVIDING to RSA**

1. Sufficient electrical power transfer required to augment Russian generated power in order to maintain essential Russian segment core systems (up to 4 kw) for the period between the delivery of P-6 on flight 4A until the SPP is delivered, installed, and operational in accordance with mutually agreed schedules for power transfer
2. Delivery and return of international crew, on 6 Shuttle flights (up to 11 if mutually agreed), to support the traffic model documented and approved in the Multi-Increment Manifest (MIM)
  - a) Required training for up to 51 crewmembers for Station, plus backup necessary for shuttle launch and/or return
3. NASA Wide Area Network (NWAN) communications systems in Russia
  - a) Design, procurement, and installation (including labor and travel), per the Joint Institutional Communications Requirements Working Group document (WG-9/NASA-RSA/001 of June 21, 1995), as amended, through assembly complete
  - b) All recurring costs through assembly complete
4. Lead role in ISS systems engineering and integration
  - a) Integrated design analyses cycles performed biannually (DAC)
  - b) Vehicle Master Data Base (VMDB) development and maintenance
  - c) Documentation for requirements, interfaces, and configuration
  - d) Schedule integration
  - e) Assembly sequence management
  - f) Station level safety and mission assurance
5. Lead role in ISS operations integration and Russian segment payload integration into ISS
  - a) Control center operations
  - b) Control center interfaces (Remote Extension Moscow (REM))
  - c) Cargo integration
  - d) Integrated vehicle sustaining engineering analyses
  - e) Multi-segment training facilities development
  - f) Strategic, tactical, and execution planning
6. Non-propulsive attitude control via Control Moment Gyros (CMGs)
7. Functional Cargo Block (FCB) functions and services to RSA
8. Integration of Science Power Platform (SPP) on shuttle, launch on shuttle, hand-off to SSRMS, and on orbit assembly on a cooperative basis with RSA
9. Integration of SPP solar arrays on shuttle, launch on shuttle, and delivery to ISS
10. Delivery of 3,000 kg of water by Shuttle to the Russian segment
11. 500 kg of upmass on Shuttle
12. 1,500 kg of recoverable downmass on Shuttle

**APPENDIX 2**

June 11, 1996

International Space Station  
NASA/RSA Contributions and Services which Cross the Interface  
DURING ASSEMBLY (through flight 19A)

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RSA PROVIDING to NASA

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1. Crew rescue capability and required training for entire international crew by the provision of 11 Soyuz TM
2. Supply and delivery of 44 MT of propellant (of which NASA's share is 31 MT)
3. Delivery of 28 MT of Life Support Systems (LSS) resupply for a three person international crew (of which NASA's share is 14 MT)
4. Delivery and return of international crew on up to 11 Soyuz TM vehicles to support the traffic model documented and approved in the Multi-Increment Manifest (MIM)
  - a) Required training, sokol suits, seat liners, and necessary equipment for up to 51 crewmembers, plus backup
5. FGB launch, integration within the Russian Segment, trainers and training, on-orbit maintenance (including up to 1.5 MT of spares), operations, and sustaining engineering per February 1995 FGB protocol
6. Accommodations/Life Support (in the Service Module [SM]) for entire International crew until US Hab Module is fully outfitted (from flight 2R to flight 19A estimated to be 5/98 to 6/02)
7. Data transmission from American segment until US lab is activated (flight 2A to 5A)
8. Ground system modifications (communication sites and MCCM) to remove limitations on commands to node 1 through the FGB
9. Up to 800 watts power transfer from service module to node 1 until P-6 delivery (flight 1R to 4A estimated to be seven months)
10. Reboost, propulsive and non-propulsive attitude control
11. Support to NASA in ISS systems engineering and integration
  - a) Integrated design analyses performed biannually (DAC)
  - b) Vehicle Master Data Base (VMDB) maintenance
  - c) Documentation for requirements, interfaces, and configuration
  - d) Schedule integration
  - e) Assembly sequence management
  - f) Station level safety and mission assurance
12. Support to NASA in ISS operations integration and Russian segment payload integration into ISS
  - a) Control center operations
  - b) Cargo integration
  - c) Integrated vehicle sustaining engineering analyses
  - d) Multi-segment training facilities development
  - e) Strategic, tactical, and execution planning

APPENDIX 2

June 11, 1996

International Space Station  
NASA/RSA Contributions and Services which Cross the Interface

ASSEMBLY COMPLETE (after flight 19A)

NASA PROVIDING to RSA

1. Contingency electrical power (up to 5 kw) to maintain Russian segment core systems
2. Lead role in ISS systems engineering and integration
  - a) Integrated design analyses cycles performed biannually (DAC)
  - b) VMDB maintenance
  - c) Documentation for requirements, interfaces, and configuration
  - d) Schedule integration
  - e) Station level safety and mission assurance
3. Lead role in ISS operations integration and Russian segment payload integration into ISS
  - a) Control center operations
  - b) Control center interfaces (REM)
  - c) Cargo integration
  - d) Integrated vehicle sustaining engineering analyses
  - e) Multi-segment training facilities development
  - f) Strategic, tactical, and execution planning
4. Non-propulsive attitude control via CMG's
5. Reboost function
6. Delivery of 24 MT of propellant
7. 3 MT recoverable down mass on Shuttle
8. Delivery of 20 MT of cargo for the Russian Segment
9. Delivery of 5 MT of water

APPENDIX 2

June 11, 1996

International Space Station  
NASA/RSA Contributions and Services which Cross the Interface

ASSEMBLY COMPLETE (after flight 19A)

RSA PROVIDING to NASA
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1. Supply and delivery of 44 MT of propellant (of which NASA's share is 24 MT)
2. FGB on-orbit operations, maintenance (including up to 3 MT of spares), and sustaining engineering per February 1995 FGB protocol
3. Reboost and propulsive and non-propulsive attitude control
4. Support to NASA in ISS systems engineering and integration
  - a) Integrated design analyses performed biannually (DAC)
  - b) VMDB maintenance
  - c) Documentation for requirements, interfaces, and configuration
  - d) Schedule integration
  - e) Station level safety and mission assurance
5. Support to NASA in ISS operations integration and Russian segment payload integration into ISS
  - a) Control center operations
  - b) Cargo integration
  - c) Integrated vehicle sustaining engineering analyses
  - d) Multi-segment training facilities development
  - e) Strategic, tactical, and execution planning

APPENDIX 2

### Appendix 3

#	ITEM	FUNDING Responsibility	TECHNICAL Responsibility
<b>1</b>	<b>All EVAs required to assure Berthing/Docking of SPP to SM</b>		
1.1	- Installation of the Stand on the FGB	RSA	RSA
1.2	- Installation of FGB Power & Data Grapple Fixture (PDGF) on the Stand	NASA	NASA
1.3	- Removal of the SPP PDGF (T&C 1.1)	RSA	RSA
1.4	- Development & T&V of an EVA backup method for SPP/SM Berthing/Docking operation (T&C 1.2)	RSA	RSA
<b>2</b>	<b>FGB PDGF Implementation (a), (T&amp;C #'s 2.1, 2.2, 2.3, 2.4)</b>		
2.1	- PDGF ORU & Video Signal Converter (VSC) (a1)	NASA	NASA
2.2	- Canadian Manufact. H/W, T&V (a2), (T&C #2.3)	NASA	NASA
2.3	- NASA Manufact. H/W & T&V (video/data cables, conn's.) (a3)	NASA	NASA
2.4	- RSA Manufactured H/W (data cables, connectors) (a4)	RSA	RSA/NASA
2.5	- PDGF H/W Integration & Prime H/W Modifications, T&V, Integration (SSCN 303) (a5)	NASA	NASA
2.6	- RACU to SSRMS power testing at SPAR (a6)	NASA	RSA/NASA
2.7	- Launch/Delivery of PDGF & associated H/W to ISS		
2.8	- PDGF Stand Dsgn, Development, T&V, & Delivery (T&C 2.4)	RSA	RSA
<b>3</b>	<b>SPP PDGF Implementation (b)</b>		
3.1	- PDGF ORU & PDGF Canadian Manufact. H/W/T&V (b1)	NASA	NASA
3.2	- Flight Releasable Grapple Fixture (FRGF) (b2)	NASA	NASA
3.3	- US/CSA SSRMS Software Modifications (b3)	NASA	NASA/CSA
3.4	- System Level NASA/Prime SSRMS/SPP Configuration Verification (b4)	NASA	NASA
<b>4</b>	<b>Transfer/Berthing of SPP to SM w/ SSRMS (T&amp;C #'s 4.1)</b>		
4.1	- Integrated ISS Operational Analysis & Modeling	NASA	NASA
4.2	- SPP/SM Interface T&V (Using results of ISS Ops Analysis)	RSA	RSA
<b>5</b>	<b>SVS Targets (c)</b>		
5.1	- SM Targets and Orientation Survey (c1)	NASA	RSA/NASA
5.2	- SPP Targets And Orientation Survey (c2)	NASA	RSA/NASA

### Appendix 3

#	ITEM	FUNDING Responsibility	TECHNICAL Responsibility
<b>6</b>	<b>Non-Standard Shuttle Services (T&amp;C 6.1)</b>	NASA	NASA
6.1	- Remotely Operated Electrical Umbilical (ROEU)		
6.2	- Thermal Model Development & Analysis		
6.3	- Design Coupled Loads Analysis/Finite Element Modeling		
6.4	- Orbiter Cabling		
6.5	- SRMS Manipulator Demonstration Facility Mockup		
<b>7</b>	<b>Second Set of SPP Solar Arrays (SA) (T&amp;C #7.1)</b>		
7.1	- Design, Development, Manufacturing, & T&V of SPP SA's	RSA	RSA
7.2	- SA Carrier	NASA	NASA
7.3	- Carrier Flight Support Equipment (FSE) to attach SA	RSA	RSA
7.4	- SPP attach point to accommodate Carrier & SA's	RSA	RSA
7.5	- EVAs required for Installation of SAs	RSA	RSA
7.6	- SSRMS Operational Analysis & Modeling	NASA	NASA
7.7	- Delivery/Launch of SPP SA's On-orbit by Shuttle	NASA	NASA
7.8	- Return of SA Carrier on the Shuttle	NASA	NASA
<b>8</b>	<b>SPP Pre-launch Processing at KSC for SPP &amp; SAs (T&amp;C 8.1)</b>	NASA	NASA
<b>9</b>	<b>TCS Two-Phase Flight Demo (T&amp;C #9.1)</b>		
9.1	- H/W Design, Manufacturing, T&V	RSA	RSA
9.2	- Flight Demo Carrier	NASA	NASA
9.3	- Carrier Flight Support Equipment (FSE) to attach Flight Demo	RSA	RSA
9.4	- Installation & Analysis of Flight Demo	NASA	NASA
9.5	- Pre-launch processing at KSC	NASA	NASA
9.6	- Delivery of Experiment On-orbit on STS-87	NASA	NASA
9.7	- Return of the Flight Demo experiment on Shuttle	NASA	NASA
<b>10</b>	<b>SPP On-orbit Assembly EVAs</b>	RSA	RSA

## **Appendix 3**

- 1.1 RSA is responsible for removal of the SPP PDGF and return to the US segment for relocation to the HAB. NASA is responsible for installation of the PDGF on the HAB.**
- 1.2 NASA/RSA agrees to have two methods for accomplishing the SPP Berthing/Docking operation that do not exceed the capabilities of the SSRMS as defined in SSP 50227. One of these methods is to be an EVA backup which would be fully tested and verified prior to launch.**
- 2.1 RSA and NASA agree to the development of requirements in joint documents NASA/RSCE/3411-SPP and SSP 50227. Existing SSRMS interface and operational requirements as defined in SSP 42003 and SSP 42004 will be incorporated. RSA is responsible for assuring that all requirements defined in the above documents are met.**
- 2.2 The FGB PDGF will remain permanently installed on the FGB. The FGB PDGF will also be used for the installation of the SPP Solar Arrays.**
- 2.3 RSA also requires that a PDGF be installed on the SPP. NASA will procure the PDGF and associated hardware by June 1, 1996 in order to utilize existing the NASA/SPAR contract at a significant discounted cost and meet the ISS Assembly Sequence schedule.**
- 2.4 As agreed at TIM 17, RSA is responsible for the development, test, verification, delivery and installation on the FGB, a support structure/stand to which a PDGF can be mounted.**
- 4.1 NASA agrees to perform an Integrated Analysis of the SPP transfer and berthing operation. RSA agrees to provide Docking Mechanism (Hybrid Probe/Cone) characteristic data as required by the NASA in order to accurately model the Docking Mechanism. Results of this analysis will be provided to RSA for incorporation in the Docking Mechanism test stand. NASA and RSA agree to the joint responsibility for the certification of the transfer and berthing operation.**
- 6.1 Items identified under section 6 are the main areas listed for Non-Standard Shuttle services. Specific items will be identified as the SPP design matures.**

## **Appendix 3**

**7.1 RSA is responsible for the development, test, verification and installation of the remaining 4 SPP solar arrays. NASA agrees to deliver on orbit these arrays utilizing a US developed carrier. RSA agrees to provide NASA required information for integrating the solar arrays onto the carrier and into the Shuttle Payload Bay.**

**NASA is responsible for the SSRMS handover of the carrier/arrays to the Russian Segment. RSA agrees that if the transfer, removal of the Solar Arrays, and return of the carrier is not possible within the defined mission timeline, RSA is responsible for providing an attach/stowage location for the carrier on the Russian Segment.**

**8.1 NASA is responsible for Prelaunch processing, including ammonia servicing, CITE testing, battery servicing and other applicable SPP services at KSC. RSA is responsible for financing Russian Segment personnel required to support planning and processing operations at KSC.**

**9.1 NASA and RSA agree to fly the Russian TCS Two Phase Flight Experiment on the Shuttle based on RSA's commitment that the Flight Experiment will be delivered to KSC by September, 1997 in support of STS-89. Final agreement for NASA to fly the Russian Two Phase Experiment is conditional pending RSA submittal of payload mass properties and dimensions data for feasibility assessments.**

**A.1 The SPP will undergo the Joint ISS/Shuttle Safety Review Process. RSA agrees to support the Joint Review Panel as required.**

**A.2 RSA agrees to provide an approved SPP schedule and to provide bi-weekly status updates as well as formal updates upon changes to the schedule. RSA further agrees to conduct periodic Joint Detailed Design Reviews to assess that the SPP is meeting all applicable Shuttle/ISS requirements and schedules. RSA and NASA agree to provide detailed documentation (schedules, drawings, Preliminary Design Documentation, Test and Verification documents, etc.).**

**(a) - FGB PDGF H/W LIST (Including T&V & USOS Modifications)**

#	ITEM	COMMENTS	SOURCE	PROCUREMENT NEED DATE
a1	PDGF ORU Assembly	Includes Thermal Blankets, Grapple Shaft ORU Assembly, & Connector Saver Set (Consists of 6 Harness Assemblies Used to simulate SSRMS LEE for T&V)	Borrowed from USOS HAB module	N/A
	Video Signal Converter (VSC)		Borrow Existing USOS Spare	N/A
12	PDGF Mounting Assembly (Adapter Ring)	Includes 8 Thermal Bushings (No Spares)	US (SPAR); Existing NASA/CSA Contract	6/1/96 (Authority To Proceed)
	VSC Mounting Kit (VSC Plate)	VSC Bracket, 2 Attraction Plates, 4 screws	US (SPAR), Existing NASA/CSA Contract	6/1/96 (Authority To Proceed)
	PDGF External Harness (Cable Bundle), with VSC Interface	Data, Power, Video Cables, VSC Connectors, & PDGF Interface Connectors	US (SPAR)	6/1/96 (Authority To Proceed)
13	1553 Cable Wire (Silver & Nickel Plated)	For interface between PDGF Harness & Node/PMA 1553 Cables	US GFE (Hay Associates)	TBD
	Video Cable (Fiber)	Interface Between S0 Truss & VSC (5 fibers for Approx 100 ft). Includes Design, Manufacturing & WETF Mockup	US GFE (Brand Rex)	TBD
	External Connectors (Power & Video) QCDs	External Connectors (3) Internal Quick Disconnect Connectors	US GFE (Amphenol) US GFE (TBD)	TBD TBD
	Power Cable Dressing & Tiedowns	External Power Cables Routing	US GFE (TBD)	TBD
	WETF PDGF Cable Harness Mockup	Low-fidelity mockup for PDGF handling training Includes VSC Mockup	US GFE (JSC)	TBD
	WETF PDGF Fiber Bundle Mockup	Low-fidelity mockup for video fiber routing Assuming EVA installation of Video Fiber	US GFE (JSC)	
14	FGB External/Internal Cable Manufacturing	RS will manufacture 1553 cables for: Interface between PDGF Harness & Node/PMA 1553 cables	RS	TBD
	External Connectors (Data)	PDGF Harness interface & FGB Feedthrough Interface	RS	TBD
	Internal Connectors (Data)	Internal FGB 1553 & Node/PMA 1553 cables interface	RS	TBD
	External/Internal Connectors (Data)	FGB Feedthrough 1553 cables interface	RS	TBD
15	US H/W Modifications, T&V & Integration	Includes PDGF H/W Integration and NASA H/W Mods	US (Prime, PG 1, PG 3)	
	- 1553 Cable/Connectors & Integration	Integration of 1553 connectors with 1553 cables	US (PG 1)	
	- Lab-Node 1 1553 Jumper Cables	2 jumpers. Prime/PG assessing via new SSCM	US (PG 1, PG 3)	
	- Video Cable Outfitting	PMA 1/Node 1 outfitting (Dressings and Tiedowns)	US (PG 1)	
	- 1553 Bus Performance Testing	1553 Bus Performance Testing	US (PG 1)	
16	Non-US (Joint) Integrated T&V	Power test of RACUs & SSRMS	US/RS (Prime, PG 2, SPAR, KHSC)	Dec 96 - Mar. 97 Window of Opportunity

**(b) - SPP PDGF Related H/W LIST (Including T&V & USOS Modifications)**

#	ITEM	COMMENTS	SOURCE	PROCUREMENT NEED DATE
b1	PDGF ORU Assembly	Includes Thermal Blankets & Grapple Shaft ORU Assembly, & Connector Saver Set (Consists of 6 Harness Assemblies Used to simulate SSRMS LEE for T&V)	US (SPAR), Existing NASA/CSA Contract	6/1/96 (Authority To Proceed)
	PDGF Mounting Assembly (Adapter Ring)	- Includes 8 Thermal Bushings (No Spares)	US (SPAR), Existing NASA/CSA Contract	6/1/96 (Authority To Proceed)
	PDGF External Harness (Cable Bundle)	Data, Power & Video Cables & PDGF Interface Connectors	US (SPAR); Existing NASA/CSA Contract	6/1/96 (Authority To Proceed)
b2	Flight Releasable Grapple Fixture (FRGF)	Required for Shuttle RMS grappling in Payload Bay	US (Existing Spare)	N/A
b3	SSRMS Software Modifications	Functionality to berth SPP & control SSRMS	US GFE (JSC), Prime, SPAR	N/A
b4	System Level NASA/Prime SSRSM/SPP Configuration Verification	SSRMS Functionality & Verification	US (Prime)	TBD

**(c) - SPP/SM Space Vision System (SVS) Targets (Including T&V)**

#	ITEM	COMMENTS	SOURCE	PROCUREMENT NEED DATE
c1	<b>SM</b> - TBD targets (4-5 minimum, 8 likely)	Work is in progress to identify quantity and need dates	US (SPAR), New procurement	TBD
	- Exact Location/Orientation Survey	Done by KSC personnel (1-2 days, 4 personnel)	US	N/A. SM schedule & US KSC personnel availability driven
c2	<b>SPP</b> - TBD targets (4-5 minimum, 8 likely)	Work is in progress to identify quantity and need dates	US (SPAR), New procurement	TBD
	- Exact Location/Orientation Survey	Done by KSC personnel (1-2 days, 4 personnel)	US	N/A. SPP schedule & US KSC personnel availability driven