Document I-43

Document title: James E. Webb, Administrator, NASA, to the President, January 31, 1964, with attached: "US-USSR Cooperation in Space Research Programs."

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

This letter from NASA Administrator Webb transmitted to President Lyndon Johnson the report on possible U.S.-Soviet cooperative initiatives related to the lunar landing program that had been requested by President Kennedy in November 1963. It also summarized the contents of the lengthy report. None of the suggested cooperative initiatives was ever implemented because the Soviet Union decided in 1964 to carry out its own lunar landing program on a crash basis.

---

[1] JAN 31, 1964

The President
The White House

Dear Mr. President:

The attached report on possible projects for substantive co-operation with the Soviet Union in the field of outer space is provided to you in accordance with National Security Action Memorandum 271, dated November 12, 1963, and my interim report to you of December 13, 1963. It has been coordinated with the Department of State, the Department of Defense, the Executive Secretary of the Space Council, the Central Intelligence Agency, the Office of the Science Adviser, and White House staff.

Since space technology is closely related to and in some measure interchangeable with technology of military interest, careful examination of the attached report is desirable in connection with further initiative in this field.

1. An appendix to the report reviews the status of agreements already reached between NASA and the Soviet Academy of Sciences for cooperation in three areas: (1) coordinated meteorological satellite program; (2) passive communications satellite experiments with the ECHO II satellite launched this month; and (3) geomagnetic satellite data exchange. The appendix also reviews Soviet rejection of numerous specific offers of space cooperation made in the past by the US. At this writing, the Soviet Academy, while in communication with NASA in regard to the agreements between us, has failed to meet time limits on most agreed action items but has conducted optical observations of the ECHO II satellite as agreed and apparently intends to proceed with communications experiments between the USSR and the Jodrell Bank Observatory. Other tests of Soviet intentions under these agreements will materialize shortly.

2. The report focuses upon possible cooperation in manned and related unmanned lunar programs. (Possibilities for cooperation in other space programs have been and will continue to be advanced in the channel between NASA and the Soviet Academy.)

[2] 3. The report recommends these guidelines to govern foreseeable negotiations with the Soviet Union in the space field: substantive rather than propaganda objectives alone; well-defined and comparable obligations for both sides; freedom to take independent action; protection of national and military security interests; opportunity for participation by friendly nations; and open dissemination of scientific results.

4. The report recognizes that cooperation with the Soviet Union must ultimately rest on specific projects. However, the advantages and disadvantages of specific proposals are not absolute. They may vary significantly, depending upon Soviet objectives, techniques, procedures, and schedules relative to ours. Lacking sufficient information of these factors, we remain uncertain of the security and tactical aspects of specific proposals which might be advanced to the Soviets.

5. Accordingly, the report outlines a preferred structured approach calculated to determine a level of confidence in any Soviet response, to gain information on basic elements of the Soviet program, and to merit confidence and support by the public and the Congress.

Briefly, this approach provides for maximum exchange of past results (generally subject to verification from other US sources), proceeds then to sufficient disclosure of the future planning of both sides to identify areas favorable for cooperation, and concludes with the joint definition of specific projects. Examples of specific projects would be put forward in the initial presentation of this approach to lend credibility and substance to it.

6. The report recognizes that the Soviet Union is unlikely to be amenable to such an approach. In that case, it would be possible to proceed directly to specific proposals. Some 15 examples of possible projects are described in the report and evaluated in such terms as our current knowledge of the Soviet program permits.

However, limitations (described in the report) attach to virtually all these proposals. These limitations reflect the general climate of US-Soviet relations and are therefore subject to change—which might bring *any* of the proposals within the range of realistic negotiation. At present, a change in sentiment appears necessary even for small steps in cooperation; for example, in the exchange of purely scientific data relating to solar radiation and micrometeorites, the Soviet Union has within the past year declined to provide details of instrumentation and calibration required for their understanding. Given a change in sentiment, however, such [3] exchanges would be useful and some cooperation might be proposed and developed in several areas including those listed below and, in addition, mutual tracking support and the recovery and return of manned capsules after their return to earth.

7. On balance, the most realistic and constructive group of proposals which might be advanced to the Soviet Union, with due regard for the uncertainties and limitations discussed above and detailed in the report, relates to a joint program of unmanned flight projects to support a manned lunar landing. These projects should be linked so far as possible to a step-by-step approach, ranging from exchange of data already obtained to joint planning of future flight missions. They include projects for the determination of:

(a) Micrometeoroid density in space between earth and moon.

(b) The radiation and energetic particle environment between earth and moon.

(c) The character of the lunar surface.

(d) The selection of lunar landing sites.

8. I believe this affords flexibility for positive action, utilizing either a variant of the structured approach (paragraph 5) or, with necessarily greater caution, selected specific proposals without reference to the structured approach (paragraph 7).

9. With regard to the timing and form of further US initiatives toward the Soviet Union, the report recommends the following:

(a) Continuing interest should be expressed through the existing NASA-Soviet Academy channel, in a positive Soviet response to the proposals for cooperation already made by President Kennedy and by you.

(b) No new high-level US initiative is recommended until the Soviet Union has had a further opportunity (possibly three months) to discharge its current obligations

under the existing NASA-USSR Academy agreement, or, in the alternative, until the Soviets respond affirmatively to the proposal you have already made in the UN.

(c) If Soviet performance under the existing agreement is unsatisfactory, a high-level initiative on a non- [4] public basis would seem desirable to prod the Soviet Union to better performance; additional public steps might be considered if this proves unavailing.

(d) If Soviet performance under the existing agreement proves satisfactory, personal initiative by you would still be required to extend this success to cooperation in manned lunar programs. Because the scope of initiative by Soviet Academy representatives seems limited, Mr. Khrushchev's personal interest and support would also seem to be required for any significant extension of joint activity. It is believed that your initiative will be more effective if taken privately in the first instance.

(e) A US initiative should establish our interest in the preferred structured approach described above. If it then becomes feasible to proceed with technical negotiations, the NASA-Soviet Academy channel should continue to be the vehicle used; as in the past, technical proposals to be considered in such negotiations should be made available for prior interdepartmental comment. (It may become appropriate to consider an effort to induce the Soviet Union to make personnel available who are closer to their technical program.)

(f) Agreements reached in technical negotiations should be embodied in memoranda of understanding, explicitly subject to review and confirmation by governments.

(g) To demonstrate the serious intentions of the US with regard to international cooperation in space and to maintain some pressure upon the Soviet Union to follow suit, we should continue to expand our current and successful joint projects with other nations to the degree possible.

This report will be kept under continuing review in NASA in concert with other interested offices and agencies, and we shall keep you advised of our progress with the Soviet Academy under the current agreement between us. I believe we are well prepared to support whatever initiative you determine to be appropriate in light of this report and stand ready to provide such additional information and judgment as you may require.

Respectfully yours,

James E. Webb
Administrator

Enclosure

****

[Enclosure page 1]

US-USSR Cooperation in Space Research Programs

President Kennedy and President Johnson have affirmed and reaffirmed the desirability of exploring further joint efforts with the Soviet Union and other countries in cooperative space activities, including manned lunar programs. (See Appendix I.) In support of these initiatives and in anticipation of possible discussions with the Soviet Union, this report examines technical proposals which might be put forward by the United States, as well as other considerations appropriate to such discussions.

For two reasons, this report concentrates upon possible cooperation in lunar programs: (1) cooperation in lunar programs was the focus of President Kennedy's September 1963 initiative and of President Johnson's confirmation of that initiative and, in particular, of his State-of-the-Union reference to the subject; (2) cooperation in other areas of space research and exploration was covered in the Kennedy-Khrushchev correspondence of February-March 1962 in both specific and general terms, has progressed to the point of firm agreement on three projects, and is the subject of an apparently continuing relationship pursuant to that correspondence and agreement. At issue now is an extension of this relationship to the only major field effectively excluded from it, i.e., manned lunar programs and related unmanned efforts. (A brief review of the current relationship [2] appears in Appendix II.)

This report necessarily assumes that the Soviet Union is engaged to some degree in a program looking toward eventual manned lunar landings. Soviet statements on this point have been ambiguous as to timing and status but clearly positive on balance. If there is *not* a Soviet program, the Soviet Union will probably confuse the issue for an indefinite period. (In that case, it has been suggested that US pressure for cooperation might even induce the Soviet to undertake manned lunar efforts not now planned. Viewed positively, this could divert Soviet resources from less desirable preoccupations; seen negatively, it could lead the Soviet Union into new technology. We believe that the safest assumption is that the Soviet Union does not exclude a manned lunar program and that no significant danger to us is involved if this assumption is incorrect.)

I.

Guidelines which have been applied in the preparation of this report follow:

(1) The central objective is to bring about continuing cooperation with the Soviet Union, rather than to achieve propaganda gains as such. (In his September 20 speech at the UN, President Kennedy stated, ". . . we must not put forward proposals merely for propaganda purposes;").

(2) In order to achieve real gains, we should press for [3] substantive rather than token cooperation.

(3) Cooperation with the Soviet Union should be well defined and the obligations of both sides made clear and comparable. (This will facilitate implementation as well as clarify responsibility in the event of failure and withdrawal.)

(4) In the present state of US-Soviet relations, we should undertake no project or other arrangement which night make us dependent upon Soviet performance, thereby impairing or limiting our independent capability in space.

(5) National security interests and military potential must be fully protected. No exchanges impinging upon security should be considered in the absence of certain, comparable, and verifiable information from the Soviet side.

(6) Opportunity for participation by other countries should be preserved and all results made available to them.

II.

Ultimately, any program of substantive cooperation with the Soviet Union must rest upon positive proposals of specific character. Such specific proposals can be defined almost without limit, and numerous examples of different modes of cooperation with the Soviet Union are provided in this report. *However, the advantages and disadvantages of specific proposals are not fixed by the terms of those proposals in an absolute sense.* The positive and

negative [4] values to us may vary markedly, depending upon Soviet objectives, techniques, procedures, and schedules relative to ours. It is therefore most desirable that we seek information on these aspects of the Soviet program so that we can evaluate and shape our own proposals effectively and prudently. Lacking such information, we would inevitably remain uncertain in matters of security, tactics, and bona fides.

Accordingly, we should define, and attempt to hold to, an approach to the Soviet Union which is calculated to (1) *determine the level of confidence* which we can place in the Soviet Union in this subject area, (2) *provide information* of the basic elements of the Soviet program, and (3) merit the confidence and support of the public and the Congress.

An approach structured to achieve these ends is spelled out in the next section of this report. *If such a structured approach is not acceptable in whole or in part to the Soviet Union, the President and the Department of State may, nevertheless, depending upon the circumstances and apparent attitude of the Soviet Union, determine that technical negotiators should proceed to the direct presentation of specific proposals. Such flexibility is desirable—but with clear recognition that different considerations will apply to the same proposals, depending upon whether they are offered with* [5] *or without some confidence and knowledge of Soviet plans.*

III.

The preferred approach to negotiations with the Soviet Union entails the discharge of outstanding obligations, followed by an escalating series of exchanges which are, in the initial stages, subject to verification. It is thus calculated to build a level of confidence upon which progressively significant cooperative activities may be based.

Since negotiation on manned lunar programs necessarily presages significant new relationships with the Soviet Union, requiring evidences of good faith, the first steps should be directed to clearing the slate as much as possible.

A most desirable first step would be material progress on both sides to implement the existing bilateral (Dryden-Blagonravov) space agreement in which the Soviets remain, at this writing, delinquent (although they have resumed communication).

A second step more directly following upon the US overtures in the UN would be the detailed exchange of data and information of the two countries' manned space programs *to date.* (This should include past flight, biomedical, and training data and could extend to early spacecraft technology.) The virtues of this step would be that it would represent a clean start, requiring from us little new information yet obliging the Soviet Union to present [6] considerable information not previously made available publicly. Since elements of the USSR contribution at this stage would be subject to verification through independent sources, a practical and useful test of Soviet intentions would be available at the earliest contact, and a first confidence level could be established.

If this step should prove a significant obstacle to further progress, it might, in the interests of flexibility, be downgraded, as it were, and subsumed quite naturally under the third step (below). It should, in any event, be tested since other means of determining the degree of Soviet good faith are not readily apparent. Opportunities for establishing a confidence level for dealing further with the Soviets would be diminished in proportion to deemphasis of this second step.

The third step would be the exchange of gross descriptions of our respective manned lunar programs. Again, this step would not place an undue burden upon us because of the publicity already given to our own intentions, but it would for the first time require the Soviet Union to describe its conceptual approach to the lunar landing problem. This step appears virtually indispensable for it is hardly possible to proceed intelligently or safely to coordinated, cooperative, or joint effort without some over-view of the proposed Soviet program.

The fourth step would seek, through more precise descriptions of our respective lunar programs, to isolate [7] elements of conflict or duplication and to discover opportunities for trade-off, complementary procedure, or joint action. Significant security considerations do not arise until this step is reached.

* * *

Examples of cooperative relationships that might develop at various stages of the above procedure follow:

– Conflict between the two programs could arise, as a crude illustration, through plans to use the same "window" for independent lunar missions on the same radio frequencies. It would be of mutual interest to eliminate any such conflicts.

– Unnecessary duplication, illustrated by independent but adequate programs for exploration of the lunar surface, would offer opportunities for thinning out or otherwise adjusting our respective programs so as to provide, together, only required information—the exact degree of thinning out depending upon the confidence level established at the time.

– In other cases, a desirable redundancy of effort might be recognized and specific provisions for data exchange made to increase reliability and confidence.

– Discovery that both sides planned to apply limited resources to the same facet of a broader problem (e.g., examination of the lunar surface in a relatively narrow region) would permit a reordering of efforts to cover additional facets of the problem on a shared-effort basis, with subsequent exchange of the results.

[8] – Some tradeoffs can be visualized, arising from differentials in schedules and capability in the two programs; e.g., the possibility that the Soviet Union might acquire a sample of the lunar surface before the United States, taken together with our twenty-four hour deep space tracking capability, suggests a trade-off between the two; medical data obtained in the Vostok flights might be traded for radiation or micrometeorite data obtained in our scientific program.

If an improved confidence level is achieved through the modest but meaningful arrangements suggested above, progress toward more advanced, integrated relationships could be made.

IV.

At various steps in the above procedure, specific projects should be put forward as appropriate to lend concrete substance to the negotiations. A relatively detailed description of such projects follows:

(Negative or uncertain values reflected in this description follow from our current lack of knowledge of Soviet plans; a more positive evaluation should be possible in each case if serious intentions on the part of the Soviet Union motivate a sufficient exchange of the necessary background information. A negative assessment of Soviet interest or desire in a given case does not necessarily mean that the proposal should not be put forward; it is intended [9] solely to reflect realistically the *present* prospects for a substantive advance of our purpose. These apparent prospects may well change in light of any information forthcoming from the Soviet side relative to their program and interests. Close examination of the comments provided in each case will show that the framing of proposals with positive appeal to both sides requires knowledge of the *objectives, modes* of attack, and relevant *schedules* of both sides. The same knowledge is necessary to determine what critical *tactical or security advantages* may be conferred or lost in a given project. These defects grow in direct proportion to the significance of the proposal contemplated.)

A. Data Exchange

1. *On Micrometeoroid Flux*—Both the US and the USSR could profit from a full exchange of information on the temporal and spatial distribution, mass penetration characteristics, and shielding of micrometeorites in earth-to-moon space. The security aspects are minimal, and present indications are that information obtained will not present radical problems of an unexpected nature. However, as recently as June 1963, Soviet scientists, in precisely such an exchange relating to their Mars and our Venus flights, declined to give us instrumentation and programming information necessary for meaningful interpretation of their data. Also, the USSR must be expected to be quite [10] reluctant to provide data on shielding materials and results.

2. *On Radiation and Solar Events*—Both sides seek greater knowledge of radiation end particle fluxes in cislunar space, particularly that associated with solar proton events. Such information is necessary to improve the predictability of proton showers so as to fix manned flight schedules safely and permit the design of optimum shielding. This is likely to be a long-range program requiring constant monitoring and predisposes both sides to welcome an exchange of information. We could advance a proposal to define a project of investigation and exchange on this subject to be carried forward by a joint working group consisting of designated representatives of both sides. There is some question, however, whether the Soviets are yet on a par with us in this work. Also, we anticipate that the USSR will continue [to be] reluctant to discuss the detailed interrelationships of data, instrumentation, and programming in adequate depth. Nor could we be sanguine about exchange relating to shielding or other countermeasures.

3. *Lunar Surface Characteristics*—Both sides require information on the characteristics of the lunar surface for final design of spacecraft to land on the moon. Whether there is the basis for an exchange relationship depends in part on the relative schedules of the two programs; if the Soviets are ahead of us, as is possible at this early stage, they will have acquired intelligence [11] of the lunar surface before we do and have little interest in any contribution we can make on this point. On the other hand, if we are on similar schedules and the lunar surface is discovered to have radical characteristics not anticipated, such information could become critical to equipment design and even mission success. It could thus become an important element in the space race itself, with critical tactical and even security value. Either side might well wish to withhold knowledge of this kind.

4. *Selection of Lunar Landing Sites*—The same considerations discussed immediately above apply to exchange of information in the survey and selection of lunar landing sites. Assuming a Soviet lunar landing program, both sides are faced with the same gross requirement, and thus there should be in principle a basis for cooperation. However, the actual degree of interest and potential for cooperation would depend in good part upon technical requirements and relative time schedules; if the latter are not close, the leading side could be expected to be relatively disinterested, whereas if they are close, information on a suitable site could become critical in a closely competitive situation.

5. *Astronaut Training and Experience*—Each side must be assumed in principle to have interest in the other's astronaut training techniques, flight experience, space medicine results, and spacecraft technology. The US has already been quite open in publishing its material along [12] these lines, and has not yet had comparable periods in orbit. The Soviet Union must therefore be presumed to have less interest than we. Indeed, a Soviet representative to a very recent International Academy of Astronautics meeting declined to participate in a second conference on manned flight, asserting that there was little new to be expected from the American program in the next year or so. (No additional manned flights can be expected in the US program for upwards of a year.) In sum, it would appear that we cannot offer mutuality for a considerable time in flight results and

space medicine. Indeed, we would appear to be leading from weakness if we pushed for exchanges in these fields. Exchanges in the related areas of astronaut training and spacecraft technology would, if they were to be meaningful, impinge upon flight systems, security considerations, and simulator techniques, and must be regarded as most difficult to approach in the initial instance with the Soviet Union.

B. Operational Cooperation

1. *Mutual Tracking Support*—Several modes of cooperation in tracking and data acquisition have been explored from time to time with the Soviet Union: the USSR was offered the support of the Mercury network for any manned flight of their own, with no strings attached (Glennan); it was asked to consider an exchange of tracking stations, each side to place a station in the other country, each to operate its own station (Kennedy); and the USSR itself [13] suggested cooperation in the tracking of deep space probes (Khrushchev), but later retracted this offer, privately implying security considerations. Despite seeming Soviet disinterest in this area and the fact that lunar missions are conducted at particular times (windows) when both sides may launch missions of their own, it seems probable that both could gain from mutual tracking arrangements. Since windows are a function of launch site and tracking station locations, mission profile and objectives, and payload capabilities, the two sides would probably utilize somewhat different windows. We might then provide twenty-four hour ground coverage (lacked by the USSR) in exchange for greater flexibility afforded by use of their land and ship-based nets.

2. *Capsule Recovery (earth)*—Both sides face the possibility of spacecraft returns to earth in areas not planned. Accordingly, they might both have an interest in exchanging the signals and recovery procedures to be utilized in emergency recoveries. Either side could then proceed to the rescue of astronauts in areas under their control. The exchange of such signals could in principle also permit either side, somewhat more readily than now, to interfere with recovery operations by the other. However, this appears a very small risk and one which might very well be taken. Such a project would appear to have few negative aspects, little prospect for wide implementation, but possibly considerable public value.

[14] 3. *Capsule Recovery (space)*—It is possible to frame a proposal that both sides agree upon common docking hardware so as to permit either to "rescue" the spacecraft of the other in distress. In fact, it is not known whether hardware common to the two competing systems would be feasible, but assuming it is, rescue operations of this kind, given current limits to spacecraft maneuverability, would require compatible trajectories and orbits, compatible oxygen supply arrangements, an agreed communications, rendezvous, and docking procedure, common training, and possibly compatible aerodynamic configurations for re-entry purposes. At a minimum, guidance systems, docking hardware, and rendezvous and docking techniques, capabilities and limitations would all appear, at early stages, to be of security concern. A proposal of this sort would, therefore, not be attractive to either side.

4. *Lunar Logistics*—Following the first manned lunar landings, it would appear possible to define a proposal for sharing logistic support for more ambitious lunar exploration. Such a proposal could be shaped in terms of a division of the logistic responsibilities or a division of responsibility as between logistics and personnel. A proposal of this type would have some appeal if the two sides were on roughly similar schedules and shared ambitious plans for lunar stations or exploration, something not known to be planned in either case. If one were well ahead [15] of the other or had no current plans for ambitious follow-on lunar projects, it would have relatively little appeal. A proposal of this type would have the disadvantage of subjecting us to reliance on the honorable and

competent discharge by the USSR of its responsibilities over a period of years. In any case, the proposal would not appear to promise early realization and should be deferred for subsequent consideration in the course of a progressive and satisfactory development of more immediate projects.

5. *Trade-Offs*—Where mutual benefits cannot be established in symmetrical projects, it may be possible to relate dissimilar activities to a single balanced cooperative effort. For example, we could offer the Soviets the support of our twenty-four hour deep space tracking capability (in periods when it is not directed to our own use) in exchange for data (or samples) of the lunar surface, which the Soviets might acquire before the US.

C. Integrated Projects

Substantial integration of major elements of flight configurations is circumscribed by two factors: (1) virtually all major contracts for accomplishment of project APOLLO have already bean placed, establishing a heavy and costly commitment in design and development; (2) the placement of responsibility in the Soviet Union for integral elements of our own program would enable the Soviets to obstruct our progress while proceeding [16] clandestinely on their own. Nevertheless, certain cooperative projects requiring close integration are widely entertained and some comment is appropriate. More important, there may be some integrated effort which is, nevertheless, possible at a relatively early stage. At least one proposal of this type is noted below.

1. *USSR Booster/US Spacecraft*—It has been widely proposed that we suggest to the Soviet Union a manned lunar effort based upon the use of their greater boosting capability and the most advanced spacecraft of the US. The Soviet Union is *not* now known to possess a booster capable of manned lunar landing and return although they are developing engines which, if clustered, could provide this capability. The US *is* building such a booster. It is not consistent with the US objective of achieving a leading space capability to delegate the development of an adequate booster to the Soviet Union. A reversal of the proposal would not appear to be in the national interest since it would employ an advanced US capability to place a Soviet spacecraft first on the moon. It would also entail Soviet access to US launching sites and techniques without the possibility of access to USSR sites under comparable circumstances.

The heart of the problem posed by a proposal of this type lies in the very extensive exchange of technology required to integrate the spacecraft of one side with the booster of the other. Such an exchange applies to all [17] significant characteristics of the booster system in design and performance, including guidance, and requires the launching authority to have full information of the spacecraft system. A continuing and extensive mutual interplay on technical terms is known (through experience in domestic as well as international satellite programs with friendly nations) to be required for spacecraft-booster integration if success and avoidance of recrimination are to be achieved. Extensive access would be required by both sides to the launch site, and, by reason of the unsymmetrical basis for the project, such access would be one-sided. The experience with the Soviet Union in areas with (or, indeed, without) military implications suggests that even a small fraction of the interchange required would be forthcoming from them.

2. *Turner Proposal*—A Republic Aviation engineer, Thomas Turner, has proposed in *Life* (October 11, 1963) a cooperative effort to circumvent (some of) the difficulties noted immediately above. According to his proposal, the US would forego the development of a large booster and concentrate simply on placing its lunar excursion module (LEM) in earth orbit. The Soviet Union would at the same time place a very large and powerful spacecraft in earth orbit. The two would rendezvous, then utilize the Soviet's spacecraft propulsion to transfer to a lunar orbit, at which time the LEM would separate and descend to the lunar surface with both a Soviet and an American aboard. It would

then [18] return to lunar orbit, the occupants would transfer to the Soviet spacecraft, abandoning the LEM, and return to earth. According to Turner, the sole requirements are common docking hardware and a communications agreement. The proposal is an ingenious one but implies that neither side would develop the total resources to conduct a manned lunar program by itself. We regard this, at this time and in the present context, as an unacceptable interdependence, prejudicing seriously our ability to proceed with our own program in the event that the Soviets do not live up to their agreement over the extended period of years required to implement it. The US requires a major booster for its own posture and broad national interest. Thus, no real saving would be effected by the Turner proposal. The notion that the necessary lunar orbit docking could be conducted without common training and practice procedures on earth is not tenable. In addition, this raises most of the questions which are specified in item B.(3) above. Our conclusion is that the Turner proposal is neither practicable nor desirable at this stage in US/USSR relationships. It could be held in abeyance until a progressive improvement in the discharge of cooperative obligations by the USSR warrants its consideration at a later date.

3. *Interchange of Astronauts*—The US could propose a reciprocal arrangement under which astronauts of each side are accepted by the other for extended periods [19] of training leading to participation in flight missions. It is apparent that such an exchange would entail long-term and extensive access to training facilities and programs, flight hardware and systems, launching sites, and so forth, as well as language preparation; however, reciprocity might be assured through synchronized phasing of the program in both countries. The US would have far more to gain than to lose from such reciprocity in view of the relative secrecy of the Soviet program to date. The prospect is particularly attractive because of its implications for opening up Soviet operations. We are informed, however, that it may be politically premature.

As always in dealing with the Soviet Union, it may be feared that comparable access, information, and training will not be afforded the American astronaut(s) exchanged with the Soviet Union. The concept of synchronized phasing of the training of the two would go a long way to correct this, since the two astronauts would move from one phase to another of the two countries' programs on a par and we could withdraw our man if we were dissatisfied. The prospects of such dissatisfaction must be regarded as rather high, given experience with exchange programs with the Soviets in the past. It may be, therefore, that greater success could be had with this same project if, again, it were developed in the course of a progressively improving relationship with Soviet space authorities. It remains, in any case, one of the more attractive possibilities. [20] In fact, early instruction of selected astronauts in the Russian language has been suggested to remove at least one obstacle to its realization.

V.

Questions of initiative, timing, and procedure for negotiations with the Soviet Union have been considered. (The pertinent background and status of past negotiations with the USSR is briefly summarized in Appendix II.)

1. As contacts continue at the agency (Dryden-Blagonravov) level, we should clearly express our continuing interest in a response from the Soviet Union on the question of extending cooperation to lunar programming and other subjects.

2. No new top-level action (by the President, Secretary of State, or Ambassador) is recommended until—

(a) the Soviet Union is given a further opportunity to evidence the discharge of its obligations under the existing NASA-USSR Academy space agreement, or

(b) the Soviets respond to US initiatives already taken in the UN.

3. After the Soviet Union has had a further opportunity to deliver or default on the existing agreement, a further top level initiative would seem appropriate.

The nature of such a US initiative might be along the following lines:

(a) In the event of continued failure of the Soviet Union to discharge existing obligations in the Dryden- [21] Blagonravov agreement, a top level US/USSR initiative would seem desirable, privately in the first instance. If Soviet intransigence persists, it may then become appropriate to tax the Soviet Union publicly with their failure in matters of cooperation.

(b) If the prospects for an extension of existing agreements to the manned lunar landing area become promising—either because of performance in the existing agreement or because of a response from the Soviet Union to our UN initiative—a further top level US action should be taken, privately in the first instance. For example, the President may wish to inform Khrushchev that we propose an orderly, structured approach toward a developing cooperation, beginning with the maximum exchange of past results, proceeding to sufficient description of future planning to permit identification of possible areas of cooperation, and concluding with the definition of specific projects. (Examples of possible projects would be included in the presentation of this structured approach to lend it credibility.) Again, if the Soviets are intransigent, consideration might be given to stating our position publicly in order to increase pressure on the Soviet Union. In such a public statement, the US approach could be openly described to domestic and foreign advantage.

[22] 4. Whether a further US initiative is taken or a specific Soviet response to the President's UN offer received, in either case making negotiations possible, it is then our considered view that our action should be for the express purpose of preparing the way for technical discussions. The NASA-Soviet Academy channel, which has been successfully opened by Dr. Dryden, should continue to be the vehicle for technical exploration and negotiation of the possibilities for cooperation with the Soviet Union. (If it should prove technically desirable or necessary, consideration should be given to requesting the Soviets to assign to the negotiations personnel closer to the technology of their program.) As in the past, proposals to be considered in such negotiations should be made available for prior inter-departmental consideration.

5. Any agreements reached at this technical level should be embodied in memoranda of understanding, explicitly subject to review and confirmation by governments.

6. As a tactical device, calculated to put pressure upon the Soviet Union, demonstrate our serious intentions, and gain good will from certain nations, consideration should be given to means by which "other countries" than the Soviet Union might be further identified with our lunar programs. (See Appendix III.)

****

[1]

Appendix I

(A) President Kennedy made the following statement regarding United States-Soviet cooperation in outer space in his address before the United Nations General Assembly on September 20, 1963:

"Finally, in a field where the United States and the Soviet Union have a special capacity—the field of space—there is room for new cooperation, for further joint efforts in the regulation and exploration of space. I include among these possibilities a joint expedition to the moon.

"Space offers no problem of sovereignty; by resolution of this Assembly, the members of the United Nations have foresworn [sic] any claims to territorial rights in outer space or on celestial bodies, and declared that international law and the U. N. charter will apply. Why should the United States and the Soviet Union, in preparing for such expeditions, become involved in immense duplications of research, construction and expenditure? Surely we should explore whether the scientists and astronauts of our two countries—indeed, of all the world—cannot work together in the conquest of space, sending some day in this decade to the moon, not the representatives of a single nation, but the representatives of all humanity."

[2] (B) President Johnson reaffirmed the above statement through Ambassador Adlai E. Stevenson who made the following remarks in Committee I of the United Nations General Assembly during debate on international cooperation on outer space, on December 2, 1963:

"As you also know, President Kennedy proposed before the General Assembly last September to explore with the Soviet Union opportunities for working together in the conquest of space, including the sending of men to the moon as representatives of all our countries. President Johnson has instructed me to reaffirm that offer today. If giant strides cannot be taken at once, we hope that shorter steps can. We believe there are areas of work—short of integrating the two national programs—from which all could benefit. We should explore the opportunities for practical cooperation, beginning with small steps and hopefully leading to larger ones.

"In any event, our policy of engaging in mutually beneficial and mutually supporting cooperation in outer space—with the Soviet Union as with all nations—does not begin or end with a manned moon landing. There is plenty of work yet to come before that—and there will be even more afterward."

[3] (C) In his State-of-the-Union address to the Congress on January 8, 1964, President Johnson said,

"Fourth, we must assure our preeminence in the peaceful exploration of outer space, focusing on an expedition to the moon in this decade—in cooperation with other powers if possible, alone if necessary."

****

[1]

Appendix II

The background of experience in negotiations with the USSR is briefly summarized: Progress at all levels has almost invariably required US initiative. It appears that new initiatives are successful only if the way is paved at the very highest levels. Negotiations are seriously hampered by the fact that Soviet representatives are drawn from the Academy complex which seems to be once removed from the actual conduct of the Soviet space program. (Soviet scientists do not often appear well informed of flight conditions or hardware.) Soviet reaction time to US initiatives and correspondence has been extremely slow. The USSR is currently delinquent on most action items scheduled in the Dryden-Blagonravov agreements; however, correspondence has been resumed by Blagonravov after more than three months of silence and agreed optical observations of the ECHO II satellite have now been performed by the Soviet Union.

The basic Soviet line for the past four years has been that significant cooperation cannot precede major improvements in the political atmosphere, including disarmament.

(The US proposals which led to the Dryden-Blagonravov agreement were apparently regarded as sufficiently modest to permit some departure from this line—though at least one of the agreed projects could lead to a joint global meteorological satellite system.)
[2] At various times the Soviet Union has rejected US offers of tracking support for manned flights, an interchange of overseas tracking stations for earth satellites or deep space probes, formal participation with NASA and other countries in experimental communication satellite tests, exchanges on standards and techniques to preclude contamination of the lunar and Martian environments, and repeated open-end offers to explore any items of interest to the Soviet Union.

With regard to Soviet plans for a manned lunar program, Khrushchev has said little more than that the USSR will not proceed until they are ready and that they are working on the problem, but it is not known whether they are developing a large enough booster although engines suitable for clustering for that purpose are reportedly under development. Khrushchev has spoken only ambiguously about cooperation and has actually seemed to accept competition as desirable.

On the other hand, some softening of the Soviet line may be indicated, not only by the Dryden-Blagonravov agreement, but also by the recent willingness of the Soviet Union to reach agreement on legal principles to apply to space activity and on radio frequencies to be used in space communications and research. The requirements for these agreements, however, are far from comparable to those applicable to cooperation in manned lunar programs.

A brief summary and evaluation of the status and content of the Dryden-Blagonravov agreement follows:

[3] A first US-USSR Bilateral Space Agreement was reached on June 6, 1962 and was then supplemented by an implementing Memorandum of Understanding which became effective August 1, 1963. Together, these agreements set forth the technical details and arrangements for cooperation in three areas:

1. Coordinated Meteorological Satellite Program
   - Exchange of cloud cover photographs and weather situation analyses gained from each country's experimental meteorological satellites;
   - Establishment of a full-time, conventional, facsimile quality communications link between Washington and Moscow for two-way transmission of these data;
   - Coordinated launchings of future experimental weather satellites, and ultimately, of operational weather satellites.
2. Communications Satellite-Experiments
   - Experimental transmissions at 162 mc/s between the USSR and the Jodrell Bank Observatory in England using the US passive reflector satellite ECHO II;
   - USSR to consider experiments at higher frequencies;

[4]
   - USSR to consider radar and optical observation of ECHO II;
   - Future negotiations on possible joint experiments with active communications satellites.
3. Geomagnetic Satellite Data
   - Launching by each country of a satellite equipped to measure the earth's magnetic field as part of research planned for the International Year of the Quiet Sun in 1965;
   - Exchange of results of satellite measurements;
   - Exchange of data from magnetic surveys of other types.

Dr. Dryden wrote Blagonravov in mid-August listing action items requiring early completion if the agreed deadlines for joint action were to be met, and conveying the United

States position on each. This communication went unanswered until December when Blagonravov acknowledged the letter, apologized for delay, indicated substantive replies were being prepared, and asked for the launch date for ECHO II. Dr. Dryden replied immediately by cable, giving the launch window and nominal orbital elements for the ECHO II satellite, and reiterating NASA's request for Soviet radar cross-section and optical observation of the satellite during the inflation stage (which occurs in part over the USSR on the first orbit). [5] This cable was immediately acknowledged by Blagonravov; as of this writing, he has provided a statement of intention to discharge at least the minimum requirements upon the Soviet Union for observation of ECHO II and communications tests with that satellite. He remains delinquent in other outstanding matters.

Although all joint action has slipped several months because of Soviet dilatoriness, this need not affect any of the proposed cooperative efforts substantively but may only delay their implementation. At this time, it seems likely that Soviet performance will continue [to be] ragged, with little regard for deadlines. The remoteness of the relationship maintained by the USSR detracts in some degree from the positive value of the cooperative association established; nevertheless, satisfactory completion of *any* of the steps prescribed in the agreements should provide the best basis for improved relationships and further progress.

****

[1]

Appendix III

Besides inviting the Soviet Union to cooperate in the lunar program in his recent UN speech, the President expressed a desire to bring other countries in as well. The possibilities include the following:

1. Tracking and data acquisition—We already enjoy the cooperation of a number of countries in the accommodation and operation of manned flight tracking and data acquisition stations and should publicize this fact along with our interest in extending the present level of participation.

2. Scientific experiments—We now give foreign scientists a chance to compete for space for their experiments in our observatory satellites. We should consider extending this practice to Gemini and Apollo, noting that these opportunities may be very limited even for our own scientists. (In addition to space and weight limitations, there could be difficulties growing out of Air Force participation in Gemini).

3. Contracts—If they materialize in sufficient number, publicity can be given to certain subcontracts entered into with foreign contractors (e.g., Canadian companies are developing and providing extensible antennae for the Gemini and Apollo missions, including the antenna to be used for rendezvous missions.) In addition, consideration [2] could be given to offering foreign governments the opportunity to take on the development and production of subsystems and parts, *on a cooperative basis* (i.e., at their own expense), to meet our design, standard, and schedule requirements. The technical and contracting limitations would, however, be severe and the takers few.

4. Astronaut orientation—A program might be organized under which foreign high performance pilots might be brought together for observation of, and limited participation in, NASA astronaut training (only) programs as a familiarization and orientation effort on a continuing basis (e.g., successive three-month classes).

5. Astronaut training and flight—The numerous and valid objections heretofore raised against including foreign pilots in our astronaut program are recognized.

The negative aspects are these: rivalry among interested foreign nations; further pressure upon our limited flight opportunities; resentment by current US astronauts; difficulties in application of commercial benefits to astronauts; security questions; pressures for flight priorities; feminist and congressional criticism; absence of practical application abroad for the training given here.

The positive aspects are these: few other single actions could more dramatically express the President's deep desire for cooperation; few other single actions could equal [3] the boost given by this one to US relations with Latin America or Asia, if pilots from those regions (many already trained here) were chosen; few other actions could do more in the next few years to eclipse Soviet propaganda in this area—or protect us more effectively against a similar Soviet move.

On balance, technical and political considerations suggest a negative conclusion on an offer of this kind and preference for the proposal reflected in item 4 above.

* * *

Perhaps the most acceptable position to meet the issue of the third country participation is represented by the recent statement of Senator Clinton P. Anderson before the AIAA, January 1964:

> *". . . we can give validity to this nation's policy to internationalize space by asserting that the United States will accept offers of support from any nation which can contribute to the space program."*

Such contributions should continue to be organized and implemented within the policies already applicable to existing (and uniformly successful) international programs of NASA.

Document I-44

Document title: Thomas O. Paine, NASA Administrator, to Academician M.V. Keldysh, President, Academy of Sciences of the USSR, July 31, 1970.

Source: Thomas O. Paine Papers, Manuscript Division, Library of Congress, Washington, D.C.

In this letter, NASA Administrator Thomas O. Paine, the successor to James E. Webb in 1968, followed up on earlier, more general overtures to the Soviet Union for enhanced post-Apollo cooperation. This was a specific proposal for cooperation in compatible docking arrangements between U.S. and Soviet spacecraft. Paine had also just announced his intention to resign as NASA Administrator in September, and he wanted to assure Keldysh that the desire for enhanced cooperation was a U.S. government position, not just his own preference. The Soviet reply to this letter was positive, and the two countries began discussions in October 1970 that led to the 1975 Apollo-Soyuz Test Project.

[1] JUL 31, 1970

Academician M.V. Keldysh
President, Academy of Sciences of the USSR
Leninsky Prospect 14
Moscow, U-71, USSR

Dear Academician Keldysh:

We were encouraged to learn of the inquiries by your Embassy to the National Academy of Sciences regarding possible discussions of compatible docking arrangements in space. I had mentioned the subject to Dr. Handler as a possible item for consideration by NASA and your Academy prior to his recent trip to the Soviet Union.

As the government agency responsible for civil space activities, NASA has direct responsibility for any discussions with Soviet officials regarding actions we might take together to assure compatible docking systems in our respective manned space flight programs. If you agree that this subject should be discussed between us in the meeting which we have had in view for some time, we will be glad, in order to facilitate adequate mutual preparation, to receive two Soviet engineers at our Manned Spacecraft Center in Houston in the very nearest future to examine NASA's current spacecraft designs for docking purposes and to discuss future docking techniques. In the next step we would propose to proceed with the responsible Soviet officials to discuss our respective views with regard to the achievement of compatible docking configurations and techniques. If we can indeed agree on common systems, and I foresee no particular technical difficulty, we will have made an important step toward increased safety and additional cooperative activities in future space operations. This is particularly timely in my view as we proceed toward the initial experiments leading to the orbiting space station.

[2] You may already know that I have submitted my resignation as Administrator of NASA to the President for personal reasons. This, of course, will not change the policies and interests of NASA with respect to international cooperation in space. Thus, you should understand our past and current correspondence on [an] official rather than personal [basis], although this matter has my wholehearted personal support. I regret very much that I will not have the opportunity to carry through personally our discussions with you to fruition, but am optimistic that much can be accomplished and hope that we can continue to make progress in the next month.

Sincerely,

T.O. Paine
Administrator

Document I-45

Document title: Glynn S. Lunney, "Trip Report—Delegation to Moscow to Discuss Possible Compatibility in Docking," November 5, 1970.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

Glynn Lunney, who headed the Flight Director's Office at NASA's Manned Spacecraft Center in Houston—renamed the Lyndon B. Johnson Space Center in 1973—was part of the first-ever delegation of NASA engineers and other officials who traveled to Moscow, October 26 to 28, 1970.

The purpose of the trip was for the initial discussions of the feasibility of a U.S.-Soviet cooperative project regarding compatible docking between the two countries' spacecraft. This trip report captures both the human and the technical aspects of the NASA team's three days in Moscow. The figures referred to in the text have been omitted.

---

[1]

MEMORANDUM TO: See attached list

FROM: FC/Glynn S. Lunney

SUBJECT: Trip Report—Delegation to Moscow to Discuss Possible Compatibility in Docking

Before I discuss our technical meetings, so many people have asked me about personal observations that I have included some of these at the beginning. In general, everything was done to make our visit pleasant and productive. General comments are as follows.

1. Our time was scheduled very well, and we kept a busy schedule.
2. Transportation and a guide/interpreter were always at the ready.
3. Weather was mostly overcast and occasional drizzle, but just "raincoat" cold.
4. We stayed in a very large, modern hotel (the Russiya—4000 rooms) and the quarters were very adequate.
5. Breakfast was a buffet arrangement in the hotel.
6. Lunch in the middle of the afternoon and dinner in the late evening were scheduled each day at various places. The food was delicious, the Russian vodka is an excellent drink; the caviar is worth eating also.
7. There is a fair amount of apartment building going on in Moscow. From what we saw, there were essentially no single-family dwellings in the city; the 7 million population apparently lives in the apartment buildings. We were in only one apartment building which is provided specifically for the foreign embassy people. The rooms were comfortable and about the size of Houston apartments.
8. We did not see any downtown or remote shopping center areas. Mostly, there were shops of different merchandise in some of the first floors of buildings we passed.

[2] 9. There is a very extensive subway system we did not see, and there never was any real traffic problems although it slowed a little around quitting time. Their car, the Volga, is about the size of a 4-door Mustang if you can imagine that.

10. The people generally seemed to me to be more serious or somber than you might find in our country (outside New York), but that is really hard to justify on very limited contact in a large city.
11. The Bolshoi Theater is a beautiful place. For the talks, we met with the same Soviet delegation on all three days. These same men also accompanied us on most of our unofficial stops.

General comments are as follows.

1. The official people we visited were friendly and openly discussed various aspects of their program. They presented and answered questions on their technical areas.
2. They were also very interested in bringing our first talks to a productive conclusion and to provide the framework for future discussions. In attempting to summarize the

technical discussions, I will include the impressions from our visit to Star City where their cosmonauts live and train. We visited there on Sunday and were greeted by the Commandant, General K. _____, General Beregovoy, who was in the U.S. last year, and Colonel Shatalov, the rendezvous pilot on Soyoz [sic] 4 and 5 flights, [who] were our principal escorts. Star City is 40 minutes out of central Moscow in pleasant woods country. There were 3 or 4 apartment buildings (about 8 stories) and another one being finished (probably a sign of continued progress in manned space). We visited their exhibit area, a memorial area for Yuri Gagarin, saw a Gagarin film and, the highlight for me, visited two [3] different simulators. The first was a general purpose simulator for all bases including docking. With reference to Figure 1, this simulator has the command module below and the orbital module attached above (with a hatch to pass through).

In the order I visited them, the orbital module was a sphere about 7-8 feet in diameter. A sketch of it is shown in Figure 2, and the inflight films and stills would indicate the flight vehicle being very similar to these simulators. The walls were covered with a light-colored, felt-like material much like the ceiling covering in some of our earlier cars. The flight atmosphere is an air mixture, slightly greater then one atmosphere, I believe. In the sketch, you can see the central trench area with the hatch in the floor. From this view, the left compartment has a hinged lid for stowage. (I imagine their space suits are stowed in there.) The right compartment is a work area, with a top like a desk and a slightly-inclined-from-the-vertical control panel. I believe there is some access to the volume underneath from the side of the central trench. There was also a manual handle in this area for water condensation removal. (Sounded like a manually operated squeezer, but I could not tell if that was their primary mode—I doubt it.) There were 4 portholes (approximately 10" diameter) 90° apart and an ECS inlet and CO_2 scrubber against the wall on the opposite side of the central trench from the EVA hatch. The side (?) view in Figure 2 attempts to show that. Based on the answers given, they do not use replaceable cartridges but add other inlets and scrubber units, dependent on the flight. I am still a little surprized [sic] by that, but maybe we lost something in the translation.

The overall impression of this module is one of simplicity, and I will try to convey that by a discussion of what I will call the control area [4] on the right-hand compartment. This is shown in Figure 2 from memory, and we did not hear what all the buttons were for. From the front, the central panel has a stowage compartment on the left side with a food warmer mounted on the wall behind it. The control panel has buttons, a C&W panel (about 6x6 lights), a speaker for A/G voice and one of the very few gauges in the ship. The gauge has three readouts—command module pressure, orbital module pressure, and ECS pressure (source or regulated—I am not sure). An identical gauge exists in the command module.

The hatch can be operated remotely from the control panel by several buttons—for depress, open and close hatch (although I did not hear this, these functions are probably repeated in the command module). The depress and hatch actuation can also be done with manual valves, handles on the hatch itself. The hatch opened into the cabin. Several other buttons on the control panel were labeled for use with the TV camera mounted on the far right of the control panel and with a long length of power cord stowed in the compartment underneath. On the tabletop in front of the control panels were several switches and a small electrical package, apparently for experiments.

From their flight films, the orbital module is the living, sleeping, and experiment area where the crew spends most of their time. It, of course, is also an airlock. I think it is worth repeating how it impressed us—a roomy area with very simple controls and instruments, probably all of which were devoted to airlock, experiment, living and sleeping functions (as opposed to attitude control, etc.).

[5] Next, George Hardy and I went down to the command module with Colonel Shatalov. For three men this is a small volume, but is only used during takeoff, landing, rendezvous, and periodically in orbit (see Figure 3); and, since they wear flight coveralls for these portions, it is adequate. Also, the couches are essentially against the floor for most flight phases. Dr. Gilruth found out that the couches are raised toward the control panel for attenuation travel at some point in the deorbit-landing phase.

Again, the very strong impression is one of simplicity—no circuit breaker panels, no large number of switches, not many displays. The couches are not exactly parallel to the display panel. As a matter of fact, we almost sat on the horizontal couches to view the panel with the upper hatch to the orbital module overhead. In Figure 3, I have sketched the control/display panel as I remember it. From the left top, the G&N area had a 6-8" diameter globe of the earth which obviously rotated with the orbital position. There were several digital readouts in this area like latitude, longitude, altitude, period, and maybe one or two others. I could not determine exactly how these readouts were driven. From the rest of what I learned, I would guess they were set up manually (probably from ground instructions) and then are driven in some approximate way to provide the pilots with general navigation data. There was a round-face clock with, I believe, a couple of controls below that. There was a C&W panel (maybe about 6x8) with red, yellow, and blue lights from the top down which is also used in some fashion in periodic systems checkout. The TV screen showing the target vehicles was approximately 5-6" square and driven from either of two TV cameras up in the nose of the ship, around the probe or drogue mechanisms. Below this screen was a range/range rate meter. On [6] the upper right were 6 digital readouts with controls for setting them. I had the impression these were digital inputs to the control system for attitude and/or translation maneuvers, but I may not have that quite right. I believe there was something in the lower right which I cannot recall—perhaps radio controls. Below the panel and above the center couch right knee was the periscope view of the target. (We were concentrating on the rendezvous and docking aspects, but I gathered that they use it for earth observation also.) The identical pressure gauge was on top of the panel, and there was a "sun lamp" above that. George Hardy was questioning about that and I did not hear the conversation. My guess is that it was a device for the pilot to see how close the vehicle alignment was for solar inertial holds for their solar panels. As in ours, the left-hand T-handle was for translation, although some switches had to be used for fore-aft braking. The right hand T-handle device was for rotation.

On the right *and* left of the main display panel was the control device which I figured to be the heart of the ship control. There were about 12 buttons down the left side of the device which seemed to be used for operating a given phase. As a phase was selected; e.g., manual docking, the pilot would punch one of these buttons. Then, next to the buttons, a set of display windows with labels on them would be mechanically rotated into view. Some of these windows would be lit, some blue, and some not lit. Although it was difficult to get a clear understanding, this device seemed to be used for whatever configuring would be necessary (perhaps deadbands, for example) and for displaying and executing any sequential functions. These could be automatic or backed up manually. There were two columns of [7] buttons to the right of these windows which seem to be this manual function. I asked if a different phase; e.g., landing, would be selected on this panel and got an affirmative. I kind of concluded that this device, then, was used to select the flight phase—some automatic configuring is probably done according to the phase; and there can be auto or manual sequential functions performed. So, it seemed to be a combination of a sequence controller and a vehicle configurer according to the flight phase. (Admittedly, this is some extrapolation on my part.) The flight films we saw showed the pilots using this device in their periodic systems checkout. So I would also guess that the

light patters there and on the C&W panel represented a checkout, monitoring tool. Also, one row of buttons across horizontally were red, indicating special precaution.

All in all, this was a fairly simple cockpit and we watched a docking exercise from about several hundred feet out into docking. Much as you would expect, the pilot monitored the TV, the periscope, and the range/range rate meter and brought the ship in to docking. Roll is easy with the displays, and at docking the periscope cross hairs were lined up on a flashing light on one of the other ships' booms. Again, no circuit breaker panels, few displays, and control switches, no attitude reference display (except periscope and perhaps sun lamp).

The second set of simulators were two command module elements—one active and one passive. There were 2 parallel tracks per module on which a model of the Soyoz [sic] spacecraft was brought towards the simulator, from about 150' away. One track was watched by the TV, the other through the periscope. The images were magnified to proper scale on the cockpit instruments. Inside the cockpit, all was very similar to the general [8] simulator and I concluded that this was a more accurate docking trainer, with a greater separation distance simulated than the general-purpose simulator. Roll control only needs to be within 15° but the cosmonauts always try for and generally make approximately 1 degree.

This simulator work was a great help in the following days of discussion. It was easy to watch and understand what was happening, but, in real specifics, it was more difficult to understand that sequencer, for example, with the time we had and the need to translate everything.

For our technical discussions with the Soviet delegation, two days were planned for a mutual exchange of experience and to outline a framework for future activities. On the third day, Wednesday, October 28, it was planned to formalize our discussions by approving a document containing the framework and schedule for future work. The members of two delegations were:

Dr. Robert Gilruth	B. N. Petrov (Academician—National Academy of Sciences)
Arnold W. Frutkin	K. P. Feoktistov (Deputy Director—Manned Space Program)
George K. Hardy	V. S. Syromyatnikov (Docking Assembly)
Caldwell C. Johnson	V. V. Suslennikov (Radio Guidance Equipment)
Glynn S. Lunney	V. A. Lavrow (Foreign Affairs)

On the first day, the U.S. side presented two discussions:

1. Rendezvous experience and techniques. (General vehicle capabilities, rendezvous techniques.)

[9] 2. Docking assemblies. (Gemini, Apollo designs, future possibilities.) The Soviet side presented two discussions, essentially parallel to our presentations, but with no reference to any future programs. Dr. Feoktistov presented the rendezvous discussion; Dr. Syromyatnikov presented the docking hardware discussion. Papers were given to us on

each of these subjects and on the radio guidance system presentation on the next day. We are in the translation process now, and these papers will be available.

With reference to rendezvous, the Soviet approach is to build a system for both unmanned and manned use. They view the rendezvous process in three distinct phases.

1. Delivery of the active vehicle to the vicinity of the target. (Done in either direct ascent fashion, or a re-rendezvous vectored from the ground.)
2. The zone of automatic rendezvous to station keeping. (The limits of this zone were not specifically identified, but the range was on the order of tens of kilometers and tens of meters per second.)
3. Station keeping from about 300 meters to docking. (Relative velocity is very low during this phase.) The system discussion primarily centered around phases 2 and 3, and I understood the second phase discussion best. Phase 3 is easy manually, but I did not fully understand the implementation for the automatic option. The automatic rendezvous is started when the two vehicles acquire each other and orient nose-to-nose. This is done with 2 acquisition-type antennas, giving spherical coverage. The radio guidance radar heads are then locked to each other. The active ship has a gimballing head and [10] the passive ship has a fixed head with vehicle orientation to keep the nose pointed at the active ship. Range, range rate and the relative angular motion is measured by the active ship. The relative angular motion is then used to continually establish the plane in which the guidance system solves the problem. The mechanization of the guidance scheme is to establish and maintain a range/range rate corridor and to keep the relative angular motion within some deadband. This is done by firing the main engine (of which there are two [?] of about 800# thrust) in the direction required to satisfy the range corridor or the line of site motion deadband. This is an iterative, driving technique to bring the vehicles within a few hundred meters.

Once in this zone of docking, small thrusters of 20# are used and relative roll control is established for docking assembly. This can be done either automatically or manually, and, I believe, signal strengths to mutually aligned antennas are used in the auto mode although I am not real positive of that. The manual mode we watched in the simulators was a very reasonable one and the bright flashing lights can be used on the lit side of the earth.

Dr. Syromyatnikov presented a discussion of the docking assembly—a probe and drogue device very similar to ours, with a few exceptions.

1. It was not designed to be removed for a tunnel transfer. (They use an EVA transfer)
2. They use an electric motor for retracting which permits unlimited reuse.
3. The docking interface automatically includes the mating of four electrical umbilicals with on the order of 20-30 pins apiece.

Once the head of the probe is engaged, there are mechanical guide pins (6" long, 1" diameter, approximately) for further alignment and then grooves to get down to a 1-minute accuracy. This must be required for [11] only the electrical umbilicals and I get a little fuzzy here. I believe that the umbilicals alone are controlled to 1 minute and the rest of the mechanism is a 1-degree fit, but I pass to Dr. Johnson who understood this portion very well. Their alignment and velocity tolerances seemed to be about the same as Apollo.

On the second day of discussions George Hardy presented a discussion of the Skylab program, and I think the long term aspects of this flight intrigued the Soviets, especially after the Soyoz [sic] 9 18-day flight. After this discussion, Dr. Suslennikov presented a more detailed paper on the radio guidance equipment used in the automatic rendezvous. This paper did not add much to my understanding of the rendezvous but did discuss some of the functional elements within the radio guidance equipment—modulators, doppler

shift extraction, etc. After this discussion, the Soviets requested similar kind of information on our system which we agreed to do. The kind of information is in the Russian text and is available in many of our block diagrams.

After these exchange discussions, we entertained the subject of what areas to study for compatibility and how to proceed. We had previously discussed the subjects which would require attention and the Soviet delegation had essentially the same ones. We grouped these subjects into logical groups such that three working groups could handle the range of subject matter. There would be some overlap between groups, and the three groups suggested are:

1. Group to assure compatibility of *overall* methods and means for rendezvous, docking, and life support.

[12] 2. Group to assure compatibility of radio, optical guidance systems and communications.

3. Group to assure compatibility of docking assembly and tunnel.

The groups, a more detailed definition of the work required, and the proposed schedule is contained in a summary of results signed by both delegations. This summary is being presented to Dr. Low of NASA and Academician Keldysh of the National Academy of Sciences. Once agreed to by these two parties, I envision the work proceeding along the lines expressed therein. It is my belief that this effort will involve a rigorous, full-time effort by a relatively small number of personnel, but with the support of many other elements. This effort will be similar to early mission and techniques planning combined with ICD tradeoffs and definition and, finally, preliminary system design to assure compatibility.

Glynn S. Lunney

Document I-46

Document title: George M. Low, "Visit to Moscow, April 1972, to Discuss Compatible Docking Systems for US and USSR Manned Spacecraft," April 4-6, 1972, with attached: "Addendum, Moscow Trip, April 4-6, 1972," May 30, 1972.

Source: George M. Low Papers, Institute Archives and Space Collections, Rensselaer Polytechnic Institute, Troy, New York.

NASA Deputy Administrator George M. Low led a three-person NASA delegation on an April 1972 trip to Moscow to make a final technical determination of whether the United States and the Soviet Union should agree to a joint test flight. This would involve an in-orbit docking of a U.S. Apollo spacecraft and a Soviet Soyuz spacecraft. Low concluded that such a test flight was indeed desirable and feasible, and NASA recommended to the White House that the United States agree to it. The U.S.-Soviet agreement to carry out the Apollo-Soyuz Test Project was announced just as an overall agreement on space cooperation was signed at a U.S.-U.S.S.R. summit meeting in May 1972.

[1] April 4-6, 1972

Visit to Moscow, April 1972, to Discuss Compatible Docking Systems for US and USSR Manned Spacecraft

Summary

In early April 1972, Arnold Frutkin, Glynn Lunney and I went to Moscow to meet with representatives of the Soviet Academy of Sciences on the subject of compatible docking systems for US and USSR manned spacecraft. The specific purpose of the trip was to determine whether the US side was ready to make a commitment to a joint test flight in 1975 involving a rendezvous and docking of US and USSR spacecraft in earth orbit. Such a commitment could be made in the forthcoming summit talks at the end of May 1972.

As a result of three days of meetings, we reached agreement on technical matters, as well as on the principles of managing and scheduling and conducting a 1975 joint test flight. Both sides affirmed the desirability of such a test flight and are ready to proceed with preparations for the flight on the basis of a prospective government-to-government agreement.

Background

Initial discussions concerning compatible docking systems, for future manned spacecraft took place in October 1970. Following those discussions, Bob Gilruth, who headed the US team to Moscow in October 1970, recommended that an early test flight using Apollo and Soyuz hardware would be highly desirable. After discussions with Henry Kissinger in San Clemente early in January 1971, I proposed such a joint test flight to Keldysh in Moscow when I was there to negotiate the Low/Keldysh agreement. During the next set of talks on the compatible docking systems in Houston in June 1971, the Soviet side agreed that an early test flight would be highly desirable, but suggested that the Salyut space station (which was then on its first and only flight) be used instead of the Soyuz spacecraft. Detailed work on an Apollo/Salyut mission for the 1975 time period continued into the Fall of 1971, and during meetings in Moscow in November/December 1971, the US and USSR agreed that such a mission would be technically feasible and desirable. [2] In the Fall of 1971, NASA also recommended to the White House that a final agreement on a test mission might be included in the agenda for the May 1972 summit meeting. As a result of several discussions on the subject, we were asked to make a firm recommendation by April 15, 1972, concerning the feasibility of conducting such a mission.

Lunney recommended that in order to assure this feasibility, we should get agreement in principle at least on three basic documents: a project technical proposal document, an organization plan, and a project schedules document. Draft versions of these documents had been prepared by MSC [the Manned Spacecraft Center] and had been transmitted to Moscow in late March 1972. At the same time, we asked for a meeting with Keldysh to explain the purpose of the documents and to establish a firm basis for discussing them. It turned out, however, that Keldysh had just entered the hospital and would not be available until early April.

We therefore decided that Frutkin, Lunney and I would go to Moscow during the week of April 2nd to discuss the documents, to reach agreement on the most important points, and especially to determine whether the Soviets really understood what we were talking about.

We decided that we would not publicize this trip, [Handwritten footnote: "This was at the request of the White House, because we were to discuss a possible agenda item for the following summit meeting." (footnote added 1-10-76)] this was at the request of the White House, because we were to discern a possible agenda item for the forthcoming summit meeting, and it took pains to make sure that only the smallest possible number of people would know that we had gone to Moscow. For example, insofar as MSC was concerned, Lunney was visiting Washington. In my own case I was on leave "to take care of family business." Then, on the day we left the United States, the New York Times carried a front-page story of an interview between John Noble Wilford and Petrov. In this interview, Petrov stated that there would be meetings in Moscow during the coming week on the compatible docking systems. Fortunately, however, at least at the time of this writing, nobody has yet asked whether anyone had indeed gone to Moscow or who had gone.

Chronology of Events

We left Washington via TWA on Easter Sunday, April 2, 1972, and arrived in Paris early the following morning. From Paris to Moscow, we were on Aeroflot (an Iluyshian 62) and arrived [3] in Moscow approximately 5:30 Monday evening, Moscow time. There we were met by Petrov, Vereshchetin, and Bushuyev. On the way to Moscow, Petrov told me that Keldysh was still in the hospital but that I would meet with the Acting President of the Academy, Academician Kotelnikov; however, Kotelnikov would not be available until Tuesday noon, and our meetings would start at that time.

Tuesday morning we had a brief meeting with Ambassador Beam, during the course of which he invited us to a luncheon on Thursday. I later found out that one of the invited guests was Bob Kaiser, the Washington Post correspondent in Moscow. I went back to see the Ambassador and told him in view of the White House and State Department desire not to publicize our trip, I felt this was a bad idea. The Ambassador assured me that this would be a purely social occasion, that he would take personal responsibility, and that Bob Kaiser would not know the purpose of our trip nor would he say anything about it. Although I was extremely skeptical about this, I had no way of avoiding the invitation.

Tuesday from noon to approximately 2 o'clock, we met with Kotelnikov, Petrov, Bushuyev, Rumyantsev, Vereshchetin, with Zonov as their interpreter. (We had also brought along our own interpreter, Cyril Murumcev.) From that session, we went to a typical Moscow luncheon at the Club of Scientists, which, I guess, is Moscow's Cosmos Club. After lunch we continued the discussions, with Petrov taking charge on the Soviet side and without Kotelnikov. We adjourned at close to 7 p.m. that evening.

We reconvened at 9:30 Wednesday morning, held discussions until approximately 2 o'clock, at which time we adjourned for lunch. The American party went to the U.S. Embassy for a quick lunch in their snack bar, as well as a complete reworking of our final document. The afternoon session started at 4 p.m. and lasted only until about 6. However, as a result of the document we had prepared during lunch, and as a result of the basic understandings reached in previous discussions, we were able to conclude the substance of our talks at that time.

[4] On Thursday morning, Frutkin and Vereshchetin worked on the editing of the final document, with the help of Jack Tech, who is the Science Attache at the American Embassy. Lunney and I continued our discussions until about 1 o'clock. This was followed

by luncheon at the American Embassy Residence (Spaso House) while the English version of the summary of the results of the talks was being typed at the Embassy.

Following lunch, we returned to the Presidium of the National Academy of Sciences (where all of the discussions had been held) in order to sign the documents. This was the usual signing ceremony in which each of us signed two English and two Russian texts. Incidentally, this signing ceremony took place in Kotelnikov's office, which he claims Napoleon used as his bedroom during his last night in Moscow on the way back to France. I also learned that the large table that I used in signing the Keldysh/Low agreement had been a desk used by Napoleon.

Thursday evening we had a farewell dinner with Kotelnikov, Petrov and the rest of the Russian delegation. There were the usual toasts, as there had been at the luncheon on Tuesday afternoon. (At the Tuesday luncheon, I had made a toast, stating that we here had an opportunity to make history and that the results of what we were trying to accomplish would probably be much more far reaching than any of us could at that time even imagine. During the Thursday evening dinner, Kotelnikov said in a toast that the true importance of what we were doing was that this could be an important step in bringing peace to men everywhere.)

Early Friday morning we left Moscow via Aeroflot to London, Pan Am to New York, and then back to Washington.

Highlights of the Talks

Tuesday Noon. This was the meeting with Kotelnikov, Petrov, Bushuyev, and Rumyantsev. After a brief welcome by Kotelnikov, I gave a brief opening statement in which I reviewed the history of 18 months of technical discussions and that the possibility now existed to reach a government-to-government agreement, perhaps during the forthcoming summit talks. I went on to say that before such an agreement can be reached, it is essential that we both understand that [5] this mission can indeed be carried out and that my specific assignment in these talks was to determine whether we are now ready to proceed. I pointed out that we had high confidence in understanding each other on technical matters, but that I was still less sure of a complete understanding on matters of schedule and organization. I concluded by stating that it was my hope that in these talks we could gain a common understanding of the basic principles for organizing, developing, scheduling and conducting a test mission so that I can advise the White House that we are indeed ready to commit to such a mission.

Kotelnikov, in his opening statement, said that they had reached a very important conclusion that they would like to lay on the table at this time. The conclusion was that they would use the Soyuz spacecraft instead of the Salyut space station for their rendezvousing vehicle.

This, of course, came as a major surprise, and we had a long discussion on the subject. The reasons for the switch, they said, were "technical and economic." They explained that the Salyut space station only had one docking port and that it would have to be redesigned completely to accept a second docked vehicle. This was a major redesign that would be extremely costly. They then took a close look at the Soyuz and found that it could be modified with all of the modifications that had already been discussed for the Salyut, and that they were prepared to do so. They were quite strong in stating that there would be no difference in any of the things that had already been agreed to. (My own assessment is that there are three possible reasons for the switch. These are: (1) the actual reason given by them; (2) major difficulties with Salyut identified during its first flight; and (3) the "political reason" that since we will not have a Skylab available for a future

flight, they are unwilling to commit a Salyut to such a mission. My inclination is to believe that the reason they gave is the actual one.) I stated that barring any technical difficulties, Lunney would have to certify that the switch from Salyut to Soyuz would be acceptable to the United States and, in fact, reminded the Soviets that this was the vehicle that we had recommended in the first instance in January 1971. From the technical point of view, Lunney was unable to identify any difficulties with this mission and, in fact, [6] pointed out that operationally this could present a simpler problem, since it would involve only two coordinated launches (Apollo and Soyuz) and not three (Apollo, Salyut and Soyuz). I also tried to think through any "political" implications and found none. It would still be possible to exchange crews, which will have the major public impact of this mission. And having a Soyuz, instead of a Salyut, will have the added benefit of not calling attention to the fact that they have a space station flying at the time when we do not.

After we had settled this issue, I stated that I wanted to bring up another matter; namely, that of the lack of the Soviet responsiveness to our proposals concerning direct voice communications between the two project managers on a regular basis. (For background, this item had been proposed by us during the November/December 1971 talks and was supposed to be confirmed by the Soviets when the agreement of those talks was confirmed. This was not done, and I sent a telegram to Keldysh asking for confirmation. As of now, we have not received a response to that telegram.) I mentioned that I was not only interested in the substance of the issue but also concerned about the lack of responsiveness on their part which, if indicative of future relationships, would make it difficult to conduct the joint mission. Kotelnikov quickly understood why I attached importance to the issue and said we should settle it right then, which we did after considerable debate and discussion.

Finally, during the first session, we determined the agenda for the remaining stay in Moscow. Specifically, we agreed that we would attempt to reach an agreement on the basic principles of the "organizational plan"; the level of detail to be included in the schedules; and any technical matters that might have come about as a result of the switch from Salyut to Soyuz. Both sides also agreed that with the exception of any new technical problems that might have resulted from the switch, we knew of no other outstanding difficulties.

Tuesday Afternoon. The discussion proceeded after lunch, with the same participants with the exception of Kotelnikov. Lunney had prepared a document entitled, Apollo/Salyut Test Mission Consideration, dated March 23, 1972, a [7] copy of which is attached to these notes. This document essentially is a summary of the organizational plan, and we had hoped to agree to this plan in detail to make it part of our agreement of these Moscow talks. At this point, however, things got to be quite confusing, and we started spending an inordinate amount of time quibbling over the exact wording of each sentence. We quickly saw that we would be in Moscow for weeks rather than days were we to proceed in this way.

We had also brought along a "Summary of Results" which was to be the basic document of agreement concerning these talks. At this point in our proceedings, we, therefore, called for a quick recess to discuss our strategy for the meeting and to show the Soviets that what we really intended to sign was something like the Summary of Results. Further, we indicated that the document which I previously discussed we had hoped to make part of this summary and to include it as an appendix. Finally I pointed out that it would be most important to reach agreement and a full understanding of the "twelve principles governing mission conduct" which were an enclosure to the Apollo/Salyut Test Mission Consideration document, and that I felt it would be best if we started discussing those. The Soviet side agreed with this recommendation.

We had no problems in reaching a very quick understanding and agreement on the first six of the principles, which concern command, control, and communications. By that time, however, it was getting late, and we decided to review the remaining six principles only very quickly for subsequent discussion in tomorrow's meeting, In this quick review, however, we determined that we might have major problems on item seven concerning astronaut training and item 12 concerning public information release.

Wednesday Morning. On Wednesday morning, we continued the discussions of Tuesday afternoon, starting out with a detailed discussion of astronaut familiarization and training. After an in depth discussion, we did agree that it would be essential to identify candidate crews one to two years before the flight and that these crews would have to be trained in the other country on the other country's normal training equipment. The discussions continued then [8] with a relatively quick understanding on the need to transmit television downlinks from one control center to the other; the need to gain participation by flight operational personnel in the talks; and the need to have the flight crews understand the other country's language. We did have some difficulty in the discussion concerning the desire to locate a small team of flight-oriented personnel from each country in the other country's control center during the flight, but, on our side, decided this was not essential and, therefore, did not pursue the point but rather left it for further discussion by the project managers. Finally, on the point of public releases we again held a rather lengthy discussion. The Soviets agreed that everything during a normal flight should be released immediately and also pointed out that during a major disaster they would be willing to have speedy releases just as they did in the case of the deaths of the Soyuz 11 cosmonauts. Their main concern seems to be with minor abnormalities during a flight, which, in their words, might be misunderstood by the general public. They indicated, however, that in all areas of public information, they were loosening up and cited the recent announcement of the intended objective of the Venera 8 as an example. I, in turn, pointed out absolute need for us to continue to disclose publicly all information that is available at the American control center and received at American tracking stations. At the conclusion of the discussions, we agreed that we would develop a public information plan which would take into account the obligations and practices of both sides.

After we finished discussing the 12 basic principles, it became time to start thinking about the wording in the summary of the results of the talks. In the meantime, the Soviets had translated our draft summary and had made a number of changes in it, and then retranslated it back into English. This was to be the basis for our joint document. However, we quickly found that the document had been weakened to the point where it really said nothing of substance. To be a little more charitable, it said that we understood each other, but it didn't say that we had agreed to anything. After a long discussion on this point, I said that the document as written by the Russians was totally unacceptable to us and that unless we could come out of this meeting with a firm agreement on at least basic principles of organi- [9] zation, as well as on the need to firm documentation and schedules, I would be in no position to recommend that we are ready to proceed with a test mission, and, in fact, would make a negative report when I returned to the United States. I further stated that I was prepared to stay in Moscow until we had hammered out the necessary words; that I believed that we did understand each other and it was now time to put all of this down on paper. Thereupon we adjourned for lunch.

Wednesday Lunch. We had a quick bite to eat in the Embassy snack bar, and then Frutkin, Lunney and I each took a piece of the summary of results that we had prepared before we left Washington and modified it to include all of the 12 basic principles, together with any changes that we had made in these principles during our previous discussions in Moscow. All of this, of course, had to be done in a great hurry, and the document was retyped before we returned to the Presidium at 4 o'clock for the afternoon session.

Wednesday Afternoon. When we returned with our new document, this came as a complete surprise to the Soviet side. It was just unthinkable for them that anybody could have recast the entire document so quickly. After a quick verbal translation by Zonov, the Soviets called for a recess of half an hour. During the course of that recess, they studied the document in detail, and when they returned, told us that the document was completely acceptable to them with the exception of some minor editorial changes. We then adjourned for the evening and agreed that Frutkin and Vereshchetin would form an editorial committee of two that would meet in the morning to go over the final document.

Thursday Morning. While Frutkin and Vereshchetin were editing the document, Lunney and I continued the discussions with Petrov, Bushuyev, and Rumyantsev. First, Bushuyev responded to the schedules document and gave an excellent discussion of his views of the need to control schedules. During the course of the scheduling discussion, we also discussed design reviews, which were understood and agreed to by both sides; joint testing, which was also understood and agreed to; and finally, the Soviet side stated that they agreed in principle to the entire organizational plan.

[10] Next I raised a question concerning the Soviet organization to do this mission. I pointed out that they knew clearly where each of us fit into our organization and what our responsibilities were. I asked if it would be possible to get the same kind of understanding of their organization. Petrov responded in some detail, but really said nothing. He said that Keldysh, as President of the Academy of Sciences, reported to the Council of Ministers, and had been charged with being responsible for the US/USSR cooperation in space. Petrov, in turn, reported directly to Keldysh, and Bushuyev to Petrov. I asked whether the same organization would be in force during the hardware and flight operational phase, and the answer was in the affirmative. Petrov indicated that they would bring additional people into the organization at that time, but that these people would still report to Bushuyev.

By this time, Vereshchetin and Frutkin had finished editing the "Summary of Results" and had prepared identical documents in English and in Russian. We reviewed these documents, had a few questions but no major hangups. Both sides agreed with the documents as they had been prepared.

Finally, Thursday morning Bushuyev discussed technically the Soyuz system and gave Lunney a document describing those systems. For the test mission in 1975, the Soyuz would fly only two men for a five-day period, plus one day in reserve. They proposed also that the Apollo spacecraft should be launched first and that the Apollo would be active in the rendezvous and docking maneuver. (In subsequent discussions with Lunney, I told him that from a policy point of view, I would actually prefer to have the Apollo launched first as the Soviets now recommended and that unless there is a good technical reason not to do so, we should accept this recommendation.)

Thursday Afternoon. After lunch at the American Embassy Residence, we returned to the Presidium to sign the Summary of Results. After the signing ceremony and after making the usual speeches, I discussed with Kotelnikov and the group the public posture relative to the meetings we had just completed. I mentioned, first, that we intended no public release of the meetings at all; second, that we do not intend to mention the fact that we were now discussing Soyuz instead of [11] Salyut; third, I indicated that if pressed and if we had to admit that meetings took place in Moscow during this week, we would say that we were preparing the agenda for the July meeting but that we could not discuss the content of the agenda; fourth, that if we were to take any different action from the above, we would so notify Petrov; and, fifth, that we would intend to remain in this posture until after the summit meeting. Kotelnikov completely agreed with this proposal, and with this we ended our formal discussions in Moscow.

Conclusions

A copy of the Summary of Results that was signed in Moscow is attached. From this, and particularly from the discussions that went along with the agreements that were reached and documented, I have reached the conclusion that we are ready to undertake this test mission. Insofar as hardware matters are concerned, we have reached an understanding and agreement on all issues which have been identified so far, and, furthermore, don't see any issues that we will be unable to agree on. On the management side, we have reached agreement on such matters as regular and direct contact through frequent telephone and telex communications, as well as visits; the requirement for and control of formal documentation; joint reviews of designs and hardware at various stages of development; the requirement for joint tests of interconnecting systems; early participation by flight operations specialists; the development of crew training plans; and the training in each country of the other country's flight crew and operations personnel. We also reached agreement on the requirement for and the level of detail of project schedules. Finally, in the area of flight operations, we reached agreement on the principles of communications command and control of the flight; the requirement for flight plans and mission rules for both normal and contingency situations; the immediate transmission of flight television received in one country to the other country's control center; the language problem; and the need to develop a public information plan, taking into account the obligations and practices of both sides.

Based on all of these agreements, it was my recommendation that the United States is ready to execute a government-to-government agreement and should now do so.

****

[Attachment page 1] May 30, 1972

Addendum
Moscow Trip, April 4-6, 1972

This is an Epilogue to the special notes I prepared after my trip to the Soviet Union on April 4-6, 1972.

During the course of that visit to Moscow we reached an agreement (signed by Kotelnikov, the then Acting President of the USSR Academy of Sciences and myself) on matters concerning the technical details, the organization, management, operational details, and scheduling of a possible joint docking mission involving the United States Apollo spacecraft and the Soviet Union's Soyuz spacecraft. Upon my return from Moscow we recommended to the White House (Henry Kissinger) that, from NASA's point of view, we were prepared to proceed with such a mission in the 1975 time period, that no further NASA/USSR Academy meetings would be required, and that the form of the agreement between the United States and the Soviet Union could be a relatively simple and straightforward one. A copy of our proposed wording for that agreement is attached.

Between the middle of April and the middle of May (the summit meeting started on May 22), there was a great deal of interest by the press in the possibility of having a joint docking mission on the summit agenda, and a large number of interviews with NASA people was held. In all of these interviews, there was a great deal of speculation about the possibility of an agreement on the docking mission at the summit, but there was never any hint of the April 4-6 meeting, nor was there ever any hint that during that meeting the

Soyuz spacecraft was substituted by the Russians by the Salyut. In other words, from NASA's side we were able to avoid any discussions of NASA's preparation for the summit meeting or of the form that any agreement might take. This was possible only because such a very small number of NASA people had been involved in the activities leading up to the summit.

[2] It was only during the week before the summit meeting that the State Department worked on the specific wording of the agreement and made only minor changes in our previously submitted wording. Apparently State and the White House started coordinating the words with the Soviet Union only on the 18th or 19th of May (we have no idea in NASA why this was undertaken only at this late date). On May 20, the USSR responded to our proposed wording with a much lengthier document, which among other things, included the Keldysh-Low agreement of January 21, 1971, in addition to the docking agreement. Furthermore, with respect to the docking agreement, the Soviet words did not include by reference our previous meetings and, instead, some rather cumbersome wording was substituted.

Apparently when the Soviet response was received by our State Department, it was immediately discussed with Kissinger and Rogers, who were at the time over the Atlantic on their way to Salzburg, a stop on the way to Moscow. Kissinger asked that we prepare an appropriate response but that insofar as possible, we should not change the wording in the Soviet text. All of this was done in a meeting at State Department starting at 2:30 Saturday afternoon, the 20th, and ending in the middle of the night. During that time we straightened out the wording in the Preamble but kept by and large the Soviet meaning. With respect to the Keldysh-Low Agreement, we did not make any significant changes, with one exception. The Soviet document had incorporated words concerning communications satellites which had not been part of the January 21, 1971, agreement, and we therefore deleted these words. Finally, with respect to the docking agreement, we selected words similar to those that we had proposed in April in our memorandum to Kissinger and especially incorporated in that article the April 4-6 agreement by reference. This document, together with the clarifying document, was forwarded to the White House/Salzburg late that night. In the clarifying document we stated that NASA had no objection to the inclusion of the Keldysh-Low Agreement in the government-to-government agreement, but [3] pointed out that this was not necessary, nor had it been the intent. State Department on the other hand felt that it should not be included because it would make our relationships with the Europeans even more difficult in light of our recent lack of enthusiasm for space cooperation with the Europeans. With respect to the April 6 agreement, we stated in the clarifying telegram that NASA insisted that it be included by reference.

Following the Saturday meeting we had no additional information except persistent signals that the space agreement was scheduled to be signed in Moscow on Wednesday, the 24th. On the 23rd, I left for the West Coast for a talk in San Diego on the evening of the 23rd, and then a visit to JPL [the Jet Propulsion Laboratory] on the 24th. During the course of the evening in San Diego (after dinner and during the preliminaries leading up to my talk), I received a telephone call, through the State Department Operations Center, involving Arnold Frutkin, somebody in State Department, and myself. State had just received a final text as it had been agreed to tentatively in Moscow. In this text the Keldysh-Low Agreement was still included and there were words acceptable to us with respect to the docking mission. The April 6th agreement was specifically included. I accepted the words as they had been read to me just in time to get back into the ballroom (I had taken the telephone call at a hallway outside) to hear myself introduced as the evening's main speaker. It is interesting to note that by this time it was 6 a.m. in Moscow on the day that the agreement was actually signed.

On the next day, May 24, I went to JPL and soon learned that the agreement actually had been signed in Moscow at apparently 11 o'clock a.m. EDT. At 2:25 p.m. EDT, the Vice President introduced Jim Fletcher, Jim McDivitt, and Glynn Lunney, who held a press conference at the Executive Office Building. Sometime thereafter, Fletcher held another press conference at NASA Headquarters, and simultaneously, I held one at JPL.
[4] There has been no adverse criticism in this country concerning the space agreement in general, or the Apollo/Soyuz test project in particular, and, in fact, there has been a great deal of overwhelmingly favorable editorial comment. . . .

Document I-47

Document title: Henry A. Kissinger, to the President, "US-Soviet Space Cooperation," May 17, 1972, with attached: "Draft Agreement."

Source: Nixon Project, National Archives and Records Administration, Washington, D.C.

The final decision to proceed with what became known as the Apollo-Soyuz Test Project was not made until shortly before the May 1972 U.S.-U.S.S.R. summit meeting in Moscow. This decision memorandum, when approved by President Nixon, was the basis for project approval.

---

[1] May 17, 1972

Memorandum for the President

FROM: Henry A. Kissinger

SUBJECT: US-Soviet Space Cooperation

In NSDM 153, you directed NASA and State to explore with the Soviets the possibility of a US-Soviet agreement on the desirability of a joint, manned space docking mission, so as to provide you with the option of announcing this agreement during the Moscow visit.

NASA's Deputy Administrator, Dr. George Low, held detailed talks on the possible joint mission with representatives of the Soviet Academy of Sciences in Moscow from April 4-6. Both sides had earlier agreed that such a mission was technically feasible and desirable. NASA Administrator Fletcher now reports that Dr. Low's April mission was successful; he was able to reach agreement on the principles of managing, scheduling and conducting a joint space docking mission.

The Soviets have informed NASA that they would like to reach formal agreement on space cooperation, including the joint manned mission, during the Moscow Summit. Programmatically, the US is ready to execute such an agreement, and NASA recommends that this be done.

The costs involved with the joint manned mission, which would be scheduled for 1975, are now estimated by NASA to be approximately $250 million. This estimate has been developed in coordination with the Office of Management and Budget.

Clark MacGregor has taken soundings to determine the likely Congressional reaction to the proposed joint mission. These soundings indicate that the proposal would gain acceptance by a 3-1 or 4-1 margin.

The text of the proposed space agreement could be quite brief, along the lines of the draft at Tab A. I recommend that you approve the proposed [2] US-Soviet space agreement, permitting the necessary steps to be taken prior to your Moscow visit to provide you with the option of announcing the agreement at the Summit.

Approve _____ Disapprove _____

With your approval, I will forward a copy of this memorandum to the Director, Office of Management and Budget, with the request that he arrange to take such budgetary steps as may be necessary to provide for implementation of the agreement.

Approve _____ Disapprove _____

****

[Attachment page 1]

Draft Agreement

The United States of America and the Union of Soviet Socialist Republics agree to a program of joint activities designed to enhance the safety of manned flight in space and provide a basis for possible cooperative space projects of mutual benefit.

Toward these goals, it is agreed that rendezvous and docking systems of future generations of manned spacecraft of both countries will be compatible, to permit rendezvous, docking, rescue, and possible joint experiments in space. It is further agreed that the first flight to test these future systems will be carried out in 1975, using specially modified Apollo-type and Soyuz-type spacecraft. In this flight the two spacecraft will rendezvous and dock in space, and cosmonauts and astronauts will visit in each other's spacecraft. This joint project will be conducted in accordance with the Summary of Results of the Meeting Between Representatives of the US National Aeronautics and Space Administration and the USSR Academy of Sciences held in Moscow on April 4 to 6, 1972.

Document I-48

Document title: George M. Low, Memorandum for the Record, "Visit to Moscow, October 14-19, 1973," November 1, 1973.

Source: George M. Low Papers, Institute Archives and Special Collections, Rensselaer Polytechnic Institute, Troy, New York.

Once the United States and the Soviet Union had agreed to carry out the Apollo-Soyuz Test Project, there were frequent interchanges of personnel between NASA and its counterparts in the U.S.S.R. NASA Deputy Administrator George Low made an October 1973 visit to Moscow for a top-level mid-term project review. This detailed memorandum for the record contains Low's observations on his time in Moscow.

[1] November 1, 1973

Memorandum for the Record

SUBJECT: Visit to Moscow, October 14-19, 1973

BACKGROUND

On August 14, I had written to Academician H. V. Keldysh, President of the USSR Academy of Sciences, suggesting a mid-term review of the Apollo-Soyuz Test Project. A copy of my letter to Keldysh is attached. In the letter I also stated that in addition to reviewing the current status of the project, I would like to discuss in detail four specific subjects: system failures; participation in and observation of the test activity and flight preparation; project milestones; and the preparation of documentation. I further asked if it would be possible to visit some Soviet space facilities during the course of my visit. Keldysh responded favorably on August 30. (A copy of his letter is also attached.) Then, about a week before my visit, I received a telephone call from Chet Lee, who was already in Moscow, indicating that Keldysh was ill and would be unable to see me. He added, however, that the Soviet side clearly wanted me to come ahead and urged him to convey to me that this is not a "diplomatic illness" and that my visit would be most worthwhile. In order to further make it desirable for me to come, they promised that they would take me to the Soviet Mission Control Center near Moscow. The telephone call was followed by an official telegram from Keldysh and after discussions with Arnold Frutkin we decided that I should go ahead with the visit as planned. (Both Arnold and I asked about Keldysh's health on many occasions after we arrived in Moscow. The response we both received was that Keldysh is not really ill in the true sense of the word but is extremely tired and rundown. He had not taken a vacation after his major operation earlier this year and had worked extremely hard ever since then. He was therefore "ordered" by his physicians to take a rest and not to participate in any of the meetings with me. During the course of my visit, his office was always dark, his secretary was nowhere in sight, and it was quite clear that he was completely away from the office during this week.)

[2] *SUMMARY OF VISIT*

Sunday, October 14

Arrived in Moscow with Frutkin early in the evening. Met at airport by Boris Petrov, Vereshchetin, Jack Tech from the U.S. Embassy, and one or two others. Rode to Hotel Rossia in Petrov's car and, as we had requested, did not participate in any official functions that evening.

Monday, October 15, 7:00 a.m.

Executive Session at Hotel Rossia with Lunney and his Working Group chairmen. According to Lunney, the two weeks of preparatory meetings had gone extremely well and much had been accomplished. The "Summery of Results" of their meetings had been prepared and a copy of this is attached. In addition, Donnelly had negotiated a first-phase (pre-flight) Public Affairs Plan which was to be ratified by Petrov and me. We discussed some of the technical results of the meeting but I will cover these later as I discuss each specific item.

Monday, October 15, 9:00 a.m.

We met at the Presidium of the Soviet Academy of Sciences for the Apollo-Soyuz "Midterm Review." Participating on our side were Low, Frutkin, Lee, Lunney, Cernan, Stafford, Smylie, Dietz, and Frank. Soviet attendees included Petrov, Bushuyev, Vereshchetin, Rumyantsev, Abduyevski (the Deputy Director of the Control Center), Cosmonaut Yeliseyev (the Flight Director), Cosmonaut Leonov (the Soyuz Commander); Tulin, Tsorev, and Kozorev of Intercosmos; Working Group Chairmen Timchenko, Legostaev, Syromyatnikov, Nikitin, Galin, and Lavrov; and their interpreter Zonov. During the course of the meetings, Bushuyev, Lunney and alternate Working Group Chairmen gave a technical review using a notebook of "Vu-graphs." Notebooks had been prepared in both languages so that all of us could follow the review.

Monday, October 15, lunch time

Frutkin, Lee, Lunney, and I joined Petrov, Bushuyev, and Vereshchetin for a small luncheon at the "Club of Scientists." [3] Even though this was very informal and there were not too many toasts, it was nevertheless a Soviet-size dinner, with five or six courses, which consumed the better part of two hours.

Monday, October 15, 3:00 p.m.

We returned to the Presidium for another session involving all participants. This was a relatively brief session with only a few questions asked by our side and responses given by their side. At the conclusion of the session, both Petrov and I agreed that good progress had been made in ASTP, that there were no open questions other than those raised by the technical Project Directors in their Summary, and that we had high confidence in meeting our launch date of July 15, 1975.

Monday, October 15, 4:00 p.m.

I had asked for an Executive Session to discuss some of the points raised in my letter to Keldysh which were not brought out during the technical meeting. Participating on our side were Low, Frutkin, Lee, and Lunney, and on their side Petrov, Bushuyev, Vereshchetin, Rumyantsev, Tulin, Tsorev, and Kozorev. During the course of this meeting, I brought up the subjects of systems failures, participation in factory installation of U.S. equipment, documentation, Stafford's desire to see actual spacecraft hardware and not only mock-ups, and the desirability of a press conference before our departure from Moscow. This was a very frank and forceful discussion with our side politely but firmly insisting on responsiveness by the Soviet side.

Monday, October 15, 7:00 p.m.

The Charge d'Affaires at the U.S. Embassy in Moscow had invited the two delegations for a small reception at the Embassy. This was quite informal and friendly with no detailed discussions about the business at hand. There was great interest in Skylab and the well-being of the Skylab's three astronauts on the part of a number of the Soviet delegation and they appeared to be amazed how well Bean and his crew had done after 59 1/2 days in space. I also picked up the following incidental piece of information from Petrov: It is the Soviet's view that TU-144 [4] accident was caused by a small French aircraft which flew into the TU-144's flight path. The TU-144 had to veer off and thus flew into the ground.

Monday, October 15, 8:00 p.m.

I met in my hotel room with Donnelly, Shafer, Frutkin, and Lee to discuss the Public Affairs Plan. Donnelly and Shafer appeared to be quite disturbed by some of the things that had happened while they were in Moscow but we agreed not to discuss this any further until we returned to Washington. We then discussed the substance of the Public Affairs Plan and agreed that it was not yet ready for ratification without further clarification.

Tuesday, October 16, 9:00 a.m.

I paid a brief call on Academician Kotelnikof, the Acting President of the Academy of Sciences. This was only a courtesy visit, with some small talk but no substance.

Tuesday, October 16, 10:00 a.m.

Visited the Institute of Geochemistry and Analytical Chemistry of the Academy of Sciences. Vinogradov was to have been our host, but we were told that he suffered a bad cold and we therefore met with his Deputy, whose name I believe is Sorkhov.

Tuesday, October 16, 11:00 a.m.

Next we visited the Institute of Space Research of the Academy of Sciences and met its new head, Prof. R. S. Sagdeyev. Sagdeyev speaks good English, is friendly and open, and looks like the sort of person with whom we ought to be able to develop good relationships.

Tuesday, October 16, 3:00 p.m.

Visited Academician V. A. Kirillin, the Deputy Chairmen of the Council of Ministers and Chairman of the State Committee for [5] Science and Technology. I had asked for this courtesy visit prior to my arrival in Moscow and as soon as I arrived there were many questions as to why I wanted to see Kirillin. I assured everybody that this was really only a courtesy visit.

Tuesday, October 16, 7:00 p.m.

Went to the ballet in the Kremlin and saw "Don Quixote" for the second time during one of my Moscow visits. For one who doesn't like ballet, this should be considered to be above and beyond the call of duty.

Wednesday, October 17, 8:45 a.m.

Left the hotel to visit the cosmonauts' training center at Star City. At Star City we were met by General Beregovoy since General Shatalov, who is now in charge, was visiting in Japan. We also met the Soyuz 12 cosmonauts, Lazarev and Makarov, as well as ASTP cosmonauts Leonov, Kubasev, and Filipchenko. Petrov and Bushuyev were with us, and we were also joined by Feoktistov, whom I had not seen since my January 1971 visit. The reason for this became apparent later. Feoktistov was there to show us through the Salyut mock-up. He knew Salyut as well as I had at one time known Apollo, and obviously is either the Chief Engineer or Program Manager on Salyut.

At Star City we had a sit-down briefing, a visit to the Soyuz simulators and docking trainers, a discussion of the ASTP version of Soyuz, and then a very detailed description of Salyut, with a tour of its high fidelity mock-up. We were also shown the Soyuz 12 space suit. We then had a quick tour of the museum and the usual seven- or eight-course dinner with the usual number (15 or 20) of toasts. I was a lot smarter this time, though, then I had been on the last visit to Star City. I did not participate in any of the "bottoms up" toasts and merely sipped my vodka politely each time.

Wednesday, October 17, 4:00 p.m.

I had asked for discussion on the ASTP Public Affairs Plan and Petrov and I decided to have this meeting while we were at [6] Star City. Participating in this meeting were the same ones who participated in the Executive Session on Monday afternoon. At the completion of this meeting we left for Moscow.

Wednesday, October 17, evening

The evening was free but Arnold Frutkin and I met in our hotel room for further discussions on the Public Affairs Plan. Here we wrote some words which we hoped would clarify the Plan, for additional discussions the next morning.

Thursday, October 18, 9:00 a.m.

Frutkin and I met with Petrov, Vereshchetin, and Rumyantsev on the ASTP Public Affairs Plan. During the course of this discussion, we reached a complete understanding of all points but did not reach agreement on them. Unfortunately, Donnelly had already left Moscow so he was unable to participate with us.

Thursday, October 18, 10:15 a.m.

We left the hotel for the visit to the Soviet Mission Control Center. This was a first for any Western visitors and, of course, of great interest to us. We arrived there approximately 45 minutes later and had a very detailed tour of the Center. Following the tour, at 2:00 p.m., we had lunch at the Control Center, complete with eight different wine, vodka, and brandy glasses in front of us, and served by waiters in dinner jackets. It was again a dinner with many, many courses and many, many toasts. Chris Kraft's cafeteria in the Houston Mission Control Center was really put to shame.

Thursday, October 18, 3:30 p.m.

We visited the Cosmos Pavilion of the USSR Exhibition of Achievements in National Economy. This is the USSR Space Museum, which I had seen once before. I, therefore, looked at only the new exhibits, which included Mars 3, Lunokhod, and several other lesser exhibits. We also were shown a countdown and launch [7] demonstration using a complete working model of the Baikonur launch complex.

Thursday, October 15, 5:15 p.m.

We were back at the Presidium for the "signing ceremony." Here we signed the Summary of Results of our meeting which, in this case, was very brief since the detailed Summary had been signed by Lunney and Bushuyev. The Summary, as well as the press release, had been worked out by Frutkin and Vereshchetin and had been previously approved by Petrov and me during our meeting at Star City. (Copies attached.)

Thursday, October 18, 5:30 p.m.

Petrov and I, in the company of Lunney and Bushuyev, held a press conference at the Presidium. Petrov preferred to call this a "meeting" with the press because he did not invite the foreign press corps (other than U.S.) nor many of the Soviet press corps. We had, however, insisted that the entire American press corps would be invited. After a brief introduction by Petrov, I gave an opening statement summarizing our entire visit. We then opened it up to questions. Unfortunately, the American press wasn't smart enough to ask some of the more difficult questions like "Where is the Mission Control Center?" or "What did you learn about the Soyuz II failure?" We were prepared on both of these questions. However, Lunney did talk to some of the American press after the press conference and did at that time get into the record that we had indeed been given a detailed report on the Soyuz II failure.

Thursday, October 18, 7:00 p.m.

The Soviet delegation had a dinner and reception in our honor at the "Hall of Mirrors" of the Hotel Prague. This was another formal sit-down dinner with many more toasts and, I might add, the second big dinner of the day. Somehow we all survived.

Friday, October 19, 8:00 a.m.

We left Moscow Airport on an Aeroflot flight for London and from there back to the U.S.

[8] *GENERAL OBSERVATIONS*

Moscow

Moscow seemed to be a friendlier place this time than I remembered it from my previous visits. There were more cars, more lights, people appeared to be livelier, and even the hotel staff appeared to be less dour. Either there has been a change or perhaps we have become accustomed to their way of life. The fact that I could understand their language this time, at least at times, and the fact that I could speak it well enough to order breakfast, get my room key, and leave a wake-up call, may also have had something to do with the apparent change in attitude.

Relations with Academy of Sciences and ASTP Personnel

In general, both sides seemed to get to the point quicker and easier and appeared to reach a fuller understanding of each issue. Discussions were more direct and more open and frank. Each side made a special effort to make sure that there would be no misunderstandings in the agreements which were reached. (The single exception appeared to be in the negotiation of the Public Affairs Plan where our people have less experience in working with the Soviets.)

NASA Contingent

The NASA contingent under Glynn Lunney is doing an outstanding job. They are diplomatic but firm in all their dealings with their Soviet counterparts. They excel not only during the course of technical discussions but also at social functions.

USSR Reaction

The general reaction to us and to our work still appears to be one of inferiority, but at the same time one that seeks parity. After each visit we were asked, "How did you like it?" "What did you think?" "How does it compare with yours?"

International Situation

We were in Moscow at the height of the Middle East conflict and at a time when Handler and Keldysh were exchanging rather firm [9] letters on the Sakharov affair. Yet neither one of these subjects came up at any time during our visit and the situation appeared to be perfectly normal. (From our side, of course, we missed getting any news about the Middle East situation.) As a matter of fact, the *New York Times* concluded "The warm treatment of Mr. Low and a team of American specialists, working with their Soviet counterparts to prepare for the Apollo-Soyuz mission, was read as a deliberate gesture by Moscow to emphasize its interest in Soviet-American cooperation and the detente despite the frictions of the Middle East conflict."

Personal Reaction

I had learned a great deal about how to "survive" for a week in Moscow since my first visit and, therefore, this visit was very much easier than previous ones had been. Generally, I had only one meal per day, that is lunch, which, as I have mentioned previously, was always a full dinner. (On Thursday, however, we had two of these dinners.) I always had only a very minimal breakfast of tea, bread, and butter at the hotel "cafeteria" and more often than not no evening meal at all. I also learned that I could coax a single vodka through many toasts.

TECHNICAL STATUS OF ASTP

During the course of the status review, Bushuyev gave a basic introduction which was followed by status reports on internal preparations in the U.S. and USSR given by Lunney and Bushuyev, respectively. Next, each of the Working Group chairmen (either a Russian or an American) gave a progress report for their respective groups: mission model, operations plans, experiments, and spacecraft integration; guidance and control, and docking aids; mechanical design; communications and tracking; and life support and crew transfer. Each group gave a detailed schedule and report of progress against that schedule. By and large, all milestones were met and when they were not being met workarounds were available.

Agreements have been reached on five joint experiments; on reciprocal participation of specialists as observers during life support system tests of Apollo and Soyuz; participation in joint seal tests; on a number of safety assessment reports and others [10] that yet had to be written; on studies for the need of electro-magnetic compatibility tests of the cable communications system; and on the participation by U.S. specialists at the Soviet

launch site during the pre-flight checkout of the VHF AM equipment. In addition, drawings had been exchanged on the Soyuz orbital module and the Apollo docking module. The problem of mixed crew descent had been discussed and it was decided that this would be considered an "unexamined contingency situation." Another area open for further discussion is additional dockings subsequent to the first undocking.

At the conclusion of the meeting, four potential problem areas were described. These were: documentation; the desirability of U.S. access to the factory in the event of problems during the installation of the VHF equipment; the launch window; and the need for continuing timely exchange of ground and flight test data on ASTP-type Soyuz and Apollo vehicles and systems.

The subject of documentation was discussed during the main meeting as well as during the executive session. I also brought it up privately with Petrov. It seems that a great deal of progress has been made by the Soviets in recent weeks in catching up in all areas where they were behind on documentation. Nevertheless, Lunney is concerned that as time grows shorter they will once again fall behind and we may stub our toe on the entire project. The Soviet solution to the problem is a better forecast of documentation requirements. We agree with this point of view but we say that this is not the complete solution because we can't possibly foresee all problem areas. I believe that Petrov finally understood what we were getting at and promised to personally keep an eye on the situation.

On the subject of access of U.S. specialists during the installation of the U.S. provided VHF equipment, it is quite clear that they do *not* want our people in their factory but have no objection to their presence at the launch site. We told them that we accepted their view on this but that they should consider now what they would do in the event they were to run into trouble and then really required our presence at the factory. I later told Petrov during the executive session that we understood that this might present difficulties and that he would be wise to work these out now for the *contingency* situation which might require our presence.

[11] Insofar as the launch window is concerned, it now closes on September 22 as a result of lighting constraints in the recovery area. Both sides agreed to work on this to see whether it cannot be extended into December.

The last point concerning the timely exchange of ground and flight test data is closely related to the documentation question which I have already discussed.

VISITS TO USSR FACILITIES

The present Soviet decision is that Star City, the Control Center, and the launch site will be open to our technical people. The Soyuz factory will not. Although we reached agreement only on pre-flight activities insofar as the launch site is concerned, Petrov let it be known during the press conference that there would be no problem with our specialists staying there during the time of the launch. Insofar as access for the news media is concerned, the present decision seems to be that Star City, or at least parts thereof, will be open to the news media but the Control Center and the launch site will not.

Tom Stafford had also voiced a concern to me about the fact that he would only see Soyuz simulators and never actual Soyuz flight hardware. I discussed this concern during the executive session. We were told that simulators really were exactly like the flight hardware but nevertheless I said that Stafford was looking for subtle differences and that it was quite important to him to see the actual flight hardware. I suggested perhaps that this too would be possible at the launch site since their spacecraft arrived there some four to six months before the launch. During the course of the executive session, Petrov agreed to look into this and later told Stafford that he thought this would be possible.

SOVIET FAILURES

During the course of the technical visits preceding my review, the Soviets had made a detailed presentation of the Soyuz II failure and had given us a copy of their failure report. They had not discussed any other failures. In the failure report, they also stated that Cosmos 496 and Cosmos 573 were both [12] unmanned test flights of the changes made after the Soyuz II failure and prior to the Soyuz 12 flight. During the course of the technical review they also stated that there will be two or three more manned Soyuz flights in 1974 and prior to the ASTP flight. Soyuz 12, by the way, did not incorporate a docking system while the 1974 flights will incorporate the ASTP-type docking system.

During the course of the executive session, I told Petrov that we greatly appreciated their report on the Soyuz II failure but that we were also concerned about additional failures reported in the American press during the summer of 1973. I specifically mentioned Salyut 2, which the press had reported as a failure, and Cosmos 557, which some American press reports had also called a Salyut-type vehicle.

Petrov was obviously prepared for the Salyut 2 question, but not for the Cosmos 557 question. On Salyut 2, he said that this bore no relation to the Soyuz which we will use in our joint mission. He stated that Salyut 2 was an improved modernized version of the Salyut. Because of the significant changes, the Salyut 2 flight had been planned from the beginning as an automated flight and was never intended to be manned. We were told that many of the changes were in the automatic control system and these changes clearly required an unmanned flight. To add emphasis, this point was repeated many times. Petrov went on to say that Salyut 2 should be considered a flight for the development of future space stations, that the Salyut is completely independent of the Soyuz, and, finally, that it was not important where it returned to the earth, merely that it returned some place in the open sea.

In summary, it was never clearly said whether Salyut 2 was a failure or a success, but only that whatever it was did not concern us because it did not relate to Soyuz.

I again brought up the subject of Cosmos 557 since there was no response on this question. Petrov did not respond, but another in the group—I believe it was Tsorev—did. He said that Cosmos 557 bore no relation to a manned flight and was neither related to Salyut nor to Soyuz. He said the reports in our press obviously were mistaken.

[13] *STAR CITY*

I saw more of Star City this time than I had during my previous visit. Of major significance is the amount of new construction underway at the present time. A new training building is being put up especially for ASTP training. It is a 4-story building which will include classrooms, lecture halls, display rooms for our spacecraft subsystems, etc. In addition, they are building a new hotel and dispensary for the United States team. I think both of these projects are underway so that astronaut treatment at Star City won't appear to be shabby in comparison to cosmonaut treatment in Houston. In addition, two or three other large buildings for training or to house simulators are under construction, as well as a large centrifuge with a capability of up to 20 g's at an onset rate of 2 g's per second for personnel or 4 g's per second for equipment. Both the ASTP classroom and the ASTP hotel buildings were started after the ASTP agreement had been reached, and neither will be quite ready at the time of the November visit but should be ready for the second visit of our astronauts.

Soyuz Simulator and Docking Simulator

I had seen both of these on my previous visit to Star City in January 1971. Leonov conducted the briefings on both. The basic change in the Soyuz reentry module is that it is equipped for only two cosmonauts now while it had room for three during my previous visit. There are also provisions to connect pressure suits and the new pressure relief and shut-off valves which were installed subsequent to the Soyuz II failure are very evident. We were told that the simulator was currently in the Soyuz 12 configuration. This configuration did not include a docking hatch. In the orbital module, we were shown the potassium superoxide air regeneration system and during the course of the discussion there was much talk about condensation removal. This must at one time have been a problem. On the way to the orbital module simulators, one passes through the room in which the optical systems for the displays are mounted. These included both Soyuz and Salyut models.

The docking trainer also showed no difference from 1971 except that the visual targets for docking now included both the Soyuz and the Salyut, whereas only the Soyuz was included in 1971.

[14] *Mock-up Area*

We next went to the mock-up area where Bushuyev went over the Paris Air Show display of the Soyuz with the new docking system, as well as an "external mock-up" of each of the two Soyuz modules. I put the words "external mock-up" in quotes because for all I know this might have been flight hardware. Of interest on this external mock-up was the external insulation, which is a fabric blanket, and the fact that the orbital module had an old style docking system, and it too was said to be in the Soyuz 12 configuration. Again we were told that the ASTP docking system will not be flown until 1974. Bushuyev also indicated that in the Soyuz 12 configuration, Soyuz is a 4-day vehicle if flown alone and a 60-day vehicle if flown with Salyut.

Space Suit

This was modeled by a technician and described by Cosmonaut Kubasev. It is a fairly lightweight garment which, according to Leonov, takes five minutes to don. It will be the type of garment used in ASTP. It is expected to be worn only for about two hours at any one time and, therefore, has no provisions for sanitation. The outer garment provides the strength. The inner garment is a thin rubber bladder, which is sealed by gathering up a bunch of rubber, twisting it, and then tying it with a large rubber band. This sealed garment is then tucked underneath the folds of the external garment which is laced shut. The suit is worn for launch, docking, undocking, and reentry.

Salyut

In the same mock-up building with the Soyuz Paris Air Show exhibit is also the Salyut mock-up. Incidentally, this is a fairly new building in which the ASTP training will also be conducted. It has a glass partition and we were told that the news media will be able to watch from behind that partition when our crews are there. (Even though the building is fairly new, somehow they managed to make the bathrooms look as though they were twenty years old.) Feoktistov was our guide around and through Salyut. (He had already met with Lunney earlier during the visit because Lunney had asked why we never see him anymore. At that time, [15] Lunney asked him when he would again visit the U.S. Feoktistov responded that he had many very serious problems and thought that he would not be able to visit for a long time to come.) Externally, the Salyut we saw differed from the pictures I had previously seen in that it had three solar panels mounted on the main part of the body. Two were mounted horizontally like wings on an airplane and the third vertically but in the same section as the horizontal ones. The horizontal ones could be pivoted to get a better exposure to the sun even while the Salyut was flying at an angle. (I don't recall whether the vertical one could also be pivoted.) Feoktistov told us that Salyut could fly in any attitude for an indefinite period of time without thermal problems.

We entered Salyut through a hatch on the side of what in Skylab would be the multiple docking adapter. I forgot to ask, however, whether it was possible to dock with more than one spacecraft at a time. I don't believe it is. We then went into the main section and first looked at the instrument panel which is very similar to that of the Soyuz. In fact, many of the instruments are identical, as are many of the subsystems. The propulsion system, for example, we were told is exactly like the Soyuz system, and the ECS is a version of the Soyuz system. In response to my question, Feoktistov said that Salyut nominally had a 60-day lifetime but that this could easily be extended to four months by trading on-board consumables for propellants. He also mentioned that food, water, and the air generation system could be resupplied but the propellant could not be resupplied. However, if the Salyut is in a sufficiently high orbit the amount of propellant used for attitude stabilization is minimal. There are no control moment gyros. We saw two rather primitive fire extinguishers, a bungie cord exerciser, including a treadmill, and a wall chart indicating the exercises to be taken. Sleep stations are tucked away around a 10-meter focal length solar telescope. There were a number of other scientific instruments—spectrometers, cameras, star sensors, sun sensors, etc.—all of which were explained in detail by Feoktistov. There is also a refrigerator and a food warmer. Finally, the bathroom is at the very tail end of the station and does not appear to be as complete as the Skylab bathroom. Also at the tail end of the station are two trash air-locks, both used for dumping garbage in bags to the outside. They are at approximately ± 45° from the vertical and appear to be of inordinately heavy construction.

[16] Incidentally, Lunney told me that he inferred from some discussions that there might be some heavy flight activity in the March-April time period next year since many of the specialists with whom he normally deals will then not be available.

SOVIET MISSION CONTROL CENTER

The drive to the Mission Control Center from the hotel took approximately 45 minutes. We headed out of town in a northerly direction, passed the Exhibition of Achievements in the National Economy (Space Museum), then the Moscow city limits, and then drove for another five minutes or so. The Center is located in the village of Kaliningrad. (After leaving the Center and on the way to the press conference, I asked Petrov how I should respond to a question concerning the Control Center's location. At first he stated that I should merely say that it is at the outskirts of Moscow, but apparently he checked this out after we reached the Academy of Sciences again and then told me that I could state, if asked, that it is in Kaliningrad. I was not asked.)

The Center is located within a large complex of buildings surrounded by a security wall. The way we entered and left the area it was difficult to see much of the other buildings. They all are several stories high and could house all sorts of equipment. There were no antennas in evidence. Some new construction is also going on. Within the Control Center building, all of the curtains on the street side were open but all of the curtains facing the rest of the complex were conspicuously drawn. The Control Center building is approximately three or four years old. It had been used in the past for the control of unmanned flights but the first manned flight under control of this Center was Soyuz 12. We were told that it would be used for all future manned flights, Soyuz as well as Salyut, but that not all Salyut flights would be controlled from there. Apparently, there will be some unmanned Salyut flights to be controlled from somewhere else. The building itself is well-constructed and well-appointed. (I will later describe the Institute of Space Research, which is very poorly constructed. By contrast, a lot more money was spent on the physical building of the Control Center than on the Institute of Space Research.) We

were first taken into the conference room on the second floor where we were greeted by Abduyevski (the Deputy Director of the Control Center). Abduyevski was with us all of the time but answered few, if any, [17] questions. I have the feeling that he is relatively new in the Control Center and does not know a great deal about it yet. In fact, he may be there solely for the purpose of dealing with NASA. Next we were briefed by Yeliseyev, the Flight Director. He used three charts which had been prepared in English as well as in Russian. These charts depicted how the Control Center fits within the overall operations (launch, network, communications, control, etc.); the flow of information within the Control Center; and the organization of flight controllers within the mission operations control room. In the first order, there is no difference in any of these areas from the way we operate in Houston. It is possible, however, that some of the functions that are performed at Goddard for manned flight control in the U.S. are actually performed within this Control Center in the USSR.

Data flow from the tracking stations apparently without any preprocessing at the stations. They are then manipulated and formatted within various parts of the Control Center and finally displayed in digital form on TV displays in the Mission Operations Control Room. Voice transmissions to the spacecraft flow in the opposite direction. There are no electronic commands generated within the Control Center. Command decisions are made at the Control Center, of course, but the electronic command generation takes place at the tracking stations.

We left the conference room through a second door and found ourselves in the viewing room of the Mission Operations Control Room. This is on a balcony overlooking the main floor of the Control Room. I don't know exactly what I expected to see when I entered the Control Room, but somehow I was surprised and had the feeling that I had wound up in the midst of a Hollywood set. The Control Room is extremely well-appointed and well-outfitted. It is not very different in appearance from our Control Room in Houston. On the front wall there are a number of large screens for either optical or television displays. Television displays are handled with an eidophor just as they are in our case.

As we entered the Control Room, a playback of the Soyuz 12 final countdown was in progress. Across the top of the front wall are a number of clocks showing Moscow time, elapsed time, station acquisition time, and station loss-of-signal time. On the left hand screen were displayed a number of trajectory parameters—apogee, perigee, period, etc. The top of the center screen was [18] a world map with a lighted dot indicating the spacecraft location. The bottom part of the screen was a piece of flight plan concentrating on the "dynamic mode" which refers to the type of control of the spacecraft, as well as a display concerning the type of data being displayed (real time, playback, etc.). On the right hand screen the top half was a television display of the booster at the launch site (later on it switched to onboard television), while the bottom half of the right hand screen contained additional flight planning parameters. (We saw later that there was access to at least this screen from a typewriter at the back of the Control Room, and they were able to type the message "Welcome American colleagues" on that screen.

On the floor were four rows of consoles. The very back row, which is out of sight from the balcony, is for the people who set up the communications and data flow within the Control Center. Also the Project Director (Bushuyev) will sit in this back row. The Flight Director is in the next row from the back and is the focal point for all activity in the Control Center. To his left and right, and in the two rows of consoles in front of him, are the various support functions, which are pretty much the same as the functions within our own Control Center, except that there is no launch vehicle console. Each console has a number of television screens, and the Flight Controller at that console calls up all sorts of

displays, either out of the computers or from any one of a number of hard copy projectors. Real time data apparently are only a few seconds behind the actual event. They are also able to generate within the computer a display which merely indicates whether all parameters on a given subsystem are normal or abnormal. If they are normal, that's the end of it. If they are abnormal, the Flight Controller can then go to another display to find out which function is specifically abnormal. There are no warning tones with any of the displays. The communications system allows the Flight Director to talk to any or all of the other consoles as well as to the back rooms. We learned that the Control Center takes over after the spacecraft has been separated from the launch vehicle in orbit. Until that time, the flight is under full control of the Launch Center. The reason for this was explained to us as follows:

First, there are no booster functions that can be performed by the astronauts themselves. Second, spacecraft functions must also be read out at the Launch Center for checkout purposes, and spacecraft experts are at the Launch Center for checkout purposes. [19] For both of these reasons it was more convenient then to handle all abort control at the launch site and not at the Mission Control Center. These facts were further borne out when we saw the onboard TV of the Soyuz 12 launch. The cosmonauts were lying in their couches with their hands folded in their laps. They are obviously just passengers during the launch phase.

In the Mission Operations Control Room Yeliseyev answered all questions concerning flight control. He has obviously been there before and has obviously worked in the Control Center on at least some simulations if not on Soyuz 12. The questions concerning the Control Center itself were answered by the "Deputy Flight Director for Measurements." I believe his name was Miltsin, but I am not sure of this. At any rate, he obviously knew the Control Center well and was able to answer every question which we asked. There was no holding back.

We left the Control Room floor and went behind the large screen where we saw the display projectors. From there we looked into a large number of rooms housing, first, communications equipment, and then computing equipment. We also went to one of the staff support rooms, which was located quite a distance from the Control Room floor, but was equipped with consoles similar or identical to those in the Control Room. Communications gear included a large number of teletype machines as well as all sorts of terminals, recorders, strip charts, and the kind of gear you see in any communications center.

We also saw rooms where all of the onboard tapes were being processed, but none for photographic processing. All of the computing equipment appeared to be made in the Soviet Union. There are three large digital computers, and my guess would be that they are of the generation we used for Mercury and Gemini and not of the Apollo generation. The external memory is a drum memory with 16 drums, each storing 32,000 48-bit words for each of the computers. I don't recall the numbers for the internal memories. In addition to the main computers, there are quite a few peripheral computers used for special tasks. The computers are used for trajectory as well as telemetry work.

As I said earlier, every one of our questions was answered in detail, and if there is anything we don't know it is only because we didn't have enough time or didn't know to ask the [20] right questions. Lunney and Frank, both of whom are very familiar with our own Control Center, should, of course, have a much better view of the real significance of what we saw. It was also of interest that the Control Center was obviously not controlling a flight while we were there. There was very little activity, although one or two people were in evidence in each or the rooms where we opened a door.

During one of the toasts at lunch, Abduyevski said that frankly they had been quite concerned about our visit because they knew of our wonderful technology and hoped that they compared favorably. Many of the private questions we were asked afterwards also concerned our views of their Center. They are obviously very proud of it.

VISIT TO INSTITUTE OF GEOCHEMISTRY

This is Vinogradov's institute where lunar samples are being analyzed. The area of sample handling and preliminary analysis is extremely primitive. Samples from Luna 16 and 20 and from Apollos 11 through 17 were all in storage. The various tools for sample analysis throughout the institute also appeared to be extremely primitive and mostly foreign made. We were shown equipment for spectrographic analysis, a scanning electron microscope, and equipment to measure magnetic spin resonance. I was impressed by neither the people nor the equipment.

INSTITUTE OF SPACE RESEARCH

This institute is in a brand new building which is not yet fully in operation. Apparently the building was constructed by a military labor battalion. It is the shoddiest construction I have ever seen.

We were taken to various laboratories in the Institute and saw flight instrumentation used in gamma ray astronomy, X-ray astronomy, particles and fields measurements, and ionospheric measurements. We also saw some of the instruments which are now on their way to Mars. Incidentally, I asked Sagdeyev whether the newspaper reports to the effect that no life sensing instruments were on the present Mars spacecraft were indeed true, and he said yes, they were not yet ready to send any instruments [21] that were capable of searching for life. He implied, however, that they were working on such instruments for the next Mars opportunity. He also asked how long it had taken us to develop the instruments we intend to fly on Viking. There was some additional discussion about the present flights to Mars and apparently one of the four spacecraft is having telemetry difficulties which have not yet been resolved.

The X-ray type instrumentation we saw apparently has already been flown and some results have been published. By their own admission, however, these results are not as good as those obtained with Uhuru. They indicated that since their satellite was not in an equatorial orbit and was only in orbit for a short period of time, they could not match Uhuru's results. The gamma ray instrumentation we saw had not yet flown on a satellite. Insofar as ionospheric measurements are concerned, they apparently have a very active program, both with sounding rockets and with satellites.

In summary, we saw instruments of the type flown in our physics and astronomy and planetary programs. Although earth resources work is also going on in the same institute, this was not discussed nor were we shown any of the work. Our guess is that they just don't have anything worth seeing.

The remaining time at the Institute of Space Research was spent on a discussion of the results of the Venus 8 spacecraft. (Sagdeyev pointed out that this was done especially at the request of Keldysh since we had discussed our Mars results with Keldysh.) The briefing was given by Abduyevski, who, as I mentioned earlier, is now the Deputy Director of the Control Center. Whereas he was a novice at the Control Center business, he knew all about the engineering of the Venus 8 spacecraft as well as the details of the scientific results. My guess is that he was deeply involved in the Venus 8 flight.

The Venus 8 spacecraft was designed to withstand the Venus surface temperatures for a short period of time (approximately 1 hour). This was achieved with good insulation and through precooling the spacecraft for several days before it arrived at Venus. Abduyevski made a major point of the fact that the insulating properties of the insulation change drastically with increasing pressures of the kind encountered at the surface of Venus (90 atmospheres), and that new materials with lower "filtration constants" had to be designed.

[22] The most interesting result was the measurement of surface lighting in an area near the Venus terminater. The conclusion is that there is adequate lighting on the surface of Venus for television, even near the terminater.

VISIT WITH KIRILLIN

As I mentioned before, this was a courtesy visit made at my request. After a few words of welcome by Kirillin, I opened the discussion by reviewing the status of ASTP and other joint projects.

Kirillin then asked my views concerning the practical results of the exploration of space. I spoke of the usual things—communications, weather, and earth resources—as well as the potential long-range results of some of the scientific efforts in space. Kirillin came back to the point that the future of space must be practical and added one subject which I had left out of my discussions of earth resources, and that is geology. He felt that major contributions to geology can be made from space.

I then asked Kirillin where he thought our future cooperation in space might go. My purpose in asking this question was to find out whether he had given the matter any thought. Apparently he had not and gave only a very vague answer.

Finally, I brought up the subject of aeronautics, reminding Kirillin that NASA, of course, has a major effort in aeronautics research and asking whether he had ever considered any cooperation in this area. His eyes immediately lit up and he started talking about some of the commercial discussions now underway with Boeing, General Dynamics, and McDonnell Douglas, but he wondered what I had in mind and how NASA might fit in. I told him that I had really nothing specific in mind when I brought up the subject but that any cooperative efforts with NASA would have to be in the areas of aeronautical research as opposed to in the commercial areas. Both of us agreed to think about future possibilities in possible cooperation in aeronautics and said that we might pursue this at a later time.

[23] *PUBLIC AFFAIRS PLAN*

Donnelly had negotiated the first phase of a Public Affairs Plan covering preflight activities. This plan had been signed by Lunney and Bushuyev; it was to be confirmed by Petrov and me. When I met with Donnelly to review the plan he was concerned that the definition of news media in the plan was not clear and that it was quite likely that the Soviet side would not permit television cameramen to accompany television correspondents. Instead, he felt that they would want to impose on us the usual practice of having the Soviets take all television film and of selling that film through Novesty news agency. Donnelly, therefore, suggested that we should not confirm the plan until this issue had been settled. (Since this was an open issue, it is still not clear to me why he asked Lunney to approve the plan in the first place.)

In subsequent discussions with Petrov, it became clear to me that the plan as signed lacked in two other respects: first, it would be quite possible that the Soviet side would admit its own news media to a joint function without at the same time admitting U.S. news

media; and secondly, Donnelly indicated that he had verbal agreements that our astronauts could be accompanied by their own documentary photographer. This was not written down in the plan.

In my first meeting with Petrov (the meeting at Star City), he appeared to understand all the points that needed to be covered, and also appeared to be in agreement with them.

We adjourned our meeting at Star City, and Frutkin and I wrote additions to the Public Affairs Plan in the area of the three points mentioned; that is, the definition of news media, the participation of news media from both sides in joint activities, and the possibility of bringing along a documentary photographer. When we met again the next morning, Petrov was not as willing to include these new additions as he had implied the night before. Obviously, he must have checked into this with somebody better versed in the ways of the press in the Soviet Union. He threw up a smoke screen about things like the copyright agreement and the lighting required whenever TV cameramen were present. I told him that I wanted him to understand that there is only one serious issue in the definition of news media and that concerns television [24] cameramen. Will U.S. cameramen be allowed in the Soviet Union or not? The meeting broke up without reaching any conclusion. Subsequently, Frutkin had additional discussions with Vereshchetin, and I had additional discussions with Petrov. Vereshchetin assured Frutkin before we left Moscow that they agreed in principle with all of our points, but they were not sure whether they could agree exactly with our language. They promised that they would send, at an early date, a new version of the Public Affairs Plan, incorporating the substance of our additions. We could then either confirm the plan or, if we still did not like it, we would have to have further negotiations.

MISCELLANEOUS ITEMS

Comet Kohoutek

I gave Petrov several reprints of the Kohoutek article which appeared in the October issue of *Aeronautics and Astronautics*, and asked whether the USSR would have any interest in participating in the planned observations. On the following day Petrov informed me that they would ordinarily be quite interested in participating, thanked me for the invitation, but told me that during the time of the Comet the weather would be so bad in the Soviet Union that it was unlikely that any of their ground observatories would be able to see it. I took this as a polite way of saying "no."

Reaffirmation of the Low-Keldysh Agreement

Frutkin informed me that he believed that the Low-Keldysh Agreement needed to be reaffirmed three years after it was approved, or in the spring of 1974. Although I was not quite sure that this was the case, I did bring up the subject with Petrov. He implied that the spring of 1974 would be a bad time because this will be the 250th Anniversary of the Soviet Academy of Sciences, and Keldysh is expected to be very busy. However, he suggested that we might get together in the summer or fall of 1974. Although he assumed that we would get together in the Soviet Union, I issued an invitation to do this in the United States. However, I am not sure how necessary it is to do anything other than to exchange letters on the subject.

George M. Low

Document I-49

Document title: George M. Low, Deputy Administrator, NASA, to Academician M.V. Keldysh, President, Academy of Sciences of the USSR, March 24, 1975.

Source: George M. Low Papers, Institute Archives and Special Collections, Rensselaer Polytechnic Institute, Troy, New York.

The United States viewed the Apollo-Soyuz Test Project as only the first step in an ambitious program of U.S.-Soviet space cooperation. As indicated in this letter, the United States was eager to begin discussing next cooperative steps with the Soviet Union even before the Apollo-Soyuz mission was completed.

---

[1] March 24, 1975

Academician M. V. Keldysh
President
Academy of Sciences of the USSR
Leninsky Prospect 14
Moscow, V-71, USSR

Dear Academician Keldysh:

I understand that the ASTP Technical Directors have now agreed on the schedule of activities for the May meetings in the Soviet Union. Accordingly, I plan to arrive in Moscow on May 17 and to join in the visit to the launch area scheduled for May 19. I would return with the Technical Directors to Moscow and remain for the Flight Readiness Review on May 23.

This schedule would make May 21 and 22 available for other business. I understand from Academician Petrov your wish to defer the meeting of full delegations for detailed discussions of future cooperation because of the demands of ASTP on the time of your specialists and because of the demands of the Academy elections on your own time. We, of course, will accede to your wishes in this respect. At the same time, I believe it would be most desirable for us to take advantage of this opportunity to meet briefly.

To assure that your concerns are met, our meeting could be entirely informal in character, with no written record. I would plan to be accompanied only by Mr. Frutkin and our interpreter. I would expect to outline the status of our thinking here with regard to future possibilities for cooperation. You would, of course, be free to comment or to indicate Soviet thinking in the degree you wish. It would be understood that no commitments of any kind were implied by either side.

Our own present thinking, which I would expand on in our meeting, is along three lines:

1. Projects in the area of manned space flight—We would be prepared to consider cooperative exploratory [2] *studies* of future space stations, with a view to pursuing such studies to further steps, if warranted. We are prepared also to consider such possible interim steps as a Space Shuttle/Salyut mission, as well as Soviet use of the Shuttle in cooperative projects of mutual value.

2. Projects in the area of unmanned scientific missions—We have in mind the possibility of a lunar farside sample return mission, and we continue to find the long-term goal of a future Mars surface sample return mission attractive.

3. Projects in the area of space applications—Here we have in mind such possibilities as coordinated environmental monitoring missions and the exchange of data relating to radiation balance, stratospheric ozone monitoring, and search and rescue.

In the informal conversation which I suggest, we might also refer to a subject which Dr. Lunney has already taken up with Prof. Bushuyev in a preliminary way. If the first NASA Space Shuttle mission is to have rendezvous and docking capability compatible with Soviet spacecraft of the 1979-80 time period, we would need, for development purposes, to have agreement by January 1976 on such parameters as diameter of the passageway, load factors, communications interface, and atmospheric pressures. To this purpose, we would want to put discussion of such parameters by our specialists on a schedule consistent with design and development requirements.

I hope it would be possible to use the occasion of my presence in Moscow for such an informal constructive conversation so that we can preserve the momentum which has been generated by our cooperation in ASTP.

Sincerely,

George M. Low
Deputy Administrator

Document I-50

Document title: A.P. Aleksandrov, USSR Academy of Sciences, and A.M. Lovelace, NASA, "Agreement Between the USSR Academy of Sciences and the National Aeronautics and Space Administration of the USA on Cooperation in the Area of Manned Space Flight," May 11, 1977.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

This agreement was the result of almost two years of discussions between the United States and the Soviet Union. It was signed at the time that the renewal of the U.S.-Soviet Space Cooperation Agreement for a second five-year term was announced. The agreement was never implemented. Carter administration displeasure with the Soviet record on human rights and then with Soviet involvement in Afghanistan led to low priority being given to U.S.-U.S.S.R. space cooperation overall.

---

[1]

Agreement Between the USSR Academy of Sciences and the National Aeronautics and Space Administration of the USA on Cooperation in the Area of Manned Space Flight

In accordance with the Agreement on Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes between the USSR and the USA, dated May 24, 1972, and taking into account the results of discussions held in Washington, October 19-22, 1976, between the delegation of the USSR Academy of Sciences, headed by the Chairman

of the Intercosmos Council of the USSR Academy of Sciences, Academician B. N. Petrov, and the delegation of the National Aeronautics and Space Administration of the USA, headed by the NASA Deputy Administrator, Dr. A. M. Lovelace, the Academy of Sciences and NASA agree to undertake the following steps for further development of cooperation between the USSR and USA in the exploration and use of outer space for peaceful purposes.

I. *Study of the Objectives, Feasibility and Means of Accomplishing Joint Experimental Flights of a Long-Duration Station of the Salyut-Type and a Reusable "Shuttle" Spacecraft (Salyut-Shuttle Program)*

In view of the fact that the long orbital stay-time of the Salyut-type station and the capabilities of the Shuttle spacecraft commend their use for joint scientific and applied experiments and for further development of means for rendezvous and docking of spacecraft and stations of both [2] nations, the two sides agree to establish two joint working groups (JWGs) of specialists, charging them with studying the objectives, feasibility and means of carrying out a joint experimental program using the Soyuz/Salyut and Shuttle spacecraft:

- a JWG for basic and applied scientific experiments.
- a JWG for operations.

Within 30 days after the Agreement becomes effective, the sides will inform each other of the initial leaders and composition of these JWGs. The work of both Joint Working Groups should begin simultaneously. The composition of the JWGs can be changed or enlarged at any time as necessary. Appropriate sub-groups can be formed.

In their studies, the JWGs should proceed on the assumption that the first flight would occur in 1981. The final date would be set in the course of the joint work.

First Phase of the Joint Working Groups' Activity

The following preliminary project documents should be prepared within 6-12 months after the agreement comes into effect:

- preliminary proposals for scientific experiments;
- preliminary technical proposals for carrying out the program;
- preliminary schedules for implementing the program.

[3] *Second Phase of the Joint Working Groups' Activity*

The JWGs should prepare the following definitive documents within one year of joint work in the second phase:

- a technical description of the joint program and its realization;
- a scientific program for the joint flight;
- a schedule for conducting the joint work;
- an organizational basis for implementing the program;
- a list of additional joint technical documentation which may be required.

The sides will make the final decision on implementing the program at the end of the second phase of the JWGs' activity.

The working period of the JWGs in the first and second phases of their activities can be shortened.

Each side will consider the accommodation on its spacecraft of payloads proposed by the other side for flight in the Shuttle-Salyut program. Such accommodation will be undertaken where both sides agree that the payloads concerned are of mutual value and interest.

II. *Consideration of the Feasibility of Developing an International Space Platform in the Future (International Space Platform Program)*

Both sides recognize that no commitments are made at [4] this stage concerning the realization of any project for creating an international space platform.

The sides agree to establish a Joint Working Group of specialists for preliminary consideration of the feasibility of developing an International Space Platform on a bilateral or multilateral basis in the future.

The JWG will carry out its work on the basis of studies conducted by each side independently and also by the two sides jointly, proceeding from each of the following stages to the next as may be mutually agreed:

- define at the first stage the scientific and technical objectives which would warrant the use of such a space platform.
- consider possible configurations appropriate to the objectives identified.
- formulate proposals on the feasibility and character of further joint work which may be desirable in this field.

At the first stage of its activity, the group will work in close coordination and contact with the JWGs set up to consider ways to realize the Salyut-Shuttle program.

The sides will appoint the initial leaders and members of the JWG for this program within two months after the Agreement goes into effect. This JWG should formulate preliminary proposals on possible scientific-technical objectives which could be achieved by an international station one year after beginning its work.

[5] This Agreement comes into force at the moment it is signed by both sides.

For the USSR Academy of Sciences	For the National Aeronautics and Space Administration of the USA
A. P. Aleksandrov	A. M. Lovelace

Document I-51

Document title: George P. Shultz and Eduard Shevardnadze, "Agreement Between the United States of America and the Union of Soviet Socialist Republics Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes," April 15, 1987, with attached: "Agreed List of Cooperative Projects."

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

As part of its overall hostile stance toward the Soviet Union, the administration of President Ronald Reagan allowed the basic U.S.-Soviet Space Cooperation Agreement, signed in 1972 and renewed in 1977, to lapse when it came up for renewal in 1982. U.S. policy toward the U.S.S.R. became much more friendly after Mikhail Gorbachev came into power in 1985, and by 1987 the two countries had agreed to restart formal cooperative activities in space. This agreement, signed by the U.S. secretary of state and the Soviet foreign minister, provided the framework for such cooperation, and an attached list identifies an initial sixteen areas of possible cooperation.

[1]

Agreement Between the United States of America and the Union of Soviet Socialist Republics Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes

The United States of America and the Union of Soviet Socialist Republics, hereinafter referred to as the Parties;

Considering the role of the two States in the exploration and use of outer space for peaceful purposes;

Desiring to make the results of the exploration and use of outer space available for the benefit of the peoples of the two States and of all peoples of the world;

Taking into consideration the provisions of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, and other multilateral agreements regarding the exploration and use of outer space to which both States are Parties;

Noting the General Agreement Between the Government of the United States of America and the Government of the Union of Soviet Socialist Republics on Contacts, Exchanges, and Cooperation in Scientific, Technical, Educational, Cultural, and other fields, signed on November 21, 1985;

Have agreed as follows:

[2]

ARTICLE 1

The Parties shall carry out cooperation in such fields of space science as solar system exploration, space astronomy and astrophysics, earth sciences, solar-terrestrial physics, and space biology and medicine.

The initial agreed list of cooperative projects is attached as an Annex.

ARTICLE 2

The Parties shall carry out cooperation by means of mutual exchanges of scientific information and delegations, meetings of scientists and specialists and in such other ways as may be mutually agreed, including exchange of scientific equipment where appropriate. The Parties, acting through their designated cooperating agencies, shall form joint working groups for the implementation of cooperation in each of the fields listed in Article 1. The recommendations of the joint working groups shall be subject to the approval of each Party in accordance with its appropriate national procedures prior to implementation. The designated cooperating agencies shall notify each other of the action taken by the parties on the recommendations within three months of their adoption by the joint working groups.

[3] *ARTICLE 3*

The joint working groups shall begin their work with the projects listed in the Annex to this Agreement. Revisions to the list of projects in the Annex, which may include the identification of other projects in which cooperation would be of mutual benefit, may be effected by written agreement between the Parties through a procedure to be determined by them.

ARTICLE 4

Cooperative activities under this Agreement, including exchanges of technical information, equipment and data, shall be conducted in accordance with international law as well as the international obligations, national laws, and regulations of each Party, and within the limits of available funds.

ARTICLE 5

This Agreement shall be without prejudice to the cooperation of either Party with other States and international organizations.

ARTICLE 6

The Parties shall encourage international cooperation in the study of legal questions of mutual interest which may arise in the exploration and use of outer space for peaceful purposes.

[4] *ARTICLE 7*

This Agreement will enter into force on the date of signature by the Parties and will remain in force for five years. It may be extended for further five-year periods by an exchange of notes between the Parties. Either Party may notify the other in writing of its intent to terminate this Agreement at any time effective six months after receipt of such notices by the other Party.

IN WITNESS WHEREOF the undersigned, being duly authorized by their respective Governments, have signed this Agreement.

DONE at Moscow, in duplicate, this 15th day of April, 1987, in the English and Russian languages, both texts being equally authentic.

[signed George P. Shultz]
FOR THE UNITED STATES OF AMERICA:

[signed Eduard Shevardnadze]
FOR THE UNION OF SOVIET SOCIALIST REPUBLICS:

****

[Attachment page 1]

Agreed List of Cooperative Projects

1. Coordination of the Phobos, Vesta, and Mars Observer missions and the exchange of scientific data resulting from them.
2. Utilization of the U.S. Deep Space Network for position tracking of the Phobos and Vesta landers and subsequent exchange of scientific data.
3. Invitation, by mutual agreement, of co-investigators and/or interdisciplinary scientists' participation in the Mars Observer and the Phobos and Vesta missions.
4. Joint studies to identify the most promising landing sites on Mars.
5. Exchange of scientific data on the exploration of the Venusian surface.
6. Exchange of scientific data on cosmic dust, meteorites and lunar materials.
7. Exchange of scientific data in the field of radio astronomy.
8. Exchange of scientific data in the fields of cosmic gamma-ray x-ray, and submillimeter astronomy.
9. Exchange of scientific data and coordination of programs and investigations relative to studies of gamma-ray burst data.
10. Coordination of observations from solar terrestrial physics missions and the subsequent exchange of appropriate scientific data.
11. Coordination of activities in the study of global changes of the natural environment.
12. Cooperation in the Cosmos biosatellite program.
13. Exchange of appropriate biomedical data from U.S. and U.S.S.R. manned space flights.
14. Exchange of data arising from studies of space flight-induced changes of metabolism, including the metabolism of calcium, from both space flight and ground experiments.
15. Exploration of the feasibility of joint fundamental and applied biomedical experiments on the ground and in various types of spacecraft, including exobiology.
16. Preparation and publication of a second amplified edition of the joint study "Fundamentals of Space Biology and Medicine."

Document I-52

Document title: Office of the Press Secretary, The White House, "Joint Statement on Cooperation in Space," June 17, 1992.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

The 1991 collapse of the Soviet Union and the emergence of the Russian Federation as its primary successor opened new prospects for space cooperation. The Russian Federation created a civilian space agency, the Russian Space Agency, in April 1992; its head was Yuri Koptev, formerly an official of the Soviet Ministry of General Machine Building. On April 1, 1992, a new NASA Administrator, Daniel S. Goldin, took office. The two agency heads met for the first time in June 1992 and quickly agreed that there were many opportunities for enhanced cooperation, particularly in the area of human spaceflight. During a summit meeting between Russian President Boris Yeltsin and U.S. President George Bush a few days later, the two countries announced their intention to broaden cooperative relations in space.

[1] June 17, 1992

Joint Statement on Cooperation in Space

— The United States and the Russian Federation have agreed on steps to broaden cooperation in the use and exploration of outer space:
  - *Space Agreement:* A new space agreement has been signed today that puts space cooperation between the two countries on a new footing, reflecting their new relationship.
  - The new agreement provides a broad framework for NASA and the Russian Space Agency to map out new projects in a full range of fields; space science, space exploration, space applications and the use of space technology.
  - Cooperation may include human and robotic spaceflight projects, ground-based operations and experiments and other important activities, such as monitoring the global environment from space, Mir Space station and Space Shuttle missions involving the participation of U.S. astronauts and Russian cosmonauts, safety of spaceflight activities, and space biology and medicine.
  - Pursuant to the agreement, the two governments will give consideration to the following:
    - flights of Russian cosmonauts aboard a Space Shuttle mission (STS 60), and U.S. astronauts aboard the Mir Space Station in 1993; and
    - a rendezvous docking mission between the Mir and the Space Shuttle in 1994 or 1995.
  - An important part of the agreement involves annual subcabinet consultations led at the Under Secretary of State/Deputy Foreign Minister level, a new mechanism for high level government review of the bilateral civil space relationship between the two countries.
— *Joint Study of Space Technology:* The two governments are also announcing detailed technical studies of the possible use of space technology.
  - NASA is awarding a contract to the Russian firm NPO Energiya; the principal area being examined in the Russian *Soyuz-TM* spacecraft as an interim crew return vehicle for Space Station Freedom.
[2] - Other important areas to be studied are the suitability of the Russian developed *Automated Rendezvous and Docking System* in support of NASA spaceflight activities, the use of the *Mir Space Station* for long–lead time medical experiments, and other applications by NASA of Russian hardware.
— *Space Commerce:* Both governments also agreed on steps to encourage private companies to expand their search for new commercial space business.
  - The United States has accepted an invitation from the Russian Federation for American businessmen to visit Russia. The Department of Commerce will lead a delegation of U.S. aerospace firms to Russia in the near future on a space technology assessment mission.
  - The Russian Federation has accepted an invitation from the United States to send a delegation of business leaders to the United states to meet with their counterparts in the American aerospace private sector.
— *Space Launch:* Reflecting its support for economic reform in Russia, the United States has decided to consider favorably a decision expected by the INMARSAT Organization in July 1992 to launch one of the INMARSAT 3 satellites from Russia.

- The INMARSAT 3 satellite is manufactured primarily in the United States. If approved by INMARSAT, this would mark the first time that a U.S. manufactured commercial satellite would be launched from Russia.
- The United States and Russia have agreed to negotiate a bilateral agreement on technology safeguards for the INMARSAT 3 satellite to enable issuance of a U.S. export license.
- The United States and the Russian Federation support the application of market principles to international competition in the provision of launch services, including avoidance of unfair trade practices.
- Recognizing Russia's current transition to a market economy, and in order to allow consideration of future proposals involving Russian launch of U.S. satellites, the Russian Federation and the United States have agreed to enter into international negotiations on an expeditious basis to develop international guidelines concerning competition in the launch of commercial satellites.
- In the case of INMARSAT, the Russian Federation has also assured the United States that the terms and conditions of the Russian proposal, including pricing, are consistent with those that would normally be offered in the international market.

Document I-53

Document title: "Implementing Agreement Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency of the Russian Federation on Human Space Flight Cooperation," October 5, 1992.

Document I-54

Document title: Office of the Vice President, The White House, "United States-Russian Joint Commission on Energy and Space—Joint Statement on Cooperation in Space," September 2, 1993.

Document I-55

Document title: "Protocol to the Implementing Agreement Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency of the Russian Federation on Human Space Flight Cooperation of October 5, 1992," December 16, 1993.

Source: All in NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

As a result of the U.S.-Russian dialogue on expanded space cooperation initiated in June 1992, NASA and the Russian Space Agency signed an agreement in October 1992 to exchange cosmonauts and astronauts on each others' human spaceflight missions and to dock the Space Shuttle with the Russian space station Mir. *During its first year in office, the administration of President Bill Clinton and Vice President Al Gore moved to expand substantially existing U.S.-Russian cooperation in human spaceflight, in effect merging large portions of the efforts of the only two countries with the capability of sending people into space; such a move was announced in September 1993. The political decision to undertake this expansion was linked to broader U.S.-Russian foreign policy concerns, such as stemming the proliferation of missile technology capability and providing job opportunities for the Russian aerospace sector. The United States agreed to provide funding for various Russian*

activities and hardware associated with the expanded cooperation; this transfer broke with the long-standing NASA tradition that its cooperative programs did not involve an exchange of funds. After a few more months of discussion, NASA and the Russian Space Agency decided to increase the intensity of their interactions, particularly with respect to flights of the U.S. Space Shuttle to dock with the Russian space station Mir. *On December 16, 1993, the heads of the two agencies signed a protocol to the October 1992 agreement that reflected this new level of activity.*

Document I-53

[1]

Implementing Agreement Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency of the Russian Federation on Human Space Flight Cooperation

PREAMBLE

The National Aeronautics and Space Administration (hereafter referred to as "NASA") and the Russian Space Agency (hereafter referred to as "RSA"), jointly referred to as "The Parties," have agreed to cooperate in the area of human space flight. This cooperative program consists of three inter-related projects: the flight of Russian cosmonauts on the U.S. Space Shuttle; the flight of U.S. astronauts on the Mir Space Station; and a joint mission involving the rendezvous and docking of the U.S. Space Shuttle with the Mir Space Station. These will be jointly referred to in the future as the "Shuttle-Mir Program."

The Parties have agreed as follows:

ARTICLE I: DESCRIPTION OF COOPERATION

1. The cooperation set forth in this Implementing Agreement will be undertaken in accordance with the Agreement Between the United States of America and the Russian Federation concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes, of June 17, 1992 (hereinafter the June 17, 1992 Agreement).

2. An experienced cosmonaut will fly aboard the Space Shuttle on the STS-60 mission, which is currently scheduled for November 1993. The cosmonaut will be an integral member of the orbiter crew, and will be trained as a Mission Specialist on Shuttle systems, flight operations, and manifested payload procedures following existing Shuttle practices.

3. The RSA will nominate two cosmonauts, for approval by NASA as candidates for the STS-60 Space Shuttle mission. In accordance with Article IV, one of the two cosmonauts will be designated the Primary Russian-sponsored crewmember, with the other being designated as a backup crewmember. Both crewmembers will receive [2] Mission Specialist Astronaut training, until the time that the STS-60 crew begins dedicated mission training. From that point, the backup crewmember will receive as much training as practical. The two cosmonauts will be scheduled for arrival at the Johnson Space Center in Houston, Texas, in October, 1992. Their names, experience and personal history will be provided to NASA by the RSA prior to the initiation of training.

4. An experienced NASA astronaut will fly on the Mir Space Station as an integral long-duration crewmember (e.g., longer than 90 days) participating as an integral member of the crew in a variety of operations and experiments. The timing of this flight will be consistent with a Shuttle docking flight in 1994 or 1995. The astronaut will be flown to the Mir on a Soyuz transportation system. Special emphasis will be placed on science, particularly life science, as well as engineering and operational objectives. Astronaut and cosmonaut participation before, during and after the long-duration flight will be emphasized to accomplish all flight objectives.

5. NASA will nominate two astronauts for approval by RSA as candidates for a long-duration Mir mission (e.g., longer than 90 days) to occur in conjunction with the rendezvous and docking of the Space Shuttle with Mir. In accordance with Article IV, one of the two astronauts will be designated as the primary U.S.-sponsored crewmember, with the other being designated as the backup crewmember. Both crewmembers will receive full cosmonaut training with their cosmonaut crew.

The two astronauts will be scheduled to begin training no later than 12 months prior to the agreed upon flight date. They will be U.S. citizens, and their names, experience and personal history will be provided to RSA by NASA no later than one month prior to the initiation of training.

6. The Space Shuttle will rendezvous and dock with Mir in conjunction with the flight of the NASA astronaut aboard Mir. NASA will transport two Russian cosmonauts in the Shuttle to replace the two cosmonauts on board Mir. Training for these cosmonauts will be in accordance with Article V of this Implementing Agreement. Life sciences experiments involving the NASA astronaut and the two cosmonauts who have been on board the Mir for 90 days or more will be conducted while the Shuttle is docked to the Mir. The NASA astronaut and the two cosmonauts who have been on the Mir for 90 days or more will be returned in the Shuttle for continued postflight life sciences experiments.

7. As part of the technical discussions leading up to the Mir rendezvous, joint implementation teams will explore the use of the Androgynous Peripheral Docking Assembly developed by NPO Energiya, consistent with the June 17, 1992 Agreement and this Implementing Agreement. (If such used appears technically [3] feasible, NPO Energiya will enter into a separate contract with an American company to provide, modify or integrate this device or its derivatives with the Shuttle.)

8. Joint implementation teams will also consider exchange of Mir crewmembers, transportation of experimental and logistic equipment, and Extra Vehicular Activity (EVA), and will define the respective responsibilities of the Parties, consistent with the June 17, 1992 Agreement and this Implementing Agreement. The implementation teams will jointly develop a contingency plan which will cover procedures for investigation, consultation, and exchange of data in the event of a mishap which causes damage to equipment or injury to personnel during the conduct of the Shuttle-Mir Program.

9. Consistent with the June 17, 1992 Agreement, each Party will be responsible for funding its respective responsibilities, consistent with its domestic laws and regulations, and subject to the availability of appropriated funds. All training, in-country travel and living arrangements, flight and other associated posts for each Party's crew members and dependents will be borne by the host country, in a manner it deems appropriate, at a standard afforded its own flight crews.

ARTICLE II: DESIGNATION OF REPRESENTATIVES AND ORGANIZATIONS

Designated Points of Contact for the implementation of the activities described herein are contained in Annex 1 to this Implementing Agreement. Annex 1 may be modified by either Party upon notification to the other Party. NPO Energiya and the Yuri Gagarin

Cosmonaut Training Facility will be the lead technical implementors of the Shuttle-Mir Program in Russia.

ARTICLE III: JOINT IMPLEMENTATION TEAMS

The Parties agree to establish joint implementation teams to coordinate and implement the activities described herein. Designated team members will be identified by each side within 30 days of the entry into force of this Implementing Agreement. Each Party may modify the membership of its joint implementation teams at its discretion. The joint implementation teams will develop a plan for implementation of the activities described herein on the basis of equality, reciprocity and mutual benefit, consistent with the June 17, 1992 agreement.

ARTICLE IV: SELECTION OF CANDIDATES

1. Selection of flight candidates will be based on mutual agreement prior to any announcement. Candidates selected will be [4] current, active members of each side's astronaut or cosmonaut corps.
2. Flight candidates selected will have previous space flight experience. The cosmonauts selected for training shall have sufficient knowledge in verbal and written English. The NASA astronauts selected for training shall have sufficient knowledge in verbal and written Russian. Information that each side's candidates meet the criteria in this Article shall be exchanged prior to any announcement on crew selections.

ARTICLE V: TRAINING

1. Throughout their training programs, the Russian cosmonauts will be based at the Johnson Space Center in Houston, Texas, and will be assigned to the Astronaut Office in the Flight Crew Operations Directorate. The NASA astronauts will be based at Yuri Gagarin Cosmonaut Training Facility ("Star City") in the Moscow Region.
2. At the beginning of the training programs, each Party will require its candidates to enter into a Standards of Conduct Agreement with the other Party, which will include, inter alia, installation safety and security matters, provisions related to prohibitions on use of position for private gain, authority of the Mission Commander, and limitations on use of information received during training and flight. Each Party will ensure that its candidates comply with the provisions of such an agreement.
3. The candidates will have completed all aspects of the required training to the full and final satisfaction of the host Party prior to certification for flight.
4. By mutual agreement, the Parties will identify any support personnel required for the flight candidates selected.

ARTICLE VI: SCIENCE

1. The Parties will establish a Scientific Working Group to coordinate appropriate scientific experiments and activities to be conducted by each side on the respective missions. Designated working group members will be identified by each side within 30 days of the entry into force of this Implementing Agreement. Each Party may modify the membership of its Scientific Working Group at its discretion.
2. Results of the scientific experiments conducted by each Party under this Implementing Agreement will be made available to the scientific community in general

through publication in appropriate journals of other established channels. In the event [5] such reports or publications are copyrighted, NASA and RSA shall have a royalty-free right under the copyright to reproduce, distribute and use such copyrighted work for their own purposes.

ARTICLE VII: LIABILITY

1. A comprehensive cross-waiver of liability between the two Parties and their related entities (e.g., contractors, subcontractors, and other participating entities associated with the Parties including any state from which RSA procures a launch to carry out its obligations under this agreement) shall apply to the activities under this agreement. The cross-waiver of liability shall be broadly construed. The terms of the waiver are set out in Annex 2.

2. Except as provided in Annex 2, the Government of the United States and the Government of the Russian Federation will remain liable in accordance with the Convention on International Liability for Damage Caused by Space Objects (the "Liability Convention") of March 29, 1972. In the event of a claim arising out of the Liability Convention, the governments will consult promptly on any potential liability, on any apportionment of such liability, and on the defense of such claim.

ARTICLE VIII: INVENTION AND PATENT RIGHTS

1. With the exception of the intellectual property rights referred to in Article X, Exchange of Technical Data and Goods, and subject to national laws and regulations, provisions for the protection and allocation of intellectual property rights created during the course of cooperation under this Implementing Agreement are set forth in Annex 1 of the June 17, 1992 Agreement.

2. Except as set forth in paragraph 1, nothing in this Implementing Agreement shall be construed as granting or implying any rights to, or interest in, patents or inventions of the Parties or their contractors and subcontractors.

ARTICLE IX: PUBLIC INFORMATION

Release of public information regarding these joint activities may be made by the appropriate agency for its own portion of the program as desired and, insofar as participation of the other is involved, after suitable consultation.

[6] ARTICLE X: EXCHANGE OF TECHNICAL DATA AND GOODS

Each Party is obligated to transfer to the other Party only those technical data and goods which both Parties agree are necessary to fulfill the responsibilities of the transferring Party under this Implementing Agreement, subject to the following:

1. Interface, integration, training and safety data (excluding detailed design, manufacturing, and processing data, and associated software) will be exchanged by the Parties without restrictions as to use or disclosure, except as otherwise restricted by national laws or regulations relating to export controls.

2. In the event a Party finds it necessary to transfer technical data other than that specified in paragraph 1 above, in carrying out its responsibilities under this Implementing Agreement that are proprietary, and for which protection is to be maintained, such technical data will be marked with a notice indicating that it shall be used and

disclosed by the receiving Party and its contractors and subcontractors only for the purposes of fulfilling the receiving Party's responsibilities under this Implementing Agreement, and that the technical data shall not be disclosed or retransferred to any other entity without prior written permission of the furnishing Party. The receiving Party agrees to abide by the terms of the notice, and to protect any such marked technical data from unauthorized use and disclosure.

3. In the event a Party finds it necessary to transfer technical data and goods in carrying out its responsibilities under this Implementing Agreement that are export-controlled, and for which protection is desired, the furnishing Party will mark such technical data with a notice and identify such goods. The notice or identification will indicate that such technical data and goods will be used and such technical data will be disclosed by the receiving Party and its contractors and subcontractors only for the purposes of fulfilling the receiving Party's responsibilities under this Implementing Agreement. The notice or identification will also provide that such technical data will not be disclosed, and such technical data and goods will not be retransferred, to any other entity without prior written permission of the furnishing Party. The Parties will abide by the terms of the notice or identification and will protect any such marked technical data and identified goods.

4. The Parties are under no obligation to protect any unmarked technical data or unidentified goods.

[7] ARTICLE XI: CUSTOMS AND IMMIGRATION

1. Each Party will facilitate the movement of persons and goods necessary to implement this Implementing Agreement into and out of its territory, subject to its laws and regulations. The RSA will take steps to expedite such movement of persons and goods to launch facilities it will utilize to fulfill its obligations under this Implementing Agreement.

2. Subject to its laws and regulations, each Party will facilitate provision of the appropriate entry and residence documentation for the other Party's nationals and families of nationals who enter, exit, or reside within its territory in order to carry out the activities under this implementing Agreement. The RSA will take steps to arrange for such provision for such activities at launch facilities it will utilize to fulfill its obligations under this Implementing Agreement.

3. The Parties agree to arrange for free customs clearance for entrances to, and exits from, their respective countries for equipment required for implementation of the activities described herein. The RSA will take steps to arrange for such clearances to and from launch facilities it will utilize to fulfill its obligations under this Implementing Agreement.

ARTICLE XII: SETTLEMENT OF DISPUTES

1. The Parties will consult promptly with each other on all issues involving interpretation or implementation of this Implementing Agreement. In the case of a continuing dispute, such matters will first be referred to the Points of Contact identified in Annex 1.

2. Any matter which has not been settled in accordance with the above paragraph will be referred to the NASA Associate Administrator for Space Flight and the First Deputy of the General Director of the RSA, or their designees, for resolution. Issues not resolved at this level will be referred to the NASA Administrator and the RSA General Director.

ARTICLE XIII: DURATION OF IMPLEMENTING AGREEMENT

1. This Implementing Agreement will terminate five (5) years following its entry into force or upon completion of all activities covered by this Implementing Agreement, whichever comes first. This Implementing Agreement may be extended or amended by written agreement of the Parties.
[8] 2. Either Party may terminate this Implementing Agreement upon six months written notice to the other Party. Termination of this Implementing Agreement shall not affect the Parties' continuing obligations under Articles VII, VIII and X, unless otherwise agreed to by the Parties.

ARTICLE XIV: ENTRY INTO FORCE

This Implementing Agreement will enter into force upon an exchange of diplomatic notes between the Governments of the United States of America and the Russian Federation confirming acceptance of its terms and that all necessary legal requirements for entry into force have been fulfilled.

IN WITNESS WHEREOF the undersigned, being duly authorized by their respective Governments, have signed this Implementing Agreement.

Done at Moscow, in duplicate, this 5th day of October, 1992, in Russian and English languages, both texts being equally authentic.

Daniel S. Goldin
FOR THE NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION
OF THE UNITED STATES OF AMERICA

Yuri Koptev
FOR THE RUSSIAN SPACE AGENCY
OF THE RUSSIAN FEDERATION

Document I-54

[1] THE WHITE HOUSE

Office of the Vice President

September 2, 1993

United States-Russian Joint Commission on Energy and Space

Joint Statement on Cooperation in Space

Having reviewed the status of the agreement between the United States of America and the Russian Federation Concerning Cooperation in the Exploration and Use of Outer Space for Peaceful Purposes dated June 17, 1992, the Parties note with satisfaction past agreement on the following: the flight of a Russian cosmonaut on the Space Shuttle System in 1993 and 1994, and American astronauts on the MIR station, the docking and a joint flight of these two space complexes in 1995. These activities are consistent with the

national space programs of both countries and the overall development of a spirit of trust, partnership, and long-term political and scientific and technological cooperation between Russia and the United States.

Based on the agreement reached at a meeting of the U.S. and Russian Presidents in Vancouver on April 3-4, 1993 and June 17, 1992, the Parties see great promise and mutual benefit through cooperation in space science and exploration activities.

Given the particular importance for Russia and the U.S. of their respective efforts in developing a new generation of orbital stations for scientific and technological progress and human activities in space, the Parties regard further cooperation in this area as most important, and consistent with the interests of both Russia and the U.S., as well as the broader international community.

With this in mind it is the intent of the U.S. and Russia to undertake a cooperative human space flight program. Interim investigation has already indicated potential advantages of joint cooperative activities in a truly international space station program. The Parties intend to pursue such cooperation in accordance with the following principles:

- joining on a mutually beneficial basis the resources and the scientific, technological, and industrial potentials of Russia and the U.S. in space activities to carry out a large-scale program of scientific, technical, and technological research;
- working with each of our current partners, and in accordance with earlier international obligations assumed by each of the Parties under the Freedom and MIR projects;

[2] - operating in an orbit which is accessible by both U.S. and Russian resources;

- utilizing compatible service systems, enhancing reliability of the station and increasing the flexibility of transportation and technical maintenance;
- performing activities under cooperative programs on mutually beneficial terms, and including on a contract basis the procurement of individual systems and units or the provision of services.

The first phase of our joint programs begins immediately and is designed to form a basis for resolution of engineering and technical problems. This initial phase encompasses an expansion of our bilateral program involving the U.S. Space Shuttle and the Russian MIR Space Station. The MIR will be made available for U.S. experiments for up to two years of total U.S. astronaut stay time. The number of Space Shuttle flights and the length of crew stay time will depend upon the details of the experiments to be defined by November 1, 1993. During phase one, the use of the Russian modules "Priroda" and "Spektr," equipped with U.S. experiments, could undertake a wide-scale research program. These missions will provide valuable in-orbit experience in rendezvous, docking, and joint space-based research in life sciences, microgravity, and Earth resources. It will bring to reality performance of large-scale space operations in the future. The Parties consider it is reasonable to initiate in 1993 the joint development of a solar dynamic power system with a test flight on the Space Shuttle and MIR in 1996, the joint development of environmental control and life support systems, and the joint development of a common space suit.

Subsequent joint efforts on the second phase will be directed to the use of a Russian MIR module of the next generation, in conjunction with a U.S. laboratory module and the U.S. Space Shuttle. This facility would provide an interim human-tended space science capability where significant scientific experimentation can take place in a microgravity environment and also provide practical experience gained out of the use of different transportation systems (including the U.S. Space Shuttle and the Russian Proton), performance of complex construction and assembly efforts and command and control process of orbital structure of considerable complexity. Successful implementation of this phase could constitute a key element of a truly international space station.

It is envisioned that the U.S. will provide compensation to Russia for services to be provided during phase one in the amount of $100 million dollars in FY 1994. Additional funding of $300 million dollars, for compensation of phase one and for mutually [3] agreed upon phase two activities, will be provided through 1991. This funding and appropriate agreements will be confirmed and signed by no later than November 1, 1993. Other forms of mutual cooperation and compensation will be considered as appropriate.

All the above programs are mutually connected and are considered as a single package, the main goal of which is to create an effective scientific research complex earlier and with less cost than if done separately. The Parties are convinced that a unified Space Station can offer significant advantages to all concerned, including current U.S. partners, Canada, Europe, and Japan.

The precise planning process and organization of drafted phases of joint activity will give the opportunity to benefit both countries through expanded cooperative efforts on the space station project.

The Parties hereby instruct NASA and RSA, in pursuance of this Joint Statement, to develop by November 1, 1993, a detailed plan of activities for an international space station. This will serve as the basis for early review and decision within each government and as the basis for consultations with the international partners. Upon conclusion of the process of government approval and consultation, appropriate implementing agreements will be signed. NASA and RSA will include within the plan overall configuration, volumes, and forms of contributions and mutual compensation for Russian and U.S. activities.

Document I-55

[1]

Protocol to the Implementing Agreement Between the National Aeronautics and Space Administration of the United States of America and the Russian Space Agency of the Russian Federation on Space Flight Cooperation of October 5, 1992

PREAMBLE

The National Aeronautics and Space Administration (hereafter referred to as "NASA") and the Russian Space Agency (hereafter referred to as "RSA"), jointly referred to as "the Parties";

Consistent with the Joint Statement on Cooperation in Space issued by Vice President Gore and Prime Minister Chernomyrdin on September 2, 1993; desiring to broaden the scope of the Implementing Agreement of October 5, 1992, on Human Space Flight Cooperation (hereinafter the October 5, 1992 Agreement) to encompass an expanded program of activities for cooperation involving the Russian Mir-1 Space Station and the U.S. Space Shuttle Program;

Having decided that the enhanced cooperative program will consist of a number of inter-related projects in two phases;

Having determined that Phase One will include those activities described in the October 5, 1992, Agreement and known as the Shuttle-Mir Program, including the exchange of the Russian Mir-1 crew and crew member participation in joint mission science, as well as additional astronaut flights, Space Shuttle dockings with Mir-1, and other activities;

Having further determined that Phase Two of the enhanced cooperative program will involve use of a Russian Mir module of the next generation mated with a U.S. laboratory module operated on a human-tended basis in conjunction with the Space Shuttle, operating in a 51.6 degree orbit which is accessible by both U.S. and Russian resources, to perform precursor activities for future space station-related activities of each Party, with launch to occur in 1997; and

Intending that activities in Phase Two would be effected through subsequent specific agreements between the Parties.

Have agreed as follows:

[2] ARTICLE I: DESCRIPTION OF ADDITIONAL ACTIVITIES

1. This Protocol forms an integral part of the October 5, 1992 Agreement.

2. An additional Russian cosmonaut flight on the Space Shuttle will take place in 1995. The back-up cosmonaut currently in training at NASA's Johnson Space Center will be the primary cosmonaut for that flight, with the STS-60 primary cosmonaut acting as back-up. During this mission, the Shuttle will perform a rendezvous with the Mir-1 Space Station and will approach to a safe distance, as determined by the Flight Operations and Systems Integration Joint Working Group established pursuant to the October 5, 1992 Agreement.

3. The Space Shuttle will rendezvous and dock with Mir-1 in October-November 1995, and, if necessary, the crew will include Russian cosmonauts. Mir-1 equipment, including power supply and life support system elements, will also be carried. The crew will return on the same Space Shuttle mission. This mission will include activities on Mir-1 and possible extravehicular activities to upgrade solar arrays. The extravehicular activities may involve astronauts of other international partners of the Parties.

4. NASA-designated astronauts will fly on the Mir-1 space station for an additional 21 months for a Phase One total of two years. This will include at least four astronaut flights. Additional flights will be by mutual agreement.

5. The Space Shuttle will dock with Mir-1 up to ten times. The Shuttle flights will be used for crew exchange, technological experiments, logistics or sample return. Some of those flights will be dedicated to resources and equipment necessary for life extension of Mir-1. For schedule adjustments of less than two weeks, both sides agree to attempt to accommodate such adjustments without impacting the overall schedule of flights. Schedule adjustments of greater than two weeks will be resolved on a case-by-case basis through consultations between NASA and RSA.

6. A specific program of technological and scientific research, including utilization of the Mir-1 Spektr and Priroda modules, equipped with U.S. experiments, to undertake a wide-scale research program, will be developed by the Mission Science Joint Working Group established pursuant to the October 5, 1992 Agreement. The activities carried out in this program will expand ongoing research in biotechnology, materials sciences, biomedical sciences, Earth observations and technology.

7. Technology and engineering demonstrations applicable to future space station activities will be defined. Potential areas include but are not limited to: automated rendezvous and docking, electrical power systems, life support, command and [3] control,

microgravity isolation system, and data management and collection. Joint crew operations will be examined as well.

8. The Parties consider it reasonable to initiate in 1993 the joint development of a solar dynamic power system with a test flight on the Space Shuttle and Mir in 1996, the joint development of spacecraft environmental control and life support systems, and the joint development of a common space suit.

9. The Parties will initiate a joint crew medical support program for the benefit of both sides' crew members, including the development of common standards, requirements, procedures, databases, and countermeasures. Supporting ground systems may also be jointly operated, including telemedicine links and other activities.

10. The Space Shuttle will support the above activities, including launch and return transportation of hardware, material, and crew members. The Shuttle may also support extravehicular and other space activities.

11. Consistent with U.S. law, and subject to the availability of appropriated funds, NASA will provide both compensation to the RSA for services to be provided during Phase One in the amount of US $100 million in FY 1994, and additional funding of US $300 million for compensation of Phase One and for mutually-agreed upon Phase Two activities will be provided through 1997. This funding will take place through subsequent NASA-RSA and/or through industry-to-industry arrangements. Reimbursable activities covered by the above arrangements and described in paragraphs 3-8 will proceed after these arrangements are in place and after this Protocol enters into force in accordance with Article III. Specific Phase One activities, schedules and financial plans will be included in separate documents.

12. Implementation decisions on each part of this program will be based on the cost of each part of the program, relative benefits to each Party, and relationship to future space station activities of the Parties.

13. The additional activities will not interfere with or otherwise affect any existing, independent obligations either Party may have to other international partners.

ARTICLE II: JOINT IMPLEMENTATION TEAMS

The coordination and implementation of the activities described herein will be conducted through the Joint Working Groups established pursuant to the October 5, 1992 Agreement or such other joint bodies as may be established by mutual agreement.

[4] ARTICLE III: ENTRY INTO FORCE

This Protocol will enter into force upon an exchange of diplomatic notes between the Governments of the United States of America and the Russian Federation confirming acceptance of its terms and that all necessary legal requirements for entry into force have been fulfilled.

IN WITNESS WHEREOF the undersigned, being duly authorized by their respective Governments, have signed this Protocol. Done at Moscow, in duplicate, this sixteenth day of December, 1993, in the English and Russian languages, both texts being equally authentic.

FOR THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION OF THE UNITED STATES OF AMERICA:
Daniel S. Goldin

FOR THE RUSSIAN SPACE AGENCY OF THE RUSSIAN FEDERATION:
Yuri Koptev