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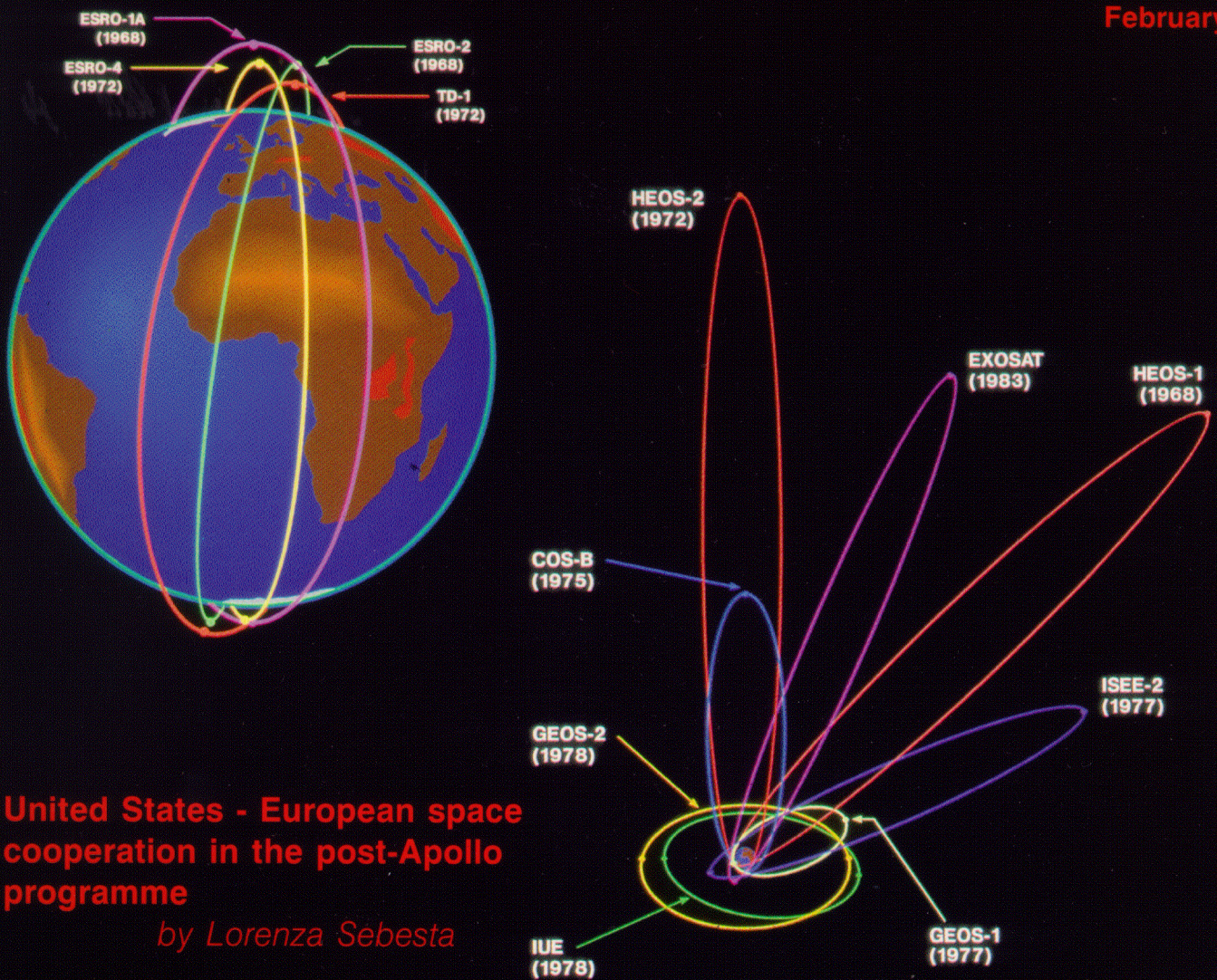
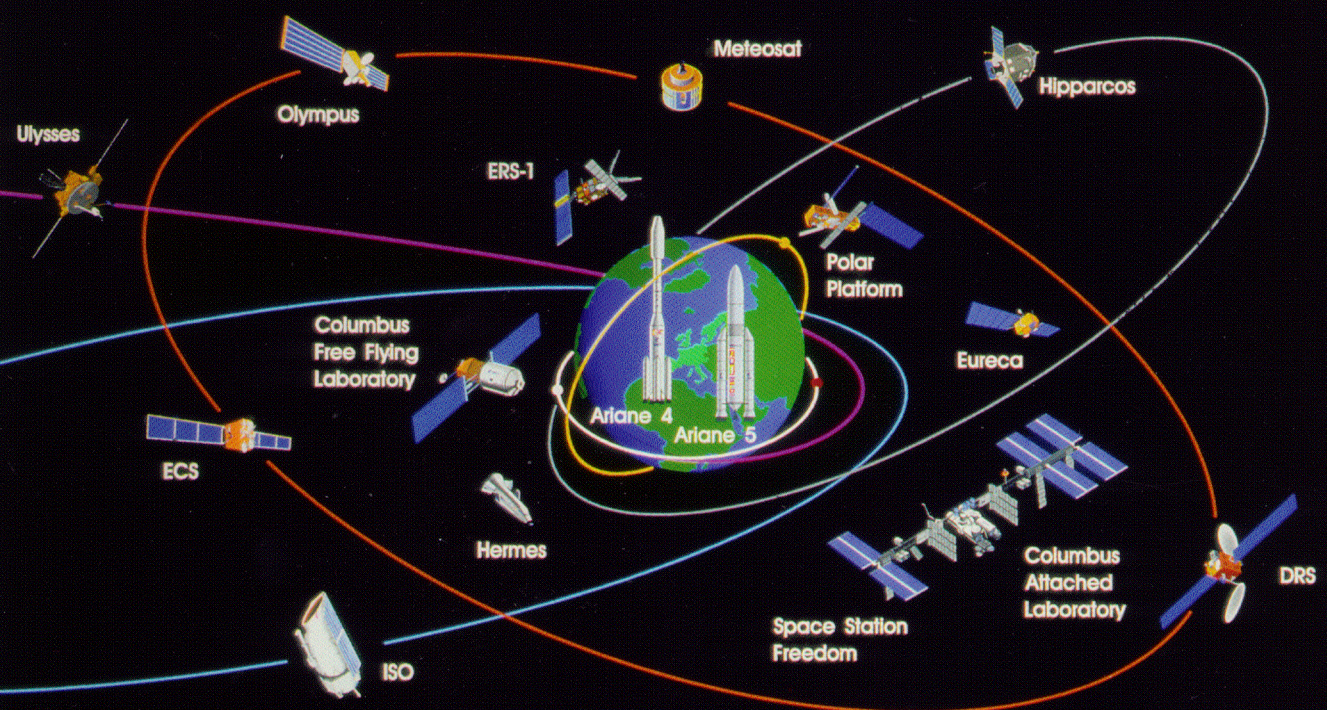


United States - European space cooperation in the post-Apollo programme

by Lorenza Sebesta



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The opinions and comments expressed and the conclusions reached are those of the authors, and do not necessarily reflect the policy of the Agency.

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US-European space cooperation in the post-Apollo programme*

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Discussions that took place during the second part of the sixties, even if unfruitful, set the stage for a broadening of perspective within US-European cooperation. Negotiations on the post-Apollo programme showed how painful and controversial this process could be. This paper will be devoted to analyze the various interlocking elements that influenced the outcome of these negotiations and the content of the two 1973 agreements which set the legal framework for cooperation on Spacelab.

1. The American offer

NASA's offer of collaboration in the post-Apollo programme was made to the Committee of Alternates of the European Space Conference by Thomas Paine, on October 1969[1]. Though

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* The first part of this work was published by the same author as ESA Report HSR-14, entitled "United States-European cooperation in space during the sixties" (ESA: Noordwijk, July 1994).

rather general in tone (see Appendix 1), it made constant reference to a much more detailed document, the Space Task Group Report, which was conveyed to European partners and served as a basis for a closed discussion session that took place after Paine's public presentation[2]. The document mainly dealt with the "post-Apollo" scenarios in the US and suggested some main technological developments, the most outstanding of which were a space station module (which could be coupled with other similar modules and eventually take the form of a space base), a reusable space transportation system (the shuttle), a tug (intended for transfer of payloads from the shuttle orbit into geosynchronous orbit), and a nuclear propulsion stage (NERVA prototype engine) to be used for interplanetary transportation.

Although it was ranked as the last goal of the post-Apollo programme, "international participation and cooperation" was nevertheless given an articulate definition. Two prerequisites for its full development were suggested:

1. "a substantial raising of sights, interest and investment in space activity by the other nations", and the
2. "creation of attractive international arrangements to take full advantage of new technologies and new applications for peoples in developing as well as advanced countries". Despite the inclusion of foreign astronauts in national missions as "the most dramatic form of foreign participation" in American programmes , the document recognized as legitimate the desire shown by advanced countries to receive "technical assistance to develop their own capabilities". In this context,the US should move toward a liberalization of their policies affecting cooperation in space activities and should "**stand ready to provide launch service and share technology wherever possible, and should make arrangements to involve foreign experts in the detailed definition of future United States space programs and in conceptual and design studies required to achieve them**".

To achieve this, three major steps were suggested:

1. "The establishment of an international arrangement through which countries [might] be assured of launch services without being solely and directly dependent upon the United States.

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1 The European Space Conference was a coordinating body for ESRO, ELDO and CETS, set up at the end of 1966.

2 The Space Task Group (consisting of Spiro Agnew, Vice President of the US, Robert Seamans, Secretary of the Air Force, and Thomas Paine, Administrator NASA) had been charged by the newly elected President Nixon in February 1969 with setting up the future goals of America's post-Apollo space policy. The report, adopted by the group in September 1969, failed to support the financial concerns shared by the White House and the Congress, and was never adopted as the "blueprint" for the future. See *The Post-Apollo Space Program: Direction for the Future*, Space Task Group Report to the President, September 1969; H. Newell, *Beyond the Atmosphere. Early Years of Space Science* (Washington: NASA, 1980) p. 288.

2. A division of labour between the US and other advanced countries or regional space organizations permitting assumptions of primary or joint responsibility for certain scientific or application tasks in space.

3. International sponsorship and support for planetary exploration such as that which was associated with the International Geophysical Year"[3].

Paine was extremely elusive in answering the questions put to him after his speech by European representatives: the real nature of the international agreement he alluded to in point 1. was not clarified[4]. To the observation advanced by Robert Aubinière, then chairman of ELDO Council, on the "very considerable impact" that his proposals could have on the European launcher programme, Paine answered that "It is precisely for this reason that we have brought before you our planning, so that indeed **it will be possible for you to review your plans in the light of what it is that we now propose to do**"[5].

This comment spurred French concern about the possibility that post-Apollo would "crowd out" their project for achieving an independent European launch capability: cooperation would obviously tie a significant part of the scarce European space resources to a programme led by the US, reducing the chances of a serious challenge to US supremacy[6]. Nor was it the first

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3 *The Post-Apollo Space Program: Directions for the Future*, Space Task Group Report to the President, September 1969.

4 Neither did he clarify this point in front of the Senate Committee which discussed NASA authorization for FY 1971 some months later. Paine would just offer a short answer "off the record" to those US Senators who asked the same question, and would repeatedly characterize the wording as "somewhat awkward". Later in the hearings, he would make clear that "this suggestion was prompted by the realization that arbitrary US restrictions upon the availability of its launch services could stimulate independent activities in Europe on political rather than simply technical or economic grounds". *Hearings before the Committee on Aeronautical and Space Sciences*, US Senate, 91 Congress, 2nd session on S 3374, March 11 1970, part 3, International Space Cooperation (Washington DC: U.S. Government Printing Office, 1970), p 1047 and p. 1062.

5 Historical Archives of the European University Institute (hereafter HAEUI), CSE/HF(69)39, Annex 2, Text of exchange of views between the members of the Committee and NASA representatives, 24 November 1969. See also P. Creola, "European-US space cooperation at the crossroads", *Space Policy*, May 1990, p. 100. As Paine would later explain to the President, his primary goal in offering Europeans collaboration in the post-Apollo ventures was **"to stimulate Europeans to rethink their present limited space objectives, to help them avoid wasting of resources on obsolescent developments, and eventually to establish more considerable prospects for future international collaboration on major space projects"**. Library of Congress, Manuscript Division (LCMD), Washington DC, Thomas Paine Papers, box 24, Letter Paine to the President, 7 November 1969.

6 The Space Station cooperative experience seemed, later, to generate among European partners the same kind of apprehension; G. van Reeth and K. Madders, "Reflections on the quest for international cooperation", *Space Policy*, August 1992, p. 228.

time that the US were conscious of these European fears. In a letter written to the newly elected President Nixon in February 1969, Paine, then NASA Acting Administrator, had stressed how Europeans considered that NASA was "attempting to divert European activities toward scientific pursuits and away from 'high pay-off' projects in space communications" and thought that its offers to provide launch facilities were "calculated to undermine support for ELDO's development of a European booster"[7].

Notwithstanding these caveats, the striking difference between this proposal and the previous American cooperative offers in space cannot be overlooked. Whereas the US had been very careful, until then, to avoid any commitment in cooperative technological development with commercial or military interest, this is what they seemed willing to offer now, even if under certain conditions.

In the first "official" call in favour of international cooperation in space (March 1970), President Nixon seemed to confirm this impression, declaring that "both the adventures and the applications of space missions should be shared by all people". He then went on to make brief reference to his willingness to extend the availability of American launching facilities to "larger applications satellites and astronauts crews"[8]. Clearly, as it would later become unmistakably clear, the President's interest rested mainly in this second option. The hypothesis of having foreign astronauts on board American space vehicles was the one that better fitted his vision of cooperation as a way of reinforcing US political leadership by means of a highly visible option involving human beings. Thus, not by chance, he favoured the presence of astronauts from the Federal Republic of Germany and Japan, the ex-enemies defeated by American superior technology[9].

Testifying during the NASA authorization hearings for fiscal year 1971 held some days after the Presidential declaration, Paine restated the original characteristics of his proposal by

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7 NASA History Office reference collection, International Cooperation File, Nixon Administration Collection, Letter Paine to the President, 12 February 1969, cited in R. Launius, "NASA, the Space Shuttle, and the Quest for Primacy in Space in an Era of Increasing International Competition", paper presented at the Colloquium "Naissance d'Ariane, 1971-1973", 4-5 May 1993, Paris.

8 Statement by President Nixon on the Space Program, 7 March 1970, Appendix J, H. Newell, *op. cit.*, p. 443.

9 LCMD, Thomas Paine Papers, box 24, Paine's Memorandum for the Record, Meeting with the President, January 22, 1970; Rensselaer Polytechnic Institute, Folsom Library (RPIFL), Troy, George Low Papers, box 69, Fletcher to Low, Summary of meeting with the President on 15 June 1972.

declaring that opportunities for foreign participation in the post-Apollo programme would be "most meaningful and satisfactory to all concerned if they (were) taken up as part of a substantive developmental, operational, or experimental involvement in the programme itself"[10].

2. Initial European reactions

The Committee of Alternates instructed ELDO and ESRO to study the proposal. A joint ESRO/ELDO working group to analyze the technical implications of European participation in the American programme was set up.

Visits to NASA headquarters, centres and industrial establishments by European representatives were organized; they were invited to attend management reviews and to receive updated briefings regarding the space station and the shuttle.

By April 1970, the working group was able to give a first assessment of the problem it had been charged to study[11]. The document, signed by the two co-chairmen of the working group, J.P. Causse and J.A. Dinkespiler, first made reference to the innovative nature of the American project. The post-Apollo space programme was not geared, as had been the case in the previous decade, to the attainment of a specific goal — the landing of human beings on the moon; it was aimed instead at changing the nature of activities in space by:

1. the use of the space environment for scientific and technical research by non-professional astronauts who would be living in orbit;
2. the use of space for particular new application purposes;
3. the exploration of the solar system by means of manned missions.

The system envisaged provided the necessary elements for the execution of missions in low earth orbit:

1. a space station, to be followed later by a space base;
2. served by a recoverable launcher, or space shuttle.

Complementary launchers should make possible the passage from this stage to a further one

1. from low orbit to geostationary orbit (space tug);
2. from low orbit to lunar orbit (space tug);

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10 *Hearings before the Committee on Aeronautical and Space Sciences*, cit., p. 1065.

11 HAEUI, WG/COOP-US/6, 16 April 1970 or HAEUI, CSE/HF(70)13.

3. from lunar orbit to the lunar surface (space tug);
4. from low orbit to interplanetary trajectories (nuclear shuttle, NERVA, which could serve, in certain cases, even for option 2).

Studies on the **station** were the most advanced, reported as being in the competitive definition phase (Phase B0, with two firms taking part, under the direction of two NASA centres, themselves in competition). The activity of the station would be oriented towards scientific and technical research. The scientific field was to cover biology, astronomy, geophysics and solid state physics. Fields that had been purely terrestrial would find new prospects when the **space tool** would be available. The station was conceived as work in progress, and was to be capable of adaptation and extension. This is why its design concept was modular, with modules capable of becoming elements of the base as well as planetary modules.

The station would require an economic means of transport for putting men and equipment into orbit and bringing them back to the ground. This means was the **space shuttle.** While the feasibility of the space station seemed guaranteed, the feasibility of the shuttle in its original configuration appeared to be dependent on technological progress that had yet to be achieved.

The **space tug** was the least known element of the system (a call for tenders had been launched by NASA for a preliminary study prior to Phase A). It was considered to be a sort of shuttle third stage, because it was thought to be used to propel spacecraft beyond the orbits reached by the shuttle itself. The tug was bound to be a manned vehicle, chemically propelled and capable of being placed in orbit not only by a shuttle but also if necessary by a Saturn launcher; it would not return to earth.

A nuclear motor called project **NERVA** had been studied for several years by the Atomic Energy Commission. This project was little known in Europe because much of it was classified. The motor would only be switched on once the vehicle was in orbit, thereby reducing the dangers of radioactive contamination in the event of malfunctioning of the launch vehicle.

While no timetable had been officially approved by NASA, the document gave a tentative one which called for the first operational flight of the shuttle in 1977, the assembly of the station after 1977 and its entry into service around 1978-79. The entry into service of the base was considered to be realistically possible around 1983-84 and the first operational flight for tug around 1980-82.

The **strategy** to enable the objectives to be attained was founded on three main principles: reusability, commonality (in order to produce a lowering of costs) and "widening the objectives of space flight", so that "it is no longer reserved to the small community of professional astronauts, but takes in categories of research workers for whom **space is not simply an end in itself but a particular means of advancing science and technology**".

"*A total metamorphosis of space activity*" (emphasis in original text) by some 15 to 20 years was forecast in the document. By 1990, the new system would, it was claimed, have completely replaced the present launching facilities.

What problems would these metamorphoses pose for Europe? The nature of the problem was double:

1. on the one hand, questions would arise about Europe's possible **participation** in the new NASA programme;
2. on the other, it would be necessary to analyze the **effects** of this American programme **on the programme decisions** to be taken by Europeans in the following months.

1. Ideally, **participation** should be "additional to the activities already embarked on" by Europe. An alternative could be to achieve all or some of the aims currently pursued in association with the US, thus saving on new developments for Europe for which American solutions already existed. For example, "a guarantee that launchers would be supplied for peaceful missions corresponding to the European objectives would be negotiated in exchange for European participation in development of the new system. Such participation should carry with it, from the outset, an 'entitlement' to launchings". The kind of cooperation envisaged involved:

a. the development of certain elements important for the system as a whole and sufficiently individualized for the corresponding management to be fully assumed by Europe, within the overall system management;
b. a large number of sub-contracts for a valid range of elements, in order to have access to the largest possible amount of technological information.

2. As far as the impact of the American programme on European programme decisions, three fields were taken into consideration:

a. space science. The station was considered to be a very rigid instrument because it would not be operational for some time (forecast for the end of the 1970s), because it would lack many specialized modules and because it would have a very special orbit. The only missions affected would be those deriving such a benefit from it that it would be absurd to try to gain a few years

by using an automatic vehicle at the price of enormous sacrifices in terms of quality and quantity of results. **Optical, infrared and ultraviolet astronomy** were identified as priority customers of the station. Most of the other fields did not appear to be affected in the short term.

b. space application. **Missions in geostationary orbit** (mainly telecommunications, scientific satellites and certain meteorological satellites) **would not be technically possible until the base and the tug were operational**, i.e. around 1983-84. The new American programme did not therefore in any way affect the decisions the Europeans might take at the present time in respect of application satellites.

c. launchers. According to the plan for using the shuttle in 1985 only two journeys would be devoted to the transport of automatic spacecraft, the other sixty being divided between lunar or planetary missions and serving the base. "**Routine use of the shuttle**" to place in orbit automatic spacecraft (such as the satellites of the European application programme) **would not happen until the end of the 1980s at the earliest**. Thus, "**a launcher such as Europa-III, available in 1978, would have the prospect of a career of at least eight to ten years**".

From the organizational point of view, it was suggested that ESRO should remain primarily responsible for matters relating to the space station and a task group of experts from the national administrations be formed under the chairmanship of J. Collet. ELDO would be entrusted with matters related to the means of transport, such as the shuttle, the tug and the nuclear transporter; a task group had been already set up under the leadership of H. Hoffmann.

A briefing activity soon got under way. The presentation by American representatives of the space station took place in Paris, in June 1970, in the presence of some 300 European scientists and space programme authorities[12]. A month later, a NASA team briefed European industrial and space representatives gathered under the aegis of ELDO in Bonn on the Space Shuttle and Space Tug[13].

The Ministerial meeting of the European Space Conference of July 1970 entrusted the President of the ESC, Theodore Lefèvre, Belgium's Minister for Scientific Policy and Programming, supported by representatives of France and the UK, the task of exploring, on behalf of the ESC, with the government of the US the political, financial and other conditions for possible European participation in the post-Apollo programme and requested him to report on

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12 D. Lord, *Spacelab. An international success story* (Washington: NASA, 1987), pp. 12-13.

13 D. Lord, *op. cit.*, p. 13.

these before the end of the year. It also stated that "in the light of the outcome of the negotiations, the participating states [should] together reconsider the conditions for the carrying-out of the European programmes, in particular where launchers [were] concerned". No votes against were registered; only three countries, Australia, Norway and Sweden, abstained[14]. Only Belgium, the Federal Republic of Germany and France were willing to commit themselves to finance long-term studies for EUROPA III until an agreement had been reached with the US. The other countries were not prepared to go along with their partners[15]. Against the UK suggestion in favour of a *menu-à-la carte* which would leave members free to choose between launchers and satellites, Belgium, the FRG and France considered it necessary to agree on the launcher and satellite programme as a whole.

The divergence between those who wanted to concentrate on the building of satellites and those who wished to consider both satellites and the facilities to launch them was one of the most important unsettled problems against the background of the European position on post-Apollo negotiations[16].

The same meeting provided financial support for the period to June 1971 up to a maximum of 2.5 MAU (Million Accounting Units); this permitted the extension of the system studies in respect of both the space transport system and the space station, and enabled technological studies to be undertaken, mainly in connection with the space shuttle[17]. In addition,

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14 HAEUI, CSE/CM(July 70)9 (Final), Res. 3 "Cooperation in the Post-Apollo Programme", 24 July 1970. See also *ESRO/ELDO Bulletin*, n. 11, September 1970.

15 Interest in the studies for EUROPA III had been expressed (without any financial commitment) before the American post-Apollo offer, by Australia, Belgium, the Federal Republic of Germany, France, Italy and the Netherlands at the ELDO Ministerial conference of April 1969; see ESRO/ELDO Bulletin, n. 5, May 1969, res. 3 concerning the studies on future programmes. American unwillingness to launch the Franco-German Symphonie satellite, if operational, had probably played a relevant role in persuading some European countries to support studies for EUROPA-III; see L. Sebesta, *United States-European cooperation in space during the sixties*, Report ESA HSR-14 (ESA: Noordwijk, July 1994), pp. 27-28.

16 The need for proceeding with both programmes was stated in the Puppi report (from the name of the head of the Committee of Senior officials set up by the European Space Conference in 1968), in HAEUI, CSE/CM(July 70)PV/1 rev., Annex 2, Presentation of the Report of the senior officials by Professor Puppi, 30 July 1970.

17 Altogether, the budgets voted by the European organizations amounted by Summer 1972 to 5.492 MAU, and the programme authorizations to 6.227 MAU; HAEUI, CSE/CS (72)WP/5 Report by the Secretary General of the ESC on the discussions between Europe and the United States on participation in the post-Apollo programme, 6 July 1972 and CSE/CM (July 70)9 (Final) Res. 3, Cooperation in the post-Apollo Programme, 24 July 1970. In this period one Accounting Unit (AU) was equivalent to the value of the US dollar.

firms in several member states, financed in most cases by their governments, entered into partnership with various NASA contractors responsible for studies on the station and the shuttle[18].

System studies (in preparation of future projects) on the model of those set up by NASA were organized by Europe in two areas: on the space tug whose propulsion techniques were considered to be sufficiently close to those being studied in connection with EUROPA-III(by ELDO) and scientific modules, intended as a peripheral element of the space station (by ESRO).

Much less was done in the field of **technological and predevelopment studies** (intended to make possible an eventual execution of the project by furthering the progress of certain essential new technologies to the maximum extent)[19].

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18 HAEUI, CSE/CS (72) WP/5 Report by the Secretary General of the ESC on the discussions between Europe and the United States on participation in the post-Apollo programme, 6 July 1972.

In 1971 a broad spectrum of exploratory studies, though of short duration and low-cost, were contracted to European industry as follows:

MATRA (France)	Comparative study of a scientific satellite to be launched by a Shuttle as opposed to the Thor Delta and study of a telecommunication satellite to be placed in synchronous orbit by Shuttle and Tug.
MBB (West Germany)	Cost study of a biological research module to be attached to a Space Station
HSD(UK)	Cost evaluation of a free-flying astronomy module
BAC (UK)	Parametric cost analysis of research and applications modules
HSD (UK)	Study of advanced telecommunication station
GETS (France)	European technological capability survey
BERTIN (France)	Study on use of space facilities for research and advanced technology
Thomson-CSF (France)	Cost evaluation of a cosmic ray facility

In D. Lord, *op. cit.*, p. 49.

19 HAEUI, ESRO/ELDO working group (WG/COOP-US/9), July 1970. By October 1970 "ESRO had already conducted some 15 applications studies related to experiments modules and shuttle payloads. ELDO had sponsored 14 technology activities in areas related to the Shuttle development and its use and had also conducted preliminary studies related to a Space Tug". D. Lord, *op. cit.*, p. 16.

3. The first political contacts

On 16 and 17 September 1970, Minister Lefèvre, accompanied by Lord Bessborough, representing the UK, and Mr. Denisse, representing France, had several meetings with their American counterparts on the political and financial aspects of European participation in the post-Apollo programme[20]. The talks were highly exploratory in nature because the programme's future shape and fate was still unresolved on the national level. Thus, no mention was made of the specific content of the cooperation.

The discussions had two focuses: **the relationship between the present negotiations and the availability of American launchers and the nature of future cooperation in terms of decision making and management**.

The main interest of the European negotiators was **the relationship between European participation in the post-Apollo programme and the development of an autonomous European launching capacity**. "Owing to its limited means", European representatives declared, "Europe would be unable to finance at one and the same time the development of launchers for these programmes (defined early on as being essential European programmes, particularly in practical applications) and a significant participation in post-Apollo programme developments". In order to be consistent with the missions that Europe had assigned itself, European cooperation in the post-Apollo programme had to be supplemented, Lefèvre stated, in the interim period "from 1970 to 1980 or 1985", with American launching facilities granted "on a commercial basis and without political conditions".

The Americans replied that "(...) **on the assumption of substantial European participation in the post-Apollo programme**" [emphasis in original] they were prepared to provide Europe, on a reimbursable basis and before the commissioning of the new Space

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20 The European delegation was assisted by members of the ESC Secretariat, led by the Secretary General, Renzo Carrobio di Carrobio. On the American side, the participants were: Alexis Johnson (Under Secretary for Political Affairs, Department of State); George Low (Acting Administrator, NASA); Edward David Jr. (Science Adviser to the President); William Anders (Executive Secretary, NASA); John Morse (Deputy Assistant Secretary of Defence for European and NATO Affairs). The talks were held at the State Department, Washington DC. Because of their explorative character no minutes were taken, viewpoints expressed were later reported in HAEUI, CSE/CS (70) 23, Statement by Mr. van Eesbeek relating to the Washington Talks (16-17 September 1970) between the ESC delegation and the American authorities, 8 October 1970.

Transportation System, "with launch service for any peaceful purpose consistent with existing international agreements"[21].

As to the meaning of "substantial", it was made clear that the Europeans would be required to contribute at least 10% of the overall development costs of the Space Transportation System. These costs were forecast as amounting to $10 billion over ten years; for Europe, this would mean $1 billion spread over that period. Broadly speaking, Lefèvre said, this would correspond to the effort Europe was supposed to make in order to continue the development of the European launcher (some disagreement seemed to exist on this point, because in Ortoli's view, the cost of European participation in the post-Apollo programme would be double that of the development of the European launcher)[22].

In reply to a request made by European representatives, the American delegates specified that "any peaceful purpose" would "include commercial purposes which could, as such, compete with American interests" ("This possibility was made quite clear by the European Delegation before the Americans stated their position".) These launches would take place at reimbursable costs — reimbursement for actual costs plus a certain margin for management expenses, but excluding amortization of development costs. The American commitment was general in nature, that is, the US would undertake to provide launch services requested by Europe "without the right of refusal or of unilateral acquiescence on a case-by-case basis"[23].

It is to be remembered that this exchange of opinions took place within the context of a major debate related to the new INTELSAT agreement which was to replace the interim agreement of 1963 as the ruling charter for the international communication satellites policy. Within this broader context, the Europeans were striving to obtain more permissive rules in the establishment of regional satellites, for example Symphonie, as opposed to the global communications satellites which were to remain the monopoly of INTELSAT. Whereas the US initially argued against the right to construct a regional system, the finally approved draft (which would eventually become part of the definite agreement of 1971) seemed to open the way to the establishment of separate space segment facilities to meet international public telecommunications services requirements of the various members (see Appendix 2). In each case, the

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21 HAEUI, CSE/CS (70) 23, Statement by Mr. van Eesbeek, *cit.*

22 HAEUI, CSE/CM (November 70) PV/1, Annex 1, Declaration by Theodore Lefèvre, 4 November 1970.

23 HAEUI, CSE/CS (70)23, Statement by Mr. van Eesbeek, *cit.*

members would have to ensure the technical compatibility with the INTELSAT space segment and avoid significant economic harm to the global system. INTELSAT was not permitted, as requested by the US, to enforce sanctions against violators, nor were its recommendations considered binding; moreover, COMSAT, the American signatory, was deprived of what amounted to be a veto power according to the Interim agreement[24].

The relationship between INTELSAT and American willingness to launch European satellites was specified in a letter written by Johnson to Lefèvre on 2 October 1970; the document stated that the US was prepared to launch European satellites "in those cases where no negative finding is made by the appropriate INTELSAT organ, regardless of the position taken by the US in the vote"[25].

"To put it simply", Theodore Lefèvre declared in relation to the US launcher availability at the ESC meeting of November 1970, "(...) the American assurances, as formulated, do not specify whether or not we can count on launchers for public service conventional operational communication satellites, even if their operation is limited to the European zone". This problem thus remained "the first substantial point" to be dealt with in any further post-Apollo negotiations[26].

As far as **decision-making** was concerned, two possibilities were discussed in the September talks:

1. to work on separate elements in the programme;
2. to join in the production of components for major systems.

The pros and cons of these alternatives were contradictory. The first solution would fit better with the concern to bring about an interdependent partnership — a principle, stated the document, "put forward by the European delegation and not rejected by the US representatives"—; at the same time, it would help Europe to be entrusted with real "prime-contractor responsibility". It was necessary to verify whether this could be achieved with the relatively small financial European effort and whether the Europeans had adequate technical capacities to succeed in this kind of collaboration. On the other hand, the second solution would afford greater financial and

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24 S. A. Levy, "INTELSAT: Technology, politics and the transformation of a regime", *International Organization*, vol. 29, n. 2, Summer 1975, pp. 669-671.

25 HAEUI, CSE/Comité ad hoc (71)9, Letter Johnson to Lefèvre, 2 October 1970.

26 HAEUI, CSE/CM (November 70) PV/1, Annex 1, Declaration by Theodore Lefèvre, 4 November 1970.

technical flexibility, challenging, at the same time, the principle of interdependence and of European "prime-contractorship". In view of the many interface problems that would eventually arise, there was a risk that it might prove financially harmful and nullify the effect of the limited European contribution.

In the written exchange that followed the meeting, this aspect was further elaborated. The question was divided into two aspects:

1. decision-making and management;
2. access to information and facilities.

What the Europeans wanted was the participation in decision making at all level of management and detailed access to technology used in the post-Apollo programme. These were the two questions on which disagreement would be especially pronounced.

The Americans considered that Europe's role in decision-making and management should "relate to, and be commensurate with, the measure and character of European participation". Participation expected was, again, defined as "substantial". In this case, "arrangements for collaboration should assure consultation in the development of the Space Transportation System and Space Station wherever of significant, mutual concern to both parties". An extensive role for Europe in the management was forecast only for those aspects of the systems in which European contractors would be involved, either directly under European governments or working as subcontractors to American prime contractors. Europe, in other words, would be a "partner in reaching any decisions which have a measurable impact upon European costs or upon European tasks in discharging their commitments to the programme". **Overall responsibility for management, however, "would necessarily rest with the US**". "Wherever there is basis for European use of the Space Transportation System or Space Stations", the Americans expected "Europe to take part in mission planning and experimental programs in generous proportion to their use".

As far as access to information and facilities is concerned, the American position was that "each participating party must have detailed access to technical data and facilities which they would need to accomplish their specific tasks under the agreed collaboration, but should also have general access to all technology and facilities in the overall development of the programme". Design, development and production data at the level of commercial know-how meant detailed access. General access included only access through visits and published or publishable documentation. Data which might be "sensitive in terms of national security" would be

exchanged, "but handled within agreed security safeguards". As for cost estimates, development costs, not including cost estimates for production, facilities and operations were estimated at $13.7 billion from 1972 to 1981 for the Shuttle, Space Tug and Space Station. To avoid the simultaneous peaking of Shuttle and Space Station expenses, the administration expected to concentrate first on the Shuttle and later on the Space Station[27].

Lefèvre gave an account of his visit during the Space Conference of 4 November 1970. He called for the beginning of a negotiation phase proper, and stressed that the talks had enabled the Europeans "to consider as a priority the hypothesis that Europe will have a large availability of American launching devices within the framework of post-Apollo cooperation". In consideration of the nebulous US guarantees on launchers, however, he suggested to follow a two-track procedure, whereby the European programme would be based "mainly and by priority on the development of the Post-Apollo Transportation System, but with the alternative solution of building a second generation European launcher". Europeans "should decide to build [their] own launchers, should these negotiations be a failure"[28].

4. National positions

The European Space Conference of November 1970 was described by journalists as dramatic and recorded later as the most troublesome of the ESC's history[29]. Post-Apollo was but a minor topic of discussions, which centred on complex topics such as the unification of European space institutions and future applications, launchers and scientific programmes[30].

Delegates were called to vote on three linked concepts:

1. programmes (subdivided in applications, launchers and scientific programmes);
2. unification of the institutions;
3. continuation of negotiations with the US on the post-Apollo programme.

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27 HAEUI, CSE/Comité ad hoc (71)9, Letter Johnson to Lefèvre, 2 October 1970, pp. 8-9 (decision-making) and pp. 10-12 (access to information and facilities).

28 HAEUI, CSE/CM (November 40) PV/1, Annex 1, Declaration by Theodore Lefèvre, 4 November 1970.

29 D. Verguese, "European space research totters", *New Scientist*, 12 November 1970. R. Fraysse, "Retour sur le passé: la décision de l'Europe de participer au programme post-Apollo", *ESA Bulletin*, November 1984, n. 40, p. 61. See also A. Russo, *ESRO's telecommunications programme and the OTS project (1970-1975)*, Report ESA HSR-13 (Noordwijk: ESA, February 1993), pp. 8-9.

30 See J. Krige and A. Russo, *Europe in space 1960-1973* (Noordwijk: ESA SP-1172, September 1994).

The positions varied widely, going from the most favourable West German one (the Federal Republic delegate was in favour of application, launchers, scientific programme, plus continuation of post-Apollo negotiations and abstained only on the unification, while it had abstained on the space programme voted during July's session) to the less manageable British one (the UK delegate voted against the launcher programme, abstained from the applications programme, the unification of the institutions and the continuation of discussions on the post-Apollo project, which he favoured in the July Conference, and was in favour of the scientific programme). In the middle was Italy, vetoing the development of an autonomous European launch capability (preferring to rely on the American one) and in favour of collaborating with the Americans on the post-Apollo project — provided that, restricted as Europe's participation would be in financial terms, "the right of total access to the technology of the whole programme and not only that part of it identifiable as financed by Europe" could be obtained as "an absolute precondition". The continuation of discussions on the post-Apollo programme was not vetoed by any delegate, but five abstained: Australia, Denmark, Norway, Sweden and the United Kingdom (Denmark and the UK changing their position from the previous favourable advice given on preliminary studies in the July conference). Belgium, the Federal Republic of Germany, France, Italy, the Netherlands, Spain and Switzerland gave their approval. The whole European launcher programme including EUROPA III, on the other hand, was favoured only by Belgium, the Federal Republic of Germany and France[31].

The British delegate (Corfield), Minister of Aviation Supply, could not see any need or scientific value, in the light of the progress made by the mission, for the development of independent launching capabilities[32]. He also made it clear that he considered that the question of the supply of launchers ought to be studied separately from that of participation in the post-Apollo programme.

To this the President, Lefèvre, retorted that as a result of his American mission the link did in fact exist. This statement was repeated by Ortoli, the French Minister of Industrial development and scientific research, who stated that "At the conference in July, the idea had been current that a European launcher could be replaced by participation in the post-Apollo programme, but it is now clear that the cost of the latter would be at least double that of a European launcher programme". It has to be specified that in July, the French representative

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31 HAEUI, CSE/CM (November 70) PV/2, Minutes of the meeting held on the afternoon of 4 November 1970, 19 November 1970.

32 HAEUI, CSE/CM (November 70) PV/1, Annex V, Declaration of the British Minister of Aviation Supply, 4 November 1970.

considered the availability of launching facilities to be part of the post-Apollo project[33]. And the ratio might become even more unfavourable in consideration of the fact that plans for the post-Apollo programme had not yet been finalised and its financial scope was not yet sufficiently defined.

After noting the very preliminary stage of consultations with the US and the vagueness of elements, Ortoli went on to state that "if Europe does really want to be present in the telecommunication market, then it should not make satellites which will be subject to outside control — which may or may not be launched — and should make a firm resolve to provide the means for launching its satellites itself, if it is true, as I believe it is, that the telecommunications market, the communication of information, will be one of the major markets of the next fifteen years". The German delegate, Professor Leussink (Federal Minister for Education and Science) agreed on that and on the fact that "the link between participation in the post-Apollo programme and the availability of United States launchers must be assumed"; in the sense that American launchers could not be obtained without participation in the post-Apollo programme. In general terms, the British delegate was isolated on this point[34].

5. The industry; the case of EUROSPACE

EUROSPACE had been created in 1961 as a non-profit association, bringing together leading European companies from seven countries (Belgium, the Federal Republic of Germany, France, Italy, the Netherlands, Switzerland, and the United Kingdom) dealing with aerospace-related fields such as aircraft, electronics, chemicals, steel and machinery to promote the development of air and space activities in Europe.

Contacts had been made by ELDO and ESRO with EUROSPACE in order to convince some of its members to carry out certain preliminary studies related to the post-Apollo project free of charge. In June 1970 EUROSPACE produced a memorandum on US-European cooperation in which it favoured collaboration in the post-Apollo programme. With the

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33 HAEUI, CSE/CM(July 70) PV/1 Rev., Annex IV, 30 July 1970.

34 HAEUI, CSE/CM(November 70)PV/2, 19 November 1970.

participation of its affiliated American firms, EUROSPACE organized a symposium in Venice during the same summer (September 1970)[35].

Yet, in 1971, its position on the post-Apollo programme was shifting towards a much more cautious one. Through its Secretary General Yves Demerliac, EUROSPACE publicly expressed its skepticism on cooperation at the American Astronautical Society's Ninth Goddard Memorial Symposium held in Washington DC on 10 and 11 March 1971. Demerliac, who declared to have consulted more than 80% of the industrial space potential in Europe, set out industrial and political motivations to support his cool reception of the American offer on post-Apollo. From an industrial point of view, he made clear that the main aim of European industry was "to manufacture operational equipment in quantity and to be able to master the management and operation of the application systems" like telecommunications, meteorology, oceanography, oil detection etc. The rather optimistic target for the European industry was set out to be "to acquire prime contractor ability for all space application systems". Technological excellency *per se* was, thus, not a priority aim. The two main concerns, instead, were the technological and managerial capabilities to produce space applications in mass quantities in order to substitute them for traditional equipment without losing the share of the markets for the new production. Cables and microwave links against telecommunication satellites was a perfect case in point. The progressive substitution of the first by the second would lead to a loss of vital markets for the industry concerned unless its market share in the new products was comparable to that in the old, conventional ones.

As far as political aims were concerned, Demerliac referred first of all to the unsatisfactory share of INTELSAT contracts in the telecommunication sector. The only means to improve this situation would be "the development and operation of complete European regional application systems". This went hand in hand with the development of an autonomous European launcher capability. "Only one British firm", Demerliac specified, "took the view that participation in post-Apollo was more urgent and vital than the development of Europa III". The size of European participation to post-Apollo should thus make reference to such political priorities.

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35 HAEUI, WG/COOP/9, Second report by ESRO/ELDO joint working group, 16 April 1970; see also Y. Demerliac (Secretary General, EUROSPACE), "European Industrial Views on NASA's plans for the '70s", *International Cooperation in Space Operations and Exploration*, AAS Science and Technology Series, vol. 27, proceedings of the AAS Ninth Goddard Memorial Symposium held at Washington DC, 10-11 March 1971 (Tarzana, Cal.: American Astronautical Society, 1971) pp. 29-35.

For this reason, a two-track approach was proposed. In the first phase, up to 1975-76, when the peak expenditures for EUROPA III would be over, Europe could not devote more than a few million dollars per year to post-Apollo. In this context, a tug-type project would not be financially viable nor would it satisfy industrial requirements as stated above. European firms would thus prefer to negotiate agreements with American contractors and to be funded, at the same time, by the respective governments.

In the second phase a "more massive and integrated European participation" in post-Apollo could be envisaged. However, even in this medium-term perspective, the tug seemed not to be preferred by industries. The only industrial representatives who seemed to like it were the Germans, who expressed interest in a tug delayed in time (entering operational service by 1985). French and British firms preferred the development of one or two major systems of the shuttle, i.e. the orbiter wing and the avionics system. In this case, however, it was very difficult to see how this participation could be integrated on time into the post-Apollo schedule.

On the other hand, because the ESRO community seemed to be favourable to shift part of its scientific budget to the space station or its cheaper replacement, the development of a European module looked like an attractive proposition[36].

Even on this last point, however, French industrialists had on previous occasions expressed their doubts. It is useful to remember that, while it had been one of the original aims of EUROSPACE to encourage European countries to finance big and technological innovative space programmes at a time when commercial uses and profits were but distant possibilities, the organization was now operating in a changing context, where real commercial opportunities (outside the "protection" of the government) were opening up for firms involved in space.

As illustration of how this influenced the investment strategies of firms, a letter had been sent in December 1970 to Ortoli by French syndicates of both electronic and aerospace industries, indicating their skepticism about the prospects of European participation in the post-Apollo programme. The (rather prophetic) rationale behind the decision was threefold:

1. Applications in space were considered feasible with non-inhabited systems at a much lower cost than with inhabited ones. The case against financing an inhabited device would always be strong, especially in cases of economic crisis. Thus, such a system would have risked to have its funds cut off in the future, before being completed.

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36 Y. Demerliac, "European Industrial Views on NASA's plans for the '70s", *International Cooperation in Space Operations and Exploration*, AAS cit., pp. 29-35.

2. The marginality of European cooperation, due to its objective weakness in technological and financial skills, would lead to "an undesirable situation of dependence"; Europeans would be excluded from the development of the new transportation system.

3. Participation in post-Apollo would crowd out funds for the independent European expendable launcher. Because it would be substantially higher than the forecast cost of EUROPA III, it could also compromise some major satellite programmes. In view of the impossibility of obtaining a reliable guarantee for the availability of American launchers, a programme of European launchers should receive priority endorsement[37].

6. The changing framework for cooperation: the revised post-Apollo programme and its "decoupling" from the question of launchers

By the end of 1970, the **post-Apollo programme** had undergone **a major change in its nature**: instead of being focused on a space station and a shuttle as a means to reach it and supply it with materials and human beings (be that aim portrayed in the framework of the ultimate goal of a manned mission to Mars or not), it became centred on the shuttle itself. The rationale for this choice was found in the wide range of possible commercial and scientific uses of the shuttle and by its potential use, with the possible addition of a research and application module (RAM) capable of being orbited by the shuttle, a substitute for the permanent space station[38]. Along with this new modular concept, some RAMs could remain docked to the shuttle and be brought back to earth by it; others could be left in orbit and merely visited and eventually recovered by the shuttle.

On the European side, by the end of the year, feelings began to be aired in the press that the US was "trying to lure Europe into curtailing the development of launchers and communications satellites in order that she will continue to be dependent on the US for these items"[39].

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37 HAEUI, ELDO Papers, box 464, Letter Syndicat des Industries de Matériel Professionnel Electronique et Radioélectrique et Union Syndicale des Industries Aéronautique et Spatiales to Ortoli, Ministre du Développement Industriel et Scientifique, 10 December 1970.

38 J. Logsdon, "Choosing Big Technologies. Examples from the US Space Program", in J. Krige (ed.), *Choosing Big Technologies* (Chur: Harwood Academic Publishers, 1993), pp. 145-146.

39 B. Valentine, "Europe and the post-Apollo experience", *Research Policy*, 1 (1971/1972), p. 115; for press position, the author cites "Space brinkmanship", *New Scientist*, 12 November 1970, pp. 310-311 and *Münchner Merkur*, 8 July 1970.

European and American delegations met again at NASA headquarters in Washington on 16, 17 and 18 February 1971[40]. These talks centred on a presentation of the new, reduced, post-Apollo programme and a discussion about the technical fields of possible European participation.

NASA's representatives seemed to join the Europeans in considering two kinds of possible European participation: one concerning a major element of the system (tug or RAM) in which the prime-contractorship would be European, the other concerning smaller and dispersed elements of the shuttle — and in this case European firms would be sub-contractors. Parts of the orbiter and booster (the two main elements, at this stage, in the configuration of the shuttle), in this second case, could be built in Europe [41].

The American presentation of the shuttle made reference to the concept of a completely reusable shuttle made up of two parts, booster and orbiter, both operated by human crews[42]. Because funds had not yet been granted by the American Congress, NASA was in the unfortunate situation of offering cooperation on a project whose configuration could not be considered as final — and which, in the event, was substantially reviewed due to financial restrictions.

At the same time, the existing linkage between European "substantial" participation in the post-Apollo programme and the availability of American launchers for European telecommunication satellites, along with the uncertain fate of the new INTELSAT agreement (due to be opened for signature in August 1971) which would govern this availability, contributed to a deadlock of the negotiations.

By the beginning of 1971, post-Apollo project negotiations between the US and Western Europe were not going well. This was officially announced by President Nixon in his report to the Congress on the future of American foreign policy, where he said: "I have asked NASA to explore in the most positive way the possibilities for substantial participation by Western Europe, Japan, Canada, and Australia in our post-Apollo programs. The result is uncertain, for there are

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40 The Europeans were headed by Causse and Dinkespiler (on the 16th) and thereafter by Ortner (17th and 18th). On the American side, the delegation was composed solely of NASA representatives together with one observer from the State Department; it was led by Charles Donlan, Director of the Space Shuttle Programme.

41 This was the only possibility, taking into account that the estimated cost of the orbiter represented 55%, and that of the booster 45%, of the shuttle's overall cost. The prime contractor was to be responsible for at least 50 or 60% of the work which would be, for the orbiter, about $2 billion. HAEUI, CSE/Comité ad hoc (71)8, Report of the Mission to Washington, 4 March 1971.

42 J. Logsdon, "Choosing big technologies. Examples from the US space program", in J. Krige (ed), *op. cit.*, p. 145.

very real difficulties to be solved. We will continue our efforts to meet these problems, for a successful international program of space exploration could set a precedent of profound importance"[43].

It was not until September 1971, after the opening to signature of the new INTELSAT Treaty, whose main features related to the availability of US launchers we have already recalled, that the deadlock was solved. At that time, "some soul-searching took place within the US delegation"[44]. In reply to Lefèvre's request of 3 March 1971, Johnson announced the new American position in a letter dated 1 September 1971 (see Appendix 3): the availability of American launchers would not be "conditioned on European participation in post-Apollo programme".

Secondly, the letter dealt with three main topics:

1. the general conditions for the supply of launchers for European programmes;
2. the conditions for supplying launchers in the particular case of European communications satellites;
3. the offer of broadening cooperative relationships with the Europeans, including "an exchange of views regarding the content of space activities in which Europe might wish to participate in the post-Apollo era". Johnson proposed that a possibility be discussed in a joint working group (Joint Expert Group), as previously suggested by the Europeans. The main object of their work would be to define — before political discussions were resumed — what elements of the Post-Apollo programme would be suitable subjects of participation.

As for the conditions upon which the US would offer its launching services for satellites intended to provide international public telecommunication services, including European regional satellites, the US adopted a restrictive interpretation of Article XIV of the definitive INTELSAT arrangements, whereby the governing body would have to make "a favourable recommendation" (not merely, as indicated in Johnson's letter of October 1970, abstain from voting against it). An eventual negative recommendation seemed to be considered binding by the US, contrary to the general interpretation of the article (see section 3 of this paper).

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43 Cit. in B. Valentine, "Europe and the post-Apollo experience", *Research Policy*, 1 (1971/72), p. 104; original source, *US Foreign Policy for the 1970s; Building for Peace*, a Report to the Congress by Richard Nixon, President of the United States (Washington: Government Printing Office), 25 February 1971, p. 222.

44 D. Lord, *op. cit.*, p. 16. On this and other aspects related to the American decision-making process during the negotiations, see L. Sebesta, "The politics of technological cooperation in space: US-European negotiations on the post-Apollo programme", *History and Technology*, 1994, vol. 11, no. 3, pp. 317-341.

As to the operational system of European communication satellites presented by Lefèvre during February's discussion, Johnson stated that "it would appear to cause measurable, but not significant, economic harm to INTELSAT. Thus, if this specific proposal were submitted for our consideration", he continued, "we would expect to support it in INTELSAT"[45].

The document was discussed among the representatives of the Committee of Alternates of the ESC; the new decoupling between launcher availability and post-Apollo was warmly received. Europeans could now get rid of the conditional form in which the Americans proposed to support the CEPT project and provide the US with additional information[46].

7. The first technical discussions and some clarification on the availability of American launchers

After an updated presentation by a NASA team of the post-Apollo project[47], the first meeting of the Joint Group of Experts on US-European cooperation was held in Washington from 30 November to 2 December 1971. J.P. Causse and J. Dinkespiler acted as spokesmen for the European delegation which was composed of members of the ESC Secretariat as well as experts nominated by the member states, while Charles Mathews headed the NASA group.

Despite the various potential areas of cooperation singled out, discussions were bogged down by the uncertainty regarding the final configuration of every element (even the most advanced shuttle). Moreover, as stated by the report, the US was waiting for "the identification by the European side of a more definite list of candidate subjects for possible participation" which could eventually lead to a joint "detailed examination of financial, management and programmatic implications".

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45 HAEUI, CSE/Comité ad hoc (71)18, Annex I, text of the letter from Under-Secretary of State Johnson to Minister Lefèvre, dated 1 September 1971. The letter, which was to be confidential in line with an American request, was passed to the Belgian press (*Le Soir*, 30 September 1971) and then given widespread publicity.

46 HAEUI, CSE/CS(71)PV, Minutes of the Joint Meeting of the Committee of Alternates and the ad hoc Committee of Officials of 22 September 1971, 27 October 1971.

47 Charles Mathews, then NASA Deputy Associate Administrator for Manned Space Flight, designated head of the American team and Capt. Robert Freitag, visited European companies involved in space studies and concluded their tour with a presentation to the Committee of Alternates of the ESC on 22 October 1971. D. Lord, *op. cit.*, p. 16. Charles Mathews's briefing was not printed as part of the conference minutes but as a separate leaflet, not to be found in the archives; HAEUI, CSE/CS(71)PV/3, Minutes of the Joint Meeting of the Committee of Alternates and the ad hoc committee of officials of 22 October 1971, 11 November 1971.

As far as the shuttle was concerned, being the most advanced project among those in which collaboration was envisaged, a few important characteristics of future cooperation were identified on this occasion:

1. in the field of utilization, NASA indicated that participants in the development programme "probably would have an advantage over other users"; no pricing policy, however, could be established at this time;

2. the kind of cooperation envisaged was limited to a relationship of subcontracting by European firms. This could be done by individual firms and, for larger elements, by a consortium of European firms. As for the subcontracts already in place, Europeans lamented the lack of formality shown for participation by European firms in the preparation of proposals by would-be US prime contractors. US representatives, on the other hand, stressed the necessity to vest clear management responsibility in the American prime contractors as far as the orbiter and booster were concerned. The latter would participate in an arrangement for controlling the expenditure of funds provided by the sponsoring European authorities;

3. the content of the cooperation seemed to favour the limiting of work packages on propulsion and avionics for technical reasons: criticality of integration, complexity of interrelationship among various systems and the considerable amount of experience already available in the US. Twelve elements of the shuttle could be developed in Europe; among these, the airframe seemed to offer the best possibilities for European participation.

As far as the tug was concerned, the time did not seem ripe for a definite decision because of the preliminarity of its development. But it seemed nevertheless a logical area for European participation since it was an easily separable item with a relatively clean set of interfaces; moreover, ELDO, in close cooperation with NASA, had elaborated a Phase A work statement. In the Orbital systems field (RAMs, sortie cans, sortie pallets) and automated satellites, various levels of involvement were identified both in the development of the elements of the system and in the scientific experiments to be hosted[48].

On 20 December 1971, the ESRO Council adopted a resolution on the reform of the organization which called, *inter alia*, for:

a. the US/European Joint Aeronautical Satellite Programme, AEROSAT (even if the work on the AEROSAT payload pre-development had started in European industry, the failure of the US to approve the Memorandum of Understanding concerning the Aerosat programme had delayed the start of a full-scale development of the spacecraft);

b. the Meteorological Satellite Programme;

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48 HAEUI, CSE/CS(71)18, Report of the meeting of the joint group of experts on US/European cooperation in Space Programmes in the Post-Apollo Period, 8 December 1971.

c. the Communication Satellite Programme[49].

AEROSAT was a joint air traffic control satellite for civilian aircraft whose first exploratory meeting between the US, Europeans, Australia, Canada, Japan and the Philippines had taken place in June. The Europeans had made unequivocally clear that they would not accept a pre-operational programme in which they would be merely subscribers to services provided by a system unilaterally established by the US. They had also guaranteed financial support for a cooperative programme; if such programme were not attainable, Europe would be prepared to proceed on its own[50]. After negotiations in Washington and Madrid, the FAA reached agreement with ESRO representing the European nations on a joint project, whereby Europe would pay half the cost and get about a third of the work (because of Europe's need to purchase US assistance in order to satisfy European responsibilities in the programme). The agreement was limited to a pre-operational system for developing procedures, with the operational follow-on system to be negotiated in the future[51]. Between the end of 1971 and the beginning of 1972, the White House declined to sign the memorandum concluded between the FAA and ESRO, giving rise to yet another round of negotiations, whereby the scope of the cooperation was restricted[52].

The ESRO resolution also contained a statement on the policy to be followed by Europe concerning launch services (which took into account the new information given by Johnson in his letter). The resolution reaffirmed that European launchers would be given priority, on condition that their cost would not exceed 125% of relevant non-European ones; should, however, such American launchers be denied, the price would be based on the cost of production, or even supplemented by the cost of specific development, if required.

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49 HAEUI, CSE/CM (Dec.72)5, Report by the Secretary General of the European Space Conference on the Status of European Space Programmes, 7 December 1972. See also A. Russo, *The Early Development of the Telecommunications Satellite Programme in ESRO (1965-1971)*, Report ESA HSR-9 (Noordwijk: ESA, May 1993).

50 Nixon Project, NARA, Washington DC, WHCF, Subject files, vt 1, box 14, Department of State, Summary of international aviation and foreign policy issues in the aeronautical satellite program, no date.

51 Nixon Project, NARA, Washington DC, WHCF, Subject files, vt 1, box 14, Memorandum Welsh to General Haig, National Security Council urgent action, 21 October 1971.

52 Despite the signature of a new memorandum in 1974, AEROSAT as originally conceived would eventually fail in 1977; see *ESA General Report, 1977*, pp. 53-54.

In consideration of the resolution, Lefèvre asked Johnson for a clearer statement on the availability of American launchers for European telecommunication satellites[53]. In particular, an account of the operational system and mission of the European telecommunication satellite system was transmitted and Johnson was requested to state, on the basis of this document, "whether, considering the concept of the system as now decided in its final form" he could confirm that his government would be willing to support the project when it would be officially submitted to INTELSAT by the participating countries, as specified in his letter of September 1971. In his reply, Johnson made reference to three difficulties related to the proposed European Communication Satellites Programme: the economic impact (in term of higher charges to users), the technical incompatibility (which could be overcome by adopting a different orbital position) and, most important of all, the definition of the European region. Johnson clarified once and for all that the US would not support the programme within INTELSAT if an expanded coverage was expected in respect to the European geographical area. In line with the ITU definition, the Europeans gave the "European Broadcasting Area" a much larger scope than the purely geographical one. It was bounded "on the West by the Western boundary of Region 1, on the East by the meridian 40° East of Greenwich and on the South by the parallel 30° North [thus, including the former French colonies in North Africa], so as to include the western part of the USSR and the territories bordering the Mediterranean, with the exception of the parts of Arabia and Saudi Arabia included in this sector. In addition, Iraq (was) included in the European Broadcasting Area"[54].

Lefèvre also informed Johnson of the decision taken at the ESC on 17 December 1971 to open fresh credits to a total of 2.25 million dollars for pursuing studies carried out on the European side on participation to the post-Apollo programme. It was envisaged that by Spring 1972 Europeans and Americans would "be able to tackle" the "political aspects" of the question[55].

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53 HAEUI, CSE/CS (72)1, Annex, Letter Lefèvre to Johnson, 23 December 1971. The whole exchange of correspondence between Lefèvre and Johnson until this date is in HAEUI, CSE/Comité ad hoc (71) 22, 22 December 1971. For the ensuing correspondence on launchers, see P. Creola, "European-US space cooperation at the crossroads", cit., pp. 98-99. On the European Communication Satellites Programme, see A. Russo, *The Early Development of the Telecommunications Satellite Programme in ESRO (1965-1971), cit.*

54 The ITU definition is cited in HAEUI, ESRO/PB-TEL(72)5, Availibility of launchers for the European Communication Satellites Programme, 22 September 1972.

55 HAEUI, CSE/CS(72)1, Annex, Letter Lefèvre to Under Secretary of State A. Johnson, 23 December 1971.

8. The new shuttle

On 5 January 1972, President Nixon publicly announced his decision to go ahead with the development of the space shuttle, though heavily modified in its configuration. The President emphasized the need to take the "astronomical costs out of astronautics" — a recurrent criticism of public opinion — and to "routinize" transportation in space ("the space shuttle will give us routine access to space by sharply reducing costs in dollars and preparation time").

The new shuttle did not represent a new challenging purpose in American space policy (such as planetary exploration, a moon landing etc.). Nevertheless, in a time of economic crisis, it was tuned to the public's expectations, as being "a potential low-cost replacement" to the costly expendable launch vehicles in use. Its "multifaceted capability for satellite placement and retrieval"[56] seemed to make it a perfect device to obtain the same services as before at a lower price[57].

In this last configuration the shuttle consisted of an airplane-like orbiter (about the size of a DC-9, capable of carrying into orbit and back again to earth useful payloads up to 18 meters in length and 4.5 meters in diameter, weighing up to 29,500 kg) and a booster. The orbiter would be designed for reuse more than 100 times. It would be able to operate in space for about a week, after which it would return to earth and land on a runway like an airplane.

The shuttle would be boosted into space through its solid-propellant booster engines and its orbiter stage liquid oxygen-liquid hydrogen main engines. The booster rockets would detach at an altitude of about 40 km and descend into the ocean to be recovered and reused. Fuels for the orbiter's liquid-hydrogen liquid-oxygen engines would be carried in an external expendable fuel tank that would be jettisoned in orbit[58].

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56 D. Lord, *op. cit.*, p. 39.

57 HAEUI, CSE/CS(72)2, Annex I, Statement by the President, 5 January 1972 (taken from *NASA News*, release n. 72-4, 6 January 1972).

58 HAEUI, CSE/CS(72)2, Annex II, Statement by Dr. Fletcher, concerning the development of the new Space Transportation System, 5 January 1972 (taken from *NASA News*, release n. 72-4, 6 January 1972). NASA's desire to have it as an entirely reusable single-stage to orbit, with no expendable parts, was considered unrealistic for the available technology and budget requirements. "National Security Space Policy", *International Security*, Spring 1987, vol. 11, n. 4, pp. 169-170. By mid-1971, NASA's plans for a **two-stage reusable shuttle had to undergo a complete reassessment**, in view of the Office of Management and Budget's wish to keep NASA's budget constant for at least the duration of the then present administration. This seemed to be incompatible with a programme that would cost over $2 billion annually at its peak. J.M. Logsdon,

As pointed out by McCurdy, "What began as a $10 to $13-billion initiative emerged from the White House as a $5.15-billion program, leaving NASA with a shuttle configuration that many believed was technologically inferior to the two-stage reusable system and a cost estimate that agency managers could not meet"[59].

In a public statement, Fletcher indicated that the shuttle in this new configuration would encourage greater international participation in space flight[60]. As stated more clearly by Nixon, the shuttle would broaden American "opportunities for international cooperation in low-cost, multi-purpose space missions".The shuttle, apparently, would be **a means through which to expand future cooperation, but not an object of cooperation in itself**.

Less than three months after Nixon's approval of the programme, in March 1972, NASA completed the definition of the configuration for the new device and issued a request for proposals to industry. Replies were expected by 12 May and NASA planned to select the prime contractor for the new space shuttle by July 1972.

This decision had a threefold impact on the post-Apollo negotiations:

1. first of all, there was a new urgency to define the precise managerial framework, financing problems, and real content of the eventual cooperative venture on the shuttle, because of the tight schedule devised by NASA and required by Congress;
2. moreover, because the first operational flight of the shuttle was now forecast for 1979 and because RAMs (free-flying and semi-permanent laboratories) would only be placed in orbit starting 1982, the need arose for a new element to cover the interim period. Orbital systems of (relatively) low cost and requiring a short period for development and construction, the sortie module or sortie-can (a small laboratory carried by the shuttle whose studies had been initiated by NASA and Europe in October 1971), acquired greater importance than the RAMs, which much more complicated research and applications modules which were to have replaced the space station;
3. lastly, the overall technology of the shuttle in its new configuration had a much lower technological appeal for the European partners than the original one. Its only real technological novelty lay, in their view, in two areas (propulsion and the heat shielding system), both of which had been excluded from European participation. This being the case "the technological interest of the items proposed to Europe (was) much smaller than it (might) have appeared at first sight". Consequently, the interest in manufacturing one or more items proposed would lie chiefly, for the Europeans, "in securing access to the orbiter and shuttle

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"Choosing Big Technologies. Examples from the US Space Programs", in J. Krige (ed.), *Choosing Big Technologies, op. cit.*, p. 146.

59 H. McCurdy, *The Space Station Decision: Incremental Politics and Technological Choice* (Baltimore: Johns Hopkins University Press, 1990), p. 231.

60 HAEUI, CSE/CS(72)2 Annex II, Statement by Dr. Fletcher, 5 January 1972.

project and so gleaning general information about it and possibly some items of particular interest"[61]. Thus, if the European principle of free access to the technology developed for the entire system was denied, as seemed highly probable, European interest in this kind of cooperation would be considerably weakened.

9. Towards a definition of the final contents of cooperation

The attention of the second ESC-NASA joint group of experts which met at Neuilly (Paris) from 8 to 11 February 1972 took account of the changing context of US-European cooperation[62]. Apart from the prospects of a European participation in the shuttle even in reduced terms, two other areas of cooperation were envisaged:

1. the tug system, on which ELDO had issued a Phase A report since the first meeting;
2. an orbital system or module and some studies on experiments definition. From the beginning of 1972 the various orbital system concepts crystallized in the form of a "sortie module", i.e. a laboratory transported by the shuttle that would remain attached to it throughout its stay in orbit.

Criteria for choosing among the package works were spelled out as being:

1. items should not be scheduled as critical nor involve high technical risk;
2. they should involve relatively few and simple interfaces;
3. they should not be those for which there would be a high probability of frequent design changes.

Compared to those spelt out during the previous meeting, these criteria seemed to be more restrictive and, in the case of the first item list, rather vague (no explanation was given about what "critical" and "high technical risk" meant).

The nature of the cooperation envisaged was far from being defined. NASA experts declared to approach "the concept of European participation in development of the shuttle within the context of a broader programme of participation which included multilateral European responsibility for development of a major element of the Post Apollo programme, such as Sortie Rams or the re-usable Space Tug". Certain government level decisions and assurances would be necessary before European contractual proposals for the shuttle were submitted to the US prime

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61 HAEUI, WG/COOP/US (72)2, European Space Conference, Report on European Participation in the post-Apollo programme, March 1972.

62 HAEUI, CSE/CS(72)6, Report of the meeting of the Joint Group of Experts on US/European cooperation in space programmes in the post-Apollo period, 14 February 1972.

contractor. These decisions and assurances would involve government-to-government agreements in principle concerning collaboration in "the development of the tug or family of RAM vehicles".

NASA felt that "participants in such major development programmes should bear full responsibility for development cost risks related to the tasks they had undertaken". "No exchange of funds" principles were reaffirmed, by which a firm working as sub-contractor would receive "technical direction from the prime contractor, but would receive payment directly from its own government authority after certification of satisfactory work progress by the prime contractor". This system, it was stated by the Europeans, could create many problems, especially in the fields of "source selection, the negotiation of out-of-scope changes, limitations on the control by the prime contractor over the subcontractor and the relations between the subcontractor and its own government authority". Alternatively, European spokesmen proposed a different application of the "no exchange of funds" principle, under which "a prime contractor on either side of the Atlantic would be responsible not only for the technical management and direction of his sub-contractors, wherever they were located, but would also be responsible for their funding". No conclusion could be reached over these innovative proposals and both sides postponed any decision, claiming that the problem was not covered by their instructions.

Neither could an agreement be reached on how to select the European contractors. The ESC indicated that it should be a European responsibility; the new funding approach suggested, on the other hand, that the weight of responsibility should shift, even in this sector, to the US. In any case the final choice would have required a joint agreement by ESC, NASA and the prime contractor. The creation of a joint NASA/ESRO user group in scientific, application and technology areas for planning payload and missions was envisaged.

Three major questions remained open at the end of the meeting:

1. A European decision on whether or not to make a commitment to participate in the Post-Apollo programme, which the Europeans undertook to reach by July 1972, and then, eventually, postponed;
2. the political rules on the **management** and **funding** under which such participation would eventually be carried out;
3. the technical content of cooperation.

The question was of special relevance for the shuttle; in view of the timetable drawn up by NASA after Nixon's decision, without an early decision on these linked problems, it would no longer be possible for European industry to be awarded sub-contracts.

By this time, two main features of post-Apollo cooperation were clear to the Europeans:

1. the **partnership would be asymmetrical**, in the sense employed by John Logsdon for the Space Station[63], in two major respects:
   a. the US would be dominant in its financial contribution;
   b. while the US would be able, if necessary, to continue their project even without a European contribution, Europeans joining the partnership would become dependent on the US for an important aspect of their future activities, because the devices they would produce could only be carried by a shuttle.

2. This partnership had **weak foundations**, as was clearly shown by the financial constraints which had urged the President to change the overall contents of the Post-Apollo and caused significant modifications in the technical configurations of the items still left open for cooperation (the shuttle, for example)[64].

Moreover, a major question continued to preoccupy the Europeans. As Lefèvre made clear in a letter to Ministers of member countries "**for a certain number of us, the question of participation in the post-Apollo programme falls within the general framework of Europe's policy on launchers**"[65].

In March 1972, the Secretary General of the ESC submitted to the organization an overall report on the studies carried out in respect of possible European participation in the post-Apollo programme. The report favoured the selection of one among three options:

1. participation in the development of the space shuttle to a total sum of about 100 MAU, in the form of a series of subcontracts financed by the European governments concerned;
2. a joint development of the tug by Europe, sub-contracting to the US being offset by European industry's participation in the shuttle development (cost: about 500 MAU);
3. a joint development of the sortie module by Europe, subcontracting to the US being offset by European industry's participation in the shuttle development (cost for Europe: 200 MAU).

Until now discussions had been focused on studying the **possible content** of European participation. It was time, the report stressed, to define **the terms under which participation**

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63 J. Logsdon, "International cooperation in the space station programme. Assessing the experience to date", *Space Policy*, February 1991, p. 37.

64 See John Logsdon's reflections on cooperation in the space station programme, *ibid.*, p. 44.

65 HAEUI, CSE/CS(72)7, Letter from the Chairman of ESC to the Ministers of the member countries, 6 March 1972.

could take place. The Committee of Alternates and the ad hoc Committee would be charged to examine the legal, financial and institutional terms on which the European governments envisaged taking part in the programme[66].

The various options regarding participation in post-Apollo within the wider framework of space activity in Europe — taking into consideration for each series of programmes its essential objectives, technical implications and long and short-term financial implications, as well as the other elements of a European Space programme — were submitted to the Committee of Alternates[67].

10. Political discussions resumed

Informal discussions between European and American representatives of both the Department of State and NASA took place in April 1972[68]. Pending Europe's final say on the whole question of post-Apollo cooperation, two hypotheses emerged from the discussions as being the most suitable to both the US and Europe:

1. participation in the shuttle plus tug;
2. participation in the shuttle plus sortie module.

The problem of funding was, not surprisingly, the first to be reported on. Once more, the US made clear their unwillingness to accept the European proposal, labelled "reciprocal funding", unless "in return for an undertaking on their part to finance certain work in Europe, they received a simultaneous undertaking from the Europeans regarding the nature of the tasks for which the latter would assume responsibility and part of which would be carried out in the United States". The Europeans had to take responsibility for possible failures and had to reciprocate external funding giving back work to the US.

Neither were they willing to provide any guarantee in respect of the access to the system or to the purchase by the US of a European tug or module. If they decided in favour of the

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66 HAEUI, CSE/CS(72)8, att.:WG/COOP/US(72)2, Report on European participation in the post-Apollo programme, 30 March 1972.

67 HAEUI, CSE/CS(72)14, Post-Apollo Programme options within European overall space activities, 8 May 1972 and CSE/CS(72)14 add., Revision of options for European participation in the post-Apollo programme, 5 July 1972.

68 HAEUI, CSE/CS(72)13, Report by the Secretary General of the ESC on the informal discussions with American officials regarding participation in the post-Apollo programme, 8 May 1972.

purchase, the US required the application of marginal prices by Europeans — excluding any amount for amortisation of development costs — and the concluding of licensing agreements by Europeans to give the US the ability to manufacture the devices themselves in the event of a European failure to build the device.

As for reciprocal access to technology, in the most "sensitive" cases of classified technology, if the basic technology could not be transferred, the US would undertake, if necessary, to sell Europe the hardware itself. A European decision in favour of merging their two space agencies would help to establish, in American eyes, "a very favorable climate for cooperation" in the programme.

At an informal meeting of the ESC Ministers held in Paris on 19 May, it was decided to ask the US to answer a certain number of questions of a political nature, which had deliberately been left aside since the time of the Lefèvre/Johnson talks and which mainly concerned the terms governing European use of the post-Apollo system as a whole and American use of the various elements supplied by Europe. A list of questions was compiled, to be presented at the next US-European political meeting scheduled for June. They touched upon the availability of US launching systems (both expendable and reusable), the criteria for establishing priority among users, the conditions of access and use of technology necessary for the execution of work undertaken in Europe within the post-Apollo programme, financing rules, the US commitment to procure from Europe the hardware developed by the latter, the nature of negotiations between agencies, and the pricing policy for users of the transportation system[69].

This was actually the agenda of the meeting between American and European representatives which took place in Washington from 14 to 16 June 1972[70]. Behind the rhetorical requirements of diplomacy, both the opening and the concluding remarks by Herman Pollack, Director Bureau of International Scientific and Technological Affairs of the Department of State, revealed the tense atmosphere of the gathering.

Cooperation on the tug and the shuttle was discarded and the responsibility for this choice attributed to European behaviour. "In the absence of a clear indication of the measure of European interest in possible participation", Pollack stated, "we shall do our best to make the US

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69 HAEUI, CSE/CM(May 72)WP/1 rev. 1, List of questions to be discussed by the European Post-Apollo Mission (14-16 June 1972), 29 May 1972.

70 HAEUI, CSE/CS (72)15, Report of the ESC Delegation on discussions held with the US Delegation on European participation in the Post-Apollo programme, 22 June 1972.

views regarding the questions you have raised as helpful as we can. Were it possible during the early part of our discussions to obtain a clearer understanding of the measure of European interest, and possible participation, our views could possibly be more responsive and useful to you". The limitations officially announced by Pollack regarding the possible field of cooperation were drastic and, as made clear during the discussion, not subject to change.

As for the shuttle, of the residual work packages proposed for Europe, the nose cap, the radiator and the instrumentation were definitely suppressed. The remaining items were the tail assembly, elevons, landing gear and cargo door. American representatives stressed the potential difficulties "that might ensue from an inter-governmental effort to produce a relatively small number of components of a massive piece of highly complex hardware, whose timetable is pressing and in whose success the political and economic stakes are so high". The conditions to be met in order to satisfy US concerns were so stringent that Pollack acknowledged that the conditions they were obliged to impose as regards the funding and management of the shuttle elements were discouraging and would substantially diminish the attractiveness of participating in the Shuttle items.

While the final veto on participation in the development of the shuttle was the end of a progressive restriction of possible cooperative work packages which had begun soon after the beginning of discussions of the Joint Group of Experts on US/European cooperation in space programmes, and had progressively developed over time, the veto on the tug came as a sudden surprise. This was the part of the post-Apollo programme in which Europe could have best profited from technology transfer[71]. The reason officially given to justify this decision was mainly technical. This, it was said, was the less advanced project, in terms of the development phase, of the post-Apollo programme; it was not clear how, when and indeed if ever it would be built (indeed it never was).

The secondary literature gives additional reasons for the US withdrawal, including:

1. American skepticism, widely shared in Europe, over Europe's technical ability to develop the tug on its own, especially as far as propulsion was concerned[72];
2. the necessity for the US not to transfer sensitive and/or economically valuable US technology;
3. NASA's concern over the safety of housing a tug with its planned cryogenic fuel in the shuttle's payload bay[73];

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71 D. Lord, *op. cit.*, p. 59.

72 P. Creola, "European-US space cooperation at the crossroads", *cit.*, p. 100.

4. military willingness to take complete control over the device[74].

Of course, removing the tug and the shuttle did not mean that there was nothing left for Europe to do. We have already seen that, as NASA firmed up its post-Apollo configuration, the RAMs were complemented by other, simpler orbital systems. They became, now, the best candidates for potential European participation.

In American eyes, these orbiting platforms, later called sortie laboratories or modules and, finally, space laboratories or spacelabs, satisfied all necessary qualifications for a viable cooperation of the 'conservative' type that had characterized US-European collaboration during the sixties. Here was a project defined in time and limited in scope, whereby cooperation could take place across "clean interfaces", each partner providing its own technology and financing its work, and NASA retaining overall operational control[75].

11. Interlude

In Summer 1972 the sortie laboratory became the major topic of discussion and concern for European-American post-Apollo project cooperation. It was the subject of a detailed presentation by NASA to the Europeans at ESTEC at the end of June 1972. From June to November 1972, the sortie laboratory was the subject of three definition studies (Phase A), which ESRO entrusted to the COSMOS, MESH and STAR consortia[76].

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73 J. Logsdon, "International involvement in the US space station program", *Space Policy*, February 1985, pp. 18-19.

74 M. Schwarz, "European policies on space science and technology, 1960-1980", *Research Policy*, vol. 8, 1979, p. 220.

75 This description draws on Pedersen's definition of the general guidelines shaping NASA's early cooperative efforts; K.S. Pedersen, "The changing face of international space cooperation. One view of NASA", *Space Policy*, May 1986, p. 121. A last Joint Tug Steering Group meeting was held on 5-6 October 1972; European studies on the Tug, that ELDO was instructed to terminate following the Committee of Alternates meeting on 12 June 1972, were presented to NASA as well as the shuttle technology studies which had been brought to a normal completion.

76 HAEUI, CSE/CS(72)18, att. annex I, Report on the technical discussions between NASA and ESRO (26-29June 1972), 4 July 1972; HAEUI, CSE/CSWP/5 rev. 1, Report by the Secretary General of the ESC on the discussions between Europe and the United States on participation in the Post-Apollo programme, September 1972. See also "Europe and Post-Apollo", *ESRO-ELDO Bulletin*, no. 22, August 1973, p. 10.

The latest developments were presented to the Committee of Alternates on 6 July 1972. Limiting cooperation to only the sortie laboratory, and thus limiting the costs of cooperation[77], only partially solved the problems connected with the post-Apollo programme that Europe had to confront, "since not only (had) interest in participation (to) be balanced against cost, but participation (had) also (to) be considered in the context of all the different aspects of a European programme"[78].

The ESC Secretariat and NASA officials met in Washington on 17-18 August 1972 to discuss the form and content of possible agreements following the new standards set out in June[79]. It was agreed that the sortie module was an essential part of the US space transportation system and that it would not be developed in parallel in the US, should the Europeans take responsibility for its production.

NASA reaffirmed its willingness to retain overall responsibility for the total programme and the last word in such vital areas as shuttle/sortie laboratory interfaces, quality control and safety. In particular, NASA would wish to be in a position to assess the efficiency of the management plan proposed by the European agency for the sortie module and stressed the necessity for a "unitary management agency" on the European side. On the other hand, NASA suggested arrangements whereby the European agency could participate in the shuttle interface control activity, in defining user requirements and in the regular review of the shuttle programme. Moreover, a wide range of NASA assistance would be available free of or at marginal cost, including provision of US designs and technology (except where specific considerations from the security and proprietary rights point of view prevented this), quality control, acceptance testing, cost control, audit and use of US facilities. The US would favour a very "slender government agreement" containing the clause about US abstention from any parallel development. The American team also insisted on the importance of an early identification of areas in which Europe foresaw the need for access and to what extent. Construction of the sortie laboratory would not

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77 The cost of the Sortie lab was then estimated at $200 million, against an estimated cost for (the abandoned) tug of about $500 million. This difference has been considered in the literature to be an important element favouring the positive resolution of the launcher-versus-post-Apollo dilemma, since it freed relevant European financial contributions in favour of Ariane. See J. Logsdon, "International involvement in the US space station program", *Space Policy*, February 1985, p. 24.

78 HAEUI, CSE/CS(72)WP/5, rev., *cit.*

79 HAEUI, CSE/CS(72)25 and ANNEX I to VI, Report on discussions between ESC Secretariat and NASA officials in Washington on 17-18 August 1972 regarding the form and content of agreements necessary in the event of European participation in the post-Apollo programme, 28 August 1972.

guarantee any preferential treatment in the use of the system. All the same countries participating in its development would enjoy a priority right in its use and would be entitled to appoint crew members for its flights.

A few days later, the Department of State informed the ESC of an amendment to the overall system planning. In the case of European withdrawal, NASA would not need to embark on the development work for the sortie laboratory before 15 August 1973 (it was considered that it would take the US one year less than Europe to build one)[80]. It was proposed that the European commitment would in principle be made at the September Conference and that formal agreements be concluded by end-October. This commitment would lead Europe to start the thorough definition phase (full-scale project definition effort) immediately. Should the cost established by this study unacceptably exceed the financial ceiling agreed by the ESC Ministerial Conference, the Europeans would be allowed to withdraw from their commitment at any time before 15 August 1973.

The feasibility of the sortie laboratory programme in Europe was considered from two points of view[81]:

1. the technology aspects;
2. the schedule constraints that it would have to satisfy in order to be a meaningful contribution to the Post-Apollo programme.

Technology in this context could have two different meanings:

a. the conventional one, associated with the state of the art in a certain number of engineering disciplines;
b. a broader one, related to frontier exploration of a wholly new approach to the utilization of space.

While the **challenges to technology** presented by the Apollo programme were in terms of launch vehicle capability, communications at distances of more than 300,000 km, landing and take-off from the moon's surface, and impossibility to terminate the mission rapidly, those presented by the sortie lab were linked to the constraints of

- supporting life in space for long duration
- flexibility

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80 HAEUI, ESRO/C(72)48, Annex I, US Aide Memoire of 21 August 1972.

81 HAEUI, CSE/CS(72)WP/5, rev., *cit.*

- multiple reuses, and
- economy of operation.

The sortie lab as conceived by NASA in mid-1972 could be built in Europe without any doubt. However, some technological areas would have to be advanced, if the programme was to be 100% European. In fact, a certain number of "off-the-shelf" items (available on stock or to be obtained from a running production line in the most extreme definition) would be available with little or no development in Europe, while a few of them consisted of such long-term and costly development products in the USA that their development in Europe would represent a major undertaking not commensurate with the sortie laboratory time-scale and cost envelope.

Decisions on feasibility would entail trade-off studies between

- performance
- cost, and
- schedule.

No relevant technology transfer was expected from collaboration in the sortie lab project. The major reasons for European interest in the collaboration stemmed from hopes to gain "programme management and systems engineering experience in a programme of this magnitude rather than in specific technical know-how or direct commercial benefits"[82]. No one doubted that Spacelab, above all, signified European willingness to enter the field of manned space activities and to pay its entrance fee.

12. Europe's final decisions on Spacelab

By the end of 1972, the European countries involved in ESRO and ELDO were passing through hard times. Three main interlocking questions had to be solved:

1. the future organizational nature of Europe in space, in the context of two concerns: from the tactical point of view, the disruptive power of the impending liquidation of ELDO (see below) had to be neutralized; from the strategic point of view, the new European concerns linked to the application capabilities of satellites (first of all in telecommunications) could not be coped with by an organization set up for mainly scientific purposes, ESRO;
2. the new configuration of a launcher capable of meeting all the new European needs in the field of application satellites;

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82 D. Lord, *op.cit.*, p. 59.

3. European participation in the post-Apollo programme in its reduced form[83].

The apparent irreconcilability of the French and British positions over these points came to the fore during the informal meeting of ESC Ministers and representatives of participating states (8 November 1972) called to organize the subsequent December CSE meeting[84]. Attention was focused on a difficult dilemma: what should be given priority, the institutional framework or the programme towards which this framework would orient its work?

Charbonnel, the French representative, subordinated the solution of the European space institutional problems to the "definition of a programme worthy of Europe", i.e. a common programme of heavy launchers capable of orbitating the payloads which Europe would develop for its needs in the field of space applications (in the three main fields of telecommunications, air navigation control and meteorology) and which would even enable it to export commercially viable complete systems.

Faced with the reluctance of certain states to join in the EUROPA-III programme of ELDO, France was prepared to carry out, on a different technical and institutional basis, a programme meeting the same objective though with different technical characteristics (see below), the future *Ariane*.

Considering the organizational question as one which would have implied a great loss of time and energy, France was more prone to begin by solving the problem which, it felt, was the most urgent one for the future, namely that of launchers. Why this choice?

1. because dismissing the programme would be seen by public opinion in Europe as an unacceptable abdication of political responsibility;
2. because it would be an economic mistake, since the funding needed to complete the programme was minimal compared with the sums Europe had invested so far. As mentioned by President Lefèvre in his opening remarks, this would have implied not only a loss of technology, but also a loss of markets;
3. because it would deprive the Symphonie project, whose exemplary value was paramount at a time when Europe was undertaking important application programmes, of some of its meaning.

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83 For these three aspects of the ESRO-ELDO crisis, see J. Krige and A. Russo, *Europe in space 1960-1973*, cit.

84 HAEUI, CSE/CM(Nov.72) 4, Meeting of Ministers in Paris on 8 November 1972 under the Chairmanship of Theo Lefèvre, plus Annexes, 17 November 1972.

As for Britain, taking into primary consideration the financial restraints in which the Conservatives (back in power since 1970) found themselves, their representative, Heseltine, subordinated any decision on the programme to the prior solution of the institutional framework. In view of what was thought to be the poor cost-effectiveness of Europe's performance in space during the previous decade (whose results did not measure up to their financial commitment), the UK singled out the cause of this in the organizational problem ("we are spending enough money to achieve results but we are not spending it in the way it ought to be spent").

Moreover, neither France nor the UK seemed enthusiastic about joining the US in the post-Apollo programme. France, noting that while the sortie lab "would enable Europe to take an interest for the first time in the problems of manned flight," added "... none of the economic needs of the next decade would be met by the development in Europe of a sortie lab, which can in no case be considered a substitute for a launcher programme". It was ready to participate in the programme only if all measures were taken to satisfy Europe's requirements particularly with regard to launchers. The UK, for its part, stated that, for the time being, Britain would not participate in the Post-Apollo programme and thought it could change this position only if progress were made in the creation of a single European Agency.

Taking an intermediate position, the German and Italian representatives were against defining a priority between programmes and the institutional problems. In particular, Von Dohanyi, the German representative, thought the question of whether the programme or the institutions should be settled first "rather like the question of the chicken and the egg". However, he was not prepared to go along with the EUROPA-III project (which the FRG had initially supported), arguing that it was financially too demanding. The Federal Republic of Germany preferred to concentrate on promoting a launcher technology — an objective-oriented one—, using existing European launchers and develop them further. The German delegate also stressed how "the deterioration of the European position in Post-Apollo (was) not the fault of the Americans but the fault of the Europeans" who had been unable to decide in good time on various steps. The Federal Republic of Germany was ready to give the US any additional assurances concerning its participation in Post-Apollo.

The Italian representative, Romita, referred to three conditions which made cooperation with the US difficult:

1. one of the prominent aims of US space policy was to keep the leadership in this sector;
2. the US was not prepared to freely surrender technical and industrial know-how and competence, as this would represent an instrument for possible European competition;

3. because of the ratio between the possible European participation in the post-Apollo and the American contribution to this programme, the US would keep control of the programme, both at the realization stage and at the stage of engine utilization.

Notwithstanding these ongoing divergences, some countries (Belgium, the FRG, Italy and Spain) agreed, under certain conditions, to finance the Phase B studies for the sortie lab (finalized to the choice of a single approach from among the alternative approaches selected through the first phase), the Committee of Alternates gave it its political blessing and invited the ESRO Council to comply[85]. The ESRO Council accepted this request on 9 November 1972 and authorized its Director General to take the necessary implementing steps[86].

The European Space Conference Ministerial meeting of December 1972 (two years after the previous one) was a crucial step in respect of both the reorganization of Europe in space, the policy of acquiring an independent launching capability and Europe's relationship vis-à-vis the US[87].

Reports on the activities of ESRO, ELDO and the Post-Apollo programme were presented at the start of the conference. Each of the three areas had its specific sets of unsolved problems. Among the more prominent was Britain's final notice of denunciation of the ELDO Convention (given on 27 September 1972), which confirmed the declaration made one year before by the UK delegation to the ELDO Council[88].

In spite of the dilatory position of the UK — whose delegates stressed how the "government did not believe in the need for a European launcher programme" and how the arguments in favour of the post-Apollo were not considered "overwhelming" — and some uncertainty on the part of the Italians — who subordinated participation in the launcher programme to a fruitful cooperation in post-Apollo and asked that the rule of "juste retour" for

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85 Technical studies on the sortie lab were reviewed at a meeting with NASA on 18-19 September and some possible module concepts were selected for further detailed study; see also "Europe and Post-Apollo", *ESRO-ELDO Bulletin*, cit., p. 10.

86 HAEUI, CSE/CM (Dec.72)5, 7 December 1972.

87 HAEUI, CSE/CM (Dec.72)8, 20 December 1972; HAEUI, CSE/CM(Dec.72)PV/2, 10 January 1973, plus Annexes.

88 The UK decision would become effective on 1 January 1973 (date after which the UK delegation would become an observer). After the failed launch of the ELDO rocket EUROPA 2 in November 1971, a reorganization of the ELDO Secretariat was undertaken in the first half of 1972; Aubinière replaced Carrobio di Carrobio from 1 January 1972.

the common programmes be respected — the resolution of the Ministerial Conference registered an important agreement on some points which had been objects of intense debate:

1. the setting up of a new organization formed out of ELDO and ESRO, i.e. the future ESA, by January 1974, if possible;
2. the sortie lab and the French launcher proposal (L3-S) to be managed within a common European framework (EUROPA III being dropped);
3. there should be a rationalization of the various satellite programmes, including the geostationary technology satellite (GTS). This programme had been initiated in the UK as a national project; originally intended for telecommunications purposes, it was subsequently reoriented to meet requirements for aiding maritime navigation and was later merged with Marots[89].

The first element of the far-reaching decisions reached at the meeting was the decision to set up a new single European space agency (ESA), whose programme would consist of a compulsory "basic" programme — science, general activities and facilities — with GNP-related contributions and an "optional" programme (including Spacelab, launcher and application satellites) in which the member states were free to decide on their participation and financial contribution[90].

One decisive element to convince hesitant states like Italy to comply with the second decision was the suggestion put forward by France and Germany about the financing of the launching programme — a fixed amount for European countries other than France instead of a fixed percentage. The other one was a French proposal dealing with a launcher (L3-S) nearly as powerful as EUROPA III, but not requiring such a large and sophisticated cryogenic stage; the device would be capable of putting payloads of 1500 kg into transfer orbit, or of 750 kg into geostationary orbit with the aid of an apogee motor. The French government was willing to assume 60% of the expenses of the development phase (estimated in 550 MAU by Charbonnel) which was due to start on 1 January 1974 and to end with qualification of the launcher in 1980. This launcher should be assured a suitable priority of use in Europe compared with means of

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89 In April 1973, the UK delegation submitted to both the ESRO Council and the Committee of Alternates a proposal to "Europeanise" the GTS programme, taking into account the state reached by the programme at the national level. The programme comprised two alternative options, GTS and Marots, whose main distinction concerned the actual management. In GTS, because of the stage already reached in defining the project, member states financing would be limited to 25% and management would be entrusted to the UK procurement executive. In Marots, the UK's contribution would be of the order of 55% and it would be developed as an ESRO programme, with the management being the responsibility of the organization. HAEUI, CSE/CM (July 73) 5, Report of the Secretary general of the ESC on the Implementation of the decisions of the Ministerial Conference of 20 December 1972, 2 July 1973.

90 J. Krige and A. Russo, *Europe in space 1960-1973*, cit.

launching developed outside Europe. The technical and financial management of the L3-S would be entrusted to CNES which would define the industrial arrangements and place contracts with industry on behalf of the programme participants; there would be a Programme Board to monitor the distribution of work among the various participants and to act as the appeals body for a participant with respect to the choice of firms made by CNES. The decision was taken as far the development programme was concerned, not on the production programme, about which participating states would have to decide before the end of the development phase[91].

A compromise was arrived at on two projects which had for a long time seemed to be mutually exclusive, mainly for economic reasons: the European launcher and participation in post-Apollo. This equilibrium was reached thanks to an agreement between France and the FRG on reciprocal participation in the launcher and spacelab projects, where the two countries would provide the majority of funds for the two projects respectively. The agreement was reached after bilateral talks, because the UK had moved away from all discussion on the European launcher. The changed position of the Federal Republic of Germany, which had previously declared itself to be satisfied with American guarantees on availability of launchers, was "a heavy political decision. It was taken in the knowledge that a negative response would almost certainly bring to an end the European ideal in space". The decision to carry on the sortie lab project within a European framework (the management of the programme being entrusted to ESRO) was communicated to the US Secretary of State by the President of ESC on 29 December 1972. On 18 January 1973 the Council authorized its Director General to negotiate with the US the terms of an arrangement concerning the implementation of the programme[92].

13. The major features of the final agreement on Spacelab

The sortie lab was conceived as a two-element device. Consisting of a pressurized manned laboratory module and an external unpressurized instrument platform or pallet, it was suitable for conducting research and application activities on shuttle sortie missions lasting from seven to thirty days. The sortie lab would be carried into orbit in the payload bay of the shuttle orbiter and would remain attached to the shuttle throughout the mission. At the end of each mission, the orbiter would make a runway landing and the laboratory would be retrieved from its bay. The

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91 HAEUI, CSE/CM (Dec. 72) PV/2, Minutes of the Afternoon Session of the ESC held in Brussels on 20 December 1972, Statement by Charbonnel, Ministre du Développement Industriel et Scientifique, France, 10 January 1973.

92 Schwarz, *art. cit.*, p. 225 and "Europe and Post-Apollo", cit., p. 10.

sortie lab was to have the flexibility to accommodate both multidisciplinary experiments and complements devoted to a single scientific or applications discipline. The laboratory module would host experimental devices, data processing and electrical power equipment, an environmental control system and crew control stations. The staff of up to six scientists would eat and sleep in the shuttle orbiter, but carry out their experimental activities in the laboratory module. Pallet experiments would be remotely controlled from the laboratory[93].

On 15 February 1973 the ESRO Council, in accordance with article VIII of the Convention, approved an Arrangement between certain ESRO member states and ESRO for the development, as an ESRO special project, of the Spacelab. It determined the objectives and elements of the programme together with the conditions for its execution and their monitoring by the Spacelab Programme Board. The arrangement was open for signature from 1 March to 10 August 1973. The participants, Belgium, the Federal Republic of Germany, Italy and Spain, with the FRG playing the leading role, decided to establish a financial envelope of 308 MAU at mid-1973 prices. The arrangements provided for a review of the overall amount at the end of sub-phase B 2 (end July 1973) of the definition phase. If the financial hypothesis would not be confirmed, but significantly exceeded, those participants who so wished could withdraw. ESRO appointed a Head of Programme and formed a team within ESTEC establishment and at the headquarters of the organization[94].

The legal framework for cooperation on Spacelab was set out in two documents:

a. an intergovernmental agreement negotiated between the member states and the US government dealing with the political commitment of the member states with regard to carrying out the programme. It situated this endeavour in the general context of cooperation between US and Europe and in relation to the space shuttle system[95];

b. a Memorandum of Understanding (MOU) negotiated between ESRO and NASA to define the tasks and responsibilities of each organization in carrying out this cooperative programme (see Appendix 4)[96].

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93 *Ibid*, p. 7 and *NASA News Release* n. 73-12, 19 January 1973.

94 HAEUI, CSE/CM(July 73)5, Report of the Secretary general of the ESC on the Implementation of the decisions of the Ministerial Conference of 20 December 1972, 2 July 1973. In the spring of 1973 France, the Netherlands and the UK signified their agreement to participate in the work of sub-phase B2, i.e. until July 1973. They were later joined by Austria and Switzerland. See "Europe and Post-Apollo", cit., p. 10. Ten member states participated, in an optional framework, in the project.

95 HAEUI, ESRO/C(73)46, rev. 1, 26 July 1973.

96 HAEUI, ESRO/C(73)45, rev. 1, 26 July 1973, Draft Memorandum of Understanding between the NASA and the ESRO for a cooperative programme concerning development, procurement and use

On 14 August 1973 the Intergovernmental agreement was opened for signature in Paris; to implement this agreement, the NASA-ESRO Memorandum of Understanding was also signed. Less than one month later the ESRO Council approved the draft agreement between certain European governments and ESRO concerning the execution of L3-S, by then renamed Ariane, first phase (development and qualifications)[97].

According to Article I of the MOU, ESRO would undertake to design, develop, manufacture and deliver the first flight unit of the SL (Space Laboratory), and other materials described in the Memorandum. The SL would be used as an element to be integrated in the Space Shuttle. NASA would set its specifications, following technical modifications of the shuttle and its timing. The first operational shuttle flight was scheduled for late 1979; accordingly, the SL flight unit ought to be delivered to NASA one year before. Although recognizing "the desirability of avoiding changes resulting in a disproportionate impact on the SL programme", NASA reserved to itself "the right to require changes affecting the interfaces or operational interactions between the Shuttle and the SL" (art. IX).

Relative costs in SL development contracts would be borne by Europe. NASA retained the overall responsibility for the total programme and the last word in such vital areas as shuttle/SL interfaces, quality control and safety, "including the right to make final determination as to its use for peaceful purposes" (art. XI).

Construction of the SL would not guarantee any preferential treatment in the use of the shuttle system. NASA, on the other hand, would provide access for the use of SL's for experiments or applications proposed for reimbursable flights by Governments participating in the SL programme in preference to those of third countries. Selection on cooperative (i.e. non-cost) flights would follow normal NASA policy, with European governments given preference over the proposals of third countries if their proposals would be at least equal to the merit of the third country's proposals (art. XI).Countries participating in the development of the SL, however, would be entitled to appoint European crew members for its flight; "It is contemplated that there will be a European member of the flight crew of the first SL flight"(art. XI).

Generally speaking, European firms were considered to have the technology they needed well in hand. The Americans were ready to sell existing American equipment (black boxes)

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of a Space Laboratory in conjunction with the Space Shuttle System, reprinted integrally in D. Lord, *op. cit.*

97 *ESRO-ELDO Bulletin*, n. 23, November 1973, pp. 18-20.

without the need to share information, thus eventually helping in development problems on a case-by-case basis[98]. The phrasing of article 6 of the intergovernmental agreement on the Space Laboratory and article X of the NASA-ESRO Memorandum of Understanding — both referring to access to technology and information — complied with the American position as stated above.

NASA agreed to procure from ESRO "whatever additional items [SL] of this type it may require for programmatic reasons, provided that they are available to the agreed specifications and schedules and at reasonable prices to be agreed"(art.VIII). NASA committed itself to buy "at least one SL" after the one given by ESRO, which actually happened (art. VIII). It also agreed to refrain from "separate and independent development on any SL substantially duplicating the design and capabilities of the first SL unless ESRO fails to produce such SL" (art. VIII).

The initial configuration and capabilities of the SL would be shaped following the shuttle requirements; Europeans were completely excluded from operating the device they were going to produce. As Douglas Lord, NASA's director of Spacelab, has so properly commented, "it was as if NASA had hired a development contractor, only in this case the contractor was in Europe and would use its own money"[99].

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98 HAEUI, CSE/CS(72)15, Report of the ESC Delegation on discussions held with the US delegation on European participation in the post-Apollo programme, 22 June 1972. As already stated in informal discussions in April 1972, in the most "sensitive" cases of classified technology, if the basic technology could not be transferred, the US would undertake, if necessary, to sell the hardware itself; HAEUI, CSE/CS(72)13, Report by the Secretary General of the ESC on the informal discussions with American officials regarding participation in the post-Apollo programme, 8 May 1972.

99 D. Lord, *op. cit.*, p. 31. The first Spacelab was handed over to the US in 1980 and the German astronauts Ulf Merbold, ESA's payload specialist, took part to the first mission in November 1983. For the scientific aspects of Spacelab missions, see D. Shapland and M. Rycroft, *Spacelab. Research in Earth Orbit* (Cambridge: Cambridge University Press, 1984).

14. Concluding remarks

The magnitude of the elements involved in the prospective post-Apollo cooperation gave rise to very high political and technological expectations from some European partners. But the range of elements was progressively restricted in the course of negotiations; political and technological European expectations were only partly fulfilled.

The post-Apollo negotiations had the merit of throwing into relief the difficulties of changing the pattern of international cooperation from a "conservative" approach geared to bilateral (and less frequently multilateral) scientific agreements to much more complex cooperative ventures in development and technological fields. In this last case, political willingness to cooperate would have to cope with direct or indirect, but altogether well rooted, commercial and security considerations[100].

The negotiations made unmistakably clear that a fruitful cooperation is the one in which every partner gets something that appeals to him/her (as opposed to the competitive zero-sum game). In order to do this, everyone has something valuable to offer. In this respect, the negotiations served the useful purpose of giving a new compelling force to the directives stated in the Causse report of 1967, whereby the European effort in space had to be imaginative and substantial in order to give credibility to Europe on the international scene and as a viable partner in international cooperation. The process of assessing new (commercial) interests, harmonizing them with the previous scientific nature of ESRO-ELDO, building up a credible organizational structure to wage this policy and find the financial means for it took place in parallel with the post-Apollo negotiations and sensibly weakened the bargaining position of Europe.

The difficulties of a normal governmental decision-making process were multiplied by the absence of a supranational structure and a clear hierarchical chain of command, whereby different European positions could be reduced to a single one by recognizing a single legitimizing authority. If the Italian Minister of Scientific Research asked for total technological sharing, the European negotiator, Lefèvre, had "to take account" of this position, without being able to enforce any change in the government's position. Nor was it easy for European representatives to practice any form of bargaining, through which one actor within the national range is normally

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[100] On these problems, see L. Sebesta, "The Politics of Technological cooperation in space: US-European negotiations on the post-Apollo programme", *History and Technology*, 1994, vol. 11, No. 3, pp. 317-341.

free to be flexible within predetermined borders, in order to exert concessions from the other negotiator.

On the other hand, the nature of the American offer changed remarkably in the course of the negotiations, defusing the offer of its original political meaning. Born of an American desire to allay European fears about the "technological gap" in the space field, it ended up by reinforcing instead of relieving them. Many reasons for the evolution of the American position are to be found in the internal interplay between NASA, the Department of State and the White House, marked by an increasing fear about technological transfer[101].

The parallel failure to cooperate on AEROSAT seems to indicate the weakness of the political willingness to sustain cooperation with Europe and a lack of coordination between the various policy-making sectors on the American side[102].

Finally, it should be noted that the substantial reduction of the US offer conveyed in June 1972 was preceded by the US-USSR Moscow meeting of May 1972 where, besides the SALT and other fundamental elements of détente, an agreement on Apollo-Soyuz docking was signed[103]. Nixon's interest seemed to be progressively shifting towards spectacular USSR-US cooperative achievements, while European importance in the US foreign policy agenda was decreasing accordingly[104]

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101 On the development of US behaviour vis-à-vis cooperation with Europe during post-Apollo negotiations, see L. Sebesta, *art. cit.*

102 See for example Nixon Project, NARA, Washington DC, WHCF, Subject files, vtl, box 14, Memorandum Welsh to General Haig, cit.

103 J. Krige and A. Russo, *Europe in space 1960-1973*, cit.

104 While historical work based on primary sources is not yet available, good accounts based on a carefully balanced analysis of memories and official documents are starting to appear. The most outstanding is P. Melandri, *Une incertaine alliance. Les Etats-Unis et l'Europe, 1973-1983* (Paris: Publications de la Sorbonne, 1988), esp. pp. 45-77. For an insightful account written by a key actor (the American ambassador at the European Communities), see R. Schaetzel, *The Unhinged Alliance. America and the European Community* (New York: Harper, 1975), esp. pp. 42-53.

LIST OF APPENDICES

Appendix 1. NASA's Future Plans and Programs. Address by Dr. T.O. Paine, NASA Administrator, before the E.S.C. Committee of Senior Officials on 14 October 1969.

NASA's FUTURE PLANS AND PROGRAMS

THANK you very much for this opportunity to meet with you and to describe NASA's future plans and programs to this distinguished group.

It is, from our standpoint, a very timely moment to be reviewing with you the future NASA programs. There are three reasons for this:

- we have now completed the first decade of space, which started with the Sputnik and ended with the lunar landing, and are now entering the second decade of space;
- secondly, with the achievement of the moon landing goal which provided so much of the focus of the American space program in the 1960s, it is appropriate that we should ask ourselves: after the moon landing, what are the next tasks that we should undertake?
- and finally, this is a time in America of the beginning of the new administration under President Nixon and a change in political parties; it is therefore a time when it is traditional to pause and re-examine plans, objectives and resources and ask ourselves what new directions should be undertaken.

And so, for these reasons, we have just completed a thoroughgoing analysis of the future direction and pace of American activities in the second and third decades of space.

It is also appropriate within the American political system to publish widely our analysis so that it can serve as the focus of public debate within the Administration, within the Congress, within the engineering and scientific communities and with the general public so that the NASA programs which emerge will have that wide acceptance and general support which is essential to a continuing effort. We must be assured that the resources which will be required at the end of a decade will be there; we must select programs today which will command the support and resources which will be necessary for their completion.

It has been an eight-month task from the start of the new Administration, to assemble the U.S. Space Task Group report which we have sent to you. This recommendation to President Nixon reflects wide participation by American decision-makers, who have laid out future U.S. space program alternatives for President Nixon's selection and choice. We have met our deadline for the completion of our recommendations for the President, and have met with President Nixon to discuss our recommendations with him. We have received his assurances that indeed the recommendations appear to be sound. We will now proceed as the next step to lay before the American Congress the new 1971 budget containing the new program starts called for in the President's new space program, and will go through the normal political process in America to establish the budgets and programs with the concurrence of the Congress. We have already appeared before the House of Representatives and Senate Committees to discuss aspects of the new program, so we are starting down this road now with considerable confidence that a new program along these lines will emerge.

The other reason why we are releasing our recommendations to the President is our feeling that this will facilitate our communication with you. It seemed to us that the fine international cooperation that has been achieved in the first decade of space among our countries is something which we should not only continue in the second decade of space, but indeed should expand. We should build upon our successes of the first decade of space, not only upon our achievements in space but also upon our achievements in cooperation.

MY purpose in speaking to you this morning, and the reason why I so much appreciate your invitation to address you, is personally to make it as clear as I can that it is the desire of America not only to continue but indeed to expand the cooperation which, from our standpoint has proved so fruitful and which we hope, from your standpoint, has also been significant.

Address by Dr. T.O. Paine, NASA Administrator, before the E.S.C. Committee of Senior Officials on 14 October 1969

In preparing our recommendations for the President we have made several assumptions which do not appear explicitly in the Report, which I would like to lay before you candidly. One of these is that we have assembled in the United States, as you have in Europe, teams of competent space scientists, engineers, and application experts who should be given challenges in the second decade of space equal to that of landing a man on the moon in the first decade of space, equal to the challenge of exploring the near planets with unmanned probes, equal to the challenge of developing weather satellites, communications satellites, geodetic satellites and the other practical benefits which we have been able, working with you, to achieve in the 1960s. So one over-riding principle has been to make the challenge to our people in the second decade of space equal to that of the first.

In order to carry out a balanced and challenging program we had to face up to the necessity for committing resources in the second decade of space comparable to those which we committed in the first decade. These resources, which have ranged recently between four billion and six billion American dollars, represent for the United States a major commitment of national effort. At the same time, this comprises less than half a percent of the U.S. gross national product. We believe that this is a wise investment in the future of our people to undertake.

So the two factors which I would summarize are that we have sought to achieve a balanced program equal in challenge to the past program's challenge, and we have recommended that resources be allocated comparable to those allocated for the first decade of space.

IN considering the the structure of the program to best achieve these goals, it was clear to us that we should recommend to the President a program balanced among science and technology and applications goals, balanced between new exploration, new technical development and the utilization of new systems and the expansion of systems which have already been put into place (such as weather and communications satellites), balanced between unmanned probes and manned activities in space. We have attempted in our Report to achieve this balance.

We also felt that it was extremely important in the second decade of space, as in all new enterprises, to follow up the initial costly feasibility demonstration with a strong program to reduce costs. Our program is therefore heavily oriented towards new simplified systems with much greater reliability and substantially lower cost.

To be specific: at the present time, with our Saturn-V launch vehicle, it is possible for us to achieve a cost for injecting one pound of payload in orbit of about $500 U.S. It is our objective in the second decade of space, with greater traffic into orbit, to reduce this by at least one order of magnitude to a cost below $50 U.S. per pound of payload in orbit. We have examined ways in which this can be achieved and concentrated upon two approaches: **re-usability,** in which a vehicle is used for many trips or a space station for many years; and **commonality,** in which a system developed for one purpose has sufficiently broad characteristics to allow the development work to be applied to other purposes. With these two approaches, we have focussed on three significant new technological developments of a major nature: the space shuttle, the space station and the nuclear propulsion stage. Let me speak briefly on each of these three major undertakings.

The space shuttle will be a new type of space transportation system designed to carry men and materials from the surface of the earth into orbit, and then return to earth for re-use many times. It will be a two-stage vehicle with a cargo capacity between 20,000 and 50,000 pounds to orbit and return.

The U.S. is now orbitting about two payloads every week. We would expect that many of our present medium-scale launch vehicle missions would be su-

perseded by space shuttle flights. We would expect to continue to launch small Scout-size rockets for special tasks, and to launch large Saturn-V rockets for major tasks in the lifting of heavy objects to orbit, although we would not expect to continue to use the Saturn-V for manned flight. Between the Scout rocket at the small end of the spectrum and the Saturn-V at the large end, it would be our desire to replace insofar as possible our present medium launch vehicles with shuttle-type operations.

The shuttle characteristic which we have in mind would allow a crew to fly with the payload to orbit in the shuttle vehicle, remain there for days, perhaps a week, perhaps longer, to carry out activities in connection with the emplacement in orbit of the payload (a weather satellite, for example). It would also allow us to repair, refurbish or resupply an existing satellite in orbit, move it to a space station or to another orbit, or retrieve a payload from orbit and return it to earth for later re-launching and re-use.

THE second new development is the space station. This is a timely subject to discuss today of course with the seven Soviet cosmonauts now aloft doing experiments in connection with space station development. Our experiments in the Apollo Application Program aim at launching a major facility in 1972, including such devices as manned solar telescopes for our first experimentation with a number of people aloft for extended periods in a large station. We envision the space station as being a place for men to live and work in orbit for an indefinite period. The space station would be a modular construction so that over the years we could add additional modules in an evolutionary fashion as we discover new applications and new experiments to carry out. The space station would thus grow over a decade to a very substantial permanent space base in orbit.

We also plan to design the space station life support and experimental systems in such a way that it should be possible to utilize the development program for the space station as a basis for the subsequent development of living quarters for a future lunar base and for manned probes to Mars.

THE final major new development which I should mention is the nuclear stage. We envision this not as the third stage of a Saturn-V, but rather as a deep-space propulsion vehicle which would never be utilized below earth orbit. It should become the standard means for moving payloads, including men, from earth orbit up to geostationary orbit or from earth orbit to lunar orbits. It will also provide the basic propulsion system that in the 1980s will carry the first men to the planets. Although the nuclear stage is in a preliminary stage of development in the United States, work has been proceeding for a number of years and considerable progress has been made. We have operated our NERVA prototype engine at full-thrust for many minutes. We have started it and stopped it many times, we have throttled it, we have operated it now for many hours. The 70,000 pound thrust engine now under test at our Nevada test site has recently completed another series of very successful tests and would become the prototype for a flight-weight nuclear stage of comparable size and thrust. It has achieved twice the specific impulse of the best chemical rockets. With a practical high specific impulse nuclear stage operating in the second half of the 1970s, it will be possible to emplace modules of the space station both in geostationary earth orbit or in polar orbit about the moon.

The NERVA nuclear stage utilizes liquid hydrogen as the propellant which is heated by the nuclear reactor and then exhausted through a nozzle. It is an extremely simple device and will have the shielding and reliability for man-rating.

THERE is always great interest in the question of when men will first visit the planets and so I would like to say a word about the proposal to the President for a manned expedition to Mars. If I don't mention it, the question will surely arise this afternoon!

It is our view and our recommendation to the President that the United States should not undertake a manned expedition to Mars with chemical propellants but should wait until the nuclear stage and the space station have been demonstrated and the space shuttle system from earth surface to orbit is in operation to carry payloads up at low cost for assembly in orbit of a deep-space Mars ship. We envision that this will become possible during the decade of the 1980s, providing that in our 1970s programs we give proper direction to the space shuttle, the space station and the nuclear stage, so these elements can readily be combined into an economical Mars expedition.

With three nuclear propulsion stages side by side, with the space station type of life-support module and with Mars landing devices that would be somewhat similar to our present lunar landing devices (but with heat shields to utilize the Martian atmosphere for deceleration), we believe that an expedition could be mounted to Mars comprising two separate spaceships with a crew of six men each. The outer two nuclear propulsion stages in each spaceship would be fired to depart

from earth orbit on a trajectory to Mars with the middle nuclear stage left unfired. After the proper velocity towards Mars was achieved, the outer nuclear stages would be detached with sufficient propellant remaining for retrofire and return to earth orbit, where new propellant could be added so they could be re-used. The two Mars ships would then be linked together for the ten-month voyage out to Mars. If it were necessary, they could be given sufficient rotary motion to provide a small amount of artificial gravity. Upon arrival in the vicinity of Mars, the ships would be detached from one another and for the first time the center nuclear stage of each space ship would be retrofired to achieve orbit about Mars. They would remain for some three months in Martian orbit during which time a surface landing would be made and surface activities carried out for some four to six weeks. At the end of this time, three men on the surface would rejoin three men orbiting Mars in each space ship for the return to earth. The nuclear stage would then be fired for the second time to begin the trip back to earth. Upon arrival at earth orbit the stage would be fired for the third and final time to put the ship back into orbit about the earth.

I mention this point because the ships would then be available, after the crew had been returned to earth via the space shuttle system, for other trips to Mars or for deep space trips to other parts of the solar system - after refurbishing, resupply and a new crew assignment. The point to be emphasized is that we are attempting to plan an era of space travel in which equipment will be utilized many times, even in the case of the manned expedition to Mars. A true space transportation system will thus gradually be built.

I mentioned that we have recommended to President Nixon a balanced space program. You will find in our proposal emphasis on continuing to explore the planets. We hope to explore for the first time with a television system the surface appearance of Mercury, in a Venus-Mercury fly-by, and we hope to send unmanned expeditions to the outer regions of the solar system in what we call the " Grand Tour " Expedition toward the end of the 1970s. This will take advantage of the favourable alignment of the planets, Jupiter, Saturn, Uranus, Neptune and Pluto, which will occur in the 1977-1979 period. This nine-year expedition to the outer planets will also be a major challenge to our space teams. We will have to design electronic and nuclear power systems able to operate untended for a decade while sending back signals across four billion miles. It is clear that we will have to equip these ships with self - checking computers that will monitor all of the on-board activity and have the capability of switching to other circuits and performing simple repairs in order to keep these ships in operation for their four-billion-mile journey.

Communications pose another challenge which we feel however is well within our capability.

Nuclear power of course will be required; because of the great distance from the sun, solar power will not be feasible.

These are challenges which we feel will return us great scientific information as well as bringing about technological advances which will have application in many other areas, for example, communications satellites right here on earth.

WE are also emphasizing in the space station a wide variety of scientific and application capabilities. We hope to develop both optical and radio telescopes to look out to the rest of the universe without the handicap of the earth's atmosphere. We hope to create a high energy physics experimental capability in orbit to study particles with energies far above the maximum energies which can be attained in accelerators here on earth. We hope to be able to carry out research programs in the biological and life sciences in which the effects of weightlessness and the effects of removal from the time signals here on earth can be studied in a variety of living systems. We hope to carry out studies of large structures and processes in weightless conditions. Similar work has been announced as one of the objectives of the current SOYUZ spacecraft, which will carry out welding experiments similar to those we have carried out in space chambers. We hope to carry out experiments in other modules of the space station looking inward to earth from the vantage point of space, to study the world's oceans and continents, its geology and geography, to study farms and forests and fisheries, to study the world's water supplies, to monitor such things as the world's weather, water and air pollution and economic activities of various types, such as the growth of cities. There are many other fields which we hope will become fruitful areas for space-based research and application. These then are some of the activities which we believe will be carried out in space stations, but I should emphasize that the economic utility of space stations will greatly depend upon the costs realized by the space shuttle system. We must be able to move back and forth from the space station to earth carrying men, materials, and equipments for the various purposes I have described.

With nuclear propulsion to emplace space stations in orbit about the moon, and to supply them with men, materials, equipment and supplies on a continuing low cost basis, we can begin to plan the true exploration of the moon to follow up the work that is now being done

with the Apollo system at the end of the first decade of space. The first lunar station will probably be a space station in polar orbit about the moon, which would be followed by a lunar surface station.

In this way we can make general observations of the moon and better support the surface station and surface exploration and utilization. We would envision the establishment of the first lunar surface station sometime toward the end of the 1970s or in the early 1980s. Many experiments in many disciplines can be carried out there besides the lunar geology which was a principal focus of the first Apollo missions, including the emplacement of radio and optical telescopes utilizing the 240,000 mile base line to similar facilities here on earth.

In the application area we plan to continue to emphasize both meteorology and communication satellite systems with new developments in such areas as navigation satellites and the new earth resource of earth survey satellite systems. The United States and India recently signed the first agreement for direct broadcast satellite experiments involving instructional TV programming to 5000 Indian villages. We have been working with other nations, principally Mexico, Brazil and Argentina, on the first development work in connection with the earth resource satellites and would welcome suggestions from other nations who would also like to join in work in this new area. It is too early to assess the full value of earth survey systems but we are proceeding optimistically to do the work necessary to determine the true economic value of this new type of application satellite.

THESE then are the principal thrusts of the planning documents which we have distributed to you. They outline the proposals which have been made to the President, to the Congress and to the American people for the U.S. space program in the 1970s and 1980s. I am grateful for the opportunity to meet with you today to emphasize in person our hope that you will study these documents. As you decide upon the course your own development programs will take, both in individual nations and in ELDO and ESRO, we will welcome your suggestions as to new means whereby we can achieve a greater degree of cooperation between our proposed space programs and your own plans for European programs. Surely we have in space a unique opportunity for a new step forward in international cooperation. Space is inherently a global enterprise involving all people and all continents. It is surely an aspiration of all mankind to extend man's domain from our home planet, earth, to other parts of the vast solar system in which the earth is such a small part. In space we have the advantage of a new field in which there are still few entrenched interests, few traditions which make it difficult in other areas to achieve substantial international cooperation. Those of us around the table who are devoting our talents and our energies to moving ahead in the new field of space should feel an extra responsibility for international cooperation because I think the people of the world, very properly, look to us to blaze new trails in cooperation as well as new trails in space science and technology. For us in America, which has been called the new world, we feel that space may represent another new world, a seventh continent, which is now opening to mankind in the region 100 miles above the surface of the globe. This is an unoccupied area which all men can develop and use by means of the new rocket transportation capability. It is a different kind of continent, an area which is not separated from the old world by miles, as was the "new world" of America from Europe, but is rather separated from the surface of earth by a velocity increment. The traveller who acquires a velocity of 30,000 km per hour enters this new world and lands in the new continent. What we are proposing now is to start building the transportation systems and the structures and ports, if you like, which will allow us to occupy and use this new continent for the benefit of man. The economic value of this new continent may in time prove to be as great as the economic value of the "new world" which was opened by Colombus and developed by European settlers. It is likely that in the future much of the world's communications will pass through and be switched in this new world, and a portion of the world's transportation will begin to utilize these channels. Some part of the world's information sensing of global activities—natural and human—will be exports of this new world, combined with information processing of the data. Surely many of the scientific discoveries of the next several decades will be made by men who live and work and utilize this new world. Most Americans feel that the investment of one half percent of our gross national product in travelling to and developing this new world is a wise investment which we are making for future generations. Each nation will have to decide for itself the degree to which it wishes to participate in this new human adventure and in this new investment for the future. We cannot yet tell whether the scale of investment that we have chosen is prudent; perhaps we are investing too much, perhaps too little.

History will judge whether we have made wise choices in our recommendations to President Nixon, and whether the program which we have now laid before you for your consideration contains new opportunities for your participation which you should recommend to your leaders. Thank you.

Source: ESRO/ELDO Bulletin, no. 8, January 1970. The original can be found in HAEUI, CSE/HF (69) 39, 24 November 1969, Annex 1, Text of the address by Dr. T.O. Paine, NASA Administrator, to the meeting of the Committee on 14 October 1969.

Appendix 2. Extract from Agreement, International Telecommunications Satellite Organization (INTELSAT), 20 August 1971.

International Telecommunications Satellite Organization (INTELSAT)

Agreement, with annexes, done at Washington August 20, 1971;
Entered into force February 12, 1973.
And operating agreement, with annex
Concluded by certain Governments and entities designated by Governments;
Done at Washington August 20, 1971;
Entered into force February 12, 1973.

(211)

management services, including the performance of the functions performed by the Secretary General up to that time, and for the supervision of the performance of the management services contractor.

(j) The Director General, acting under relevant policies and directives of the Board of Governors, shall take all necessary steps to ensure that the permanent management arrangements are fully implemented not later than the end of the sixth year after the date of entry into force of this Agreement.

ARTICLE XIII

(Procurement)

(a) Subject to this Article, procurement of goods and services required by INTELSAT shall be effected by the award of contracts, based on responses to open international invitations to tender, to bidders offering the best combination of quality, price and the most favorable delivery time. The services to which this Article refers are those provided by juridical persons.

(b) If there is more than one bid offering such a combination, the contract shall be awarded so as to stimulate, in the interests of INTELSAT, world-wide competition.

(c) The requirement of open international invitations to tender may be dispensed with in those cases specifically referred to in Article 16 of the Operating Agreement.

ARTICLE XIV

(Rights and Obligations of Members)

(a) The Parties and Signatories shall exercise their rights and meet their obligations under this Agreement in a manner fully consistent with and in furtherance of the principles stated in the Preamble and other provisions of this Agreement.

(b) All Parties and all Signatories shall be allowed to attend and participate in all conferences and meetings, in which they are entitled to be represented in accordance with any provisions of this Agreement or the Operating Agreement, as well as in any other meeting called by or held under the auspices of INTELSAT, in accordance with the arrangements made by INTELSAT for such meetings regardless of where they may take place. The executive organ shall ensure that arrangements with the host Party or Signatory for each such conference or meeting shall include a provision for the admission to the host country and sojourn for the duration of such conference or meeting, of representatives of all Parties and all Signatories entitled to attend.

(c) To the extent that any Party or Signatory or person within the jurisdiction of a Party intends to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its domestic public telecommunications services requirements, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall consult the Board of Governors, which shall express, in the form of recommendations, its findings regarding the technical compatibility of such facilities and their operation with the use of the radio

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frequency spectrum and orbital space by the existing or planned INTELSAT space segment.

(d) To the extent that any Party or Signatory or person within the jurisdiction of a Party intends individually or jointly to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its international public telecommunications services requirements, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall furnish all relevant information to and shall consult with the Assembly of Parties, through the Board of Governors, to ensure technical compatibility of such facilities and their operation with the use of the radio frequency spectrum and orbital space by the existing or planned INTELSAT space segment and to avoid significant economic harm to the global system of INTELSAT. Upon such consultation, the Assembly of Parties, taking into account the advice of the Board of Governors, shall express, in the form of recommendations, its findings regarding the considerations set out in this paragraph, and further regarding the assurance that the provision or utilization of such facilities shall not prejudice the establishment of direct telecommunication links through the INTELSAT space segment among all the participants.

(e) To the extent that any Party or Signatory or person within the jurisdiction of a party intends to establish, acquire or utilize space segment facilities separate from the INTELSAT space segment facilities to meet its specialized telecommunications services requirements, domestic or international, such Party or Signatory, prior to the establishment, acquisition or utilization of such facilities, shall furnish all relevant information to the Assembly of Parties, through the Board of Governors.

The Assembly of Parties, taking into account the advice of the Board of Governors, shall express, in the form of recommendations, its findings regarding the technical compatibility of such facilities and their operation with the use of the radio frequency spectrum and orbital space by the existing or planned INTELSAT space segment.

(f) Recommendations by the Assembly of Parties or the Board of Governors pursuant to this Article shall be made within a period of six months from the date of commencing the procedures provided for in the foregoing paragraphs. An extraordinary meeting of the Assembly of Parties may be convened for this purpose.

(g) This Agreement shall not apply to the establishment, acquisition or utilization of space segment facilities separate from the INTELSAT space segment facilities solely for national security purposes.

ARTICLE XV

(INTELSAT Headquarters, Privileges, Exemptions, Immunities)

(a) The headquarters of INTELSAT shall be in Washington.

(b) Within the scope of activities authorized by this Agreement, INTELSAT and its property shall be exempt in all States Party to this Agreement from all national income and direct national property taxation and from customs duties on communications satellites and components and parts for such satellites to be launched for use in the global system. Each Party undertakes to use its best endeavors to bring about, in accordance with the applicable domestic procedure, such further exemption of INTELSAT and its property from income and direct property taxation, and customs duties, as is desirable, bearing in mind the particular nature of INTELSAT.

Source: *Space Law and Related Documents. International Space Law Documents, US Space Law Documents*, 101st Congress, 2nd Session, S. Print 101-98 (Washington DC: US Government Printing Office, 1990).

Appendix 3. Letter from Under-Secretary of State Johnson to Minister Lefèvre, 1 September 1971.

EUROPEAN SPACE CONFERENCE

AD HOC COMMITTEE OF OFFICIALS

CSE/Comité ad hoc(71)18 Neuilly, 8th November 1971

Annexes : 3

Note from the Secretariat

Letter from Under-Secretary of State A. Johnson

Please find enclosed :

in Annex I : the text of the letter from Under-Secretary of State A. Johnson to Minister Th. Lefèvre, dated 1st September 1971;

in Annex II : the text of the amplifying comments issued by the Department of State;

in Annex III : the text of the Press Statement published in Washington on 1st November 1971.

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CSE/Comité ad hoc(71)18 Annex I

Letter from Mr. A. Johnson, Under-Secretary of State to Minister Théo Lefèvre

Under Secretary of State
for Political Affairs
Washington

September 1, 1971

Dear Minister Lefèvre:

This letter is in response to yours of March 3, 1971, concerning possible European participation in Post-Apollo space programs. It sets out our current views on the matters of consequence which were involved in our discussions this past February and in September, 1970. It overtakes my letter to you of October 2, 1970.

I regret that it has not been possible to respond to you earlier. We felt that our mutual interests would be served best if we took sufficient time to review our position carefully in the light of your letter and of events since our discussions in February. As I stated during those discussions, our ultimate views on most of these matters remain contingent on choices yet to be made in Europe as to the measure and character of European participation and on further development of our own plans for Post-Apollo programs.

Since we have understood that the matter of greatest concern to the European Space Conference is the availability of launchers for European satellite projects we have reviewed our position so as to meet the concerns expressed in your letter and during our earlier discussions. Our new position in this regard described in the numbered paragraphs below, is not conditioned on European participation in Post-Apollo programs. I believe it should provide a basis for confidence in Europe in the availability of U.S. launch assistance. Specifically:

(1) We recognize the concern of the European Space Conference with regard to the availability of launch assistance for

European payloads. In this respect, U.S. launch assistance will be available for those satellite projects which are for peaceful purposes and are consistent with obligations under relevant international agreements and arrangements, subject only to the following:

(a) With respect to satellites intended to provide international public telecommunications services, when the definitive arrangements for Intelsat come into force the U.S. will provide appropriate launch assistance for those satellite systems on which Intelsat makes a favorable recommendation in accordance with Article XIV of its definitive arrangements. If launch assistance is requested in the absence of a favorable recommendation by Intelsat, we expect that we would provide launch assistance for those systems which we had supported within Intelsat so long as the country or international entity requesting the assistance considers in good faith that it has met its relevant obligations under Article XIV of the definitive arrangements. In those cases where requests for launch assistance are maintained in the absence of a favorable Intelsat recommendation and the U.S. had not supported the proposed system, the United States would reach a decision on such a request after taking into account the degree to which the proposed system would be modified in the light of the factors which were the basis for the lack of support within Intelsat.

(b) With respect to future operational satellite applications which do not have broad international acceptance, we would hope to be able to work with you in seeking such acceptance, and would favorably consider requests for launch assistance when broad international acceptance has been obtained.

(2) Such launch assistance would be available consistent with United States laws either from United States launch sites (through the acquisition of United States launch services on a cooperative or reimbursable basis) or from foreign launch sites (by purchase of an appropriate United States launch vehicle). It would not be conditioned on participation in Post-Apollo programs. In the case of launchings from foreign sites, the United States would require assurance that the launch vehicles would not be made available to third parties without prior agreement of the United States.

(3) With respect to European proposals for satellites intended to provide international public telecommunications services, we are prepared to consult with the European Space Conference in advance so as to advise the Conference whether we would support such proposals within Intelsat. In this connection we have

undertaken a preliminary analysis of the acceptability of European space segment facilities for international public telecommunication services separate from those of Intelsat, in terms of the conditions established by Article XIV, and find that the example of a possible operational system of European communication satellites, which was presented during our discussions in February, would appear to cause measurable, but not significant, economic harm to Intelsat. Thus, if this specific proposal were submitted for our consideration, we would expect to support it in Intelsat.

(4) With respect to the financial conditions for reimbursable launch services from U.S. launch sites, European users would be charged on the same basis as comparable non-U.S. Government domestic users.

(5) With respect to the priority and scheduling for launching European payloads at U.S. launch sites, we would deal with these launchings on the same basis as our own. Each launching would be treated in terms of its own requirements and as an individual case. When we know when a payload will become available and what its launch window requirements will be, we would schedule it for that time. We expect that conflicts would rarely arise if at all. If there should be a conflict, we would consult with all interested parties in order to arrive at an equitable solution. On the basis of our experience in scheduling launchings, we would not expect any loss of time because of such a conflict to be significant.

The United States is considering the timing and manner of public release of this position. Accordingly, it is requested that there be no public disclosure of this position without prior agreement with us.

With regard to Post-Apollo cooperation, as you know, the United States has not yet taken final decisions with respect to its Post-Apollo space programs, nor can we predict with assurance when such decisions will be taken.

With respect to the more detailed questions on Post-Apollo collaboration posed in your letter of March 3, 1971 and in our earlier discussions in September 1970 and February 1971, our views remain broadly as we put them to you in my letter of October 2, 1970 and in our meetings of last September and February. We would much prefer to continue the consideration of such questions in the context of specific possibilities for collaboration rather than in the abstract.

The relationship we are seeking with Europe with respect to Post-Apollo space programs would, we believe, be well served if we can jointly consider the possibilities for collaboration

in the context of a broader examination of the content and purposes of the space programs of the late 1970s and 1980s.

Accordingly, we suggest broadening your earlier suggestion for a joint expert group to conduct technical discussions. The purpose of these discussions will include the definition of possible cooperative relationships between Europe and the U.S. in a program of development of the space transportation system, but would be broadened to include an exchange of views regarding the content of space activities in which Europe might wish to participate in the Post-Apollo era. The technical questions relevant to such participation, including the remaining questions raised in your letter of March 3 would be examined as well. The joint group would carry on its activities with no commitment on either side. The U.S. representation would be led by Charles W. Mathews, Deputy Associate Administrator, Office of Manned Space Flight, NASA.

This group could most usefully commence its work after the end of September when the results of NASA's current technical studies of space transportation systems become available.

I trust, Mr. Minister, that this summary of our present views is a helpful response to the matters raised in your letter of March 3. I am pleased to confirm our continuing interest in cooperating with interested European nations in the further exploration and use of space.

Sincerely,

U. Alexis Johnson

CSE/Comité ad hoc(71)18 Annex II

Amplifying Comments to Under Secretary Johnson's Letter to Minister Lefevre of September 1, 1971

In response to inquiries from Europe, the United States has provided amplification and clarification of several specific points in Under Secretary Johnson's letter of September 1, 1971. A summary of these comments follows.

The letter was intended to provide a positive basis of confidence in the availability of U.S. launch assistance and reflects a major effort to accommodate known European views and concerns. This assistance is available independent of any decisions Europe may make on development of its own launch capability.

The use of the phrases "we expect that we would provide launch assistance" and "we would expect to support" in the section of the letter dealing with regional telecommunications satellites (subparagraphs 1(a) and 2) simply recognizes the fact that the U.S. cannot be in the posture of dismissing a priori the views of our INTELSAT partners. These words were not designed to provide a loophole in the offer of launch assistance. Denial of launch assistance, should that be our intention, would be more directly accomplished by denying our support in INTELSAT to the satellite proposal itself.

The reservation in subparagraph 1(b) of the letter concerning "future operational satellite applications which do not have broad international acceptance" is simply a recognition of the fact that we are dealing with a very rapidly developing technology, and that we must necessarily anticipate that applications may emerge, some in areas not yet foreseen, where the international implications of the proposed satellite services are not yet well understood and are not governed by specific international agreements or arrangements. In the absence of such understanding and arrangements, such new applications could create international tensions. For example, on the basis of views already expressed by some European countries and others, it appears that direct TV broadcasting via satellite across international borders might in some circumstances fall in this category.

Subparagraph 1(b) would clearly not cover scientific research satellites or such satellite applications as meteorological satellites, navigation satellites, satellites to provide international public telecommunication services or specialized aeronautical and maritime telecommunication services, and satellites to provide direct TV broadcasting services on the basis of agreed regional arrangements. It is intended to apply only to operational satellite systems which would provide an established, continuing service, not to satellites flown solely for purposes of research and development.

We expect that broad international acceptance of earth

resource surveying by satellite will have been achieved well before such satellites are flown on an operational basis. This use of satellites is still in the experimental stage and, therefore, not subject to the reservation of subparagraph 1(b). Since we are at this early stage in developing this application, we feel that we must consider proposals for launching operational satellites for this purpose as falling within subparagraph 1(b) at the present time.

The references in subparagraph 2 to "U.S. laws" is intended to recognize treaty obligations, such as the Outer Space Treaty, and extant U.S. legislation such as that affecting exports. Since the INTELSAT agreement is not a treaty, it constitutes an international undertaking of the U.S. which is consistent with existing U.S. law but does not create new U.S. law.

CSE/Comité ad hoc(71)18 Annex III

Press Statement; Nov. 1, 1971

Washington, D.C.

The United States has recently informed the European Space Conference that U.S. launch assistance will be available on a purchase basis for those satellite projects which are for peaceful purposes and are consistent with obligations under relevant international agreements and arrangements.

This position, was conveyed to Minister Théo Lefèvre, Chairman of the European Space Conference in a letter from Under Secretary of State for Political Affairs, U. Alexis Johnson. It encompasses launch assistance for satellites for such peaceful purposes as scientific research, meteorology, navigation, telecommunications and specialized aeronautical and maritime services.

In light of the INTELSAT agreement the U.S. position sets forth the conditions under which launch assistance would be available to Europe for satellites intended to provide international public telecommunications services separate from those provided by INTELSAT.

We have also informed the European Space Conference of our agreement to enter into early exploratory technical discussions seeking to define possible European participation in key post-Apollo space programs. The launch position we have now set forth to the European Space Conference does not, however, depend on the nature or extent of any joint efforts on such future space programs.

Source: HAEUI, CSE/Comité ad hoc (71) 18, Annex, text of the letter from Under-Secretary of State Johnson to Minister Lefèvre, 1 September 1971.

Appendix 4. A Memorandum of Understanding between the National Aeronautics and Space Administration and the European Space Research Organization for a Cooperative Programme concerning Development, Procurement and Use of a Space Laboratory in Conjunction with the Space Shuttle System, 14 August 1973.

A Memorandum of Understanding

Between The
National Aeronautics And Space Administration
And The
European Space Research Organization
For A Cooperative Programme Concerning Development,
Procurement And Use Of A Space Laboratory In Conjunction
With The Space Shuttle System

PREAMBLE

Pursuant to the offer of the Government of the United States of America to Europe to participate in the major US space programme which follows the Apollo programme, and in particular in the development of a new space transportation system (Space Shuttle), the execution of which has been entrusted by the Government of the United States of America to the National Aeronautics and Space Administration (NASA), European States, members of the European Space Research Organisation (ESRO), have manifested their desire to develop a Space Laboratory, hereinafter referred to as "SL", in the form of a Special Project within ESRO, for the purpose of participation in the Space Shuttle programme. These States, by means of an international Arrangement have charged ESRO or its successor organisation with the execution of the SL programme. In order to provide for appropriate association of the two Agencies in the execution of both programmes and in order to assure the necessary coordination between them, NASA, acting for and on behalf of the Government of the United States of America, and ESRO, acting for and on behalf of the Governments of those States participating in this Special Project, have drawn up this Memorandum of Understanding which sets out the particular terms and conditions under which such association and coordination will be effected. This Memorandum of Understanding will be subject to provisions of the Agreement between the Governments of the above participating States and the Government of the United States of America concerning this cooperative programme.

MEMORANDUM OF UNDERSTANDING

ARTICLE I

OBJECTIVES

The purpose of this Memorandum of Understanding is to provide for the implementation of a cooperative programme in which ESRO undertakes to design, develop, manufacture and deliver the first flight unit of an SL, and other materials described in this Memorandum. This flight unit will be used as an element to be integrated with the Space Shuttle. This Memorandum sets out furthermore the provisions for ESRO access for use of the SL and for the procurement by NASA of additional SLs, and establishes the cooperative structure between NASA and ESRO for dealing with all questions concerning interface between the Shuttle and SL programmes and concerning the missions to be defined.

ARTICLE II

GENERAL DESCRIPTION OF THE SL PROGRAMME, ITS INTERFACE WITH THE SPACE SHUTTLE, AND ITS USES

1. Summary description of the SL programme

The SL programme provides for the definition, design and development of mannable laboratory modules and unpressurised instrument platforms (pallets) suitable for accommodating instrumentation for conducting research and applications activities on Shuttle sortie missions. The SL module and SL pallet will be transported, either separately or to-

gether to and from orbit in the Shuttle payload bay and will be attached to and supported by the Shuttle orbiter throughout the mission. The module will be characterised by a pressurised environment (permitting the crew to work in shirt sleeves), a versatile capability for accommodating laboratory and observatory equipment at minimum cost to users, and rapid access for users. The pallet, supporting telescopes, antennae and other instruments and equipments requiring direct space exposure, will normally be attached to the module with its experiments remotely operated from the module, but can also be attached directly to the Shuttle orbiter and operated from the orbiter cabin or the ground. Both the module and the pallet will assure minimum interference with Shuttle orbiter ground turnaround operations.

2. Interface with Shuttle

The Shuttle will : serve in missions to deliver payloads to earth orbit; maintain station on orbit for mission durations in the order of seven days or more; provide safety monitoring and control over payload elements throughout the missions; and provide seating and complete habitability for crews, including free movement between the SL module and the Shuttle. In the interest of minimising developmental and operational costs, and maximising reliability, an effort will be made to optimise commonality between SL and Shuttle components.

3. Use objectives

The SL will support a wide spectrum of missions for peaceful purposes and will accept readily the addition of special equipment for particular mission requirements. The SL will facilitate maximum user involvement and accessibility. The flight equipment complement will be capable of augmentation as appropriate to satisfy approved programme needs. It will be possible for users to utilise the SL with or without supplementary equipment for a single experiment or, in the alternative, to utilise only a small portion of the SL in combination with other experiments. The standard resources of the SL may be utilised to any degree appropriate by an experimenter adhering to standardised interfaces which are to be defined and procedures which are to be set forth. Considerable flexibility in equipment and mission structuring shall be available to the user for effective mission operation.

ARTICLE III

PHASING AND SCHEDULING

1. Phase B studies

Based on present schedules, the Phase B (preliminary design) studies of the SL are expected to be completed around the end of 1973.

2. Phases C & D

At the completion of the Phase B studies, the parties will mutually agree on a design for immediate imple-

mentation and development by ESRO in Phases C & D (final design and hardware development and manufacture).

3. Completion schedules

It is currently planned that the first operational space flight of the Shuttle will occur in late 1979. To permit adequate time for experiment integration, check-out and compatibility testing, the SL flight unit shall be delivered to NASA about one year before the first operational Shuttle flight.

4. Schedule changes

Each party will keep the other fully and currently informed of factors affecting the schedules of the Shuttle and the SL respectively and their potential effects on flight readiness.

ARTICLE IV

PROGRAMME PLANS

The foregoing gross descriptions of the SL programme and of the phasing, scheduling and working arrangements are amplified in greater detail in the preliminary version, dated 30 July 1973, of the Joint Programme Plan. The parties recognise that many issues remain to be resolved in the Joint Programme Plan, which is to be developed and updated as appropriate by the Programme Heads. This plan is to be based on the results of preliminary design studies now in progress in both Europe and the United States, on the results of independent and joint studies of user

requirements, and on the final definition of, and the requirements for integration with, the Shuttle.

ARTICLE V

RESPECTIVE RESPONSIBILITIES

1. ESRO responsibilities

Among ESRO's responsibilities are the following :

(a) design, develop and manufacture one SL flight unit (consisting of one set of module and pallet sections), one SL engineering model, two sets of SL ground support equipment, initial SL spares, along with relevant drawings and documentation; and qualify and test for acceptance this equipment according to NASA specifications and requirements;

(b) deliver to NASA the items listed above;

(c) design, develop and manufacture such elements as ESRO and NASA may agree to be necessary for the programme in addition to those listed in (a) above;

(d) establish in the US and accommodate in Europe agreed liaison personnel;

(e) provide all necessary technical interface information;

(f) provide agreed progress and status information;

(g) following delivery of the above flight unit, maintain and fund an SL sustaining engineering

capability through the first two SL flight missions, and ensure for NASA's account the future availability to NASA of such engineering capability to meet NASA's operating requirements, on the same conditions as would apply to ESRO;

(h) ensure the production in Europe and possibility of procurement by NASA of subsequent flight units, components and spares; and

(i) provide for preliminary integration of experiments which ESRO supports, as well as acquire the corresponding data, within the overall responsibilities of NASA described in paragraph 2 (j) of this Article, and process it.

2. NASA responsibilities

Among NASA's responsibilities are the following :

(a) establish in Europe and accommodate in the US agreed liaison personnel;

(b) provide general technical and managerial consultation;

(c) provide all necessary technical interface information;

(d) provide agreed progress and status information;

(e) monitor ESRO technical progress in selected areas as defined in the Programme Plans;

(f) review and concur in the implementation of ESRO activities critical to the NASA programmatic requirements for the SL as defined in the Programme Plans;

(g) specify, in order to assure successful operation of the SL in the Shuttle system, operational plans, and hardware and operational interfaces as defined in the Programme Plans;

(h) conduct systems analyses for development of operational concepts and utilisation plans, and assess the impact of changes at all SL external interfaces;

(i) develop selected peripheral components, not part of, but necessary to the successful operation of the SL (e.g. access tunnel, docking ports); and

(j) manage all operational activities subsequent to the delivery of the SL, including experiment integration, crew training, check-out, flight operations, refurbishment, data acquisition, preliminary processing and distribution of data.

3. By agreement of the NASA Administrator and the Director General of ESRO, changes may be made in the above responsibilities, as may be desirable for the implementation of this cooperative programme.

ARTICLE VI

COORDINATION - LIAISON - REVIEWS

1. Programme Heads

Each of the parties has designated in their respective Headquarters an SL Programme Head. They will be responsible for the implementation of this

cooperative programme and they will meet and communicate as they require.

2. Project Managers

In addition, each of the parties will designate an SL Project Manager responsible for day-to-day coordination in the implementation of this cooperative programme.

3. Joint SL Working Group (JSLWG)

The two Programme Heads will together establish a Joint SL Working Group with appropriate technical representation from each party. The Programme Heads will be co-chairmen of the JSLWG. The JSLWG will be the principal mechanism for :

(a) the exchange of information necessary to inform both parties fully of the status of both the Shuttle and the SL;

(b) monitoring interface items, problems and solutions;

(c) early identification of issues or problems of either party which may affect the other; and

(d) assuring early action with respect to any problems or requirements.

4. Liaison

The parties shall each provide and accommodate liaison representation at levels as mutually agreed. The representation will be such as to assure each

party adequate visibility of the other's progress especially with regard to interfaces and their control. ESRO shall have representation on appropriate Shuttle change control boards to assure adequate opportunity to present the views and interests of ESRO with respect to any change. The ESRO representatives on the boards will have a voice but will not vote. NASA will have similar representation on the comparable ESRO SL board. ESRO and NASA will enable and arrange for visits to their respective contractors as required.

5. Progress reviews

Each party shall schedule progress reviews of its work in the Shuttle and SL programmes and shall provide access to the other to such reviews. Annual reviews will be conducted by the NASA Administrator and the ESRO Director General.

ARTICLE VII

FUNDING

1. Costs

NASA and ESRO will each bear the full costs of discharging their respective responsibilities arising from this cooperative programme, including travel and subsistence of their own personnel and transportation charges for all equipment for which they are responsible.

2. Availability of funds

The commitments by NASA and ESRO to carry out this cooperative programme are subject to their respective funding procedures.

3. Principle on pricing

Neither party will seek to recover government research and development costs incurred in the development of items procured from the other in connection with this cooperative programme.

ARTICLE VIII

NASA PROCUREMENT OF SLs

1. Principle

Subsequent to the delivery by ESRO of the SL unit and other items referred to in Article V,1 (a), NASA agrees to procure from ESRO whatever additional items of this type it may require for programmatic reasons, provided that they are available to the agreed specifications and schedules and at reasonable prices to be agreed. NASA should give an initial procurement order of at least one SL at the latest two years before the delivery of the SL unit referred to above. Recognising the desirability of gaining operational experience with the first flight unit before ordering additional units, but that the price and availability of production units will be dependent on the maintenance of a

continuing production capability, NASA will endeavour to provide significant lead time for any subsequent procurement order.

2. NASA abstention from SL development

NASA will refrain from separate and independent development of any SL substantially duplicating the design and capabilities of the first SL unless ESRO fails to produce such SLs, components and spares in accordance with agreed specifications and schedules and at reasonable prices to be agreed. For any NASA SL programme requirements which are not met by SLs developed under this cooperative programme, NASA will have the right to meet such requirements either by making the necessary modifications to the SLs developed under this cooperative programme, or by manufacturing or procuring another SL meeting such NASA requirements.

3. Notice of prospective requirements

NASA will endeavour to give ESRO advance notice of any prospective requirements for substantially modified or entirely new SLs so as to provide ESRO with an opportunity to make proposals which might meet such requirements.

ARTICLE IX

CONTINGENCIES

1. Non-completion of first SL or failure to meet specifications

NASA's obligations with respect to the SL shall lapse and ESRO will turn over to NASA without charge and without delay all drawings, hardware and documentation relating to the SL if ESRO abandons the development of the SL for any reasons, or ESRO is otherwise unable to deliver the SL flight unit prior to the first operational Shuttle flight, or the completed SL does not meet agreed specifications and development schedules. The right of NASA to use the said drawings, hardware and documentation shall be limited to the completion and operation of the SL programme. ESRO shall ensure that it will be in a position to provide as hardware any proprietary item for which it does not hold transmissible rights of reproduction.

2. Non-availability of subsequent SLs

If SLs, components and spares required by NASA after the first flight unit are not available to NASA in accordance with agreed specifications and schedules and at reasonable prices to be agreed, NASA shall be free to produce such units in the United States. For this purpose, ESRO will arrange in advance on a contingency basis any necessary licensing arrangements.

3. Design changes

While it is understood that ESRO will be represented on the Shuttle change control boards, NASA reserves the right to require changes affecting the interfaces or operational interactions between the Shuttle and the SL after hearing and considering ESRO's views with respect to the prospective effect of such changes on the SL design or cost. NASA recognises the desirability of avoiding changes resulting in a disproportionate impact on the SL programme. To the extent that changes affect the Shuttle and SL programmes, NASA and ESRO will bear the increases in the costs of their respective Shuttle and SL development contracts.

ARTICLE X

ACCESS TO TECHNOLOGY AND ASSISTANCE BY NASA

1. Principles

(a) ESRO will have access to technology, including know-how, available to NASA and needed to accomplish successfully its tasks under this cooperative programme; for the same purposes, NASA will have access to technology, including know-how, available to ESRO. NASA will do its best to arrange for such technical assistance as ESRO and its contractors may require for the satisfactory completion of the SL programme. Access to technology and arrangements

for technical assistance shall be consistent with applicable US laws and regulations.

(b) NASA will make available to ESRO general information related to the design, development, and use of the Shuttle and orbital system, particularly that required for the understanding of that system.

(c) Requests for use of technology, including know-how, in other than SL development and production tasks will be considered on a case-by-case basis.

(d) To the extent that NASA can make the required information readily available, it will do so without charge; in other cases, NASA will use its best efforts to facilitate its availability on favourable conditions.

(e) The access to technology, including know-how, referred to above will be effected in such a way as not to infringe any existing proprietary rights of any person or body in the United States or Europe.

2. Joint definition of areas

The two parties shall provide for the earliest possible joint definition of areas in which help in the procurement of hardware and technical assistance from US Government Agencies or nationals may be required.

MEMORANDUM OF UNDERSTANDING

3. Form of assistance

In providing such help to ESRO as may be agreed, NASA may respond on an in-house basis or may refer ESRO and/or its contractors to US contractors. NASA reserves the right to arrange for such assistance in the form of hardware, rather than know-how.

4. Quality control and acceptance

Where ESRO needs to procure US hardware, NASA agrees to use its good offices in connection with arranging the services of US quality control and acceptance and cost control and auditing personnel in US plants where available and appropriate.

5. Facilitation of export licenses

Early advance notification of contemplated ESRO procurements of US hardware or technology, including know-how, will facilitate assistance by NASA in connection with arrangements for export licenses consistent with applicable US laws and regulations.

6. Use of US facilities

Where it is jointly determined that it is appropriate and necessary for the conduct of the cooperative programme, NASA will use its good offices in connection with arranging for the use of US Government or contractors' facilities by ESRO and/or its contractors.

ARTICLE XI

PRINCIPLES CONCERNING ACCESS TO AND USE OF SHUTTLE/SL

1. Planning

There shall be adequate European participation in NASA planning for Shuttle and SL user requirements, with a view to providing for inputs relevant to both the SL design and to European use of the SL. Appropriate representation and relevant procedures are being jointly prepared and will be subject to agreement by NASA and ESRO.

2. Flight crews

Flight crew opportunities will be provided in conjunction with flight projects sponsored by ESRO or by Governments participating in the SL programme and utilising the SL. It is contemplated that there will be a European member of the flight crew of the first SL flight.

3. Special provisions for the use of the first SL flight unit

(a) In order to assure the integrity of operation and management of the Shuttle system, NASA shall have full control over the first SL unit after its delivery, including the right to make final determination as to its use for peaceful purposes.

(b) With regard to the first flight of the first SL unit, the system test objectives will be the

responsibility of NASA. The experimental objectives of this first flight will be jointly planned on a cooperative basis. Thereafter, the cooperative use of this first SL unit will be encouraged throughout its useful life although not to the exclusion of cost reimbursable use. NASA will otherwise have unrestricted use of the first SL unit free of cost.

(c) NASA may make any modifications to the first SL which it desires. Should NASA find it desirable to effect major modifications to this unit, these shall be discussed with ESRO which will be given the opportunity to provide modification kits. With respect to minor modifications, the normal procedures for configuration control will be relied on to provide adequate information on changes.

4. Subsequent availability and preferred access to participants

While it is premature to define the ultimate terms and conditions for operation and use of the Shuttle with the SL after the first SL mission, it is expected that the following principles will apply :

(a) NASA will make available the Shuttle for SL missions on either a cooperative (non-cost) or a cost-reimbursable basis. In the latter case, costs which may be charged include, but are not limited to, integration, check-out, crew training and data reduction, processing and

distribution, as well as the costs of the launching services provided.

(b) In regard to space missions of ESRO and Governments participating in the SL programme, NASA shall provide access for use of SLs developed under this cooperative programme for experiments or applications proposed for reimbursable flight by ESRO and Governments participating in the SL programme, in preference to those of third countries considering, in recognition of ESRO's participation in this cooperative programme, that this will be equitable in the event of payload limitation or scheduling conflicts. Experiments or applications proposed for cooperative flight will be selected on the basis of merit in accordance with continuing NASA policy; such proposals of ESRO and Governments participating in the SL programme will be given preference over the proposals of third countries provided their merit is at least equal to the merit of the proposals of third countries. ESRO and the Governments participating in the SL programme will have an opportunity to express their views with respect to the judgement of merit regarding their cooperative proposals.

ARTICLE XII

PUBLIC INFORMATION

Each party is free to release public information regarding its own efforts in connection with this cooperative

programme. However, it undertakes to coordinate in advance any public information activities which relate to the other party's responsibilities or performance.

ARTICLE XIII

PATENTS AND PROPRIETARY INFORMATION

Each of the parties and their contractors shall retain unaffected all rights which they may have with respect to any patents and/or proprietary information, whether or not they antedate this Memorandum of Understanding. Where it is mutually determined that patentable or proprietary information should be transferred in the interest of successfully implementing this cooperative programme, this may be done under arrangements which fully recognise and protect the rights involved. In addition, each of the parties shall secure from its contractors the rights necessary to discharge the obligations contained in this Memorandum of Understanding in accordance with its internal rules.

ARTICLE XIV

SETTLEMENT OF DISPUTES

1. Any disputes in the interpretation or implementation of the terms of this cooperative programme shall be referred to the NASA Administrator and the Director General of ESRO for settlement.

2. Should the NASA Administrator and the Director General of ESRO be unable to resolve such disputes, they may be submitted to such other form of resolution or arbitration as may be agreed.

ARTICLE XV

DURATION

This Memorandum of Understanding shall remain in force until 1 January 1985, but at least for five years from the date of the first flight of the SL. This Memorandum shall be extended for three years unless either NASA or ESRO gives notice of termination prior to 1 January 1985, or prior to the expiration of the five years, whichever is applicable. Thereafter, the Memorandum of Understanding shall be extended for such further periods as the parties may agree.

ARTICLE XVI

ENTRY INTO FORCE

This Memorandum of Understanding shall enter into force when both the NASA Administrator and the Director General of ESRO have signed it and it has been confirmed under the terms of the Agreement between the Governments of the participating European States and the Government of the United States of America concerning this cooperative programme.

MEMORANDUM OF UNDERSTANDING

Dated 14 August 1973

For the
European Space
Research Organisation

For the
National Aeronautics and
Space Administration

Source: D. Lord, *Spacelab. An international success story* (Washington DC: NASA, 1987), Appendix A. The two signatures are those of A. HOCKER, Director General of ESRO and J.C. FLETCHER, NASA Administrator.
The original can be found in HAEUI, ESRO/C (73) 45, rev. 1, Draft Memorandum of Understanding between the NASA and the ESRO for a Cooperative Programme concerning Development, Procurement and Use of a Space Laboratory in Conjunction with the Space Shuttle System, 26 July 1973.

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