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UNITED STATES AIR FORCE

P R O P O S E D

NATIONAL SPACE PROGRAM

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MEMORANDUM FOR THE SECRETARY OF DEFENSE

SUBJECT: USAF Proposed National Space Program

1. Your memorandum of April 13, 1961, requested the Department of the Air Force to submit a recommended national space program to meet national defense requirements. The United States Air Force Proposed National Space Program is herewith submitted.

2. The Department of the Air Force is seriously concerned by the apparent inadequacy of our current National Space Program. The extent and the implications of these deficiencies are clearly pointed out in the recently completed Gardner Committee Report.

3. Unless the program is substantially broadened and up-graded at an early date, it is questionable that we will achieve timely availability of the fundamental capabilities to support the known and anticipated space system requirements of the several services or of the Nation. The inclosed proposal is based on the content of the Gardner Committee Report and on other studies previously conducted by the Department of the Air Force. It offers an effective program through which the expansion and acceleration of our space efforts which we consider essential can be accomplished.

4. I have reviewed the proposal in detail and it has my personal endorsement. I urgently recommend your support.

2 Inclosures
1. USAF Proposed National Space Program
2. Addendum - The Threat

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Memo to Sec'y of Defense

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A United States space program which can overcome the Soviet psychological lead in space is both economically and technically feasible. The characteristics of the fundamental technical problems involved are well understood. The solution of these problems awaits only the implementation of a vigorous broad based investigative and experimental effort. The Nation's economy, scientific and technological base and industrial capacity are fully adequate to support a greatly expanded space program. Our only current limitation is firm decision and clear cut direction.

Current evaluations of relative over-all United States and Soviet technology provide good reason to believe that the United States is ahead of the Soviet Union in large solid and liquid hydrogen propellants and in nuclear rocket propulsion. This technology, together with existing development-management capability such as has been applied to our ballistic missile and space programs, presents the opportunity to achieve the fundamental capabilities which will allow us not only to equal Soviet space accomplishments but to outstrip them within the period of the proposed program herein recommended.

In contrast to this, it is our opinion that our current National Space Program, even when fully realized, will not permit us to compete with future Soviet accomplishments. Further, the program appears inadequate in both scope and content to produce at a sufficiently early date the fundamental capabilities to support known and anticipated national space system requirements. Nonetheless, with few exceptions, the individual projects in the existing program are of value. In any expanded national program, they should be continued in the same, or in some selected cases, at accelerated levels.

For the United States to compete successfully in the future, a thoroughly revised and upgraded national space program must be initiated now. Such a program demands:

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a. Establishment of clear national space objectives which will be sufficiently dramatic in psychological gain and adequately productive of side benefits to other elements of the over-all space program to warrant marshalling our national resources to its attainment.

b. Continuing national resolve to fulfill these objectives within definite periods of time.

c. A philosophy of selective concurrency with appropriate priority assignment of resources and the establishment of adequate authority to permit progress at the maximum pace which technology will support. This is similar to the approach established in 1954 for the accelerated development of intercontinental ballistic missiles.

d. Concurrent initiation and parallel pursuit of broad scientific investigations to produce the future technology which will insure maintaining the initiative which we now seek.

The most immediate problem area requiring attention is the large booster program. Our deficiencies in this area are the primary cause of our lagging the Soviets in space. Booster improvement is the keystone of any effort to equal or surpass them. It is essential for support of all recommended actions made herein.

To overcome the deficiencies made so manifest by our lag in the booster program, the United States must establish clear cut national and military objectives and equally clear assignment of responsibility to the organizations which will implement the program to achieve them. In determining these objectives, it is important to keep in mind the inseparable relationship of military tasks to other objectives in our over-all national space program. Vital importance must be attached to the demonstration of our national technological supremacy as a symbol of national prestige and indisputable power. Accordingly, the military and the national aspects of space must be integrated even more carefully than in the past.

Our assessment of military goals and objectives in space has identified certain priority tasks as follows:

a. Geodetic location of targets and collection of mapping data for limited war application.

b. All aspects of reconnaissance and surveillance of the enemy from space including meteorological, electronic, communications, and photographic.

c. Surveillance, inspection, and neutralization of enemy systems in space.

d. ICBM early warning and active defense during boost and/or mid-course.

e. Surface target strikes from space.

f. Command and control of military forces operating both in space and on the terrestrial surface including the means for reliable multi-channel communications and for navigation.

g. Support functions incident to space and present military tasks.

The technical content of our national space program must be of sufficient breadth to insure development of the fundamental capabilities which will support the eventual effective accomplishment of the above military tasks. It is our belief that the investigative and experimental efforts thus required will benefit all aspects of the total national space program. Early achievement of these capabilities dictate the assignment of the highest priority to accelerated applied research in the following areas.

a. Sensors

b. Orientation and support of man-in-space

c. Weapon technology

d. Auxiliary power

e. Propulsion

f. Re-entry and precise recovery

In order to make the best possible technical examination of an accelerated and simplified space program, the then Air Research and Development Command last fall convened a committee of scientists particularly qualified in space and missile matters to make recommendations concerning a national space effort. This committee has recently completed its work and has contributed a valuable deep look at our future in space. The views of this committee in large part support and substantiate our own views and recommendations.

We have the opportunity now to achieve several dramatic firsts. For example, a short time still remains to make the decision to develop the boosters and payloads which will place a man on the moon and return him to earth before the Soviet Union.

The program proposed in the following pages outlines a specific plan of action for the National Space Program, the early implementation of which the Air Force considers to be essential.

A. FUNDAMENTAL SPACE CAPABILITIES

1. BOOSTERS

a. General

Today the United States depends for space launching upon ballistic missiles with modest performance upper stages. The largest payload within our capability is 5,900 lb in a 300 mile high orbit. The present national program calls for development of the Centaur stage for use with the Atlas missile, and the Saturn Program. The Atlas-Centaur vehicle will provide payload capabilities still inferior to demonstrated Soviet launchings. The Saturn program is the only development effort to exceed present Soviet space capabilities. Careful analysis has shown the Saturn vehicles to be unreliable, expensive and operationally unsuitable for military applications. In order for the Air Force to meet its defense obligations in space it must have adequate launching capabilities. The needs for such capabilities have been studied in depth and in detail over the last eighteen months. The program needed to meet these objectives has been formulated and it is presented here.

b. Titan II - Chariot

The launching capability of ballistic missiles can be extended by development of a new high-energy upper stage (nicknamed Chariot) to be used with a slightly uprated Titan II. A program was recently initiated by the USAF for development of a fluorine-hydrazine 35,000 lb thrust engine suitable for this purpose. The Chariot will double the Atlas-Centaur payload for the critical high altitude satellite missions and 40% more for the low altitude missions, and can be efficiently used on other recommended stages discussed later with further payload increases. Because of existing performance limitations and development deficiencies in United States present upper stage capabilities, the Chariot is required for natural growth and improvement in our existing reconnaissance and military communications support systems. Estimated cost for this program is 157 million dollars from 1961 to 1964 including four test launches.

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c. Large Booster Program

For payloads beyond the capability of Titan II - Chariot a new booster is needed. Such a booster system must provide adequate payload capability, reliability, economy, operating flexibility, and timely availability. The types of equipment needed have been investigated thoroughly. This investigation has reviewed development programs now in progress as well as considering new techniques now within our grasp.

This review has shown that decisive application of new techniques can provide a significant improvement in booster capability compared with present development programs and plans in the current national booster program. The new techniques can provide booster advances as significant as that of Minuteman over Atlas, Titan and Thor in ballistic missiles. If a decision is now made to pursue these promising new ideas, the principal need is for judgment concerning how long present programs should be carried in parallel until the practicality of the new techniques have been proved.

These techniques permit boosters to be developed which stress simplicity and reliability; for example, only one liquid engine per stage (compared with 8 and 6 for Saturn stages) and dependence on segmented solid propellent rockets for first stages. Such a system minimizes the total costs for putting a series of payloads of various sizes into orbit. Versatile components can be achieved so that a few basic stages are used for a great number and variety of missions, thus greatly simplifying our booster program in the decade ahead.

The new boosters would make use of segmented solid propellant first stages and oxygen-hydrogen upper stages. Recent theoretical analysis has shown the superiority of this combination compared with the oxygen and RP-1 first stages now in use. At typical first stage burnout speeds solid propellant vehicles are significantly cheaper than oxygen-RP-1 first stages. It has been found that the relatively small and slim

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first stage solid propellant rockets fit conveniently on the sides of the bulky oxygen-hydrogen second stage. Even more important, with this arrangement the number of solid propellant segments can be selected to provide the size of payload desired. The oxygen-hydrogen engine is free to start when needed without the usual staging sequence problems.

A series of vehicles which exploit these findings has been devised in the course of Air Force studies. They provide a virtually continuous payload capability from 4400 lb to 250,000 lb in low orbit. The oxygen-hydrogen stages are designated A, B and C. Stage A uses the 200,000 lb thrust J-2 engine recently under development. Stage B requires a new type of 800,000 lb thrust engine which operates effectively at sea level and also in vacuum. Stage C requires a 3,000,000 lb thrust engine which can be developed with the aid of data obtainable from a reorientation of the F-1 engine program. Clustering of stage C engines could increase the payload potentially to 700,000 lb in low orbit. Segmented solid propellant motors of large size are currently under investigation in several places. Extensive expansion of this work would be needed for the proposed program.

The cost-effectiveness of the type vehicles proposed has been shown to be outstanding. Figure 1 presents a comparison of costs for several space launching systems, both existing and proposed. The stepped line labeled Phoenix system is for the proposed vehicles. It will be noted that they are very much cheaper than the complex Saturn system and show some improvement over the Atlas-Centaur and Atlas-Agena where the ballistic missile program absorbed much of the development costs. The cost comparison for these cases was made by the Rand Corporation. Cost data for the Aerospaceplane case which appears competitive on the chart, was taken directly from Convair analyses and the system requires major technological advances to be realized. The line labeled R.OS in from an Air Force evaluation of contractor proposals for a recoverable booster system which is also further in the future. The line labeled "Phoenix Inflatable Wing

Recovery" is for a re-usable adaptation of the recommended booster system. Recovery was found to increase the cost for the present state of the art, but improvements in high temperature materials could make this approach preferable in the low payload region.

Together with vehicle studies, the Air Force has investigated means for solving current problems in launch stand utilization. A method of indoor vehicle assembly and checkout has been devised which permits reduction of the time a vehicle spends on the launch pad to less than a week. An extremely efficient launch facility can be constructed using these techniques. The new vehicle designs are particularly well suited to this type of operation.

Exploitation of these new possibilities will make maximum use of programs already in existence. The J-2 engine, now planned for the Saturn S-II stage, would be used to full advantage in the A stage. The present programs for large solid propellant motors, Minuteman as an example, will make direct contributions to first stage development. Tests of F-1 engine components using oxygen-hydrogen propellants would contribute to B stage engine development.

To reduce risk, development of the F-1 engine should be accelerated to be available for a booster stage in the event unforeseen difficulties delay development of the large solid motors.

d. Summary

The schedule, which would be achieved if a concurrency program is initiated similar to that which gave this country the Atlas and Thor in a very condensed time scale, is as follows: first flight of A stage in late 1963, first flight of the B stage in 1964, of the A stage with solids in 1965 and of the C stage in 1965. Expressed in another way, payload capability in low orbit would be 20,000# in 1964, 52,000# in 1965, 81,000# in 1966, and 230,000# in 1967. The costs for this program are estimated as:

[illegible]

FY62	FY63	FY64	FY65	FY66
245M	622M	684M	621M	457M

Summarizing the specific actions needed to implement the advanced booster program:

(1) Urgent development of a large segmented solid propellant motor, for first stage applications. An objective must be the earliest possible demonstration of operational suitability for booster application.

(2) Immediate development of oxygen-hydrogen stage A for use with the J-2 engine.

(3) Initiation of a development program for the [illegible]00,000 lb thrust stage B oxygen-hydrogen engine using advanced engine technology.

(4) Start stage B development as soon as the engine has been defined.

(5) Adaptation of F-1 engine components to testing of oxygen-hydrogen propellants at a size level applicable to the 3,000,000 lb thrust stage C engine.

(6) Acceleration of the F-1 engine development in parallel with the solid rocket motor program aiming toward a date for deciding whether the solid motor program will provide the desired first stage motors in time for flight test.

(7) Since no other program now exists, maintain the Saturn vehicle development until the advanced vehicles have shown satisfactory operation.

c. Nuclear Stages

Nuclear heat-exchanger rockets are not now competitive with advanced chemical rockets for first stage booster applications. However, these rockets show promise in application as upper stages, especially if very high final velocities are required.

For example, a nuclear heat-exchanger stage designed for transfer from satellite orbit around one planet to orbit around another shows attractive performance advantages as compared with a chemical stage for this purpose.

2. SPACE PAYLOAD RECOVERY

Much greater capability to recover objects from orbit and from deep space is required. Specifically, we need to increase the reliability with which we can recover, we need to recover with maneuverable vehicles capable of airplane-type landing at pre-selected fields, and we need to recover from higher speeds than those now being used. There are several approaches to meeting these requirements. Heating during reentry can be withstood either by radiative systems in which the heat is radiated away, or mixed ablative-radiative designs in which part of the heating vaporizes the surface in a progressive manner. This vaporization absorbs a critical part of the heating and shields the underlying structure. Pure radiative systems can be either of fixed structure such as Dyna Soar or can be inflatable structures of wire mesh type with suitable coating. Each reentry technique has advantages for particular types of operations and limitations for other purposes. It is expected that all will find application in the future but for different missions. Rigorous development of each is appropriate now.

Experimental data currently available for recovery system design has been derived primarily from the Thor-Able ballistic missile reentry research program (RVX-1), a few ballistic missile RVX-2 tests, and data taken directly from Atlas and Titan reentry vehicle flights. This is supported by some data obtained in electric arc wind tunnels and hypersonic shock tubes.

Little or no data is available above the ballistic missile reentry speeds of about 23,000 fps, and only flight test program can provide reliable design data in this region. A broad theoretical and experimental program in the areas of aerodynamics, structures, dynamics, communications, heat protection systems, and test facilities is urgently required to obtain data for reentry speeds up to 45,000 fps.

To provide data on a meaningful time scale, supporting ground research and test vehicle design must be initiated as early as possible in FY 1962 leading to sub-scale vehicle flight in the 25,000 to 35,000 feet/second speed range in mid-1963 and subsequent flights at two months intervals thru 1964. Full-scale vehicle flights can begin in 1964 and continue at three months intervals. Flights in the 35,000 to 45,000 feet/second regime can logically follow beginning in early 1964 with sub-scale vehicles at two months intervals. Similarly, full-scale vehicle flights can start in late 1964 programmed at three months intervals. Thor-Agena and Thor-Able-Star vehicles will be used initially. To implement this effort, $67.0 million in FY 1962, and $140.7 million in FY 1963, will be required.

An advanced technology program in expandable structures has been prepared and should likewise be implemented. Two suborbital flights using Thor boosters in the latter part of 1962 could be achieved; also, three orbital flights on Atlas during the second and third quarters of 1963 are possible. Adequate supporting ground research and this flight program will necessitate $[illegible].7 million of 1962 funds and $9.3 million for FY 1963.

The Dyna Soar Step I program will provide useful data as a research vehicle in support of manned reentry techniques. To be of maximum value, however, the flight schedule should be accelerated. Total costs for Step I of the Dyna Soar program should remain essentially unchanged, but acceleration of the flight schedule would require more funding in earlier years.

3. RENDEZVOUS

Rendezvous developments are needed on advanced orientation and positioning systems, systems for closing and interlocking (docking), and techniques and equipment to permit the capture and recovery of uncooperative satellites.

It is proposed that development of these added capabilities be accomplished within the Saint program. Four additional launches will accomodate advanced rendezvous technique demonstrations plus docking and fuel transfer development and demonstrations. Because of the urgency associated with the development of a rendezvous capability, the program will be accelerated to provide for the first launch in September 1962 instead of the currently scheduled March 1963.

The participation of manned space rendezvous will facilitate the final closure and docking and ease the requirement for sophisticated electronic and optical equipment. Manned rendezvous is planned in association with other manned flight objectives and experiments with a manned rendezvous demonstration scheduled for mid-1964 as an extension of the Saint program.

The schedule for development of the rendezvous technology and funding for these developments will be covered under the Saint program.

4. MANNED SPACE FLIGHT

The significant restrictions in payload capability have, to date, mediated seriously against adequate considerations being given to man's potential usefulness as an integral component in space vehicles regardless of their objective or mission. This negative approach has resulted in a most serious lack of a well conceived, integrated and supported program of space biology and medicine directed towards valid determination of man's basic needs, tolerance and performance capabilities in even the first generation of orbital vehicles with mission times not exceeding 2-7 days. A conservative analysis of Soviet space biomedical achievements during the past year would indicate that our own capability in life support and allied componentry is at least 3 to 4 years behind. Out of 59 U. S. orbital flights, no animals have been flown. In comparison, the Soviets began to accrue hard life science data on their second orbital flight in 1957 and have flown biological specimens in 6 of their 12 orbital flights. It follows therefore that attainment of larger boosters and significantly increased payload capability will not of itself alone bring us into serious contention with the Soviets in manned space flight technology. Therefore, unless a broad-based program in applied bioastronautics research and advanced technology be vigorously prosecuted on a national basis under single competent management, the full exploitation of rapidly increasing payloads will not be realized.

Primary objectives of such an adequate bioastronautics program are well defined from an objective appraisal of the critical biomedical factors implicit in exposure to the space environment and are compounded by both duration and distance from the earth. Of immediate concern are the following, (a) reliability of an environmental control system which closely duplicates the normal terrestrial biosphere, (b) adequacy of communicating subjective and objective evidence of the viability and effectiveness of the human component, and (c) development of protective devices and procedures against vehicular-produced and space intrinsic hazards in the form of dynamic forces of launch, maneuver and reentry, weightlessness, ionizing energies and space debris.

Extrapolation from current biomedical knowledge plus ground-based simulation can provide reasonable answers for low altitude orbital flights of 24 hours duration. Beyond this, there is no alternative but to carry out a series of animal experiments in space vehicles to provide answers for the two most urgent problems having great influence in vehicular design and useful payload; namely, (a) shielding requirements against space ambient radiations, and (b) tolerance limits by time to weightlessness. Neither of these potential hazards can be evaluated on earth.

A flight test program designed to obtain the information outlined above calls for a series of 4 Thor-Agena vehicles carrying small primates into orbit for periods up to 96 hours in late 1961 and 1962. Following this would be used a series of 6 Atlas-Agena vehicles carrying larger primates and exact prototypes of advanced biomedical componentry which would allow penetration into the Van Allen belts with flight durations up to 7 to 10 days. By 1963, valid criteria and reliable componentry would support manned orbital flights to begin (1963) and proceed (1964) to manned system rendezvous, inspection and docking operations. Estimated costs for this animal space flight program would be .157 million for FY 1962 and FY 1963.

5. APPLIED RESEARCH

Progress in space systems as in other military systems depends greatly on the quality and quantity of the applied research program. Looking back 10 years we can recognize that in 1951 we didn't have thermonuclear weapons, we didn't know about the Van Allen belts, we didn't have inertial guidance good enough for ICBM's, we didn't have large thrust rocket motors, transistorized equipment or honeycomb sandwich material. These advances were made in part because of applied research programs in the early 50's and have, of course, been used to achieve the dramatic progress in weapons systems which has led to ICBM's, IRBM's, and soon to operational AICBM's and space systems such as Samos. Similarly, our capabilities in 1971 will depend, in large measure, on the applied research program we have now. For example, a new device, the laser, is becoming practical and holds promise for using light beams to make communication links and optical radars. Such "radars" may have application to tracking ICBM warheads after burnout, thus permitting mid-course interception. There now appears to be a possibility of producing a fusion reaction explosion without initiation by a fission reaction. If realized, this would permit very small, light bombs. Not only would this make changes in weapons and in the systems built to carry weapons, but might also have a great effect on the Orion concept of a nuclear propulsion system in which a series of small explosions propel the vehicle. In addition to this concept, there are other areas of weapons and weapons effects research which could perhaps be exploited to produce weapons more suitable for space applications. It may well be that a combination of air-breathing and rocket engines will permit more economic and more flexible space systems than if only rocket engines are used. Studies need to be made of the advantages of various combinations including the liquid air cycle engine, turbo-ramjets and supersonic burning ramjets. These studies should then lead to a vigorous applied research program in this field. New structural techniques for equipments to be assembled in space will no doubt be developed and there will be further advances in materials, perhaps exploiting such concepts as the "whiskers", fine strands of metal in perfect crystal form of greatly enhanced strength.

This category is also intended to include increases in Basic Research. Over the ten year period under consideration here, there is an excellent chance that new fundamental knowledge, derived from Basic Research can materially shorten the time required to achieve some of our goals. For this purpose, we propose an increase of $12 million over the present FY 1962 budget, a further increase of $10 million for FY 1963, and cost of living increases over the rest of the ten year period. These increases are included within the Advanced Technology - Applied Research line item.

An expansion of the advanced technology - applied research program applicable to space is recommended. This expansion, plus the increase in basic research mentioned above, would be from a level of $115 million to $359 million in FY 1962, increasing to a level of $700 million in later years.

B. MILITARY SPACE PROGRAMS

1. **SATELLITE SYSTEMS**

In the assessment of the national goals and objectives of the space age, which we are just entering, priority military tasks have been identified which are essential to achievement of the national goals. These tasks are:

a. Geodetic location of targets and collection of mapping data for limited war application.

b. All aspects of reconnaissance and surveillance of the enemy from space including meteorological, electronic, communications, and photographic.

c. Surveillance, inspection, and neutralization of enemy systems in space.

d. ICBM early warning and active defense during boost and/or mid-course.

e. Surface target strikes from space.

f. Command control of military forces operating both in space and on the terrestrial surface, including the means for reliable multichannel communications and for navigation.

g. Support functions incident to space and present military tasks.

Each of the military satellite systems listed below have been evaluated in terms of these tasks, the impact of recent events, and the Gardner report. In this respect, the USAF concurs in general with the recommendations regarding information satellites. The programs to implement these are under way and development plans will be submitted in those areas requiring DOD action. Pending more definitive recommendations, it has been determined that all the programs listed below should be continued and that no change at present is required from the programmed status. The documents outline the present recommended programs and are listed for reference but are not included herein.

PROGRAM	LATEST APPROVED OR RECOMMENDED PROGRAM DOCUMENT
SAMOS	Development Plan, 11 August 1960
MIDAS	Development Plan, 31 March 1961
DISCOVERER	Development Plan, 29 November 1960
ADVENT	Sec/Def Memo to Sec/Army-Air Force, 15 September 1960
TRANSIT	ARPA Order to Department of the Navy, August 1960
SPADATS	Sec/Def Memo to Sec/Air Force, 10 October 1960
ANNA	Tri-Service Asst Secretary (R&D) Ltr to DDR&E, 3 November 1960; ASN (R&D) Contract No. S-1295; Asst Sec/Def (Comp) Ltr to Bureau of Budget, 9 December 1960
DYNA SOAR	Development Plan, April 1960
VELA HOTEL	Development Plan, 9 March 1961

The fundamental capabilities which have been proposed earlier in this paper and the program of applied research and advanced technology are large and primarily directed toward improving our military satellite systems. As these development efforts bear fruit, and as the added weight-carrying capabilities of our recommended booster becomes available, the tremendous flexibility for improving our military space capabilities and accomplishing the military tasks listed above will be incorporated into our existing military satellite program.

2. BAMBI

The BAMBI program has been reoriented to de-emphasize system design and to place individual project emphasis on basic measurement and techniques under integrated program management. The continuing program objective is to focus advanced research on the orbital defense problem and to provide factual data necessary for determination of system feasibility within 12 to 18 months. The area of primary study will be directed toward definition and solution of the more difficult problems of detection, intercept, decoy detection and kill mechanisms associated with the boost-phase anti-ICBM concept. This reoriented program is in general agreement with the recommendations of the Gardner Committee report.

ARPA will be requested to furnish $8.3 million FY 1961 funds and $20.36 million FY 1962 funds in order to implement the reoriented program.

3. SAINT

The SAINT program was established to develop and demonstrate feasibility of a prototype inspector vehicle capable of coorbital rendezvous with, and inspection of unidentified satellites. The approved program now includes four feasibility shots beginning in March 1963, study to define the complete inspector system, and development of long-lead-ti[illegible] components for the system. Cost is estimated at $81.3 million including $32.1 million in FY 62.

It is recommended that SAINT be broadened in scope to provide a general program under which a variety of rendezvous development and test experiments will be undertaken leading to manned rendezvous capability. Additionally, the first rendezvous experiment will be accelerated six months in time to September 1962. The revised program augments the rendezvous experiments and additionally includes demonstration of fundamental capabilities in docking, fuel transfer, and station keeping during FY 1963. Flights 5 and 6 will be utilized to incorporate improvements in the inspector vehicle such as hot gas control system for extended station keeping, operation in higher orbits requiring extensive orbital plane changes, installation of advanced guidance systems and tests of added inspection sensors. Flight numbers 7 and 8 will provide closure with a target and either a fuel transfer demonstration, or a capture of a target satellite and its subsequent return to earth.

These techniques will provide essential stepping stones toward a reconnaissance and offensive capability against hostile satellites. Additionally, studies and systems analysis will be undertaken on non-coorbital intercept. Intensive planning is under way on manned rendezvous directed toward demonstration flights in CY 1964.

The increase in the flight test program from four to eight shots is in concert with, and responsive to, desires expressed in the 25 August 1960 memorandum to the Air Force from DDR&E and comments in the Gardner report. The additional program costs are $42.4 million dollars for a total FY 1962 expenditure to $74.5 million.

4. METEOROLOGICAL INFORMATION SATELLITE SYSTEM

It is recommended that approval be given to the USAF to proceed on an expedited basis with an inexpensive, limited-purpose, meteorological satellite involving a Tiros-type camera and the Blue Scout launch vehicle. This system is in direct support of the SAMOS reconnaissance program and would provide current accurate cloud cover data of the Soviet Union. Additionally, the testing of improved space-to-ground electronic data transmission devices will be undertaken. With immediate program go-ahead the first payload would be completed by January 1962 and launched approximately one month later. The second launch with improved Blue Scout third and fourth stage motors and improved payload is programmed to be launched in mid-CY 1962. Launches thereafter could be made on an as required basis and have been programmed at four to six months intervals. To implement this program, approval must be obtained for expenditure of $1.5 million of FY 1961 funds and authorization provided for $14.0 million in FY 1962.

5. MEDIUM ALTITUDE ACTIVE COMMUNICATION SATELLITE SYSTEM (MAACS)

The United States at present has the capability to provide the first world-wide telephonic and television service utilizing satellites. With maximum effort, operational trans-Atlantic services could be provided by April 1963 followed by world-wide service late in 1963. If accomplished, the program would have a tremendously favorable impact on United States prestige both due to the magnitude of the achievement and its utilitarian nature. This satellite system would use existing launch vehicles (ATLAS-AGENA) and is contemplated as a joint industry/(DOD)/USAF venture. Communications components and ground stations are already under development and construction by industry.

The USAF considers such a program to be in the national interest and commends DOD consideration of a program with a target date to achieve trans-Atlantic service in November 1963 followed by world-wide service in mid-1964. The total cost of such a program is estimated at $203 million dollars, a large portion of which would be borne by industry.

The implementation of a joint DOD/industry venture in a communications area raises the specific question of which government agency should have the responsibility for the establishment and continued operation of a satellite network. It is necessary that the early assignment of responsibility for operating such a system be given to a single organization. It is clear that the Department of Defense possesses unique capabilities to assume this task.

6. A NATIONAL OBJECTIVE

The space lag existing between the USSR and the United States is due in large part to failure to establish a sharply focused national space goal and clear-cut assignment of responsibility for its achievement. The exploitation of fundamental capabilities in large boosters, recovery and re-entry, rendezvous, and manned space flight will provide for military space requirements during the next several years. They will not provide for regaining supremacy in space exploration unless a national space goal is established. Such a goal must capture the imagination of the world. It must be worthy of the technological potential achievements of this nation.

A Lunar Expedition plan, previously approved as a part of the USAF Study Requirement program, will soon be available in detailed development plan form. This Air Force investigation of the feasibility of lunar landing and return began before the first Sputnik and before the establishment of the NASA. It has been under way since that date with a concentrated military/industry study effort. The program is designed to gather environmental design data, develop a lunar transportation system, and mount a lunar expedition. It is divided into six phases.

Phase I: Lunar Probes

Phase II: Lunar Orbits

Phase III: Soft Lunar Landing

Phase IV: Lunar Landing and Return

Phase V: Lunar Transport Vehicle Development

Phase VI: Lunar Expedition

The first four phases of this program are unmanned and consist primarily of obtaining the environmental and physical characteristics of the lunar surface and cis-lunar space. These phases are necessary to provide basic information before final design and construction of a lunar landing vehicle. The NASA presently has programs under way to meet some of these requirements.

The fifth phase, lunar transport vehicle development, is the key to the lunar expedition. Preliminary design is under way for a lunar transport vehicle consisting of two payloads - a manned lunar payload and a cargo payload. The manned lunar payload consists of a three man re-entry vehicle, a lunar landing stage, and a lunar launching stage. It weighs 134,000 pounds when fully fueled and must be boosted to escape velocity.

The manned re-entry vehicle which returns from the moon weighs approximately 20,000 pounds. It will be capable of an aerodynamic re-entry into the earth's atmosphere and conventional landing. By using the same Space Launching System and Lunar Landing Stage, the cargo payload can deliver 40,000 pounds of usable payload to the lunar surface.

As a result of Lunar Transport Vehicle development, it will be possible to achieve highly significant space "firsts." Specifically, the United States will accomplish the following:

Manned Circumlunar Flight..........................1964

Manned Lunar Landing and Return....................1965

The Establishment of a Lunar Expedition...........1966

The development of the three-man lunar vehicle and the cargo packages will not only provide a capability to mount and resupply a lunar expedition, but also other space capabilities such as circum-Mars or Venus flight, orbital resupply, and maintenance.

The technical advances required to accomplish this difficult task will provide a striking increase in our fundamental space capabilities. A lunar expedition has tremendous national significance and its accomplishment will provide, as a fallout, better ways to accomplish the national defense mission. A clearly stated goal will permit maximum advantage to be realized from the work presently under way by NASA and DOD and will provide a challenge to stimulate our efforts. Specifically, the Lunar Expeditionary Program will establish a technological and physical base for:

a. Manned exploration of the solar system.

b. Prevention of unilateral Soviet space exploration.

c. Possible strategic military capabilities.

The following actions are required to initiate the lunar program and to meet the recommended dates:

a. Establish the Lunar Expedition as a National goal.

b. Assign priority.

c. Appoint single manager.

d. Arrange for total National support.

e. Approve funds for Lunar Transport Vehicle and Lunar Expedition.

These funds are shown below and include costs to sustain a 21-man expedition on the lunar surface for an indefinite period.

FY	62	63	64	65	66	67	68	69	70
Millions	27	112	350	710	1382	1405	1760	1237	631

It should be noted that the funding for the next three fiscal years is at a relatively low level but will insure that no further time is lost in regaining supremacy in space exploration.

The Air Force recommends the establishment of a Manned Lunar Expedition as a National space goal.

7. SUMMARY OF COSTS AND SCHEDULES

In summary, the total program outlined herein requires approximately 915 million of additional FY 62 funds. It must be noted that untime allotted for the preparation of these costing estimates has been inadequate and hence these estimates must be considered as approximate. These funds when added to the current approved FY 1962 program total 1670 million dollars. Not included are FY 1962 NASA funds, FY 1962 Army and Navy space funds, other than space boosters. National space program fund requirements are estimated to climb linearly to a national total of slightly over 4000 million dollars by FY 1966. The figure at that time includes NASA funds estimated in the amount of 500 million for space research and scientific flight objectives.

The decision to implement this program will provide significant achievement, a portion of which is shown below.

EVENT	EARLIEST DATE
Orbit of Small Primates up to 4 days duration	Late 1961
Precise Re-entry and Recovery	Mid 1962
Rendezvous	Late 1962
Maneuverable Re-entry and Recovery	Mid 1963
Manned Rendezvous Manned Maneuverable Re-entry	Mid 1964
Over 50,000 pounds in orbit	1965
Over 80,000 pounds in orbit	1966
Manned Lunar Landing	1967

6. RECOMMENDATIONS:

a. Establish the Manned Lunar Expedition as the National space goal.

b. Approve the plan presented in principle and take action to acquire the funds necessary for the individual programs and projects as they are approved.

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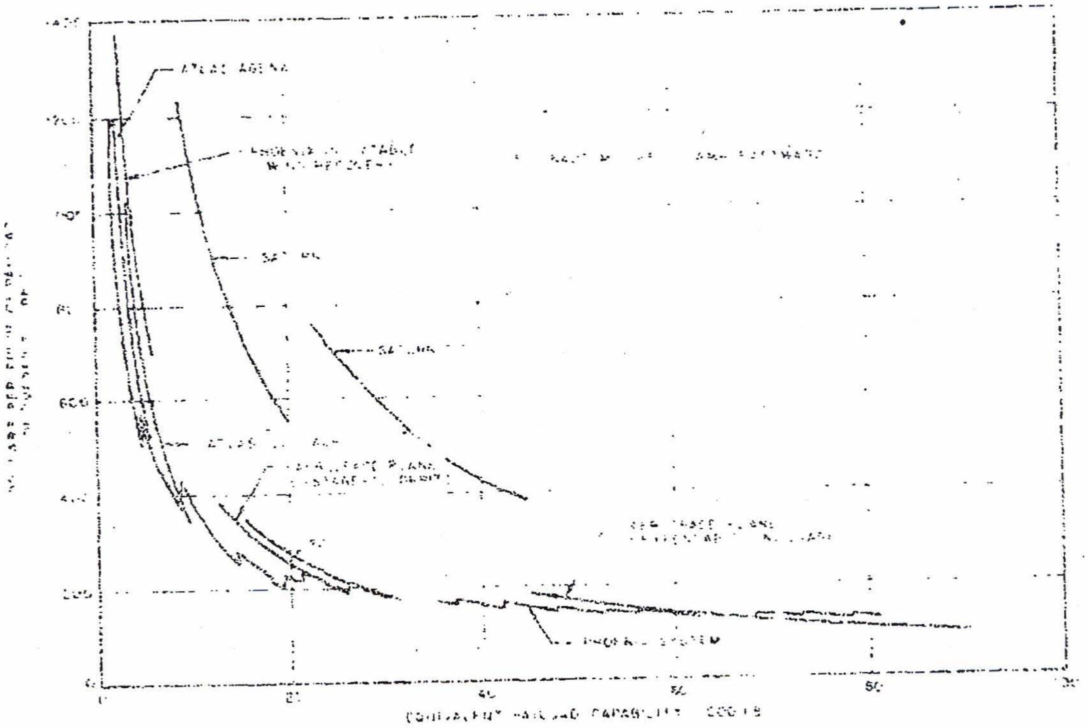

MISSION FORECAST COMPARISON

FIGURE I

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ADDENDUM A

THE THREAT

ROUGH DRAFT

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CHART 1 INTRODUCTION

Ten years ago the USSR was clearly militarily inferior to the United States but today the Soviets are approaching parity with us.

The Soviets are approaching this parity by concentrating major national effort upon fundamental research programs which are developing modern nuclear weapons, new means of delivery, and significant space capabilities.

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The Soviets will not be satisfied with military parity, but will expend every feasible effort to achieve military dominance over the United States.

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INTRODUCTION

- ○ 1950 USSR INFERIOR TO U.S.
- ○ 1960 USSR APPROACHING PARITY WITH THE U.S.
- ○ FUTURE, USSR WILL NOT BE SATISFIED WITH MIL PARITY.

CHART 2 SOVIET OBJECTIVES

Kruschev reminded us of the Soviet objective to dominate the world recently when he said, "I hope to live long enough to see the Red banner flying over the entire planet." In carrying out this objective, the Soviets have embarked upon a major program to achieve uncontested supremacy in space. The means by which the Soviets will attempt to achieve dominance of space are not at all clear, but some indications of developments to come can be described. To see these indications in proper focus, let us briefly review our discovery of major Soviet developments in the past and then project new developments into the future.

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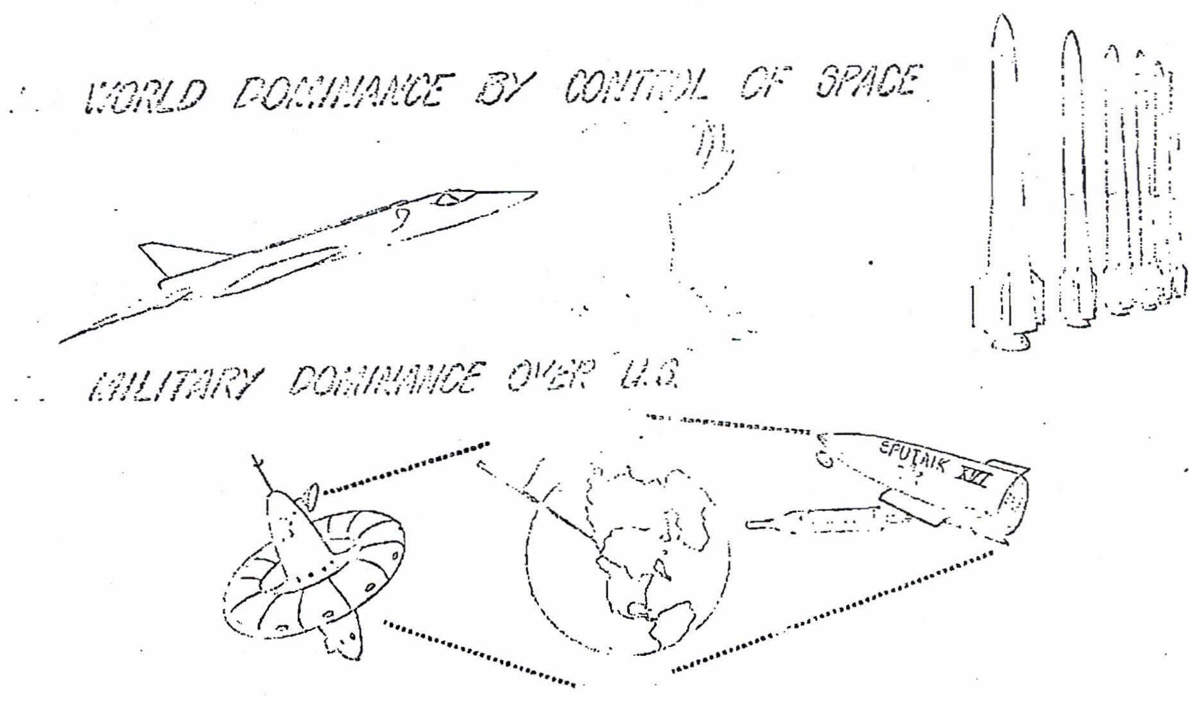

... WORLD DOMINANCE BY CONTROL OF SPACE
... MILITARY DOMINANCE OVER U.S.
SPUTNIK XVI

CHART 3 THE GROWING INFORMATION GAP

Firstly, it is frankly admitted that there has been, and is now, a growing information gap between the United States and USSR. As long as the Soviets copied from the West, we felt secure. When they developed a new weapon, we recognized it as patterned after one of our older models. We were not concerned. But a new trend has been observed in Soviet weapon development. We now see Soviet pioneer research and development, which has always been basically good, beginning to reap the benefits of long-range education and scientific programs initiated as early as 1920. These programs started producing significant dividends in 1953-1954. Since then, we have seen Soviet ICBM's, Sputniks, Man-in-Space shots, and similar developments that were not copies of Western developments. As the Soviet scientists move into the future, protected by history's most elaborate security system, this information gap may increase. Nevertheless, intelligence has in the past acquired early indications of significant Soviet military developments.

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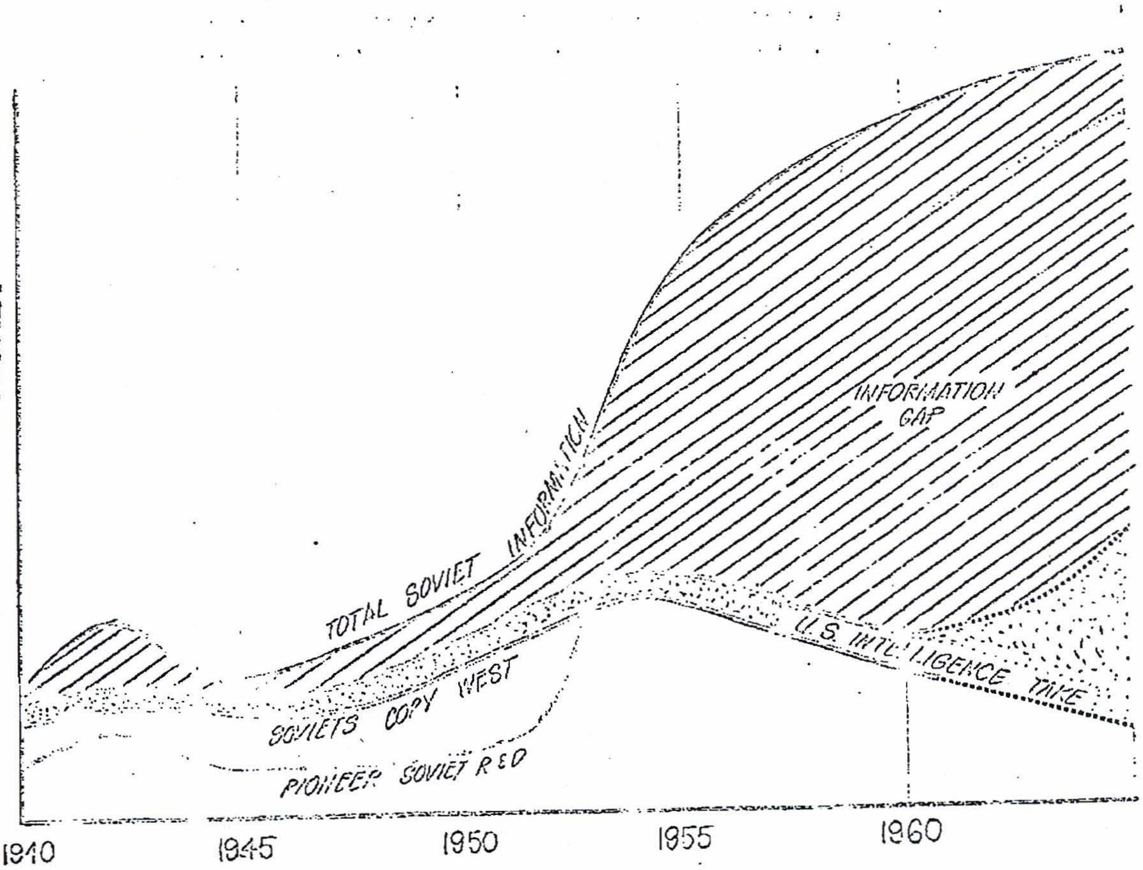

TOTAL SOVIET INFORMATION
INFORMATION GAP
U.S. INTELLIGENCE TAKE
SOVIETS COPY WEST
PIONEER SOVIET R&D
1940
1945
1950
1955
1960

CHART 4 INTELLIGENCE ESTIMATES (PAST)

In June of 1946, Intelligence prepared an estimate which siad that the Soviet Union would explode its first atomic weapon on or about July 1949. The reaction was one of complete disbelief. What happened, of course, is history. The Soviets did explode their first A-bomb in 1949. Subsequently, we discovered from open literature that this prediction could have been made at an earlier date.

In a similar manner, the Soviet Sputnik, improved Air Defense Systems and Ballistic Missiles were forecast before they actually appeared. The reaction to the 1954 indication that the Soviets had an eight-year lead on us in missiles is well known. It was near panic.

We can see frenzied reactions in order to keep abreast of the Soviets in the future unless we concentrate major effort upon fundamental capabilities which will result in significant inroads into the frontiers of space.

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INTELLIGENCE ESTIMATES (PAST)

	PREDICTION	EARLY INDICATION	FIRM INFORMATION
NUCLEAR WEAPONS	40	JUN 48	JUL '49
SATELLITE	46	SEP '57	OCT '57
AIR DEFENSE	50	53	57
BALLISTIC MISSILES	49	50	54

CHART 5 ESTIMATED SOVIET BALLISTIC FLIGHT TEST PROGRAM

The Russians have test fired over 1200 ballistic missiles and space shots since the inception of their flight test program in 1947. This record implies that Soviet objectives for missiles and space are of long standing. It also reflects a national steadfastness of purpose and demonstrates that their programs have enjoyed virtually complete freedom from "feast or famine" support over the years. We know, of course, that they have developed over an extended period of time a large corps of experienced scientists, engineers, technicians and factory workers whose competence extends through all of the fundamental aerospace disciplines. Our studies of Soviet scientific and technical manpower resources estimate that in mid-1960 they had about 2,000,000 employed graduates of university level of technically trained personnel, about 25% more than in the United States.

ESTIMATED SOVIET BALLISTIC FLIGHT TEST PROGRAM
(SUCCESSFUL FLIGHTS)

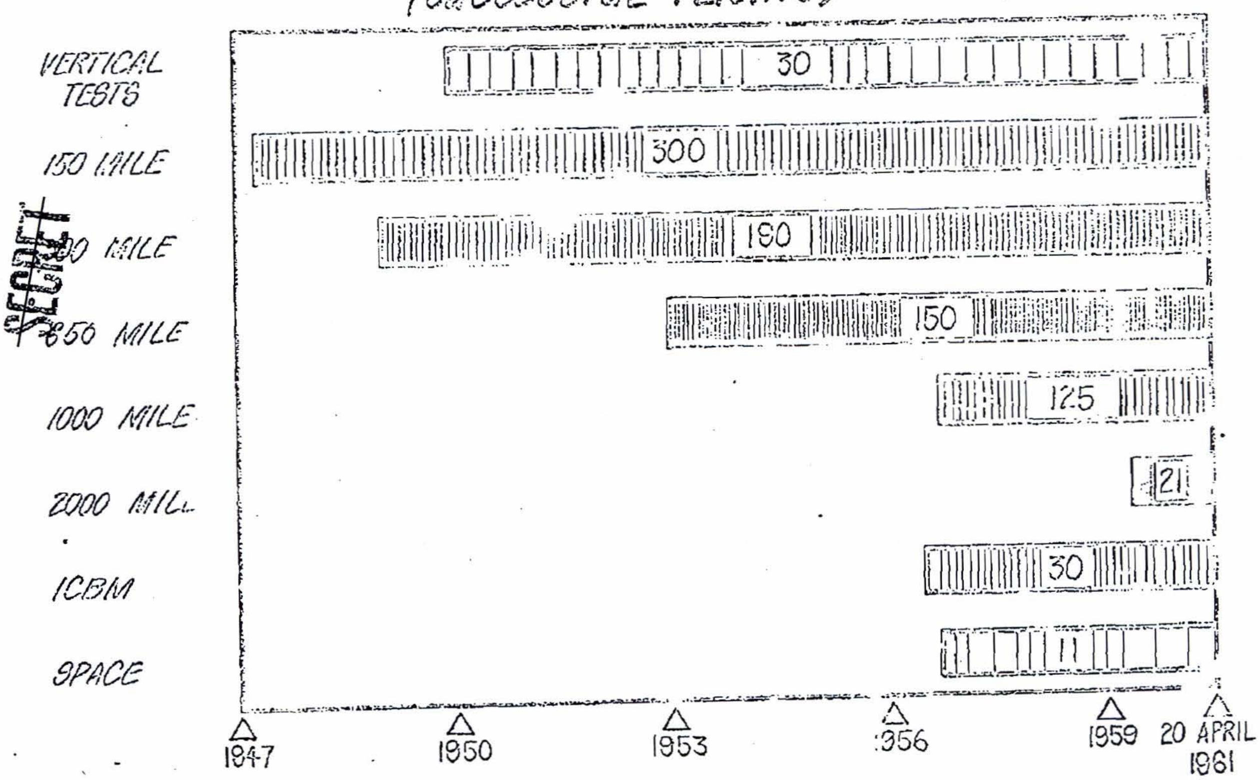

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CHART 6

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SECRET

50X1 and 3, E.O.13526

CHART 6A INTELLIGENCE ESTIMATE (FUTURE)

The Soviets are now working on very large rocket engines with thrusts of 1 - 2.5 million pounds. The 2.5 figure seems most reasonable on the basis of all available evidence. These engines could become available in 1965. The maximum booster size possible from this engine would, we believe, be in a five engine cluster. Such a configuration could provide close to a 100-ton payload capability in a three-hundred mile circular orbit.

We have evidence of Soviet research applicable to nuclear powered rockets and we believe that, despite the complexity of the problem, they could develop such a rocket by about 1970.

In the course of its program to develop an anti-missile missile system, we believe the USSR has the potential of achieving a limited capability by 1962-64 to destroy satellite vehicles after they have made a number of orbits. The Soviets are devoting significant resources to this effort at Sary Shagan. Their requirement for satellite interceptors especially in the case of SAMOS is clear. We believe that their initial anti-ICBM system can be extended to include low orbit satellites by 1962 and to higher altitude satellites by 1963-1964.

We believe they will reconnoiter the more distant space environment in greater detail when necess for manned earth-moon travel. Also significant is the fact that through their Sputniks they have obtain a wealth of information on subsystems which have military implications.

Although it is too soon to expect to see specific Soviet military space systems we must keep in mind the fact that in their present materialistic approach to space conquest they are developing a broad capability.

50X1 and 3, E.O.13526

On April 12, the successful Soviet man in space shot marked a major milestone in their systematic drive to acquire a manned maneuverable spacecraft.

It isn't easy to say, what path the Soviet spacecraft development program will take in the next ten years. They have stated, and the evidence indicates, that they are definitely proceeding to the development of a truly grandiose space station, constructed from payload modules. It is believed that these stations would be limited in number and measures would be taken to assure permanency. A vehicle of this size almost certainly would incorporate propulsion units for the purpose of maintaining a stable orbit and insuring its long life and would call for the concurrent development of shuttle or ferry vehicles for carrying personnel and supplies from the earth to the station and back.

A feasibility demonstration of the first, short duration, manned space platforms could occur in 1965. Long duration space platforms of over 30 days duration should be available by about 1970.

In the field of unmanned lunar rockets, they now have the capability to conduct biological probes, to launch lunar satellites, and to conduct soft landings on the moon.

By 1963-64, they could achieve lunar landing, return, and earth recovery.

A manned circumlunar flight attempt probably could have a reasonable chance of success by 1964-65, with a manned lunar satellite possibly a year later. A manned lunar landing could be successfully completed about 1970.

We should remember, in predicting Soviet technical breakthrough, that their research and development base is very broad and continues to increase. We can therefore expect new technical developments in other areas in which they are working.

What we have tried to do here is to identify the most significant ones. They are significant because they describe some of the Soviet technological progress that has been made and focus our attention upon the technological conflict in which the United States and the Soviet Union are engaged. We believe this conflict is critical to our survival and will determine, to a large degree, the ultimate outcome of the Cold War.

Let us look briefly at the Cold War and the impact of the technological conflict upon it.

SECRET

INTELLIGENCE ESTIMATE (FUTURE)

		FIRST R & D TEST	LIMITED OPERATIONAL CAPABILITY
LARGE BOOSTERS	CHEMICAL	NOW	'65
	NUCLEAR	UNK	'70
BOOST GLIDE VEHICLE		'63	'64-65
ANTI-ICBM SATELLITE		'61	'62-64
MANEUVERABLE MANNED EARTH SATELLITE		'62	'63-64
		'70 (NUCLEAR)	'71-72
MANNED SPACE PLATFORM		'65 (SHORT DURATION)	'66-67
		'70 (LONG DURATION)	'71-72
UNMANNED SATELLITE WEAPONS		'65-68	'70-75

CHART 7 COMMUNIST PROGRESS IN THE COLD WAR

In 1955 when U. S. military power was easily superior to Soviet military power, the U. S., together with its Allies, had the capability to persuade the Communists to behave in a manner acceptable to the family of Free Nations. This capability was demonstrated to a degree as late as 1958 in the Lebanon crises and again in the Taiwan Straits crises when the deployment of significant U. S. military power persuaded the Communists to desist from aggression in those areas.

But today, the Communist forces are becoming stronger and are being employed with greater disregard for the power of the West. We can expect the Communist to employ their forces with even greater daring if their over-all military capability achieves parity with ours.

If future Soviet space efforts should result in clear military superiority over the United States the indications are that the Soviets would become ever more bold in waging internal offensives against free governments, and would brandish their new military power to intimidate and dominate the entire globe.

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COMMUNIST PROGRESS IN THE COLD WAR . . .

- ○ 1955 U.S. MILITARY POWER SUPERIOR TO SOVIETS
  - △ SOVIETS DISSUADED FROM AGGRESSION
- ○ 1961 U.S. VS MILITARY POWER APPROACHING PARITY
  - △ COMMUNIST INTERNAL OFFENSIVES AGAINST FREE NATIONS NOT DISSUADED
- ○ THE FUTURE ?

CHART 8 SOVIET TECHNOLOGICAL THREAT

The Technological Instrument of Strategy

Today, the technological conflict is critical. In the past, classical theory of conflict recognized four instruments of national power: the political, economic, military, and psychological. But brief reflection on the ongoing technoligcal explosion and its impact upon the Cold War leads to the conclusion that a fifth instrument of national power, the technological one, has joined the team. Not only has it joined the team, but it has taken on high priority and importance.

Today, we are in a transitory period during which the relative military power of the United States and Russia is changing. Major opportunities for significant growth in military power derive from technology. It appears that for the immediate future, technology may enable the United States or Russia to gain a major power advantage over the other.

Soviet Technological Threat

We mentioned earlier that Soviet growth in military power has been achieved by concentrating major national effort upon fundamental research and development. Many of our top nuclear scientists have pointed out that there are practical lines of development of nuclear weapons which could be pursued through further testing which would prove to be revolutionary. It is prudent to assume that the Soviet Union is actively developing nuclear technology along these revolutionary lines that will lead to "third-generation" type nuclear weapons.

Major opportunities for significant changes in military power, derive from a technological base. The demonstrated Soviet space capabilities are the result of a major National effort of science and technology over the last ten years.

It is clear that the Soviets must not be permitted to win the technological race for space which potentially could shatter the Free World, security, alliances, and prestige.

Only if the U. S. pursues a vigorous, highly coordinated national space program designed to systematically explore the full potential of space can we hope to overcome the Russian exploitation of space technology as a world strategy.

SECRET

SOVIET TECHNOLOGICAL THREAT

DEVELOPMENT OF

- SPACE BASE
- SPACE BOMBING SYSTEMS
- SPACE WARNING & INTERCEPTION SYSTEMS
- ANTI-MISSILE & ANTI-SATELLITE SYSTEMS
- "THIRD GENERATION" NUCLEAR WEAPONS

CHART 9 SUMMARY

From 1945 to 1950 the Soviets were recuperating from World War II devastation.

Soviet progress in the fifties is the result of forceful and comprehensive Soviet plans and programs to establish a dominant posture in world science and technology. This progress derives from a sound technological and scientific base that they have created, which is second to none.

The Soviet goal is to establish an order of military power in space which would enable them to dominate the world.

From 1960 to 1970 the technological progress which is forecast threatens to give the Soviet Union the capability to win in outer space.

In order to meet this Soviet threat, it is urgent that we immediately develop our own fundamental capabilities for space operations.

SECRET

SUMMARY

- SOVIET PROGRESS DERIVES FROM SOUND TECHNOLOGICAL & SCIENTIFIC BASE
- SOVIET GOAL IS A NEW ORDER OF MILITARY POWER TO DOMINATE THE WORLD
- THE 1960-19[illegible] FORECAST OF SOVIET TECHNOLOGICAL PROGRESS THREATENS TO GIVE SUPREMACY IN SPACE
- TO MEET THIS THREAT, THE U.S. MUST DEVELOP BROAD FUNDAMENTAL CAPABILITIES FOR SPACE OPERATIONS

AIR FORCE SYSTEMS COMMAND

UNITED STATES AIR FORCE

FY 62 - 63 PROGRAM DOCUMENTATION

PROPOSED SYSTEM PACKAGE PROGRAM

(ABSTRACT)

LUNAR EXPEDITIONARY FORCE

PROGRAM (U)

ROUGH DRAFT

APRIL 1961

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FOREWORD

This document provides a program for a Lunar Expeditionary Force. The basic information has been abstracted from the Lunar Base Development Plan (See Appendix). Initially it calls for the development of a Lunar Transport Vehicle and eventually the establishment of a lunar facility. This program will capture the imagination of the world and regain the initiative for the United States in the space race.

The successful accomplishment of the program would tremendously increase the technical, political and military prestige of the United States, provide a base to support deep space exploration, and provide a base capable of being expanded to support a strategic space system.

The document has been based on the results of Air Force planning studies and a Program Plan prepared by the Air Force Lunar Team. The Lunar Team is under the direction of SSD and consists of technical experts from all the AFSC organizations.

In view of the importance and magnitude of the Lunar Expeditionary Force, it is recommended that the highest nation priority be assigned to the development of the Lunar Transport Vehicle Program. Further, assignment of a single program manager and adequate funding to support the proposed program is recommended.

SYSTEM PACKAGE PLAN

TABLE OF CONTENTS

SECTION I

PROGRAM SUMMARY

LUNAR EXPEDITIONARY FORCE

1.0 INTRODUCTION

The Air Force has had a study program for several years investigating the military potential of the moon and cislunar space.

This effort has shown that:

(1) It is technically feasible to build a lunar facility.

(2) The moon may possess strategic military value for space operations.

(3) The moon offers a possible location for a deterrent recallable strike-second-earth-bombardment force.

(4) Exploratory operations to determine more accurately the military potential of the moon and to exploit it as found desirable could be conducted in the 1967-70 period.

This document outlines an example of a program for establishing a lunar expeditionary force on the moon. This example of a Proposed System Package Program is based on a Program Plan for establishing a Military Lunar Base that was published by the AFBMD in April 1960. The original AFBMD Military Lunar Base Plan and the present Lunar Expeditionary Force Program consists of the following six phases or Sub-Programs:

I Lunar Probes

II Lunar Orbits

III Soft Lunar Landings

IV Lunar Landing and Return (Unmanned)

V Lunar Transport Vehicle (Manned and Cargo)

VI Lunar Expeditionary Force

The first four phases of this program are unmanned and consist primarily of obtaining the environmental and physical characteristics of the lunar surface and cis-lunar space. These phases are necessary to provide basic information before design of a lunar landing vehicle and subsequent base build-up is possible. Specifically, detailed lunar surface charts, lunar surface core samples, and lunar environmental characteristics are required. The NASA presently has programs underway to meet most of these requirements. The results of the Air Force studies were made available to NASA to assist them in planning their programs.

The fifth phase, Lunar Transport Vehicle Development, is the key to the whole Lunar Expeditionary Force and will determine the final capability of lunar operations. For this reason it is important that Air Force requirements be recognized in the design of the Lunar Transport Vehicle and the final Lunar Facility.

This Partial Package Program emphasizes and recommends action on Sub-Program V - Lunar Transport Vehicle. This Partial Package is being revised and updated with preliminary design information obtained from present studies. The complete System Package Program for the Lunar Transport Vehicle will be available in September 1961, and for the Lunar Facility by the end of the year.

The Lunar Expeditionary Force funding requirements in millions are as follows:

FY62	FY63	FY64	FY65	FY66	FY67	FY68	FY69
27	112	350	710	1320	1405	1760	1700

1.1 PURPOSE

The purpose of the Lunar Transport Vehicle Sub-Program is to provide a manned round-trip lunar transportation vehicle and an unmanned one-way lunar cargo vehicle.

1.2 PERFORMANCE

The manned vehicle has a crew of three (six in an emergency), and the payload of the cargo vehicle is in excess of 40,000 pounds delivered to the lunar surface. Both configurations are being designed for launch by the same Military Space Launching System.

This transport capability will allow the United States to fully explore the moon and the cislunar and earth orbital areas. It will be the first and only presently "programmed" manned vehicle with a truly escape capability (37,000 ft/sec) for military operational use. As a by-product of its escape capability it could be readily used throughout the earth orbital area to support military missions.

Present designs indicate that the Lunar Transport Vehicles will weigh 134,000 pounds when they achieve escape velocity. For the manned configuration the Lunar Landing Stage will weigh 84,295 pounds, the Lunar Launching Stage 29,500 pounds and the Manned Re-entry Vehicle 20,205 pounds. In the case of the cargo vehicle the same Lunar Landing Stage will be used to soft-land the total weight of 49,705 pounds of which approximately 40,000 pounds will be useful payload.

1.3 DEVELOPMENT PHILOSOPHY

The recommended development philosophy for the program to be accomplished with the requested funds, is basically the same as the philosophy for past ballistic missile programs. See Chart 1-A & B. Essentially, the present Preliminary Design will be completed and the System Package Plan will be available September 1961. Then it is proposed that a full Engineering Design and Mock-Up competition by two contractors be initiated for the Lunar Transport Vehicle. Two different re-entry vehicle design approaches will be selected and in January 1963 the optimum design concept will be selected for the

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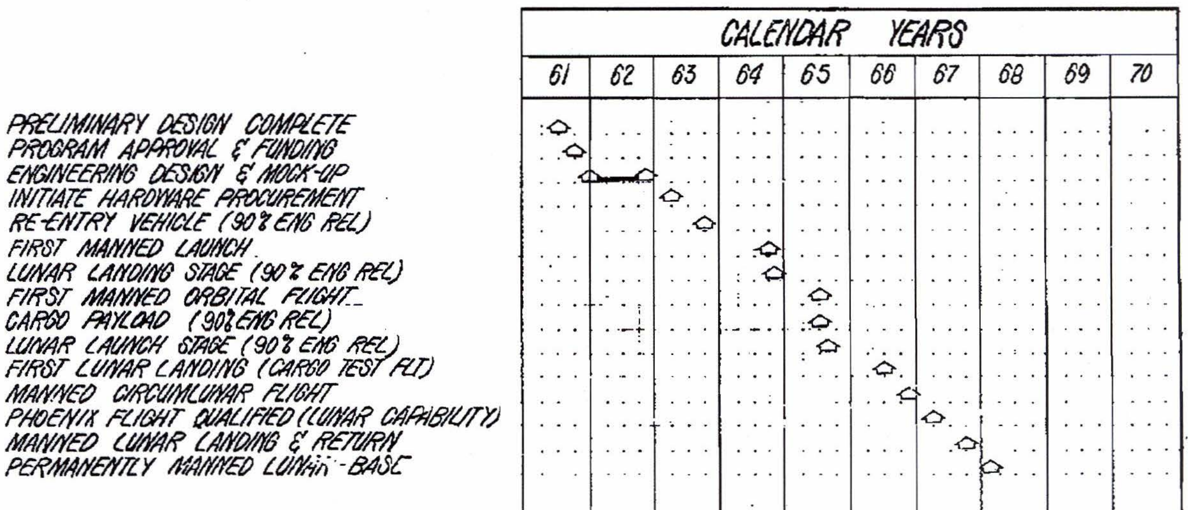
LUNAR EXPEDITIONARY PROGRAM SCHEDULE



	61	62	63	64	65	66	67	68	69	70
LUNAR EXPEDITIONARY FORCE (LEF) FUNDING REQUIREMENTS (MILLIONS)		27	112	350	710	1320	1405	1760	1700	1700

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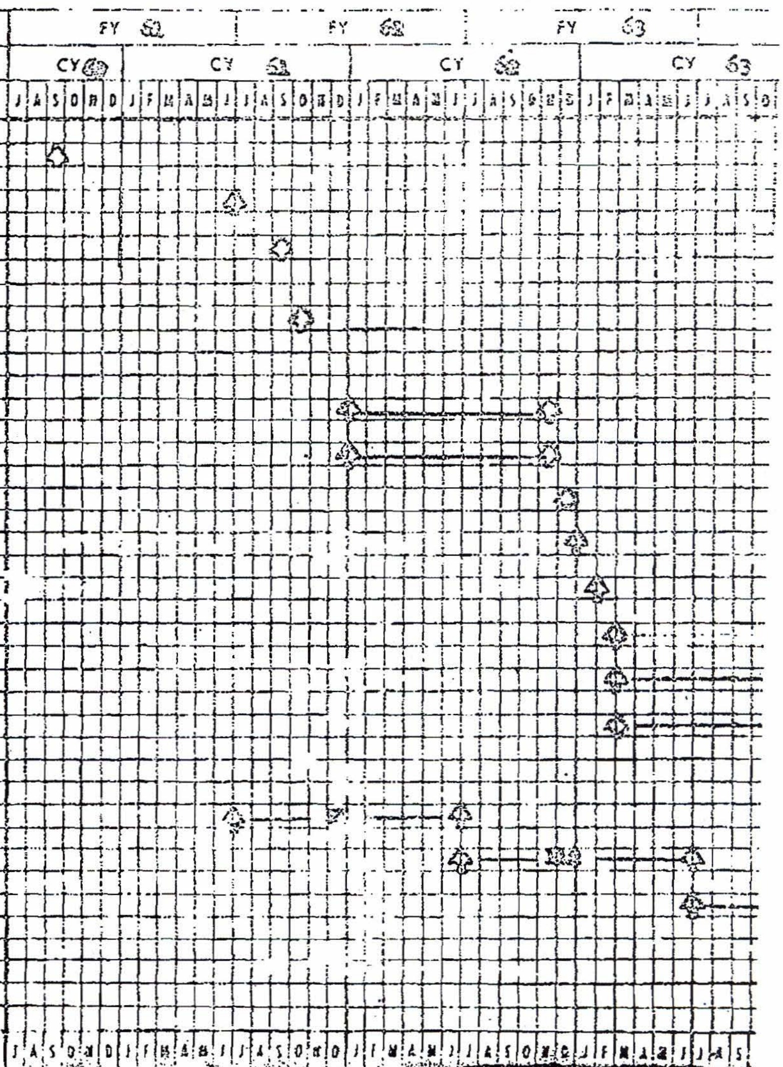
PROGRAM SCHEDULE C.T.I.O.

LS	LUNAR EXPEDITIONARY [illegible] MILESTONES FY62 – FY63
	[illegible] PRELIMINARY [illegible]
	[illegible] PRELIMINARY [illegible]
	DEVELOPMENT PLAN COMPLETED (LUNEX AND LUNAR EXPEDITIONARY FORCE)
	PROGRAM APPROVAL AND [illegible]
	[illegible] DESIGN COMPETITION & MOCK-UP
	CONTRACTOR A
	CONTRACTOR B
	[illegible] – [illegible]
	[illegible] CONTRACT [illegible]
	APPROVAL FOR PROGRAM GO-AHEAD
	CONTRACT AWARD
	LUNAR [illegible] VEHICLE PROGRAM
	LUNAR EXPEDITIONARY FORCE PROGRAM
	[illegible] FUNDING (MILLIONS)
	FY-62
	FY-63
	FY-64



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Production Program which is to begin March 1963. Present designs indicate that the Thick Delta and a Lenticular-Glide configurations will be the approaches selected for design competition.

SECTION II

INTELLIGENCE ESTIMATE

LUNAR EXPEDITIONARY FORCE

2. INTELLIGENCE ESTIMATE

2.0 The Problem

The purpose of this section of the program plan is to estimate the foreign threat in terms of technical capabilities and probable programs which may affect the establishment of a base on the moon. The threat will be defined in terms of major performance characteristics and dates of operational availability.

2.1 Foreword

The source of the following data is DCS/Intelligence, Hq ARDC.

2.2 Summary and Conclusions

50X1 and 3, E.O.13526

There is also evidence of a cluster of five 140,000 pound units.

The Soviets are developing engines of 1 to 2½ million pound thrust. The estimated time for a booster to match this engine is as follows:

Single engine booster - 1963

Clustered engine booster - 1965

In general, it takes approximately half the time for development required in the U.S.

50X1 and 3, E.O.13526

By using higher energy chemical propellants in modified upper stages, the payload can be increased up to 15,000 or 20,000 pounds during 1961. However, approximately 50,000 pounds of payload may be attained by 1962 if ICBM launch vehicle thrust is increased.

In the 1965-1970 period, a new clustered chemical booster should allow the Soviets to place 50 to 100 tons in orbit on individual launches. This will permit landing a man on the moon.

During the early 1970's it is possible that space weapon systems will be developed as a supplement to earth-based delivery systems. It is also possible that military facilities may have been established on or in orbit around the moon. Atmospheric and climatic conditions will demand an air conditioned environment for moon-based delivery systems. For increased survival security and decreased requirements for "imported" construction material, it seems reasonable to assume that these would be constructed under rather than above the moon's surface. Sub-surface installations on the moon might vary in hardness to withstand from 50 to several hundred PSI, depending on sub-surface characteristics and types of construction employed.

The Soviets do not differentiate between military and non-military space systems. They have talked of a peaceful intent of their space program but there are many pounds of payload in their satellites which cannot be accounted for on the basis of data given out. It should be presumed that this could be military payloads.

SECTION III

DEVELOPMENT TEST-PRODUCTION-MANAGEMENT

PLAN

LUNAR EXPEDITIONARY FORCE

3.0 INTRODUCTION

This section of the plan provides a detailed description of the Lunar Transport Vehicle and correlated phases of the Lunar Expeditionary Force Program. In addition the program management philosophy is presented.

3.1 GLOSSARY OF TERMS

SUB-PROGRAM

The term "Sub-Program" is used extensively throughout this package program. It is subservient to the term "Program" which in this case is defined as the entire lunar effort. For example, Sub-Program V "Lunar Transport Vehicle" is one of six parts of the overall Lunar Expeditionary Force Program and is the effort emphasized in this System Package Plan.

PHASE

The term "Phase" is used interchangeably with the term "Sub-Program."

PEP

PEP are the initials for "Program Evaluation Procedures." PEP employs a computer program in management and control of Air Force Programs.

3.2 SUMMARY

AFSC has completed studies on the feasibility of establishing a (U) Lunar Observatory and on the military usefulness of a (U) Strategic Lunar System. The study results demonstrated that it was technically feasible and desirable to establish a manned base on the moon. The results of these studies led to the development of a 6 phase lunar program plan. The phases are defined as Sub-Program of the Lunar Expeditionary Force Program and are organized under the following listed Sub-Program titles:

- I LUNAR PROBES
- II LUNAR ORBITS
- III SOFT LUNAR LANDINGS
- IV LUNAR LANDING AND RETURN (Unmanned)

V LUNAR TRANSPORT VEHICLE (Manned and Cargo)

VI LUNAR EXPEDITIONARY FORCE

A preliminary design study is presently investigating technical aspects of the last two Sub-Programs. In June 1961 the results of this investigation by six prime contractors will be available and an Engineering Design competition will be initiated as soon as funding is available.

This Systems Program Plan has been prepared to initiate this action. It reflects the application of the majority of the effort on the Lunar Transport Vehicle and this is the major step toward providing an Operational Lunar Base.

The present technical approach taken by the NASA and the objectives of their unmanned lunar exploration programs are compatible and similar to those outlined in the first four Sub-Programs of the Air Force Lunar Plan. Consequently, the DOD would utilize the NASA exploratory information, and concentrate effort on the Sub-Programs V and VI, Lunar Transport Vehicle and Lunar Expeditionary Force. This would be in keeping with current space policies and ensure that the DOD will be capable of meeting future military space requirements as the need arises.

The key items required for the Lunar Expeditionary Force Program are a large chemical booster, a Manned Lunar Payload and an unmanned Cargo Payload. The combination of these items will provide a Lunar Transport Vehicle capable of transporting and supporting three men on a round-trip, 10 day mission to the moon. The preliminary design of the lunar transport requires an escape weight of 134,000 pounds and a re-entry weight at 20,000 pounds. The difference in weight is accounted for by expended fuel, a lunar landing stage that remains on the lunar surface, and a lunar launch stage that is discarded prior to re-entry.

The primary objective of the Lunar Expeditionary Force is to build up and equip a lunar base. The lunar base will be permanently manned and 21 men will be the normal complement. It is anticipated that the military use of the Lunar Facility will be initially limited to surveillance and control of cislunar space. If at some future date it is desired, the base can readily be expanded to support a strategic "Recallable Earth Bombardment System."

The goals for the Lunar Expeditionary Force are imaginative and relatively close. In order to meet the proposed schedules a Single Program Manager must be appointed. The DOD has past experience and specialized capabilities that particularly well qualify the organization to carry out a program of this magnitude. The DOD is now organized in a manner that will allow the program to be assigned directly to the Space Systems Division of the AFSC and implementation will be immediately possible.

To assist in the management and control of this complex lunar program the System Program Director will utilize computer program techniques (PEP), a multi-company approach, and a military team known as the "Air Force Lunar Team." The lunar team is made up of Air Force personnel from the various technical areas that are required to support a lunar program. This team was formed during the early days of the Air Force lunar studies and it has participated in the Air Force past evaluation of study results and in the formulation of the Lunar Program. The team represents a nucleus of experienced personnel that can be readily expanded to accomplish the Lunar Expedition.

3.3 LUNAR EXPEDITIONARY FORCE PROGRAM DESCRIPTION

3.3.1 HISTORY. This program is based on extensive and detailed investigations by the "Lunar Observatory;" "Strategic Lunar System" and "Permanent Satellite Base and Logistic System" studies. The "Lunar Observatory" study was released to industry groups on 4 April 1958. The broad and initial objective of this study was to determine an economical, sound and logical approach for establishing a manned intelligence observatory on the moon. Study contracts were awarded to Boeing Airplane Company and North American Aviation Corporation. At a later date United Aircraft C orporation was selected for a funded Supplementary Study. Three additional companies performed the study on a voluntary basis. They were Republic Aviation Corporation, Douglas Aircraft Company and Minneapolis-Honeywell Regulator Corporation.

The contractors presented the results of their studies at the AFBMD during the week of 2 November 1959. Personnel from Headquarters United States Air Force, Headquarters Air Research and Development Command, Strategic Air Command, Rome Air Development Center, Wright Air Development Division, Cambridge Research Center, Air Materiel Command, Air Force Special Weapon Center, Air Force Flight Test Center, Air Force Missile Test Center, School of Aviation Medicine, ARPA, Rand, and the Air Force Ballistic Missile Division attended these presentations and assisted in evaluating the contractor study results.

The evaluation of the study results by technical personnel resulted in the publication of a Study Summary and Program Plan for establishing a military base on the moon. The publication is numbered AFBMD TR 60-44, dated April 1960, and entitled: MILITARY LUNAR BASE PROGRAM (C) or Lunar Observatory Study (U), Volume I (Study Summary and Program Plan) and Volume II (Technical Development Plan).

On 29 August 1958, the "Strategic Lunar System" study was released to industry to investigate and provide information for developing military concepts for lunar and cislunar space. A study was conducted on a voluntary basis by Bell Aircraft Corporation, Northrop Corporation, and the Martin Company. Contracts were awarded to Aerojet-General Corporation, Douglas Aircraft Company, and North American Aviation, Incorporated. Evaluation comments furnished by technical personnel of various ARDC organizations, Air Force agencies and the Rand Corporation contributed to the formulation of evaluation report number AFBMD TR 61-31, "Strategic Lunar System Final Report," dated March 1961.

On 29 August 1960, the "Permanent Satellite Base and Logistics System" preliminary design was released to industry groups. Contracts for this study were awarded to the General Electric Company, The Martin Company and North American Aviation, Incorporated. The voluntary contractors selected were: Convair, a Division of General Dynamics Corporation, Douglas Aircraft Company, Incorporated, Vought Astronautics, Division of Chance Vought Aircraft.

The results of the Lunar Observatory and Strategic Lunar System studies illustrated that it was technically feasible to establish a manned base on the moon. A Program Plan was prepared in order to provide an orderly approach for establishing a manned lunar base. The last two of the six parts of this program called for the development of a manned and unmanned lunar transportation system as well as the design and construction of a permanent base on the moon. The major effort under the "Permanent Satellite Base and Logistics System" preliminary design has been directed toward this end. This preliminary design study was divided into three parts. The first part, Manned Lunar Payload Design, considers the manned vehicle, the lunar landing stage and the lunar launching stage. Industry groups furnished SSD with a manned lunar payload design at the end of this part of the design study. This data assisted SSD in determining the design requirements of the PHOENIX vehicle launching system which will be used to launch the lunar payload. The second part of this study deals with the Cargo Payload and base design. The Cargo Payload uses the same PHOENIX launch system and Lunar Landing Stage as is used for the Manned Lunar Payloads. The useful payload size and weight limitations of this cargo vehicle has a direct influence on the various payloads that can be landed for the construction of the lunar base. During the second part of the study the design of a temporary and permanent lunar base will be continued. Some of the base design problems ~~an~~ under investigation are: site location, base construction materials, and techniques, personnel suit design, base power syst~~e~~em, communications, insulation and support of equipment for military operations, etc. During the last part, or part three of the study, the industry groups will consolidate and integrate the information obtained, with the PHOENIX vehicle design that will be furnished by SSD. The final report will provide a completely integrated system and will be submitted by the contractors on 30 June 1961. The combination of the Strategic Lunar System final report, the Lunar Observatory final evaluation report and preliminary results of the Preliminary Design Study represents the approach recommended for the Lunar Expeditionary Force Program.

3.3.2 <u>LUNAR EXPEDITIONARY FORCE PROGRAM BREAKDOWN</u>. Reference is made to the following diagram which represents a division of the Lunar Program. This diagram depicts the relative cost and magnitude of the six Sub-Programs. They are:

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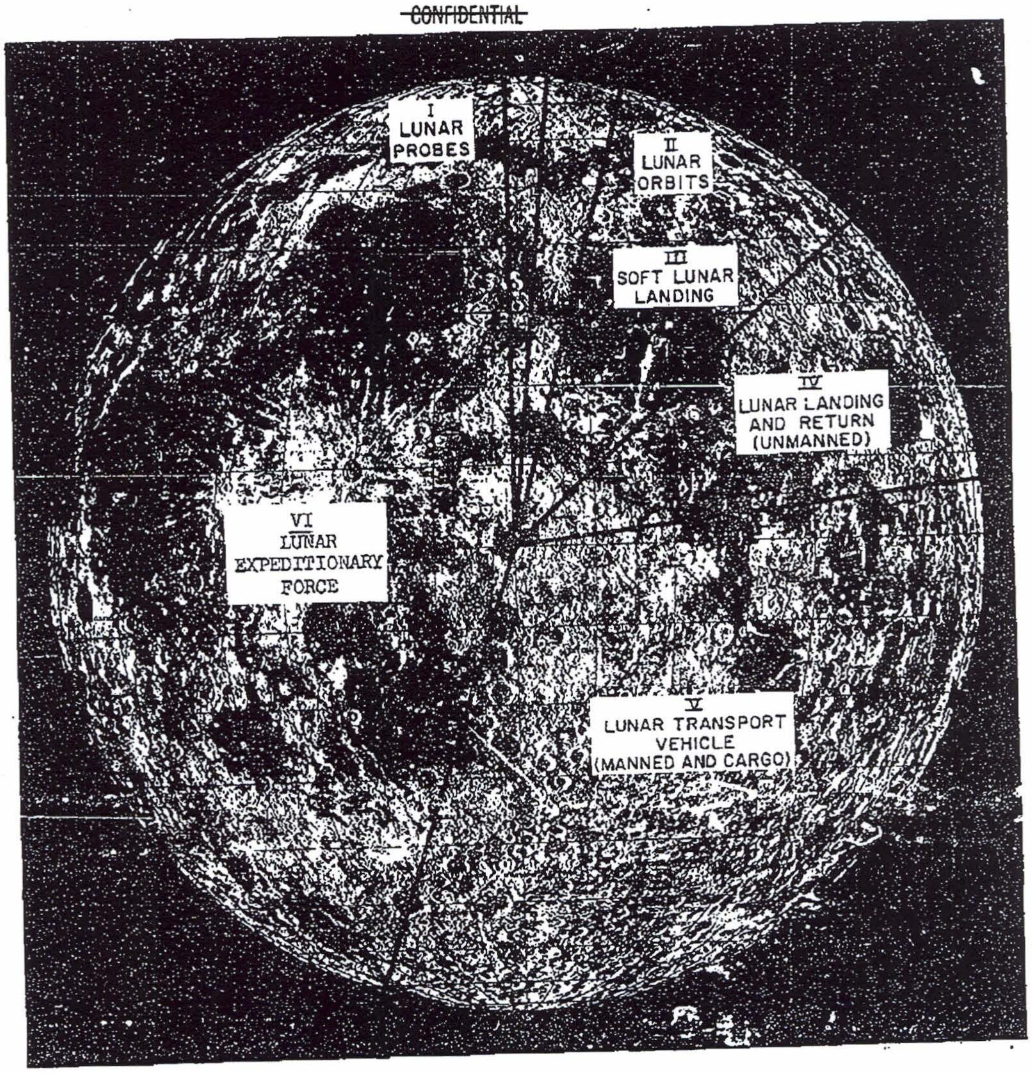

DIVISION
OF
LUNAR PROGRAM

I. LUNAR PROBES

II. LUNAR ORBITS

III. SOFT LUNAR LANDINGS

IV. LUNAR LANDING AND RETURN (Unmanned)

V. LUNAR TRANSPORT VEHICLE (Manned and Cargo)

VI. LUNAR EXPEDITIONARY FORCE

The first four Sub-Programs are presently underway to varying degrees by the National Aeronautics and Space Administration in keeping with existing policies. The description of each of the first four Sub-Programs will provide guidance milestones that must be met by the various NASA programs in order to satisfy the requirements of the Air Force Lunar Expeditionary Force Program. Sub-Program V Lunar Transport Vehicle (Manned and Cargo) and VI Lunar Expeditionary Force should be accomplished expeditiously by the DOD in keeping with current policies.

3.3.2.1 SUB-PROGRAM I - LUNAR PROBES

Objective

The primary objective of this phase is to obtain environmental information of cislunar space and the surface of the moon.

Requirement

Environmental information will be required to design the life sciences portion of the manned vehicle as well as the lunar expedition facility on the moon.

Much of this information will be obtained from the proposed early life science program and the NASA Ranger program. The early manned orbital flights and the unmanned circumlunar flights will be used to check-out equipment and to substantiate the design of the environmental control systems for the manned vehicle.

Status

No programming for this phase is included in the Lunar Expeditionary Force Program.

3.3.2.2 SUB-PROGRAM II - LUNAR ORBITS

Objective

The primary objective of this phase is to obtain detailed photographic information of the complete lunar surface.

Requirement

Detailed lunar charts will be required to soft-land unmanned and manned vehicles at selected sites on the lunar surface. This will require photographic resolutions of less than 100 feet.

The selection of the site for constructing the Lunar Expeditionary Force facility will require a detailed analysis of the lunar surface and improved resolutions of 10 to 15 feet will be necessary.

Status

At the present time the NASA has a Lunar Orbiter program initiated, but not funded, or firmly scheduled for operation. This program must be implemented so that lunar surface charts are available by the first lunar flight of the Lunar Transport Vehicle in mid-1966

3.3.2.3 SUB-PROGRAM III - SOFT LUNAR LANDING

Objective

The primary objectives of this phase are to soft land several vehicles on the lunar surface, obtain environmental data on the lunar surface, and to check-out the landing system.

Requirement

It will be necessary to have detailed information about the lunar surface to design the Lunar Landing Stage for the Lunar Transport Vehicle.

The delivery of manned and cargo vehicles to a preselected site will require a radio beacon to assist the vehicle guidance system during lunar terminal landing. A soft-landing vehicle is required to deliver the radio beacon to the decided lunar site.

Status

The NASA presently has a funded and scheduled Surveyor Program to accomplish this mission. No programming for this phase is included in the Lunar Expeditionary Force Program because the NASA program should meet the stated requirements.

3.3.2.4 SUB-PROGRAM IV - LUNAR LANDING AND RETURN

Objective

The primary objective of this phase is to return the first payload launched from the lunar surface.

Requirement

The design and construction of the Lunar Expeditionary Force facility and the lunar surface support equipments will require a knowledge of the composition of the lunar surface. A core sample of the selected lunar sites is required for this purpose.

The development of lunar resources requires a knowledge of the water content of the material in the upper layer of the lunar surface. When this is known basic research can be initiated to determine processes for obtaining water, hydrogen and oxygen from lunar materials.

The lunar core samples are required by November 1964.

Status

At the present time a program is not scheduled by the NASA to meet this requirement. It is not included in the Lunar Expeditionary Force program, but could be incorporated.

3.3.2.5 SUB-PROGRAM V - LUNAR TRANSPORT VEHICLE (Manned and Cargo)

Objective

The primary objective of this phase is to develop a lunar transportation system capable of carrying men and equipment to the lunar surface, and capable of returning men to the earth's surface.

This phase of the Lunar Expeditionary Force Program is of major importance to the Air Force. The previous phases are exploratory and scientific in nature, but this phase provides a capability that will allow men to go to the moon, establish a base, and use the base for military purposes. Therefore, it is essential that the Air Force becomes involved in developing the Lunar Transport Vehicle if the military potential of the moon is to be exploited.

Vehicle Development

The Lunar Transport Vehicle consists of the Military Space Launching System (PHOENIX) and one of two payloads. The two payloads are described as the Manned Lunar Payload and the Cargo Payload.

The key item to the Lunar Transportation Vehicle is the Manned Reentry Vehicle. The Manned Re-entry Vehicle, the Lunar Landing Stage and the Lunar Launching Stage represent the major parts of the Manned Lunar Payload. Only after the Re-entry Vehicle has been designed is it possible to also the Lunar Landing and Lunar Launching Stages of the payload. Then with this payload complete, the military Space Launching System (PHOENIX) can be designed. The Cargo Payload will also be designed for delivery to the lunar surface with the same Space Launching Vehicle. A sketch showing the relationship of these items is shown on the next page.

The preliminary design for the Manned Lunar Payload and the Cargo Payload is presently underway and will be completed by June 1961. The preliminary design for the PHOENIX vehicle will be available in August 1961.

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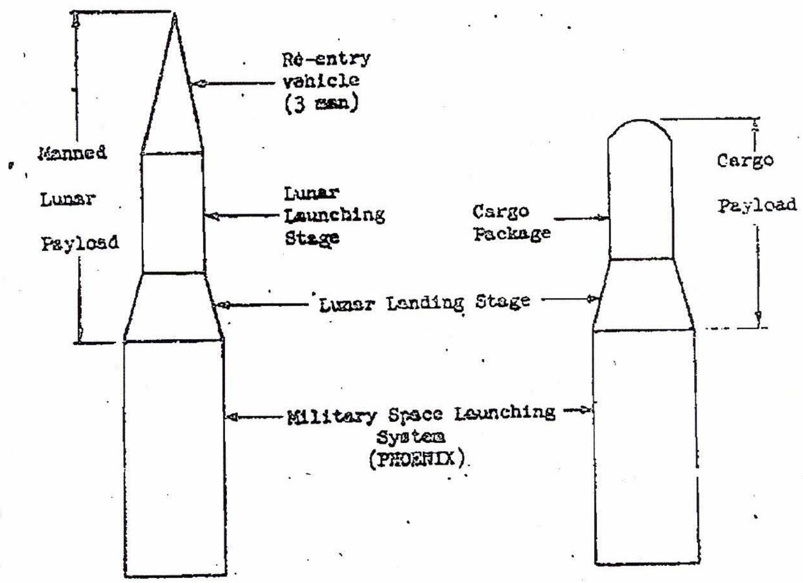

LUNAR TRANSPORT VEHICLES

The payloads and the PHOENIX vehicle designs will be integrated into one System Package Plan that will be available in September 1961. This plan will present the complete Lunar Expeditionary Force Program.

The vehicle development could be accomplished by the steps listed below:

(1) Preliminary Design (Presently underway)

(2) Engineering Design

(3) Manufacturing

(4) Flight Test

(5) Operational

The timing of each development step is critical if the end operational date of 1968 is to be achieved. The first step is currently underway in the Permanent Satellite Base and Logistics System Preliminary Design Study. The second step, Engineering Design, should start by January 1962.

The flight tests will be conducted by using the PHOENIX Space Launching System as its capability becomes available. The early capability will allow earth orbital and high altitude flights, then as propulsion capability increases, a circumlunar flight and finally a soft lunar landing will be possible. The types of test flights that will be needed are as follows:

High Altitude

These are extremely high altitude, unmanned earth orbital shots (an apogee of approximately 50,000 miles) that are designed for re-entry and recovery testing.

Lunar Pass

These shots have a planned trajectory that takes the unmanned vehicle around the moon and then returns for earth re-entry and recovery.

Manned High Altitude

This is the same type of flight trajectory as specified above, except a man or men will go along on the flight.

Manned Circumlunar

This is the same flight as specified above, except man will be included in the vehicle. This is the first time man will actually enter the lunar area. The manned vehicle will be a prototype of the final re-entry vehicle that will be used in the operational system.

Lunar Landing

The final "manned" configuration will be flown unmanned on the first shots. When this series of flights is completed and the manned return vehicle has been proven capable of landing and returning automatically from the moon, the vehicle will be considered "man-rated".

Manned Lunar Landing

The first manned flights with the "manned-rated" vehicle will be for site exploration and system check-out. When this has been accomplished the Cargo Payload vehicle will be checked out. With the manned and the cargo vehicles available it will be possible to proceed with the construction of the Lunar Expeditionary Force facility.

<u>Preliminary Design Characteristics</u> - <u>Manned Lunar Payload</u>

The preliminary design of the Manned Lunar Payload is nearly complete and the following characteristics are included to illustrate the type of vehicle that is required for the lunar mission.

Item			Escape Velocity Weight - lbs
Manned Lunar Payload			134,000
Manned Re-entry Vehicle			20,205
Body		7,500	
Structure	3,500		
Heat Shield	4,000		
Wing Group		2,000	
Structure	800		
Heat Shield	1,200		
Control System		775	
Aerodynamic	600		
Attitude	175		
Environmental Control		1,530	
Equipment Cooling	138		
Structure Cooling	940		
Cryogenic Storage	452		
Landing Gear		700	
Instruments & Displays		200	
Electric Power System		600	
Guidance and Navigation		400	
Communications		250	
Furnishing and Equipment		850	
Seats and Restraints	225		
Decompression Chamber	175		
Equipment Compartment	300		
Miscellaneous	150		

<u>Life Support</u>		400	
Food	20		
Water	100		
Hydrogen	175		
Oxygen	78		
Nitrogen	27		
<u>Crew (3 men)</u>		800	
<u>Radiation Shielding</u>		1,200	
<u>Abort System</u>		3,000	
Lunar Launching Stage			<u>29,500</u>
Lunar Landing Stage			<u>84,295</u>

The General Arrangement of the Manned Lunar Payload is illustrated on the next page and the size of the Manned Re-Entry Vehicle follows.

The illustrated Manned Re-entry Vehicle uses a "thick-delta configuration" and is capable of supporting three men on a 10 day mission to the lunar surface, and then returning to a preselected earth base. On the return flight the vehicle is capable of carrying six men under emergency conditions. In each phase of the mission a relatively safe abort philosophy is being developed to protect the members of the crew.

The vehicle may be landed at a preselected site on the moon and it is capable of supporting the construction of the Lunar Expeditionary Force Facility. Upon return to the earth it will be capable of landing at a base, such as Edwards Air Force Base, with relatively normal landing characteristics.

The vehicle is designed to serve as an "initial base" to support the crew on the lunar surface while the temporary or permanent lunar base is being constructed. The crew will be able to leave the vehicle and by means of lunar suits, or a surface transportation vehicle, complete their surface mission.

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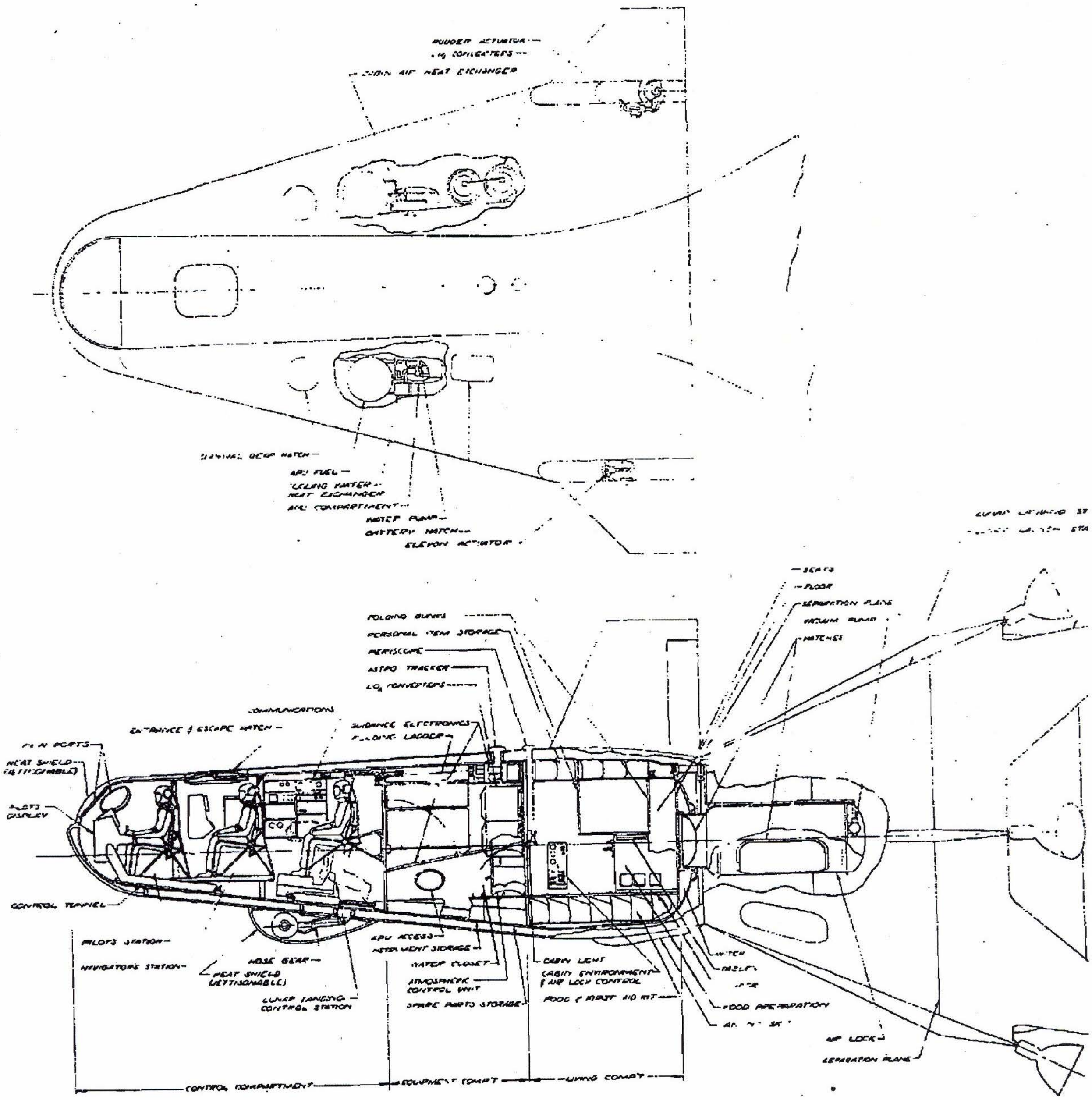

GENERAL ARRANGEMENT
MANNED LUNAR PAYLOAD

The Manned Lunar Payload is 52 feet 11 inches long, has the c.g. located 33 feet 8 inches from the nose of the re-entry vehicle and the interface diameter of the payload is 25 feet. The Manned Re-entry Vehicle weighs 20,205 pounds and the Space Launching System is required to boost 134,000 pounds to escape velocity on the lunar trajectory.

The design characteristics have been selected so that it will be possible to launch a vehicle at least once each day and thus not operationally limit the lunar system. The payload will be capable of landing at any point on the lunar surface and will be designed to utilize a beacon for terminal lunar base guidance.

An alternate Manned Re-entry Vehicle using a "lenticular-glide" configuration is proving very interesting in the Preliminary Design Study.

At the present time several designs for the manned vehicle have been completed. Present planning calls for the selection of the two best design configurations at the conclusion of the Preliminary Design study. When this has been accomplished the Engineering Design step would proceed with two contractors in competition. The Engineering Design step would include mock-up of the selected vehicles by each contractor and at the conclusion of this design competition in January 1963, the final selection would be made for manufacture. This schedule is compatible with the Military Space Launching System program and should provide for successful lunar occupation during 1968.

The Cargo Payload uses the same Lunar Landing Stage, but the Lunar Launching Stage and the Re-entry Vehicle is replaced by a Cargo Payload. The preliminary design of this payload is now being accomplished and it is estimated that approximately 45,000 pounds of usable payload can be delivered to the lunar surface with the Cargo Payload.

3.3.2.6 SUB-PROGRAM VI - LUNAR EXPEDITIONARY FORCE FACILITY

<u>Objective</u>

The primary objective of this phase is to build-up and equip a lunar base. The manned vehicles will have been developed in the previous phase and can now be considered available to transport men to the moon. Similarly the one-way cargo vehicle is also available and capable of delivering at least 45,000 pounds of cargo on the lunar surface.

The nature of the build-up will require further analysis as technological advances become available. Of particular importance is the sample of the lunar surface material, and the detailed mapping of the lunar surface features. Only when these are available will it be possible to complete the design of the Lunar Facility. However, the present preliminary design study is continuing the investigation on how to design the lunar facility based on the best information presently available. This design will be prepared so that it can readily be modified as detailed lunar data becomes available.

A primary advantage of performing a preliminary design on the Lunar Facility at this time is to provide design parameters for the Cargo Payload. The types of payloads that will be required to deliver the items needed for any type of lunar construction can be determined. The special payloads required to construct and support the base can be designed once educated assumptions are made. With these payloads decided, it is possible to prepare a delivery sequence for the Cargo Payloads at the lunar site. When this has been accomplished the lunar and earth base facility requirements can be determined. The present design study will be completed in June 1961 and then this portion of the plan can be completed in detail.

The military use of the Lunar Expeditionary Force Facility will initially be limited to surveillance and control of cislunar space. As the base capability increases it will be possible to install a strategic recallable earth bombardment system on the moon. This system can be protected and developed at a cost that is competitive with other presently planned weapon systems. This is not an objective of this program. However, this program has the objective of making this possible by providing a military base that can readily be expanded for strategic use if required.

Base Build-up

It can be seen from the objectives set forth above, that the lunar base is to be permanently manned. Depending upon the future missions capable of being performed from the moon, the number of personnel assigned to the base will change, but to meet the immediate objective, a build-up to 21 men is planned.

This build-up is accomplished by first placing a guidance beacon and then two cargo vehicles on the site. These will contain supplies and equipment. The third shot will be unmanned but it will contain a manned return vehicle. This vehicle will stay on the site and be used later. The fourth shot will contain three men and occur as soon as it can be ascertained that the third shot is successful. This fourth shot will also contain means for the men to transfer from the ascent vehicle to the return vehicle. The transfer means will be either moon suits or a surface vehicle. A surface vehicle is desired so that it could be used later for excavation and exploration. These first three men will stay a few days awaiting the arrival of the next three man crew.

Shots five and six will be similar to shots three and four respectively. Thus when the original three return to earth after the sixth shot there will be two lunar surface vehicles on the lunar site. Later when these vehicles are used, they can each serve as an emergency backup vehicle for the other in case one should encounter trouble. It is considered more economical to have several working vehicles which are also capable of helping each other rather than developing specialized rescue machines.

Although several designs for a surface vehicle have been prepared, it is considered premature to make a choice at this time. More must be known about the lunar surface characteristics but a surface vehicle is obviously desirable. It also appears desirable to have it capable of transporting at least three men for 100 miles and of operating specialized attachments for excavation and drilling. This vehicle will require a power source which will deliver up to 15 kilowatts without refueling for one week. This power source should not weigh over 1800 pounds.

In addition to the surface vehicle, moon suits are required. The most desirable moon suit should be self-contained and supply a life-supporting environment. The suit should have at least a 40 hour life before replacement. A less desirable moon suit, but acceptable, is one that maintains its life support environment through an umbilical cord from the surface transportation vehicle or other vehicles.

The seventh shot will be an unmanned supply vehicle containing base and life support supplies. The eighth shot will be unmanned, but contain an earth return vehicle. The ninth shot will be manned and contain another surface transport vehicle. It will be fired as soon as it is determined that the eighth shot is successful. Using this surface [illegible] and the other two surface vehicles previously [illegible]sitioned [illegible] could begin to construct a base. They will have three 45,000 pound supply vehicles (shots two and seven) which will contain the necessary equipment. One of the most important jobs they will accomplish is the emplacement of a nuclear reactor for supplying power to the base. This should produce at least 300 kilowatts for at least [illegible] years. It is to be noted that the men will have an earth return vehicle standing by at all times in case it is needed. Three men will remain on the site until three more men arrive the following month. If no deleterious effects are sustained, the stay period will be [illegible] and night [illegible]. [illegible] transportation [illegible] possible.

[illegible] support supplies [illegible]

[illegible]

[illegible]

[illegible] to accomplish the [illegible] The resulting sensor system will monitor phenomena ranging from large-scale slow-moving types such as weather and cloud cover to [illegible] moving point types such as manned space vehicles.

The area survey sensor will employ a telescope with [illegible] inch mirror and spectral filter elements to monitor an image of the earth [illegible] in the visual and infrared regions of the spectrum. [illegible] observed with this system are primarily earth weather and cloud cover. Basic resolution

best available copy

of this system varies from 500 ft to 10,000 ft. Images obtained from this system at visual wavelengths contain an enormous amount of information and necessitate the use of a slowed down optical scanning technique to allow for transmission in a reasonable bandwidth.

Time-lapse photographic techniques will be employed with the 60 inch telescopic mirror and optical filter elements. These equipments will be used to survey the cislunar volume and to track earth satellites (with altitudes in excess of 0.5 earth radii), lunar vehicles, and interplanetary vehicles as they pass through the cislunar volume. The same equipments will be used to monitor natural phenomena, such as solar flares, corpuscular streams and meteor showers. The equipments will also be used to detect nuclear explosions in space and on the earth's surface, thereby providing indication of hostilities as well as reconnaissance data on enemy nuclear test activities. This detection capability would have significant importance in the future when a retaliation force is possibly located on the lunar surface or in space.

Technical Areas

An important task the first men must accomplish is the implacement of improved terminal guidance equipment. During the early shots of this phase the guidance equipment delivered by the unmanned soft-lunar landing system will be utilized. However, by using the lunar surface vehicle to place and set up equipment, greatly improved terminal, and ascent accuracies, can be obtained as well as a safer system. When a moon base tracking system is operational it will result in an integrated lunar-terminal and lunar-ascent system.

The same life support equipment as was used in the manned vehicle can be used initially on the lunar surface. However, since there are usable materials on the moon and the period of stay will be much longer, improvements can be made which will reduce transportation costs. Water removal can be accomplished through condensation on the cool surface of the thermal control cooling equipment. Water reprocessing can be utilized to save resupply weight. This could save approximately 1000 pounds per man per month. Regeneration of CO_2 and odor absorption is desirable. Chemical methods of processing CO_2 to obtain oxygen will reduce the resupply requirements of oxygen by 80%. Essentially this means that a permanent base can expect to eventually operate with a closed ecological system. The desirability of originally designing for this goal is obvious from the following table.

ECOLOGY	METHOD OF LIFE SUPPORT	OXYGEN LB	WATER LB	NUTRIENT LB	TOTAL LB
Open	Provisions without recycling	140,160	68,400	140,160	348,720
Transitional	Provisions with recycling	23,350	---	140,160	163,520
Closed	Recycling and regeneration	---	---	---	---

Another important task the men must accomplish is the establishment of adequate communications between their base and the earth. This means the construction of a space antenna at the lunar facility. Portable line-of-sight communications on the lunar surface and man-to-man communications beyond line of sight are also required. Exploration via the manned surface vehicle will also require a video system for transmission to the main base.

Many other technical areas of equal importance have been investigated and are covered in the final Lunar Observations Program Plan. They will not be covered at this time in this plan, but they will be added to the final System Package Program in September 1961.

3.4 MANAGEMENT TECHNIQUES

3.4.1 PROGRAM DIRECTION

The Single Program Manager will act as chief of the System Program office that will be established within the Space Systems Division under the Air Force Systems Command. The Program Manager will have management responsibility for directing activities associated with the "Lunar Transport Vehicle" and "Lunar Expeditionary Force" Sub-Programs. He will monitor the first four sub-program areas to insure that the NASA program will produce the required data for the Air Force Lunar Expeditionary Force Program. In the event the required data is not furnished he must take measures to obtain it.

3.4.2 MANAGEMENT TOOLS

The basic philosophy of developing all elements of this program on a concurrent basis introduces rigid scheduling requirements. When specific tasks can be defined and held, management is relatively simple, but when development problems dictate that many factors be varied to keep abreast of advancing state-of-the-art, concurrency and even the end objectives are affected, and possibly delayed. A computerized management system will be established and used to support the Program Manager in planning, operating and controlling this complex program plan. It will be used in the initial stages of the Lunar Expeditionary Force Program and continue through the final operational phase. The introduction of a computer program in management planning and control of Air Force Programs is known as "PEP" which stands for Program EValuation Procedures.

This Lunar Occupation Program stresses the desirability for grouping of effort and capabilities resulting from a widening spectrum of technology. To optimize the development of the lunar program, the use of a "military team" and/or "multi-company" approach is required.

The first major step to be taken in this System Package Plan is to start the engineering design for the Lunar Transport Vehicle (Sub-Program V). Two contractors will be competing during this engineering design effort. At the end of the engineering design phase, one contractor will be selected to proceed with the manufacturing. During the manufacturing of the Lunar Transport Vehicle, as well as during the initial engineering design investigation, a military team and multi-company organization will be integrated by a sound management practice.

3.5 ORGANIZATIONAL RELATIONSHIPS

Space Systems Division, Air Force Systems Command, will establish the System Program Office (SPO) and will be responsible for the "Lunar Expeditionary Force Program". Under this management structure, the Space System Division will have responsibility for development formerly accomplished by ARDC, air material support functions formerly supplied by AMC, and for some of the civil engineering functions formerly accomplished by the Corps of Engineers. Arrangements will be made to obtain additional support from other organizations and these arrangements will be included in a future revision of the System Package Program. This additional support will be required from the Office of Aerospace Research, Using Command, and Training Command. Coordination of the National Range Commander is being obtained at the present time. A statement on his ability to support the program will be included in a System Package Program revision to be submitted in September 1961.

The System Program Office (SPO) will follow the NASA space program closely so that technical data necessary for the Air Force Lunar Program will be available on a timely basis. The SPO will establish certain Lunar Air Force Requirements that NASA should meet. In the event that certain critical data is not supplied, the SPO will alter the Air Force Lunar Program so that the data is obtained on a timely basis.

The Single Program Manager will utilize a military team known as the "Air Force Lunar Team." This team is made up of Air Force personnel who have responsibilities in the technical areas that are involved in the Lunar Program. The Lunar Team was initially established by the Air Force lunar study manager. The lunar study results were evaluated by the technical personnel of the lunar team. The "team" has participated in the evaluation of all lunar study results and has assisted in the formulation of the lunar program.

SECTION IV

MASTER SCHEDULES

LUNAR EXPEDITIONARY FORCE

4.0 INTRODUCTION

The Master Summary Schedule included in this section covers a complete Lunar Expeditionary Force Program. It is based on approximately three years of combined Industry-Air Force study effort and a total funding of approximately 4 million dollars. A complete Program Plan for establishing a facility on the lunar surface was prepared. All of the technical items required to establish the facility were studied and evaluated. Detailed development schedules for all the known technical items were prepared and then integrated to obtain the Master Summary Schedule. This schedule follows, and it presents the six Sub-Programs of the Lunar Expeditionary Force Program.

This Proposed System Package Program has been prepared to emphasize and support the development program required for the Sub-Program V-Lunar Transport Vehicle. This is the key Sub-Program for the development and military use of the lunar area. Therefore, the Lunar Transport Vehicle Master Flight Schedule and the Lunar Transport Vehicle Overall Milestone Schedule are presented.

A detailed Program Plan had been prepared for the complete Lunar Expeditionary Force Program. It is presently being revised to reflect the existing NASA programs and to include the latest technical data being developed in the funded Lunar Transport preliminary design program being conducted by the SSD.

When the preliminary design data has been evaluated in July 1961, revised and complete schedules for the Lunar Transport Vehicle Sub-Program will be prepared for the final System Package Program to be submitted in September 1961.

4.1 MASTER SUMMARY SCHEDULE

This schedule presents the complete effort required to establish an operational military base on the moon. This base would be capable of performing a "space surveillance and control" mission and would be readily expandable to support a strategic earth bombardment system, if desired at some later date.

The first four Sub-Programs are now the responsibility of the NASA and their program should provide the scientific data required for the last two Sub-Programs.

The military potential of the moon has been evaluated and recommendations have been made to Hq AFSC and Hq USAF that a military lunar base should be established as rapidly as possible. Completion of Sub-Programs V - Lunar Transport Vehicle and VI - Lunar Expeditionary Force Facility would make a military lunar base a reality.

4.1.1 LUNAR TRANSPORT MASTER FLIGHT SCHEDULE

This schedule is an expansion of the Sub-Program V - Lunar Transport Vehicle shown on the Master Summary Schedule. Specifically, this schedule represents the work to be accomplished as funds are made available for the Lunar Transport Vehicle Sub-Program. The funding requested for FY 62 and FY 63 would permit a full go-ahead for this program. Upon completion of the program manned and unmanned cargo vehicles would be available to support the manned exploration, and occupation of the moon. The cargo vehicle will be capable of transporting approximately 45,000 pound "cargo packages" to the lunar surface for constructing the base and logistically supporting the facility. This same vehicle will be capable of transporting "lunar based earth bombardment vehicles" for installation in a lunar strategic facility, if desired at some later date.

Prior to the first "manned lunar landing and return" mission, a series of test and check-out flights will be required. These will initially consist of orbital flights, and then very high altitude (50,000 miles or more) elliptical flights for testing the vehicles under re-entry conditions. When these have been completed, the first flights will be made around the moon (circum-lunar) and return to an earth base. With a completely man-rated vehicle, and unmanned lunar landing missions completed, man will then make the first landing on the moon for the purpose of selecting a site for the Lunar Expeditionary Force Facility. This is the end objective of this Sub-Program and the actual facility construction would be accomplished under Sub-Program VI. Complete program documentation for Sub-Program VI will be submitted, when appropriate.

4.2 OVERALL MILESTONE SCHEDULE (Lunar Transport Vehicle)

This schedule presents the milestones to be accomplished for each major sub-system of the Lunar Transport Vehicle Sub-Program.

Essentially two different lunar payloads are required to be launched by the Military Space Launching System (PHOENIX). The payloads are the Manned Lunar Payload and the Cargo Payload. The Manned Re-entry Vehicle is capable of a round-trip mission from the earth to the moon, while the Cargo Package is designed for only a one way trip to the moon.

This is a realistic, but "tight" schedule, and fully uses the concurrency idea. However, without this approach the possibility of competitively conducting a lunar program is not possible.

Industry competition is included in the early steps of the Manned Lunar Payload design, but a decision must be made in December 1962 concerning the re-entry vehicle approach to be followed for the production program. This will not be an exceptionally difficult decision at that time because adequate test and design data will be available to justify the selected approach.

The end result of this schedule will be an operational manned transport vehicle and an unmanned cargo vehicle that will be capable of supporting the lunar mission and deep space operations.

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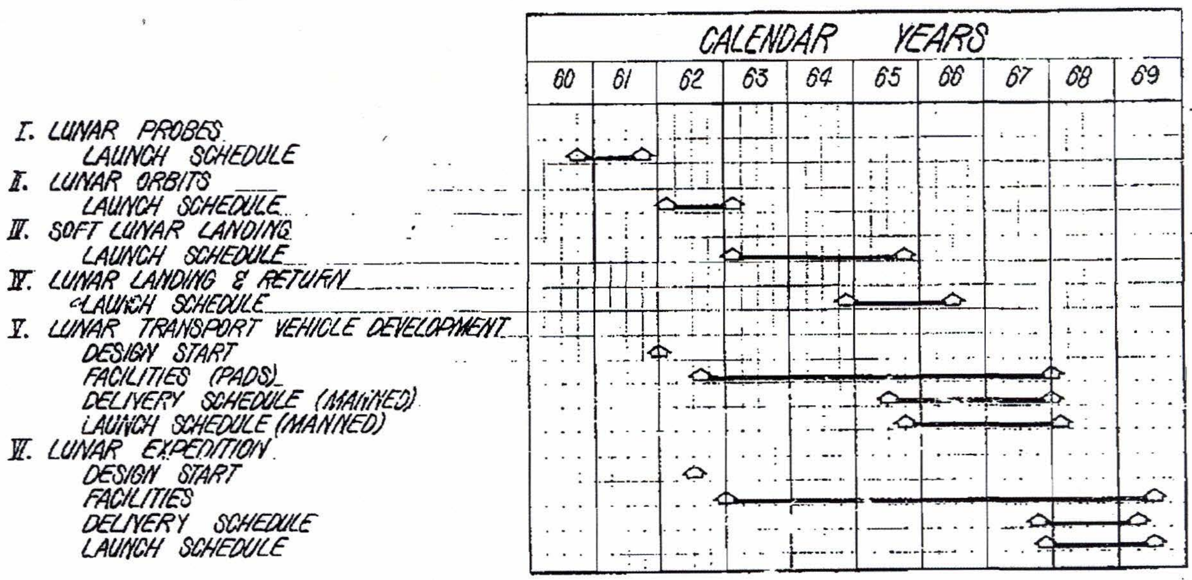

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CHART II

12 Year

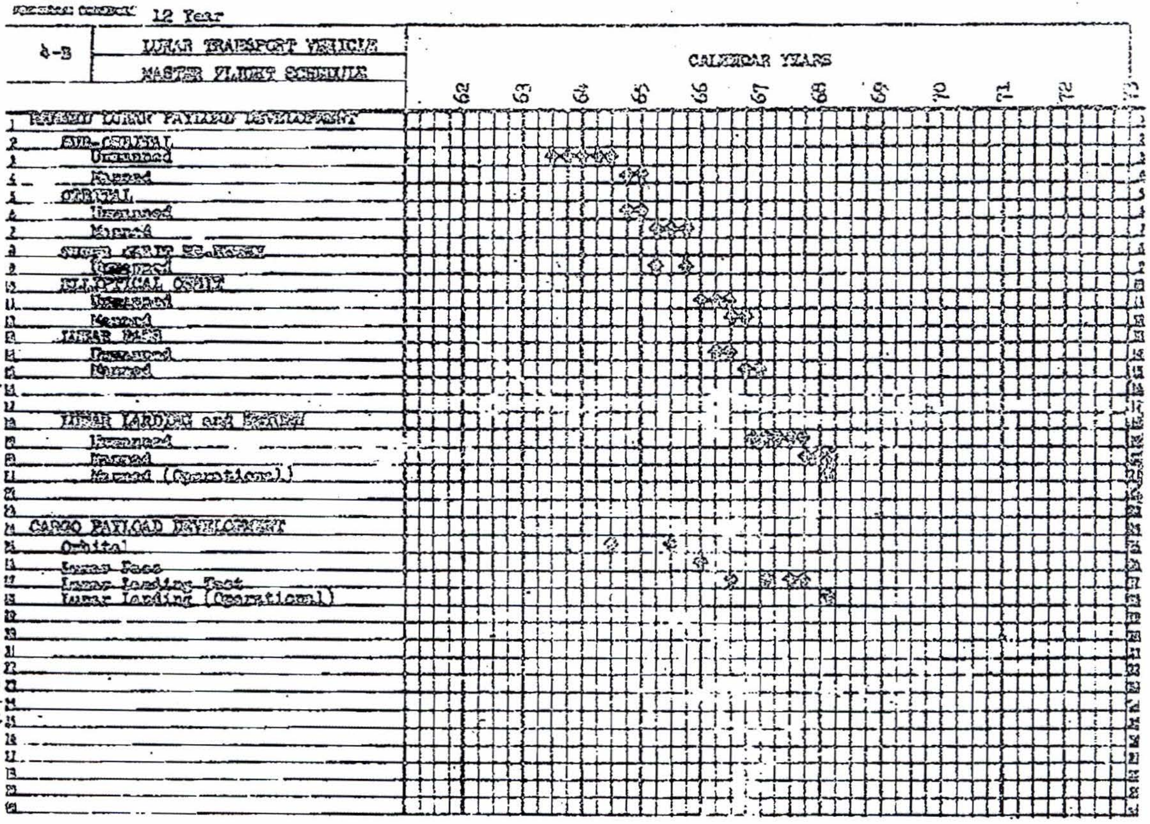

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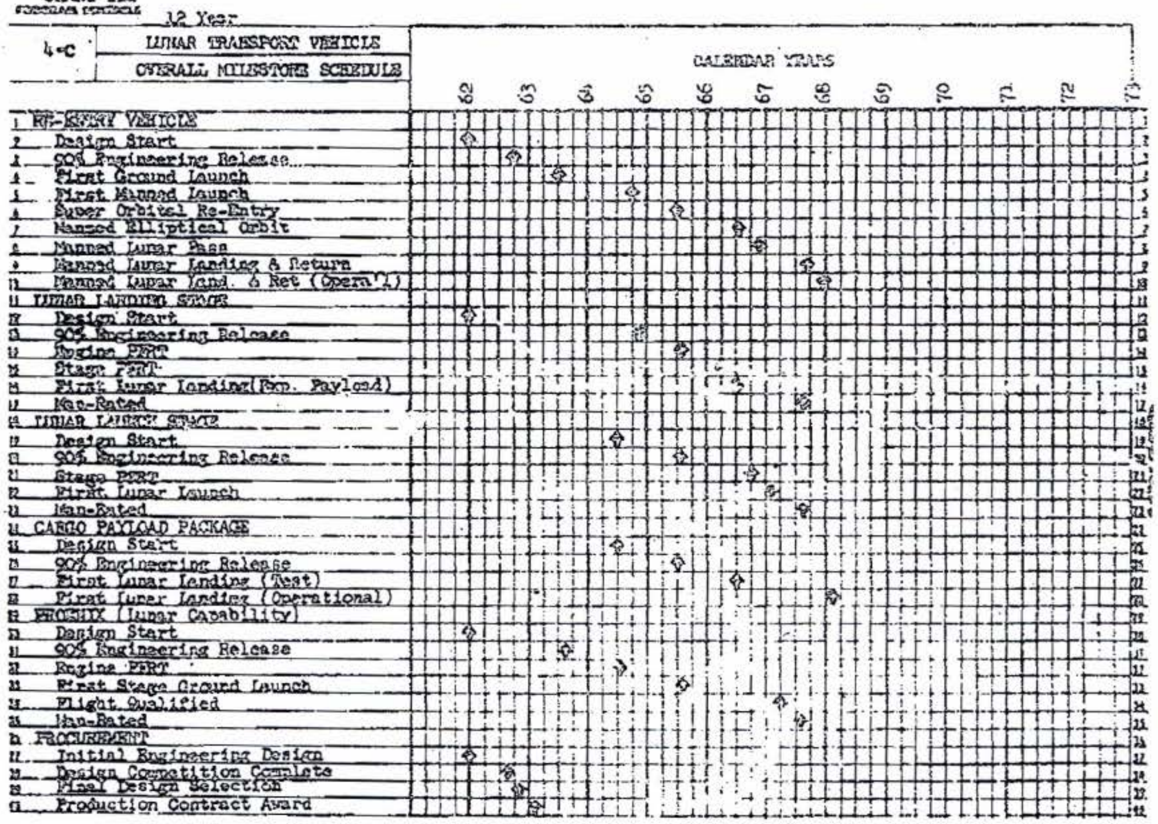
CHART III



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SECTION V

BUDGET AND FINANCIAL PLAN

LUNAR EXPEDITIONARY FORCE

5.0 INTRODUCTION

The funds required for the Lunar Expeditionary Force Program are based on the results obtained from previous concept, feasibility, and preliminary design studies. These results were published in the Lunar Observatory Final Report, Volume I - Study Summary and Program Plan, numbered AFBMC TR 60-44 and dated April 1960. The costing of this program was accomplished by the Rand Corporation and was based on the complete system development and lunar base construction program.

The funds presented for the Lunar Expeditionary Force represent all the costs of establishing a military base on the moon except the cost of developing the PHOENIX Space Launching System. This base would be capable of supporting space operations and of performing a surveillance and control mission in cislunar space.

This funding will provide a Lunar Transport Vehicle development program that will give the U.S. the capability of militarily using space and the moon. Then if the need should develop in the future, the Lunar Facility could be expanded to support strategic operations. The studies have shown that the moon possesses real military potential and it could support a recallable deterrent capability. The development of the Lunar Transport Vehicle represents a minimum program for the Air Force to obtain control of the cislunar volume and the lunar surface.

5.1 BUDGET ESTIMATE AND FINANCIAL PLAN

A preliminary design for the Lunar Transport Vehicle is being accomplished by six contractors on an active study program. This program was funded for $300,000 in FY 61 and three of the contractors are each performing the design on a $100,000 contract. The other three contractors are participating on a voluntary basis. The final reports for this preliminary design will be submitted to the SSD on 30 June 1961. A detailed System Package Plan for the Lunar Transport Vehicle will be available in September 1961. The Program Plan has an Engineering Design competition scheduled for initiation in January 1962. This competitive effort would be evaluated and a decision on the manufacturing approach would be possible by January 1963. To accomplish this program the following funds will be required.

SSD REQUIREMENTS (In millions)

Year	FY-62	FY-63
$	26.9	112.2

Should the above funds not be made available, the schedule for establishing a Lunar Occupation Facility will be delayed proportionally to the delay in funds.

5.2 COST ESTIMATES

The funding indicated in this section is submitted for planning purposes only. It represents the complete costs for all the Sub-Programs presented in the complete Lunar Program. However, the majority of the costs for the first four Sub-Programs are presently being covered by the NASA programs. It would be necessary for the A.F. to fund these items only in the event that the NASA programs did not provide the data needed by the Air Force.

P.X COSTS (In millions)

(Not included in Lunar Expeditionary Force Program)

Sub-Program	1960	1961	1962	1963	1964	1965	1966	1967
I	65	50	8					
II	15	75	85	15				
III	5	12	40	225	215	80	45	11
IV	2	10	35	85	285	265	[illegible]	24
Annual Totals	87	147	168	325	500	345	130	35
Program Total								[illegible]

The funding requirements for the Lunar Expeditionary Force Program (Phase V and VI) are as follows:

F.Y. COSTS (In millions)

	1962	1963	1964	1965	1966	1967	1968	1969
R & D	26.9	112	335	660	1020	705	100	20
Investment			15	50	300	700	700	910
Support								
Operational Costs							960	478
Annual Total	26.9	112	350	710	1320	1405	1760	1700
Program Total								7387