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15 Jan 1960

SPACE SYSTEM DEVELOPMENT PLAN

SAMOS R & D PROGRAM

HEADQUARTERS
AIR FORCE BALLISTIC MISSILE DIVISION
AIR RESEARCH AND DEVELOPMENT COMMAND

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30 OCT 1989

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Director, Aerospace Studies Institute, ATTN: Archives Branch, Maxwell AFB, Ala.

15 March ~~1958~~ 1960

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RECORD OF CHANGES

SAMOS R&D PROGRAM

Change No.	Description of Change	Date Entered	Entered By
1	Funding and Facility Sections	11 July 60	Sm

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30 OCT 1989

Change Number 1 - 15 March 1960 - Samos R&D

SECTION II - FUNDING PROGRAM

Old Page No.	New Page Number
II-1	II-1
II-2	II-2

SECTION III - FACILITIES PROGRAM

Old Page No.	New Page Number
III-5	III-5
III-6	III-6

REVIEW ON 31 Dec 2010

1. All pages replaced or deleted should be destroyed in accordance with AFR 205-1.

When inclosur[illegible] withdrawn the classification [illegible] correspondence will be [illegible] UNCL [illegible]

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HEADQUARTERS

AIR RESEARCH DEVELOPMENT COMMAND

(UNCLASSIFIED TITLE)

SAMOS

SPACE DEVELOPMENT PLAN

15 JANUARY 1960

B. A. Schriever
Lt. General, USAF
Commander

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AIR FORCE BALLISTIC MISSILE DIVISION

AIR RESEARCH AND DEVELOPMENT COMMAND

15 January 1960

FOREWORD

This volume presents the planning, funding levels, facility requirements and schedules for the continuation of the Advanced Reconnaissance System, SAMOS, under Air Force management and in compliance with the Hq USAF (AFDAT message 98212) guidance for technical emphasis and available program funding. This volume describes the system concept, program objectives, system characteristics, the various subsystems which comprise the whole, and the testing program being employed to develop the system.

Within the funding available to the program (FY 60, $160.0 millions [redacted] and the Hq USAF guidance, cited above; the development emphasis in this plan gives priority to visual reconnaissance over ferret and to the recovery method over the readout method. Every possible effort is being taken to provide the earliest possible flight demonstration of the system. The plan will permit the development of the basic reconnaissance payloads and R&D equipment without compromise. This plan does not include any concurrent operationally directed efforts during FY 60 and FY 61 leading to an early operational configuration of the system.

The plan described herein can be summarized as a minimum essential research and development program capable of satisfying the SAMOS research and development objectives. The plan is responsive to Hq USAF guidance in that the funding allocated to SAMOS is within the current FY 60 and FY 61 fund ceilings. The disadvantage to the plan is the delay occasioned to the future operational program by fund limitations.

It is recommended that the plan be approved as written and funded in accordance with the FY 1960 Financial Plan and FY 1961 Budget Estimate included in the plan.

for

O. J. RITLAND
Major General, USAF
Commander

~~CONFIDENTIAL~~

[redacted]

AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)

SAMOS DEVELOPMENT PLAN

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BACKGROUND

The concept for using a satellite as a platform for reconnaissance equipment was a natural outgrowth of the requirement for obtaining intelligence information of a potential enemy whose area and security precludes the effective collection of this information by ordinary aerial reconnaissance or other usual means. The need for timely and continuous intelligence information, to assess a potential enemy's capabilities and probable intent, has become more critical as the advancement of technology has produced offensive weapons with inter-continental range and greater destructive powers. The impetus which motivated the military establishment to foster work on new methods for collection of intelligence information came from the realization that current, reliable, prehostilities intelligence information is required to insure proper direction of national planning in the development of effective counterforce weapons and counterforce strategy.

The results of the numerous studies conducted since 1946, at the direction of the Department of Defense, established that a Satellite Intelligence System was feasible and would satisfy to a great extent the requirements for intelligence information to aid the national planners in making decisions.

The concept of the Advanced Reconnaissance System is a result of studies conducted at the Rand Corporation. A study completed in 1947, together with similar investigations by other contractors, concluded that a satellite vehicle was feasible as a reconnaissance vehicle but not as a weapons carrier. In 1950, the Research and Development Board vested satellite custody in the Air Force, and Rand was directed to explore its possible military utility.

Recommendations for an expanded study of reconnaissance applications were made to the Air Staff in late 1950, and a formal report (Rand-217) followed in April 1951. Feasibility studies for critical subsystems initiated at that time were television (RCA), attitude control (North American Aviation), and nuclear auxiliary power units (Bendix Aviation, Frederick Flader, Allis-Chalmers and Virto Corporation).

Recommendations for the ARS development were made by Rand in November 1953, and these were followed by a final report (Rand-262) in February 1954. Subsequently, the Air Force issued System Requirement No. 5, dated 27 November 1954, later revised on 17 October 1955, and General Operational Requirement No. 80 (SA-2C), dated 16 March 1955. In the spring of 1955, design study proposals were solicited by the Air Force from selected contractors.

The number of sources solicited was limited by the Government's desire to maintain a secure program throughout the design and development phase. The WS 117L is a reconnaissance system involving the launching of a vehicle into orbit for the ultimate purpose of collection and dissemination of intelligence information. Therefore, the problem of providing an airframe and engines did not need to be the sole guide to the type of contractors solicited. Those solicited were the Lockheed Aircraft Corp., the Radio Corporation of America, Glenn L. Martin Company, and Bell Telephone Laboratories. Bell Telephone Laboratories declined to submit a proposal.

The three contractors conducted their design studies between June 1955 and March 1956. These design studies culminated in three separate and distinct development plans. The Lockheed proposal was considered to meet the requirements most satisfactorily.

An ARDC System Development Directive No. 117L was issued on 17 August 1956. The development and test of WS 117L was awarded the Lockheed Aircraft Corp on Contract AF 04(647)-97 in October 1956. The Massachusetts Institute of Technology was awarded the contract for research and development of the WS 117L Guidance and Orbital Attitude Control Equipment on Contract AF 04 (647)-103 in November 1956. Executive management of the project is the responsibility of AFBMD.

By decision of the Secretary of Defense, 1 November 1957, the directive was issued to proceed with the WS 117L at the maximum rate consistent with good management.

The primary objective, established by the USAF's General Operational Requirement for WS 117L, was to "provide continuous (visual, electronic or other) coverage of the U.S.S.R. and satellite nations for surveillance purposes". In its capacity as Prime Weapon System Contractor, operating under the direction of AFBMD, Lockheed initiated a broad program of research and development to meet this objective; the program included both visual and electronic reconnaissance systems.

In January 1958, in order to accelerate the program, it was decided to augment the WS 117L program by making an interim use of the Thor booster for nine (9) flights. This would permit an early achievement of orbital capability. Subsequently, approval was granted for the use of five (5) additional Thor-boosted satellites to conduct biomedical experiments.

On 30 June 1958, the Advanced Research Projects Agency (ARPA) Order No. 9-58 was issued confirming previous Department of Defense directives for the assumption of responsibility by ARPA for the Advanced Reconnaissance Satellite Development Program. This directive established the Director, ARPA, as the source of policy and technical guidance for future WS 117L development.

General Operational Requirement No. 80 was revised on 26 September 1958, placing additional requirements upon the Weapon System. Two (2) significant additions included in the revised GOR 80 were the requirements for a recoverable satellite for intelligence use and a mapping and charting addendum to the GOR.

ARPA Order No. 48-59, dated 16 September 1958, confirming previous instructions directed that the Thor-boosted portion of the WS 117L development be separated from that program and continue as an independent project identified as DISCOVERER.

On 5 November 1958 the ARPA published Order No. 38-59 which separated the Infrared Reconnaissance Development (Subsystem "G") from the basic SAMOS Program and established the Infrared Development as the Missile Defense Alarm System (MIDAS).

On 1 December 1958 the ARPA proposed, in a memorandum report, a reorientation of the WS 117L program. This proposal was directed to the Under Secretary of the Air Force in a memorandum on 5 December 1958. The reorientation was generated as the result of the ARPA being provided with the consolidated SAMOS intelligence requirements by the Air Force (ACS/I).

As the result of the reorientation directives of early December, AFBMD presented a briefing to the ARPA on 15 December which included an analysis of the ARPA proposed program and an AFBMD counter proposal. The results of the briefing and subsequent negotiations culminated in an ARPA memorandum to The Under Secretary of the Air Force, dated 17 December 1958. The 30 January 1959 Development Plan reflected the instructions of the 17 December 1958 memorandum with regard to program structure and technical objectives. Further, the 30 January plan provided for the development of a SAMOS Reconnaissance System which possessed the capability to satisfy the SAMOS intelligence requirements.

By Amendment No. 11 to ARPA Order No. 9-58, dated 14 April 1959, the ARPA announced qualified approval of the 30 January 1959 SAMOS Development and Funding Plan.

On 27 April 1959 the ARPA was briefed at AFBMD on the analysis and planning for new work for the SAMOS reoriented program. In the late May 1959 AFBMD was notified by Headquarters ARDC (TWX RDZGW 26-5-43-E, dated 26 May 1959) that the ARPA approval of the 30 January SAMOS Development Plan did not include approval of the SAMOS recoverable mapping payload. In compliance with this directive instructions were issued to the contractor to terminate all work related to the development of a SAMOS mapping capability.

In late June, instructions were received from the ARPA (TWX 961412, dated 24 June 1959) to defer work on the SAMOS recovery program pending an ARPA program review. The reason for the deferral by the ARPA was fund limitations due to the demands of other programs. This deferral action by the ARPA will possibly delay the SAMOS system capability needed to satisfy the vital intelligence requirements of the Air Force.

On 4 September 1959, ARPA directed that AFBMD proceed with contract negotiations that deferred the recovery costs but protected certain long lead time items, such as the E-5 camera, under a fund ceiling of $143.7 million.

On 9 September 1959, ARPA directed that AFBMD negotiate a program containing the High Resolution Recovery package and instructed that AFBMD was to reduce the readout programs as necessary to accomplish this goal. A new funding authorization of $148 million dollars for FY 60 and a planning level of [redacted] dollars for FY 61 accompained this directive.

In a memorandum to the Chairman, Joint Chief of Staff, subject: Coordination of Satellite and Space Vehicle Operations; dated 18 September 1959; the Secretary of Defense approved specific assignments to the Air Force of the interim satellite early warning system, MIDAS, and Phase I of the satellite reconnaissance system, SAMOS. The date of transfer of these systems from the Advanced Research Projects Agency (ARPA) to the Air Force would be subject to the approval of the Secretary of Defense. The Secretary announced that prior to assuming responsibility for a specific program, the appropriate military department would submit to the Secretary for approval detailed plans for the system including our relationship with Unified and Specified Commands and other appropriate agencies.

On 23 October 1959, General LeMay in a letter to General Schriever concerning SAMOS and MIDAS, advised General Schriever that the ARPA funding level for SAMOS would be $159.5 million dollars in FY 60 and [redacted] dollars in FY 61 instead of the previously requested [redacted]

In compliance with the instructions of the Secretary of Defense on 18 September 1959, Hq USAF (AFDAT) issued instructions and guidance on 21 October 1959 which included the preparation of the necessary plans by appropriate commands for the transfer of SAMOS to the Air Force. The required plans and responsible commands were: Research and Development Plan, ARDC; Operational Plan, SAC; and Logistic Support Plan, AMC. The time scale for submission of these plans to Hq USAF was 23 November 1959, and reaffirmed the ARPA SAMOS funding ceiling for the R&D program as follows: FY 60, $159.5 million dollars; FY 61, [redacted] dollars plus some part of [redacted] dollars of Air Force funds to be divided between SAMOS and MIDAS.

A reclama on the effect of the above funding ceilings on the SAMOS development and operational programs was made by AFBMD on 17 November 1959. In this reclama AFBMD requested permission to present the development plans then in preparation which were the result of an extensive planning effort based on all planning guidance except that contained in the Hq USAF (AFDAT 1328/59) message of 13 November 1959. It was noted by AFBMD that the plans proposed for presentation would not be within the announced funding ceilings.

On 20 November 1959, Hq USAF (AFDAT message (91935) reaffirmed the 13 November 1959 instructions and stated that the Development plans to be presented on 16 December 1959 would be consistent with funding ceilings; however, AFBMD could present as an additional agenda item a recommended program that exceeded the funding ceiling.

Two Development plans were prepared by AFBMD. The first plan, dated 1 December 1959, described the AFBMD recommended program for the continuation of SAMOS. The second plan described the continuation of SAMOS under the Hq USAF funding ceiling (AFDAT 1328/59). These plans were presented to Hq USAF during 14-16 December 1959.

As the result of the 14-16 December 1959 presentations further guidance and funding information were received from Hq USAF (AFDAT message 98212). These instructions called for the submission of a new development plan with specific guidance for the preparation of the SAMOS plan which included: emphasizing photo over ferret; earliest flight demonstration of both readout and recovery with preferential emphasis on recovery; development of basic payloads and basic R&D equipment should not be compromised; and necessary compromises should be made by reducing the sophistication and scope of the planned operational phase of the program.

Additional instructions were received from Hq USAF (AFDAT message 61415) in early January 1960 which directed that the revised development plan include FY 62 and FY 63 fund estimates. These estimates should be ARDC recommendations based on maintaining the FY 60 and FY 61 funding ceilings established in AFDAT message 98212 and the requirement to become fully operational as soon as practicable.

The plan to follow has been prepared in response to the instructions received.

DESIGN CHARACTERISTICS

I. INTRODUCTION

A. SAMOS MISSION

1. The SAMOS Program will provide a satellite reconnaissance system which will fulfill the military requirements outlined in GOR No. 80, 26 September 1958, and amendments thereto, ARDC SR No. 5, 17 October 1955, USAF DD No. 85, 3 August 1956 and ARDC SDD No. 117L, 17 August 1956. The system will be capable of obtaining reconnaissance information which will be disseminated to operational military agencies and integrated into the USAF intelligence data handling system. The SAMOS Program, employing orbiting satellites composed of AGENA vehicles and reconnaissance payloads, will provide surveillance of the entire Soviet Complex, permitting the evaluation of Sino-Soviet Bloc intentions to attack. Timeliness of receipt of the intelligence information with daily reconnaissance coverage of high resolution is the ideal. In consideration of the requirement for earliest availability of the SAMOS system, the engineering progression and Air Force acceptance will be from the lesser to the greater resolution. The research and development effort will be directed toward providing equipment which permits the following:

a. Coverage of world-wide areas of interest

b. Detecting new and hitherto unknown targets

c. Determining electronic signal characteristics

d. Locating and verifying targets and defenses

e. Collecting data on technological progress

f. Evaluating military and industrial strength

g. Monitoring electronic emissions

h. Observing enemy build-up indications

i. Evaluating attack capability

j. Assessing damage from high-yield weapons

k. Reconnoitering military movements

l. Locating naval forces throughout the world

B. SYSTEM CONCEPT

1. The SAMOS concept utilizes satellite vehicles, modified ICBM boosters, launch facilities, tracking facilities, and a complex communication and data processing network with related facilities. The booster provides the primary propulsive power to the SAMOS satellite vehicle. Separation occurs on attainment of the proper altitude and attitude. As the booster falls away, the satellite vehicle continues in a self-stabilized, predetermined coast to a programmed altitude. Orbital altitudes will be selected according to mission requirement. At the termination of the coast phase, the satellite orbital boost engine activates, supplying the orbital velocity increment required to establish a substantially circular orbit. The internal controls then orient the vehicle to the proper attitude. The most common orbits will pass within a few degrees of the poles. The vehicle will complete a revolution of the earth at approximately 94-minute intervals. Because the orbit is essentially fixed in space, while the earth rotates inside it, successive passes over the earth's surface will be displaced slightly more than $22\frac{1}{2}^{\circ}$ at the equator. This offsetting will permit a single vehicle to observe the entire earth in a total time period which depends, in part, on the width of the swath observed.

2. Two types of ground space link will be employed for SAMOS reconnaissance data retrieval: electronic readout and physical recovery. The satellite vehicle equipment used in the readout portion of the SAMOS Program will be programmed by a secure ground-space communication link to activate and deactivate visual or electronic sensing equipment over the target. Over a SAMOS ground receiving station, the vehicle shall, upon command, transmit the recorded data. These data will be received, processed, and transmitted to the using agencies. Useful operations will be terminated when air drag changes the orbit sufficiently to prevent operations, or when either the electrical power supply is exhausted or a failure of equipment takes place. Expected mean useful life for early versions of the readout satellite vehicle is about 10 to 30 days. Expected mean useful life for later versions of the readout satellite vehicle is more than a year for ferret reconnaissance equipment and 4 to 12 months for visual reconnaissance equipment.

3. The satellite vehicle equipment used in the recovery portion of the SAMOS Program will be programmed to provide high resolution photo reconnaissance of specific areas of interest. For positioning the satellite vehicle as required to obtain maximum utilization, the orbital period may be adjusted by ground command during the high resolution flights. The payload will be aimed in order to obtain coverage of the desired targets. Upon recovery, the exposed film will be transported to the processing and using agencies. Useful operations will be terminated upon command or upon the exhaustion of the film or the electrical power supply. Expected mean useful life for the high resolution payload is approximately 15 to 30 days.

4. The re-entry and recovery sequence of operations may be initiated by the vehicle timer or by ground command. The recovery capsule will be slowed to re-entry velocity by orienting the vehicle and restarting the AGENA engine. The vehicle will provide all control and stabilization functions down to 400,000 feet. Pre-recovery capsule will then be separated from the satellite vehicle and propelled in an appropriate re-entry trajectory for air recovery in the ocean area adjacent to Hawaii. While only over-water recovery is currently planned, the satellite vehicle, recovery capsule, and airborne recovery components and equipment will be designed to allow for over-land recovery within the United States Zone of Interior if required. At the proper altitude a parachute system will be deployed. Simultaneously, the recovery capsule radio beacon and light beacon begin operating. Aircraft specially equipped with direction finder systems and air recovery gear will detect, locate, and accomplish air recovery of the capsule. If over-water air recovery fails, surface vessels, similarly equipped with direction finder systems, will recover the capsule from the sea with the assistance of helicopters.

5. The data processing portion of SAMOS will develop the capability to process the data collected by the SAMOS vehicle sensors, correlate the data with time and the orbital information, and extract and report time-significant information, convert the collected data to formats which can be readily utilized by all intelligence agencies, and analyze the collected data to provide feed-back information for proper control and operation of SAMOS vehicles and associated payloads.

C. <u>SYSTEM CONSIDERATIONS</u>

1. The satellite network configuration is determined by the inter-relating factors of SAMOS reconnaissance coverage criteria and vehicle performance characteristics. The coverage criteria establish the minimum fraction of the U.S.S.R. which must be kept under surveillance to satisfy information requirements. The over-all system characteristics are then determined by correlation of these criteria with the obtainable vehicle performance capabilities. These include on-orbit payload versus altitude restrictions, sensor performance, power and data transmission limitations, and the ability to establish and maintain the selected work configuration.

2. The data processing portion of SAMOS will provide the Air Force with the capability to process the data collected by the SAMOS vehicle sensors, correlate the data with time and the orbital information, and extract and report time-significant information, convert the collected data to formats which can be readily utilized by all intelligence agencies, and analyze the collected data to provide feed-back information for proper control and operation of SAMOS vehicles and associated payloads.

3. It is becoming evident that this system, in its operational concept, is not a system which must necessarily follow the "stereo-typed" concepts of other systems as the system becomes operational. This is particularly true in the logistics and procurement areas. As an example, there may be no period of operational training with the vehicle. Presumably, vehicles will not be held for long periods of readiness as in the case of the Ballistic Missiles. Neither may there be extensive training flights requiring extensive logistic support as in the case of manned systems. Due consideration must be given to selecting a logistic concept which will allow this program to be handled economically and which will provide the flexibility which is desirable.

D. PROGRAM OBJECTIVES

1. Readout

a. Visual Reconnaissance (Subsystem E)

The reconnaissance equipment for the visual reconnaissance readout portion of the SAMOS Program consists of the satellite-borne equipment required to collect information in the visible spectrum, to process and store this information, and on a command signal from the ground to convert stored images to appropriate signals for transmission to the ground. In addition to the satellite-borne equipment, related ground-based equipment will be required to take the output of the satellite-borne data link and reconstitute the signal into photographic form for system control, further processing and intelligence use. The ability to view the system output provides a means of adjusting vehicle capability. The long life of the readout vehicles permits economy of operation by reducing the total number of vehicles and launch pads required to attain a particular capability. Initial visual equipment is to be capable of resolving targets 20 feet in size, and a limited study will continue toward the goal of achieving resolutions of 5 feet or less. Target location will have an error no greater than 1 mile with respect to the North American Datum. The readout system provides rapid return of reconnaissance data on a repetitive basis. The system will collect perishable intelligence information of selected targets as determined by the programming of vehicle operation. The steerable payload permit coverage up to 150 miles each side of the orbit path. Consideration will be given to the use of advanced sensors such as electrostatic tape. The incorporation of a reuseable storage medium will allow for larger active life on orbit. Within the resources available, effort will be applied to the photographic approach in order to improve the early capability prior to the time that the electrostatic tape systems could be available. The visual reconnaissance readout payloads have been defined as follows:

(1) E-1 Component Test Payload

(2) E-2 Steerable Payload providing 20 foot ground resolution

(3) E-3 Steerable Payload providing 5 foot ground resolution. (NOTE: This work will be limited to study effort. Flights are not scheduled for this payload.)

b. Ferret Reconnaissance (Subsystem F)

(1) The ferret reconnaissance portion of the SAMOS Program consists of the satellite-borne equipment required to collect information from radiation in certain selected regions of the electromagnetic spectrum, to store this information, to filter or index it as may be necessary, and at the proper time to convert the stored information into an appropriate electrical signal for transmission to the ground. Ground-based equipment will be required for inflight calibration and vehicle equipment adjustment; engineering evaluation of vehicle equipment performance, and transmission of reconnaissance, calibration, attitude, and time information to the data processing activities.

(2) This subsystem includes the equipment to conduct a program of increasing sophistication to provide a system capable of conducting effective satellite reconnaissance of the entire Soviet Bloc. This system will initially produce a general coverage vehicle (F-2) and a specific mission vehicle (F-3) capable of total coverage of the frequency spectrum from 59-18,000 mc/s. This will provide general coverage of the Soviet Bloc every five days and a capability to take close looks at all signals of interest. Indications of unusual signals and activity will be incorporated in the F-2 vehicles so that the F-3 system can then be programmed to produce data for complete analysis of these signals. [redacted]

2. Recovery (Subsystem E)

a. The recovery portion of the SAMOS Program will provide a payload (E-5) which will be designed to obtain high resolution photographic reconnaissance and is to be capable of achieving 5 foot ground resolution with a location accuracy of one nautical mile. The system will have an active orbit life of 15-30 days and will permit coverage of selected targets. The data will be returned to earth in a recovery capsule ejected from the satellite vehicle. The recovered film will be delivered to the Data Processing Subsystem for processing.

b. The recovery system makes possible an earlier achievement of 5 foot ground resolution since the vehicle will orbit at a lower altitude and the original film will be recovered. The lower altitude restricts the useful life but it provides the capability to obtain wide area coverage in order to collect durable type of intelligence information which supports the readout operation.

3. Data Processing (Subsystem I)

The outputs of Subsystem I are designed to provide information and source material in quantities and formats to satisfy the requirements of all members of the intelligence communities. Subsystem I data processing will be oriented to provide for the rapid processing, redirection, screening, titling and transcription of the raw reconnaissance data received into the required formats that will permit immediate use of the data by the appropriate intelligence agency. This timely processing capability will make it possible to contribute information for the assessment of imminence of attack and for the rapid feedback of technical data for efficient system operation, as well as provide data that is useful in long term analysis for military targeting, measuring changes and activity of military and industrial complexes, and evaluating technological progress. As the full system capability evolves, control and scheduling of reconnaissance coverage of the satellites become increasingly important and complex. Thus, the programming of intelligence requirements into the system, the quick review of mission success, and output of resulting reconnaissance data to user agencies, will require careful consideration and planning.

E. DEVELOPMENT APPROACH

1. General

a. The objectives of the SAMOS Program will be fulfilled with a development approach which includes minimum flight and ground testing, a comprehensive reliability program, and investigations to evolve not only system operating techniques and procedures, but also advance system applications. Personnel training activities will be restricted to that which can be accomplished at the contractors plant. The vehicle and ground systems for the SAMOS Program will make maximum use of the AGENA vehicle developed for the DISCOVERER and MIDAS Programs, and the ground installations and equipments associated with those programs. An ATLAS D modified booster will be used in the lift-off phase of placing a payload into orbit.

b. It is recognized that the SAMOS system will progress through an evolutionary process toward attainment of an operational capability. This process acknowledges the urgent requirement for timely and current intelligence data and provides for exploitation of the intelligence data collected during the research and development phase of the SAMOS system. This evolutionary system development approach makes it mandatory that a joint developmental/operational transitional phase be programmed.

2. Study

With respect to study activity, minimal engineering and operational analysis and system design studies will be conducted. The scope of this activity will include coordination of the studies conducted in the various subsystem areas. In a manner compatible with SAMOS development objectives, support will be provided the Geophysics Research Directorate (GRD) in the form of necessary facilities, TM channels, power source, vehicle design, technical information and other items which will enable the GRD to utilize SAMOS test flights for collection of that geophysical data which has been determined to be critical to system design and operation.

3. Testing

a. Details of planned flight and ground test activity are indicated in the "Test Annex" portion of this development plan. But in general, the following test activity will be pursued in the SAMOS development approach. The parts, sub-assemblies, components, subsystems, and complete system will be subject to testing at progressive stages in their development. Components, subsystems, and systems will be tested as outlined in the respective specifications. The testing program at LMSD, subcontractor plants, and flight test bases will consist of: (1) in-plant tests, to include development acceptance, qualification reliability, type, and acceptance tests; (2) systems development test at Santa Cruz Test Base; (3) special field tests; and (4) flight tests. The latter will include pre-launch, launch, recovery tests and operations, and orbit tests. In the transition of this system into an initial operational phase, it is clearly apparent that only a minimum R&D flight testing and subsystem checkout will have been accomplished. It is further recognized that operational system activities must be completely responsive to the continuing R&D needs if a reconnaissance system capable of meeting stated intelligence objectives and requirements is to evolve.

b. It may be assumed that in all flights prior to the completion of R&D testing, information gathered by satellites will be made available to the intelligence agencies. Planning should proceed in order that facilities are available for the intelligence community to utilize this information as it becomes available in R&D testing. However, it is recognized that until R&D is completed, access to required data and control of the R&D program flights must rest with the development agency.

c. In the course of flight testing a point of minimum development and testing will be reached which will warrant a user (using command) providing the resources necessary to attempt launches for the expressed purpose of collecting intelligence information. For planning purposes, that transition point is reached in each payload configuration as soon as there has been at least one flight in which the system has functioned sufficiently to allow the various performance parameters to be assessed. Based upon expected over-all system reliability estimated at 27%, during the early phases of the flight test program, the transition point for the Ferret (F-2 and F-3) and the Photo (E-2) systems may be expected to occur no earlier than after the evaluation of the 4th flight of each model.

4. Personnel Training

Training of Air Force personnel will be limited to that which can be conducted on an informal basis at system facilities with no interference with the R&D program.

5. Reliability

Achievement of a reliability which will allow long unattended operation of vehicles and other payloads is recognized as the most critical problem to be solved in this program's development. To achieve desired SAMOS reliability, the development approach calls for continuous design reviews at all levels of complexity above component parts to assure equipment design for maximum operational life in orbit. Also involved in the reliability approach is a comprehensive parts program to increase the average life of component parts used in the satellite equipment. Further, materials and processes will be evaluated for compatibility with SAMOS reliability goals. In addition, effort will be conducted to determine and measure the orbital environment of SAMOS equipment. Reliability tests will be conducted at part, component and system levels over a suitable range of simulated environmental conditions. A fabrication, test, and checkout control program will be in force to assure that system equipments are protected from the viewpoint of inherent reliability while undergoing the procedures required for these activities. A concerted effort will be made to minimize the over-all system functional requirements of the satellite equipment so that the system can be simplified. Furthermore, all practices (such as failure reporting) called for by such documents as MIL-R-26674 (USAF) will be applied to increase system reliability.

6. Test Facilities

The flight testing for the SAMOS Program will be conducted on the Pacific Missile Range. Launchings are programmed from the Pt Arguello Complex starting in September 1960, and continuing throughout the development program. Launchings of the E-5 (recoverable photo payload) are programmed from the same Complex starting in September 1961.

II. SAMOS SYSTEM CHARACTERISTICS

A. GENERAL

1. In the SAMOS R&D phase, ten technical areas or subsystems representing both space and ground design activities are to be developed.

a. Airframe - Subsystem "A"

b. Propulsion - Subsystem "B"

c. Auxiliary Power - Subsystem "C"

d. Guidance and Control - Subsystem "D"

e. Visual Reconnaissance - Subsystem "E"

f. Ferret Reconnaissance - Subsystem "F"

g. Command and Control - Subsystem "H"

h. Data Processing - Subsystem "I"

i. Geophysical Environment - Subsystem "J"

j. Qualitative Personnel Requirements Information - Subsystem "K"

2. The design characteristics of the flight articles representing the subsystems are reflected in four basic flight configurations for the development of the electronic readout capability and by a single basic flight configuration for development of the recovery capability. In each case, payload variation and the resulting modification of satellite vehicle design provide the basis for distinguishing between flight configurations. An additional flight configuration will be incorporated at a later date when the payload using electrostatic tape sensors has been configured.

B. AIRBORNE SYSTEM

1. Flight Configuration I (3 Flights through February 1961)

a. Subsystems

(1) Airframe - Subsystem "A": Design characteristics for this configuration are adapted to the dual payload installation described below. The satellite vehicle airframe will consist of the following: The nose-cone assembly, a part of which will be jettisonable; the forward midbody assembly, including the forward equipment rack and payload supports; the aft midbody assembly; the aft equipment rack; the propellant tanks; the pressure spheres; fairings; antenna and instrumentation booms; and the adapter assembly, including the provisions for retro-rockets. The airframe will be the carrier for the equipment it houses and supports and will provide the necessary environmental protection, structual integrity, and alignment. During the coast phase the vehicle airframe will separate from its adapter, which will have been attached to the ATLAS booster during ground preparation for launch. To assure maximum reliability, the airframe subsystem is designed with a safety factor in accordance with good engineering

practice. Further assurance of high reliability is attained by subjection of the airframe subsystem to qualification testing under the appropriate structural and environmental specifications. The most severe conditions are simulated as accurately as possible to that which the vehicle will encounter in use. Continuous reliability design reviews will be conducted to improve reliability.

(2) Propulsion - Subsystem "B": The satellite vehicle propulsion subsystem will consist of the rocket engine and associated equipment. The rocket engine, USAF Model No. YLR-81-BA-5, will incorporate a single thrust chamber assembly, oxidizer and fuel valves; a turbine pump assembly, including a gas generator, turbine and gear box, oxidizer and fuel pumps, and turbine exhaust duct; an engine mount, including a gimbal ring; and associated switches, valves, plumbing, and wiring. The associated equipment will include the ullage control rockets; the propellant pressurization equipment, including necessary regulators, valves, and plumbing; and the necessary auxiliary equipment. The liquid propellants will consist of inhibited red fuming nitric acid (IRFNA) as the oxidizer, and unsymmetrical dimethylhydrazine (UDMH) as the fuel. The propulsion subsystem will be capable of providing the second stage thrust to enable the satellite vehicle to achieve the velocity necessary to accomplish its mission after separation from the ATLAS booster. Primary and auxiliary propulsion devices for this subsystem will be developed, improved and modified as necessary to provide the degree of reliability for successful accomplishment of the mission. The highest degree of reliability assurance possible prior to flight will be attained through logical, timely, and extensive development testing of components, subassemblies, assemblies, and the entire subsystem under applicable environmental conditions, to the degree that it is possible to duplicate such conditions. Air Force technical management of this program will emphasize utilization of suitable test facilities and experience available at ARDC Centers as well as other institutions, civilian or military, during the prelaunch development and qualification phase. The propulsion reliability gained through experience in the DISCOVERER Program is directly applicable to the SAMOS Program.

(3) Auxiliary Power - Subsystem "C": The auxiliary power subsystem will consist of silver peroxide-zinc primary batteries, inverters, a voltage regulator, wiring harness, the flight termination equipment, a power switch, a limiter assembly, and associated connectors, plugs, terminal strips, attachments, and wiring. The subsystem will be capable of supplying electrical power for all vehicle equipment requiring such power, except for the flight termination equipment which shall have its own power supply. Reliability of the auxiliary power subsystem will be maintained and improved by:

(a) Analyzing and rectifying the high failure rate known to exist for auxiliary power systems components, particularly the 400 cps and the 2000 cps inverters.

(b) Conducting diagnostic tests of the auxiliary power systems components operated on the bench into actual loads with realistic on-off cycling and with suitable instrumentation to observe internal transients and abnormal behavior.

(c) Conducting component and subsystem design improvement program, utilizing redundancy, derating parts, minimizing stress, reducing complexity and incorporating such other features as will extend lifetime without significantly degrading performance.

(d) Isolating shorted or defective loads, loss of which will not be catastrophic, so that power will continue to be supplied to operable portions of the load.

(e) Conducting component life tests in all significantly different modes of operation, including on-off cycling, programmed power levels, and/or continuous operation as applicable. Performing of these tests with actual or suitably simulated loads and environment.

(f) Broadening component specifications without ambiguity to insure that all anticipated duty cycles and application conditions are covered.

(g) Determining the extent to which quality control has been a factor in component failures, and thus instituting more rigorous inspection procedures. Initiating a back-up production source if warranted.

(h) Instituting more rigorous procedures for reporting the circumstances associated with inverter failures, and maintaining historical summary of experience with each model indicating operating time, repair, or rework accomplished, and known or probable cause of failure.

(i) Extending cycle life testing of secondary batteries to 10,000 cycles with appropriate depth of discharge and period, and determining the engineering changes necessary to meet specified cycle life.

(4) <u>Guidance and Control - Subsystem "D"</u>: The guidance and control subsystem will consist of: guidance, including the computer, the timer, the inertial reference package, the horizon scanner, and the secondary junction box; flight control, including electronics, pneumatic, and hydraulic controls; orbital stabilization equipment, including the attitude damping system; and equipment for measuring and recording attitude to satisfy reconnaissance equipment performance requirements. The guidance and control subsystem will be capable of establishing attitude references for readout purposes and aligning the vehicle with them during the coast, orbital boost, reorientation and orbital phases and it will be capable of determining vehicle velocity and of terminating engine thrust when the correct velocity has been reached. In addition, the guidance and control subsystem will initiate programmed signals for starting, stopping, and maintaining various system equipment operations during the coast, orbital boost, reorientation, and orbital phases. Provide the degree of reliability required for the successful accomplishment of the mission as follows:

(a) Require all components such as gas jets, horizon scanners, attitude control, etc., to perform satisfactorily under simulated environmental conditions and to demonstrate a mean-time-to-failure (MTTF) compatible with the required life.

(b) Where a satisfactory MTTF cannot be assured, as may be true in mechanical parts, such as the head of the horizon scanner, two heads will be used. Two gyros will be used in the roll-yaw channel of the attitude control as a redundant feature.

(c) Where parallel programs or channels are available, each will be used to command a single function, one as a backup for the other. Examples of this are the use of backup "D" timer signals for vehicle separation from the booster and lock out signal to preclude premature engine shut down by an accelerometer integrator malfunction.

(d) Require component failure reports during all phases of testing to isolate failure areas and allow determination of optimum run-in time, overhaul time and replacement time. Run-in time is particularly important in items such as gyros where infant mortality is high.

(e) Such items as the velocity meter which are only needed occasionally on orbit will be turned off and then turned on only while needed, using extremely reliable on-off switching methods.

(5) <u>Communication and Control - Subsystem "H"(Vehicle-borne):</u>

(a) <u>Radar Transponder:</u> An S-band radar transponder will transmit a signal triggered by the signal received from the VERLORT radar to provide the capability for accurate long range tracking of the vehicle at tracking and acquisition sites not equipped with the UHF system. The transponder will be equipped with a decoder so that real-time commands may be transmitted over the radar beam to initiate equipment functions within the vehicle.

(b) <u>VHF Acquisition Transmitter:</u> A miniaturized, transistorized, low-power VHF transmitter will be used to emit the signal which will assist the initial acquisition and angle tracking of the vehicle.

(c) <u>UHF Command Receiver:</u> A UHF command receiver will be used to receive program commands and ranging signals. The command signals provide real-time activation of equipment functions or are stored in the vehicle for later use. Accurate transmission and reception of command signals is noted by verification over the return telemetry link. The ranging signals are returned to the ground over the narrow-band data transmitter for comparison with the transmitted tones for the determination of range data.

(d) <u>Sequence Programmer:</u> A sequence programmer will be used to provide an accurate clock, a program storage, and a sequenced control for reading out and executing stored or real-time commands. The programmer will be capable of furnishing timing signals for vehicle functions or for vehicle position indexing. It will be subject to overriding by ground command.

(e) Intermediate Storage Unit: An intermediate storage unit will be used to provide additional stored program command and real-time command capacity to supplement the command capability of the sequence programmer in support of the visual and ferret reconnaissance payloads.

(f) PAM Multiplexer: A PAM Multiplexer will be used to sample and encode the outputs from a number of information sources for transmission to the ground over the UHF narrow-band data transmitter.

(g) UHF Wide-Band Data Transmitter: A UHF wide-band data transmitter will be used to transmit wide-band reconnaissance data to the ground based data link receivers in accordance with either programmed or real-time commands received from the ground.

(h) UHF Narrow-Band Data Transmitter: A UHF narrow-band data transmitter will be used to transmit narrow-band reconnaissance, ranging tones, environment, equipment status, scientific, or other useful data to the ground receiver.

(i) VHF Narrow-Band Data Transmitter: The VHF narrow-band transmitter will be used to transmit the stored F-1 reconnaissance data to the ground receiver.

(j) Mixer-Filter Unit: A mixer-filter unit will be used to provide separation of ranging tones and command information from command receiver output for return to ground stations via the narrow-band data transmitter; to provide sub-carrier signals used for transmission of visual and ferret reconnaissance telemetry data; and to combine such data with returning ranging and command information, for transmission via the narrow-band data transmitter.

(k) Vehicle Antennas: Because of the interaction between antennas in the vehicle, antennas will be provided as integrated systems for all vehicle requirements.

(l) FM/FM Telemeter: Unitized FM/FM telemeters will be installed. Tape recorders will be installed with a high ratio of read-in to readout time. The tape recorder will be of a continuous loop design and two recording tracks will be provided for recording the outputs of two commutators. The recorder-reproducers will be programmed for read-in and for off periods by the recorder programmer.

b. Flight Configuration I Payload

(1) Visual Reconnaissance. The visual reconnaissance test payload for this configuration termed E-1, will be incorporated in a dual installation with the ferret equipment described below. The visual reconnaissance subsystem will consist of film supply and take-up, test cameras, a film processor, web supply and take-up, storage loopers, and electronic readout system, thermal

and humidity control, equipment mounting structure, pressure housing and circuitry for executing real-time and programmed commands. The E-1 equipment will have the capability to process pre-exposed film, electronically sense, and readout the information via the vehicle-ground communications link. E-1 equipment also will be capable of exposing raw film within the limitations imposed by the dual payload and configuration.

(2) Ferret Reconnaissance. The ferret reconnaissance subsystem for F-1 shall consist of antennas, receivers, data handling equipment, a recorder, and control equipment. Frequency bands covered will be portions of S- and X-bands. Fixed nadir-looking circularly polarized antennas, covering a nominal 150-nautical-mil-diameter circle on the earth's surface will be utilized. The receivers are scanning superheterodynes which will provide a high probability of intercept. The data handling system converts the output of the receivers to coded digital signals which are stored by the magnetic tape recorder. The control system turns the equipment on and off for read-in of intercept data over the area of interest and readout of coded data over a tracking station. Each intercept consists of a digital word containing measurements of pulse repetition frequency, pulse width, vehicle time, and frequency.

2. Flight Configuration II (8 Flights through CY 1962)

a. Subsystems

(1) Airframe: The vehicle airframe will be changed from Flight Configuration I to include double capacity propellant tanks; provisions for the Bell Model 8096 engine; the solar voltaic collector array and secondary and primary batteries; and auxiliary propulsive devices for orbit control.

(2) Propulsion: The propulsion subsystem will be the Bell Model 8096 engine.

(3) Auxiliary Power: The APU will be the same as for Flight Configuration I except that solar power photovoltaic equipment developed in the MIDAS Program, combined with secondary batteries, will power the E-2 equipment, the data link, command equipment, and the guidance equipment.

(4) Guidance and Control: This equipment will be the same as for Flight Configuration I, except that the attitude damping system will be replaced by an active attitude control system.

(5) Communication and Control (Vehicle-borne): Will be the same as for Flight Configuration I except that the VHF narrow-band transmitter and the intermediate storage unit will be deleted and the sequence programmer will be replaced by a command programmer and decoder. In addition, the PAM multiplexer will be replaced by a more advanced unit.

b. Flight Configuration II Payload

(1) Visual Reconnaissance: The visual reconnaissance subsystem for the E-2 payload configuration will consist of a 36-inch focal length lens, associated 70mm camera and controls, film supply and take-up, two speed film processor, web supply and take-up, storage loopers, electronic readout system, thermal and humidity control, equipment mounting structure, pressure housing, and circuitry for executing real-time and programmed commands. The payload will be trainable to provide for oblique and/or stero aerial photography. The E-2 equipment will have the capability to aim the camera and photograph specific areas of interest, process the exposed film, and electronically sense and read-out the information via the vehicle-ground communications link. The resultant photography will have a design goal for a ground resolution of less than 20 feet.

3. Flight Configuration III (7 Flights through November 1962)

a. Subsystems

(1) Airframe: This will be the same as for Flight Configuration II.

(2) Propulsion: This will be the same as for Flight Configuration II.

(3) Auxiliary Power: This will be the same as for Flight Configuration II.

(4) Guidance and Control: This will be the same as for Flight Configuration II.

(5) Communication and Control (Vehicle-borne): This equipment will be the same as for Flight Configuration II except that the wide-band transmitter will be omitted on the first four flight vehicles of this configuration and an additional UHF narrow band data transmitter substituted.

b. Flight Configuration III Payload

(1) Ferret Reconnaissance: The ferret reconnaissance subsystem will consist of the F-2 and the F-3 equipments installed in flight vehicles of this configuration. The first four flight vehicles will contain F-2 general coverage all-digital equipment. This shall consist of antennas, receivers, data handling equipment, recorders, and control equipment. The antennas and basic data handling equipment shall utilize the same techniques as F-1. The F-2 systems have electronic Order of Battle (EOB) information gathering capability and cover priority frequency bands 1,2,3b and 3c. The band 3b equipment will have limited inhibit action. In addition to collecting data on convention radars, this equipment will have unusual signal recognition capabilities as follows:

(a) Non-uniform PRF detection

(b) Wide pulse width detection and recognition

(c) Frequency agility radar detection

(d) Single-frequency, sequential pulse (IFF type) emitter detection.

Additionally they will be capable of:

(e) Increased accuracy in locating emitters

(f) Pulse amplitude measurement.

The fifth flight of this configuration shall be Specific Mission vehicles designated F-3 which will provide in addition to F-2 capabilities:

(g) Six mc/s bandwidth Analog Recording

(h) Start-stop frequency Scan

(i) Controllable Antenna Patterns.

Frequency coverage will be limited to bands one and three.

4. <u>Flight Configuration IV (7 Flights through November 1962)</u>

a. <u>Subsystems</u>

(1) <u>Airframe</u>: Will be the same as Flight Configuration II except for provisions for ejecting the nose cone package.

(2) <u>Propulsion</u>: Will be same as Flight Configuration II.

(3) <u>Auxiliary Power</u>: Will be the same as Flight Configuration II except that an independent battery and associated circuitry will be provided for the flight termination equipment. A separate auxiliary power supply will be integrated into the recovery capsule and will consist of silver-peroxide-zinc batteries, power converters and inverters, voltage regulator, and control recovery capsule during re-entry and recovery.

(4) <u>Guidance and Control</u>: Will be the same as Flight Configuration II except that it will also include provisions to position the satellite to the proper retro-angles for separation and re-entry.

(5) <u>Communication and Control (Vehicle-borne)</u>: The vehicle-borne communications will consist of:

(a) <u>UHF Command Receiver:</u> A UHF command receiver, consisting of a receiver, input devices to command decoding equipment, and other necessary equipment, will be used to receive operational program commands, time signals, antenna orientation signals, and other ground to space control signals. The command signals provide real-time activation of equipment functions or are stored in the vehicle for subsequent use. Accurate transmission and reception of command signals is noted by verification over the return to telemetry link.

(b) <u>Command Programmer:</u> A command programmer and decoder will be used to provide an accurate clock, a program storage and a sequenced control for reading out and executing stored or real-time commands.

(c) <u>PAM Multiplexer:</u> A PAM multiplexer will be used to sample and encode the output from a number of information sources for transmission to the ground.

(d) <u>UHF Narrow-Band Data Transmitter:</u> A UHF narrow-band data transmitter will be used to transmit range, environment, equipment status, scientific, and other useful data to the ground receivers.

(e) <u>Vehicle Antennas:</u> Because of the interaction between antennas in the vehicle, antennas will be provided as integrated systems for all vehicle requirements.

(f) <u>FM/FM Telemeter:</u> A unitized FM/FM Telemeter will be installed. A tape recorder will be installed with a high ratio of read-in to readout time. The tape recorder will be of a continuous loop design and two recording tracks will be provided for recording the output of two commutators. The recorder-reproducers will be programmed for read-in and for off periods.

(g) <u>S-Band Radar Transponder:</u> Will provide tracking and command capability utilizing VERLORT radars.

(h) <u>UHF Acquisition Transmitter:</u> A miniaturized, transistorized UHF transmitter for initial acquisition.

b. <u>Flight Configuration IV Payload</u>

(1) <u>Visual Reconnaissance:</u> The visual reconnaissance subsystem for the E-5 payload configuration will consist of a long focal length camera with time and attitude recording devices, film control, transport, ejection doors for camera aperture, control circuits capable of executing command signals from the vehicle programmer, and a suitable mounting structure. Provision will be made for interchangeable mechanical and electrical connections with the vehicle and recovery capsule. The subsystem will include environmental control equipment. The long-focal-length camera system will be designed for a capability of achieving a five foot or less resolution. The locational accuracy of the photographic data will be one mile. The camera will be placed in a horizontal position with a mirror providing the ground view. Stereo will be provided by tilting the mirror.

(2) Recovery Capsule: The recovery capsule subsystem will consist of the equipment to be recovered plus all associated equipment to house, operate and detach the recovery payload. Recoverable equipment will include the recommended payload minus the mirror, and will include acquisition and homing beacon, light beacons and stabilization equipment. During early development flights, a telemeter and tape recorder will be included in the capsule to measure performance during re-entry. Recovery aids will include the capsule heat shield, radio beacon, and light beacon. The rocket engine restart capability and stabilization and control equipment of the AGENA vehicle will be used to provide the retro-impulse for re-entry.

C. GROUND SYSTEM

1. General

a. The design of the SAMOS Ground System includes not only required equipments and procedures for the subsystems incorporated in the flight configurations (A, B, C, D, E, F and H) but also the arrangements required for the additional subsystems:

(1) Data Processing - Subsystem "I"

(2) Geophysical Environment - Subsystem "J"

(3) Qualitative Personnel Requirements - Subsystem "K"

b. Further, the ground configuration involves the critical development areas of logistics, reliability, and that designated as "ground support equipment". It is to be noted that in the SAMOS approach, the ground support equipment responsibility includes not only development of equipment and procedures for ground handling, servicing, and checkout of SAMOS flight articles, but also for launch monitoring and control.

c. The design features of the R&D ground configuration are indicated in the following summary treatment of the ground system plan. Descriptions of SAMOS equipments, facilities and related procedures are also offered to indicate specific development areas in the ground system. The mode of operation integrating the ground system with orbiting equipment is indicated in the "Test Annex".

2. Summary of Ground System Plan

a. Ground Based Control System Philosophy

(1) The development of the ground-based satellite control system will proceed from relatively simple design of limited DISCOVERER Program capability to more defined versions capable of meeting stated requirements of the advanced systems. It is emphasized that the initial designs which have

been developed and the equipment now being built, though primarily manuals, are such that they can readily lead to more automatic operation and control of these complex functions. Basic system design shall be as flexible as possible to provide relatively rapid reaction to changing requirements. Common system functions are being integrated and expanded to accommodate the SAMOS, DISCOVERER and MIDAS program requirements.

(2) The integrated system design is based upon categorizing its over-all functions independent of location as follows:

(a) Satellite Control is concerned with launching, tracking, orbital control and, where applicable, vehicle recovery. These are functions of all satellite systems. These functions are required to enable tracking to insure minimum radar search time, to relate data received from the satellite with satellite position, and to enable programming the vehicle for future data collection.

(b) Sensor Control is concerned with the operation of payload equipment and is accomplished through instructions sent by means of the ground-space communications subsystem and based on system scheduling. Such commands may be for real-time operation or stored program instructions for application when the satellite is out of contact with the tracking and acquisition station.

(c) Data Control assures proper indexing of the reconnaissance data relative to identification of the equipments and facilities which have handled given data, geo-positioning information which established the area of the earth's surface where the data was collected, and "confidence tagging" which indicates the extent to which the ground and space equipments handling the data performed within required tolerances.

(d) Scheduling: The control system will provide the scheduling of all vehicle operations that effect the research program and supporting efforts. These schedules will determine the appropriate vehicle capable of performing the specific research and development mission, when it can acquire the data (based upon its flight path and previous data requests), and when and where this data can be acquired from the vehicle. To establish the schedules, it will be necessary to determine the orbit of each vehicle and refine these calculations as further information becomes available. Also to be scheduled into the vehicle operation are such internal system requests as regular and special calibration checks and quality-control-initiated adjustments. An interstation schedule will be maintained to assure optimum unitization of each remote station and its equipment.

(e) Data Processing: SAMOS data processing will be oriented to provide for the rapid reduction, screening, titling and transcription of the raw reconnaissance data into formats that will permit immediate use of data by other elements of the intelligence community. This timely processing capability will make it possible to contribute information for the assessment of the imminence of attack and for the rapid feedback of technical data for efficient system operation, as well as providing data that is useful in long term analysis for military and industrial complexes, and evaluating technological progress. As the full system capability evolves, control and scheduling of reconnaissance coverage of the satellites become increasingly important and complex. Thus, the programming of intelligence requirements into the system, the quick review of mission success, and output of resulting reconnaissance data to user agencies will require careful consideration and planning. This data processing development will provide the capability to initially develop and process raw photographic and ELINT data, store and retrieve intelligence source material used by Photographic Interpreters, and Electronic Analysts; interpret photography and analyze electronic intercepts collected by SAMOS; prepare, extend and improve geodetic networks and reproduce items prepared during accomplishment of the above.

b. Ground Based Satellite Control System for Electronic Readout

The over-all ground system for electronic readout can be divided into the following elements. At the hub of the communications network is the STC which ties directly into the launching and the tracking network:

(1) Tracking and Acquisition Stations (TAS)

(a) Receive data from the sensors in the vehicle

(b) Encode commands received from the STC for transmittal to the vehicle

(c) Provide real-time adjustments

(d) Track the vehicle

(2) Satellite Test Center (STC)

(a) Over-all direction of the ground based control system

(b) Generation of the vehicle schedule

(c) Generation of calibration tables

(d) Generation of ground track information

(e) Provide information required for engineering evaluation of system performance

(f) Tracking information for the TAS

(g) Generation of stored program commands for control of the vehicle and payloads.

(h) Utilize feedback from SS/I to determine optimum methods for use of SS/I derived data in an integrated control center.

(3) Intelligence Data Processing

(a) Initial processing indexing, titling, reporting and reproducing of the reconnaissance data.

(b) Determination of accurate positional data on ground control points used for titling of photographic data for targeting.

(c) Reports of new and unusual activities derived from electromagnetic intercept and visual data.

(d) Transcription of incoming records into formats which will be usable with standard equipments in other intelligence operating agencies.

(e) Collection control data based on intelligence requirements for programming of SAMOS sensors.

(f) Quality control feedback including calibration data to other sections of the SAMOS system.

c. Samos Ground System for Recovery

For the Samos recovery satellite tracking, telemetry read-outs and command will be provided at Vandenberg AFB, Northeast, and Hawaiian Islands tracking and acquisition stations, with ground links to the Satellite Test Center at Sunnyvale, California.

The Recovery Force will consist of five C-130 aircraft equipped with the air snatch and direction finding equipment described above. These aircraft will nominally be based at Hickam Air Force Base, Honolulu, Hawaii. It is planned to include two Naval vessels (Pacific Missile Range recovery ships) in the recovery force. The Recovery Force is controlled and deployed by the Hawaiian Control Center (HCC) at Hickam AFB. This control center is part of the SAMOS communication network and has voice and teletype links to the Satellite Test Center at Sunnyvale and to the various tracking stations. The HCC is directly responsible for the deployment and control of the Recovery Force under the authority delegated to it by the STC in Sunnyvale.

The HCC will effect Recovery Force control through the use of single side-band HF radio. The C-130 aircraft will be equipped with the ARC 58 and ARC 65 single side-band transceivers and the HCC will utilize single side-band facilities supplied by AACS. This type of radio communications will permit control of the Recovery Force at ranges up to 2500 miles and will permit the force to operate within the endurance limits of the aircraft in a 2500 mile radius circle centered around the HCC.

The recovery capsule is ejected from orbit and placed in a descent path that permits deployment of the parachute at 55,000 feet at a point south and west of Oahu. The recovery beacon will start transmitting shortly after orbit ejection. The flashing lights will be switched on at parachute deployment. In the event of an unsuccessful aerial recovery, a sea marker package will be opened at water impact. Surface ships will move toward the water-borne capsule by direction of the command C-130 or C-130 having the capsule in sight. Additional sea marker packages will be opened at a period appropriate to the persistence of the marker and the seasonal sea state.

The Recovery Force will be deployed when directed by the Satellite Test Center, STC through the HCC. In general, it is planned that recovery operations will be accomplished in the area south and west of the Island of Oahu. This area is particularly desirable because of its ideal weather conditions and low radio and radar noise. The actual impact area will be located as close as practical to Oahu, but at least 200 miles from its southwest extremities. It is estimated that the aircraft can reach the impact area at this location in less than an hour.

As mentioned previously, it may be desirable under certain international conditions to recover on orbit passes which would yield impact points located at a considerable distance from Oahu. As a matter of fact, it is possible that the impact area could be located in the Continental United States. In these instances, the Recovery Force would be deployed by the HCC and the control of the Force would be relinquished at the point at which the aircraft reached the boundaries of some other controlling agency such as the Defense Command or SAC.

Only four of the five C-130 aircraft are dispatched and the fifth is held in reserve at Hickam. It is planned that the three C-130 aircraft of the Recovery Force will be deployed at the mid-points of the sides of the equilateral triangle that can be inscribed in the predicted impact circle. The fourth aircraft will be centrally located. One apex of this triangle will be oriented north or to the expected azimuth of re-entry. After the aircraft have arrived on stations, they immediately begin a beacon search covering the impact area and the re-entry path. The aircraft at the triangle base is designated as a command aircraft and will serve as the information center for the Force. As soon as any aircraft detects a signal, it will report the bearing of this signal to the command aircraft, which will plot the information on a master plotting board and relay the data to the other aircraft and the HCC.

After signal detection, and assuming the capsule falls in the predicted area, the command C-130 will direct the two closest aircraft to the parachute-suspended capsule to intercept it and attempt air recovery. The third aircraft will be directed to stand by at a range of 3 miles. During initiation of search, the command C-130 will attempt to interpret the re-entry data to refine the impact point prior to parachute deployment. The command aircraft, in addition to its command function, also serves as a recovery aircraft and will be staffed accordingly. This means that if the parachute deployment point is closest to the command aircraft, it will direct itself and the closest C-130 to attempt actual recovery. The remote C-130 will remain on stand-by.

All of the C-130 aircraft of the Force are equipped with single side-band radio. However, this link will be used only for communication with the HCC by the command aircraft and for MAYDAY communication by the other three aircraft. Inter-aircraft communication will be accomplished on HX UHF equipment such as the ARC 27 or suitable substitute.

After air snatch, the Samos Recovery Capsule will be brought aboard the C-130 aircraft as rapidly as possible. The capsule will then be delivered to the Data Processing Subsystem.

d. Samos Ground Communications Network

In addition to voice and teletype circuits, Samos planning indicates the possible need for wide-band communication links an operational program. For a Samos R&D program, there may not be a need for wide-band data links except as part of an evaluation program. The use of courier aircraft or other means of physically transporting the wide-band recorded data is competitive with wide-band radio links until such time as an extensive operational program is in being. A wide-band data link between Vandenberg and the STC will provide information on capability for future programs. Additionally, it will assure immediate and positive control of the R&D system, and be a valuable tool of R&D during the development program. When completed, this link could also handle substantially all of the voice and data communications between Vandenberg and the STC for all programs including Samos and MIDAS.

3. GROUND SUPPORT EQUIPMENT

The following categories of ground support equipment will be employed in the Samos Program.

a. Ground Equipment

(1) Ground Handling Equipment. Ground Handling Equipment shall be capable of supporting the satellite vehicle and its components, including the visual, ferret, and recovery capsule subsystem equipment, and shall consist of ttansport trailers, maintenance and checkout stands, handling dollies, yokes, and slings, and other handling equipment.

(2) Ground Service Equipment. Ground servicing equipment shall be capable of servicing the vehicle, and shall consist of fuel and acid handling equipment, umbilical mast plumbing and wiring, personnel hi-lift and other required servicing equipment.

(3) Launch Monitor and Control Equipment. Launch monitor and control equipment shall be capable of adequate power conversion and distribution within the launch complex, of monitoring and controlling launch pad servicing functions and countdown operations, and shall consist of adequate electrical conversion and distribution equipment, including launch complex cabling, blockhouse consoles, recorder and countdown equipment, closed-circuit television, and other required launch monitor and control equipment.

(4) Vehicle Subsystem Checkout Equipment. Subsystem checkout equipment shall be capable of evaluating and recording the performance of each subsystem or unit within pre-selected limits and isolating component malfunctions. Vehicle subsystem checkout equipment shall consist of checkout consoles for the propulsion, auxiliary power, guidance and control, vehicle-borne communications, visual, ferret, and recovery capsule subsystems: checkout consoles for pressurization and tankage; checkout equipment for the telemeter units and beacons; and other vehicle subsystems checkout equipment.

(5) Vehicle System Checkout Equipment. The vehicle system checkout equipment shall be capable of evaluating and recording the performance of each subsystem or unit operating as an integrated system. The vehicle system checkout equipment shall consist of an automatic control section composed of a test programmer, automatic evaluation equipment providing readout by printed document and lights;

vehicle propulsion and guidance sections vehicle communication section, power supply and distribution section, visual, ferret, and recovery capsule sections.

b. Satellite Ground Control Equipment. The following categories of ground control equipment will be used in the Samos Program.

(1) VERLORT Radar Equipment. The VERLORT radar equipment shall be capable of obtaining tracking information in the form of azimuth, elevation, and slant range through the use of S-band radar equipment which interrogates a vehicle-borne S-band transponder by means of coded pulses. The VERLORT equipment shall also provide a command capability other than guidance through the use of an additional command pulse. The VERLORT radar equipment shall include command encoding equipment, analog computers (for acquisition and rough orbit computations), digital data output equipment, standby power units, and antennas.

(2) VHF Acquisition and Tracking Equipment. The VHF acquisition and tracking equipment shall provide the means for accomplishing initial acquisition and rough tracking of the vehicle. The equipment shall consist, in part, of tri-helix antennas with associated control equipment, preamplifiers, multicouplers, and phase-coherent Doppler receivers. The tri-helix antenna output shall perform three functions by providing an RF signal which is used for acquisition and tracking; telemetry information which is fed to a telemetry receiver for data reduction; and Doppler information which is fed to a phase-coherent receiver for vehicle velocity determination. The remaining integral part of the VHF acquisition and tracking equipment shall consist of TLM-18 (60 foot parabolic dish) antennas with associated control and drive equipment, pre-amplifiers, multicouplers for telemeter and reconnaissance data receiving equipment, and null seeking error signal units which shall provide control information for directing the 60-foot dish antenna. The TLM-18 antenna output shall consist of a reconnaissance data channel, telemetry channels, and synchro data. The VHF acquisition and tracking equipment described is that normally found at a tracking and acquisition station; however, depending upon the locality and requirements of the individual station, instrumentation may vary.

(3) Ground Control and Display Equipment. The ground control and display equipment shall be capable of displaying vehicle space position parameters and vehicle equipment status, such as vehicle temperatures, vehicle equipment power levels, vehicle orientation rates (yaw, pitch, roll), etc. It shall provide controls for acquisition and tracking equipment, and shall include a capability for issuing real-time commands to the vehicle. The ground control and display equipment shall consist of supervisor's consoles, master control consoles, acuisition programmers, and plotting boards.

(4) Data Handling and Computation Equipment. The data handling and computation equipment shall handle, process, and convert vehicle functional and tracking data, accomplish mission scheduling, and support operations control. The equipment shall consist of computers; data analysis equipment; and data conversion and buffering units necessary to operate slaving, recording, real-time data displays, and tracking equipment.

(5) VHF Data Receiving Equipment. The VHF data receiving equipment shall provide the means to receive, demodulate, record, demultiplex, and furnish sensor data from F-1 payloads and boost-phase Atlas Booster data to the display equipment. This equipment shall consist of TLM-18 automatic tracking antennas, FM receivers, demultiplexing units, and recorders.

(6) UHF Acquisition and Tracking Equipment. The UHF tracking and acquisition equipment shall provide the capability for searching and for acquiring the vehicle prior to the determination of precise vehicle coordinates, as well as tracking the vehicle to ascertain precise vehicle azimuth, elevation, and range. The UHF tracking and acquisition equipment shall consist of a precision UHF direction finder for acquisition and tracking; associated with these major elements are command transmitters, transmitting antennas, telemetry receivers and associated antennas, computers for acquisition and orbit computations, digital data output equipment, and standby power units.

(7) UHF Command Transmitting Equipment. The UHF command-transmitting equipment shall provide the means to transmit digital real-time commands from the ground which will activate equipment functions in the vehicle. The equipment shall consist of a high-power FM transmitter and a directional transmitting antenna.

(8) Payload Ground Equipment. The payload ground equipment shall be capable of accepting, reconstructing, and displaying visual and ferret reconnaissance data and auxiliary information. The payload ground equipment shall consist of sensor display consoles command encoding equipment, and associated equipment.

(9) Ground Timing and Display Equipment. The ground timing and display equipment shall be capable of supplying master timing information for ground stations, synchronizing signals, and timing aids necessary both to establish vehicle position in orbit as a function of time and to synchronize ground station operations. The ground timing and display equipment shall consist of WWV time receivers, master time generators (synchronized with WWV), time display units, and timing terminal units for remote timing indications. The equipment required for this function of satellite ground control is listed under the headings of the equipment for which it supplies a support function.

(10) Intra/Interstation Communications and Data Transmission Equipment. The intrastation and interstation communications and data transmission equipment shall facilitate the flow of reconnaissance data, voice, teletype, launch control, and tracking information within portions of single ground station between ground stations. The equipment shall also provide the means for controlling and coordinating launch and post-launch activities. The intrastation and interstation communications and data transmission equipment shall consist of the following types of network: A wide-band communication link between VAFB and the STC to be used for evaluation purposes, 100 wpm teletype, 60 wpm teletype, alternate voice/teletype, voice paging, hot-line direct communication, and normal voice communications. The equipment required for this function of satellite ground control is listed under the headings of the equipment for which it supplies a support function.

(11) Alignment and Calibration Equipment. The alignment and calibration equipment shall provide the optical, photometric, and electronic means to align and calibrate angle tracking, acquisition, and range measuring equipment. Alignment is effected by use of boresight cameras, telescopes, target boards, and beacons after the optical and electrical axes of the antenna have been collimated. Additionally, Calibration Vans will be required at each tracking and acquisition site to transmit standard signals

to the SS/F payloads for retransmission to the payload ground equipment. These data will then be used to calibrate and evaluate the operation of these SS/F sensor equipment. The equipment required for this function of satellite ground control is listed under the headings of the equipment for which it supplies a support function.

c. Miscellaneous Equipment. The miscellaneous equipment shall include maintenance and storage equipment, standard test equipment at stations outside the zone of the interior, and miscellaneous hand tools.

4. PERSONNEL SUBSYSTEM (Subsystem K)

a. General

Development activity in Subsystem K will be concerned with the design and the development of the personnel component of the Weapon System. Development activity will center in human engineering, personnel, personnel requirements, information, training, and technical manuals efforts. All equipments are to be designed with full knowledge of personnel qualifications and limitations and, further, positions will be defined insofar as possible in terms of existing job classifications. Training, training materials, and definitions of operational procedures will be accomplished with the objective of attaining high proficiency of well-trained personnel.

b. Human Engineering

The human engineering program shall participate in the design and development of the system hardware so as to establish and incorporate human factor objectives and criteria, ensure proper allocation of system functions to men and machines, describe the sequences of operator decisions and actions, incorporate maintainability into equipment design and arrangement, and provide for efficient equipment and work-space layout to include the man-man and man-machine communication links; participate in and conduct reviews to evaluate and verify from a human factors standpoint the adequacy of initial modification of equipment and/or procedure. This includes a human factor review of system operation for each test flight and field analysis to detail the potential and actual failures of the personnel subsystems and to recommend remedial action.

c. Personnel Requirements

A training program consistent with the R&D program will be conducted.

d. Manuals and Job Aids

Utility Manuals will be developed as required for the R&D program.

e. Coordination with Discoverer/MIDAS Personnel Activity

Experience gained in developing personnel systems for Discoverer/MIDAS is directly applicable to the SAMOS. The SAMOS personnel development system will benefit from the prior and parallel development of personnel systems for Discoverer and MIDAS. Economy in time and effort, therefore, can be achieved, for the SAMOS personnel system because many problems common to this and the other personnel systems need to be solved only once.

5. GEOPHYSICAL ENVIRONMENTAL MEASUREMENTS (Subsystem J)

The geophysical environment measurements program has as its primary purpose the acquisition of environmental data which is necessary, or may contribute, to the technological improvement of satellite systems.

The SAMOS vehicles provide unique instrumentation platforms for geophysical and astrophysical measurements due to the payload capacity and to the vehicular attitude control. Additionally, the low-altitude polar orbits provide the opportunity for mapping the entire surface of the earth in terms of the several environmental parameters.

These parameters include the properties of the auroral regions, electric fields, and magnetic fields. It is particularly desirable to determine the radiation levels and the relation between auroral and Van Allen radiation. In addition to determining radiation damage to satellite components, there may exist the possibility of utilizing the radiation zones for military purposes.

The use of the earth's magnetic field for vehicle guidance or attitude orientation will require a detailed mapping of the field components. This knowledge of the shape and strength of the earth's field would be valuable in interpreting charged particle data and the explanation of physical phenomena affecting vehicle/ground communications.

Predicting atmospheric drag forces affecting satellite orbital life-times depends upon accurate knowledge of the density and constituents of the atmosphere at orbital altitudes.

Measuring the earth's radiation, in both the infrared and the visible portion of the spectrum, is desirable for determining satellite heat balance and the ambient background affecting observations from satellites.

Measurement of the spectral power density and other characteristics of the extreme ultraviolet radiation upon satellite components and the mechanism of the formation of ions in the upper atmosphere.

The number, size, and velocity of micro-meteorites is of interest in estimating erosion damage and the probability of damaging impacts.

Other physical measurements which would contribute to understanding the factors acting upon orbital vehicles include the characteristics of the ambient ion population, the low-energy neutron flux, and the vehicular electrical field.

Equipment to make the measurements listed in the following table is presently scheduled for the SAMOS vehicles in accordance with the varying capabilities:

PLANNED GEOPHYSICAL MEASUREMENTS*

Measurement	Flight						
Earth thermal radiation					5		
Earth visible radiation					5		
Cosmic ray radiation	1						
Thermal neutron flux			3	4	5		
Ambient ion population	1		3				
Atmospheric molecular masses distribution				4			
Earth magnetic field components				4		6	
Micro-meteorites	1	2	3	4	5	6	7
Atmospheric density		2	3	4	5	6	7
Solar extreme ultraviolet spectrum					5		7
Vehicular electric potential	1		3				
Extra-terrestial galactic radio noise							7

* Subject to change due to weight and space limitations, ground-space telemetry availability, and the current requirements for data.

It is expected that the instrumentation payloads of the later vehicles may be modified in view of results obtained from earlier flights and experiements performed and analyzed from other programs.

6. RELIABILITY PROGRAM

a. Reliability Design Review

Continuous relability design reviews are being conducted within the funds available to assure equipment design for maximum reliable life in orbit. The major objectives of these reviews are: (1) To maintain a reliability prediction for the system concept so that decisions can be made regarding the total permissible complexity at system level. (2) To establish complexity values down to the equipment level and (3) To assure that each equipment will meet its reliability goal.

The prediction techniques and part failure rates outlined in such reports as RCA-TR 1100, RACC TN 58-81, and VITRO 98 are used to to accomplish the foregoing objectives. The early predictions will be based on the use of currently available parts, and assumed proper applications. Some of the benefits obtained by use of the reliability review are as follows:

(1) Isolates marginal application of parts

(2) Identifies marginal engineering design

(3) Provides a basis for considering redundacy

(4) Provides a measure of mean-time-to-failure (MTTF)

(5) Provides a detailed thermal evaluation of packaging

(6) Establishes areas of thermal penalty

(7) Evaluates fail-safe features

(8) Identifies parts for additional research and development.

(9) Provides a measure of mean-time-to-repair(MTTR)

(10) Determines adequacy of that program

(11) Defines probable modes of failure

(12) Reveals use of non-standard fabrication processes

(13) Reveals usage of unacceptable parts; i.e., parts known to have unacceptable failure rates.

Experts in many specialties including parts, parts application, design, and fabrication are being used to effect reliability design reviews.

b. <u>Parts Program</u>

A comprehensive parts program is in progress to increase the average life of piece parts used in the satellite equipment. This program includes parts evaluation and establishment of application criteria for the orbital environment. The major efforts to reduce part failure rates include the following:

(1) Selection of source and exact production line

(2) Analysis of part instabilities

(3) Circuit design to minimize the effects of these instabilities

(4) Optimum derating

(5) Improved inspection techniques

A survey of parts application and development programs at govenmental agencies, subcontractors and vendors is presently being made. This survey will be intensified. In addition, participation in the Reliable Electronic Parts Program of Battele Memorial Institute will continue, and the LMSD Data Interchange Program will be expanded to include parts test data, specifications, and test plans. Information obtained from these sources, and other test data, will be used to prepare parts list. This list and application data to be developed from the parts study will be given to design personnel for their use in development work. The quality of all approved parts will be monitored and maintained by the quality control program. It is anticipated that improved quality control acceptance criteria will permit ordering optimum production batches from part suppliers. Acceptance Test Specifications and Acceptance Test Procedures will be analyzed to assure that only the highest quality parts which meet stringent performance requirements are purchased.

The part testing program is being oriented toward establishment of failure modes, development of application data, and formulation of accelerated life tests. One task to be initiated will be to establish the effects of cyclic and of continuous operation of active parts such as transistors and microwave tubes. This study will be correlated with the effects of voltage transients, if possible. Efforts will also be undertaken to develop techniques for detecting latent failures. The follow-on R&D program imposes a requirement for additional specimens for ground testing. Parts are presently being evaluated in critical application areas and high failure rates have been observed in the following parts:

(1) Microwave tubes

(2) Tantalum Capacitors

(3) Connectors

(4) Relays

(5) Potentiometers

(6) Diodes

(7) Power transistors

(8) Electron Tubes

(9) Motors

A research and development program will be initiated to obtain a reliable microwave tube, since presently available devices do not have the required life. Although there are several case histories of magnetron and klystron tubes surviving 6000 hours, their near life is about 500 hours. Consideration will be given to the use of a traveling wave tube which will last for 5000 to 10000 hours.

The use of rotating parts such as motors, slip rings, and doding wheels will be minimized. In addition, solid state devices will be developed to replace relays where feasible.

A failure reporting system is being used to identify problem areas in part applications. Some failed parts are selected for dissection and analysis so that fabrication defects can be determined and test and application criteria can be established.

c. Materials and Processes Program

A study will be made to determine the degradation of materials in a vacuum. The long term effects of orbital environments on lubricants, foam plastics, and dielectric materials have not been correlated with satellite requirements, but it is anticipated that evaporation, sublimation, and redeposition may cause degradation or failure.

In bearing and gear design, spontaneous interface migration will be studied on a quantitative basis. Such processes as wire wrap, solderless connectors, and spot welding instead of soldering for part lead attachment, will also be investigated.

Assembly techniques will be developed to reduce stresses to a minimum during assembly. The need to alter the configurations of present parts to ease problems in this area will also be studied.

Methods for fabricating long life printed circuitry will be studied to obtain optimum circuitry for use in all SAMOS equipment. Printed circuit techniques will be evaluated using tests which employ particular thermal shock stresses.

Many process specifications have been reviewed in the light of SAMOS long life, orbital requirements, and additional reviews and revisions will be made.

Specifications will be reviewed to prevent undesirable reliability performance traceoffs.

d. Reliability Tests

A considerable effort will be made to ascertain and measure the environment of SAMOS equipment. An extensive effort has already been made to define the ground and launch environment of SAMOS.

Studies will continue on the effects on the following:

(1) Electromagnetic Radiation

(2) Cosmic Radiation

(3) Radiation Belts

(4) Interplanetary Dust

(5) Solar Wind

(6) Vacuum

(7) Weightlessness

The effects of these environmental factors on materials, parts and components will be evaluated in LMSD ground laboratory and space laboratory programs using the criteria established in above study of the unique space environment.

Reliabiliby tests will be conducted at part, component and subsystem levels. The types of tests that will be conducted are as follows:

Accelerated life (parts)

Nominal life (system level)

Elevated environmental stress limits (parts and components)

Thermal cyclic and shock (parts and components undergoing orbital thermal change)

Vacuum life (materials, parts, components)

Radiation life (particularly organic materials)

e. Equipment Fabrication, Test and Checkout Control Program
The long-life equipment that will be developed for the SAMOS vehicle will require particular precautionary test and use measures in all ground operations between manufacturing checkout and final satellite launch. All phases of these operations will be evaluated from a reliability standpoint, and procedural measures will then be developed to protect the inherent high reliability of the equipment during these phases. The amount of actual operation that equipment will be subjected to will be rigidly controlled. This control will be imposed to minimize the hazard of misuse. Effective recording of all tests will be mandatory to indicate any instances where equipment may have incurred misuse. Such

equipment, while it may still meet acceptance test specifications, will be removed and evaluated from a reliability standpoint to determine its suitability for further use in a long-life SAMOS vehicle system. These stringent measures are expected to keep such instances of misuse to a minimum and to assure reliable control and evaluation of equipment that does experience misuse.

f. System Simplification Program

A concerted effort will be made to minimize the overall system function requirements of the satellite equipment so that the system can be simplified. From this effort it may be possible to eliminate certain components, or to reduce their duty cycle. For example:

(1) SS/C will be reviewed, with consideration given to elimination of the 3-phase inverter and possibly the 2 KC inverter and synchronous power amplifier.

(2) SS/D may be able to operate on a duty cycle of less than 100 percent; such a decision will be based on a system error analysis.

(3) In SS/H, the decoder-programmer (LODAP) function will be considered for fail-safe operation as well as reduction in number of components.

A reduced power requirement and improved system reliability should be realized from this system simplification study.

g. Communications Subsystem R liability (Subsystem H). Effort will continue to establish and meet realistic time-phased reliability requirements for SS/H. It is essential that the ultimate configuration of SS/H meet operational requirements in regard to loss and distortion of data, time inoperative, and accuracy of ephermis determination. It is also recognized that substantially accelerated SS/H reliability growth and higher ultimate reliability goals can require markedly higher funding.

h. Redundancy vs Weight Penalty Analysis Program. Where the state-of-the-art part life precludes achieving the desirable equipment reliability goal, the use of redundant components will be considered. It is realized that the use of redundancy is a poor substitute for mature design and, therefore, duplicate components will not be considered unless no other solution is feasible. The weight of each redundant component and its associated contribution to enhance satellite reliability will be considered in reaching a decision on each problem.

A study will be completed which will determine the optimum use of redundant components with reference to the weight penalty. Some components which may be considered for redundancy are as follows:

(1) Inverters SS/C

(2) Solar array control SS/C

(3) Voltage limiter circuits

(4) Electronics of the attitude control system SS/D

(5) Azimuth drive motor SS/G

(6) Data transmitter SS/H

(7) Decoder-programmer (LODAP SS/H

SUMMARY DESCRIPTION OF CONTRACTS BY WEAPON SYSTEM

1. AF 04(647)-97 and AF 04(647)-347 Lockheed Aircraft Corporation, Missiles and Space Division

A. MANAGEMENT

LMSD: The central direction and control of concepts, studies, analyses, expenditures, programming, scheduling and reporting; the administrative support required to provide manning, funding and coordination of all activities of the Weapon System: the source of evaluation and progress information to the customer.

B. SYSTEMS

1. LMSD: Perform analyses, design studies and flight tests (and basic development tests not applicable to a particular subsystem) in determining compatibility of systems, establishing system concepts, design criteria and constraints. This includes design, development and/or provision and operation of ground equipment systems, ground-space tracking, communications, command systems and related test, servicing, calibration and logistical support equipment (both contractor and/or government furnished) embracing human engineering and Q. P. R. I. studies as well as engineering research and required manufacturing for R & D purposes only.

2. Subcontract: Conduct a program of analytical study and system simulation and conduct A&E studies.

C. AIRFRAME SUBSYSTEM

LMSD: Develop and produce satellite airframe. Provide: Propellant and pressurization tankage; aerodynamic fairings; structural supports, brackets and fittings; mechanical and electrical fittings not included in other systems; environmental controls; and ground equipment required for transporting, servicing, erecting and launching.

D. PROPULSION SUBSYSTEM

1. LMSD: Obtain and integrate the orbital thrust rocket engine and orbit position propulsion device. Develop and provide propulsion subsystem including: feed and loading systems, engine gimbal capability, and equipment required to start and stop the propulsion subsystem in response to command (or program) ullage orientation requirements, and ground based items for testing, calibrating and servicing.

2. Subcontract: Bell Aircraft Corporation: Manufacture and deliver the YLR-81-BA-5 rocket engine for Flight Configuration I. Manufacture and deliver the XLR-81-BA-9 (Bell Model 8096) for subsequent Flight Configurations.

3. Aerojet-General: Manufacture of solid propellant ullage orientation rockets.

E. AUXILIARY POWER SUBSYSTEM

1. LMSD: Develop and/or provide and integrate: energy source and power conversion equipment required to furnish electrical power for all subsystems within satellite from time just prior to launch to mission's ending, and equipment required for testing and servicing.

2. Subcontract: Design, development and production of prime energy sources and power conversion equipment, including power inverters, voltage regulators, photovoltaic collectors, control relays and design, development and production of primary and secondary batteries.

F. GUIDANCE AND CONTROL SUBSYSTEM

1. LMSD: Develop and/or provide and integrate: ground based and on board guidance and control (command) equipment required to stabilize, direct, separate and boost orbiting vehicle and equipment required for servicing, testing and calibration.

2. Subcontract: Design, development and production of horizon scanners, inertial reference package, control valves and nozzles, and MIT attitude control system.

G. VISUAL RECONNAISSANCE SUBSYSTEM

1. LMSD: Develop and/or provide and integrate: photographic system (s) required to collect, store, filter (or process), convert into video signal to photographic form for use and the equipment required for servicing, testing, and calibration.

2. Subcontract: Eastman Kodak: Research, development and fabrication of visual reconnaissance equipment and photo simulation studies.

3. Subcontract: Itek Corporation research, development and fabrication of recovery reconnaissance payload.

H. FERRET RECONNAISSANCE SUBSYSTEM

1. LMSD: Develop and/or provide and integrate: An electronic system(s) required to collect, store, filter (or process), reconvert (as required) and decode electromagnetic intelligence information and the equipment required for servicing, testing and calibration.

2. Subcontract: Airborne Instruments Lab: Conduct a program to develop an electronic reconnaissance system for use in a satellite vehicle. Additionally, maintain cognizance of the electronic environment which can be effectively observed from satellite vehicles.

3. Development of wide-band video recorder.

4. Other: Conduct a study of operational requirement for the electronic reconnaissance system.

I. GROUND-SPACE COMMUNICATIONS SUBSYSTEM

1. LMSD: Develop and/or provide and integrate and operate: Space-ground and ground communication and tracking equipment required by contractor to coordinate and monitor all flights and assist the government in determining, equipping and manning facilities required for service controlled activities. This includes all ground support equipment required for servicing, testing and calibrating.

II. AF 04(647)-309 - Space Technology Laboratories, Ramo-Wooldridge Corporation

A. SPACE TECHNOLOGY LABORATORIES

1. Since Lockheed Aircraft Corporation has the prime contract for WS 117L under the direction of AFBMD, contribution of the Space Technology Laboratories lies primarily in the area of consulting services and technical studies. These services are performed for, and at the specific request of AFBMD.

2. The STL studies are general in nature and indicate trends rather than highly detailed final results. STL is not responsible for technical direction, quality of design, contractor performance, or contractor evaluation.

III. LETTER CONTRACT DESIGNATED AS SUPPLEMENTAL AGREEMENT #13, CONTRACT AF 04(647)-4 CONVAIR ASTRONAUTICS DIVISION, GENERAL DYNAMICS CORP.

A. CONVAIR ASTRONAUTICS DIVISION, GENERAL DYNAMICS CORP.

Responsible for providing such services as are required to adapt the SM 65 booster, its facilities, ground support equipment etc., to the AGENA and launch the combined SM 65/AGENA vehicle into orbit.

IV. OA 58-25 (OA 59-1) ROME AIR DEVELOPMENT CENTER

A. ROME AIR DEVELOPMENT CENTER

Responsible for conduct of a program of research and development on equipments, techniques and methods for processing of photographic and ferret data returned from the satellite, into meaningful intelligence information. RADC is delegated the responsibility for the conduct of the program for the Data Processing Subsystem. The Ramo-Wooldridge Corporation has contractual responsibility for this subsystem under Contract AF 30(602)-1814.

V. OA 58-10, AIR FORCE CAMBRIDGE RESEARCH CENTER

A. AIR FORCE CAMBRIDGE RESEARCH CENTER

Responsible for conduct of a program of research and development on equipments, techniques and methods for the collection of geophysical environmental data. AFCRC has been delegated the responsibility for the conduct of the program for the Geophysical Environment Subsystem.

VI. LETTER CONTRACT AF-04(647)-532 (TO BE DEFINITIZED PRIOR TO 30 JUNE 1960

A. PHILCO CORPORATION WESTERN DEVELOPMENT LABORATORIES, 3875 FABIAN WAY PALO ALTO, CALIFORNIA

1. Requirements:

a. Perform feasibility and engineering design studies to meet requirements and define Communication and Control (C & C) Subsystem, including integration and operation of the T & A Stations. Define preliminary operation concept and plans for system design criteria, and investigate alternative applications of C & C Subsystem.

b. Conduct reliability program on hardware items. Provide personnel, training technical manual, and human engineering support for C & C Subsystem.

c. Receive, install, assemble, calibrate, checkout, operate and maintain equipment for T & A Stations performing such modifications as required to support this function.

d. Develop and procure 1960 T & D receiving antennas.

e. Develop and fabricate 110' and 26.5' radomes for T & D and Angle Tracker Antennae.

f. Develop and fabricate Angle Tracker Systems.

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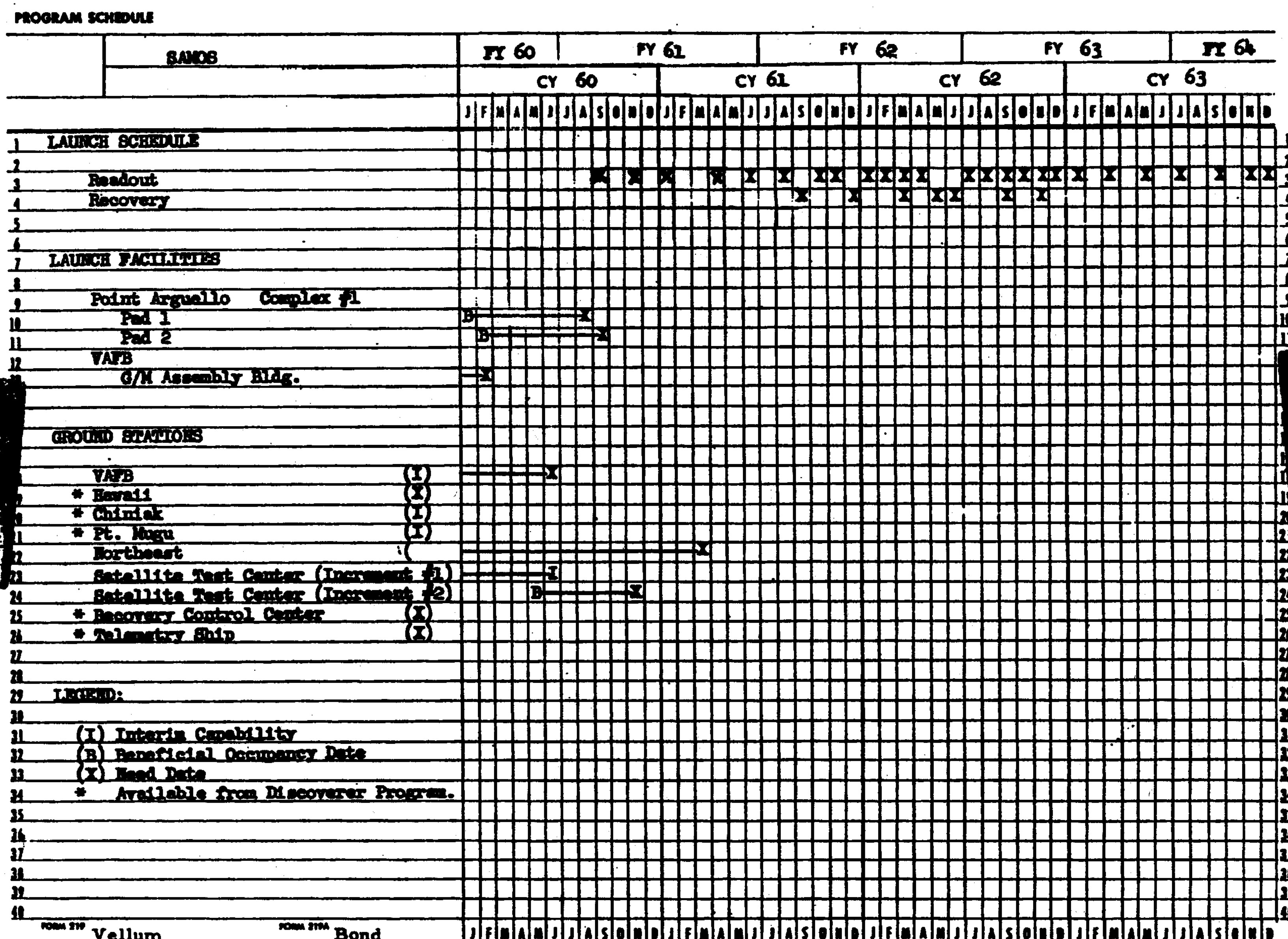

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systems are added until the ultimate configuration is reached.

Primary dependence on flight testing to obtain design and system parameters information is recognized as inefficient and extremely costly. Consequently a comprehensive system of ground tests have been initiated as a prerequisite to flight test. These tests, described later in this test annex, have proven that ground testing of the space elements of the system can be effective and economical. This requirement has, however, established the requirement for new test facilities and techniques in simulating system test environment. Many of these facilities are located in the contractor's "backyard" and many are Government owned facilities used as they are available and suitable for the tests to be conducted. These facilities also include new Government facilities and equipments required to test the system. In this type of testing the system can be operated over long periods of time providing masses of statistical information to aid in the development of a reliable system. Ground testing under simulated system test environment has limited usefulness, however, in that all of the system environment cannot be simulated particularly as they apply to the space vehicle and its functional subsystem. Temperatures, pressures and shock caused by variations in these parameters can be simulated however, many parameters cannot be simulated, i.e., solar radiation characteristics, Van Allen radiation belts affects - infinite-volume vacuum, etc., these items must be tested on orbit. These factors plus many others have lead to the conclusion that a balance of testing must be tested on orbit. These factors plus many others have lead to the conclusion that a balance of testing must be established between ground simulation and actual system tests on orbit.

No testing is accomplished at any level if it can be done more effectively at a lower level. However, the cost of a bit of additional design data becomes increasingly expensive as a test at a specific level is repeated over and over, until a point is reached wherein the collection of a needed bit of design data becomes more expensive to achieve in ground testing than it would by an actual systems tests. For example, early flight tests demonstrate the compatibility of the booster; the space vehicle; the guidance and control; and ground space communications systems - in addition specific design and operating data are collected on the operation of other functional subsystems. Relating the flight test program to the ground test program, the number of tests on the ground will represent an order of magnitude more testing than the flight test program. Thus any flight system test represents tens of thousands of tests on parts, components, subsystems, and system simulation testing. Therefore, the test program looks like a pyramid, schematically, with its broad base resting on the part and component test program. The types of testing accomplished are described in the following sections.

2. <u>Test Description</u>

a. The Readout Program will consist of 18 flights through CY 62 carrying visual and ferret payloads. This Readout Program will comprise the major effort in the development flight testing of components and subsystems. It will lead to, but not necessarily complete, an operational SAMOS capability of E2, F2 and F3 payloads. In the period beyond CY 62, the projected follow-on R&D program will initiate flight tests of advanced ferret and visual payloads, (7 flights in CY 63, 4 in CY 64).

It is presumed that an operational/development program will be concurrently flown from mid CY 62 on; and it is expected that special projects and minimum R&D corrective actions can be explored aboard these vehicles.

b. The Recovery Program will be conducted concurrently with the Readout Program. It will consist of 7 test flights and will have its primary objective the demonstration of a visual payload recovery capability. Other objectives include the refinement of satellite recovery techniques and the collection of research data in the field of visual reconnaissance.

3. <u>System Testing Responsibilities</u>

a. <u>Support Testing</u>: In support of the development design of visual recovery and readout payloads and consequent vehicle design, the following types of design support testing will be conducted:

- Wind tunnel tests
- Environmental tests
- Horizon scanner tests (Balloon)
- Nuclear auxiliary power unit tests (termmated)
- Recovery system tests
- Ferret tests
- Data processing equipment
- Propellant tank tests
- Telemetry system tests
- GSE tests
- Roll control tests (simulation)
- Photographic systems tests
- Solar auxiliary power unit test
- Propulsion system altitude star tests
- Aircraft drop tests
- Aircraft/ship data package snatch test

b. <u>Captive Testing</u>: Convair Astronautics will have the responsibility for any component and captive testing on the ATLAS booster. LMSD will provide captive testing for the SAMOS satellite vehicle in the form of an in-plant systems run and a captive firing of each satellite vehicle less its recoverable payload at the Santa Cruz Test Base. From Santa Cruz, each vehicle will be delivered to the flight test launch area, Vandenberg Air Force Base.

c. <u>Flight Testing</u>: The responsibility for overall flight test direction and planning falls on the prime weapon system contractor. Pre-flight checkout responsibility will be shared, however, by LMSD and Convair Astronautics for their respective vehicles and equipment. SAMOS system control will be tested in the Satellite Test Center at Sunnyvale under direct Air Force cognizance, and control will be subrogated from this Center to other stations as the need arises during operation.

d. <u>Data Processing Subsystem Testing</u>: The test program for subsystem "I" will be conducted at two facilities; initially at the Data Processing Laboratory at Denver with follow-on system testing at the R&D Intelligence Processing Facility (DP) located at Offutt Air Force Base. The tests are planned for developing optimal system procedures, verifying requirements for the initial operating capability, and for developing advanced systems which will utilize military personnel as operators. There will thus be a gradual buildup of a military cadre. Test will, of course, begin with equipment checkout. Equipment will be installed, checked against specifications, and then interconnected to insure proper marriage between different pieces of equipmer

Following this establishment of the equipment in the proper configuration, the first system test, with relatively few pieces of equipment and a small military cadre, will be carried out at relatively low input rates. This first limited system test will show any gross shortcomings in procedures or processing rates, which can then be modified by re-routing the flow of information and material, by improving computer programs, and by changing personnel requirements and training. The next system test will be conducted with much higher input rates - close to those predicted for the initial operating capability. This will be done to force improvements in the data processing efficiency. On the basis of these tests, final specifications for facilities and communications, personnel selection and training, quantities of pieces of equipment and equipment modifications, and system procedures. Subsystem "I" testing should accomplish the following goals: (a) Testing the system before operational use; (b) Developing the most effective system procedures; (c) Verifying personnel, training, and facilities requirements; (d) Developing advanced systems; and (e) Providing man-machine system training.

B. <u>FLIGHT TEST PROGRAM</u>

1. <u>Overall Program Objectives</u>

a. SAMOS orbital performance characteristics will, by 1960, have been established and the significant test objectives of the readout and recovery programs will be:

(1) <u>Readout Program</u>: Demonstration of orbit capability. Demonstration of ability to achieve and maintain a stabilized nose-down orientation. Test and evaluate high resolution trainable photo-reconnaissance systems. Test and evaluate data link readout electronics. Test and evaluate environmental control components. Test and evaluate interim and operational ferret systems. Demonstrate capability of electronic and visual reconnaissance systems to obtain intelligence information. Evaluate the operation of equipment in zero gravity field. Evaluate orbit tracking and ground/space command and communications system. Test and evaluate data acquisition, handling, and processing systems.

(2) <u>Recovery Program</u>: Demonstration of heavy capsule system recovery techniques and equipment. Evaluation of high precision vehicle attitude control stabilization system. Demonstration of precise vehicle position and attitude determination techniques. Demonstration of system compatibility with extreme resolution photographic requirements. Evaluation of system tracking and positional computing systems.

2. <u>Flight Test Plan</u>

a. <u>Readout Program</u>

(1) The first 3 flights will carry components of the visual reconnaissance and ferret payloads for testing under spatial conditions. Readout will be accomplished at the various ground stations, with information assembled via the inter-station communications network at the STC for evaluation. The vehicles used on these flights are designated Configuration I (See Design

Characteristics Section) and the flight missions are as follows:

(a) Demonstrate the ability of the SAMOS/ATLAS combination to place the SAMOS satellite on a planned orbit.

(b) Demonstrate the ability of the satellite to achieve and maintain a predetermined attitude orientation on orbit.

(c) Utilizing E-1 visual equipment, readout pre-exposed and pre-processed film, process and readout pre-exposed film, and perform total subsystem operation within the capability limits imposed by the dual payload configuration.

(d) Utilizing the F-1 ferret equipment, monitor electromagnetic emissions, quantize and store significant characteristics of these emissions, and readout these data via the vehicle-ground communication link to evaluate ferret reconnaissance techniques.

(e) Test and evaluate the basic subsystems comprising the satellite vehicle.

(f) Test and evaluate the capability of the ground equipment and facilities to support the satellite vehicle in its prelaunch, launch, ascent and orbital phases.

(g) Collect, record, and transmit telemetered data.

(h) Demonstrate the capability of the satellite ground control system to maintain control of system operations.

(2) Six of the vehicles in the Readout Program are designated Configuration II and consist of visual reconnaissance payloads. The flight missions for these vehicles are as follows:

(a) Demonstrate the ability of the SAMOS/ATLAS combination to place the SAMOS Satellite on a planned orbit.

(b) Demonstrate the ability of the satellite vehicle to achieve and maintain a predetermined attitude orientation on orbit.

(c) Utilizing the E-2 visual reconnaissance equipment, demonstrate the ability to photograph specific areas of interest, process the exposed film, and electronically sense and readout the information via the satellite vehicle-ground communications link.

(d) Test and evaluate a vehicle auxiliary power system incorporating solar voltaic collectors, primary and secondary batteries.

(e) Test and evaluate the basic subsystems comprising the satellite vehicle.

(f) Test and evaluate the capability of the ground equipment and facilities to support the satellite in its prelaunch, launch, ascent, and orbital phases.

(3) Five of the vehicles in the Readout Program are designated Configuration III and are satellites carrying a Ferret Reconnaissance payload. The flight mission for these vehicles is as follows:

(a) Demonstrate the ability of the SAMOS/ATLAS combination to place the SAMOS Satellite on a planned orbit.

(b) Demonstrate the ability of the satellite vehicle to achieve and maintain a predetermined attitude orientation on orbit.

(c) Utilizing the F-2 and F-3 Ferret equipments, monitor electro-magnetic emissions, quantize and store significant characteristics of these emissions, record special signals by analog methods, and readout these data via satellite-ground communications line to evaluate ferret reconnaissance equipment.

(d) Test and evaluate a vehicle auxiliary power system incorporating solar voltaic collectors, and primary and secondary batteries.

(e) Test and evaluate the basic subsystems comprising the satellite vehicle.

(f) Test and evaluate the capability of the ground equipment and facilities to support the satellite vehicle in its prelaunch, launch, ascent and orbital phases.

(g) Demonstrate the ability to transmit known signals from the ground and read this data out of the vehicle for system calibration purposes.

(h) Demonstrate the ability to adjust the vehicle payload from ground stations to achieve optimum performance of the system.

(i) Obtain and process geophysical data.

b. Recovery Program

(1) The SAMOS Satellite vehicle and test system Configuration IV are substantially the same for each of the four recovery flights. The vehicle will be stabilized in the tail-first horizontal orientation. All flights involve capsule recovery and the flight missions are as follows:

(a) Demonstrate the ability of the SAMOS/ATLAS combination to place the SAMOS satellite on a planned orbit.

(b) Demonstrate the ability of the satellite vehicle to achieve and maintain a predetermined attitude orientation on orbit.

(c) Evaluate precise vehicle position and attitude determination techniques.

(d) Test and evaluate a vehicle auxiliary power system incorporating a solar photovoltaic source and primary and secondary batteries.

(e) Test and evaluate the capability of the E-5 High Resolution Visual Reconnaissance System to provide high resolution photographic coverage of specified areas of interest.

(f) Test capsule separation, retrodynamics, thermal protection, and recovery techniques.

(g) Demonstrate the capability of the satellite ground control system equipment and facilities to control system operations and to collect, record, and assess telemetered data.

3. <u>Flight Test Organization</u>

Subject to the overall management by the Air Force Ballistic Missile Division, the Lockheed Missiles and Space Division has been assigned responsibility fo technical direction of the SAMOS Development Program. In accordance with ARDC regulations, the AFBMD Weapons System Project Office (WSPO) exercises technical test control of SAMOS systems tests. The Commander, 6594th Satellite Test Wing is the Systems Test Controller, participates in the test planning, and is assigned responsibility for exercising control of the technical tests of the SAMOS/ATLAS during the flight test operations. Within the broad direction established by AFBMD for SAMOS development, system requirements will be generated and integrated by LMSD and appear as general and detailed test plans and support requirements. Following project approval at AFBMD, the documents become official test plans with which all participants in the program comply. The test operations will be executed by LMSD and Convair Astronautics (CVAC), the booster contractor, under the control of the systems Test Controller. In general, systems test direction and execution will be accomplished by LMSD personnel. In the case of the SM-65 booster, CVAC personnel have been assigned responsibility for direction and execution of booster activities. Test control and direction will be established at each SAMOS field site with the center of operations located at the Satellite Test Center. Major decisions concerned with such items as launch under marginal conditions will be made at STC based on recommendations made by various field stations. In all cases, final authority in the areas of test control and direction will be at the STC.

4. <u>Test Program System Operation</u>

a. <u>General</u>: The system, consisting of orbiting vehicle, launch and checkout facilities, tracking stations, control centers, and computing facilities, is considered as an operating entity, and the functioning of each element of the system is discussed as that element becomes active in the test.

b. <u>Prelaunch Planning</u>: The basic planning, several months prior to the scheduled launch date, will include an adequate description of the test configuration and test objectives. In addition, the specific plans for attaining the objectives will be explained. It thus represents a summary discussion of the vehicle/booster combination and the ground station configuration, as they are planned for any given flight.

c. System Test and Checkout: A program of test and checkout will begin at the part and component level and be expanded until the entire system is operating as a single integrated unit. Convair Astronautics will deliver a flight-ready modified ATLAS booster to Vandenberg Air Force Base directly from the San Diego plant. SAMOS vehicle test and checkout will begin at Sunnyvale, with the individual components which will be bench-tested and accepted prior to installation in the airframe. After manufacturing and assembly, the vehicle will be tested and checked out at subsystem levels and operated through a simulated flight which will program information into the vehicle and record the outputs for calibration inspection and comparison. After the final test and checkout is successfully completed, the vehicle will be shipped to Santa Cruz Test Base for a short-duration static firing of the rocket engine. At Vandenberg Air Force Base the vehicle will again be run through a simulated flight less engine run with all functions recorded and compared to previous tests to determine possible deterioration of components. The checkout of launch facilities will be accomplished on a schedule compatible with the flight preparation of the complete weapon system. During the X-2 day countdown, the blockhouse consoles will quantitatively evaluate the information received from the vehicle. During the launch countdown, the consoles will function to make critical parameter checks indicating "go - no/go" conditions, with data recorded to permit later evaluation. The final checkout for the SAMOS system will be the mock countdown on X-2 day from the anticipated time of launch. Blockhouse checks and calibrations of the electrical power, guidance, beacon and payload will be made. Simultaneously, the ATLAS booster will be checked out. This X-2 day mock firing will also serve to check out the communications system and procedures.

d. Communication System Countdown: Communication system countdown will be initiated five hours before launch with a communication check to each station which also will provide a station readiness report and a time synchronization. Through the countdown, the Satellite Test Center will direct major activities of individual status reports and integrate separate efforts into a unified operation. The time relationship of individual station operations will be planned for a simultaneous readiness condition of launch and tracking support equipment.

e. Launch, Exit, and Orbit Injection Phases: The operation of the complete system, from the instant of launch to the end of attitude stabilization on orbit, is beyond the scope of this report; only a representative description follows:

(1) At the instant of lift-off, all booster/vehicle systems will be operating.

(2) Beginning with lift-off, the booster will be programmed to roll until it attains its nominal flight path azimuth. During this period, the booster/vehicle will be in vertical flight.

(3) After the roll programming is completed, the booster will be programmed in pitch to hold a zero-lift trajectory until the separation attitude is reached. From then until separation a constant-attitude trajectory will be programmed into the ATLAS control system.

(4) Simultaneous with vernier engine shutdown, the guidance timer wil issue signals to fire the separation devices, open the pneumatic control system shutoff valve, and jettison the nose cap. Almost immediately afterward, the retrograde rockets will fire, effecting vehicle separation. After separation, a coast period will carry the SAMOS to its orbital boost altitude, while guidance and control subsystem maintain the pitch and roll attitude of the SAMOS vehicle oriented to the local horizontal.

(5) The propulsion subsystem will inject the SAMOS vehicle into the desired orbit, and the preprogrammed reorientation will stablize the satellite in either a tail-first (for visual recovery) or nose-down (for readout) orbital positio

After a launching, the launch complex will be refurbished to prep for the next flight. Damaged parts will be replaced and checked out, and existing equipment will be modified or new equipment will be incorporated into the launch complex as necessary.

f. <u>Orbital Phase</u>: The operation of the entire system during the period after the vehicle is on orbit and stabilized in attitude and before the time when the capsule is ejected (or the vehicle power decays in the case of readout flights), will be described as the orbital phase during which the payload operation is to be carried out. All tracking stations of the SAMOS system will conduct a systematic equipment check prior to each vehicle contact. This exercise will serve to indicate the readiness of the station and verify the operability of its equipment. Operation of airborne visual and electronic reconnaissance equipment will continue as describe in TAB 2. SAMOS readout will be performed initially over VAFB with wide band data reception capabilities expanding subsequently to Northeast and Central stations. Ferret readout initially will utilize all existing tracking stations.

g. <u>Recovery Operation</u>: Present planning provides that the recovery capsule will be ejected from orbit to be air-recovered, probably in the Hawaiian area. The basic recovery system, however, will be adaptable to overland operations. Thus, recovery can be accomplished in a variety of operational modes. The definite selection of the final operational mode will be made when all system factors have been evaluated.

5. <u>Command and Control Responsibilities and Procedures</u>

a. <u>General</u>: System command and control will be a world-wide problem requiring an extensive communication network. The actual functions of command and control are not complex in themselves. The problem is made complex because of the geographic separation of the various ground stations and the need for reliable transmission of tracking and system status data on a 24-hour basis. The tasks to be accomplished in the command and control of the SAMOS recovery and readout test configurations include:

(1) The collection and presentation of various types of data that can serve as the basis for command generation.

(2) The refinement and analysis of selected data to permit its employment in the decision or command determination process.

(3) The definition and selection of emergency operational modes in the event of system component failure.

(4) The transmission of system commands.

(5) The evaluation of system response to the commands and the determination of required modifications to scheduled command flow.

Central control authority will be vested in the Satellite Test Center. A portion of this authority will be delegated to the Vandenberg Control Center and to the Hawaiian Control Center for the control of operations in their local areas. The degree to which control can be exercised over the system is limited by the capability of the ground-to-vehicle command link and by the high degree of system automaticity.

b. <u>Prelaunch</u>: The Satellite Test Center monitors the system checkout and the countdown during the prelaunch phases. Specifically, during the system dry run at X-2 days and again during the system countdown at T-5 hours, the DCC will initiate the following activities:

(1) Communication system checkout

(2) Simulation transmission from tracking stations to the computer center.

(3) Dry run orbit calculation

During the system countdown, the launch facilities aspects of the countdown will be under the direct control of the Vandenberg Control Center. The Satellite Test Center, in its direction of the overall countdown, will be continually receiving and retransmitting system status information and other pertinent data such as weather and recovery force status. Vandenberg Control Center will plot the important data received from the STC and in turn, the Vandenberg Control Center continuously will advise the STC of the status of the launch countdown. The Hawaiian Control Center will also be in constant contact with the STC during the countdown. Of particular concern to the Hawaiian Control Center is the estimated time of launch and the weather conditions in the planned impact area. The mission of all control centers during this phase clearly is to establish the readiness of the system for the planned flight. The decision to initiate or delay a launch will be made at the Satellite Test Center.

c. <u>Launch and Ascent</u>: The STC functions, during this phase, will be concerned primarily with system coordination, as follows:

(1) The tracking stations will be alerted and notified of initial orbit parameters.

(2) The Computer Center will be sent the times of vehicle engine start and termination of orbital boost.

(3) The recovery force will be informed of orbit achievement and redirected, if required.

(4) The Vandenberg Control Center functions will be the direct control of the launch facilities and vehicle command during this phase of the test operation.

d. Orbit: The exercise of control over the vehicle in orbit will be limited to the following commands:

(1) Reset of the orbit timer

(2) Adjustment of the orbit timer

(3) Initiation of the recovery sequence, or

(4) Initiation of reconnaissance readout. The intervals at which these commands are given will be controlled by the vehicle position in orbit relative to the tracking stations. Therefore, the STC has very little freedom in command choice or determination insofar as the vehicle itself is concerned. However, it will continuously monitor the SAMOS system during the orbital phase. Unexpected component failure in the vehicle or on the ground will dictate a redetermination of the normal operational sequence.

e. Recovery: The decision to initiate recovery will be made by the STC and the command issued to the vehicle on orbit by one of the SAMOS tracking stations. The aircraft will depart before the dump command is sent. From this point, Hawaiian Control Center will become the focal point for the exercise of system control as delegated by STC. Progress of the search and recovery operation will be plotted against a predetermined time schedule. Periods, which have been established following rigid safety standards, will be allowed for air and sea search. Changes in weather conditions will be carefully evaluated in terms of these predetermined standards. STC will be continuously informed of the progress of the recovery operation. Any decision to postpone or halt the recovery attempt of the capsule search will be made at Sunnyvale Satellite Test Center on the basis of the information received from the Hawaiian Control Center.

6. System Test Evaluation: A comprehensive evaluation of the Recovery and Readout Programs test results will be conducted. The necessary evaluation effort will be accomplished concurrently by designated Air Force, Convair Astronautics and LMSD organizations.

a. Data Flow: System test data generated as a result of the Recovery and Readout Programs will be observed and recorded at geographical locations as follows:

Vandenberg AFB
Telemetry Ship
Kaena Point Tracking Station, Hawaii
Chiniak Tracking Station, Alaska
Recovery Force

Northeast Tracking Station, USA
Central Tracking Station, USAF (Deferred)

The types of data involved are:

Telemetry data
Radar tracking and control data
Launch (umbilical) data
Launch (optical) data
Weather data
Prelaunch servicing notes
Recovery data
Operations data (reconnaissance readout)

To insure the rapid incorporation of test results in the planning and conduct of subsequent operations, it is imperative that a complete evaluation of each test be accomplished within the time span occurring between flights. Every effort will be made, therefore, to streamline the data flow process so that lag times may be minimized.

b. Data Handling Procedures: Each item of data required to evaluate test results will be specified in detailed test objectives for each flight. Because of the many individual pieces of information which must be assembled within a short period of time, every attempt will be made to deliver each item of data within a specified time. Deviations dictated by conditions peculiar to an individual flight will be covered in the detailed test objectives. Other necessary deviations resulting from conditions arising during or subsequent to a test will be coordinated through the STC.

c. Data Reduction: With the exception of data derived from metric optics, all raw SAMOS telemetry test data requiring reduction to usable forms will be processed by the contractor data services. Since nearly all quantitative information derived from a flight will be of this category, rapid processing of such data is essential to the timely flow of information. Also, because of the large volume and random order of arrival of many separate items of data, the processing scheme will be both expedient and highly flexible. To permit an early evaluation of SAMOS results, the data reduction process will be accomplished in two parts, in the manner described below.

(1) "Quick-look" data: Data reduction required to support "quick-look" evaluation activity will be accomplished on a first priority basis after receipt of pertinent data. Nominal "quick-look" data requirements will be specified in detail 60 days prior to each flight.

(2) Final Data Compilation: A final, comprehensive compilation of launch data as required for detailed subsystem analysis will be completed within a period of 3 to 5 days after launch.

d. System Evaluation: A complete evaluation of test results will be made. This evaluation will encompass all weapon system test activities as they affect the achievement of ultimate program goals and objectives. Major emphasis, however, will be devoted to the timely evaluation of system flight tests as required to properly redirect the program. The areas to be covered will include:

(1) Overall system performance in terms of predicted versus actual results.

(2) Validity of test plans and conduct in terms of the timely achievement of test objectives.

(3) Techniques and procedures employed in the conduct of system test operations.

(4) Adequacy and suitability of systems communications, ground support equipment, facilities, and logistics.

Follow-through action will be taken to investigate problem areas revealed by preliminary evaluation and detailed analysis of test activity. The actions permit an integrated evaluation of overall system operation. Necessary remedial actions affecting the planning and conduct of the next test will be coordinated with all organizations concerned and fully implemented at the earliest possible date. Complete and accurate records of program test activity and results will be maintained. A continuing evaluation of system operations on a flight-to-flight basis will be conducted. Operations concepts, equipment, and procedures will be modified as necessary for proper program redirection.

C. <u>GROUND TEST PROGRAM</u>

1. <u>Testing Requirements</u>

a. <u>Ground Tests</u>: In addition to satellite vehicle tests, components, subassemblies, assemblies, and subsystems shall be subjected to development tests, qualification tests, and inspection tests as applicable. These tests are defined as follows:

(1) <u>Development Tests</u>: Development tests shall be defined as those tests conducted on equipment or material for the purpose of evaluation of performance, operation, and limits.

(2) <u>Qualification Tests</u>: Qualification tests shall be defined as those tests conducted on equipment or material for the purpose of evaluation of the operation under environmental conditions specified in the environmental specification.

(3) <u>Inspection Tests</u>: Inspection Tests shall be defined as those tests conducted on articles of a given design for the purpose of maintaining surveillance of quality in accordance with specified requirements.

(4) <u>Payload Orbit Simulation Tests</u>: Ground tests will be conducted on complete ferret and visual payloads that will simulate long term orbital operation. Programmed operations will be conducted in normal orbital sequence to determine weak points within the subsystems and critical items related to the payloads.

b. Reliability Tests: Those tests conducted to determine modes of failure; primarily tests to failure or destruction.

2. Vehicle Systems Tests

a. The vehicle systems test is conducted after all components and subsystems have been installed in the vehicle and is performed in compliance with an Acceptance Test Specification. The test is a detailed checkout and analysis of the performance and interaction of all subsystems when functioning as a complete system. Flight sequences of operation are simulated as nearly as possible. An analysis is made of the effects of such items as control functions, switching transients and radiated interference. All command links are carefully checked, the telemetry instrumentation calibrated, and center of gravity of the vehicle is determined. The engine gimbal axis is aligned. The azimuth indicator of the IR scanner is aligned with a reference azimuth position on the vehicle, and the vertical axis of the payloads aligned with the yaw axis of the vehicle. The telemetry system and umbilical connections are used to monitor selected functions during the system test.

b. The Santa Cruz Test Base (SCTB) is a test facility for captive testing of various configurations of the AGENA vehicle.

c. After satisfactory completion of the flight vehicle systems test at Sunnyvale, the unit will be transported to SCTB. The vehicle will be erected on the test stand and prepared for a systems test during static firing of the engine. Complete instrumentation and monitoring provisions are provided to evaluate all subsystem andsystem performance during engine ignition and firing. Special instrumentation is provided to evaluate vibration effects. Emphasis will be placed on engine performance, including propellant and pneumatic control. Guidance and control components, including engine gimbaling, will be tested during the firing. The umbilical release mechanism and ground support equipment will also be tested and evaluated at this facility.

3. Flight Base Hangar Tests

Upon completion of the vehicle systems development test at SCTB, the satellite vehicle will be shipped to the flight test base. Inside the hangar, access panels will be removed and a visual inspection performed. A systems test will be conducted to check whether any change in performance has been caused by shipment. Subsystems will then be given an acceptance test in the vehicle or on the bench, as required, to insure that no deterioration in performance has occurred. The vehicle will be reassembled and again given a system test to insure that the overall performance is acceptable. This systems test will be similar to that performed during Mod and Checkout except that extended runs in an appropriate cycling operation will be accomplished to establish a reasonable expectation of reliable performance on orbit.

4. Pad Tests

a. After the ATLAS booster is erected on the launch pad, the SAMOS vehicle will be erected and mated with the booster. Mechanical and electrical mating tests will be performed. Subsystem tests will be performed using the remote control functions inside the blockhouse and the RF links to the hangar and the tracking, telemetry, data link, range safety, and guidance stations located at the flight test base. Fueling tests will be performed on the facility checkout vehicle erected on the launch pad. Pneumatic tests will be conducted to check control and leakage; booster/vehicle interface tests will be conducted to test the operation of range safety, guidance, and other intersystem functions. The IR scanning system will be tested through the RF telemeter link and the command circuits from the blockhouse. On early launch vehicles, a dry run countdown will be conducted to ensure adequacy of the countdown, compatibility of the blockhouse remote control function, and satisfactory system performance.

b. Prior to missile launch, the vehicle will be unmated from the booster and lowered for final launch preparations. On early vehicles, after prolonged pad tests, it will be necessary to move the vehicle to the hangar for a complete systems test. Prior to re-erection on the pad, the primary electrical power source and pyrotechnic devices will be installed in an unarmed condition. This function will be performed two days before the launch. The vehicle will be erected the same day, the umbilicals connected, and other pre-countdown preparations will be completed.

c. It is estimated that countdown using the R&D ATLAS booster now requires approximately five hours. The actual countdown time for the booster and vehicle will be dependent on future development of automatic sequencing type launch equipment. The countdown will ensure satisfactory system operation and compliance with all necessary flight preparations. Both the booster and vehicle countdown procedures will be defined and consolidated into a single document. During the countdown, pyrotechnic devices will be armed, the service tower will be removed, remote fueling and pneumatic pressurization will be performed; all subsystems will be tested and monitored through the blockhouse consoles and telemetry, and facility items will be checked and prepared. The umbilicals will be ejected at lift-off.

d. Post-launch tests before the vehicle is in orbit will consist of monitoring the tracking and telemetry data. Real-time readout of position, staging, separation, ignition, burnout and other parameters will be provided. Data reduction of the telemetry and tracking data will provide further analysis of system performance. For the payload systems, telemetry data will monitor vibration frequencies and amplitudes in critical areas.

5. <u>Fly-by Tests</u>

Operations have begun for extensive fly-by tests using T-33 aircraft equipped with a beacon transponder, telemetry transmitter, and flashing lights to check operation and calibration of both the airborne components and the ground station equipment. The tests include S-band beacon interference and operational checkout; tracking antenna (including tri-helix antenna) calibration; TLM-18 telemetry operational checkout and calibration; VELORT tracking radar operation and calibration checkout; tracking station systems checkout; and photo triangulation system operation and calibration ehcekout. As the tracking and telemetry receiving stations employing UHF equipment are readied, additional fly-by tests will be conducted. The tests will be continued for all tracking stations as they become activated. Repeat tests will be required during the course of the program to recheck the operation and calibration of the equipment.

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DEPART[redacted] FORCE
SAMOS PROGRAM
FY 1961 BUDGET ESTIMATE
AND
REVISED FY 1960 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS

FUNDING SOURCE	PRIOR YEARS	FY 1960	FY 1961
FY 1956 - P620			
FY 1957 - P131	389,245		
FY 1957 - P620	3,900,000		
FY 1958 - P131	10,000,000		
FY 1958 - P151	41,500,000		
FY 1958 - P244	70,000		
FY 1958 - P313	7,600,000		
FY 1958 - P321	920,000		
FY 1958 - P620	5,874,000		
FY 1958 - P684	9,998,553		
FY 1959 - ARPA Order #9-58	675,000		
FY 1959 - P270	96,600,000		
FY 1959 - P321	350,000		
FY 1959 - ARPA Order #41-59	3,599,000		
	9,000,000		
FY 1960 - P321		2,545,000	
FY 1960 and FY 1961 - P630		160,000,000	[redacted]
TOTAL	190,475,798	162,545,000	

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DEPARTMENT OF THE AIR FORCE
SAMOS PROGRAM
FY 1961 BUDGET ESTIMATE
AND
REVISED FY 1960 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS

FUNDING SOURCE	PRIOR YEARS	FY 1960	
FY 1956 - P620	389,245		[redacted]
FY 1957 - P131	3,900,000		
FY 1957 - P620	10,000,000		
FY 1958 - P131	41,500,000		
FY 1958 - P151	70,000		
FY 1958 - P244	7,600,000		
FY 1958 - P313	920,000		
FY 1958 - P321	6,174,000		
FY 1958 - P620	9,998,553		
FY 1958 - P684	675,000		1002
FY 1959 - ARPA Order #9-58	96,600,000		
FY 1959 - P270	350,000		
FY 1959 - P321	3,599,000		
FY 1959 - ARPA Order #41-59	9,000,000		
FY 1960 - P321		2,545,000	
FY 1960 and FY 1961 - P630		160,000,000	[redacted]
TOTAL	190,775,798	162,545,000	

(Revised 24 Feb 60)

DEPARTMENT OF THE AIR FORCE
SAMOS PROGRAM
FY 1961 BUDGET ESTIMATE
AND
REVISED FY 1960 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS

	PRIOR YEARS	FY 1960	[redacted]
Lockheed	129,750,622	83,300,000	[redacted]
Communications and Control		31,000,000	[redacted]
Spares		1,900,000	[redacted]
Atlas Boosters	14,800,000	14,800,000	[redacted]
RADC	13,321,912	24,200,000	[redacted]
AFCRC	2,901,470	1,500,000	[redacted]
MIT	3,320,000	700,000	[redacted]
STL	600,000	1,000,000	[redacted]
Industrial Facilities	3,712,336	282,000	[redacted]
Facilities	19,593,000	2,545,000	[redacted]
Other	2,676,458	1,318,000	[redacted]
PROGRAM TOTAL	190,775,798	162,545,000	[redacted]

(Revised 24 Feb 60)

GENERAL STATEMENT

1. This section contains the consolidated facility requirements for SAMOS Research and Development which must be included in the FY 1960 Military Construction Program to insure their availability on a schedule compatible with the other phases of the total system. Facilities shown herein are required to support the following functions of the program: booster and vehicle assembly and checkout; launch; guidance; satellite tracking, control, and telemetry; data reception, interpretation and dissemination.

2. Boosters and Vehicles will be maintained, reassembled and checked out in the Missile Assembly Building at Vandenberg AFB. The missiles will be launched from Launch Complex Nr. 1 at Point Arguello. The existing SM 65-1 MOD II Guidance System at Vandenberg AFB will be utilized. Launch data will be obtained by utilizing VHF facilities at the Vandenberg AFB Tracking Stations and the Downrange Telemetry Ship. Orbital tracking, command and data readout will be performed initially at the Vandenberg AFB Tracking Stations. As the system develops, additional tracking capability will be available at the Kaena Point, Hawaii and New Boston, New Hampshire Tracking Stations. Additional Data Readout capability will be available at the New Boston Tracking Station. A Satellite Test Center located adjacent to the AGENA production plant at Sunnyvale, California will serve as a command, administrative and control center throughout the development phase.

3. Prior years' military construction programs have provided the following facilities: Missile Assembly Building at Vandenberg AFB for reassembly, checkout and maintenance of boosters and vehicles; Launch Complex Nr. 1 at Point Arguello; Tracking and Data Acquisition Stations at Vandenberg AFB, Kaena Point, Hawaii; and New Boston, New Hampshire; Downrange Tracking and Control Station at Naval Air Missile Test Center, Point Mugu, California; Tracking and Control Station at Annette Island, Alaska; and Increment Nr. 1 of the Satellite Test Center, Sunnyvale, California.

4. Generally, the facilities requested in the Development Plan for the FY 60 MCP consist of the following: Additional support facilities at the Vandenberg AFB Missile Assembly Building and for the Point Arguello Launch Complex Nr. 1; a Fuel Storage and Disposal System at Vandenberg AFB; and Increment Nr. 2 of the Satellite Test Center, Sunnyvale, California.

5. Technical facilities have been sited in a manner that will permit maximum utilization of support facilities at existing military bases or contractor plants. Support facilities required and rehabilitation of facilities in existing military bases required to support the technical facilities are included. Industrial Facilities (P-151) are not included in this section.

6. AF Form 161 which contain a detailed description of each project based on the best knowledge available at this time and justification for the requirement are contained under separate cover.

7. Planning and design costs to be incurred by the Corps of Engineers and Bureau of Yards and Docks for the projects in this Development Plan are not included.

8. Definitions of MCP actions associated with this section are as follows:

a. Design Start Date: The date upon which the design agent commences preliminary design. Implicit in this date is the understanding that approval of the project will have been received, design funds will have been made available, an Architect-Engineer will have been selected and design guidance furnished him by the Air Force or its agent.

b. Design Completion Date: The date upon which the Air Force receives final drawings and specifications from the Architect-Engineer for review and approval. It also indicates that, prior to the date shown, preliminary drawings and specifications will have been submitted, reviewed and approved and a control estimate provided.

c. Construction Contract Award: The award to the contractor, made after approval of final drawings and specifications and receipt of funds. Dates shown assume issuance of Notice to Proceed at same time as award.

d. Construction BOD (Beneficial Occupancy Date): The date when buildings and/or other construction will be completed to a point that will permit occupancy by the using agency for the purpose of installation of unit equipment, special and/or fixed equipment that is not included as construction contractor-installed property.

9. Index Identification System numbers are included to furnish a uniform code and reference system for each item in the plan. The Index Identification System is made up as follows:

BMD INDEX IDENTIFICATION SYSTEM

Part I Base or Location

1. Edwards AFB
2. Holloman AFB
3. Patrick AFB
4. Vandenberg AFB
5. ATLAS OPNL Bases
   - 5A. Warren I & II
   - 5B. Offutt AFB
   - 5C. Fairchild AFB
   - 5D. Forbes AFB
   - 5E. Schilling AFB
   - 5F. Lincoln AFB
   - 5G. Warren III
   - 5H. 10th Squadron
   - 5I. 11th Squadron
   - 5J. 12th Squadron
   - 5K. 13th Squadron
6. TITAN OPNL Bases
   - 6A. Lowry AFB
   - 6B. Ellsworth AFB
   - 6C. Mt. Home AFB
   - 6D. Larson AFB
   - 6E. Beale AFB
   - 6F. 7th Squadron
   - 6G. 8th Squadron
   - 6H. 9th Squadron
   - 6I. 10th Squadron
   - 6J. 11th Squadron
   - 6K. 12th Squadron
   - 6L. 13th Squadron
   - 6M. 14th Squadron
7. MINUTEMAN OPNL Locations
8. SPACE SYSTEMS Locations
   - (1. Edwards - As listed above)
   - (2. Holloman - As listed above)
   - (3. Patrick - As listed above)
   - (4. Vandenberg - As listed above)
   - 8A. Pt. Arguello, Calif.
   - 8B. New Boston, New Hampshire
   - 8C. Ottumwa, Iowa
   - 8D. Ft. Stevens, Oregon

Part I Base or Location - Contd

- 8F. Alaska
- 8G. Greenland
- 8H. United Kingdom
- 8I. Sunnyvale, Calif.
- 8J. Pt Mugu, Calif
- 8K. Africa
- 8L. Offutt AFB

Part II Item Functional Category
R&D & Space Systems Opns

1. Launch
2. Launch Support
3. Area Support/Missile Support
4. Range/Tracking/Telemetry/Control Ops
5. Captive Test
6. Special Test
7. Captive Test Support
8. Ground Based Communications

Training

1. Training Launch Facilities
2. Technical Training Facilities
3. Support

ICBM Operations

1. Launch
2. Launch Support
3. Guidance
4. Command and Communications
5. Support Center or Base
6. Missile Support

(Contd)

Part III Weapons Systems or Weapons System Phase

1. WS 107A-1
2. WS 107A-2
3. WS 315A
4. SAMOS & MIDAS

4A. Communications Satellite
4B.
4C.

5. Common Facility (2 or more WS or uses)
6. ICBM - IOC
7. IRBM - IOC
8. WS 133A

Part IV Line Item

Each line item listed under a Functional Category is numbered consecutively.

NOTE 1: The BMD Index Number consists of the four basic parts listed above, Parts I, II, III, and IV.

PART I defines the location or base. This is indicated by the first numerical digit and the alphabetical digit, if any, immediately following the first digit. As noted above, the ARDC centers and Vandenberg AFB are identified by the first numerical digit alone.

PART II defines the items functional category, i.e. R&D, Training, Support, etc. This is indicated by the second numerical digit of the number.

PART III defines the Weapon System. This is indicated by the third numerical digit and the alphabetical digit, if any, immediately following the third numeral. Certain systems are defined by the third numeral alone (ATLAS, TITAN, SAMOS, MIDAS and IRBM systems).

PART IV indicates the line-item sequence for each base, within each functional category.

Example : BMD Index Nr 8F4.4.A1
(8F) represents a Space System location in Alaska: the first (4) indicates the tracking function of the project; the (4.A) indicates the Communications Satellite System; the (1) indicates the first line item at that location for the specific system and function.

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FACILITIES SUMMARY

FOR

SAMOS R&D

TYPE FUNDS: P-300

(FIGURES ARE IN MILLIONS OF $)

ITEM CATEGORY:		BUDGET ESTIMATE					
		PRIOR YRS	FY 58	FY 59	FY 60	FY 61	TOTAL
Launch	Point Arguello, Calif			6.096	.425		6.521
Launch Support	Vandenberg AFB				.250		.250
Missile Support	Vandenberg AFB		.304	2.545	.750		3.599
Control Operations	Sunnyvale, Calif		1.500		1.120		2.620
Tracking & Telemetry	Vandenberg AFB		2.275				2.275
Tracking & Telemetry	New Boston, N.H.			3.369			3.369
Tracking & Telemetry	Hawaii		1.715				1.715
Tracking & Telemetry	Alaska		.062				.062
Tracking & Telemetry	Point Mugu, Calif		.018				.018
Control, Data Handling*	Offutt AFB		.300				.300
Advance Project Planning			.920	.589	.100		1.609
			7.094	12.599	2.645		22.33?

*(Early Fix)

?DLP?-251 (Change No. 1, 15 Mar 5?)
III 5

(Revised 24 ... ...)

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Type Funds: P-300 MCP

BUDGET ESTIMATES

LOCATION (8A) POINT ARGUELLO, CALIF

	FY 60	FY 61	TOTAL
SAMOS	.425		.425

(Figures Are In Millions of $)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP.	AWARD	BOD
8A1.4.1	G/M Launch Facility Nr 1 (Addn)				.425		01/60	02/60	02/60	06/60

WDLPB-251 (Change No. 1, 15 Mar 60)
III-6

LOCATION: (8A) POINT ARGUELLO

SAMOS

ITEM CATEGORY: (1) Launch

DESCRIPTION AND UTILIZATION:

The SAMOS launch complex, consisting of two (2) launch stands and one (1) blockhouse was funded under the FY 59 Military Construction Program. This FY 60 project will provide technical and support facilities at this launch complex including maintenance shops, engineering and administrative offices, military ready room and training classrooms, a shelter for protection of the AGENA vehicle during prolonged holds during countdown, a building to house a 1750 KW electrical generator, camera shelters, utilities and supporting items as required.

Type Funds: P-300 MCP

BUDGET ESTIMATES

LOCATION (4) VANDENBERG AFB

	FY 60	FY 61	TOTAL
SAMOS	0.250		.250

(Figures Are In Millions of $)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP.	AWARD	BOD
42.4.3	Propellant Storage and Disposal Facility				.250		01/60	02/60	02/60	06/60

SECRET
(When Filled In)

LOCATION: (4) VANDENBERG AFB

SAMOS

ITEM CATEGORY: (2) LAUNCH SUPPORT

DESCRIPTION AND UTILIZATION:

These items will be provided to support the DISCOVERER, SAMOS, MIDAS, and COMMUNICATIONS SATELLITE programs, and other future space programs at Vandenberg AFB and Pt Arguello. The storage facility will provide bulk storage for IRFNA and UDMH in quantities sufficient to insure an uninterrupted fuel and oxidizer supply at the launch stands, but not so large as to create a safety hazard for the base. The disposal areas will provide for the burning and/or leaching of UDMH & IRFNA when contaminated during launch operations. Present interim storage facilities are inadequate to support continuing large-scale launch programs such as SAMOS and MIDAS. This facility is needed also to provide for the safe and economical handling of fuels and oxidizers. The disposal facility is required for the elimination of hazardous storing and handling of contaminated propellants which, for the lack of disposal facilities, have to be shipped off-base at the present time

SAMOS

Type Funds: P-300 MCP

BUDGET ESTIMATES

LOCATION (4) VANDENBERG AFB

FY 60	FY 61	TOTAL
.750		.750

(Figures Are In Millions of $)

BMD ndex Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUC	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP	AWARD	B
43.4.4	Missile Support Facilities				.750		01/60	02/60	02/60	06/

SECRET
(When Filled In)

LOCATION: (4) VANDENBERG AFB

ITEM CATEGORY: (3) Missile Support

SAMOS

DESCRIPTION AND UTILIZATION:

This facility will provide the following:

a. GSE shops and maintenance and component storage areas in support of the ATLAS-booster assembly area, SAMOS G/M Assembly-Command and Administration Facility.

b. Component storage areas in support of the AGENA vehicle assembly area, SAMOS G/M Assembly-Command and Administration Facility.

c. Administrative space to house personnel required to operate the above facilities, paragraph a and paragraph b.

d. Helium off-loading facilities in support of the ATLAS booster assembly area, SAMOS G/M Assembly-Command and Administration Facility.

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Type Funds: P-300 MCP

BUDGET ESTIMATES

LOCATION (8I) SUNNYVALE CALIF

	FY 60	FY 61	TOTAL
SAMOS	1.120		1.120

(Figures Are In Millions of $)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTI(	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP	AWARD	BO
8I4.4.2	SATELLITE TEST CENTER				1.120		01/60	02/60	02/60	06/6(

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WDLPR-251
III-12

LOCATION: (8I) SUNNYVALE, CALIF.

SAMOS

ITEM CATEGORY: (4) Control Operations (Satellite Test Center)

DESCRIPTION AND UTILIZATION:

Satellite Test Center (Increment Nr 2): This is a 46,000 SF addition to the Satellite Test Center, Increment Nr 1, and includes the additional elements and expansion of facilities necessary for completely autonomous operation of the center. The Increment Nr 1 facility consisted of a 54,000 SF building. Function of this facility is to control research and development of a large scale data-gathering weapon system. The facility will serve as a control point for data receiption, processing and procedures of the system. Space is provided for the R&D System Test Control Manager, the Development Flight Test Control Organization, managerial contractor, and the technical and administrative personnel conducting the operation of the entire weapon system during the R&D phase. The specific functions provided for are R&D Test Control, communication sub-system operation, engineering evaluation, flight test analysis, scientific data analysis, verification, program information center, administrative offices, office services, maintenance and storage.