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HEADQUARTERS

AIR RESEARCH AND DEVELOPMENT COMMAND

(UNCLASSIFIED TITLE)

SAMOS R&D PROGRAM

11 August 1960

REVIEW ON 31 Dec 2010

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B. A. Schriever
Lt. General, USAF
Commander

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AIR FORCE BALLISTIC MISSILE DIVISION

AIR RESEARCH AND DEVELOPMENT COMMAND

5 August 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 Hq USAF guidance for technical emphasis. 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.

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. This plan does not include any concurrent operationally directed efforts during FY 61 and FY 62.

The plan described herein can be summarized as an essential research and development program capable of satisfying the SAMOS research and development objectives, responsive to the overall intelligence requirements of the USIB.

It is recommended that the plan be approved as written and funded in accordance with the FY 1961 Financial Plan and FY 1962 Budget Estimate included in the plan.

for O. J. RITLAND
Major General, USAF
Commander

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MANPOWER SUMMARY

1. Effective with the realignment of the SAMOS Program the initiation of many augmentation features will have a considerable impact on personnel requirements not only at AFBMD but at various supporting agencies. Included in the augmentation features, which will require additional effort are:

a. Technical facilities for testing components, subsystems, and complete systems under appropriate environment for extended periods of time.

b. Additional special testing, including reliability testing, at not only the prime or integrating contractor facilities but at the various new subcontractor facilities which must be monitored closely to assure progress matches the desired time schedules and quality requirements.

c. Additional contractors involved in the new search camera and recovery subsystem fields will require a considerable increase in travel requirements for the Program Office and supporting agency personnel.

d. Workload imposed due to initiating a THOR launched component test program at a separate facility and the possible utilization of the AMR will again require an extensive increase in travel by appropriate project personnel.

2. The above technical requirement load and the plan to establish a new integrating contractor, which may not be LMSD for the new parallel dual development of the new E-6 cameras and associated recovery subsystems, will expand the workload at AFBMD for the SAMOS Program Office and supporting Directorate personnel an estimated 50%. Accordingly, detailed justification and establishment of new personnel requirements is being provided by separate correspondence related to this plan. It is essential that expedited recognition and support of these additional manpower requirements be provided if these accelerated and augmented SAMOS efforts are to proceed as rapidly and effectively as desired.

AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)

SAMOS DEVELOPMENT PLAN

TABLE OF CONTENTS

BACKGROUND SUMMARY

The SAMOS Program is a program currently documented under AFBMD Regulation established under Gillette Procedures. Under this documentary procedure, formalized development plans have been the basis for development of the system. The latest previous development plan was submitted 15 January 1960. For a complete background, these development plans offer detailed information.

The SAMOS Program has had several designations and has been a part of the broader WS 117L or Advanced Reconnaissance System. It will be noted that the program had its genesis at the RAND Corporation as early as 1946. It then had a period of limited activity, except for studies, culminating in the publishing of RAND Report 262 (November 1953 and February 1954). This report attested to the feasibility of a satellite as a platform from which intelligence sensors might be operated and recommended that development proceed. 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 Corporation, 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. The development and test of WS 117L was awarded the Lockheed Aircraft Corporation 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. At this time, the executive management of the project was designated to be 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.

On 30 June 1958, the Advanced Research Projects Agency (ARPA) Order No. 9-58 was issued confirming Department of Defense directives for the assumption of responsibilities 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. SAMOS remained an ARPA responsibility until very recently.

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 reassignments to the Air Force of MIDAS and SAMOS. The date of transfer of these systems from the Advanced Research Projects Agency (ARPA) to the Air Force was to 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 departments would submit for approval to the Secretary detailed plans for the system including our relationship with Unified and Specified Commands and other appropriate agencies.

Development plans, dated 15 January 1960, were prepared in response to these instructions. These plans were submitted in two parts. One part encompassed the basic R&D program, another part outlined the operational aspects of the program. The Air Force submitted the plans, in its two parts, to the Department of Defense. At this level the SAMOS basic R&D program was approved to the extent of releasing those funds required to pursue the FY 60 portion of the basic R&D program. Approval of the basic R&D program for FY 61 has been "tentatively" granted at a slightly lower fund level than requested. The operational FY 60 and FY 61 program has been withheld primarily because of the Air Force's approach to the operational aspects of the program. It was felt that the Air Force's plan to proceed with a separate operational program at this time would be to the detriment of the national interests. An attempt to gain a separate operational capability at this time was expected to interfere with the research and development program and would have the effect of delaying the over-all program and raise the program cost. Available funds were to be utilized to emphasize research and development in such a manner as to obtain proven feasibility and reliability of the system at the earliest date.

Early in June 1960, direction to submit a revised SAMOS Development Plan was received from AFDSD (Letter, subject: Exploitation of Initial SAMOS Data, dated 1 June 1960, signed by Lt. Gen. Wilson). The letter stated that a re-evaluation of plans was required because of (1) technical uncertainty as to the character and quality of information that may be obtained by the different SAMOS payloads, and (2) because the character of the initial operational program will be strongly conditioned by the R&D results. The letter directed parallel R&D testing of readout and recovery, earliest achievement of flight dates, and provision for a minimum capability to process intelligence "take".

Other guidance was received in mid-June 1960 in the form of a study on SAMOS prepared in the OSD (DD/R&D). This study proposed reduction in the planned photo readout program, and institution of additional photo recovery payloads.

Based on this guidance, a proposed program was presented to the AFBMC on 15 July 1960 and to the Department of Defense on 18 July 1960.

Specific direction from Hq USAF, as a result of these presentations, has been received (AF DSD-AT 71953, dated 23 July 60) and the plan which follows has been prepared to conform to the guidance received.

DESIGN CONSIDERATIONS

I. INTRODUCTION

A. OBJECTIVES FOR SAMOS

1. The national importance of timely intelligence is fully recognized. In examining how well SAMOS will contribute to satisfying the intelligence needs of the country the following points must be kept in mind.

a. SAMOS will complement and supplement, but not necessarily replace, other intelligence collection systems and techniques. It should be considered as a very productive and timely adjunct to all other sources.

b. SAMOS has two major unique characteristics (common to satellite systems) which set it apart from other collection systems:

(1) It is capable of unlimited geographic access with the least risk of major political ramifications.

(2) It is capable of high repetitive world-wide collections in a very time responsive manner.

2. The SAMOS R&D effort is likely to produce, as a part of its controlled R&D testing, intelligence information of a great value which will be reflected in modification of the requirements. The system must not be limited to the support of only military requirements. It must be basically responsive to intelligence and surveillance requirements as dictated by national policies.

3. Intelligence requirements to be satisfied by Satellite Reconnaissance System such as SAMOS have been passed to the program by the United States Intelligence Board (USIB-D-33.6/8 dated 5 July 1960). Depending upon state-of-the-art considerations, the SAMOS Program will be addressed to developing sensors and related equipments to permit the reconnaissance of:

a. Terrain and culture features of the earth's surface; i.e. visual aspects by photos or other means.

b. Electromagnetic emission; i.e., Ferret, Comint, other.

4. Within these broad reconnaissance areas, the first priority shall be to provide a broad base of coverage over designated large areas of the earth. The resolution or nature of this broad coverage should be compatible with providing this coverage at the earliest possible time. There is the additional requirements to provide surveillance or observance of selected areas on a "more sophisticated"

basis in a repetitive manner. Also, sensors must be developed which can collect information which will be useful in assessing technical accomplishments or capabilities of specified nations. The timeliness of the development of these sensors must be emphasized.

5. The following is an abstract from the above referenced USIB document:

* * * * *

"At the present time, the U.S. Intelligence Board is faced with several outstanding problems which should be considered on a priority basis for system development and employment of the photographic satellite vehicles during the 1961-1962 time period as follows:

(1) a. Our first and most urgent priority requirement is for a photographic reconnaissance system capable of locating suspect ICBM launch sites. It is estimated that many sites for the launching of operational Soviet ICBM's will be completed between now and the end of 1962. It is our strong belief that our best and possibly our only chance to detect these sites will be during the construction phase; once these sites are completed, we will have considerably less opportunity to detect them. It is important, therefore, that a maximum effort be made to find the Soviet operational ICBM launch sites before the end of 1962. Once any ICBM site is located, a satellite reconnaissance system with adequate ground resolution should be able to maintain surveillance and report changes in its status, but if these sites are not located before the end of the construction phase almost any reconnaissance system would be of considerably less value against such a target. We believe that if we are to find the Soviet operational ICBM launch sites, our highest priority effort should be directed to a general search of a substantial portion [redacted] Photo[redacted]on [redacted] search mission would need to approach 20 feet on a side. Repetition of this general search at the rate of approximately once each month initially would give us a relatively high degree of assurance of providing the information required. Read-out of the photography on this frequency would establish trends and priorities for the programming of subsequent search missions. It is expected that the photography will also be used to supplement that obtained by other means for the improvement of mapping and more precise location of targets in the Soviet Union in response to the Emergency War Plans of the Armed Services.

b. If suspicious locations are identified which might be possible ICBM launch sites, these locations will be added to the highest priority category of the National Priority Reconnaissance Requirements List. Our second priority requirement, therefore, is for photographic coverage of the highest priority target category in the USSR, with a photographic system of sufficient resolution to supply us with descriptive information on those targets. It is believed that resolution approaching 5 feet on a side is necessary for this requirement. There should be a capability to launch and/or control these missions on-call at short notice to meet the needs of the intelligence situation as it develops.

c. Our third priority requirement is for a photographic system of sufficient resolution to supply us with the technical characteristics of the highest priority targets before the end of 1962. This will require a resolution of better than 5 feet on a side.

d. If technological development barriers preclude the design objectives for resolutions described above, the USIB will designate resolutions which are acceptable from an intelligence standpoint."

* * * * *

6. Information collected of intelligence value during any portion of the program, including initial R&D take, will be made available to the intelligence community. <u>It is considered to be a mandatory objective of the SAMOS R&D program to collect information of intelligence value as soon as practicable in the flight test program. This practicability is a function of requirements for sound development and testing (including diagnostic testing)</u>.

B. <u>GENERAL DEVELOPMENT CONSIDERATIONS</u>

1. It is of the highest priority for this system to satisfy critical collection requirements at the earliest time. So far as the agency operating the devices is concerned, the means by which this requirement is met or the development status of the system is unimportant in satisfying the requirement. Thus, there is latitude to depart from the classical system development approaches and to depart from classical military planning for the deployment of the system, particularly since:

a. It is evident that the over-riding problem for at least the ensuing few years will continue to be the development problem due to the uniqueness of the unattended satellite platform as a collection system. This has required advances in the state-of-the-art during the past years. Many of these advancements, although presently incorporated in the system design, are yet not thoroughly proven and are critical to the satisfactory routine performance of the system.

b. The nature of the intelligence mission requires flexibility of operation with multi and/or adaptable sensors. It is improbable that any model of sensor will be serially produced in large quantities. Job shop production and special handling may be expected to keynote the preparation of sensors for some time to come. It is also contemplated that various aspects of the vehicles and boosters will be subject to modification as a result of sensor variation to meet mission requirements.

c. The types of information collectable, information rates, scales and scope of photographic coverage, high coverage repetition rates for both visual and electronic sensors, and the geo-time correlatable nature of mixed sensor information, are relatively new and unique.

2. Carefully controlled experimentation and study of both the collection and the analysis functions must be conducted during the R&D period with test results to determine the best methods of employment and information processing prior to the establishment of firm operational doctrine and procedures. Dual development approaches are necessary in many areas in order to optimize and/or assure success of the system. The selection of single approaches should be postponed until appropriate feasibility and reliability can be demonstrated. Standardization, design freezes and other "over control" during development can only inhibit the efficient development of this unique system.

3. <u>The pacing nature of the development program, the inability to define fully the requirements for exploitation of the system, and the requirement for flexibility in the sensors, gives the strong indication that the SAMOS System will have an "R&D complexion" for some time to come and if not throughout its life.</u> Therefore, the stringent assignment of particular requirements for an "operating system" can be postponed until more is learned of system capabilities, information processing methods and the realistic requirements for the time period under consideration.

4. A system as important as this must be given every opportunity to succeed. Therefore, we must fully exploit <u>on a continuing basis</u> the maximum levels of American technology.

5. Coincident with the requirement for special and unique equipment and techniques is the requirement for relatively small units of specially skilled personnel to operate the equipment. Much of the advantage of improved techniques and methodologies can be lost because the complexities attending the new compact operations come into conflict with the G.I. concept which is established to satisfy wide-spread large

scale operations.

6. This system in particular, involving as it does the use of widely varying equipment systems and techniques in most phases, may not lend itself to the "standard force" concept of operating personnel. Therefore, careful consideration should be given to the utilization of very skilled technical specialists in combination with experienced and sympathetic operational personnel in every phase of the SAMOS System.

7. The requirement for complex non-standard equipment, specially skilled technical personnel and maximum security to perform the mission at a modest level of effort, are not compatible with standard Air Force organizational and logistic concepts. The R&D facilities for launch, tracking, command, readout and processing required for the system testing and to gain the maximum amount of intelligence during the R&D phases can all be utilized for the later "operational" phase of the program, rather than considering the establishment of an entirely new duplicate set of facilities and equipments.

8. It is not possible, for instance, to take immediate advantage of state-of-the-art improvements in equipment and techniques on a mass production basis. The standardization of equipment necessary for force-wide use within the Air Force restrict us, time-wise and money-wise, to major equipment improvements, thoroughly tested and programmed, and for the operation of which large numbers of personnel can be early trained. This is unlikely to ever be the case. The relatively small centrally controlled system of high collection rate capability will most likely be singularly unique and certainly firmly fixed geographically. These features make the system very amenable to special treatment from an organization and logistic viewpoint. Even still, certain portions of the system may be subject to some degree of standardization. These must be individually examined and standardization should take place when it is clearly apparent these will not inhibit flexibility and capability of the system.

9. Security of the operation is yet another complex problem. For all these - the changing nature and detail of the national requirements, the many unknowns surrounding the full utilization of the unique data collected, the complex and experimental nature of the equipments comprising the system and the combination of special technical and operating skills of the personnel required for sensible system operation - the results, methods and techniques obtained and learned during the planned R&D program, will provide a preliminary yardstick to determine the firm future course of action. Therefore, the SAMOS Employment Program should be guided by the following considerations:

a. Remain completely flexible to permit fulfillment of changing requirements (compression of lead time between expression of need and examination of flight results).

b. Retain ability to incorporate extremely complex experimental equipment into its operations means that very close contact with ARDC developers is required.

c. Be staffed by specially trained, technical personnel in combination with personnel experienced in reconnaissance and intelligence operations.

d. Integrate closely all elements of the system to provide for high system response and to provide a means of applying maximum security cover to portions of the "take" of the operation if this is deemed desirable. Likewise, if it is a possibility that the program or elements thereof become unclassified at some point in time, this compact integration of all system elements will provide the least risk of security compromise.

C. REQUIRED PROGRAM ALIGNMENTS

1. NEW DEVELOPMENT EFFORT

a. An appraisal of the development program which existed to the time of this Development Plan will show that primary emphasis and effort has been directed toward providing a relatively high resolution (5') photo sensor system and a medium resolution (20') readout surveillance. Both of these photo systems are limited in swath width and search capability. A review of the USIB priority requirements indicates that highest priority is placed upon "general search of a substantial portion of [redacted] The search should be at 20' resolution. Repetition of this general search is required.

b. It is evident that the past development apportionment of efforts is not compatible with the latest USIB established priorities.

c. Therefore, this Development Plan includes a major new development effort addressed to providing a "search capability". This search capability will be provided by new recoverable photo (film) technique system. The system will have a 20' resolution (or better) capability. Gross area coverage per orbital trace will be a feature. Accurate overland recovery of the exposed film will be included. Subsequently, in this plan, this new "Search Capability" (Area Coverage Reconnaissance) has been designated an E-6, includes back-up recovery systems. An application of the ATLAS ICBM will be used as the initial or sole stage for the launch of this system.

d. In pursuing this new effort, emphasis will be placed on technical soundness; the Aerospace Corporation will participate in a technical role. The contractor base will be broadened, with competition a factor.

2. CHANGES TO PROGRAM IN BEING

The existing program has been a minimum R&D effort in terms of "back-up" and depth. In line with the new guidance and the importance placed upon early accomplishment of objectives, many changes to the "program in being" are included in this plan. It is important to understand that the program which is in being offers the best and only opportunity for early flight testing and resulting intelligence "take". Unfortunately, the initial flight tests cannot be made with a system of optimum characteristic for the highest priority search requirement. This must follow on an accelerated basis. Many changes have been directed which will assure the early flight success of the program. In order that maximum effort be placed upon the "Search" problem, the Surveillance System (E-2) has been reduced in scope of flight testing; the Ferret (F-2) testing has been reduced, and launches of the F-3 have been eliminated for the time being.

3. INCREASED TECHNICAL (development) SCOPE

This plan will direct emphasis on studies, research, and development which will lead to solution of such problems as (1) obtaining one (1) foot resolution from satellites, (2) the weather (cloud coverage) effect, (3) special sensor applications (new stereo techniques, optics, filters, stabilization, etc.), (4) employment techniques, (5) special Ferret applications and (6) recovery techniques.

D. SYSTEM CONCEPT

1. The SAMOS concept utilizes satellite vehicles, modified ICBM and IRBM boosters, launch facilities, tracking facilities, and a 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 90-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 appropriately 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. Sensors aboard the orbiting vehicle will record intelligence information over areas of interest. Two types of ground-space links will be developed for SAMOS data retrieval: Physical recovery and electronic

readout.

2. Re-entry and recovery will be achieved by two methods:

a. High Resolution Flights (E-5): 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. Over-land as well as over-water recovery is planned. At the proper altitude a parachute system will be deployed. Simultaneously, the recovery capsule radio beacon and light 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.

b. Search Resolution Flights (E-6): The re-entry and recovery sequence of operations may be initiated by the vehicle timer, or by ground command. The vehicle will provide all control and stabilization function up to capsule separation from the vehicle. The recovery capsule will then be separated from the satellite vehicle and propelled in an appropriate re-entry trajectory. The initial recovery will be accomplished over water with eventual recovery being accomplished over land. The impact area initially will have a 5 nm radius with an ultimate goal of 1 nm radius. Various re-entry and recovery techniques will be considered.

3. The satellite vehicle equipment used in the readout portion of the SAMOS program will be programmed by a 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 at least 4 months for visual reconnaissance equipment.

4. 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.

The further development use and planning for Subsystem I requirements is contained in Appendix I to this Development Plan, which is to be published at a later date.

E. PROGRAM ELEMENTS

1. Visual Reconnaissance (Subsystem E)

a. Recovery

(1) One recovery portion of the SAMOS Program will provide a payload (E-5) which will be designed to obtain high resolution visual 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 with approximately a seven day film supply when used on every daylight pass over the target area. Total coverage of 6,000,000 nm^2 can be obtained. Payload steering and programming permit target selection. A stereo capability can be used as desired for selected target areas. The data will be returned to earth in a recovery capsule ejected from the satellite vehicle.

(2) Major emphasis in the program will be placed on providing a visual reconnaissance payload (E-6) designed to attain 20 foot or better ground resolution with a location accuracy of one nautical mile. It will have an active orbit life up to 8 days with a potential ground coverage in excess of 9,000,000 nm^2. This will provide a search capability.

(a) Because of the urgency of obtaining a recovery system with a payload of the E-6 characteristics, it may be desirable to fund and pursue parallel approaches through the design phase of the development; thereby minimizing the probability of overlooking the most desirable and expeditious approach.

b. Readout

(1) The E-1 is a visual reconnaissance component test payload. It is intended to attain a 100' ground resolution with location accuracy of one nautical mile. It contains a slit camera with inflight processing and negative storage. On command from a ground station, the negative images are scanned and converted to electrical signals which are transmitted to the ground station. Here ground reconstruction equipment changes them back to photographic images.

(2) The E-2 is a readout payload with steerable visual reconnaissance features permitting target selection and stereo coverage. It is intended to attain a 20' ground resolution with location accuracy of one nautical mile. Like E-1, it contains a slit camera, but of greater focal length. In-flight processing, scanning, transmission and ground reconstruction are the same as in E-1.

2. Electronic Reconnaissance (Subsystem F)

a. The equipment required to conduct reconnaissance in the portion of the electromagnetic spectrum between 60 and 18,000 megacycles consists of satellite-borne receiving equipment including the data processing and storage capabilities required to return meaningful reconnaissance data to the ground data handling facilities. Ground-based equipment will be required for inflight calibration and vehicle equipment adjustment plus the transmission of reconnaissance data to the data processing facilities.

b. This subsystem includes equipment developed to provide for the examination of electronic emissions from any part of the Soviet Bloc both from the point of view of over-all emitter activity and close examination of specific emitters or areas. The general coverage vehicle (F-2) is capable of producing a digital readout identifying all emitters intercepted [redacted] thereby providing complete coverage of [redacted] entire Soviet land mass once every five days. The system will be increasingly sophisticated to assure recognition of new exotic type emitters presently under development. A specific mission vehicle (F-3) is under design and engineering study to provide the capability of looking at specific emitters in great detail and to exploit the take of the F-2 and other intelligence sources. An F-4 system has also been under study to accomplish these missions more effectively using advanced techniques and combining the advantages of both type systems.

3. Data Processing (Subsystem I) See Appendix 1 to be added at a later date.

F. DEVELOPMENT APPROACH

1. General

a. The objectives of the SAMOS Program will be fulfilled with a development approach which includes 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 contractor's plant. The SAMOS R&D Program will, where applicable, make maximum use of ground installations and equipments associated with the MIDAS and DISCOVERER Programs. The Agena satellite vehicle developed jointly under the SAMOS, MIDAS and DISCOVERER Programs will be utilized as the orbital stage for all SAMOS flights with the possible exception of the new search system, which may not necessarily require a second stage.

b. SAMOS flights will utilize Atlas Series D or E boosters. Some component testing will be accomplished using THOR boosted vehicles.

c. Provisions will be made for forwarding reconnaissance data, collected during the R&D program, to the intelligence community in accordance with procedures to be established by the intelligence community.

2. Study

Engineering, R&D operations analysis, and system design studies will be conducted. Studies which explore possible system configurations and operational employment techniques for a future exploitation phase of the SAMOS program will be limited to that required to satisfy current R&D program objectives. Until such time as the requirements for an operational system are firmly defined, no studies will be conducted to define and freeze the design of an optimum SAMOS operational system configuration. 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 contractor and subcontractor plants, and flight test bases will consist of: (1) development acceptance, qualification, reliability, type and acceptance tests; (2) captive tests at Santa Cruz Test Base; (3) special field tests; and (4) flight tests. The latter includes system testing to be accomplished during the pre-launch, launch, on-orbit and recovery phases of R&D flight operations, as well as component test launches where feasible.

b. In addition, tests will be conducted using a system experimental test laboratory, equipped with Agena vehicles or portions thereof, and laboratory checkout equipment similar in function to that used during modification and checkout of flight articles. This capability is required to provide adequate testing in a system environment for new or modified satellite equipment without interfering with production, modification and checkout of flight test satellites. Further, this laboratory will provide a capability for diagnosis and verification of the cause of certain on-orbit malfunctions. Precision collimators and photo simulators are included.

c. Additional Agenas, payloads and boosters will be procured on an unassigned basis to provide the flexibility of introducing program changes, testing, and to augment the included launch schedule wherever possible, either at the PMR or AMR.

d. The testing program for Subsystem I developed equipment will be as shown in Subsystem I Appendix to be attached hereto at a later time.

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 AFBMD Exhibit 58-10, will be applied to increase system reliability.

6. Test Facilities

a. Flight testing for the SAMOS Program will be conducted at the Pacific Missile Range. An Atlas/Agena launch complex consisting of two launch pads and one blockhouse has been completed for initial launchings beginning in September 1960. Combined SAMOS/MIDAS launch schedules have been compressed to the maximum extent on this facility providing no flexibility or possibility of program augmentation through Calendar Year 1962. In order to regain flexibility and to insure against program stoppage due to a catastrophic failure or destruction of either of the present pads, additional pads and a blockhouse is to be provided in the near vicinity of the present complex. These additional facilities are expected to be completed by mid 1962 and will be designed and sited so that they will support future SAMOS, MIDAS or other program requirements. It is anticipated that some re-entry testing may be accomplished from AMR as a part of Ballistic Missile testing. Some component testing for payload or recovery system development purposes may also be scheduled at the AMR, dependant on pad availability.

b. In support of the SAMOS and other Programs, Vandenberg Air Force Base Complex 75-1 (THOR) will be converted for use beginning in mid 1961. At least one pad of the complex will be modified to support THOR launched vehicles for component tests in support of the SAMOS Program. The MAB facility presently in use at VAFB in support of MIDAS, DISCOVERER, and SAMOS, will also be modified or expanded if necessary to support this operation.

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 two basic flight configurations 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.

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, structural 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, sub-assemblies, 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 re-work 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, re-

orientation 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. This real-time command capability will be utilized to provide backup in the event that the primary command system fails.

(b) <u>VHF Acquisition Transmitter</u>: A minaturized, 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) UHF Command Receiver: 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) Sequence Programmer: 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.

(m) Auxiliary Timer: A Fairchild Timer will be installed to provide minimum backup for the sequence programmer. This timer, which will be actuated throughout the S-band Radar transponder, will be utilized in the event that malfunctions prevent use of the primary stored program command capability.

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 sensed 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. [redacted] 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 (E-2) (3 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 data 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:- Visual Reconnaissance. The visual reconnaissance subsystem for the E-2 payload configuration will consist of a 36-inch focal length lens, associated 70 mm 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 stereo 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 readout 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 (F-2) (2 Flights through December 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 - Electronic Reconnaissance: The electronic reconnaissance subsystem will consist of the F-2 equipment installed in flight vehicles of this configuration. Four (4) flight payloads will be provided, however, only two are scheduled for flight at this time. These vehicles will contain F-2 general coverage digital equipment consisting 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 will have the capability to indicate the overall activity of emitters in [redacted] The low frequency band will have limited location accuracy of emitters. Additionally, this equipment will be able to recognize the following unusual signals:

[redacted]

Additionally it will be capable of:

[redacted]

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Limited development efforts will continue toward providing essential components for a specific mission analog capability. However, flight testing of these components will not be scheduled pending the determination of the feasibility of satellite ferretry as a result of the F-1 and F-2 flight test program. Principle effort will continue on the wide band tape recorder, start-stop frequency scan and controllable antennas.

4. Flight Configuration IV (E-5) (7 Flights through December 1962 plus two diagnostic flights).

a. Subsystems

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

(2) Propulsion: Will be the same as Flight Configuration II.

(3) Auxiliary Power: 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-periodice-zinc batteries, power converters and inverters, voltage regulator, and control recovery capsule during re-entry and recovery.

(4) Guidance and Control: 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) Communication and Control (Vehicle-borne): The vehicle borne communications will consist of:

(a) UHF Command Receiver: 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) Command Programmer: 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) PAM Multiplexer: A PAM multiplexer will be used to sample and encode the output from a number of information sources for transmission to the ground.

(d) UHF Narrow-Band Data Transmitter: 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) Vehicle Antennas: Because of the interaction between antennas in the vehicle, antennas will be provided as integrated systems for all vehicle requirements.

(f) FM/FM Telemeter: 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) S-Band Radar Transponder: Will provide tracking and command capability utilizing VERLORT radars.

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

b. Flight Configuration IV Payload

(1) Visual Reconnaissance: 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. Steering of the payload across the line of flight will be achieved by rolling the vehicle.

(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 recommended portions of the 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 head 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.

5. Configuration V (E-6) (7 Flights through December 1962 plus diagnostic flights):

a. Subsystems:

This configuration shall perform the mission of recovery of film from a low altitude circular orbit. The first stage shall be an ATLAS. The second stage, if required, shall be the AGENA B, dependent on selection of launch site, degree of development required, and performance capability. The general characteristics include possible requirements for secondary propulsion to maintain the orbit for the mission life, solar photovoltaic converters for auxiliary electrical power, and stabilized attitudes on orbit. The selection of second stage shall also be influenced by the mission orbit characteristics which are still to be established, such as allowable inclination angles, altitude variation, and total active life. Maximum utilization will be made of equipment developed under the SAMOS Program as well as other Air Force programs. Changes from the present equipment will be necessary in the subsystems presently used as follows:

(1) Airframe: Installation of new or altered equipment.

(2) Propulsion: Addition of secondary propulsion.

(3) Auxiliary Power System: Installation of a solar photovoltaic array with its associated secondary batteries.

(4) Guidance and Control: Extension of the attitude control life will be necessary for either stage. The possibility of combining this with the secondary propulsion system will be evaluated. Installation of attitude reference for the mission life will be necessary if the Able Star is used.

(5) Communication and Control (Vehicle Borne): Insofar as is feasible, this equipment will be a simplified version of that employed on Configuration IV. Also, some consideration will be given to use of communication and command control equipment under development for other satellite systems provided no significant augmentation of existing ground stations is required.

b. Flight Configuration V Payload

(1) Visual Reconnaissance: The visual reconnaissance subsystem for the E-6 payload will consist of a camera of moderate focal length. The subsystem will be designed to obtain wide area coverage in a few days at the best resolution consistent with overall development objectives. Compatability with data processing equipment already developed or under development will be a major consideration.

(2) Recovery Capsule: The recovery capsule subsystem will consist of the equipment to be recovered plus all associated equipment to house, operate, detach and guide the recovery payload. Recoverable equipment will include recommended portions of the payload, acquisition and homing beacon, light beacon and terminal guidance equipment. Recovery aids will include the capsule heat shield, radio beacon, light beacon, and parachute. After separating, a recovery guide aid system. yet to be selected, will be used to return the capsule to a selected recovery area.

C. GROUND SYSTEMS

1. General

a. The design of the SAMOS Ground System includes not only required equipments and procedures for the subsystems (A, B, C, D, E, F and H) incorporated in the flight configurations, 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 the relatively simple design of the limited DISCOVERER Program capability to more refined versions capable of meeting stated requirements of the advanced systems. It is emphasized that the initial designs which have been developed and are to be used in the early phases are primarily manual. Ultimately a highly automated system for tracking, readout and recording, and processing of data will be required. As experience is gained and the state-of-the-art advances this early system will be redesigned and modified to provide more automatic operation and control of the complex system functions. This re-design or major modification will be limited to that required to support the R&D program. 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 when and where data can be acquired from an airborne vehicle. To establish a schedule, it will be necessary to determine the orbit of a vehicle and refine the 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.

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 payload.

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

c. SAMOS Ground System for Recovery: For the SAMOS recovery satellite tracking, telemetry readouts 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.

(1) Ground System for Flight Configuration IV:

(a) 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.

(b) 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.

(c) 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 waterborne 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.

(d) 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.

(e) 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.

(f) 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.

(g) 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.

(h) 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.

(i) 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 Handling Facility.

(2) Ground System for Flight Configuration V: The Recovery Force will consist of high altitude chase aircraft, C-130 recovery aircraft, H21 helicopters and ground mobile tracking stations. These aircraft will be based in the Continental United States. The Recovery Force will be controlled by a Recovery Control Center at some existing communication and control facility within the Continental United States. Standard recovery techniques will be used in the retrieval of the controlled re-entry capsule at the impact area.

d. SAMOS Ground Communications Network: In addition to voice and teletype circuits, SAMOS planning includes a wide-band data link between Vandenberg and the STC to provide information on its capability to support future programs. Additionally, this link will assure immediate and positive control of the system and be a valuable R&D development tool. When completed, this link will 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 transport 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, acquisition 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, demultiplex and record signals from VHF telemetry and data transmitters aboard the booster and satellite. Ferret Data from the F-1 payload and telemetry data from the payloads, AGENA and the booster will be recorded and distributed to appropriate display and data handling equipment as required. Configuration at each station will vary depending on assigned functions.

(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 . This equipment shall be capable of control of payload operation through appropriate elements of Subsystem H. In addition for readout payloads, it shall be capable of accepting, reconstructing and displaying visual and ferret reconnaissance data and auxiliary information. The payload ground equipment shall consist of payload sensor and payload telemetry display devices, command consoles, photo reconstruction equipment and limited special purpose payload data processing 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 generatros (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. Data Processing (Subsystem I)

This subject will be discussed in detail in Appendix I to this document. To be published separately at a later date.

5. GEOPHYSICAL ENVIRONMENTAL MEASUREMENTS (Subsystem J)

a. 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.

b. 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.

c. 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.

d. 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.

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

f. 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.

g. 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.

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

i. 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.

j. 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 experiments performed and analyzed from other programs.

6. Persønnel 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 cammon to this and the other personnel systems need to be solved only once.

7. RELIABILITY PROGRAM

a. Reliability Design Review

(1) Continuous reliability 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 item of equipment will meet its reliability goal.

(2) 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 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:

(a) Isolates marginal application of parts

(b) Identifies marginal engineering design

(c) Provides a basis for considering redundacy

(d) Provides a measure of mean-time-to-failure (MTTF) or - repair (MTTR)

(e) Provides a detailed thermodynamic evaluation of packaging

(f) Establishes areas of thermal penalty

(g) Evaluates fail-safe features

(h) Defines probable modes of failure

(i) Reveals use of non-standard fabrication processes

(j) 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. Parts Program

(1) 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:

(a) Selection of source

(b) Analysis of part instabilities

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

(d) Optimum derating

(e) Improved inspection techniques

(f) Preparation of parts specifications, including adequate reliability requirements, to facilitate (a) and (e)

(2) A survey of parts application and development programs at governmental 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 has been expanded to include Hi-Reliability parts test data, specifications, and test plans. Information obtained from these sources, and other test data, will be used to prepare a 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.

(3) 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 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:

(a) Microwave tubes

(b) Tantalum Capacitors

(c) Connectors

(d) Potentionmeters

(e) Relays

(f) Diodes

(g) Power transistors

(h) Electron Tubes

(i) Bearings, gears and bearing surfaces

(4) 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.

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

(6) 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. <u>Materials and Processes Program</u>

(1) 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.

(2) 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.

(3) 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.

(4) 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.

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

(6) Specifications will be reviewed to prevent undesirable reliability performance traceoffs.

d. Reliability Tests

(1) 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:

(a) Electromagnetic Radiation

(b) Cosmic Radiation

(c) Radiation Belts

(d) Interplanetary Dust

(e) Solar Wind

(f) Vacuum

(g) 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.

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

(a) Accelerated life (parts)

(b) Nominal life (system level)

(c) Elevated environmental stress limits (parts and components)

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

(e) Vacuum life (materials, parts, components)

(f) 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 command decoder-programmer function will be considered for fail-safe operation as well as reduction in number of components.

(4) In conjunction with (3) above, the number of stored program command functions required to operate the E-2 and E-5 payloads will be reduced as far as possible. Further, the new E-6 payload will be designed in a way that will keep command requirements to an absolute minimum. A reduced power requirement and improved system reliability should be realized from this system simplification study.

g. Communications Subsystem Reliability (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

(1) 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 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 enchance satellite reliability will be considered in reaching a decision on each problem.

(2) 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:

(a) Inverters(SS/C)

(b) Solar array control (SS/C)

(c) Voltage limiter circuits

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

(e) Data transmitter (SS/H)

(f) Decoder-programmer (LODAP, SS/H)

i. Subcontractor and Vendor Reliability Programs

Prime and associate contractors will be made aware of the importance of the need and will be contractually required to insure that their subcontractors and vendors implement and maintain reliability programs which will adequately support all of the above aspects of the over-all SAMOS Reliability Program.

SUMMARY DESCRIPTION OF CONTRACTS BY WEAPON SYSTEM (PRESENT PROGRAM)

I. AF 04(647)-97 (COMPLETE) AF 04(647)-347 AND AF 04 (647)-563 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.

4. Engine Modification: Explore the growth potential of the AF LR-81 rocket engine through modification to improve the basic engine design. Conversion to a nitrogen tetraoxide-hydrazine blend propellant combination appears most attractive for "storable" systems application and improved engine performance.

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 colibration.

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 AF 04(647)-595, LOCKHEED AIRCRAFT CORP AND AF 04(647)-532, PHILCO CORP

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. 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.

III. 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 Thompson-Ramo-Wooldridge Corporation has contractual responsibility for this subsystem under Contract AF 30(602)-1814.

IV. OA 58-10, COMMAND & CONTROL DEVELOPMENT DIVISION

A. COMMAND & CONTROL DEVELOPMENT DIVISION

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.

V. LETTER CONTRACT AF-04 (647)-532

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.

VI. AF 04(647)-103, MASS. INSTITUTE OF TECHNOLOGY, CAMBRIDGE, MASS.

Responsible for developing and testing an all-inertial guidance and orbital control subsystem to provide guidance and control signals to the satellite vehicle during all phases of flight.

SUMMARY DESCRIPTION OF CONTRACTS BY WEAPON SYSTEM

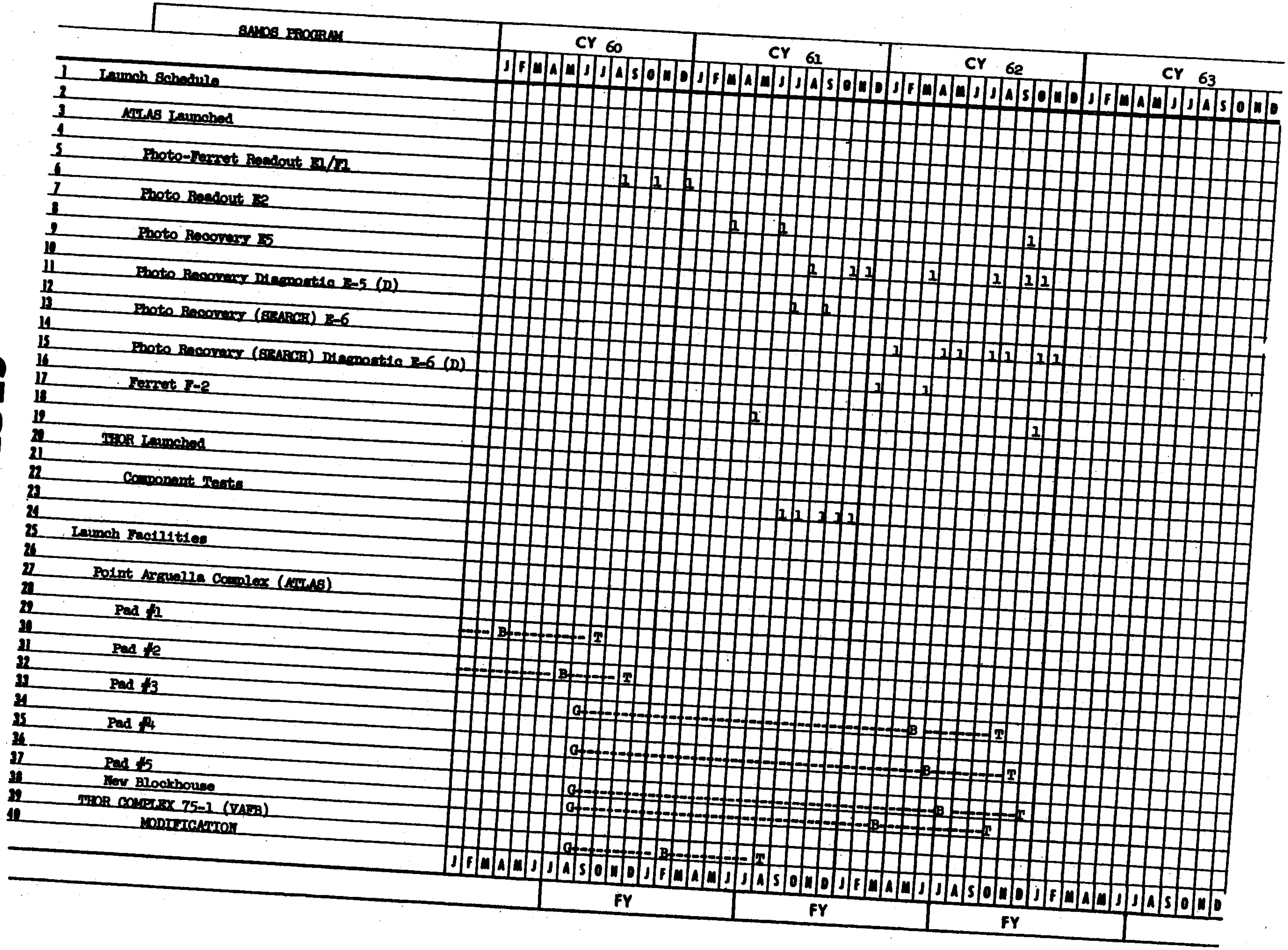
(NEW PROGRAM)

SEARCH CAPABILITY

Contractual arrangements have not been definitized at the present time, however, it is planned that a group of associated contractors, responsive to the technical supervision of Aerospace Corporation, will be used to pursue the program. In those instances wherein it will be beneficial to the program to determine associates by competitive source selection methods, this will be done. However, it is also anticipated that it may be beneficial, in special instances, to select participants in the program on a technical capability basis.

At such time as the contractual arrangements for the new portion of the program are completed, a Management Report to this Development Plan will be issued.

PROGRAM SCHEDULE



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PROGRAM SCHEDULE

	SAMOS PROGRAM	CY 60 – CY 63 (J F M A M J J A S O N D)
1	Payload Development	
2		
3	Combination Photo-Ferret	
4		
5	E-1/F-1	
6		--T
7	Photographic	
8		
9	Readout - E-2	
10		----------T
11	Recovery E-5	
12		----------T
13	Recovery E-6	
14		G----------T
15	Ferret	
16	F-2	
17		----------T
18		
19	Recovery System Development	
20		
21	Primary (E-5)	
22		G----------T
23	Alternate (E-6)	
24		G----------T
25		
26	Facilities	
27	Satellite Test Center	
28	Increment No. 1	
29	Increment No. 2 (Interim)	----------T
30	Increment No. 2 (Final)	--------B----T
31		----------T
32	Ground Stations	
33		
34	Vandenberg T/A (UHF)	
35	Interim	
36	Final	----------T
37	New Boston T/A	----------T
38	Interim	
39	Final	B----------T
40		B----------T

LEGEND: G- GO AHEAD T- COMPLETION DATE

B- BENEFICIAL OCCUPANCY

FY	FY	FY

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TEST ANNEX

I. DESCRIPTION OF TEST PROGRAM

A. GENERAL

1. Test Philosophy

a. In any research and development program, the bridge from pure theory to practical and reliable hardware rests upon the keystone of an adequate and balanced testing program. That which provides both form and substance to the keystone is the test philosophy. Thus a worthwhile testing program must begin with a strong test philosophy. The test philosophy must have its origin in good engineering practice and previous experience modified to meet the problem under consideration.

b. The development of a test philosophy for SAMOS has, as a point of departure, the fund of knowledge resulting from the following:

(1) The DISCOVERER Program. This program has provided space vehicle and vehicle subsystems performance and reliability data; testing philosophy, testing procedures and techniques both ground and space-borne; equipments and facilities; and technical principles.

(2) The Ballistic Missile Programs. These programs have provided test philosophy, procedures, equipments, testing techniques; and the boosters themselves which are used as the prime movers for the space programs.

(3) The Manned Aircraft Programs. These programs have provided test philosophy, basic engineering and scientific principles of demonstrated effectiveness.

c. From this storehouse of knowledge a space system test philosophy has been derived which assures the rigorous testing of individual parts, components, and subsystems up to and including the complete weapons system. The major difference between previous test programs and space test programs, hence the test philosophy, is the problem of long-term unmanned vehicle operation in a spatial environment. Up to the point of orbital injection, the facilities, concepts and techniques of the ballistic missile programs are directly applicable to the test of space systems; once a space vehicle is placed in orbit, the environmental and time functions become unique to space and produce unique problems. Thus, many new system elements must be considered; therefore, generating many new and varied testing procedures for a military space system.

d. Development testing of a weapons system has a single purpose; which is to achieve a highly reliable system that will fully satisfy the system functional design objective. In a new weapons system such as SAMOS, involving many new techniques and operating in a new environment, the system design must be determined through an iterative design and test redesign process. The test program must be designed to insure the prompt and complete engineering feed-back of test information at all development stages into the design and re-design phases. Both ground and space system testing are developed on the building-block principle. For example, in the early phases of testing the simplest parts and components of an individual subsystem are tested; as the testing program proceeds in scope and complexity, additional subsystems are added until the ultimate configuration is reached.

e. 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 subsystems. Temperatures, pressures and shock caused by variations in these parameters can be simulated, however, many parameters cannot be adequately 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 established between ground simulation and actual system tests on orbit.

f. 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 eight flights through CY 62 carrying visual and ferret payloads. The intent is to demonstrate feasibility insofar as the limited numbers of flights will permit.

b. The Recovery Program will, starting in mid 1961, become the major effort in flight testing. Two types of satellites, each utilizing a different recovery technique will be flight tested. One will contain the relatively sophisticated E-5 camera. The other will contain a simpler camera (E-6) designed for search coverage and will utilize a different recovery technique. The primary objective of the Recovery Program will be the earliest possible demonstration of a reliable method of photographing vast areas and returning such data physically to the ground.

c. The high resolution program (E-5) will consist of seven flights through CY 62. The backup program (E-6) will consist of seven flights through CY 62. In each case, the camera flights will be augmented by two additional fully instrumented diagnostic payload flights (Atlas) to check out the recovery techniques.

d. 5 Thor launched (VAFB) component flight tests are programmed in support of all SAMOS development objectives. Specific test requirements in this category are being developed as well as possible utilization of the AMR for added Atlas launches.

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 (terminated)
- Propellant tank tests
- Telemetry system tests
- GSE tests
- Roll control tests (simulation)
- Photographic systems tests
- Solar auxiliary power unit tests
- Recovery system tests
- Ferret tests
- Data Processing equipment
- Propulsion system altitude start tests
- Aircraft drop tests
- Aircraft/ship data package snatch test
- Systems experimental test

b. Captive Testing: 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. (Responsibilities associated with the E-6 Recovery Program have not yet been defined.)

c. Flight Testing: 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. (Responsibilities associated with the E-6 Recovery Program have not yet been defined.)

d. The testing program for Subsystem I developed equipment will be explained in Appendix I to this Development Plan which is to be published separately.

B. FLIGHT TEST PROGRAM

1. Overall Program Objectives

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) Readout Program: Demonstration of orbit capabil-

ity. 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 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) Recovery Program:

(a) High Resolution (E-5). 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 tracking and positional computing systems.

(b) Search Resolution (E-6). Demonstration of orbit capability. Demonstration of backup recovery techniques and equipment. Evaluation of satellite attitude control and stabilization system. Evaluation of gross photo coverage capability. Evaluation of tracking and positional computing systems.

2. Flight Test Plan

a. Readout Program

(1) The first three flights will be of the Configuration I vehicle with the E-1 visual reconnaissance payload and the F-1 ferret payload. (See Design Characteristics Section). Readout will be accomplished at the various ground stations with data assembled by the inter-station communications network at the STC for evaluation. The test objectives for these flights are:

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

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

(c) Demonstrate the capability of the E-1 payload to process and readout exposed film and perform the total subsystem operation within its capability limits.

(d) Demonstrate F-1 ferret payload capability to monitor electromagnetic emissions, digitize and store the characteristics of these emissions, and readout this data by the vehicle-ground communication link to evaluate the ferret reconnais-ance technique.

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

(f) Determine the capability of the ground support equipment and facilities to support the vehicle in its various phases of operation.

(g) Determine the capability of the ground control subsystem to maintain control of system operations.

(2) Three of the vehicles in the readout program are Configuration II with the E-2 visual reconnaissance payload. (See Design Characteristics Section) The test objectives for these flights are:

(a) Determine the ability of the E-2 payload to photograph specific areas of interest, process the exposed film, and electronically transmit and readout the photography by the vehicle ground communications link.

(b) Test and evaluate the basic subsystems of the satellite vehicle.

(3) Two of the vehicles in the readout program are Configuration III with the F-2 ferret payload. The test objectives for these flights are:

(a) Determine the capability of the F-2 payload to monitor electromagnetic emissions, digitize and store the significant characteristics of these emissions and to transmit and readout this data via the satellite-ground communications link, and otherwise evaluate all ferret equipment.

(b) Obtain and process geophysical data.

b. <u>Recovery Program</u>

(1) The Configuration IV satellite will be tested in increments beginning with the launch of fully instrumented

diagnostic flights which do not contain the E-5 camera. Such capabilities as orbit adjustment, roll steering, stereo photography, etc will be introduced in steps to reduce the probability of failure in early flights. All flights will involve capsule recovery. The test objectives are:

(a) Determine the capability of the E-5 photographic payload to provide high resolution photography of specific areas of interest.

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

(c) Demonstrate the capability of the satellite ground control system equipment and facilities to control system operations without direct access to collected reconnaissance data.

(2) The Configuration V satellite testing will begin with launches of fully instrumented diagnostic payloads which do not contain the E-6 camera. The recovery techniques used will differ from those used for the Configuration IV vehicle. The following are the test objectives:

(a) Determine the ability of the E-6 camera to provide gross coverage of areas of interest at specified ground resolution.

(b) Determine the capability of the new recovery subsystem to successfully return the payload to the earth's surface at a selected position. Compare this capability with that of the E-5 recovery subsystem.

3. Flight Test Organization

a. Readout and E-5 Recovery Flights: Subject to the over-all management by the Air Force Ballistic Missile Division, the Lockheed Missiles and Space Division has been assigned responsibility for technical direction of the SAMOS Development Program. In accordance with ARDC regulations, the SAMOS Program Officer exercises technical test control of SAMOS systems tests. The Commander, 6594th Test Wing (Satellite) or his designated representative 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.

b. E-6 Recovery Flights

(1) Air Force participation and procedures will be identical to item 3a above.

(2) The role of the integrating contractor will change. Responsibilities for the integrating contractor and associates will be defined subsequent to publication of this document.

4. Test Program System Operation

a. General: 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. Prelaunch Planning: 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. The booster contractor will deliver a flight-ready modified booster to Vandenberg Air Force Base directly from the 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 booster will be checked out. This X-2 day mock firing will also serve to check out the communications system and procedures. Some change in the above procedures will be necessary if the Able/Star is selected as the orbital stage for the backup recovery program.

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, or be ready to operate on command.

(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 will 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 stabilize the satellite in either a tail-first (for visual recovery) or nose-down (for readout) orbital position.

(6) After a launching, the launch complex will be refurbished to prepare 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. Orbital Phase: 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 described in TAB 2. SAMOS readout will be performed initially over VAFB with wide band data reception capabilities expanding subsequently to Northeast station.

g. Recovery Operation (E-5): Present planning provides that the recovery capsule will be ejected from orbit to be air-recovered 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.

h. Recovery Operation (E-6): The recovery techniques to be utilized will be determined subsequent to publication of this Development Plan. It is anticipated that recovery will be effected in the ZI using a maneuverable, terminally guided capsule.

5. Command and Control Responsibilities and Procedures

a. General: System command and control will be a world-wide problem requiring an extensive communication network. 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.

(6) 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 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. Except for terminal recovery control, the responsibilities and procedures described herein are equally applicable to the E-6 recovery flights. Appropriate E-6 recovery procedures will be defined subsequent to publication of this Development Plan.

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 STC will initiate the following activities:

(1) Communication system checkout

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

(3) Dry run orbit calculation

(a) 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 Ships
Kaena Point Tracking Station, Hawaii
Chiniak Tracking Station, Alaska
Recovery Force
Northeast Tracking Station, USA

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. GROUND TEST PROGRAM

1. Testing Requirements

a. The data given in this section applies to the Readout Program and the E-5 Recovery Program. Testing requirements for the E-6 Recovery Program have not yet been defined in detail. When defined, it is anticipated that requirements and procedures will be similar to that listed in this section.

b. Ground Tests: 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) Development Tests: Development tests shall be defined as those tests conducted on equipment or material for the purpose of evaluation of performance, operation, and limits.

(2) Qualification Tests: 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) Inspection Tests: 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) Payload Orbit Simulation Tests: 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.

(5) System Laboratory Experimental Tests: Tests will be conducted in a system experimental test laboratory equipped with an Agena vehicle or portions thereof, and laboratory type checkout equipment similar in function to that utilized during modification and checkout of flight articles. This capability is required to provide adequate testing in a system environment for new or modified satellite hardware without interfering with the modification and checkout of flight test satellites. Further, this laboratory will provide a capability for simulation and verification of the cause of certain on-orbit malfunctions.

c. 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 and system 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. <u>Flight Base Hangar Tests</u>

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. <u>Pad Tests</u>

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. Fly-by Tests

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 checkout. 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.

INTERIM DATA PROCESSING CAPABILITY FOR R&D

I. INTERIM DATA PROCESSING

A. An Appendix I to this document will be published separately in the early future which shall take up in detail the procedures for processing and handling R&D "take."

B. The STC as well as the prime or integrating contractors requires limited access to this take for purposes of quality assurance and control. Accordingly, some processing and review must take place at the STC.

SAMOS PROGRAM
FY 1962 & 63 BUDGET ESTIMATE and REVISED FY 1961 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS

	PRIOR YEAR	FY 61	FY 62	FY 63
FY 1956 - P620	389,245			
FY 1957 - P131	3,900,000			
FY 1957 - P620	9,997,239			
FY 1958 - P131	41,500,000			
FY 1958 - P151	58,550			
FY 1958 - P244	7,600,000			
FY 1958 - P313	920,000			
FY 1958 - P321	5,899,000			
FY 1958 - P620	9,998,553			
FY 1959 - (ARPA Order #9-58)	96,600,000			
FY 1959 - P321	3,599,000			
FY 1959 - (ARPA Order #41-59)	9,000,000			
FY 1960 - P313	400,000	[redacted]		
FY 1960 - P321	3,360,000			
FY 1960 - P630	160,000,000		[redacted]	[redacted]
TOTAL	353,221,587	[redacted]	[redacted]	[redacted]

*Includes FY 61 funds stated for RADC, however, [redacted] of FY 61 SAMOS funds were provided during July 1960.

WDLPR-406
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SAMOS PROGRAM
FY 1962 & 63 BUDGET ESTIMA[redacted]
REVISED FY 1961 FINAN[redacted]

SUMMARY OF RE[redacted]ENTS

	PRIOR Y[redacted]	FY 61	FY 62	FY 63
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
TOTAL PROGRAM	[redacted]	[redacted]	[redacted]	[redacted]

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FINANCIAL PLAN ADDENDUM

1. Included in the Atlas costs are three unassigned boosters, including estimated launch costs. A firm schedule for delivery of these boosters is not available at the time of the Development Plan publication, nor is a firm utilization plan pending completion of a complete study now in progress.

2. Costs for conversion of Pad #3 and associated GSE costs at AMR, to support proposed SAMOS launches for a 5 month period are included in the new program costs for 5 months.

3. Miscellaneous includes estimated costs for weather studies, an expanded advanced and special R&D technical augmentation program, contingency funds, and miscellaneous contract costs.

SAMOS R&D
GENERAL STATEMENT

1. This section contains the consolidated facility requirements for SAMOS Research and Development Program which must be included in the FY 1961 Military Construction Program to insure their completion in line with the other phases of the total system. Facilities shown herein are required to support the following program functions: launch, booster and vehicle assembly, tracking, control, and telemetry; data reception, interpretation and dissemination.

2. Boosters and vehicles will be maintained, reassembled and checked-out in the existing SAMOS Missile Assembly Building at Vandenberg AFB. The ATLAS satellite boosters will be launched from existing Launch Complex Nr. 1 at Point Arguello. Launch Complex Nr. 2, Point Arguello, consisting of 3 launch stands, a launch control center (blockhouse) and associated support will be required to insure continuous satellite launching capability and preclude untenable program slippage in the event of a missile disaster on one of the existing launch stands and to provide for expansion capability in support of further SAMOS-MIDAS follow-on programs. Conversion of the 75-1 (THOR) complex at Vandenberg AFB is under way to allow AGENA B launchings in support of SAMOS NASA and other programs. The existing SM 65-1 MOD II Guidance System at Vandenberg AFB will be utilized for launches in support of SAMOS-MIDAS R&D and NASA programs.

Launch data will be obtained by utilizing VHF facilities at the Vandenberg AFB and Point Mugu tracking stations in conjunction with downrange tracking and telemetry ships. Orbital tracking and command will be performed by the Vandenberg AFB and Kaena Point, Hawaii, tracking stations. Data readout will initially be carried out by the Vandenberg AFB station with additional capability for tracking and data readout becoming available upon activation of the New Boston, New Hampshire, tracking station. A Satellite Test Center, located adjacent to the LMSD production plant at Sunnyvale, California, will serve as command, administrative and control center throughout the development phase of this program.

3. Prior years military construction programs have provided the following facilities: a missile assembly building at Vandenberg AFB for reassembly, checkout and maintenance of boosters, vehicles and satellites; Launch Complex Nr. 1 at Point Arguello; support facilities at Vandenberg AFB and Point Arguello consisting of technical support, laboratory, vehicle hold building, generator station and a fuel storage and disposal area; tracking and data acquisition stations at Vandenberg AFB, California; Kaena Point, Hawaii and New Boston, New Hampshire; downrange tracking and control station at Naval Air Missile Test Center, Point Mugu, California; and Increments Nrs. 1 and 2 of the Satellite Test Center, Sunnyvale, California.

4. Generally, the facilities requested in the Development Plan for the FY-61 MCP include the following: Launch Complex Nr. 2, consisting of three (3) launch stands and one (1) launch control center (blockhouse), Point Arguello and additions to the Missile Assembly Building and the Technical Support Building, Vandenberg AFB. Revised and updated budget estimates for FY 60 MCP items are indicated by asterisks.

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 on existing military bases required to support the technical facilities are included. Industrial facilities (P-260) 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
6. TITAN OPNL Bases
7. MINUTEMAN OPNL Bases
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
9. MISCELLANEOUS

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

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 (Advent)
4B. System 609A
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 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.

MCP
FACILITIES SUMMARY

FOR

SAMOS R&D

TYPE FUNDS: P-300

(FIGURES ARE IN MILLIONS OF DOLLARS)

ITEM CATEGORY:		BUDGET ESTIMATE					
		PRIOR YRS	FY 58	FY 59	FY 60	FY 61	TOTAL
Launch	Point Arguello, Calif.			6.096	.750*	[redacted]	
Launch Support	Vandenberg AFB				.500*		.500
Missile Support	Vandenberg AFB		.304	2.545	.990*	[redacted]	
Control Operations	Sunnyvale, Calif		1.500		1.120		2.620
Tracking & Telemetry	Vandenberg AFB		2.300				2.300
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
Advance Project Planning			.920	.589	.600	[redacted]	
			6.819	12.599	3.960	[redacted]	

* Revised budget estimates (Confirms AFBMD Msgs. 27 May & 20 Jun 60)

** This station deactivated on 1 Nov 59

SAMOS R&D

LOCATION (8A)Pt.Arguello, California

Type Funds: P-300 MCP

BUDGET ESTIMATES

Totals in Millions of Dollars	
FY 60	.750
FY 61	[redacted]

(Figures Are in Millions of Dollars)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP.	AWARD	BOD
8A1.4.3	G/M Launch Facility Nr. 1 (Addn)				.750		1/60	5/60	6/60	12/60
8A1.4.2	G/M Launch Facility Nr. 2					[redacted]	9/60	11/60	12/60	2/62

LOCATION: (8A) POINT ARGUELLO

SAMOS

DESCRIPTION AND UTILIZATION:

The SAMOS launch complex Nr 1, consisting of two launch stands and one blockhouse, was funded under the FY59 Military Construction Program. This FY60 project provides 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 when prolonged holds occur during countdown, a generator station building, camera shelters, a vehicle fall-back area, utilities and supporting items as required.

This project provides for construction of a second launch complex consisting of three launch stands and one launch control center (blockhouse) as a readily available back-up stand in support of the SAMOS-MIDAS R&D programs. This FY61 project will provide the necessary capability and will include all necessary utilities and supporting items.

SAMOS R&D

LOCATION(4) Vandenberg AFB, California

Type Funds: P-300 MCP

BUDGET ESTIMATES

Totals in Millions of Dollars	
FY 60	.500
FY 61	

(Figures Are In Millions of Dollars)

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 Stor. & Disposal Facility				.500		1/60	3/60	5/60	10/60

LOCATION: (4) VANDENBERG AFB

SAMOS

DESCRIPTION AND UTILIZATION:

These items are being provided under FY60 MCP to support the Discoverer, SAMOS, MIDAS and ADVENT
satellite programs, and other future space programs at Vandenberg AFB and Point 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, without creating a safety hazard
for the base. The disposal areas will provide for the burning and/or leaching of UDMH and 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 also
needed 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 pro-
pellants which, for the lack of disposal facilities, have to be shipped off base at the present
time. A railroad spur is required to eliminate excessive number of transfers from one mode of
transport to another, thus reducing possibilities of propellant contamination with ensuing
wasteage and/or missile fuel system malfunctions. Substantial economies will also be achieved
by rail versus truck or combination rail and truck deliveries to the storage area.

SAMOS R&D

LOCATION (4) Vandenberg AFB, California

Type Funds: P-300 MCP

BUDGET ESTIMATES

Totals in Millions of Dollars	
FY 60	.990
FY 61	[redacted]

(Figures Are in Millions of Dollars)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP.	AWARD	BOD
43.4.41	Missile Support Fac. (ADDn).				.990		1/60	5/60	6/60	12/60
43.4.42	Missile Support Fac. (ADDn).					[redacted]	8/60	10/60	11/60	8/61

WDLPR-406
III-10

SECRET

LOCATION: (4) Vandenberg AFB

SAMOS

DESCRIPTION AND UTILIZATION:

1. Missile support facilities provided under FY 60 Military Construction Program include 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, paragraphs a. and b.

d. Laboratory space in support of the AGENA vehicle assembly area.

e. Helium off-loading facilities in support of the ATLAS booster assembly area, SAMOS G/M Assembly-Command and Administration Facility, and SAMOS Launch Complex Nr. 1, Point Arguello.

f. Pyrotechnic Storage and Check-out Facility.

2. The additional facilities programmed in FY-61 MCP consist of the following:

a. A 25,000 sq. ft. addition to the SAMOS G/M Assembly Building to support the SAMOS E-5 Recovery Payload requirements, increased assembly work-load associated with the 75-1 conversion and associated support requirements and allow timely support of follow-on projects utilizing the ATLAS-AGENA, THOR-AGENA configuration of space vehicles.

b. A 34,000 sq ft addition to the SAMOS Technical Support Building in support of added requirements indicated in (a) above.

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SAMOS R&D

LOCATION Various

Type Funds: P-300 MCP

BUDGET ESTIMATES

Totals in Millions of Dollars	
FY 60	.600
FY 61	[redacted]

(Figures Are In Millions of Dollars)

BMD Index Nr	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION	
		PRIOR	FY 58	FY 59	FY 60	FY 61	START	COMP.	AWARD	BOD
	Advance Project Planning				.600	[redacted]				

SAMOS

LOCATION: Various

DESCRIPTION AND UTILIZATION:

This item will provide for the investigation of construction sites, Title I architect-engineer services for the development of design criteria and for final design and preparation of plans and specifications for SAMOS R&D facilities.