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SPACE SYSTEM DEVELOPMENT PLAN

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SENTRY PROGRAM

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HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND

(UNCLASSIFIED TITLE)
SENTRY
SPACE SYSTEM DEVELOPMENT PLAN

30 January 1959

REVIEW ON 31 Dec. 2009

APPROVED:

S. E. Anderson
S. E. ANDERSON
Lt. General, USAF
Commander

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AIR FORCE BALLISTIC MISSILE DIVISION
HEADQUARTERS
AIR RESEARCH AND DEVELOPMENT COMMAND

30 January 1959

FOREWORD

This volume presents the planning for the Advanced Reconnaissance System, Sentry. The plan reflects the reorientation of the Sentry Program under the management of the Advanced Research Projects Agency (ARPA). The planning described in this volume provides for the earliest possible development of the requirements stated in GOR No. 80, dated 16 March 1955, revised 26 September 1958, with one exception: the requirement of GOR No. 80 for an infrared reconnaissance capability have been withdrawn from the Sentry Program and made a separate Program, Missile Defense Alarm System (MIDAS).

This volume covers the capability of the Sentry System by summarizing its physical characteristics and by explaining the techniques for its operation. It also provides a brief explanation of the various subsystems that comprise the whole, the testing program being used in developing the system, and other significant areas that bear directly on the task of meeting the designated requirements. In addition, this volume covers the facility program requirements, including (1) test facilities at ARDC centers, and (2)the military construction required in support of the development system. Lastly, a summary of the funding requirements is included to reflect the revised FY 1959 financial plan and a new FY 1960 budget plan of dollars necessary to support the program included herein.

B. A. SCHRIEVER
Major General, USAF
Commander

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AIR FORCE BALLISTIC MISSILE DIVISION (ARDC)

SENTRY

DEVELOPMENT PLAN

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BACKGROUND

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

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

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

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

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

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

An ARDC System Development Directive No. 117L was issued on 17 August 1956. The development and test of WS 117L was awarded the Lockheed Aircraft 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. Executive management of the project is the responsibility of AFBMD.

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

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

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

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

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

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

On 1 December 1958 the ARPA proposed, in a memorandum report, a reorientation of the WS 117L Program. This proposal was directed to The Under Secretary of the Air Force in a memorandum on 5 December 1958.

As the result of the reorientation directives of early December, AFBMD presented a briefing to the ARPA on 15 December which included an analysis of the ARPA proposed program and an AFBMD counter proposal. The results of the briefing and subsequent negotiations culminated in an ARPA memorandum to The Under Secretary of the Air Force dated 17 December 1958. The following Development Plan reflects the instructions of the 17 December 1958 memorandum with regard to program structure and technical objectives.

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

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DESIGN CHARACTERISTICS

I. INTRODUCTION

A. Program Objectives

1. The Advanced Reconnaissance System, Sentry, described in this Development Plan, is designed to fulfill the military requirement outlined in GOR No. 80, 26 September 1958, and amendments thereto, ARDC SR No. 5, 17 October 1955, USAF DD No. 85, 3 August 1956, and ARDC SDD No. 117L, 17 August 1956.

2. A vital requirement for the defense of the United States is the earliest possible warning of a Soviet intention to attack. This system, employing an orbiting satellite, will provide at a reasonably early date, surveillance of the whole Soviet complex. The use of varied sensing devices in the satellite system will reveal Soviet preparations for a possible attack well in advance of the event.

3. Timeliness of receipt of the intelligence information is essential, with daily reconnaissance coverage at high resolution the ideal. In consideration of the requirement for earliest availability of the Sentry System, the engineering progression and Air Force acceptance will be from the lesser to the greater resolution.

4. The development objective will be to provide a satellite reconnaissance system capable of providing reconnaissance information which can be integrated into the USAF Intelligence Data Handling System and disseminated to operational military agencies. The research and development effort is directed toward providing reconnaissance equipment that will permit the following:

a. Terrain and mapping coverage.

b. Detection of new and hitherto unknown targets and verification of known targets.

c. Determination of electronic signal characteristics.

d. Location of targets and defenses.

e. Collection of data on technological improvements.

f. Evaluation of military and industrial strength.

g. Monitoring of electronic emissions.

h. Surveillance of enemy build-up indications.

i. Warning of attacks under way or pending.

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j. Assessment of high-yield weapons' damage.

k. Reconnoitering of military movements.

l. Location of Naval forces throughout the world.

m. Collection of world-wide weather data (Primarily Cloud Cover).

II. SENTRY OVERALL OPERATIONAL CHARACTERISTICS

A. GENERAL

1. The Sentry System is composed of the satellite vehicle, the ICBM booster, launch facilities, tracking facilities, and a complex communication and data processing network with related facilities. The ICBM booster provides the primary propulsive power to the Sentry satellite vehicle. Separation occurs on attaining the proper altitude and attitude. As the booster falls away, the satellite vehicle continues in a self stabilized predetermined coast to a program altitude. Orbital altitudes will be varied according to mission requirements, vehicle on orbit weights, and similar technical considerations. At the termination of the coast phase, the internal satellite power plant activates, supplying the orbital velocity increment required to establish a substantially circular orbit. Subsequent platform motion and the internal controls will then erect the vehicle to the proper attitude. The most common reconnaissance orbits will pass within a few degrees of the poles. The vehicle will be programmed to initiate and terminate sensing equipment in the target area in accordance with a predetermined program.

2. The vehicle will continue around the earth, and when within range of a ground receiving station, upon command, read-out sensory equipment will begin to transmit the recorded data. These data will be received, processed, and transmitted to the using agencies. In case of a recovery payload, the vehicle will receive programming commands only from the tracking station.

3. The vehicle will then begin its next cycle. These revolutions will be repeated 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 approximately 22-1/2 degrees at the equator. This offsetting will permit a single vehicle to view the entire earth in a total time period which depends on the width of swath observed. Useful operation will be terminated upon command at the exhaustion of the film supply in the case of a recoverable payload. In the case of a readout payload, termination will occur either when air drag slows the vehicle to point that it plunges into dense atmosphere, when the electrical power supply is exhausted or when a failure of equipment takes place. Expected useful life for early versions of the system is of the order of 10 to 30 days. Expected useful life for later versions of the system is in excess of a year.

4. The Sentry satellite vehicles will be equipped with devices for sensoring and relaying to the ground or storing for later recovery, reconnaissance information in the radio and visual regions of the electro-magnetic spectrum.

5. The Weapon System will provide a reconnaissance capability of two modes, readout and recovery.

a. Readout Program

(1) Visual

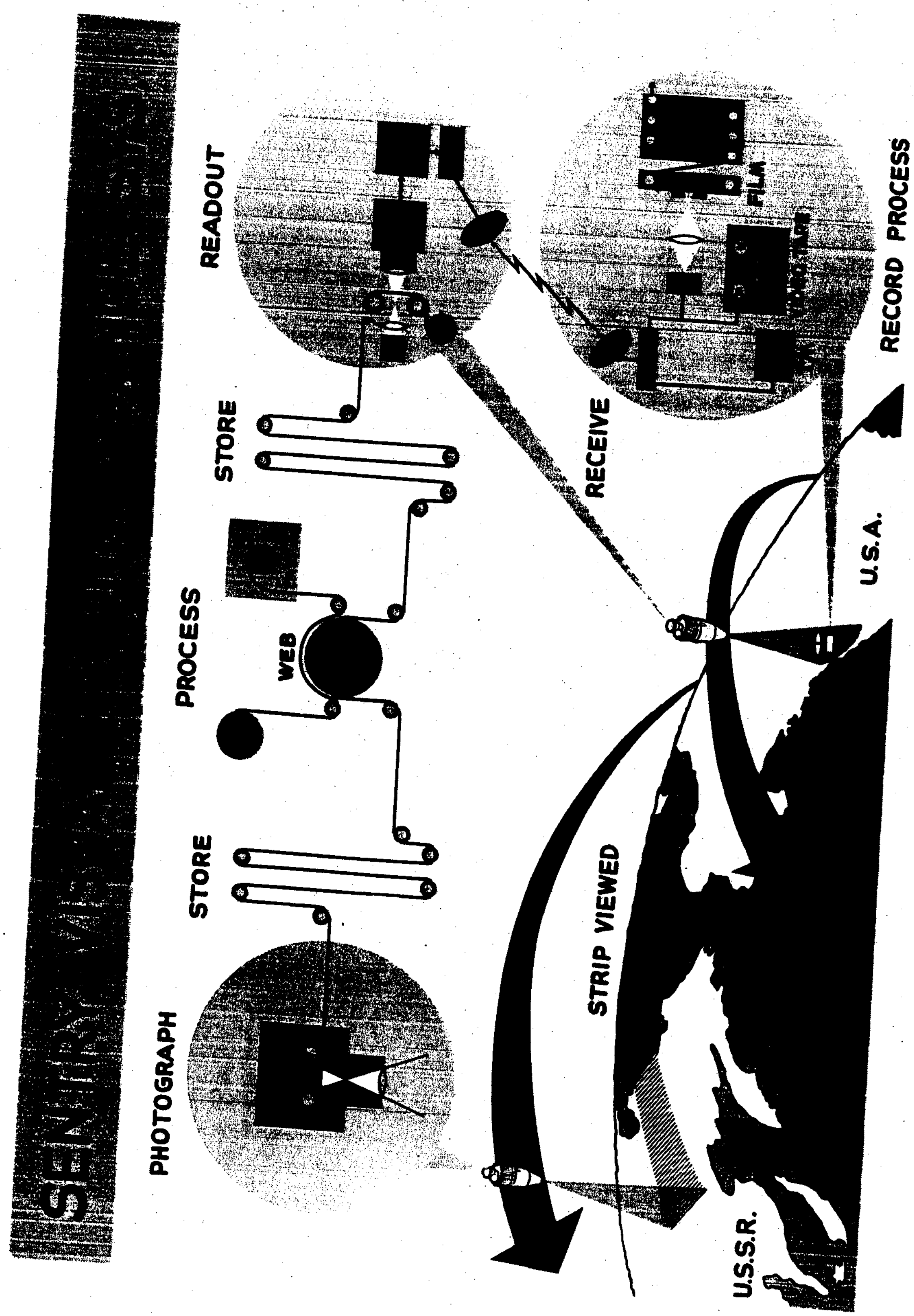
The reconnaissance equipment for the visual reconnaissance readout program consists of those satellite-borne equipments required to collect intelligence information in the visible spectrum, to process and store this information and on a command signal from the ground to convert stored images to appropriate signals for transmission to the ground. In addition to the satellite-borne equipment, related ground base equipment is required to take the out-put of the satellite-borne data link and reconstitute the signal into photographic form for further processing and intelligence use. Initially, the system will employ conventional photographic techniques with a special automatic film processing and television type data readout. Future consideration will be given to the development and use of electrostatic sensors and high resolution television in conjunction with magnetic tape storage. Initial visual equipment will be capable of resolving targets 20 feet in size and development will continue toward the goal of achieving resolutions of 5 ft or less.

(2) Ferret Reconnaissance

The Electronic Reconnaissance Subsystem (Ferret) consists of the satellite-borne equipment required to collect information from radiation in the region of the electromagnetic spectrum between 30 to 40,000 mc/sec, to store this information, to filter or index it as may be necessary, and, at the proper time, to reconvert the stored information into an appropriate electrical signal for transmission to the ground by the Ground-Space Communication Subsystem. The sub-system also includes the ground-based equipment required for in-flight calibration and vehicle equipment adjustment, engineering evaluation of equipment performance and decoding of reconnaissance data, time, and vehicle position for further data processing.

b. Recovery Program - Visual

The visual recovery program will provide, initially, for two separate payloads. The first of these payloads will be designed to obtain photographic coverage of mapping accuracy and the other payload will be designed to obtain high resolution reconnaissance information. In both cases, the data will be returned to the earth in the recovery capsule portion of the satellite vehicle. The advantage gained from a recoverable capsule is that it permits the collection of data over a large geographical area at a rate which would exceed the limits of a readout data link capability.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6. Sentry Data Processing will be oriented toward use of the data in order to assess imminency of immediate attacks. Equipment will be developed to integrate single isolated facts into an overall warning picture based on data from the reconnaissance satellites. With full system capability, control of reconnaissance coverage of the satellites becomes increasingly important. Thus, the programming of intelligence requirements into the system and feed back of the resulting reconnaissance data will require careful consideration and planning. Since the satellite reconnaissance data will be useful in long term analysis of change and activity, transcriptions will be made of the original records into formats suitable for use without special equipments by military operating agencies.

III. DESIGN SPECIFICATIONS AND GENERAL OPERATING DATA

A. SENTRY

1. The Sentry System is being developed over a period of years and it will include a variety of configurations, capabilities and useful satellite life spans. The development of the system will proceed from relatively simple design of limited capability to more refined versions capable of meeting stated system requirements. The original design and subsequent development work will endeavor to keep the basic system design as flexible as possible to provide a relatively rapid reaction to changing requirements. The present design objectives include two basic programs - readout and recovery.

a. Readout

(1) General

The Readout Program is divided into two reconnaissance modes; Visual and Ferret. To support these two reconnaissance modes, the ground space communications system will be provided as a means for communicating with the vehicle from ground stations and for receiving, monitoring and encoding environmental, vehicle, functional, and all reconnaissance data from the vehicle subsystems. The ground space communications system ground equipment will provide for the acquisition and tracking, reception of data, and the transmission of specific commands to the satellite vehicle. The communications system will include the equipment which will provide for interstation ground communications including the transmission of reconnaissance data and command and control instructions throughout the system. The readout development program will provide daily visual and electronic surveillance of potential enemy military installations. This system will provide the United States Air Force with intelligence data, the evaluation of which will constantly indicate the enemy's military position. It will indicate the imminence of hostilities and the buildup of activities having military significance. This will allow the initiation of retaliatory planning and enhance the capability of both active and passive defenses. Peacetime operation of the system permits the detection and identification of enemy radar and other electronics devices, and of enemy military activities in the preparation, training, and firing of ICBM's IRBM's and satellites.

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(2) Visual

(a) The purpose of this program is to develop a reconnaissance satellite using a 36 inch focal length camera configuration capable of resolving 20 feet ground objects. With this system it will be possible to locate objects with an accuracy of approximately 1 mile of the true location.

(b) Ultimately, the visual readout program will incorporate a long focal length high resolution camera system (5 feet ground resolution). While the initial work in the long focal length high resolution area will be conducted in the Recovery Program, a great deal of this work will be directly applicable to the Readout Program.

(c) The visual reconnaissance satellite will consist of a stabilized vehicle and a visual reconnaissance payload operating with three data acquisition stations and an intelligence data processing center. The visual photographic payload will be employed with an electronic readout and transmission over the ZI. Auxiliary power will be supplied by batteries initially and later by solar or nuclear power supplies. The 36 inch system will cover a 17 mile width in the vertical position but will be programmed across the line of flight to intercept areas of definite interest. In later versions of this system the camera system will have the capability of program movement in the vehicle to provide stero photography when desired.

(d) The major activity of this program is concerned with the design, fabrication, and laboratory evaluation of experimental and prototype models of photographic visual payloads. Such work includes extensive environmental testing of the prototype, determining compatibility with the data link and command links, and flight testing. An important part of this program will be the achievement of sufficient reliability of the visual subsystem on orbit. Extensive testing on the ground and on orbit will have to be performed to obtain the reliability required for long life unattended operation.

(3) Ferret

The Electronic Reconnaissance System (Ferret) will be designed to provide a logically developed capability to satisfy the National Intelligence objectives in the area of electronic reconnaissance. It will progress from a basic package with limited capability to an eventual sophisticated surveillance system. This system is logically divided into capabilities consistent with the development time scale. These capabilities have been labelled Ferret-1, Ferret-2, Ferret-3 (F-1, F-2, F-3). The eventual Ferret Surveillance System will combine features of both F-2 and F-3 to provide continuous coverage of the desired portions of the electromagnetic spectrum over the area of interest. Ferret-2 and later equipments will be of modular construction to provide a maximum flexibility, making possible a variety of mission capabilities, dependent upon information gained in earlier flights and changes in National Intelligence objectives.

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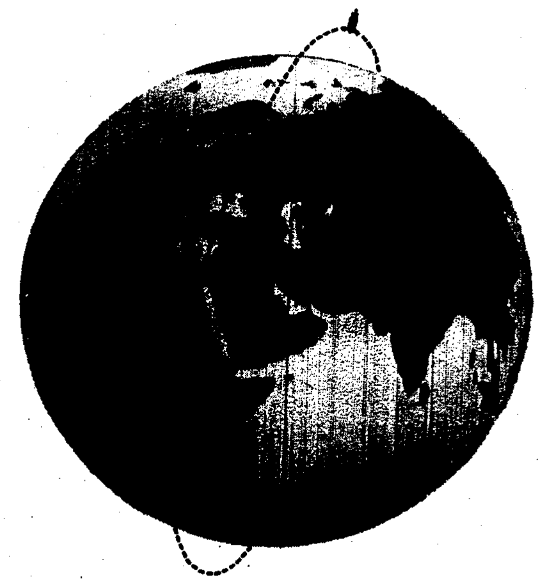
SENTRY ELECTRONIC RECONNAISANCE

OBJECTIVE

THE OBJECTIVE OF ELECTRONIC RECONNAISSANCE IS TO DETECT AND OBTAIN INFORMATION ON ELECTRONIC EMITTERS IN AREAS WHERE SUCH INFORMATION DOES NOT NOW EXIST.

ADVANTAGES OF SATELLITE FERRET SYSTEM OVER CONVENTIONAL FERRET TECHNIQUES:

1. COMPLETE WORLD COVERAGE
2. CONTINUOUS UNATTENDED SURVEILLANCE
3. ALL WEATHER OPERATION
4. RELATIVE FREEDOM FROM CAMOUFLAGE
5. ABILITY TO IDENTIFY HIGH PRIORITY INSTALLATIONS BY ELECTRONIC SIGNATURES
6. RAPID RECOVERY AND DISSEMINATION OF ELINT INFORMATION



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(a) Ferret-1 Equipment

This equipment will demonstrate the feasibility of the satellite ferret concept within the limitations imposed by equipment development time. It will consist of antennas, receivers, a data handling system, a recorder, and a programmer in the vehicle within in-flight calibration vans and a data handling system on the ground. [redacted] and converts the coded word received from the vehicle via the ground space communications system into a format compatible with an IBM 704 or 709 computer. The in-flight calibration equipment will transmit signals with accurately known characteristics from the ground to the vehicle receiving equipment. When read-out at the tracking stations, signals received, by comparison with those transmitted, will provide a high degree of system calibration.

(b) Ferret-2 Equipment

This equipment will be designed to intercept, measure, store, and readout to a ground station pulsed emission in the electromagnetic spectrum from 50 to 18,000 mc/s. [redacted] consist of antennas, receivers, a data handling system, a recorder, and a programmer in the vehicle with in-flight calibration vans and a data handling system on the ground. [redacted]

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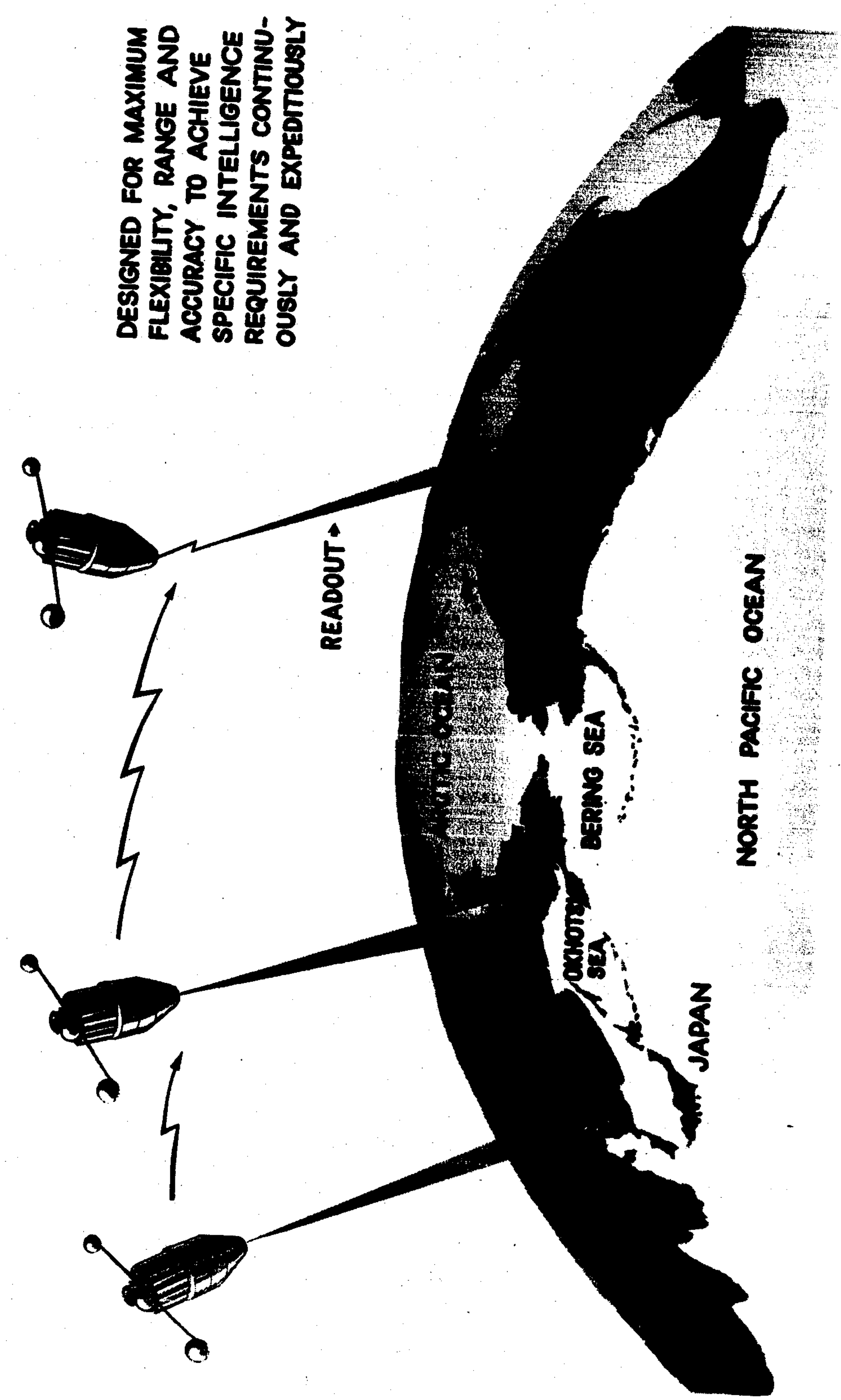

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[redacted] The ground data handling system performs error checking and word counting operation and converts the coded work received from the vehicle into a format compatible with an IBM 704 or 709 computer. The in-flight calibration equipment transmits a signal of accurately known parameters to the vehicle receivers. When this signal is readout in digital form, it is compared by the ground data handling system with the transmitted signal to obtain system calibration. As a result of the ground evaluation of system operation, various commands may be transmitted to the vehicle to adjust components of the receiving system.

(c) Ferret-3 Equipment

This equipment will extend the capability of the Ferret-2 program and provide an advanced capability to intercept a wide variety of electronic emissions for purposes of obtaining an indication of imminence of hostilities, providing an electronic order of battle and furnishing data for technical intelligence purposes. Included will be extension of the frequency coverage to 30-40,000 mc/s, improvement in the accuracy of parameter measurement, provision for positive locational accuracy techniques, development of a QRC capability, and improvement in the detection and recording of unconventional and exotic electronic emissions. These objectives will be met by the use of techniques such as modular construction for flexibility, analog recording, start-stop frequency scanning measurement of signal strength, scan rate and beam width of emitters and ability to track any given signal for an extended period of time to allow specific [redacted] and development of a signal recognition circuit which will provide a capability of transmitting National Indicator Alarms either in real time or by tagging them for special attention during readout of the recorder.

b. Recovery

(1) General

The Recovery Reconnaissance System (Visual) will be designed to meet two basic requirements; that of mapping and high resolution reconnaissance. It is envisioned that the development will include a large recovery capsule. The capsule will provide the means to recover a relatively large quantity of exposed film from orbit.

(2) <u>Visual</u>

(a) The objective of this system is to obtain durable intelligence information which is not effected by the dalay which could be associated with a relatively long life vehicle. Both a mapping and a high resolution capability are planned for this vehicle. This program has a particular application where the area to be covered or the rate at which information is acquired would exceed the transmission capability of a data link readout system. The high resolution systems developed for this program also will have application in the readout program.

(b) The Recovery Mapping System will have the capability of providing cartographic agencies with photographic mapping coverage of the land mass areas of the world, including those areas which are not presently accessible for political or other reasons. The end product will result in maps and charts of geodetic accuracy. A cartographic camera of suitable focal length will be employed which will provide ground resolutions of approximately 150 feet. The camera will be designed to operate on an intermittent basis upon receipt of an actuating signal from the vehicle programmer. The intermittent operation will be planned to provide daylight photographic coverage for all passes over the area of interest. The film supply will be sufficient to meet thirty days of programmed operation.

(c) The High Resolution System will have the capability of providing detailed reconnaissance information. It is planned that this camera system will resolve objects that are 5 feet on a side from an orbital altitude of 200 miles.

(d) In order to provide data on the satellite vehicle orientation at the time that the payload camera is operated, a stellar field camera will be concurrently developed. The stellar field camera will be capable of observing the stellar field to within 20 seconds of arc relative to the true vertical. The stellar camera will be exposed simultaneously with the payload camera and provisions will be incorporated into the system to record the time of frame exposure from the vehicle timer. The satellite vehicle will orbit in a horizontal attitude with a payload life of 15 days and an orbital life of approximately one month, depending upon altitude. Tracking, telemetry readouts and command will be provided at Vandenberg AFB, Northeast, Central, and Hawaiian Islands tracking and acquisition stations, with ground links to the Development Control Center at Sunnyvale, California. In addition to the camera system, control, transport, and storage equipment capable of executing the command signal provided by the vehicle programmer and command control communications will be provided. This system will also include equipment necessary to enable ground photo reconstruction and processing to convert the recovered film into required photographic form.

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(3) Recovery Capsule

(a) A large recovery capsule will be developed. The capsule will have a base diameter of approximately five feet and the reentry body will weigh approximately twelve hundred pounds, with a recovery payload of six hundred pounds. The heat shield will be either ablation or sublimation type and will be separated from the recovery payload at 55,000 feet by means of a reentry programmer. Instrumentation will be provided in the initial flights to record conditions of acceleration and temperature during reentry.

(b) The design of the capsule will be such as to incorporate the basic Sentry vehicle design; thus, exploiting all improved performance characteristics of the propulsion subsystem. This approach will save both development time and funds.

(4) Recovery Operation

Over-water recovery will be accomplished by utilizing aircraft with air recovery equipment. Determination of the type of aircraft to be used will be the subject of future study. The capsule will be decelerated by a spin type parachute deployed at 55,000 feet. Reentry dispersion for precision recovery will be within 30-mile diameter circle at 50,000 feet. The recovery system will be so designed that over-land air recovery can be accomplished without changes in the recovery equipment.

c. Data Processing

The objectives of the data processing system are to extract and correlate critical intelligence from Sentry reconnaissance seasons for short term imminence indications, provide convenient to use transcriptions of reconnaissance records, and to provide collection control and quality control feedback within the Sentry system.

B. SUBSYSTEMS

1. Readout Program

a. The Sentry development subsystems applicable to the Readout Program are as follows:

(1) Subsystem "A" - Airframe

(2) Subsystem "B" -- Propulsion

(3) Subsystem "C" - Auxiliary Power

(4) Subsystem "D" - Guidance and Control

(5) Subsystem "E" - Visual Reconnaissance

(6) Subsystem "F" - Ferret Reconnaissance

(7) Subsystem "H" - Ground-Space Communication

(8) Subsystem "I" - Data Processing

(9) Subsystem "J" - Geophysical Environment

(10) Subsystem "K" - Qualitative Personnel Requirements Information.

b. <u>Subsystem "A" - Airframe</u>

(1) The Airframe Subsystem includes the entire vehicle airframe, propellant tanks, nitrogen and helium storage vessels and equipment installations. The basic Sentry vehicle is utilized in the initial test phase. Incorporating the full solar array on Flight 3 will necessitate some redesign of the vehicle's aft section and adapter section. Layout design studies have been performed as to the feasibility and the proposed design configuration is within the existing structural envelope.

(2) The adapter section includes the structure and airframe that mates the satellite vehicle to the Atlas booster. It contains the solid propellant retro-rockets to achieve separation.

(3) The booster is the SM-65D model, less warhead and warhead installation adapter. The Atlas G. E. guidance system is utilized during ascent to establish and maintain the vehicle on a selected trajectory and to send attitude information to the ground computer. The command beacon on the Atlas is used to transmit the vehicle guidance system attitude correction.

(4) A feasibility study will be conducted providing a combined visual and electronic payloads configuration.

c. <u>Subsystem "B" - Propulsion</u>

(1) This subsystem includes the orbital boost engine (UDMH - IRFNA); the gas generator and turbo-pump propellant feed system; the helium pressurization propellant feed system; the turbo-pump start system; the ullage control rockets; the helium, fuel, and oxidizer vent systems used to depressurize vehicle systems after establishing orbit, and the retro-rockets installed on the adapter to facilitate vehicle separation from the Atlas booster.

(2) Also included is a low thrust propulsion system capable of making positive or negative orbital velocity corrections as required by the payload (orbital control system).

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d. <u>Subsystem "C" - Auxiliary Power</u>

This subsystem will utilize the advanced primary silver zinc battery Auxiliary Power System Flights 1 and 2. The solar photovoltaic Auxiliary Power System will be used on all subsequent flights with the high energy (hydrogen-oxygen fuel cell) battery Auxiliary Power System for back-up. Also, the possibility exists for using the SNAP I Radioisotope Auxiliary Power System beginning in late 1961.

e. <u>Subsystem "D" - Guidance and Control</u>

(1) This subsystem includes the equipment necessary to guide and control the satellite into the desired orbit and to control its attitude on orbit.

(2) Guidance during boost will be accomplished by the Atlas G. E. guidance system. The satellite guidance and control subsystem effects control of the vehicle after separation from the Atlas.

(3) Attitude control on orbit depends on the gravitational field divergence and the vehicle moment of inertia ratios to determine the equilibrium attitude of the orbiting vehicle (dumbbell effect). Effective damping is introduced by sensing angular veolcities with gyro components and applying these angular velocity signals to inertia reaction wheels whose reaction torques provide stabilization of the vehicle oscillation. In addition, a pitch axis wheel rotating at constant angular velocity is used to provide additional restoring torques about the vehicle longitudinal axis.

f. <u>Subsystem "E" - Visual Reconnaissance</u>

(1) <u>Readout Program</u>

(a) The subsystem equipment for the Visual Reconnaissance Readout Program consists of the satellite-borne equipment required to collect intelligence information in the visible spectrum, to process and store this information and on a command signal to convert the stored image to an appropriate video signal for transmission to the ground by the Ground-Space Communications Subsystem Data Link. This subsystem also consists of the ground based equipment required to take the output of the data link and reconstitute the signal into photographic form for further processing and intelligence use. The requirement for accurately locating the coverage can be relaxed since the mapping system will provide the necessary accuracy to which other coverage can be related.

(b) Visual data acquisition will employ conventional photographic techniques with special features of automatic processing and television type data readout. Within limitations imposed by the state-of-the-art future considerations will be given to the development and use of electrostatic sensors and high resolution television in conjunction with magnetic tape storage.

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(c) The initial subsystem will contain a 36 inch focal length camera capable of resolving targets 20 feet in size with a location accuracy of one mile. The camera will be aimable up to 30° each side of the orbital path and will permit coverage of selected targets on a programmed basis. Exposure control and film velocity changes can be made with the subsystem control operating from the programmer.

(d) Longer focal length systems will be developed in order to obtain coverage of objects less than 5 feet in size.

g. <u>Subsystem "F" - Ferret Reconnaissance</u>

This subsystem includes the equipment to conduct a program consisting of increasingly sophisticated ferret packages progressing from the basic F-1 system through the F-2 and F-3 system to an eventual surveillance capability. [redacted] improvements of the F-2 packages (more accurate parameter measurements, additional frequency coverage, etc.). Later versions will include detection and classification of unusual signals, measurement of additional parameters, improved locational accuracy, analog recording of specific signals and National Indicator type alarms. Unusual signals to be detected would include simultaneous multi-frequency pulse, sequential multi and single frequency pulse, CW like signals, intra-pulse modulation, jittered or staggered PRF, PW modulation, MTI, and frequency jumping and scanning. Additional features to be included in later F-3 packages include activity indicators for low priority bands, improved sensitivity, rapid scan rates, extended frequency coverage, increased locational accuracy, and more flexible system control. A combination of F-2 and F-3 components will be utilized to provide an eventual ferret surveillance capability.

h. <u>Subsystem "H" - Ground-Space Communications</u>

(1) The Ground-Space Communications Subsystem will perform the following functions: Acquisition and tracking of the satellite vehicles, telemetry, visual and electronic recovery data link, vehicle antennas, inter and intra-stations communications, and the command system.

(2) Vandenberg AFB will provide the only wideband readout. The Hawaiian and Northeast Tracking and Acquisition stations will provide their usual functions of satellite programming and control.

i. <u>Subsystem "I" - Data Processing</u>

(1) The Data Processing Subsystem includes all services necessary to design, develop, fabricate, install, provide training, operate, and maintain a system to process the input from developmental satellites of the Sentry program and ultimately to deliver intelligence data derived from the satellite reconnaissance inputs in a timely manner.

[redacted]

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(2) Input to the subsystem includes:

(a) Analog and digital electromagnetic intercept data as originally ground recorded together with necessary calibration and orbital data.

(b) Visual data as originally ground recorded together with necessary calibration and orbital data.

(3) Outputs of the subsystem include:

(a) Initial interpretation of the reconnaissance data. These interpretations will be primarily directed toward determination and correlation of short term imminence indicators.

(b) Accurate positional data of ground control points used for targeting or tilting of photographic data.

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

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

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

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

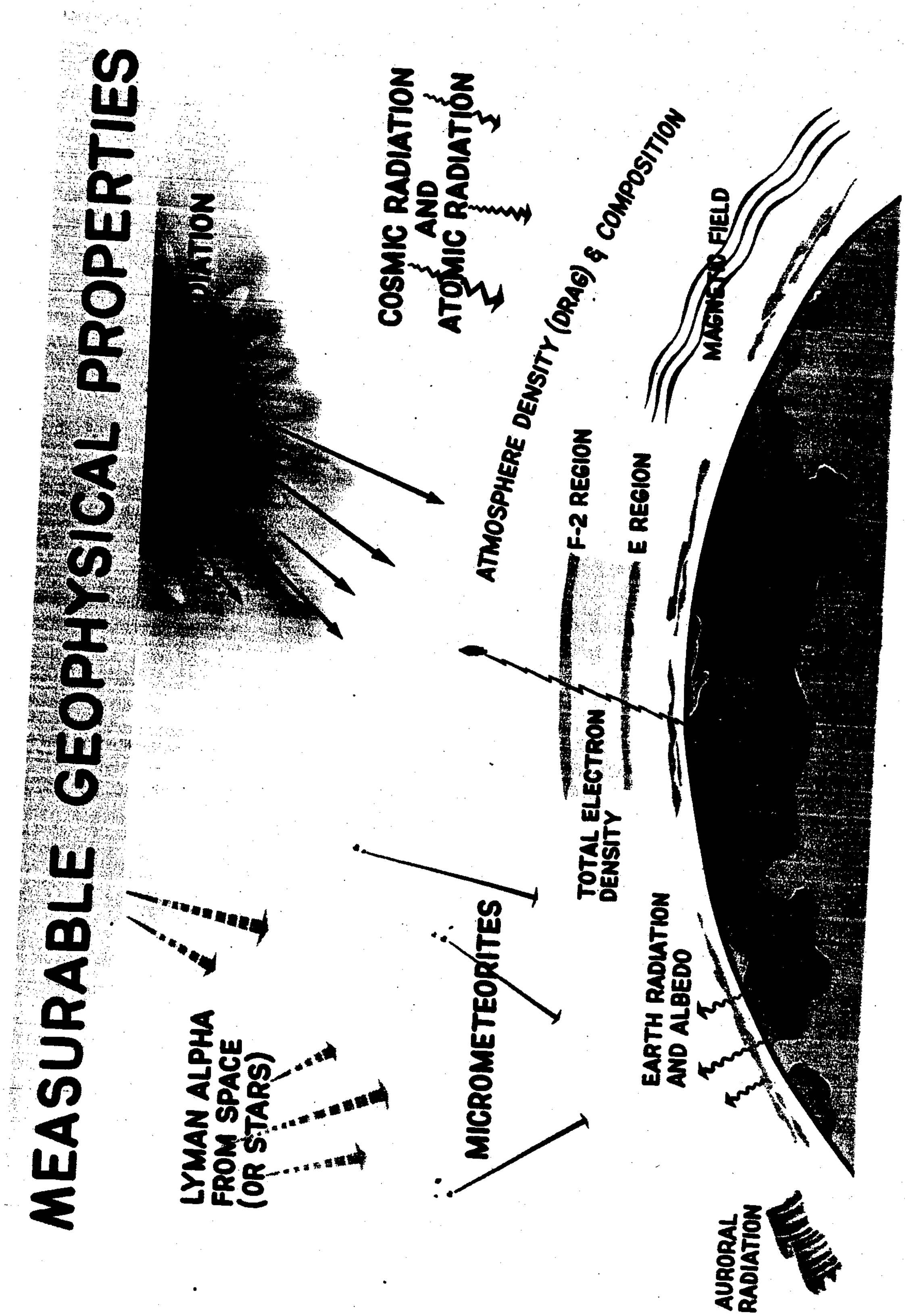
(4) The Data Processing Subsystem in order to perform the short term indication operation and to handle the large quantities of input data, is designed to process records with minimum delay. An intimate relationship is established between interpreters and a Central Data Processor so that updated reporting on individual items can be correlated for imminence analysis. Throughout the evolutionary development of the system development, efforts will be geared toward reducing the time delays between receipt of data and presentation for interpretations. Facilities for comparing previous cover and background intelligence with new take and for collating data from photo, ferret and infrared sensors will be provided.

(5) In-operation data processing will be carried out primarily in a central facility. Data will be relayed from Tracking and Acquisition Stations, as received, over wide-band data links. During the development period this central facility will be provided by the contractors.

j. <u>Subsystem "J" - Geophysical Environment</u>

Subject to weight, space and ground-space telemetry availability and a current requirement for data, consideration will be given to flight of geophysical instrumentation during the Sentry Program.

[redacted]


MEASURABLE GEOPHYSICAL PROPERTIES
COSMIC RADIATION AND ATOMIC RADIATION
ATMOSPHERE DENSITY (DRAG) & COMPOSITION
MAGNETIC FIELD
F-2 REGION
E REGION
TOTAL ELECTRON DENSITY
MICROMETEORITES
LYMAN ALPHA FROM SPACE (OR STARS)
EARTH RADIATION AND ALBEDO
AURORAL RADIATION

k. <u>Subsystem "K" - Qualitative Personnel Requirements Information (QPRI)</u>

(1) The Personnel Subsystem (concerned with the design and the development of the personnel component of the Weapon System), consists of human engineering, personnel, personnel requirements, information, training, and technical manuals efforts. The integrated functions of the subsystem will assure that:

(a) All equipments have been designed with full knowledge of personnel qualifications and limitations and, further, that positions have been defined insofar as possible in terms of existing job classifications, and that training, training materials, and definitions of operational procedures have been accomplished with the objective of attaining high proficiency of well-trained personnel.

(b) Human engineering work including new design study coordination, design review and evaluation of equipment and procedures will be conducted to maximize operational and maintenance efficiency of equipment and to minimize the opportunities for human error.

(c) Personnel requirements information will be generated. This function requires analysis of the job operations to be performed, the development of a logical personnel activities structure and attendant planning evolving into a sound organizational concept for effective system operations. Personnel requirements information will insure the orderly acquisition, training, and organizational utilization of personnel as required.

(d) Training requirements will be determined, training plans will be developed, and a coordinated program will be conducted to satisfy these requirements. These efforts will include the determination of the levels and kinds of training, the devices, aids, materials, and facilities in which the training will be conducted.

(e) Requirements for technical manuals, handbooks, and job aids to be used by operator and maintenance personnel will be determined and developed.

l. <u>Ground Support Equipment</u>

Ground support equipment includes that ground equipment necessary for the handling, transporting, servicing, checkout, and launch monitor and control functions. System checkout equipment for the complete vehicle will be required at IMSD, Santa Cruz Test Base, and the launch base. Launch base control blockhouse consoles and cabling are part of the required ground support equipment. Subsystem checkout consoles will be required to calibrate and measure each subsystem performance.

m. General Operating Data

(1) Sunnyvale Development Control Center

(a) The Sunnyvale Development Control Center provides for a centralized satellite control and data processing facility to accomplish the research and development of satellite systems. It is also to be utilized to develop prototype operational systems capabilities.

(b) The Sunnyvale Development Control Center provides for research and development control capability for the special characteristics of satellite systems. These special characteristics are included in the functions of (1) satellite operation and control, (2) satellite equipment (both airborne and ground) operation and control, (3) data reception and storage, and (4) data analysis.

(c) Satellite operation and control consists of those functions relating to central control of launch operations and to control of the vehicles on orbit. Orbit functions include tracking, station acquisition, attitude control, telemeter monitoring, command generation, recovery operations control, and engineering evaluation.

(d) Satellite equipment operation and control consists of those control functions concerned with the operation of airborne and ground sensor equipment. This includes functions such as calibration, scheduling, command generation, geoposition, confidence indices, quality control, and engineering evaluation.

(2) Orbit Computations

Orbit computations are made on the basis of tracking data and are extrapolated so that trackers and readout units may have sufficient information to acquire a satellite which comes within its range. The scheduling and display functions are also dependent on orbit computations.

(3) Scheduling

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

(4) Quality Control

Operation of various data control equipment will be monitored to determine the efficiency of equipment. In the event of malfunction within any piece of equipment or system, corrective measures will be determined and action commands initiated or prepared for future initiation. Deviations from the normal level of efficiency of the various pieces of equipment or systems will be recorded and used to determine the quality of the data outputs. Records will be maintained of all equipment malfunction or failures, and these will be reported to the responsible departments for future system improvement. In addition, all such data obtained by the various subsystems on their own equipment will be reported to the Data Control System for use in data quality control efforts.

(5) Automatic Telemeter Data Handling

Control of Sentry vehicles requires that malfunctioning vehicle equipment be adjusted or replaced while the vehicle is within contact of the readout station. Automatic telemeter data-handling capability will be provided for analysis of selected telemetry data in real time so that adjustment or replacement of malfunctioning vehicle equipmment may be made while the vehicle is in contact with the readout station. The same capability will be used to analyze telemetry data for use in preparing data certification information. Finally, the capability will also be used to determine assignable causes of variation in the remaining telemetered performance data so that engineering analysis effort will be more effectively directed.

2. Recovery Program

a. The Sentry development subsystems applicable to the Recovery Program are as follows:

(1) Subsystem "A" - Airframe

(2) Subsystem "B" - Propulsion

(3) Subsystem "C" - Auxiliary Power

(4) Subsystem "D" - Guidance and Control

(5) Subsystem "E" - Visual Reconnaissance

(6) Subsystem "H" - Ground-Space Communication

(7) Subsystem "I" - Data Processing

(8) Subsystem "J" - Geophysical Environment

(9) Subsystem "K" Qualitative Personnel Requirements Information (QPRI)

(10) Subsystem "L" - Recovery Capsule Subsystem

b. Subsystem "A" - Airframe

(1) The Airframe subsystem includes the entire vehicle airframe, propellant tanks, nitrogen and helium storage vessels, and equipment installations. The basic Sentry vehicle will be designed to accommodate the recovery capsule.

(2) The adapter section includes the structure and airframe that mates the satellite vehicle to the Atlas booster. It contains the solid propellant retro-rockets to achieve separation. The booster is the SM-65D model, less warhead and warhead installation adapter. The Atlas G. E. guidance system is utilized during ascent to establish and maintain the vehicle on a selected trajectory and to send attitude information to the ground computer. The command beacon on the Atlas is used to transmit the vehicle guidance system attitude correction.

c. Subsystem "B" - Propulsion

This subsystem includes a high performance orbital boost rocket engine; the gas generator and turbo-pump propellant feed system; the turbo-pump start system; the ullage control rockets; the helium, fuel, and oxidizer vent systems used to depressurize vehicle systems after establishing orbit; and the retro-rockets installed on the adapter to facilitate vehicle separation from the Atlas booster. The system will provide means for adjusting orbital velocity to change the orbital period as required for adjustment of coverage areas. The controlled thrust will be achieved either by multiple burning of the engine, solid rockets, or gas jets.

d. Subsystem "C" - Auxiliary Power

(1) This subsystem consists of the solar photovoltaic APS which will be operational for all visual recovery flights. A high-energy battery system will serve as backup. Also, the possibility exists that the SNAP I Radioisotope APS may be used for Flights 6, 7 and 8. The system also includes necessary regulators and inverters.

(2) An entirely integrated APS will be designed for the recovery capsule to provide power during reentry and recovery. This system will consist of silver-zinc primary batteries, power converters and inverters, voltage regulator, and control components.

e. Subsystem "D" - Guidance and Control

(1) The ascent guidance and control system for these flights will use the G. E. radio guidance system to guide the booster and to provide steering commands to the vehicle guidance and control system, which uses body mounted gyros monitored by a horizon scanner for attitude reference and reaction gas jets and hydraulic actuators gimbaling the engine for attitude control. An accelerometer-integrator combination is used to cut off the engine when orbital

velocity has been attained. The orbital guidance and control will require both greater accuracy and longer life than that attained in the guidance and control system developed for the Discoverer programs. These increased requirements will be met by utilizing reaction wheels in all axes with movable vanes or gas jets in pitch and yaw. Gas jets in roll will be utilized as necessary to prevent saturation of the wheels.

(2) In addition, the orbital period will be controlled to provide the desired target coverage. This will be accomplished with Subsystems B and H. The basic plan will be to obtain information about the orbit period from ground tracking stations and compute the corrections necessary in orbital velocity to provide the proper period for positioning in the desired spot at approximately the desired time; transmit this information to the vehicle via the beacon; orient the vehicle so as to either increase or decrease the velocity as desired; and fire a large reaction jet for the appropriate time, or an appropriate number of smaller jets for a fixed time; to provide the desired thrust.

(3) The control requirements during the recovery phase can be minimized if use is made of a tractor system, with the rocket engine or engines ahead of the center of gravity. The simplest system would spin the engine to correct for thrust misalignment. If the accuracy of this system is too low, active control could be maintained using attitude and/or rate gyros controlling sidewise thrust (by varying the size of ports in the main engine) at the appropriate time, since this is the most important source of reentry error.

f. Subsystem "E" - Visual Reconnaissance

(1) The plans for the recovery program call for two separate payloads. One for the purpose of obtaining mapping coverage, the other for high resolution reconnaissance information. In both cases the data is returned to earth in the recovery portion of the satellite vehicle. This means of data recovery is advantageous when the area to be covered or the rate of data collected would exceed the limits of a data link capability.

(2) The mapping payload will have a relatively short focal length mapping lens and use conventional size topographic film. Associated directly with this camera as practically an integral part will be stellar recording camera. The stellar camera will probably contain a different film but the two cameras will operate as a unit and will be indexed to the same time base. The location accuracy of the system is dependent upon the airborne equipment, tracking, and data processing, but the overall area will be less than 1000 feet with respect to North American datum. The resolution of the system will be approximately 150 feet. This system will enable the output of other payloads to be more accurately located by matching their output to the accurate mapping background.

(3) The large payload capability of this vehicle will probably permit the installation of additional payloads which will make this system more flexible.

(4) A high resolution payload using a long focal length system will be developed to provide a ground resolution of 5 feet from 200 mile orbit. The large payload of the recovery system permits the use of large quantities of film which would be impractical to process in the vehicle. This approach provides a high resolution capability for the situation where the delay in returning the information would not affect its intelligence value.

g. Subsystem "H" - Ground-Space Communications

(1) The ground-space communication subsystem will perform the following functions: Acquisition and tracking of the satellite vehicles, telemetry, vehicle antennas, inter and intra-station communications, and the command systems for both the satellite and recovery capsule systems.

(2) A high capacity programmer will be developed to handle the large number of commands and allow for increased accuracy of timing.

(3) Vandenberg Air Force Base, the Northeast, Central, and Hawaiian tracking stations will provide telemetry readout and command during the eight flight tests.

(4) The requirement for visual tracking of the satellite and the ability of outside agencies such as Space Track to meet this requirement will be investigated.

h. Subsystem "I" - Data Processing

The Data Processing subsystem associated with the Recovery program will be similar to that to be employed with the Readout program except inputs will be batched rather than received over a data link. The principal function of the Data Processing subsystem will be to receive the raw development records, title the records, accurately locate specific points of interest, and transcribe the records into formats readily useable by development activities without the use of special equipment. A number of components developed under the Readout program will be employed in this task.

i. Subsystem "J" - Geophysical Environment

Subject to weight, space and ground-space telemetry availability and a current requirement for data, consideration will be given to flight of geophysical instrumentation during the Sentry program.

j. <u>Subsystem "K" - Qualitative Personnel Requirements Information (QPRI)</u>

The Personnel Subsystem for the Recovery Program is essentially the same as for the Readout Program.

k. <u>Subsystem "L" - Recovery Capsule Subsystem</u>

This subsystem includes the reentry vehicle, recovery capsule, retro-system, and heat shield. It will be defined for precision recovery of the recovery capsule. It will include provisions for its own auxiliary power system and guidance system.

l. <u>Ground Support Equipment</u>

(1) Ground support equipment refers to any or all non-airborne implements or devices which are required at the launch complex to inspect, test, adjust, calibrate, appraise, gauge, measure, repair, overhaul, assemble, disassemble, service, transport, safe-guard, record, store, actuate, or otherwise perform a function in support of the airborne vehicle prior to launch.

(2) Ground support equipment designed and fabricated for previous WS 117L programs will be used where possible, and modification to existing equipment will be made where feasible.

(3) Design, fabrication, and testing of ground support equipment will be required to support the payload and any other changes to the vehicle and its subsystems which require GSE support.

m. <u>General Operating Data</u>

(1) <u>Sunnyvale Development Control Center</u>

The initial increment of the Sunnyvale Development Control Center will provide the data processing equipment and necessary displays for operation of the Recovery program. This data processing equipment performs three major functions: orbit computations, scheduling, and integrated display generation. Subsystem "H" will provide ground links to the Sunnyvale Development Control Center.

(2) <u>Reliability and Operations Analysis Considerations</u>

(a) The basic design goal of the Recovery Development Program is to achieve the capability of high-grade photo intelligence and precision recovery of the visual payload. Individual subsystem reliability requirements will be directed toward these reliability goals by early initiation of a comprehensive reliability effort which must be maintained throughout the life of the development program.

(b) These efforts will include: system reliability analyses; element, component, subsystem, and system testing; stringent quality control; qualification testing; and test results evaluation.

(c) Operations analysis efforts will be directed toward the visual payload subsystem, the reentry and recovery, nose cone and the integration to the overall Sentry vehicle. Also, the recovery techniques will be subjected to further operations analysis covering the more sophisticated equipments used in this program.

SUMMARY DESCRIPTION OF CONTRACTS BY WEAPON SYSTEM

I AF 04(647)-97 and AF 04(647)-181 Lockheed Aircraft Corporation

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 to ensure compliance of space bound system components with the concept for each successive system and complete systems integration. 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.

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. Develop and provide propulsion subsystem including: feed and loading systems, engine gimbals, and equipment required to start and stop rocket engine in response to command (or program) ullage orientation requirements, and ground based items for testing, calibrating and servicing.

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2. Subcontract: Bell Aircraft Corporation: Modification and development of XLR-81 rocket to YLR 81-Be-3(IRFNA and JP-4 propellants) engine; performance of PFRT and delivery of ground and flight engines, including spares, engine rework, engine repair and handbooks. Modification and development of YLR 81-Be-3 to IRFNA and UDMH propellant configuration, perform PFRT and delivery of ground and flight engines including spares, engine rework, engine repair and handbooks.

3. Aerojet-General: Design, develop and manufacture of solid propellant ullage orientation rockets.

E. AUXILIARY POWER SUBSYSTEM

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

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

F. GUIDANCE AND CONTROL SUBSYSTEM

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

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

G. VISUAL RECONNAISSANCE SUBSYSTEM

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

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

3. Other: Development of wide-band video recorder and TV feasibility study.

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.

3. Other: Conduct a study of operational requirements for the electronic reconnaissance system.

I. GROUND-SPACE COMMUNICATIONS SUBSYSTEM

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

2. Subcontract: Philco Corporation: Conduct a program for research, design, development and fabrication effort for the ground space communication subsystem and early operation of subsystem; manning and planning of ground stations; and installation of Subsystem H ground equipment.

II AF 04(647)-165 - Space Technology Laboratories, Ramo-Wooldridge Corp.

A. SPACE TECHNOLOGY LABORATORIES

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

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

III LETTER CONTRACT DESIGNATED AS SUPPLEMENTAL AGREEMENT #13, CONTRACT AF 04(645)-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 WS 117L and launch the combined SM 65 - WS 117L vehicle into orbit.

IV <u>OA 58-25 (OA 59-1) ROME AIR DEVELOPMENT CENTER</u>

A. <u>ROME AIR DEVELOPMENT CENTER</u>

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

V <u>OA 58-10, AIR FORCE CAMBRIDGE RESEARCH CENTER</u>

A. <u>AIR FORCE CAMBRIDGE RESEARCH CENTER</u>

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

VI <u>MIPR 58-54</u>

A. <u>NAVAL AIR STATION, MOFFETT FIELD, CALIFORNIA</u>

Helium for Lockheed

VII <u>CSO 58-33</u>

A. <u>BALLISTIC RESEARCH LABORATORY, ABERDEEN, INDIANA</u>

Wind Tunnel Tests, WS 117L Models

VIII <u>CSO 58-39</u>

A. <u>ARMY ORDNANCE COMMAND, JOLIET, ILLINOIS</u>

Munitions for Lockheed

IX <u>MIPR 72</u>

A. <u>BUREAU OF ORDNANCE MODEL TESTS, PRESSURIZED BALLISTICS RANGE, NAVAL ORDNANCE LABORATORIES, WHITE OAK MARYLAND</u>

X <u>CSO 59-54</u>

A. <u>BALLISTIC RESEARCH LABORATORIES, ABERDEEN PROVING GROUNDS, ABERDEEN, MARYLAND</u>

Transonic Free Flight Tests

XI MIPR 59-58

A. NAVAL ORDNANCE TEST STATION, CHINCOTEGUE, VIRGINIA

High Altitude Nose Cone Flight Tests

XII MIPR 59-73

A. NAVY

For Restoration and Modification of USNS Pvt. Joe E. Mann

XIII OA 58-62

A. KIRTLAND AIR FORCE BASE, MEXICO

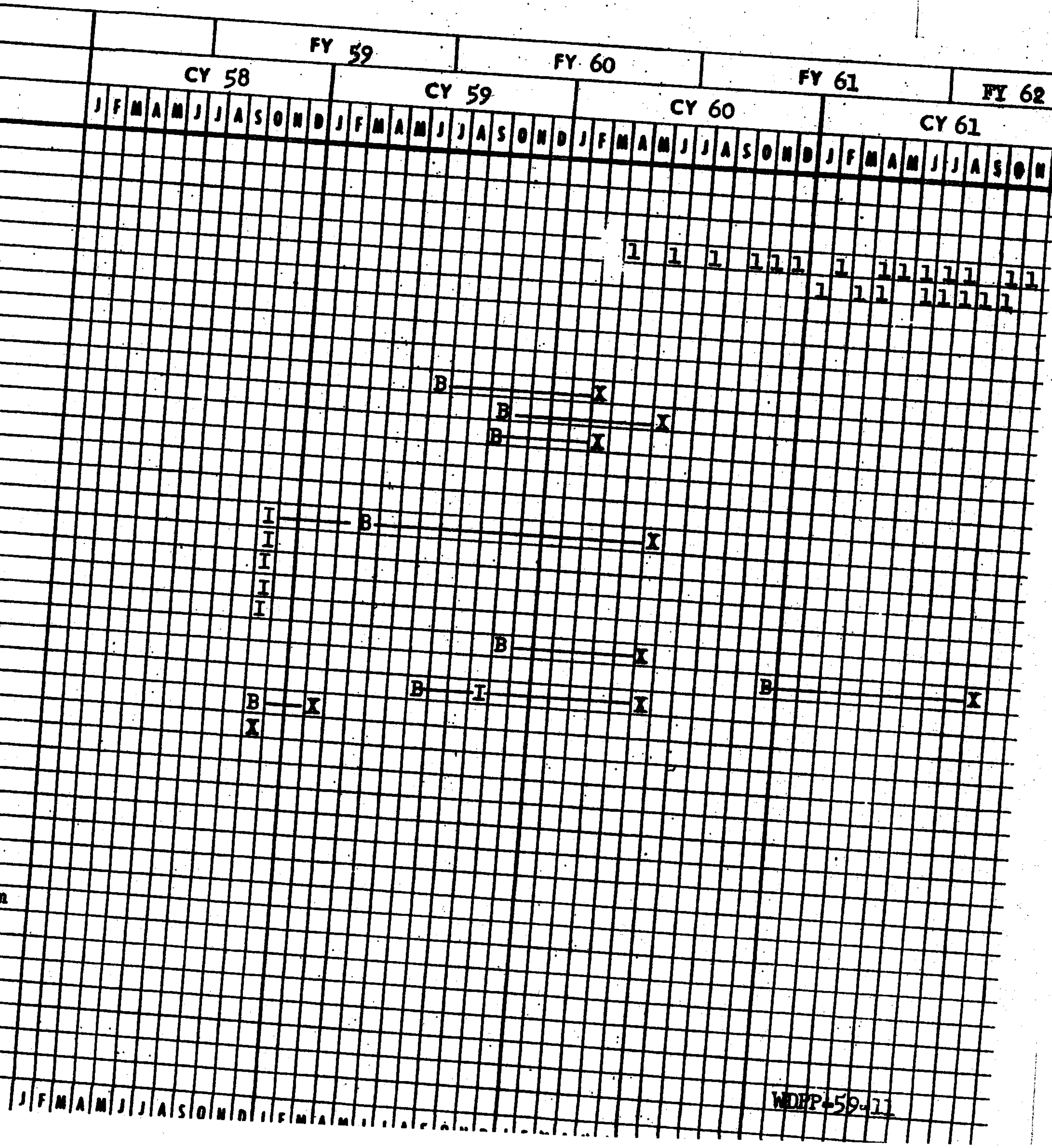
Propellant Tank Tests for Advanced Study

WDPP 59-11

PROGRAM SCHEDULE

SENTRY

1
2 LAUNCH SCHEDULE
3
4 Readout
5 Recovery
6
7 LAUNCH FACILITIES
8
9 Point Arguello Complex #1
10 Pad 1
11 Pad 2
12 G/M Assembly Bldg
13
14 GROUND STATIONS
15
16 VAFB
17 Hawaii
18 * Annette
19 * Chiniak
20 * Pt. Mugu
21 Northeast
22 Central
23 Development Control Center
24 * Recovery Control Center
25 * Telemetry Ship
26
27
28 LEGEND
29
30 I Interim Capability
31 B BOD
32 X Need Date
33 * Available from DISCOVERER Program



W FORM 219 Vellum   B-W FORM 219A Bond

WDPP-59-11

TEST ANNEX

I. DESCRIPTION OF TEST PROGRAM

A. GENERAL

1. Test Description: The Readout Program consists of 14 flights carrying visual and ferret payloads. This Readout Program comprises the major effort in the development flight testing of components and subsystems leading to the operational Sentry capability.

2. The Recovery Program is conducted concurrently with the last half of the Readout Program. It consists of eight test flights and has as its primary objective the demonstration of a visual recovery capability. Other objectives include the refinement of satellite recovery techniques and the collection of research data in the field of visual reconnaissance.

3. System Testing Responsibilities

a. Support Testing: 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:

(1) Wind tunnel tests

(2) Environmental tests

(3) Horizon scanner tests (balloon)

(4) Nuclear auxiliary power unit tests

(5) Recovery system tests

(6) Ferret tests

(7) Data processing equipment (large volume)

(8) Propellant tank tests

(9) Telemetry system tests

(10) GSE tests

(11) Roll control tests (simulation)

(12) Photographic systems tests

(13) Solar auxiliary power unit tests

(14) Propulsion system altitude start tests

(15) Aircraft drop tests

(16) Aircraft/ship data package snatch 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 Sentry 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 AFB.

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. Sentry system control will be vested in the Development Control Center at Sunnyvale under direct Air Force cognizance, and control will be subrogated from this Center to other stations as the need arises during an operation.

B. FLIGHT TEST OBJECTIVES

1. Overall Program Objectives: Sentry orbital performance characteristics will, by early 1960, have been established at AFMTC and Vandenberg AFB, and the significant test objectives of the readout and recovery programs will be:

a. Recovery Program:

(1) Demonstration of heavy capsule system recovery techniques and equipments.

(2) Evaluation of high precision vehicle attitude control stabilization system.

(3) Demonstration of precise vehicle position and attitude determination techniques.

(4) Demonstration of system compatibility with extreme resolution photographic requirements.

(5) Evaluation of orbital period adjustment control and computing techniques.

(6) Demonstration of system compatibility with global photogrammetry requirements.

(7) Evaluation of system tracking and positional computing systems.

b. Readout Program:

(1) Demonstration of orbit capability.

(2) Demonstration of ability to achieve and maintain a stabilized nose-down orientation.

(3) Test and evaluate high resolution trainable photo-reconnaissance systems.

(4) Test and evaluate data link readout electronics.

(5) Test and evaluate environmental control components.

(6) Test and evaluate interim and operational ferret systems.

(7) Demonstrate capability of electronic and visual reconnaissance systems to obtain intelligence information.

(8) Evaluate the operation of equipment in zero gravity field.

(9) Evaluate orbit tracking and ground/space command and communications system.

(10) Test and evaluate data acquisition, handling, and processing systems.

2. Detailed Test Objectives: Detailed test objectives will be documented for each flight.

6. FLIGHT TEST PLAN

1. Recovery Program: The Sentry satellite vehicle and test system configuration are substantially the same for each of the eight flights of the Recovery Program. The vehicle will be stabilized in a tail-first horizontal orientation. All flights will involve capsule recovery.

2. Readout Program: During the fourteen test flights of this program, the payload will be stabilized in orbit. The first three flights will carry components of the visual reconnaissance and ferret payloads for testing under spatial conditions. Readout will be accomplished at the various ground stations, with information assembled via the inter-station communications network at the Sunnyvale Development Control Center for evaluation. The remaining eleven flights will employ visual and ferret reconnaissance payloads as determined to be necessary in attainment of program objectives.

Wide-band visual readout capability is programmed initially only for the Vandenberg AFB Tracking Station, with the Northeast T/A Station following in fiscal year 1960 and the Central T/A Station in fiscal year 1962.

3. Test System Configuration: The test system configuration consisting of the launch facilities, tracking stations, a downrange telemetry readout station, computing facilities, control centers, and communications network, is described in the Facilities Section of this document.

D. FLIGHT TEST ORBANIZATION

Subject to the overall management by the Air Force Ballistic Missile Division, the Lockheed Missile System Division has been assigned responsible technical direction of the Sentry Development Program. In accordance with ARDC regulations, the AFBMD Weapons System Project Office (WSPO) exercises technical test control of Sentry systems tests. The Chief, Palo Alto Field Office, is the Systems Test Controller who is assigned responsibility for exercising control of the technical tests of the Sentry/Atlas during the test planning phase and flight test operations. Within the broad direction established by AFBMD for Sentry development, system requirements are 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 are 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 is 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 has been established at each Sentry field site with the center of operations located at the Palo Alto Development Control Center (PADCC). Major decisions concerned with such items as launch under marginal conditions will be made at PADCC based on recommendations made by various field stations. In all cases, final authority in the areas of test control and direction is at the PADCC.

II. 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, includes an adequate description of the test configuration and test objectives. In addition, the specific plans for attaining the objectives are 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

1. 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.

2. Convair Astronautics will deliver a flight-ready modified Atlas booster to Vandenberg AFB directly from the San Diego plant.

3. Sentry vehicle test and checkout will begin at LMSD, Sunnyvale and Palo Alto, 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.

4. At Vandenberg AFB the vehicle will again be run through a simulated flight with all functions recorded and compared to previous tests to determine possible deterioration of components.

5. The checkout of launch facilities will be accomplished on a schedule compatible with the flight preparation of the complete weapon system.

6. 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.

7. The final checkout for the Sentry system will be the mock countdown and firing on X - 2 days from the anticipated time of launch. Blockhouse checks and calibrations of the electrical power, guidance, beacon and payload will be made. Simultaneously, the Atlas booster will be checked out. This X - 2 day mock firing will also serve to check out Sentry communications system and procedures.

D. COMMUNICATION SYSTEM COUNTDOWN

1. Communication system countdown is initiated five hours before launch with a communication check to each station which also provides a station readiness report and a time synchronization.

2. Throughout the countdown, the Sunnyvale Development Control Center will direct major activities of individual tracking stations, the recovery force and of the Hawaiian Control Center, evaluating overall system conditions from individual status reports and integrating separate efforts into a unified operation. The time relationship of individual station operations are planned for a simultaneous readiness condition of launch and tracking support equipment.

E. LAUNCH, EXIT, & ORBIT INJECTION PHASES

1. 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:

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

b. Commencing 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.

c. 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.

d. Simultaneous with vernier engine shutdown, the guidance timer will issue signals to fire the explosive separation bolts, 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 Sentry to its orbited boost altitude, while guidance and control subsystems pitch the Sentry to local horizontal.

e. The propulsion subsystem will inject the Sentry 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.

2. After a launching, LMSD and CVAC personnel will refurbish the launch complex 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

1. Definition: 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), is described as the orbital phase during which the payload operation is carried out.

2. All tracking stations of the Sentry system conduct a systematic equipment check prior to each vehicle contact. This exercise serves to indicate the readiness of the station and verifies the operability of its equipment.

3. Operation of airborne visual and electronic reconnaissance equipment will continue as described in TAB 2.

4. Sentry readout will be performed initially over VAFB with wide band data reception capabilities expanding subsequently to Northeast and Central stations. Ferret readout initially will utilize all existing tracking stations.

G. RECOVERY OPERATION

Present planning provides that the recovery capsule will be ejected from orbit to be air-recovered, probably in Hawaiian waters. The basic recovery system, however, is adaptable to over-land operations. Thus, recovery can be accomplished in a variety of operational modes. The definitive selection of the final operational mode will be made when all system factors have been evaluated.

III. COMMAND & CONTROL RESPONSIBILITIES & PROCEDURES

A. GENERAL

1. System command and control is a world-wide problem requiring an extensive communication network. The actual functions of command and control are not complex in themselves. The problem is made complex because of the geographic separation of the various ground stations and the need for reliable transmission of tracking and system status data on a 24 hour basis.

2. The tasks to be accomplished in the command and control of the Sentry recovery and readout test configurations include:

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

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

c. The definition and selection of emergency operational modes in the event of system component failure.

d. The transmission of system commands.

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

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

B. PRELAUNCH

1. The Sunnyvale Development Control 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 count-down at T - 5 hours, the DCC initiates the following activities:

a. Communication system checkout

b. Simulation transmissions from tracking stations to the computer center.

c. Dry run orbit calculation.

2. During the system countdown, the launch facilities aspects of the countdown are under the direct control of the Vandenberg Control Center. The Sunnyvale Development Control Center, in its direction of the overall countdown, is continually receiving and retransmitting system status information and other pertinent data such as weather and recovery force status. Vandenberg Control Center plots the important data received from the Sunnyvale DCC and in turn, the Vandenberg Control Center continuously advises the Sunnyvale DCC of the status of the launch countdown.

3. The Hawaiian Control Center is also in constant contact with the Sunnyvale DCC 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 is made at the Sunnyvale Development Control Center. This decision can only be made after all the major system components have been verified as operative.

C. LAUNCH & ASCENT

1. The Sunnyvale DCC functions, during this phase, are concerned primarily with system coordination, as follows:

a. The tracking stations are alerted and notified of initial orbit parameters.

b. The Computer Center is routed the times of vehicle engine start and termination of orbital boost.

c. The recovery force is informed of orbit achievement and redirected, if required.

2. The Vandenberg Control Center functions are the direct control of the launch facilities and vehicle command during this phase of the test operation.

D. ORBIT

1. The exercise of control over the vehicle in orbit is limited to the following commands:

a. Reset of the orbit timer

b. Adjustment of the orbit timer

c. Control of orbit altitude and period

d. Initiation of the recovery sequence, or

e. Initiation of reconnaissance readout.

2. The intervals at which these commands are given is controlled by the vehicle position in orbit relative to the tracking stations. Therefore the Sunnyvale DCC has very little freedom in command choice or determination insofar as the vehicle itself is concerned. However, it must continuously monitor the Sentry 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

1. The decision to initiate recovery is made by the Sunnyvale DCC and the command issued to the vehicle on orbit by one of the Sentry tracking stations. The aircraft will have departed before the dump command is sent. From this point, Hawaiian Control Center becomes the focal point for the exercise of system control as delegated by Sunnyvale DCC.

2. Progress of the search and recovery operation is plotted against a predetermined time schedule. Appropriate periods, which have been established following rigid safety standards, are allowed for air and sea search. Changes in weather conditions are carefully evaluated

in terms of these predetermined standards. Sunnyvale DCC is continuously informed of the progress of the recovery operation.

3. Any decision to postpone or halt the recovery attempt or the capsule search will be made at Sunnyvale Development Control Center on the basis of the information received from the Hawaiian Control Center.

IV. 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

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

   a. Vandenberg AFB

   b. Telemetry ship

   c. Kaena Point Tracking Station, Hawaii

   d. Chiniak Tracking Station, Alaska

   e. Recovery Force, PMR

   f. Northeast Tracking Station, USA

   g. Central Tracking Station, USA

2. The types of data involved are:

   a. Telemetry data

   b. Radar tracking and control data

   c. Launch (umbilical) data

   d. Launch (optical) data

   e. Weather data

   f. Prelaunch servicing notes

g. Recovery data

h. Operations data (reconnaissance readout).

3. 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. <u>DATA HANDLING PROCEDURES</u>

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 Sunnyvale DCC.

C. <u>DATA REDUCTION</u>

1. With the exception of data derived from metric optics, all raw Sentry 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 Sentry results, the data reduction process will be accomplished in two parts, in the manner described below.

a. 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.

b. A final, comprehensive compilation of data as required for detailed subsystem analysis will be completed within a period of 3 to 5 days after launch.

D. <u>SYSTEM EVALUATION</u>

1. 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:

a. Overall system performance in terms of predicted versus actual results

b. Validity of test plans and conduct in terms of the timely achievement of test objectives

c. Techniques and procedures employed in the conduct of system test operations

d. Adequacy and suitability of systems communications, ground support equipment, facilities, and logistics.

2. Follow-through action will be taken to investigate problem areas revealed by preliminary evaluation and detailed analysis of test activity. These 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.

3. 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.

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DEPARTMENT OF THE AIR FORCE
SENTRY PROGRAM
FY 1960 FINANCIAL PLAN
AND
REVISED FY 1959 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS

	FY 58 & PRIOR	FY 1959 ARPA FUNDED	FY 1959 AF FUNDED	FY 1960 ARPA FUNDED	FY 1960 AF FUNDED
LMSD	(65,479,000)	(66,700,000)		(104,000,000)	(5,851,000)
Manage & Sys Engineering		12,978,000		31,570,000	
Vehicle Subsystems		8,775,000		14,502,000	
Payload Subsystems		25,790,000		37,082,000	
Communications Subsystems		16,062,000		18,072,000	1,000,000
GSE		3,095,000		2,774,000	4,851,000
Atlas Booster	600,000	14,200,000		34,400,000	
RADC	2,820,000	9,000,000		17,000,000	
AFCRC	2,842,000	-0-		1,500,000	
MIT	1,420,000	1,700,000		-0-	
Facilities	5,718,000	9,000,000	3,369,000	-0-	4,649,000
Industrial Facilities	70,000	4,400,000		-0-	
STL	-0-	600,000		1,000,000	
MISC	391,000	-0-		2,100,000	
TOTAL	79,340,000	105,600,000	3,369,000	160,000,000	10,500,000

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DEPARTMENT OF THE AIR FORCE
SENTRY PROGRAM
FY 1960 FINANCIAL PLAN
AND
REVISED FY 1959 FINANCIAL PLAN

SUMMARY OF REQUIREMENTS BY AGENCY AND BUDGET PROJECT

	FY 1959	FY 1960
ARPA	105,600,000	160,000,000
AIR FORCE		
244	-0-	5,851,000
321	3,369,000	4,649,000
TOTAL	108,969,000	170,500,000

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DEPARTMENT OF [redacted]RCE
SENTRY PROGRAM
FY 1960 FINANCIAL PLAN
AND
REVISED FY 1959 FINANCIAL PLAN

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960
1. Management and Systems Engineering	12,978,000	31,570,000
2. Vehicle Subsystems	8,775,000	14,502,000
3. Payload Subsystems.	25,790,000	37,082,000

1. MANAGEMENT AND SYSTEMS ENGINEERING

FUNDS REQUESTED IN THIS CATEGORY ARE FOR DESIGN STUDIES, ESTABLISHING CRITERIA, MANUFACTURING COSTS, AND TESTING THE VEHICLE. INCLUDED UNDER MANUFACTURING COSTS ARE THOSE EXPENSES RESULTING FROM TOOLING, PLANNING, MOCKUP, VEHICLE FABRICATION, MANUFACTURING SERVICES AND QUALITY ASSURANCE. UNDER TESTING ARE INCLUDED THE OPERATION OF TRACKING SITES AND THE DEVELOP- MENT CONTROL CENTER, ALONG WITH IN-PLANT, STATIC TEST FIRINGS AND FLIGHT TESTING. THE LOCKHEED PROGRAM MANAGEMENT COST IS INCLUDED IN THIS ESTI- MATE.

2. VEHICLE SUBSYSTEMS

THE BASIC VEHICLE SUBSYSTEMS INCLUDING AIRFRAME, PROPULSION AUXILIARY POWER AND GUIDANCE ARE INCLUDED IN THIS ESTIMATE. IT COVERS THE COST OF THE RESEARCH AND DEVELOPMENT OF THESE SUBSYSTEMS AND THE PRODUCTION OF THESE SUBSYSTEMS FOR THE 23 FLIGHT VEHICLES. EFFORT IS REQUIRED TO DE- SIGN PROVISIONS FOR A LARGER CAPSULE AND TO CARRY A PAYLOAD AND TEST COM- PONENTS OF OTHER PAYLOAD SUBSYSTEMS. AUXILIARY POWER SUBSYSTEM DEVELOP- MENT WILL INCLUDE HIGH ENERGY BATTERIES, A SOLAR APU AND A SNAP I APU.

3. PAYLOAD SUBSYSTEMS.

THE PAYLOAD SUBSYSTEMS IN THE SENTRY PROGRAM CONSISTS OF THE PHOTO, FERRET, AND CAPSULE SUBSYSTEMS. EFFORT IN THE PHOTO SUBSYSTEM WILL IN- CLUDE ANALYSIS, STUDIES, BREAD BOARD MODELS, SERVICE TESTING, AND PRODUC- TION OF THE FLIGHT HARDWARE. WORK TO BE ACCOMPLISHED UNDER SUBSYSTEM F IS THE DEVELOPMENT OF START-STOP RECEIVER SCANNING AND ANALOG RECORDING SYS- TEM, SPECIALIZED COMPONENTS, PARAMETER MEASUREMENT ACCURACY, AND THE PRO- DUCTION OF FLIGHT HARDWARE. CAPSULE DEVELOPMENT WILL INCLUDE STRUCTURE, RETRO-SYSTEM, RECOVERY SYSTEM WORK IN ADDITION TO FLIGHT ARTICLES.

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DEPARTMENT OF THE AIR FORCE
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FY 1960 FINANCIAL PLAN
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JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960
4. Communications Subsystem	16,062,000	19,072,000

The funds programmed for this subsystem will be used to design and develop communications equipment including a wide band capability. Airborne portions will be produced for the 23 flights scheduled in this program. Ground based equipment will be produced to equip the tracking sites and the Development Control Center.

	FY 1959	FY 1960
5. Ground Support Equipment	3,095,000	7,625,000

The funds programmed for GSE are required to equip a maintenance facility, blockhouse, and two pads at Vandenberg AFB for this program. Development work will include effort to convert the launch monitor and control equipment to a digital data handling system and expand for a thorough payload monitor and check.

	FY 1959	FY 1960
6. Atlas Boosters	14,200,000	34,400,000

Atlas booster costs were computed on the basis of $3,000,000 per missile including engineering changes, launch costs, and other support costs incident to a flight. Costs were distributed by fiscal year on the basis of 15 months from order to flight. Atlas GSE costs for a maintenance facility, blockhouse, and two pads are included in this estimate.

	FY 1959	FY 1960
7. Rome Air Development Center	9,000,000	17,000,000

Included in this requirement are studies and analyses to determine feasibility of design concepts, establish design criteria, and accomplish detailed design fabrication and testing of experimental version of the data processing subsystem and its various components.

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DEPARTMENT OF THE [redacted]ORCE
SENTRY PROGRAM
FY 1960 FINANCIAL PLAN
AND
REVISED FY 1959 FINANCIAL PLAN

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960
7. ROME AIR DEVELOPMENT CENTER (CONTINUED)		

THE MAJOR COST ELEMENTS INCLUDE: STUDY DESIGN AND FABRICATION OF PHOTO PROCESSING, PHOTO DATA REDUCTION, FERRET DATA REDUCTION, DISPLAY AND DATA PROCESSING EQUIPMENTS; CONTINUING STUDY AND ANALYSIS OF FERRET REQUIREMENTS, COMPUTATIONAL ROUTINES, DISPLAY REQUIREMENTS, REPORTING METHODS, IMMINENCE INDICATORS, SYSTEM SIMULATION; INTEGRATION OF EQUIPMENTS AND PROCEDURES FOR SYSTEM TEST AND HANDLING DATA FROM EARLY FLIGHTS.

ALSO INCLUDED IS THE COST OF FABRICATION AND TESTING OF PRODUCTION MODELS OF THE EQUIPMENT. THE MAJOR COST ITEMS ARE: PHOTO PROCESSING EQUIPMENT, PHOTO CONVERSION EQUIPMENT, PHOTO INTERPRETER VIEWERS, FERRET DATA REDUCTION CONSOLES, ANALOG FERRET DATA REDUCTION EQUIPMENT, DISPLAY EQUIPMENT, CENTRAL DATA PROCESSING EQUIPMENT, AND MISCELLANEOUS COMMUNICATION TERMINAL EQUIPMENT.

	FY 1959	FY 1960
8. CAMBRIDGE RESEARCH CENTER	-0-	1,500,000

THE FOLLOWING TASKS COMPRISING THE GEOPHYSIC SUBSYSTEM WILL BE PERFORMED BY CAMBRIDGE RESEARCH CENTER: THERMAL RADIATION, METEOR PHYSICS, ATMOSPHERIC DENSITY, ATMOSPHERIC COMPOSITION, SOLAR ULTRAVIOLET RADIATION, ROCKET INSTRUMENTATION, ELECTRON CHARGE AND ION DENSITY, AND COSMIC RADIATION.

	FY 1959	FY 1960
9. MIT	1,700,000	-0-

THESE FUNDS ARE FOR THE DESIGN, FABRICATION, AND TESTING OF EXPERIMENTAL GUIDANCE AND CONTROL EQUIPMENT BY THE MIT INSTRUMENTATION LABORATORIES.

	FY 1959	FY 1960
10. FACILITIES	12,369,000	4,649,000

A DESCRIPTION AND JUSTIFICATION OF FACILITIES REQUIRED IS CONTAINED IN THE FACILITIES SECTION OF THIS DEVELOPMENT PLAN.

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DEPARTMENT OF THE AIR FORCE
SENTRY PROGRAM
FY 1960 FINANCIAL PLAN
AND
REVISED FY 1959 FINANCIAL PLAN

JUSTIFICATION OF REQUIREMENTS

	FY 1959	FY 1960
11. Industrial Facilities	4,400,000	-0-
12. Space Technology Laboratories	600,000	1,000,000
13. Miscellaneous	-0-	2,100,000

11. INDUSTRIAL FACILITIES

FACILITIES TO BE PROVIDED CONSIST OF A SMALL QUANTITY OF GENERAL PURPOSE MACHINE TOOLS AND PRODUCTION EQUIPMENT; AND LABORATORY AND TEST EQUIPMENT. THE PREDOMINANT REQUIREMENT IN THIS CASE, AS IS GENERALLY TRUE IN OTHER BALLISTIC MISSILE FACILITIES EXPANSIONS, IS THAT FOR LABORATORY AND TEST EQUIPMENT. THE FY 58 REQUIREMENT OF $70,000 WAS FOR A FLOW TURNING MACHINE FOR FABRICATION OF COMPONENT EQUIPMENT. ABOUT $4,900,000 OF THE FY 1959 REQUIREMENT IS FOR LABORATORY AND TEST EQUIPMENT. TYPES AND QUANTITIES OF LABORATORY AND TEST EQUIPMENT REQUIRED FOR THIS PROGRAM ARE NOT AVAILABLE IN INDUSTRY, NOR ARE SUCH ITEMS GENERALLY AVAILABLE IN THE INDUSTRIAL RESERVE. OF THE TOTAL $5,100,000 IS FOR MACHINERY AND EQUIPMENT AND THE REMAINDER IS FOR INSTALLATION COSTS.

12. SPACE TECHNOLOGY LABORATORIES

INCLUDED UNDER THIS ESTIMATE ARE REQUIREMENTS FOR ENGINEERING ASSISTANTS AND CONSULTANTS TO BE FURNISHED BY SPACE TECHNOLOGY LABORATORIES.

13. MISCELLANEOUS

FUNDS REQUESTED ARE FOR UNFORESEEN TASKS NOT INCLUDED IN THE PRIME CONTRACT AND MOSTLY ACCOMPLISHED BY OTHER DOD AGENCIES.

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SECTION III

TABLE OF CONTENT

WDPP 59-11

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GENERAL STATEMENT

1. The section contains the consolidated facility requirements for WS 117L (SENTRY) which must be included in the FY 1959 and FY 1960 Military Construction Programs and ARPA FY 1959 Program to insure their availability on a schedule compatible with the other phases of the total weapon system effort. The ARPA Facilities in FY 1959 are authorized by ARPA Order 41-59, as amended. The Facilities Program is developed to support the Technical Program, Section I. Facilities shown herein are required to support the following functions of the program: booster and vehicle assembly and checkout; launch; satellite tracking, control, and telemetry; data reception, interpretation and dissemination.

2. Boosters and Vehicles will be maintained, reassembled and checked-out in the Missile Assembly Building at Vandenberg AFB. The missile will be launched from the Sentry/Atlas Launch Complex Nr. 1 at Point Arguello. Launch data will be obtained by utilizing VHF facilities at the Vandenberg Tracking Station and the Downrange Telemetry Ship. Orbital tracking, command and data readout will be performed initially at the Vandenberg Tracking Station. As the System develops additional tracking capability will be available at the Hawaiian and New Boston Tracking Stations by June 1960. Additional Data Readout capability will be available at the New Boston Tracking Station by September 1960 and at the Ottumwa Tracking Station by September 1961. A Development Control Center located adjacent to the Sentry Production Plant at Sunnyvale, California will serve as a command, administrative and control center throughout the development phase.

3. Personnel and non-technical support facilities are not included in this plan as all technical facilities have been sited to take advantage of support available at existing military bases or contractor plants. Industrial Facilities (P-151) are not included in this section.

4. AF Forms 161 which include the detailed description of each project based on the best knowledge available at this time and justification for requirement are contained under separate cover.

5. Advance planning funds required for planning and design costs to be incurred directly by AFBMD for the items in this section are not included. 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.

6. 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 of the specific project. 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 installing unit equipment, special and/or fixed equipment that is not included as construction contractor-installed property.

e. Construction Completion Date: The date when the construction contractor (brick and mortar) has completed to the satisfaction of the contracting agency and the Air Force that work which he was obligated to accomplish under the terms of his contract. On Air Force bases, this is the date upon which the AF Form 290 is signed and the facility is transferred to base accountability records. Construction can be accepted by the Air Force subject to correction of deficiencies noted at the acceptance inspection.

f. Need Date: That date when the facility is required to be capable of accomodating or performing the function for which it was acquired.

7. 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:

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Part I Base or Location

1. Edwards AFB
2. Holloman AFB
3. Patrick AFB
4. Vandenberg AFB
5. ATLAS
6. TITAN
7. MINUTEMAN
8. 117L/Space/MIDAS
   - 8A Pt Arguello, Calif.
   - 8B New Boston, New Hampshire
   - 8C Ottumwa, Iowa
   - 8D Ft Stevens, Oregon
   - 8E Hawaiian Is. T.H.
   - 8F Alaska
   - [redacted]
   - 8I Sunnyvale, Calif.
   - 8J Pt Mugu Calif
9. Miscellaneous

Part II Item (Functional) Category

R and D

1. Launch
2. Launch Support
3. Area Support/Missile Support
4. Range/Tracking/Telemetry
5. Captive Test
6. Special Test
7. Captive Test Support

IRBM/ICBM Training

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

ICBM Operations

1. Launch
2. Launch Support
3. Guidance
4. Guidance
5. Command & Communications
6. Missile Support

Part III Weapons System or Weapons System Phase

1. WS 107A-1
2. WS 107A-2
3. WS 315A
4. WS 117L/Space/MIDAS
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 total index code number will be made up of the four basic parts with the first two or three digits indicating the Base and Item (Functional) Category combined into one number. The third and fourth digits, representing the Weapons System or Phase and the Line Item, will be separated by decimal points.

Example: The number 43.6.5 would indicated Vandenberg AFB (Nr. 4), Guidance (Nr. 3 of ICBM), .6 (ICBM), .5 (fifth line item). It should be emphasized that since the item (Functional) Category is broken down into three functional areas (R&D, IRBM, ICBM), the third digit (or Weapon System Code) will indicate which sub-category the second number belongs to.

[redacted] CONFIDENTIAL

Example: In the number 43.6.5, the digit .6 indicates ICBM and the second digit .3 (of the number 43) would then indicate "Guidance".

NOTE 2: Base or Location Number is indicated in parentheses following "LOCATION". Item (Functional) Category Number is indicated in parentheses following "ITEM CATEGORY". The index Column carries only the third and fourth digits of the Index Identification Numbers on the Weapons System and Line Item identifications.

CONFIDENTIAL [redacted]

FACILITIES SUMMARY

FOR

SENTRY - WS 117L

TYPE FUNDS: P-300

(FIGURES ARE IN MILLIONS OF $)

LOCATION	BUDGET ESTIMATE					
	PRIOR YRS	FY 57	FY 58	FY 59	FY 60	TOTAL
Vandenberg AFB			2.568			2.568
Hawaii			1.550			1.550
Alaska			0.080			0.080
Pt Mugu, Calif			0.020			0.020
New Boston, N.H.				3.369		3.369
Ottumwa, Iowa					3.369	3.369
Sunnyvale, Calif			1.500		1.280	2.780
Total			5.718	3.369	4.649	13.736

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[redacted] ~~CONFIDENTIAL~~

FACILITIES SUMMARY

FOR

SENTRY - WS 117L

TYPE FUNDS: ARPA

(FIGURES ARE IN MILLIONS OF $)

LOCATION	BUDGET ESTIMATE					
	PRIOR YRS	FY 57	FY 58	FY 59	FY 60	TOTAL
Pt Arguello, Calif				6.000		6.000
Vandenberg AFB				3.000		3.000
Total				9.000		9.000

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[redacted] CONFIDENTIAL

FACILITIES SUMMARY

FOR

SENTRY - WS 117L

TYPE FUNDS: P-300
ARPA

(FIGURES ARE IN MILLIONS OF $)

ITEM CATEGORY	LOCATION	BUDGET ESTIMATE					
		PRIOR YRS	FY 57	FY 58	FY 59	FY 60	TOTAL
Launch	Pt Arguello				6.000*		6.000
Missile Support	Vandenberg AFB			0.259	3.000*		3.259
Tracking & Telemetry	Vandenberg AFB			2.309			2.309
Tracking & Telemetry	Hawaii			1.550			1.550
Tracking & Telemetry	Alaska			0.080			0.080
Tracking & Telemetry	Pt Mugu			0.020			0.020
Tracking & Telemetry	New Boston				3.369		3.369
Tracking & Telemetry	Ottumwa					3.369	3.369
Special Test (D.C.)	Sunnyvale			1.500		1.280	2.780
	Total			5.718	12.369	4.649	22.736

* ARPA Funds

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[redacted]

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TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION: (8A) PT ARGUELLO

ITEM CATEGORY (1) Launch

SENTRY-WS117L

PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
			6.000		6.000

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY: PRIOR	FY 57	FY 58	FY 59	FY 60	DESIGN: START	COMPL.	CONSTRUCTION: AWARD	BOD	COMPL.	NEED DATE
4.1	G/M Launch Facility Nr 1				6.000							
	Stand 1						07/58	10/58	12/58	08/59	08/59	03/60
	Stand 2						07/58	10/58	12/58	10/59	10/59	05/60
	Operations Building						07/58	10/58	12/58	07/59	07/59	03/60

~~CONFIDENTIAL~~ [redacted]

[redacted] (When Filled In) ~~CONFIDENTIAL~~

LOCATION (8A) PT. ARGUELLO

ITEM CATEGORY: (1) Launch

DESCRIPTION AND UTILIZATION:

A complete launch facility will consist of two launch stands, with flame deflectors, underpad instrumentation and equipment space, service towers, umbilical masts, fuel storage and transfer facilities, water and electrical power transmission and distribution lines, hardstands, a operations building which contains controls and instrumentation and is designed to protect personnel from blast or direct fall-back of a missile. Detailed description may be found in the applicable Form 161. Guidance will be effected through the use of the G.E. Mod II Guidance System built as a part of the SM 65-1 Launch Complex.

These launch facilities will provide for all R&D Atlas-boosted launchings.

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TYPE FUNDS: P-300 MCP (ARPA)

BUDGET ESTIMATES

LOCATION: (4) VANDENBERG AFB

ITEM CATEGORY (3) Missile Support

SENTRY - WS 117L

PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
		0.259	3.000		3 259

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	DATE
4.1	G/M Assembly Building (Interim)			0.259			04/58	05/58	06/58	08/58	09/58	11/58
4.2	G/M Assembly-Command and Administration Fac				3.000*		05/58	01/59	02/59	10/59	11/5)	03/60

* ARPA

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CONFIDENTIAL

LOCATION (4) VANDENBERG AFB

ITEM CATEGORY: (3) Missile Support

DESCRIPTION AND UTILIZATION:

G/M Assembly Building (Interim): This facility consists of rehabilitated building that provides an assembly and shop area for the WS 117L vehicle and its Thor-booster. Rehabilitated buildings also provide office, sub-system, laboratories and shops. Utilities, security fencing and parking areas are also provided.

This facility will support the Thor-boosted WS117L flights from Vandenberg AFB.

G/M Assembly-Command: This facility will provide space for the receiving, assembly, check-out, and maintenance of the WS 117L vehicle, its Atlas booster, components and subsystems and office space for operating personnel. It will provide office space also for administrative and command personnel directing the overall WS 117L test operation at Vandenberg AFB. It will be of metal frame with masonry and metal siding, and metal roof, on a concrete slab on grade. It will have a total of approximately 100,000 SF of floor space, divided essentially as follows: Vehicle Unit - 60,000 SF and Booster Unit - 40,000 SF.

Special purpose areas will be air-conditioned. Other areas will be provided with filtered ventilation air to prevent dust infiltration to a reasonable extent.

This facility will support the WS 117L Launch Complex at Pt. Arguello.

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TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (4) VANDENBERG AFB

ITEM CATEGORY (4) Tracking & Telemetry

SENTRY - WS 117L

~~WS 107A-1~~
~~WS 107A-2~~
~~WS 315A~~
~~COMMON~~

PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
		2.309			2.309

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY: PRIOR	FY 57	FY 58	FY 59	FY 60	DESIGN: START	DESIGN: COMPL.	CONSTRUCTION: AWARD	CONSTRUCTION: BOD	CONSTRUCTION: COMPL.	NEED DATE
4.1	Tracking and Telemetry Sta			2.309								
	Interim Station						03/58	04/58	05/58	08/58	[illegible]	11/58
	Permanent Station						05/58	08/58	12/58	06/59	12/59	03/60

[redacted] CONFIDENTIAL

LOCATION (4) VANDENBERG AFB

ITEM CATEGORY: (4) Tracking & Telemetry

DESCRIPTION AND UTILIZATION:

Interim Station: The interim portion of the tracking and telemetry station consists of one 60 ft diameter TIM-18 Telemetry Antenna, a Telemetry Receiver Building (approximately 2300 SF) a Tri-Helix Telemetry Antenna, a Mod II Radar Antenna with van-mounted equipment, three boresight towers, access roads approximately two miles in length, utilities, security fencing and minor appurtenances. This portion of the complete station has been completed in time to support the early phase launchings from Vandenberg AFB.

Permanent Station: The permanent station will consist of the following, in addition to the interim facility:

a. UHF Telemetry Antenna, 60 ft diameter dish with radome;
b. UHF Telemetry Receiver Bldg., approximately 2100 SF;
c. Vehicle-command Transmitter Building, approximately 1400SF, with roof mounted, 6 ft diameter antenna;
d. Angle Tracker Antenna, 10 ft diameter dish, with radome;
e. Angle Tracker Building, approximately 1100 SF;
f. Administration, Data Acquisition and Processing Bldg, approximately 33,200 SF and
g. Interconnecting roads and instrumentation ducts, utilities, security fencing, etc. All buildings will be of permanent type construction and will be fully air conditioned as required to maintain electronic equipment reliability.

The interim tracking and telemetry station provides an initial ground terminal point at which the performance of the orbiting vehicle is monitored during the early test flights. The permanent station is required for later programs. Its function is to intercept and track the oribiting vehicle; transmit program commands and time signals to the vehicle: receive, index, record telemetry data; exchange trajectory data with other stations and provide for training of personnel for the manning of this or other stations.

[redacted] CONFIDENTIAL

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8B) NEW BOSTON, NEW HAMPSHIRE

	PRIOR YEARS	FY [redacted]	FY 58	FY 59	FY 60	TOTAL
ITEM CATEGORY (4) Tracking & Telemetry (Data Acquisition) SENTRY - WS 117L [redacted]				3.369		3.369

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY PRIOR	FY 57	FY 58	FY 59	FY 60	DESIGN START	DESIGN COMPL.	CONSTRUCTION AWARD	CONSTRUCTION BOD	CONSTRUCTION COMPL.	NEED DATE
4.1	Tracking & Data Acquisition Station				3.369		09/58	02/59	04/59	11/59	06/60	06/60

CONFIDENTIAL [redacted]

LOCATION (8B) NEW BOSTON, NEW HAMPSHIRE

ITEM CATEGORY: (4) Tracking & Telemetry (Data Acquisition)

DESCRIPTION AND UTILIZATION:

This station will be utilized in support of the WS 117L R&D programs. It will provide the following functions:

a. Intercept and track the vehicle;
b. Transmit vehicle program commands and time signals to the vehicle;
c. Receive, index, record and process telemetry data into its reassembled form;
d. Transmit telemetry data to the data analysis center;
e. Receive, process and record vehicle instrumentation and environmental data;
f. Exchange trajectory and vehicle data with other stations, and
g. Receive general operational and command information from other stations and the data analysis center.

The station is located near Grenier AFB and will utilize its support capability. The station will consist of the following:

a. Vehicle Command Transmitter Bldg., approximately 1300 SF, with roof-mounted, 6 ft antenna, with radome;
b. Vehicle Command Transmitter Antenna, 6 ft diameter with radome, on concrete support structure;
c. Data Acquisition and Process Bldg., 35,000 SF;
d. (2) UHF Telemetry Antennas, 60 ft diameter, with radomes;
e. (2) UHF Telemetry Receiver Buildings, approximately 2100 SF each;
f. Angle Tracker Bldg., 1800 SF;
g. (2) Angle Tracker Antennas, 10 ft diameter, with radomes;
h. Security Control & Identification Bldg., 150 SF;
i. Security Fencing and Control Bldgs;
j. (4) Boresight towers; and
k. Utilities, roads, and minor appurtenances.

All buildings will be of permanent type construction and will be air conditioned to maintain electronic equipment reliability.

CONFIDENTIAL

[redacted]

(When Filled In)

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8c) OTTUMWA, IOWA

	PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
ITEM CATEGORY (4) Tracking & Telemetry (Data Acquisition)	SENTRY - WS 117L [redacted]				3.369	3.369

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED DATE
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	
4.1	Tracking & Data Acquisition Station					3.369	03/59	06/59	11/59	07/60	04/61	05/61

CONFIDENTIAL

[redacted]

(When Filled In)

LOCATION (8C) OTTUMWA, IOWA

ITEM CATEGORY: (4) Tracking & Telemetry (Data Acquisition)

DESCRIPTION AND UTILIZATION:

This station will be utilized in support of the WS 117L R&D programs. It will provide the following functions:

a. Intercept and track the vehicle;
b. Transmit vehicle program commands and time signals to the vehicle;
c. Receive, index, record and process telemetry data into its reassembled form;
d. Transmit telemetry data to the data analysis center;
e. Receive, process and record, vehicle instrumentation and environmental data;
f. Exchange trajectory and vehicle data with other stations;
g. Receive general operational and command information from other stations and the data analysis center.

The station will be located on Ottumwa Naval Air Station (inactive). Existing buildings are available for utilization as support facilities. The station will consist of the following:

a. Vehicle Command Transmitter Bldg., approximately 1300 SF, with roof-mounted, 6 ft antenna, with radome;
b. Vehicle Command Transmitter Antenna, 6 ft diameter with radome, on concrete support structure;
c. Data Acquisition and Process Bldg., 35,000 SF;
d. (2) UHF Telemetry Antennas, 60 ft diameter, with radomes;
e. (2) UHF Telemetry Receiver Bldgs., approximately 2100 SF each;
f. Angle Tracker Bldg., 1800 SF;
g. (2) Angle Tracker Antennas, 10 ft diameter, with radomes;
h. Security Control & Identification Bldg., 150 SF;
i. Security Fencing and Control Bldgs,;
j. (4) Boresight Towers; and,
l. Utilities, roads, and minor appurtenances.

All buildings will be of permanent type construction and will be air conditioned to maintain electronic equipment reliability.

[redacted] ~~CONFIDENTIAL~~

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8E) KAENA POINT, OAHU, T.H.

ITEM CATEGORY (4) Tracking & Telemetry

SENTRY - WS 117L
~~WS 107A-1~~
~~WS 107A-2~~
~~WS 315A~~
~~COMMON~~

PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
		1.550			1.550

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED DATE
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	
4.1	Tracking & Telemetry Station			1.550								
	Interim Station						03/58	04/58	05/58	08/58	11/58	11/58
	Permanent Station						05/58	08/58	09/58	04/59	04/59	06/60

~~CONFIDENTIAL~~ [redacted]

[redacted] (When Filled In) CONFIDENTIAL

LOCATION: (8E) KAENA POINT, OAHU, T.H.

ITEM CATEGORY: (4) Tracking & Telemetry Station

DESCRIPTION AND UTILIZATION:

Interim Station - The interim portion of the tracking and telemetry station consists of one 60 ft. diameter TLM 18 Telemetry Antenna, an Administration and Telemetry Receiver Building (Approximately 6400 SF), a Tri-Helix Telemetry Antenna, a Mod II Radar with van-mounted equipment, three boresight towers, interconnecting instrumentation ducts, an access road approximately two miles in length, approximately two miles of interconnecting roads, security fencing, and utilities. This portion of the complete station has been completed in time to support the early phase launchings from Vandenberg AFB.

Permanent Station - The permanent station will consist of the following, in addition to the interim facility:

a. Angle Tracker and UHF Telemetry Receiver Bldg, approximately 1800 SF, with roof-mounted, 10 ft diameter Angle Tracker Antenna, and

b. Vehicle-Command Transmitter Bldg, approximately 1300 SF, security fencing, utilities, etc. All buildings will be constructed of locally available materials where acceptable. They will be fully air conditioned as required to maintain electronic equipment reliability.

The Interim Station provides an initial ground terminal point at which the performance of the orbiting vehicle is monitored during the early test flights. The Permanent Station is required for later programs. Its function is to intercept and track the orbiting vehicle; transmit program commands and time signals to the vehicle; receive, index, record and exchange trajectory data with other stations.

CONFIDENTIAL [redacted]

[redacted]
(When Filled In)

~~CONFIDENTIAL~~

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8F) ALASKA

ITEM CATEGORY (4) Tracking and Telemetry

	PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
SENTRY - WS 117L ~~WS-107A-1~~ ~~WS-107A-2~~ ~~WS-315A~~ ~~COMMON~~			.080			.080

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	DATE
4.1	Tracking & Veh. Recovery Command Station			.080			05/58	06/58	06/58	08/58	08/58	11/58

~~CONFIDENTIAL~~

[redacted]
(When Filled In)

WDPP 59-11
III-20

LOCATION: (8F) ALASKA

ITEM CATEGORY: (4) Tracking and Telemetry (Recovery)

DESCRIPTION AND UTILIZATION:

The Alaska Tracking and Telemetry Facility consists of two installations. The first is an existing AC&W site at Chiniak Bay, Kodiak Island. No new construction is required at Chiniak Bay. The second is a new facility at Annette Island, consisting of a Tri-Helix Telemetry Antenna, a Mod II Radar Antenna, two boresight towers, a W. W. V. Antenna Support Pole, Van-mounted receiver, transmitter, power-generating equipment on gravel hardstands, access road and parking area; perimeter fencing, and minor appurtenances. All construction will be the minimum required to provide a temporary facility for use during the interim launch program. Personnel housing and messing will be provided by the contractor in existing Pan American Airways facilities.

The Alaskan Facilities will insure the acquisition of the vehicle on the first orbital pass, and on subsequent passes, and will command the vehicle to release the recoverable package at the instant required for impact within the desired pick-up zone.

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8J) NAVAL AIR MISSILE TEST CENTER, PT. MUGU, CALIFORNIA

ITEM CATEGORY (4) Tracking & Telemetry

SENTRY - WS 117L
~~WS 107A-1~~
~~WS 107A-2~~
~~WS 315A~~
~~COMMON~~

PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
		.020			.020

(FIGURES ARE IN MILLIONS OF $)

BMD NDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED DATE
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	
4.1	Down Range Tracking Station			.020			07/58	07/58	07/58	08/58	10/58	11/58

LOCATION: (8J) NAVAL AIR MISSILE TEST CENTER, PT MUGU, CALIFORNIA

ITEM CATEGORY: (4) Tracking and Telemetry

DESCRIPTION AND UTILIZATION:

This facility will provide a down-range tracking and control station for high-latitude launchings from Vandenberg AFB during the interim Thor-booster program. From this station, accurate tracking of the vehicle from launch to second stage burn-out, and ignition command, will be effected.

The facility consists of the following:

a. Tri-Helix Telemetry Antenna;
b. Mod II Radar Antenna;
c. Two boresight towers;
d. Van-mounted receiver, transmitter, and power-generating equipment and
e. Minor appurtenances.

[redacted]
(When Filled In)

~~CONFIDENTIAL~~

TYPE FUNDS: P-300 MCP

BUDGET ESTIMATES

LOCATION- (8I) SUNNYVALE CALIFORNIA

ITEM CATEGORY (6) Special Test
(Development Control Center)

	PRIOR YEARS	FY 57	FY 58	FY 59	FY 60	TOTAL
SENTRY - WS 117L ~~WS 107A-1~~ ~~WS 107A-2~~ ~~WS 315A~~ ~~COMMON~~			1.500		1.280	2.78

(FIGURES ARE IN MILLIONS OF $)

BMD INDEX	ITEM DESCRIPTION	BUDGET ESTIMATE, FY					DESIGN		CONSTRUCTION			NEED
		PRIOR	FY 57	FY 58	FY 59	FY 60	START	COMPL.	AWARD	BOD	COMPL.	DATE
.1	Development Control Center (Increment Nr. 1)			1.500			11/58	01/59	02/59	07/59	02/60	02/60
.2	Development Control Center (Increment Nr. 2)					1.280	04/59	08/59	10/59	03/60	06/60	06/6

~~CONFIDENTIAL~~

[redacted]
(When Filled In)

LOCATION (81) SUNNYVALE, CALIFORNIA

ITEM CATEGORY: (6) Special Test (Development Control Center)

DESCRIPTION AND UTILIZATION:

Development Control Center (Increment Nr. 1): This is a 54,000 SF building to be located adjacent to the Sentry production plant. Function of this facility is to control research and development of a large-scale data-gathering weapon system. The facility will serve as a control point for data reception, processing and procedures of the system. Space is provided for the R&D System Test Control Manager, the Development Flight Test Control Organization, managerial contractor, and the technical and administrative personnel conducting the operation of the entire weapon system during the R&D phase. Specific functions provided for are R&D Test Control, communication sub-system operation, engineering evaluation, flight test analysis, scientific data analysis, verification, program information center, administrative offices, office services, maintenance and storage.

Development Control Center (Increment Nr. 2): This is a 46,000 SF addition to the above building and includes the additional elements and expansion of facilities necessary for completely autonomous operation of the center.

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DECLASSIFIED

[redacted]

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE
WASHINGTON 25, D.C.

RETURN TO
SHRC
MAXWELL AFB AL 3611

K168.8636-14
59/04/16 - 59/08/14

14 AUG 1958

AFMDC-3E

MEMORANDUM FOR DIRECTOR OF INFORMATION SERVICES

SUBJECT: Security and Public Release of Information Regarding USAF Satellite Program

1. This memorandum concerns the subject of security and public release of information regarding the USAF satellite program. The specific project in question is WS 117L (Advanced Reconnaissance System).

2. The thoughts expressed below also relate to those set forth in our memorandum to you dated 12 November 1957, subject: "Security and Public Release of Information Regarding USAF Guided Missiles Program."

3. Recently this office proposed to send a TWX (see attached) to the Commander, BMD, ARDC, setting forth the authority to declassify the information that the WS 117L is a reconnaissance satellite, that ATLAS or THOR can be used for the first stage, and that its popular name is SENTRY. So far as is known, the latter was a name selected by your office and was never classified. The TWX specifically stated that the declassification did not constitute public release authority. This guidance was proposed in recognition of the fact that such information had already been officially expressed by top-ranking DOD personnel in Congressional Committee open hearings, and therefore security safeguarding of the information was not justified. Specific reference to the committee hearings is given in Tab A.

4. The Office of Security Review, OSD declined to coordinate, stating that it was contrary to guidance set forth by ARPA. Since the information we sought to declassify (except for the term "SENTRY") has been expressed in open hearings and has been published in public documents it cannot be denied that the Soviet Union has had access to this information. Moreover, since declassifying such information would save security costs and make handling within the Air Force easier, it cannot be denied that the Air Force is thereby put to needless security expense and administrative inconvenience by retaining classification, both within our field agencies and contractor facilities. Finally, it must

CLASSIFIED BY
SUBJECT TO GENERAL DECLASSIFICATION
SCHEDULE OF EXECUTIVE ORDER 11652
AUTOMATICALLY DOWNGRADED AT TWO YEAR
INTERVALS DECLASSIFIED ON DECEMBER
31, 1966

1029951

Overall document ~~SECRET~~

This page DECLASSIFIED

19 DEC 1985

[redacted]

HS 58-3855-A1

REVIEW ON 8/14/1989

MICROFILMED BY HOTM

DECLASSIFIED

[redacted]

Memo to SAFIS, subj: Security and Public Release of Info Regarding USAF Satellite Program (Cont)

be suggested that such impractical retention of classification cannot help but lead to cynicism regarding the validity and function of the overall classification system. During a recent visit to BMD the need to declassify subject information was reaffirmed. Additionally, as you are aware, although not a part of the action sought in the subject TWX, the public release of information which has been publicly stated in Congressional hearings is thwarted by decisions such as cited above.

5. This issue raises the fundamental question of whether the Air Force must coordinate with DOD regarding declassification of Air Force information. As stated in the 12 November 1957 memorandum referenced in paragraph 1 above, it is our position that the authority for classification and declassification rests with the Secretaries of the Military Departments. It is still desired that the guidance outlined in paragraph 2 above be sent to BMD; therefore, clarification is requested as to whether it is necessary for us to seek prior approval from the Office of Security Review, OSD, to declassify such information.

2 Incls
Tab A, References
Tab B, Proposed TWX to BMD

Joseph J. Liebling

JOSEPH J. LIEBLING
Assistant for Security
Deputy Chief of Staff, Materiel

[redacted]

DECLASSIFIED

The following references contain statements made in open Congressional Committee hearings relative to WS 117L being a reconnaissance satellite and using ATLAS or THOR as boosters.

1. Pages 304, 305, Department of Defense Appropriations for 1959, Hearings Before the Subcommittee of the Committee on Appropriations, House of Representatives, 85th Congress, testimony of Dr. York, ARPA.

2. Pages 1634-5, Inquiry Into Satellite and Missile Programs, Hearing Before the Preparedness Investigating Subcommittee of the Committee on Armed Services, U. S. Senate, 85th Congress, testimony of General Shriever, USAF.

TAB A

SECRET

26

THE DEPUTY SECRETARY OF DEFENSE
Washington 25, D. C.

APR 1 0 1958

MEMORANDUM FOR ASSISTANT SECRETARY OF DEFENSE (R&E)
DIRECTOR OF GUIDED MISSILES
DIRECTOR, ADVANCED RESEARCH PROJECTS AGENCY

SUBJECT: Definition of ARPA Programs

Excluded from General Declassification Schedule.

The following summarizes briefly our discussions on April 4th of ARPA programs with a view to defining these in relation to programs in related areas to be conducted by the military departments under ASD (R&E) and Director of Guided Missiles coordination and direction.

(1) Satellites - While it was originally planned that the VANGUARD series of satellites would continue under the Director of Guided Missiles' coordination, it now appears desirable to make a clean transfer of all satellite programs to ARPA. This is with the understanding, however, that the Director of Guided Missiles will continue to arrange for support of satellite programs by necessary rocketry, launching and other range facilities and the like. Director, ARPA and Director, Guided Missiles, will collaborate in preparation of an ARPA directive to the above effect.

(2) One-million pound rocket motor development - This Air Force project (in collaboration with NACA) is of interest both to military programs and to civilian space programs. There appears to be no present advantage in transferring this program to ARPA. It will, therefore, remain under Air Force management, with ARPA and NACA cooperation, and with ASD (R&E) (or Director, Guided Missiles) coordination. The latter two will prepare a coordinated instruction to the Air Force clarifying relationships on this project.

(3) Solid propellants - It appeared from the discussions that it would be necessary as a background for further definition of this program to prepare a complete statement of solid propellant research and development work already under way in various Defense Department agencies.

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Dr. Kistiakowsky's report attached to Dr. Killian's letter to the Secretary of Defense of March 18, 1958, recommends that there be a considerably expanded research program on solid rocket propellants in order to expand the scientific basis for the development of rocket motors with substantially higher specific impulse. After you have had an opportunity to summarize the program and to review Dr. Kistiakowsky's report, we will sit down again to define the organization of this work.

(4) Anti-missile missile research and development - Assuming that Congress appropriates the supplemental FY 1959 funds requested by the President, it appeared from our discussions that the development of NIKE-ZEUS as an anti-missile missile system would already have reached a specific development stage that would make it inappropriate to turn this phase of the work over to ARPA. NIKE-ZEUS would accordingly remain a responsibility of the Army for coordination by the Director of Guided Missiles. It was apparent, however, that a broader scientific base should be prepared for longer-range developments in the anti-missile missile field. It was, therefore, agreed that available funds growing out of the NIKE-ZEUS-WIZARD-PLATO and FY 1959 supplemental appropriations would be reviewed. When this information is available we will sit down again to define the organization of missile defense and the area of the work that ARPA will be authorized to undertake.

The above is not a complete list of ARPA projects but merely covers those project areas requiring further resolution. I would like to take up the above matters with the addressees as soon as they are in a position to do so.

/s/
DONALD A. QUARLES

Incl
Ltr to SecDef fr Dr.
Killian dtd 3-18-58 w/incl.

Secret

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7 August 1958

MEMORANDUM FOR RECORD

SUBJECT: (UNCL) First Meeting of the DOD-NASA Rocket Engine Technical Management Committee

1. The first meeting convened at 1330 today and lasted until 1630. Present were:

Silverstein,	NASA, Chairman
Tishler	NASA
Woodward	NASA
Stosick	ARPA
Cesaro	ARPA
Heaton	USAF
Schnare	USAF
Rogers	USAF

Excluded from General Declassification Schedule.

2. This gathering was preceded by sessions the evening of 6 August and morning of 7 August between Air Force representatives and Dr. Silverstein for the purpose of giving him background information - technical, programming and fiscal - on the programs identified for transfer to NASA. The evening meeting involved Silverstein, Woodeard, Schnare, Heaton and Appold of ARDC. I had asked Col Appold to brief this group on technical information which has not been disseminated among Propulsion Lab and Lewis Lab rocket groups but which could have a controlling influence on the optimum propellant combination for high energy upper stages. Since this information was not available to the Propulsion Lab during the studies which led to selection of F_2/N_2H_4 for the 12,000 and 80,000 pound thrust upper stage rocket projects now being transferred to NASA, there exists a possibility that this propellant combination is not optimum. Mr. Schnare and Col Appold compared study results and found that they did not agree. It was therefore decided that a technical evaluation group would be formed consisting of experts from the Lewis Lab of NASA, the Propulsion Lab of WADC, Hq ARDC and ARPA to reconcile these disparities and either develop a unanimous conclusion on the optimum combination or identify data which must be experimentally verified before valid conclusions may be drawn.

3. It was also agreed that the major objective of the Technical Management Committee would be to decide on and recommend the major features of an advanced rocket and supporting research and facility program which is optimum for the national requirement.

4. Dr. Silverstein opened the meeting on Thursday, 7 August with the following observations:

a. NASA is not yet an official entity; no head has been named and therefore no policy can be decided. However, although implementation of the committee's recommendations must wait, the committee can address itself to important issues.

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b. The mission of the committee is to render advice, not make decisions. Decisions will be made by whichever agency, NASA or ARPA, has responsibility for the project on which a recommendation is made.

c. The DOD (ARPA and the Air Force) are transferring about $117 million to NASA. Also, NASA will get new money to increase this figure to a total of $242 million - an amount agreed to at Presidential level. As usual, NASA wanted more, the BOB wanted them to get less and $242 million is the resulting compromise. Moreover, of this $242 million, $30 million is allotted to propulsion work. None of this $30 million can be spent for facilities - in fact NASA must get congressional approval for all facility investments over $250,000. NASA must fund within the $30 million the portion of the ROVER program the Air Force has been supporting.

d.. The committee should concern itself first with devising a national program. We should not in this initial step of determining what is essential in the way of a program, hold to any arbitrary dollar limit. In other words, he enunciated the objective described in 3 a. above.

5. Dr. Silverstein set up as the agenda for this meeting a discussion of:

a. Big boosters and various methods of approaching their development.

b. Upper stages

c. Program for technical growth in basic areas of importance in the field of rocketry.

The specific objectives of this first meeting were to:

a. Identify projects which all can agree should be included in a national program.

b. Make recommendations on a. and on all other projects which require immediate or imminent decisions if delays are to be avoided.

6. During the two hour meeting, the conversation ranged over the first two agenda items only. Recommendations were substantially as follows:

a. A design study in FY 59 of a booster vehicle using a cluster of 5-6 THOR or TITAN booster engines. Purpose - to make available the design of a booster which can be developed in about two years if a requirement materializes for a 1000K unit before a 1000K single chamber engine

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can be perfected in about five years. NASA should budget in FY 1960 for funds to begin to convert this design to hardware if a requirement develops.

b. Continue the 300-400K engine to the extent of its value in guiding development of the 1000K single chamber engine. In FY 1959 the program should be funded at approximately the 1958 level ($3-4 million). Work with this money should include bread-board engine running and tests up to the chamber pressure of the 1000K engine to obtain heat transfer and combustion data.

c. Continue the 1000K single chamber engine at a rate which will yield a PFRT engine in five years. (Note: This permits no delay in the program and a prompt acceleration to the $16 million level in 1959. Also required in the test stand modification at Santa Susanna first needed for the 300K engine.)

d. Continue the 12K F_2/N_2H_4 project at Bell as a state-of-art program for now. Hold up on the projected long duration stand at Bell (AF '58 dollars). ✓

e. Defer initiating the 80K F_2/N_2H_4 rocket pending the effort to apply the latest technical inputs to determine the optimum propellant combination for high energy upper stage applications by a combined NASA-AF-ARPA team (referred to in paragraph 2 above). The Edwards facility will likewise be held up. The evaluation team is to be headed by Tishler of Lewis Lab and will strive to reach a conclusion on basis of technical facts in three weeks. This is an optimistic schedule. NASA agrees

f. Defer committing about $300,000 of Air Force money for tankage for AGC on 100K $H_2 - O_2$ chamber feasibility investigations until after the Tishler group make their report. OK

g. Continue under Air Force sponsorship the storable propellant program now in progress. Apply knowledge gained to aid in propellant choices for the space rocket program.

7. With regard to the problem NASA faces in funding adequately a space rocket program I pointed out the possibility that ARPA may be in a position to relieve NASA of the necessity of supporting the development of complete engines for upper stage use, leaving NASA to concentrate on the big chemical and nuclear boosters. Of course NASA will continue in-house research in all rocket areas. This possibility stems from two considerations. First there is the probability that, as recommended by the Air Force in the program proposed to ARPA and passed to NASA, two upper stage high energy engines will meet foreseeable needs - a 12,000 pound unit for advanced 117L and man-in-space capsules and about an 80,000 pound

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rocket for large payload satellites and DYNA SOAR. The 117L program is funded by ARPA outside of the $350 million national ceiling on singularly space related work. Funding of this project by ARPA or by the Air Force for ARPA presents problems, however. Secondly, ARPA has authorization and money to undertake development of an upper stage engine defined as the unit which will put the heaviest payload in orbit when employed on top of ATLAS or TITAN. Such an engine, it appears, will fall in the 80,000 pound thrust category. The catch here is that ARPA may decide on a storable rather than a high energy stage. Of the $30 million NASA has for 1959 propulsion projects about $15 million will be needed for the 1000K booster and about $6 million for ROVER. The design study for clustering THOR or TITAN engines should not be expensive so NASA can support additional work of some description.

8. I felt that the committee should undertake two additional tasks. One would be to suggest logical assignments of rocket development projects between ARPA and NASA largely on the basis of availability of funds and the source, scientific or military, of the initial incentive for the project. The second would be to explore and recommend means of providing funds and facilities to implement the recommended program. I suggested these two additions to Dr. Silverstein who did not agree. He preferred to leave these matters to higher echelons of NASA and ARPA.

9. With only Air Force and NASA people present I told Dr. Silverstein that the Air Force would like as a general rule to handle the technical and administrative management of major liquid engine developments by industry for the space program, whether under the direction of NASA or ARPA. I pointed out that the new family of rockets must suffice for military as well as scientific requirements. It is imperative, therefore, that the development agency within the DOD best qualified by past achievement and present capability in the liquid rocket field have an active role in the development of all of the engines in the advanced program to insure that these engines are readily adaptable to the military space systems which are sure to materialize. The Air Force occupies an indisputable position of leadership among the Services in the liquid rocket field. Air Force foresight, money and technical guidance are behind every successful liquid rocket engine of major significance in the United States so far and it is the Air Force program for advanced rockets which is being transferred to the NASA. Dr. Silverstein said that he feels decisions as to whether a given NASA project should be contracted and managed by the Air Force or by the NASA directly should be governed by the circumstances surrounding each case. He also stated that agreements on the subject should be reached by direct negotiation between the NASA and the Air Force.

10. It will take NASA up to two years to build and man their Space Flight Research Center which is being created to implement their space

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program. Consequently, the Air Force should have little difficulty securing the assignment of management responsibility for the development of rocket engines now or soon to be initiated under NASA sponsorship. However, it is most important that the Air Force at the DCS/D or Assistant Secretary for R&D level begin now, while NASA plans for their Space Flight Research Center are still relatively fluid, to persuade NASA at the Dr. Glennan-Dr. Dryden level to avoid duplicating the Air Force technical and procurement staff at Wright Field for the management of complete rocket development projects. Points we can stress include:

a. The Air Force Wright Field staff can and will be responsive to NASA desires. It exists now and is ready to serve.

b. The Wright Field staff must be maintained to carry out engine developments and adaptations to meet military requirements which are certain to materialize and be accorded commanding priorities. Such requirements, in all probability, will become firm before development is complete on the engine concerned.

c. The Air Force, keenly alive to our responsibilities to foster an adequate program in the rocket area for military purposes, will work with NASA to break down any barriers which are thrown up which would prevent the Air Force from contributing to the NASA programs by constructing test stands, providing propellants, etc. for these programs.

11. The committee will meet again on Thursday, 14 August, to get more deeply into problems of avoiding delays in going projects.

DONALD H. HEATON
Colonel, USAF
Chief, Aeronautics Division
Directorate of Research & Development
Office, Deputy Chief of Staff, Development