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THE SPACE SYSTEMS DIVISION - BACKGROUND

(October 1957-June 1962)

History of the Space Systems Division
January-June 1962

Volume I

by

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Gen B. A. Schriever

LtGen H. M. Estes

MajGen O. J. Ritland

MajGen B. I. Funk

COMMANDERS WHO DIRECTED THE EARLY BALLISTIC MISSILE AND SUBSEQUENT SPACE DEVELOPMENT ORGANIZATION LOCATED AT LOS ANGELES, CALIFORNIA, FROM 1954 - 1962. GENERAL SCHRIEVER, JULY 1954-MAY 1959. GENERAL RITLAND, MAY 1959-MAY 1962. GENERAL ESTES, MAY 1962-OCTOBER 1962. GENERAL FUNK, OCTOBER 1962--.

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FOREWORD

One purpose of this study--a part of the first formal history of the Space Systems Division--is to trace the main currents in organizational development and mission growth which resulted in the creation of an Air Force organization exclusively concerned with military space systems.

The narrative follows the evolution of a small Western Development Division organization of 1954, initially responsible for development of a single ballistic missile system, into the substantially larger complex of 1961, which was actively engaged in developing and activating missile and space systems. The chief concern thereafter is the transition of the Air Force Ballistic Missile Division into two entities, the Ballistic Systems Division and the Space Systems Division.

The Air Force space mission was not the product of dramatic change in development emphasis or of technical "breakthroughs," but rather emerged from the evolutionary exploitation of ballistic missiles and very early military satellite programs. The space vehicle program began with modest concentration on a single military satellite, was stimulated by overwhelming public reaction to the first Soviet Sputniks in late 1957, and proliferated into a series of varied, heterogenous programs. Despite the presence of divergent objectives which led the Air Force at one point to describe its space effort as "confused and inhibited," the Air Force systems development command tenaciously continued its attempts to acquire the facilities, specialized manpower, and program stability essential to the creation of a militarily useful competence for operations outside the earth's atmospheric envelope.

Documentary sources for this brief study were the files of the Space Systems Division historical and program offices, and project files located at Air Force headquarters in Washington, D. C. The influences, trends, and mission assignments associated with concern for an Air Force "space identity" were, of course, far more extensive and complex than those brought forward in this historical summary. For these ommissions and even less excusable faults of construction and composition the author accepts full responsibility.

R. F. P.
February 1963

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CHRONOLOGY

1954 Jun 21	Air Force headquarters instructs the Air Research and Development Command (ARDC) to attain an operational ballistic missile at the earliest possible date.
Jul 15	ARDC General Order Nr. 42 provides for "Reorganization of Headquarters ARDC and Establishment of the Western Development Division," effective 1 July 1954, duty station at Inglewood, California.
1955	The Air Force affirms its need for a long lived auxiliary power unit in reconnaissance satellites. The Atomic Energy Commission (AEC) begins to develop subsystems for nuclear auxiliary power to meet the need.
Jul	Western Development Division (WDD) is reorganized to include a deputy commander for plans.
Oct 10	ARDC transfers responsiblity for management of Weapon System 117L from Wright Air Development Center to WDD.
1956 Jan 14	Preliminary development plan covering a scientific satellite version of the 117L system is published; WDD emphasizes urgency of support requirements if the program is to succeed.
Mar 1	Lockheed proposes to develop a capability to detect ballistic missile launchings by means of satellite-borne infrared sensors.
Apr 2	WDD publishes a first full development plan for the 117L system, proposing a military reconnaissance satellite program which would be fully operational by July-September 1963.
11	ARDC submits to Air Force headquarters a proposal for development of a family of ballistic, orbital and lunar research and test vehicles.
Jul 24	Air Force headquarters approves 117L development plan.
Aug 28	ARDC issues System Requirement 143 for a determination of the feasibility of weapon systems to combat hostile satellites.

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	Oct 3	WDD recommends expansion of the division's mission to include additional space projects.
1957	Jun 1	Western Development Division is redesignated Air Force Ballistic Missile Division (AFBMD).
	Jul	AFBMD and AEC establish a joint committee to insure compatibility of nuclear power source and 117L satellite vehicles.
	Oct 4	Sputnik I
	Nov 1	Secretary of Defense (OSD) approves "in principle" acceleration of the 117L program.
1958	Jan 6	Lockheed proposes to accelerate the 117L program by using Thor boosters and 117L (Agena) upper stages.
	29	AFBMD issues a contract to Lockheed covering Thor-boosted test vehicles in the basic 117L configuration.
	Feb 3	President D. D. Eisenhower directs the highest and equal national priority be accorded development of the intercontinental and intermediate-range ballistic missiles (ICBM, IRBM) and the 117L military satellite system.
	3	Air Force headquarters reveals tentative plans to use Thor boosters to orbit instrumented satellites in support of the 117L program.
	7	DOD Directive 5105.15 activates the Advanced Research Projects Agency (ARPA) with authority to assume responsibility for all Department of Defense (DOD) space programs during research and development phase.
	12	AFBMD establishes a deputy commander for Military Space Systems.
	27	ARPA assumes direction of the 117L program.
	28	ARPA states its awareness of Air Force interest in developing a manned space flight capability.
	Mar 3	OSD approves acceleration of the 117L program, including the launch of test vehicles using the Thor booster.
	6	ARDC commander requests AFBMD assistance in preparing a development plan for a manned satellite test system.

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31 AFBMD is instructed to prepare a development plan for a military space system program leading to a manned flight to the moon and return.

Apr 7 AFBMD publishes a "Lunar Probe Program Development Plan" for a series of three moon flights scheduled in the fall of 1958.

25 AFBMD prepares a "USAF Manned Military Space Systems Development Plan," the first of seven such plans prepared during 1958.

May 13 AFBMD Service Building (Bldg 11) housing cafeteria, dispensary and club, is opened.

22 Biomedical experiments are added as a secondary objective in from three to five of the planned Thor-boosted 117L flights.

28 ARPA gives the name "Sentry" to the 117L program.

28 AFBMD development plan for a manned space flight proposes use of an Atlas booster and Agena second stage to place a man in an 150 nautical mile orbit during October 1960.

Jun 18 AFBMD begins to identify positions and recruit personnel for a space program.

19 GOR 140 establishes an Air Force requirement for a satellite tracking and control system and a satellite defense system.

30 ARPA advises AFBMD that the OSD had assigned full responsibility for management of the 117L development program to ARPA.

Jul AFBMD begins preliminary arrangements to establish a special military unit equipped with C-119J aircraft and trained for aerial recovery of 117L data capsules returned from orbit.

1 Start of Geneva negotiations on discontinuing nuclear testing.

11 ARPA requests Air Force headquarters to direct ARDC to prepare an abbreviated development plan for a communications satellite.

29 National Aeronautics and Space Act creates National Aeronautics and Space Council and National Aeronautics and Space Administration (NASA).

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	Aug 1	6593rd Test Squadron (Special) organizes at Hickam AFB, Hawaii.
	5	Total number of Thor-117L vehicles on order is extended from 10 to 19.
	17	The first Able-1 lunar probe vehicle is launched from the Atlantic Missile Range (AMR). The Thor booster exploded 74 seconds after launch.
	26	Commander ARDC informs the Air Force Vice Chief of Staff, General C. E. LeMay, that because of increased Air Force interest in military space programs he had instructed AFBMD to establish and man an organizational element for space systems development.
	Sep 10	ARPA separates Midas, the infrared attack alarm system, from the 117L program.
	Oct 11	A second lunar probe, Pioneer I, is launched from AMR. Although the payload did not reach escape velocity it set a new altitude record of 71,700 statute miles.
	22	ARPA informs the Air Force of its plans to develop a satellite communications system. The Army is to develop the communications payload and the Air Force the booster and satellite vehicle.
	Nov 12	AFBMD is assigned responsibility to furnish the vehicle portion of the 24 hour communications satellite program.
	17	ARPA orders design and construction of the first 117L launch complex at Point Arguello.
	Dec 4	ARPA directs Thor - Sentry launches be managed as a separate program called Discoverer.
	9	NASA requests AFBMD to procure, modify and launch nine Atlas Series D missiles for manned "Project Mercury" program.
	18	ARDC completes an abbreviated development plan for a Hyper-Environment Test (Blue Scout) System, Nr. 609A.
1959	Jan 28	ARDC assigns management of System 609A, "Blue Scout" test rocket, to AFBMD.
	30	AFBMD issues a Midas program plan calling for an accelerated full-scale system development effort.

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Feb 5 ARDC directs AFBMD to prepare a detailed plan for development of a solid propellant multi-stage Blue Scout vehicle to perform a wide range of space assignments.

20 AFBMD completes preparation of development plans for Transit and Tiros satellite systems.

~~28~~ 29 Discoverer I launch successfully boosts Agena satellite into a polar orbit.

Mar 6 General C. E. LeMay, Vice Chief of Staff, states that both a 24-hour equatorial satellite and polar satellite system are essential to Air Force communications.

Apr 6 6594th Test Wing organized at Palo Alto, California.

25 Major General B. A. Schriever is promoted to Lieutenant General, relieved as commander AFBMD, and assigned as commander ARDC. Brigadier General O. J. Ritland is assigned commander AFBMD.

May 22 ARPA directs development of communications satellite system by means of a three phase program called Steer, Tackle and Decree.

Jun 1 Operational control of the 6593rd Test Squadron (Special) is assigned to 6594th Test Wing. ARDC establishes 6594th Launch Squadron at Vandenberg AFB which is also assigned to the 6594th Test Wing.

Jul 1 6594th Data Processing Squadron, Lowry AFB, and 6596th Instrumentation Squadron, Vandenberg AFB, are established by ARDC and assigned to the 6594th Test Wing.

Aug 6 ARPA changes the name Sentry to Samos.

10 AFBMD issues a preliminary plan for a satellite interceptor and inspection (Saint) system.

25 President approves a high priority Samos program encompassing high resolution photography, recovery, and ferret readout to be managed "with the direction that the Air Force has used on occasion, with great success, for programs of over-riding priority."

Sep 9 The first Project Mercury test flight vehicle, an Atlas topped by a NASA developed flight capsule, is successfully launched from AMR in a ballistic trajectory.

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Sep 17 Transit 1A, navigation satellite, is launched from the Atlantic Missile Range. The payload failed to achieve orbit.

18 ARPA directs ARDC to undertake a contractual study for evaluation of technical and operational factors associated with the detection and location of all high altitude nuclear explosions.

21 OSD assigns all responsibility for developing and launching all military space boosters and associated systems integration to the Air Force.

Oct 1 6594th Instrumentation Squadron is organized at Grenier Field, Manchester, N. H., and assigned to the 6594th Test Wing.

1 6594th Data Processing Squadron, Lowry AFB, is redesignated the 4999th Data Processing Squadron and moved to Offutt AFB without change in parent organization.

6 AFBMD issues an abbreviated Vela Hotel development plan for detection and location of nuclear detonations in space.

Nov 1 ARDC organizes 6594th Recovery Control Group, Hickam AFB, Hawaii, and the 6593rd Instrumentation Squadron, Wheeler AFB, Hawaii. The 6593rd Test Squadron (Special) is assigned to the 6594th Recovery Control Group.

16 AFBMD, in part of the command wide reorganization of ARDC, is reconstituted and activated as a new military organization with the same name, personnel, equipment and location.

16 6592nd Support Group is organized and assigned to AFBMD and the 6592nd USAF Dispensary is assigned to the 6592nd Support Group. 6594th Test Wing, Palo Alto, is reassigned from ARDC to AFBMD.

17 Discoverer, Samos and Midas programs are approved for transfer from ARPA to Air Force management.

Dec 21 6555th Test Wing (Development) is organized at Air Force Missile Test Center and assigned to AFBMD.

23 A Ramo-Wooldridge study proposes a satellite based random barrage system as a defense against intercontinental range missiles.

1960 Jan Aerojet-General Corporation completes development of the Able-Star, a new second stage compatible with Atlas and Thor boosters.

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Feb 12 A biomedical space capsule successfully sustains the life of a primate for 55 hours. The test included full simulation of orbital flight through re-entry and recovery.

26 A Midas I is launched from the Atlantic Missile Range but a staging malfunction resulted in activation of the destruct system.

29 The three-phased satellite communications program is cancelled in favor of a single Advent 24-hour microwave satellite system.

Mar 11 Thor Able-4 (Pioneer V) is launched from the Atlantic Missile Range. A highly successful deep space probe revealed new and valuable scientific data and demonstrated feasibility of communications over interplanetary distances.

Apr 1 A Tiros three stage Thor-Able with a camera equipped satellite is successfully launched from the Atlantic Missile Range. The experiment demonstrated feasibility of long range weather forecasting by satellite.

13 Transit 1B, second in a series of navigational satellite vehicles sponsored by ARPA, is launched from the Atlantic Missile Range and successfully placed in orbit.

21 Satellite Inspector Program, called Project Saint, is assigned to AFBMD.

May 24 Midas II is launched from the Atlantic Missile Range into an almost perfect circular orbit. Malfunctions in a payload subsystem prevented collection of useful infrared data.

27 AFBMD publishes an abbreviated development plan for a nuclear system orbital flight test program.

Jun 22 A Transit IIA vehicle (Thor Able-Star) successfully places a Transit navigation satellite and a smaller parasitic radiation measuring satellite, called Greb, into orbit, using an Able-Star restart second stage.

Jul 1 NASA's Scout 1 (basically the same vehicle as the Air Force's Blue Scout), carrying vehicle instrumentation, is successfully launched on a ballistic trajectory.

1 The government chartered non-profit Aerospace Corporation begins replacing Space Technology Laboratories in furnishing technical staff assistance, advanced systems analysis, administrative and technical support services and general systems engineering and technical direction to Air Force space programs.

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Aug 10 Discoverer XIII is launched from Vandenberg AFB, orbited, and successfully recovered on 11 August after 17 passes. This was the first recovery of an orbiting payload from outer space.

12 An Office of Vice Commander for Satellite Systems is established at AFBMD for management of the Samos project.

18 Discoverer XIV is launched from Vandenberg AFB. After the 17th orbit the payload ejected on command to be recovered in mid-air over the Pacific by an Air Force crew flying a C-119 "Flying Box Car."

26 Discoverer program is increased to a total of 41 launches.

26 The Air Force Ballistic Missile and Space Committee is briefed on AFBMD facility requirements and possible alternate locations which would alleviate the physical space problems existing at the Los Angeles location of the division.

Sep 6-9 Twelve scientists from the President's Science Advisory Committee, chaired by Dr. W. K. H. Panofsky, review the Midas program and report that, in their view, the Midas concept is sound and its development should continue.

15 The Secretary of Defense directs transfer of administrative and technical responsibility for the Advent program to the Army.

21 The first Air Force Blue Scout rocket is successfully launched from the Atlantic Missile Range.

Oct 14 The Secretary of the Air Force establishes a Directorate of the Samos Project (SAFSP) at AFBMD. The new directorate is responsible to and reports directly to the Secretary on Samos project management and is a field extension of his office.

20 6565th Test Wing is organized at Vandenberg AFB and assigned to AFBMD.

31 Air Force headquarters announces a move of the Ballistic Missile Center from Los Angeles to Norton AFB, California, on an orderly timed basis extending from November 1960 to late 1961.

Nov 30 A Transit 3A vehicle launched from the Atlantic Missile Range is destroyed after 152 seconds of flight.

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Dec 15 AFBMD establishes a Deputy for Program 624A (Titan III).

15 Secretary of the Air Force instructs all major commands that effective immediately no new internal or public information concerning Samos is to be originated by any Air Force organization.

15 A Vela Hotel Joint Management Team, consisting of members from AEC, NASA and ARDC, convenes at AFBMD to begin planning a high altitude satellite system for nuclear detection.

1961 Jan 9 Air Force headquarters urges AFBMD to continue efforts to define the need for a space payload capability between the Atlas-Centaur booster vehicle and the early Saturn.

Mar General Thomas D. White awards the MacKay Trophy for 1960 to the 6593rd Test Squadron (Special), Hickam AFB, Hawaii, for the squadron's work in recovery of Discoverer payloads returned from orbital space flights.

6 OSD assigns the Air Force exclusive responsibility for the development of military space systems and vehicles, and launching operations.

Apr 1 Effective date for establishing Air Force Systems Command, Deputy Commander for Aerospace Systems, (DCAS), Space Systems Division (SSD), and Ballistic Systems Division (BSD).

May 1 Air Force Secretary E. M. Zuckert forwards to the Secretary of Defense a proposal for a long term national space program.

13 SSD offers a preliminary plan for developing high lift boosters by wrapping large solid fuel engines around a liquid rocket second stage.

25 President J. F. Kennedy announces that manned lunar exploration is a national space objective and that NASA would conduct the program.

Jun 3 Aerojet-General single-segment, 100-inch diameter solid propellant motor delivers 450,000 pounds of thrust for 45 seconds.

5 Under Secretary of the Air Force J. V. Charyk instructs the Air Staff to prepare a solid booster program to satisfy the requirements of the Air Force and NASA.

20 ARPA furnishes additional funds to support the first four Discoverer-Vela Hotel piggyback flights and to pay for technical assistance from the Aerospace Corporation.

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	Jul 5	SSD creates a solid booster development program office.
	12	Midas III (Atlas/Agena B) is launched into a polar orbit to furnish data readout for five passes.
	Sep 15	Director of Defense Research and Engineering (DDR&E) asks the Air Force to study potential usefulness of Titan II as a core for a standardized space launch vehicle (Titan III).
	Oct 3	Because of delays in the Centaur program and Advent management difficulties, Air Force headquarters recommends cancellation of the Advent program and the start of a new satellite communications development effort.
	13	DDR&E authorizes the Air Force to begin early actions for development of the Titan III (modified Titan II with strap-on solid boosters).
	20	Air Force headquarters directs SSD to begin expedited actions leading to Phase I of the Titan III program.
	21	Midas IV is launched into an orbit which furnished payload data for 34 passes before power failure occurred.
	Nov 17	NASA, DOD, and the Air Force arrive at a mutual decision to cancel 240-inch class solid rocket motor program but, at the same time, continue state-of-the-art effort in large solid rockets.
	18	DDR&E approves the start of Phase I of the Titan III program "subject to availability of funds."
	30	The Ruina Committee, appointed to evaluate the Midas program, reports that early operation of the Midas system would be technically premature.
	Dec 12	SSD completes preliminary contractual arrangements for Phase I development of the Titan III program.
1962	Feb	SSD asks Douglas Aircraft to define performance and design of a "Standard Thor", Model DSV-2C, with three strap-on solid propellant motors (Thrust-Augmented-Thor: TAT).
	Mar	The Air Force and AEC Joint Working Group schedule the first orbital flight of a nuclear power unit during September 1963
	Apr 9	Midas V is launched into orbit.

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Apr 17-18 Study Group on National Military Communications Satellite Systems recommends a new start on developing a single medium altitude system operational by 1965.

30 Space Technology Laboratories (STL) and SSD complete negotiations of a definitive cost-plus-incentive-fee contract for the Vela Hotel spacecraft.

May 3 Designated System Management Group approves the Titan III Proposed System Package Plan.

23 The Secretary of Defense issues directives to the Army, Air Force and Defense Communications Agency which, in effect, cancel the Advent program and approve a new development to meet a minimum essential satellite communications system requirement.

Jun 1 SSD and Aerospace Corporation complete a review of the ballistic boost intercept concept of an anti-missile defense weapon. They conclude that current data was insufficient to affirm or deny the plan's technical feasibility, but that its economic feasibility was highly questionable.

Jun 25 The DDR&E restates his view that Midas "must remain an R&D program oriented toward developing techniques."

28 DDR&E suggests that the Air Force make several significant changes in the Titan III program including use of a modified Titan II guidance system, five segment solid motors, and an improved upper stage for 24-hour orbit.

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CHAPTER 1

ESTABLISHMENT OF WESTERN DEVELOPMENT DIVISION

On 21 June 1954, Lieutenant General D. L. Putt, Air Force Deputy Chief of Staff Development, directed the commander of the Air Research and Development Command to attain ". . . an operational long-range ballistic missile at the earliest possible date." This was to be accomplished through reorientation and acceleration of an Atlas program revitalized with the highest priority of any program conducted by the Air Force. Putt further instructed the development command to "establish a field office on the west coast with a General Officer in command having authority and control over all aspects of the program." [1]

It was, without question, an assignment of some magnitude. The task was to include not only hardware development but a much wider mission: ". . . development of a complete weapon system including ground support and the development of recommended operational logistic and personnel concepts." It was with this assignment that Brigadier General B. A. Schriever, formerly assistant for development planning, deputy chief of staff development at Air Force headquarters, arrived at Inglewood, California, during early July 1954, with a small and highly competent staff to get the program going. [2] *

From the very beginning of the new command, unusual departures in normal Air Force organization and procedures were apparent. On 29 July 1954, Lieutenant General Thomas S. Power, then head of the Air Research and Development Command, informed Schriever that, "In your assignment as Assistant to me you will occupy the status of a Deputy Commander for all matters pertaining to Project Atlas." Elsewhere in the letter, Schriever was

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* The first facility occupied by the newly named Western Development Division was the premises of a parochial school at 409 East Manchester Boulevard in downtown Inglewood.

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advised that, "In the accomplishment of your mission you will be responsible and accountable directly to me. Under my policies and such instruction as I may issue from time to time, you are authorized to issue orders direct to ARDC Commands in the name of the Commander, ARDC. . . " In a final clarification General Power added, "The Western Development Division is not a staff agency of the Headquarters ARDC but is an operating location of the Headquarters as defined in AFR 2-27."[3]

Interestingly enough, the main elements of a new approach to weapon system management underway in Inglewood had their genesis some years before. In 1951, then Colonel Schriever, on the staff of the Deputy Chief of Staff, Development at headquarters Air Force, had prepared a study entitled "Combat Ready Aircraft." Although the study undoubtedly expressed the views of other forward looking officers it broke new ground in suggesting--in the context of the 1951 Air Force--a unified development effort which would have as its chief aim the compression of the weapons development time cycle. The study proposed establishment of a single management agency which would assure rapid, adequate, and suitably balanced consideration of the interests of each element involved--technical, operational-procurement-funding--in developing a weapon system. Management was to be ". . . continuously effective during development, procurement, test and operational use." It was apparent that adoption of such an organizational concept was intended to greatly enhance the rapid delivery of combat weapons to the Air Force.[4]

In the following three years Schriever had the opportunity to develop and mature his ideas on effective management of weapon system development programs and the most significant element of management, to which he later applied the descriptive and single word "concurrency." This was more precisely defined in the weapon system acquisition process as a ". . . shortening of lead time from weapon concept to operational availability (lead time was becoming greater as systems increased in complexity) by conducting all critical elements of the development, test, and procurement process simultaneously."[5] In any event, the application of this principle became one of the chief management characteristics of the ballistic missile development program.

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Increasing impetus for strong new direction in this undertaking was furnished, not surprisingly, by groups of scientists enlisted by the Air Force to provide advisory guidance on its weapons development programs. As far back as December 1952, an ad hoc committee of the Air Force Scientific Advisory Board had reviewed the Atlas program, then a glacial Project MX-1593 under the prime contractor direction of Convair.* The committee vigorously recommended development of an intercontinental ballistic missile designed to carry an atomic warhead.[6] Additional recommendations contained proposals for drastic changes leading to a completely re-oriented program to assure its successful early development. Sometime later, the Armed Forces Policy Council established a Department of Defense Study Group on Guided Missiles to evaluate various missile programs of the military departments. The group's report contained the important recommendation ". . . that intercontinental ballistic missiles could best be evaluated by a special group of the nation's leading scientists."[7]

Thus was established in October 1953 the Air Force Strategic Missiles Evaluation Committee -- more frequently called the "Teapot" or Von Neumann Committee -- under the chairmanship of Professor John Von Neumann, Institute of Advanced Study, Princeton University.** This group proposed far reaching changes in the Atlas program to assure its rapid development. In addition to prompt revision of Atlas military specifications in the light of new thermonuclear warhead technology a bold new management entity was proposed to direct the entire program, including the Convair effort. Additionally, the committee contended that, "The nature of the task for the new agency requires that over-all technical direction be in the hands of an unusually

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* The committee was composed of C. B. Millikan (chairman), H. W. Bode, M. V. Clauser, C. S. Draper, G. B. Kistiakowsky, G. F. Metcalf, H. J. Stewart, and M. J. Zucrow.

** In addition to the chairman the committee included Clark B. Millikan, Charles C. Lauritsen, Louis G. Dunn, Hendrik W. Bode, Allen E. Pucket, George B. Kistiakowsky, J. B. Wiesner, Lawrence Hyland, Simon Ramo and Dean Wooldridge.

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competent group of scientists and engineers capable of making systems analyses, supervising the research phases, and completely controlling the experimental and hardware phases of the program."[8]

At subsequent meetings the committee continued to urge a completely revamped and accelerated missile development effort. Trevor Gardner, Special Assistant to the Secretary of the Air Force for Research and Development and one of the chief proponents of a new program for development of long range ballistic missiles, felt that ". . . the ICBM program should be aggressively pursued, and that the existing Air Force organizational set up and the present Atlas program could not achieve an ICBM capability within the time period desired. A group responsible for 'systems engineering and scientific management' was needed."[9]

Thus the general outlines of a management structure began to take form. The Air Materiel Command moved quickly to assign contracting personnel to the Inglewood office. Western Development Division assumed entire control of all aspects of the development program, even to the systems engineering and technical direction effort, which was contractually assigned to Ramo-Wooldridge Corporation, a newly created scientific-engineering research firm of particular competence. Moreover, as the program advanced it received the strongest support from higher managerial levels of the Air Force and Department of Defense. On 8 September 1955, the Atlas program was assigned the highest national priority. A little more than a week later, on 17 September, the Secretary of Defense directed the Secretary of the Air Force to, "Prosecute within his assigned responsibilities the ICBM research and development program with maximum energy and recommend to the Secretary of Defense such additional actions or administrative arrangements as he considers necessary . . ."[10]

This was, in effect, an opportunity for the Air Force to institute radically new patterns in administrative and managerial procedures. For this task, Hyde Gillette, Deputy for Budget and Program Management, Office of the Air Force Assistant Secretary, Financial Management, was appointed chairman of a special study committee to work out a genuinely streamlined management system. The group brought forward a "Gillette Committee Plan" proposing

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drastic short cuts in normal Air Force administration of its development programs. Approval by Secretary of the Air Force Donald A. Quarles followed on 21 October 1955. The Secretary of Defense acted with equal speed on 8 November stating that he ". . . approved new management procedures designed to achieve maximum acceleration. . . " of long range ballistic missile programs.[11]

The crux of the new management procedures involved creation of two ballistic missile committees at Air Force and Department of Defense level. Both committees were composed of Assistant Secretaries, one chaired by the Secretary of the Air Force and the other by the Deputy Secretary of Defense (later the Department of Defense Director of Guided Missiles). The two committees were to weigh and approve, in turn, major ballistic missile development actions. Western Development Division (later re-named Air Force Ballistic Missile Division) was to prepare for their periodic review complete development plans containing funding and facilities requirements for step by step progress to an operational system. When the submitted programs received the approval of the two committees it became the responsibility of General Schriever's development division to carry them out. In the words of a subsequent reviewer, ". . . the requirement for rapid decisions which was implicit in the concurrency approach was now provided for, and all elements necessary for the effective functioning of the unique management complex were present."[12] It was perhaps the best management structure for its mission ever developed by the Air Force.

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NOTES - CHAPTER 1

1. Ltr, LtGen D. L. Putt, to Cmdr, ARDC, 21 Jun 1954, subj: Project Atlas, in SSD Hist Ofc files.

2. GO No. 42, ARDC, 15 Jul 1954, in SSD Hist Ofc files.

3. Ltr, LtGen T. S. Power, Cmdr, ARDC, to BrigGen B. A. Schriever, Asst to the Cmdr, 29 Jul 1954, subj: Assignment of Authority, Responsibility and Accountability, in SSD Hist Ofc files.

4. Rpt, Combat Ready Aircraft, A Special Report Based on an Air Force Study Completed April 1951, prep by DCS/D, USAF, SSD Hist Ofc files.

5. Rpt, The Ballistic Missile Program, Evolution of a Management Thesis, 2 Mar 1962, prep by DCAS Hist Ofc, in SSD Hist Ofc files.

6. Memo, SAB to C/S, USAF, 13 Dec 1952, subj: Report of the USAF Scientific Advisory Board's Ad Hoc Committee on Project Atlas, 8-13 Dec 1952, in SSD Hist Ofc files.

7. Trevor Gardner, Spec Asst for R and D to SAF, in transmittal ltr, Recommendations of the Strategic Missiles Evaluation Committee, 16 Feb 1954, in SSD Hist Ofc file.

8. Recommendations of the Strategic Missiles Evaluation Committee, 10 Feb 1954, p 7, in SSD Hist Ofc files.

9. Rpt, Overall Ballistic Missile Program, 16 Aug 1960, Vol II, p 47, in SSD Hist Ofc files.

10. Rpt of the Atlas Scientific Advisory Committee Meeting, 20-21 July 1954 and Subsequent Actions, in SSD Hist Ofc files.

11. Memo, C. E. Wilson, SOD, to All Asst SODs, et al, 8 Nov 1955, subj: Establishment of the OSD Ballistic Missile Committee, in SSD Hist Ofc file.

12. Rpt, The Ballistic Missile Program, Evolution of a Management Thesis, 2 Mar 1962.

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CHAPTER 2

MISSION AND PROGRAMS

Western Development Division (after June 1957, Air Force Ballistic Missile Division) rapidly augmented the dimensions of its operations to include development of additional ballistic missile weapon systems and initial efforts in the new arena of military space systems.

Briefly, these major development programs included the addition of Titan, a more advanced intercontinental ballistic missile, an intermediate range Thor ballistic missile and, most significant in terms of planning and expended resources, development of a ballistic missile initial operational capability. At about the same time (October 1955) the division acquired responsibility for developing a reconnaissance satellite system, designated Weapon System 117L, which had earlier been assigned to Wright Field. Because of Department of Defense hostility to the space flight thesis, relatively little progress was recorded in the 117L program until Sputnik I, in October 1957, forced a complete revision of national space policies. Finally, in February 1958, the division started one of its most important projects, development of an advanced "second generation" solid propellant intercontinental ballistic missile.

These varied increments and outgrowths from each were to create, by January 1962, a development program of truly monumental proportions.* The division mission, until 1 April 1961 when the Air Force Ballistic Missile Division was divided to create the Ballistic Systems Division and the Space

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* Aptly illustrated by a statistical study conducted February 1960. At that time the division was allocated $2.6 billion of total Air Force fiscal year 1960 budget of $18.5 billion. The division, on the other hand, retained only 0.3 percent of the total Air Force manpower of 833,000. This comparison would also generally hold true for fiscal years 1961 and 1962.

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Systems Division, was to "Plan, program, budget for and manage the development of all ballistic missiles, military space systems, space projects and other specifically directed programs."1

The mission of the space division after April 1962 was not greatly different although it was possibly phrased in more formal terms and, of course, excluded any reference to ballistic missiles. It was to ". . . plan, program, develop, and manage space projects and systems, make timely delivery of complete operable space systems to user organizations; provide a continuous assessment of the effectiveness of weapon systems concepts and developments. . ." and conduct applied research to insure the utmost advance in new techniques and engineering; and finally, ". . . collaborate with other AFSC development agencies, other services, the DOD, and civilian agencies in furnishing payload services, booster, launching, and on-orbit control services in the attainment of national space objectives."2

As the work of the division continued there were inevitable adjustments to completed tasks and advancing technology. For example, formal development of the Thor intermediate range ballistic missile was completed on 1 January 1960; Thor engineering maintenance heretofore performed by the division was transferred to the Air Materiel Command. Similarly, by mid-1962, the SM-65 Atlas was for practical purposes a completely installed and operational system. Titan I and II, successful development completed for the former and underway for the latter, were destined soon to fulfill a vital strategic role in the nation's defense. Finally, the solid propellant Minuteman, embodying radically new technology, was moving rapidly toward operational status.3

After 1955, and particularly after October 1957, the planning and management of space programs occupied, in division activities, an increasingly significant role. With interest and emphasis on space systems heightened by the first spectacular Soviet satellite successes, the Department of Defense, Air Force, and the National Aeronautics and Space Administration assigned additional programs to investigate spatial phenomena.

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To be sure, the Air Force Ballistic Missile Division had been concerned with military space programs since 1955 * and unquestionably had greater competence in that area than any other American organization. Hence, in January 1958, in response to the general urgency of the time, it was logical to accelerate Weapon System 117L (also called "Sentry" the Advanced Reconnaissance System, or more simply, military space system). Among the acceleration proposals was one involving the use of a Thor booster instead of the originally planned Atlas for 10 early satellite launches. [4]

Throughout 1958, despite the desire to get the space effort rolling at a faster pace, or perhaps because of it, several administrative changes were introduced into the military satellite undertaking. The most significant of these occurred on 30 June 1958 when the newly created Advanced Research Projects Agency (established to conduct space research and to prevent its duplicatory proliferation) assumed responsibility for the advanced reconnaissance satellite program. As matters were arranged, funding and basic policy decisions affecting the program were made in Washington and day-to-day technical management of the system was retained by the division. [5]

From 30 June until 4 December 1958 the Advanced Research and Projects Agency allocated funds for Thor boosters and Lockheed second stages needed to get the program underway as rapidly as possible. (The money had mostly been transferred from the Air Force.) In the meantime, a study effort carried on by the agency resulted in a decision to divide the military satellite system into separate development projects. As these adjustments were made, primarily to ease budgetary difficulties, the Thor

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* The Air Force had been thinking about exploiting "space" for intelligence uses since 1946. Technical development had moved forward so that in 1953 Rand Corporation recommended development of a Satellite Intelligence System. In the spring of 1955 the Air Force solicited design proposals from selected contractors. In October 1955 Western Development Division was assigned management of the project. In October 1956, Lockheed Aircraft Corporation was awarded a contract to develop and test the proposed system and the Massachusetts Institute of Technology was awarded a contract for research and development of the orbital attitude control equipment. Thus the Air Force and the division possessed well laid ground work for the beginning of a strong space effort.

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booster phase of the program became an independent project ultimately identified as Discoverer. The infrared reconnaissance phase of the program became a separate missile defense alarm system (Midas). Nonetheless, Sentry, later renamed Samos, remained the backbone of the future reconnaissance satellite system.[6]

The next major managerial switch came about 12 months later. In a significant change of policy the Advanced Research Projects Agency abbreviated its space systems development role by returning to the military services most of the space projects it had taken from them a year before. On 17 November 1959, full development responsibility for Discoverer, Midas and Samos was officially returned to the Air Research and Development Command and the Air Force Ballistic Missile Division. Samos was segregatedas a secretariat - level project in August 1960, but Discoverer, Midas, and offshoots of each remained as paramount development goals of the new Space Systems Division after 1 April 1961.[7]

Notwithstanding these varied changes, the development of upper stage and satellite vehicles proceeded with remarkable success. The second-stage vehicles were those designed and produced by Lockheed Aircraft Company, Aerojet-General and Allegany Ballistic Laboratory and ultimately included such excellent performers as the Agena, Able-Star, Able and ABL 248. Except for the Agena, developed in the WS 117L program, the second stage vehicles were derived from modified upper stages of the earlier and lamentably unreliable Vanguard rocket; these, in turn, were based on the still earlier Aerobee rocket. This parentage was rather attenuated, however, and by January 1958 advanced second stage vehicles were in full development and early production. Moreover, the vehicles, depending on their use, could be made compatible with both Thor and Atlas boosters. As development continued more sophisticated designs, characteristic of the Lockheed Agena and Aerojet-General's Able-Star, were made susceptible to ground directed orbital adjustment and control. In any event the division was prepared, during a crucial period, to conduct and manage the development of space vehicle systems readily adaptable to the varied objectives of military and civilian space programs.[8]

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The Air Force naturally looked to the first upper stage satellite designed by Lockheed for the 117L weapon system to carry the major load imposed by new programs. A "space-rated" development of the Bell-Hustler rocket engine, an interesting and highly useful by-product of another Air Force development program,* was basic to the versatility of the vehicle. Although originally designed for use with an Atlas booster, it was successfully adapted to the less powerful Thor. This variation in design permited early introduction of low orbit instrumented Agena satellite flights--the famed Discoverer series--essential to the conduct of more advanced military space programs. Modifications subsequent to Agena's first use significantly improved its value by doubling propellant capacity and adding in-flight guidance and attitude control. [9]

Apart from the Agena upper stage-satellite combination the division directed the development of two other second stage competitors that proved to be particularly useful in highly specialized applications. These were Aerojet-General's Able-Star and Able. The former, developed as an upper stage vehicle compatible with Thor, and Atlas boosters, contained a sophisticated propulsion system providing high performance, automatic starting, re-starting, shutdown, and coast on command with complete attitude control. Able-Star, operational in January 1960, was designed for a series of Transit (navigational aid experimentation) and Courier (communications data) orbital flights. The Able, basically a modification of an upper stage used on the Vanguard rocket, possessed an excellent guidance capability during second stage operation. It was designed for use on Transit, Tiros (weather data collection) and Able series of orbital, re-entry and space probe flights. [10]

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* Bell Aircraft developed the engine for use in the Air Force B-58 bomber program. In 1957 it was decided to drop this idea but the Air Force missile development division sensed its possibilities for use as a second stage power source. Bell became a subcontractor to Lockheed and continued engine development was assured.

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Allegany Ballistics Laboratory also designed and developed the ABL 248 upper stage, based on the most advanced solid propellant engine of its size then available (1958). This engine was a solid propellant unit adapted from an existing design.* Used as a third and fourth stage, it furnished excellent performance for Able-1, Able-3 and Able-4 series of space flights.[11]

Discoverer

The Air Force thus armed hastened into the space arena with missiles turned boosters and upper stages developed or available. And among its first actions was to introduce the Discoverer series of orbital flights which was to score as the most dramatic of sustained United States space efforts.

The basic purpose of the program was to achieve through the use of a relatively economical vehicle, development of operational techniques and acquisition of vital knowledge of the space environment. Therefore the Air Force focused program attention on recovery of data or biomedical capsules from relatively low orbits (which were necessitated by the relatively low thrust of the Thor). Ultimate perfection of this technique open wide vistas to speedy and reliable data acquisition as well as other potentially useful applications.[12]

The Discoverer undertaking embraced development and operation of an orbital flight program which began on 21 January 1959 and reached a total of 45 launches by June 1962. The first launch--all launches were from Complex 75,1-2, at Vandenberg Air Force Base--was marred by failure of the second stage Agena. On the second launch, 29 February 1959, the Thor-Agena vehicle successfully boosted its satellite into a polar orbit. There

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* Another by-product of the Vanguard project it was developed, beginning in 1955, as a third stage solid propellant engine. Development contracts were awarded to the Allegany Ballistics Laboratory and the Grand Central Rocket Company, Redlands, California. Engine development was completed in August 1958 at about the same time the Air Force was to put them into use in its Able lunar probes program. The engine was by general concensus of the time the highest performing qualified solid propellant rocket the nation possessed.

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followed a series of 11 launches which resulted in seven satellites achieving orbit but which for one reason or another failed to end in the physical recovery of a data capsule. Either the attitude or the timing of the capsule recovery process proved incorrect in several instances, while faulty parachute deployment caused the re-entry body to go directly to the bottom of the Pacific in other trials. Twice the test series was halted for program overhaul. Finally, on 10 August 1959, months of intensive engineering research paid off. Discoverer XIII attained orbit successfully; the capsule was ejected on the 17th orbit and recovered in the water. The next launch on 18 August was completely successful, culminating in the first air recovery of the data capsule. Thereafter the program recorded an ever increasing ratio of orbital flights, successful data collection, and air recoveries. By 30 June 1962, 33 of the 45 Discoverer vehicles launched had attained orbit (two of the launches involved non-recoverable operations) and 17 satellites had been recovered. Of these, 13 were recovered in the air and 4 were retrieved in the water. Moreover, ascendancy of program objectives resulted in approval for 18 more Discoverer flights through 1962 and 1963. [13]

Continuation of the orbital program offered wide ranging opportunity for bold space experimentation and research by various agencies of the government. Among these experimenters and experiments were the Army Corps of Engineers which sent aloft a satellite-borne transponder to measure unknown distances by means of triangulation from two know points; the School of Aviation Medicine, which sent living tissue into orbit; measurements of several types of radiation encountered in space; a determination of the frequency of micrometeorites wandering in space; and investigation of the reaction of metals to a space environment. [14]

Scientifically dramatic flights also marked the Discoverer series. Among these was Discoverer XVII, launched 12 November 1960 to measure ambient radiation which happily encountered and dutifully reported extraordinary quantities of radiation from a massive solar flare that occurred shortly before launch. On 12 December 1961, a satellite containing Oscar I, an orbiting amateur radio transmitter, sent a morse-code "Hi" to delighted radio "hams" scattered around the world and at the same time returned vital experimental data. [15]

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Midas

Beyond the Discoverer program, one of the paramount interests of the Air Force was developing of an early warning system effective against ballistic missiles. Lockheed, contractor for weapon system 117L had proposed as early as 1956 that infrared sensitivity be used as the basis of a swiftly responsive missile defense alarm system. If the idea proved workable, satellites equipped with infrared "eyes" would signal the launch of large rockets as soon as they left their launch pads. The plan projected accurately positioned polar orbiting satellites which would sweep over the vast Sino-Soviet land mass and instantly report their findings to one of three strategically located ground data stations. After initially managing the development as Subsystem G of WS 117L, the Air Force in December 1958 decided to conduct this phase of the program as a separate undertaking. [16]

Through 1959, despite the importance of early warning to the nation's total defense structure--it was regarded by Lieutenant General B. A. Schriever, head of the research command, as of the greatest national urgency--limited funding imposed a slow approach. In February 1959, the Advanced Research Projects Agency submitted the Midas development plan to the cold analysis of the Director of Defense Research and Engineering. Scientific concensus sustained the view that Midas was technically feasible but would be extremely costly. The satellite power source and the sensitive infrared detectors would have to survive the rigours of space for at least a year in an operational system. Obviously, such components would take a little time to develop. Nevertheless, although denied approval for total system acquisition, the division continued research and development work on the system. [17]

On 25 February 1960 the first Midas was launched from the Atlantic Missile Range but, disappointingly, the heavily instrumented satellite failed to achieve orbit. However, on 24 May 1960, the second Atlas-Agena A Midas vehicle functioned with astonishing precision to enter the, "Most perfect circular orbit achieved by the United States." Unhappily, however, transmission of infrared data to a ground readout station was but briefly demonstrated before a critical component failure. On the 13th pass the vehicle fell permanently silent. Nevertheless, the test produced enough information

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on Midas operation to support contentions that the system was feasible. Another important aspect of the second flight was sustained stabilization of the satellite in a correct nosedown orientation during the recorded orbits. [18]

Encouraged by the moderate success of the second Midas flight and, in early September 1960, a favorable review of the project's basic scientific and engineering concepts by the Panofsky panel of the President's Science Advisory Committee, the division extended system development through 1960. Discoverer XIX, launched 20 December 1960, carried Midas radiometric equipment aloft to obtain background infrared radiation information. Although the Agena satellite ran into attitude difficulties, useful information was recorded for four days. The high-altitude U-2 aircraft was also used during the months from January to June 1961 to obtain background infrared data. On 18 February 1961, Discoverer XXI orbited another radiometric package to obtain additional background infrared data. [19]

Preparations were now advanced for the third full scale Midas flight. On 14 September 1961, an Atlas-Agena B, the latter a more sophisticated, controllable, high fuel capacity second stage vehicle than any heretofore used in the program, soared from Point Arguello into a near circular 1,900 nautical mile orbit. Again, payload operation was short lived. Data was transmitted for only five orbits and despite the advanced guidance devices aboard the satellite, it suffered from attitude instability after the first orbit.

A month later, the Air Force tried again. On 24 October 1961 Midas IV was launched from the Pacific Missile Range to enter a 2,000 nautical mile orbit. This time the system worked much better. Although there were symptoms of attitude instability, infrared data was transmitted for 50 orbits before power exhaustion. The final flight of the first series occurred on 9 April 1962 when Midas V was launched over the Pacific Missile Range to enter a 1,500 to 1,800 nautical mile earthly circuit. Power failure stopped data collection on the seventh pass, but the system collected background infrared data of good quality. Thus the series of flights proved the basic technical feasibility of the system, although it was apparent that individual components would need substantial improvement if its life and reliability were to be significantly extended. [20]

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These problems, notwithstanding Air Force conviction that the concept should move forward rapidly to system development, led the Director of Defense Research and Engineering to schedule a second critical review of the whole Midas idea. A blue-ribbon scientific group to handle the assignment was organized under Dr. Jack Ruina of the Advanced Research Projects Agency. The gist of the resulting study, completed at the end of November 1961, was a recommendation to develop a simplified, more reliable Midas before pinpointing an operational date--in other words keep the system in a research and development status. In conformance with the Ruina commitee recommendations, the Air Force in late 1961 was directed to orient the Midas program to the revised approach. Accordingly, the Space Systems Division overhauled the Midas development plan with emphasis on resolving basic technical shortcomings. In mid-1962 development of the Midas warning system remained an important, if somewhat uncertain, element of the mission of the Space Systems Division.[21]

Samos

The remaining portion of the original 117L system, that element concerned with visual and electronic reconnaissance, was to undergo a unique transformation. Its beginning was found early in 1958, when the Advanced Research Projects Agency assumed control of the 117L system, an action officially confirmed on 30 June 1958. Between May 1958 and December 1959, austere funding and uncertain program objectives severely handicapped progress toward early system acquisition. This disappointing state of affairs persisted despite the formal assignment of the highest national priority to Samos development. To be sure, the Discoverer project, which was receiving major program emphasis at the time, included development of certain subsystems (such as recovery) essential to Samos operation. By January 1959, the Advanced Research Projects Agency had redirected the program to provide for acceleration of a camera readout system, development of a recovery program for high resolution photography, and photo-reconnaissance mapping and charting. In mid-1959, however, the defense agency instructed the missile division to defer work on key aspects of the

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Sentry system until a general review of the entire program could be completed. This situation persisted until September 1959, when the agency authorized the division to move ahead with a combined readout-recovery program based on a fiscal year 1960 funding level of $148 million. Then on 18 September the Secretary of Defense agreed to transfer Samos back to the Air Force. The Air Force Ballistic Missile Division immediately embarked on the preparation of a new development plan which limited [redacted] funding and redefined objectives the program would move rapidly forward to an operational system. [22]

On 30 January 1960 the division published a revised Samos plan which reflected the current emphasis on visual reconnaissance--both photo recovery and readout systems. Twenty-five launchings were projected to test ferret and visual, airborne and ground equipment. But the plan, approved by the Air Force Weapons Board and Air Force Ballistic Missile Committee, failed acceptance by the Director of Defense Research and Engineering. Dr. H. F. York approved the plan "in principle" but directed additional emphasis to visual recovery techniques, with visual readout and ferret readout following in priority. Moreover, in April 1960 York urged the Air Force to reduce its emphasis on "operational aspects" of Samos, forget the "concurrency" approach, and concentrate on developing system feasibility and increasing reliability. [23]

Before the Samos program could actually adopt such an approach, international politics intervened. U-2 flights over Russia were abruptly terminated after the May 1960 "Powers Incident," inevitably centered attention on alternate data gathering systems. Just 15 days after the abortive 1 May U-2 flight, the Air Force Deputy Chief of Staff, Development, Lieutenant General R. C. Wilson, with approval from Air Force Under Secretary J. V. Charyk, ordered the research and development command to prepare a plan for early operational exploitation of Samos research and development. Shortly thereafter, President Eisenhower told his Secretary of Defense to re-evaluate Samos and brief the National Security Council on

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his findings and recommendations. This evaluation was actually performed by Charyk, John Ruble (York's deputy in the office of the Director of Defense for Research and Engineering), and Dr. G. B. Kistiakowsky (the President's scientific advisor). Concurrently, the Senate Appropriations Committee characterized the Samos program a[redacted]

During July 1960 Samos matters continued to ferment. Proposals for complete reorientation of Samos management were heard. One of the most persistent suggestions was to establish a new single manager system under an Air Force brigadier general with complete authority for financial and technical management. The parallel with the early Atlas program was apparent. Meanwhile, improved financial resources became available and on 12 July 1960, the missile division revised the Samos plan to provide for substantially greater emphasis on photo recovery rather than readout, although the latter technique was not eliminated. At the same time plans were laid for expansion of launch facilities at Point Arguello. [25]

During the next few weeks various plans for management were reviewed and considered at several levels of government. The solution was found early in August 1960 and was confirmed on 25 August, following a National Security Council review of the Samos development plan, when the President directed that the program be conducted under "very high priority" and managed by an Air Force general officer reporting directly to the Office of the Secretary of the Air Force. [26]

By 31 August the Secretary of the Air Force had created an Office of Missile and Satellite Systems in the Pentagon (SAFMS) and an Office of the Secretary of the Air Force, Samos Project (SAFSP) to manage and direct the program. Bridadier General R. E. Greer, formerly Assistant Chief of Staff for Guided Missiles, became director of the Samos Project Office located together with Air Force Ballistic Missile Division headquarters in Los Angeles, California. [27]

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At this point of transition, ultimate Samos objectives were defined as ". . . resolution of photographic images of low contrast objects from 20 feet down to 1 foot on a side, on the ground from the operational altitude of . . . 300 miles . . ." Almost exclusive emphasis was to be accorded photo recovery. In addition, a new three-pad complex was to be constructed at Point Arguello. Funding, as planned at that point, amounted to $160 million in fiscal year 1960, [redacted] latter [redacted]

On 6 September the Office of the Secretary of Defense approved the Air Force Samos development plan. On 15 September, the Secretary of the Air Force was formally directed to assume direct responsibility for the Samos program. The program manager, General Greer, would report directly to the Secretary of the Air Force. He, in turn, was to keep the Director of Defense Research and Engineering fully informed on progress.[29]

By December 1960 it was apparent that the program was to be a research and development effort rather than a "concurrent development-operational" program along the lines of the 1955-1959 ballistic missile effort. As a program of wide ranging experimentation was to be conducted, no effective operational planning was in immediate prospect. Samos thus became an Air Force program excluded from normal management and program documentation procedures. Although the Samos program office was associated with the Air Force Ballistic Missile Division, and following the 1 April 1961 reorganization, the Space Systems Division, it remained an independent and tightly managed entity responsible to the air secretariat rather than the air staff. On 15 December 1960 the Secretary of the Air Force directed all major commands to originate no new internal or public information concerning the Samos program. Thereafter, progress was marked by the oblivion of silence.[30]

Anti-Satellite Systems

The Air Force early demonstrated an intense interest in exploring techniques to combat hostile satellites. On 28 August 1956 the Air Research and Development Command issued System Requirement 143, which became

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the basis for the first projection of anti-satellite weapon systems. Nothing much was done to satisfy the formal requirement until 18 April 1958, when General D. L. Putt, Deputy Chief of Staff, Development, instructed the Air Research and Development Command to renew satellite interceptor feasibility studies. On 1 May 1958 the research command issued System Requirement 187 and allocated $400,000 for studies of satellite interceptor systems. During the same month, Air Force headquarters directed the preparation of a General Operational Requirement for a satellite defense system. [31]

The projected program now began to take definite shape. Following the release of General Operational Requirement 170 on 19 June 1958, plans were laid for a space tracking control center and the preliminary design of a satellite space defense system was prepared. Various studies conducted by industry confirmed the technical practicality of such a system. Generally, the plan called for a ground system of radars that would gather position and orbital data on an unknown satellite. Then an interceptor vehicle would be launched to survey the stranger at close range and if necessary destroy or disable it. [32]

The Air Force Ballistic Missile Division had prepared, by 10 August 1959, a preliminary satellite interceptor and inspection development plan. The proposed system, named Saint, projected a series of launches of increasingly sophisticated vehicles to prove out the concept. After reviewing the proposal, Air Force headquarters directed the missile division to submit a revised and much scaled down development plan. The revised approach was to be designed to assure utmost reliability in all components. Only when that had been achieved, and as the last step, would the feasibility of the complete system be demonstrated. [33]

On 8 February 1960 the division issued a new Saint development plan which, if approved, would emphasize development of reliable subsystems and ultimately demonstrate satellite rendezvous and inspection. The plan was studied by the Advanced Research Projects Agency, the Air Staff, and critically reviewed by the Director of Defense Research and Engineering (Dr. H. F. York). On 16 June 1960, York approved a limited research

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and development program managed and funded by the Air Force. But there were some conditions. It was his view that surveillance devices should not be made inherent in early test versions and that nothing beyond co-orbital experiments should be initially undertaken. Once again the division returned to its calculations to prepare another revised development plan. By 1 July 1960, the new program scheduled the design, fabrication and launch of a prototype vehicle which would demonstrate satellite rendezvous and inspection. This was to be accomplished in four launches beginning about November 1962.[34]

During the late summer and fall of 1960 the Saint development plan was studied and approved by the Air Force Ballistic Missile Committee and the Office of the Director of Defense Research and Engineering. On 17 October 1960 Air Force headquarters issued a formal Development Directive authorizing an $8.15 million program for fiscal year 1961. By the last of November, Radio Corporation of America had been selected as the development contractor. At that point Pentagon officials discretely decided the new incoming administration might have some different ideas on the program and ordered a deliberate approach until fiscal year 1962 research, development, test and evaluation funds could be clearly defined.[35]

As it happened, there was increasing interest in the Saint program. The revised Presidential budget raised fiscal year 1962 program funds from $12 million to $26 million. There was also mounting conviction within the Air Force and the Department of Defense that the nation should acquire as rapidly as possible an outer space defense capability. Ample evidence strongly suggested a technological capability would soon exist to orbit nuclear payloads.[36]

As increasing attention was focused on the program, there appeared inevitable divergent currents of opinion and direction. Concern that program costs were getting out of hand collided with the viewpoint that the program must be thoroughly developed, tested, and proved out in an operational system regardless of cost. Alternate technologies gained support: it would be less expensive to develop a cross-course interceptor for launch into the path of a hostile satellite (the same principle as the Nike-Zeus system).

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To bring these various notions into proper focus Air Force Undersecretary Charyk established, in early 1961, an ad hoc working group to study the total Air Force space program.[37] At the same time, discussions were in progress to combine Saint technical objectives with space projects already underway. Saint goals of interception and inspection were closely paralleled by Mercury II (Gemini) objectives of docking and transfer. It was proposed, therefore, that the Air Force and the National Aeronautics and Space Administration work out a joint program. Meanwhile, the program continued to develop along the lines of the 1 July 1960 approved plan, although increased costs and the non-appearance of additional money required stretching the schedule another four to six months. This meant, in effect, that the first launch would occur in July 1963 and the others would follow at approximately three month intervals.[38]

Although funding problems remained acute, efforts to work out a coordinated Saint and Gemini program which could draw funds from two agencies ran up against the difficulty of too many technical contradictions between strictly scientific interests and military requirements. Early in 1962, the Air Force Systems Review Board, in an effort to accelerate matters, ruled that the Saint project was vital to the national and military interest and that the systems command should prepare an alternative funding plan to accelerate development. One day later, on 23 March 1962, the Designated Systems Management Group directed six rather than four launches and recommended a boost in fiscal year 1963 funding to $65 million.[39]

The Air Force action was not approved. Moreover, on 28 June 1962 the Director of Defense Research and Engineering expressed second thoughts about the value of [redacted] He pointed out that there was no firm intelligence which established a need for an early weapon system capability -- an opinion the Air Force did not share. Nevertheless, the Air Force was directed to conduct the Saint program as a limited research and development effort and was reminded that it had been instructed to do so on 16 June 1960. Procurement of six launch vehicles and spacecraft was authorized, although spending was not to exceed $40 million in fiscal year 1963. At mid-1962, development

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of subsystems and high reliability took precedence over acquisition of a complete system pending redefinition of national strategic considerations.[40]

Launch Vehicles

As the tempo of military and scientific space activity increased, there was an accompanying demand for development of improved yet standardized all-purpose space launch vehicles. The division, particularly since 1959, had explored various possible solutions to the problem of lowering costs on one hand and significantly increasing thrust on the other.

One of the most promising technical avenues to achieving these heretofore contradictory objectives possibly lay in use of solid propellant engines. Air Force-supported solid propellant research programs had by 1959 led to development and production of the Minuteman intercontinental ballistic missile. At the time that solid propellants were scoring their most spectacular demonstrations in Minuteman, and to lesser extent Polaris, even greater advances were underway. The Air Force, in March 1959, solicited industry proposals for demonstration of a one-million-pound-thrust solid motor with a 20-second burning time. By April 1959 Aerojet-General had been tentatively selected to conduct the program. But work reviews and redefinition of objectives postponed final contractual action until mid-1960. At that point the Air Force decided to enlarge the effort by adding a separate segmented-motor research program. By August 1960 both Aerojet-General and Grand Central Rocket were conducting research in large solid motors. Concurrently, United Technology Corporation, an unsuccessful bidder for the Air Force contract which Aerojet won, was working on state-of-the-art developments for the National Aeronautics and Space Administration. The company was also carrying on an internally funded program to develop super-size solid motors.[41]

Separately from such activity, Space Technology Laboratories began and Aerospace Corporation completed a broad examination of the potential advantages of large and super size solid motors for space booster use. Results of this investigation were first released early in 1961 under a "Phoenix Study" title. The study emphasized the value of large solid motors for space launch vehicle applications.[41]

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Obviously, use of solid boosters to accelerate the United States space effort to some degree of competitive equality with Soviet massive thrust rockets appeared attractive. Moreover, it was a view supported by strong and sound technical progress. By early 1961 Aerojet had successfully fired a 65-inch three segmented solid motor which developed a thrust output of 400,000 pounds for 18 seconds. This event as well as additional evidence supported Charyk's opinion, expressed to Air Force Secretary E. M. Zuckert in early April 1961, that a large-solid motor with performance comparable to that of the clustered-engine, liquid-fuel Saturn could be developed earlier than Saturn, and probably at less cost. [43]

The Air Force backed this view by forwarding to the Secretary of Defense a proposal for a national space program. The proposal forthrightly stated that the United States must have superiority in booster thrust to surpass Soviet space achievements. In the opinion of the Air Force this could be most rapidly achieved by using first stage large-solid segmented rocket motors topped by oxygen-hydrogen upper stages. In any event, the segmented rocket motor could lead to early successful achievement of a manned expedition to the moon. [44]

On 8 May 1961, the Secretary of Defense and the head of the National Aeronautics and Space Administration, in a joint Memorandum of Understanding forwarded to the Vice President, recommended a national program leading to a manned lunar landing and return. It was agreed that dual approaches--liquid and solids--would be pursued for the first or second stages of the required launch vehicle. Parallel development was to be continued until the superiority of one was demonstrated. The defense department and the space agency agreed that the Air Force should be responsible for the solid-fuel program. [45]

On 13 May 1961 the Space Systems Division released a proposal and preliminary plan of approach for development of large solid boosters. The division concluded that segmented rocket motors ". . . may be wrapped around a liquid rocket engine second stage to keep overall vehicle height to desirable limits." [46] On 24 May, in response to a request from Charyk received the

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day before, the division proposed a program based on emphasizing development of a solid motors in segments or building blocks from 100 to 140 inches in diameter, burning times from 60 to 90 seconds, and weights from 50,000 to 100,000 pounds. A tentative judgment contemplated a development time of 30 months and a cost of $62,000,000. [47]

On 5 June 1961, Under Secretary Charyk instructed the Air Force to propose a solid booster program that would not only satisfy the National Aeronautics and Space Administration but meet certain Air Force needs as well. Four days later, the Air Force Systems Command submitted a tentative plan for development of segmented 3,000,000 pound thrust solid boosters. The Air Force plan envisioned 124-inch diameter rocket with 90 second burning time and weight in the neighborhood of 750,000 pounds. If development were started immediately, vehicle flight tests could be scheduled in 1965 and manned flights by 1967. Total estimated costs, admittedly elastic in view of program vagueness, came to $939 million for development, production and test facilities. [48]

By mid-1961 some difficulties and voices of dissent were apparent. The National Aeronautics and Space Administration could not bring itself to submit booster specifications to the Air Force. Charyk was also less than hopeful that the management scheme contrived by the two organizations, defined in a "White Paper" issued 6 June 1961, would really work. Meanwhile, the Space Systems Division set up a system program office for the solid booster effort and almost immediately requested that it be permitted and given the funds ($15,650,000) to start work on 14 specific long lead time elements of the program. [49]

By 12 September 1961 the Department of Defense had found $13.65 million for release to the space division to start the program. Probably by coincidence, the Air Force Systems Command on the same day forwarded its approval. By that time, however, the Air Force and the National Aeronautics Administration, admittedly unable to see eye to eye on certain aspects of the program, discontinued the plan for parallel time schedules on solid rocket development. Instead the Air Force decided to move in three directions. First, it

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would undertake development of a 120-inch segmented rocket which had the advantages of mission orientation, needed no new facilities, and was air transportable in segments. Second, it would develop a 156-inch rocket up to static testing but not beyond unless there were crises in the liquid program. Third, it would carry to the point of demonstration firings the development of monolithic rockets in the 240-300 inch category which would be built on the test site. These ideas were approved in a 17 November 1961 agreement between the defense secretary and the head of the National Aeronautics and Space Administration. [50]

Almost immediately the National Aeronautics and Space Administration and the Office of the Director of Defense, Research and Engineering began to express reservations about the direction development was to take. Neither agency could agree on priorities as between motor sizes and the extent of facilities. At mid-point 1962, development of large solid motors, with the exception of the 120-inch diameter version, was limited to long-lead-time items and basic research. Outright development programs awaited a clear definition of objectives. [51]

Another development effort so closely associated with the large solid rocket program that in a sense it could be considered a part of the same undertaking was what became Titan III. The basic concept envisioned a modified Titan II ballistic missile serving as a core around which building blocks of solid motor boosters and extra stages might be assembled. Early in 1961 the space division, drawing on the results of the Phoenix Study, began working on the details of booster size and configuration. Higher management levels of the Air Force and Department of Defense were very interested in the advantages such a new more powerful booster system would offer. [52]

By mid-August 1961 this interest induced Assistant Secretary of the Air Force B. H. McMillan and Deputy Director J. H. Rubel of the Department of Defense research and engineering office to create an ad hoc group to examine the question of a standardized "workhorse" space booster. The group concluded that Titan II with strap on solid boosters would meet the need. The proposal and recommendation were of such merit that on 15 Sept 1961, Rubel asked the Air Force to undertake a comprehensive study of

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important aspects of what he designated the Titan III system. The study was to include vehicle specifications, design analysis, and mission applications. The Space Systems Division, assigned the task, was to submit its report by 6 October 1961. [53]

The report was completed and forwarded on 4 October 1961. The division, confident in the soundness of the proposal, stated that with immediate approval and adequate funds, first development flights could be scheduled for the summer of 1963 and the first full solid booster-Titan flight for January 1964. [54]

Roughly two weeks later the space division was instructed to proceed with a program definition phase of Titan III development and to start planning the management structure of the program. * The concept involved a "ruggedized" Titan II, an upper stage, and solid booster engines 120 inches in diameter by 176 inches long. Possessing an additional third stage, Titan III would be able to loft to high trajectories payloads varying in weight from 5,000 to 25,000 pounds. [55]

The division began evaluating possible contractors during November 1961. During February and March 1962, study contracts were awarded to Martin Marietta Corporation, Aerojet-General Corporation, and Aerospace Corporation. By early May, division contract specialists were negotiating for development of the solid boosters by United Technology Corporation. At the same time, the first phase study effort was sufficiently well along to permit preparation of a development plan (Proposed System Package Plan) which contained several inovations over the original proposal: more flight tests, a four segmented solid booster, and production follow-on. The plan was forwarded for approval of Air Force headquarters and the Director of Defense of Research and Engineering. There followed intensive program analyses, additional development proposals and an attempt to define program

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* Phase I was stated to be the technical period to ". . . define the scope of the program; identify principal areas of technical work; complete the preliminary design effort and establish development principles and objectives that will not change during the life of the program."

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funding requirements. Finally, on 28 June 1962, the director of research and engineering urged the Air Force to use a modified Titan II guidance system in lieu of a new system, change the upper stage to 22,000 pound thrust unit, develop a solid five segment booster motor instead of the four segment motor, and construct only a two pad instead of a three pad launch facility at the Atlantic Missile Range. In early July the space division's Titan III program office began to introduce these changes into the development program. Meanwhile, the Air Force was instructed to restrict development work by United Technology Corporation to a first phase contract study which was to extend from 1 July to 15 August 1962. Thereafter it was anticipated that hardware development of solid motors would begin. [56]

Funding support for the program remained uncertain. Fiscal year 1962 development costs were limited to $18.5 million but mounted steeply toward the $251 million estimated for fiscal year 1963. [57]

Paralleling the Titan III program in some respects, the Air Force had been moving toward further booster standardization. A logical candidate was the Thor booster derived from the first Air Force developed medium range ballistic missile. Although it was first used because it was the earliest booster available in quantity, Thor turned out to be a highly reliable and versatile vehicle ultimately employed in widely diverse space assignments.

The first move in the direction of booster standardization occurred early in March 1958 when the Secretary of Defense directed the Air Force to accelerate the satellite test vehicle program through the use of Thor boosters. This decision resulted in the first production run of 10 Thor boosters designed to accept the second stage Agena vehicle. Then, on 4 September 1958, the Advanced Research Projects Agency asked the Air Force Ballistic Missile Division to furnish two complete Thor Able 1 (Thor booster, second stage Aerojet-General AJ10-101, and third stage ABLX248-9) configuration vehicles for space launchings. This order was amended on 26 November 1958 to provide for delivery of an additional eight Thor-Able vehicles and, in this case, two Atlas booster vehicles. Additional orders followed for what became a series of Thor boosters and stages in the general Able 1 arrangement. [58]

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These procurement demands resulted, for all practical purposes, in a standard Thor booster. But there was a great deal of work and money involved in fitting the booster which was still basically a Thor missile to match various upper stage combinations and payload variations. * By 1961 steps were taken to standardize production hardware. Model Thor DM-21, a space booster, was produced, with cleaned up wiring and plumbing to fit various upper stage combinations. By mid-year 1962 all Thor subsystems were standardized except wiring. A plan to develop an electrical wiring system which would permit plug-ins in any combination desired from the Agena, Able Star and Delta upper stage combinations was under study and was a prospect for early adoption. [59]

Beyond this effort another important step was taken to exploit the advantages of solid propellant boosters. In February 1962 the Space Systems Division asked Douglas Aircraft Company to specify the performance and design of a Thor booster (Model DSV-2C) with three solid propellant rocket motors strapped to its outside shell to furnish more thrust. Engineering study proposed three Thiokol Sergeant (XM-33) solid propellant motors installed around the Thor engine section and attached to its three main thrust beams with only minor vehicle modification. These three additional motors would add 163,500 pounds of thrust for 27 seconds after lift-off. Thrust tail-off would continue for another 13 seconds. This arrangement would give the Thor-Agena vehicle, for instance, an extra 500 pounds of payload on a 300 mile circular orbit. [60]

The increase in cost for additional performance appeared to be the small difference between a cost of $1.05 million for the launch of a Thor booster and $1.40 million for the launch of a Thor-Sergeant. Contractual actions for the improved standard space vehicle were

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* Thor-Agena second stage, used on Discoverer flights; Thor-Able second stage (choice of three) and ABL X248-9 third stage, this vehicle was called Thor-Delta or sometimes NASA-Delta, and was used on space penetration and orbital missions for Transit, Courier, Advent, Anna and other government agency sponsored programs; and Thor-Able Star second stage, also used on Transit, Anna, and other projects.

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completed with Thiokol Chemical Corporation and Douglas Aircraft Company by the close of June 1962. The first launch of the new model was initially scheduled for November 1962, with nine more launches to take place through 1963. [61]

Increasing emphasis on space standardization inevitably focused attention on Atlas booster procurement. As demand continued to mount, the advantages of standard production run boosters and standardized kits which could be quickly integrated to perform specialized missions became obvious. During the last half of 1961, thirteen space programs were using Atlas boosters and by 30 June 1962 a total of 137 boosters were on production contract. [62]

A formal program to develop a standard Atlas booster began 1 January 1962. Air Force headquarters in April approved the opening of contract negotiations after a detailed Space Systems Division proposal had been favorably received at all management levels within the Air Force Systems Command, Air Force headquarters, National Aeronautics and Space Administration, and the Department of Defense. Contract provisions, including radically new cost and reliability incentive provisions, were settled by the close of June. General Dynamics-Astronautics agreed to develop a standard vehicle of improved performance and reliability that could be quickly converted to various booster purposes. The negotiated contract called for production of 35 boosters at a cost of $78,000,000. [63]

As early as April 1956, the Air Research and Development Command had expressed interest in obtaining an economical, versatile and highly reliable space research vehicle and had submitted such a proposal to Air Force headquarters. By later standards the performance requirements were modest: to boost a maximum payload of 200 pounds some 200 miles into space or to function as a ballistic missile re-entry test vehicle. A second and third phase development was planned leading to higher performance, orbital experiments and payloads of greater weight. [64]

Air Force headquarters approved and directed preparation of a development plan. In early 1957 the research command submitted a plan for development of an all purpose rocket test vehicle to operate at altitudes

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between 100 and 320 miles. The plan successfully ran the gauntlet of the Air Staff but was turned down by Richard E. Horner, then acting Assistant Secretary of the Air Force (R and D). Apparently the secretary felt there was insufficient justification for another rocket, at least of the kind described.[65]

Another development plan was prepared which sought to overcome the objections to the first. The project was designated as the Ballistic Research and Test System, No. 609A, and the plan for its development was submitted 18 December 1957. This plan too was favorably received by key elements within Air Force headquarters but at higher echelons the climate was not favorable for starting another rocket system no matter how useful it might appear to be. Air Force plans for the project were apparently stalemated when Air Force headquarters in June 1958 suggested a joint Air Force and National Advisory Committee for Aeronautics (NACA) project. Within a few weeks, conferences between the two agencies had strongly indicated agreement on vehicle characteristics. The vehicle was to consist of a 40-inch Aerojet-General first stage, an improved Sergeant second stage, and Meteor third and fourth stages. As discussions continued NACA came to favor a less complicated vehicle than the Air Force required. It was decided--by this time it was October 1958--that the National Aeronautics and Space Administration (NASA, successor to NACA) would develop the vehicle it wanted and the Air Force would modify the vehicle as necessary to meet its requirements.[66]

Based on the agreement with the civilian agency, the Air Research and development command drew up an abbreviated development plan for a Hyper Environment Test System, No. 609A. The responsibility for working out the plan was assigned to the Air Force Ballistic Missile Division and a joint division-civilian team was organized to run what was now called the Blue Scout project. In the spring of 1959 the National Aeronautics and Space Administration signed a development-production contract with Chance-Vought to produce the basic Scout vehicle. In June 1959, the Air Force selected the Ford Motor Company, Aeronutronics Division, to handle test, payload and systems integration functions. In order to bring its planning up to date,

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the division completed a new detailed System 609A development plan which included a list of scientific test flights in store for the Blue Scout vehicle. This plan, submitted 18 May 1959, was not formally approved by Air Force headquarters until September 1959.[67]

Project development was essentially completed by November 1961 but low reliability dictated continued development effort. Nevertheless, its potential ready availability and relatively low cost stimulated a wide demand for its use. The demand continued despite a prolonged wait for adequate development to support a flight schedule. Finally, on 1 July 1960, the first Scout was successfully launched from Wallops Island. Launches thereafter were conducted, as facilities and mission made appropriate, from the Atlantic Missile Range and later from Point Arguello, looking out over the Pacific Missile Range. Thus was continued a series of test and experimental flights vitally significant for the nation's military and civilian agencies.[68]

Communications Satellites

The space division also undertook development of one of the most obvious and useful satellite applications--communications. Long before satellites freely roamed through outer space Rand Corporation suggested the possibility (February 1947) of a 24-hour synchronous orbit satellite. Several necessary developments and a decade later the Advanced Research Projects Agency, on 11 July 1958, directed the Air Research and Development Command to prepare an abbreviated development plan for a communications satellite.[69]

On 26 August 1958 the research command issued a development plan outlining a proposed system for satellite relay arrangement to be followed by actual demonstration of a 24-hour satellite communications system. The Air Force forwarded the development plan together with an outline of its communication needs to the Advanced Research Projects Agency. Before acting on the plan, the latter agency established an ad hoc committee of experts from the three services to advise on technical possibilities, military applications, and funding. The group recommended and the Advance Research Projects Agency adopted a dual plan which would result in an interim relay

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satellite by 1962. The communications payload would be developed by the Army Signal Corps and the booster and satellite vehicle by the Air Force. A joint development plan was to be prepared for issue in early December 1958.[70]

The program continued in the discussion-definition phase through early 1959. Divergent interests of the Army, Advanced Research Projects Agency, and the Air Force proved difficult to compromise. In any event, on 20 January 1959, the Department of Defense agency issued orders to the Air Research and Development Command and the Army which marked off their respective roles in developing the delayed repeater interim and the 24-hour equatorial satellite systems. Meanwhile, the Air Force continued its efforts to assure a project development that would meet its most urgent communications needs.[71]

On 22 May 1959 the Advanced Research Projects Agency directed important changes in project planning. The plan was divided into three parts: Steer was to be a Strategic Air Command polar satellite; Tackle would follow as an electronically advanced polar satellite; Decree would, hopefully, function as a 24-hour global satellite on an equatorial orbit 22,000 miles in space. The Army Signal Corps was to develop payloads and ground communications for Tackle and Decree; Wright Air Development Center was to take care of aircraft equipment for all three projects and Steer payload, and overall technical direction was to remain in the hands of the Advanced Research Projects Agency.

A private contractor was to be selected to take care of system engineering.[72]

For all practical purposes the Ballistic Missile Division managed the Air Force portion of the project. On 9 June 1959, Space Technology Laboratories was approved as the systems engineering contractor. Subsequently the Missile and Space Vehicle Division of General Electric Company was selected to work on the polar satellite system and Bendix Aviation Corporation to develop the specialized communications equipment the program would require.[73]

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Difficulties continued through the fall of 1959 and into early 1960. Finally, on 29 February 1960, the Advanced Research Projects Agency issued an order which in effect cancelled the three-pronged program. Substituted was project Advent, a single 24-hour microwave communications satellite. The management structure for the new program was not basically altered. Although launches of polar orbiting satellites were contemplated in the revised program, frequent changes had virtually eliminated the Air Force's much sought polar communications system. On 15 September 1960, the defense department transferred the administrative and technical responsibility for the Advent project to the Army. [74]

No improvement resulted. Technical changes, mounting costs, and monumental managerial difficulties eventually caused cancellation of the controversial program on 26 May 1962. Abetting this decision was an action by Defense Secretary McNamara three days earlier. The Department of the Air Force was to be responsible for development, production and launch of all space devices necessary for the establishment and progressive improvement of defense communication satellite systems. The Air Force was to carry out this assignment under the integrating direction of the Defense Communications Agency. [75]

The Space Systems Division moved rapidly to meet the complex demands of its new assignment. On 11 June 1962, a systems management office, called the Deputy for Space Communications System, was established to direct the program. Aerospace Corporation set up a similar organization to handle systems engineering and technical direction of the program. Rapid, effective progress was essential to meet the first launchings scheduled in the first half of 1964 and to attain an operational capability by early 1965. [76]

Nuclear Effects Detection

Among the more esoteric space applications undertaken by the division was the project designated "Vela Hotel." Its lines of descent originated in the July 1958 Geneva negotiations on discontinuing nuclear testing. The American diplomatic position supported establishment of a control commission to supervise an international agreement to discontinue nuclear testing.

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Such a commission would have to be armed with radiation detection systems to enforce the ban. Curiously, there was an absence of reliable data which would define detection techniques either underground or in the upper atmosphere.

Here and there committees of the nation's leading scientist were asked to wrestle with the problem. The Presidential special assistant for science and technology, Dr. J. R. Killian, Jr., conferred with Deputy Secretary of Defense D. A. Quarles and Chairman John McCone of the Atomic Energy Commission. They agreed the Department of Defense should undertake a research and development program directed toward detection of nuclear explosion--radiation effects. At the same time the Atomic Energy Commission and the National Aeronautics and Space Administration were to undertake certain phases of the research effort. The entire program was called Project Vela. The high altitude phase of the program became, for reasons not too apparent, Vela Hotel. [77]

On 2 September 1959, the Advanced Research Projects Agency became manager of the Vela Project. About two weeks later the agency asked the Air Force research command to undertake a contractual study of the technical and operational factors involved in detection and location of high altitude nuclear expolsions of one kiloton or larger in space. While this study was continuing, the missile division, on 6 October 1959, issued an abbreviated development plan covering the Vela Project. [78]

Straws in the wind indicated a long program. Although initial study results and preliminary Department of Defense technical information was passed to the United States delegation at Geneva as early as October 1959, a Vela coordinating group expressed the opinion it might take three or four years to determine the exact operation and limitations of a detection system. In any event, the first task was to move ahead with a satellite-borne detection system. The Advanced Research and Projects Agency assigned the job of producing a satellite and integrating the payload to the Air Force Ballistic Missile Division. Rather than authorizing an immediate start on system development, however, the Advanced Research Projects Agency during the first week of 1960 urged six more months of study of a satellite high altitude

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detection system. Booster stages might be Thor, Atlas, Agena B or Able. An idea then current was that it might become a multi-nation program. At the same time the division was to devise a concept for a unilateral American based satellite system. [79]

Although Vela was an Advanced Research Projects Agency program, a multi-agency working group managed certain phases of the project. During January 1961 a joint planning team of representatives from the Atomic Energy Commission and National Aeronautics and Space Administration, chaired by a representative from the Air Research and Development Command, prepared a new Vela Hotel development plan. Similarly, a joint group was selected, organized in the same fashion, to supervise technical aspects of the program. The latter group gave its attention to "low orbit" phase of Vela Hotel by arranging for piggyback instrumentation flights aboard Discoverer satellites. However, by mid-1961, information was received from the Panofsky Panel of the President's Science Advisory Committee that Vela Hotel must include two high altitude (50,000 miles) Atlas-Agena satellites. The development plan was appropriately revised to meet the additional requirements. [80]

The first Vela Hotel piggyback launching took place on 30 August 1961, aboard Discoverer 29. The first orbiting instruments included X-ray detectors and a spectrometer which recorded the energies and intensities of electrons in space. Other launches of a similar nature occurred on 17 September, 5 November, and 12 December 1961. By June 1962 plans for high altitude orbital penetrations were well underway and modification of Pad 13 for Vela Hotel launchings at the Atlantic Missile Range was in progress. [81]

Space Biomedicine

Besides the varied space penetration and satellite programs to which the division was heavily committed, it carried on, for a time, active basic research in the crucial development area of space life support systems. In the early stages of the post-Sputnik 117L program, the Advanced Research Projects Agency had directed that five Thor boosted flights be used for

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biomedical experiments. About two weeks later the Air Force Ballistic Missile Division authorized Lockheed to develop through a subcontractor, a recoverable capsule to accommodate a biomedical package. On 6 May 1958, Lockheed contracted with General Electric Company for development of a life support system and a recoverable capsule. [82]

The first Mark I biomedical capsule was successfully orbited on 3 June 1959. Although there were no live specimens aboard, the capsule was electronically rigged to report through telemetry successful operation of the life support system. A second capsule was launched on 25 June 1959 with four mice aboard. Although the capsule was not recovered, 600 seconds of telemetry reported the justifiably worried animals in good condition. From October through December 1960, the experimental basis of the program was significantly widened by participation of the School of Aviation Medicine, Air Force Special Weapons Center, and the Geophysics Research Directorate in including biomedical packages aboard Discoverer, Atlas E, and re-entry vehicle test flights. In some cases capsules containing live mice and biological tissue were safely recovered. [83]

From this modest beginning the program acquired, on 9 November 1960, a capsule which would support a six pound primate for as long as 27 hours in orbit. This was a significant acquisition and, although it was not put to immediate flight use, was valuable in conducting ground simulated orbital missions. It was 10 November 1961 before a luckless and very small monkey (half pound) was launched aboard an Atlas E flight over the Atlantic Missile Range. The missile was destroyed about 30 seconds after launch. Again on 19 December 1961 another monkey, equally fated, was selected for a ride aboard an Atlas E test missile. A highly personal record of the flight was obtained by a means of a one channel transmitter surgically implanted in the monkey's body. He sent back good telemetry signals, but neither capsule nor monkey was recovered. [84]

During the course of these experiments the division forwarded to Air Force headquarters, as appropriate, proposals for long range bioastronautics research and development programs. Following the submission of one such plan on 16 May 1961, the division was advised to integrate its bioastronautics

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planning effort with the National Aeronautics and Space Administration, which was most immediately concerned with space life support systems. By mid-1962, allocation of funds to more demanding objectives resulted in virtual cessation, at least for the time, of the space division's bioastronautics research effort. [85]

Man-In-Space

On 28 February 1958, one of the first acts of the newly organized Advanced Research and Projects Agency was to assign the Air Force the task of conducting manned space flights. By mid-March the Air Research and Development Command had completed an abbreviated plan outlining in broad terms program orientation and objectives. At the same time the ballistic missile division was going ahead with preparation of a detailed development plan for placing a man in space and returning him safely. [86]

On 25 April the division brought forward a plan--the first of seven such plans prepared during 1958--which by its name, "Man-In-Space-Soonest," revealed the emphasis and purpose of the program. The Air Force document called for a series of non-manned data-gathering exploratory orbital flights to determine the extent of the hazards and adjustments man would experience in the harsh space environment. If program development started promptly, by October 1960 a man could be blasted into a 150 mile orbit and in due course be safely returned to earth. It was estimated the program would cost approximately $398 million. It was anticipated too that this would be but a step in the development of a complete space military system which would include lunar reconnaissance, a moon landing and a safe return to earth. [87]

The division, shortly after submission of the development plan, was instructed by command headquarters to limit development to a manned orbital flight capability. A rapidly revised division plan, released on 2 May, envisioned a phased development of a manned orbital capability by using a Thor booster with an Agena or Vanguard second stage. System reliability and life support would be sufficiently advanced to project a man into space

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on the tenth flight. Immediately following the release of this plan the division was again instructed to revise the plan to include use of Atlas boosters and Agena second stages. Several more changes were introduced into program planning in subsequent months, changes that were reflected in a lengthening list of revised development plans. [88]

It was during this period that space programs and objectives became a matter of national policy debate. On 29 July 1958, the National Aeronautics and Space Administration was established with authority to plan, direct and conduct aeronautical and space activity. It shortly became apparent that any manned military space program would have to receive the approval of the civilian agency. On 14 August an agreement between the two organizations was devised which sanctioned continued Air Force development of a manned space system but at a reduced level of effort which, in effect, removed "soonest" from the program. [89]

This agreement was quickly overtaken by Presidential action which directed the transfer of the military manned space system program and $30 million of fiscal year 1959 funds from the Department of Defense to the National Aeronautics and Space Administration. Although the ballistic missile division published the eighth and final "Man-In-Space-Development Plan" on 11 September 1958, the direction of events was counter to any immediate development of a manned military space system. [90]

Nuclear Auxiliary Power

The essentiallity of a nuclear auxiliary power source was recognized simultaneously with the birth of the 117L system. Initial studies began as early as 1952, and in 1955 and 1956 the Atomic Energy Commission launched a program to develop such a power system. In mid-1957 the Air Force Ballistic Missile Division and the Atomic Energy Commission set up a joint committee to insure compatibility of the power unit with 117L satellite vehicles. The first subsystem for nuclear auxiliary power (inevitably abbreviated SNAP) proposed a radioisotope unit promising a 250 watt output for 230 days and a reactor unit producing a 3 kilowatt output for one year. [91]

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The Atomic Energy Commission encountered some inhibiting problems and technological changes which slowed development. Nevertheless, by the end of March 1960, Air Force headquarters had authorized the Air Research and Development Command to prepare a development plan for ground and flight testing of the nuclear power unit. On 27 May the Air Force Ballistic Missile Division submitted a plan for a "SNAP" test program embracing four Atlas-Agena B launches over the Atlantic Missile Range. Generally five to seven months apart, launches which would seek to orbit nuclear power units were scheduled to be completed by January 1964. The plan was well received at Air Force headquarters and the Department of Defense, obtaining full approval on 27 December 1960. Adequate funding seemed assured. [92]

By April 1961, however, several changes had been introduced in the program. The test site was changed from the Atlantic to the Pacific Missile Range and nuclear power units of more advanced designs--and higher cost--were scheduled for the first orbital tests. Despite these changes the ballistic and space division issued a letter contract to Lockheed covering adaptation of Agena test vehicles to the nuclear power system. Curiously in view of the long range planning such a program entailed, there apparently were some last minute diplomatic qualms at the prospect of orbiting radiation devices. [93]

On 24 January 1962 the Air Force Systems Command, Space Systems Division and the Atomic Energy Commission approved a charter for a "Snapshot" working group. The group also included representatives of Lockheed and Atomics International, contractors for the Air Force and the Atomic Energy Commission. Arrangements called for the Air Force to furnish flight vehicles, launch services and payloads with the commission providing completed flight-ready nuclear power units. Their development, although somewhat delayed, was among the most promising technical advances in satellite systems so far achieved in space research. The first unit (SNAP 10A), producing 500 continuous watts of power for one year, was scheduled for a September 1963 initial launch as the first in a total of four. [94]

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Ballistic Missile Defense

In September 1945, the Air Force outlined military characteristics of a weapon capable of detecting and destroying ballistic missiles at altitudes to 500,000 feet. Two contracts to study the problem, called Project Thumper and Project Wizard, were issued in 1946. Nothing much came of these except a final gloomy conclusion in 1952, when the last study was completed, that a defense against the intercontinental ballistic missile appeared to be impossible. By 1955, unwilling to concede complete defeat, the Air Force had decided to conduct new anti-missile studies. Review of study reports in May 1956 and again in 1957 resulted in the conclusion that a defense system would be premature but that study of the problem should continue. [95]

But by now there was an added complication. Since 1955 the Army had been developing its ground-to-air Nike-Zeus defense system to intercept intercontinental ballistic missile warheads in their terminal dive. In January 1958, the Secretary of Defense, to avoid duplication of systems, issued a compromise directive which limited the Air Force to development of passive defense (radar early warning nets) and studies, and the Army to sole pursuit of its Nike-Zeus development work. Then the Advanced Research Projects Agency, newly established in February 1958, was assigned the task of devising an active anti-missile system other than Nike-Zeus. To perform this task, the agency created the Defender Program, which enlisted the aid of the Air Force in investigating all aspects of the problem. The Ballistic Missile Division and its successor, the Space Systems Division, undertook intensive study of what became known as the Space Counter Weapons Program. [96]

In general, the anti-missile systems as proposed by Air Force studies (roughly classified under Project Bambi--ballistic missile boost intercept) envisioned satellites equipped to detect the launch of enemy missiles and capable of taking counter action by releasing interceptors to disable the missiles during the early phase of their flight. Variations were proposed by a Ramo-Wooldridge study which offered a random barrage system (RBS) and a Convair study which proposed a space patrol area defense system

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(SPAD). These studies were thoroughly reviewed (1960 and 1961) by the Scientific Advisory Board and other qualified groups within the Air Force and Department of Defense. Opinions and recommendations varied from critical disapproval to enthusiastic endorsement. [97]

Studies, primarily conducted by Hughes, Convair, and Space Technology Laboratories, were continued into 1962. The Department of Defense and the Air Force had reached the point of hard realistic thinking about the problem. By mid-1962 the Space Systems Division and Aerospace Corporation concluded that no system or concept so far proposed ". . . showed enough promise to warrant further development." There was one note of optimism, "That some of the technologies associated with previously identified problems inherent in a mid-course intercept system should be re-investigated." [98]

Lunar Projects

One of the more interesting research efforts stimulated by response to Sputnik began with the 4 April 1958 issuance of Air Research and Development Command System Requirement (Study) No. 183, Lunar Observatory. The purpose of the study was to ". . . determine an economical, sound and logical approach for establishing a manned intelligence observatory on the moon." The missile division, charged with conducting the study, assigned the investigation to Boeing, North American Aviation, and United Aircraft Corporation. Other corporations, with highly capable study staffs, participated in the research at their own expense. Among these were Douglas Aircraft, Minneapolis-Honeywell Regulator Company, and Republic Aviation Corporation. [99]

On 29 August 1958 this particular interest was furthered by issuance of System Requirement 192, entitled "Strategic Lunar System." The purpose of this study was to ". . . explore the possible advantage of a lunar weapon system and determine the operational problems and effort that would be required to develop and support such a system." Again, the Air Force paid

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for this search for ideas by Aerojet-General, Douglas Aircraft, and North American Aviation. At the same time Bell Aircraft Corporation, Northrop Corporation and the Martin Company participated without cost to the Air Force. [100]

During April 1960 evaluations of the lunar studies resulted in preparation of a "Military Lunar Base Program," a two volume summary of the studies already performed leading to a defined logical approach to establishing a manned base on the moon. It would be a gigantic project but within reach of Air Force development and technical resources. Financial resources were another matter. The plan, if undertaken on the scale proposed, would result in an operational lunar base by June 1969. [101]

Yet another study was undertaken to complete the cycle of lunar investigations. On 29 August 1960 the research command issued System Requirement-17532, titled "Permanent Satellite Base and Logistics Study." The study concentrated on the problems of lunar transport vehicles, supporting a lunar base, and the design of the base itself. The division issued cost contracts to General Electric, North American, and the Martin Company. Chance Vought, General Dynamics Astronautics, and Douglas Aircraft volunteered to participate in the program without pay. [102]

The program was revised in May 1961 to the stature of an Air Force recommended national space goal. It was the view of the Air Force that the lunex program offered the most complete plan for a lunar expedition from which the nation could derive lasting and repeatable benefits. The plan acquired supporters, but not so the proposal for Air Force management. On 25 May 1961 the President called for a NASA-managed moon expedition as a national objective. Within a few months the civilian space agency was embarked on preparations for the vast decade long assignment. The Air Force, aware that it was, for the time being at least, out of the moon race, turned over to the National Aeronautics and Space Administration the studies and plans on which the original proposal had been based. [103]

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Support of Space Operations

Apart from the space programs in which the Space Systems Division and its predecessors played leading or strong supporting roles, the division furnished the space vehicle and launch service and frequently managed, as well, all or certain portions of the programs conducted by agencies other than the Air Force. The first of these, the Able program, was inaugurated in April 1958, and then, in a rather curious transformation, particular flights for specialized missions were conducted under the Able designation by both the Advanced Research Projects Agency and the National Aeronautics and Space Administration. The latter organization sponsored a series of Able launches which included the first effort of the United States to extend its reach to outer space. It was an effort often marked by failure or inadequate equipment, but despite difficulties many flights were distinguished by sound scientific achievement. The Able series, continued through 1959 and 1960, included five successful launches and two which performed extraordinarily well. Of the latter, on 7 August 1959 a Thor Able-3 (also called Explorer VI or Paddlewheel Satellite) boosted an instrument payload into an extreme elliptical orbit (apogee of 22,926 nautical miles and perigee of 136 nautical miles) and obtained evidence, among other phenomena, of the existence of a large ring of electrical current circulating about the earth. [104]

Another widely heralded space venture, a National Aeronautics and Space Administration project in which the ballistic division played a prominent role (launch vehicle and services, technical management, integration of various systems) reached culmination on 11 March 1960. A basic Air Force-developed three-stage Thor-Able-4 vehicle (Pioneer V) boosted a satellite into a giant elliptical solar orbit spanning millions of miles (perihelion of 65 million nautical miles and aphelion of 80 million nautical miles). To add to its laurels the satellite transmitted the first radiation and magnetic field measurements beyond 500,000 miles and demonstrated a communications system capable of spanning interplanetary distances. The last satellite transmission, received on 26 June 1960, originated from what would be normally considered an incredible distance of 22.5 million miles.

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If scientific "firsts" were meaningful, then Pioneer V gained the most distinguished accolade of exceeding all previous achievements in space research including command control, range, scientific measurements and power of the payload transmitter. [105]

Encouraged by the success of Pioneer V, the National Aeronautics and Space Administration acted to undertake (more accurately pay the Air Force to undertake) additional space exploration projects. In February 1960, the division was asked to plan and prepare for the launch of two Atlas-Able three-stage vehicles to place satellites into lunar orbits. These were rather elaborate efforts involving detailed planning of ground requirements, payload design, Atlas booster modification and other elements to be completed prior to the September and November 1960 launches. [106]

Neither attempt to reach the moon environment was successful. The two launches, on 25 September 1960, and 15 December 1960, were marred by equipment failure. [107]

The National Aeronautics and Space Administration also asked the Air Force to supply the launch vehicle and take care of generally complex engineering essential to the launch and operation of the Tiros program. The division directed assembly of a three-stage Thor-Able-Star vehicle which was launched from the Atlantic Missile Range on 1 April 1960. It carried a payload of more than passing interest, two television cameras designed to observe, record and transmit weather data on command. Although minor malfunctions occurred in payload operation, the first Tiros satellite returned high quality pictures of the earth's surface and its cloud coverage until it ceased operation on 29 June 1960. During the 90 days of its functional life Tiros I transmitted an incredible 22,952 pictures of the earth's cloud cover observed during 1,302 orbits around the earth. [108]

Among the varied National Aeronautics and Space Administration projects aided by the division the most important in human terms was Project Mercury--understandable in view of its objective of placing a manned satellite in orbit and effecting a controlled re-entry and successful satellite recovery. The role of the ballistic division was to furnish 14 Atlas boosters

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and direct their modification to particularly assure pilot safety. This required development of a highly sensitive system which would swing into action instantly upon the slightest hint of a malfunction. The "Abort Sense and Implementation System" was first successfully flight tested on an Atlas missile launched on 26 May 1960. Thereafter the Mercury man-in-space program was primarily a National Aeronautics and Space Administration effort, but one to which the Air Force and space division made highly significant contributions. [109]

The Advanced Research Projects Agency, following its organization in early 1958, assigned a series of projects to the space division. Among these, distinct from military space programs, was the Transit satellite project which became a part of the division's mission on 4 September 1958. [110]

The purpose of the Transit project was to develop a new navigational system of utmost precision--and one particularly valuable to Polaris type submarines. Priority of Navy interest was recognized by transfer of management responsibility for Transit to the Navy on 9 May 1960. The Air Force exercised by now its well learned role as vehicle developer--Thor-Able and Thor-Able-Star were selected--and provider of launch service and system integration functions to meet the experimental goals of the program. [111]

The first Transit launch from the Atlantic Missile Range on 17 September 1959 failed to achieve orbit. The second, on 13 April 1960, was very successful. Of seven launches--the last on 15 November 1961--only two failed completely and one was a partial success. The Transit program, in addition to other returns, demonstrated its versatility in furnishing radio "fixes" which permitted, for instance, a ship at sea to determine its location with pin point accuracy--an absolute essential for Polaris firing submarines. [112]

On 24 January 1962 the space division furnished its by now usual services to launch a Thor-Able-Star on a project called Composite I which was in the same lineal succession as the Transit program. The launch was, in fact, a highly experimental and scientifically sophisticated effort to orbit

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multiple satellites to collect solar radiation data. Although orbiting multiple satellite vehicles by one launch had been successfully accomplished in the Transit series, this time the attempt failed. The satellites failed to go into orbit. 113

On 10 May 1962 the first of the Anna series of satellites was launched. Like Composite I, Anna was in the same hereditary line as Transit and under over-all management of the Navy. Its purpose was to furnish useful geodesy data to the three military services and the National Aeronautics and Space Administration. The space division again performed its usual functions but in this instance had a proprietary interest in payload performance. Each service was responsible for tracking its own equipment. The Air Force furnished a flashing light system, the Navy a Transit doppler system, and the Army a transponder for radio ranging data. Regrettably, a malfunction in the usually reliable Thor booster resulted in a disappointing failure. Anna 1B, with similar objectives, was launched in the fall of 1962. This time the launch and orbital performance were characterized as outstandingly successful. 114

Another Advanced Research and Projects Agency program was assigned to the Air Force ballistics division on 1 July 1959. The division was asked to launch a Courier 1A Thor-Ablestar vehicle carrying an Army-developed relay communications satellite payload. The vehicle was launched on 18 August 1960 but an unfortunate booster malfunction resulted in failure of the flight. Courier 1B, launched on 4 October 1960, entered the correct orbit and as it circled the earth it obediently relayed voice and teletype communications on command. 115

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DEVELOPMENT PROGRAMS*

Atlas ICBM	May 1954
Titan ICBM	May 1955
Thor IRBM	Nov 1955
Initial Operational Capability	Nov 1955
Weapon System 117L	Feb 1956
Solid Propellant IRBM	Apr 1957
Weapon System 224A, Early Warning System	Nov 1957
Atlas Acceleration	Dec 1957
Initial Operational Capability Transferred to SAC	Jan 1958
Weapon System 117L, Acceleration	Jan 1958
Weapon System 224A, Transferred to AMC	Feb 1958
Solid Propellant ICBM, Minuteman	Feb 1958
Able-O (Re-entry Test)	Apr 1958
Acceleration of Installation and Checkout, ICBM	May 1959
Lunar Probes (Able-1)	Mar 1958
Bioastronautics-Capsule Development	May 1958
Project Score	Jul 1958
Venus Probes	Sep 1958
Samos Project	Sep 1958
Able-3 and Able-4 Space Projects	Nov 1958
Midas Satellite System	Nov 1958
Communications Satellite System	Nov 1958
Project Mercury	Nov 1958
Discoverer Program	Nov 1958
Able-2 (Re-entry Test)	Jan 1959

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Development Programs (Cont)

Project 609A, Blue Scout Test Vehicle	Feb 1959
Hustler Rocket Engine Development	Apr 1959
Courier Satellite Project	Apr 1959
Tiros Satellite Project	Apr 1959
Able-Star Upper Stage Development Project	Apr 1959
Transit Satellite Project	Apr 1959
Advent Program (Communication Satellites)	May 1959
Delta Project Development	Jun 1959
Vega Project Development	Jun 1959
Agena Satellite Development	Dec 1959
Fifty Research Projects Transferred from ARDC	Jan 1960
Bambi	Jan 1960
Dyna Soar Program	May 1960
Satellite Inspection System	Oct 1960
Anna (Satellite Program)	Apr 1961
Vela Hotel (Satellite Program)	Jun 1961
Bioastronautics Orbital Space Program	Jun 1961
Cue Ball (Satellite Program)	Nov 1961
Project Fish Bowl (High Altitude Nuclear Tests)	Dec 1961
Military Orbital Development System	Jun 1962

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FUNDS ALLOCATED TO AIR FORCE SPACE PROGRAMS*

Total Funds - By The Year
(In Millions)

1958	1959	1960	[redacted]
10.114	226.515	236.036	[redacted]

Funding by Programs -- Division Administered Funds

	Authorized FY 1961 And Prior Years	FY 1962
Blue Scout	14.339	.963
Aerospace Corporation	26.100	30.200
Snapshot	.750	10.000
Satellite Inspector	8.230	26.800
Atlas Boosters		4.000
[redacted]		
Midas	184.033	163.800
Big Solids--Titan III Booster		15.000
Agena D		21.600
Transit	2.205	4.700
Advent	25.000	5.493
Vela Hotel	3.640	9.095
Bambi	7.242	3.881
Large Solid Propellant Booster		17.150
Mercury	44.754	12.800
Thor Boosters	2.954	11.120

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CHAPTER 3

ORGANIZATION TO MEET THE TASK

One of the first tasks confronting General Schriever on his arrival in Los Angeles was to create an efficient responsive management organization. The quality of the managerial and administrative talents possessed by the top level members of the new organization was one determinant, but equally important was the organizational framework within which management would be conducted. The original management structure embodied a concept under which all non-technical and supporting functions were grouped under a deputy commander for resources. All technical elements and functions were assigned to a deputy commander for technical operations. Effectively manned, such an organization would relieve the commander of routine activities in supervising the resource functions and permit him to concentrate on the vital mission and technical functions of his command. 1

Western Development Division, new and temporarily small, was in practice tailored to the simplest possible organizational structure. Under the commander were a deputy commander for technical operations and a deputy commander for program management. * In July 1955, the division adjusted to increases in manpower and mission by establishing deputy commanders for plans (operational planning was an important part of the division's mission), and support operations. This scheme of organization remained in effect with only minor adjustments and increases in the commander's staff until April 1956, when Schriever added a director of installations on the same staff level as the deputy commanders. 2

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* In May 1955 Colonel Charles H. Terhune, Jr., was in charge of technical operations and Colonel William A. Sheppard was in charge of program management.

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In the spring of 1957 the director of installations became the assistant to the commander for installations, functioning in direct staff support. At the same time under the commander and staff elements on the organizational chart appeared deputy commanders responsible for resources (internal support and housekeeping), plans and operations, and weapon systems (formerly technical operations).* It may be recalled, in connection with these changes, that the division was then deeply engaged in the most crucial phase of three ballistic missile developments, was planning toward operational deployment of the weapons, and was starting initial development of its first space program, weapon system 117L.[3]

On 1 June 1957 the division was more aptly renamed the Air Force Ballistic Missile Division without effecting any significant or immediate change in its organization. Through 1957 the division continued to increase in size--though at a much slower rate than in 1956--as early hardware production and giant static and flight test programs sprang into being.**[4]

Despite this rapid expansion of manpower, the existing organizational structure proved reasonably effective. Indeed, the division organization possibly would not have been changed at all in 1957-1958 had it not been for the impact of Soviet space accomplishments during the last months of 1957. But among the first concrete Air Force responses to heightened interest in space and missile programs was withdrawal from the ballistic missile development division of its initial operational capability assignment (missiles). By order

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* These were Colonel J. B. Hudson, Resources; Colonel W. Large, Plans and Operations; and Colonel C. H. Terhune, Weapon Systems.

** From a total of 58 military and civilian employees on 1 January 1955, totals increased to 177 by January 1956, 502 by January 1957 and 601 by January 1958. In addition, occupying the same or adjacent offices and buildings, by 1 January 1958 the Ballistic Missile Center (AMC) and the Strategic Air Command Office brought the total number of Air Force people employed in the complex to 919. Also, by 1 January 1958, Space Technology Laboratories, furnishing materiel support to the division as well as technical and engineering services, had increased to 1,976 personnel. As the programs continued manpower figures continued to mount.

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of General T. D. White, Air Force Chief of Staff, the Strategic Air Command on 1 January 1958 assummed all responsibility for ballistic missile operations. This caused a considerable reshuffling of command areas and the transfer, in total, of a deputy commander element--in this case plans and operations--to the Strategic Air Command. The division promptly moved to concentrate its resources on major missile and space developments.[5]

Other changes made by early 1958 were notable in one important respect. Although the deputy-commander organization was continued, the deputy commander for weapon systems reverted to his early title of deputy commander for technical operations and became responsible for two basic and highly important mission elements: development of ballistic missiles (through an assistant deputy commander for weapon systems) and development of space projects and programs (through an assistant deputy commander for space systems). One element was responsible for development of Atlas, Titan, Thor, and Minuteman. The other element contained not only a directorate for managing the WS 117L military space system program but several subordinate "divisions" responsible for other space systems and for technical direction of re-entry vehicles, propulsion, and guidance and control developments.*[6]

This organizational framework, although retaining enough "stretch" to remain responsive to moderate growth or shift of mission responsibilities, was subjected to heavy stress by the unprecedented number of assignments that now seemed to inundate the division. In addition to problems arising from the 1958 acceleration of existing missile and space development programs, the division had to deal with an installation and checkout task (readying a missile system for actual operation) of increasing complexity and, as well, new high priority programs.

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* The list of division key personnel now included in addition to the commander, Major General B. A. Schriever; Vice Commander, Brigadier General O. J. Ritland; Colonel J. L. Hamilton, Executive Officer; Deputy Commanders Colonel C. H. Terhune, Technical Operations: Colonel W. E. Leonhard, Installations; and Colonel J. B. Hudson, Resources.

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The division's immediate response was to assign new responsibilities to its existing development elements and establish field offices to direct installation and checkout activity at each missile base. In the space area, the growing number of projects and the continuous amplification of space research objectives required the division to assume the job of launching and operating satellite space systems.

Furtherance of the latter goal was aided by availability of launch stands at Cape Canaveral and Vandenberg Air Force Base adaptable to satellite operations. The Air Force took over and appropriately modified launch facilities at these locations and began the construction of two more Atlas booster launch stands at Point Arguello, adjacent to Vandenberg Air Force Base. This location was made to order for boosting satellites into polar orbits. Finally, satellite operations required an extensive, world-wide ground tracking and communications network. Hence, during the first half of 1958, the

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At that point, Air Force headquarters assigned to the division complete responsibility for the early developmental phase of the Discoverer program. This assignment brought a requirement for more tracking stations, which were ultimately located on Kaena Point (Oahu), Hawaii; Vandenberg Air Force Base; and on Annette Island, Alaska. Such stations were erected to control orbiting polar satellites and to convey satellite control information to the data reduction center planned at Palo Alto, California (home of Lockheed Missile Systems Division, prime contractor to the Discoverer Program). There the division established, in the fall of 1958, a field office to direct the full range of growing space activity focusing in this area.[8]

Plans to acquire an operational space force moved ahead rapidly. To satisfy requirements for the recovery of Discoverer capsules from orbit, the division organized a squadron equipped with C-119 aircraft and shipped it to Hawaii where in July 1958 it was officially designated as the 6593rd Test Squadron (Special), with station at Hickam Air Force Base. The aircraft were equipped with appropriate guidance - tracking instrumentation and a

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drag-line arrangement designed for mid-air retrieval of parachuting data capsules ejected from orbiting Discoverer satellites. In case air snatch failed, a sea force would attempt recovery.[9]

Effective 6 April 1959, the division established a headquarters for the 6594th Test Wing at Palo Alto and made the wing responsible for the direction and maintenance of subordinate units at Edwards Air Force Base, and Chiniak and Annette Island, Alaska.[10] The wing organization gradually absorbed the work of the Palo Alto division field office, which was discontinued on 1 June 1959. Simultaneously, the Hawaiian air recovery squadron and the Hawaiian field office, heretofore assigned to the division's Weapon System 117L Directorate, were placed under the operational control of 6594th Test Wing. It was felt at the time that these actions were temporary, pending final disposition of the division's Hawaiian organizations.[11]

An increasing number of subordinate units were added to the Palo Alto wing. On 1 June 1959, the 6594th Launch Squadron was organized at Vandenberg to conduct the launch of space vehicles from Vandenberg Air Force Base and Point Arguello. The latter area was assigned to Navy and Pacific Missile Range operations but containing Samos and Midas launch stands. On 1 July 1959, the 6596th Instrumentation Squadron was organized at the Vandenberg base and, on the same date, the 6594th Data Processing Squadron (redesignated the 4999th Squadron on 1 Oct 1959) was organized at Offutt Air Force Base, Nebraska.[12]

Other operational units were created to augment the operational capability of the wing. On 1 October 1959, the 6594th Instrumentation Squadron was organized at Grenier Field, Manchester Municipal Airport, Manchester, New Hampshire. And, one month later, the promised realignment of the Hawaiian satellite operational units occurred. On 1 November 1959 the 6594th Recovery Control Group, formerly the division's weapon system 117L field office, was organized and placed under the operating control of the 6594th wing at Palo Alto. The Recovery Control Group thus became the wing's Hawaiian management arm, directing the 6593rd Instrumentation Squadron, located at Wheeler Air Force Base, and the 6593rd Test Squadron (air recovery), at Hickam Air Force Base.[13]

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The 6594th wing was thus assigned the mission of manning, operating and supporting a launching squadron at Vandenberg, and tracking and data acquisition stations at Vandenberg, Annette Island, Kaena Point, [redacted] In addition the 6594th Recovery Control Group would, as a subordinate element of the wing, direct Hawaiian air recovery operations based at Hickam field. Thus by 1 January 1960, the Air Force Ballistic Missile Division possessed the basic organizational structure which, as it increased in experience and manpower, could assume full operational control of vital reconnaissance and communications satellite systems.[14]

While these events were taking place, the Air Force Ballistic Missile Division was actively pursuing its mission commitments in other areas. The most demanding proved to be design, development, installation and final checkout of elaborate ground equipment which operational missile systems required. The division's first major confrontation with the complex installation and checkout task occurred in England in the late fall of 1957, occasioned by the accelerated pace of Thor intermediate range ballistic missile deployment. Atlas bases in the United States proper reached a comparable activity level in 1958. The division found it necessary to expand vastly its administrative apparatus to direct overseas and stateside contractual activity. To keep abreast of these rapid developments, the division created field offices at each missile base to direct technical installation and final checkout of ground support equipment. Concurrently, development of ballistic missiles continued, the flight test program was accelerated, and an increasing number of space projects were assigned to Air Force management and operation.

Apart from these developments, other less dramatic but important headquarters organizational changes were taking place. On 1 August 1958 the 6592nd United States Air Force Dispensary was organized and located within the management complex area to furnish convenient medical and dental services to division military personnel. At about this time the 6592nd Support Squadron (Missile Technical), staffed with mathematical specialists, completed its training in computer-missile targeting applications at division headquarters. On 15 August 1958 it was transferred to Offutt Air Force Base, Nebraska, to practice its obscure arts for the Strategic Air Command.[15]

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As 1958 advanced, division organization was subjected to inevitably greater stress in the face of augmented programs and rapidly increasing manpower. The major growth areas were in such division elements as space systems (within the deputy commander technical operations organization), in the increasing number of field offices responsible to the division commander, and in Space Technology Laboratories' manpower--expanded to direct the division's technological tasks and operations.

General Schriever summarized the burgeoning problem: "Certainly our management problems have become more complex - not only because of new programs, but because of rapid growth." It was therefore considered expedient, during September 1958, to halt division manpower increases temporarily until a thorough review of organization and manpower use was completed. A committee under the chairmanship of Colonel J. W. O'Neill, Assistant Deputy Commander, Ballistic Missiles, conducted what proved to be an exhaustive investigation of division use of its manpower resources.* 16

In the meantime, during the final months of 1958, the division worked out the framework of a revised organization. Expansion in the number of military space programs brought command headquarters to favor enlargement of the division's deputy commander organizational structure. Thus on 12 September 1958, mission and support functions were assigned to four deputy commanders (instead of the former three), --one each for ballistic missiles, military space systems, installations, and resources. Probably most significant was elevation of the space program function to the deputy commander level. As heretofore in division organization, the deputy commander for resources directed

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* Committee study was directed to determine if the management structure of Space Technology Laboratories, Deputy Commander, Ballistic Missiles, and the contractor team permitted inefficient management practices and duplication of functions. Intensive study revealed that, in fact, no significant management defects or duplication of manpower functions existed. The committee did recommend, however, a modification and strengthening of the management tools for the control and monitoring of Space Technology Laboratories technical activities.

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essential and diverse support elements; i.e., dispensary, chaplain, administrative services, and so on. However, the original concept of diverting all indirect mission and support activities to the deputy commander for resources had been subjected to some erosion. A special staff and independent offices existed in the new organization to perform such functions as plans and policies, programming, judge advocate, and comptroller services. At the same time the increasing number of field offices and operating locations continued to report directly to the division commander. Although there were no further significant changes in division organization until November 1959, the problem of achieving the most efficient form of management structure continued under intensive study.* 17

One of the more important investigations concerned a proposal to adopt a chief of staff organization. This study, like the management study just completed, was assigned to a committee headed by Colonel J. W. O'Neill. On 15 April 1959 he reported to Brigadier General O. J. Ritland, division vice commander, that his committee recommended a modified chief of staff structure. There was no immediate response to the O'Neill recommendations, however, because of imminent command-wide changes which promised to affect the division's organization. 18

The 1959 Reorganization

Rapid exploitation of scientific and technological advances to create superior weapon systems had been for years one of the crucial problems of the command. This concern was, of course, not new. Since the beginning of the research and development command, high level and critically introspective analyses of the research-to-hardware development cycle had emphasized the urgency of compressing time and improving weapons quality. One of the most penetrating investigations was directed by General Thomas D. White, Air Force Chief of Staff, on 21 November 1957. The Scientific Advisory Board

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* Deputy commanders remained as they were in early 1958 but with the addition of Colonel R. D. Curtin, Deputy Commander, Military Space Systems.

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was requested to investigate the manner ". . . in which the Air Force conducted its program in research and development and to recommend methods by which the Air Force might improve its management of research and development."[19]

A committee of distinguished scientists and administrators was brought together under the chairmanship of Dr. H. Guyford Stever to make appropriate recommendations. In a report released 20 June 1958, the committee made far reaching proposals for the re-direction and reorganization of the Air Force research and development effort. Among the suggestions was a recommendation that,[20]

> The Air Research and Development Command should be reorganized along the distinct functional lines of the research and development program, i.e., research, technical development, weapon systems, and testing. There should be Deputy Commanders in Air Research and Development Command in charge of each of these areas, who, not only have responsibility for the program, but also are in charge of the Centers, laboratories, and other facilities which are directly engaged in their activity.

These and additional recommendations contained in the report were carefully reviewed and the impact of their adoption thoroughly studied. Lieutenant General S. E. Anderson, then chief of the research and development command, on 20 November 1958 formally created a "Working Group to Review Headquarters ARDC Organization." Its objectives were to seek a headquarters organization that would efficiently control the research and development program and clarify the lines of authority to the several centers. In an exercise in realism, the committee declared that the Stever objectives and those goals specified by other investigative groups could only be achieved by "radical and wholesale upheaval of the existing situation." As a more palatable substitute, the committee proposed consolidation of command functions into "four broad areas, aerodynamic systems, ballistic and military space systems, electronic support systems, and basic research." The group also suggested a deputy

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chief of staff structure with a considerably greater consolidation of of responsibility and authority under the four major field commanders.

Effectively on 25 April 1959, officially on 13 May, General Schriever was relieved of command of the ballistic missile division to assume direction of the Air Research and Development Command. At once the generally recognized need for a new approach to weapons development--which had been in the forefront of command thinking for some time--assumed a new command wide emphasis and specific direction.* Moreover, in addition to reorganization interest which gained new impetus when Schriever took over direction of the command, assiduous study and planning was under way at Air Force headquarters to search out new management concepts for application to weapon system programs.[22] **

On 15 May 1959 General Schriever--holding in abeyance the recommendations of the "Working Group to Review Headquarters ARDC Organization" submitted to General Anderson in February--appointed a "Task Force on ARDC Organization" (more popularly called the Maxwell Group for its chairman, Colonel J. C. Maxwell) to start an immediate review of the command's organization and mission and to recommend appropriate changes. The task force did an exhaustive analysis, concluding that ". . . lack of clear, vertical

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* The intense interest of the research command in improving the performance of its research and development mission was attested to by its nearly continuous investigation of management of the weapons acquisition process. For example, between 1951 and 1958 there were at least eight committees which studied and recommended changes in command procedures and organization. Of these perhaps the most prescient was a study entitled "Research and Development of Guided Missiles and Space Vehicles over the Time Period 1955-1957," dated November 1956. Better known as the Yates Report, it recommended organization of the command on the basis of systems management, a concept which was adopted some five years later.

** Hardly had Schriever taken over his new duties when he was appointed a member of a general officer study group charged with the development of a major analysis of Air Force weapons acquisition management and recommendations for its improvement.

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decision-making channels down to those portions of the command directly responsible for managing development efforts. . . " had substantially reduced the over-all effectiveness of the whole command and that there was ". . . uncoordinated variation in the assignment of priorities and allocations of resources at all levels." Finally, the group noted ". . . confusion arising out of a lack of clear definition of responsibility and authority for program direction at the operating level." 23

It was obvious that the impetus toward a system-oriented command structure was reinforced by the missile division's five year experience with the "concurrency" concept first enunciated by General Schriever. The success of the missiles division in shortening the development cycle, in bypassing "routine" channels, in . . . relying on a highly talented 'exclusive' group of scientists for direct support of systems management effort, and of concentrating previously separated 'command responsibilities' in a single agency with a unique access to decision points . . . " suggested elements of management and organization suitable for command wide application. 24

The task force committee completed its work in July 1959 and presented its recommendations to the command's Commander's Conference at Patrick Air Force Base on 1 September 1959. The proposals were somewhat modified at the conclusion of the conference to accommodate recommendations of the division and center commanders. Using the designations temporarily in vogue at the time, a plan of reorganization was finally developed for " . . . creation of the Western and Central Development Forces and Air Force Research Division." 25

Briefly, the plan proposed establishment of conventional, special and general staff structures at command headquarters. Management of the technical and operational programs was to be decentralized to four field commands. * Command reorganization, in addition to that effected within

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* Identified at the time as the Central Development Force at Wright Patterson Air Force Base; Western Development Force at Los Angeles; Eastern Development Force in the Boston, Massachusetts area; and Air Force Research Division in the Washington, D. C. area.

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command headquarters, was to begin with the Air Force Ballistic Missile Division. The four principal field elements were to be headed by Air Research and Development Command deputy commanders with ample planning, programming, budgeting and management authority to get their job done. This was to further insure that ". . . programming will reflect total impact of the system on the Air Force with the philosophy of concurrency." 26

It was generally conceded that the missiles division was already well aligned with the objectives envisioned for operating echelons of the command. Nevertheless, much remained. Major General O. J. Ritland, commander of the division since the departure of General Schriever, appointed a committee to iron out the details of a new organization. The committee began work in early September 1959 under the chairmanship of Colonel S. B. Hardwick, Jr.*

The committee worked through September and October to prepare, in close coordination with command headquarters reorganization group, an acceptable organization plan. In October it was decided to drop the "Force" designations in the proposed organization. For the time being the Air Force Ballistic Missile Division was to retain its name (briefly and unofficially it was called ". . . Missiles and Space Division"). The proposed Central Development Force was called Wright Air Development Division, and Eastern Development Force was called Command and Control Development Division. In any case, by 30 October 1959 the division had presented its organization plan at command headquarters, where certain relatively minor revisions

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* With the promotion of Major General Schriever to lieutenant general and command of the Air Research and Development Command on 13 May 1959, the division vice commander, Brigadier General O. J. Ritland, was elevated to command of the division and promotion to the rank of major general. Colonel C. H. Terhune, Deputy Commander, Ballistic Missiles, was assigned to the position of division vice commander, June 1959, and a month later was promoted to brigadier general. Colonel John W. O'Neill succeeded Terhune as Deputy Commander, Ballistic Missiles. Colonel S. B. Hardwick, recently assigned to the division as Assistant Deputy Commander, Resources, became a full Deputy Commander with the reassignment of his immediate superior, Colonel J. B. Hudson, to command headquarters.

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were suggested. By early November; varied organizational problems had been resolved and the objective of creating " . . . AFBMD as a model for carrying out General Schriever's objective of making ARDC a dynamic and effective systems oriented development agency for the Air Force," had been accomplished. The plan was forwarded to command headquarters on 9 November 1959 for Schriever's final approval. [27]

During the early days of November the division hastened to complete remaining actions essential to its re-creation as a new organizational entity. New manning documents were issued. Remaining realignment of subordinate division elements were completed. The result was an organization compatible with command headquarters, possessing a chief of staff, special staff and deputy commander structure. (Details of the new organization may be observed in the chart on the opposite page.)

On 13 November 1959, the first of the legal formalities of creating a new organization from the materials of the old were completed. The division was assigned to command headquarters and the "Detachment No. 2" concept was discontinued. Effective 16 November 1959, the 6592nd Support Group was organized as a division subordinate unit. The 6594th Test Wing was assigned to the division, and the 6592nd United States Air Force Dispensary was assigned to the 6592nd Support Group. Finally, on 16 November 1959, the division announced its own reorganization effective the same date. [28] *

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* The first General Order (No. 1, 16 November 1959) announced that Colonel W. R. Morton was assuming command of the 6592nd Support Group. The staff selected to aid Major General Osmond J. Ritland, Commander, and Brigadier General Charles H. Terhune, Jr., Vice Commander, included Colonel S. B. Hardwick, Jr., Chief of Staff; Colonel R. E. Soper, Executive Officer and director of the Policy Office; Colonel John W. O'Neill, Deputy Commander, Ballistic Missiles; Colonel Richard D. Curtin, Deputy Commander, Space Programs; and Colonel W. W. Leonhard, Deputy Commander, Facilities (formerly Installations). New deputy chiefs of staff and their subordinate echelons, elements created by the 16 November reorganization, included Colonel E. W. Phillips, Comptroller; Colonel N. M. Lulejian, Plans and Operations; Colonel D. W. Wickland, Intelligence; Colonel J. T. Johnson, Materiel; and Lieutenant Colonel R. Lemes, Personnel and Manpower.

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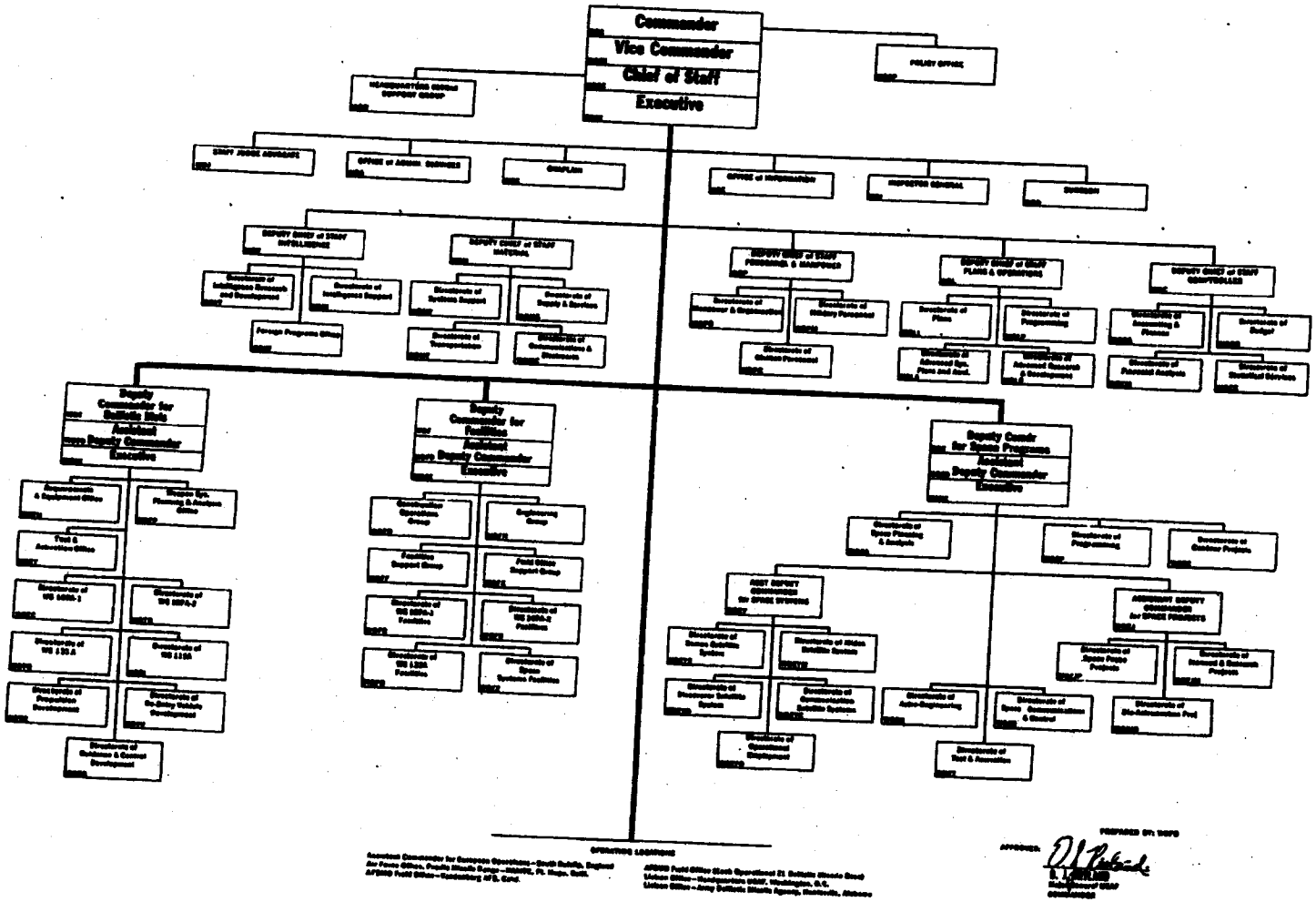
HEADQUARTERS AIR FORCE BALLISTIC MISSILE DIVISION ARDC



AFBMD Organization, November 1959

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While these organizational changes were going on, development effort both in the area of ballistic missiles and space projects continued to expand. By the fall of 1959, installation and checkout work at Atlas sites was well underway, the Titan flight test program was in full swing, and Minuteman hardware development was advancing rapidly. Space projects underway or planned included the Discoverer, Samos, and Midas series; Able program; military man in space; lunar probes; Project Score; Project Mercury; communication satellite system; Transit; Tiros; and the Explorer satellites. Missile flight tests and space launches kept the Atlantic and Pacific missile ranges at peak activity. This vast burgeoning development effort, satisfying as its many accomplishments were, nonetheless highlighted a somewhat complex and disturbing problem.

Division reorganization was nearly complete except for the Office of Assistant Commander for Missile Tests (located at Air Force Missile Test Center, Patrick Air Force Base, Florida). Here too, plans were underway to augment and improve operations. For some months the division had been viewing with increasing gravity the absence of an Air Force test and evaluation capability in both ballistic missile and space development areas. In early 1959 the division offered some organizational changes which, if adopted at Air Force Missile Test Center and other command test centers, would enable the Air Force to acquire this type of "blue suit" proficiency. After a review of the proposals by the command staff the division was directed to submit a detailed workable program. Thus on 21 October 1959 the division forwarded a "Detailed Test Plan" which, if carried out would " . . . represent a substantial step forward in investing the Air Force with a capability for testing and evaluating its own missile and space weapon systems."[29]

The plan proposed training and eventual transition to full competence of Air Force "blue suit" units at the Atlantic and Pacific Missile Ranges and Edwards rocket base. Additional momentum for adoption of the plan was furnished by a division follow on study which affirmed that the Air Force depended too much on contractor self appraisal. "The contractor evaluation of a weapon system should be completely objective and the development contractor should not be the sole evaluator of his product."[30]

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The division continued to urge positive action to get the program moving. At the same time, additional studies recommended selection of the Atlantic Missile Range for a good starting place. Here, in fact, early action in this regard had already been taken. The 6555th Guided Missile Group, established for the specific purpose of developing a military ballistic capability in launch operations, had for some time been working closely with the division office directing contractor-conducted missile flight tests. The close association of the two elements and the similarity of their missions led, when final action was decided upon, to a decision to merge the two activities. Thus on 21 December 1959, command headquarters acted to create an Air Force military test and evaluation capability by establishing the 6555th Test Wing (Development) at Air Force Missile Test Center, making it directly responsible to the division commander.[31] *

The division was fully aware that this was only the first of several actions which would be necessary if a genuine "blue suit" test and evaluation capability were to be created within the Air Force. Consequently, plans to advance this area of command interest continued to receive attention. On 19 April 1960, the director of operations at command headquarters set up a committee to establish plans and procedures for expanding this capability and a " . . . system of controls to insure fulfillment of this desired Air Force and ARDC goal." The committee acted favorably on division proposals to establish a second wing at Vandenberg Air Force Base and approved other recommendations which would begin remaining phases of the program.[32]

Space Comes of Age

Reorganization of the Air Force Ballistic Missile Division was now complete. For the most part, except for some shifting about of key personnel and some name changing, pre-November organizational structure was little altered. Not so, however, for the other newly created divisions within the

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* Colonel Henry H. Eichel, formerly Assistant Commander for Missile Tests, was reassigned as commander of the 6555th Test Wing.

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command. At these locations the reorganization created some significant organizational upheavals which, in their total effect, shifted the command from " . . . performance of a general function (research and development) to emphasis on a central focus: systems."[33]

But, in a sense, the successful creation of a systems-oriented command was the first stirring of change increasingly discernable throughout the Air Force. There remained unresolved issues which would not only alter the organization of the ballistic and space division but affect the roles and organization of those Air Force commands responsible for the entire weapons acquisition process.

The first of these movements began on the second day of January 1959, when General C. E. LeMay, Air Force Vice Chief of Staff, and his assistant, Major General Jacob E. Smart, asked the commanders of the materiel and development commands to name qualified senior officers to a special ad hoc group to draft the terms of reference for a projected study of Air Force weapon systems management. The group first met on 21 January 1959. During their one day meeting, the nominees produced a draft that, taking the whole Air Force for its province, directed formation of a study group to produce " . . . a well thought out management plan in which all the factors entering into the making of decisions at the various levels of the decision making process, were clearly identified and thoroughly understood."[34]

The group to undertake this major task was selected on 29 May 1959. It included among its members General Anderson, now chief of the materiel command and chairman of the group, General Schriever, now head of the research command, and selected members of the Air Staff.

The first accomplishment of the study group in early July 1959, was to name an 11 man working committee to investigate, study, and finally offer a weapons acquisition management plan for consideration by the principal body. The working committee--containing some of the best minds and specialized talent in the Air Force--organized itself into seven panels to explore special

areas of management.* It soon became apparent that the working committee was undertaking a no-holds-barred approach to the total weapons development-procurement management problem. The committee reported its preliminary judgments to the study group on 23-24 November 1959. The report was frankly critical of the dual command practice of weapon system management and strongly recommended weapon system planning be on a package basis. The working committee received approval of continuing its study along this line and during the next two months developed a "detailed and fully-articulated management system" the essence of which was that planning, programming, budgeting and funding for each program should be assembled into a complete package under a program director who would control all Air Force elements participating in the program. The program director, in turn, would be part of a single command which would have charge of the whole acquisition process.[35]

The somewhat revolutionary plan was presented to the study group on 11-12 February 1960. It was not yet the time for bold inovations, however. Neither, as matters turned out, was the design for reform allowed to gather dust in some obscure file. But for the moment it was the occasion for compromise. The principal committee endorsed a more conservative plan to improve the management process without reorganization or functional realignment of the two concerned commands. The role of the program director was strengthened, the package program concept was given wider application and, in general terms, the management techniques practiced at the Air Force ballistic missile development complex were endorsed for general use. This important although admittedly far from complete reorganization plan was formalized in the "375" series of regulations published by the Air Force in August 1960.[36]

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* For example, there was a ballistic and space systems panel which spent two months study and analysis of the "unconventional" management procedures practiced by the ballistics and space division. Interestingly, the panel offered some cogent comments about the Air Force space effort. In the view of the panel, the Air Force space effort was confused and inhibited primarily because of a lack of a firm definition of its role and the presence of outside influences. The Air Force was advised to ". . . develop an integrated, purposeful, and objective space program and sell it to the USAF, OSD, and NSC."

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Thus the momentum for modernizing the entire weapon system research-development-procurement cycle was stayed but, as it turned out, only temporarily. The divisions of the command set about adapting themselves to the new regulations. Nothing much happened in the way of inter-command realignment or intra-command organization for the next nine months but the necessity for resolving some of the more basic Air Force problems--which directly or indirectly concerned ballistic missile and space development --became even more compelling.

At the same time, at the local level of ballistic missile and space division operations, there were management developments which too would ultimately influence command wide changes and decisions. Among the most urgent problems, and one that was seemingly the most baffling, was that of space--physical office space required by continued accessions in manpower to cope with the division's increasing expansion of its mission.

When Western Development Division began in July 1954, a handful of officers and civilians worked in temporary offices converted from a former parochial school building in the heart of downtown Inglewood, California. Within a few months, as the organization began to grow, these quarters became extremely crowded, shared as they were with Ramo-Wooldridge technical specialists and the materiel command's Special Aircraft Project Office. Meanwhile, through the contract that required Ramo-Wooldridge Corporation to furnish materiel and service support as well as systems engineering and technical direction, larger and more permanent facilities were being acquired. Thus early in 1955 the first of two buildings under construction was completed and occupied to become the headquarters offices of Western Development Division. The buildings were located on Arbor Vitae Street, a few blocks west of Inglewood's city limits. *

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* Despite the change of location to Los Angeles the name of the original location lingered on in informal references to the ballistic missile division as the "Inglewood complex", "Inglewood development center" or similar designation.

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Buildings three and four, identified in the illustration on the next page, were leased by the Air Force but the high cost of leasing led to their purchase in the fall of 1955. Also in the fall of 1955, the Ramo-Wooldridge Corporation purchased approximately 41 acres on the southeast corner of El Segundo and Aviation boulevards, about three miles south of the Arbor Vitae Street offices. There was constructed, beginning in mid-1956, the facility called Research and Development Center. It belonged to Space Technology Laboratories, a subsidiary of Ramo-Wooldridge Corporation organized to take over from the parent firm the systems engineering and technical direction responsibilities in ballistic missile and space programs.

The increasing numbers of military and civilian Air Force personnel, a parallel increase in contractor manpower, and expanding total of liaison offices located within the development complex taxed existing facilities to their limits. To solve these problems the division leased buildings in the Arbor Vitae area--and, in some instances, as much as 12 miles from headquarters offices--and additional Air Force personnel moved into the Research and Development Center.* The severity of the problem was illustrated by manpower totals: on 1 January 1959 ballistic missile division personnel at work totaled 1,177; the materiel command's contracting and logistic planning contingent numbered 378; and there were 145 people in the planning office of the strategic command for a total of 1,700 Air Force personnel. In addition to these, 3,080 Space Technology Laboratories engineering and support personnel were housed in the various offices.[37]

In the spring of 1959 the division, realizing that long term planning offered the only permanent solution, created a committee to investigate the division's facility requirements. The committee conducted a thorough review of the problem but due to some temporarily unsettling mission assignments had to leave its work unfinished. A fresh start was made in the fall of 1959 with the

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* In a general way the numbers designating the buildings in the accompanying illustration indicate the sequence in which the Air Force built or leased additional floor area.

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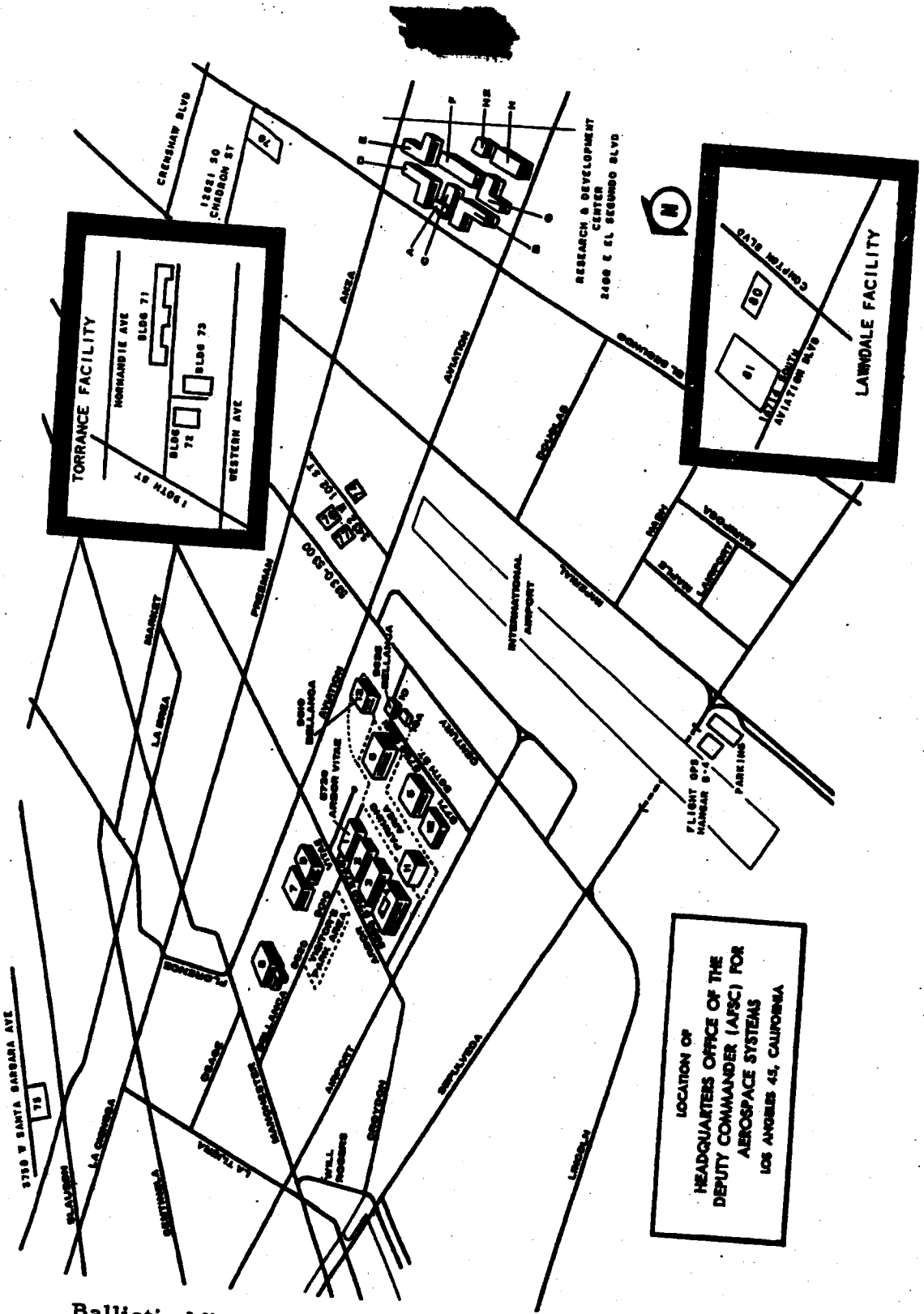

Ballistic Missile and Space Development Complex

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appointment of a full time Long Range Facility Committee to study and recommend a future permanent location for the ballistic and space development division. Several locations were studied, recommended, and eventually rejected--a process that occasionally reached the Air Force secretariat level. Sites that were promising but were unacceptable for one reason or another included Los Alamitos Naval Air Station, located a few miles east of Long Beach, California; Navy-Douglas property and buildings located on the northwest corner of El Segundo and Aviation boulevards; and 80 acres of vacant land located on the southwest corner of the same intersection. On 26 August 1960, while search and study continued, the Air Force Ballistic Missile and Space Committee reaffirmed the permanence of the ballistic and space development organization in the Air Force structure and, at the same time, suggested that the division consider Norton Air Force Base at San Bernardino, California, and March Air Force Base, at Riverside, California (both are about 70 miles east of Los Angeles) as possible permanent "home"sites. The local committee concluded that in each instance base facilities were inadequate.[38] *

But the necessity to do something about obtaining additional quarters was approaching a crisis. On 9 July 1960 the Air Force decided, in response to acute missile site activation problems to assign the management of all site activation work to the materiel command. After July 1960 the ballistic missile division retained executive management responsibility for development of the systems, and the materiel command's Ballistic Missile Center, virtually sharing the same office space with the division, was responsible for site activation. However, a significant impact of the change within the context of the space problem was that about 800 more workers were brought into the missile development complex area, which by now was barely able to contain the 7,500 people already there.[39]

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* Interestingly, in the light of later events, the committee determined that San Bernardino Air Force Base would not be suitable for the entire ballistic missile and space program as it would ". . . require a complete construction of a new facility and would not be conducive to the Aerospace Corporation in association with the Air Force."

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Moreover, the augmented role for the Ballistic Missile Center of the materiel command created for the first time "... two management missions of highest national urgency within the complex, which though related involved separate organizations which are competing for management attention and resources." The inevitable result was "serious organization tensions ... aggravated by the lack of physical space to accommodate the rapid buildup of personnel for the overall site activation task."[40]

In the face of this situation the Air Force vice chief of staff, on 31 August 1960, directed the materiel and research commands to thresh out the problem and come up with a plan to relocate those elements of the complex that did not require close coordination with Space Technology Laboratories. A plan of action was to be worked out by 26 September 1960, a deadline that allowed little time to solve a problem which had defied solution for nearly two years. Under the circumstances the choice of San Bernardino as an alternate location gained increasing support. On 6-7 September, General W. E. Leonhard, deputy commander for facilities, presented to members of the air staff a plan for moving certain elements of the ballistic division and materiel procurement functions to the San Bernardino base.[41] *

As more thought was given to the relocation problem the advantages of the proposed move to Norton Air Force Base became increasingly attractive. General Schriever, in a letter to the Air Force chief of staff on 23 September 1960, clearly stated that such a separation offered the opportunity to restore "... the singleness of purpose and cohesiveness of management ... mandatory for the aggressive translation of technology into space capabilities of importance to the national security ..." Therefore, Schriever endorsed the proposal that current ballistic missile programs be moved from the Inglewood complex to San Bernardino "as rapidly as possible." Furthermore, said Schriever, concurrent with this transfer, program management responsibility should be assigned to the materiel command.[42]

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* Colonel Leonhard and Colonel Richard D. Curtin, deputy commander of division space programs were promoted to brigadier general on 1 May 1960.

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This letter got quick results. On 29 September the Air Force vice chief of staff ordered that site activation management task be ". . . immediately relocated to San Bernardino where the current ballistic missile program can be accommodated on a phased basis." He added that the Inglewood complex would ". . . become the permanent focal point and be strongly identified as the USAF military space development agency."[43]

While these various threads were becoming thoroughly intertwined, significant alteration had been made in the role of Space Technology Laboratories. Because of its unique contractual relationship with the Air Force, the laboratories and its parent organization (Ramo-Wooldridge Corporation) were denied ballistic and space hardware development contracts. This exclusion, in addition to certain other aspects of its profit making relationship with the Air Force and with industry, resulted in a plan to replace the laboratories with a non-profit, government-chartered corporation to perform systems engineering and technical direction of Air Force programs. Protracted negotiations were necessary to unravel complex legalities and interests. They were concluded in time to permit establishment of the new non-profit corporate entity, Aerospace Corporation, by mid-June 1960. The first corporation assignment was to man the world-wide space tracking network and perform systems engineering and technical direction on early portions of space programs. The change-over was finally completed on 9 December 1960, when the Air Force purchased the Research and Development Center on El Segundo, which became, for the time being, the home of the Aerospace Corporation and Air Force space project offices. Some alleviation in office space availability was gained as Space Technology Laboratories personnel gradually moved into their own office and laboratory installations.[44]

By December 1960 the division's physical space problem was fairly well resolved and the closely related objective of creating a strong space development force seemed within reach. But as the moving plan matured, widening fissures in its application became apparent. Heretofore such functions as materiel procurement and development management activity had been carried on virtually side by side, working under accelerated decision making procedures to hasten acquisition of weapon system hardware. Thus removal of

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contractual and procurement services to San Bernardino was viewed with some alarm not only by the space program offices but by the ballistic system managers not yet ready for immediate transfer of development programs to executive management of the materiel command. It was evident that the kind of cooperation called for in "375 Series Regulations" was not always possible. Some critics concluded that a strong, responsive, Air Force program for rapid development of military space systems would be difficult to achieve if there was a return to conventional dual-command management arrangements.[45]

Complicating this and other issues was the January 1961 change of national administration and the inevitable advent of new policies and currents of opinion. On 28 January 1961 newly appointed Secretary of the Air Force Eugene M. Zuckert called a Pentagon conference of key civilian and military leaders in the Air Force.* Already informed about major problem areas confronting any new definition of Air Force policies, Zuckert wanted to furnish to new Secretary of Defense R. S. McNamara a realistic appraisal of the Air Force's capability to meet new demands on its technical excellence. At the same time a review of issues and frank exchange of views would presumably be useful in clearing the air and arriving at a useful position. Moreover, the areas of divergent interests may have, inadvertently, demonstrated that a functional realignment of certain command responsibilities was long over due.[46]

In any case, events leading to an Air Force wide reorganization now moved very rapidly. The most important of these actions occurred on 6 March 1961 when the Secretary of Defense assigned to the Air Force exclusive responsibility for development of all space systems. This long sought goal was obtained at the price of a major reorganization. There followed an intensive review of outstanding reorganization studies earlier conducted, including the recent

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* Present were Secretary Zuckert, Under Secretary J. V. Charyk, Assistant Secretary Lyle S. Garlock, Chief of Staff, General T. D. White; Vice Chief of Staff, General C. E. LeMay; Lieutenant General B. A. Schriever; Lieutenant General S. E. Anderson; Lieutenant General Mark E. Bradley; Lieutenant General R. C. Wilson; Major General T. P. Gerrity; and Major General O. J. Ritland.

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Anderson Study Group recommendations. On the basis of such research, the chief of staff presented a reorganization plan to a special Air Force headquarters staff meeting on 13 March 1961. A public announcement of the sweeping command changes was made four days later. Effective 1 April 1961, the Air Research and Development Command was to become the Air Force Systems Command ". . . designed to centralize direction of the ballistic missile programs and to insure the most effective discharge of those military space responsibilites assigned to the Air Force."[47]

The former research command was placed in control of the entire weapons acquisition process. Heretofore a principal function of the materiel command, procurement-and-production was now assigned to the new systems command. In place of the materiel command, an Air Force Logistics Command was created to furnish, as its name suggested, logistic support to the Air Force. Within the systems command new divisions were organized: Electronic Systems in the Boston area, and Aeronautical Systems at Wright Patterson Air Force Base, Ohio. But the greatest impact of the command reorganization was felt at the missile development complex. There the Air Force Ballistic Missile Division and the Ballistic Missiles Center were discontinued. In their place were created two new organizations, the Space Systems Division and the Ballistic Systems Division. To insure utmost response and close control in these two prime areas of interest, a Deputy Commander for Aerospace Systems was established in Los Angeles directly over the two divisions. The vast amount of detail work involved in creating three new organizations was to be completed and fully in effect by 1 July.[48]

There followed days of rapid shuffling of former ballistic division elements to create a deputy command organization, two divisions, and an equitable distribution of personnel and available resources. It was a task performed under considerable pressure without minimizing management energies normally directed to mission assignments.

On 23 March 1961 an "Organization Task Group" was established at command headquarters to supervise the general organization of the command. Local task groups and committees were set up to apply broad organizational directives. It was immediately agreed that the two divisions would operate

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independently with wide latitude of action in program matters and a clear line of authority extending to command and Air Force headquarters. The deputy commander for Aerospace Systems was not to function as another layer of review and approval, but to direct and guide in matters of command interest and policies. To keep the deputy commander's staff small and yet furnish support services to the two divisions, the 6592nd Support Group within the deputy command structure took over such common support functions as information, comptroller, and personnel.[49] *

As a practical starting point, it was announced on 31 March that personnel working for the ballistic missile division would be considered employees of the Space Systems Division and employees working for the Ballistic Missile Center would be considered employees of the Ballistic Systems Division. On 1 April, in the absence of other written orders, a message from command headquarters furnished the legal basis for establishing the three new organizations and appointed their commanders. Major General O. J. Ritland was named commander of the Space Systems Division and Major General T. P. Gerrity, former commander of the Ballistic Missile Center, commander of the Ballistic Systems Division. The four subordinate military units of the ballistic missile division were reassigned to the new organizations. The 6592nd was assigned to the deputy commander's office and the 6555th Test Wing (Development), stationed at Patrick Air Force Base, was assinged to the Ballistic Systems Division. The two California test wings, the 6594th at Sunnyvale, and the 6565th at Vandenberg Air Force Base, were assigned to the Space Systems Division. In May the rocket development agency at the Air Force Flight Test Center at Edwards Air Force Base was transferred to the Space Systems Division.[50]

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* A general outline of organization for the two divisions and the deputy command was presented to General Schriever on 12 May 1961. It was forwarded for final approval of General LeMay who directed that the deputy commander staff should not exceed 23 people. This total was later increased to 35.

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Thus the new Space Systems Division acquired the identity and capability essential to further advanced programs in the new space arena. Some concessions to reality were necessary. For example, for the time being, the critical shortage of technical personnel caused technical development specialists to remain with the Ballistics Systems Division and advanced systems planning personnel with the Space Systems Division. Each group would service the needs of the other division as requested. These and problems of a similar nature were ironed out by 1 July 1961, when manning actions involving the three organizations were virtually complete.*

While the reorganization was going on, the move to Norton Air Force Base at San Bernardino was not forgotten. On 1 May 1961, the Secretary of the Air Force ruled that "After careful consideration, it has been determined that the entire Ballistic Missile Systems Division should move to Norton Air Force Base on a planned phase basis beginning at the earliest practicable date." (Some elements of the Atlas and Titan program offices had already relocated on the base.) Further moves were delayed pending the availability of base facilities capable of adjusting to the influx of approximately 2,000 more employees. A plan to remodel an existing warehouse and to furnish Aerospace Corporation support at the new location delayed the move of the Ballistic Systems Division until June and July of 1962.[51]

Thus nearly a year passed before the basic objectives involved in establishing a single space agency were finally realized. The close association of the two divisions in Los Angeles directly under the Deputy Commander for Aerospace Systems was widely considered to be an "interim" pattern of organization. By May of 1962, a plan was in existence to provide the two divisions

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* Space Systems Division leading personnel included in addition to Major General O. J. Ritland, Commander; Major General R. E. Greer, Vice Commander, Colonel R. A. Berg, Assistant Vice Commander; Colonel N. M. Lulejian, Advanced Systems Plans and Analysis Office; Colonel H. H. Eichel, Deputy for Technical Development; Colonel J. S. Bleymaier, Deputy for Launch Vehicles; Colonel H. L. Evans, Deputy for Satellite Systems; and Colonel J. C. Manatt, Deputy for Foreign Technology. Total manning, military and civilian, stood at 977.

with normal supporting groups and staff services (such as information, comptroller, and personnel) earlier allocated to the 6592nd. Thus by 1 June, each division was able to stand alone, the one prepared to relocate at Norton Air Force Base and other to remain at its Los Angeles location.[52]

The problem of adequate office area had been solved. Scattered offices throughout the south Los Angeles area were consolidated as rapidly as circumstances permitted. But a complete consolidation of the space division's headquarters offices remained uncertain. During 1961 the Air Force had acquired 40 acres of land and two large buildings from Douglas Aircraft, located at Aviation and Compton boulevards, about one and one-third miles south of the Research and Development Center. These buildings, 80 and 81, while containing temporary offices, required extensive modification to meet division needs. Modification of the buildings was authorized by mid-1962.[53] *

Thus was new progress made in the long effort to acquire facilities, talents and leadership for developing an Air Force space capability. The Air Force possessed in the Space Systems Division the means for the ". . . aggressive translation of technology into space capabilities of importance to the national security. . ."[54] As General Schriever told the Air Force chief of staff, as ". . . the scope of our functional responsibilities diminish in the ballistic missile area and increase in the space area . . ." the role of the space division would expand. In Schriever's view the development of a space force, ". . . together with the Aerospace Corporation, will play the key role in establishing a strong military-scientific-industrial space team."[55]

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* At the time of this writing (February 1963) a final solution to the Space Systems Division housing problem had been found. After a period of considerable uncertainty during the summer and fall of 1962, plans were underway to locate division headquarters and supporting offices in the Air Force-owned Research and Development Center in El Segundo. Aerospace Corporation was constructing new quarters near by.

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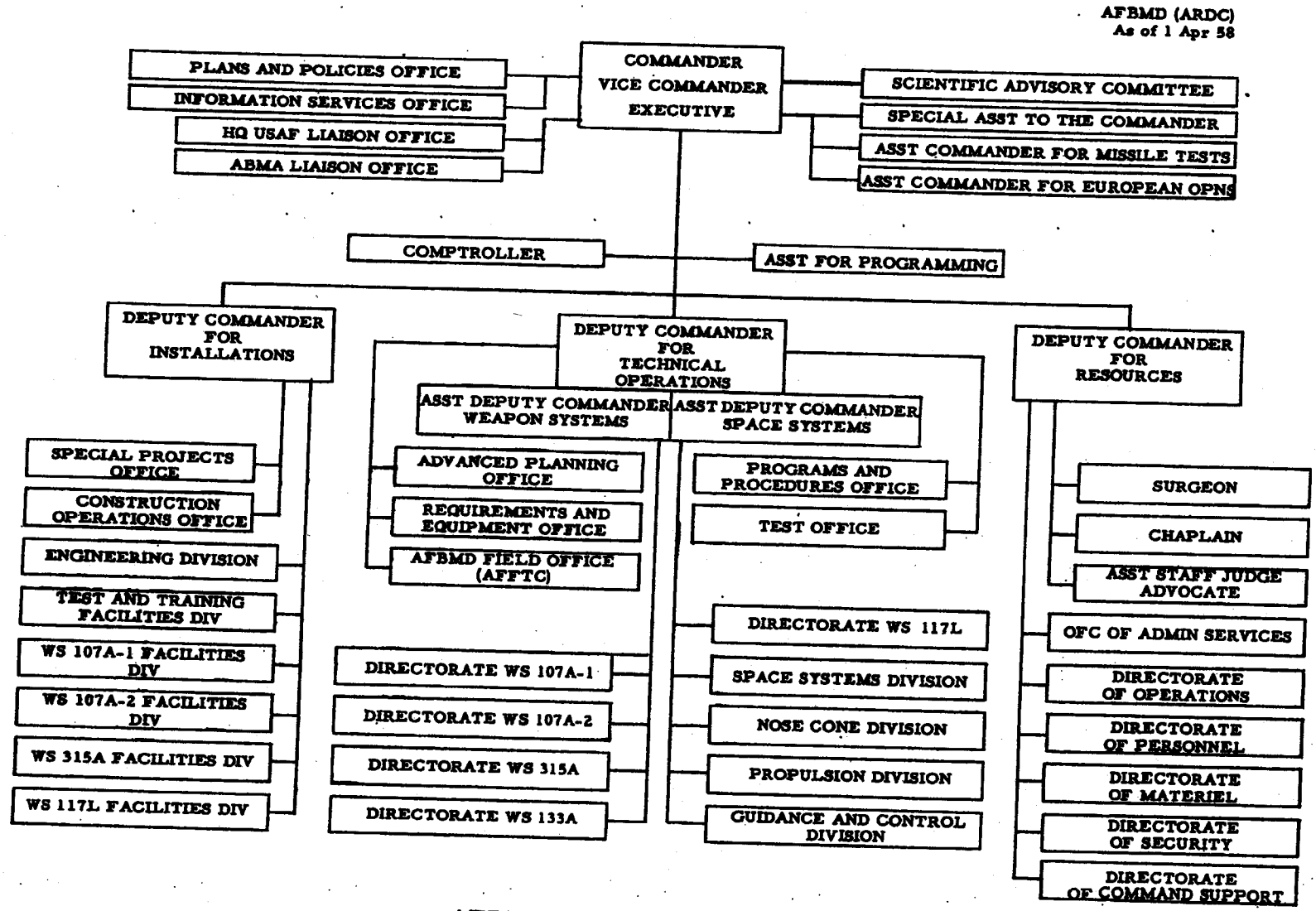
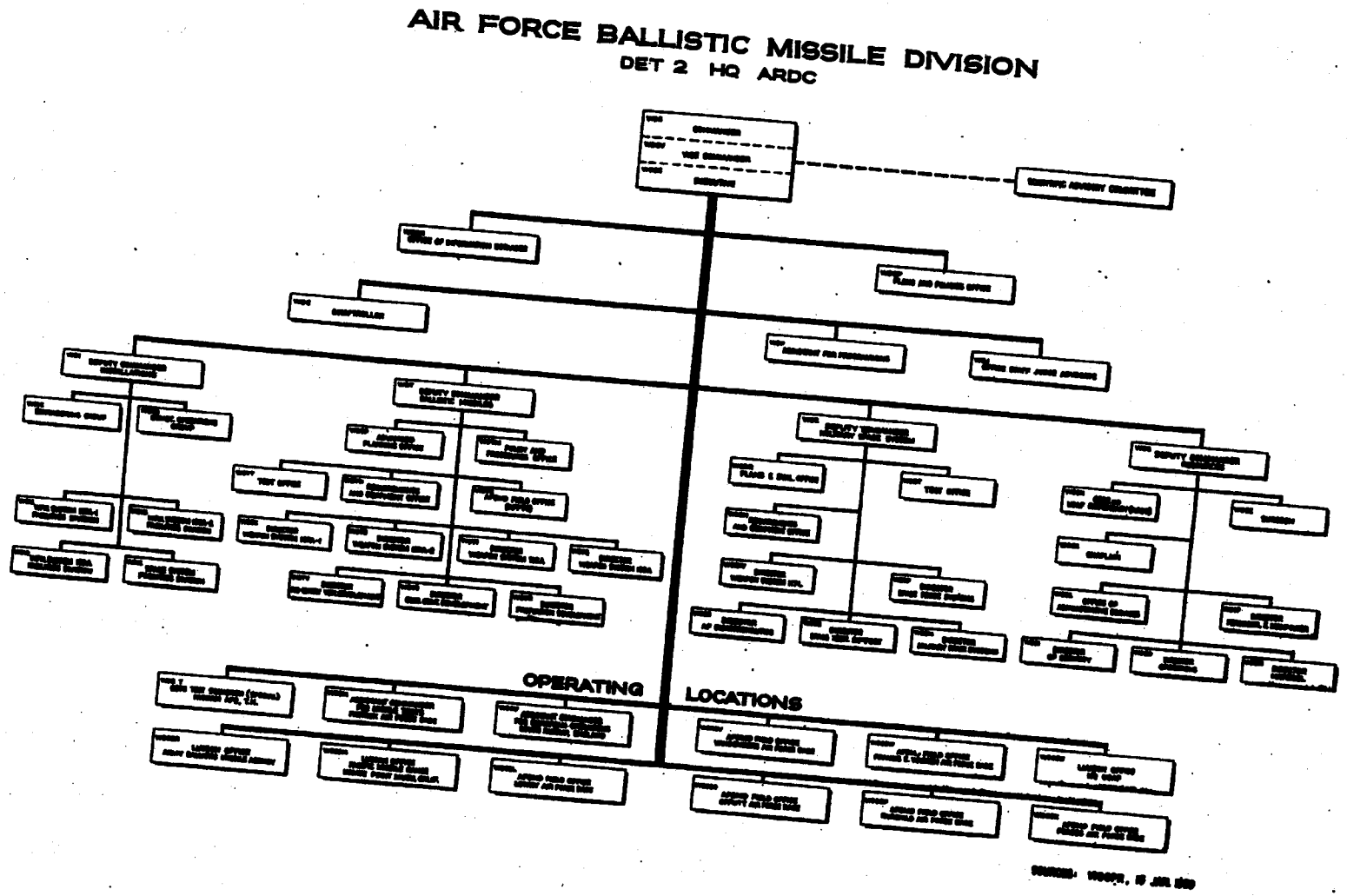
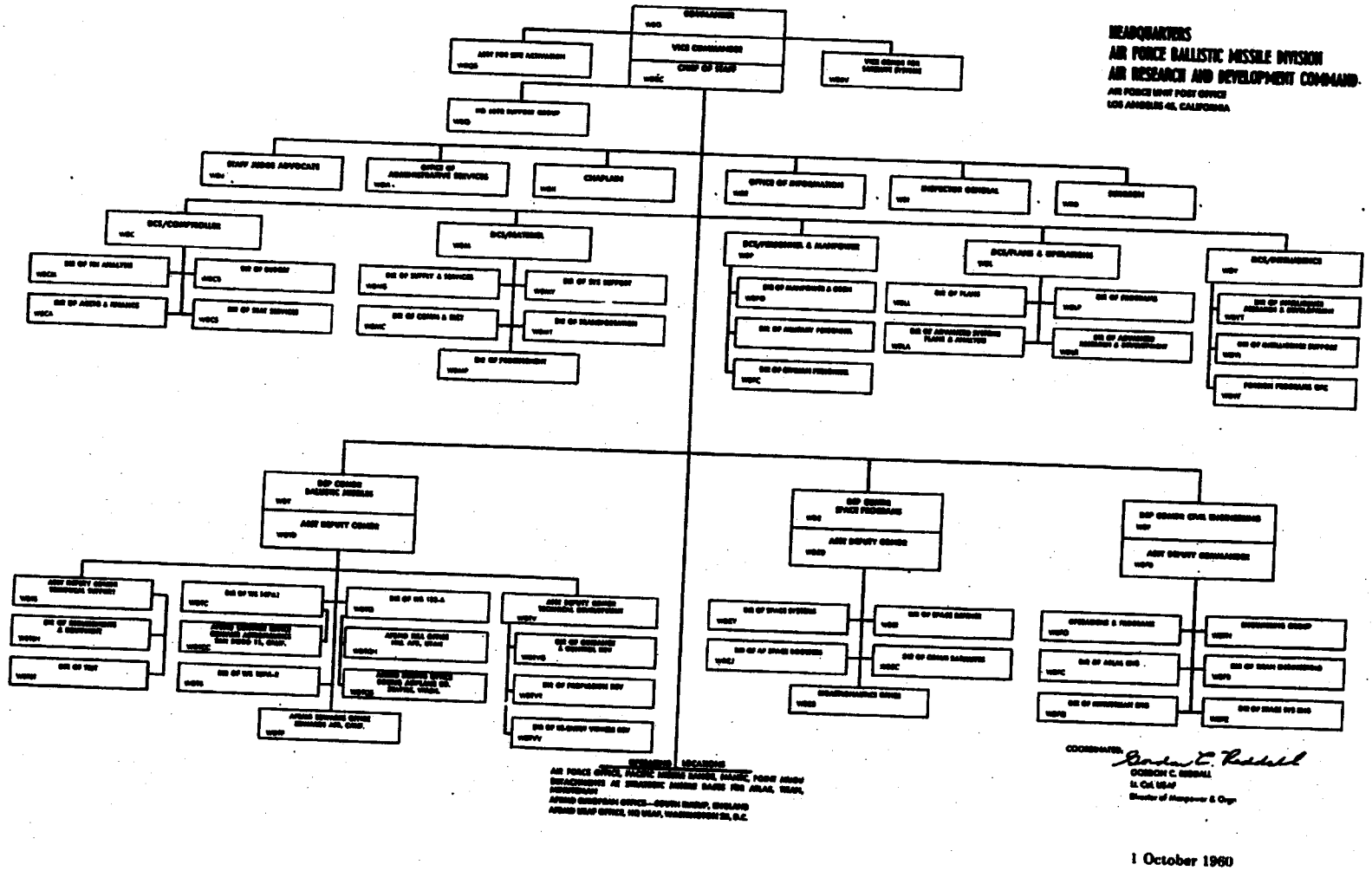


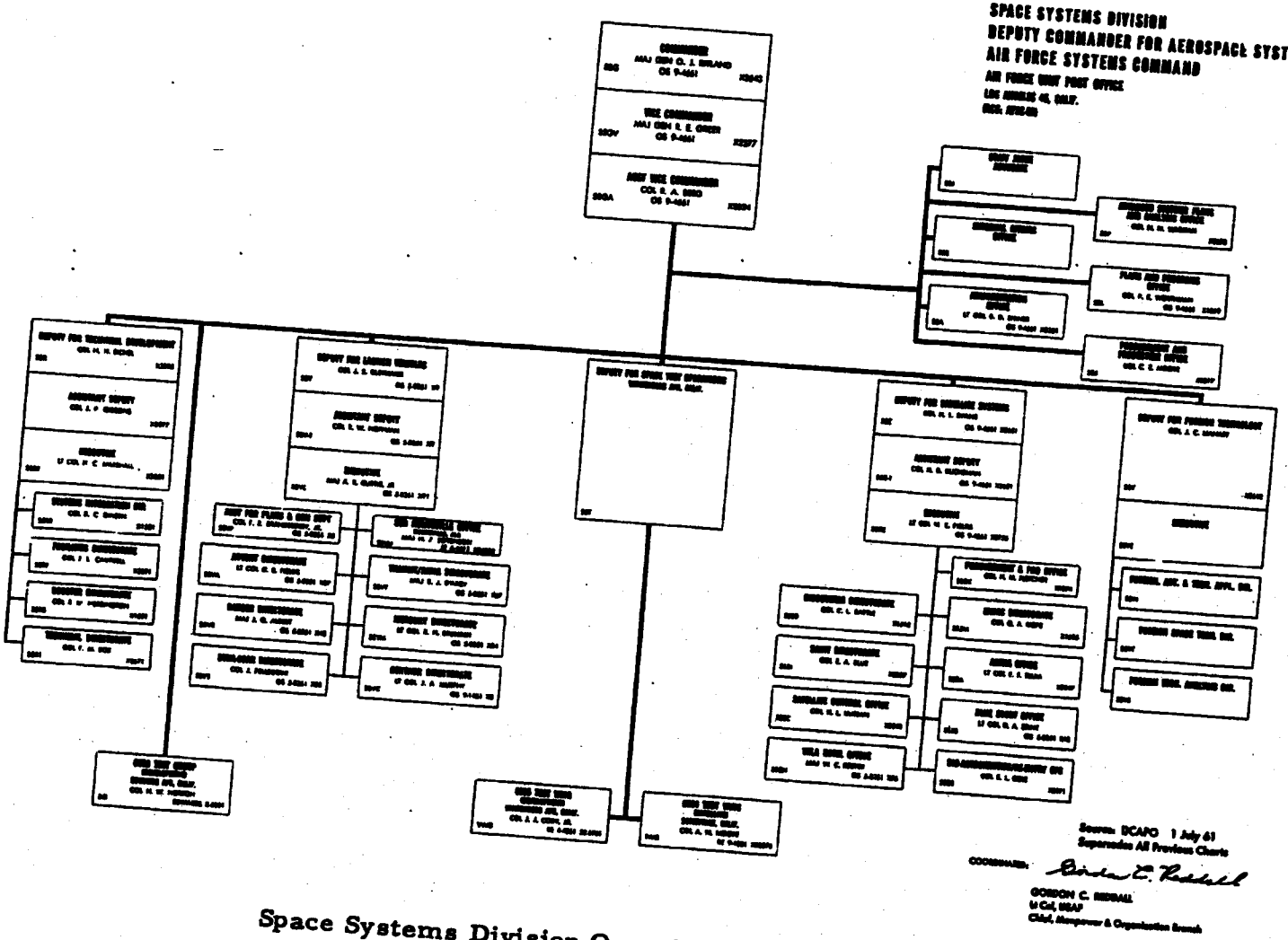
AFBMD Organization, 1 April 1958



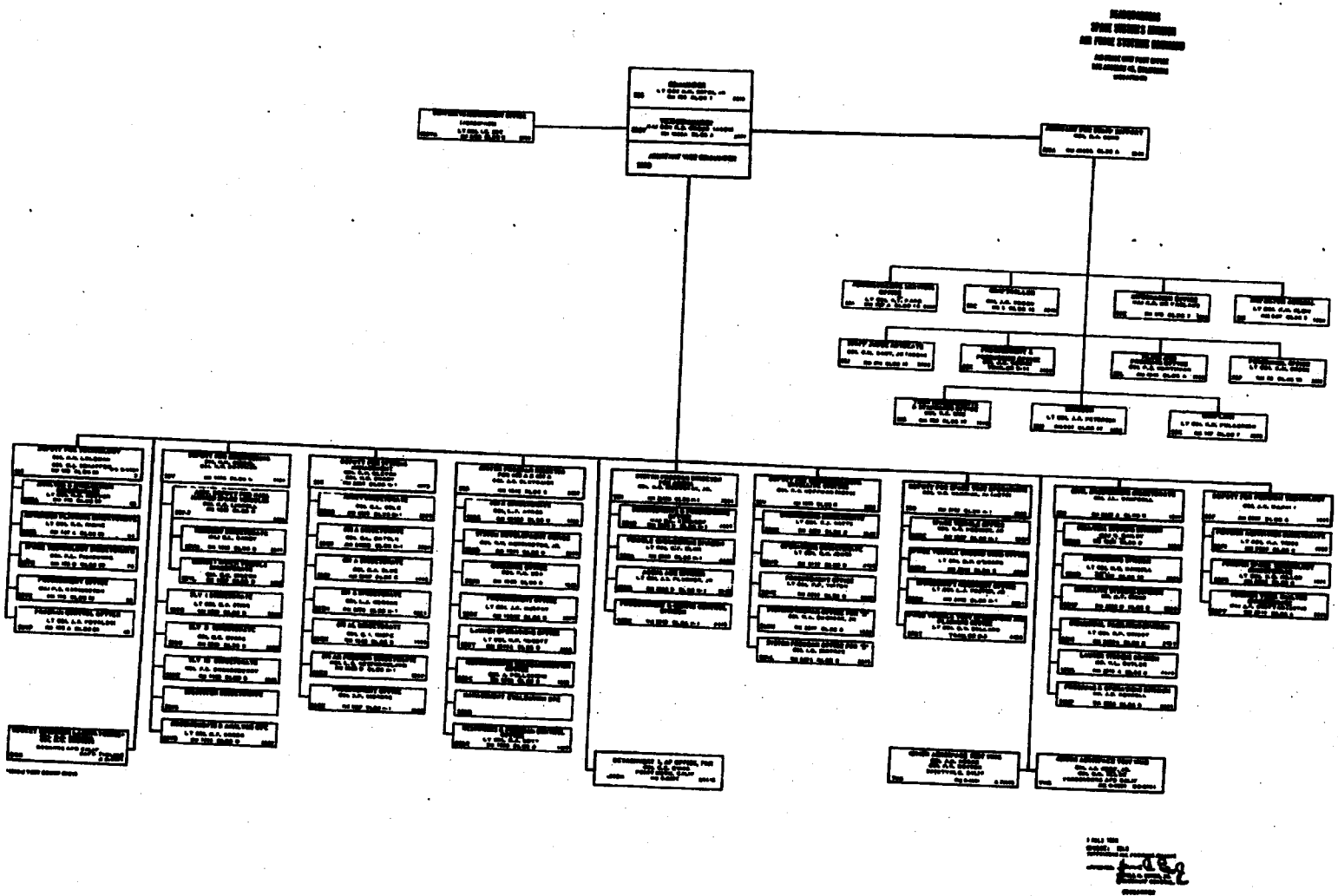
AFBMD Organization, 15 January 1959



AFBMD Organization, 1 October 1960



Space Systems Division Organization, 1 July 1961



Organization, 1 July 1962

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GLOSSARY OF ABBREVIATIONS

Actg	Acting
Admn	Administration
AEC	Atomic Energy Commission
AF	Air Force
AFBM and SC	Air Force Ballistic Missile and Space Committee
AFCHO	United States Air Force Historical Division Liaison Office, Headquarters USAF
AFLC	Air Force Logistics Command
AFMTC	Air Force Missile Test Center
AFSC	Air Force Systems Command
AFTAC	Air Force Tactical Air Command
AMC	Air Materiel Command
ARDC	Air Research and Development Command
ARPA	Advanced Research Projects Agency
ARS	Advanced Reconnaissance System
ASAF	Assistanct Secretary of the Air Force
Asst	Assistant
Bd	Board
BMTS	Ballistic Missile Test System
Br	Branch
BrigGen	Brigadier General
BSD	Ballistic Systems Division
Capt	Captain
CG	Commanding General
C/S	Chief of Staff
Chf	Chief
DCAS	Deputy Commander, Air Force Systems Command, for Aerospace Systems
DCS	Deputy Chief of Staff
DCS/D	Deputy Chief of Staff, Development
DCS/Mat	Deputy Chief of Staff, Materiel
DCS/S and L	Deputy Chief of Staff, Systems and Logistics
DDR and E	Director of Defense Research and Engineering
Def	Defense
Dep	Deputy
Dev	Development
Dir	Director; Directive
Div	Division
DSMG	Designated Systems Management Group

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Engr	Engineering
Eqp	Equipment
FY	Fiscal Year
Gen	General
GO	General Order
GOR	General Operational Requirement
Gp	Group
Hist	Historical
Hq	Headquarters
Ind	Indorsement
Intel	Intelligence
Lt	Lieutenant
Ltr	Letter
Maint	Maintenance
Maj	Major
Memo	Memorandum
MFR	Memorandum for the Record
Mtg	Meeting
Msg	Message
NASA	National Aeronautics and Space Administration
Nr	Number
NSC	National Security Council
Ofc	Office
Off	Officer
Opns	Operations
Ord	Order
OSD	Office of the Secretary of Defense
Prep	Prepared
Presn	Presentation
Progs	Programs
Proj	Project
R and D	Research and Development
Rep	Representatives
Res	Research
Rpt	Report
SA	Secretary of the Army
SAC	Strategic Air Command; Scientific Advisory Committee
SAF	Secretary of the Air Force

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SAF/R and D	Secretary of the Air Force, Research and Development
SAF/US	
Sec	Secretary
SLV	Standard Launch Vehicle
SN	Secretary of the Navy
SO	Special Order
SOD	Secretary of Defense
SR	System Requirement
SRB	Systems Review Board
SSD	Space Systems Division
STL	Space Technology Laboratories
Subj	Subject
Sys	System
TAM	Technical Area Manager
Tech	Technology
TRW	Thompson-Ramo-Wooldridge Corporation
USAF	United States Air Force
U/SAF	Under Secretary of the Air Force
V/Cmdr	Vice Commander
V/CS	Vice Chief of Staff
Vol	Volume
WADC	Wright Air Development Center
WDD	Western Development Division
Wkly	Weekly
WS	Weapon System
Yr	Year

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