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MAXWELL AIR FORCE BASE, ALABAMA

July 23, 2009
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AFHRA/RSA
600 Chennault Circle
Maxwell AFB, AL 36112-6424 USA

Mr. John Greenewald, Jr.
[REDACTED]

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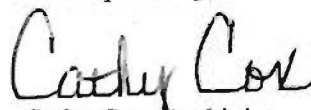
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IRIS Number: 00474163

Main: AJK MATERIEL COMMAND

Title: HISTORY OF PASCAL WEAPON SYSTEM, HISTORICAL STUDY NUMBER 321

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1952-1958
(Unclassified)

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HISTORY OF
THE RASCAL WEAPON SYSTEM
1952-1958
(Unclassified)

VOLUME I: TEXT

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PREFACE

This history of the Rascal Weapon System deals primarily with the procurement and production of major components. Some of these components are the airframe, guidance system, propulsion unit, and director aircraft. Early research and development, as well as later development, are also discussed briefly. The sections on research and development are included for two reasons--background material is necessary for a complete understanding of the program, and development forms an important and integral part of the Rascal procurement and production story. Rascal development and production are so entwined that it is impossible to discuss one without the other.

The terms Rascal and GAM-63 are used synonymously in this history. Other words used interchangeably are Washington for Headquarters USAF, Wright Field and center for the Wright Air Development Center, and Baltimore for the Air Research and Development Command.

The author gratefully acknowledges the cooperation and assistance of Colonel H. W. Lanford, Jr. and Captain F. J. Barles of the Guided Air Missile Weapon System Project Office.

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I. THE RASCAL (GAM-63)* WEAPON SYSTEM AND ITS MISSION

The Rascal is a rocket-propelled air-to-ground missile manufactured by the Bell Aircraft Corporation. It can carry a 3,000-pound nuclear warhead at a maximum speed of Mach 2.95 and a maximum range of 90 nautical miles.¹ A director aircraft must² carry the Rascal to within this distance of a target. The flight of the missile after release from the carrier to impact on the target consists of four phases--launch, climb, mid-course, and terminal dive.

The Rascal Weapon System

Four major components comprise the GAM-63 Weapon System. These are the missile, the DB-47 director aircraft,^{**} ground support equipment, and training aids.

The Missile

The missile is divided into four major parts: airframe, guidance systems, control or stabilization systems, and propulsion system.

-
- * The name Rascal is derived from the guidance system used during the missile's dive on the target. This system of guidance is referred to as a Radar Scanning Link, and the word Rascal is formed by combining the underlined letters of the three words. GAM is the abbreviation for Guided Air Missile.
 - ** Various aircraft were considered as missile carriers, but the system finally evolved as a DB-47/GAM-63 combination.

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Airframe. The missile airframe consists of a cylindrical aluminum alloy fuselage and exterior control or wing surfaces. These control surfaces are located at both the front and rear of the missile and on all four sides. * The forward horizontal surfaces consist of wings and elevators. The front vertical surfaces are all-movable rudders. The rear horizontal surfaces are wings with attached ailerons and the vertical surfaces are fixed fins.³

Structurally, the airframe consists of five major sections. These sections, from front to rear, are the radome nose which houses the search radar, the forward body which contains the guidance equipment, the warhead section, the center body or tank section, and the aft body shell which contains the propulsion unit.⁴ Some of the principal dimensions of the airframe are: over-all length, 32 feet; maximum outside body diameter, 4 feet; horizontal span, 17 feet; and height, 12.5 feet.⁵

Guidance Systems. The GAM-63 is guided by two separate systems. An inertial system which emits no external signals (non-emanating) guides the missile during the launch, climb, and mid-course phases of flight. The MA-8 navigation system located in the director aircraft feeds information such as the airplane's

* This is referred to as a canard cruciform wing configuration. For a picture of this construction, see Appendix A.

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velocity, heading, and distance-to-target into the inertial system just prior to launch. After the missile completes the launch and climb phases of flight, the inertial system guides the missile along a pre-selected flight path. Accelerometers located in the inertial system measure the distance traveled by the missile. They also indicate when the missile is to begin its terminal dive phase of flight. When this terminal dive point is reached, the inertial system places the missile in a 35-degree dive.⁶

The second guidance system is automatically activated as the missile begins its dive. This one is a remote radar relay command system which also can be turned on at any time by the guidance operator located in the director aircraft. It consists of a search antenna located in the nose of the Rascal and electronic equipment capable of sending a radar picture from the missile to the director aircraft. The search antenna scans a 150-degree sector in front of the missile. The resulting radar signal of the target area appears on a scope viewed by the guidance operator. This picture shows the position of the missile in relation to the target, thereby permitting the guidance operator to make proper flight-path corrections if the Rascal is off-course.⁷

Stabilization Systems. Servopilots, hydraulic valves, and mechanical linkage systems aerodynamically stabilize the GAM-63.

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These control the roll, pitch, and yaw of the missile while in flight. Both of the Rascal's guidance systems can transmit control signals to these stabilization systems.

*

The first step in maintaining roll control is accomplished by a vertical gyroscope which always maintains a vertical position. This gyroscope measures any deviations caused by the rolling motion of the missile. It also transforms the measured amount of deviation into an electric signal, the strength of which is equal to the amount of roll. The gyroscope then sends the signal through an amplifier to hydraulic valves. These valves move a distance equal to the strength of the signal. This movement activates those mechanical links which move the missile's ailerons. The ailerons, in turn, move just enough to offset the roll.

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As it does for roll, the vertical gyroscope provides the first step in maintaining pitch control. It measures how much the missile deviates from its lateral axis. After measuring the deviation, the gyroscope sends an electric signal through an amplifier to hydraulic valves. Again, the amount of deviation determines

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- * The United States Air Force Dictionary defines roll as "any movement of an aircraft about its longitudinal axis."
- ** Pitch is defined by The United States Air Force Dictionary as "the movement of an aircraft about its lateral axis; the extent of this movement, measured in degrees."

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the strength of the signal. The valves receiving the signal control the mechanical links which position the elevators. The elevators move a distance just far enough to offset the pitch.

A free gyroscope is the primary sensing element for yaw stabilization. This gyroscope measures the missile's deviation from the pre-selected course or direction it is to travel. Using the same sequence of steps as in roll and pitch control, the yaw stabilization system then operates the rudder to bring the missile back on course.

Propulsion System. The GAM-63 uses a Bell-developed and manufactured liquid rocket engine designated the LR67-BA-9. This engine consists of three identical thrust chambers placed in a vertical column at the rear of the missile. Low-pressure propellant tanks and a gas turbine pumping unit feed JP-4 fuel and inhibited red fuming nitric acid oxidizer into these chambers. Each of the thrust chambers produces 4,000 pounds of thrust at an altitude of 40,000 feet. All three chambers operate during the climb or boost phase of flight. The three chambers stop operating when the missile reaches the half-way point of the mid-course phase of flight.

* "The movement of an aircraft, projectile, or the like about its vertical axis; the extent of this movement, measured in degrees" is the way The United States Air Force Dictionary defines yaw.

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All three chambers operate for a period of about 153.4 seconds.

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Missile speed at this point is about Mach 2.86.

Director Aircraft

The Rascal Weapon System uses modified B-47 airplanes as director aircraft. These airplanes receive the DB-47 designation after modification. The primary purposes of the DB-47 are to carry the Rascal to a point within 90 nautical miles of a target, launch the missile, and guide it after launch. A standard MA-8 radar navigation-bombing system directs the carrier to the correct location for launching the missile. At the same time, this MA-8 system computes and feeds pre-launch data into the Rascal's inertial guidance system.

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Additional equipment, however, is necessary for launching and guiding the missile. Employees of the Boeing Airplane Company place this equipment in and on the B-47 during its modification.

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This equipment consists of the following:

- a. A system for holding the missile to the airplane while being carried to the launch point.
- b. An Automatic Checkout System (ACS) for verifying that all of the missile's components are operating properly and for automatically releasing the missile.
- c. A system for maintaining constant guidance contact with the missile.

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- d. A control station for allowing the guidance operator to monitor the missile's flight.

Ground Support Equipment

Rascal ground support equipment can be separated into three categories--servicing, handling, and checkout. Servicing equipment includes such items as fuel, oxidizer, and acid disposal trailers. Carriages, dollies, assembly stands, and slings are some of the items in the handling category. All test equipment for maintaining electronic, electrical, and hydraulic systems
14
comprise the checkout category.

The Rascal Mission

The Rascal mission is the destruction of peripheral targets having strong local defenses, thereby reducing losses of manned aircraft because of these defenses. The missile will be used as an initial attack weapon when time and the tactical situation permit. However, only those targets which present well defined radar re-
15
turns can be attacked with the Rascal. The DB-47/GAM-63 system may operate non-stop to a target from its home base by means of air refueling. If refueling is not possible or desired by the Air Force, the mission may begin from a forward ZI or oversea base.

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In a typical maximum range mission, the DB-47 carries the missile to a predetermined launch point 90 nautical miles from a target. The DB-47's standard navigation-bombing system constantly computes the distance and course to target while in flight to the launch area. Immediately prior to launch, the ACS checks all critical components of the missile to verify proper functioning. At the same time, the MA-8 feeds data regarding the director aircraft's velocity, heading, and distance from target into the inertial guidance system. The ACS, together with the DB-47's navigation-bombing system, automatically releases the missile when the launch point is reached. Minimum launch altitude is 35,000 feet and minimum launch velocity is Mach 0.79.

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As the missile clears the launch gear of the director aircraft, its rocket engine ignites. It climbs at an angle of 19 degrees to an altitude of about 65,000 feet. The Rascal then levels off and half-way through the cruise phase its three rocket chambers automatically stop operating. The inertial system next guides the missile to within about 17 nautical miles of the target. The missile, therefore, is guided by the inertial system for a distance of about 73 nautical miles, or for a time period of about 195 seconds. The inertial system places the missile in a 35-degree dive when the terminal dive point is reached.

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The start of this terminal dive activates the missile's search antenna which then scans a 150-degree sector ahead of the missile. A guidance operator in the director aircraft determines the missile's position by consulting the picture in the scope. This operator can either monitor the flight or change the missile's direction if it heads
18
off-course.

It is possible for the DB-47 to drop the missile as a gravity bomb if a malfunction should occur during the mission. In these cases, the director aircraft releases the missile over a less
19
heavily defended alternate target.

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II. EARLY RESEARCH AND DEVELOPMENT

First Characteristics for an Air-to-Surface Missile

The Army Air Forces (AAF) published the first military characteristics for an air-to-surface missile on 16 July 1945. These characteristics called for a missile capable of being launched from a bomber at any altitude between 20,000 and 45,000 feet, reaching supersonic speed of at least 1,200 miles per hour, traveling a distance of at least 100 miles, and hitting within 500 feet of a target at least 75 per cent of the time. This missile was to be guided either by a remote or self-contained¹ guidance system.

The characteristics did not specify what model bomber should be used for carrying and launching the missile. They did indicate, however, that the aircraft finally selected was to suffer a performance penalty of no more than two per cent as a² result of transporting the missile.

The Bell, Goodyear, and McDonnell Aircraft Corporations received Air Force letter contracts for a year's study leading to the development of an air-to-surface missile. Bell's contract was dated 1 April 1946, Goodyear's 8 April 1946, and McDonnell's

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7 May 1946. Under the terms of these contracts, Goodyear was required to study both subsonic and supersonic missiles; Bell, a subsonic missile only; and McDonnell, a supersonic one. ³ As a result of a general review of the guided missile program in May 1947, the Air Materiel Command (AMC) terminated the Goodyear ⁴ and McDonnell projects. This left Bell as the only AAF air-to-surface missile contractor.

Early Characteristics Changes

The letter contract awarded to Bell carried the number W33-038 ac-14169. It identified the air-to-surface missile development program as Project MX-776. This letter contract changed the July 1945 characteristics in two respects; it specified the B-29 as the launch aircraft and it changed the missile's speed requirement from supersonic to subsonic. ⁵ The original characteristics called for a missile capable of a speed of at least 1,200 miles per hour, but the letter contract changed this requirement to 600 miles per hour.

Two months later amendment No. 2 to the letter contract required Bell to conduct studies on both supersonic and subsonic versions of the missile. ⁶

The definitive cost-plus-fixed-fee (CPFF) contract awarded to Bell repeated the requirement for both subsonic and supersonic

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studies. This contract, W33-038 ac-14169 dated 14 October 1946,⁷ did not receive Air Force approval until 11 April 1947. It placed⁸ the cost of the studies at \$1,380,108.85. This amount, however, did not include Bell's fixed fee of seven per cent (\$96,607.62).

A third change was made in the study program during the first half of 1947. In this case, AMC asked Bell to stop all work on the subsonic version of the missile and concentrate on develop-⁹ ing a supersonic one. Supplemental agreement No. 1 made this¹⁰ program change official in May 1947.

In June 1947 Headquarters AAF assigned a 1A priority to the development of a supersonic air-to-surface missile with a¹¹ range of 100 miles. In July, however, Headquarters AAF proposed that the range of the missile be extended to 300 miles. Washington also proposed that the missile payload capability¹² be increased from 2,000 to 3,000 pounds. In reply to these proposals, AMC indicated that a supersonic missile with the suggested characteristics was not immediately feasible. It pointed out that information obtained from studies conducted¹³ in the air-to-surface missile field revealed the following:

- a. A missile carrying a 3,000-pound warhead, and capable of sustained flight, will not fit the bomb bay of any operational, experimental, or planned bombardment airplane.

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- b. A liquid rocket power plant is the only type suitable for supersonic flight performance at the present time, and probably for five years to come. Fuel requirements for such a power plant will make it uneconomical and very poor choice for powering any missile designed for ranges in excess of 150 miles.

AMC also included a set of recommended characteristics in its reply to the Headquarters AAF proposals. These called for a "work-horse" missile capable of carrying a 2,000-pound warhead a distance of 150 miles. This type of missile, command personnel felt, would "have the greatest degree of economy, utility and general value as a potential offensive weapon."

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A conference was held in Washington, D. C. during September 1947 to settle the problem of air-to-surface missile characteristics. AMC representatives indicated that a missile could be completed in a relatively short time if Headquarters USAF lowered the requirements. These people estimated that a test missile could be completed before the end of 1948 if the range requirement were lowered to 50 miles and the payload weight were reduced to 2,000 pounds. The conferees decided to leave the Headquarters AAF proposals in the development program and to consider them only as ultimate goals. As a result of the meeting, AMC asked Bell to stop all work on the 150-mile range missile and start developing a missile with a range of 300 miles.

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The Shrike Program

In January 1948, four months after the Washington meeting,
*
AMC split Project MX-776 into two parts. One part, Project MX-776A, called for the development of a test vehicle capable of carrying a 1,000-pound payload for 50 miles. The test vehicle called for under this part of the program eventually became known as the Shrike. The other half of the program, designated Project MX-776B, called for the development of a guidance system which would be capable of directing the Rascal a distance of 100 miles. 17

When AMC informed Bell of the program change, it asked that both programs "be prosecuted simultaneously and with equal emphasis." 18 At the same time, the command established a timetable for the Shrike program. This called for completion of preliminary designs by 1 April 1948, start of fabrication by 1 July 1948, completion of the first missile by 1 March 1949, and start of the flight test program by May 1949. 19 Although the flight test program started on schedule, the first powered Shrike did not fly until May 1950. 20

AMC divided Project MX-776 into two parts in order to provide the Air Force with a tactical air-to-surface missile as quickly

* Project MX-776 was the number assigned to the Bell program for development of an air-to-surface missile. See p. 11.

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and as economically as possible. Command personnel believed that a test vehicle was more economical and easier to produce than the larger, more complicated Rascal. They also felt that the test vehicle would economically produce needed technical information for the Rascal program, and the Shrike could be used as a tactical weapon when fully developed.

In January 1949, one year after Bell started work on the test vehicle, AMC asked the Under Secretary of the Air Force to approve the purchase of 100 Shrike missiles. Headquarters USAF took no action and returned the request because it did not comply with certain required procurement directives. AMC submitted a second request two weeks later. In this, the command asked for permission to purchase 93 Shrikes. As a result, Under Secretary of the Air Force A. S. Barrows authorized the purchase of the 93 test vehicles at an estimated cost of \$6,190,000.

Supplemental agreement No. 5 to contract W33-038 ac-14169 officially authorized Bell to manufacture the test missiles. This agreement, dated 3 March 1949, also contained a Shrike delivery schedule which required the contractor to deliver 12 Shrikes in 1949, 35 in 1950, and 46 in 1951.

Almost two years after authorizing the manufacture of the 93 vehicles, AMC decided that only 50 would be needed for the flight

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test program because of rapid advances in Shrike development.

Command personnel, therefore, asked Headquarters USAF to authorize conversion of the remaining 43 test vehicles into

tactical weapons.²⁷ Washington disapproved the request on the grounds that the Air Force had no requirement for an operational Shrike. At the same time, Headquarters USAF

recommended that AMC procure only 50 test vehicles.²⁸

During the next few months, AMC reduced the program even below the level suggested by Headquarters USAF. One of the primary reasons for this step was a reduction in funds. By

June 1951, the Shrike flight test program consisted of only 31 missiles.²⁹ Bell tested the last Shrike in January 1953.

Return to the Rascal Development Program

Development of a guidance system was the only work directly related to the Rascal performed by the contractor from January 1948 to July 1949. At the end of July 1949, AMC asked Bell to submit a cost proposal for performing various items of work for both the Shrike and the Rascal. One of these items called for the design of a supersonic missile capable of delivering a 3,000-pound payload a distance of 100 to 150 miles.³⁰ After receiving Bell's proposals, AMC wrote supplemental agreement No. 6 to contract W33-038 ac-14169. This agreement, dated

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25 August 1949, authorized Bell to continue its work on the Rascal guidance system and to draw up the necessary preliminary designs. 31

In December 1949 AMC asked Bell to resume work on all phases of the Rascal development program. Two specific items of work listed in the AMC request were: (1) develop a missile capable of carrying a 5,000-pound warhead for 150 nautical miles, and (2) design the missile so it could be carried by either a B-36 or a B-52. Because the B-52 was still in the design stage, AMC suggested that the contractor use what information was available on the airplane as of 1 December 1949. 32

Headquarters USAF made another change in the Rascal development program in February 1950. Washington, in this case, divided the program into two phases. The characteristics listed for each phase were as follows: 33

<u>Requirement</u>	<u>Phase I</u>	<u>Phase II</u>
Range	about 100 n. m.	150 n. m.
Speed	Mach 1.5 to 2.0	Mach 3.0
Warhead	5,000-pound atomic	5,000-pound atomic
Carrier airplane	B-50	B-50 and B-36
Inertial Guidance Systems	desirable	mandatory

Headquarters USAF recommended that the contractor work on both phases simultaneously. It also set January 1954 as the target date for completion of Phase I and July 1955 as the completion date for Phase II. 34

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Four months later Headquarters USAF asked AMC to accelerate the Rascal program. Both phases, Washington indicated, were to be completed six months earlier than the dates listed in February. As a result of the change, July 1953 became the new completion date for Phase I and January 1955 the new completion date for Phase II. Headquarters USAF also listed its desired completion dates for Phase I and Phase II service tests. These were July 1954 and January 1956. ³⁵ AMC indicated that the new dates could be met if Washington allocated sufficient funds to cover ³⁶ the cost of the accelerated program.

The Rascal - B-47 Marriage

Toward the end of 1951 the Air Force realized that changes would have to be made in the Rascal program. This resulted from two factors--the emergence of the B-47 as the Air Force's primary strategic bomber and the belief that local defenses of a potential enemy would be considerably strengthened in the future. The Air Force felt that successful attacks in the future would be possible only if the then existing weapon systems were continuously improved. To meet this challenge, Headquarters, Air Research and Development Command (ARDC), issued a development directive which changed the GAM-63 program in two respects--the B-47 replaced the B-36 as the primary missile carrier, and certain

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engineering changes were made so the missile could be carried by the B-47. ARDC, however, retained the B-36 in the program as the alternate Rascal carrier. WADC personnel informed Bell of the program change at the beginning of March 1952. AMC made the change official one week later.

ARDC called a meeting in Baltimore for late April 1952; representatives from five different organizations attended. The purpose of this meeting was to establish a master plan for the development of the Rascal Weapon System. During the conference, one of the Headquarters ARDC representatives revealed that the program had been divided into three objectives by that command.

Objective I received first priority and called for incorporation of the B-47 as the basic missile carrier, development of a simplified inertial guidance system, development of a terminal guidance system, and initiation of atomic warhead tests. The completion date for this first objective was July 1954.

Objective II, which received second priority, called for incorporation of the B-36 as the basic Rascal carrier and continuation of inertial and terminal guidance system development and warhead

* These organizations were Headquarters ARDC, Headquarters AMC, Headquarters WADC, Headquarters AFMTC, and the 6540th Missile Test Wing.

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tests. The completion date for this objective was December
42
1954.

The last objective received third priority and called for development of alternate warheads, development of a more sophisticated or improved inertial guidance system, and incorporation of the B-52 and B-60 airplanes as missile carriers. The contractor, however, was to expend no special effort on the third objective. Only that information obtained by Bell from its work
43
on Objectives I and II was to be applied to Objective III.

44
Headquarters USAF changed these objectives as follows:

- a. Objective I: Marriage of B-63 with B-47 carrier; (B-63 with single-axis inertial, X-band radar and atomic warhead).
- b. Objective II: Marriage of B-63 with B-36 carrier; (B-63 with single-axis inertial, X-band radar and atomic warhead).
- c. Objective III: Additional warhead capability in the B-63.
- d. Objective IV: Improved terminal radar and mid-course system; possible additional carriers.
- e. Objective V: Completely non-emanating guidance systems for the B-63.

During 1952, before and after the ARDC meeting, some Air Force personnel felt that the usefulness of the Rascal Weapon Sys-
45
tem was marginal at best. One of these was General Curtis E.

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LeMay, Commanding General of the Strategic Air Command. General LeMay disapproved of the Rascal because he felt that other missiles, such as the Snark, had more to offer the Air Force than the Rascal. He also believed that the Rascal presented operational problems so severe that they made its usefulness questionable. ⁴⁶ Other objections that appeared at the time were: (1) the Rascal system imposed penalties on the carrying aircraft, (2) it made the complex B-47 bombing and navigation system even more complicated, (3) the system added \$300,000 to the unit cost of the airplanes selected to carry the Rascal, and (4) it created additional oversea logistic support problems. ⁴⁷

Secretary of the Air Force Thomas K. Finletter was concerned about the objections raised against the Rascal Weapon System. He was especially disturbed by General LeMay's opinions. ⁴⁸ After analyzing the situation, the Air Force Council recommended and the Air Force subsequently approved that one B-47 squadron be eliminated, but that one B-36 and two B-47 Rascal squadrons remain in the Air Force program. ⁴⁹

Basically, there were two reasons for this decision. First, the

* See pp. 62-66.

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penalties imposed by the Rascal on the B-47's performance were not serious. Second, the Rascal would allow the B-47 to deliver atomic warheads at supersonic speeds during a future period of time when this might be the only way that some targets could be reached.
50

The Air Force Council made its recommendations almost two years after the Air Force and Bell entered into a production contract. Bell and the Air Force signed two other contracts at almost the same time the council presented these recommendations. One of these contracts provided for the manufacture of tooling for the Rascal production line. * The second contract called for the conversion of a B-36H airplane into a missile carrier. **

Project MX-776 research and development did not stop nor were all research problems solved by the end of 1952. Bell had not yet concluded the Shrike program, although 29 of the 31 vehicles planned for the program had been tested. No Rascal missiles, however, had been flown. Bell's efforts to improve the GAM-63 continued throughout almost the entire life of the missile. ***

* See Chapter III.

** See Chapter V.

*** These later research phases are discussed in the sections of this history devoted to the various components of the missile. Propulsion system research after 1952, for example, is discussed in Chapter IV. See pp. 41-44.

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III. PROCUREMENT OF MISSILES AND PRODUCTION TOOLING

Rascal Procurement

Letter Contract AF 33(038)-15069

A Bell letter sent to AMC in July 1950 marked the start of the Rascal procurement program. * This letter contained the contractor's cost proposal for the manufacture of 18 missiles and three sets of interim guidance equipment. Bell placed the cost of this limited production program at \$2,254,993.96.¹ After a meeting and an exchange of correspondence had reduced Bell's recommended program, both parties agreed to a letter contract dated 8 August 1950.² It called for the manufacture of three recovery glide missiles, four Rascal missiles, spare parts, and three sets of interim guidance equipment at a cost of \$850,000.³

AMC issued the first two amendments to this letter contract during October 1950. Amendment No. 1 added \$850,000 to the sum initially provided, making the total \$1,700,000.⁴ Amendment No. 2 established a delivery schedule calling for one glide missile each in

* Research failed to reveal whether this letter was preceded by an AMC Request for Proposal.

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April, May, and June 1951. It also called for the delivery of one
6
Rascal each in July, August, September, and October 1951.

Bell objected to this schedule because it did not correspond
to one outlined earlier by AMC. The contractor maintained that
this earlier schedule allowed 11 months for delivery of the seven
7
missiles. Amendment No. 2 provided only seven months. Bell
finally agreed to accept the latter schedule only if it were changed
8
in the definitive contract.

Definitive Contract Negotiations

Contractor and AMC personnel started their definitive negotia-
tions in the fall of 1950. While the negotiators quickly solved the
problem of probable costs, a difference of opinion developed over
the contractor's rate of fee. AMC personnel offered six per cent,
but Bell wanted seven per cent. At a meeting held on 14 November
1950 AMC personnel offered the contractor a compromise fee of 6.5
per cent. The Bell representatives refused the offer and requested
9
a meeting with the AMC Procurement Committee. This meeting
was held the following day.

During the meeting, the Bell officials presented their argu-
ments for a seven per cent fee. They claimed that the company
actually received a profit of only 2.5 to 3 per cent after taxes and
deductions, Bell planned to invest a great deal of money in facilities

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to produce the missiles, and the contract really called for research and development work and not production work. The contractor personnel also stated that Bell had suffered a reduction in its sub-contracting business and that it needed the seven per cent fee to remain in a relatively sound financial position. After hearing Bell's arguments, the committee offered the company a fee of 6.5 per cent.¹⁰

The Bell representatives stated that they did not possess the authority to negotiate a fee of less than seven per cent. They also indicated that this decision could only be made by Bell's Executive Committee.¹¹ Although Bell continued to press for the seven per cent fee after the meeting, the company accepted the 6.5 per cent on 6 December 1950.¹²

Definitive Contract AF 33(038)-15069

The resulting CPFF definitive contract, AF 33(038)-15069, dated 27 November 1950, called for the following items: (1) three mockup missiles, (2) three recovery glide missiles, (3) four powered Rascals, (4) tooling, (5) three sets of interim guidance equipment, and (6) spare parts. The estimated cost of these items was \$2,838,372.28. Bell received a fixed fee of 6.5 per cent (\$184,494.20). The delivery schedule outlined in the contract provided for delivery of the 10 missiles over a 13-month period.¹³

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Procurement under Letter
Contract AF 33(038)-15069

The Air Force did not actually approve the definitive contract until 11 September 1951, ten months after the date listed on it. Bell did not approve it until about one year later. Bell delayed signing the contract because it and AMC could not agree on some of the missile specification changes made by the company. 14

In December 1950 Bell forwarded a cost proposal to AMC for the manufacture of 20 additional missiles. This occurred about three weeks after AMC wrote definitive contract 15069. The contractor also asked AMC to authorize production of these missiles. This authorization, Bell indicated, was needed immediately because valuable manufacturing time had already been lost. The company said "it is questionable whether this time can be made up by extra effort, extreme cooperation from our suppliers, and excellent progress in the Research and Development Program." 15

AMC issued a number of amendments to letter contract 15069 in reply to Bell's requests. Distribution of these amendments covered a time span of 17 months. Command personnel issued the first one in December 1950 and the last one in May 1952. 16 AMC issued these amendments because both parties had not yet approved the definitive contract.

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The amendments authorized the contractor to manufacture 38 additional missiles and certain items of ground support equipment. They also allowed Bell to procure the necessary materials¹⁷ for the eventual manufacture of 16 additional Rascals. Bell, in the area of ground support equipment, received permission to construct the following: (1) 6 missile carriages, (2) 6 sets of missile checkout equipment, (3) 4 sets of B-50 lift ramps, (4) 5 high pressure trailers, (5) 12 sets of hoist slings, (6) 18 field assembly transport skids, (7) 24 field assembly fixture cradles,¹⁸ and (8) 12 sets of component cradles.

Bell disagreed with the requirements listed in amendment No. 9, which called for installation of a final guidance system in¹⁹ all missiles after the 30th. The contractor indicated that his plans did not call for inclusion of final guidance until the 51st missile. After a conference with command personnel, Bell agreed to revise its plans and start developing a final system. Bell emphasized, however, that it still felt a minimum of 51 missiles with interim guid-²⁰ance should be used in the Rascal program.

Procurement under Definitive
Contract AF 33(038)-15069

AMC and Bell personnel held numerous conferences between December 1950 and December 1952 to negotiate supplemental agreements for basic contract 15069. Command personnel wrote six

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supplemental agreements during this 23-month period. The definitive contract and these supplements did not replace the letter contract and its amendments as the official contractual documents, however, until AMC issued supplemental agreement No. 6. The delay was caused by Bell's failure to sign the definitive contract until just before AMC issued this agreement, which was dated 10
21
November 1952 and approved on 9 February 1953.

By the end of 1952 the AMC Rascal procurement program called for the manufacture of 48 missiles. This included the 10 contracted for in the definitive contract and the 38 called for by supplemental agreements No. 1, No. 4, and No. 6. The program also called for the procurement of materials for 26 additional missiles. This placed the total number of Rascal missiles to be manufactured by Bell at 74, representing an increase of 10 missiles over the number called for by the replaced letter contract and its amendments.

In the years after 1952 AMC issued three more supplemental agreements which provided for the manufacture of Rascals. Supplemental agreement No. 7, dated 16 March 1953, authorized Bell
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to manufacture five missiles. It also allowed the contractor to
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purchase the necessary materials for 40 additional missiles. Supplemental agreement No. 10, dated 30 June 1953, called for 61

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24
missiles. This agreement provided for the greatest single procurement in the Rascal program. Supplemental agreement No. 47, 25
dated 21 December 1956, authorized the manufacture of 22 missiles. This brought the total number of Rascals to be manufactured by Bell to 136.

Procurement of Production Tooling and Materials

Initial Procurement

In October 1950 Bell informed AMC that it needed special tools and equipment. The contractor stated that these materials were necessary for the successful completion of Project MX-776 research and development. AMC, however, decided that this equipment should be procured under the terms of a production rather than a research contract. 26
As a result, command personnel wrote amendment No. 3

to letter contract 15069. This amendment, dated 24 October 1956, allowed the contractor to manufacture or procure special equipment up to a cost of \$200,000. 27

Letter Contract AF 33(038)-20402

In December 1950, two months after AMC authorized Bell to procure special equipment, the contractor prepared a cost proposal for creating the Rascal production line. The company placed the cost at \$1,206,746.27 for the first eight months of 1951. 28
Bell's cost proposal covered only an eight-month period because the company

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understood that funds for this type of work were limited. This
problem of limited funds for production tooling appeared later
during definitive contract negotiations and again in 1954.

AMC issued letter contract AF 33(038)-20402 on the last day
of January 1951. This contract allowed Bell to begin its prepro-
duction planning, design, manufacture, and procurement of tools
and machinery. It also required the contractor to formulate the
necessary methods and processes for the production of 20 missiles
per month on a one-shift basis. The letter contract's time schedule
listed 31 December as the completion date for the production line.
This gave the contractor 11 months' time. The letter contract allo-
cated \$940,000 for this work and the necessary equipment.

Definitive Contract AF 33(038)-20402

Bell and AMC negotiated for almost two years before agreeing
on terms of a definitive contract. At first, Bell had difficulty in
estimating the cost of the production planning and tooling programs.
A second problem encountered during the negotiations was the lack of
funds to cover Bell's program. Later on, command personnel felt
that Bell's estimates were too high. The parties finally solved
their differences in November 1952.

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The definitive CPFF contract was dated 10 December 1952 and approved on 9 January 1953. It required Bell to perform five tasks--redesign the Rascal to allow the production of 20 a month on a one-shift basis and 50 on a three-shift basis, develop missile production methods and techniques, manufacture or procure all necessary tools for the production line, design and manufacture all necessary test equipment, and submit progress reports.

37

*

The contract allocated a total of \$8,190,999.26 for the work.

38

This figure included Bell's fixed fee of 5.5 per cent.

In February 1954 AMC asked Bell to reduce its monthly missile production capability. The new rate fixed production at four missiles a month on a one-shift basis and six per month on a multi-shift basis. Fund difficulties were again encountered and Bell used its own money for almost two months to keep the tooling program alive. AMC reimbursed Bell and, at the same time, requested that all future price quotations be submitted on a monthly basis.

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* The contract placed the estimated cost of the five items at \$7,763,980.34. This figure plus Bell's fixed fee of \$427,018.92 made the total \$8,190,999.26. The estimated cost figure listed in the contract represented 100 per cent of the cost and fixed fee of four of the items, but only 86.65 per cent of the estimated cost and fixed fee for the other item. The amount allocated by the contract, therefore, represented only 97.33 per cent of the expected total cost.

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IV. PRODUCTION OF RASCAL MISSILES

Delivery Schedules and Changes

As noted earlier, production contract AF 33(038)-15069, dated 27 November 1950, authorized the manufacture of 10 missiles and three sets of interim guidance equipment.¹ The contract specified that the 10 missiles would consist of three mock-up models, three recovery glide missiles, and four powered vehicles. It scheduled delivery of the first Rascal for 28 February 1951 and the last one for 31 March 1952.² Bell delivered the first missile on 6 July 1951 and the last one on 5 February 1953.^{*} The contractor, therefore, actually delivered the last missile almost one year after the date specified in the contract.

AMC issued supplemental agreement No. 1 sixteen months after writing the contract. This supplement, dated 5 March 1952,³ authorized the manufacture of 20 missiles. Command personnel distributed supplemental agreement No. 4 five months later. It called for 15 additional missiles.⁴ The schedules in the contract and these two supplements specified the following Rascal deliveries:⁵

* See Appendix E.

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Table I
Delivery Schedule for First 45 Rascals

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951		1	1	0	1	1	0	1	0	1	0	0	6
1952	1	1	2	0	0	0	0	0	0	0	0	2	6
1953	2	2	2	3	2	2	2	2	1	3	4	4	29
1954	4												<u>4</u> 45

AMC issued still a third supplemental agreement in 1952 calling for the production of Rascal missiles. This was supplemental agreement No. 6, dated 10 November 1952. It authorized the contractor to manufacture three missiles and procure all necessary materials for the eventual production of 26 additional Rascals. It contained a schedule which listed the delivery dates for the 48 missiles Bell was authorized to produce and the 26 for which the company was to procure materials. In addition, it made slight changes in the schedules published in earlier supplements. The new schedule was as follows:

Table II
Missile Deliveries According to S. A. No. 6

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951		1	1	0	1	1	0	1	0	1	0	0	6
1952	1	1	0	0	0	0	0	0	0	0	1	0	3
1953	1	1	2	1	2	3	4	3	4	3	4	4	32
1954	5	5	6	7	7	3							<u>33*</u> 74*

* Includes the 26 for which only materials were to be procured.

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Although this schedule called for completion of the 48 missiles by February 1954, Bell actually delivered only 16. The contractor did not complete the 48th missile until August 1955, one and one-half years behind schedule.

After 1952, AMC issued three more supplemental agreements for the manufacture of additional Rascals. These were No. 7 dated 16 March 1953, No. 10 dated 30 June 1953, and No. 47 dated 21 December 1956. The schedules were as follows:

Table III
S. A. No. 7 Delivery Schedule
(5 missiles - material for 40)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
1954						4	8	7	7	7	7		40

Table IV
S. A. No. 10 Delivery Schedule
(61 missiles)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1954						2	7	5	6	6	7	9	42
1955	9	8	2										19
													61

Table V
S. A. No. 47 Delivery Schedule
(22 missiles)

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
1958		1	4	3	3	3	3	3	2				22

* See Appendix E.

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The Rascal procurement program remained stable for the three and one-half years between supplemental agreement No. 10 and supplemental agreement No. 47. The command had distributed five documents which authorized the production of missiles before it released supplemental agreement No. 10 in June 1953. These five documents, together with supplemental agreement No. 10, provided for the manufacture of 114 missiles. This number did not increase until AMC issued supplemental agreement No. 47 in December 1956.

The schedules in the contract and supplements which provided for the 114 missiles called for delivery of the last one in September 1954. In February 1954, however, AMC authorized a schedule change which listed March 1956 as the delivery date for the 114th missile.⁹ This new date extended the original schedule by 18 months. Nine months later, in November 1954, AMC issued another schedule change. This one authorized delivery of the 114th missile in January 1957, slipping the delivery date for the 114th missile an additional 10 months.¹⁰

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Table VI
Original Rascal Delivery Schedule

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951	0	1	1	0	1	1	0	1	0	1	0	0	6
1952	1	1	0	0	0	0	0	0	0	0	1	0	3
1953	1	1	2	1	2	3	4	3	4	3	4	4	32
1954	5	5	6	7	7	9	15	12	13	13	14	9	115*
1955	9	8	2	0	0	0	0	0	0	0	0	0	19
1956	0	0	0	0	0	0	0	0	0	0	0	0	0
1957	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	0	1	4	3	3	3	3	3	2	0	0	0	22
													<u>197</u>

Table VI lists in consolidated form the delivery schedules included in the contractual documents. It reflects changes made in earlier schedules by later supplements. For example, supplemental agreement No. 4 changed the delivery schedules listed in the contract and supplemental agreement No. 1. The table does not list these earlier schedules, but it does include the schedule which appeared in supplemental agreement No. 4.

Although the table calls for a total of 197 missiles, AMC bought only 136. One reason for this difference is the fact that supplemental agreement No. 6 authorized the manufacture of three missiles and the procurement of materials for 26.

* This figure includes the 66 missiles for which Bell was to procure materials. It is actually five less than what it should be. This occurred because supplemental agreement No. 7 called for a total of 45 missiles, but its delivery schedule listed only 40.

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The supplement's delivery schedule included all 29 missiles. A second reason for the difference is that supplemental agreement No. 7 called for a total of 45 missiles, but the delivery schedule accounted for only 40. Adding five missiles to the total listed in Table VI produces a new total of 202. Subtracting the 66, for which only material was to have been procured, from the new total of 202 gives the actual total of 136.

Table VII
Revised Rascal Delivery Schedule

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951	0	0	0	0	0	0	1	0	1	0	0	1	3*
1952	3	0	0	0	0	0	0	0	2	0	0	1	6*
1953	0	1	0	0	0	1	0	0	1	0	0	3	6*
1954	1*	0	2*	0	1*	1*	1*	2*	0	3*	3	2	16
1955	2	3	3	3	4	3	4	3	4	3	4	3	39
1956	3	3	3	3	3	4	4	4	4	4	4	4	43
1957	1	0	0	0	0	0	0	0	0	0	0	0	1
1958	0	1	4	3	3	3	3	3	2	0	0	0	22**
													136

Table VII lists the missile deliveries authorized by the change made in November 1954. It also includes the 22 missiles procured by supplemental agreement No. 47. A comparison of this table with Table VI shows how the changes AMC authorized

* Bell delivered these 26 missiles before 1 November 1954 in the months indicated in the table.

** These were the 22 missiles called for by supplemental agreement No. 47, dated 21 December 1956.

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in 1954 expanded the delivery schedule for the first 114 missiles. The numbers marked by a single asterisk indicate those missiles Bell delivered before the November 1954 change.

Production Problems and Delays

Changes in Missile Characteristics

Changing requirements led to delays in the Rascal production program. Near the end of 1949 when Bell returned to full-scale Rascal development, the Air Force wanted a missile with the following characteristics: (1) capable of carrying a 5,000-pound payload, (2) a range of 150 nautical miles, and (3) capable of being carried and launched by either the B-36 or B-52 airplane. 11

Early in 1950 Headquarters USAF divided the Rascal development program into two phases. Phase I called for a missile with a range of 100 nautical miles, a speed of Mach 1.5 to 2.0, and a 5,000-pound payload capability, while having the additional capability of being carried by a B-50 airplane. 12 The Phase II program called for a missile with a range of 150 nautical miles, a speed of Mach 3.0, and a 5,000-pound payload capability, to be carried and launched by either the B-50 or B-36 airplane. 13

Toward the end of 1951 the Air Force introduced the B-47 14 into the Rascal program as the primary missile carrier. As

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a result, the contractor had to make changes in the missile to adapt it to the Stratojet.

In the middle of 1952 Headquarters USAF outlined a Rascal development program with five objectives. Basically, these objectives were a B-47/GAM-63 combination, a B-36/GAM-63 combination, development of alternate warheads for the Rascal, development of improved inertial and terminal guidance systems and incorporation of new carriers into the program, and development of a completely non-emanating guidance system. ¹⁵

The program remained stable for three years. In the middle of 1955, however, Headquarters USAF made another change. This one called for the cancellation of objectives III, IV, and V; cancellation of the objective II Operational Suitability Test (OST) Program; cancellation of the DB-36/GAM-63 operational squadron; orientation of all work on objective II toward expediting completion of objective I; and establishment of objective VI. ¹⁶ The new objective VI called for development of a Rascal with an extended range.

This reorientation forced AMC and WADC to stop the Rascal development program so it could be re-evaluated, reorientate the flight test program, incorporate about 70 changes in existing guidance equipment, and modify director aircraft. ¹⁷ As a result,

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missile deliveries, director aircraft deliveries, squadron augmentation, and the OST program were delayed.¹⁸

Delays Produced by the R&D Program

The Rascal production and development programs were closely allied. The development program used almost three-fourths of all the missiles produced. In July 1952 WADC estimated that 94 Rascals would be needed for the research and development phase.¹⁹

It also estimated that the 94th article would be tested in December 1954.²⁰ A little over two years later, in August 1954, the Air

Force reduced the number of missiles to be used in the development program to 74.²¹ The Air Force listed April 1956 as the delivery date for the 74th Rascal.²² The contractor did not deliver the 74th Rascal until January 1957 and the 94th until December 1957.^{*}

Early Delays. Bell analyzed the results of each flight test and made whatever engineering changes were necessary in the next missile. Therefore, practically all of the early articles were entirely different.²³ This program of continuous change delayed the production of early Rascals.

The lack of suitable gyroscopes also delayed the contractor's first research and development efforts. In June 1951 WADC

* See Appendix E.

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personnel pointed out that, in addition to the small number available, the late delivery of gyroscopes had delayed the flight test

24

program. Six months later WADC indicated that other factors,

primarily propulsion and guidance difficulties, were holding up

the development program. Gyroscopes were held to be only a

25

contributing factor.

Propulsion System Difficulties. Bell encountered propul-

sion development problems during a large part of the Rascal

production program. At the start of Rascal development in

26

1946 the contractor worked only on turbojet power plants.

Later, when evaluating all possible power plants, Bell listed

ramjet engines as least desirable. AMC, however, listed the

27

ramjet as most desirable. The command placed the rocket

engine in second place and put the turbojet at the bottom of the

28

list.

In the fall of 1947 it appeared that a rocket power plant

would be needed to propel the missile. Both AMC and Bell

agreed that the Rascal's weight and range requirement pointed

to the use of rocket propulsion. Bell requested AMC's permis-

sion to secure bids for the development of the necessary rocket

29

power plant.

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At the beginning of 1948 Bell asked AMC for approval to build three rocket test cells. These cells, the company indicated, were needed for the development and testing of rocket engines.³⁰ AMC replied that it could not approve Bell's request. The command pointed out that it "did not regard with favor" the idea of airframe manufacturers producing power plants.³¹ All necessary engines, the command indicated, would be provided as Government Furnished Equipment (GFE). AMC also asked the company to stop all rocket research being performed under the terms of contract W33(038) ac-14169.³²

Bell immediately discontinued its rocket engine research and development work.³³ However, it stated that it did not understand AMC's attitude, since the company had worked for years on this type of research.³⁴ In addition, the company pointed out that it was already recognized as a well-established producer of rocket engines. AMC changed its attitude in September 1948 and gave Bell full responsibility for developing the Shrike's liquid rocket motors.³⁵

Two years later, in September 1950, Bell placed a subcontract with the Aerojet Engineering Corporation which called for the development and production of pump-drive assemblies. These assemblies formed an integral part of the Rascal's rocket

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engine. The subcontract, No. 314, dated 1 September 1950, provided for the production of three assemblies. Bell subsequently placed two additional subcontracts with Aerojet raising the total on contract to 67.

However, Aerojet encountered development difficulties which delayed production and raised costs. These technical difficulties affected the company's delivery of pump assemblies. The original schedules in the subcontracts called for the following:

Table VIII
Original Delivery Schedule for Pump Assemblies

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951	2	0	0	4	2	3	2	0	3	4	6	6	32
1952	7	7	7	7	7								35
													67

Bell revised this schedule at the beginning of 1952. The change placed delivery of the last unit 10 months behind the date originally scheduled. The new schedule called for the following:

Table IX
Revised Delivery Schedule for Pump Assemblies

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1951	0	0	0	0	0	0	0	0	0	0	0	1	1
1952	5	4	2	0	0	1	3	4	6	6	7	7	45
1953	7	7	7										21
													67

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Difficulties with the Aerojet turbine pump continued to harass
the Rascal development program as late as November 1955. The
late delivery of pumps still held up the production program in Octo-
ber 1954. Bell finally completed a successful test of the LR67-
BA-9 engine in August 1956.

Guidance System Difficulties. The Rascal characteristics
released in July 1945 listed three possible types of guidance sys-
tems. Contract 14169, dated 14 October 1946, listed the same
three types mentioned in the characteristics. The three types
were an independent system, a remote control system, and a
combination of the two.

Headquarters USAF specified director aircraft or remote
control for the Rascal in the July 1947 characteristics. AMC
personnel, however, recommended that the Air Force place pri-
mary emphasis on a preset or independent system. They
suggested that the director aircraft system should receive only
secondary consideration.

The Air Force did not accept the AMC suggestion, for the
command asked Bell to develop a radar relay or remote system
in January 1948 at the time it divided the Rascal development
program into two parts.

* Research failed to produce any documents which contained
Headquarters USAF's disapproval of the recommendation.

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Bell started two separate development programs to construct the required relay system. The first was for development of a system for successfully sending a radar picture from the missile to the director aircraft. The Air Force wanted a system capable of transmitting the picture at least 100 miles. The other program aimed to develop a method for producing clear pictures of the target area in the director aircraft. Air Force requirements stated that the system had to permit target identification in adverse weather. These requirements also called for a system that would allow this identification when the missile was at least 25 miles from the target.

In February 1952 ARDC changed the Air Force position on Rascal guidance. It requested that emphasis be placed on developing an inertial or independent system rather than the remote system. ARDC indicated that the relay system could be used, but only for the terminal portion of flight, and allowed the relay system to remain in the program so that Bell could meet existing schedules. The command pointed out that the Bell-developed inertial system had to be compatible with the "K" series bombing and navigation system. It also stated that modifications to the "K" system had to be held to a minimum.

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AMC had prepared for the change in guidance systems almost two years before it actually occurred in February 1952. Command personnel had issued supplemental agreement No. 8 to research contract 14169 in June 1950. Among other things, No. 8 called for a study leading to the development of an inertial guidance system. 56

Three years after it issued No. 8, AMC issued supplemental agreement No. 18 dated 12 May 1953 and approved 26 June 1953. It provided for the design and manufacture of three director aircraft terminal guidance systems, manufacture of three spare systems, construction of production tooling and test equipment, and the engineering design for modification of eight bombing- 57 navigation computers. The supplement called for delivery of one terminal guidance system each on 1 November 1953, 1 58 December 1953, and 1 January 1954. It listed 1 February 1954, 1 March 1954, and 1 April 1954 as the delivery dates for 59 the three spare systems. The agreement also contained a delivery schedule for the eight computers. This schedule listed only two dates--November 1953 as the delivery date for the first 60 unit and April 1954 for the last one.

Production contract AF 33(038)-15069, dated 27 November 1950, provided for the manufacture of three interim guidance 61 sets. Supplemental agreement No. 9, dated 29 May 1953,

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authorized the manufacture of 34 B-47B and 22 B-36F director
62
aircraft guidance systems. Spares accounted for 28 of the 56
systems. The supplement also authorized the contractor to supply
63
tools and additional equipment for the 56 guidance systems.

Supplemental agreement No. 9 contained three separate de-
livery schedules. The first outlined the delivery dates for 17
64
B-47B guidance systems as follows:

Table X
B-47B Guidance System Delivery Schedule

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Totals</u>
1954	0	0	0	0	0	0	0	0	2	1	0	1	4
1955	3	3	2	2	3								<u>13</u> 17

The second schedule listed the delivery dates for 11 B-36F guid-
ance systems as follows:

Table XI
B-36F Guidance System Delivery Schedule

	<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>	<u>Total</u>
1954	0	3	3	1	2	1	1	0	0	0	0	0	11

The last delivery schedule dealt with the 28 spare systems called
for in the supplement. This schedule did not list specific delivery
dates; it authorized delivery of the first spare system on 15 July
65
1954 and the last one on or before 1 May 1955.

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In October 1953 AMC received informal information from contractor personnel that guidance system deliveries would be delayed. This occurred only five months after the command issued supplemental agreement No. 9 which authorized production of the guidance units. AMC asked Bell to verify the information and submit a new schedule.

Bell subsequently informed the AMC that guidance system deliveries would be delayed. It indicated that the last unit would not be delivered until December 1955, seven months behind schedule. The contractor said the delay was caused by three factors-- AMC had failed to sign and issue contractual documents on time, the company had miscalculated the time needed to transfer a system from engineering to production, and Bell had underestimated the time needed by subcontractors for ordering materials and manufacturing components.

Bell requested and AMC authorized a number of schedule changes after November 1953. By October 1955 AMC had authorized delivery of the last unit in October 1956. In February 1956 AMC again changed the delivery dates for the guidance systems, allowing Bell to deliver the last unit in April 1957. It slipped the original delivery date in supplemental agreement No. 9 almost two years.

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The Strategic Air Command objected to the design of certain components soon after Bell began to manufacture the guidance system. SAC requested that the contractor redesign the tracking handle system to eliminate unnecessary operator confusion. ⁷²

Also, SAC objected once again to the Rascal Weapon System. *

On the one hand, the command indicated that it did not want the Rascal in its inventory; on the other hand, it requested that the change be made to increase the weapon's effectiveness. ⁷³ SAC wanted the best weapon possible until the Air Force officially cancelled the program.

Funding Problems

Early Overrun in Production Funds. Bell notified AMC early in 1952 that the company needed more funds than it had requested to manufacture the first few missiles. ⁷⁴ A few months later AMC gave Headquarters USAF an indication of how badly Bell had underestimated actual costs. The command pointed out that the contractor had underestimated direct labor hours by 210 per cent, tool labor hours by 350 per cent, tool design labor hours by 123 per cent, direct material costs by 2.2 per cent, tool material costs by 909 per cent, and direct expense

* For SAC's first objection, see pp. 20-21.

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costs by 169 per cent. The average for the six categories was

293.8 per cent. In addition, Bell had overestimated engineering

76

labor hours by 16.8 per cent.

The company did not offer any concrete evidence to AMC to explain its error. However, it did list three possible reasons.

First, the company's engineering department underestimated the weight of the airframe by 1,900 pounds. Second, the company

underestimated the cost of installing and modifying missile electronic systems. Third, the company based tooling costs on

77

producing a 1,800-pound airframe and not one of 3,700 pounds.

78

Bell summarized its position on the overrun as follows:

... our original conception of the missile was that it was quite simple in structure and light in weight, serving only as a container for complicated and intricate mechanisms. We have subsequently learned that this was not the case, but that this missile is a complex and expensive airframe requiring far more precision and manpower input than the average airframe required for fighters. We further believe that an average cost of approximately \$85.00 per pound is not unreasonable for this type of work.

An AMC representative discussed the problem of overrun with Bell officials immediately after the contractor asked for more money. These conferences verified that the reasons offered by the contractor did cause some of the overrun. They also produced two other possible reasons for the higher production costs. These new factors were

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poor coordination among the various departments at Bell and de-
lays in the development and production programs. The AMC

representative concluded his report on the conferences as
follows:

In conclusion the undersigned would like to go on record as stating that his general opinion leads him to believe that the Contractor [sic] was so anxious to obtain a contract for the building of these missiles and the related components of equipment that they were willing to agree to do almost anything as well as sign almost anything in order to commit the Government so as to assure continuance of this program. It also seems to be the feeling of the undersigned that a feeling exists in the Field Office that Washington is "missile minded" and the Government will bail all missile producers out of any financial difficulty as they have previously bailed such contractors out of difficulties on similar projects in the past.

AMC issued change order No. 3 to contract 15069 to cover the overrun. This order, dated 15 January 1952, added \$2,806,820.55 to the contract. It was given Air Force approval on 19 March 1952.

Shortage of Fiscal Year 1953 R&D Funds

A second funding problem appeared a few months after AMC disposed of the overrun situation. It resulted from the lack of sufficient Rascal development funds for Fiscal Year 1953 which WADC feared would prevent the Rascal from meeting its planned operational dates. WADC informed ARDC of this situation in July 1952. The

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center also offered a solution to the problem. It proposed that
AMC support the development program with production funds.
WADC placed the cost of this support at nine million dollars.

ARDC presented the problem to Washington. Headquarters USAF, in turn, attempted to secure the funds from the Department of Defense.

In October 1952 WADC placed Fiscal Year 1953 Rascal costs at 31.575 million dollars. The center indicated that it needed 8.025 million of the 31.575 million dollars for various development programs. Lack of funds, WADC pointed out to ARDC, would not only delay Rascal research and development, but the entire procurement program. WADC also reported that the amount of delay would depend on the amount of money provided for development.

WADC asked Bell to prepare cost estimates for reduced development programs. The center made these requests in October 1952 and again in December. In December the center asked for a cost estimate after the contractor terminated 24

* Headquarters USAF apparently did not receive the requested funds from the Department of Defense, for WADC later asked Bell to reduce its development program. However, research failed to produce any concrete evidence to substantiate this.

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projects, limited the scope of five, and transferred the costs of 10
90
projects to director aircraft production contracts. Two months
later WADC stopped all work on 10 projects and limited the scope
91
of 10 more. The center pointed out that Bell's Fiscal Year 1953
92
costs were not to exceed 22.602 million dollars.

Lack of Fiscal Year 1955 Funds

During an ARDC meeting at Wright Field in January 1954,
AMC personnel predicted that research and development funds
for Fiscal Year 1955 would fall 1.5 million dollars short of the
93
required amount.

Research contract 14169 expired on 15 October 1954 and
AMC planned to issue a new contract to replace the old one.
94
However, Bell and the command could not agree on terms.
Consequently, AMC issued letter contract 14169 designated
supplemental agreement No. 28 as a temporary measure. This
supplement, dated 15 October 1954, allocated 7.5 million dollars.
It allowed the contractor to continue his development efforts from
95
15 October 1954 through 1 January 1955.

Bell and AMC representatives met in the middle of Decem-
ber 1954 to discuss development costs for 1955. AMC personnel
discovered during the conference that Bell's estimates were con-
96
siderably higher than the 23.809 million dollars available.

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Command personnel estimated that 8.837 million dollars more
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were needed to meet Bell's estimates. The AMC decided to
reduce the contractor's development efforts in 1955 to the level
98
allowed by available funds. WADC agreed that no other alter-
99
native existed. It recommended that AMC "Purchase all work
under Objective I and II and approximately 1.5 million under Ob-
jective V for that length of time which present authorized funds
100
will permit. "

In February 1955 AMC criticized Bell for the way it had
101
managed two financial aspects of contract 14169. First, Bell
had failed to notify the Air Force on schedule that an overrun
102
would occur on Fiscal Year 1954 funds. Second, it criticized
the manner in which Bell had presented the cost estimates for the
103
period from 16 October 1954 through 31 December 1955. AMC
pointed out that the company had estimated the cost of the develop-
ment program at \$27,519,955.87 during early negotiations. How-
ever, the company had placed the cost of the program at about 33
million dollars during negotiations held on 16 December 1954.
AMC objected to the fact that Bell had informed no one before
the December meeting that costs would rise above the 27.5 mil-
104
lion dollar figure. The command admonished Bell as follows:
105

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Appropriated funds today require close budgetary controls within the Defense Department. Timely and reasonably close estimating are prerequisites to effective control. It is requested that this matter be brought to the attention of the appropriate people in your organization in order that corrective action may apply in the future.

Bell answered the AMC criticism immediately. Although the company admitted that it had not forwarded "distinct and separate advice" that a funds overrun would occur, it claimed that monthly financial reports sent to the AMC had supplied the necessary information. ¹⁰⁶ The contractor also indicated that Air Force

requirements had raised the estimate from 27.5 to 33 million ¹⁰⁷ dollars. Bell cited the Air Force requirement that the estimate be based on completing items of work as an example. Past estimates had covered only periods of time and not item completion. New items of work introduced by the Air Force after the early conferences, ¹⁰⁸ Bell stated, had also increased costs. ¹⁰⁹ The company summarized its position as follows:

In this negotiation the work requested by the Air Force obviously was going to cost more than the Air Force could fund at the moment. In recognition of this, we willingly agreed to an arbitrary reduction of 5% in our quotation, and also agreed to operate under partial financing. We thus assumed a financial management burden not ordinarily placed on a contractor.

The management of Bell Aircraft Corporation is keenly aware that appropriated funds, as you say, today require close budgetary controls within the Defense Department. This has been regularly and repeatedly called to the attention of our various operating department heads, together with the reminder that Defense Department budgetary controls in turn depend to a great extent upon correspondingly efficient and effective controls by the various contractor companies. We recognize further, that a significant factor in these budgetary controls is timely and reasonably close estimating.

AMC wrote a new research and development contract at the end of 1955 to replace contract 14169. Actually, the command had wanted to write the contract one year before. This contract, AF 33(600)-31948, dated 1 January 1956, allocated \$22,038,774.94 for improvements in the Rascal Weapon System.

Rascal Funding, Fiscal Years 1957 and 1958

Headquarters USAF established a Fiscal Year 1957 ceiling of 19.433 million dollars for the Rascal program. ARDC personnel at Wright Field, on the one hand, recommended that the Rascal program not be cut to meet the ceiling, but, on the other hand, they outlined a limited six-month program that met ceiling requirements. This program consisted of six different items. It provided for a production stretch-out and limited product improvement. It also

* See p. 53.

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confined Bell's development and production efforts to the first half
113

of Fiscal Year 1957. ARDC Detachment No. 1 placed a price
tag of over 26.6 million dollars on continuation of its program
114
over the last half of the fiscal year.

Two months later, in July 1956, the detachment indicated
that completion of the Rascal Weapon System would require 67
115
million dollars. The detachment placed Fiscal Year 1957
116
costs at 53.5 million dollars. Completion of the 22 Rascals
procured in Fiscal Year 1956 required 17.75 of the 53.5 million
117
dollars. Research and development support and product im-
118
provement required the remaining 35.75 million dollars.

The detachment also indicated that a total of 13.5 million dollars
from Fiscal Year 1956 funds could be applied to Fiscal Year 1957
119
costs.

In January 1957 Headquarters USAF directed AMC to cancel
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all product improvement. In the middle of March 1957 the
command started, stopped, and again started to terminate portions
of research contract 31948. It started to terminate the contract on
11 March, stopped it on 19 March, and started it again on 21
121
March. During the third week in April 1957 AMC started to
122
terminate portions of production contract 15069.

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The ARDC detachment at Wright Field pointed out in August 1957 that contract 31948 established performance requirements.

It pointed out that Bell had met all but the repeatability, warhead

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testing, and operational mission requirements. The detach-

ment also indicated that the Rascal could not be depended upon

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under operational conditions. It evaluated the weapon system

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and Bell's efforts as follows:

Based on the contractor's past flight test performance with the Weapon System and this Command's knowledge of the design short comings inherent within the present configuration, it is our opinion that no major improvement in the flight test performance of the Weapon System can be expected by the completion of R&D thus the operational dependability of the Weapon System will be very marginal. It has been our opinion that only by major subsystem redesign and simplification could the Weapon System performance reach the desired operational proficiency. Individual developments to overcome these system deficiencies were directed by the Air Force and undertaken by the Contractor. By Hq USAF direction in May of this year all redesigns, with the exception of the engine conversion to Red Acid, were terminated.

In summation it is our opinion that the contractor has performed satisfactorily under the terms of his contract and the present configuration of the Weapon System is being built to as high a quality and performance standard as the design will permit.

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In 1957 AMC estimated that an expenditure of 12.3 million dollars during Fiscal Year 1958 would complete the Rascal program. ¹²⁶ The command and Bell negotiated a work program for that amount.

Increased overhead and labor rates, production stretch-out, and test program difficulties doubled the estimated Fiscal Year 1958 costs. Final costs came to 24.7 million dollars for the year. ¹²⁷ The command applied the 12.3 million dollars provided for Fiscal Year 1958 and 2.3 million dollars from reprogrammed Fiscal Year 1957 funds toward the 24.7 million dollar cost. ¹²⁸ This left a balance of 9.9 million dollars.

The command asked Headquarters USAF to provide the 9.9 million dollars in Fiscal Year 1959. AMC explained that it needed 5.5 million dollars to complete missile production, 0.7 million dollars for sustaining engineering, 3.3 million for tooling maintenance, and 0.4 million for technical data. ¹²⁹ The Rascal program also required about 8.9 million dollars for spare parts and ground support equipment. ¹³⁰ Contract termination, the command pointed out, would cost the Air Force 6.0 million dollars. ¹³¹ On the other hand, program completion required only 50 per cent more funds than contract termination. Failure to fund the program, AMC ¹³² stated, would result in the following:

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First, we are forced to admit publicly that the United States Air Force is unable to perfect an air-to-surface missile inspite [sic] of the news reports, pictures and publicity that has [sic] been given to the program already. The contractor, Bell Aircraft Corp., stops all work on 14 July 1958. The missile production ceases with the June deliveries. Test support by the contractor ceases. A redirection of the program is required.

In October 1958 SAC again recommended to Headquarters USAF that the Rascal program be terminated. Headquarters USAF approved the recommendation and instructed AMC to phase-out the program. 133

It requested that a Rascal operational capability be maintained only for a limited period of time. 134 The program came to an end during

the first week in December 1958. * At that time Headquarters USAF directed AMC to terminate the Rascal program immediately. 135

Headquarters USAF instructed the command to dispose of missiles, spares, and associated equipment as soon as possible. 136

* For Rascal research, production, tooling, and modification of director aircraft costs, see the totals listed after each contract in Appendices B, C, and D.

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V. MODIFICATION OF CARRIER AIRPLANES

The original July 1945 Rascal characteristics did not specify¹ any particular airplane as a carrier. However, in the years that followed the Air Force listed almost every heavy bomber in its inventory as a possible carrier. This "parade" started in April 1946² when letter contract 14169 specified the B-29. This research and development contract was the first that AMC issued in the Rascal program. A little over three and one-half years later, in December 1949, the Air Force selected the B-36 and B-52.³ This was the first time that the Air Force had designated the B-36. The Air Force made another change just two months later. In February 1950 the B-50 replaced the B-52.⁴ The B-36 remained in the program. Early in 1952 the Air Force made its last change when it named the B-47 as the primary Rascal carrier and the B-36 as⁵ the Stratojet's alternate.

The B-36

On 7 July 1952 AMC took its first step toward providing the Air Force with a B-36/Rascal combination. This occurred about two and one-half years after the Air Force listed the airplane as a possible carrier. The command and Convair entered into letter

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contract AF 33(600)-21997 which called for wind tunnel tests, a B-36 cabin and aft bomb bay mock-up, conversion of one B-36⁶ into a Rascal carrier, and maintenance of the airplane.⁷ The contract allocated \$500,000 for the work.⁸ It specified 1 January 1953 as the delivery date for the converted B-36.

Convair and AMC entered into a definitive CPFF contract on 15 December 1952. It called for the same items of work⁹ listed in the letter contract and carried the same number.¹⁰ It allowed Convair to spend \$2,551,958. Also, it changed the 1 January 1953 delivery date to 1 September 1954.¹¹ However, this new delivery date did not remain firm very long. Two months after it had distributed the definitive contract, AMC¹² specified a new date of 1 June 1954.

AMC called for 11 more modified B-36 airplanes on 17 April 1953.^{*} Both Convair and the command agreed to a schedule which called for their delivery from May 1954 through¹³ December 1954. The command changed this schedule in¹⁴ January 1954 to allow the contractor to deliver three airplanes¹⁵ in June 1955 and the remaining nine before June 1956.

* These airplanes were called for by letter contract AF 33(600)-21997 designated supplemental agreement No. 2. This supplement was replaced by a later supplemental agreement No. 2. The latter agreement was dated 18 February 1955.

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Six months later, in June 1954, the command again slipped the B-36 delivery dates because of delays in the Rascal development program.¹⁶ These delays removed the need for completed airplanes on the earlier dates. This new schedule called for delivery of the first B-36 in December 1954 and the last in March 1957.¹⁷

AMC terminated almost all of contract 21997 on 7 July 1955.¹⁸ It cancelled most of the contract in order to carry out the program reorientation ordered by Headquarters USAF the preceding month.^{*} The command allowed Convair to complete three airplanes, and removed the remaining nine from the program.¹⁹ On 12 July 1955 AMC confirmed this termination.²⁰ Convair returned 1.6 million dollars to the Air Force as a result of the termination.²¹

The B-47

Boeing and AMC entered into a \$500,000 letter contract (AF 33(038)-22108) two weeks after the command issued the letter contract to Convair for modifying B-36 airplanes. This second contract, dated 23 July 1952, called for a B-47B mock-up.²² It also called for the necessary engineering and design work for modifying two B-47B airplanes into prototype missile

* See p. 39.

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carriers and 17 B-47's into a production configuration.²³ It specified 15 March 1953 as the mock-up completion date, but did not²⁴ contain a delivery schedule for the B-47's.

AMC released the B-47 completion dates nine months after writing the letter contract. Amendment No. 2, dated 20 April 1953, specified 1 May 1954 and 15 June 1954 as the delivery dates²⁵ for the two prototype B-47's. This amendment also incorporated a new item into the contract by indicating that AMC would issue a supplemental agreement later for the modification of 17 additional²⁶ B-47's.

AMC issued a number of amendments to the letter contract over the next two years. These both modified and added new items²⁷ of work. Some of the more important amendments were as follows:

<u>Amendment</u>	<u>Date</u>	<u>Contents</u>
No. 3	5 June 1953	Added \$8, 150, 000 to the letter contract
No. 4	22 July 1953	Added three more B-47's for modification under item two. Specified July 1954 as their delivery date
No. 8	11 December 1953	Provided spare parts for the prototype B-47's
No. 9	17 September 1954	Called for B-47 flight tests and radio noise tests. Changed item six to indicate that a supplemental agreement would be issued for the modification of 32 airplanes

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No. 12

29 July 1955

Revised item six to provide for the modification of only two airplanes. Specified May and June 1956 as the delivery dates.

Boeing and AMC personnel started their definitive contract negotiations before the command issued the letter contract. These negotiations continued into 1955 because a number of difficulties delayed an early agreement. Some of these delaying factors were: (1) AMC and Bell did not agree on a definite missile configuration until November 1953, (2) AMC did not establish a definite GFAE (Government Furnished Aeronautical Equipment) delivery schedule for Boeing until December 1953, (3) Boeing did not want to prepare a cost estimate until after it received a concrete GFAE delivery schedule, and (4) Boeing objected to some of the contract's clauses as first written. ²⁸ The parties met in November and December ²⁹ 1954 to resolve their differences.

The definitive contract, dated 20 August 1954, did not receive Air Force approval until 10 March 1955. ³⁰ This CPFF contract called for modification of two B-47 airplanes, flight tests, wind tunnel tests, mock-ups, technical data, a training program, maintenance of a B-47 airplane during Phases II and ³¹ IV flight testing, spare parts, and engineering changes. It also called for the delivery of one airplane as soon as the

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contractor received the contract. It scheduled the delivery of the second B-47 for three and one-half months after completion

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of Phase IV testing. The contract listed 10 January 1955 as

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the probable Phase IV completion date. It allocated \$3,735,682

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to Boeing. This amount included the company's five per cent

fee. Boeing later modified an additional 30 B-47's at its Wichita,

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Kansas, plant as part of the Ebbtide program. Headquarters

USAF cancelled the entire program in December 1958.

* See p. 60.

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VI. LOGISTICS

AMC released its concept of Rascal logistics during an MX-776 Phasing Group Meeting on 3 February 1954.¹ However, the concept did not reflect an official Air Force opinion because command personnel released it before coordinating it with the Air Staff.²

The concept established the framework around which the eventual logistics system would be built. This framework consisted of two parts. Part one described the missile and its capabilities.³ Part two outlined the operational conditions under which the support system would operate.⁴ Some of these operational conditions were: (1) both B-36 and B-47 airplanes would carry the Rascal,^{*} (2) the B-36 squadrons would operate only from the United States, (3) the B-47 squadrons would operate from bases both in the United States and overseas, (4) each B-36 squadron would consist of 10 airplanes, (5) each B-47 squadron would consist of 15 airplanes, and (6) all of the squadrons would receive 45 missiles.⁵

* The Air Force eliminated the B-36/Rascal squadrons in June 1955. See pp. 39, 63.

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The latter part of the concept contained the command's ideas on supply, maintenance, and transportation. It indicated that the Rascal supply system would have to use advanced methods of distribution and property accounting. Also, it pointed out that economy and limited spares required efficient use of all AMC assets. It specified air transportation for the movement of critical items and those sent from the United States to the operational units. Surface transportation was limited to the movement of routine articles and to the initial supply phase.

In the area of Rascal repair the concept pictured a system that used only unit and depot maintenance. Field maintenance was eliminated. Depot maintenance, the concept indicated, would consist of both Air Force and contractor capability. It did not indicate how great a contractor capability would be established at depot level.

Supply

AMC also published preliminary Rascal supply and maintenance plans about the same time that it released the logistics concept.

The supply plan called for two support systems--a new contractor organization and the established Air Force system.

The new contractor organization furnished company controlled

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or manufactured items. The normal Air Force system supplied

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all common Air Force items. This supply plan created the con-

tractor support system only to supplement, not to replace, the Air Force

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organization. The Air Force later adopted the system outlined

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in the preliminary plan as its supply program for the Rascal.

Maintenance

The preliminary maintenance plan, just as the logistics

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concept, called for organizational and depot-level maintenance.

Organizational maintenance consisted of those repairs that could

be made in about one day with the equipment provided each unit.

The types of maintenance specified as organizational were re-

placement and alignment of electronic equipment such as tubes,

condensers, transformers, and resistors; minor adjustments

and calibrations; power plant replacement; and technical order

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compliance.

This preliminary plan limited depot maintenance to com-

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ponent repair. However, it indicated that IRAN (Inspect and

Repair as Necessary) procedures might require the establish-

ment of a missile assembly, checkout, disassembly, and

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repackaging capability at selected depots.

The plan also called for the creation of a facility operated

by the contractor to repair company controlled or manufactured

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21 items. The plan limited the facility's period of operation to one
22 year and required the LAMA (Lead Air Materiel Area) to monitor
23 its operation for the 12-month period. At the end of the year the
LAMA was to determine whether contractor maintenance should be
24 continued or dropped.

The Rascal logistics plan prepared by the Oklahoma City Air
Materiel Area in 1958 adopted almost the entire preliminary plan.
This OCAMA plan, as did the earlier preliminary plan, called for
25 only two levels of maintenance. It established a contractor
26 repair facility and directed the LAMA to monitor its operations.

Transportation

AMC originally outlined a two-container system for trans-
27 porting the Rascal. However, it realized subsequently that
weight and size made the two-container method impractical, so
28 it asked Bell to study other possible methods. These studies
indicated that a commercial van offered more advantages than
any other method. For example, it made "door to door" delivery
possible and eliminated intermediate loadings and unloadings
since the entire van could be sent overseas on the deck of a
ship. Also, it reduced the size and weight of packaging mate-
29 rials and simplified dispersal and route changes. Possible
resale of the vans to industry offered still another advantage.

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The supply plan pointed out that the use of metal containers for highway shipment would require two trailers, special permits,
30
and armed guards. Likewise, rail shipment would require
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two 40-foot flat cars or one 60-foot gondola. On the other
hand, the use of vans would require only armed guards for high-
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way shipment and one flat car for rail shipment.

In the summer of 1954 SAC recommended that the initial
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supply of missiles be airlifted to the operational units. SAC
also suggested that the B-50 airplane be used as the ferry air-
34
craft. The command pointed out that conventional supply
methods could be used after units had established their initial
35
stockpiles. These recommendations closely followed some
outlined earlier by Bell. The B-63 Weapons Phasing Group
36
approved the SAC recommendations in October 1954. This
method of transporting the missile offered one great advantage--
37
it eliminated the need for special packaging and special vehicles.

In May 1955 AMC asked WADC to authorize further study of
38
the Rascal transportation problem. Specifically, it wanted Bell
to analyze an alternate method of transporting the missile because
of the many logistic support problems connected with the use of
39
B-50 airplanes. This alternate method consisted of dividing
40
the missile into three parts and shipping it in a C-124 airplane.

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The contractor had earlier evaluated a method somewhat
41 similar to the one outlined by AMC. Bell's method consisted
42 of dividing the missile into four parts rather than three. How-
43 ever, the company did not develop any cost data. It promised
to forward this information to AMC as soon as possible. Bell
also determined that a new van designed by the Trailmobile Van
44 Company could be used to carry the missile. This van could
carry one disassembled missile mounted on skeletal shipping
supports. It cost about \$6,000 and conformed to the size limi-
45 tation laws of all 48 states.

AMC finally adopted air ferry of the Rascal in an assembled
46 condition on a B-50 as the primary method of transportation.
47 It also adopted an alternate and an emergency system. The
alternate method consisted of dividing the missile into four parts,
mounting them on skeletal supports, and carrying them in a C-124
48 airplane or a Trailmobile van. The emergency method called
for attaching the assembled missile to director-aircraft which
49 then ferried it to its destination.

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2. See note above.
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4. Bell Airc. Corp. [hereafter BAC] Rpt. No. 56-981-021-45, "Proj. MX-776," 30 June 1956, pp. 2-3, in GAM WSPO files.
5. Std. Airc. Char., "GAM-63A," 17 March 1958, Doc. 2.
6. BAC Rpt. No. 66-947-011, "Air Guided Missile (Rascal), GAM-63A," 21 Sept. 1954, pp. 29-30, in GAM WSPO files; Rpt., "Guided Missile Consolidated Rpt.," 1 Oct. 1955, prep. by ARDC, pp. 124-125, in AMC Hist. Archives.
7. See note above.
8. BAC Rpt. No. 66-947-011, 21 Sept. 1954, p. 34; "Guided Missile Consolidated Rpt.," 1 Oct. 1955, p. 125.
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10. Ibid., p. 35.
11. Ibid., pp. 53-55; "Guided Missile Consolidated Rpt.," 1 Oct. 1955, p. 124; Std. Airc. Char., "GAM-63A," 17 March 1958, Doc. 2.
12. BAC Rpt. No. 56-981-021-45, 30 June 1956, p. 2.
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18. See note above.
19. "Final GAM-63 (Rascal) Opl. Plan," 12 Aug. 1957, p. 3.

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2. Ibid.
3. Julius King, "The Devel. of the Rascal Guided Missile, 1945-1953" [hereafter "Devel. of the Rascal"], Jan. 1956, Vol. I, pp. 4-5, in AMC Hist. Archives; R&R, Chief, Aero. Equip. Sect., Proc. Div., to Chief, Proc. Div., Hq. AMC, 5 March 1947; Ltr., DCG, Eng., to CG, AAF, 6 May 1947, Docs. 11, 14.
4. Ltr., DCG, Eng., Hq. AMC, to CG, AAF, 6 May 1947, Doc. 14.
5. Ltr. Contr. W33-038 ac-14169, 1 April 1946, Doc. 5.
6. Amend. No. 2 to Ltr. Contr. W33-038 ac-14169, 14 June 1946, Doc. 6.
7. Contr. W33-038 ac-14169, 14 Oct. 1946, Doc. 8.
8. Ibid.
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11. Memo. for CG, AAF, by Dep. AC/AS-3, 16 June 1947, Doc. 17.
12. Ltr., Chief, Res. & Eng. Div., Office of AC/AS-4, Hq. AAF, to CG, AMC, 10 July 1947, Doc. 18.
13. 1st Ind. (ltr., Chief, Res. & Eng. Div., Office of AC/AS-4, Hq. AAF, to CG, AMC, 10 July 1947), Chief, Eng. Div., Hq. AMC, to CG, AAF, 14 Aug. 1947, Doc. 20.
14. Ibid.
15. Min. of Mtg. for the Discussion of Air-to-Surface Guided Missiles, 15 Sept. 1947, Doc. 22.
16. R&R, Chief, GM Sect., Eng. Div., Hq. AMC, to DCG, Eng., 5 Nov. 1947, Doc. 24.
17. Ltr., GM Sect. to BAC, 22 Jan. 1948, Doc. 26.
18. Ibid.
19. Ibid.
20. "Devel. of the Rascal," I, pp. 8-9.
21. Ltr., GM Sect. to BAC, 22 Jan. 1948, Doc. 26.
22. Ltr., Chief, Proc. Div., Hq. AMC, to Under Secy. AF, 28 Jan. 1949, and ind. thereto, Doc. 32.
23. 1st Ind. (ltr., Chief, Proc. Div., to Under Secy. AF, 28 Jan. 1949), Asst. DC/S, M to CG, AMC, 4 Feb. 1949, Doc. 32.
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26. R&R, Chief, GM Sect., to Airc. & Missiles Sect., Proc. Div., Hq. AMC, 8 April 1949, Doc. 35.
27. Ltr., Chief, Airc. & Missiles Sect., Eng. Div., Hq. AMC, to Dir., R&D, Hq. USAF, 12 Feb. 1951, and ind. thereto, Doc. 70.
28. 1st Ind. (ltr., Chief, Airc. & Missiles Sect., to Dir., R&D, 12 Feb. 1951), Airc. Div., Dir., R&D, DC/S, O, Hq. USAF, to CG, AMC, 26 April 1951, Doc. 70.
29. Ltr., Chief, Airc. & Missiles Sect., Proc. Div., to D/P&PE, Hq. USAF, 30 June 1951, Doc. 82.
30. Ltr., Contr. Officer to BAC, 29 July 1949, Doc. 36.
31. Ltr., BAC to CG, AMC, 9 Aug. 1949; R&R, Associate Buyer, GM Sect., to Proc. Comm., 30 Aug. 1949, Docs. 37, 38.
32. Ltr., Chief, GM Sect., to BAC, 15 Dec. 1949, Doc. 39.
33. Ltr., Dir., R&D, Office, DC/S, M, Hq. USAF, to CG, AMC, 14 Feb. 1950, Doc. 40.
34. Ibid.
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36. Ltr., AMC, to Dir., R&D, Hq. USAF, 31 Aug. 1950, Doc. 46.
37. "Gen. Opl. Req. for Strat. Bomb. System," prep. by Dir., Req., Hq. USAF, 8 Dec. 1951; "Mil. Char. for a Pilotless Parasite Bomber," prep. by Dir., Req., Hq. USAF, 14 Dec. 1951; Devel. Directive No. 00027-A1, by Hq. ARDC, 4 Feb. 1952; Ltr., Dep. for Devel., Hq. ARDC, to CG, WADC, 5 Feb. 1952; Ltr., Dep. for Devel., Hq. ARDC, to CG, WADC, 5 Feb. 1952, Docs. 86, 87, 92, 93, 94.

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39. Ltr., Contr. Officer, Hq. AMC, to BAC, 12 March 1952, Doc. 101.
40. Min. of Rascal Prog. Conf. on 28 April 1952, by Asst. for SAC Systems, Office of Dep. for Devel., Hq. ARDC, 7 May 1952, Doc. 104.
41. Ibid.
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45. Memo. for DC/S, D, by Chief, Strat. Air. Div., Dir., Req., Hq. USAF, 9 April 1952, Doc. 103.
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47. Memo. for DC/S, D, by Chief, Strat. Air Div., 9 April 1952, Doc. 103.
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49. Memo. Routing Slip, Dep. Dir., Req., Hq. USAF, to Gen. Craigie, DC/S, D, 24 Oct. 1952; Memo. for Secy. AF, 24 Oct. 1952, Doc. 122.
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3. Ltr. Contr. AF 33(038)-15069, 8 Aug. 1950, Doc. 45.
4. Amend. No. 1 to Ltr. Contr. AF 33(038)-15069, 5 Oct. 1950, Doc. 47.
5. Amend. No. 2 to Ltr. Contr. AF 33(038)-15069, 16 Oct. 1950, Doc. 48.
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8. Ltr., BAC to CG, AMC, 13 Nov. 1950, Doc. 54.
9. Ltr., BAC to CG, AMC, 31 Oct. 1950; Wire, Chief, Airc. & Missiles Sect., to BAC, 6 Nov. 1950; R&R, Chief, Airc. & Missiles Sect., to Proc. Comm., Hq. AMC, 15 Nov. 1950, Docs. 52, 53, 55.
10. R&R, Proc. Comm., to D/P&P, Hq. AMC, 16 Nov. 1950, Doc. 56.
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19. Amend. No. 9 to Ltr. Contr. AF 33(038)-15069, 30 Jan. 1951,
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20. Ltr., BAC to CG, AMC, 24 Feb. 1951, Doc. 71.
21. S. A. No. 6 to Contr. AF 33(038)-15069, 10 Nov. 1952, in
Contr. Files, Aero. Systems Center.
22. S. A. No. 7 to Contr. AF 33(038)-15069, 16 March 1953, in
Contr. Files.
23. Ibid.
24. S. A. No. 10 to Contr. AF 33(038)-15069, 30 June 1953, in
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25. S. A. No. 47 to Contr. AF 33(038)-15069, 21 Dec. 1956, in
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26. Ltr., BAC to CG, AMC, 20 Nov. 1950, Doc. 57.
27. Amend. No. 3 to Ltr. Contr. AF 33(038)-15069, 24 Oct. 1950,
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32. Ibid.
33. Hist. Record of Verbal Coord. by Mr. Richard T. Lawrance, Contr. Officer, Airc. & Missiles Sect., 8 June 1951, Doc. 76.
34. DF, Chief, Plans & Ops. Office, Proc. Div., to Chief, Airc. & Missiles Sect., 3 July 1952, Doc. 108.
35. Ltr., Contr. Officer, AFPRO, BAC, to CG, AMC, 8 Nov. 1952, Doc. 126.
36. DF, Chief, Proc. Control Office, Proc. Div., to Dep. Chief, Proc. Div., 24 Nov. 1952, Doc. 128.
37. Contr. AF 33(038)-20402, 10 Dec. 1952, Doc. 131.
38. Ibid.
39. Ltr., Chief, Airc. Br., Proc. Div., to AFPR, BAC, circa Feb. 1954, Doc. 167.
40. Ltr., BAC to Comdr., AMC, 8 Feb. 1954; Ltr., BAC to Comdr., AMC, 7 April 1954; Ltr., BAC to Comdr., AMC, 24 April 1954; DF, Chief, Proc. Div., to Proc. Comm., 12 May 1954. Docs. 165, 168, 170, 171.
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10. Wire, Chief, Airc. Div., Hq. AMC, to AFPR, BAC, 15 Nov. 1954, Doc. 189.
11. Ltr., Chief, GM Sect., Eng. Div., Hq. AMC, to BAC, 15 Dec. 1949, Doc. 39.
12. Ltr., Dir., R&D, Office of DC/S, M, Hq. USAF, to CG, AMC, 14 Feb. 1950, Doc. 40.
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23. DF, Chief, Airc. & Missiles Sect., Proc. Div., to Airc. Sect., Proc. Div., Hq. AMC, 29 March 1951, Doc. 72.
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25. Ltr., Chief, Weapon Systems Div., to BAC, 28 Jan. 1952;
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26. Ltr., BAC to CG, AMC, 4 Sept. 1946, Doc. 7.
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30. Ltr., Chief, GM Sect., to BAC, 26 Jan. 1948, Doc. 27.
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40. Ltr., BAC to Comdr., Det. #1. ARDC, 29 Nov. 1955, Doc. 218.
41. Ltr., Chief, Prod. Div., AFPRO, BAC, to Comdr., AMC, 29 Oct. 1954; Ltr., Chief, Prod. Div., to Comdr., AMC, 30 Nov. 1954, Docs. 188, 190.
42. Wire, Asst. Chief, Bomb. Missiles Div., Dir. of Systems Mgmt., Det. #1, ARDC, to Comdr., ARDC, 8 Aug. 1956, Doc. 234.
43. Ltr., Actg. Chief, Office of AC/AS-3, Hq. AAF, to AC/AS-4, Hq. AAF, 16 July 1945, Doc. 3.
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57. S. A. No. 18 to Contr. W33-038 ac-14169, 12 May 1953, in Contr. Files.
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66. Ltr., Chief, GM Br., Proc. Div., Hq. AMC, to BAC, 16 Oct. 1953, Doc. 154.
67. Ltr., BAC to Comdr., AMC, 6 Nov. 1953, Doc. 155.
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72. Ltr., Chief, Airc. Systems Br., Dir. of Ops., SAC, to Comdr., WADC, 9 Dec. 1954, Doc. 192.
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79. Trip Rpt., by Contr. Specialist, Air Launched Br., Hq. AMC, 25 Feb. 1952, Doc. 99.
80. Ibid.
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82. Ltr., Chief, Weapon Systems Div., to CG, ARDC, 1 July 1952, Doc. 107.
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- 121. Ltr., Contr. Officer, Hq. AMC, to BAC, 14 March 1957; Wire, Dep. Chief, Term. Staff Br., Hq. AMC, to BAC, 19 March 1957; Wire, Contr. Officer to BAC, 19 March 1957; Wire, Contr. Officer to BAC, 21 March 1957, Docs. 239, 240, 241.
- 122. Ltr., Term. Contr. Officer, AFPRO, BAC, to Comdr., AMC, 19 April 1957, Doc. 243.
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- 126. Ltr., Hq. AMC, to Dir. of Mat. Progs., Hq. USAF, 3 July 1958, Doc. 249.
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- 128. Ibid.
- 129. Ibid.
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- 131. Ibid.
- 132. Ibid.
- 133. AMC DSD, 31 Oct. 1958.
- 134. Ibid.
- 135. AMC DSD, 8 Dec. 1958.
- 136. Ibid.

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- 1. Ltr., Actg. Chief, Office of AC/AS-3, Hq. AAF, to AC/AS-4, 16 July 1945, Doc. 3.
- 2. Ltr. Contr. W33-038 ac-14169, 1 April 1946, Doc. 5.
- 3. Ltr., Chief, GM Sect., Eng. Div., Hq. AMC, to Bell Airc. Corp. [hereafter BAC], 15 Dec. 1949, Doc. 39.
- 4. Ltr., Dir., R&D, Office of DC/S, M, Hq. USAF, to CG, AMC, 14 Feb. 1950, Doc. 40.
- 5. Devel. Directive No. 00027-A1, by Hq. ARDC, 4 Feb. 1952; Ltr., Dep. for Devel., Hq. ARDC, to CG, WADC, 5 Feb. 1952; Ltr., Dep. for Devel., to CG, WADC, 5 Feb. 1952, Docs. 92, 93, 94.

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6. Ltr. Contr. AF 33(600)-21997, 7 July 1952, Doc. 109.
7. Ibid.
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9. Contr. AF 33(600)-21997, 15 Dec. 1952, Doc. 133.
10. Ibid.
11. Ibid.
12. Ltr., Chief, Airc. Br., Proc. Div., Hq. AMC, to Consolidated Vultee Airc. Corp. [hereafter Convair], 3 Feb. 1953; Ltr., Convair to CG, AMC, 17 Feb. 1953; Ltr., Chief, Airc. Br., to Convair, 3 April 1953, Docs. 136, 138, 142.
13. DF-3, Chief, Airc. Br., to Proc. Comm., Hq. AMC, 1 Sept. 1953, Doc. 152.
14. Wire, Chief, Airc. Br., to Convair, 8 Jan. 1954, Doc. 159.
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18. Wire, Dep. Chief, Term. Br., Readj. Div., Hq. AMC, to Convair, 7 July 1955, Doc. 202.
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21. Ltr., Chief, Airc. Div., to AFPR, Convair, 9 Sept. 1955; S. A. No. TS-14 to Contr. AF 33(600)-21997, 26 Oct. 1956, Docs. 212, 235.
22. Ltr. Contr. AF 33(600)-22108, 23 July 1952, Doc. 113.

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23. Ibid.
24. Ibid.
25. Amend. No. 2 to Ltr. Contr. AF 33(600)-22108, 20 April 1953, Doc. 144.
26. Ibid.
27. Amend. No. 3 to Ltr. Contr. AF 33(600)-22108, 5 June 1953;
Amend. No. 4 to Ltr. Contr. AF 33(600)-22108, 22 July 1953;
Amend. No. 8 to Ltr. Contr. AF 33(600)-22108, 11 Dec. 1953;
Amend. No. 9 to Ltr. Contr. AF 33(600)-22108, 17 Sept. 1954;
Amend. No. 12 to Ltr. Contr. AF 33(600)-22108, 29 July 1955,
Docs. 150, 151, 157, 184, 205.
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31. Ibid.
32. Ibid.
33. Ibid.
34. Ibid.
35. Ibid.
36. DF-2, Chief, Proc. Office, Airc. Div., to Proc. Comm., 7 Feb. 1956, Doc. 221.

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1. Min. of MX-776 Weapon Phasing Gp. Mtg. Held on 3 Feb. 1954, 15 Feb. 1954, Doc. 162.
2. Ibid.

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3. Ibid.
4. Ibid.
5. Ibid.
6. Ibid.
7. Ibid.
8. Ibid.
9. Ibid.
10. Ibid.
11. Ibid.
12. "Prelim. Log. Plan (Sup. and Maint. Portion) For the B-63 Pilotless Airc." [hereafter "Prelim. Log. Plan for the B-63"], circa Feb. 1954, Doc. 163.
13. Ibid.
14. Ibid.
15. Ibid.
16. "DB-47/GAM-63 Log. Plan," by OCAMA, 14 March 1958 in GAM WSPO files.
17. "Prelim. Log. Plan for the B-63," Doc. 163.
18. Ibid.
19. Ibid.
20. Ibid.
21. Ibid.
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23. Ibid.

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24. Ibid.
25. "DB-47/GAM-63 Log. Plan," 14 March 1958.
26. Ibid.
27. "Prelim. Log. Plan for the B-63," Doc. 163.
28. Ibid.
29. Ibid.
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31. Ibid.
32. Ibid.
33. Wire, Chief, Bomb. Missiles Div., D/WSO, WADC, to Comdr., ARDC, 5 Aug. 1954, Doc. 180.
34. Ibid.
35. Ibid.
36. Min. of B-63 Weapon Phasing Gp. Mtg. Held on 13 Oct. 1954, 21 Oct. 1954, Doc. 186.
37. Ibid.
38. Ltr., D/T&S, Hq. AMC, to D/WSO, 31 May 1955, Doc. 198.
39. Ibid.
40. Ibid.
41. Ltr., DC/S, O, WADC, to Comdr., AMC, 5 July 1955, Doc. 200.
42. Ibid.
43. Ibid.
44. Ibid.

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- 45. Ibid.
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- 47. Ibid.
- 48. Ibid.
- 49. Ibid.

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GLOSSARY

AAF	Army Air Forces
AC/AS-3	Assistant Chief of Air Staff, Operations, Commitments and Requirements
AC/AS-4	Assistant Chief of Air Staff, Materiel
ACS	automatic control system
Actg.	Acting
Add.	Addendum
Aero.	Aeronautical
AF	Air Force
AFPR	Air Force Plant Representative
AFPRO	Air Force Plant Representative Office
Airc.	Aircraft
AMC	Air Materiel Command
Amend.	Amendment
ARDC	Air Research and Development Command
Asst.	Assistant
BAC	Bell Aircraft Corporation
Bomb.	Bombardment
Br.	Branch
CG	Commanding General
Char.	Characteristics
C. O.	Change Order
Comdr.	Commander
Comm.	Committee
Conf.	Conference
Contr.	Contract, Contracting
Coord.	Coordination
CPFF	cost-plus-fixed-fee
C/S	Chief of Staff
CTCI	Contractor Technical Compliance Inspection
DCG	Deputy Commanding General
DC/S, D	Deputy Chief of Staff, Development
DC/S, M	Deputy Chief of Staff, Materiel
DC/S, O	Deputy Chief of Staff, Operations
Dep.	Deputy

GLOSSARY

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Det.	Detachment
Devel.	Development
DF	Disposition Form
Dir.	Director(ate)
Div.	Division
Doc(s).	Document(s)
D/P&P	Director, Directorate of Procurement and Production
D/P&PE	Director, Directorate of Procurement and Production Engineering
DSD	Daily Staff Digest
D/T&S	Director, Directorate of Transportation and Services
D/WSO	Directorate of Weapon System Operations
ed.	edition
Eng.	Engineering
Equip.	Equipment
Exec.	Executive
GAM	Guided Air Missile
Gen.	General
GFAE	Government Furnished Aeronautical Equipment
GFE	Government Furnished Equipment
GM	Guided Missile
Gp.	Group
Hist.	History, Historical
Hq.	Headquarters
Ind.	Indorsement
Indust.	Industrial
IRAN	Inspect and Repair as Necessary
LAMA	Lead Air Materiel Area
Log.	Logistic
Ltr.	Letter
MAAMA	Middletown Air Materiel Area
Maint.	Maintenance
Mat.	Materiel
Memo.	Memorandum
Mgmt.	Management

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Mil.	Military
Min.	Minutes
Mtg.	Meeting
OCAMA	Oklahoma City Air Materiel Area
Opl.	Operational
Ops.	Operations
OST	Operational Suitability Test
Plan.	Planning
Prelim.	Preliminary
prep.	prepared
Proc.	Procurement
Prod.	Production
Prog(s).	Program(s)
Proj.	Project
R&D	Research and Development
Readj.	Readjustment
Req(s).	Requirement(s)
Res.	Research
Rpt.	Report
R&R	Routing and Record Sheet
S. A.	Supplemental Agreement
SAC	Strategic Air Command
Sect.	Section
Secy.	Secretary
Std.	Standard
Strat.	Strategic
Sup.	Supply
Term.	Termination
USAF	United States Air Force
Vol.	Volume
WADC	Wright Air Development Center
WSPO	Weapon System Project Office
ZI	Zone of the Interior

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C--RESEARCH AND DEVELOPMENT CONTRACTS

D--DIRECTOR AIRCRAFT CONTRACTS

E--RASCAL ACCEPTANCES

APPENDIX

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RESTRICTED DATA
ATOMIC ENERGY ACT 1954



CLASSIFICATION CANCELLED
FOR CHANGED TO *Confidential*
BY AUTHORITY OF *USJCS 204, 1 Dec 1951*
(INDIVIDUAL OR OFFICIAL AUTHORITY)
BY *[Signature]*
[Signature]
[Signature]

Standard Missile Characteristics

BY AUTHORITY OF
THE SECRETARY
OF THE AIR FORCE

XGAM-63
RASCAL
BELL

ONE YLR67-BA-9
BELL

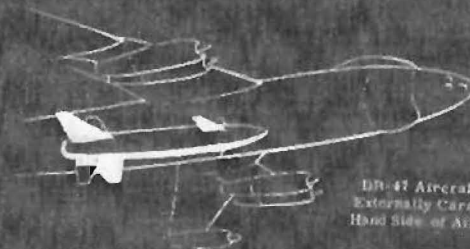
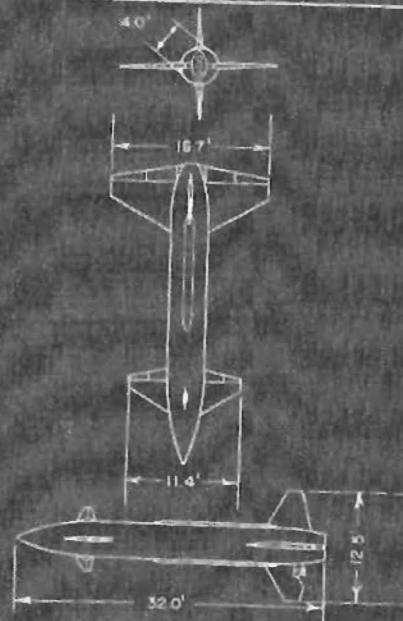
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XGAM-63

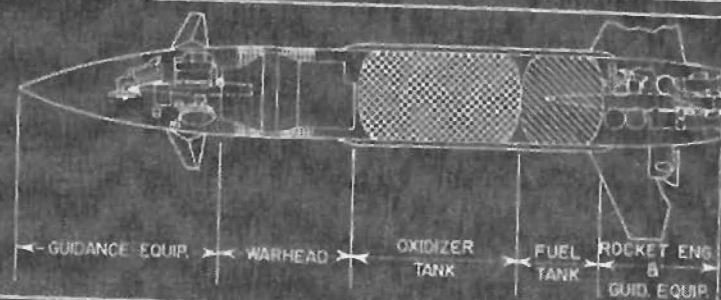
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A

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DB-47 Aircraft Installation
Externally Carried on Right
Hand Side of Aircraft



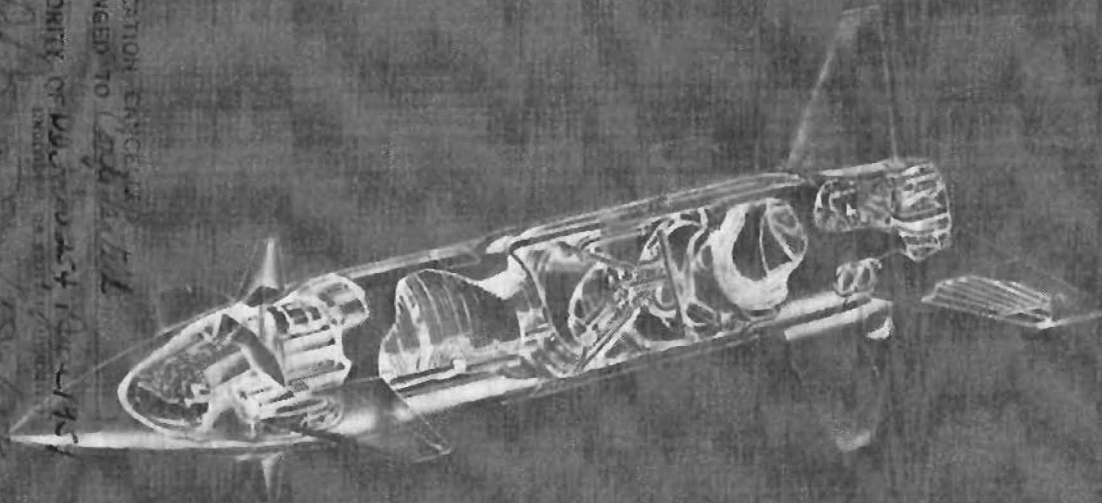
GAM-63A

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10 JAN 58

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SECRET

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OR CHANGED TO *CONFIDENTIAL*
BY AUTHORITY OF *SECURITY*
10 JAN 58



Standard Missile Characteristics

BY AUTHORITY OF
THE SECRETARY
OF THE AIR FORCE

GAM-63A

RASCAL
BELL

ONE LR 67-BA-9

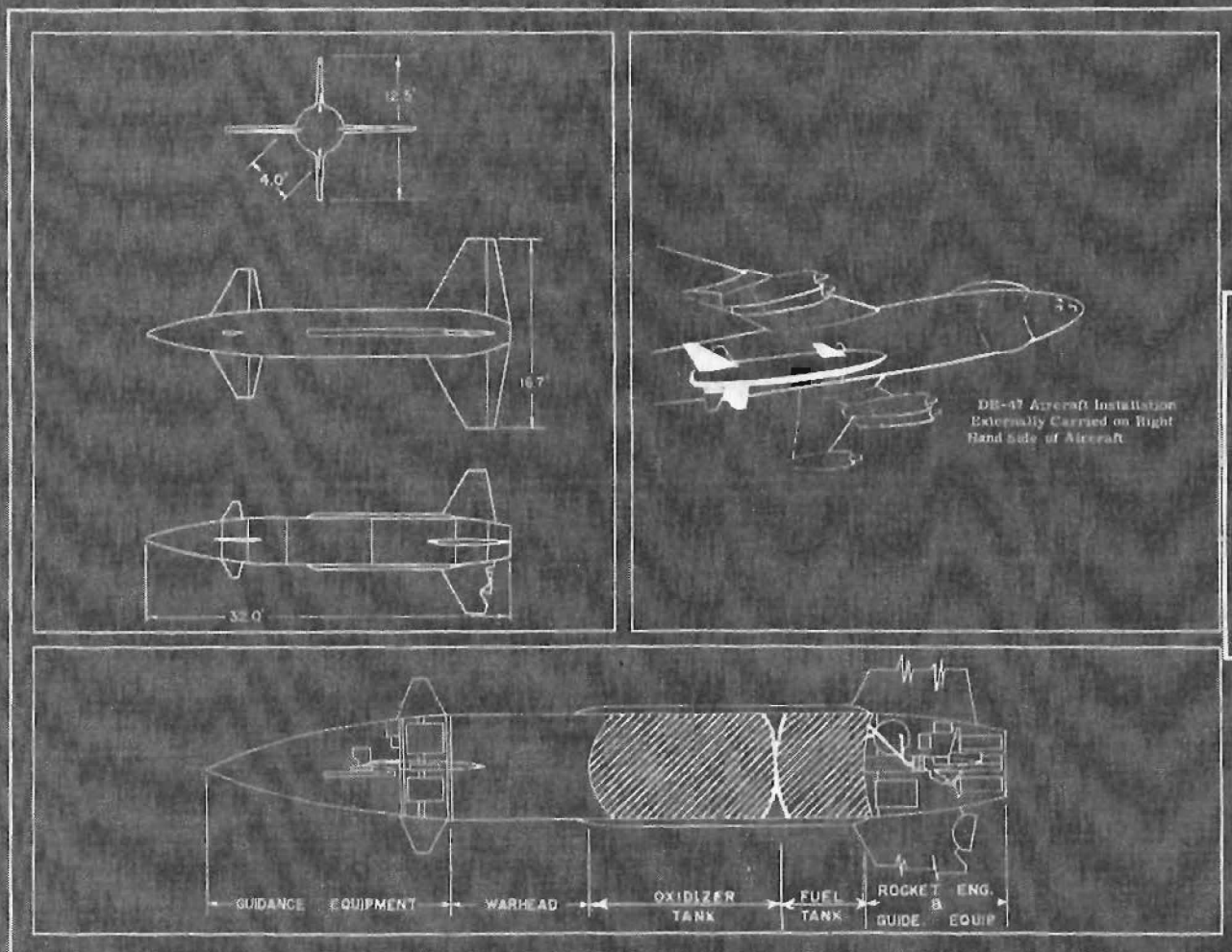
BELL

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RESTRICTED DATA
ATOMIC ENERGY ACT 1954

XGAM-63

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4 SEP 54

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AF 33(038)-15069
PRODUCTION

<u>Document</u>	<u>Date</u>	<u>Funds Allotted</u>	<u>For</u>	<u>Number of Missiles</u>
Contract	27 November 1950	\$ 3,022,866.48	MX-776 Missiles and Spare Parts	10
S. A. #1	5 March 1952	increase 13,124,873.73	Twenty Additional Missiles	20
S. A. #2	23 November 1952	decrease 10,859.20	Partial Termination of Contract	
S. A. #3	15 January 1952	increase 2,806,870.55	Overrun	
S. A. #4	28 August 1952	increase 16,070,418.21	Fifteen Rascal Missiles and Related Equipment	15
S. A. #6	10 November 1952	increase 5,774,383.61	Three Rascal Missiles; Material for Twenty-six Additional Missiles and Training Parts	3
S. A. #7	16 March 1953	increase 6,547,134.95	Five Rascal Missiles and Material for Forty Additional Missiles	5
S. A. #8	28 April 1953	increase 1,931,000.00	One Mobile Training Unit and Miscellaneous CCN's	
S. A. #9	29 May 1953	increase 9,246,380.01	Fifty-six Direct Aircraft Guidance Systems, Tooling and Data	

540-4-045

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S. A. #10	30 June 1953	increase	36,116,031.43	Sixty-one Rascal Missiles, Spares Parts and CCN's 3, 7 and 13	61
S. A. #11	30 June 1953	increase	1,914,834.00	Amendment of Item 6 and Additional Funds for Train- ing Parts and Engineering Changes	
S. A. #12	20 July 1953	increase	300,000.00	Ground Handling Equipment	
S. A. #13	26 October 1953	increase	3,970,986.56	Squadron and Depot Ground Handling Equipment	
S. A. #15	14 January 1954	no change		Revision of Items 6, 18, 30, 31 and 41	
S. A. #16	30 June 1954	increase	2,528,388.23	Addition of Items 51, 52, 53 and 54	
C. O. #17	16 June 1954	no change		Miscellaneous CCN's	
C. O. #18	21 June 1954	increase	4,063,000.00	Overrun	
C. O. #19	18 August 1954	no change		Miscellaneous CCN's	
S. A. #21	26 November 1954	increase	55,285.33	Addition of Item 55	
C. O. #22	21 February 1955	decrease	2,213,182.13	Decrease in Amount of Item 23	

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S. A. #23	16 March 1955	no change		Miscellaneous CCN's
C. O. #24	5 April 1955	no change		Increase in Committed Amount of Item 49
C. O. #25	9 May 1955	increase	2,340,000.00	Increase in Committed Amount of Item 49
S. A. #26	19 May 1955	no change		Miscellaneous CCN's
S. A. #27	30 June 1955	increase	244,515.81	Incorporation of CCN's
S. A. #28	19 August 1955	increase	12,845.04	Miscellaneous CCN's and Class Coding
S. A. #29	14 September 1955	increase	1,007,719.31	Miscellaneous CCN's
S. A. #30	10 October 1955	increase	1,274,541.02	Amendment of Items 45, 46, 47, 48 and 50
S. A. #30-1	20 April 1956	increase	42,229.35	Miscellaneous Ground Support Equipment
S. A. #30-2	9 May 1956	decrease	381.67	Amendment of Item 50
S. A. #30-3	19 July 1956	increase	334,051.22	Miscellaneous Ground Support Equipment
S. A. #30-4	13 December 1956	increase	2,714,768.05	Miscellaneous Ground Support Equipment

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S. A. #30-5	29 June 1956	decrease	18,923.78	Amendment of Item 50
S. A. #30-6	30 October 1956	increase	13,401.69	Amendment of Item 50
S. A. #30-7	30 October 1956	decrease	90,046.95	Miscellaneous Ground Support Equipment
S. A. #30-8	14 January 1957	increase	15,216.48	Miscellaneous Ground Support Equipment
S. A. #30-9	11 January 1957	decrease	35,804.52	Amendment of Item 50
S. A. #30-10	19 March 1957	no change		Miscellaneous Ground Support Equipment
S. A. #30-11	17 September 1957	no change		Ground Support Equipment
S. A. #30-12	24 May 1957	increase	104,589.53	Miscellaneous Ground Support Equipment
S. A. #30-13	20 September 1957	no change		Ground Support Equipment
S. A. #30-14	15 November 1957	no change		Ground Support Equipment
S. A. #30-15	15 November 1957	no change		Ground Support Equipment
S. A. #30-16	15 November 1957	no change		Ground Support Equipment
S. A. #30-17	15 November 1957	no change		Ground Support Equipment
S. A. #30-18	30 December 1957	no change		Ground Support Equipment

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S. A. #30-19	12 March 1958	no change	GAM Checkout Equipment
S. A. #30-20	12 March 1958	no change	Ground Support Equipment
S. A. #30-21	6 August 1958	no change	Ground Support Equipment
S. A. #30-23	3 July 1958	no change	Ground Support Equipment
S. A. #31	7 October 1955	decrease 4,358,494.11	Supercession of CCN's 101, 106, 107 and Deobligation of Engineering Funds
C. O. #32	1 November 1955	increase 4,403,582.00	Overrun
S. A. #33	9 November 1955	increase 411,859.14	Incorporation of CCN's
S. A. #34	24 January 1956	increase 488,055.05	Addition of Sub-item to Item 30 and Deletion of Item 55
S. A. #35	22 December 1955	increase 1,185,697.32	Miscellaneous CCN's
S. A. #36	3 February 1956	increase 108,475.22	Miscellaneous CCN's
S. A. #37	8 February 1956	no change	Supercession of CCN 150
C. O. #38	15 February 1956	increase 420,518.00	Overrun
S. A. #39	29 February 1956	increase 83,512.32	Miscellaneous CCN's
S. A. #40	7 March 1956	increase 611,022.47	Miscellaneous CCN's

- 5 -
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C. O. #41	28 February 1956	no change	Commitment of Funds for Items 18, 45 and 50
S. A. #42	7 March 1956	increase 7,420,000.00	Addition of Item 56
S. A. #43	3 April 1956	increase 45,003.55	Miscellaneous CCN's
C. O. #44	12 April 1956	no change	Commitment of Funds for Items 6a, 50, and 45
S. A. #45	19 April 1956	decrease 83,078.71	Miscellaneous CCN's
S. A. #46	10 May 1956	increase 4,606.04	CCN's 116 and 173
S. A. #47	21 December 1956	increase 14,767,294.97	Addition of Items 57 through 60 22
C. O. #48	25 May 1956	no change	Commitment of Funds under Item 23
S. A. #49	1 June 1956	increase 576,339.86	Miscellaneous CCN's
S. A. #50	22 June 1956	increase 71,924.73	CCN's 167 and 187
C. O. #51	9 July 1956	no change	Commitment of Additional Funds for Item 49
S. A. #52	13 July 1956	increase 17,249.12	Miscellaneous CCN's
S. A. #53	30 July 1956	increase 272,247.36	Incorporation of CCN 189
C. O. #54	8 August 1956	increase 1,282,169.00	Overrun and Increase in Committed Amount for Spares

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S. A. #55	27 August 1956	increase	33,363.57	Miscellaneous CCN's
C. O. #56	30 August 1956	no change		Commitment of Funds under Item 23
C. O. #57	14 September 1956	no change		Commitment of Additional Funds for Item 49
S. A. #58	11 October 1956	increase	406,427.33	Miscellaneous CCN's
S. A. #59	19 October 1956	increase	180,906.73	Miscellaneous CCN's
C. O. #60	20 November 1956	no change		Commitment of Additional Funds under Item 49
C. O. #61	30 November 1956	increase	96,482.00	Overrun and Increase in amount Committed under Items 46 and 50
S. A. #62	3 December 1956	increase	975,458.33	Revision of Items 51 and 52 and Addition of Item 61
S. A. #63	14 December 1956	no change		Miscellaneous CCN's
S. A. #64	23 January 1957	increase	26,441.71	Miscellaneous CCN's
S. A. #65	29 January 1957	no change		Spare Parts for Ground Handling Equipment
S. A. #65-1	13 June 1957	no change		Spare Parts for Ground Handling Equipment

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S. A. #65-2	30 January 1958	no change		Spare Parts for Ground Handling Equipment
S. A. #66	26 February 1957	increase	737,084.77	Spare Parts for GAM-63
S. A. #66-1	13 June 1957	increase	323,746.11	Spare Parts for GAM-63
S. A. #66-2	4 December 1957	no change		Spare Parts for GAM-63
C. O. #67	5 February 1957	increase	350,000.00	Increase in Funds Committed Under Items 6a and 47
S. A. #69	7 March 1957	no change		Spare Parts for AN/APW-17
S. A. #69-1	13 February 1958	no change		Spare Parts for AN/APW-17
S. A. #70	7 March 1957	no change		Special Tools and Test Equipment for Squadron and Depot Operational Equipment
S. A. #70-1	3 July 1957	no change		Special Tools and Test Equipment for Squadron and Depot Operational Equipment
S. A. #70-2	23 May 1958	no change		Special Tools and Test Equipment for Squadron and Depot Operational Equipment

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S. A. #70-3	5 August 1958	no change		Special Tools and Test Equipment for Squadron and Depot Operational Equipment
S. A. #70-4	8 August 1958	no change		Special Tools and Test Equipment for Squadron and Depot Operational Equipment
S. A. #70-5	27 August 1958	no change		Transfer of Funds from Item 47 to Item 45
C. O. #71	29 March 1957	increase	460,000.00	Increase in Amount Committed under Items 31b and 32b
S. A. #72	22 March 1957	increase	59,923.27	Miscellaneous CCN's
S. A. #73	29 April 1957	decrease	29,179.40	Deobligation and Decommitment of Funds; Deletion of Item 54
S. A. #74	26 March 1957	no change		Miscellaneous Spare Parts for Ground Support Equipment
S. A. #76	4 April 1957	increase	13,416,151.62	Reliability Program, addition of Facility Clause and Schedule Change
S. A. #78	9 April 1957	no change		Spare Parts for GAM-63

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S. A. #78-1	14 November 1957	no change		Spare Parts for GAM-63
S. A. #79	2 May 1957	decrease	197,389.84	Miscellaneous CCN's
S. A. #80	3 May 1957	increase	3,516,581.56	CCN 215
S. A. #81	17 May 1957	no change		Miscellaneous Revisions
S. A. #82	15 May 1957	decrease	24,593.69	Miscellaneous CCN's and Deletion of Item 30b
C. O. #83	31 May 1957	decrease	776,000.00	Decrease in Amount Com- mitted under Item 49
S. A. #84	2 July 1957	decrease	14,290.99	Deletion of Item 41
S. A. #85	4 October 1957	increase	3,229,827.19	Support of Project MX- 776; Production and Operational Programs
S. A. #86	4 October 1957	decrease	172,774.93	Miscellaneous CCN's
S. A. #87	25 October 1957	no change		Training Parts
S. A. #88	5 November 1957	increase	5,043,731.00	Overrun
S. A. #89	10 January 1958	increase	1,395,941.00	Overrun
S. A. #90	13 January 1958	increase	434,609.12	Miscellaneous CCN's
S. A. #91	5 March 1958	increase	47,934.86	CCN 242

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<u>Document</u>	<u>Date</u>		<u>Funds Allotted</u>	<u>For</u>	<u>Number of Missiles</u>
C. O. #92	18 April 1958	increase	3,642,106.50	Overrun	
S. A. #93	30 April 1958	increase	22,721.48	CCN's 231, 241, and 244; Government Bill of Lading	
C. O. #94	20 May 1958	increase	4,203,958.00	Overrun	
S. A. #95	26 May 1958	increase	11,667.13	CCN's 243 and 245	
S. A. #96	6 August 1958	decrease	210,904.78	Partial Termination of Contract, Adjustment of Fee Only	
C. O. #97	17 July 1958	increase	8,371,056.68	Overrun	
S. A. #98	7 August 1958	decrease	61,712.53	Miscellaneous CCN's	
TOTALS			\$186,439,389.40		136

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CONTRACT AF 33(038)-15069

- Item 1 - three (3) MX-776 Mock-up missiles
- Item 2 - three (3) MX-776 recovery glide missiles
- Item 3 - four (4) MX-776 powered missiles
- Item 4 - tooling
- Item 5 - three (3) sets of interim guidance equipment
- Item 6 - spare parts
- Item 7 - twenty (20) MX-776 Rascal missiles
- Item 8 - tooling for Item 7
- Item 9 - test equipment for the articles called for under Items 1, 2, 3, 5 and 7
- Item 10 - XB-63 Checkout tooling test stations
- Item 11 - six (6) missile carriages
- Item 12 - four (4) fixed checkout units
- Item 13 - two (2) mobile checkout units
- Item 14 - five (5) high pressure trailers
- Item 15 - twelve (12) hoist sling sets
- Item 16 - eighteen (18) assembly transport skids
- Item 17 - twenty-four (24) assembly transport cradles
- Item 18 - spare parts for the articles called for under Items 10 through 17
- Item 19 - four (4) MX-776 Rascal Missiles

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- Item 20 - eleven (11) MX-776 Rascal Missiles
- Item 21 - tooling for the articles called for under Items 19 and 20
- Item 22 - test equipment for the articles called for under Items 19 and 20
- Item 23 - engineering and/or specification changes
- Item 24 - three (3) MX-776 Rascal Missiles
- Item 25 - procure materials for twenty-six (26) MX-776 Rascal Missiles
- Item 26 - training parts
- Item 27 - costs applicable to materials purchased or placed on order and cost applicable to fabrication initiated prior to 14 February 1952
- Item 28 - five (5) Rascal Missiles
- Item 29 - procure materials for forty (40) MX-776 Rascal Missiles
- Item 30 - one (1) Mobile training unit (MTU) and spare parts
- Item 31 - manufacture and prepare for shipment seventeen (17) B-47B director aircraft guidance systems and spare parts
- Item 32 - manufacture and prepare for shipment eleven (11) B-36F director aircraft guidance systems and spare parts
- Item 33 - manufacture and prepare for shipment seventeen (17) B-47B and eleven (11) B-36F spare systems
- Item 34 - furnish tooling and production test equipment required for the manufacture of fifty-six (56) guidance systems

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- Item 35 - prepare drawings and handbook data
- Item 36 - engineering liaison during installation of guidance systems at Convair and Boeing for Items 31 and 32
- Item 37 - fabricate sixty-one (61) MX-776 Rascal Missiles
- Item 38 - seven (7) missile carriages
- Item 39 - one (1) relay antenna dolly
- Item 40 - one (1) director aircraft guidance capsule stand
- Item 41 - spare parts for articles called for under Item 38
- Item 42 - squadron operational equipment
- Item 43 - depot operational equipment
- Item 44 - ground support equipment
- Item 45 - spare parts for Items 42, 43 and 50
- Item 46 - spare parts for Item 44
- Item 47 - special tools and test equipment for squadron and depot operational equipment
- Item 48 - engineering liaison required during the manufacture of squadron and depot operational equipment
- Item 49 - engineering and/or specification changes for the articles called for under Items 42 through 48
- Item 50 - additional items of operational ground support equipment deemed necessary but not contained in Items 42 and 43
- Item 51 - technical data for thirty-two (32) AFOSI missiles
- Item 52 - technical data for operational ground support equipment procured under Items 42 and 43

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- Item 53 - three (3) sets of RGOT model 110 equipment for use in RGOT units
- Item 54 - spare parts for the articles called for under Item 53
- Item 55 - one (1) aluminum production tool for DB-36 recess and structural installation
- Item 56 - maintenance of all tooling and test equipment needed for the production of the GAM-63 missile, up to and including the 114th article
- Item 57 - twenty-two (22) GAM-63A Rascal Missiles
- Item 58 - spares and spare parts for the missiles called for under Item 57
- Item 59 - revised technical data for the missiles called for under Item 57
- Item 60 - engineering and technical data

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AF 33(038)-20402
TOOLING

<u>Document</u>	<u>Date</u>	<u>Amount</u>	<u>For</u>
Contract	10 December 1952	\$ 8,190,999.26	Initial Pre-production Planning and Tooling for B-63 Missile
S. A. #1	31 December 1952	increase 1,940,791.94	Continuation of Pre-production Planning and Tooling for B-63 Missile
S. A. #2	10 April 1953	increase 501,438.49	Continuation of Production Planning for the B-63 Missile
C. O. #3	1 July 1953	no change	Delivery Schedule Change
C. O. #4	30 September 1953	no change	Delivery Schedule Change
S. A. #5	22 October 1953	increase 412,874.95	Industrial Planning Materials Study for the B-63
S. A. #6	10 November 1953	increase 779,446.40	Continuation of Production Planning for the B-63 Missile
S. A. #7	29 December 1953	increase 2,000,000.00	Continuation of Production Planning for the B-63 Missile
S. A. #8	10 May 1954	increase 3,225,858.17	Continuation of Production Planning for the B-63 Missile

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NAME, GRADE OR INDIVIDUAL PAYING CANCELLED
DATE

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S. A. #9	25 August 1954	increase	1,554,847.99	Completion of Production Planning for the B-63 Missile
S. A. #10	7 March 1955	no change		Articles of Government Furnished Property and Change in Rascal Missile Designation (from XB-63 to XGAM-63)
C. O. #11	1 July 1955	increase	29,416.09	Overrun
TOTAL			\$18,635,673.29	

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RESEARCH AND DEVELOPMENT

<u>Document</u>	<u>Date</u>	<u>Amount Allotted</u>	<u>For</u>	<u>Number of Missiles</u>
Contract	14 October 1946	\$ 1,476,716.47	Research and Development Work	
S. A. #1	23 May 1947	increase 400,268.06	Continuation of R&D	
S. A. #2	31 July 1947	increase 1,200,000.00	Continuation of R&D	
C. O. #3	3 July 1947	no change	Amendment of Item 3	
C. O. #4	2 October 1947	no change	Amendment of Article 21	
S. A. #5	3 March 1949	increase 6,189,969.16	Continuation of R&D	93 Shrike Test Missiles
S. A. #6	25 August 1949	increase 3,655,798.92	Continuation of R&D	
C. O. #7	3 February 1950	no change	Extension of Delivery Dates for Handbooks of Operating Instructions	
S. A. #8	5 June 1950	increase 699,972.82	Additional Research Work, Radar Sets, Two Launch- ing Gears and Reports	
S. A. #9	25 August 1950	increase 3,950,000.00	Continuation of Work Under Item 2 of Article 1(a), Addi- tional Work and other Changes	

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11/16/54

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S. A. #10	8 June 1951	increase	8,659,565.71	Additional Research Work	
S. A. #11	14 July 1951	increase	1,216,750.00	Additional Research Work	
C. O. #12	1 June 1951	no change		Engineering and/or Specification Changes	
S. A. #13	18 June 1951	increase	842,936.85	Additional Research Work	
S. A. #14	15 November 1951	increase	15,653,856.44	Additional Research Work	
S. A. #15	23 January 1952	no change		Redefining of Item 7	Reduced 93 Shrikes to 31
S. A. #16	2 June 1952	increase	1,977,257.44	Reorientation of Work Under Project MX-776	
S. A. #17	9 April 1953	increase	23,009,906.91	Continuation of R&D	
S. A. #18	12 May 1953	increase	5,786,000.00	Prototype Operational Guidance Systems, Data and Modification of K-4 Systems	
S. A. #20	30 June 1953	increase	5,754,000.00	Continuation of R&D	
S. A. #21	10 September 1953	no change		Revision of Item 42	
C. O. #22	22 September 1953	no change		Spare Parts	
S. A. #23	5 October 1953	increase	1,500,000.00	Continuation of R&D	

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C. O. #24	6 November 1953	no change	Extending Period of Performance
S. A. #25	28 November 1953	increase 23,999,000.00	Continuation of R&D
S. A. #26	23 December 1953	increase 738,389.33	Ground and Interference Tests for Project MX-776
S. A. #27	14 July 1954	no change	Subcontracts with General Dynamics Corporation (Convair Division) and Boeing Airplane Company
S. A. #28	25 February 1955	increase 25,346,182.13	Addition of Items 59 thru 63 and Modernization of Contract terms
C. O. #29	18 October 1954	increase 2,107,000.00	Overrun
S. A. #30	21 October 1954	no change	Modification of Paragraph (f) of Article One
S. A. #31	1 March 1955	no change	Incorporation of CCN's 2, 3, 4, 5, 6, 7, 9, 10 and 12
S. A. #32	27 June 1955	increase 857,206.67	Amendment of Item 60
S. A. #33	15 June 1955	no change	Miscellaneous CCN's
S. A. #34	1 July 1955	increase 69,443.48	Amendment of Item 59

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<u>Document</u>	<u>Date</u>	<u>Amount</u> <u>Allotted</u>	<u>For</u>	<u>Number of</u> <u>Missiles</u>
C. O. #35	30 June 1955	increase 4,057,000.00	Increase in Funds Allotted Pursuant to Article 61	
S. A. #36	22 September 1955	decrease 924,698.89	CCN's 17 and 18	
C. O. #37	21 October 1955	increase 4,250,817.87	Increase in Funds Allotted Pursuant to Article 61	
S. A. #38	24 January 1956	increase 175,929.63	Miscellaneous CCN's and Increase of Funds Committed Under Item 47	
S. A. #39	3 February 1956	increase 364,368.21	Miscellaneous CCN's	
S. A. #40	13 November 1956	increase 76,325.07	Spare Parts	
S. A. #40-1	7 March 1957	decrease 8,367.77	Spare Parts	
S. A. #41	5 March 1956	increase 167,883.45	CCN's 27 and 28	
C. O. #42	11 April 1956	no change	Commission of Funds for Item 36b	
S. A. #43	25 April 1956	no change	BNC Spare Parts	
C. O. #44	11 October 1956	no change	Decrease in Amounts Committed under Item 47	

TOTALS \$143,249,480.16

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CONTRACT W 33(038) ac-14169

- Item 1 - research and development for subsonic vehicle
- Item 2 - research and development for supersonic vehicle
- Item 3 - furnish and deliver progress reports
- Item 4 - furnish specifications and equipment developed by the contractor
- Item 5 - furnish a final report of the work called for under Items 1 and 2
- Item 6 - furnish a proposal for a contract for construction of an experimental test quantity of the articles developed
- Item 7 - first called for fabrication of 93 Shrikes;--later changed to 3 glide missiles, 15 Model 59, 13 Model 59A missiles (a total of 31)
- Item 8 - study leading to the development of an inertial guidance system
- Item 9 - development of an auxillary power source for the Rascal
- Item 10 - three (3) experimental unattended Radar Sets
- Item 11 - modification of one (1) B-50 airplane
- Item 12 - design and fabrication of two (2) missile launching gears for installation in B-50 type aircraft
- Item 13 - submission of progress reports for work called for under Items 8 to 12
- Item 14 - continuation of the research and development program called for under Item 2
- Item 15 - continuation of the research and development program called for under Item 2

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- Item 16 - engineering and/or specification changes
- Item 17 - modify three (3) model B-50 airplanes
- Item 18 - continue research and development of the Shrike test missile
- Item 19 - continue research and development of the Rascal
- Item 20 - conduct studies for improving and extending the performance of the Rascal
- Item 21 - conduct a Rascal flight test program at Holloman Air Force Base
- Item 22 - modification, operation and maintenance of airplanes bailed to the contractor
- Item 23 - operation of the Modeltown Test Facility (AF Plant No. 38)
- Item 24 - development of ground handling and support equipment
- Item 25 - development and procurement of test and checkout equipment
- Item 26 - negotiation of subcontracts
- Item 27 - solve other problems as they arise and as agreed upon between the AMC and the contractor
- Item 28 - continuation of the research and development phase of Project MX-776 and launch 21 Shrike test missiles
- Item 29 - continuation of research and development
- Item 30 - solve related problems
- Item 31 - (a) fabricate prototype operational equipment, (b) fabricate research and development ground support and laboratory test systems and equipment
- Item 32 - (a) operate and perform normal maintenance on bailed aircraft, (b) modify bailed aircraft

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- Item 33 - negotiation of subcontracts
- Item 34 - maintain close coordination with all agencies
- Item 35 - reports
- Item 36 - design and fabricate three (3) director aircraft terminal guidance systems
- Item 37 - fabricate, test and prepare for shipment three (3) spare systems
- Item 38 - fabricate, test and prepare for shipment one(1) bench set system
- Item 39 - tooling and production test equipment for the fabrication of seven (7) director aircraft terminal guidance systems
- Item 40 - Service and Operation Manuals for Items 36, 37 and 38
- Item 41 - engineering liaison with Boeing and Convair during performance of work under Item 36
- Item 42 - design and fabricate two (2) sets of ground checkout equipment for a complete director aircraft terminal guidance system
- Item 43 - engineering data for Item 36
- Item 44 - engineering design and fabrication attendant with modification of eight (8) bombing navigator computers
- Item 45 - preliminary handbooks covering modifications provided under Item 44
- Item 46 - engineering drawings and data for Item 44
- Item 47 - engineering and/or specification changes
- Item 48 - continuation of research and development

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- Item 49 - solve related research and development problems
- Item 50 - (a) fabricate prototype operational equipment, (b) fabricate research and development ground support equipment and laboratory test systems and equipment
- Item 51 - (a) operate and accomplish normal maintenance of bailed aircraft, (b) modify bailed aircraft
- Item 52 - negotiation of subcontracts
- Item 53 - maintain close coordination with all agencies
- Item 54 - submission of reports
- Item 55 - ground testing of one (1) prototype guidance system at Seattle, Washington
- Item 56 - ground testing of one (1) prototype guidance system at Fort Worth, Texas
- Item 57 - maintain and operate director aircraft guidance equipment, the Pilotless Parasite Bomber and the XB-63 system ground support equipment during DB-47 noise interference tests at Walker Air Force Base
- Item 58 - maintain and operate director aircraft guidance equipment, the Pilotless Parasite Bomber and the XB-63 system ground support equipment during DB-36 noise interference tests at Walker Air Force Base
- Item 59 - Weapon System Development Management
- Item 60 - Objectives I & II
 - I - development of a PPB weapon system using a B-47
 - II - development of a PPB weapon system using a B-36
- Item 61 - Objective III - conduct no R&D under this Item
 - III - the same as I & II, except for the addition of a BW/CW capability

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Item 62 - Objective IV (to 15 January 1955)

IV - the same as I & II, except for the substitution of an alternate emanating guidance system

Item 63 - Objective V (discontinued on or before 31 December 1955)

V - same as I & II, except that the guidance system shall be nonemanating and included the B-52 as a director aircraft

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AF 33(600)-31948
Research and Development

<u>Document</u>	<u>Date</u>	<u>Amount Allotted</u>	<u>For</u>
Contract	1 January 1956	\$22,038,774.94	Research and Development on MX-776 Weapon System
S. A. #1	1 June 1956	increase 117,631.53	CCN No. 3
S. A. #2	30 July 1956	increase 1,041,891.49	Electronic Vulnerability Test Program
C. O. #3	10 August 1956	increase 4,513,914.39	Exercise of Option
S. A. #4	23 August 1956	increase 302,750.16	CCN No. 1
C. O. #5	30 October 1956	increase 4,500,000.00	Overrun
S. A. #6	29 November 1956	increase 7,273,176.08	Revision of Items 1, 2, 4 and 5
S. A. #7	2 January 1957	increase 2,574,781.10	Additional Work under Item 3; CCN No. 4
C. O. #8	27 December 1956	increase 920,000.00	Overrun
C. O. #10	5 April 1957	increase 6,174,154.00	Overrun
S. A. #12	24 April 1957	increase 383,837.87	Incorporation of CCN No. 5 and other changes

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BY AUTHORITY OF *DD FORM 2541* 11 June 1957
BY *H. J. [Signature]*
CHECKED BY *[Signature]*
DATE *11 Aug 57*

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C. O. #13	11 June 1957	increase	6,779,868.17	Overrun
S. A. #14	3 October 1957	increase	575,108.14	Revision of Items 3g and 3jj
S. A. #15	22 May 1958	increase	69,491.30	New item pp and CCN No. 10
S. A. #16	24 June 1958	decrease	1,913,631.27	Terminated certain portions of the contract
S. A. #17	16 September 1958	decrease	384,862.80	Reduction of Maintenance Work on Bailed Aircraft
TOTAL			\$54,966,885.10	

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CONTRACT AF 33(600)-31948

- Item 1 improve the Weapon System developed under Contract W33(038)ac-14169
- Item 2 continually study all aspects of the entire program including the Weapon System for possible improvements
- Item 3 perform the following improvements of the system developed under Item 1:
- a. conduct an investigation including design, fabrication and development tests of a system to provide the Weapon Systems with a capability for the selection of alternate targets or aim points
 - b. design, fabricate and test a method to provide the Weapon System with a Gravity Bombing Capability
 - c. design, fabricate, and test a system to provide the Weapon System with an alternate warhead capability
 - d. design and deliver drawings of a boattail fairing with decreased drag characteristics
 - e. design and deliver drawings of a thin wing for improved performance
 - f. redesign and simplify the finfold system
 - g. redesign, fabricate and test the LR-67-BA-9 engine utilizing IWFNA (later changed to IRFNA)
 - h. fabricate and test the XLR-67-BA-9 rocket engine components and determine where design changes are necessary to adopt the XLR-67-BA-9 rocket engine to the use of IRFNA as the oxidizer

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- i. redesign, fabricate, and test gas generator sequence valve
- j. design, fabricate and complete ground and functional tests on an acid-rich gas generator
- k. design, fabricate and complete functional tests of fittings containing built-in orifices and having AN type characteristics
- l. design, fabricate and complete functional tests of an integral-thermal relief valve for incorporation in the hydrazine cadridge.
- m. design, fabricate and complete functional tests to determine the superiority of eliminating the gas separator provision in the oxidizer small cone tank
- n. design, fabricate and complete functional tests to determine the superiority of using air as a propellant tank pressurizing medium
- o. design, fabricate and complete functional tests of a narrow band-width X-band system
- p. design, fabricate and complete functional tests of a tuneable magneton and associated circuitry for the low power USR and Relay Command System
- q. design, fabricate and complete functional ground testings of a tuneable magneton for the high power USR
- r. design, fabricate and complete functional tests of a high power USR system
- s. design, fabricate and complete functional ground tests of an improved X-band relay link
- t. redesign, fabricate and complete functional ground tests of the Inertial Range Computing System

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- u. redesign, fabricate and complete functional ground tests of prototypes of the stable platform
- v. redesign, fabricate and complete functional tests of the autopilot power supply
- w. redesign, fabricate and complete functional ground tests of a prototype antenna stabilization system
- x. redesign, fabricate and complete functional ground test of a roll control system
- y. redesign, fabricate and complete functional ground testing of the autopilot system
- z. design, fabricate and complete functional ground tests of double nozzle servo valves
- aa. design, fabricate and complete functional ground tests of lower drift rate gyros
- bb. design and fabricate a prototype of a range, azimuth and altitude offset computer for use with the Model 110 terminal guidance control station
- cc. design and fabricate a prototype of a narrow band width video and command relay system
- dd. design, fabricate and complete functional tests of a reconnaissance system for indirect bomb damage assessments
- ee. the contractor shall revise its existing designs for weapon system ground support and training equipment
- ff. redesign and fabricate the all-optical radar simulator
- gg. develop superior ways and means of constructing radar simulator maps

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- hh. accomplish such EF-89C flight tests as may be required to establish practicability of an open loop steering system
- ii. design, fabricate and functional test special support equipment for overhaul depot use
- jj. the contractor shall accomplish the Electronic Vulnerability Test Program
- kk. thin wing and boattail
- ll. engine qualification test
- mm. acid bladder tanks
- nn. acid isolation device
- oo. stabilized Automatic Tracking Relay Antenna System (SATRAS).

Item 4 supply the following engineering and technical data:

- a. flight test reports
- b. program planning reports
- c. flight test planning reports
- d. quarterly progress reports
- e. quarterly reliability reports
- f. fiscal reports
- g. film reports
- h. monthly letter reports of the status of Item 2
- i. summary reports of cash study conducted under Item 2
- j. summary reports defining tests and results

Item 5 perform maintenance of bailed aircraft

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AF 33(600)-41997
Modification of B-36H

<u>Document</u>	<u>Date</u>	<u>Amount Allotted</u>	<u>For</u>
Contract	15 December 1952	\$2,551,958.87	Modification of B-36H aircraft into Director Aircraft
S. A. #1	6 April 1953	no change	Overhead rate
S. A. #2	18 February 1955	increase 4,109,912.33	Addition of Items 10 through 12, increase in funds for Item 9, supersession of CCN's
C. O. #4	11 June 1953	increase 13,104.33	Addition of new Item 8 and incorporation of CCN Nos. 1 and 2
C. O. #6	12 April 1954	increase 50,384.81	Addition of new Item 9, incorporation of CCN Nos. 5, 6, 7, 9, 11, and revision of delivery schedule for Item 3
S. A. #7	9 April 1954	no change	Revision of overhead rate
C. O. #8	4 May 1954	increase 57,803.64	Incorporation of CCN No. 14
S. A. #10	5 October 1954	no change	Revision of overhead rate
S. A. #11	8 March 1955	no change	Class coding
S. A. #12	27 May 1955	increase 268,982.77	Incorporation of CCN No. 2
S. A. #13	20 June 1955	no change	Incorporation of revised fixed rate of general office, general and administrative expense

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11 Sept 59

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S. A. #15	8 September 1955	increase	5,373.60	CCN Nos. 17, 18, 20, 21 and 22
S. A. #16	23 September 1955	decrease	413,375.04	Decrease of funds for Item 5
S. A. #17	3 February 1956	no change		Incorporation of revised fixed rate of general office, general and administrative expense
S. A. #18	23 April 1956	no change		Incorporation of Exhibit "A" and revisions 1 and 2, and spare parts
S. A. #19	29 May 1956	no change		Incorporation of revised fixed rate of general office, general and administrative expense
S. A. #20	30 July 1957	no change		Same as above
TOTAL			\$6,644,143.31	

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CONTRACT AF 33(600)-21997

- Item 1 - modify 1/26 scale high-speed YB-60 Model, and conduct thirty (30) hours of testing in cooperative wind tunnel
- Item 2 - mock-up forward cabin, relay antenna, and aft bomb-bay for missile installation
- Item 3 - perform the engineering, manufacturing and testing necessary to modify one (1) government-furnished B-36H airplane
- Item 4 - contractor shall conduct five (5) hours of prototype normal shakedown flight testing and two 3-hour preliminary test flights
- Item 5 - contractor shall provide and maintain necessary engineering and factory personnel for tests at Holloman Air Force Base
- Item 6 - contractor shall perform additional work as follows:
 - a. conduct study to determine spares support required for the prototype airplane
 - b. conduct pressurization study of the bomb bay electronic package
 - c. install provisions for checking the position of the radar relay antenna in flight
 - d. provide mechanical means for manual extension and retraction of the radar relay antenna
 - e. provide additional clearance for vertical fins in bomb bay fairing
 - f. conduct studies of various mechanisms designed to facilitate the loading of the missile

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- g. provide adequate electrical power
- h. install flush closure doors for radome
- Item 7 - furnish technical data
- Item 8 - rework four (4) Government-furnished F-84 Wing tip tanks
- Item 9 - engineering changes
- Item 10 - modify eleven (11) Government-furnished B-36H airplanes to the tactical director configuration
- Item 11 - furnish technical data for Item 10
- Item 12 - spare parts for Item 10

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AF 33(600)-22108
Modification of B-47E

CLASSIFICATION: *Confidential*
OR CHANGED TO
BY AUTHORITY OF *DoD Form 207, 1-2-51*
100-442601-201
BY *W. H. Anderson* 11 SEP 58
100-442601-201
100-442601-201

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S. A. #10	19 February 1957	decrease	9,641.21	Miscellaneous CCN's
S. A. #11	12 March 1957	increase	85,255.64	CCN Nos. 17 and 21
C. O. #12	6 February 1958	no change		Decrease in Amount Committed under Item 9

TOTAL \$7,376,566.88

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CONTRACT AF 33(600)-22108

- Item 1 - engineering, fabrication and modification of two (2) B-47E Airplanes
- Item 2 - flight tests
- Item 3 - wind tunnel tests and static tests of the missile release system
- Item 4 - construct mock-ups and conduct demonstrations
- Item 5 - technical data
- Item 6 - training program
- Item 7 - maintain B-47E Airplane
- Item 8 - spare parts for the prototype aircraft called for under Item 1
- Item 9 - engineering changes
- Item 10 - accomplish the design and modification to convert two (2) government-furnished model B-47E Aircraft to DB-47E configuration
- Item 11 - perform static test of Item 10 and prepare reports
- Item 12 - mock-up
- Item 13 - technical data

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AF RASCAL ACCEPTANCES*

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Total
1951	0	0	0	0	0	0	1	0	1	0	0	1	3
1952	3	0	0	0	0	0	0	0	2	0	0	1	6
1953	0	1	0	0	0	1	0	0	1	0	0	3	6
1954	1	0	2	0	1	1	1	2	0	3	4	2	17
1955	2	1	3	3	3	3	0	1	3	0	0	2	21
1956	1	1	2	2	1	2	1	2	1	2	2	2	20
1957	1	2	3	2	0	0	0	1	3	3	4	3	22
1958	3	3	4	4	4	4	4	4	4	3	1	0	36

* A total of 131 missiles were accepted by the Air Force and five were yet to be delivered

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RASCAL MISSILE ACCEPTANCES

Missile	AF Acceptance Date	Contract Item No.	Model+	Old AF+ Serial No.	New AF Serial No.
1	6 July 1951	2	XGAM-63	11122	51-17584
2	5 Sept 1951	2	"	11124	51-17586
3	4 Dec 1951	2	"	11123	51-17585
4	11 Jan 1952	1	"	11119	51-17581
5	11 Jan 1952	1	"	11120	51-17582
6	11 Jan 1952	1	"	11121	51-17583
7	5 Sept 1952	3	"	11125	51-17587
8	16 Sept 1952	3	"	11126	51-17588
9	18 Dec 1952	3	"	11127	51-17589
10	5 Feb 1953	3	"	11128	51-17590
11	2 June 1953	7	"	19175	51-17593
12	8 Sept 1953	7	"	19177	51-17595
13	18 Dec 1953	7	"	11129	51-17591
14	23 Dec 1953	7	"	19180	51-17598
15	28 Dec 1953	7	"	19191	51-17609
16	13 Jan 1954	7	"	11130	51-17592
17	15 Mar 1954	7	"	19176	51-17594
18	29 Mar 1954	7	"	19178	51-17596
19	5 May 1954	7	"	19179	51-17597
20	16 June 1954	7	"	19181	51-17599
21	28 July 1954	7	"	19183	51-17601
22	4 Aug 1954	7	"	19184	51-17602
23	27 Aug 1954	7	"	19186	51-17604
24	14 Oct 1954	7	"	19188	51-17606
25	18 Oct 1954	7	"	19190	51-17608
26	20 Oct 1954	37	"	53-388	53-8227
27	4 Nov 1954	7	"	19185	51-17603
28	12 Nov 1954	7	"	19187	51-17605
29	23 Nov 1954	19	"	19273	51-17611
30	26 Nov 1954	7	"	19189	51-17607
31	2 Dec 1954	7	"	19182	51-17600
32	16 Dec 1954	19	"	19274	51-17612
33	18 Jan 1955	7	"	19192	51-17610
34	31 Jan 1955	20	"	19277	51-17615
35	11 Feb 1955	19	"	19276	51-17614
36	7 Mar 1955	19	"	19275	51-17613
37	16 Mar 1955	20	"	19281	51-17619
38	31 Mar 1955	20	"	19278	51-17616
39	27 April 1955	20	"	19283	51-17621
40	28 April 1955	20	"	19282	51-17620

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41	29 April 1955	20	XGAM-63	19279	51-17617
42	26 May 1955	20	"	19285	51-17623
43	27 May 1955	20	"	19284	51-17622
44	31 May 1955	20	"	19286	51-17624
45	23 June 1955	20	"	19287	51-17625
46	29 June 1955	24	"	19288	52-10984
47	29 June 1955	24	"	19290	52-10986
48	4 Aug 1955	28	"	19292	53-8195
49	8 Sept 1955	28	"	19293	53-8196
50	29 Sept 1955	28	"	19295	53-8198
51	30 Sept 1955	24	"	19289	52-10985
52	27 Dec 1955	20	"	19280	51-17618
53	30 Dec 1955	37	GAM-63	19305	53-8208
54	16 Jan 1956	37	"	52-2354	53-8210
55	28 Feb 1956	37	"	53-392	53-8231
56	29 Mar 1956	37	"	52-2355	53-8211
57	30 Mar 1956	37	"	19306	53-8209
58	5 April 1956	37	"	19296	53-8199
59	17 April 1956	37	"	52-2356	53-8212
60	25 May 1956	37	"	52-2357	53-8213
61	22 June 1956	37	"	52-2358	53-8214
62	27 June 1956	37	"	52-2359	53-8215
63	20 July 1956	37	"	52-2360	53-8216
64	8 Aug 1956	37	"	52-2361	53-8217
65	31 Aug 1956	37	"	52-2362	53-8218
66	24 Sept 1956	37	"	52-2363	53-8219
67	22 Oct 1956	37	"	53-387	53-8226
68	31 Oct 1956	37	"	53-382	53-8221
69	13 Nov 1956	37	"	53-381	53-8220
70	16 Nov 1956	37	"	53-383	53-8222
71	29 Nov 1956	37	"	53-391	53-8230
72	27 Dec 1956	37	"	53-384	53-8223
73	28 Dec 1956	37	"	53-385	53-8224
74	14 Jan 1957	37	"	53-386	53-8225
75	4 Feb 1957	37	"	53-389	53-8228
76	18 Feb 1957	37	"	53-390	53-8229
77	12 Mar 1957	37	"	53-393	53-8232
78	26 Mar 1957	37	"	53-394	53-8233
79	27 Mar 1957	37	"	53-395	53-8234
80	17 April 1957	37	"	53-396	53-8235
81	19 April 1957	37	"	53-397	53-8236
82	29 Aug 1957	37	"	53-398	53-8237
83	Sept 1957#	37	"	53-399	53-8238

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84	25 Sept 1957	37	GAM-63	53-400	53-8239
85	27 Sept 1957	37	"	53-401	53-8240
86	Oct 1957	37	"	53-402	53-8241
87	24 Oct 1957	37	"	53-403	53-8242
88	31 Oct 1957	37	"	53-404	53-8243
89	12 Nov 1957	37	"	53-405	53-8244
90	20 Nov 1957	37	GAM-63A	53-407	53-8246
91	25 Nov 1957	37	"	53-406	53-8245
92	27 Nov 1957	37	"	53-409	53-8248
93	20 Dec 1957	37	"	53-410	53-8249
94	23 Dec 1957	37	"	53-408	53-8247
95	27 Dec 1957	37	"	53-411	53-8250
96	9 Jan 1958	37	"	53-412	53-8251
97	15 Jan 1958	37	"	53-413	53-8252
98	28 Jan 1958	37	"	53-415	53-8254
99	5 Feb 1958	37	"	53-414	53-8253
100	14 Feb 1958	37	"	53-417	53-8256
101	26 Feb 1958	37	"	53-416	53-8255
102	10 Mar 1958	37	"	53-419	53-8258
103	27 Mar 1958	28	"	19291	53-8194
104	28 Mar 1958	37	"	53-418	53-8257
105	31 Mar 1958	37	"	53-420	53-8259
106	17 April 1958	37	"	19297	53-8200
107	23 April 1958	28	"	19294	53-8197
108	28 April 1958	37	"	19299	53-8202
109	30 April 1958	37	"	19298	53-8201
110	15 May 1958	37	"	19301	53-8204
111	20 May 1958	37	"	19300	53-8203
112	26 May 1958	37	"	19302	53-8205
113	28 May 1958	37	"	19303	53-8206
114	10 June 1958	37	"	19304	53-8207
115	18 June 1958	57	"		56-4448
116	24 June 1958	57	"		56-4449
117	27 June 1958	57	"		56-4450
118	10 July 1958	57	"		56-4451
119	16 July 1958	57	"		56-4452
120	8 Aug 1958	57	"		56-4453
121	14 Aug 1958	57	"		56-4454
122	22 Aug 1958	57	"		56-4455
123	29 Aug 1958	57	"		56-4457
124	5 Sept 1958	57	"		56-4456
125	15 Sept 1958	57	"		56-4459
126	19 Sept 1958	57	"		56-4459

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127	26 Sept 1958	57	GAM-63A	56-4458
128	8 Oct 1958	57	"	56-4462
129	10 Oct 1958	57	"	56-4463
130	22 Oct 1958	57	"	56-4461
131	3 Nov 1958	57	"	56-4466

* All missiles were provided by Contract AF 33(038)-15069 which called for a total of 136. The following list indicates the items of the contract which called for the production of missiles and the number of missiles provided by each item:

Item 1 - 3 missiles	Item 20 - 11 missiles
Item 2 - 3 missiles	Item 24 - 3 missiles
Item 3 - 4 missiles	Item 28 - 5 missiles
Item 7 - 20 missiles	Item 37 - 61 missiles
Item 19 - 4 missiles	Item 57 - 22 missiles

+ A total of 52 XGAM-63's, 37 GAM-63's, and 42 GAM-63A's were produced by November 1958. Five additional GAM-63A's were yet to be delivered by Bell.

+ The 22 missiles called for under Item 57 did not have old AF Serial Numbers.

Research failed to reveal the exact date in the month.

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