ADC HISTORICAL STUDY NO. 12

AIRCRAFT IN AIR DEFENSE 1946 - 1960

by

Richard F. McMullen

Historical Division
Directorate of Information
Air Defense Command

GROUP-3
Downgraded at 12 year intervals;
Not automatically declassified.

CONFIDENTIAL

THIS PAGE IS UNCLASSIFIED IAW EO 13526

PRIORITY
PT 00115
PTTUZYUW RUWMABA0003 2600050-UUUU--RUCIEUA.
ZNR UUUUU
P 170015Z SEP 69
FM 55 WEARSQ/55MWC/MCCLELLAN AFB CALIF
TO RUWMODA/MASDC/DAVIS MONTHAN AFB ARIZ
INFO RUWTABA/OCAMA/OCMPSW/TINKER AFB OKLA
RUCIEUA/MAC/MAMMGAS/MAMMFD/MACOA
RUCIEUA/AWS/AWMAMP/SCOTT AFB ILL
ZEN/9WEARWG/9MAC/MCCLELLAN AFB CALIF
BT
UNCLAS 55MWC.
SUBJ: AFM 65-110 REPORTING, 1HAF-A1 INVENTORY GAIN.
51005218/WB47E/MASDC/S1/FBZZ/PL/08/GB/PRJY/Q1/9253/.
51002402/WB47E/MASDC/S1/FBZZ/PL/11/GB/PRJY/Q1/9254/.
51002417/WB47E/MASDC/S1/FBZZ/PL/10/GB/PRJY/Q1/9254/.
51002390/WB47E/MASDC/S1/FBZZ/PL/09/GB/PRJY/Q1/9255/.
51007063/WB47E/MASDC/S1/FBZZ/PL/09/GB/PRJY/Q1/9255/.
51002363/WB47E/MASDC/S1/FBZZ/PL/09/GB/PRJY/Q1/9255/.
BT
#0003

NNNN≠

00000

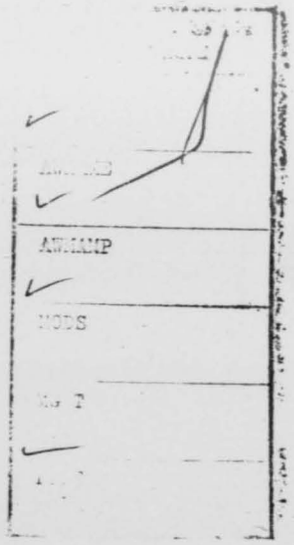
17 Sep 69 04 54z

17 Sep 69 01 45Z

OPR	CYS
M	3
INFO	CYS
0	7
COA	3
X	5
MAP	1
CHO	1
MWS	3
	21

F-1

ACTION
MDC
INFO



CONFIDENTIAL

ADC HISTORICAL STUDY NO. 12

AIRCRAFT IN AIR DEFENSE 1946 - 1960

by

Richard F. McMullen

Historical Division
Directorate of Information
Air Defense Command

GROUP-3
Downgraded at 12 year intervals;
Not automatically declassified.

CONFIDENTIAL

THIS PAGE IS UNCLASSIFIED IAW EO 13526

TABLE OF CONTENTS

ILLUSTRATIONS

INTRODUCTION

Although there was no air defense system in the United States prior to World War II, the all-weather interceptors of the sixties were the more-or-less direct descendants of the fighter aircraft of the thirties. In the years immediately before the war, the Army Air Corps developed and produced in limited quantities fighters which could have been used for air defense purposes. These were significant improvements over the aircraft developed in the decade following World War I. The pioneer in this early group of modern fighters was the P-26, the last fighter Boeing produced in quantity. Tested in 1932 and accepted as Air Corps standard in 1933, the P-26 was capable of a speed of 230 miles an hour. It was copied by the Russians and as the "Rata" was the fastest aircraft used by the Loyalist forces in the Spanish Civil War of 1936-39.

Successful development of the P-26 launched a whole series of similar, but improved, fighters. Republic began development of the P-35 in 1935 and the first aircraft was accepted in July 1937. It was capable of an altitude of 30,000 feet and a speed of 282 miles an hour. Republic followed the P-35 with the P-43 "Lancer." First accepted

in 1940, production of the Lancer had ended by Pearl Harbor. The ultimate improvement of the P-35 was the P-47 "Thunderbolt" of World War II. The Thunderbolt was first accepted in December 1942. Because it could reach a speed of 425 miles an hour, the Thunderbolt was widely used during the war.

Curtiss, another of the giants in the fighter field, began work on the P-36 "Mohawk" in 1934. The P-36 accepted in 1937 was capable of a speed of 288 miles an hour and could reach an altitude of 35,000 feet. From the P-36 beginning came the P-40 "~~Tomahawk~~ War-hawk," one of the two modern fighters available to the Air Corps in some quantity at the beginning of World War II. It could fly at 350 miles an hour, but was at a serious disadvantage at altitudes above 20,000 feet. The third member of the P-36 family was the workhorse P-51 "Mustang" of World War II. Although the P-51 was produced for the British in late 1941, the Air Corps did not fully realize the potentialities of this fighter until the British sent glowing reports of its performance. The AAF, therefore, did not get a P-51 group to the combat area until November 1943. The P-51H could reach an altitude of 40,000 feet and was capable of a speed of 487 miles an hour.

Though no air defense ground environment was then available, the Chief of the Air Corps, in 1936, directed development of a larger interceptor of maximum firepower. One result of this request was the Bell "Airacuda," a radical departure from the small single-seat fighters then being used. The Airacuda had a five-man crew and weighed 13,000 pounds as opposed to the 4,500 pounds for the P-36. Because of its extreme size and weight, the Airacuda was not what the Air Corps wanted and only 13 were built, with acceptances beginning in 1938. While the Airacuda was a failure, the work was not wasted, because it resulted in the single-seat P-39 "Airacobra," first delivered in 1940. It had a ceiling of 32,000 feet and offered a speed of 370 miles an hour. Many were used by the British and Russians in the early stages of World War II.

A second result of the 1936 requirement for a larger, more heavily armed interceptor was the Lockheed P-38 "Lightning." This was a twin-engine fighter weighing 11,000 pounds, but nevertheless capable of 400 miles an hour and an altitude of 38,000 feet. The first Lightning was delivered in January 1939. It saw service in all theaters during World War II.

Despite impressive improvements in fighters during the thirties, these aircraft were limited to daylight operations and British experience in the early days of World War II indicated that most air defense operations were conducted at night. Because their need was more pressing, the British led in the development of night fighters. Northrop, however, began work on an American night fighter in November 1940. But development was slow, because the night fighter was a new concept. It had to be fast, since it was expected to overtake a bomber, and it had to be large, because it was required to carry two men and much electronic equipment. These two requirements pulled in opposite directions and complicated design work.

The United States entered World War II before the experimental model of the Northrop night fighter had been flown, which led to an abortive attempt to convert the A-20 attack bomber into a night fighter. Nearly 300 A-20's were converted to night fighter (P-70) configuration and reached the combat zone in February 1943 when the 6th Night Fighter Squadron arrived on Guadalcanal. Unfortunately it took the P-70 forty-five minutes to reach 22,000 feet and at that altitude Japanese medium bombers could outrun it. The P-70 was obviously inadequate.

The Northrop night fighter--the P-61 "Black Widow"--made its first flight on 26 May 1942 and deliveries began in July 1943. The P-61 was the largest fighter built to that time, being nearly the size of a medium bomber. It was relatively slow at 360 miles an hour, but was highly maneuverable and could reach an altitude of 30,000 feet. During the last year of the war it appeared in most active theaters.

The war did not end, but only encouraged, progress in interceptor development. In the 14 years between 1946 and 1960, ADC was provided with a series of ever-better aircraft. They flew higher and faster and were equipped with improved armament and electronic gear. The first jet all-weather interceptor (F-94A) appeared in 1950. These better aircraft, though, were never quite what ADC wanted or thought was required. The state of the aircraft art was never sufficiently advanced to fully meet ADC, or USAF, requirements in the time specified. The "1954 interceptor" outlined in 1949 was not ready until 1959 and then did not fully meet the specifications laid down ten years before. Because of this development lag, ADC was forced to accept a series of "interim" interceptors--F-82, F-94, F-86D, F-102, F-104, F-101B--which had to serve until the specially designed interceptors were available. This

continued inability of the development and production agencies to make reality coincide with plans posed a never-ending problem for the programming people on the ADC staff. Long-range programming was almost a fruitless endeavor in ADC, because the program was never stable enough to permit much advance action. ADC programmers were reduced, many times, to short-range predictions that often made aircraft conversions a harried "crash" activity that frayed tempers and reduced combat capability.

CHAPTER ONE

THE SEARCH FOR A JET ALL-WEATHER INTERCEPTOR

World War II

The idea of specialized aircraft for air defense was debated in the years before World War II, notably by fighter purists like Capt. Claire L. Chennault,[1] but the idea did not become practical until radar became available during the war. The British, because their need was pressing, were pioneers in the development of what were first known as night fighters.

On the basis of British experience, a requirement for an American night fighter was recognized before Pearl Harbor and Northrop began designing such an aircraft in November 1940. But development was relatively slow, because the night fighter was a new concept. The night fighter required speed, because it was expected to overtake a bomber, and it also had to be large in order to

---

1. USAF Historical Study No. 89, The Development of Air Doctrine in the Army Air Arm, 1917-1941, Sept 1955, p. 59.

accomodate two men (pilot and radar operator) and a considerable amount of electronic equipment. These two requirements pulled in opposite directions and complicated design work.

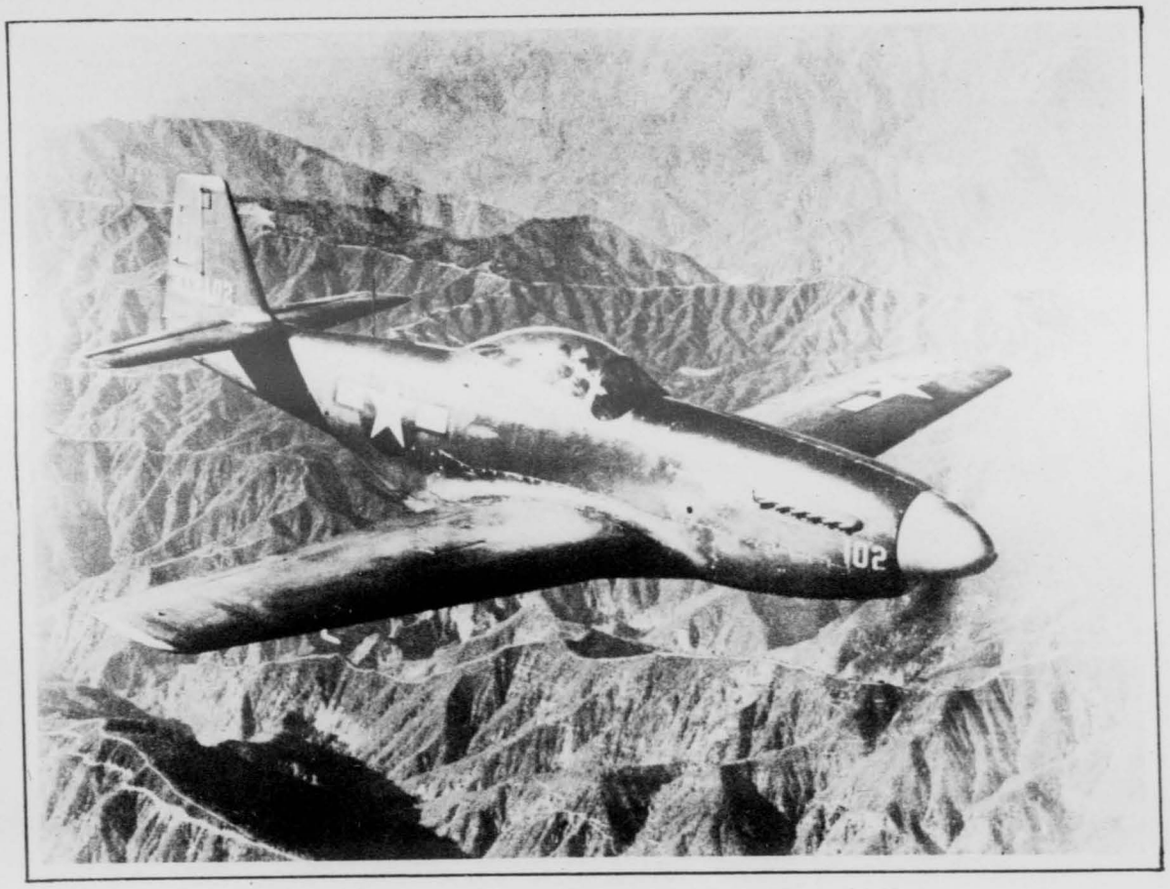
The United States entered World War II before the experimental model of the Northrop night fighter had been flown, so an attempt was made to convert the A-20 attack bomber into a night fighter. The attempt was a failure. Two hundred sixty-nine A-20's were converted to night fighter (P-70) configuration and P-70's reached the combat zone in February 1943 when the 6th Night Fighter Squadron arrived on Guadalcanal. Unfortunately, however, it took the P-70 45 minutes to reach an altitude of 22,000 feet and at that altitude Japanese medium bombers could outrun it. Although the P-70 remained in the Pacific theater until late 1944, not much use was made of it.[2]

The experimental model of Northrop's P-61 Black Widow made its first flight on 26 May 1942 and Army Air Forces began to accept delivery of the production model in July 1943. A total of 682 was produced. The P-61 was the largest fighter which had yet been built, being nearly the size of a medium bomber. It was relatively slow at 360

---

2. W. F. Craven and J. L. Cate, eds., The Army Air Forces in World War II (Chicago, 1950 and 1955), IV, 153 and VI, 212-221; USAF Historical Study No. 92, Development of Night Air Operations, 1941-1952 (1953), pp. 14-15 and 29-51.

P-47



P - 51

miles an hour, but was highly maneuverable and could reach an altitude of 30,000 feet. During the last year of the war it appeared in most active theaters, though it was seldom put to its intended use because the Allies enjoyed universal air superiority by the time the P-61 became operational. Fourteen squadrons of P-61's were operating in overseas theaters at the end of the war--seven in the Pacific, three in the Mediterranean, two in Europe and two in China-Burma-India. In one of the few instances where the P-61 was used for air defense purposes, the results were not encouraging. Between October 1944 and January 1945 the Japanese made 63 night bombing raids on Morotai, an important AAF base approximately midway between New Guinea and the Philippines. Ground radar detected 33 of these 63 raiders and P-61 aircraft went aloft to make the interception 61 times. On only five occasions was the bomber destroyed. Malfunctions in the airborne radar were most often blamed for unsuccessful interceptions.[3]

The F-82

When the Air Defense Command was created in March 1946 there was no debate as to which night fighter aircraft would be used for air defense purposes. The only

---

3. Craven and Cate, IV, 153 and VI, 212-221; USAF Historical Study No. 92, pp. 14-15 and 29-51.

one available was the P-61. It was hardly a match for B-29 and B-50 bombers, however. In the search for something better, the AAF hit upon the P-82 (subsequently rechristened F-82) as a temporary solution until a really satisfactory night fighter could be obtained. The P-82, essentially two P-51's joined by a center wing section (and therefore known as the "Double Mustang"), was originally designed as a long-range escort fighter to succeed the P-51. North American began development in January 1944.

The development effort was overtaken by the end of the war, so the first XP-82 aircraft were not accepted by AAF until late 1945. With the war finished, there did not seem to be any particular use for the P-82. After studying the problem, the AAF Operations Group recommended, in November 1945, that if the P-82 was to be procured in any quantity it should be utilized as an interim all-weather fighter. General Carl A. Spaatz, Deputy Commander, AAF, agreed with the A-3 reasoning and on 29 November 1945 authorized procurement of the P-82 as an all-weather fighter, assuming that yet-to-be-held tests would show it to be adequate for that purpose.[4]

---

4. AMC Historical Study No. 213, Development and Production of Fighter Aircraft for the United States Air Force (Oct 1949), pp. 84-85; Memo, TSBPA4A (Air Technical Service Command) for TSBPA, "Trip to Washington," 8 Nov 1945 (Doc 8 in AMC Historical Study No. 34, Case History of the F-82E, F and G Airplanes--hereinafter cited as AMC Historical Study No. 34).

A contract for 250 P-82 aircraft was formalized in February 1946, before the all-weather test was begun. One hundred were to be P-82E long-range escorts. The remaining 150 were to be P-82F and P-82G all-weather interceptors. In the spring of 1946 it was anticipated that production of P-82E aircraft would begin in April 1947 and that production of the all-weather version would start when P-82E production was complete.[5]

For a brief period in the spring of 1947, AAF considered changing the P-82F/G back to day fighter configuration because Eglin tests accused the aircraft of poor maneuverability, slow deceleration and poor pilot visibility. AMC pointed out, however, that if the P-82 was not put to night fighter use there would be nothing beyond the P-61 until the P-87 or P-89 became available two years, or more, in the future. AAF reluctantly agreed that, whatever its shortcomings, it was the P-82 or nothing.[6]

---

5. Memo, Research and Engineering Division, AC/AS-4, AAF to Commitments Division, AC/AS-3, "P-82 All-Weather (P-82C and P-82D) Night Fighter Versions," 28 Feb 1946 (Doc 25a to AMC Historical Study No. 34); Memo, Research and Engineering Division, AC/AS-4, AAF to Requirements Division, AC/AS-3, "P-82E Aircraft Equipment (Night-Fighter Versions)," 10 Apr 1946 (Doc 36 to AMC Historical Study No. 34).

6. AMC to AAF, "Contract W33-038-AC-13950 P-82F and G Airplanes, Continuation of Night Fighter Program," 19 May 1947 (Doc 134 to AMC Historical Study No. 34); AAF to AMC, "P-82 Night Fighter Aircraft," 1 Jul 1947 (Doc 146 to AMC Historical Study No. 34).

The shortcomings of this interim night fighter became more and more evident as the months rolled by. The Allison V-1710 engine was pretty much of a failure and although development work continued through 1947 and into 1948 it was never satisfactory. North American went ahead with the airframes and by the end of 1947 was storing 130, pending completion of engine development. Some of the airframes had been in storage since April 1947 and had deteriorated to the point where the Inspector General became concerned. The engine situation was so desperate by January 1948 that it was suggested that the Packard V-1650 engine be substituted for the Allison model. This was an impossible alternative, however, because both the Packard and Continental engine plants had been dismantled and several months and considerable expense would be required to rebuild either. Anyway, the Allison production line had been underway for months before the serious deficiencies of the Allison engine had come to light and 82 per cent of the 750 engines ordered had already been

P - 61

P-82

produced. As a practical matter, then, it was imperative that the Allison engine be made to work.[7]

Because it was forced into a corner, AMC found it necessary to release the Allison engine for P-82 installation in March 1948, assuming that a long list of modifications would be made and that the engines would be operated at a power rating considerably below the rating called for by the specifications. Meanwhile, because the P-61 had proven to be entirely unsuitable for the operations ADC had in mind, ADC was getting anxious for the P-82 with its 400-mile speed and 34,000-foot ceiling, even though it was equipped with an engine of dubious reliability and less power than had been expected. With the engine log-jam broken, it was possible to comply with the ADC request. All P-82F/G aircraft had been delivered by the end of 1948. The five squadrons of the 52nd and 325th All-Weather Fighter Wings received F-82's in 1949, but the combat capability of ADC was not appreciably improved thereby. The F-82 was almost impossibly difficult to maintain, especially since

---

7. Msg, AMC to NAA, 27 Jul 1947 (Doc 145 to AMC Historical Study No. 34); Memo, TSEPP-8K, AMC, to TSBPA, AMC, "War Emergency Operation of V-1710-143 and -145 Engines in P-82E Airplanes," 3 Jul 1947 (Doc 147 to AMC Historical Study No. 34); Memo, Col. J. S. Holtoner, Aircraft Branch, USAF, to General Craigie, "P-82 Difficulties," 8 Dec 1947 (Doc 226 to AMC Historical Study No. 34); Memo, MCPPXE43, AMC to MCPPXA, AMC, "Proposition of Changing Engine Installations for Type P-82 Aircraft," 29 Jan 1948 (Doc 255 to AMC Historical Study No. 34).

production of the aircraft ceased in 1948 and no provision had been made for an adequate supply of spare parts. The F-82's had all been replaced by the F-94A by early 1951, the few F-82's remaining in the command being relegated to target towing.[8]

The F-89

At best, the P-82 was regarded as only a stopgap all-weather fighter. Long-range dependence was to be placed on the aircraft to result from the design competition announced by the AAF immediately after World War II. Three types of fighters were planned, a long-range "penetration" model, a short-range day fighter and a large, heavily armed, two-place all-weather interceptor. Six aircraft manufacturers entered the all-weather competition--Bell, Consolidated, Curtiss, Douglas, Goodyear and Northrop. AAF originally had in mind a conventional aircraft, but since most of the six competitors submitted

---

8. Memo, MCR, AMC to MCP, AMC "Contingent Release of P-82 Airplanes," 11 Mar 1948 (Doc 273 to AMC Historical Study No. 34); ADC to USAF, "P-82 Aircraft," 24 Mar 1948 (Doc 281 to AMC Historical Study No. 34); ADC to AMC, "P-82 Aircraft," 21 Apr 1948 (Doc 290 to AMC Historical Study No. 34); 1st Ind (NAA to AFPR, NAA, "Report of Estimated Aircraft Acceptances," 31 Dec 1948), AFPR, NAA to AMC, 31 Dec 1948 (Doc 342 to AMC Historical Study No. 34); Hist of ADC, Jan-Jun 1951, p. 148.

designs for a jet model, it soon became obvious that the new all-weather interceptor would be a jet.[9]

AAF was definitely seeking an advanced night fighter, since the specifications against which the competitors were asked to bid called for an aircraft capable of a speed of 525 miles an hour at 35,000 feet, 550 miles an hour at sea level, ability to climb to 35,000 feet in 12 minutes and a combat radius of 600 miles. Provisions for launching air-to-air rockets were to be included. The aircraft was to be armed with a minimum of six machine guns or 20 mm cannon. IFF and AI radar were to be included in the design. After studying the six proposals during the winter of 1945-46, AMC decided that the Northrop design was the most promising. Curtiss had already been given a contract to develop its entry, an aircraft subsequently known as the P-87. The Goodyear entry was rejected for poor tail design. Douglas proposed a fighter of such great weight that it was primarily a bomber. Bell suggested the use of four engines, two of one type and two of another,

---

9. ASTC to Northrop, "Request for Design Proposals on Experimental Fighter Airplanes," 28 Aug 1945 (Doc 1 to AMC Historical Study No. 37, Case History of the F-89 All-Weather Fighter Airplane, hereinafter cited as AMC Historical Study No. 37); Msg, AAF to AMC, 2 Apr 1946 (Doc 8 to AMC Historical Study No. 37); AMC to AAF, "Procurement of All-Weather Fighters Fiscal Year 1946," 25 Mar 1946 (Doc 9 to AMC Historical Study No. 37).

leading, AMC felt, to maintenance complications. Consolidated also proposed an aircraft of extreme weight and one which would probably have difficulty in spin recovery.[10]

Northrop actually submitted four designs for the all-weather fighter competition. Two were for conventional fighters, one with two engines, one with three. The other two designs were for jets, one a radical tailless "flying wing" type. Northrop still had hopes that a flying wing fighter could be developed. This hope was natural, since Northrop had been working on a flying wing jet since the autumn of 1942. This was the ill-fated P-79 which, had it been successful, would have been the first American jet aircraft. Northrop was so busy with standard types of aircraft during 1942 and 1943, however, that development of the P-79 was turned over to a small subcontractor. The subcontractor proved unable to do what Northrop wanted done and Northrop had to resume the project in its own shops in 1944. The only P-79 ever built was completed in 1945. Aside from its distinctive appearance, the P-79 was also unique in that the pilot was placed in a prone position. It was powered by a single

---

10. Memo, AC/AS-3, AAF to AC/AS-4, AAF, "Military Characteristics of Aircraft (All-Weather Fighter)," 23 Nov 1945 (Doc 4 to AMC Historical Study No. 37); AMC to AAF, "Procurement of All-Weather Fighters Fiscal Year 1946," 18 Mar 1946 (Doc 7 to AMC Historical Study No. 37).

Westinghouse jet engine and was designed to reach a speed of 630 miles an hour and an altitude of 45,000 feet. Unfortunately, the P-79 crashed and was destroyed during its first flight on 12 September 1945. Despite Northrop confidence that the P-79 design could be adapted to all-weather use, AMC chose a design which called for orthodox wing and tail surfaces. AAF gave AMC permission, 10 April 1946, to write Northrop a contract for two XP-89 aircraft.[11]

By September 1946, Northrop was ready for inspection of the mock-up version of the P-89 which by that time was seen as a twin-engine, two-place interceptor weighing 36,000 pounds and armed with four 20 mm cannon. The power plant was to consist of General Electric J35-GE-3 engines. The first flight was expected to take place in November 1947. AMC was not favorably impressed with the mock-up presented by Northrop in September 1946, however, and asked that the contractor re-think the design in terms

---

11. Northrop to ATSC, "Design Proposal on Experimental Fighter Airplane," 1 Nov 1945 (Doc 2 to AMC Historical Study No. 37); AMC Historical Study No. 213, Development and Production of Fighter Aircraft for the United States Air Force (Oct 1949), pp. 107-109; Northrop to ATSC, "Design Proposal on All-Weather Fighter Airplane," 29 Nov 1945 (Doc 5 to AMC Historical Study No. 37); 1st Ind (AMC to AAF, "Procurement of All-Weather Fighters Fiscal Year 1946," 25 Mar 1946); AAF to AMC, 10 Apr 1946 (Doc 9 to AMC Historical Study No. 37).

suggested by the AMC inspection team. The AMC people wanted the radar operator moved closer to the pilot, the canopy re-designed, aluminum substituted for magnesium in the wings and something done about unsatisfactory fuel and oil systems, plus numerous minor changes. Another mock-up session was held in December 1946 and this time AMC was satisfied. Northrop was free to proceed with construction of the first aircraft.[12]

But progress was relatively slow on the P-89, because of continuing indecision as to the engines to be used. This was a time of much development activity in jet engines and newer and more powerful engines appeared in rapid succession. In addition to the J35-GE-3 engine mentioned in September 1946, attention was also given to the J35-A-9, J35-A-15 and J35-A-17 (all built by Allison) which came along later. Also, despite the earlier decision in favor of the P-89 as the first specially designed post-war all-weather interceptor, there were nagging doubts that the P-89 was really best for the purpose. There was recurring discussion of the Curtiss P-87, the Lockheed P-90 and the Douglas F3D (a Navy type) as possibilities in the

---

12. Memo, Engineering Division, AMC to Procurement Div., AMC, "Contract W33-038-AC-14541, XP-89 Airplane--Mock-up Inspection," 6 Sep 1946 (Doc 15 to AMC Historical Study No. 37); Memo Report on Revised Mock-up Inspection of the XP-89 Airplane, Power Plant Laboratory, AMC, 20 Jan 1947 (Doc 21 to AMC Historical Study No. 37).

all-weather field. Because of the air of uncertainty that prevailed, it was not surprising that the first flight of the XP-89 did not occur in November 1947 as originally planned. It was not until 16 August 1948 that the XP-89 successfully got off the ground.[13]

With the successful experimental flight of the XF-89, it became apparent that a reasonably final decision would soon have to be made as to whether or not this aircraft was to be the first jet all-weather interceptor. As background for this decision, the F-87 and F3D were flown by experienced night fighter pilots and a special series of flight tests of the XF-89 were conducted during September 1948. The XF-89 was not too impressive, since the J35-A-9 engines could not be operated at full power because they generated excessive tail pipe temperatures. As a

---

13. Memo, Brig. Gen. T. S. Power (Chief, Requirements Div, USAF) to Lt. Gen. E. E. Partridge (Dir/R&D, USAF), "Future Performance of All-Weather Fighters," 1 Apr 1948 (Doc 40 to AMC Historical Study No. 37); Northrop to AMC, "Contract W33-038-AC-14541, XP-89 Airplane, Engine Change," 29 Apr 1948 (Doc 43 to AMC Historical Study No. 37); Engineering Acceptance Inspection of XP-89 Airplane, AMC, 28 Jun 1948 (Doc 50 to AMC Historical Study No. 37); USAF to AMC, "Recommended Engine Change in No. 2 XF-89 Aircraft," 28 Jul 1948 (Doc 56 to AMC Historical Study No. 37); Memo, MCPPXA, AMC to MCREAOA4, AMC "Procurement Plans for XF-89 Airplane," 13 Aug 1948 (Doc 59 to AMC Historical Study No. 37); AMC Engineering Liaison Officer (Muroc) to AMC, "Progress and First Flight Report for XF-89 Airplane," 18 Aug 1948 (Doc 60 to AMC Historical Study No. 37); 1st Ind (AMC to USAF, "Contract W33-038-AC-14541, Recommended Engine Change in No. 2 XF-89 Airplane," 25 Aug 1948), USAF to AMC, 13 Sep 1948 (Doc 69 to AMC Historical Study No. 37).

result, the aircraft required an especially long take-off run (about 5,500 feet). The XF-89 did manage to get to 30,000 feet in 14.7 minutes, however, and attained a speed of 565 miles an hour at 20,000 feet and 523 miles an hour at 30,000 feet. The test pilot was of the opinion that acceleration in the XF-89 was slower than in other jets he had flown.[14]

In a sense, the decision had already been made, since Curtiss had been awarded a contract for 88 F-87 Blackhawks in June 1948. There was a body of opinion within the Air Force, though, that believed this action to have been hasty. To find a solution to what had become a major problem, therefore, the Secretary of the Air Force appointed a board of senior officers (Maj. Gen. K. B. Wolfe, AMC; Maj. Gen. F. O. Carroll, AMC; Brig. Gen. Carl A. Brandt, USAF; Col. Bruce K. Holloway, ADC; and Col. Albert Boyd, AMC; plus six relatively junior officers) to determine which of the competing aircraft had the most potential as an all-weather fighter. The Board met at Muroc AFB, California, on 7-8 October 1948. It was agreed by the conferees that none of the aircraft under discussion (F-87, F-89 and F3D) was really

---

14. Memo, MCRF, AMC to MCREOA, AMC, "Special Flight Test Report on the XF-89 All-Weather Fighter," 22 Sep 1948 (Doc 71 to AMC Historical Study No. 37); Memo, Dir/R&D, USAF to DCS/M, USAF, "All-Weather Fighters," 23 Sep 1948 (Doc 72 to AMC Historical Study No. 37).

satisfactory as an all-weather interceptor. On the question of which was the least unsatisfactory, none of the members voted in favor of the F-87 or F3D. Generals Wolfe and Carroll, Colonel Boyd (all from AMC) and four junior members voted to procure the F-89. General Brandt, Colonel Holloway and two junior members voted against procuring any of the three.[15]

The action recommended by the majority of the Board was taken almost immediately. On 14 October 1948, General Muir S. Fairchild, USAF Vice Chief of Staff, directed the USAF DCS/M to halt production of the F-87 and start production of the F-89 as soon as possible. This action was approved by Secretary of Defense James Forrestal in November 1948 and funds for the purchase of 48 F-89's were released by President Harry S. Truman in January 1949. Northrop was authorized to proceed with the construction

---

15. Aero Digest, Jan 1951; Memo. Maj. Gen. Grandison Gardner, USAF for A. S. Barrows, Under Sec AF, "P-87 Airplane," 22 Jun 1948 (Doc 49 to AMC Historical Study No. 37); Minutes of Senior Officers Board, Muroc AFB, 7-8 Oct 1948 (Doc 75 in AMC Historical Study No. 37); Muroc AFB to USAF, "Conference at Muroc Air Force Base, Muroc, California on All-Weather Fighter Requirements," 8 Oct 1948 (Doc 76 in AMC Historical Study No. 37).

of 48 F-89's on 10 January 1949. AMC anticipated that deliveries would begin in June 1950.[16]

Although production of the F-89 had been authorized, there remained the fact that it was not regarded as a satisfactory all-weather fighter. AMC, therefore, was faced with the job of making it as satisfactory as possible before it was actually put to active air defense use. To improve high-altitude performance, Northrop was ordered, in November 1948, to put the J35-A-17 engine in the second XF-89. At the same time, the contractor was directed to meet complaints that the F-89 would be a maintenance nightmare by modifying the airframe to the point where it would be possible for five men to change an engine within 30 minutes. Also, AMC wanted certain equipment removed in order to hold the weight down to a manageable 36,000 pounds. When these changes were made, Northrop estimated that the F-89 would be able to do 564 miles an hour at 35,000 feet, climb to 35,000 feet in 4.5 minutes and reach a ceiling of 48,000

---

16. Memo, VC/S, USAF to DCS/M, USAF, "Production of Fighter Aircraft," 14 Oct 1948 (Doc 78 in AMC Historical Study No. 37); Memo, W. Stuart Symington, Sec AF, for James E. Forrestal, Sec Def, "Revised Authorization for Procurement of Aircraft," 29 Oct 1948 (Doc 83 to AMC Historical Study No. 37); Memo, MCP4, AMC, for MCPPXA, AMC, "Supplemental FY 1948 Appropriation--FY 1949 Aircraft Procurement Program," 7 Jan 1949 (Doc 101 to AMC Historical Study No. 37); Msg, AMC to Northrop, 10 Jan 1949 (Doc 102 in AMC Historical Study No. 37).

feet. If this performance proved possible with the actual aircraft, the F-89 would be much superior to the all-weather fighter envisioned in the AAF specifications of August 1945.[17]

There was continuing doubt, however, that the F-89 would be able to do what was promised. By early February 1949, additional testing of the initial experimental model had revealed such a degree of tail flutter and general instability that it was found necessary to reduce the allowable speed in the aircraft to 400 miles per hour. Northrop worked to strengthen the tail, but the problem was one which apparently went deeper than mere strength of structural members. A minor accident from this cause occurred 20 May 1949. Then, on 27 June 1949, vibration during a test flight became so severe that it was necessary to crash-land the XF-89 on Muroc Dry Lake, causing major damage to the aircraft. Despite this setback, AMC, in August 1949, hopefully established a production schedule which called for receipt of the first production model F-89 in July 1950. In addition, Northrop was given a contract for 64 additional F-89's in October 1949 and January

---

17. USAF to AMC, "Weight Reduction Program for F-89 Aircraft," 12 Nov 1948 (Doc 87 to AMC Historical Study No. 37); Msg, AMC to Northrop, 15 Nov 1948 (Doc 89 to AMC Historical Study No. 37); Msg, AMC to USAF, 19 Nov 1948 (Doc 90 to AMC Historical Study No. 37).

1950, for a total of 112. Test flying of the repaired XF-89 was resumed in the autumn of 1949.[18]

All hopes for a prompt and easy solution to the tail flutter problem were dashed 22 February 1950 when, during a demonstration flight before a gathering of AMC officials, the XF-89 disintegrated in air. The Northrop test pilot was seriously injured and the engineer flying in the radar operator's position was killed. There was obviously something radically wrong with the design or construction of the F-89. And it was patently something that could not be solved in time for production of the combat-ready interceptor in July 1950. By April 1950, AMC had laid out a test program designed to measure the strains placed on the airframe during the various phases

---

18. Memo, MCREOA, AMC to MCRE, AMC, "Status of XF-89 Project," 16 Feb 1949 (Doc 106 to AMC Historical Study No. 37); AMC to USAF, "Status of the XF-89 Project," 21 Feb 1949 (Doc 108 to AMC Historical Study No. 37); Report, Muroc AFB, "Aircraft Accident Meeting on XF-89," 29 Jun 1949 (Doc 124 to AMC Historical Study No. 37); Report, AMC, "Repair of XF-89 Airplane," 1 Aug 1949 (Doc 128 to AMC Historical Study No. 37); Memo, Dir/Procurement and Industrial Planning, DCS/M, USAF for Dir/Program Standards and Cost Control, Comptroller, USAF, "F-89 Production Schedule," 9 Aug 1949 (Doc 130 to AMC Historical Study No. 37); AMC to Northrop, "Twenty-seven F-89A Airplanes," 4 Oct 1949 (Doc 133 to AMC Historical Study No. 37); AMC to Northrop, "Additional Procurement of F-89A Series Airplanes," 23 Jan 1950 (Doc 149 to AMC Historical Study No. 37).

of flight.[19] Meanwhile, production of the F-89 was suspended.

No really acceptable "fix" for the tail flutter in the F-89 had been discovered by the end of 1950 and testing continued into 1951. It had been decided by the end of 1950 that the first 18 production models, in which flutter was artificially controlled by judicious placement of balance weights, would be the only ones designated F-89A. Subsequent aircraft, in which flutter would be controlled by improved design, would be known as F-89B. The Northrop production line was to halt after production of the 18th item until an aerodynamically acceptable tail was devised. An accelerated service test was conducted by AMC and the Air Proving Ground Command prepared to begin operational suitability testing. But by early November 1950 only eight F-89 aircraft were produced and these were all the "A" model which was unacceptable for tactical use. An additional 47 F-89's were

---

19. Msg, AMC to USAF, 23 Feb 1950 (Doc 159 in AMC Historical Study No. 37); Tel conv, E. H. Schwartz, AMC and Fred J. Peck, Los Angeles, 28 Feb 1950 (Doc 160 in AMC Historical Study No. 37); Memo, MXPPXA41, AMC for MCP, AMC, "Evaluation of XF-89 Accident," 3 Mar 1950 (Doc 162 in AMC Historical Study No. 37); Memo, MCREXA-5, AMC for MCPPXA-15, AMC, "Status of XF-89 Accident Investigation," 22 Mar 1950 (Doc 168 in AMC Historical Study No. 37); AMC to Northrop, "YF-89A Airplane S/N 46-679 and F-89A Series Airplane Test Programs," 4 Apr 1950 (Doc 174 in AMC Historical Study No. 37); USAF to AMC, "XF-89 Accident Investigation Report," 28 Apr 1950 (Doc 186 in AMC Historical Study No. 37).

ordered (for a total of 159) with Fiscal 1951 money in August 1950, but the order was limited because of continuing uncertainty about the future of the aircraft.[20]

If production schedules for the F-89 had not been disrupted by design difficulties, the inability of Allison to deliver acceptable engines for the aircraft would have precluded meeting the July 1950 date for initial acceptance of the completed interceptors. Although the XF-89 was powered with the Allison J35-A-9 engine, it was decided in the summer of 1949 to use the more advanced Allison J35-A-21 engine in subsequent models. Allison, however, had considerable difficulty producing the required engines. Four of the new engines had been promised by January 1950, but only two were available at that time

---

20. Memo, MCRFT, AMC for MCRF, AMC, "Comments on the XF-89 Unsatisfactory Characteristics," 29 May 1950 (Doc 191 in AMC Historical Study No. 37); Pers ltr, Brig. Gen. Mark E. Bradley, Jr., Acting Dir/Procurement and Industrial Planning, AMC, to Oliver P. Echols, Chairman of the Board, Northrop, 7 Jul 1950 (Doc 210 in AMC Historical Study No. 37); USAF to APGC, "Operational Suitability Test of the F-89A Aircraft," 24 Jul 1950 (Doc 216 in AMC Historical Study No. 37); AMC to Northrop, "F-89A Series Airplanes, Fiscal Year 1951 Procurement," 7 Aug 1950 (Doc 221 in AMC Historical Study No. 37); AMC to Northrop, "F-89A Series Airplanes, External Balance Weight," 12 Oct 1950 (Doc 237 in AMC Historical Study No. 37); Memo, MCRFXC, AMC for MCPPXA-41, AMC, "Utilization of F-89 Production Aircraft," 18 Oct 1950 (Doc 240 in AMC Historical Study No. 37); Memo of Discussion with Northrop Officials, by John A. McCone, Undersecretary of the Air Force, 28 Nov 1950 (Doc 247 in AMC Historical Study No. 37).

F - 89 D

and neither was satisfactory for flight. Engine development dragged unsuccessfully through 1950 and when engines began to arrive in some quantity in the autumn of that year, it was discovered that blades had a tendency to come off turbine wheels. Northrop found it necessary, in October 1950, to ground all F-89's until this problem could be solved. It had not been controlled by the end of the year.[21]

Meanwhile, there was talk of using still more powerful engines in the F-89. In June 1950, USAF asked AMC to consider using either Allison J35-A-23 or General Electric J47-GE-21 engines in later models of the F-89. The J47 was already under development for the B-47 bomber and adaptation to the F-89 was thought possible. AMC agreed that the adaptation sounded feasible and, above all, desirable, since the J47 developed a thrust of 9,100 pounds without afterburner, while the J35-A-21 was rated at only 6,800 pounds when the afterburner was used. Tests

---

21. Northrop to AMC, "YF-89 Airplanes, J35-A-21 Engines," 13 Jan 1950 (Doc 142 in AMC Historical Study No. 37); Memo, MCPPXE-54, AMC for MCPPXA-41, AMC, "Availability of J35-A-21 Engines," 29 Jun 1950 (Doc 207 in AMC Historical Study No. 37); Northrop to AMC, "Engine Delays," 17 Jul 1950 (Doc 214 in AMC Historical Study No. 37); Msg, Northrop to AMC, 13 Oct 1950 (Doc 239 in AMC Historical Study No. 37).

of the J47 in the F-89 airframe were underway at the end of 1950.[22]

The first F-89B was delivered to ADC in June 1951, the initial aircraft going to the 84th FIS at Hamilton. This was slightly more than five years from the date Northrop was authorized to proceed with development of the F-89. For the first time, ADC possessed a jet all-weather interceptor specifically designed for air defense use. But deliveries were slow--only 25 had been made available to ADC by the end of 1951--because development of the F-89 was far from complete.[23]

Even though there had been five years between contract and delivery of the combat aircraft, the F-89 was still not ready. In early 1952, three F-89's disintegrated in air in fairly rapid succession. Also, the low-slung engine of the F-89 earned a reputation as the "world's largest vacuum cleaner" by picking up litter from the runway. A vagrant piece of metal, on several occasions, was sucked into engine inlets, causing disintegration of the compressor rotor blades. Pieces of the

---

22. USAF to AMC, "Increased Thrust Engine for F-89 Aircraft," 20 Jun 1950 (Doc 198 in AMC Historical Study No. 37); AMC to USAF, "Increased Thrust Engine for F-89 Aircraft," 28 Aug 1950 (Doc 228 in AMC Historical Study No. 37).

23. Hist of ADC, Jan-Jun 1951, p. 153; Hist of ADC, Jul-Dec 1951, pp. 45-51.

compressor then destroyed the remainder of the engine. Inlet screens were an answer of sorts, although it was discovered that at extremely high altitudes the inlet screen could become completely clogged with ice. The main problem was encountered at low altitudes, however, where the major accidents had occurred.[24]

WADC was of the opinion that the jet wake fairings on the F-89 were primarily at fault. It was argued that the existing fairings, intended to decrease the vibration caused by the wake from the jet engines, actually transmitted severe stress to the entire airframe. At any rate, AMC, in June 1952, limited the F-89 to a speed of 350 knots at altitudes below 15,000 feet until something could be done about the structural weaknesses of the aircraft. At the same time, USAF refused to accept 65 completed F-89's until Northrop could come up with an answer. Meanwhile, the 74th FIS at Presque Isle AFB, Maine, received the first F-89C aircraft in January 1952. Because of the lack of structural reliability, however, deliveries were halted in March 1952 when the 74th had received only 19 aircraft. The chances of making an acceptable interceptor of the F-89 were so bleak by the middle of 1952 that

---

24. Hist of WADC, Jan-Jun 1952, pp. 197-203.

W. L. Campbell of the Aircraft Production Board made a public recommendation that the F-89 be scrapped.[25]

Although Mr. Campbell's suggestion was not followed, the situation with regard to the F-89 got worse before it got better. Four more F-89's (all F-89C models) disintegrated in air in the summer of 1952, one at the national air show in Detroit in late August. In every instance the aircraft was being flown at a speed in excess of 350 knots and at an altitude less than 15,000 feet. Following the accident of 22 September 1952, all F-89's were grounded until the obvious structural faults were remedied. Close and detailed study of the F-89 structure during the late summer and early autumn of 1952 made it appear that the failures resulted from the stresses imposed by maneuvers, low stability resulting from a center of gravity too far aft on the aircraft and possible structural fatigue.[26]

The blame for this situation apparently lay in an assumption of the design engineers that the straight wing

---

25. Ibid.; Hist of ADC, Jan-Jun 1952, p. 94; Aviation Week, 28 Jul 1952, pp. 12-15.

26. Daily Information Report, D/O, WADC, 25 Sep 1952; Memo, Col. D. D. McKee, WADC, to Asst C/S, WADC, "Meeting with Northrop," 17 Nov 1952 (Doc H-25 in Hist of WADC, Jul-Dec 1952).

was a rigid structure which would experience only negligible aerolastic effects. This assumption was proved wrong when the F-89 began to fly, but ARDC was not inclined to reproach Northrop design engineers for this mistake. ARDC pointed out that "most structures designers" agreed with the Northrop assumption at the time the design was prepared and that "what happened to air during transonic flow over a wing" was simply not known at that time. Tests in subsequently available wind tunnels had shown that the design was in error. All that could be done at that point was redesign the 189 F-89's already produced (at a cost of approximately 17 million dollars) and apply the new knowledge to aircraft to be produced. Northrop began to redesign the airframe, expressing the hope, in November 1952, that the modifications could be introduced into the production line by April 1953.[27]

USAF reacted to the F-89 crisis by transferring 54 F-94B aircraft from Air Training Command to ADC. Most of the F-94B's, which were to provide all-weather interceptor

---

27. Summary of WADC Weekly Conference, 23 Oct 1952 and 20 Nov 1952; Memo, Col. D. D. McKee, WADC, to Asst C/S, WADC, "Meeting with Northrop," 17 Nov 1952 (Doc H-25 in Hist of WADC, Jul-Dec 1952); Memo, Weapons Systems Div, WADC for V/C, WADC, "Post-Mortem Consideration of F-89 Structural Problems," 1 Dec 1952 (Doc H-32 in Hist of WADC, Jul-Dec 1952).

coverage for the grounded F-89's at Presque Isle, Hamilton and Madison (Wisconsin) Airport, were received by ADC during the last two months of 1952.[28]

The design improvements directed in late 1952 found their way into the Northrop production line in April 1953. By the middle of 1953 ADC had 31 of the modified F-89C's available. The number had doubled by the end of 1953. But the F-89 was still a relatively unreliable aircraft. There was another rash of F-89 accidents during the last half of 1953, many of them laid to control system failures. Vibration was still noticeable at low altitudes, but was not considered serious enough to justify further re-design. Anyway, the F-89 had been in development for so many years that it was becoming obsolescent before it became operational to a significant degree. In addition to other problems, it was discovered that the engines in the F-89 (J35-A-21, -33 and -35) were susceptible to a "power droop" of as much as 10 per cent at altitudes above 20,000 feet.[29]

---

28. ADC Daily Diary, 1 Dec 1952; ADC Command Data Book, Jan 1953.

29. Air Weapons Review, WADC, April 1953, p. 14; WADC Weekly Activity Report, 26 Oct 1953; Memo, Col. O. E. Knox, Asst Dir/Air Weapons Systems Div, WADC for Cmdr, WADC, "Grounding of F-89 Series Aircraft for Immediate Inspection," 2 Nov 1953 (App. F-4 in Hist of WADC, Jul-Dec 1953); Summary of WADC Weekly Conference, 2 Sep, 9 Sep, 16 Sep and 23 Sep 1953; WADC Weekly Information Report, 11 Sep 1953; Dir of Air Weapons Systems Review, WADC, Nov 1953; Hist of ADC, Jul-Dec 1953, p. 119.

Finally, after nearly eight years of development, the first F-89D reached ADC on 7 January 1954. The first unit to receive the "ultimate" result of F-89 development was presumably complete, although the ARDC Weapons System Project Office, in February 1954, asked AMC to placard all F-89D's with a warning never to exceed a speed of 425 knots at an altitude of less than 20,000 feet. Subsequent improvements to the rudder and automatic pilot, however, improved the maneuver capability of the aircraft. As to the undesirable "power droop" in the J35 engine, shielding of the temperature sensing element of the engine power control proved to be the answer and this problem disappeared.[30] By the end of 1955, ADC possessed 250 of the last of the basic F-89 models (the F-89B and F-89C had disappeared in early 1954). The F-89D was in use in ADC until late 1958.

The F-89H

Almost as soon as it was decided that the Falcon (GAR-1) air-to-air missile being developed by Hughes would be used by interceptors rather than bombers, it was also decided that the F-89 would be used as the initial

---

30. Hist of ADC, Jan-Jun 1954, p. 89; Dir of Air Weapons Systems Review, WADC, Feb 1954 and Jan 1955; WADC Weekly Information Report, 12 Feb 1954; R&D Review, ARDC, 31 Mar 1955.

carrier. When the idea of arming the F-89 with the Falcon was first broached in 1951, an operational date of 1 January 1954 was suggested. But, as was often the case with proposed operational dates, this date was wildly optimistic. By August 1952, the operational date had slipped to 1 October 1954.[31]

The most difficult problem in modifying the F-89D for use as a Falcon carrier was the fire control system. The E-9 system of what came to be known as the F-89H had twice as many components as the E-6 used in the F-89D. What with the missiles and electronic equipment to be placed in pods on the wing tips of the aircraft, it amounted, in the words of a WADC spokesman, to suspending an F-84 fuselage on each wing tip of the F-89. Also, there was the possibility that the F-89H would be so heavy that it would be necessary to use the advanced J-71 engine as a power plant, thus creating further delays.[32]

These problems were eventually solved, but each solution required time. The first airborne test of the E-9 fire control system occurred 3 August 1953. Falcons

---

31. Hist of WADC, Jan-Jun 1952, pp. 197-203; Summary of WADC Weekly Conference, 7 Aug 1952.

32. Presentation on AMC-ARDC Interceptor Aircraft Program, WADC, 28 Jan 1953; Summary of WADC Weekly Conference, 18 Feb 1953.

were successfully fired from a modified F-89D on 21 October 1953, but the missile pod showed a tendency to collapse after firing and re-design was necessary. Progress was being made, but not quickly enough to meet the operational date of 1 October 1954. By the end of 1953, that date had receded to August 1955.[33]

The first production model of the E-9 system was delivered by Hughes on 1 May 1955 and testing with the complete weapons system consumed the remainder of 1955 and the early months of 1956. The first operational F-89H was delivered to the 445th FIS at Wurtsmith AFB, Michigan, in March 1956, more than two years after the date originally set for operational employment of the Falcon-equipped F-89. The delay in converting the F-89 to missile armament doomed the F-89H to short operational life, because the F-102A, which also mounted Falcon missiles and offered performance superior to that of the F-89H, was nearly ready by the time the F-89H became available. At the high point of F-89H use only 112 were included in the ADC inventory. Twenty-one remained by the middle of 1959 and these had disappeared by the following September.[34]

---

33. WADC Weekly Information Report, 14 Aug 1953; R&D Review, USAF, 30 Sep 1953, pp. 68 and 71.

34. AMC Daily Staff Digest, 6 May 1955; Hist of ADC, Jan-Jun 1956, p. 41; RCS: 1-AF-V14, 2 Jan 1957, 1 Jul 1959 and 30 Sep 1959.

The F-89J

ADC began to consider the use of atomic weapons in conjunction with interceptors as early as 1951, but the concept gained few immediate converts because of the immense difficulty of developing an atomic rocket that could be carried by an interceptor. Various possibilities were considered, such as adaptation of existing atomic bombs, but progress was negligible. The result of this 1951-52-53 activity was a conclusion that atomic armament for interceptors was just not possible until the Atomic Energy Commission could design a small warhead in the 1-20 kiloton category. The AEC accepted this task. Meanwhile, ARDC and ADC agreed that the F-89D was the most likely carrier for the atomic weapon.[35]

Since the feasibility of atomic armament for interceptors hinged on development of a suitable warhead, there was little Air Force activity in this regard, aside from planning, through 1954. By early 1955, however, there

---

35. ADC to ARDC, "Nuclear Weapons for Air Defense," 21 May 1952 (Doc 50 to Hist of ADC for Jan-Jun 1952); USAF to ARDC, "Atomic Weapons in Air Defense," 29 May 1952 (HRF); ADC to USAF, "Air Defense Weapons System," 18 Feb 1953 (HRF); ADC to USAF, "Requirement for Development of Atomic Warheads for Air Defense Weapons," 23 Mar 1953 and 1st Ind, USAF to ADC, 22 May 1953 (HRF); ADC to USAF, "Requirement for Weapons with Atomic Capability in the Air Defense System," 6 May 1953 and 1st Ind, USAF to ADC, 22 Jun 1953 (HRF); Msg, ADC to USAF, 11 Sep 1953 (HRF); Msg, USAF to ADC, 22 Sep 1953 (HRF); ADC to USAF, "Atomic Weapons in Air Defense," 8 Jan 1954 (Doc 20 to Hist of ADC, Jan-Jun 1954).

began to be solid evidence that production of the necessary warhead was possible. On 9 March 1955, therefore, USAF instructed ARDC to institute a "crash" project to convert the F-89D into a carrier for what was then known as the Ding Dong (subsequently MB-1) rocket. By direction of the National Security Council, ADC was to have atomic capability by 1 January 1957. There was no particular difficulty encountered in modifying the F-89D, since the fire control system was a relatively simple modification of the E-9 known as MG-12. The limiting factor continued to be the rocket and warhead. The first F-89J (as the atomic carrier was designated) was delivered to the 84th FIS at Hamilton AFB, California, in December 1956. An F-89J, equipped with an MB-1 rocket, was available at Hamilton on 1 January 1957, thereby meeting the deadline established in March of 1955.[36]

From January 1957 until the F-101B became available in January 1959, the F-89J was the only ADC interceptor to carry an atomic punch. Because the F-101B and

---

36. ADC to USAF, "Atomic Weapons in Air Defense," 26 Nov 1954 (Doc 272 to Hist of ADC, Jul-Dec 1954); R&D Review, USAF, 31 Mar 1955, p. 43; Report of the Director of Weapons Systems Operations, WADC, 7 Jun, 21 Jun and 28 Jun 1955; AMC Daily Staff Digest, 31 May 1955; ARDC to ADC, "HIGH CARD Effectiveness at High Altitudes and Launch Speeds," 8 Mar 1956 (Doc 282 to Hist of ADC, Jan-Jun 1956); RCS: 1-AF-V14, ADC, 2 Jan 1957; ADC to WADF, "Atomic Air-to-Air Capability," 27 Mar 1957 (Doc 258 in Hist of ADC, Jan-Jun 1957).

F-106A did not immediately become available in large numbers, the F-89J was still much in evidence at the end of 1959. Two-hundred-seven of a peak inventory of 286 (30 June 1958) were on hand at that time. But the end of the F-89J was in sight. It was expected to disappear by the close of 1960.[37]

The F-94

Although the Board of Senior Officers which met at Muroc on 7-8 October 1948 voted to continue development of the F-89 as the first specially designed all-weather jet fighter, none of the members of the Board was particularly enthusiastic about the F-89. It was merely considered the best of a poor lot. This fact, plus the increasing evidence that the interim F-82 interceptor was highly unsatisfactory, led the Board to consider using the F-80 as an interceptor. The F-80 was USAF's first operational jet fighter and had recently been redesigned to allow the addition of a second crew member. The purpose of this conversion was to permit an instructor pilot to ride with a student while giving jet transition training to pilots of conventional aircraft. This training version of the F-80 was first known as the TF-80 and later became the T-33, the workhorse jet of the 1950's.

---

37. ADCM 27-2, 31 Mar 1960, Vol. II.

Since the TF-80 could carry two crew members, it occurred to the Board that airborne radar might be added to create an interim interceptor that would provide jet punch to the interceptor force until the F-89 was ready. The development agencies agreed that such a conversion was entirely feasible and the interceptor version of the F-80 was christened F-94. Prompt action was taken on this recommendation of the Board. On 14 October 1948, General Fairchild directed the USAF DCS/M to put the F-94 into production as soon as possible. Secretary of Defense Forrestal approved this action in November 1948 and funds for the purchase of 110 F-94's were released by President Truman in January 1949.[38]

By the time the President had released funds for initial procurement of the F-94, the Board of Senior Officers had met again (28 December 1948-6 January 1949) and had recommended that, despite reduction in the authorized

---

38. Minutes of Senior Officers Board, Muroc AFB, 7-8 Oct 1948 (Doc 75 in AMC Historical Study No. 37); Muroc AFB to USAF, "Conference at Muroc Air Force Base, Muroc, California on All Weather Fighter Requirements," 8 Oct 1948 (Doc 76 in AMC Historical Study No. 37); Memo, VC/S, USAF to DCS/M, USAF, "Production of Fighter Aircraft," 14 Oct 1948 (Doc 78 in AMC Historical Study No. 37); Memo, W. Stuart Symington, Secretary of the Air Force for James E. Forrestal, Secretary of Defense, "Revised Authorization for Procurement of Aircraft," 29 Oct 1948 (Doc 83 to AMC Historical Study No. 37); Memo, MCP4, AMC, for MCPPXA, AMC, "Supplemental FY-1948 Appropriation--FY-1949 Aircraft Procurement Program," 7 Jan 1949 (Doc 101 in AMC Historical Study No. 37).

size of the Air Force from 70 to 48 groups, 178 additional F-94's be procured. AMC predicted, in late January 1949, that delivery of F-94 aircraft would begin in December of that year and would reach a production rate of 20 a month by July 1950.[39]

Conversion of F-80 day fighters to F-94 interceptors got underway in 1949, and normal progress was experienced, but evidence that the Russians had succeeded in detonating an atomic device in the late summer of 1949 forced a re-examination of the interceptor program. The Board of Senior Officers met again on 24 October 1949 and discussed the need for more rapid modernization of air defense forces, but postponed a decision because the matter appeared to require further study. The Board reconvened on 14 December 1949 and, among other decisions, recommended that the total number of F-94 aircraft to be procured be raised to 368, as against the previously authorized total of 288, because "foreign possession of the atomic bomb necessitates acceleration of the USAF

---

39. Minutes of a Board of Officers Appointed by the Secretary of the Air Force, 29 December 1948 to 6 January 1949 (Doc 266 to AMC Historical Study No. 247, History of the USAF Five Year Aircraft Procurement Program, 1 Jan 1948 to 1 Jul 1949, hereinafter cited as AMC Historical Study No. 247); Memo, MCPO, AMC for MCGEH, AMC, "Five Year Production Planning Program," 24 Jan 1949 (Doc 283 to AMC Historical Study No. 247).

program to modernize its interceptor and all-weather fighter force at the earliest possible time."[40]

While it was a relatively simple matter to convert the single-place F-80 into the two-place TF-80, it was more difficult to make the TF-80 into an all-weather interceptor. By early 1950, it had been decided that the transition from TF-80 to all-weather interceptor would have to be done in three steps. First would come the F-94A, equipped with the low-power E-1 fire control system and armed with machine guns. The next step would be the F-94B, which would have an instrument approach system, automatic pilot, increased cabin pressurization, complete internal and external purging of the fuel system, airborne radar with a power output of 250 kilowatts, a zero reader, thermal anti-icing equipment and rocket armament. Finally would come the F-94C to include a thinner wing, which would increase speed from .8 mach to .9 mach, and a larger power plant. The Allison J33-A-29 and British Nene (J-48) engines were suggested as possibilities.

---

40. Report of the Fifth Meeting of the Board of Senior Officers, 24 Oct 1949 (Doc 107 to AMC Historical Study No. 248, History of the USAF Five Year Procurement Program, 1 July 1949 to 31 December 1949, hereinafter cited as AMC Historical Study No. 248); Report of Sixth Meeting of the Board of Senior Officers, 14 Dec 1949 (Doc 127 to AMC Historical Study No. 248).

Earlier models of the F-94 were to use the Allison J33-A-23 engine.[41]

Subsequent technical study of the development plan in early 1950, however, indicated that the original plan with regard to the F-94 was much too optimistic. The engineers concluded that it would be possible to include only the instrument approach system, zero reader, increased cockpit pressure and windshield de-icing in the F-94B. The other items mentioned by USAF would have to wait for the F-94C, or later, since deliveries of the F-94B were scheduled to begin in November 1950, with the first F-94C's to follow in the spring of 1951. An attempt would be made to use the J48 engine and the thin wing in the F-94C, although there was doubt that either would be fully developed by the time they were needed. The automatic approach system would not be tested until July 1950 and probably would not be ready. The same situation applied to the 250-kilowatt radar and rocket armament, since neither would be ready for testing until 1951. The automatic pilot was too large for the F-94 and would not be used. An advanced fuel purging system would be used

---

41. USAF to AMC, "Procurement Directive 50-28 (F-94 Aircraft)," 13 Jan 1950 (Doc 18 to AMC Historical Study No. 249, History of the USAF Five Year Aircraft Procurement Program, 1 January 1950 to 30 June 1950, hereinafter cited as AMC Historical Study No. 249).

if the contractor's development program made sufficient progress.[42]

The F-94A did not reach air defense units during the latter part of 1949 as originally scheduled, but did begin to arrive in May 1950. These initial jet interceptors were received by the 325th Fighter Wing, based at McChord and Moses Lake. By the end of 1950 ConAC had 60 of these aircraft.[43]

Less than a year later, in April 1951, the second model of the F-94 (F-94B) began to arrive in ADC, with the 61st FIS at Selfridge AFB, Michigan, being the first air defense unit to be so equipped. The F-94B differed from the F-94A in that it included a zero reader to permit more accurate landings in bad weather, a high-pressure oxygen system, an improved hydraulic system and external fuel tanks mounted along the center line of the aircraft instead of suspended from the wing tanks.

---

42. AMC to USAF, "Configuration of F-94 Aircraft, Fiscal Year 1950 Procurement," 6 Feb 1950 (Doc 134 to AMC Historical Study No. 249); Progress Report, USAF Five Year Program (Finnster VI), 31 Mar 1950 (Doc 65 to AMC Historical Study No. 249); AMC Technical Instruction 2350-26A, "Procurement of 108 F-97A Aircraft Under "P" Program--Procurement Directive No. 50-28," 19 May 1950 (Doc 86 to AMC Historical Study No. 249); AMC Technical Instruction 2350-9B, "Procurement of F-94B Aircraft Under "P" Program (Procurement Directive 50-10, revised by Procurement Directive 50-28)," 19 May 1950 (Doc 87 to AMC Historical Study No. 249).

43. Hist of ConAC, Jan-Jun 1950, pp. 5-6; Hist of ADC, Jan-Jun 1951, pp. 151-153.

Neither the F-94A nor the F-94B was an all-weather interceptor, however, because neither was fitted with anti-icing equipment. What had been supplied was essentially a jet night fighter and ADC was pleased to receive it, but the need for an effective jet all-weather interceptor remained.[44]

Development of an F-94C that was an appreciable improvement over the F-94A and F-94B proved a matter of some difficulty. After flying test aircraft in late 1951 and the first half of 1952, representatives of ADC came to the conclusion that because of low speed (about 40 knots slower than the F-89) and poor maneuverability, the F-94C was unacceptable to the command. After sober second thought, however, ADC added the cautionary postscript that if nothing better was available, the F-94C would be accepted if all deficiencies were corrected.[45]

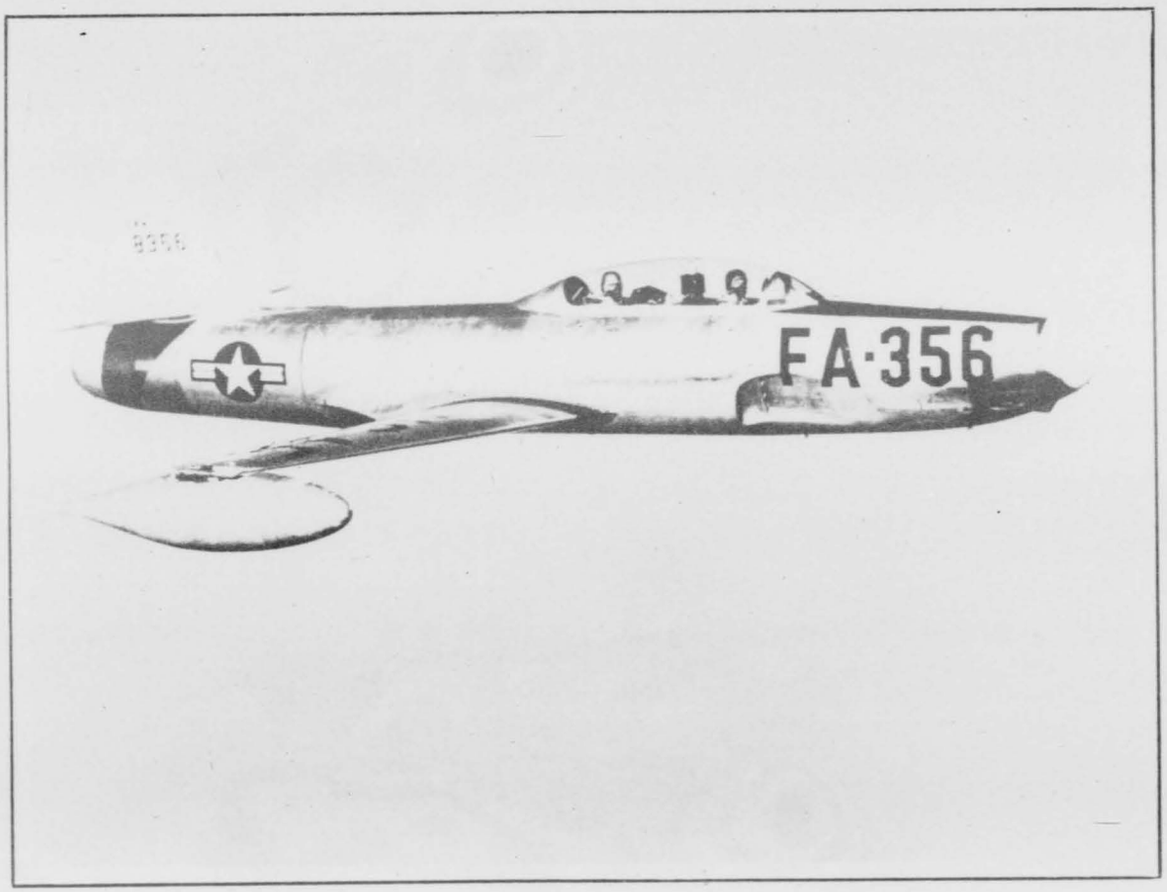
Because of ADC objections to the F-94C, representatives of USAF, ARDC, APGC and ADC met in August

---

44. Hist of ADC, Jan-Jun 1951, p. 151; 2nd Ind (Unsatisfactory Report No. 50-248, Larson AFB, 29 Aug 1950), AMC to Larson AFB, 8 Nov 1950 (Doc 118 to Hist of ADC, Jan-Jun 1951); ADC to AMC, "F-94A General Icing Conditions," 27 Feb 1951 (Doc 117 to Hist of ADC, Jan-Jun 1951).

45. Col. John C. Meyer, ADC, to Lt. Gen. Earle E. Partridge, Cmdr, ARDC, 19 Feb 1952 (Doc 63 to Hist of ADC, Jan-Jun 1952); Staff Visit Report, Lt. Col. Thomas D. DeJarnette, ADC, 11 Mar 1952 (Doc 62 to Hist of ADC, Jan-Jun 1952); Msg, ADC to APGC, 30 Jun 1952.

F-86D



F - 94C

1952 to discuss the deficiencies of the aircraft. It was finally agreed that five improvements would make the aircraft acceptable for air defense use. These included variable position dive brakes, aileron spoilers, an improved drag chute, improved armament (which meant substituting rockets for machine guns) and improved engine reliability. The first three modifications were relatively simple and by the middle of December 1952 Lockheed had arranged for their installation in the field. The armament problem was somewhat complicated, in that the engine flamed out when the full load of 24 2.75-inch rockets (carried in the nose) was salvoed at altitudes above 25,000 feet. This phenomenon could be avoided by firing only half the rockets, but even this tactic produced a near flame-out that seriously reduced the speed of the interceptor. The answer was to mount the rockets in wing pods, 24 rockets to a pod, but this solution required development and was not likely to be available until the 163rd F-94C was on the production line. As to the Pratt and Whitney J48-P-5 engine, it was subject to fuel burner nozzle failures. This deficiency was remedied by fitting all engines with improved nozzles.[46]

---

46. Hist of WADC, Jul-Dec 1952, pp. 490-496; Summary of WADC Weekly Conference, 16 Oct 1952; AMC Weekly Activity Report, 27 Oct 1952 and 15 Dec 1952.

The F-94C was finally made available to, and accepted by, ADC in March 1953. The first ADC unit to receive the aircraft was the 437th FIS at Otis AFB, Massachusetts. Since the F-94C was credited with the capability of destroying no bomber better than the Russian TU-4 (a copy of the B-29), it was received about two years late. Intended as a "quick-fix" interim all-weather interceptor to plug the air defense gap until the F-89 was ready, 1949 planning had anticipated an operational F-94C in 1951. Since it was not ready at that time, enthusiasm for the F-94C waned and two of the four contracts calling for production of the converted F-80 were cancelled in late 1952, reducing total production from 617 to 387. By the middle of 1954, ADC had 265 F-94C's, the high point of F-94C usage. Despite its relatively poor performance, the F-94C proved to be remarkably long-lived as a first-line interceptor. The last F-94C did not disappear from the air defense system until early 1959. The earlier models of the F-94 (F-94A and F-94B) were gone by the end of 1954.[47]

The F-86D

The same delay in development of the F-89 which prompted the decision to procure the F-94 also led to

---

47. AMC Weekly Activity Report, 27 Oct 1952; Hist of EADF, Jan-Jun 1953, p. 230; RCS: 1-AF-V14, ADC, 1954-1959 (HRF).

conversion of the F-86 to interceptor configuration. In point of time, however, what became known as the F-86D was approved after approval of the F-94. While the Board of Senior Officers recommended the purchase of the F-94 at its first meeting on 7-8 October 1948, approval of a one-man interceptor did not come until the meeting of 29 December 1948 to 6 January 1949.

The slight delay in recommendation of the F-86 conversion was occasioned by doubts that a single-seat interceptor was feasible. All previous night fighters built, or building, were two-place aircraft. Many experienced night fighter pilots contended that one man was incapable of both monitoring the radar equipment and flying the aircraft. But the Board was eventually convinced that the effort should be made. At the same time, the Board pointed out that it would be necessary to develop a high-speed automatic pilot and a "single-presentation" radar in order to make a one-man interceptor possible.

The choice of the F-86 as the basic airframe was almost automatic, since it was the best of the current jet fighters. By March 1949 tentative specifications for an interceptor version of the F-86 had been drawn up. The following month North American began to modify two F-86A aircraft for use as interceptors. When the Board of Senior Officers met again on 16-17 May 1949, it was ready to accept the recommendation of Major General Gordon

P. Saville, commander of ConAC's Air Defense Command, that the F-86D be designated the single-seat interceptor the Board had had in mind when it recommended procurement of a single-seat interceptor back in January.[48]

The recommendations of the Board were approved by the Secretary of the Air Force and on 19 July 1949 AMC was authorized to spend seven million dollars on conversion of the F-86 to interceptor configuration. After an engineering inspection of August 1949 proved favorable, 79 million dollars were made available the following month for the purchase of 124 F-86D's. The first flight of the experimental F-86D occurred in September 1949. The Board was favorably impressed, so that when it was decided in December 1949 that Soviet possession of the atomic bomb made prompt creation of a modern interceptor force imperative, the F-86D was chosen to be the backbone of that force until the advanced "1954 interceptor" became

---

48. Minutes of a Board of Officers Appointed by the Secretary of the Air Force, 29 Dec 1948 to 6 Jan 1949 (Doc 266 to AMC Historical Study No. 247); Report of Third Meeting of the Board of Senior Officers, 16-17 May 1949 (Doc 418 to AMC Historical Study No. 247); AMC Background Study, The F-86 Sabre, undated, pp. 3-4.

available. Approximately 900 F-86D's were ordered with Fiscal 1950-51-52 funds.[49]

While test models of the F-86D became available in March 1951, the tactical model was not provided to ADC until approximately two years later. In 1951 there was hope that ADC would get the F-86D in the spring of 1952. But this hope was not realized because of continuing difficulty with the General Electric J47-GE-17 turbojet engine and the Hughes E-4 fire control system. Most of the engine problems appeared to stem from a unique engine control system. If the system worked as planned, the pilot controlled the engine, variable nozzle area and afterburner from a single lever. The control system synchronized such variables as engine speed, fuel-air ratio and exhaust temperature. The trouble was that

---

49. USAF to AMC, "Authority to Obligate Fiscal Year 1950 Funds in the Amount of $95,300,000," 29 Jul 1949 (Doc 18A in AMC Historical Study No. 248); USAF to AMC, "Procurement Directive 50-8 (F-86D Aircraft)," 16 Sep 1949 (Doc 55 in AMC Historical Study No. 248); AMC to USAF, "FY 1951 Aircraft Procurement Program," 4 Oct 1949 (Doc 92 in AMC Historical Study No. 248); Report of the Fifth Meeting of the Board of Senior Officers, 24 Oct 1949 (Doc 107 to AMC Historical Study No. 248); Report of the Sixth Meeting of the Board of Senior Officers, 14 Dec 1949 (Doc 127 to AMC Historical Study No. 248); AMC Background Study, The F-86 Sabre, undated, p. 4; Chart, United States Air Force Five Year Program (Finnster No. VI), 31 Mar 1950 (Doc 65 to AMC Historical Study No. 249); FY 1951 Budget, "1472 Airplane Program," AMC, 6 Jun 1950 (Doc 92 in AMC Historical Study No. 249); FY 1952 Budget, "1714 Airplane Program," AMC, 16 Jun 1950 (Doc 98 in AMC Historical Study No. 249).

it would not work. Because the control system was subject to frequent malfunction, there were violent fluctuations in revolutions-per-minute, fuel pressure and exhaust gas temperature. As a result, General Electric had fallen 18 months behind in engine deliveries by early 1952. Since airframes were beginning to pile up around the North American plant, AMC asked that General Electric be permitted to ship engines even though ARDC did not consider the engines qualified for use. The AMC view prevailed and 250 engines were shipped. Happily, General Electric developed, in mid-1952, a modified control system which promised to remedy many of the engine difficulties. The J47-GE-17 had passed its 150-hour qualification test by the end of 1952.[50]

The E-4 fire control system was plagued by similar problems. In 1952 alone, Hughes made 150 changes to the system. WADC's Armament Laboratory traced more than 40 per cent of the E-4 failures to tubes in the system's amplifier. Use of a magnetic device in place of the electronic amplifier, however, reduced the failure rate.

---

50. Hist of ADC, Jan-Jun 1952, pp. 91 and 219; Hist of Weapons Systems Div, WADC, Jul-Dec 1952, p. 3; Summary of WADC Weekly Conference, 13 Nov 1952; Daily Activity Report, Director of Laboratories, WADC, 22 Dec 1952; AMC to WADC, "J47-GE-17 Engine Acceptance," 12 May 1952 (App. 1 to Hist of WADC, Jul-Dec 1952); WADC to AMC, "J47-GE-17 Engine Acceptance," 25 Jun 1952 (App. 6 to Hist of WADC, Jul-Dec 1952).

Because many of the deficiencies in the E-4 were not noted until service tests had begun, the development period was unusually long. Since USAF would not accept the aircraft from North American until a satisfactory E-4 was available, delivery to ADC was further delayed. The E-4 was not deemed sufficiently reliable for inclusion in production aircraft until August 1952.[51]

The fact that the F-86D was highly complicated because of the need to adapt the interceptor's electronic equipment to one-man operation, plus the fact that frustrating engine and fire control problems were encountered, made it impossible to deliver the F-86D to ADC by the spring of 1952, nor by the revised date of November 1952. When the F-86D's were declared ready, however, they descended on ADC in a flood. Several ADC squadrons received the F-86D in April 1953. By the end of June 1953, eleven squadrons had received the interceptor version of the F-86 Sabre. The build-up thereafter was rapid. By the end of 1953 ADC had 600 F-86D's and in 1955 the number exceeded a thousand. The F-86D had become the keystone of the air defense interceptor force and held that status until the F-102 became available in quantity. On

---

51. WADC Presentation, "The F-86D Interceptor," 20 Nov 1952 and 21 Jan 1953; Historical Report of the Armament Laboratory, WADC, Jul-Dec 1952; AMC Weekly Activity Report, 3 Nov, 8 Dec and 22 Dec 1952; Summary of the WADC Weekly Conference, 25 Sep, 6 Nov and 26 Nov 1952.

30 June 1955, for example, ADC controlled 1,405 tactical aircraft of which 1,026 (or 73 per cent) were F-86D's. The remainder were F-94C's and F-89D's.[52]

But development of the F-86D was not complete, although production rate of better than a hundred aircraft a month was attained in 1953 and 1954. Even though it was introduced into the air defense system nearly two years behind schedule, it was still not ready. This was made clear in the autumn of 1953. Between 13 September and 16 December 1953, 13 F-86D's were destroyed by engine fires and explosions. On the latter date all F-86D's were grounded until the suspect fuel system could be made safe. Hastily formed teams of technicians were sent into the field by North American and General Electric and most of the F-86D's were released for flight by the end of February 1954. But this was merely a stop-gap measure and thoroughgoing modification of early model interceptors was indicated. This led to a tremendous, and costly, modification program known as "Project Pullout" which involved making approximately 300 individual modifications to about 1,200 F-86D aircraft. Work began in March 1954 and was completed in the late summer of 1955.

---

52. Hist of ADC, Jan-Jun 1953, p. 64; RCS: 2-AF-D4 (ADC-1) and 1-AF-V14, ADC, 1953 through 1959.

When "Pullout" was finished, ADC had a modern all-weather interceptor. At the same time, "Pullout" was a vivid demonstration of the cost of imperfect development.[53]

The F-86L

Conversion of the F-86D to the F-86L was more a matter of modification than development. It was necessary that the electronic equipment of the F-86D be re-worked in order to permit the F-86D to operate in conjunction with the GPA-37, electronic heart of an advanced system of ground controlled interception which immediately preceded SAGE. It was the USAF intention to modify 1,240 ADC F-86D aircraft when the modification program was first announced in the fall of 1955, but the number actually converted amounted to about half that number. Modification began in May 1956 and was accomplished by Sacramento Air Materiel Area and the North American plants at Inglewood and Fresno, California.[54]

---

53. Daily Activity Report, Fighter Aircraft Branch, WADC, 16 Dec 1953; Daily Staff Digest, AMC, 31 Dec 1953, 31 Mar 1954 and 27 July 1954; Summary of WADC Weekly Conference, 16 Dec 1953; Msg, WADC to ARDC, 5 Jan 1954 (App. G-18 in Hist of WADC, Jul-Dec 1953); AMC to USAF, "Commander's Monthly Summary," 12 Feb 1954 (WADC central files); Summary Control Statement, USAF, 25 Mar 1954; Hist of ADC, Jul-Dec 1955, pp. 87-88.

54. Msg, ADC to USAF, 18 Nov 1955 (Doc 200 to Hist of ADC, Jul-Dec 1955); Msg, USAF to ADC, 11 Jul 1956 (Doc 201 to Hist of ADC, Jan-Jun 1956).

The first F-86L was received by the 49th FIS at L. G. Hanscom Field, Massachusetts, in October 1956. Output from the modification project (known as Follow-On) accelerated rapidly during late 1956 and 1957 until ADC had 576 F-86L aircraft at the end of 1957. With the advent of SAGE-compatible, data-link-equipped interceptors of the F-101B and F-106 type the need for the F-86L declined and only 133 remained at the end of 1959. Plans called for their disappearance by mid-1960.[55]

---

55. RCS: 1-AF-V14, ADC, 29 Oct 1956, 30 Dec 1957 and 30 Dec 1959; ADCM 27-2, 31 Mar 1960, Vol. II.

CHAPTER TWO

THE SECOND GENERATION OF JET INTERCEPTORS

Despite the hopeful plans of 1948-49, ADC was not completely equipped with all-weather jet interceptor aircraft until early 1955. This was at least two years behind the schedules prepared in the anxious days immediately following confirmation of the intelligence that the USSR had managed to detonate an atomic device in the early fall of 1949. But the F-89B/C/D, F-94A/B/C and F-86D were eventually developed and produced and the World War II fighters (F-47 and F-51) and the day jets (F-80, F-84 and F-86) were eventually replaced with aircraft offering combat capability at any hour of the day or night and in any kind of weather.

Long before ADC was completely equipped with all-weather interceptors, however, plans for the replacement of these first-generation aircraft were laid and the development of improved interceptors was underway. It had long been recognized that the F-94 was the most desperate sort of makeshift conversion of the F-80, the

earliest USAF jet, and did not offer nearly the performance needed to counter modern bombers. Likewise, the F-86D was another "interim" interceptor, created by hanging electronic equipment and improved armament on what happened to be the best jet aircraft available in 1948. Only the F-89 was specifically designed for the air defense mission. The performance and reliability of the F-89, however, from the very beginning left much to be desired and there was talk of replacing it almost before the ink on the development contract was dry. Development of advanced interceptors proceeded even as the development of earlier types was being completed.

The F-102

When the Board of Senior Officers held its first meeting in October 1948, most members expressed dissatisfaction with all possible interceptors currently under development. At that time the Board recommended, albeit reluctantly, that work on the F-89 continue. It also recommended, as an interim measure, that the F-80 be converted to interceptor configuration. At a subsequent meeting, a similar conversion of the F-86 was recommended. For the long term, however, the Board recommended that USAF organize a new design competition calculated to provide the air defense forces with a really satisfactory all-weather interceptor. The Board established 1954 as

the operational date for this new aircraft. It became known as "the 1954 interceptor" until it received the numerical designation of F-102.[1]

In this period of financial austerity, however, action on the 1954 interceptor was slow in coming. The Board again referred to this aircraft in its meeting at the end of 1948 and at that time recommended that the proposed design competition be held in 1950. USAF approved this recommendation in February 1949.[2]

Three months later, in May 1949, General Fairchild called the leaders of the aircraft and electronics industries together to discuss the proposed new interceptor and a new approach to the development of aircraft. In the past, General Fairchild explained, experts within the Air Force had conferred on aircraft requirements and had presented the industry with a rigid set of military specifications with which the manufacturer was expected to comply. This was a narrow, parochial approach to the problem, in General Fairchild's estimation, which made no

---

1. Minutes of Senior Officers Board, Muroc AFB, 7-8 Oct 1948 (Doc 75 in AMC Historical Study No. 37); Muroc AFB to USAF, "Conference at Muroc Air Force Base, Muroc, California on All-Weather Fighter Requirements," 8 Oct 1948 (Doc 76 in AMC Historical Study No. 37).

2. Minutes of a Board of Officers Appointed by the Secretary of the Air Force, 29 Dec 1948 to 6 Jan 1949 (Doc 266 to AMC Historical Study No. 247); USAF to AMC, "Interceptor Program," 4 Feb 1949 (Doc 302 to AMC Historical Study No. 247).

use of the great reservoir of engineering talent controlled by industry. Therefore, General Fairchild proposed to prepare for the 1954 interceptor by briefing the industry representatives on the air defense problem and encouraging industry proposals for coping with it. Not merely an advanced airframe was involved, but a complete weapons system including armament, electronic controls and communications. Maj. Gen. Gordon P. Saville, commander of Air Defense Command (during this period a shadowy "operational" command under the jurisdiction of Continental Air Command), presented the briefing, outlining the ground electronic environment and describing the actions necessary to detect and destroy hostile bombers. At the end of the conference, General Fairchild urged the industry representatives to go home and meditate on these matters and let him know their reactions.[3]

The results of this unique approach, unfortunately, were negligible. The habits of competition were apparently ingrained, because none of the industry representatives

---

3. Summary of Minutes, Air Force-Industry Conference, National Defense Building (Pentagon), 20 May 1949 (Doc 5 to WADC Study, "History of the Development of the F-102 Aircraft," Apr 1957, hereinafter cited as WADC F-102 Study). Among the conferees were William M. Allen of Boeing, Lamotte T. Cohu of Convair, Robert E. Gross of Lockheed, J. H. (Dutch) Kindelberger of North American, J. J. McDonnell of McDonnell, John K. Northrop of Northrop, Donald A. Quarles of Bell Telephone, Hugo Schuck of Minneapolis-Honeywell, Hector R. Skifter of Airborne Instruments Laboratory and Dean Wooldridge of Hughes Aircraft.

responded with the wide-ranging, thoughtful replies General Fairchild had anticipated. Some saw an opportunity to establish themselves on the ground-floor of air defense and offered to serve as prime contractors for the entire air defense system, including the ground environment. Others responded with "selling" letters, pushing the company's particular product. Still others, mostly smaller companies, wanted to change the existing procurement system only to the extent of selling their products directly to the government instead of acting as subcontractors to prime contractors.[4]

Although the industry replies were disappointing, the concept of developing weapons systems as entities, rather than collections of independently developed components, caught hold. While AMC was somewhat cautious and warned that the radical new "weapons system" method of development "should be implemented with care,"[5] USAF decided, in November 1949, that the weapons system method would be used in developing the 1954 interceptor. First, a suitable electronic fire control system would be designed. Then an airframe compatible with the electronic

---

4. AMC Memo, "Establishment of Military Characteristics," undated but probably June 1949 (Doc 6 to WADC F-102 Study).

5. AMC to USAF, "Military Characteristics for the Development of Interceptor Fighter Aircraft," 29 Sep 1949 (MX-1179 file, WADC central files).

equipment would be developed. USAF directed AMC to provide preliminary military characteristics for the complete interceptor by 30 June 1950.[6]

Therefore, in January 1950, AMC invited 50 firms to submit their terms for developing the fire control system for the new interceptor. Eighteen responded with proposals. That the Air Force was venturing into virtually uncharted development territory was indicated by the wide variance in the bids. Emerson Electric Company was confident it could do the job for $1,680,000. Northrop felt that the development would cost $14,250,000. General Electric foresaw no insurmountable problems and estimated development could be completed in 27 months. Westinghouse, on the other hand, pessimistically predicted a development period of 63 months. AMC analyzed the bids on the basis of price, past performance and other factors and by early May 1950 thought it could recognize six potential winners. From a technical standpoint, North American, Sperry Gyroscope and Hughes appeared to be the best qualified. From the logistics standpoint (supply and promptness of delivery

---

6. USAF to AMC, "Procedure for Development of the New USAF Interceptor," 5 Dec 1949 (Doc 7 to WADC F-102 Study).

of spare parts), Westinghouse, Bendix and General Electric looked best.[7]

Discussions regarding a development contractor moved to the Pentagon at this point. A group charged with evaluating the proposals as to operational suitability recommended acceptance of the Hughes bid if the Hughes proposal could be amended to include portions of the Westinghouse plan. Meanwhile, USAF had appointed an ad hoc board to determine which of the proposals had the most merit. This board was headed by General Saville, who had become USAF Deputy Chief of Staff for Development since he briefed the assembled industry representatives in May of 1949. General Saville in turn appointed a special Air Defense Engineering Committee, headed by Dr. George E. Valley, to assist him in technical evaluation of the various proposals. The Valley committee recommended that the award be made from a group of bidders which included Glenn L. Martin, Sperry and North American. After sifting the conflicting recommendations, the Saville board narrowed the competitors down to Hughes and North American. The Board visited the West Coast in early June 1950

---

7. AMC to USAF, "Results of AMC Evaluation of Proposals Submitted for the Electronic and Control System for the 1954 Interceptor," 10 May 1950 (MX-1179 file, WADC central files).

and not only toured both plants but also interviewed officials of both firms.[8]

Members of the Valley committee saw enough during this visit to recommend accepting the North American offer, although the ideal situation, the committee felt, would be to award development contracts to both. The Saville board did not agree with the Valley committee, however, and, in July 1950, declared Hughes the winner of the competition. The North American radar scanner, inertial automatic navigator and radar power package were to be developed separately to fit the basic Hughes system. Contract discussions were opened with Hughes in late July 1950, but because of various disagreements over costs the final contract was not approved by AMC until 2 October 1950.[9]

---

8. Memo, USAF, DCS/D for USAF, Dir/Req, "Evaluation of the 1954 Interceptor Proposals," 10 Apr 1950 (MX-1179 file, WADC central files); Memo, Maj. B. E. Turner, DCS/D Project Officer for USAF, DCS/D, "Composite Electronic and Control System," 31 May 1950 (Doc 9 to WADC F-102 Study); Memo, AMC, Fighter Br, Engineering Div for AMC, Acft and Guided Missiles Sec, Engineering Division, "Visit to West Coast Relative to Project MX-1179 Evaluation," 13 Jun 1950 (Doc 10 to WADC F-102 Study); Msg, USAF to AMC, 1 Jun 1950 (MX-1179 file, WADC central files).

9. Memo, AMC, Fighter Br, Engineering Div for AMC, Acft and Guided Missiles Sec, Engineering Div, "Visit to West Coast Relative to Project MX-1179 Evaluation," 13 Jun 1950 (Doc 10 to WADC F-102 Study); USAF to AMC, "Evaluation of Electronic and Control System for Project MX-1179," 7 Jul 1950 (Doc 11 to WADC F-102 Study); Hughes Aircraft Co. to AMC, "Project MX-1179," 31 Jul 1950 (Doc 12 to

Competition for the airframe contract was then organized. USAF furnished the military characteristics to AMC on 18 August 1950. Less than two weeks later, on 1 September 1950, 19 possible contractors were invited to submit bids.* The contractors were given five months to put their ideas in written form. Deadline for proposals was originally the end of 1950, but this was later extended to 31 January 1951. More than a simple airframe was involved in the proposals, since the winner would have to assume responsibility for the "satisfactory functioning of the airplane as a weapon."[10] The prospective development

---

(Cont'd) WADC F-102 Study); Memo for file, H. H. Gottschlich, Procurement Div, AMC, "Meeting Held at AMC 12 September 1950 with Representatives of the Hughes Aircraft Company," undated but about 14 Sep 1950 (Doc 16 to WADC F-102 Study); Memo, AMC, Procurement Div for AMC Procurement Committee, "Request for Authority to Issue Notice of Award," 19 Sep 1950 (Doc 17 to WADC F-102 Study); AMC to Hughes Aircraft Co., "Contract No. AF33 (038)-15982," 2 Oct 1950 (Doc 18 to WADC F-102 Study).

* The following aircraft manufacturers were invited to submit proposals:

Boeing	Lockheed
Douglas	Northrop
Republic	North American
Convair	McDonnell
Ryan	Curtiss-Wright
Glenn L. Martin	Bell
Grumman	United Aircraft
Goodyear Aircraft	Fairchild
Chase Aircraft	Hughes
Chance-Vought	

10. AMC to aircraft manufacturers (19), "Request for Proposals in Design Competition," 1 Sep 1950 (Doc 14 to WADC F-102 Study); USAF to AMC, "1954 Interceptor Competition," 18 Aug 1950 (Doc 13 to WADC F-102 Study).

contractors were also instructed to work closely with Hughes to make sure the airframe would be compatible with the electronic equipment. Because an advanced airframe design was obviously desired, several of the competitors sought research assistance from the National Advisory Committee for Aeronautics (NACA).[11]

At the deadline for the airframe competition, six contractors had submitted nine proposals. Republic submitted three bids, North American two. Single proposals were offered by Chance-Vought, Lockheed, Douglas and Convair.* By the end of March 1951, AMC had rated the proposals with respect to technical and logistical considerations. A board of general officers, appointed by the USAF Director of Requirements, then examined the proposals from the standpoint of operational suitability. The decision, announced by USAF on 2 July 1951, was both confusing and surprising. It was confusing in that three winners were named. Convair, Republic and Lockheed were all to proceed with development through the mock-up stage. Then the firm providing the most promising design would be

---

11. AMC to aircraft manufacturers (19), "Request for Proposals in Design Competition," 1 Sep 1950 (Doc 14 to WADC F-102 Study); Msg, AMC to USAF, 18 Sep 1950 (MX-1179 file, WADC central files); AMC to aircraft manufacturers (19), "NACA Data for Use in Design Proposals," 6 Nov 1950 (MX-1554 file, WADC central files).

* Known as Consolidated-Vultee until April 1954.

awarded a production contract. The decision was surprising, because all three winners ranked comparatively low in the technical and logistical rankings. The Lockheed entry, a more-or-less conventional straight-wing aircraft intended to fly at Mach 2, ranked fourth in the technical ratings and fifth on the basis of logistical supportability. Republic's winning proposal involved a complicated turbojet-ramjet power plant in a delta-wing, delta-tail aircraft which tied for the lowest rating as to logistics and finished eighth in the technical standings. Convair submitted a plan for an aircraft that was essentially a refinement of the delta-wing F-92 it had been developing in the late forties until the project was cancelled on the grounds of excessive cost. The F-92 first flew in September 1948. AMC had rated the Convair proposal last on the basis of technical feasibility, but third in terms of logistical support.[12]

---

12. Memo, Procurement Div, AMC, for Engineering Div, AMC, "Logistics Evaluation of 'MX-1554' Fighter Interceptor," 22 Mar 1951 (Doc 22 in WADC F-102 Study); AMC Report, "Technical Evaluation of Airplane Proposals in Connection with Project MX-1554," 27 Mar 1951 (Doc 23 in WADC F-102 Study); AMC to USAF, "The 1954 Interceptor Competition," 28 Mar 1951 (MX-1554 file, WADC central files); USAF to ARDC, "Evaluation of Project MX-1554 (1954 Interceptor)," 2 Jul 1951 (Doc 24 in WADC F-102 Study); Lockheed to AMC, "Submittal of Lockheed L-205-1 Interceptor Fighter Proposal," 25 Jan 1951 (Doc 20 in WADC F-102 Study); Republic to AMC, "Interceptor Proposal," 29 Jan 1951 (MX-1554 file, WADC central files); Convair to AMC, "MX-1554 Interceptor," 26 Jan 1951 (Doc 21 in WADC F-102 Study); AMC Study, "Development and Production of Fighter Aircraft for the United States Air Force," Oct 1949, p. 121.

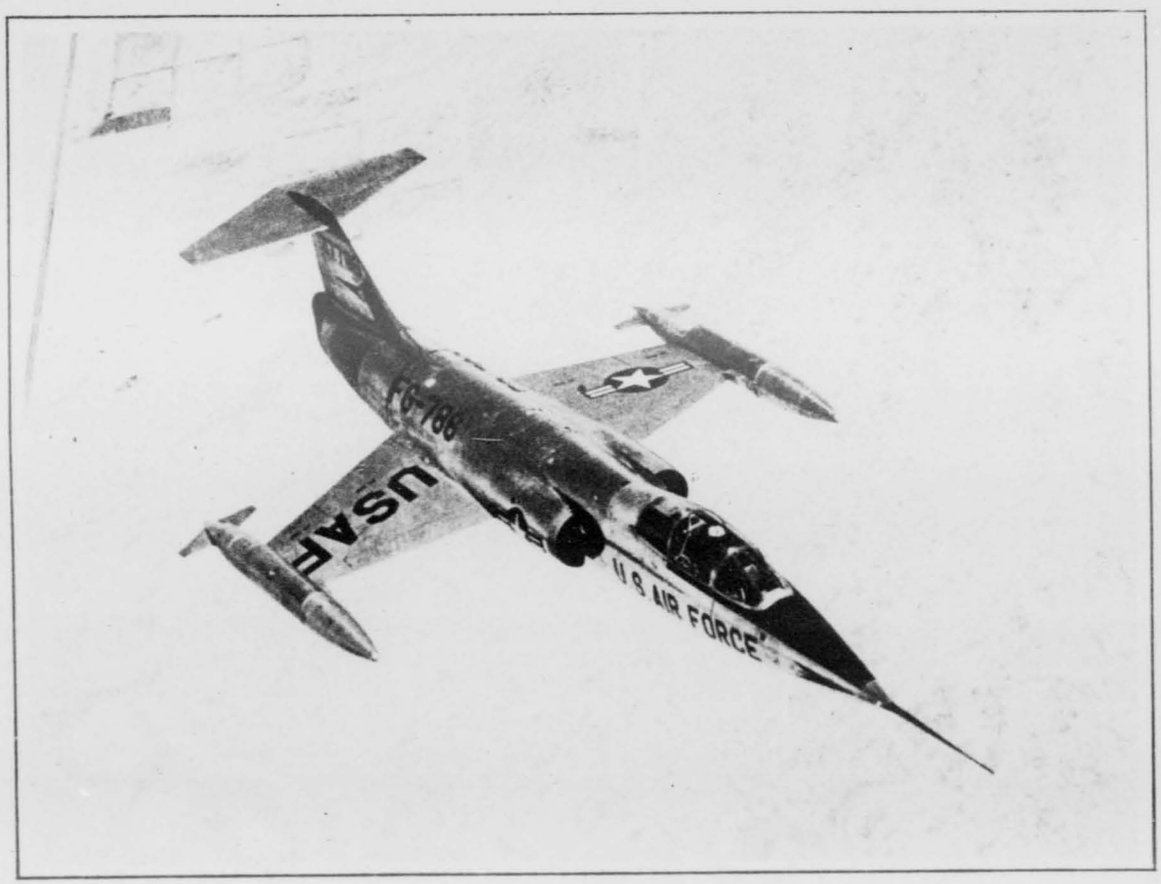
The plan for three-pronged development of the 1954 interceptor (Project MX-1554) died a quick death, however. Although each of the three winners was notified of his good luck and the procurement wheels were turning in AMC in July and August of 1951, the plan was buried in September when Roswell L. Gilpatric, Under Secretary of the Air Force, decided it was unwise to finance three concurrent Phase I development programs. Mr. Gilpatric therefore ordered that Lockheed be dropped, that the Republic program be supported through the mock-up stage and that Convair be given a contract for a prototype interceptor.[13] This action, in effect, declared Convair the undisputed winner of the design competition for the 1954 interceptor.

In the fall of 1951, while the matter of an airframe contractor was being settled, it was becoming painfully evident that the "1954 interceptor" was not going to be ready in 1954. There were doubts that it would be ready by 1956. But intelligence estimates of the 1954 threat indicated a pressing need for a modern all-weather interceptor at that time. Consideration of another "interim" interceptor, such as the F-86D and F-94C were

---

13. Memo, Cmdr, WADC, for C/S, WADC, "Project MX-1554," 6 Sep 1951 (Doc 26 in WADC F-102 Study); Msg, USAF to ARDC, 11 Sep 1951 (MX-1554 file, WADC central files); Los Angeles Engineering Field Office, WADC to WADC, "MX-1554 Activity Report," 12 Sep 1951 (Doc 27 in WADC F-102 Study).

F-102A



F-104A

regarded, was begun. After assessing the Navy F4D, the F-91 (a Republic development based on the design competition of 1945 which led to selection of the Northrop F-89), and the North American Sabre-45 (an improvement of the F-86 which ultimately became the F-100), USAF decided that a partially developed MX-1554 was most promising.[14]

The 1951 planning foresaw an interim interceptor that would be identical to the "ultimate" 1954 interceptor, except for the engine. The J-57 engine planned for the interim interceptor was believed capable of producing aircraft speed of about 850 knots. The J-67 engine for the ultimate interceptor was expected to provide speed of nearly 1,200 knots. Because of this considerable difference in performance, it was the original intention to hold production of the interim model to a minimum, putting primary emphasis on development of the ultimate version. But as 1952 wore along and the difficulties involved in developing the ultimate interceptor became more and more evident, it became apparent that the period between the obsolescence of the F-86D and the appearance of the ultimate 1954

---

14. USAF to ARDC, "USAF Interceptor Aircraft Plan," 26 Oct 1951 (Doc 28a in WADC F-102 Study); ARDC to WADC, "Interceptor Aircraft Evaluation," 30 Oct 1951 (MX-1554 file, WADC central files); Memo, C/S, WADC for Weapons Systems Div, WADC, "Convair Interim Interceptor," 16 Nov 1951 (F-102 WSPO files, WADC); USAF to ARDC, "Development and Production of Convair MX-1554," 24 Nov 1951 (Doc 29 in WADC F-102 Study).

interceptor was likely to be a long one. Therefore, by almost imperceptible steps, the interim model assumed greater importance and the quantities discussed grew larger. More emphasis on the interim model meant less emphasis on the ultimate model and did violence to the weapons system concept outlined by General Fairchild in 1949. The realities of the development situation, however, dictated this undesirable trend.[15]

The difference between the interim 1954 interceptor (by this time known as the F-102A) and the ultimate model (F-102B) was further widened in late 1952 when it was determined that the MX-1179 fire control system being developed by Hughes would not be ready in time for the F-102A. USAF was forced to the conclusion that the F-102A would have to be equipped with either the E-4 or E-9 fire control system, "whichever was closer to realization." The E-4 was programmed for use in the F-86D, the E-9 for use in the F-89D. Neither was as advanced as the MX-1179, for which Hughes had been given a development contract in October 1950. On the basis of a WADC recommendation, the E-9 was subsequently chosen as the fire control system for the F-102A.[16]

---

15. Minutes of WADC Weekly Staff Conference, 20 Nov 1952; Aviation Week, 22 Sep 1952.

16. AMC Weekly Activity Report, 5 Jan 1953.

Although it was fairly well known by November 1952 that the F-102A would be much less of a weapons system than was envisioned in 1949, the F-102 mock-up inspection held at that time was conducted in a climate of wishful thinking. The model was packed with representations of "black boxes" that were expected to be available for the ultimate interceptor, but were obviously too advanced for the F-102A. Even so, Air Force inspectors were reasonably well satisfied with the general arrangement presented by Convair and the contractor was free to proceed with development.[17]

At this point a great configuration debate began. Although there were no delta-wing aircraft currently available to the USAF, the idea was not new. Convair's experimental XF-92A was a delta-wing aircraft and the British had been contending for several years that the delta-wing was ideal for high-speed aircraft. The principal advantages were that the delta-wing was aerodynamically thin but structurally thick while at the same time being much easier to build than a straight thin wing. The straight thin wing required special heavy machinery. The delta-wing could be built with standard tooling.[18]

---

17. Minutes of WADC Weekly Staff Conference, 20 Nov 1952 (WADC historical files).

18. Aviation Week, 22 Sep 1952.

But the designers who prepared the original Convair proposal failed to make proper allowance for the aerodynamic "drag" produced by the delta-wing aircraft. While Convair had predicted a maximum altitude of 57,600 feet and a combat radius of 350 miles for the F-102A, wind tunnel tests conducted by the NACA in late 1952 and early 1953 indicated that the probable maximum altitude of the aircraft would be 52,400 feet and the combat radius 200 miles. The problem, stated simply, was that the aircraft was so bulky amidships that an undesirable drag was produced. The solution was to indent the fuselage to a "coke bottle" configuration, but this was not arrived at overnight. Convair had to be shown where its original design was in error and it was not until August 1953 that Convair accepted the implications of the "NACA ideal body theory" and joined in the recommendations that the design of the F-102A be changed to meet the requirements of that theory. These changes were many. It was necessary to lengthen the fuselage by seven feet and move the wings and tail rearward in order to accomodate the indented fuselage. The wings were to be provided with a cambered leading edge and "warped" tips in order to eliminate the drag encountered when the elevons were deflected to maintain the appropriate angle of attack during the cruise and climb phases of flight.[19]

---

19. Hist of. WADC, Jan-Jun 1953, II, pp. 212-235.

Meanwhile, Convair was working to build early test models of the F-102. Production had already begun when the "coke-bottle" decision was finally reached, so it was decided to accept 10 straight-fuselage aircraft before reorienting the production line toward the "coke-bottle" model. After the coke-bottle discussion, not much was expected of these first 10 aircraft, although some aspects of delta-wing performance could be checked.[20]

The first flight took place at Edwards on 24 October 1953. On this occasion R. L. Johnson, chief Convair engineering test pilot, took the aircraft to an altitude of 15,000 feet and reached a speed of 270 miles an hour. Five additional flights took place during the next week, the YF-102 reaching an altitude of 35,000 feet and a speed of .9 Mach. While stability was relatively good and control was not overly difficult, the general performance of the aircraft was not satisfactory. The fuel system operated erratically and the engine did not develop its full power. The pilot complained of fumes in the cockpit and a mild buffeting at speeds approaching .9 Mach. The main landing gear would not satisfactorily retract. The suspicions that the F-102 was not yet ready for flight testing were borne out on 2 November 1953 when the test aircraft appeared to wallow through the air immediately after

---

20. WADC Weekly Information Report, 30 Oct 1953.

takeoff, never rising more than 20 feet from the runway. The subsequent wheels-up landing damaged the underside of the aircraft so badly that it was eliminated from the test program. Test Pilot Johnson was seriously injured. The actual villain was later determined to be the Bendix fuel control which had failed to function properly on any of the six flights.[21]

Flying in the second YF-102 began 11 January 1954, with E. D. Shannon, chief Convair experimental pilot, at the controls. Shannon made a number of flights in the YF-102, noting buffeting, an occasional tendency to yaw and increased difficulty of control at speeds approaching .9 Mach. By early April 1954 Johnson had recovered sufficiently to resume his testing duties. He pushed the YF-102 to 47,000 feet, but the effort was so great that he placed the practical ceiling of the aircraft at 40,000 feet. He was also able to reach a speed of 1.24 Mach by assuming a 30-degree dive angle. Subsequent to this effort, the second YF-102 was modified by extending the

---

21. Report, R. L. Johnson, Convair, "Flight Status Report, Flight No. 1," (also reports of Flights No. 2, 3, 4, 5 and 6), 24, 28, 29 and 31 Oct 1953 (F-102 WSPO files); Report, J. W. Redd and V. L. Allwardt, Convair, "Flight No. 7, Preliminary Report," 2 Nov 1953 (Doc 44 to WADC F-102 Study); Convair to AMC, "Development of Improvements," 10 Nov 1953 (Doc 43 to WADC F-102 Study); WADC to AFFTC, "Testing of Power Control System of YJ57-P-11 Engine," 4 Dec 1953 (F-102 WSPO files).

tail cone, cambering the wings, adding new speed brakes and adding 592 pounds of ballast. These modifications were improvements, because Johnson was then (14 April 1954) able to reach an altitude of 47,500 feet without the struggle he had experienced earlier. There was a notable improvement in stability and control.[22]

Primarily because the modified YF-102 showed improved performance, ARDC pressed for an accelerated Phase II test (use of military pilots). Convair had insisted earlier that Phase II flying could not possibly begin before June 1954. ARDC won the argument and Maj. Gen. Albert Boyd, WADC commander, on 28 April 1954 was the first military pilot to fly the YF-102. By 1 June 1954, ARDC pilots had completed 56 hours of test flying in the aircraft. Military pilots tended to verify Johnson's test reports.[23]

But testing in the YF-102 was not the main show, since the YF-102 was the straight-fuselage model and USAF

---

22. Reports, E. D. Shannon, Convair, "Flight Status Report" (Flights 1, 3, 5, 7 and 28 in second YF-102), 11, 20 and 26 January and 2 April 1954 (F-102 WSPO files); Reports, R. L. Johnson, Convair, "Flight Status Report" (Flights 33, 34, and 37 in second YF-102), 14 and 19 April 1954 (F-102 WSPO files).

23. Reports, J. W. Redd, V. L. Allwardt and R. L. Johnson, Convair, "Flight Status Reports" (Flights 43-46, 83-86 and USAF Phase II in second YF-102), 28 Apr, 3-22 May and 1 Jun 1954 (F-102 WSPO files).

had decided that the "coke-bottle" design was to be the combat configuration. Really significant testing would have to await coke-bottle aircraft. To permit testing to begin as soon as possible, Convair pushed a coke-bottle airframe through the production line, not bothering with many of the refinements which would be included in the tactical aircraft. By this forced-draft method, the first coke-bottle aircraft, designated YF-102A or "Hot Rod" to distinguish it from the straight-fuselage models, was ready in December 1954. Johnson made the first flight in it on 19 December. Advantages over the straight-fuselage model were immediately apparent. The Hot Rod used less runway for takeoff than did the YF-102. It attained a speed of Mach 1.2 in level flight and was still climbing strongly at an altitude of 51,600 feet.[24]

Although testing of the F-102A continued through 1955 and early 1956, the basic development of the successor to the F-86D was completed with the successful test flight of December 1954. The first tactical F-102A aircraft to be received by ADC arrived at George AFB, California (327th FIS), in April 1956. This meant that the "interim" version of the "1954 interceptor" became available approximately two years after the date the Board of Senior Officers, meeting in October 1948, had established

---

24. Hist of WADC, Jul-Dec 1954, II, pp. 50-55.

as the operational date of the ultimate model. Experience with the F-102A only served to provide additional evidence, if any was needed, that development of modern all-weather interceptors was a long and difficult job.[25]

After the first F-102A was received by ADC, expansion of the F-102A force was rapid. Ninety-seven were in ADC hands by the end of 1956 and 428 were available by the end of 1957. The high point in the ADC inventory was reached at the end of 1958, when 627 F-102A aircraft were on hand. The F-102A began to leave the air defense system in 1959 with the receipt of the F-101B and F-106A. At the end of 1959, however, there were still 482 F-102A's in ADC, or about 40 per cent of the total tactical inventory of 1,200 aircraft.[26]

The F-103

The F-103 was a product of the same design competition that eventually produced the F-102. The original decision with respect to the "1954 interceptor," announced 2 July 1951, was that Convair, Republic and Lockheed would proceed with development through the mock-up stage. This proposal was promptly shot down by Roswell L. Gilpatric, Under Secretary of the Air Force, who

---

25. Hist of ADC, Jan-Jun 1956, p. 41.

26. RCS: 1-AF-V14, ADC, 1956 through 1959 (HRF).

directed, in September 1951, that Lockheed would be dropped from the program, that the Republic development would be supported through the mock-up stage and that Convair would be given a contract for a prototype interceptor. Convair proceeded to develop and produce the F-102. The Republic design, much less adequately funded than that proposed by Convair, was named F-103.[27]

The F-103 was, like the F-102, a delta-wing design, which would also include the MX-1179 fire control system and J-67 engine of the ultimate F-102. It was expected to offer Mach 3 speed and a ceiling of 80,000 feet. The F-103 differed from the F-102 in that it was to have an alternate ramjet engine for high speed at extreme altitudes.

---

27. Memo, Procurement Div, AMC, for Engineering Div, AMC, "Logistics Evaluation of 'MX-1554' Fighter Interceptor," 22 Mar 1951 (Doc 22 in WADC F-102 Study); AMC Report, "Technical Evaluation of Airplane Proposals in Connection with Project MX-1554," 27 Mar 1951 (Doc 23 in WADC F-102 Study); AMC to USAF, "The 1954 Interceptor Competition," 28 Mar 1951 (MX-1554 file, WADC central files); USAF to ARDC, "Evaluation of Project MX-1554 (1954 Interceptor)," 2 Jul 1951 (Doc 24 in WADC F-102 Study); Lockheed to AMC, "Submittal of Lockheed L-205-1 Interceptor Fighter Proposal," 25 Jan 1951 (Doc 20 in WADC F-102 Study); Republic to AMC, "Interceptor Proposal," 29 Jan 1951 (MX-1554 file, WADC central files); Convair to AMC, "MX-1554 Interceptor," 26 Jan 1951 (Doc 21 in WADC F-102 Study); AMC Study, "Development and Production of Fighter Aircraft for the United States Air Force," Oct 1949, p. 121; Memo, Cmdr, WADC for C/S, WADC, "Project MX-1554," 2 Sep 1951 (Doc 26 in WADC F-102 Study); Msg, USAF to ARDC, 11 Sep 1951 (MX-1554 file, WADC central files); Los Angeles Engineering Field Office, WADC to WADC, "MX-1554 Activity Report," 12 Sep 1951 (Doc 27 in WADC F-102 Study).

The use of titanium alloys rather than aluminum or magnesium was also anticipated. Another innovation in the F-103 was the lack of a raised canopy. The pilot would sit well down in a perfectly smooth fuselage. Use of a periscope or retractable cockpit was suggested as a means of giving the pilot a sufficient field of vision for takeoff and landing. Since immediate production of the F-103 was not anticipated, no production funds were available for expediting development. This promised to be a serious problem, because it was estimated that the first two test aircraft would cost $21,000,000 and this sort of development money was simply not available. In fact, the F-103 program was in trouble as early as Fiscal 1952, because Republic was making such rapid progress that funds ran short. Only a two million dollar allotment from the Department of Defense emergency fund permitted development activity to continue.[28]

The idea that the F-103 would ever become an operational interceptor died early, especially since the costs of development continued to rise. By the middle of 1953 the estimated cost of developing the F-103 had reached $41,000,000, leading USAF to give up the earlier plan of financing development to the point where a prototype interceptor would be built. USAF, instead, began to see

---

28. Hist of WADC, Jan-Jun 1952, pp. 210-213.

the F-103 as purely an experimental aircraft, used to push advancement in the state of the aircraft art.[29]

Republic was given a contract for the construction of a single experimental aircraft in June 1953. The first flight was scheduled for March 1957, a significant change from the development contract awarded Republic in 1951 which called for initial flight in 1955. Progress with the F-103 was slow, however, because there were perpetual shortages of funds. In early 1954, ARDC asked for $13.3 millions of F-103 money for Fiscal 1955, but USAF would not agree, suggesting instead a stretched-out development program funded at the rate of about five million dollars a year. WADC countered by preparing a program which called for $6.2 million in Fiscal 1955, $8.9 million in Fiscal 1956 and $5.6 million in Fiscal 1957. If this level of funding could not be provided, WADC added, it would be better to cancel development. WADC won a partial victory in this instance. The necessary funds for continued F-103 development were provided, but only after

---

29. R&D Quarterly Review, USAF, 31 Mar 1953, p. 46; Project Status Report, WADC, MX-1554, 15 Jun 1953.

reductions were made in funds set aside for development of a low-level strategic bomber and an advanced strategic bomber.[30]

Revitalized by the promise of money, the F-103 program took on new life. Republic was awarded a Phase II development contract in June 1954 and plans were made for the construction of three experimental aircraft. The first was scheduled to fly in February 1957 and was to explore aerodynamic conditions at 75,000-foot altitudes and Mach 3 speed. The second was to test the operational capability of the combination turbojet-ramjet engine and was to begin flying in June 1957. The third was to fly in December 1957. It was to be equipped with a fire control system and armament and was to be used to develop operational tactics for interceptor aircraft.[31]

The bloom of health exhibited by the F-103 program in late 1954 was misleading, however. The F-103 concept was far ahead of the state of the art and what had been hopefully planned in 1951 proved impossible of accomplishment, at least at the scale of funding allocated

---

30. R&D Quarterly Review, USAF, 30 Sep 1953, pp. 68 and 71; Hist of WADC, Jul-Dec 1953, p. 471; Msg, ARDC to WADC, 9 Feb 1954 (Cmdr files, WADC central files); Memo, DCS/O, WADC for Cmdr, WADC, "XF-103," 15 Feb 1954 (Cmdr files, WADC central files); WADC Staff Conference, 30 Jun 1954.

31. Hist of the Directorate of Weapons Systems Operations, WADC, Jul-Dec 1954.

to this development. The heart of the F-103 proposal was a plan to mate a turbojet engine with a ramjet engine in order to produce the high altitude (80,000 feet) Mach 3 performance desired in this advanced interceptor. It was planned that the RJ-55 ramjet engine would act as an afterburner for the J-67 turbojet engine to 40,000 feet and Mach 2.1. Then the ramjet was to begin operation, pushing the F-103 to 80,000 feet and Mach 3. But the theory was never tested, because the F-103 never got off the ground. The theory that titanium alloys would withstand the 500-degree heat generated by the Mach 3 speed of the F-103 also remained a theory, despite years of testing on the ground, because the F-103 never flew. Other advanced ideas suffered a similar fate. F-103 development proceeded slowly through 1955 and 1956, but was cancelled in September 1957 when USAF decided that it was not making sufficient progress to justify the expense. If this starved offshoot of the "1954 interceptor" proved anything, it proved, again, that there were thousands of unseen pitfalls along the path from design proposal to operational hardware.[32]

---

32. Hist of the Directorate of Weapons Systems Operations, WADC, Jan-Jun 1955; Hist of ARDC, Jan-Jun 1956, p. 193; Hist of ARDC, Jul-Dec 1957, p. 99.

The F-104

The same 1950-51 design competition which resulted in the F-102 and F-103 also resulted, in a sense, in the F-104. The July 1951 decision in the competition for the privilege of developing the "1954 interceptor" was that there were three winners--Convair, Republic and Lockheed. By subsequent action of the Under Secretary of the Air Force, however, Convair became the manufacturer of the F-102. Republic was given a contract for the experimental F-103. Lockheed was dropped from contention at that time. In early 1952, however, USAF directed ARDC to negotiate with Lockheed for the development of a very advanced day fighter.[33]

Negotiations were long and complicated, however, because of continuing confusion as to the type of aircraft Lockheed was to develop, and legal complications. As to the aircraft itself, the Air Force was originally interested in a relatively heavy delta-wing fighter (the Lockheed entry in the "1954 interceptor" competition was a straight-wing type), but Lockheed muddied the waters by also offering a "featherweight" straight-wing model. As

---

33. USAF to ARDC, "Evaluation of Project MX-1554 (1954 Interceptor)," 2 Jul 1951 (Doc 24 in WADC F-102 Study); Memo, Cmdr, WADC for C/S, WADC, "Project MX-1554," 6 Sep 1951 (Doc 26 in WADC F-102 Study); Msg, USAF to ARDC, 11 Sep 1951 (MX-1554 file, WADC central files); R&D Review, USAF, 31 Dec 1952, p. 39.

1952 merged into 1953 the merits of the delta-wing model versus the featherweight model were debated within USAF and the planned production date of 1956 became more and more unrealistic. Finally, in January 1953, USAF decided to proceed with development of the lightweight model. Lockheed was given a contract in March 1953.[34]

The legal problems concerned the handling of patent rights. Lockheed balked at accepting a contract which forfeited all F-104 patent rights to the government and would thereby make it possible for USAF to assign a production contract to a firm other than the original designer. The same problem had occurred in dealings with North American (F-100), Convair (F-102) and McDonnell (F-101) and the government had given ground. But the AMC Judge Advocate had come to the conclusion that the Lockheed contract was a good one on which to stand firm, before too many precedents were established. As a consequence, contract negotiations dragged along for several months until General Boyd, WADC commander, insisted in June 1952 that the deadlock be broken. So, when the matter of the lightweight aircraft was settled, there was no

---

34. Hist of WADC, Jul-Dec 1952, II, pp. 46-48; Memo, Weapons Systems Div, WADC for Cmdr, WADC, "Day Fighter Development Program," 27 Jan 1953 (App. G-2 to Hist of WADC, Jan-Jun 1953); Daily Activity Report, Dir/ Operations, WADC, 22 Jan 1953; Daily Activity Report, Weapons Systems Div, WADC, 16 Feb 1953, R&D Review, USAF, 31 Mar 1953, p. 50.

legal barrier to the prompt negotiation of a contract with Lockheed. The government again retreated on the patent issue.[35]

The F-104 was not intended as an interceptor. It was designed as a light, fast, relatively inexpensive air superiority fighter. The designers hoped it would reach a speed of nearly Mach 2, have a combat ceiling of 53,000 feet and climb at a rate of 49,000 feet a minute, beginning at sea level. It was the smallest of the post-war combat aircraft, with short, straight, extremely thin wings. It was not, strictly speaking, a new development, deriving much from the Douglas X-3 experimental craft and the F-90 developed by Lockheed in the late forties. The Douglas aircraft had not been successful because of the failure of the engine contractor to produce a suitable engine. In order to recoup its losses on the X-3 program, USAF directed Douglas, over strong Douglas objections, to deliver the X-3 plans to Lockheed. Many of the X-3 ideas went into the F-104.[36]

---

35. Hist of WADC, Jan-Jun 1952, pp. 195-197; Memo, Weapons Systems Div, WADC for Cmdr, WADC, "Lockheed Contract for Air Superiority Fighter," undated but about 8 Jun 1952 (Commander's files, WADC central files); WADC to AMC, "Lockheed Contract for Air Superiority Fighter," 10 Jun 1952 (Commander's files, WADC central files); Hist of WADC, Jul-Dec 1952, II, pp. 446-448.

36. USAF Aircraft Characteristics (Green Book), F-104, 22 May 1953 (HRF); Hist of WADC, Jul-Dec 1953, pp. 216-217.

Perhaps because of its derivation from earlier developments, the F-104 was unique in that it experienced few serious problems during development. A satisfactory mock-up inspection was held 30 April-1 May 1953, barely weeks after the definitive development contract was signed with Lockheed. At that time the first flight was scheduled for March 1954. And, surprising enough, the first flight was made according to schedule, on 5 March 1954. Although the Wright J-65 engine used in the initial aircraft was not equipped with an afterburner, the F-104 managed to reach a speed of Mach .98 at 30,000 feet by the middle of April 1954. By this time, use of the J-65 engine was regarded as only a temporary measure, because the General Electric J-79 engine (developed for use in the B-58) had come along and promised much better performance than the J-65.[37]

ARDC was highly pleased with the progress and performance of the test models of the F-104, but was faced with the ironic fact, in mid-1954, that neither TAC nor ADC had ever filed a requirement for such an aircraft. Lockheed could not be given a contract for volume production of the F-104 until such a requirement had been placed.

---

37. ARDC Form 82, R-430-288, 11 May 1953; R&D Review, USAF, 31 Mar 1954, p. 55; Weapons Systems Operations Reports, WADC, 9 Mar, 30 Mar, 13 Apr, 20 Apr and 27 Apr 1954; USAF Aircraft Engine Characteristics (Gray Book), J65-B-3, 15 Mar 1954 and XJ79-GE-1, 15 June 1954.

Because of the advanced performance of the tiny craft, however, ARDC was confident that either one or both of the possible users would be happy to have it when they learned of its potentialities. To increase the interest of ADC in the F-104, WADC's Armament Laboratory began working on a fire control system that would combine search and range radar to permit detection of a target at 10 miles and lock-on at 7,000 yards and provide range information within 2,000 yards. A simple, lightweight system was sought.[38]

ADC was caught unawares by the proposal to use the F-104 as an interceptor. Its initial reaction (September, 1954) was generally negative, however, in that it did not "appear that this aircraft could be expected to meet the performance and electronic criteria established for all-weather interceptors without seriously jeopardizing its... performance."[39] At the same time, ADC was looking for an interim interceptor to help fill the gap between the F-102 and the F-106. It was willing to consider the F-104, or any other fighter aircraft. So, during late 1954 and the early months of 1955, ADC watched F-104 development and

---

38. WADC Staff Conference, 28 Mar 1954 and 20 Oct 1954, DD Form 613, WADC, Project 5022, 15 Jul 1954; Weapons Systems Operations Report, WADC, 17 Aug 1954.

39. ADC to ARDC, "Evaluation of F-104 for Air Defense," 18 Sep 1954 (Doc 244 to Hist of ADC, Jul-Dec 1954).

debated its possible use in air defense. The aircraft was certainly impressive in terms of performance. On 23 March 1955, a test model of the aircraft flew Mach 1.9 and reached an altitude of 60,000 feet. This was especially noteworthy, since the test aircraft was powered by the J-65 engine instead of the advanced J-79 engine to be used in production models. By the middle of 1955, ADC was half-way convinced that it wanted the F-104, and asked USAF to have ARDC carefully study the aircraft with air defense requirements in mind.[40]

Oddly enough, although at one time ARDC had been in the position of "selling" the F-104 to the using commands, its study of late 1955 was not favorable to the use of this aircraft for air defense purposes. This stand was based generally on the lack of satisfactory airborne radar in the F-104. The radar developed by WADC's Armament Laboratory could track a target at a range of 10 miles or less, but had no search capability. The fire control system could fire infrared missiles, but not radar-controlled missiles. It was not sophisticated enough to direct the interceptor on a lead-collision course. It could not direct the interceptor in a snap-up maneuver.

---

40. Ibid.; ADC to USAF, "F-104 Interceptor," 18 Jun 1955 (HRF); ADC to USAF, "Evaluation of F-104 Aircraft," 7 Oct 1955 (HRF); WADC Staff Conference, 30 Mar 1955.

For all these reasons, ARDC could not recommend use of the "limited capability interceptor" (F-104).[41]

But now the positions were reversed and ADC had decided that it would like to have the F-104, whatever its shortcomings as to electronic equipment, as an interceptor. USAF agreed and in April 1956 awarded ADC six squadrons of F-104's for air defense use. It was anticipated that ADC would receive its first F-104's at Hamilton AFB, California, in early 1957.[42]

With the decision taken to provide the F-104 to ADC, the honeymoon with regard to this aircraft ended abruptly. The early stages of F-104 development had been unprecedented, in that development progress was rapid and performance of the aircraft had been better than expected. But when testing for operational suitability began, deficiencies began to appear. The F-104A demonstrated an undesirable tendency to "pitch-up" at high speeds and was subject to such a tail flutter at high speed and low altitude that it was restricted to 575 knots at 20,000 feet and below. It was also doubtful that the airframe could withstand the

---

41. Pers ltr, Lt. Gen. T. S. Power, Cmdr, ARDC, to Lt. Gen. D. L. Putt, DCS/D, USAF, no subject, 13 Jan 1956 (Doc 251 to Hist of ADC, Jan-Jun 1956).

42. Hist of ADC, Jan-Jun 1956, p. 43; Msg, USAF to ADC, 13 Apr 1956 (Doc 155 in Hist of ADC, Jan-Jun 1956).

7.33 "G" forces the F-104 might encounter in high speed turns. Finally, the J-79 engine was almost impossible to re-light when it flamed out at altitudes above 30,000 feet. Because ADC continued to insist that it could not accept an unproved aircraft, the F-104 did not find its way into the ADC tactical inventory in early 1957. It was still in test and development status throughout 1957. The test program was slowed by the loss of four aircraft during April and May of 1957. But progress was made. The tail and airframe were strengthened and the reliability of the engine was improved. By the end of 1957 ADC was reasonably well satisfied that it was getting a usable aircraft, although it was a day fighter and not an interceptor. The first F-104 in ADC was received by the 83rd FIS at Hamilton AFB, California, on 26 January 1958.[43] Because

---

43. Msg, AF Flight Test Center (Edwards) to ADC, 18 Oct 1956 (Doc 143 to Hist of ADC, Jul-Dec 1956); ADC Project Office (Edwards) to ADC, "F-104," 23 Oct 1956 (Doc 144 to Hist of ADC, Jul-Dec 1956); Msg, ADC to USAF, 29 Nov 1956 (Doc 145 to Hist of ADC, Jul-Dec 1956); Minutes of F-104 Meeting, ADC, 4 Dec 1956 (Doc 146 to Hist of ADC, Jul-Dec 1956); ADC Project Office (Edwards) to DC, "F-104 Status," 28 Dec 1956 (Doc 147 to Hist of ADC, Jul-Dec 1956); ADC to USAF, "The F-101B and F-104A Weapons Systems," 11 Jan 1957 (Doc 148 to Hist of ADC, Jul-Dec 1956); Minutes of F-104 Meeting, ADC, 16 Jan 1957 (Doc 226 to Hist of ADC, Jan-Jun 1957); ADC to CONAD, "Status of F-104A Weapons System," 24 Jan 1957 (Doc 227 to Hist of ADC, Jan-Jun 1957); Minutes of F-104 Meeting, ADC, 19 Mar 1957 (Doc 228 to Hist of ADC, Jan-Jun 1957); ADC Project Office (Edwards) to ADC, "Monthly Activities Report--Phase VI F-104A," 5 Apr 1957 (Doc 229 to Hist of ADC, Jan-Jun 1957); Msg, ADC to ARDC, 30 Apr 1957 (Doc 230 to Hist of ADC, Jan-Jun 1957);

of financial pressures, USAF purchased fewer F-104A aircraft than had been originally planned and ADC was given four squadrons instead of the six initially programmed. At the end of 1958, ADC had 100 of the tiny fighters. But the F-104 was short-lived as a factor in air defense. Since it could not be fitted with data link equipment, the F-104 could not be used in the SAGE environment. It was necessary, then, to plan for retirement of the F-104A when SAGE became operational. Although ADC still possessed 90 F-104A's at the end of 1959, the weapons program in

---

(Cont'd) Msg, AMC to ADC, 10 May 1957 (Doc 231 to Hist of ADC, Jan-Jun 1957); Msg, AMC to USAF, 13 Jun 1957 (Doc 235 to Hist of ADC, Jan-Jun 1957); Msg, ADC to USAF, 5 Jul 1957 (Doc 236 to Hist of ADC, Jan-Jun 1957); Minutes of F-104 Weapons Systems Phasing Group Meeting, AMC, 15 May 1957 (Doc 237 to Hist of ADC, Jan-Jun 1957); Msg, ARDC to ADC, 15 Aug 1957 (Doc 207 to Hist of ADC, Jul-Dec 1957); Pers ltr, Lt. Gen. J. H. Atkinson, Cmdr, ADC to Gen. Curtis E. LeMay, Vice C/S, USAF, 27 Aug 1957 (Doc 208 to Hist of ADC, Jul-Dec 1957); Msg, AFFTC to ADC, 27 Aug 1957 (Doc 209 to Hist of ADC, Jul-Dec 1957); Msg, ADC to USAF, 11 Sep 1957 (Doc 210 to Hist of ADC, Jul-Dec 1957); Msg, USAF to ARDC, 13 Sep 1957 (Doc 211 to Hist of ADC, Jul-Dec 1957); Msg, USAF to ARDC, 23 Sep 1957 (Doc 212 to Hist of ADC, Jul-Dec 1957); Msg, USAF to AMC, 23 Sep 1957 (Doc 213 to Hist of ADC, Jul-Dec 1957); Msg, OTIG to ARDC, 27 Sep 1957 (Doc 214 to Hist of ADC, Jul-Dec 1957); Msg, AFFTC to ARDC, 15 Nov 1957 (Doc 215 to Hist of ADC, Jul-Dec 1957); Msg, AFFTC to ARDC, 22 Nov 1957 (Doc 216 to Hist of ADC, Jul-Dec 1957); Msg, ARDC to USAF, 4 Dec 1957 (Doc 217 to Hist of ADC, Jul-Dec 1957); Msg, ARDC to USAF, 16 Dec 1957 (Doc 218 to Hist of ADC, Jul-Dec 1957); Msg, APGC to ARDC, 16 Dec 1957 (Doc 219 to Hist of ADC, Jul-Dec 1957); Msg, APGC to ARDC, 18 Dec 1957(Doc 220 to Hist of ADC, Jul-Dec 1957); Hist of ADC, 1958, p. 141.

effect in early 1960 called for inactivation of all four F-104 squadrons in the spring and summer of that year.[44]

The F-101B

Like the F-89, the F-101B was the result of the design competition held immediately after World War II. But the process was long and complicated. One of the winners of the 1945 competition was McDonnell, which proposed to build a long-range "penetration" fighter ultimately designated F-88. McDonnell made excellent development progress with the F-88 and managed first flight on 20 October 1948. This swept-wing aircraft, equipped with two J-34 engines rated at 3,150 pounds of thrust each, reached a speed of 700 miles an hour. Because of this highly respectable performance, it was planned to begin production in 1949, but the economy wave of that year engulfed the F-88 and production plans were scrapped. Then, in June 1950, USAF ordered a competitive evaluation of the F-88, the Lockheed F-90 and the North American F-93 in another attempt to determine the best penetration fighter. The F-88 won this competition, but the evaluation board decided that it did not have sufficient range and endurance to be an adequate penetration fighter. The F-88 went back on the shelf. Finally, in 1951, McDonnell produced a revised version of the F-88 which was so

---

44. ADCM 27-2, 31 Mar 1960, Vol. II.

different from the original that it was re-christened F-101. It was expected, in 1951, that it would be capable of 918 knots at 35,000 feet, with a combat radius of 800 miles. Whether it would be a bomber escort, a penetration fighter or a fighter-bomber was a moot question during 1952, but in early 1953 USAF decided it could be used for all three purposes.[45]

USAF did not mention that ADC was also interested in the possibility of using the F-101 as an interceptor, because USAF had rejected a tentative ADC suggestion (first expressed to WADC in October 1952) that this aircraft be modified to interceptor configuration. It was the WADC opinion that ADC had been rebuffed in this matter because of the high cost of the F-101. Besides, McDonnell production facilities were limited and production of an interceptor version of the F-101 would probably require construction of another plant. USAF had decided to solve the interceptor problem by increasing the number of F-86D's and "putting the heat on" the F-102.[46]

---

45. AMC Study, "Development and Production of Fighter Aircraft for the USAF," Oct 1949, p. 120; AMC Weekly Activity Report, 2 May 1952; Hist of AMC, Jul-Dec 1950, p. 196; Hist of WADC, Jul-Dec 1952, II, pp. 463-466.

46. Summary of WADC Weekly Conference, 16 Oct 1952; Hist of WADC, Jul-Dec 1952, II, pp. 467-470.

ADC regarded this initial refusal as merely temporary, however, and in April 1953 again approached USAF with a proposal to use the long range F-101 as an interceptor on the perimeter of the United States and in areas where ground radar was limited. USAF did not disapprove the ADC request, but replied that the F-101 would be considered, along with other fighters, in providing an interceptor to help fill the gap between the F-89 and F-106.[47]

WADC was of the opinion that of the two fighters (F-100 and F-101) as yet uncommitted for interceptor modification, the F-101 was the most promising. The F-100 was essentially an improved version of the F-86 and would probably contain many of the drawbacks of the F-86. Furthermore, the F-100 had a much shorter range than the F-101. Even the F-101 did not offer the 60,000-foot ceiling and 1,000-mile radius of action mentioned by USAF when the study of the two fighters was requested. WADC estimated that the F-101 would have a ceiling of about 50,000 feet and a maximum radius of about 750 miles. It was further estimated (late 1953) that 20 months would be

---

47. ADC to USAF, "Requirement for Long Range Interceptor," 7 Apr 1953 and 1st Ind, USAF to ADC, 23 Apr 1953 (Doc 113 to Hist of ADC, Jan-Jun 1953).

required to produce a prototype aircraft and 44 months would be required to develop a suitable fire control system.[48]

By early 1954 there appeared to be three aircraft that might meet the ADC requirement--an advanced F-89 and interceptor versions of the F-100 and F-101. In June 1954, ADC announced that it considered the F-101 the best of the three. After some initial confusion, it was decided that the interceptor version (subsequently titled F-101B) would contain the MG-3 fire control system of the F-102A and would carry Falcon missiles. At the end of 1954, WADC was ready to predict that the F-101B, equipped with the advanced J-67 engine (early F-101's would have the J-57), would be ready to fly by the middle of 1956, that production could begin in 1957 and that aircraft could be made available to active interceptor squadrons in early 1958.[49]

Meanwhile, the first flight of the basic F-101 occurred on 29 September 1954. The test aircraft climbed smoothly at Mach .9 and leveled off at 35,000 feet. In

---

48. WADC to ARDC, "F-100 Interceptor," 6 Nov 1953 (App. 5 in Hist of WADC, Jul-Dec 1953); Summary of WADC Weekly Conference, 9 Dec 1953.

49. Report of Director of Weapons Systems Operations, WADC, 23 Mar 1954; AMC Daily Staff Digest, 2 Jul 1954; Presentation, "The F-101 Interceptor," made by Brig. Gen. H. M. Estes, WADC, before ADC Staff, 15 Dec 1954.

less than a month, McDonnell test pilots had reached a speed of Mach 1.4 in the aircraft. At that speed, however, there was a distinct "rumble" which indicated a need for redesign of the engine air intake duct. Also, almost every flight experienced compressor stall. Although Pratt and Whitney engineers were confident that the compressor stall problem in the J-57 could be solved, no solution was immediately evolved.[50]

Official approval of development of the F-101B came from USAF in February 1955 and active development began. The J-57 engine was to be used, instead of the J-67 or J-75, because the advanced engines had not completed development. Major problems, if they developed, were expected to involve the compatibility of the fire control system, the flight control system and the airframe. No difficulty was expected in adding a second man (radar observer) to the crew.[51]

As such estimates generally were, the 1954 prediction that the first flight of the F-101B would occur in mid-1956 proved to be optimistic. It was not until 27 March 1957 that the F-101B made its maiden flight.

---

50. AMC Daily Staff Digest, 6 Oct 1954; AFFTC Progress Report, Oct 1954, pp. 50-52; Report of Director of Weapons Systems Operations, WADC, 15 Jan 1955.

51. Report of Director of Weapons Systems Operations, WADC, 15 Feb 1955, 1 Mar 1955 and 5 Apr 1955; AMC Daily Staff Digest, 7 Mar 1955 and 4 Apr 1955; R&D Review, USAF, 31 Mar 1955, p. 43.

Although it gave indications that it would be able to conduct a snap-up attack on a target at 65,000 feet (the interceptor itself would be at a somewhat lower altitude) and attained a speed of Mach 1.72, there were still problems in connection with this aircraft. Pratt and Whitney had solved the compressor stall difficulty in connection with the engine, but the F-101B continued to display a tendency to "pitch-up" when the nose was raised slightly. This was correctible through use of a mechanical device, but it was the consensus of WADC engineers that the correction of the aeronautical flaw that made it possible would have been a better solution. The F-101B was also addicted to spins that were a definite hazard to inexperienced pilots.[52]

The need to remedy these deficiencies and ADC's insistence on a thoroughly tested, effective interceptor upon delivery served to delay receipt of tactical F-101B aircraft within ADC. The ADC stand was based on experience with the F-102A, which had been delivered before testing was complete and had proven to be a source of continual trouble. As late as April 1958, USAF was adamant that ADC would receive combat aircraft the coming July, as previously scheduled, but AMC broke the bad news shortly

---

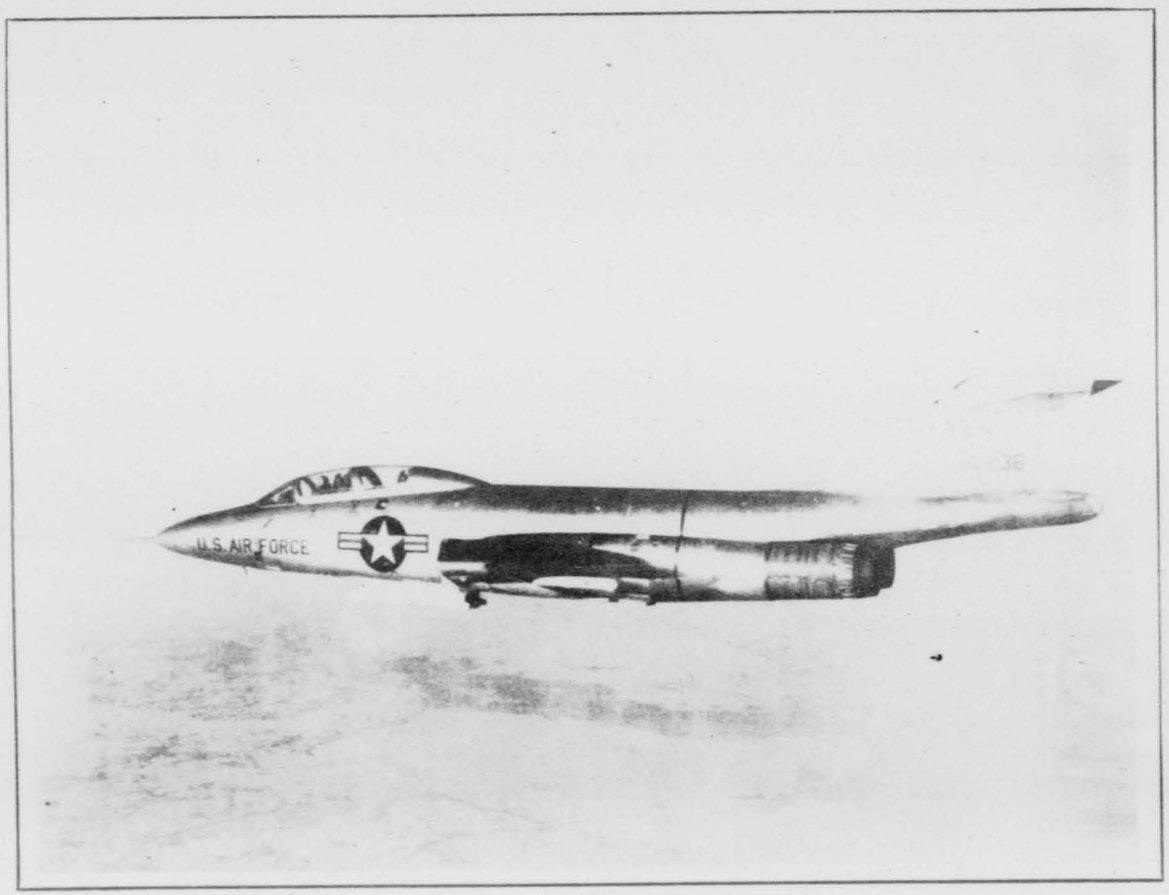
52. Hist of ARDC, Jul-Dec 1956, p. 480; Briefing, Capt. R. I. Weber, ADC Directorate of Requirements at ADC Commanders' Review, 29 Aug 1957.

thereafter. McDonnell had failed to deliver test aircraft on schedule and quantity production was being held up until enough test flying had been done to make sure that ADC would get a usable aircraft. As a consequence, ADC did not receive its first F-101B until 5 January 1959. The 60th FIS at Otis AFB, Massachusetts, was the first ADC unit to be so equipped.[53]

The F-101B received by ADC was a well-tested aircraft which offered advanced performance. It had, from the ADC standpoint, only two serious flaws. In the first place, ADC thought that the radar observer's cockpit had been badly designed, but there was little that could be done except to request minor changes. More important, the MG-13 fire control system was not nearly as advanced as the airframe in which it was placed. The MG-13 was merely a refinement of the E-6 fire control system of the F-89D and was not sufficiently sophisticated to control the weapons of an interceptor as fast as the F-101B. ADC

---

53. Memo, Lt. Gen. J. H. Atkinson, Cmdr, ADC to all staff sections, ADC, "Development of Weapons Systems," 29 Mar 1957 (Doc 225 to Hist of ADC, Jan-Jun 1957); Msg, ADC to USAF, 18 Mar 1958 (Doc 459 to Hist of ADC, 1958); Weekly Activities Report, ADC, ADLPR, 19 Jan 1958 and 12 Mar 1958; Msg, USAF to AMC, 26 Mar 1958 (Doc 460 to Hist of ADC, 1958); Msg, USAF to ADC, 1 Apr 1958 (Doc 461 to Hist of ADC, 1958); Msg, ADC to AMC, 2 Apr 1958 (Doc 462 to Hist of ADC, 1958); Msg, AMC to USAF, 11 Jul 1958 (Doc 463 to Hist of ADC, 1958); Hist of ADC, Jan-Jun 1959, p. 255.



F-101B

F-106A

therefore asked permission to replace the MG-13 with the MA-1 system of the F-106. On cost grounds, however, USAF denied the request. The only alternative was to attempt improvements to the Central Air Data Computer that was the heart of the MG-13 system.[54]

ADC had 188 F-101B aircraft in its combat inventory at the end of 1959. From 1961 into the indefinite future, the F-101B would be the major element in the ADC interceptor force. When it was fully deployed in 1962, nearly half, or 20, of ADC's 42 active interceptor squadrons would be equipped with F-101B aircraft. In mid-1964, when plans called for the reduction of the interceptor force to 38 squadrons, 18 of these squadrons would be F-101B's.[55]

The F-106

The seed that was planted by the USAF Board of Senior Officers in October 1948 eventually flowered in 1959 when the first F-106A aircraft were received by ADC.

---

54. Msg, ADC to ARDC, 9 May 1958 (Doc 475 to Hist of ADC, 1958); Msg, ADC to APGC, 13 May 1958 (Doc 476 to Hist of ADC, 1958); Msg, ADC to AMC, 18 Jun 1958 (Doc 477 to Hist of ADC, 1958); Msg, ADC to ARDC, 14 Jul 1958 (Doc 478 to Hist of ADC, 1958); Msg, ADC to USAF, 19 Dec 1958 (Doc 479 to Hist of ADC, 1958).

55. RCS: 1-AF-V14, 30 December 1959; ADCM 27-2, Vol. II, 31 Mar 1960 (HRF).

What the Board wanted by 1954 simply could not be had by that time. Because of the state of the art, the "1954 interceptor" mentioned in 1948 was developed in two steps. First came the "interim" model (F-102A), which became available in 1956. Development of the ultimate F-106A was agonizingly slow because concentration on the F-102 in the 1952-56 period lessened the attention which could be given to the F-106.

The essential differences between the F-102 and the F-106 lay in the engine and fire control system. The primary reason for establishing two-phase development of the "1954 interceptor" was the realization that the J-67 engine and the MX-1179 fire control system would not be ready for several years. Since some sort of advanced interceptor was needed as soon as possible, development of the F-102 with a J-57 engine and a much less sophisticated fire control system was decided upon. The unfortunate consequence of this decision was that components for the F-102 could be financed from production funds, while development of the J-67 engine and MX-1179 fire control system had to be financed from much less plentiful research funds. A two-year delay in development of the MX-1179 was anticipated. There was apparently little to be done about

this situation, however, until development of the F-102 was completed.[56]

In spite of the funding problem, however, ARDC was hopeful in 1952 that a test version of the F-106 would begin flying in late 1954. This hope proved, in view of subsequent events, hopelessly optimistic. The J-67 engine was an American version of the British Olympus engine. Although it showed early promise, Wright (the American licensee) was nearly a year behind schedule in adapting it to the F-106 by August 1953. In October 1953, therefore, USAF authorized ARDC to proceed with the engineering work necessary to make the Pratt and Whitney J-75 engine compatible with the F-106. This was a form of insurance, in the event Wright difficulties with the J-67 proved insuperable. The J-75 was an advanced version of the J-57 engine used in the F-102. Also in the late summer of 1953, it was recognized that development of the fire control system for the F-106 (first known as MX-1179 and subsequently titled MA-1) was slipping badly and the test program was extended a year. The proposed date for

---

56. Hist of WADC, Jul-Dec 1952, pp. 507-518; AMC Weekly Activity Report, 5 Jan 1953 and 24 Feb 1953; Summary of WADC Weekly Conference, 11 Feb 1953.

the first flight of the F-106 was consequently pushed back to February 1955.[57]

By early 1954, Hughes progress with the MA-1 fire control system was so disappointing that Maj. Gen. C. S. Irvine, Deputy Commander for Production, AMC, recommended bringing the Bell Telephone System into the development effort in order to guard against Hughes failure. Bell, however, was not interested in merely backstopping Hughes, but wanted to plunge into an entirely new line of development. Everybody concerned agreed that any Bell development would probably be completed some time after the MA-1 was ready, so the idea of using Bell was dropped. Also, it was becoming obvious that development of the Pratt and Whitney J-75 engine was progressing at a much more rapid rate than development of the Wright J-67. The decision to substitute the J-75 for the J-67 was made in 1955.[58]

---

57. Summary of WADC Weekly Conference, 19 Aug 1953; AMC Weekly Activity Report, 19 Oct 1953; Report, Significant R&D Accomplishments of FY 1954, WADC Power Plant Laboratory, 17 Mar 1954; R&D Review, USAF, 30 Sep 1953.

58. WADC to ARDC, "Back-up Program for Hughes MG-3 and MX-1179 Projects," 13 Jan 1954 (App. N-2 to Hist of WADC, Jan-Jun 1954); Memo, Maj. Gen. C. S. Irvine, Dep Cmdr for Prod, AMC for Lt. Gen. O. R. Cook, DCS/M, USAF, "Hughes Tool Company Contracts," 11 Jan 1954 (App. N-1 to Hist of WADC, Jan-Jun 1954); Memo, Mr. J. E. Keto, Tech Dir, WADC for Dir/Labs, WADC, "Back-up Program for MG-3 and MX-1179," 15 Jan 1954 (App. N-3 to Hist of WADC, Jan-Jun 1954); WADC to ARDC, no subj, 30 Mar 1954 (App. N-6 to Hist of WADC, Jan-Jun 1954); ARDC to USAF, "F-102B

Although the J-75 engine had been chosen over the J-67 because of more rapid development in 1954 and 1955, the J-75, in turn, also became a source of delay in the F-106 program. Because of continuing problems in the development of the engine, not to mention the fire control system, initial flight in the F-106 did not become possible until January 1957. At that time, Convair began testing the flight characteristics of the aircraft. The first USAF test flight took place at Edwards AFB, California, on 29 April 1957. At that time the F-106 reached a speed of Mach 1.9 and an altitude of 57,000 feet.[59]

This should have been a time of rejoicing, but it was not. Because neither the J-75 engine nor the MA-1 fire control system was as reliable as either USAF or ADC would have liked, because ADC was going to insist on a thoroughgoing test program before accepting the F-106 and because money was tight, USAF was getting to the point, in the spring of 1957, where it was willing to throw in the

---

(Cont'd) Fire Control System," 9 Jun 1954 (AMC contract files; Contract AF 33 (600)-23107); WADC to Convair, no subj., 3 Nov 1954 (App. K-7 to Hist of WADC, Jul-Dec 1954); ARDC Weekly Activity Report, 25 Oct 1954; Report, Dir/Weapons Systems Operations, WADC, 21 Feb 1955, 8 Mar 1955, 26 Apr 1955 and 17 May 1955.

59. Minutes of the F-106A Weapons System Phasing Group Meeting, SAAMA, 6 Mar 1957 (Doc 250 in Hist of ADC, Jan-Jun 1957); ADC Daily Diary, 17 May 1957.

sponge on the F-106. A possible alternative was re-design of the F-106 as a long-range interceptor. Also, because of an acute shortage of funds, USAF raised the possibility that the F-101B might have to be dropped if the F-106 was retained.[60]

None of these alternatives was palatable to ADC, "short of clear recognition that the F-106/MA-1 /program/ ...has failed."[61] Re-design as a long-range interceptor would take so long, in the ADC view, that such a decision would mean the end of the F-106. If it were necessary to reduce the total numbers of F-101B/F-106 aircraft procured, ADC favored applying the reductions equally to each type since they were complementary in that the F-106 had a relatively short range when compared with the F-101B.[62]

USAF saw ADC's point at the conclusion of this discussion and the F-106 was retained. The first F-106 reached ADC in late May of 1959, with the 498th FIS at Geiger AFB, Washington, being the first interceptor squadron to convert to the "ultimate" version of the "1954 interceptor." ADC was not sure it was being presented with a combat-ready weapons system, but bowed to affirmative

---

60. Staff Meeting Minutes, ADC DCS/P&R, 29 May 1957 (Doc 249 to Hist of ADC, Jan-Jun 1957).

61. Msg, ADC to USAF, 11 Jun 1957 (Doc 248 to Hist of ADC, Jan-Jun 1957).

62. Ibid.

opinions on the part of ARDC, AMC and USAF and accepted the F-106. Experience in late 1959 and early 1960, however, tended to substantiate the ADC doubts. Development and testing were obviously not complete at the time ADC began to receive aircraft for tactical use, because continual production line changes were made to both the airframe and fire control system. This practice was so common that by early 1960 ADC possessed F-106 aircraft with so many divergent configurations that maintenance support was becoming almost impossible. By the end of February 1960, ADC could list 63 changes in the fire control system and 67 changes in the airframe that would be necessary to give early model F-106's the same configuration as the most recent aircraft off the production line. A major retrofit program was in prospect. And even assuming that all production line changes were advantageous, ADC still did not have a combat-ready aircraft. The communications, navigation and landing systems of the F-106 were so unreliable that on 3 March 1960 ADC found it necessary to restrict F-106 aircraft from flying under IFR conditions when the weather offered a ceiling of less than 5,000 feet and

visibility was less than five miles. These restrictions,[63] of course, would not apply in a combat emergency.

At the end of 1959, ADC possessed 97 F-106 interceptors which were allocated to five squadrons. Conversion was continuing and it was planned that 15 squadrons would be so equipped by the end of 1960. Since the F-106 was the last of the manned interceptors (as of spring, 1960), it would be a major factor in the air defense system into the ill-defined future.[64]

---

63. Hist of ADC, Jan-Jun 1959, p. 255; Msg, ARDC to ADC, 13 Mar 1959 (Doc 452 to Hist of ADC, Jan-Jun 1959); Msg, AMC to USAF, 17 Apr 1959 (Doc 456 to Hist of ADC, Jan-Jun 1959); Msg, USAF to ADC, 28 Apr 1959 (Doc 457 to Hist of ADC, Jan-Jun 1959); Msg, ADC to AMC, 23 Dec 1959 (HRF); Msg, ADC to USAF, 14 Jan 1960 (HRF); Msg, ADC to SAAMA, 23 Feb 1960 (HRF); Msg, ADC to SAGE Divs and WADF, 3 Mar 1960 (HRF).

64. RCS: 1-AF-V14, ADC, 30 Dec 1959; ADCM 27-2, Vol. II, 31 Mar 1960.

CHAPTER THREE

THE THIRD GENERATION OF JET INTERCEPTORS

The Long Range Interceptor (LRIX)

Many months before the first of the second generation jet interceptors (F-102A) became operational, planning for a third generation began. On 7 April 1953, ADC submitted to USAF a requirement for a long-range interceptor capable of a thousand-mile radius of action, a combat altitude of 60,000 feet and speed between Mach 1.5 and Mach 2. ADC saw this aircraft as a multi-engine type with a two-man crew. Not much happened immediately, however, since the aircraft required was somewhat in advance of the art. But in October 1953, USAF asked for further justification of a long-range interceptor. The ADC justification was that augmentation of the radar network would ultimately provide radar coverage 250 to 500 miles beyond the borders of the United States and that an interceptor was needed which would exploit the advantages gained by this extended radar coverage. Also,

since the long range interceptor would carry atomic armament, it was felt necessary to intercept enemy bombers as far from the domestic borders as possible.[1]

USAF agreed that the ADC request was a valid requirement and in January 1954 the Aircraft and Weapons Board decided that an industry-wide competition should be held with regard to the LRIX. At the same time, USAF took the position that the ADC requirement that the aircraft be available for evaluation in 1956-57 was unrealistic and that 1960 was a more realistic date. This extension of the evaluation date, however, caused ADC to revise its requirements. If the LRIX was not to be available until 1960, ADC wanted an aircraft which would fly at Mach 3, have a combat altitude of 70,000 feet, carry three atomic missiles as armament, have a fire control system with a lock-on range of 50 miles and a completely integrated electronic system. As to range, ADC now wanted an LRIX which could proceed to a control point 600 miles away, loiter for three hours, then proceed at Mach 2.5 to an intercept point as much as 200 miles away and still have enough fuel remaining to reach a re-service base as much

---

1. ADC to USAF, "Planned Use of Long Range Interceptor," 20 Oct 1953 (Doc 1 to Chap. VIII, Hist of ADC, Jan-Jun 1954); 2nd Ind (29 AD to CADF, "Qualitative Operational Requirements," 12 Feb 1954), ADC to CADF, 20 Mar 1954 (Doc 2 to Chap. VIII, Hist of ADC, Jan-Jun 1954).

SECRET

AIR DEFENSE AIRCRAFT

1950 – 1959

Aircraft	Dec 50	Jun 51	Dec 51	Jun 52	Dec 52	Jun 53	Dec 53	Jun 54	Dec 54	Jun 55	Dec 55	Jun 56	Dec 56	Jun 57	Dec 57	Jun 58	Dec 58	Jun 59	Dec 59
F-82	26	19	4																
F-94A&B	60	82	144	117	93	20	45	14											
F-89B&C		4	25	51	60	31	62	40											
F-80		41	37	17	15	15													
F-84	43	103	38	16	41	115	21												
F-86 (Day)	236	255	174	192	215	229	180	82	37										
F-47		96	70	72	43	17													
F-51		213	195	149	172	160	31												
F-86D						123	601	798	783	1026	1041	1014	710	345	36				
F-94C						103	187	265	201	196	199	172	164	116	52	20	16		
F-89D								76	118	183	250	222	106	104	34	12			
F-86L													56	393	576	419	327	188	133
F-89H												72	112	107	78	40	49	21	
F-89J													15	124	242	286	264	260	207
F-102A												5	97	301	428	517	627	611	482
F-104A																51	100	86	90
F-101B																		73	188
F-106A																		18	97
Total	365	813	687	614	639	813	1127	1275	1139	1405	1490	1485	1260	1490	1446	1345	1383	1257	1197

SECRET

as 300 miles away. ADC had also changed its mind about the size of the crew, now requesting a one-man, rather than two-man, crew.[2]

Even though there was general agreement that such an aircraft should be developed, the administrative wheels moved slowly. In February 1954, ARDC learned that it was to be directed to hold a design competition, but it was not until May that the directive was actually received. Fifteen potential manufacturers were contacted and 13 expressed interest. When interested contractors were asked to attend a meeting on 28 May, 11 responded by sending representatives.[3]

A relatively short deadline date--15 July 1954--was originally established for the submission of proposals, but this proved too short and was later moved back to 16 August 1954. Further, the competition was divided into two phases, one for the airframe and engines, the other for the fire control system. This division left the airframe competitors pretty much in the dark, since they could not know what the fire control system would be like and could not make adequate provisions for it in designing

---

2. Msg, ADC to USAF, 15 Jan 1954 (Doc 4 to Chap. VIII, Hist of ADC, Jan-Jun 1954).

3. WADC Staff Conference, 12 May and 18 Aug 1954; Report, Dir/Weapons Systems Operations, WADC, 11 May and 1 Jun 1954.

the airframe. Too, the military characteristics against which the contractors were asked to design were considerably different from the requirements ADC outlined in January. The manufacturers were asked to design an aircraft which could reach a speed of Mach 1.7 at 40,000 feet, cruise at an altitude of 60,000 feet and offered a thousand-mile radius of action. Two types of armament were specified. One armament configuration included 48 2.75-inch FFAR rockets plus eight GAR-1 Falcons. The alternative was three atomic rockets of the MB-1 type. The aircraft was to have at least two engines and was to carry a two-man crew. The fire control system was to be capable of detecting a target the size of a B-47 at a range of 100 miles.[4]

By 16 August 1954, the closing date of the airframe and engine competition, WADC had received 15,000 pounds of paper and 24 aircraft models from the eight contractors who had participated--Boeing, North American, Lockheed, Douglas, Northrop, McDonnell, Martin and Republic. The designs varied immensely in detail, although most proposed using the J-67 engine. Every contractor projected the use of at least two engines, although McDonnell

---

4. Hist Report, Dir/Weapons Systems Operations, WADC, Jul-Dec 1954; Presentation, "The Long Range Interceptor," 3 Nov 1954, by Col. C. G. Allen, Fighter Acft Div, WADC; USAF, Research and Development Review, 30 Sep 1954, p. 45.

suggested using three and Martin and Douglas proposed using four. All proposals envisioned large aircraft--from the 59,000-pound model proposed by Douglas to the 120,000-pound behemoth suggested by Martin. The average weight was about 75,000 pounds. The job of evaluating the various proposals was difficult enough when WADC proposed checking only those prepared with close attention to the military characteristics provided in advance. But each contractor also submitted "alternative" proposals which often made little reference to the stated LRIX characteristics. USAF made evaluation especially difficult by insisting, over ARDC objections, that all proposals be evaluated on the theory that promising "alternative" suggestions should not be allowed to escape. After three and one-half months of wrestling with this mound of paper, WADC concluded, 30 November 1954, that none of the proposals met the military specifications.[5]

---

5. Hist Report, Dir/Weapons Systems Operations, WADC, Jul-Dec 1954; Presentation, "The Long Range Interceptor," 3 Nov 1954, by Col. C. G. Allen, Fighter Acft Div, WADC; WADC Staff Conference, 18 Aug 1954; Report, Dir/Weapons Systems Operations, WADC, 9 Nov and 16 Nov 1954; ARDC to USAF, "Evaluation of Long Range Interceptor Proposals," 3 Sep 1954 (Doc K-1 to Hist of WADC, Jul-Dec 1954); 1st Ind (ARDC to USAF, "Evaluation of Long Range Interceptor Proposals," 3 Sep 1954); USAF to ARDC, 28 Sep 1954 (Doc K-1A to Hist of WADC, Jul-Dec 1954); 2nd Ind (ARDC to USAF, "Evaluation of Long Range Interceptor Proposals," 3 Sep 1954), ARDC to WADC, 8 Oct 1954 (Doc K-1B to Hist of WADC, Jul-Dec 1954).

The only possibility of providing a reasonably satisfactory aircraft by 1959, WADC believed, would require adoption of a design calling for a 100,000-pound model and then the chance of satisfying the requirement for a 60,000-foot ceiling would be marginal unless range requirements were relaxed. Acquisition of a B-47 target on the airborne radar at a range of 100 miles was simply not feasible. WADC felt that the MX-1179 (the Hughes-developed fire control system for the F-106) with a 40-inch radar dish and increased power would do as well as any of the 30-odd fire control systems proposed during the competition. At any rate, ARDC presented the facts to ADC in December 1954 and awaited ADC reaction.[6]

The ADC response was one of negative frustration. In the first place, an interceptor was useless if it could not counter the expected threat, so ADC recommended that none of the proposals be developed. Furthermore, ADC recommended giving selected airframe manufacturers contracts for general design studies which would eventually lead to the sort of LRIX ADC had in mind. Meanwhile, ADC

---

6. Presentation, "The Long Range Interceptor," 15 Dec 1954, by Brig. Gen. H. M. Estes, Dir/Weapons Systems Operations, WADC; Hist Report, Dir/Weapons Systems Operations, WADC, Jul-Dec 1954.

recommended that an interceptor version of the F-101 be procured in order to provide interim long range capability until the LRIX was ready.[7]

ADC held this position only briefly, however. By February 1955, ADC was arrayed against the idea of additional design studies, recommending instead that competitive development contracts be immediately awarded to two contractors. Since it was apparently not possible to build the aircraft ADC wanted, ADC was willing to compromise to the point where it would accept an LRIX that would have a radius of action of 500 miles, plus the ability to loiter for an hour at 500 miles, plus the ability to make a supersonic dash of 100 miles and engage in five minutes of combat at that point. ADC continued to fight this battle through early 1955, taking repeated exception to the proposal of the USAF Aircraft and Weapons Board to get on with the LRIX program by asking two contractors to make further design studies. In late April 1955, ADC was recommending that these two contractors each be authorized to build six aircraft for competitive test, with the production contract to be awarded to the winner. There were other far-out solutions proposed. The 28th Air Division

---

7. Minutes of the meeting of the ADC Command Council, 13 Dec 1954 (Doc 232 to Hist of ADC, Jul-Dec 1954).

The formal GOR was presented to ARDC in October 1955, but ARDC had already taken action to put its provisions into effect. Northrop, Lockheed and North American had been authorized to begin parallel development of the airframe, while Hughes and Sperry had begun competition in the design of an aircraft and weapons control system. This procedure represented a victory for ADC, which had inveighed against an LRIX program limited to design studies.[10]

At the end of 1955 a new factor--the budget--began to interfere with LRIX progress. USAF had approved development of two types of advanced interceptors, a medium range aircraft (MRIX), designed to replace the F-102, as well as the LRIX. Budget pressures were so severe, however, that USAF proposed to designate the F-103 (an experimental type under development for several years) as the MRIX, thereby combining the two projects and saving money. ADC felt this to be undesirable and recommended, instead, that development of the LRIX be halted in order to provide funds for the development of the MRIX. In short, ADC had decided that the MRIX held a higher priority than the LRIX.[11]

---

10. Hist of ADC, Jul-Dec 1955, p. 101.

11. Msg, ADC to USAF, 11 Jan 1956 (Doc 238 in Hist of ADC, Jul-Dec 1955).

The LRIX was not cancelled, but the LRIX competition of 1955-56 was as indecisive as the competition of 1954. There was a nominal winner in 1956--North American--but the theoretical performance of the winning model was far short of that needed to counter the threat expected in 1960-65. Besides, the North American design envisioned an interceptor that would weigh 107,000 pounds--nearly as much as the B-47. Neither USAF nor ADC was satisfied that the North American aircraft was the LRIX desired. ADC was convinced that it was "impossible to use a bomber to catch another bomber." ADC proposed, therefore, to sit down with North American and try to convert the winning design into something much lighter in weight that could achieve a speed of Mach 2.5, a combat altitude of 70,000 feet and a range of 300-350 miles. Because ADC was willing to sacrifice range for speed and altitude, the conversations with North American were intended, in effect, to create an acceptable MRIX from an unsatisfactory LRIX. Sperry and Hughes were to continue work on designs for an advanced aircraft and weapons control system.[12]

---

12. Msg, USAF to ADC, 28 May 1956 (Doc 258 in Hist of ADC, Jan-Jun 1956); Pers Ltr, Lt. Gen. T. S. Power, Cmdr, ARDC, to Gen. E. E. Partridge, Cmdr, ADC, 16 Apr 1956 (Doc 259 in Hist of ADC, Jan-Jun 1956); Pers ltr, Gen. E. E. Partridge, Cmdr, ADC, to Lt. Gen. T. S. Power, Cmdr, ARDC, 1 Jun 1956 (Doc 259 in Hist of ADC, Jan-Jun 1956); Pers ltr, Gen. E. E. Partridge, Cmdr, ADC, to Lt. Gen. D. L. Putt, DCS/D, USAF, 6 Jun 1956 (Doc 260 in Hist of ADC, Jan-Jun 1956).

USAF, however, would not recede from the long-range concept. Although ADC protested (in reversal of a former position) that range in excess of the control capability of the ground environment offered no advantage and that the value of "loitering" had never been demonstrated, USAF was still convinced that an LRIX had more to recommend it than did an MRIX. The LRIX now imagined by USAF had somewhat less capability than that required by earlier specifications. USAF changed the General Operational Requirement, 30 November 1956, to call for an aircraft with speed of Mach 2.5 and a ceiling of 60,000 feet. ADC continued to hold out, if it was necessary to develop an LRIX, for an aircraft capable of Mach 3 speed and a ceiling of 70,000 feet.[13]

Because of ADC's repeated objections to the LRIX, USAF hesitated to make a unilateral decision in this matter and in February 1957 appointed a Board of General Officers to study the situation and make recommendations.

---

13. Pers ltr, Maj. Gen. N. B. Harbold, Acting VC, ADC, to Lt. Gen. F. F. Everest, DCS/O, USAF, 16 Nov 1956 (Doc 153 in Hist of ADC, Jul-Dec 1956); Msg, USAF to CONAD, 14 Nov 1956 (Doc 154 in Hist of ADC, Jul-Dec 1956); Msg, ADC to USAF, 21 Nov 1956 (Doc 155 in Hist of ADC, Jul-Dec 1956); Msg, USAF to ARDC, 23 Nov 1956 (Doc 156 in Hist of ADC, Jul-Dec 1956); Msg, USAF to ARDC, 30 Nov 1956 (Doc 157 in Hist of ADC, Jul-Dec 1956); Msg, USAF to CONAD, 4 Dec 1956 (Doc 158 in Hist of ADC, Jul-Dec 1956); Msg, ADC to USAF, 21 Dec 1956 (Doc 159 in Hist of ADC, Jul-Dec 1956).

Members of the Board were Maj. Gen. Albert Boyd, WADC commander; Maj. Gen. Kenneth P. Bergquist, Director of Operations, DCS/O, USAF; Maj. Gen. James Ferguson, Director of Requirements, DCS/D, USAF; Dr. Courtland Perkins, USAF Chief Scientist and Maj. Gen. Hugh A. Parker, DCS/O, ADC. The result of the Board's deliberations was a compromise between the USAF and ADC points of view. The Board recommended development of an LRIX that would (1) be capable of Mach 3 speed within a 350-mile radius and offer 10 minutes of combat at 70,000 feet; (2) offer a thousand-mile radius at a speed of Mach .9, plus five minutes of combat at Mach 3; (3) include airborne radar capable of detecting a target the size of a B-47 at 100 miles; (4) carry as armament two nuclear missiles with a range of 15-25 miles; (5) be capable of attack on a target with an altitude differential of 40,000 feet (up to 100,000 feet); (6) offer all this performance without the use of external fuel tanks. North American, which had "won" the 1956 LRIX competition, was to build the airframe to meet these requirements. Hughes and Radio Corporation of America were to conduct parallel and competitive development of the complementary aircraft and weapons control system. Sperry

had apparently been dropped from consideration in this area of competition. ARDC was directed, 11 April 1957, to proceed with development of the re-oriented LRIX.[14]

The LRIX program achieved recognition of a sort in mid-1957 when the aircraft to be developed acquired a name--F-108. Otherwise, the latter part of 1957 was spent in studying the problem. North American produced four design studies which ARDC outlined to USAF in October 1957. USAF was not particularly happy with any of the four, since in each case the most recent military specifications were compromised. USAF then reiterated that it would be necessary for the F-108 to carry three 95-pound nuclear Falcons (designated GAR-9). The GAR-9 was to be so designed as to be effective at 100,000 feet. ARDC contended that increasing the effective altitude of the missile to 100,000 feet would require a larger wingspan on the missile and recommended that the requirement be lowered to 90,000 feet. As to range, USAF insisted on a radius of action of a thousand miles, though ARDC recommended accepting a design which offered something less and acquiring the thousand-mile range through "growth." ARDC estimated that the state of the art would limit the range of the airborne radar to

---

14. Memo, Lt. Gen. D. L. Putt, DCS/D, USAF, for Members of the Board of General Officers, "Appointment of Board of General Officers," 1 Feb 1957 (Doc 251 in Hist of ADC, Jan-Jun 1957); Msg, USAF to ARDC, 11 Apr 1957 (Doc 252 in Hist of ADC, Jan-Jun 1957).

60-70 miles. USAF was adamant, however, directing ARDC to order the contractor (Hughes) to concentrate on a fire control system which included a radar with a range of 80-100 miles.[15]

With obvious reluctance, ARDC agreed to push forward in the direction indicated by USAF. At the same time, ARDC felt constrained to add the cautionary note that "schedule advances and design emphasis shifts definitely move this program into the realm of high risk."[16]

The F-108 was also in the high risk area as regards funding. To a suggestion that it might be necessary to cancel F-108 development for lack of funds, ADC replied that development of an advanced manned interceptor had to be pursued until the intentions of the USSR in the manned bomber field were more fully known and until the operational capabilities of interceptor missiles were proven. ADC believed the F-108 as then conceived was a significant advance over the F-106 and would make an important contribution to the store of knowledge concerning high-speed, high-altitude flight.[17]

---

15. Msg, USAF to ARDC, 9 Aug 1957 (Doc 244 in Hist of ADC, Jul-Dec 1957); Msg, USAF to ARDC, 18 Nov 1957 (Doc 245 in Hist of ADC, Jul-Dec 1957).

16. Msg, ARDC to USAF, 18 Dec 1957 (Doc 246 in Hist of ADC, Jul-Dec 1957).

17. Msg, ADC to USAF, 20 Jan 1958 (Doc 247 in Hist of ADC, Jul-Dec 1957).

But this did not end the money problems of the F-108. Although development appeared to progress normally during 1958, the threat of death by financial starvation hung over the F-108 at all times. As USAF began, in November 1958, to prepare the budget for Fiscal 1960, it appeared that the F-108 program would suffer from fiscal malnutrition to the extent that the operational date of the advanced long-range interceptor would slip from 1963 to 1965. ADC replied that this delay was totally unacceptable, but USAF was in no position to obtain the financing needed to support the development program on the scale previously planned. At the end of 1958, USAF forecast the future of the F-108: (1) Every effort would be made to achieve the first flight of the F-108 in February 1961; (2) The operational date would be delayed from 1963 to 1964; (3) The number of test aircraft would be reduced from 31 to 20, thereby lengthening the development period.[18]

Whatever financing problems might arise, the characteristics of the F-108 began to take firmer shape during 1958. USAF continued to hold firm to a requirement for a highly sophisticated control system which would provide automatic operation of the F-108 from a point just

---

18. Msg, ADC to USAF, 26 Nov 1958 (Doc 503 to Hist of ADC, 1958); Msg, USAF to ADC, 28 Nov 1958 (Doc 504 to Hist of ADC, 1958); Msg, USAF to ADC, 8 Dec 1958 (Doc 505 to Hist of ADC, 1958); Msg, USAF to ARDC, 30 Dec 1958 (Doc 506 to Hist of ADC, 1958).

after takeoff to a point just before touch-down. USAF also asked that the F-108 be capable of assessing damage, identifying and rejecting decoys, and detecting nuclear weapon carriers. ADC at first (August 1958) objected to inclusion of these characteristics, but on sober second thought decided to go along on the theory that any improvement in the capability of an interceptor was desirable, no matter how unlikely the chances of achieving it might seem. Although ADC could see no need for it from an air defense point of view, USAF was unwavering in its requirement for in-flight refueling. As to the engine, it appeared that the General Electric J-93 would be chosen, although the Pratt and Whitney J-58 showed early promise. By the end of 1958 General Electric had been given a contract for six prototype engines and three had been established in test cells. The possibility that it might be necessary to pre-heat the J-93 before starting it at temperatures below -20 degrees was a matter of some concern to ADC. No method for avoiding this procedure was immediately available.[19]

---

19. Msg, USAF to ARDC, 24 Apr 1958 (Doc 507 in Hist of ADC, 1958); Msg, USAF to ARDC, 25 Apr 1958 (Doc 508 in Hist of ADC, 1958); Msg, USAF to ARDC, 29 Apr 1958 (Doc 509 in Hist of ADC, 1958); Msg, USAF to ARDC, 23 May 1958 (Doc 510 in Hist of ADC, 1958); Msg, USAF to ARDC, 14 Aug 1958 (Doc 512 in Hist of ADC, 1958); Msg, ADC to USAF, 25 Aug 1958 (Doc 513 in Hist of ADC, 1958); Msg, ADC to USAF, 5 Sep 1958 (Doc 514 in Hist of ADC, 1958); Msg, USAF to ARDC, 9 Oct 1958 (Doc 515 in Hist of ADC, 1958); Msg, ADC to ARDC, 2 Dec 1958 (Doc 516 in Hist of ADC, 1958); Msg, USAF to ARDC, 18 Dec 1958 (Doc 517 in Hist of ADC, 1958).

While development of the F-108 proceeded during early 1959, the negative financial pressures which seemed to indicate that development would never be completed continued to build up. In July 1959 USAF asked ADC if there were any development programs that might be cancelled to provide funds for the F-108. The ADC reply was negative, because the F-108 was so expensive that major programs (such as BOMARC or frequency diversity radar) would have to be junked in order to provide enough money for development of the F-108. And this ADC did not want to do. It was the ADC conclusion that the F-108 would have to be funded by direct, and additional, appropriations.[20]

A month later, 21 August 1959, USAF directed the strictest sort of austerity in the development of the F-108, ordering the deletion of various refinements in the control and communications system. But this action amounted to whistling up-wind, because on 28 September 1959 USAF found it necessary to call a halt to development. At the same time, development of the ASG-18 pulse

---

20. Weekly Activities Reports, ADC, ADLSI-B, 7 Jan 1959 and ADLAN, 23 Jul 1959 (HRF).

doppler fire control system and the GAR-9 nuclear Falcon missile were to continue at an annual rate of 10 million dollars.[21]

Although the F-108 was almost dead from the USAF standpoint, ADC and NORAD preferred to believe it was only sleeping. NORAD continued to include the F-108 among its requirements and when, in December 1959, ARDC proposed fitting the ASG-18 and GAR-9 to existing interceptors, ADC took the view that the only satisfactory vehicle for the ASG-18/GAR-9 combination was the F-108. USAF helped keep hopes alive by asking Congress to increase the amount spent on ASG-18/GAR-9 development from nine million dollars in Fiscal 1960 to 15 million in Fiscal 1961. Since USAF asked for no F-108 development funds for Fiscal 1961, ADC became more receptive to the idea that a long-range interceptor might be created by adding the ASG-18/GAR-9 combination to something besides the F-108. In May 1960, ADC asked ARDC to check into the possibility of using as an LRIX a North American airframe (designated A3J), powered by the Pratt and Whitney J-58 engine, and equipped with the

---

21. Msg, USAF to ARDC, 21 Aug 1959 (Doc 118 in Hist of ADC, Jul-Dec 1959); Msg, USAF to ARDC, 26 Aug 1959 (Doc 119 in Hist of ADC, Jul-Dec 1959); Msg, ADC to USAF, 28 Oct 1959 (Doc 120 in Hist of ADC, Jul-Dec 1959); Weekly Activities Report, ADC, ADLSI-B, 12 Oct 1959 (HRF).

ASG-18/GAR-9. The need for a manned interceptor beyond the F-101B was still felt within ADC.[22]

The Medium Range Interceptor (MRIX)

In early 1953, ADC took steps to do something about the fact that there was no medium-range interceptor programmed beyond the F-102 (and an advanced version first known as F-102B and later as F-106). Because intelligence indicated that by 1958 the USSR would possess a large fleet of high speed bombers, ADC asked, 7 January 1953, that it be provided with an interceptor possessed of speed and altitude capability considerably in excess of that to be offered by the F-102. This interceptor, as ADC saw it, would be able to climb at Mach 2.5, cruise at Mach 3, include a fire control system with a lock-on range of 50 miles and have a combat radius of 525 miles. Altitude capability was not specified, being given simply as "very high." ADC thought that the F-103, currently under development, might be what was required.[23]

---

22. Msg, ADC to USAF, 2 Nov 1959 (Doc 26 in Hist of ADC, Jul-Dec 1959); Weekly Activities Report, ADC, ADLPD, 11 Dec 1959 (HRF); Hearings before the Subcommittee of the Committee on Appropriations, House, "Reappraisal of Air Defense Program," 24 Mar 1960 (HRF); Msg, ADC to ARDC, 19 May 1960 (HRF).

23. ADC to USAF, "High Speed, High Performance Interceptor," 7 Jan 1953 (Doc 112 in Hist of ADC, Jan-Jun 1953).

USAF agreed, citing approval of the Joint Chiefs of Staff, that an advanced interceptor of the type advocated by ADC was required. USAF added, however, that the new interceptor was not required until October 1959. Also, USAF pointed out that the F-103 was primarily a research vehicle and that it was probably not appropriate for the air defense mission. In view of experience with the F-102 program, USAF stressed the need for prompt development of detailed requirements if a new aircraft was to be made available by October 1959.[24]

But there was no prompt development of detailed specifications, apparently because what ADC proposed would require great advances in metallurgy and in aircraft and engine design. There was no noticeable action in connection with the ADC requirement for nearly two years. ADC repeatedly brought this matter to the attention of USAF and ARDC, but it was not until November 1954 that USAF presented to ADC a draft MRIX GOR for comment. ADC was not particularly impressed with the USAF proposal, commenting that what was needed was an interceptor which could cope with a cruise missile similar to the U.S. "Navaho." This, at the time, was believed to be the ultimate in

---

24. 1st Ind (ADC to USAF, "High Speed, High Performance Interceptor," 7 Jan 1953), USAF to ADC, 28 Jan 1953 (Doc 112 in Hist of ADC, Jan-Jun 1953).

air-breathing airborne threats. The Navaho was designed to fly at a speed of Mach 3.25 and attain an altitude between 80,000 and 88,000 feet.[25]

There was, happily, a near meeting of minds on the subject of an MRIX and, in May of 1955, USAF forwarded the necessary GOR to ARDC. But again nothing much happened. Instead, USAF and ARDC began talking of the F-103 as a possible MRIX. Oddly enough, the revival of the F-103 as a topic for discussion resulted in a direct reversal of position. In January 1953, when ADC first asked for a medium-range interceptor to replace the F-102/F-106, the F-103 was suggested as a possibility. USAF then took the stand that the F-103 was essentially a research vehicle and probably unsuited for the air defense mission. Now, in late 1955, USAF was suggesting the use of the F-103 as an MRIX, while ADC demurred:[26]

---

25. Pers ltr, Gen. B. W. Chidlaw, Cmdr, ADC, to Lt. Gen. T. S. Power, Cmdr, ARDC, 19 Aug 1954 (Doc 226 in Hist of ADC, Jul-Dec 1954); USAF to ADC, "Draft Copies of GOR for a Piloted Interceptor Weapons System (Medium Range)," 15 Nov 1954 (Doc 233 to Hist of ADC, Jul-Dec 1954); 1st Ind (USAF to ADC, "Draft Copies of GOR for a Piloted Interceptor Weapons System (Medium Range)," 15 Nov 1954), ADC to USAF, 28 Dec 1954 (Doc 233 to Hist of ADC, Jul-Dec 1954); ADC to USAF, "Proposed GOR for Medium Range Interceptor," 27 Jan 1955 (Doc 231 to Hist of ADC, Jul-Dec 1954).

26. Pers ltr, Gen. E. E. Partridge, Cmdr, ADC, to Gen. N. F. Twining, C/S, USAF, 6 Jan 1956 (Doc 237 to Hist of ADC, Jul-Dec 1955).

> The F-103 involves a dual cycle engine system involving the J-67 engine which was discontinued some three months ago. Speaking very broadly, the Republic proposal was to combine the characteristics of the jet engine with those of the liquid powered ram jet, through the utilization of a ducting arrangement. This Rube Goldberg device has yet to be tried and, in fact, study of the F-103 proposal uncovers a multiplicity of problems and a great need to relegate to basic research many of the physiological, aerodynamic and power plant problems operating in the Mach 3.0 and 80,000 foot altitude region.

ADC recommended, instead, that the aircraft industry be asked to develop an MRIX which would make use of the Allison J-89, the Pratt and Whitney JT-9 or a similar high performance turbo jet engine. So anxious was ADC to obtain an MRIX that it proposed in early 1956, that the LRIX be dropped in favor of the MRIX when it became apparent there would be insufficient funds to finance both.[27]

The results of the LRIX competition, announced in the spring of 1956, temporarily, and indirectly, strengthened the ADC hand. Although North American was announced as the winner of the LRIX contest, neither USAF nor ADC was satisfied that the 107,000-pound aircraft was the LRIX desired. ADC then proposed (as explained in the LRIX discussion above) an attempt to convert the unsatisfactory

---

27. Ibid.; Memo for Record, Gen. E. E. Partridge, Cmdr, ADC, "Conversation with Brig. Gen. Estes on Medium Range Interceptor," 8 Dec 1955 (Doc 236 to Hist of ADC, Jul-Dec 1955); Msg, ADC to USAF, 11 Jan 1956 (Doc 238 to Hist of ADC, Jul-Dec 1955).

LRIX into a much lighter MRIX capable of a speed of Mach 2.5, a combat altitude of 70,000 feet and a range of 300-350 miles.[28]

The MRIX was dead, however, although ADC refused to attend the funeral. In November 1956, USAF announced that the LRIX would be the only third-generation jet interceptor developed, because of the primary need for an aircraft with a wide radius of action, long endurance and the ability to accomplish more than one firing pass at a target. ADC protested this decision, but the protests were ineffective. The MRIX had ceased to be a topic for discussion by early 1957.[29]

From the vantage point of 1960 in was fairly obvious that the third generation of manned interceptors, conceived in 1953, had been stillborn. Although, so long as the advanced fire control system (ASG-18) and armament (GAR-9)

---

28. Pers ltr, Gen. E. E. Partridge, Cmdr, ADC, to Lt. Gen. D. L. Putt, DCS/D, USAF, 6 Jun 1956 (Doc 260 to Hist of ADC, Jan-Jun 1956); ADC to USAF, "Follow-on Interceptor," 16 Jul 1956 (Doc 261 to Hist of ADC, Jan-Jun 1956).

29. Msg, USAF to CONAD, 14 Nov 1956 (Doc 154 to Hist of ADC, Jul-Dec 1956); Msg, ADC to USAF, 21 Nov 1956 (Doc 155 to Hist of ADC, Jul-Dec 1956); Msg, USAF to ARDC, 23 Nov 1956 (Doc 156 to Hist of ADC, Jul-Dec 1956); Msg, USAF to ARDC, 30 Nov 1956 (Doc 157 to Hist of ADC, Jul-Dec 1956); Msg, USAF to CONAD, 4 Dec 1956 (Doc 158 to Hist of ADC, Jul-Dec 1956); Msg, ADC to USAF, 21 Dec 1956 (Doc 159 to Hist of ADC, Jul-Dec 1956).

continued under development, there was hope that some type of LRIX might be revived, it was a slim hope. The concentration of attention on the ICBM, and defenses against it, made it difficult to whip up much enthusiasm for improved defense against the air-breathing threat.