THE F-15 EAGLE

ORIGINS AND DEVELOPMENT

1964 - 1972

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OFFICE OF AIR FORCE HISTORY

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by

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OFFICE OF AIR FORCE HISTORY

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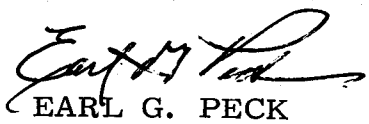
[redacted]

FOREWORD

This account of the Air Force's efforts to acquire a new air superiority fighter covers events going back to 1964, a time when the F-111 was entering the inventory. The latter was visualized by some as complementing and eventually replacing the F-105 and F-4C as the mainstay of USAF fighter forces. A decade ago the Air Force also had under development a smaller tactical fighter, the F-5, which rolled off the assembly line in time to begin combat testing in the Republic of Vietnam in October 1965. The F-5 subsequently entered the Vietnamese Air Force and also was made available for sale to other friendly countries under the Military Assistance Program.

When the war in Southeast Asia escalated--and particularly after air-to-air combat operations over North Vietnam increased in intensity--it became evident to the Air Force that it needed a new air superiority fighter. Whereupon, USAF officials initiated studies aimed at defining such an aircraft. A lengthy concept formulation phase ensued, during which the important theory of energy maneuverability emerged. In 1969, after the Air Force was authorized to proceed with the project, contract definition studies got under way, industry competition followed, and by year's end the winning contractor was selected.

The Air Force's long-term interest in acquiring more advanced systems is reflected in a number of historical studies prepared by the Office of Air Force History and its predecessor. They include the following titles: The Search for New USAF Weapons, 1958-1959, by Arthur Marmor; Nuclear Propulsion for Manned Aircraft: End of the Program, 1959-1961, by Robert D. Little; Quest for an Advanced Manned Strategic Bomber, 1961-1966, by Bernard C. Nalty; and Development of Fixed-Wing Gunships, 1962-1971, by Lt. Col. Jack S. Ballard.



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PREFACE

Military aircraft seldom, if ever, leap unchanged from drawing board to flight line; rather, they evolve slowly, each stage of development influenced by such diverse factors as technology, economics, politics, enemy threat, and just plain chance. These varied forces interacting--not the planner's original vision--frequently dictate the end result. The history of aircraft is studded with examples affirming this thesis; what began as a fighter evolved into an interceptor; an attack plane, into a fighter-bomber; and a commercial airliner, into a military transport.

The F-15 marks a turning point in that unpredictable pattern. After a false and misguided start in early 1965, the F-15 underwent a barrage of internal and external pressures that affected its final design. But because of the effort of a few men dedicated to reviving the air superiority mission, the F-15 emerged at the time of its first flight in July 1972 as nearly intact as they could have reasonably expected. More important, in causing a reexamination of basic doctrine, the F-15 opened new issues whose ultimate impact on Air Force thought and programs must await the verdict of future historians.

This study is based on the files and correspondence of the Office of the Vice Chief of Staff, Deputy Chief of Staff (R&D) directorates, the F-15 System Program Office (SPO), and the histories of Air Staff agencies and the Aeronautical Systems Division (ASD). The author also interviewed key Air Force and defense officials who contributed to the F-15's development.

The author wishes to thank the following for granting interviews: Generals Arthur C. Agan (Ret.), Albert P. Clark, Glenn A. Kent, Felix M. Rogers, John J. Burns, Edward A. McGough, Roger K. Rhodarmer, and William F. Georgi; Colonels John R. Boyd and Richard K. McIntosh (Ret.); Messrs Calvin B. Hargis, Thomas P. Christie, Dale Davis, Charles E. Myers, Pierre Sprey, and Heinrich J. Weigand. The author is appreciative of the assistance of Mr. Herb Cheshire, Business Week reporter, who let him read interviews with some of the F-15 principals.

Among the many people who helped with the research were Col. Lloyd M. N. Wenzel, Lt. Col. Gordon E. Williams, Lt. Col. John Islin (USA), Mr. Glen Hoover, and Major David J. Teal. Air Force historians, including Albert E. Misenko, Walter L. Kraus, Malcolm D. Wall, Ben Goldman and John I. Lumpkin, helped with documents and suggestions. Dr. James C. Hasdorff and Hugh N. Ahmann secured valuable interviews. My colleagues at the Office of Air Force History, Mr. Bernard C. Nalty and Thomas A. Sturm, provided valuable constructive criticism; Mr. Carl Berger wrote a portion of Chapter II and edited the manuscript. Capt. Mel Hoke (AFRes) edited portions of the study and prepared much of the illustrative data. Mrs. Selma Shear proofread and typed various drafts; Mrs. Eleanor Patterson and Mr. William Mattson typed portions of the study as well as interview transcripts; Mrs. Gail Guido secured supporting documents from myriad sources.

ABSTRACT

This study traces the evolution of the F-15 Eagle air superiority fighter from its beginning in 1964 through the aircraft's first flight in July 1972. It examines the military, technological, economic, and political influences on the weapon system acquisition process. Among the more innovative elements of this research and development program were: the energy maneuverability theory of Col. John R. Boyd and Thomas Christie; a contractual arrangement loosely billed as the "fly-before-buy" philosophy; and the definite Air Force commitment to building the aircraft first manifest in the appointment of Brig. Gen. Roger K. Rhodarmer as Washington F-15 spokesman, then through the support given Maj. Gen. Benjamin N. Bellis, the F-15's strong program director. The story ends with air superiority reaffirmed as a major mission, but not yet fully defined.

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I. THE AIR SUPERIORITY MISSION

(U) The roots of air superiority stem from the battlefields of World War II. In 1939 and 1940 the German Stuka-Panzer drive across Poland, France, and the Lowlands stunned the world with its demonstration of the striking power of tactical air support. Influenced by the German example, the United States War Department Field Manual 31-35, "Aviation in Support of Ground Forces," 9 April 1942, allocated aircraft resources to ground units and placed pursuit aviation under Army control. It specifically prescribed that airpower's mission was to attack "the most serious threat to the operations of the supported ground force."[1] This doctrine's first combat test came during the North African campaign in the winter of 1942. Components of the Twelfth Air Force under Second Corps provided air patrol, reconnaissance, and ground support of troop landings at Casablanca and Oran. Although air power helped a few ground units to move forward, its use to achieve the immediate objectives of the ground commander failed to accelerate the progress of the overall force. More importantly, it neither stopped German air attacks nor exploited such major objectives as enemy airfields and logistics.

(U) As a result of these experiences, U.S. officials attending the Casablanca Conference in January 1943 adopted a new concept on the use of air power. Modeled after the Royal Air Force's support of the British Eighth Army in the Western Desert, the new arrangement centralized air resources under an air commander. The Allies then formed the joint American and British Northwest African Air Forces, which made possible the successful Allied drive from El Alamein to Tunisia. The new doctrine, formalized by Field Manual 100-20, "Command and Employment of Air Power," 21 July 1943, set the pattern for the remainder of the war. It made land power and air power "co-equal and interdependent forces; neither [was]...an auxiliary of the other." Moreover, it ranked "the gaining of air superiority ...the first requirement for the success of any major land operation,"[2] placing this function ahead of tactical air's interdiction and close air support missions. Under this doctrine, the Allied Command's heavy bombing of enemy airfields, supplies, and communications was consistently successful. For example, in September 1943, prior to the Allied invasion of Sicily,

tactical bombing and strafing destroyed more than half the once numerically superior Axis air force. Gaining and maintaining air superiority smoothed the way for the land invasion and prompted Field Marshall Kesselring, German air commander in Italy, to describe the effort as "the most effective large-scale air force employment I have ever seen."

(U) World War II tested another theory of air power. American planners had entered the war convinced of the supremacy of the bomber. Its potential to strike decisively against an opponent's "sustaining sources of military strength" appeared to them as simply a matter of intelligent target selection and precision bombing. They completely discounted the possibility of tactical air interfering with or deterring bombing runs. The Battle of Britain, from June 1940 to the spring of 1941, demonstrated the vulnerability of German bombers to a determined and well-executed RAF fighter defense. Rejecting British advice to conduct night operations, the Army Air Forces (AAF) in 1943 launched daylight bombing raids into Germany which were initially handicapped by a shortage of aircraft, the limited range of fighter escorts, and bad weather over the European continent.[3] Above all, the "sting" of German fighters prevented effective results. American missions against Schweinfurt, Regensburg, Kiel, and other German targets incurred heavy losses--some as high as 50 percent.

(U) Following the second Schweinfurt raid in October 1943, the AAF halted unescorted bomber penetrations. To provide long-range fighter escort, it adapted external fuel tanks, originally designed for ferrying operations, for use on fighters. The range of the P-47, for example, was extended from 175 to 400 miles. But it was not until after the arrival of the P-51 at the end of 1943 that the Eighth Air Force had a superior highly maneuverable fighter which could escort bombers to almost any target in Germany. A later change in the mission of a portion of the P-51 force also had far-reaching effects. While one-third of the growing inventory of fighters provided close escort for bombers, the remaining two-thirds made offensive sweeps "pursuing and destroying" enemy fighters wherever they were found. The air campaign between February and May 1944 established Allied air superiority to the point that by D-Day General Eisenhower could assure the Normandy invasion force, "If you see fighter aircraft over you, they will be ours."[4]

(U) The cost of achieving and maintaining air superiority came high. Prior to June 1944, the AAF lost 4,325 aircraft, 17,000 crewmen, and another 21,000 missing or captured. Bombers as well as fighters fought the battle for air superiority, with a major portion of the B-17 strikes being launched against German aircraft plants, oil refineries, and airfields. From D-Day through the end of the war, 320,000 sorties, or 25 percent of the total, involved air superiority.[5] The postwar U.S. Strategic Bombing Survey (USSBS) measured air power's accomplishments;[6]

> ...by the extent to which they contributed to the destruction of the enemy's military strength... [but] of far more significance then statistics of strength and damage is the outstanding fact that the Allied Air Forces won the air war over Germany and obtained mastery of the skies in Europe.*

(U) During the Korean War, commanders applied with only minor changes the tactical air lessons learned in World War II. Again, top priority was given to winning air superiority. However, a major difference between the two wars was that in Korea the air battle proved "short and sweet."[7] During the first 2 months of Korean operations, the United States Far East Forces (FEAF) achieved air superiority over a small and relatively weak opponent. Attacked on the ground and in the air, the North Korean Air Force lost 110 of its 132 aircraft by mid-August 1950.[8]

(U) The second phase of the air superiority contest began in November 1950, when the Communist Chinese MIG-15 fighters suddenly appeared in the skies over North Korea. Because political restrictions barred attacks on Chinese bases north of the Yalu River, the Air Force concentrated on destroying all enemy airfields in North Korea. Accordingly, FEAF bombers and fighters continually struck these airfields to keep them inoperative. Meanwhile, FEAF deployed F-86 Sabrejets to challenge the MIG-15's in air combat. Although the two aircraft were evenly matched, the more experienced and better trained American pilots proved superior in dogfights. Patrolling and engaging the enemy fighters in "MIG Alley" over the Yalu, the Sabres relentlessly whittled down Communist air strength during 1951-1952.

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*In the Pacific, the island-hopping trek northward established a pattern of gaining air superiority by defeating local Japanese air forces in the air and neutralizing air bases on the ground.

Though the enemy air force was never totally eliminated, the 10-1 kill ratio in air combat permitted FEAF to maintain air superiority throughout the Korean War.[9]

(U) Following the Korean War, President Dwight D. Eisenhower adopted a policy of nuclear deterrence that relied primarily on the strategic air force and downgraded the conventional war mission of tactical fighter aircraft. For example, the Century series fighters (F-100 through F-111) were increasingly designed for use against strategic targets in nuclear war rather than for tactical air combat. Although air superiority remained the "prerequisite" for conducting any air operation, Gen. Bruce K. Holloway, the Air Force Vice Chief, wrote in 1968 that plans to develop a new day fighter were continually sacrificed in favor of interceptor and fighter-bomber designs:[10]

> Penetration was more important than maneuverability, ordnance load-carrying capability more important than armament, alert status more important than sustained sortie rates. The tactical fighter became less and less an air superiority system and more and more what was once called an attack aircraft.

Indeed, jet fighter-bombers had performed so well in Korea that a 1957 study rated them "just as capable in aerial combat as the day fighter."[11]

(U) Forgetting the political and geographic limitations that shackled FEAF in Korea, the Air Force continued to promote the most expeditious means of gaining air superiority: to "first destroy the enemy air forces at the place where he is most vulnerable, which is on the ground and in his nest."[12] Maj. Gen. A. J. Kinney, Assistant Deputy Chief of Staff for Research and Development (DCS/R&D) summarized this basic strategy:[13]

> To achieve air superiority, the most lucrative method is to destroy enemy air capability when it is on the ground by attacking his airfields and parked aircraft. Runways are bombed to prevent takeoffs, airplanes are destroyed before they can be employed; fuel and ammunition dumps, maintenance facilities and command and control centers are attacked.

(S) Project Forecast, a 1963 Air Force attempt to identify future weapons requirements, had foreseen such notable developments as the C-5 and B-1 programs. Directed by Gen. Bernard A. Schriever, Commander, Air Force Systems Command (AFSC), Project Forecast proved less clairvoyant regarding the future of fighters. It predicted that Air Force fighter needs in the 1970's would be met best by F-111 and F-4 variants "optimized for the air superiority role," and that strategic bombing from aircraft able to fly faster and higher than the enemy's would insure air superiority. Almost as an afterthought, Project Forecast added that "the counterair force must be able to destroy aircraft in the air...."*14

*The study did not address the issue of a new multipurpose tactical fighter, primarily because the Office of the Secretary of Defense (OSD) and the Air Force in early 1962 had agreed that the latter would purchase a number of F-4C's, a Navy-developed multipurpose tactical fighter, pending acquisition of the newer F-111. The first F-4C's entered the Air Force inventory in November 1963. The first F-111A rolled out from its General Dynamics plant on 15 October 1964.

II. THE REQUIREMENTS PHASE

(S) Upon becoming Air Staff Director of Plans on 1 July 1964, Maj. Gen. Arthur C. Agan* found a great many Pentagon officials believed that the dogfight and aerial guns were relics of the romantic past and that missiles would dominate future air battles. This certainly was the view of Army members of the Joint Staff, whose situation had greatly improved vis-a-vis the Air Force under the Kennedy administration.+ For example, Lt. Gen. Theodore W. Parker, Army Deputy Chief of Staff for Military Operations, had questioned the effectiveness of all tactical fighter aircraft for gaining air superiority and for interdiction in future conventional wars. Parker argued that the growing advantages of surface-to-air missiles (SAM's) would shortly become clear and would impose unacceptable losses on fighter aircraft. [1]

(S) General Agan disagreed. As a former World War II P-38 pilot and group commander who flew 45 combat missions over Europe, he was convinced that high performance fighter aircraft would survive and remain the key to successful ground operations. Unfortunately, since OSD had authorized the Air Force to acquire two new multipurpose fighters--the F-4C and the F-111--Gen. Curtis E. LeMay, Air Force Chief of Staff, and Secretary of the Air Force Eugene M. Zuckert were in no position to ask for development of still another fighter.

(S) In meetings with Dr. Alain C. Enthoven, Assistant Secretary of Defense for Systems Analysis, General Agan learned that OSD favored purchase of large numbers of small, inexpensive attack aircraft for the tactical air forces. [2] Enthoven and other members of Secretary McNamara's Systems Analysis staff thought in terms of measuring the effectiveness of the three primary

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*On 1 December 1964 Agan became Assistant Deputy Chief of Staff/ Plans and Operations for Joint Matters.

+By February 1964, in building up its air mobile forces, the Army was training 1,500 pilots, the same number being trained by the Air Force.

tactical air missions--air superiority, close air support, and interdiction--"by their impact on the force ratio between opposing land forces, and thus...the land/air 'trade-off' would be a decisive factor in sizing U.S. tactical air forces."[3] While General Agan and the Air Staff were not particularly opposed to this cost effectiveness approach, they felt it ignored the essential point--that in wartime little could be done without first achieving air superiority and that one of OSD's highest priorities should be to insure the United States acquired the best possible fighters in the world.

(S) Like most members of the Air Staff since the McNamara era dawned, General Agan found Enthoven and other members of the OSD staff hostile to Air Force views. Thus, whereas during the 1950's President Dwight D. Eisenhower's policy of strategic deterrence had made the Air Force the dominant service, under President Kennedy the Army achieved the stronger position. The President adopted the concept of "flexible response," which had been advocated in the late 1950's by Gen. Maxwell D. Taylor, the former Army Chief of Staff. In 1961 President Kennedy brought General Taylor back to active duty, first as his special military representative and later as Chairman of the JCS.

(S) Frustrated by OSD's cost-effectiveness approach, General Agan determined to find some way to articulate his strong feelings about air superiority. Thus, in the fall of 1964 he commissioned a prestigious committee of fighter aces and other experienced fighter pilots to examine the Air Force's tactical air capabilities. He hoped this group might provide the leverage needed to begin development of an aerial gun for the F-4C and help launch a new air superiority fighter program. Chaired by Brig. Gen. Harrison Thyng, the group included Colonels Francis S. Gabreski, William Dunham, Winston W. Marshall, George Laven, Jack Holly, and John J. Burns.* Predictably, the group concluded there was an urgent need to develop a new fighter to offset the growing Soviet capability in this area.+ However, well aware of the Air Force's

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*"Assessment of TAC Air Capabilities," circa October 1964. Burns believes only 20 copies were produced; none can be found.

+The MIG-21 Fishbed which first flew in 1956, was followed by the appearance of another advanced prototype fighter in 1964.

sensitivity to any challenge to the decision to acquire the F-111, the Thyng committee merely recommended more study of a new fighter development program. OSD received a copy of the committee report but took no action.[4]

(U) Although General Agan failed to convert OSD officials, he did manage to persuade LeMay's successor, Gen. John P. McConnell (he became Chief of Staff on 1 February 1965), of the need for a new fighter. Backed by McConnell, Agan drafted a statement on tactical air superiority that the former endorsed and circulated Air Force-wide. The policy statement, issued in May 1965--after combat operations over North Vietnam had begun--recognized the Air Force's requirement "to win air superiority."[5]

(U) Another individual who helped promote the air superiority mission was a former Navy flier and experienced test pilot, Charles Myers. In 1963 and 1964 Myers was working for Lockheed Aircraft trying to sell F-104's to the services. During the course of his visits with Air Force and Navy officials he became acquainted with several aspects of aerial combat that no one appeared to have previously addressed. In discussing the subject with pilots of both services, he learned that most aerial combat was confined to a spatial area or flight envelope between sea level and 30,000 feet, was conducted at speeds up to Mach 1.6, and that air-to-air missiles had severe limitations. For example, an F-4 pilot first had to close with his target for positive enemy identification and then drop back far enough to launch his Sparrow missile effectively. Myers developed a considerable following in the services lecturing on these facts, although he came to realize that the F-104 was not saleable. Subsequently, he formed a private consulting firm but continued to push air superiority.[6]

The War's Impact

(S) OSD interest in acquiring new fighters did not appear until it became clear that the existing USAF aircraft being used to provide close air support for South Vietnamese troops were obsolete and dangerous. For example, in March and April 1964 two Air Force T-28 close air support aircraft crashed when their wings sheared off during bomb runs, killing all crewmembers. Wing failures discovered in RB-26 strike aircraft also led to their grounding. In response to this situation, Secretary Zuckert in December 1964 requested $50 million to modernize and expand the Air Force's

Special Air Warfare (SAW) strike and reconnaissance force. On 7 January 1965 Mr. McNamara responded by allotting only $10 million in fiscal year 1966 funds for Air Force modification of existing tactical aircraft. At the same time he directed the Air Force to consider developing a new fighter "optimized for close support and useful in ground attack" and to assume tactical air superiority in their planning for Vietnam.[7]

(S) Secretary Zuckert and Air Staff officials were disturbed by McNamara's instructions that they "assume" tactical air superiority in their planning.[8] In a reply on 2 February 1965, Zuckert reported that the Air Force could not define a new tactical fighter without first assessing its effect on the tactical force structure.[9] At the time of his reply, the Air Staff had been working since August 1964 on a study titled "Force Options for Tactical Air." Named after its chairman, Lt. Col. John W. Bohn, Jr., it critically assessed the Air Force's reliance on high-performance tactical fighters to provide "the greatest flexibility at the lowest cost." Because it found that aircraft like the F-111 were far too costly to be risked in nonnuclear war, the study sparked interest in lightweight, lower cost specialized aircraft. Using both manual and computer analyses,* the Bohn group surveyed several kinds of aircraft, including stripped versions of the A-1E, F-4, A-6, F-104, and vertical or short takeoff landing aircraft. It subsequently rejected all these alternatives, branding the cheaper versions of high-performance aircraft as "non-cost effective" and declaring that the others did not meet desired performance requirements.[10]

(S) Completed on 27 February 1965, the Bohn study recommended the Air Force acquire a mix of high- and low-cost aircraft as the most economical way to strengthen the tactical force. For the support role, the study narrowed the candidates to the lightweight, comparatively inexpensive Air Force F-5 and the Navy's A-7. Both seemed equally attractive; the A-7 could carry a greater payload, whereas the F-5 was considered superior because of its air-to-air combat capability. General McConnell was briefed on the study on 9 March and Secretary Zuckert and his staff 2 days later.[11] McConnell subsequently advised Zuckert that the Bohn study showed the folly of assuming air superiority and, in support of this view, he cited recent Defense Intelligence Agency estimates that new

*Col. John J. Burns provided the analytical capability.

Soviet interceptors posed a threat beyond the capability of existing U. S. forces to counter. He argued that air superiority involved the ability of fighter aircraft to survive attacks both by enemy interceptors and AA weapons.[12] As evidence of the latter, he could cite the 2 March 1965 downing of three Air Force F-105's and two F-100's over North Vietnam by enemy ground fire. As for the close air support mission itself, he proposed bringing a mix of lower-cost aircraft into the Air Force inventory.

(S) Although Secretary Zuckert backed McConnell, he warned that outsiders would view the Air Force recommendation as an attempt to expand its force structure by beefing up its SAW resources. Nevertheless, Zuckert on 16 March forwarded the Bohn study to OSD and recommended the Air Force be authorized to purchase two wings of F-5's as an interim measure while beginning work on a medium cost tactical fighter for the 1970's. He amplified his position in April, when he described the proposed new fighter to McNamara as one which also would have "significant air-to-air fighting capability."[13]

(S) Meanwhile, another Air Staff study on "Tactical Fighter Ground Attack Aircraft" had gotten under way under the direction of Col. Bruce Hinton. Completed in June 1965, this study concluded that the A-7 would be the best close support aircraft if the Air Force could assume air superiority. However, Hinton's group questioned that assumption and recommended the Air Force select the F-5. It noted that acquisition costs of the F-5* could be recouped through the Military Assistance Program since the basic version of the fighter was intended for sale to America's allies.[14]

(S) Aware of Air Staff disagreement about the A-7 vs. the F-5, and noting OSD's indecision on the matter, Secretary Zuckert decided not to press for the latter until the Air Force had crystalized its position on tactical forces.[15] Another important reason for delay was to enable the Air Staff to undertake a detailed examination of the proposed medium-cost F-X (fighter experimental).

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*The Air Force F-5 would be an improved version of the aircraft not the model intended for export.

The F-X Working Group

(S) In April 1965 Lt. Gen. James Ferguson, Deputy Chief of Staff for R&D won the support of Dr. Harold Brown, Director of Defense Research and Engineering (DDR&E) for the official Air Force position. That is, Dr. Brown agreed to the interim acquisition of the F-5 and authorized development of an F-X.[16] Thereupon, General Ferguson established an Air Staff work group under Brig. Gen. Andrew J. Evans, Jr., Director of Development, and Dr. Charles H. Christenson, science advisor to the R&D deputate. The group conducted prerequisite studies for an F-X to cost between $1-2 million each, with a production run of 800 to 1,000 aircraft. The contemplated fighter would possess "superior air-to-air, all-weather, and aided-visual-ground attack" capabilities. It also was envisioned as a single-seat, twin-engine fighter stressing maneuverability over speed. The F-X initial operational capability (IOC) was 1970.[17]

(S) The F-X group, recognizing early it needed help to produce worthwhile studies, began seeking funds to contract out the effort. DDR&E representatives told the group it could obtain study funds if the F-X was presented as a multi-purpose fighter,* whereas any attempt to point it in the direction of a specialized combat plane would fail.[18] Supporters of an air superiority fighter, including Generals Ferguson and Jack J. Catton, Director of Operational Requirements, found this view was shared by elements of the Air Staff.[19] They therefore decided to disguise the F-X as a multi-purpose fighter and advertised air-to-ground capability ahead of air-to-air. By July 1965, program element 6.34.06.84.4, "Close Support Fighter," emerged as the logical source for obtaining study funds and on 12 August the Air Force requested $1 million for parametric design studies for the F-X under the Close Support Fighter funding line.[20]

(S) Meanwhile, Air Force complacency over tactical air superiority began evaporating after two F-105's were shot down on 4 April 1965 by several supposedly obsolete MIG-15's while on a

*The Directorate of Operational Requirements and Development Plans envisaged the F-X as capable of performing a host of ground-attack missions, including close support, interdiction, armed reconnaissance, and day/night surveillance. [Hist (S), Dir/Opl Rqmts & Dev Plans, 1 Jan-30 Jun 65, p 156.]

bomb run near Thanh Hoa, North Vietnam.[21] Since the fighter-bombers were laden with ordnance, the contest was not an equal one. The Air Force's response was to immediately dispatch F-4C's to the theater to fly cover for the fighter-bombers. The episode rekindled interest in tactical air superiority,[22] lent added urgency to the F-X effort, and prompted General Ferguson to seek cooperation from the field. On 29 April, using the same guidelines established for the Air Staff's concurrent F-X studies, he directed the Air Force Systems Command to undertake studies at the Aeronautical Systems Division (ASD) of a multi-purpose fighter with a short takeoff and landing (STOL) capability.[23]

(S) The requirement for a STOL fighter attracted the attention of Col. John J. Burns, Assistant Director of Requirements, Headquarters, Tactical Air Command (TAC). Colonel Burns, who had been a member of the Bohn study group and the Thyng committee and was an ardent air superiority advocate, pounced on the STOL requirement and immediately drafted a position paper for an air superiority fighter. Though Gen. Walter C. Sweeney, the TAC commander, was sympathetic to the proposal, Colonel Burns was unable to convince him to issue a formal requirement for a lightweight day fighter. General Sweeney's upcoming retirement and poor health may explain in part the temporary shelving of the proposal.[24]

(S) However, TAC did convene a select panel of field commanders in June 1965 to consider the projected Soviet tactical fighter threat. In a departure from concepts pursued in USAF tactical fighter development over recent years, the TAC commander's panel expressed a clear preference for a lightweight day fighter. Their model was a single-seat, twin-engine airplane in the 20,000 to 25,000-pound class. Though asking for an aircraft that could fly from Mach 1.2 on the deck up to Mach 2.5, the panel stressed maneuverability more than speed. The panel's report was not distributed; however, its conclusions--which closely paralleled Colonel Burns' views on air superiority--served as a kind of framework for the TAC position.[25]

(S) When on 1 August 1965 Gen. Gabriel P. Disosway--a World War II fighter pilot commander--took over TAC, he immediately reviewed Colonel Burns' work and wasted little time

in issuing Qualitative Operation Requirement (QOR) 65-14-F* on 6 October. The document, sent to the Air Staff, emphasized TAC's interest in an "aircraft capable of out-performing the enemy in the air." Besides challenging the notion that only a multi-purpose fighter could gain OSD and Congressional approval and bringing the controversy into the open, it specified an aircraft like the one described by the June 1965 TAC panel, except that it raised the plane's weight to a 30,000 to 35,000 pound range. The requirement also called for providing the new aircraft with a radar capability similar to the F-4's and that it be equipped with both infrared and radar missiles. TAC also emphasized the need for maneuvering performance and high thrust-to-weight ratio but for temperature limitation,+ it lowered the maximum speed requirement from Mach 3.0 to 2.5--a change that would save between 35 and 40 percent of the total cost, or $4.5 versus $2.5 million per copy.[26]

The Pivotal Decision

(S) During the summer and fall of 1965 the Air Force continued to wrestle with the F-5 versus the A-7 issue. OSD, particularly Systems Analysis, was still enamored of the "commonality" principle wherein the Air Force and Navy would possess a combined tactical force comprised of F-111, F-4, and A-7 aircraft. In July Secretary McNamara directed OSD and the Air Force to begin a joint study to select either the F-5 or A-7 for the close air support role in Vietnam. At the same time, but on a lower priority, he endorsed the Air Force's prerequisite work on developing the new F-X fighter.[27] Meanwhile, Dr. Brown --who as DDR&E had backed the F-5--reversed his position after

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*Significantly, the Navy issued a Specific Operational Requirement (SOR) on 8 October for their VFAX multi-mission, all-weather fighter to replace the F-111B, which it had shelved. [Hist (S), Dir/Opl Rqmts & Dev Plans, 1 Jul-31 Dec 65, pp 176-77.]

+The temperature limits of the less expensive aluminum surfaces prevented aircraft from travelling above Mach 2.5.

being named Secretary of the Air Force, a position he assumed on 1 October.* On 5 November he and General McConnell proposed acquiring 11 squadrons (264 aircraft) of A-7's. Although criticized in some Air Force circles as a capitulation to OSD, the decision to buy the A-7 was in fact a sensible compromise that ultimately gained approval for the F-X. General Agan recognized this point and endorsed the decision. The F-X could now be justified as a "more sophisticated, higher performance aircraft...an air superiority replacement for the F-4."[28]

(U) General Agan later described the various kinds of aircraft the Air Force needed to fight in various conflicts. He wrote that the Air Force believed

> that the basic F-111A and F-4 inventory of the future must contain other aircraft. The views of the characteristics which these aircraft should have vary widely. By study, by wargaming, and by testing we hope to arrive at an answer.
>
> My own belief is that a smaller aircraft than the F-111, and possibly than the F-4, is needed--and needed now. It can be smaller because we can plan to use it for air superiority and close air support and thus can accept less range and payload in order to get superior agility. We can accept less range because the majority of the targets which we expect in close air support will be within 250 miles (400 km) of the forward edge of the battle area. We can accept less payload because of improved ordnance and more accurate delivery of weapons.
>
> Such an aircraft may be able to win the air superiority fight over the battlefield. It should be a medium-cost aircraft, because we will need many.[29]

(S) F-X work statements were revised to call for an aircraft with the "best combination of air-to-air and air-to-ground characteristics" vis-a-vis the previous description of the development as aiming at a medium-cost, multi-purpose aircraft

*Dr. Brown approved the Air Force's $1 million request for the F-X studies on 30 September, the day before he became Secretary of the Air Force. [Hist (S), Opl Rqmts & Dev Plans, 1 Jul-31 Dec 65, pp 176-77.]

highlighting close air support.[30] Although this change seemed mere semantics, it permitted the Air Force to launch a major effort to acquire a new fighter. Secretary Brown had opened the door to the F-X and, more importantly, he placed the emphasis on the air-to-air mission and the need to increase the size of the tactical force.

(S) Meanwhile, TAC began to move after many years coming out second best in the internal struggle for resources with the "monolithic, global commands such as MAC and SAC." To restore some balance, General Disosway worked to bring to bear the influence of all major tactical air commanders. For example, he arranged periodic conferences with his counterparts in the United States Air Forces, Europe (USAFE) and the Pacific Air Forces (PACAF). Their joint position statements, aptly called the "12-star letters" (three four-star generals)--which they sent to General McConnell--were difficult to ignore. The first such conference held at TAC headquarters at Langley AFB, Va., in February 1966, produced several position statements on tactical air power. Signed by Generals Disosway, Holloway, and Hunter Harris, the letters significantly influenced the F-X requirement. The three commanders stated simply that air superiority would be severly jeopardized if the F-X were designed to accommodate both air-to-air and air-to-ground missions. Instead, they urged the Chief of Staff to endorse air superiority as the primary mission of the F-X, with secondary missions being considered a bonus from the aircraft's superior design.[31]

(S) General Disosway and his operations advisors, Colonels Burns and Gordon M. Graham, believed that air superiority was essential throughout the spectrum of tactical warfare. Given the limitations on the employment of tactical air power, such as the enemy sanctuaries that existed during the Korean and Vietnam Wars, an uncompromised fighter was needed to sweep the skies clear of enemy aircraft. They argued that the only way the Air Force could meet the challenge posed by lightweight, maneuverable Soviet fighters in the 1970's was to design a superior air combat fighter.[32]

(S) Although the 12-star letters received high-level consideration, Headquarters USAF decided to follow the path of least resistance--namely, to continue to study, justify, and document the case for a fighter capable of handling both the air superiority and ground attack missions. General Ferguson, who became commander of the

Air Force Systems Command (AFSC) in September 1966, responded to TAC by asking General Disosway to await the results of parametric design studies that began in March 1966.* Ferguson personally opposed the parametric study requirement but believed the results would substantiate the case for an air superiority fighter.[33] Six types of aircraft, including two "families" of low, medium, and high-cost fighters (costing $1.8, $2.5 and $3.2 million respectively) were studied. One family of fighters studied emphasized air combat capability with ground attack being a secondary requirement, whereas the second examined the effect of reversing the mission order.[34]

*See pp 17-18.

III. CONCEPT FORMULATION PHASE (CFP)

(S) On 8 December 1965 the Air Force sent requests for proposals (RFP's) to 13 aircraft manufacturers for the initial F-X parametric design studies. After receiving bids from eight companies, the Air Force on 18 March 1966 awarded study contracts to Boeing, Lockheed, and North American. A fourth firm, Grumman, participated in the study effort on an unfunded basis. After considering the effects of five variables--avionics, maneuverability, payload, combat radius and speed--on the F-X in terms of weight and cost, the contractors came up with some 500 proposed designs. In July, after examining these designs, the Aeronautical Systems Division (ASD) selected what it believed was the best one for an air-to-air and air-to-ground aircraft.[1]

(U) Indeed, the emphasis on the multi-purpose features of the F-X dominated ASD's parametric studies. The Division's goal was to develop an aircraft with sufficient performance capability to offset the alleged Soviet superiority in maneuverability while maintaining the continued U. S. edge over Russian planes in range. To accommodate these multi-purpose requirements, the four study-contractors agreed that the F-X needed avionics comparable to the F-111's Mark II system. Moreover, they understood that multi-purpose meant the use of a variable sweep wing design for the F-X and that a high bypass-ratio turbofan engine seemed preferable to a low-bypass engine. As for armaments, they called for considerable air-to-ground ordnance including the 20-mm M-61 machine gun with 1,000 rounds, four fuselage-mounted missiles, and a 4,000-pound allowance to permit loading eight MK-82 bombs, or other munitions. Finally, the contractor designs favored podded engines over fuselage mounting (to avoid the inlet distortion problems of the F-111) and placing the horizontal tail surfaces on the engine pods for increased area.[2]

(S) Some critics saw ASD's parametric F-X design as a typical case of "goldplating." They complained that the Aeronautical Systems Division, convinced that the F-X represented the "one aircraft for the generation," had decided to advance aeronautical art by applying their "wish lists" across several disciplines. Others, however, thought that while the ASD engineers had made a sincere attempt to provide the Air Force with the "best airplane possible," they had become "victims of the system."[4] Regardless of these criticisms what emerged was

a proposed F-X weighing more than 60,000 pounds (to accommodate all the avionics and armaments packages). The aircraft would have a 110-pound per square foot (ft^2) wing loading, a thrust-to-weight ratio of .75, and a 2.2 bypass turbofan engine. Finally, the F-X would require extensive use of exotic new materials to attain a top speed of Mach 2.7. All told, ASD's Deputy for Advanced Systems Planning estimated R&D costs for fiscal years 1967-1972 would be about $760 million. The F-X, then, promised to be a very expensive aircraft resembling the F-111 but which, in no sense, would be an air superiority fighter.[5]

Energy Maneuverability

(U) General Ferguson and his development planners, Maj. Gen. Glenn A. Kent and Brig. Gen. F. M. Rogers, sensed that the F-X requirements were "badly spelled out." They subsequently were able to persuade General Disosway to modify his requirements, thanks in large part to the work of Maj. John R. Boyd. In October 1966 Boyd joined the Tactical Division of the Air Staff Directorate of Requirements. When asked to comment on the "Representative F-X design," he summarily rejected it. A veteran pilot of the late 1950's and author of the air combat training manual used by the Fighter Weapons School at Nellis AFB, Nev., Boyd was well qualified to assess fighter aircraft. In 1962, while completing an engineering course at Georgia Tech, he studied the relationships between energy and energy changes of aircraft during flight and devised a method to measure aircraft maneuverability--the ability to change altitude, airspeed, and direction.

(U) Major Boyd continued his energy maneuverability (EM) studies at his next station, Eglin AFB, Fla., even though his primary assignment there was maintenance officer. At Eglin he met Thomas Christie, a mathematician who also saw promise in the EM theory and who had access to a large-capacity, high-speed computer. With Christie's help Major Boyd gained access to the computer to confirm his calculations. For this irregularity--i.e., working outside authorized channels--they were both severely criticized. However, with the help of Brig. Gen. Allman T. Culbertson, Air Proving Ground Center (APGC) vice commander, Boyd and Christie fought off repeated attempts to terminate their studies and in May 1964 published an official two-volume treatise on energy maneuverability.[6]

Energy Maneuverability Formula* (S)

$$P_s = \frac{T-D}{W} V$$

P_s = specific power

T = specific power thrust

V = velocity

W = weight

D = drag

*APGC-TDR 64-35, Energy Maneuverability Theory, May 1964

The F-15's "fuel allowance" for a period of high-thrust, sharp maneuvering during aerial combat is expressed as 144,000 feet of energy for maneuvering and is equivalent to about one-third the aircraft's internal fuel capacity. This translates to about 1.6 times the combat energy of the F-4E. Also the basic thrust-to-weight ratio of the engine alone is about twice that of the F-4E engine. [Extract Study (S), "The Air Force F-15 Air Superiority Fighter," Studies and Analysis (AF), SAMI-7102772.]

Table 1

(S) Although the EM theory+ did not represent anything new in terms of physics or aerodynamics, it led Boyd and Christie to devise a revolutionary analytical technique that permitted fighter "jocks" to communicate with engineers. The EM theory expressed in numbers what fighter pilots had been trying to say for years by moving their hands. It also permitted planners and developers to compare competing aircraft directly and to demonstrate the effects of design changes on aircraft performance. Finally, the theory could be used to teach pilots how to exploit their aircraft's advantages‡ over that of the enemy.7

+The EM theory was not in final form at that time (1964), and it has undergone five or six improvement or refinement phases since then.

‡An early example of this was reported by an F-105 pilot who survived the 4 April 1965 MIG attack. He credits Major Boyd's EM presentation with teaching him to use the "last ditch" maneuver and saving his life. [Mission Report (S), Atch to ltr (S), Comdr 1002 SEG to DCS/Plans and Opns, subj: PACAF Tactics/Techniques Program (Bulletin No. 2), 5 May 1965.]

(U) During 1964 the EM theory was informally brought to the attention of members of the Air Staff, including Generals Agan and Catton. Colonel Burns who made use of it in his studies beginning with the Thyng Committee study,* assigned values to various elements of the EM theory and established "measures of merit" for comparing different aircraft designs in terms of maneuverability. Perhaps because the EM analytical technique was in its formative stages and not widely known, it did not gain immediate acceptance.[8]

(U) Meanwhile, working within the Tactical Division, Major Boyd began to apply the EM theory to the F-X, projecting how the aircraft would perform in the critical maneuvering performance envelope--the subsonic and transonic speeds up to Mach 1.6 and altitudes up to 30,000 feet. He then asked TAC, ASD, and the study contractors to provide tradeoffs between range, structural requirements, and on-board equipment. Then, by comparing configuration changes for fixed and variable wing sweeps, Major Boyd designed a model that would demonstrate the effects of specific requirements on the F-X design. For example, he could show the maneuverability penalty that TAC would have to pay if it desired the F-X to have a given range.[9]

(U) By the spring of 1967, through the efforts of Boyd and others, a 40,000-pound F-X aircraft was "popped out." Its proposed engine bypass had been lowered to 1.5, thrust-to-weight increased to .97, and the F-X top speed scaled down to a range of Mach 2.3 to 2.5. During the various design tradeoffs, Major Boyd challenged the validity of ASD's drag polars (lift versus drag charts) and argued that lower wing loadings on the order of 80 pounds/ft^2 would be more appropriate for the F-X design. Doggedly pursuing his research into drag polars, he later examined the effects of optimizing propulsion, configuration, avionics, and weapons for the fixed and variable sweep-wing designs. His calculations of these tradeoffs pointed to 0.6 as the "best" engine bypass ratio and to a 60 to 65 pounds/ft^2 wing loading. The design

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*Colonel Burns also worked on the Bohn Study and Joint AF/OSD study. See pp 9, 10, 23 and 24.

studies incorporated into the final F-15 configuration confirmed these values.*[10]

Concept Formulation

(U) The F-X formulation phase continued through the spring and summer of 1967. By March a three-part Concept Formulation Package (CFP) and a Technical Development Plan (TDP) were drafted to specify the F-X rationale, cost, and development schedule. In June a complete CFP was issued and underwent a final Air Staff-ANSER+ "massaging" by August 1967. Secretary Brown then submitted the revised cost proposal to OSD as the Air Force's recommended new tactical fighter candidate to replace the F-4. He noted the Air Force's tactical force structure for the mid-1970's--limited to 24 wings by OSD--included 13 F-4, 6 F-111, and 5 A-7 wings that were respectively oriented to perform counterair, interdiction, and close air support missions.‡ Secretary Brown now argued for the paramountcy of counterair (air superiority), without which the other missions would be either too costly or impossible, and the need to protect ground forces against enemy air attack. He noted that although the multi-purpose F-4 Vietnam workhorse was a capable air-to-air fighter, its continued effectiveness was doubtful in view of the appearance of a new, advanced Soviet fighter series. U.S. intelligence (NIPP-67, 13 March 1967) projected that by the mid-1970's approximately half the Soviet tactical aircraft inventory would consist of such modern fighters as the Fitter (SU-7) and

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*At Air Force Systems Command, Maj. Gen. Glenn A. Kent, Deputy Chief of Staff for Development Plans, and his assistant, Maj. Larry D. Welch, made a significant contribution to the F-X design by applying the EM technique to the TAC Avenger computer simulation model.

+Analytical Services, Inc., a non-profit Air Force contractor.

‡Counterair operations were intended to achieve and maintain air superiority and, if possible, eliminate enemy air interference. Interdiction meant the reduction or elimination of support for enemy ground forces by destroying his installations and disrupting his communications. Close air support sought to provide fire support to friendly ground forces engaged in combat with the enemy.

Twin Sukhoi (68-TF), both said to excel the F-4 in air combat.*

(S) The Air Force Secretary noted that recent Soviet fighter designs concentrated on improving range and payload. U.S. tactical air superiority in the Korean and Vietnam Wars was attributed to "superior pilot skill and better armament and avionics." These advantages were not expected to prevail in a conventional war in Europe, for example, because of the likelihood of encountering well-trained Soviet pilots. Moreover, the Soviets were increasing their maneuverability edge and significantly improving their missile and fire-control systems. The Air Force cautioned that it could no longer "rely on pilot skill alone to offset any technical inferiority of U.S. aircraft.... To win an air war against Soviet forces it is essential that U.S. pilots be given the best aircraft that technology can afford."[11]

(S) The various Air Force analyses, Secretary Brown said, indicated that little improvement could be expected from modifying existing aircraft such as the F-4, F-111, YF-12, A-7, and a U.S.-German V/STOL design. Additionally, the cost of such an effort would be extremely high, approaching that required to develop a completely new fighter. It conceded that additional study was required to refine the F-X characteristics, but tentatively recommended a "representative" fighter as a 40,000-pound[12]

> single-place fighter with a variable sweep wing... powered by two high-thrust turbofan engines... capable of sustained flight at Mach 2.3 with a burst capability to Mach 2.5. The avionics...[included] advanced dual mode radar, internally carried penetration aids, and advanced navigation, communications, computation and identification equipment. The F-X armament will consist of long-range radar missiles, short-range IR or electro-optical missiles, and an internal gun. [In addition, it] would be equipped to deliver with improved accuracy, all the ballistic air-to-ground munitions and air-to-ground guided missiles in the USAF tactical inventory during the period 1970 to 1980.

*The Mach 3 Foxbat, first seen at the July 1967 Moscow Air Show, had been designated the MIG-23, but has since been renamed the MIG-25.

(S) Total F-X costs were estimated at $7.183 billion, including $615 million for R&D, $4.1 billion for procurement, and $2.468 billion for operations and maintenance over a five-year span. Based on a 1,000 aircraft buy, the average F-X flyaway cost was computed at $2.84 million per copy. The proposed initial operational capability (IOC) date was December 1973.[13]

(S) In his memorandum to Mr. McNamara, Secretary Brown reiterated that there were several unresolved areas involving the "Representative F-X," such as whether or not the proposed aircraft could be flown by a single pilot. He said that additional wind-tunnel testing was required to confirm the effectiveness of certain high-lift devices and more detailed work was needed to define the F-X engines and avionics. Dr. Brown also foreshadowed the commonality issue by predicting that certain components and subsystems of the F-X and the Navy's VFAX could be made interchangeable. He was less optimistic regarding "the extent to which common airframe assemblies may be used for these two aircraft."[14]

The Commonality Issue

(S) By the spring of 1965 there was a general consensus in the Air Force and Navy that the TFX (F-111) would not meet the needs of both services. It was, thus, hardly surprising that in October 1965 the Air Force and Navy independently issued operational requirements for multi-mission fighter aircraft.* Anticipating that OSD might impose a new commonality requirement on them, the services "agreed to disagree" from the onset. In December they established a joint "working group of senior officers" to weigh the merits of the commonality philosophy in the development of the next fighter.[15] The effort did little more than stiffen service resistance to the commonality push. General McConnell put the issue succinctly when he stated: "I don't mind the fact that OSD is the decision-maker, but I do mind them telling the Services how to prepare their proposals." To head off OSD, the Chief established an Air Force F-X study and analysis group under General Kent, AFSC Deputy Chief of Staff for Development Plans.+[16]

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*See p 26.

+See p 21n.

(S) OSD, however, refused to tolerate this kind of intransigence and in May 1966 McNamara ordered a joint review of the commonality issue.[17] Conducted over the next 18 months, the review confirmed that the needs of the Air Force and Navy could not be met by a single airframe. The two services argued that attempts to merge their requirements would produce, at exorbitant cost, a grotesque mutation with increased weight, and reduced performance. Whereas the Air Force emphasized maneuverability performance through low wing loading, the Navy was more concerned with mission versatility, such as extended loiter time for fleet air defense. The services conceded it might be feasible to produce separate airframes--optimized for each service and using essentially common propulsion and avionics subsystems*--or to produce variations of a common airframe using common systems, but the potential savings of either alternative could not be estimated accurately without further data. Another element of their proposal was for each service to ask their contractors to submit a service design and a variant for the other service.[18]

(S) The differences that emerged during the joint study convinced some in the Air Force that, like it or not, they were in direct competition with the Navy for money to support development of a new fighter. General Ferguson, among others, sensed the challenge and urged ASD to step up its F-X work.[19] Although the joint position statement satisfied some people in the Air Force, it did not persuade General Disosway, who adamantly opposed a joint program with the Navy.[20] In March 1968, he and General Ferguson warned the Chief of Staff that the Navy was readying a double-cross, that while the Air Force was engaged in "playing at the commonality game," the Navy was pressing for approval of one or more new Navy fighters. "We think the time has come," they declared, "for the Air Force to state its position firmly with regard to the joint aircraft."[21]

An Air Force Position Emerges

(S) Sensing that the Navy was about to promote its new aircraft as an air superiority fighter, and convinced the Air Force could produce a better design, General Disosway decided the time

*For a discussion of subsystems commonality, see Chapter V.

had come to settle the controversy within the Air Force between the multi-purpose and air superiority advocates. In February 1968, he issued TAC Required Operational Capability (ROC) 9-68, an update of the October 1965 QOR.* The document cited two new threats in justifying its call for an air superiority fighter. First, the MIG-21, exploiting its ground control interception advantage, continued to trouble USAF fighter pilots in Vietnam.+ Secondly, the Soviets had displayed several new fighters at the July 1967 Moscow Air Show, and one of these--the Foxbat--was regarded as superior to existing and projected American counterparts (including the "Representative F-X" described in the August 1967 CFP) in speed, ceiling, and endurance.

(S) To counter this threat, TAC established several "minimum acceptable requirements":[22] (1) a STOL capability over a 50-foot obstacle with a 4,000-pound load within 3,000 feet; (2) a 230 nautical-mile radius of action on internal fuel and 2,600 nautical-mile ferry range with external fuel; (3) speeds between Mach 1.1 on the deck and Mach 2.7 bursts at altitude; (4) high energy maneuverability; and (5) one-pilot crew. TAC expressed no preference between fixed and swing-wing designs, or between turbofan and turbojet engines, provided the engine was smokeless. However, even as it attacked the multi-purpose advocates for having undermined the air superiority effort, TAC wanted the F-X to possess an all-weather capability and be able to "look-down and shoot-down." Moreover, the ROC specified that the F-X be adaptable for ground support missions once air superiority was achieved.[23]

(S) As noted earlier, the issue concerned means, not ends. Both Headquarters USAF and TAC wanted a new fighter, but the multi-purpose advocates believed it best to present the F-X as a successor to the F-4, whereas the air superiority proponents were equally convinced that only their approach could defeat the Navy's bid. At any rate, by early 1968, the air superiority advocates had gained the upper hand. A decisive factor favoring the air superiority school was that two fighter "types"--Generals Disosway and

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*The QOR was redesignated TAC ROC 11-67, 21 Feb 67. See p 13.

+The Red Baron Studies showed that the air-to-air ratio between U.S. and North Vietnamese aircraft was roughly 2.5 to 1, a marked drop from the 10-1 rate established in the Korean War.

Holloway--occupied key positions at the same time and fought persistently for their viewpoint.* However, the fear that the Navy would walk off with the prize unless the Air Force decided to "speak with one voice" united the factions.[24] In May 1968 General McConnell explained the Air Force position to the Senate's Armed Services Committee:[25]

> We had a very difficult time in satisfying all the people who had to be satisfied as to what the F-X was going to be. In fact, we had a difficult time within the Air Force. There were a lot of people in the Air Force who wanted to make the F-X into another F-4 type of aircraft. We finally decided--and I hope there is no one who still disagrees--that this aircraft is going to be an air superiority fighter.

When asked if the F-X might also be used for close air support, the Air Force Chief of Staff replied, "It would be over my dead body."

(U) Meanwhile, the Navy had undertaken to improve its fighter's energy maneuverability characteristics whenever the Air Force did so. Dissatisfied with the VFAX, its replacement for the F-111B model of the TFX, the Navy decided to cancel it and tacitly accept an unsolicited bid from Grumman Aircraft--a traditional Navy contractor--to develop a more competitive fighter.+ Designated the VFX,‡ the Navy's proposed aircraft combined previous multi-mission requirements including air superiority, in two variant designs--the VFX-1 and the VFX-2. The Navy now argued that the VFX not only could match the F-X performance but was also adaptable to both carrier and land-based operations.

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*General Disosway continued to apply the leverage which the TAC-PACAF-USAFE tri-commanders' forum afforded. General Holloway spoke out on the subject in a lengthy article, "Air Superiority in Tactical Air Warfare," Air University Review, Mar-Apr 68, pp 2-15.

+The Navy did not officially cancel the VFAX until June 1968, although it began considering this action in late 1967.

‡The VFX subsequently became the F-14 "Tomcat."

Clearly, the Air Force's task was to counter Navy strategy by presenting an unqualified air superiority fighter--one uncompromised by secondary mission requirements. One compromise remained, however--namely, the F-X had to accommodate Sparrow missiles to shoot down the high-flying, high-speed Soviet Foxbat.

(S) In May 1968 General McConnell assigned top priority to the F-X program and designated 1 January 1969 as the target date for implementing contract definition.[26] This meant strengthening the F-X program office at Wright-Patterson AFB, Ohio, and providing all available "manpower or other resources to get the job done."[27] Further encouragement came from Dr. John Foster (the new DDR&E) who predicted that the F-X would get OSD approval by September 1968. AFSC's vice-commander, Lt. Gen. Charles Terhune, stressed the importance of running an exemplary program to gain support for the F-X from the next administration which would take office in January 1969.[28]

(U) By the spring of 1968 DDR&E accepted that its commonality drive had petered out. Dr. Foster recommended, however, that the Air Force and Navy conduct a joint engine-development program--the one item both services had agreed upon. (The Navy was interested in the engine because it would provide more thrust than the TF-30 engine intended for the VFX.)* In June Assistant Secretary of the Air Force for R&D, Alexander Flax, told AFSC to proceed with a unilateral program because he considered the commonality issue dead. To unify the effort, the Air Force made Brig. Gen. Roger K. Rhodarmer liaison for F-X activities.+ He proceeded to select a staff of fighter pilots including Colonels John Boyd and Robert Titus and Major John Axley, to help him sell the F-X program. General Rhodarmer saw his task as twofold: First, he had to achieve a unified position within the Air Force, specifically by resolving outstanding differences. This was no mean task, since TAC and ASD continued to clash over such basics as the F-X's maximum speed, energy maneuverability, and

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*See p 55ff.

+An Air Staff F-X office was established, with General Rhodarmer as its director.

structural loads. The second task was to steer the F-X documentation through OSD and Congress.[29]

Point Design Studies

(S) Meanwhile, the Air Force on 11 August 1967 had solicited bids from seven aerospace companies for a second round of studies. These "point design" studies sought to refine the F-X concept in four areas: (1) validating the aircraft's performance in wind tunnel tests; (2) matching propulsion requirements against performance; (3) examining the preferred avionics and armaments systems; and (4) studying the effects of crew size.* In short, the effort was to establish a technical base for the F-X proposal. On 1 December the Air Force awarded study contracts to General Dynamics and McDonnell-Douglas, while Fairchild-Hiller, Grumman, Lockheed, and North American undertook unfunded studies. All investigations were completed by June 1968, at which time a composite Air Force team assembled at Wright-Patterson AFB, Ohio, to "scrub down" the results and rewrite the Concept Formulation Package.[30]

(U) More than 100 people helped in the scrub down effort headed by Col. Robert P. Daly. The basic airframe issues were resolved within reasonable time, but the avionics caused considerable disagreement. A major issue in the avionics controversy concerned the F-X fire control system. Specifically, the multi-purpose advocates tried to retain such items as terrain-following radar and blind-bombing capability. They argued that "advances" in radar, antennas, and computers would permit inclusion of these features, but overlooked both the costs and risks involved. The scrub down was only partly successful, since many high-risk, high-cost items remained.[31]

CFP Supplement

(S) Although differences remained, the point design studies and scrub down proved fruitful. In August 1968 the Air Staff issued a supplement to the CFP that not only updated the original

*Dr. Alexander Flax, Assistant SAF for Research and Development, claims to have influenced the decision to provide a two-seat version of the F-X for later growth. [Intvw (U), author and Dr. James Hasdorff with Dr. Alexander H. Flax, 27-29 Nov 73.]

formulation document but also recommended some fundamental changes. For example, there no longer remained any ambivalence over the Air Force's air superiority doctrine. Thus, the CFP supplement stated:[32]

> It is sometimes held that air combat of the future will assume an entirely different complexion than that of the past. The Air Force does not share that contention. To the contrary, tactical applications of air superiority forces will remain essentially the same for the foreseeable future.

(S) It further noted that the war in Southeast Asia had taught the Air Force that smaller-sized aircraft could better escape radar and visual detection. Thus, the supplement specified a one-man crew for the F-X but retained a two-man trainer version. The wing planform remained open, although the "Representative F-X" described a swing-wing rather than a fixed-wing design. The major subsystems--engine, radar, and gun--would be selected on a competitive flyoff basis. While the Air Force did not resolve some of the difficult issues, it decided to stress the air superiority aspects of the F-X and relegated to a secondary or bonus status air-to-ground capabilities.

(S) F-X costs in the August 1968 CFP supplement were presented on a different basis than they had been the previous year. In 1967, for example, cost estimates were predicted on a 10-year, 1,000 aircraft buy, whereas the 1968 estimates considered a 635-aircraft production run:[33]

F-X Cost Estimates (1968)

Development cost	$1,162.46 million
Investment cost	7,070.29 "
Flyaway cost per aircraft	4.68 "
Operating costs	5,666.71 "
Total system cost	13,899.46 "

Table 2

On 15 August, General McConnell approved the F-X source selection plans and the joint Air Force-Navy engine development program. Secretary Brown's endorsement came the next month.[34]

(S) The final task in the concept formulation phase was to write an F-X Development Concept Paper (DCP). Prepared by DDR&E's staff with Air Force assistance, the DCP described the F-X as "a single-place, twin-engine aircraft featuring excellent pilot visibility, with internal fuel sized for 260 nm design mission, and...a balanced combination of standoff [missiles] and close-in [gun] target kill potential." The one-man crew decision, validated during the point design studies, was predicated on the ability of a single pilot to perform nearly all missions assigned. The penalties for adding a second crewman, which included 5,000 to 6,000 pounds of extra weight at a cost of $500,000 per aircraft, were considered unacceptable. The twin-engine design was selected because it featured faster throttling response, commonality with the F-14, and earlier availability.[35]

(S) The DCP called for a 260-nautical mile (nm) mission radius including a 200-nm cruise out and back, and a 60-nm low-altitude terminal dash with between 2.5 and 3 minutes of maximum-power combat time. This capability replaced TAC's original requirement for a 100-nm dash with 5 minutes combat time. Still, the internal fuel load, plus the external tanks going out, provided the F-X with an 800- to 850-nm radius of action compared to the 450-nm for the F-4. Operational experience in World War II, Korea, and Vietnam influenced this decision by showing that the amount of internal fuel determined fighter performance and combat time over enemy territory.[36]

(S) In terms of speed, there was some compromise away from TAC's original requirements. The sea level maximum speed was set at Mach 1.2, to provide a continued U.S. advantage over Soviet fighters in that region, although relaxing the requirement to Mach 0.9 could have saved 2,000 pounds in weight. Similarly, TAC settled for a maximum speed of Mach 2.3, with bursts of Mach 2.5, as against its original Mach 2.7 requirement that would have added 3,000 pounds to the F-X weight and reduced its dash radius to 30 nm. (The Development Concept Paper failed to point out that to try to achieve Mach 2.7 would have greatly increased the cost of the F-X because of the added titanium metal content.)[37]

(S) The most ambiguous features, however, involved the F-X radar and avionics packages, which were lumped together as "flexible vs. specialized counterair capability." Accordingly, such items as the "auxiliary power unit, soft-field landing gear, tail hook, drag chute, auto-pilot, self-sealing or foamed fuel tanks, armor, and bullet-proof glass" were justified on the basis of their survivability features. This equipment increased the aircraft's load factor (from 6.5 g at 60 percent fuel to 7.33 g at 80 percent fuel) and gross weight (from 30- 35,000 pounds to 40,000 pounds) but was justified as necessary for the early detection of the enemy. "Feather Duster" and "Have Doughnut," two tactical-fighter flight tests conducted in 1968, showed that early detection of enemy aircraft was essential to permit a pilot to get into position for a first--and usually lethal--shot. Thus, the choice was between a smaller, lighter aircraft that would be difficult for the enemy to detect and a larger aircraft like the F-X that could more easily detect an enemy aircraft. Although selecting the latter, the Air Force left open a final tradeoff until sometime during the contract definition phase.[38]

(S) Cost estimates changed again because of a revised aircraft buy. The Air Force's future tactical force had been restructured to 29 wings, including 9 F-4, 5 F-X, 7 F-111, and 4A-7 and 4A-X (later A-10) wings. This plan required only 520 aircraft.[39]

DCP 19 F-X Program Costs

Development cost	$1,078 million
Investment cost	4,059 "
Flyaway cost per aircraft*	5.3 "
Operating costs (10 years)	2,991 "
Total system cost	8,128 "

Table 3

*The unit cost of an aircraft can be very confusing because of the misleading terminology used. Flyaway cost represents the basic cost of an aircraft without R&D, spares, initial production and support costs. Unit production cost omits costs for R&D. Unit program cost includes the unit production cost plus all R&D, test and evaluation, ground support, training equipment, spares, and depot tooling. For example, Air Force Magazine, June 1971, p 30, cited the F-15 flyaway cost at $6.2 million, unit production cost at $7.6 million, and unit program cost at $10 million. [Memo (U), Hansen to Seamans, subj: Congressional Hearing Resume, 22 Jul 69.]

Prototyping Rejected

(S) The final issue in the F-X DCP was whether to pursue contract definition or prototyping for aircraft procurement. Dr. Foster, who had succeeded Brown as DDR&E, supported the Air Force's request to begin contract definition immeidately, whereas Dr. Enthoven* favored a 9-month postponement to permit study of a smaller, lighter-weight fighter that would be "based on the competitive prototype approach."[40] The Air Force argued it could afford neither the delay nor the estimated $600,000 cost of prototyping.+ Moreover, the Air Force indicated that the aerodynamic and avionics risks were not great enough to require building a prototype.[41]

(S) Actually, the Air Force position on this issue had grown out of a "sense of urgency" because of the challenge from the Navy's VFX and the inauguration of a new President who would make the usual changes in OSD's civilian leadership. The Air Force, therefore, found it expedient to "keynote...urgency over ideal procurement."[42] The F-X airframe would be purchased via the Total Package Procurement concept, but higher risk subsystems would undergo competitive prototyping. Both those who favored "total package" and the prototype advocates believed that their particular approach would prove faster in the long run. Two other alternatives--to improve the F-4 and to develop the Navy's VFX (F-14) for the Air Force--were dismissed because of cost and mission incompatibility. On 28 September 1968, Deputy Secretary of Defense Paul H. Nitze approved contract definition of the F-X.[43]

(U) These efforts demonstrated that, although differences remained within the Air Force, outwardly it could present a unified stand. The Air Force had won approval to develop a new fighter (the F-X becoming the F-15),‡ marshalled its resources toward that goal, and established a central office in Washington to deal with whatever problems arose.

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*See p 6.

+In the fall of 1966, Brig. Gen. F. M. Rogers, Assistant Deputy Chief of Staff for Development Plans, HQ AFSC, investigated and later recommended prototyping as an alternative acquisition strategy for the F-X. However, except for General Ferguson, the Air Force secretariat (led by Dr. Flax) and Air Staff officials rejected the proposal. [Intvw, author w/General Rogers, 17-18 July 1974.]

‡With superstition influencing the Air Force to reject the F-13 as the designation for its new fighter, it chose F-15 instead. [Ltr (U) R. F. Semler, Dir/Engnrg Stds (ASD) to ASZQ, subj: Request for Designation (ASZQ Ltr, 12 Sep 68), 24 Oct 68.]

IV. CONTRACT DEFINITION

On 30 September 1968, the Air Force launched the F-X contract definition phase by soliciting bids from eight aircraft companies. Only four contractors responded--Fairchild-Hiller, General Dynamics, McDonnell Douglas, and North American. Four other firms--Boeing, Lockheed, Grumman,* and Northrop--had participated in the concept formulation effort but did not submit proposals. In November-December the Aeronautical Systems Division and the F-15 program office (established in August 1966) began evaluating the four proposals and negotiating with the firms. On 30 December 1968 Dr. Flax announced the award of $15.4 million in contracts for contract definition to all bidders except General Dynamics.+ They were asked to submit technical proposals--including the projected cost of the aircraft and a development schedule--by the end of June 1969.[1]

As contract definition began, a question arose over the number of competitors the Air Force should maintain and for what length of time. In February 1969, shortly after becoming Secretary of the Air Force, Dr. Robert C. Seamans issued new guidelines to reduce the number of contractors. These guidelines required the firms to indicate the number of workers and the amount of other resources that each proposed to devote to the competition and updated information on their planning and organization, their record of correcting deficiencies, and the effect their other aircraft programs‡ might exert on the F-15. Dr. Seamans also assigned Robert Charles, his assistant for Installations and Logistics (I&L) to investigate each firm's ability to assume the commitments and

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*Grumman was in hot pursuit of the Navy's F-14 contract, which it won in February 1969.

+General Dynamics was eliminated during the evaluation process but the Air Force was unable to further trim the competition to two contestants. [Memo (S), Foster to Dep SECDEF, subj: F-15 Status, 3 Mar 69.] See Appendix I for a complete breakdown of F-15 funding.

‡All three were competing for other contracts: Fairchild-Hiller for the A-X (A-10), North American for what became the B-1 bomber, and McDonnell Douglas for the F-14.

risks required by the new contractual approach.* Secretary Seamans hoped the information obtained would enable him to eliminate one of the three contractors by April and another by September 1969.[2]

(U) Dr. Foster, on the other hand, believed that the three F-15 contestants should continue to compete for a longer period and he suggested the Air Force extend the competition to January 1970. He thought the delay would be well worth the extra costs; that the extended competition might prove a good investment in terms of the final cost of the F-15 development contract.[3]

A New Contracting Philosophy

(S) Meanwhile, a rising tide of public and Congressional criticism over the enormous cost overruns in the C-5A program forced the Air Force to drop its plan to procure the F-15 under the fixed-price "total package" concept used for the huge cargo aircraft. Maj. Gen. Harry E. Goldsworthy, ASD commander, was directed to set up a study group to recommend an alternative approach. In a report to General Ferguson, Goldsworthy pointed out that while no single element of the F-15 proposal represented an inordinate technical risk, its proposed integrated system would be a major challenge to an industry that had little recent experience in developing an air superiority fighter. Moreover, he maintained that cost estimates for an aircraft yet to be designed were highly unreliable, especially considering the 5- to 7-year lead time required to build a new fighter.[4]

(S) The ASD commander cited the C-5A experience as demonstrating the futility of relying on cost projections for long-term programs. Although "total package" could stablize engineering changes and quantity schedules, it also inhibited technical innovation because it tied the contractor to a fixed-price arrangement that emphasized cost over performance. Thus, Goldsworthy advocated some kind of production commitment during the competitive phase of the program but only if it also protected the contractor against unreasonable finanacial risk. As a corrective, he recommended relying on a cost-type arrangement for the development

*See the following Chapter ("A New Contracting Philosophy") for details.

phase with a fixed-price incentive provision to govern the production phase.*5

(S) Another weakness seen in the "total package" procurement approach was that it committed the government to production without providing adequate control over technical development and allowed the contractor to adjust designs and costs during development. General Goldsworthy believed that if the contractor's financial risk was minimized he would not "cut corners" and therefore would produce a better aircraft. Moreover, by allowing the Air Force to authorize initial production and permit separate prototype development for the high-risk subsystems, the new approach would avoid later modifications because of inadequate design. Finally, this approach reduced concurrency+ between production and development by proof-testing the weapon system prior to releasing it to large-scale production.6

Selling the New Approach

(S) If the Air Force seemed satisfied with the Goldsworthy procurement method, OSD was not. Through the spring and early summer of 1969, Secretary Seamans pressed OSD to grant its approval.7 Dr. Foster, however, continued to act as a "nemesis" by opposing anything other than a fixed-price contractual arrangement. Preoccupied with spiralling costs for tactical weapons, he cautioned that the F-15 might have to be placed "on an equal-cost basis," in which "explicit force tradeoffs" would have to be specified and "either the number of aircraft or other Air Force tactical air programs would have to be reduced." To avert this compromise, Dr. Foster urged the Air Force to monitor the F-15's cost growth closely and advise its contractors that it sought an aircraft that would achieve the majority of its design objectives.8

(S) Meanwhile, although he was said to favor the Air Force plan, Deputy Secretary of Defense David Packard had not made a

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*The C-5A program contract included a fixed-price for all aspects of development and production.

+When development and production occur together (concurrently), development mistakes are more costly if not corrected before production begins. Therefore, reducing concurrency usually saves money.

decision. At a crucial meeting with Seamans in June, he conceded it was unrealistic to delay further the setting of a price for the F-15. Packard indicated his preference for the "soundest-priced" aircraft over the cheapest one and agreed that the development and production phases ought to be conducted separately. However, the unresolved question remained whether to proceed with a cost-type development contract.[9]

(U) With OSD delaying its authorization, Secretary Seamans was forced to withdraw his original February 1969 guidance to the contractors regarding the proposed production schedules and to ask them to provide ceiling-price estimates that the Air Force might invoke at its discretion. He also requested the firm to submit a plan to maintain a production capability until production approval was granted. Finally, he asked the contractors to propose a set of demonstration milestones that they would be committed to reach so as to "provide technical confidence in the program." These milestones (see Table 4 on p 37), which were to prove central to the new weapon system acquisition approach, would be negotiated with the successful bidder.[10]

(C) Dr. Foster, continuing to insist that a fixed-price arrangement was the only approach he would support, recommended another round of design studies to reduce the F-15's requirements and realign the aircraft's flyaway costs to the $5.33 million figure specified in the DCP.[11] Though opposed to his reasoning, the Air Force offered to ease some of the aircraft's air-to-ground mission requirements.[12] On 27 June, with contract time running out, Secretary Seamans appealed once again to the Deputy Secretary of Defense. That same day, Secretary Packard gave the Air Force the go-ahead on its F-15 contracting method.*[13]

(U) The F-15 contract negotiations, conducted during November-December 1969, involved a total of six contracts with three airframe

*Throughout the contract definition phase, the Air Staff office, headed by General Rhodarmer, played a major role in selling the F-15 program to the new administration. Eventually, OSD adopted the program as its own creation and sallied forth to show everyone just how effectively a weapon system program could be managed.

F-15 DEMONSTRATION MILESTONES*

	Event	Estimated Date	OSD Decision Point
A.	DEVELOPMENT GO-AHEAD		Dec 69
1.	Preliminary Design Review	Sep 70	
2.	Radar Contractor Selected	Sep 70	
3.	Critical Design Review (Air Vehicle)	Apr 71	
4.	Avionics Equip Development Review	Jun 71	
5.	Struc Test - Major Airframe Subassemblies	Nov 71	
6.	Engine Preliminary Flt Rating Test (PFRT)	Feb 72	
7.	Engine/Inlet Compatibility Test (AEDC)	Mar 72	
8.	First Flight	Jul 72	
9.	Bench Avionics Integration Complete	Sep 72	
10.	Initial Acft Performance Demo	Sep 72	
B.	LONG LEAD RELEASE (U/E AIRCRAFT)		Oct 72
11.	Initial Abn Avionics Performance	Dec 72	
12.	Fatigue Test - One Lifetime	Jan 73	
13.	Static Test - Two Critical Conditions	Jan 73	
14.	Engine Military Qualification Test (QT)	Feb 73	
C.	FIRST WING RELEASE		Feb 73
15.	Armament Ground Test	Jun 73	
16.	One (1) G Flight Envelope	Aug 73	
17.	Fatigue Test - Three Lifetimes	Nov 73	
18.	AF Performance Summary Evaluation	Dec 73	
D.	RELEASE RATE TOOLING		Jan 74
19.	Equipment Qualified	Mar 74	
20.	Cat II Test Acft and Equip in Place	Mar 74	
21.	Training Equipment in Place	May 74	
22.	Fatigue Test - Four Lifetimes	Jul 74	
23.	External Stores Flutter Release	Aug 74	
24.	AGE Equipment in Place	Oct 74	
25.	Cat I Flight Test Essentially Complete	Nov 74	
26.	First Aircraft to TAC	Nov 74	
E.	SECOND WING RELEASE		Dec 74

*Based on DCP 19A, 4 Nov 70, p 7 Data as of Dec 1969 (estimated).

Table 4

companies. Each company also signed contracts with two engine manufacturers. The idea was to have all these contracts in force, pending first the Air Force's selection of an airframe builder and, following that, the engine developer. In effect, the Air Force obtained commitments without having to wait for the results of the competitions. Table 5 (p 39) specifies the kinds and numbers of aircraft planned for the F-15 force structure at this point in contract definition.

(U) Although Dr. Foster continued to provide "informal direction" to the F-15 program office, the new contracting method remained intact. Air Force officials did not delude themselves into thinking that the milestone contracting method offered any more than a first step in the right direction.[14] Conducting a detailed and frank self-analysis of the problems that they might face with the contract, they apparently resolved most of them before selecting the winning contractor.*[15]

The F-15 Program Office

(S) Several years before contract negotiations began, the Air Force established an F-X special projects office at Wright-Patterson AFB, Ohio, to oversee development of both the F-X and A-X close air support aircraft. The office first came under ASD's Deputy for Advanced Systems Planning, more specifically, the General Purpose Planning Division. Established on 12 August 1966, it was initially headed by Col. Robert P. Daly and allotted 17 "validated" positions.[16]

(S) Throughout 1967, Colonel Daly's staff was preoccupied with the task of preparing the F-X concept formulation documents. These ranged from a description of the program to documents dealing with planning, programming, and funding. The System Program Office (SPO) also provided extensive data to satisfy OSD's demands for a proposed joint Air Force and Navy advanced tactical fighter. Headquarters USAF established January 1969 as the target date to begin contract definition, and in May 1968 the A-X (later A-10) close support fighter SPO was separated from

*For a detailed account of the F-15 contract, see Appendix 2.

F-15 Force Structure

Total aircraft	749	
UE Aircraft	432	(6 wings)*
Training Aircraft	108	
Test and test support	12	
Command support	54	
Attrition	143	
Deployment		3 tactical wings in ZI 3 tactical wings overseas (1 PACAF and 2 USAFE)

*Each wing will have 3 operational squadrons of 24 aircraft each, i.e. 6 wings x 3 squadrons x 24 aircraft = 432 UE.

Table 5

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the F-X and set up as a separate entity. In June 1968 Col. Robert M. White became the new SPO director.*17

(U) With the creation of the F-X focal point in Washington in the spring of 1968, the SPO was spared the press attention normally devoted to a weapon system development program. Following OSD's approval of the F-X DCP in September 1968, the SPO was reorganized on 7 October and assigned to the Deputy for Systems Management for both operational and administrative support. A number of internal changes occurred at this time, including setting up four divisions: configuration management, program control, procurement and production, and test and deployment. Generally, however, the SPO continued to perform the mundane functions of management.

*Working with the Air Force executive agent designated for the joint USAF-Navy engine program, General McConnell promised to man the SPO fully. From 1967 to May 1968, authorized strength rose from 17 to 50. On 1 April 1968, after Colonel Daly was named ASD Deputy for Development Planning, Col. Lloyd M. N. Wenzel became interim SPO director until Colonel White's permanent appointment in June.

(U) An important change that affected the F-15 SPO took place on 11 July 1969 when Brig. Gen. designee Benjamin N. Bellis was named its new director, replacing Colonel White who became his deputy.* General Bellis was one of the Air Force's most experienced R&D managers, with service dating back to a 1947 assignment to the Special Weapons Project at Sandia Base, N. Mex. Having made his reputation in the development field with the Matador and Atlas missiles, he later managed the F-12/SR-71 aircraft development project and served as ASD Deputy for Reconnaissance and Electronic Warfare before assuming the F-15 directorship. In addition, General Bellis had written the Air Force 375-series management regulations, acquired his own warrant as a procurement specialist, and earned advanced degrees in aeronautical engineering and business administration. Considered the ideal man to direct the Air Force's top priority F-15 program,[18] he was the unanimous choice of Secretary Seamans and Generals Ferguson and John D. Ryan, the new Air Force Chief of Staff.[19]

(U) By July 1969, the F-15 had become identified as the model development and procurement program for both the Air Force and OSD. Recognizing the program's important status, the Air Force broadened the authority of the new director. In reviewing his responsibilities, General Bellis, too, was well aware of their importance. Describing his role in 1970, he said:[20]

> I am the single individual who must account for the progress, expenditure of funds, problems and solutions that will make the F-15 a successful part of the Air Force inventory.... I can hold down changes that might only add higher costs and complexity without increasing the true capability of the F-15 fighter. I am the single source of decision for integrating all elements of the system, and this allows me a proper perspective on total dollar costs and technical progress. With this type of control, there can be no excuses for uncontrolled changes.

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*The general officer position was established from the vacancy opened by the cancellation of the Manned Orbital Laboratory (MOL) program in June.

General Bellis later expressed his confidence in the program, saying "we will not only produce the number-one aircraft in the U.S. inventory but also reestablish the Air Force's credibility as a manager of major weapon system programs and regain the confidence and support of the Congress and the taxpayer."[21]

(U) On 19 October, the F-15 office became a "Super SPO" when General Bellis was named Deputy for F-15. In reporting directly to the AFSC commander, he bypassed ASD, which remained responsible for providing administrative support only. To centralize control, the new F-15 Deputy reorganized the SPO, assuming total responsibility for program management, including the engine, armaments, and avionics systems. The Joint Engine Program Office (JEPO) became a component of the F-15 SPO. Colonel Wenzel, who headed the engine office and had a naval officer as deputy, answered to General Bellis, but the deputy reported to the Navy's F-14 program manager. General Bellis, in turn, reported on the engine program to both AFSC and the chief of the Naval Materiel Command. The JEPO was self-sufficient in procurement, engineering, and testing, but relied on the F-15 SPO for functional assistance.[22]

(U) General Bellis was also given authority to select the best personnel he could find to join the F-15 project. Following cancellation of the Manned Orbital Laboratory program in June 1969, he was able to handpick top-caliber people for his staff, which in a short time grew to about 230 people--half military and half civilian. The prestigious F-15 assignment attracted many experienced, highly competent people to the program. Moreover, because General Bellis was keenly interested in the career advancement of his staff, he was able to build a tightly-knit and well-motivated group.[23]

(U) After studying the SPO's internal organization, General Bellis increased the number of its directorates to include procurement and production, test and deployment, configuration management, integrated logistics support, program control, systems engineering, and projects. The last-named was unique in that it was responsible for insuring that its vital components--airframe, avionics, and armaments--were developed and available when needed. This arrangement permitted General Bellis to exercise strict control over systems development.[24]

(U) General Bellis' staff also included liaison officers from TAC, Air Training Command (ATC), and Air Force Logistics Command (AFLC). Their function was to provide close coordination with the user commands so that the first F-15 wing could become fully operational at the end of the development and testing phases. For example, a Systems Application Panel brought together veteran TAC pilots to make sure the F-15 would remain a "fighter pilot's plane."[25] Finally, General Bellis established a Straight Arrow Group to guard against improper conduct between SPO personnel and the F-15 contractors.

(U) However, some aspects of General Bellis' management caused controversy. For example, he was sometimes overly secretive in managing the F-15 office--a tendency that probably derived from his experience with the "hush-hush" SR-71 project. General Bellis believed that he alone was responsible for program management and brooked no outside interference. His tough stance that the Air Force could replace him whenever it felt he was not doing his job embittered his relations at times with officials in the Air Force Secretariat who were authorized to monitor the F-15 program. By concentrating authority within the SPO, General Bellis made outside inspection of his activities difficult. Indeed, during the source selection phase in the late summer and fall of 1969, he complained about the intensive scrutiny that the F-15 was receiving from various agencies. As a result, Secretaries Seamans and Packard instructed Air Force and OSD officials to operate strictly through the F-15 SPO in their work.[26]

Management Facelift

(U) The F-15 reorganization marked the beginning of a thorough housecleaning of the Air Force's management procedures. Under Congressional pressure because of the unhappy C-5A experience, Defense Secretary Melvin Laird decided that a Presidential "Blue-Ribbon" panel should examine the Department's procedures. However, because the development problems could not wait, Secretary Packard conducted his own assessment. Concluding that "total package" was not working, he undertook to make extensive changes. His first action was to eliminate unessential layers of staffs in decision-making. He also improved cost-estimating procedures and placed greater emphasis on prototyping, i.e., "flying before buying."

(U) In April 1969, anticipating the need to improve the Air Force weapon-system acquisition process, General Ferguson decided to centralize program control. He advised ASD that all configuration changes for the F-15 "affecting the mission, increasing the weight or target cost, and impacting the schedule" would be approved by a triumvirate including himself, General Ryan, and Lt. Gen. Marvin L. McNickle, the Deputy Chief of Staff (R&D).[27] Next, General Ferguson convinced Secretary Seamans and General Ryan to reorient the Air Force management philosophy. The first step was to get the Air Staff out of the management "business" by shifting the Program Element Monitor (PEM) function to AFSC.* This move, effective 1 August 1969, freed the Air Staff to "focus on policy and plans," and enabled General Ferguson as AFSC commander to monitor the program through the new F-15 SPO. However, his recommendation to establish an AFSC liaison office in the Pentagon was turned down.[28]

(U) The new reporting channel--from Bellis to Ferguson to Ryan and Seamans--was called the Blue Line. It fulfilled the Air Force's decision to reduce "the number of review echelons."[29] The AFSC program monitor, known as the Assistant for F-15, assumed the duties previously assigned to General Rhodarmer during the F-15 advocacy stage and also served as the Washington area focal point for all F-15 matters. The monitor briefed the Air Staff monthly on the F-15's progress, while General Bellis presented quarterly briefings and written reports--known as Selected Assessment Reviews--to Secretary Seamans, General Ryan, and other top officials. This arrangement insured tight program control and released the F-15 SPO to concentrate on day-to-day management activities.[30]

(U) These streamlined procedures, which closely paralleled Secretary Packard's views on weapon system management, account

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*The transfer of the F-15 PEM function to AFSC foreshadowed similar changes in other Air Force development programs. Thus General Ryan assigned the F-111, Minuteman, and Program 647 (a classified space project) to AFSC, effective 1 November 1969. He justified these actions by citing the successful streamlining of the F-15 program management and the need to meet manpower reductions that the administration imposed. [Ltr (U), Gen Ryan to Gens Ferguson and McNickle, subj: Air Force RD&A in the Washington Area, 18 Sep 69.]

for the harmonious relationship that existed between OSD and the Air Force on the F-15 program. After meeting with General Ferguson in June 1969, Secretary Packard established specific guidelines for weapon-system managers:[31] (1) use a standard program information format for OSD, USAF, and AFSC; (2) reduce paperwork by providing less detailed information at each successively higher level; (3) insure decisions are made expeditiously, with authority delegated to the SPO;* (4) definitize+ all changes in weapons; and (5) weigh costs against schedule and performance factors in approving changes in weapons under development with contractors. In May 1970, after having formalized these weapon-system management principles, Secretary Packard sent memorandums to the Service secretaries in which he emphasized that OSD's role was to: 32

> enable the Services to improve their management of WS [weapon system] programs. Improvement in the execution of these programs will be made to the extent the Services are willing and able to improve their management practics. The Services have the responsibility to get the job done. It's imperative they do the job better in the future than in the past.

Source Selection

On 1 July 1969, the three F-15 airframe competitors--Fairchild-Hiller, McDonnell-Douglas, and North American--submitted technical proposals and 2 months later, on 30 August, their cost proposals. The Source Selection Evaluation Board (SSEB), headed by General Bellis, then evaluated these bids, examining 87 separate factors under four major categories--technology, logistics, operations, and management. They rated the competitors in each category and, without making a recommendation, submitted the raw data to a Source Selection Advisory Council (SSAC), comprised of

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*OSD was told to stop "meddling" in management [Memo (U), Packard to OSD, subj: F-15 and Related Management Action, 11 July 69.]

+To definitize is to spell out all changes to a system, including proposed costs, schedule, and application, on a firm contractual basis. This provision insures that all changes in a system are contractually binding before approval is granted to proceed with work.

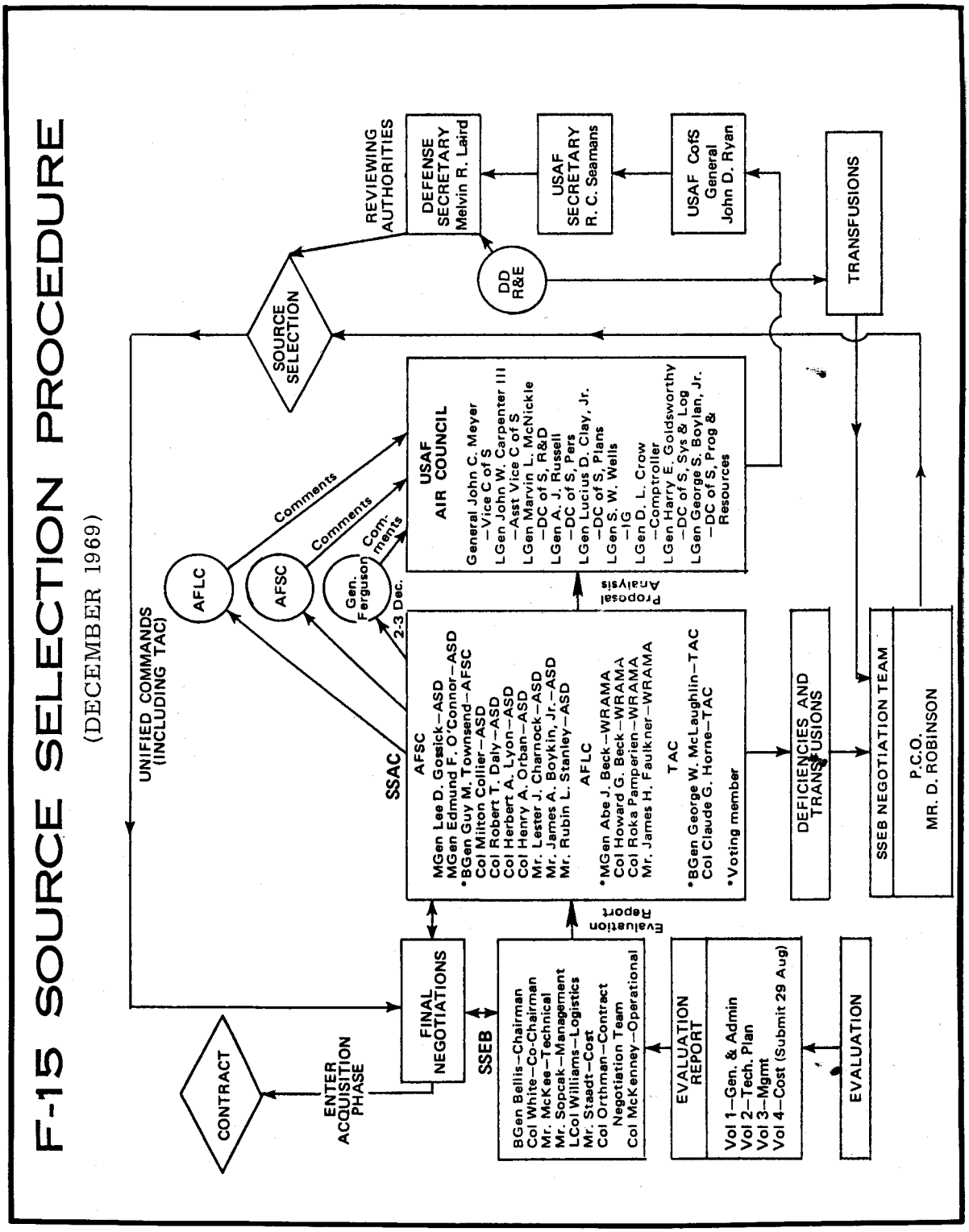
F-15 SOURCE SELECTION PROCEDURE
(DECEMBER 1969)
UNIFIED COMMANDS (INCLUDING TAC)
AFLC
AFSC
Gen. Ferguson
2-3 Dec.
Comments
Comments
Comments
SSAC
AFSC
MGen Lee D. Gossick—ASD
MGen Edmund F. O'Connor—ASD
*BGen Guy M. Townsend—AFSC
Col Milton Collier—ASD
Col Robert T. Daly—ASD
Col Herbert A. Lyon—ASD
Col Henry A. Orban—ASD
Mr. Lester J. Charnock—ASD
Mr. James A. Boykin, Jr.—ASD
Mr. Rubin L. Stanley—ASD
AFLC
*MGen Abe J. Beck—WRAMA
Col Howard G. Beck—WRAMA
Col Roka Pamperien—WRAMA
Mr. James H. Faulkner—WRAMA
TAC
*BGen George W. McLaughlin—TAC
Col Claude G. Horne—TAC
*Voting member
USAF AIR COUNCIL
General John C. Meyer —Vice C of S
LGen John W. Carpenter III —Asst Vice C of S
LGen Marvin L. McNickle —DC of S, R&D
LGen A. J. Russell —DC of S, Pers
LGen Lucius D. Clay, Jr. —DC of S, Plans
LGen S. W. Wells —IG
LGen D. L. Crow —Comptroller
LGen Harry E. Goldsworthy —DC of S, Sys & Log
LGen George S. Boylan, Jr. —DC of S, Prog & Resources
Proposal Analysis
SOURCE SELECTION
REVIEWING AUTHORITIES
DEFENSE SECRETARY Melvin R. Laird
USAF SECRETARY R. C. Seamans
USAF CofS General John D. Ryan
DD R&E
TRANSFUSIONS
DEFICIENCIES AND TRANSFUSIONS
SSEB NEGOTIATION TEAM
P.C.O. MR. D. ROBINSON
Evaluation Report
FINAL NEGOTIATIONS
SSEB
BGen Bellis—Chairman
Col White—Co-Chairman
Mr. McKee—Technical
Mr. Sopcak—Management
LCol Williams—Logistics
Mr. Staadt—Cost
Col Orthman—Contract Negotiation Team
Col McKenney—Operational
EVALUATION REPORT
Vol 1—Gen. & Admin
Vol 2—Tech. Plan
Vol 3—Mgmt
Vol 4—Cost (Submit 29 Aug)
EVALUATION
ENTER ACQUISITION PHASE
CONTRACT

Chart 1

representatives from the user commands and chaired by Maj. Gen. Lee V. Gossick, the ASD commander. The Council then applied a set of previously established weighting factors that they had defined in June 1969, before the start of the evaluation. Although rating the contractors in the four major categories, the Council, too, did not select a winner. Instead, it forwarded the scores through the Air Staff to Secretary Seamans, who, as Source Selection Authority (SSA), was the final decision-maker.[33]

Project Focus

(S) During this evaluation, however, Secretary Packard directed the Air Force to minimize costs by making a thorough final review (Project Focus) of the F-15 program requirements. He acknowledged that the review, in taking several months to complete, would delay the F-15 IOC date, but he felt this compromise would be worthwhile if it avoided costly mistakes.[34] The Deputy Secretary also clamped a $1 billion per year spending limit on the F-15 program and directed that Project Focus be completed by mid-November 1969 to avoid disturbing the source-selection process. Sensitive to criticism of the F-15 program, he especially examined these items:[35] recommendations for alternate avionics; simpler data and reporting systems; reducing airframe costs; alternate subsystems; and contractor suggestions.

(S) In October 1969, Dr. Foster (DDR&E) resumed his campaign to extend the F-15 selection process by more thoroughly evaluating the contractor proposals. Citing the F-111 and C-5A competitions as examples of programs that had suffered from inadequate evaluation, he stated that last-minute changes were the cause of their problems. Dr. Foster also warned that F-15 cost estimates had already exceeded the September 1968 DCP threshold and asked the Air Force to control escalating costs.[36] Ivan Selin, OSD's chief for Systems Analysis, echoed Foster's concern over the rising costs and hinted that further cuts might be in order.[37]

(S) Meanwhile, the Air Force had acted promptly to meet Secretary Packard's call for a program review. General Bellis established a Program Evaluation Group (PEG) to define a $1 billion annual production plan, restrict development funds in fiscal years 1970 through 1972, and cut unit production costs.[38] The Group quickly suggested a long list of items to reduce F-15 costs by more than $1.5 million per aircraft. As a result of Project Focus, the

Actions Taken to Hold Down F-15 Costs

Aircraft

Windshield bird-proof requirement deleted
Use "Fail Safe" in lieu of "Fail Operational" flight control system
Use F-105 escape seat technology
Install M61 gun (provide for 25-mm gun)
Delete nuclear curtain
Delete pressure suit
Delete voice warning
Eliminate soft field landing requirement
Evaluate material usage

Other

Reduce training requirements
Reduce MIS satellite complex
Reduce data requirements

Avionics

Replace vertical tapes with round dials
In the radar:
- Deleted parametric amplifiers
- Deleted low PRF long range mode
- Reduce threshold of sizable clutter
- Simplified digital signal processor
- Reduced air-to-ground map range
- Deleted inflight fault isolation
- Eliminated hydraulic boresight
- Reduced computation requirement, eliminated one computer
- Using off-the-shelf communications equipment
- Reduced inertial navigation accuracy requirements
- Using off-the-shelf navigational instrument
- Reduced IFF and TEWS packages

Test

Combined testing where common instrumentation existed
Reduced Flight test hours
Reduced spares and spare parts
Modified system demonstrations
Deleted High performance test bed
Reduced air-to-ground delivery qualifications

SOURCE: Hearings before the Senate Cmte on Amd Svcs, 91st Cong, 2d Sess, Authorization for Military Procurement, Research and Development, Fiscal Year 1971, and Reserve Strength, pt 2, p 939.

Table 6

Air Force asked its contractors to update their costs proposals in October 1969. McDonnell Douglas, reducing its cost estimate by about $500,000, submitted the lowest revised bid.[39] The cost review continued throughout the F-15 project and a subsequent General Accounting Office (GAO) report in July 1970 credited it with about $1 billion savings.[40] In December 1969, encouraged by the work of Project Focus, Secretary Packard authorized the Air Force to go forward with the F-15 development.*[41] (See Table 6, p 48).

McDonnell Wins

(U) Secretary Seamans, having announced the award of the F-15 contract to McDonnell-Douglas on 23 December 1969, estimated that the development phase, including the design and fabrication of 20 aircraft, would cost $1.1 billion.[42] Donald Malvern, McDonnell's F-15 general manager, reported that the firm had already spent 2.5 million man-hours in winning the F-15 contract. His team of between 200 and 1,000 people had worked for 2 years examining over 100 alternative designs with thousands of variations. From an economic standpoint, the F-15 contract "saved" one third of the company's 33,000 jobs in the St. Louis, Mo., area despite the fact that in 1968 McDonnell led the nation's aerospace firms, earning $95 million on revenues of $3.6 billion. The F-15 contract also promised to increase McDonnell's sagging commercial airliner sales and absorb the slack of lowered F-4 production.[43]

(U) As for the losers, North American planned to lay off 1,500 of its 6,500 Los Angeles Division employees. Ironically, the company had reduced its Advanced Manned Strategic Aircraft (AMSA) effort in May 1969 to concentrate on the F-15 competition but went on to win the bomber project in June 1970.[44] The smallest of the three companies, Fairchild-Hiller, failed to establish itself as a major defense contractor, though it did win the A-X competition in 1973.[45] Table 7, page 49 (Weighted Scores) and Diagrams 1-4 present specific details about the competing designs.

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*A major concern at this point in the F-15 development was the start of weight surveillance to insure the aircraft would remain as lightweight as possible. [Talking Paper (U), subj: AFSC Program to Improve Major Weapon System Acquisition, 30 June 70.]

SSAC WEIGHTED SCORES

Area	Maximum Achievable	McDonnell Douglas Corp	Fairchild Hiller	NAR
Technical	445	222.0	215.5	199.5
Operations	250	139.0	120.5	110.5
Logistics	200	112.0	89.5	101.0
Management	105	69.5	51.5	35.0
	1,000	542.5	477.0	446.0

SOURCE: Rprt (S) "Advanced Tactical Fighter, F-15: SSAC Proposal Analysis," s/Maj Gen Abe J. Beck, AFLC, Brig Gen George W. McLaughlin, TAC, Brig Gen Guy M. Townsend, AFSC, Maj Gen Lee V. Gossick, ASD, Ch F-15 SSAC, 25 Dec 69.

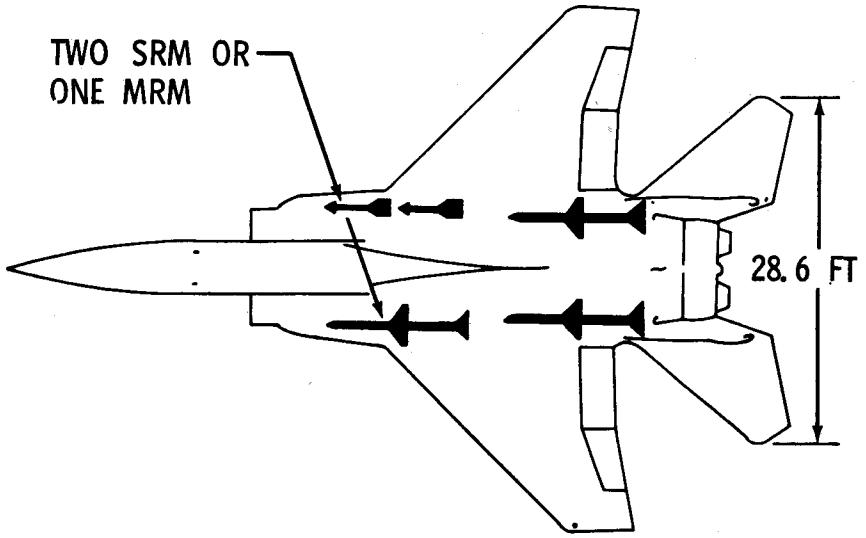
See Atch 3[1] for winning configuration.

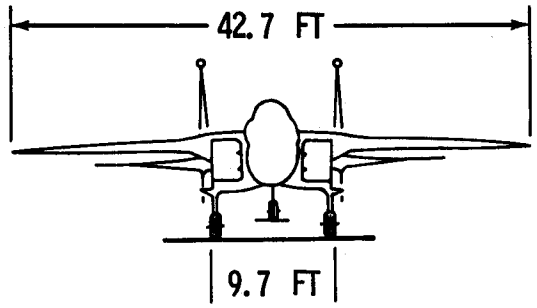
Table 7

GENERAL ARRANGEMENT

CONTRACTOR A (McDONNELL DOUGLAS)

	ENGINE	
	GE	P & W
TAKE-OFF WEIGHT (LB) (4) MRM	39,523	39,740
WING AREA (SQ FT)	608	608
ASPECT RATIO	3	3
INT. FUEL (LB)	11,300	11,500





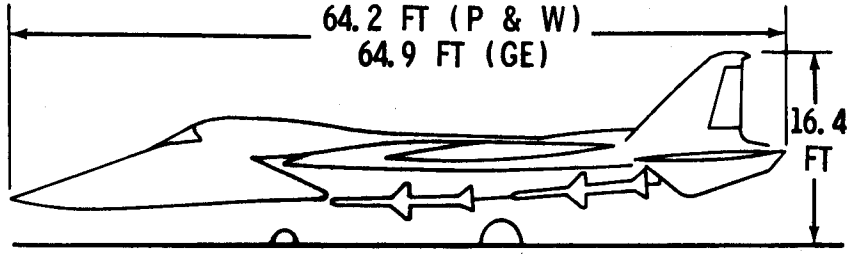
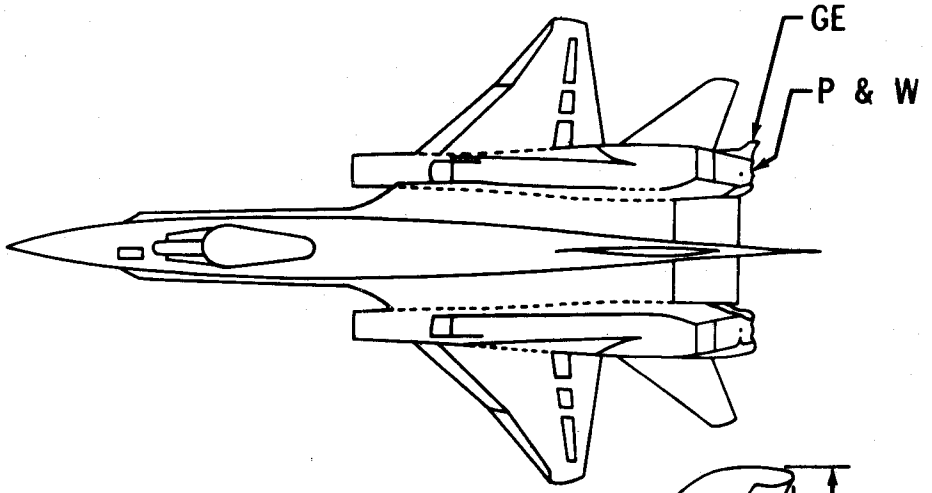


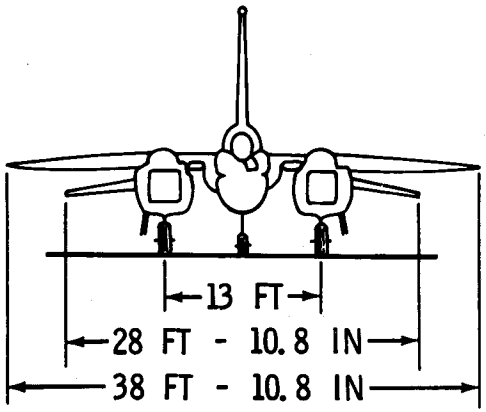
Diagram 1

GENERAL ARRANGEMENT

CONTRACTOR B (FAIRCHILD)

	ENGINE	
	GE	P & W
TAKEOFF WEIGHT (LB) (4) MRM	39,975	39,750
WING AREA (SQ FT)	527	527
ASPECT RATIO	2.87	2.87
INT. FUEL (LB)	11,100	11,100





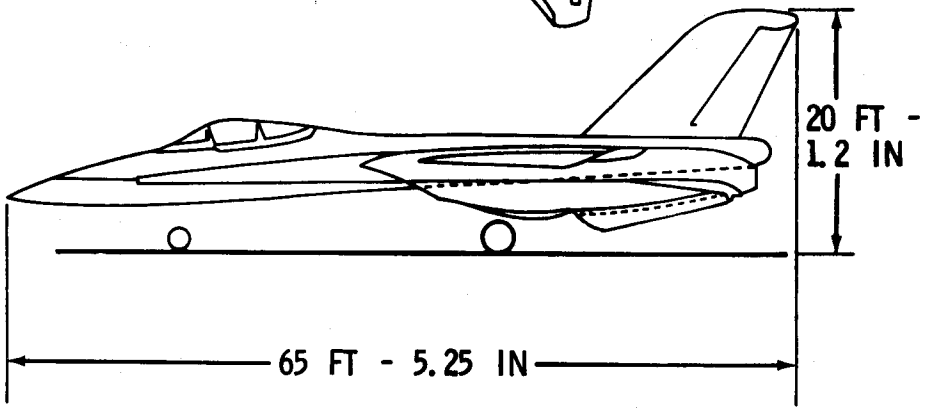
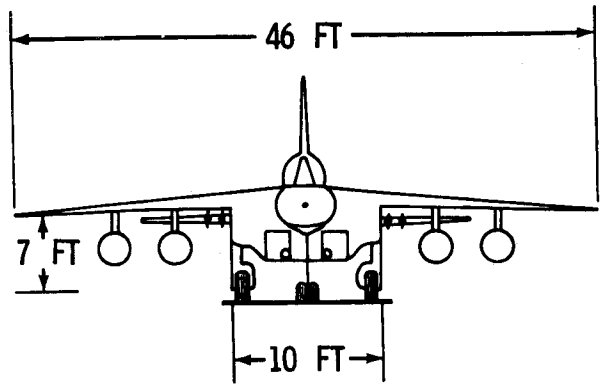


Diagram 2

GENERAL ARRANGEMENT

CONTRACTOR C (NORTH AMERICAN)

	ENGINE	
	GE	P & W
TAKE-OFF WEIGHT)LB) (4) MRM	39,200	39,222
WING AREA (SQ FT)	500	500
ASPECT RATIO	4.23	4.23
INT. FUEL (LB)	10,471	10,331



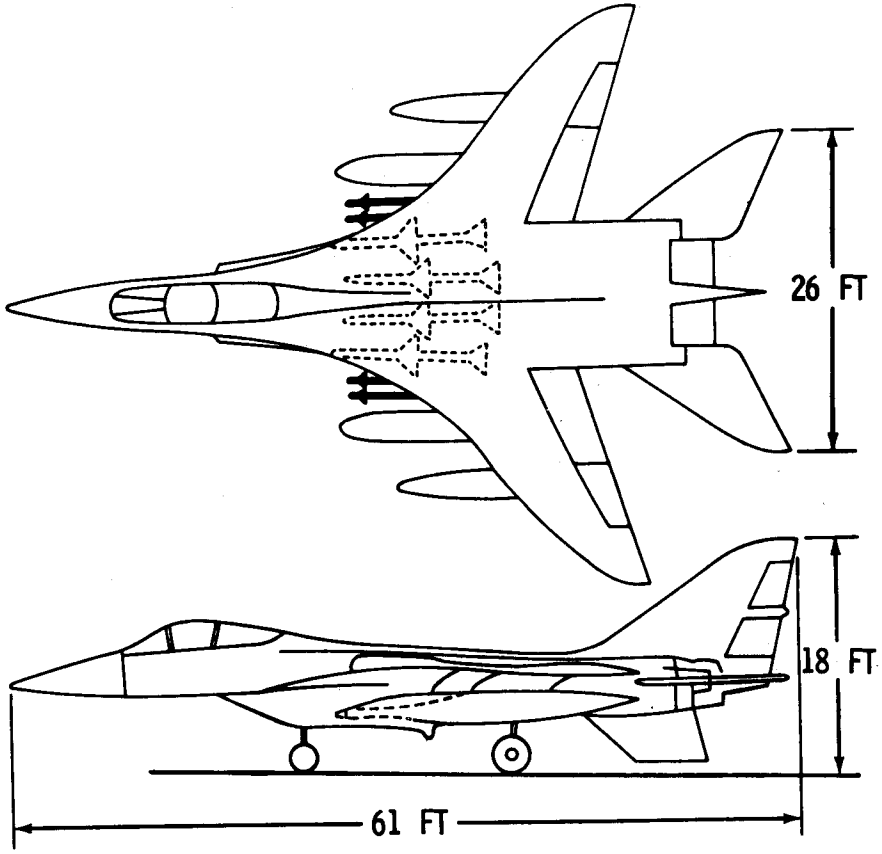


Diagram 3

SECRET

Air Force Weathers Congressional Scrutiny

(U) Before and after the award of the contract to McDonnell-Douglas, the F-15 competition was the target of considerable scrutiny from Congress and the media. One of the thorniest issues concerned disclosure of the Air Force's source selection criteria. In July 1969, John R. Blandford, chief counsel for the House Armed Services Committee (HASC), asked the Air Force to reveal this information. Assistant Air Force Secretary Philip N. Whittaker opposed meeting the request because, he argued, it would set an "extremely bad precedent." He won a reprieve until after contract award by explaining to the Committee that the release of the criteria would compromise "business confidentiality."[46] Even when the competition was completed, Secretary Whittaker parcelled out only selective bits of information to Congress.[47]

(U) In a 22 November article in the Armed Forces Journal, writer Bruce Cossaboom charged that the Air Force had illegally withheld disclosure of the F-15 source selection weighting factors from the contractors.[48] Representative Otis Pike (Dem.-N.Y.), a frequent critic of defense spending, brought the case to the House floor in December 1969, charging the Air Force with violating Section 2271, Chapter 135, Title 10 of the U.S. Code.[49] When Chairman L. Mendel Rivers (HASC) asked the Air Force to respond,[50] Secretary Seamans labelled Cossaboom's charges "mistaken" because they were based on an obsolete Air Corps Act of 1926. Reviewing the Act's legislative history, the Secretary noted that the Air Force could furnish the weighting factors, but that such an action was "in no sense mandatory." He also reminded his critics that the selection criteria had been established on 2 June 1969, before the contractors had submitted their proposals. Though further explaining the source selection process, he did not divulge the requested criteria.[51] The Air Force position in this case was later vindicated through a GAO investigation that found itself "in full agreement with the Air Force" on the interpretation of the 1926 Act.[52]

(U) Throughout the F-15's contract award "countdown," the Air Force's policy of gingerly sidestepping a torrent of political pressure and influence peddling avoided the usual charges of favoritism that follow a weapon-system contest.[53] In fact, Fairchild-Hiller's president, Edward C. Uhl, endorsed the Air Force's handling of the F-15 competition as having "been conducted in a most professional manner and... fairly run."[54]

(U) A second controversial issue that threatened to delay the F-15's development concerned alleged discriminatory employment practices at McDonnell's St. Louis plant. "A major flap arose today," began Under-Secretary of the Air Force, John L. McLucas, in a 21 January 1970 memorandum explaining why the Air Force had failed to obtain McDonnell-Douglas' compliance with minority employment laws before contract award. Caused by the inadvertent use of an obsolete checklist that omitted the requirement, this procedural error could have revoked the F-15 contract. Further, since the fault was solely theirs, the Air Force stood to pay any resulting contract termination costs.[55]

(U) The incident came at a time when McDonnell's employment record was under intense public attack. Local militants and the prestigious U.S. Commission on Civil Rights charged that, although blacks accounted for half the St. Louis population, only about 8 percent of McDonnell's work force was black. They also cited as inadequate the company's equal-opportunity employment plan filed at the Department of Labor's St. Louis office in December 1969. With the expected involvement of Sen. Edward M. Kennedy (Dem.-Mass.) lending an added political voice, OSD officials scrambled to solve the problem.[56]

(U) Secretary Laird sent his assistant for Manpower and Reserve Affairs, Roger T. Kelly, to iron out the matter personally with McDonnell, and Dr. Seamans interrupted a conference he was attending in Puerto Rico to meet contractor officials in St. Louis. The Air Force bluntly told McDonnell to draft an acceptable equal-opportunity employment plan or risk losing its F-15 contract as well as "all other Government programs." Responding to his pressure and bad publicity, McDonnell negotiated a new plan. Announced on 11 February 1970, the plan's key features included a provision to raise minority hiring and upgrading levels to 15.8 percent during 1970, establish a $1 million training program, and expand open housing. The Air Force's decisiveness and quick action thus averted a potentially damaging blow to the F-15 program.[57]

V. THE SUBSYSTEMS

(U) Although USAF officials had rejected a prototype competition for the F-15 airframe contract, they readily pursued this approach for the airplane's subsystems. The explanation was simple: since the engine, radar, and short-range missile were the critical subsystems, a prototype competition among several contractors would reduce program costs and risks. System contractors were to be selected on the basis of proof-testing and demonstration of subsystem prototypes.

The Engine

(S) In December 1967, the Air Force and Navy agreed to conduct a joint engine-development program.[1] Their goal was to develop a high-performance afterburning turbofan Advanced Technology Engine (ATE),* drawing upon the experience gained in the development of the lift-cruise engine of the U.S.-West German V/STOL and AMSA bomber programs. The proposed new engine was required to produce 40 percent more thrust and weigh 25 percent less than the 12-year-old TF-30 engine used in the F-111. New lightweight materials and improved design promised more efficient compressor stage-loading and higher turbine temperatures. Generally, military specifications called for the new engine to develop more than 20,000 pounds thrust and have a 9 to 1 thrust-to-weight ratio. It featured a 22 to 1 pressure ratio in only 10 stages, whereas, by comparison, the J79 (F-4 aircraft engine) had an overall 14 to 1 ratio involving 17 compressor stages.[2]

(S) From the start of the engine project, the Air Force and Navy disagreed about its management. In early 1968 the Air Force proposed establishing within one service a joint engine-program office (JEPO)+ run according to its management procedures and subject only to change for operational and logistical requirements of the other service. This proposal, reflecting the Air Force's

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*Also called the Advanced Turbine Engine Gas Generator (ATEGG) program.

+The JEPO was made part of the F-15 SPO. See p 41.

GENERAL ARRANGEMENT

(F-15 Subsystems)

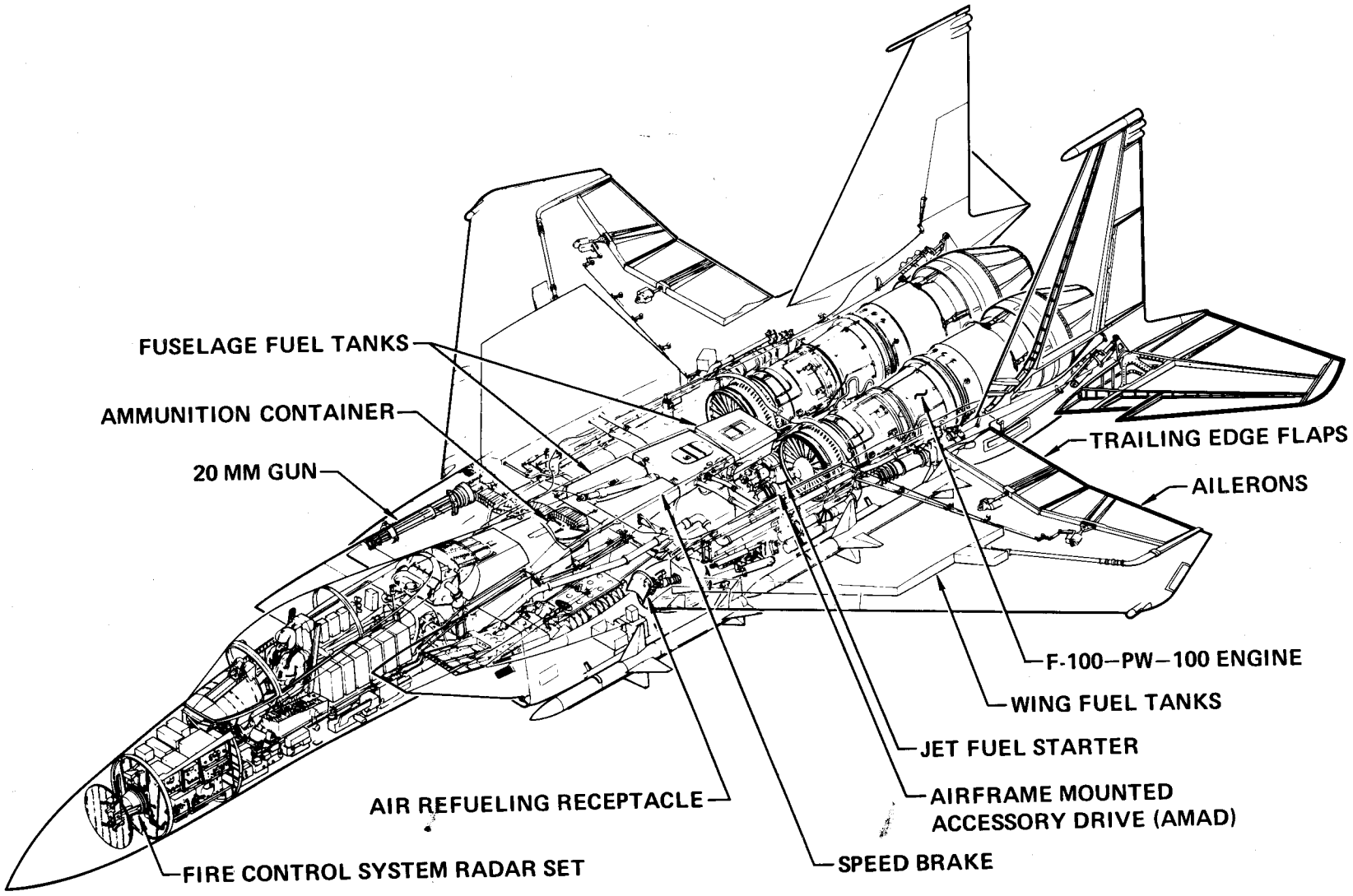

Diagram 4

single-management concept* for the F-15 program, had precedent in other joint projects such as the Navy's purchase of Air Force J79 engines for their F-4's. On the other hand, the Navy favored single-source procurement and creation of a Joint Executive Committee to oversee separate project offices in each service. The Air Force rejected this proposal, fearing that it would produce divergent engine configurations without yielding the desired cost savings.[3]

(C) The situation reached an impasse, with neither side willing to budge from its position. At one point in this stalemate, Air Force and Navy officials convened a meeting where they simply read their respective position statements and then left without even discussing their differences.[4] The issue was partially resolved in April 1968, when Dr. Foster named the Air Force executive agent to manage the Initial Engine Development Program (IEDP), but he left open his decision on management of the final development phase. Dr. Foster also sought to retain for OSD final source selection authority, but the services were able to persuade him to delegate this authority to them.[5]

(C) On 8 April 1968, requests for proposal were sent to General Electric, Pratt & Whitney, and the Allison Division of General Motors. Revised in July, these requests outlined a "bare-bones" $125 million program to develop a 22,300-pound thrust engine weighing 2,790 pounds and having a "common core" gas generator interchangeable with the Navy's F-14 engine. At the end of August, OSD authorized the award of two 18-month contracts+ totaling $117.45 million to General Electric and Pratt & Whitney. The Air Force contract was a composite cost-plus and fixed-type arrangement similar to that for the F-15 airframe, except for a different set of fees and ceiling prices. The Navy's contract, on the other hand, specified fixed prices for both the development and production phases.[6]

(C) Jointly funded by the Air Force and Navy, the contracts authorized each company to build two prototype engines--one for each service. The purpose was not merely to develop different

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*Under the F-15 contract, McDonnell-Douglas assumed total system responsibility over the airframe and all subsystems.

+On the Air Force's part, initial engine development was conducted under a letter contract to avoid delay and represented the only instance of an "undefinitized" contract in the F-15 program.

engines, but to fulfill each service's thrust requirements. Since the Navy's proposed aircraft was heavier than the F-15, it required a larger engine. Although both the Air Force and Navy engine models were to be designed, only one of the models would actually be built. However, since the Navy planned to use the TF-30 engine in their F-14 prototype, the services agreed that only the Air Force engine model and some components of the Navy model would be built initially.* Later, though, both General Electric and Pratt & Whitney invested their own funds to build the Navy's engine model as well.[7]

(C) In November 1968 the plan for a joint engine program appeared to flounder when the Air Force and Navy announced they would conduct separate "contracting and funding arrangements" at the end of the initial engine development phase.[8] Dr. Foster, however, wished to retain one service as the project manager, at least until both services' engine models met their Military Qualification Test (MQT).[9] Accepting his ruling, the Air Force and Navy agreed to proceed as before,+ but postponed submitting an engine development plan for the remaining phases of the program. Although they appreciated and endorsed the advantages of a joint effort, the Air Force and Navy preferred to await further definition of the F-X and VFX airframe designs before making a commitment.[10]

Source Selection

(U) Meanwhile, the Air Force and Navy agreed to share source selection authority for the engine. General Goldsworthy, the ASD commander (and his successor, Maj. Gen. Lee V. Gossick), represented the Air Force, with Adm. J.T. Walker, Naval Air

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*Long-lead parts were to be purchased to allow running the Navy model in June 1970 and to complete Preliminary Flight Rating Tests (PFRT) for both prototypes by February 1972. It was essential to define the PFRT as soon as possible prior to signing the IEDP because the master schedule was derived from the engine PFRT.

+See "A New Contracting Philosophy," pp 34-35.

Systems Commander, being his Navy counterpart.[11] Both parties agreed that in the event of conflict between engine and airframe selections, authority would revert to the service secretaries. A similar arrangement governed the source selection Board and Council, with Air Force and Navy personnel serving as co-chairmen for the two groups.[12]

(U) Even with initial engine source selection under way, the services continued to ignore program management during the final phase. Dr. Foster did not forget and in August 1969 he warned the R&D secretaries that unless they submitted an acceptable management plan by the engine qualification test date, OSD would reassume source selection authority.[13]

Despite this deadline, the two services continued to disagree. The Air Force argued that changing the JEPO arrangement would disturb the F-15 program,[14] whereas the Navy insisted on having "plant cognizance"* if Pratt & Whitney won the engine contract.[15] With each side claiming its approach was the more economical and efficient one, the issue festered until October 1969, when both asked Secretary Packard for a ruling.[16] Some 2 months later he advised the service secretaries that the Air Force would continue as lead service for the engine development, threatening to take back selection authority if they were unable to choose a winner.[17] General Ferguson and Adm. I. J. Gallantin, Chief of Naval Materiel Command, finally resolved the issue by negotiating an Air Force-Navy agreement to continue the JEPO under the F-15 office and to have General Bellis respond to the Naval Materiel Command chief on F-14 matters and to AFSC on the F-15.[18]

(U) Earlier, in June and July 1969, the two engine contractors submitted technical and cost proposals. The Source Selection Evaluation Board began its study of them on 7 July but did not complete the task until 30 January 1970 because the contractors were late submitting their design substantiation data. In February 1970, after reviewing this data, the Board designated the Pratt & Whitney design as "clearly superior to the General Electric System." After the Source Selection authority (Secretary Seamans) also chose Pratt & Whitney, that company received the formal award on 1 March 1970 authorizing the Air Force and Navy to sign separate engine contracts with it.[19]

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*Plant cognizance is having management authority.

(U) The Air Force engine model, designated the F100-PW-100, was an augmented twin-spool, axial-flow gas turbine that delivered more than 22,000 pounds thrust and weighed less than 2,800 pounds. The Navy version of the ATE--the F401-PW-400--used the same "common core" as the F100, including common compressors, a smokeless annular combustor, and two high-pressure stages. The two engines differed in the fan, afterburner, and compressor sections. The addition in the Navy model of a "stub" compressor* in front of the main compressor increased engine airflow but, by raising its weight, lowered the engine thrust-to-weight ratio. The F401 generated over 27,000 pounds of thrust and weighed under 3,500 pounds.[20]

(U) Developing the Advanced Technology Engine was the main problem in an otherwise exemplary F-15 program. In November 1970, because of F-14 funding cuts, the Navy pared its engine request from 179 to 69 units in fiscal years 1972 through 1974. Since the larger number of engines set the original cost, this cut required a new formula with a higher price per engine for the Air Force. In the spring of 1971, the Navy further cut its order to 58 engines to fit the lagging F-14B airframe schedule. Then, on 22 June, a new Navy decision to buy 301 F-14A's (the model that used the TF-30 engine) cancelled the remaining 58 engines and voided the joint Navy-Air Force engine production contract.[+21]

(U) Earlier, in February 1971, Pratt & Whitney projected a $65 million cost overrun in the engine funding for fiscal year 1973.

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*In January 1969, the Navy changed the size of its engine because the F-14B (formerly VFX-2) would be larger than planned. Although the change increased the differences between the F-15 and F-14 engines, the common core approach remained intact and did not affect costs. The Navy's change required increased airflow to raise thrust from 25,000 to 27,100 pounds for the GE version and from 26,000 to 28,160 for the P&W design. GE's solution was to raise the fan bypass ratio, whereas P&W added a stub stage to the fan to supercharge the common core. [ASSS (C) Maj Gen Henry B. Kucheman, Jr., Dir/Devt, no subj, 14 Feb 69; memo (C), Flax to Foster, subj: F-15/F-14B Engine Development, 25 Feb 69.]

+Development contracts (in contrast to production contracts) remained in force and design work continued.

Although the JEPO stood fast then, advising the contractor that no more funds were available, these new circumstances forced the Air Force to rewrite its own engine production contract. The new agreement raised Air Force costs by about $532 million. Under this revised program, development milestones for the F401 engine slipped from February to December for the PFRT, from February to June 1973 for the military qualification test and from June 1972 to mid-1974 for the delivery of production models.[22]

(U) The Advanced Technology Engine also suffered from several technical problems. At the start of the development program, there were two compressor designs: the primary aerodynamic compressor Series I engine, and the advanced aerodynamic compressor Series II. In October 1970 both services favored Series I because it was lighter and on schedule. However, by mid-1971, when it appeared that Series I would not meet its full production requirements, the services revived Series II. The Air Force eventually installed Series I in its first five test aircraft and Series II in all remaining test aircraft and in its F-15 and F-14B production models.[23]

(U) In February 1972, the YF100 (Series I) engine passed its PFRT* milestone on schedule, in time for the F-15's first flight in July. The Air Force rated Series I superior in thrust-to-weight, fuel consumption pressure ratio per stage, and turbine temperature levels. Meanwhile, in August 1972, the Air Force suspended MQT testing three times for the Series II engine--an early warning of the many engine troubles to come in 1973.[24]

Other Subsystems--Radar and Armament

(U) The F-15's remaining subsystems were open to competitive development. After soliciting industry bids on 8 August 1968, the Air Force selected Westinghouse Electric and Hughes Aircraft in November to develop, produce, and test models of the attack radar subsystem. McDonnell-Douglas, the airframe contractor, was responsible for selecting the winner of the 20-month competition after flight testing and evaluating both radar prototypes. The Air Force wanted a lightweight, highly reliable advanced design

*The PFRT engine was 191 inches long by 37 inches in diameter (maximum 46.5 in.) and weighed 2,837 pounds.

suitable for one-man operation. The radar's capabilities were to include long-range detection and tracking of small, high-speed objects approaching from upper altitudes down to "tree-top" level. The radar was to send tracking data to a central on-board computer for accurate launching of the aircraft's missiles. For close-in dogfights, the radar was to acquire* targets automatically on the head-up display so that the pilot would not have to do this task manually.[25] In July and August 1970, McDonnell-Douglas conducted more than 100 flights to test competing radar units aboard its modified RB-66 aircraft. With Air Force approval, McDonnell awarded Hughes Aircraft the radar contract in September.

(U) To cut costs, the Air Force ordered another thorough "scrubdown" of the F-15 requirements. Starting in July 1970, a panel headed by Maj. Gen. Jewell C. Maxwell reviewed the avionics and armaments, focusing on three items: (1) the Tactical Electronic Warning System (TEWS), whose development cost the panel favored separating from the F-15 program; (2) Target Identification Sensor--Electronic Optical (TISEO), a device for target identification beyond visual range; and (3) the AIM 7-E-2-missile, a backup for the AIM-7F Sparrow. The Air Force adopted the panel's recommendation to eliminate the last two systems.[26]

(U) The F-15's armament included both missiles and an internal cannon. The Air Force added the gun on the advice of veteran pilots and Vietnam returnees as well in light of the Israeli success with cannon in the June 1967 "Six-Day War."+ Though the primary gun for the F-15 was the M61 Vulcan (a 20-mm Gatling-type cannon used in Vietnam), the Air Force also began a long-term project to develop a 25-mm cannon using caseless ammunition. In the spring of 1968, it selected Philco-Ford and General Electric to design a prototype of the advanced gun, designated the GAU-7A Improved Aerial Gun System. The $36 million fixed-price competition ended in November 1971, when Philco-Ford won the contract. The comparison between the M61 and GAU-7A in Table 8 (p 63) shows the superior velocity and impact (projectile weight) of the latter:[27]

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*Target acquisition includes detection, identification and tracking.

+The exclusive use of cannon enabled the Israeli pilots to score a phenomenal 54-0 air-to-air victory over Arab fighters.

Gun Comparison

Area	M61	GAU-7A
1. Weight	1,142 pounds	1,663 pounds
2. Caliber	20-mm	25-mm
3. Muzzle Velocity	3,380 ft/sec 6,000 ft in 4.4 sec	4,000 ft/sec 6,000 ft in 2.1 sec*
4. Firing Rate	6,000 rounds per min	6,000 rounds per min
5. Projectile (both high-explosive incendiary)	6.6 inch (round)	6-inch long cylinder made of hardened propellant which consumes itself in firing
6. Weight of Projectile	1,580 grains	3,000 grains

Table 8

(S) The Air Force also proposed to equip the F-15 with a new short-range missile (SRM) for use against maneuvering fighters at close range. In March 1970, the Air Force selected three contractors--Philco-Ford, Hughes Aircraft, and General Dynamics--to begin competitive prototype development. Six months later, however, the Air Force cancelled the SRM because of rising costs,+ agreeing with the Navy to substitute an improved version of the Sidewinder missile.[28]

*Measured at static sea level conditions, the GAU-7A yields flatter trajectory, more concentrated firing pattern, and greater kill probability.

+SRM cost had risen to more than $209 million in 1970, with another $37 million projected for fiscal year 1971.

VI. DISSENT AND DECISION

(U) Despite USAF attempts to stem criticism of the F-15, basic differences arose within and outside the Pentagon over the kind of aircraft to acquire. The Air Force was especially sensitive to criticism because of competition with the Navy to get funds for an air superiority fighter. Having established the F-15's basic requirements, the Air Force decided to "speak with one voice" and not tolerate any dissent. Nevertheless, criticism of the F-15 made the Air Force reexamine the project and design an aircraft markedly superior to the one it had promoted at the beginning of the program.

F-XX

(U) One proposed alternative to the F-15, dubbed the F-XX, was the brain child of Pierre M. Sprey of Systems Analysis. He believed that ASD engineers, responding to TAC's exorbitant requirements and paying little heed to cost, had produced a design that was too expensive, incorporated high-risk technology, was unnecessarily complex, and would not achieve its advertised air superiority performance. Sprey's alternative was a 25,000-pound, single-seat, one-engine fighter with a high thrust-to-weight ratio and an estimated 25 percent more range than the F-X.* The F-XX was to be specifically designed for combat in the subsonic-transonic region, employing a fixed-wing planform with 60 pounds/ft^2 wing loading. It would carry a light internal gun and two Sidewinder missiles. Sprey's F-XX proposal shunned complex avionics, featuring instead a simple visual radar, easy and inexpensive maintenance, and a unit cost of only $2 million. Sprey favored prototype development similar to Clarence L. ("Kelly") Johnson's Skunk Works approach+ in building the SR-71. This alternative also included a VFXX substitute for the Navy's F-14.[1]

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*The F-XX would carry internal fuel for 600 nm versus the F-4's 487 nm and F-15 load for 800 to 850 nm.

+The "Skunk Works" approach requires a small group directly responsible to a single manager. Its distinctive features include low budgets, quick responsiveness, and the opportunity for early testing of the product under development. [See study (U), Col William J. Campbell, ICAF No. 112, "USAF Weapon System Acquisition--Are We Getting Our Money's Worth?" 15 Mar 72, pp 32-41.]

(U) The Air Force and Navy were not impressed. They rejected the proposed lightweight fighter because it lacked range for missions deep in enemy territory and could not carry the requisite avionics for countering enemy defenses. The services cited the short, unhappy experience of the F-104 as an example of the inadequacy of lightweight fighters. After enemy SAM's downed two F-104's on an escort mission over North Vietnam in 1966, the Air Force hastily withdrew the aircraft from further combat. Finally, the services argued that only the F-15 and F-14 could counter the high-speed, high-altitude Foxbat.*[2]

(U) But Sprey was not alone in advocating a lightweight fighter. Indeed, many veteran Air Force fighter pilots facetiously recommended that the best solution to the air superiority problem was to "buy MIG-21's." Simulations and flight tests during 1968 (Feather Duster and Have Doughnut) demonstrated the superior maneuverability of lightweight fighters. Several members of the Air Staff, aided by dissident Navy fliers, designed a lightweight fighter alternative to the F-15 and, in August 1969, submitted their proposal to General Ryan. Suppressing the proposal, F-15 advocates used the episode to unify the Air Force position on the air superiority fighter.[3]

(U) As later events showed, Sprey's F-XX idea, though having considerable merit, was ill-timed. His criticism only united the Air Force and Navy against him because they were too far along in their advocacy to turn back to the "drawing board." Neither wanted to relinquish the field to the other. Although by no means the last challenge to the F-15 and F-14 programs, it set the stage for their defense. A critical factor here was OSD's inflexibility on the tactical air force structure. Because they could not shake OSD force size limits, both services preferred to develop aircraft that were as versatile as possible.

(U) The F-15 design also came under fire from Dr. Richard L. Garwin, chairman of the President's Science Advisory Committee (PSAC) Aircraft Panel. Citing the numerical superiority of Soviet fighters, Dr. Garwin criticized the abandonment of such promising

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*Actually, the Foxbat was an interceptor and not an air superiority fighter.

innovations as the helmet-mounted sight and the trainable gun because he believed their absence placed the F-15 in an unfavorable "exchange ratio" against enemy aircraft.[4] In replying for OSD, Dr. Foster justified the F-15 design by restating the various elements that determined air superiority, including "pilot skill, aircraft handling qualities, multiple-aircraft and single-aircraft tactics, fuel load, weapons, avionics, command and control equipment, and procedures." Similarly, he justified development of separate Air Force and Navy aircraft because of "the unique needs of each Service."[5]

F-15 vs. Foxbat and the F-14

(U) In urging development of the F-15, the Air Force was pressed to explain the aircraft's alleged "inferiority" to the Soviet Foxbat. Basically, industry sources claimed the F-15 could not defeat the high-speed, high-altitude Foxbat (Mach 3+ at 80,000 ft.) and urged scrapping the F-15 program. General Rhodarmer's team, however, convinced Congress that, in terms of maneuverability, the F-15 was superior to any existing or projected Soviet aircraft. They noted its superior maneuverability in air combat, emphasizing the F-15's decided edge in such key dogfight factors as wing loading and thrust-to-weight ratio:[6]

	F-15	Foxbat
Thrust-to-weight	1.1	.78
Wing loading (pounds/ft^2)	65	98

Appendix 3, "Specific Excess Power," presents a full maneuverability comparison of the F-15, Foxbat, and MIG-21F.

(S) Criticism of the F-15 prodded the Air Force to look at other aircraft. It established a joint flight-test program with the National Aeronautics and Space Administration (NASA) to experiment with the YF-12--a high-speed, high-altitude fighter developed by Clarence Johnson of Lockheed. The Air Force also funded Mr. Johnson to study an advanced tactical fighter combining the speed advantages of the YF-12 and the F-15's superior maneuverability. Eventually, the Air Force concluded that the cost of developing such an aircraft would be prohibitive and that the F-15's maneuverability, radar, and "shoot-up" Sparrow missiles could

F-15 and F-14

General Specifications

	F-15	F-14
Length	63.8 feet	62.0 feet
Height	18.6 feet	16.0 feet
Wing Span	42.8 feet	37.5 feet and 62.8 feet
Propulsion	Two P&W F100 turbofans	Two P&W TF30 or Two P&W F401 turbofans
Weight	40,000-lb class	Approx 70,000 lb. (basic 54,000 lb. fighter plus interceptor missiles and external fuel)
Speed	Mach 2 plus	Mach 2 plus
Armament	AIM-7 Sparrow AIM-9 Sidewinder M61A1 Vulcan 20 mm cannon plus options	AIM-54 Phoenix AIM-7 Sparrow AIM-9 Sidewinder M61A1 Vulcan 20 mm cannon plus options
Crew	Pilot	Pilot and radar intercept officer

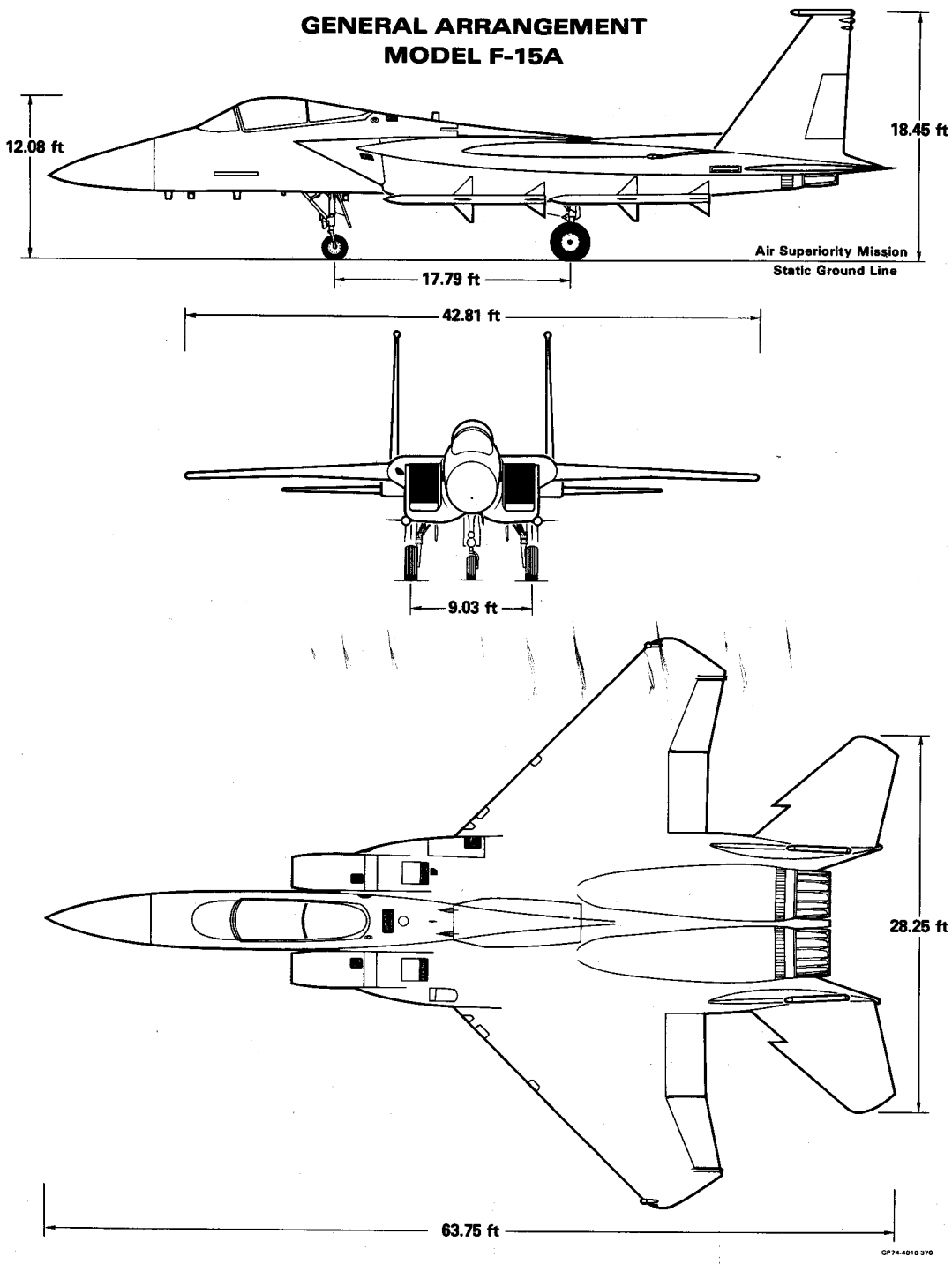
Table 9

defeat the Foxbat. Describing the Foxbat as a technological threat only, the Air Force remained convinced of the F-15's ability to "out-fly, out-fight, and out-fox the rest."[7]

In authorizing development of the next generation tactical fighters, OSD generally presented the F-15 and F-14 as non-competitive aircraft. It saw the F-14 providing the Navy with a long-range missile capability (AWG-9 Phoenix) for fleet air defense and the F-14 variants performing "other fighter roles," whereas the F-15 was to achieve overall air superiority. When Congressmen asked the inevitable question as to which of the two aircraft would win in a dogfight, neither the Navy nor the Air Force was hesitant to advance its own candidate. However, in the spring of 1969, General McConnell and Adm. Thomas Moore, Chief of Naval Operations, agreed to toe the OSD line--namely, that the two aircraft were intended for different missions. Whenever the issue did arise, the Air Force highlighted the F-15's maneuverability advantage and the mission differences between it and the F-14.[8]

Modifications and First Flight

Criticism of the F-15's design assumptions, though viewed as a threat by some military officials, actually produced distinct advantages. These challenges obliged the Air Force to reexamine the aircraft's design more critically and "scrub out" extraneous requirements. In particular, NASA's role as a consultant during the source selection and its independent laboratory evaluation uncovered certain deficiencies that might otherwise have gone unnoticed. For example, NASA found the F-15's subsonic drag level was higher than reported.[9] To correct this problem, designers removed the ventral fins and enlarged the vertical fin.[10] General Bellis, testifying in the spring of 1971 before the Senate Armed Services Committee, discussed the major design changes in the F-15 since its contract award (see diagram on opposite page):[11]



MCDONNELL DOUGLAS CORPORATION

Diagram 5

(This page is UNCLASSIFIED)

> The radome has been made more symmetrical to enhance the radar performance. Cowl fences have been added to the upper outer edge of the inlet to improve directional stability. The inlets have been refined. The bluntness of the cowl lip has been changed.... The wing and horizontal tail were both moved 5 inches...to improve aircraft balance and maintain the desired handling qualities and stability.... To improve the external aerodynamics, the aft section of the aircraft has undergone some refinement; this includes modified lines, ventral removal, and increased vertical tail height.

(U) On 26 June 1972, the F-15 made its ceremonial debut at McDonnell-Douglas' St. Louis plant. Appropriately painted "air superiority blue" and christened the Eagle, it was hailed as America's first air superiority fighter since the F-86 appeared some 20 years earlier. The F-15's next milestone event--the first flight--occurred on 27 July when Irving L. Burrows of McDonnell-Douglas piloted the fighter on a 50-minute maiden flight over Edwards AFB, Calif. All systems "worked as expected," and the Eagle attained 12,000 feet and about 320 miles per hour. This event also launched the F-15's flight-test program, which continued on schedule without any significant problems through its 1,000th flight in November 1973. By that date the F-15 had flown above 60,000 feet at speeds over Mach 2.3.[12]

(U) The flight-test program, perhaps the most rigorous one ever conducted in American aviation, included wind-tunnel, structural-materials, and flight-simulation tests. Category I testing by the contractor involved 12 aircraft instrumented for specific flights. For example, the No. 1 prototype tested the aircraft's stability and control characteristics, aerodynamic parameters, and provided a "quick look" at the YF100 pre-production engines and overall aircraft performance. Prototypes 13 through 20 were designated for Air Force use in Category II testing. The Air Force and McDonnell-Douglas also shared test time on 5 of the first 12 prototypes. Flight testing took place at three locations--Edwards AFB, Eglin AFB, and the McDonnell-Douglas airfield in St. Louis.* Wind tunnel tests occurred at Arnold Engineering Development Center (AEDC), Tullahoma, Tenn.

*At Edwards AFB, the test team included seven TAC pilots and six ASD pilots.

(U) NASA supported the F-15 flight-test program by evaluating three-eighths scale models of remotely piloted research vehicles (RPRV's). The aluminum and fiberglass RPRV's, 23.8 feet long with 16-foot wingspans and weighing 2,000 pounds, were dropped from 45,000 feet at 175 knots from B-52 aircraft. These trials provided invaluable data that enhanced the safety of the full-scale tests later.[14]

That Central Bird

(U) Although priding itself on not being tied to any particular operational doctrine, the Air Force owed its very existence to the principle of centralized control of air resources by a separate service commander. This doctrine's chief value lay in its "inherent flexibility" to exploit the combat situation while managing air resources economically. Given no cost limits and a reduced tactical force structure, the Air Force predictably selected multi-purpose rather than specialized aircraft.

(U) Inflation and the war in Southeast Asia, however, paved the way for low-cost, specialized aircraft. Accordingly, in October 1965 the Air Force moved to acquire Navy A-7's for close air support until it could develop its own A-X candidate for this mission. Besides satisfying OSD's penchant for commonality and averting forfeiture of the close air support role to the Army, this strategem helped the Air Force to make a case for replacing its aging F-4 fleet by the mid-1970's. Indeed, the Air Force's advanced tactical fighter concept--the F-X--began life as the best combination of air-to-ground and air-to-air capabilities. These features plus its STOL capability won the F-15 initial funding support for design studies.

(U) However, because diverse interests within the Air Force wanted to stamp their particular imprint upon the aircraft, the F-15 emerged as an overcompromised design that stood little chance of gaining approval. In addition, the Air Force--faced with keen competition from the Navy for funds--had to overcome Systems Analysis' campaign to replace tactical air's inventory of large, sophisticated aircraft with smaller, less costly ones.

(U) In a masterful stroke the Air Force in the spring of 1968 adopted air superiority--the sine qua non of aerial combat--as the best way out of its dilemma. South Vietnam's "permissive

environment," the Air Force argued, had lulled OSD into pursuing the mistaken policy of "assuming" air superiority in weapon-system development. But the air war over North Vietnam had already shown that even older MIG's could outclass sophisticated but less maneuverable American fighters. Only by hurriedly installing an aerial gun in the F-4 did USAF manage to keep an air-combat edge. Furthermore, the Air Force emphasized the folly of assuming air superiority over Europe--a region of more vital concern to the United States. The Moscow Air Show in July 1967 forcefully brought this point home when the Soviets paraded a half-dozen new fighters for Americans to evaluate and contend with in the years ahead.

(U) In the summer of 1968, the Air Force rallied behind a new slogan: "To fly and fight." It applied a 40,000-pound weight limit on the F-15 and pointed the design toward an uncompromised air superiority fighter. Significantly, the design yielded a bountiful "fallout" capability. Thus, at little extra cost, the F-15 could carry enough fuel, armaments, and avionics to perform a host of air-to-ground missions as well. In short, the Air Force advertised air superiority, while in fact developing a worthy successor to the F-4. The F-15 became "that central bird" the Air Force needed for flexibility* under its centralized control doctrine.

*Approval of the F-15 gave the Air Force the luxury of considering specialized aircraft, provided OSD relaxed its stringent force structure ceilings. The A-X (A-10) was ready for procurement to provide close air support, while a low-cost, lightweight fighter (YF-16 and YF-17) was undergoing prototyping for the air superiority mission.

APPENDICES

F-15

RDT&E FUNDING
($ in millions)

Fiscal Year	Appropriated	Reprogrammed	Current Program	Obligated	Expended
1967	-	+1.0	1.0	1.0	1.0
1968	4.0	-3.0	1.0	1.0	1.0
1969	37.0	+38.5	75.5	75.5	75.5
1970	175.1	-	175.1	175.1	174.9
1971	370.0	-20.5	349.5	349.5	349.5
1972	414.5	+5.7	420.2	420.2	420.2

SOURCE: Extract (U), "Status of Funding for Major Weapon Systems as of 31 Dec 73," F-15, AFACBIA, ca Feb 74.

APPENDIX 2

The F-15 Contract

(U) The F-15 contract, a composite cost-plus and fixed-price agreement, had three major divisions or "items," each with its own costs and incentives. Item I, pertaining to aircraft design and development phases, was on a cost-plus, incentive-fee basis to stimulate technical achievement by removing cost as an obstacle. A 90-percent government and 10-percent contractor cost-sharing formula protected the contractor against catastrophic loss. What motivated the contractor to keep costs down was the chance to increase his fee. Thus, his profits declined from 12 percent to 2 percent as he overran the $588 million target cost estimate.*

(U) Item II--covering delivery of 20 aircraft, spares, and equipment to support Air Force acceptance tests--was on a fixed-price incentive, successive-target-cost basis. The agreement featured a "not-to-exceed" ceiling price at 150 percent of the original target cost estimate. To give the Air Force greater confidence in the contractor's cost estimates, Item II set a new adjusted price 30 days after delivery of the fourth aircraft.+ Upon price reset, Item II then became a straight fixed-price contract with a profit ceiling at 13 percent of the original target cost. Here, too, the cost risk was shared on a 90/10 ratio by the government and the contractor to encourage technical excellence.

(U) Item III--governing the production of the first wing (107 aircraft), had a cost clause similar to that described in Item II but differed in its lower cost-incentive provisions for a 12-percent profit ceiling, an 85/15 cost-sharing ratio, and a ceiling price of 145 percent of the initial target cost. Price reset

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*If the contractor attained the target cost, he would earn 8 percent or $47 million.

+Price reset occurred about February 1973. In contrast, the C-5A contract had a repricing formula that was less specific in defining time and cost limits and in its general applications.

for Item III was scheduled for June 1974.* The table below compares item costs in specific areas:

Item Comparisons in the F-15 Contract

(All dollar figures in millions)

Area	Item I	Item II	Item III
Aircraft	0	20	107
Target Cost	$588	$469	$646
Target Fee	$47 (8%)	$42 (9%)	$58 (9%)
Target Price (Total)	$635	$511	$704
Ceiling Price	N/A	$703 (150%)	$937 (145%)

(U) The F-15 contract avoided most of the problems in cost and development that plagued the F-111 and C-5A. For example, these earlier aircraft had "inadequate visibility and control over technical development, resulting in premature commitments to production and lack of contractual flexibility to make the most advantageous tradeoffs between technical performance and cost." The F-15 contract avoided these problems by specifying technical milestones to be reached before the start of each successive production commitment. The Air Force could decide unilaterally whether the developer had met his commitment and could delay funding or cancel the program if he had not. The F-15 contract also provided for more visible accounting by tying the contractor to the Air Force's Cost and Schedule System Criteria

*Ceiling prices on price options for the second and third wings were subject to inflation and the contract contained a base period and a formula for this variable. Further, the number of production aircraft could be varied plus or minus 50 percent.

that standardized reporting procedures and tightened control.*

(U) Another new control was the Limitation-of-Government-Obligation clause that held development funding to a predetermined schedule and required the contractor to continue performing as long as the government funded the plan. If the contractor foresaw a need for more funds, he had to give 17-months' advance notice--a period corresponding to the government's budget cycle. Failure to comply would result in the contractor's working at his own expense.

(U) To insure technical excellence, the contract made the airframe builder responsible for integrating the "total system," including propulsion, armament, and avionics, and assuring the system would meet all performance requirements. The contract also specified responsibility for correcting deficiencies. Unlike the C-5A contract, the F-15 contract required the developer to correct deficiencies without price adjustment+ and within a time limit after acceptance. This responsibility also eliminated the so-called "ripple effect" of deficiencies by making the contractor accountable for previously furnished spares or support equipment later found defective. Finally, an incentive award--a kind of report card--held out a $400,000 bonus per year (up to $2 million) to the contractor for management excellence in selected areas. Though seen by some as "chickenfeed" in a $2 billion contract, the bonus was "highly regarded because it was so easily identifiable."

(U) Finally, a major provision, written in after contract award, required that all proposed contract changes be "definitized,"

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*The management information system utilized some 3,500 cost, schedule, and performance indicators to signal management action.

+It extended 18 months after delivery of the last Category II aircraft (October 1974) or 6 months after delivery of an aircraft, whichever was later.

i.e., priced and negotiated before allowing the contractor to proceed. This provision remedied a serious flaw in the Armed Services Procurement Regulations wherein the contractor had been permitted to make changes before they were contracted for. In that way, the government was invariably committed to pay whatever the contractor demanded.*

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APPENDIX 3

Specific Excess Power (P_s) (ft/sec)

	F-X (minimum)	Foxbat	Mig-21F
Maximum Power			
Mach 0.9 10,000 ft 1 g	800	730	530
Mach 2.2 40,000 ft 1 g	1,200	NC	NC
Mach 0.9 30,000 ft 5 g	-250	NC	-710
Mach 1.6 35,000 ft 5 g	0	-270	-540
Military Power			
Mach 0.9 10,000 ft 1g	200	360	160
Mach 0.9 30,000 ft 1 g	100	150	90
Mach 0.9 10,000 ft 5 g	0	20	-210
Mach 0.9 30,000 ft 5 g	-550	NC	-980

NC = Not capable

SOURCE: Rprt (S/NF), Sup to CFP for the Advanced Tactical Fighter (F-X), AFRDQ/ASZQ, 9 Aug 68, pp 19-20.

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GLOSSARY OF TERMS AND ABBREVIATIONS

AAF	Army Air Forces
acft	aircraft
Actg	acting
ADC	Aerospace Defense Command
Adm	Admiral
AF	Air Force
AFB	Air Force Base
AFEO	Air Force Eyes Only
AFLC	Air Force Logistics Command
AFRDQ	Air Staff Directorate of Operational Requirements and Development Plans
AFSC	Air Force Systems Command
AIM-7F	Sparrow missile
AIM-9	Sidewinder missile
AIM-54	Phoenix missile
AIM-82A	Short range missile
Air Superiority Fighter	an aircraft that can gain and maintain control of the air arena by outperforming the enemy because of advantages in speed, firepower, thrust, range, avionics, and maneuverability
Ala	Alabama
Amd	armed
AMSA	Advanced Manned Strategic Aircraft, the B-1
ANSER	Analytical Services Incorporated
Appns	appropriations
Apr	April
ASB	Air Staff Board
ASD	Aeronautics Systems Division
ASD	Assistant Secretary of Defense
ASSS	Air Staff Summary Sheet
Asst	assistant
ASZQ	Systems Engineering Group (ASD)
ATC	Air Training Command
atch	attachment(s)
ATE	Advanced Technology Engine

ATEGG	Advanced Turbine Engine Gas Generator
AU	Air University
Aug	August
avionics	electronic systems aboard aircraft, such as radar, fire-control systems, and computers
AWC	Air War College (Maxwell AFB)
Brig	Brigadier
Calif	California
Capt	captain
commonality principle	use of variants of the same design, with interchangeable components and subsystems for different aircraft programs
C	Confidential
CD	contract definition
CFP	Concept Formulation Package
Ch	chief
Chap	chapter
Cmte	committee
CNO	Chief of Naval Operations
Co	company
contract definition	specifying in written agreement the terms for developing and producing a given item such as an aircraft
COFRAM	Controlled Fragmentation Munitions
COIN	counterinsurgency
Col	colonel
Comdr	commander
Comm	commission
Comndt	commandant
Compt	comptroller
Cong	Congress
Corp	corporation

CPIF	cost plus incentive fee
cost-plus contract	In contrast to fixed-price, this contract is used when the government is less certain of its cost estimate for a program. The government agrees to pay whatever costs are necessary for development up to an agreed upon limit (target cost). As in fixed-price, the contractor's profit declines as the limit is exceeded.
DCP	Development Concept Paper
DCS	Deputy Chief of Staff
D-Day	6 June 1944
DDR&E	Director of Defense Research and Engineering
Dec	December
definitize	to spell out all changes to a system, including proposed costs, schedule, and applications, on a firm contractual basis.
Dep	deputy
Dev	development
DIA	Defense Intelligence Agency
Dir	director, directorate
Div	division
DO	director of operations
Dr.	doctor
DSMS	Defense Systems Management School, Ft Belvoir, Va.
EEO	Equal Employment Opportunity
EM	energy maneuverability
Energy maneuverability	the ability of an aircraft to change altitude, airspeed, and direction during combat; this ability is a function of thrust, drag, weight, speed and other factors in the EM formula.
et al	and others

Exec	executive
FEAF	Far East Air Forces
Feb	February
fixed-price incentive contract	In contrast to cost-plus, this contract is used when the government is more certain of its cost estimate for a program. As in the cost-plus, the contractor's profit margin decreases as he exceeds the target cost.
ft	foot, feet
F-X	fighter, experimental
FY	fiscal year
GAO	General Accounting Office
Gen	General
Gp	Group
HASC	House (of Representatives) Armed Services Committee
hist	history
Hngs	hearings
HQ	headquarters
H.R.	House of Representatives
Ibid	ibidem, in the same place
ICAF	Industrial College of the Armed Forces
IED	initial engine development
I&L	installations and logistics
Inc.	incorporated
Intvw	interview
IOC	initial operational capability
IR	infrared

Jan	January
JCS	Joint Chiefs of Staff
JEPO	joint engine program office
Jr.	junior
Jt	joint
Jul	July
Jun	June
Lt	lieutenant
Ltr	letter
L&L	Legislative Liaison
MAC	Military Airlift Command
Maj	major
Mar	March
Mass	Massachusetts
memo	memorandum
Mgmt	management
Mgr	manager
Mil	military
mm	milimeter
MQT	military, or model qualification test
MR	memorandum for record
Msg	message
Multi-purpose Fighter	An aircraft that can perform a variety of missions, including air combat as well as ground support. Counterair operations achieve air superiority and eliminate enemy interference, interdiction is destroying enemy installations and air resources (on ground or in air), and close air support provides firepower to friendly ground forces.
NASA	National Aeronautics and Space Administration
NASC	Naval Air Systems Command
nd	no date given

NIPP	National Intelligence Planning Projections
nm	nautical mile
N. M.	New Mexico
No.	number
NOFORN	No foreign dissemination
Nov	November
N. Y.	New York
Oct	October
ofcr	officer
Opnl	operational
opns	operations
OS	office of the secretary
OSD	office, Secretary of Defense
p	page
PACAF	Pacific Air Forces
PEG	Program Evaluation Group
PEM	Program Element Monitor
PFRT	Preliminary flight rating test
Pol	policy
pp	pages
Pres	President
Proj	project
prototypes	the first production models built for testing and evaluation
PSAC	President's Science Advisory Committee
pt	part
QOR	Qualitative Operational Requirement. Stipulates performance and other criteria the using command wants built into the weapon system.

R.A.F.	Royal Air Force
R&D	research and development
re	as regards
reqs	requirements
Ret	retired
Rev	revision
RFP	requests for proposal
ROC	Required Operational Capability
Rprt	report
RPRV	remotely piloted research vehicle
scrubdown	a thorough review of a program to cut costs and to eliminate anything not essential to the mission of a given item
S	secret
s/	signed by
SA	Systems Analysis
SAC	Strategic Air Command
SAF	Secretary of the Air Force
SASC	Senate Armed Services Committee
SAW	special air warfare
Sbcmte	subcommittee
Sec	Secretary
SECDEF	Secretary of Defense
sect	section
Sen	Senate
Sep	September
Sess	session
Skunk-Works approach	A small group of people are directly responsible to a single manager. This approach includes low budgets, quick responsiveness, and the opportunity for early testing of the product under development
SOR	Specific Operational Requirement
Source Selection Authority	the power to evaluate bids from competing contractors and select the winner

SPO	System Program Office
SRM	short range missile
SSA	Source Selection Authority
SSAC	Source Selection Advisory Committee
SSEB	Source Selection Evaluation Board
STOL	short takeoff and landing aircraft
subj	subject
sup	supplement
supt	superintendent
svcs	services
TAC	Tactical Air Command
TDP	Technical Development Plan
Tenn	Tennessee
TEWS	Tactical Electronic Warfare System
TFX	tactical fighter, experimental the F-111 aircraft's early designation
TISEO	target identification sensor, electronic optical
TPP	total package procurement
Total Package Procurement Concept	The contract includes provisions for research, development, and production, with both performance and delivery commitments.
U	unclassified
Univ	university
USAF	United States Air Force
USAFE	United States Air Forces, Europe
USSBS	United States Strategic Bombing Survey
VCSAF	Vice Chief of Staff, United States Air Force
VFAX	Navy, experimental fighter
VFX	Navy, experimental fighter
Vol	volume
vs.	versus
V/STOL	Vertical/short takeoff and landing aircraft
V/TOL	Vertical takeoff and landing aircraft

w/	with
WS	weapon system(s)

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41. AFXOOSV
42. AFXOOSO
43. AFXOOSW
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45. AFXOOTR
46. AFXOOTW
47. AFXOOW
48. AFXOV
49. AFXOXF
50. AFXOXFT
51. AFXOXJ
52. AFXOXX
53. AFXOXXEP
54. NGB

MAJOR COMMANDS

55-56. AFLC
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64-66. ATC
67-68. MAC
69-70. PACAF
71-72. SAC
73-76. TAC
77-78. USAFE
79. USAFSS
80. AULD

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81-82. AFSHRC
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