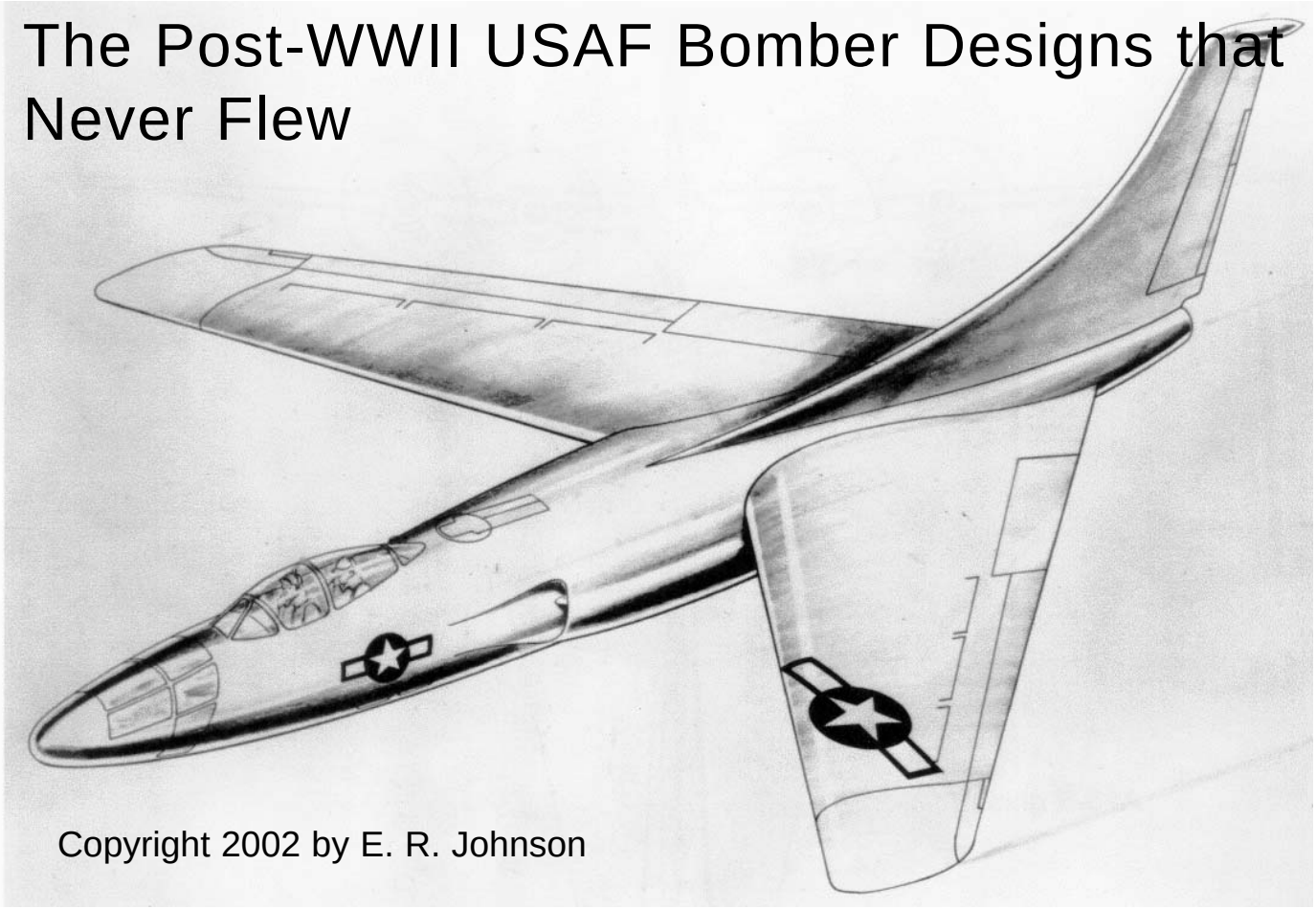
The Post-WWII USAF Bomber Designs that Never Flew



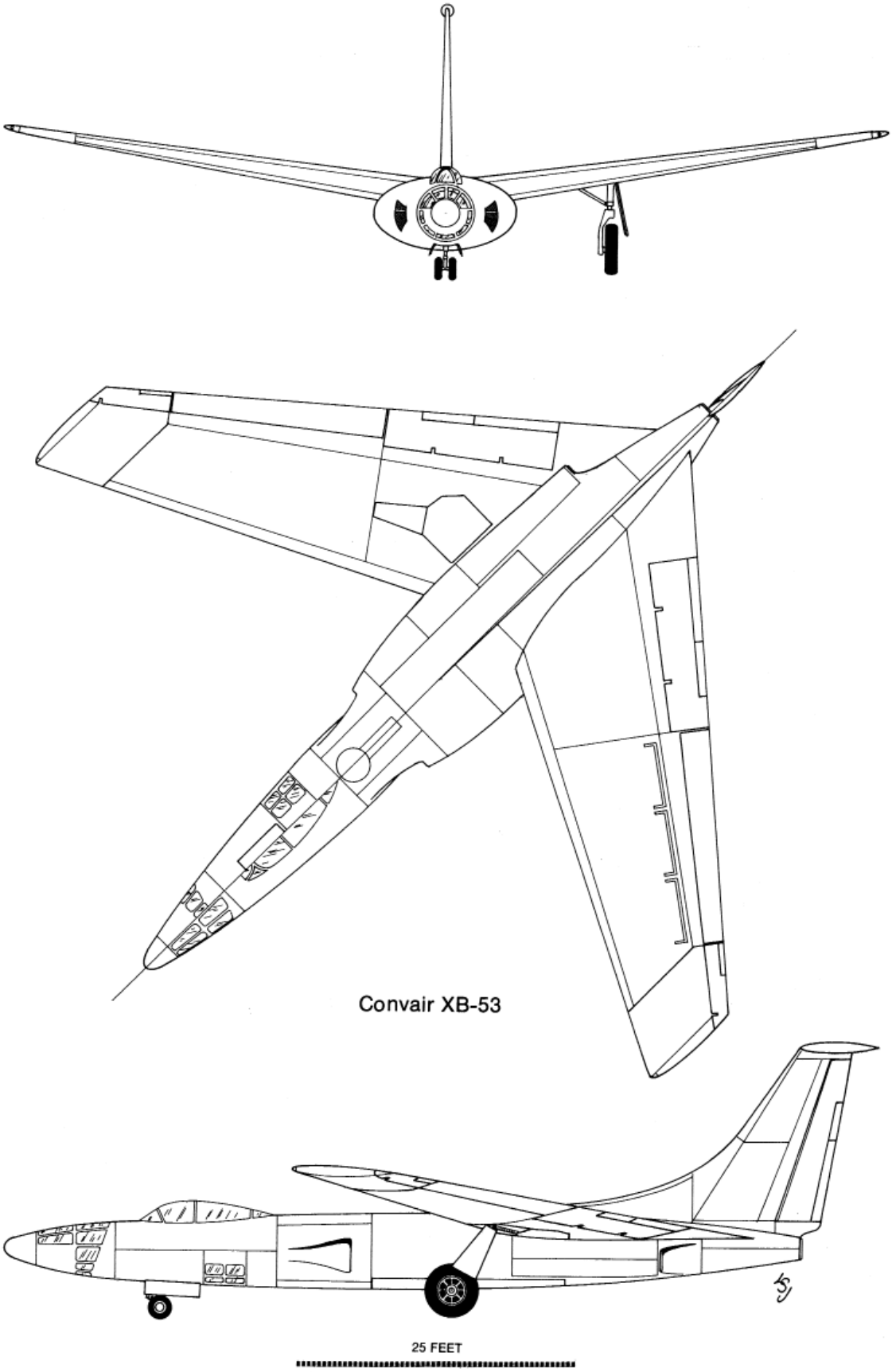
An artist's conceptual drawing of the Convair XB-53. (Drawing from the author's collection)

Overview of Post-War Bomber Procurement

For much of the World War II period, development of new aircraft designs in the United States was purposefully delayed to allow aviation contractors to focus their energies on mass-production of the thousands-upon-thousands of aircraft needed in the war effort. With some notable exceptions, the aircraft produced for the armed forces during the war were based upon pre-1942 specifications.[1] Once wartime restrictions were lifted, however, the advance in American aeronautical technology was absolutely phenomenal. A large part of the stimulus came from the U. S. Army Air Forces (AAF) Research and Development Board, set up in 1944 by AAF chief General Henry H. "Hap" Arnold and headed by renowned aeronautical scientist Doctor Theodore von Karmen of Cal Tech. Arnold, who astutely foresaw that America's military responsibilities would not end with the war, told von Karmen to develop a technological blueprint for a post-war Air Force that possessed global striking powers.[2]

Military contractors, particularly those who built airplanes for the AAF, were encouraged now to undertake new and untried concepts utilizing turbojet and turboprop propulsion systems. When the war finally ended, American design efforts received an additional boost from captured German documents containing masses of research data on many different transonic aerodynamic planforms.[3] The impact of the German data was sufficiently enlightening to cause several AAF contractors to go back and start virtually from scratch on their design proposals (i.e., North American XF-86, Convair XF-92, and Boeing XB-47).[4] With respect to AAF bomber development, perhaps as noteworthy as advances in aerodynamic and propulsion systems was the availability of atomic weapons beginning in 1945. Indeed, Consolidated-Vultee's long-awaited XB-36 might never have progressed beyond the mockup stage but for the intervention of the atom bomb and, with it, the AAF's perceived need for a long-range nuclear deterrent.[5]

From late-1944 onwards, the AAF, and later the U. S. Air Force (USAF), began circulating bold requirements among various American aircraft contractors for turbojet or turboprop-powered tactical and strategic bomber designs which would be expected to attain unprecedented levels of performance.[6] To a certain degree, these specifications were conspicuous examples of the government practice of inflating requirements with the hope that it would end up with something minimally acceptable. Complicating matters was the AAF/USAF habit of adding new requirements, such as greater speed or nuclear capability, after a project was well underway.[7] A fair number of the designs fostered by this process went on to achieve production and distinguish themselves in operational service (i.e., B-45, B-47, B-52, B-58 and B-66), while others made it only to experimental or pre-production status (XB-46, XB-48, YB-49, XB-51, YB-60 and XB-70), but what of those that never made it off the drawing board or beyond the mockup stage? Their story follows.

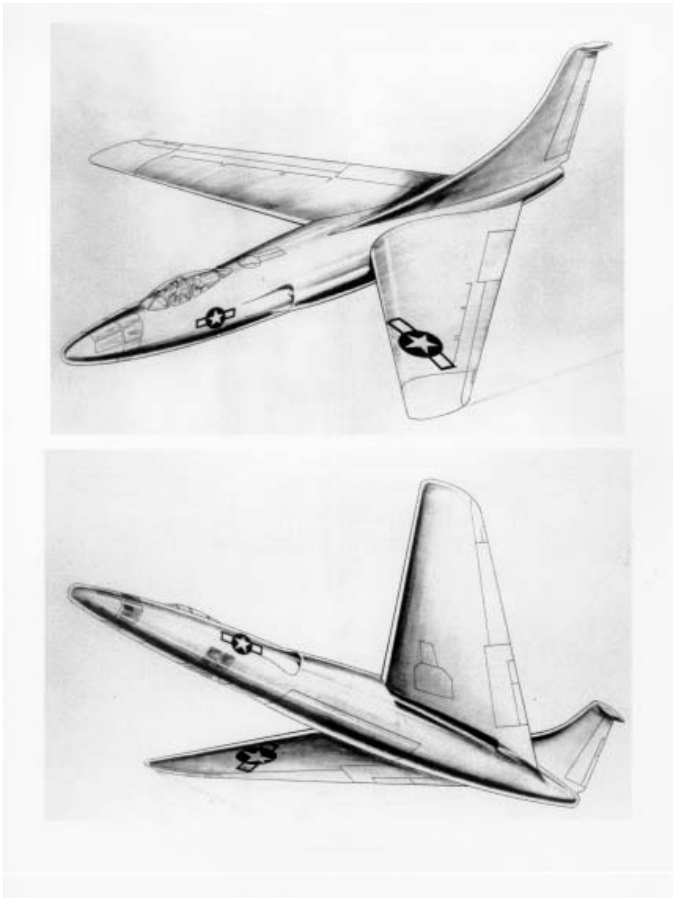


Three-view drawing of the Convair XB-53. (Drawing by Lloyd S. Jones)

Convair XB-53

In 1944, the AAF solicited proposals for its first jet-propelled tactical bomber, assigning a project to Convair Aircraft (formerly Consolidate-Vultee) under the designation XA-44 and another to Martin Aircraft as the XA-45. The designation system was subsequently revised by the USAF in 1948 so that the XA-44 became the XB-53 and the XA-45 became the XB-51. While the project was in the preliminary stages, the XA-44/XB-53 design staff was influenced by captured German research data associated with testing on the Junkers Ju 287V-1, a very unusual four-engine jet prototype.[8] The aerodynamic configuration of the XA-44/XB-53, as it emerged in 1945, was undoubtedly one of the most unorthodox bomber ideas conceived up to that time: a tailless plan-form featuring a 30 degree forward swept wing with 8 degrees dihedral.[9] In theory, the pronounced forward sweep would increase the critical Mach number, while simultaneously avoiding the problem of wing-tip stalling attributed to a sweptback wing.

The wing incorporated variable-incidence tip panels which could be deflected upward 20 degrees to increase angle of attack. Power would come from three General Electric J35 turbojet engines of 4,000 lbs./s.t. each, mounted abreast in the broad oval fuselage. According to design specifications, the XA-44/XB-53 would possess a wingspan of 80 feet 7 inches, a length of 79 feet 6 inches, and an estimated takeoff weight of 60,000 lbs. Up to 12,000 lbs. of bombs could be carried in an internal bomb bay and underwing pylons could accommodate 40 high-velocity aerial rockets (HVARs). Armament consisted of 20 fixed .50 caliber machine guns in the solid-nosed attack version, and in the glazed-nose bomber version, an unspecified number of .50 caliber guns were to be housed in retractable turrets located behind the cockpit. Projected performance was a top speed of 580 mph, a service ceiling of 44,000 feet, and a maximum range of 2,000 miles.[10]



An artist's conceptual drawing of the Convair XB-53. (Drawing from the author's collection)

Prospects for the unusual bomber looked bright in mid-1946 when funds originally allotted to the Convair's cancelled XB-46 program were transferred to the XB-53, with the result that two aircraft were ordered (i.e., s/n 45-59583/4).[11]

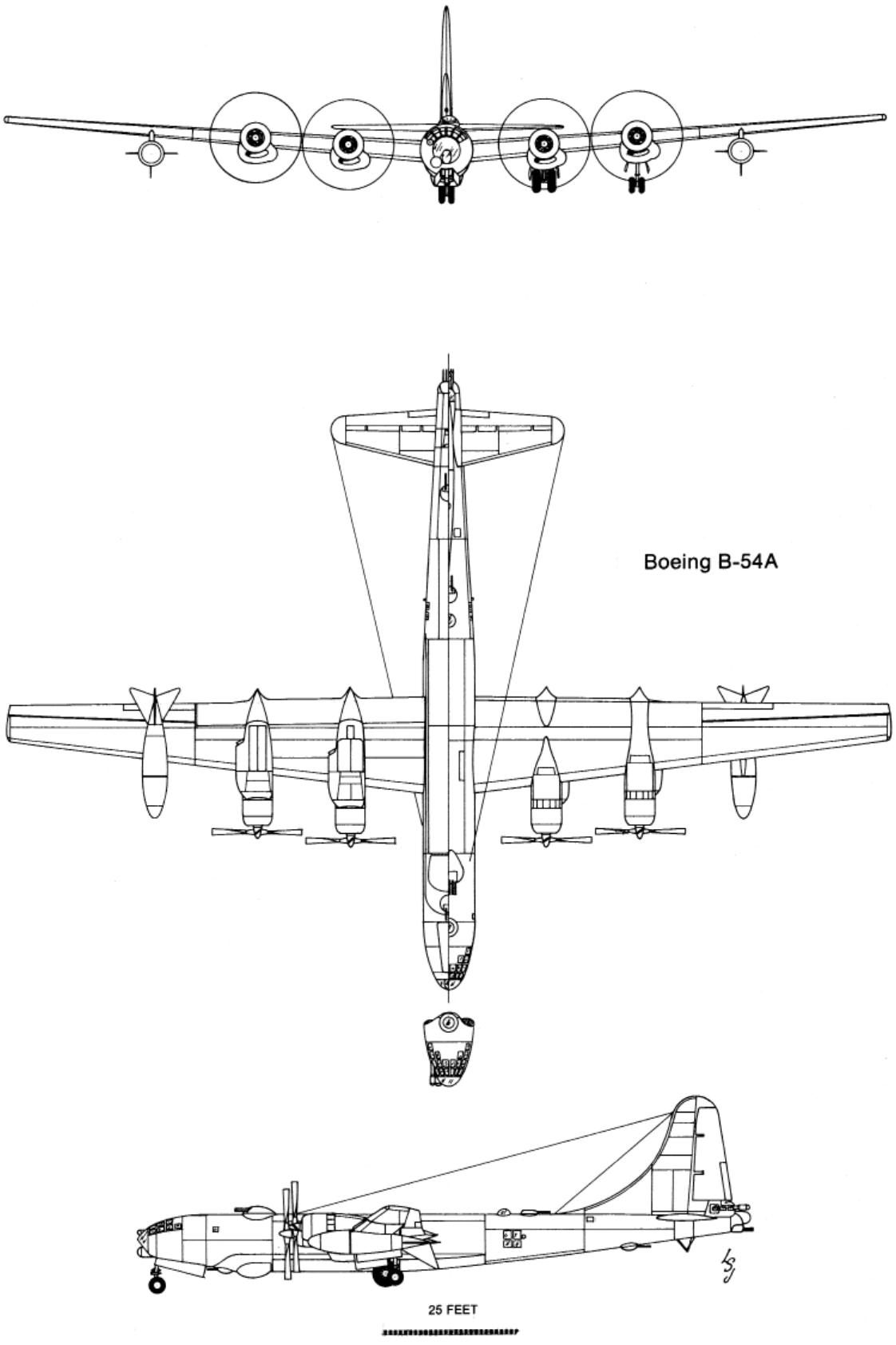
In 1948, however, Martin's XB-51 entry was selected by the USAF as winner of the tactical bomber competition, and the XB-53 project was cancelled before any airframes could be completed.[12] How the structural engineers might have solved the problem of aeroelastisity – the torsional and bending forces that would have been imposed upon the forward swept wing – is left to speculation. In any event, a variation of this uncommon planform would not appear again as a government-funded project until the advent of the Grumman X-29 in 1984.

Boeing YB-54A

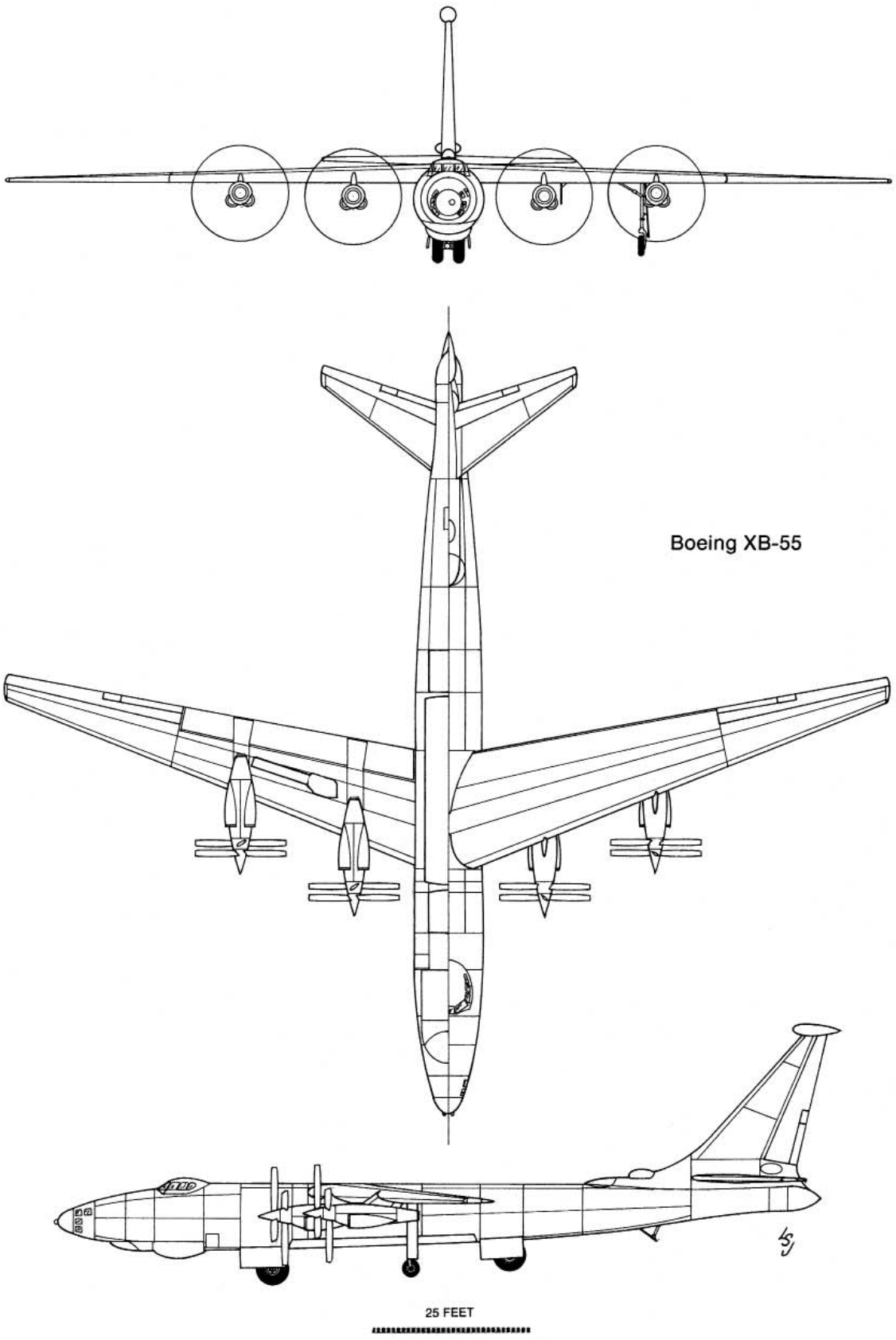
Because of concerns within the USAF over the operational suitability of the B-36 prototypes, Boeing was asked in 1947 to develop an improved version of its B-50A to be powered by four new Pratt & Whitney R-4360-43 turbocompound engines, sometimes referred as Variable Turbine Discharge (VTD) engines.[13] Other changes to the basic B-50A airframe included a 20 foot increase in wingspan (161 feet 2 inches), a 10 inch increase in length (111 feet), and a 50,000 lb. increase in gross weight (207,000 lbs. max.). To support the increased span and weight, retractable outrigger wheels would be placed in the outer engine nacelles. Originally planned as the YB-50C, the USAF concluded that the design was sufficiently different to assign a new model designation of YB-54A. Much of the plane's additional space would be used to enlarge fuel capacity, giving it an estimated unrefueled range of 9,300 miles. Its projected cruise speed of 308 mph was 50 mph faster than the B-36B.[14]

Mockup completion in late 1948 was followed by an order for 43 production B-54s. However, drastic cuts in the 1949 defense budget led to the elimination of many military development programs. The chief of Strategic Air Command, General Curtis E. LeMay, forcefully lobbied for development of the B-36D, an improved version of the type which added a pair of jet engines to each wing in underslung nacelles. The

Artist's conceptual drawing of Boeing B-54A. (Drawing from author's collection)



Three-view drawing of Boeing B-54A. (Drawn by Lloyd S. Jones)



Three-view drawing of Boeing XB-55. (Drawn by Lloyd S. Jones)

B-36 versus B-54 issue was really a small part of a much larger debate raging within the entire defense establishment over the USAF's monopoly in strategic nuclear deterrence. A board of senior USAF officers was convened to resolve the bomber dispute, deciding eventually to support LeMay's bid for the B-36D. Shortly afterward, in April 1949, the YB-54A program was formally terminated.[15]

Boeing XB-55

Listed as the Boeing Model 474, the XB-55 holds the distinction of being the only all turboprop-powered design to ever bear a USAF bomber designation.[16] Designed to meet a medium bomber specification issued by the USAF in 1947, the aircraft was essentially a B-47 enlarged by a factor of 1.15, with sweepback reduced to 20 degrees. Power would be derived from four Allison T40-A2 turboprop engines driving six-bladed contra-rotating propellers. Official schizophrenia within the USAF hierarchy over new bomber development explains the reason why a turboprop design would come up at time when the pure jet B-47 was nearly complete and slated to undergo flight testing – a hedge undoubtedly against the possibility the more advanced design would fail to become operational.[17] It is interesting to note that Boeing's Model 464 heavy bomber project (later the XB-52) had originally been laid down with six turboprop engines and 20 degrees of wing sweep before being redesigned to a pure jet configuration.[18]

General dimensions planned for the propjet bomber were a wingspan of 135 feet and a length of 118 feet 11 inches. Maximum weight at takeoff was estimated at 168,000 Ibs., only marginally greater than that of the B-47A, but the XB-55's projected range was longer by almost 2,300 miles.[19] An anticipated top speed of 490 mph and a cruise of 450 mph, combined with a service ceiling of 42,000 feet, would have given it performance similar to the B-36D – markedly inferior when compared to the pure jet aircraft of the day.[20] To compensate for increased vulnerability at lower speeds, the XB-55 was given a formidable defensive armament of twelve 20 millimeter cannons mounted in three turrets.[21] The gunners would have operated them from remote stations similar to those on the B-36 and the B-50. Predictably, with the advance of the B-47 to operational testing and the budget crunch of 1949, the XB-55 was cancelled before even reaching the mockup stage.

In 1955-1956, the USAF actually tested the turboprop concept when two B-47Bs were modified as testbeds with a pair of 10,000 hp Wright YT49-W-1 engines (a turboprop development of the Armstrong-Siddeley *Sapphire*) mounted in the inboard engine pods.[22] The program never progressed beyond the experimental stage.

Boeing YB-56

A persistent problem with the first B-47 production models was the low maximum power rating of its J47-23 engines (i.e., 5,970 lbs./s.t. each).[23] Early in 1950, the Boeing Company proposed a more powerful, four-engine version of the basic B-47 design, which incorporated other improvements intended to lighten the airframe. Initially classified as the YB-47C, the modification entailed installation of four Allison J35-A-23 engines with afterburners, rated at 9,700 lbs./s.t. maximum power and 8,200 lbs./s.t. for continuous operation.[24] To compensate for the reduced weight and change in C.G., the single inboard engine pods were canted outward and mounted much further forward on the pylons. While cruising speed was expected to be only slightly higher than previous models, combat range would be extended by over 1,100 miles. One B-47B (s/n 50-082) was set aside to undergo the modifications; however, when the proposed engines failed to produce anything near expected power output during testing, the project was placed on hold.

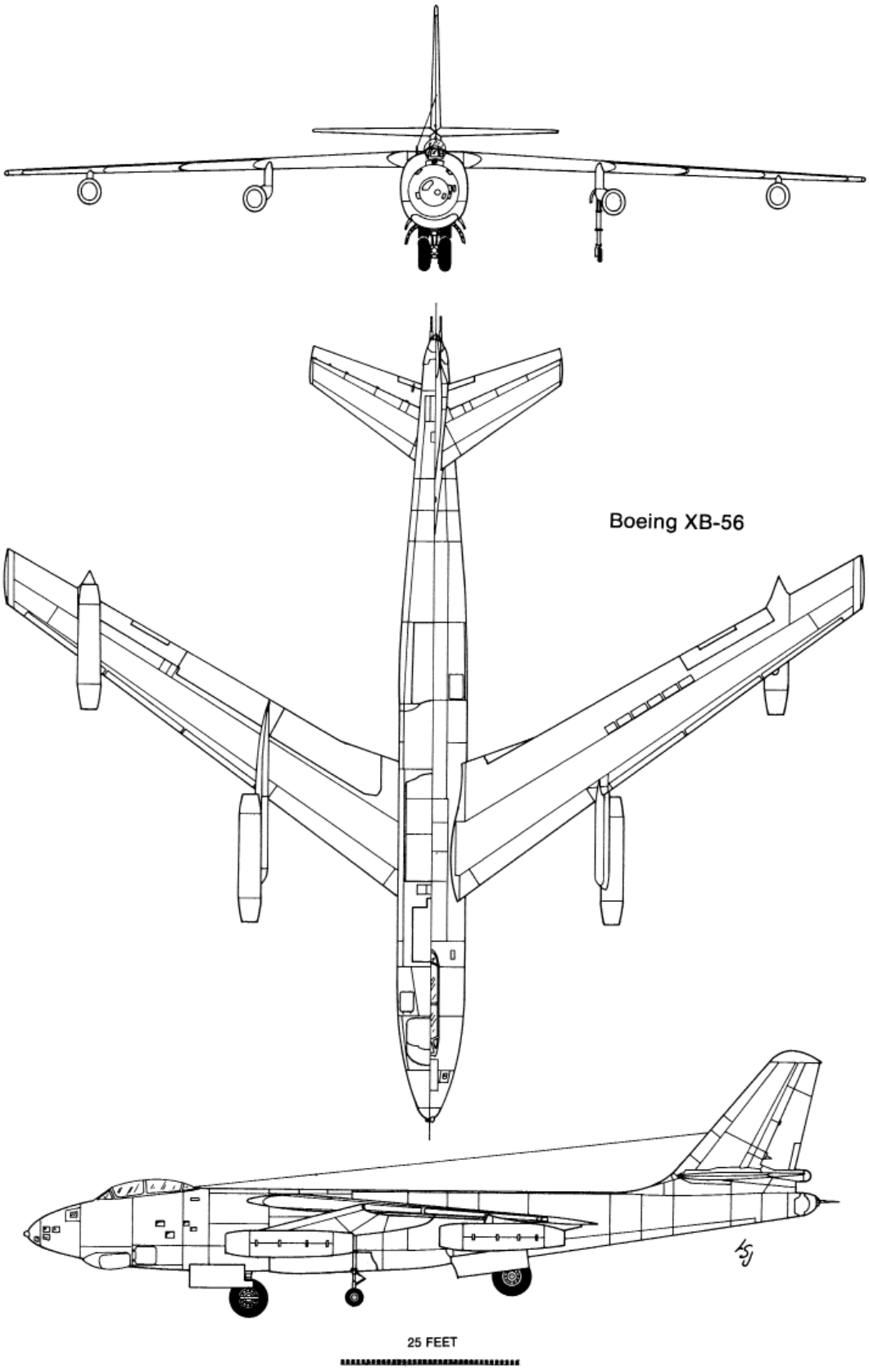
Sometime later, probably late 1951, the project was reinstated under the new model number YB-56, with the plan of using the experimental Allison J71-A-5 engines in place of J35s. The J71, an improvement of the J35 with a sixteen stage compressor and cannular combustion chamber, was expected to deliver 10,700 lbs./s.t. at maximum power.[25] Continued development problems and delays with this powerplant, however, led Boeing to make yet another proposal for substituting the new Pratt & Whitney J57 engines. Inasmuch as all foreseeable J57 production was being earmarked for the B-52 program, the USAF decided to abandon the YB-56 and proceed with the improved B-47E.[26]

As late as 1959, a Rand Corporation study proposed that the USAF re-engine its B-47 fleet instead of ordering the controversial Convair B-58 into full production. In light of the newest Soviet air defenses, the study concluded that the supersonic B-58's penetrative ability would only be marginally better than that of the subsonic B-47. Of course, the proposal was rejected.[27]

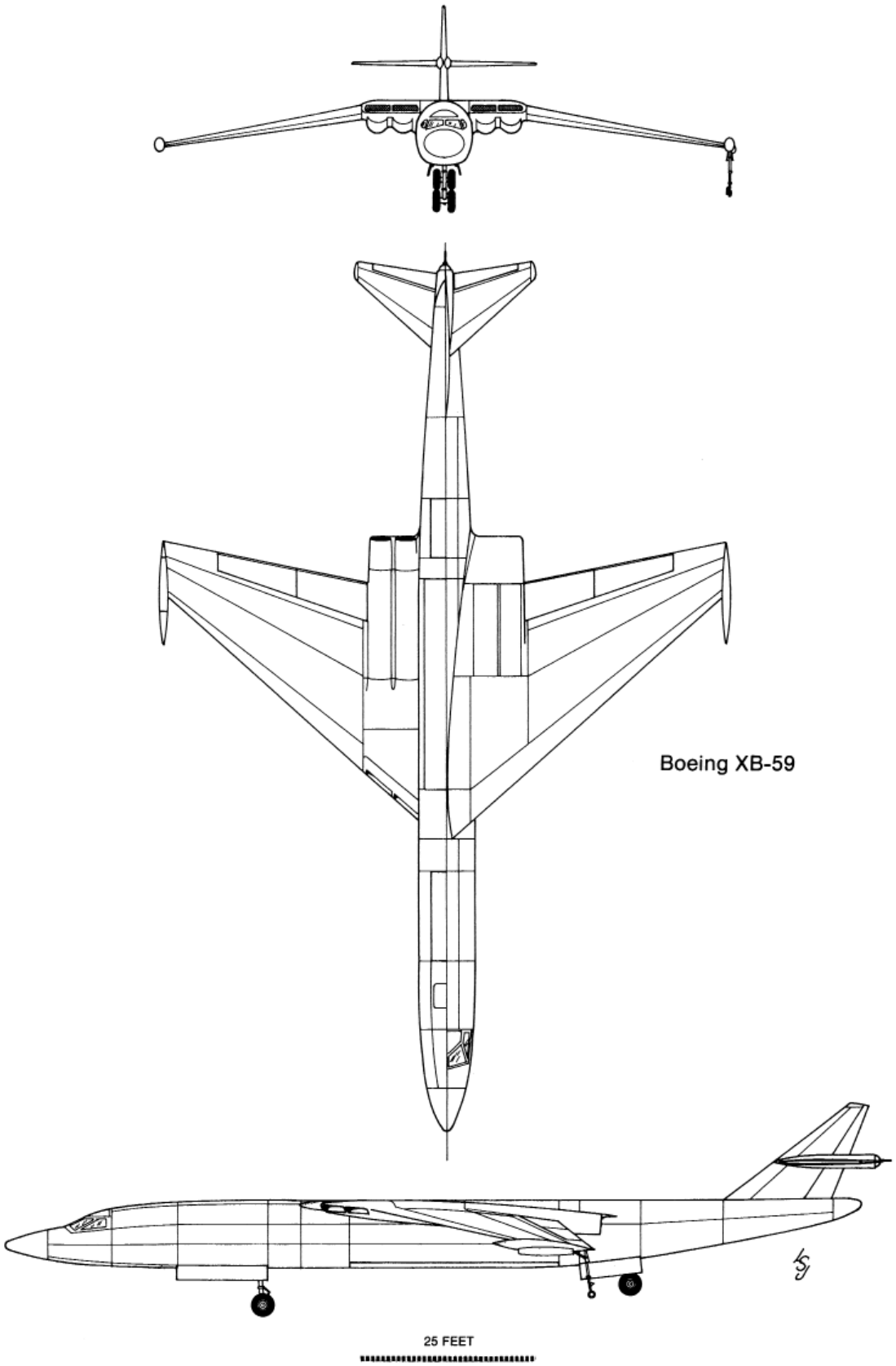
Boeing XB-59

At the behest of the USAF, Boeing and Convair both conducted studies in the late-1940s to evaluate various concepts for a supersonic bomber. By late 1951, progress was encouraging enough for the USAF to issue its first general operating requirement (GOR) for a supersonic aircraft bomber (SAB). GOR/SAB-51, as it was known, called for bomber aircraft with a high subsonic cruise, supersonic dash capability, an unrefueled range of 2,000 miles, and an operational ceiling of 50,000 feet.[28] Although the USAF's Air Material Command (AMC) solicited proposals from six different contractors, Boeing and Convair, because of their advanced research, were judged as having the best chance of success.[29]

It is rather intriguing that two companies could come up with such distinct solutions to the same problem: Convair's MX-1964 (later XB-58) was a small (140,000 lb.) tailless delta with 60-degrees sweepback that utilized an expendable pod to carry the weapons and much of its fuel; Boeing's equally modern but somewhat more conventional MX-1965 (later XB-59) employed a thin-section, low-aspect wing of 40 degrees sweep, shoulder-mounted to a long, slender fuselage. The MX-1964's swept tail surfaces were arranged in a cruciform configuration and the four afterbuming turbojets were mounted in pairs in nacelles that blended in to the wing roots. The aircraft sat on widely-spaced, double-wheeled tandem gear with outriggers retracting from wing-tip pods. The aft position of the highly-loaded wing presumably would have generated an angle of attack requiring the pilot to effect a high-speed



Three-view drawing of Boeing XB-56. (Drawn by Lloyd S. Jones)


Boeing XB-59
25 FEET

touchdown (150 mph+) on the back bogie alone-yikes! Curiously, the general layout of Boeing's concept bears some resemblance to British Aircraft Corporation's TSR.2, which did not appear for another ten years. The MX-1 965/XB-59 would have been powered by either General Electric J73s or Pratt & Whitney J57s, both of which utilized afterburning. The J73-X24A engine was basically a development of the J47 expected to produce 9,300 lbs./s.t., whereas the J57-P-2 was an entirely new twin-spool engine expected to deliver even more power.[30] Dimensions for the XB-59 were a wingspan of 81 feet 4 inches, a length of 123 feet 4 inches, and a maximum gross weight of 148,300 Ibs., making it roughly comparable in mass (if not configuration) to Convair's MX-1964 entry. Armament and weapons would consist of one radar-guided 30 millimeter cannon in the tail and up to 10,000 lbs. of bombs carried internally. Estimated performance for this aircraft, as designed, was given as a maximum speed of 1,200 mph (Mach 1.8 at 50,000 feet), a cruise of 600 mph, an operational ceiling of 50,000 feet, and a range of 2,500 miles.[31]

In early 1952, the USAF amended the GOR/SAB-51 requirement with Directive 34, mandating that the supersonic bomber project would be developed as a "weapons system."[32] The weapons system concept dictated that the airframe, weapons, and combat systems be developed together as an integrated whole around a specified mission objective. In this instance, Convair had considerably more experience because of its work at the time on the so-called "1954 Interceptor" (i.e., the F-102A). When the competition had progressed to the detailed design phase, the USAF's Air Research Development Command (ARDC) believed that Convair's B-58 delta design, though more complex, stood a better chance of achieving supersonic performance than Boeing's B-59.[33] Thus, it came as no surprise in November 1952, when the USAF announced Convair the winner of the supersonic bomber competition and the XB-59 was cancelled. Boeing, fully aware of the huge problems that Convair would face and otherwise fully occupied with the B-47E, X/YB-52, Model 367 (707/C-135), plus air refueling, reportedly did not lose any sleep over the announcement.

Martin XB-68

The USAF's post-war search for a jet propelled tactical bomber is a convoluted story that never ended happily. After scrapping the sleek but mission limited XB-51 and selecting the more versatile B-57 *Canberra* as a stopgap, the USAF decided to try again in early 1952 by soliciting design proposals under a requirement known as Weapons System 302A.[34] Proposals were known to have been submitted by Douglas and Martin as the XB-66 and XB-68, respectively; however, the exact sequence of events that followed is not clear. Apparently, Douglas was awarded a contract very early on because of the commonality of its design with the Navy's XA3D-1 *Skywarrior* (slated to fly sometime in mid-1953), with the idea that production B-66s could be made operational as early as 1955.[35] At any rate, in 1954, due to shortcomings in the program, Martin was invited to re-submit its proposal, together with two new concepts from North American and Boeing. Boeing subsequently failed to meet the USAF's deadline and little is known about North American's bid.

Looking something like a cross between a B-58 and an F-102, the XB-68, was originally conceived (according to one reference) as a three-engine, tailless delta plan form with an area-ruled fuselage.[36] Two of the afterburning General Electric J79 engines were to be mounted in pods below the wings with a third located in the fuselage, air being fed to it through lateral intakes aft of the cockpit. The J79, being developed by GE specifically for supersonic flight, used a three stage afterburner that produced 15,000 lbs./s.t.+ at maximum power settings. Estimated performance was an astonishing 1,650 mph (Mach 2.5) at altitudes exceeding 50,000 feet. Planned dimensions and weights are not known.

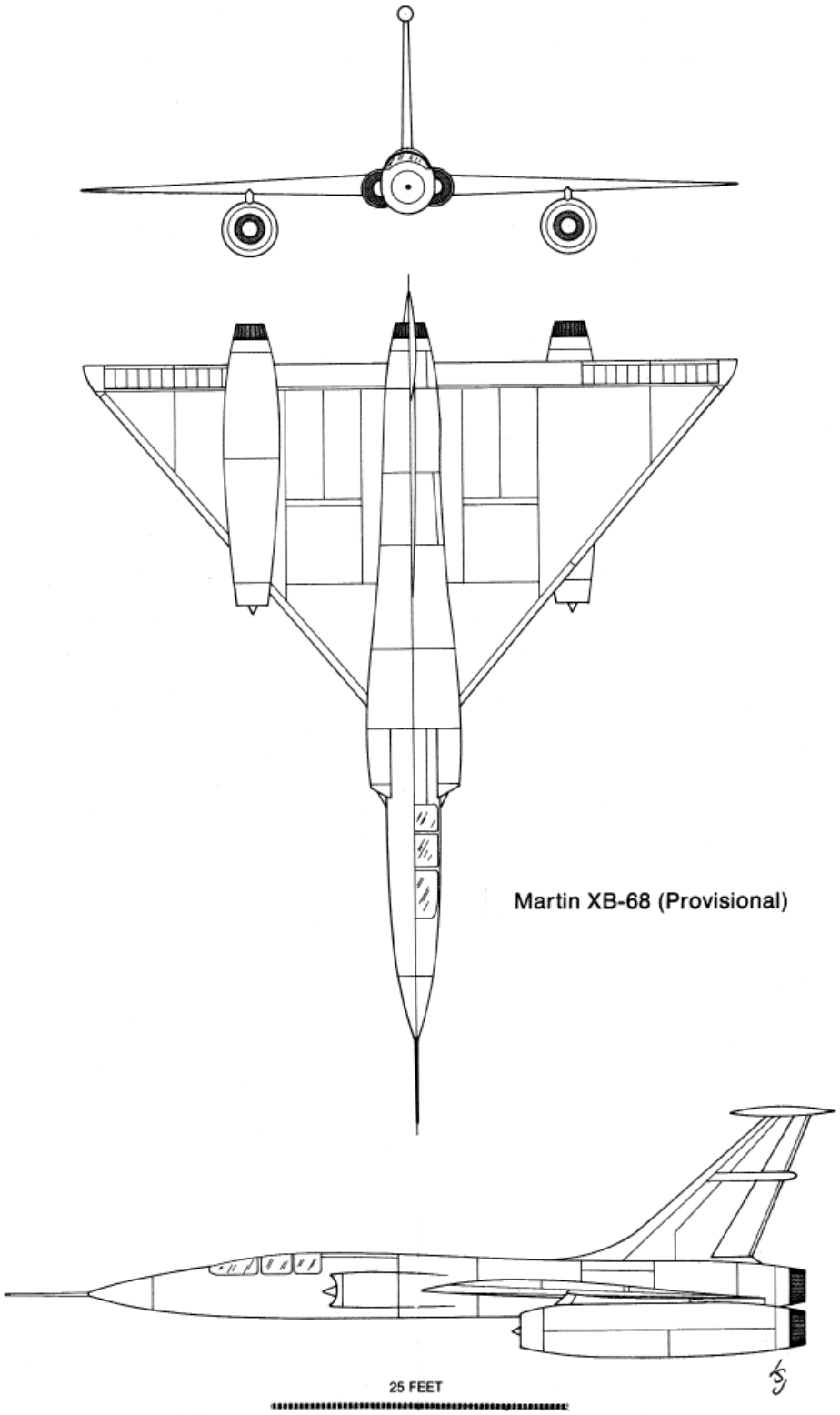
At some point, possibly 1956, the delta wing design was replaced by an entirely new twin-engine configuration, which now looked more like a blown-up F-104. The razor-thin, very high-aspect ratio wing possessed 26 degrees leading edge sweep and a straight trailing edge, joined to a needle-like fuselage having a swept T-tail.[37] Power would be derived from a pair of General Electric J75 engines, rated at 27,500 lbs./s.t. each with afterburning and ISEC (Induction System Evaporative Cooling with water injection). The big engines were side-mounted to the fuselage with ramp type intakes extending ahead of the wing. Planned dimensions were a wingspan of 53 feet and a length of 109 feet 8 inches, and maximum takeoff weight was estimated at 102,720 lbs. Predicted performance was listed as a dash speed of 1,580 mph (Mach 2.4), a continuous supersonic speed of 1,390 mph (Mach 2.1), an operational ceiling of 54,700 feet, and a combat radius of 1,086 miles with a 3,700 lb. payload.[38]

Operating at high Mach numbers, Martin's engineers anticipated the XB-58 would experience significant skin heating (as high as 350 degrees F.) due to aerodynamic friction, which would require extensive use of steel and titanium alloys for wing and fuselage skins rather than duralumin. In order to keep the temperature of the two-man crew compartment at habitable levels, the designers proposed an evaporative refrigeration system that worked off engine bleed-air. Other advanced features planned for the advanced plane included a boundary layer diverter (presumably to enhance slow flight characteristics), a detachable, multi-purpose rotary bomb bay, and inflight refueling capability.[39]

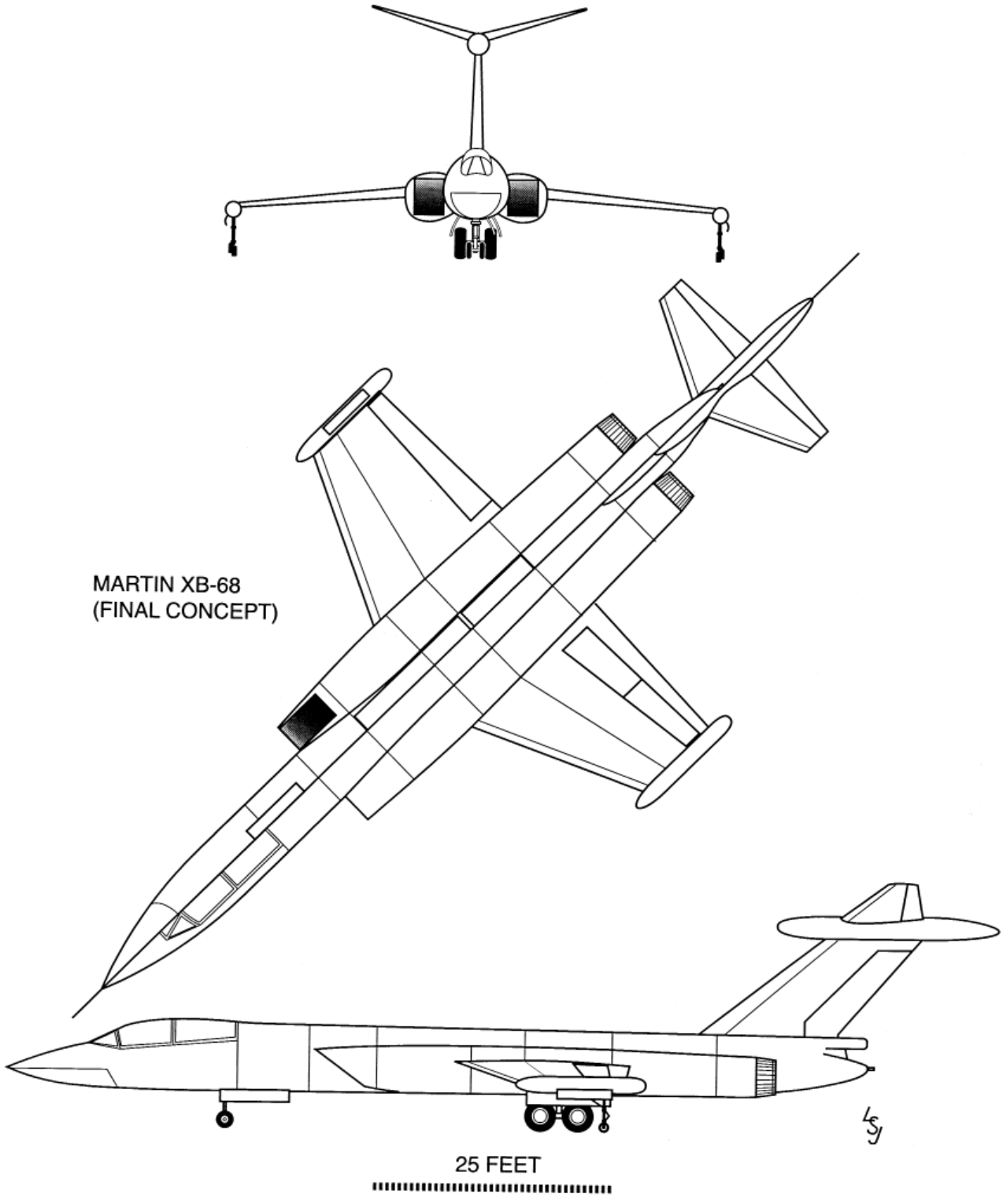
Martin was declared winner of the 1954 competition and told to proceed with design work for two prototypes and one static test aircraft. (Note, Douglas continued the B-66 program under the original specification, flying the first prototype in June 1954 and making delivery of the first operational type, the RB-66B, in early 1956, followed by the B-66B.) As to Martin's program, serious difficulties were encountered developing the highly sophisticated inertial navigation and bombing systems the advanced aircraft would use. In early 1957, citing stringent budget limitations and higher priority of other weapons systems, the USAF cancelled the XB-68.[40]

The Missing Numbers

Beginning in 1951, USAF bomber designations were given to sixteen guided missiles then in various stages of development: B-61 *Matador* (1951), B-62 *Snark* (1951), B-63 *Rascal* (1951), B-64 *Navajo* (1951), B-65 *Atlas* (1951), B-67 *Crossbow* (1951), and B-68 *Titan* (after the manned bomber was can-



Three-view drawing of the provisional design of the Martin XB-68. (Drawn by Lloyd S. Jones)



Three-view drawing of the final concept of the Martin XB-68. (Drawn by Lloyd S. Jones)

celled), B-72 *Quail* (1956), B-72 *Bull Goose* (1956), B-75 *Thor* (1956), B-76 *Mace* (1956), B-77 *Hound Dog* (1956), B-78 *Jupiter* (1956), B-80 *Minuteman* (1956), B-83 *Bullpup* (1956), and B-87 *Skybolt* (1956).[41] Fortunately, the missiles were later redesignated with reference to a standardized missile nomenclature system. The designation RB-69 was assigned to several ex-Navy Lockheed P2V-7s used by the USAF for radio training and B-71 was reserved but never used for a bomber variant of the Lockheed YF-12/SR-71. The designations B-74, B-79, B-81 and B-82, and B-84 through B-86 were apparently never assigned. The bomber numbering system started over again in 1969 when the North American-Rockwell AMSA (Advance Manned Strategic Aircraft) received the designation B-1A.[42]

Footnotes

[1] Maj. Dik Daso, "Hap Arnold's Command Years and Aviation Technology, 1936-1945," Aerospace Power Chronicles, Maxwell AFB, 1996. pp. 4-5.

[2] Daso, p. 11.

[3] Marcelle S. Knaack, Encyclopedia of U. S. Air Force Aircraft and Missile Systems, Vol. II: Post-World War II Bombers 1945-1973, Office of Air Force History, Washington, D. C., 1988, p. 101.

[4] Ray Wagner, American Combat Planes, Doubleday & Company, Inc., New York, rev'd ed. 1968, pp. 261-262.

[5] Knaack, pp. 11-12.

[6] ibid, p. 61.

[7] Ibid, p. 77.

[8] William Green and Roy Cross, The Jet Aircraft of the World, Hanover House, New York. 1957, p. 52.

[9] Lloyd S. Jones, U.S. Bombers B1-B70, Aero Publishers, Los Angeles, 1962, p. 180.

[10] "Convair XB-53," U.S. Air Force Museum (USAFM Archives, www.wpafb.af.mil/museum, undated, p. 1.

[11] "Convair XB-53," p. 1.

[12] Wagner, p. 149.

[13] Knaack, pp. 181-182.

[14] Jones, p. 183.

[15] Knaack, p. 20.

[16] Jones, p. 186.

[17] Knaack, pp. 356-357.

[18] Ibid, pp. 207-208.

[19] Wagner, p. 147.

[20] Ibid, p. 261.

[21] Jones, .p. 186.

[22] Knaack, p. 131.

[23] Ibid, p. 109.

[24] "Boeing B-56A," USAFM Archives, undated, p. 1.

[25] Green and Cross, p. 21.

[26] "Boeing B-56A," p. 1.

[27] Knaack, p. 382.

[28] Ibid, p. 358.

[29] Ibid, p. 361.

[30] Jones, p. 200.

[31] Green and Cross, p. 25.

[32] Knaack, p. 362.

[33] Ibid, pp. 363-364

[34] Ibid, p. 405n.

[35] Ibid, p. 405.

[36] Jones, p. 226.

[37] "Martin XB-58," USAFM Archives, pp. 1-2.

[38] Ibid, p. 2.

[39] Ibid P. 1.

[40] Knaack, p. 405n.

[41] "U. S. Military Aircraft Designations, 1911-1999," www.driko.org/usdes.html, 1999, pp. 10-11.

[42] Knaack, p. 579.

ILLUSTRATION REFERENCES

1. Three-views of XB-53, YB-54, XB-55, YB-56, XB-59 and XB-68. These were drawn by Lloyd S. Jones in 1962 and appeared in his book, mentioned above. They will be scanned and copied to a CD disk. Copyright is 40 year old and Aero Publishers is no longer in business, but I will attempt to get permission to use them from Mr. Jones or his heirs.

2. Three-view, fuselage profile, oblique cutaway drawings of XB-58 (second development). These may be directly copied from the USAFM website: www.-wpafb.af.mil/museum/research/bombers/b5/b5-59.htm.

3. Artists' conceptions of XB-53 and YB-54. Same source as 1., above.

4. Artist's conception of XB-53 (second development). Same source as 2., above.