

The Curtiss-Wright XA-43 Attack Airplane

By Wai Yip

The breakthrough year for jet-propelled military aircraft appears to be 1944, primarily due to the advent of the axial-flow jet engine. The axial-flow turbojet offered many advantages over the earlier-developed jet engine using the centrifugal flow compressor. These advantages included less weight and less frontal area of the engine, translating to less drag. The axial-flow jet engine consisted of alternate rows of rotating blades attached to the rotating shaft and stationary vanes attached to the engine casing to compress the air before feeding it into the combustion chambers.¹ The U.S. War Department saw the potential of this type of jet engine and in September 1943 directed Air Materiel Command (AMC) at Wright Field to initiate studies for an experimental airplane to incorporate one or more GE TG-180 axial-flow jet engines (redesignated J-35 in 1946 when military designation for jet engines was introduced). This engine was still under development under Project Number MX-414. Further studies of the TG-180 engine conducted by the AMC indicated that this engine would probably be well suited for high altitude photographic aircraft or light bombardment types. In 1944, encouraged by the result of the studies, AAF requested the aircraft industries to submit design proposals for various types of airplanes to be powered by this General Electric jet engine. Aircraft types to be considered included a day fighter, a

bomber and an attack airplane. The day fighter developed into the Republic P-84. Three aircraft manufacturers, Boeing, Convair, and North American Aviation, initially submitted proposals for the bomber competition. Martin was later added to the contender list. The Boeing design was eventually selected and became the B-47. Army Air Forces (AAF) approached Curtiss-Wright Corporation for the attack aircraft, providing them with a preliminary set of performance characteristics in September 1944. By October 16, 1944, Curtiss-Wright had submitted their Model 100 design proposal to the AAF. A Letter Contract was signed on November 22, 1944. Attack aircraft designation XA-43 was applied and Project Number MX-582 was assigned. Curtiss-Wright was authorized to proceed with Phase I development of the proposed aircraft that included preliminary engineering and data, wind tunnel model, tests, test report and a mock-up. Phase I work was to be completed by March 15, 1945. Figure 1 shows an artist's impression of the XA-43 by AAF.

The XA-43 was to be a tandem two-seat attack aircraft powered by four GE TG-180 jet engines. Curtiss-Wright came up with a straight wing design with two TG-180 engines in the mid-section of each wing housed in a single nacelle. This method of grouping two or three engines into one wing-mounted nacelle was popular in the early jet aircraft designs. The XB-45, XB-46, XB-48 and the Navy's unbuilt XF9F-1 all had similar engine nacelle arrangement though the details of the nacelle design varied in each. This design configuration was not a coincidence. National Advisory Committee for Aeronautics (NACA) had conducted research on the drag and interference of engine nacelles on the wing. Based on the findings from the research conducted in the 1930s and 1940s, the nacelle offered least drag when placed as far as possible within the wing with fairing between the wing and the nacelle. NACA also found that the reduction in wing lift occurred mainly in the neighborhood of the nacelle. Surprisingly, the arrangement of having the engine nacelle within the wing had very little adverse effect on the lift as compared to other nacelle arrangements, such as on top of the wing or hung under the wing by struts.² The twin-engine nacelle design also offers some additional benefits. The area between the two engines becomes an ideal place to house the main landing gear. For the XA-43 design, the main landing gear was located in the rear of the nacelle resulting in a rather blunt afterbody. As will be seen later, the revised XA-43 landing gear design had dual side-by-

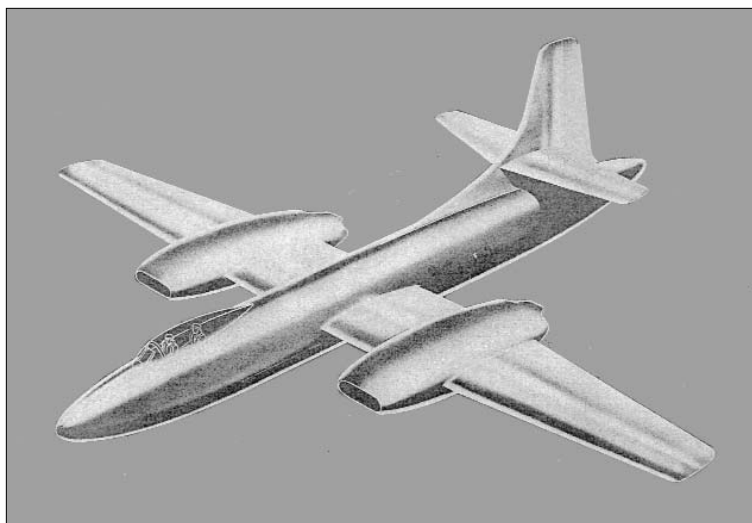


Figure 1: This is the artist's impression of the original XA-43 design. Note the general similarity in shape to the XP-87 and the engine nacelle mounting. The obvious difference is the tandem seating. (AAF via the National Archives)

side wheels. This made it difficult to retract into the typically thin, high-speed wing section, resulting in the engine nacelle being much more useful to house this landing gear design.

The wing design used NACA's 66-(1.5)11 (a=1) section throughout. This airfoil section is designed for high-speed, low-drag flight with maximum airfoil thickness at 11 percent of chord length, making it a relatively thin wing. According to Curtiss-Wright, the primary reason for the selection of 66-series wing section was because they provided greater space for the aileron balance and the flap mechanism than did the sections with the maximum thickness farther forward.³

The TG-180 jet engine had a “target” military power of 4,000 lbst at 7,700 rpm at sea level (also takeoff thrust rating), and a normal rating of 3,340 lbst at 7,300 rpm at sea level. Actual performance of TG-180 was found to be less. The engine weighed 2,400 lbs with 37 inches diameter and 178 inches (about 15 feet) in length. The engine burned kerosene at a rate of 1.08 lbs per pound thrust per hour at normal rating.¹¹ GE started development of the TG-180 jet engine in 1943 with the first run of the engine taking place in April 1944. The first 50-hour run did not occur until February 1946. From this development timeline it’s clear that both the TG-180 jet engine and the XA-43 airframe were developed in parallel.

The XA-43 was designed to have a crew of two with an option for a third crewmember, possibly a gunner. The guns were to be controlled by a gunner equipped with periscopic sights located in the mid-section of the fuselage. In October 1945, GE proposed a fire control system for the XA-43, but by then the XA-43 project was in the process of being cancelled and this equipment was never incorporated into the design.

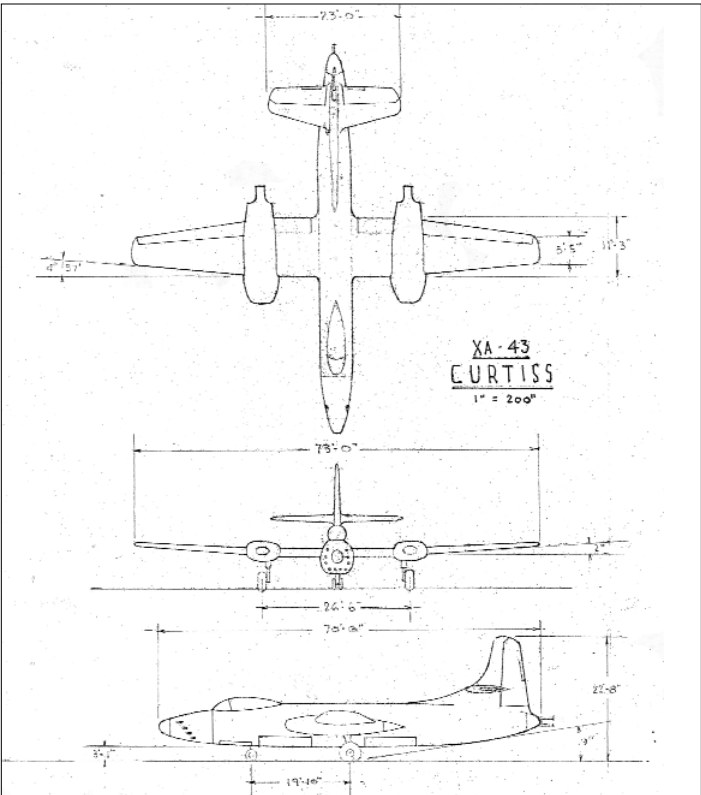


Figure 2: This is the 3-view diagram of the originally proposed XA-43. (AAF via the National Archives)

Design gross weight was to be 69,400 lbs with a bomb load of 6,000 lbs and 2,835 gallons of fuel. Performance at this gross weight and bomb load was estimated to be 400 mph with a range of 1,500 miles. The armament consisted of 10 fixed forward-firing 0.50 cal. nose guns and two 0.50 cal. tail turret controlled by AN/APG-3 radar. Figure 2 shows the 3-view diagram of the originally proposed XA-43 and Table 1 shows the details of the armament.

Initial design of XA-43, proposed by Curtiss-Wright in Report #9428, dated October 10, 1944, involved the use of four 3,000 lbst (military power) Westinghouse 24-C turbojet engines instead of the TG-180 engines. This proposal possibly pre-dated AAF’s requirement to use the TG-180 engines. Figure 3 shows the XA-43 proposal with the Westinghouse 24-C turbojets. The general shape of the airplane remained very similar to the TG-180 powered version with the exception of the engine nacelle design. In the Preliminary Phase I Model Specification Report # 9428A, Curtiss-Wright stated, “Careful consideration shall be given to the possible use of alternate powerplants, in the events of better availability of other units.” In Report #9428, Curtiss-Wright emphasized that the powerplant assembly was a single readily removable unit in the event of a larger powerplant becoming available. Therefore, Curtiss-Wright must have had an idea of the potential availability of the more powerful GE TG-180 engine. The Westinghouse 24-C engine-powered version of XA-43 was smaller, being of 67 ft 6 in length, a 73 ft span, and a wing area of 666 sqft. A gross weight of 56,300 lbs with 6,000 lb bomb load and an estimated speed of 611 mph at sea level. Incorporated into this design proposal, Curtiss-Wright provided the option of replacing the rear gun turret with one Westinghouse 19XB2a

Table 1				
Armament of the original XA-43 design				
Gun & Cannon				
	No.	Cal.	Rds/Gun	Position
Normal				
	10	.50	500	Nose (fixed forward firing)
	2	.50	500	Tail (Turret)
Alternate				
	8	.60		Nose (fixed forward firing)
or	8	20 mm		Nose cannons
or	1	75 mm		Center Nose cannons
or	1	105 mm		Center Nose cannons
Bombs				
	Normal		Alternate	
	No.	Size	No.	Size
	54	100 lbs	72	100 lbs
or	24	250 lbs	16	500 lbs
or	12	500 lbs	12	1,000 lbs
or	6	1,000 lbs	10	1,600 lbs
or	3	2,000 lbs	6	2,000 lbs
or	6	3,000 lbs	Hydro Bombs	
or	1	12,000 lbs		
Source: Curtiss-Wright XA-43 spec. sheet, dated 3/20/45				

jet engine as the night fighter version. The additional engine would boost the top speed at sea level to 630 mph.

The mock-up inspection took place during the week of February 19, 1945. Incorporating all the comments from the mock-up inspection raised the estimated weight of the airplane to 85,000 lbs. Several major design changes were made resulting in the reduction of the gross weight of 62,000 lbs. The changes included increasing the wing span and wing areas, reducing the structural weight of the airplane, and reducing the fuel load by about 550 gallons. Other modifications included changing the tail turret to two backward facing nacelle turrets resulting in the deletion of the tail turret AN/APG-3 radar, reducing the bomb load from 6,000 lbs to 4,000 lbs, and adding new options of 24 0.50 cal. gun package or 32 five-inch HVAR rockets in the bomb bay. At the design gross weight of 62,000 lbs and a bomb load of 4,000 lbs, the projected endurance performance would be 370 mph with a range of only 1,200 miles. The main landing wheel design was revised from a single landing wheel to dual landing wheels. All these changes resulted in shorter range and lower speed, but with improved takeoff roll, climb rate, and lower design gross weight. AAF allowed the outward leg of the flight at an altitude not to exceed 5,000 feet instead of at sea level. Table 2 shows the details of the armament of the revised XA-43 design. Table 3 provides a comparison between the original design and the revised design parameters.

The Air Technical Service Command (ATSC), the research branch of the AAF involved in the development of new types of military airplanes, recommended, based on the Curtiss-

Wright XA-43 project report dated April 20, 1945, to continue the XA-43 project on an experimental basis despite some concerns that the range and takeoff roll would not meet the AAF requirements. This recommendation resulted in a supplement to Letter Contract being made on May 22, 1945, for the Phase II of this project by ordering the following:

- Item 1: One Static Test Article and Three Flight Test Articles of XA-43 in according to Curtiss-Wright's spec 9533 dated March 15, 1945, and including all engineering drawings and reports.
- Item 2: Test Models for XA-43.
- Item 3: One TG-180 aircraft engine, installed and flight tested on Government-owned C-46 airplane to be loaned to Curtiss-Wright under bailment.

On June 27, 1945, amendment to this letter contract supplement was made by revising Item 1 to one stripped flight article and one completely equipped flight article and replacing Item 3 with one TG-180 aircraft engine installed and ground tested in a ground testing installation. The expenditure amount authorized was increased from about \$2.9 million to \$5.4 million.

AAF issued on July 23, 1945, a revised military characteristic for the attack airplane making some of the requirements more stringent. These changes made the Curtiss-Wright design even less attractive. The revised military characteristics also drew the attention of Convair that soon submitted a proposal for consideration and received AAF military designation of XA-44 for Phase I design studies.

In a memo to Headquarter AAF dated September 10, 1945, ATSC recommended cancellation of the XA-43 project. The memo explained that the project was initiated with acceptance of some compromise in range and bomb load (due to over estimation of engine performance). Subsequent information on the windmilling drag on jet units, together with a correction in the method used for range calculations, have further reduced range of the XA-43 to 500 miles below AAF minimum established in military characteristics for attack airplanes. The range was approximately 1,000 miles short of the 1945 characteristics. Completion of this project would have required approximately one third of the remaining 1946 funds allocated for the development of bombardment type aircraft. ATSC did not believe that the XA-43 airplane represented sufficient improvement in the art of airplane design to warrant continuation of this project in the light of the compromises and expenditures involved. AAF approved the cancellation on September 29, 1945, as a result of this recommendation and directed that all work

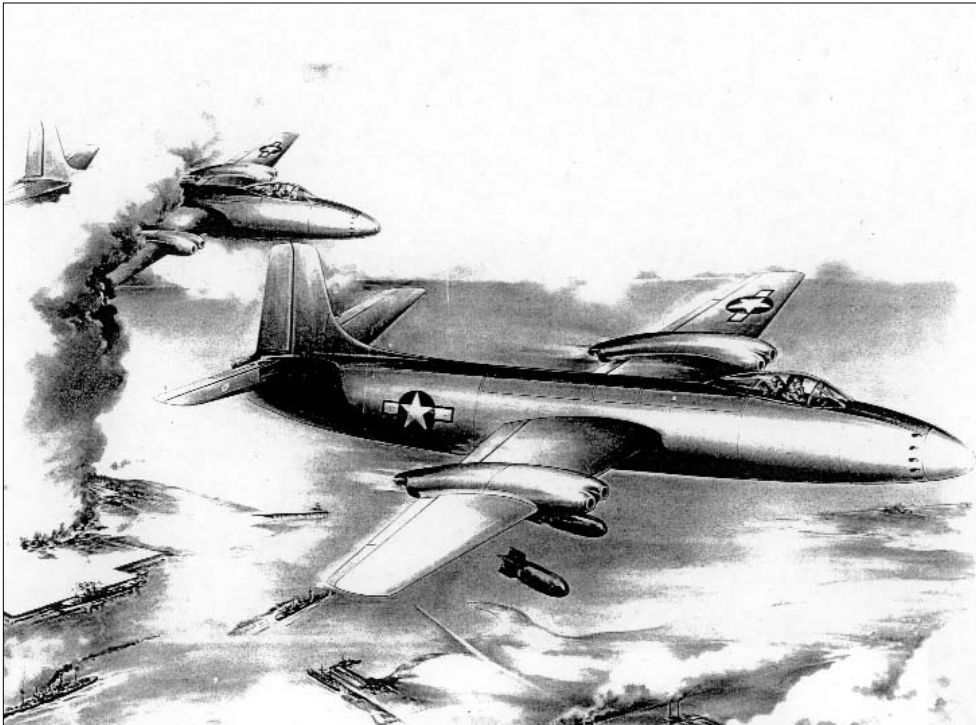


Figure 3: Artist's impression of the initial XA-43 design proposal with four Westinghouse 24-C turbojet engines submitted by Curtiss-Wright to AAF in October 1944. The recognizable difference between the Westinghouse engine-powered version and the GE engine-powered version is the difference in the engine nacelle design. (Curtiss-Wright via the National Air & Space Museum Archives)

Table 2
Armament of the revised XA-43 design

Gun & Cannon

	No.	Cal.	Rds/Gun	Position
Normal				
	10	.50	500	Nose (fixed forward firing)
	2	.50	500	Nacelle turrets (facing backwards, 1 gun each)
Alternate				
	8	.60		Nose (fixed forward firing)
or	8	20 mm		Nose cannons
or	1	75 mm		Center Nose cannons
or	1	105 mm		Center Nose cannons
or	24	.50		Bomb Bay Package

Bombs

	Normal		Alternate	
	No.	Size	No.	Size
	8	500 lbs	48	100 lbs
or	14	500 lbs		
or	7	1,000 lbs		
or	4	1,600 lbs		
or	4	2,000 lbs		
or	4	3,000 lbs		Hydro Bombs
or	1	12,000 lbs		
or	32	5" HVAR Rockets		

Source: Curtiss-Wright XA-43 spec. sheet, dated 5/21/45

associated with the XA-43 project cease by October 30, 1945.

The performance of the TG-180 jet engine appears to have been overestimated when initially conceived. The original target military power was 4,000 lbst at 7,700 rpm but only about 3,750 lbst was achieved. This appears to have contributed to the projected under performance of the XA-43 as it was originally designed to have thrust of 4,000 lbst per engine. Also, the idea of thrust augmentation by injection of water and alcohol mix at the compressor inlet did come about until 1947-'48, too late for this project. NACA research¹² in 1948 had revealed that this thrust augmentation method would provide about an additional 15 percent thrust to the TG-180 jet engine and therefore would have brought the maximum thrust to above the target 4,000 lbst.

Curtiss-Wright appeared to have proposed to the AAF the all-weather fighter design for the second time, which would be eventually designated XP-87.. In the revised military aircraft characteristics approved by the AAF in late 1945, the day fighter and the night fighter classifications were revised into interceptor fighter, penetration fighter, and all-weather fighter classifications. This seems to be another reason why the AAF was receptive to the idea of reallocating the unused XA-43 project fund to the XP-87 design.

There have been debates as to whether the design of the XP-87 was derived from the cancelled XA-43. Comparing the XA-43 and the XP-87 designs, they look remarkably similar although their dimensions, weights, and missions are totally

Parameters design	Table 3	
	Original design	Post Wt savin
	(3/20/45)	(5/21/45)
Wing Span	76' 3"	77' 7"
Length	74' 10"*	74' 10"
Wing Area	725 sq ft	750 sq ft
Empty Wt	40,852 lbs	39,140 lbs
Design Gross Wt	69,400 lbs	62,000 lbs
Fuel	2,835 gallons	2,280 gallons
Cruising Speed	400 mph	370 mph
High Speed at SL	590 mph	585 mph
Range	1,500 miles	1,200 miles
Rate of Climb	4,430 ft per min	4,800 ft per min

* There are some discrepancies of the dimensions between the Spec sheets and in the 3-view drawings. The author can only speculate that the dimensions were constantly being revised during the design phase and the Spec sheets and the drawings the author obtained from the National Archives might have been from different stages of the design.

different. The only major differences in the appearance are that the XA-43 had the tandem two-seat design while the cockpit of the XP-87 accommodated side-by-side seating. The XA-43 had no wing tip tanks while the XP-87 was originally designed with the wing tip tanks. The other difference, though not readily apparent, was the use of Westinghouse 24-C (redesignated J-34 in 1946 when military designation for jet engines was introduced) jet engines instead of the GE TG-180s. Subsequent modifications to the XP-87 design during 1947 and 1948 made the XP-87 less resemble the XA-43. Table 4 provides a comparison of various parameters between the XA-43 and the XP-87. The author has not been able to find any Curtiss-Wright document to confirm that the design of the XP-87 was based heavily on the XA-43 project. However, telltale clues the author was able to find to infer this claim can be found in two AAF memos. The first AAF memo, dated December 6, 1945, requesting the reallocation of funds from the cancelled XA-43 project to the XP-87 proposal, stated, in part, the following:

"... it appears that conversion of the unexpended portion of the funds allocated for the XA-43 to the purchase of the XP-87 would save the Government the \$700,000 already spent."

This statement could only mean that the XP-87 design proposal must have made use of a lot of design features originally developed for the XA-43 so that the would-be \$700,000 expenses for the development of the XP-87 could be saved.

The second AAF memo is a supplement to the XA-43 letter contract stopping all work on the XA-43 project and authorizing the construction of one XP-87. It stated, in part, the following:

"... all works on the XA-43 shall be utilized by Curtiss-Wright to the extent practicable in the performance of work relating to the construction of the XP-87."

Two AAF serial numbers were assigned to the two XA-43s ordered. However, when the XA-43 project was cancelled by late 1945, one of the serial numbers was reused for the first XP-87. The reason was the approval from AAF to reallocate the remaining unspent funds from the XA-43 project to the XP-87 project. An AAF memo dated January 24, 1946, on the subject of Fighter Aircraft Development Funds might explain the reason a bit better. When the letter contract for Phase 2 of the XA-43 was issued on May 25, 1945, for three flight and one static test articles, \$8,500,000 was allotted with \$5,500,000 from the Fiscal Year (FY) 1945 funds and the remaining \$3,000,000 from the FY1946 funds.

Subsequently, supplement to the letter contract for Phase 2 reduced the amount to \$5,500,000 for two flight articles, one completely equipped and one stripped. When the XA-43 project was cancelled, \$4,200,000 was still available. This amount of money was reallocated to the XP-87 project and was sufficient for only one flight test article. Since it is from the FY1945 funds, this XP-87 flight test article was allowed to keep the FY1945 serial originally assigned to the first cancelled XA-43. This explains the apparent discrepancy why FY1945 AAF serial was assigned to the first XP-87 that was ordered in February 1946. The second XP-87 was ordered essentially the same time but FY1946 funds were used. As a result, a new FY1946 serial was assigned to the second XP-87 instead of using the FY1945 serial number assigned to the second cancelled XA-43. The two AAF serials assigned to the two XA-43s are listed as follows:

USAAF serials	Remarks
45-59600	reused by the first XP-87
45-59601	cancelled, not reused

Exactly how much did the XA-43 project cost? Different AAF memos gave slightly different answers, probably due to interpretation of the charging practices by different departments. However, the final report on the procurement of Curtiss-Wright's *Blackhawk*, published by USAF, Air Materiel Command, dated June 1949, seems to have provided the most reliable numbers. According to this report, the total cost of the XA-43 project was \$863,959 (1945 dollars).

Competition

In November 1943, AAF had instructed Douglas to modify the static test articles of the piston-engine driven XA-42 (the attack designation was changed to XB-42 a month later in November 1943) to carry two GE TG-180 jet engines. Military designation XB-43 was assigned to this jet-propelled bomber design. This became the first experimental jet-propelled airplane to be powered by the TG-180 engines to explore its characteristics. A proposal was made by Douglas in February 1945 to develop the XB-43 into an attack airplane,⁶ which, the author believes, was to meet the same attack design request as

Table 4

Parameters	XA-43	XP-87 (early design)
Span	77' 7"	60'
Length	74' 10"	62' 10"
Wing Area	750 sq ft	600 sq ft
Empty Wt	39,140 lbs	27,935 lbs
Design Gross Wt	62,000 lbs	37,350 lbs
High Speed	585 mph	600 mph
Time to climb	35,000 ft in 11.5 min	35,000 ft in 13.8 min
Armaments	10 .5 Cal. nose guns 2 .5 Cal. nacelle turret	4 20mm nose cannons 2 .5 Cal. tail guns

that of the Curtiss-Wright XA-43. The proposal from Douglas involved replacing the left and right inboard wing fuel cells with 16 forward-firing fixed guns. The numbers of rounds for each gun varied from 400 rounds per gun from the extreme inboard to 300 rounds per gun to the extreme outboard locations. By April 1945, Douglas had furnished further information concerning the attack version of the B-43 which was considered sufficiently promising by the ATSC to warrant procurement of 13 service test articles, designated YB-43, for the purpose of investigating the merits of this design. By this time, the total number of 0.50 caliber guns had increased to 18. In May 1945, Douglas came back with a quote for 13 YB-43s and the delivery date starting from December 1946 and ending in September 1947. AAF authorized the purchase on May 14, 1945, and assigned Project Number MX-685 to the activity. By June 1945, AAF decided to postpone the order until after the flight test of the XB-43.

Also, ATSC felt that the delivery dates were not sufficiently early enough and investigated similar types such as the YB-45 or YB-46 for earlier delivery. When delivery of 13 YB-45s by North American Aviation between November 1946 and May 1947 might be a possibility, AAF decided to pursue ordering 13 YB-45s in lieu of the 13 YB-43s from Douglas. The reason given was that these airplanes could be used for tactical test purposes as early as possible. As a result, the attack version of the B-43 was not pursued. As history has revealed, the YB-45s were not built either. However, one of the three XB-45s was completed as "tactical" model for evaluation but did not lead to a production order.¹⁰ Part of the reason might have been due to the elimination of the attack classification by the AAF. Per a memo on the subject of military characteristics for aircraft from AAF Headquarter, dated December 1945, various military aircraft classifications were redefined. The bomber classifications were to be revised from heavy bombardment aircraft and medium bombardment aircraft to heavy bomber, medium bomber, and light bomber classifications. The attack airplane classification was to be eliminated and the "bombing in cooperation with Ground Forces" part of its function was to be absorbed by the light bomber classification. With the requirement not existing anymore, the YB-43 and YB-45 were not pursued.

There is another tidbit of information relating to the XA-43 project that is worth mentioning. In an AAF memo

dated December 1, 1945, another reason given by the ATSC to cancel the XA-43 project was that it was considered obsolete in comparison with other attack-type airplanes such as the proposed XA-44. The XA-44 (MX-716) was another little known attack airplane project proposed by Convair to the AAF soon after AAF came up with revised military characteristics of the attack airplane in July 1945. The XA-44 only received the Phase II development go-ahead when two of the three flight articles of the XB-46 contract were cancelled in December 1945. Convair was able to convince AAF to reallocate the remaining XB-46 funds for two XA-44s. The XA-44 was a very radical design with forward swept-wings and no horizontal tail planes. It was to be powered by three TG-180 jet engines. In June 1946, the XA-44 project was converted into a light bomber project with some design revision to conform to the light bomber role. It was redesignated XB-53. As mentioned earlier, the reason was that the military requirement for the attack airplane no longer existed. The easily recognizable change from the early XA-44 was the redesign of the forward wing sweep from 12 degrees (at 25 percent chordline) to 30 degrees. This project was also cancelled by AAF in December 1946 when AAF determined that development of the XB-53 was at a much higher cost than the comparable Martin XB-51. Some books and articles have inferred that the XA-43 and XA-44 were both ordered at the same time to compete for the AAF's attack airplane design request. Though they were competing for the same attack airplane design, they were not ordered at the same time for concurrent evaluation. A simple way to tell is by the assignment of the Air Materiel Command's MX project number. If the assigned project numbers were close or next to one another, they were likely to have been ordered by the AAF at the same time for concurrent development and evaluation. As the assigned project numbers were quite different for XA-43 (MX-582) and XA-44 (MX-716), they were definitely not ordered by the AAF at the same time.

References

1. If readers are interested, the following Web site provides an excellent introduction to the principles of jet engine operation. "www.geocities.com/nedu537/turbine/." It discusses the merits of the centrifugal compressor and the axial compressor.
2. National Advisory Committee for Aeronautics (NACA) Technical Notes No. 320, "The Drag and Interference of a Nacelle in the Presence of a Wing" by Eastman Jacobs. Two other NACA reports of interest are: "The Development of Jet-Engine Nacelles for a High-Speed Bomber Design" by Robert E. Dannenberg, NACA RM No. A7D10, dated August 29, 1947, and "An Experimental Investigation of Several Low-Drag Wing-Nacelle Combinations with Internal Air Flow" by Julian Allen, Charles Frick, and Myles Erickson, NACA ACR No. 5A15, dated 1945. The author was unable to obtain a copy of the NACA 5A15 Report but believes that it must have some influences on the XA-43 nacelle design.
3. The following NASA Web site contains a wealth of airfoil data and explanation which will keep any curious reader satisfied.

"<http://naca.larc.nasa.gov/reports/1945/naca-report-824/naca-report-824.pdf>." The detailed discussion of the merit of this airfoil design is beyond the scope of this article and certainly beyond the comprehension of the author who is no aerodynamicist.

4. *Air Force Developmental Aircraft, AFR 190-16*, dated April 1957, prepared by Air Research & Development Command, USAF.
5. "Case History of the XF-87 All-Weather Fighter Airplane," prepared by Helen W. Schulz, Historian, Air Materiel Command, Wright-Patterson AFB, January 1950 and its supporting AAF documents.
6. "Case History of XB-43 Airplane," compiled by Historical Office, Air Materiel Command, Wright-Patterson Air Force Base, November 1948 and its supporting documents.
7. *Aviation Week Magazine*, Volume 47 No. 11, "AAF Unveils New XP-87 Fighter," dated September 15, 1947.
8. AAF Letter Contract W33-038-ac-6266.
9. Air Technical Service Command, *Research & Development Projects of the Engineering Division, Sixth Edition* (Jan 1, 1945) & *Seventh Edition* (July 1, 1945) on MX-582 Project.
10. *Encyclopedia of U.S. Air Force Aircraft and Missile Systems, Volume II, Post-World War II Bombers, 1945-1973*, by Marcelle Size Knaack.
11. *Jet Power in Naval Aircraft – NAVAER 02-1-514*, published by the Chief of the Bureau of Aeronautics, dated February 15, 1949. Information in the engine history Web site, www.engine-history.org is also very useful. Readers are encouraged to visit this Web site to learn more about the U.S. piston and jet engines development.
12. NACA Research Memorandum, "Experimental Investigation of Thrust Augmentation of Axial-Flow-Type 4000-Pound Thrust Turbojet Engine" by Water and Alcohol Injection at Compressor Inlet," by Burnett Baron, Harry W. Dowman and William C. Dackis, RM No. E7K14, dated July 8, 1948.
13. Curtiss-Wright Report No. 9428, "Design Evaluation Army Attack Bomber" and Report No. 9428A, "Preliminary Phase I Model Specification," dated October 10, 1944.

Acknowledgement

This is the author's third article for this *Journal* and hopes that the subject matter is of interest to the member readers. The main source of information for this article is from various AAF memos the author was able to obtain from the National Archives. The author must apologize that the way the article is presented sounds very verbose. This is because a lot of wordy statements in the AAF memos are quoted or repeated in this article. The author appreciated the help from Mr. John Weber from the Historian Office of USAF Air Materiel Command for the MX Research Project Progress Reports and the help from the National Archives for the XA-43 3-view diagrams and the spec sheets. This article is by no means complete. Readers' insights and comments on this subject are kindly solicited.