

# *F-108* *RAPIER*

By Erik Simonsen





Illustrations by Erik Simonsen

## The Air Force's Mach 3 interceptor that almost was.

**T**he sleek, triple-sonic F-108 Rapier was to have been the fighter-interceptor half of an Air Force nuclear tag team with the B-70 Valkyrie supersonic bomber. Both were futuristic designs developed to vault ahead of rival Cold War technologies of their day—one defending the homeland against Soviet bombers and missiles, the other carrying the nuclear fight to the Soviet heartland at unprecedented speed.

Despite great optimism surrounding the projects, neither the Rapier nor the Valkyrie would see operational service.

The Valkyrie was done in by politics, changing mission requirements, and cost.

The Rapier was a victim of changing requirements and better information about the threat—eclipsed by more

expedient designs with more modest ambition. While some view the Rapier as too far ahead of its time, others see it as a lost opportunity. Among aviation fans, it reigns as one of the best supersonic fighters that never was.

In the late 1950s new aircraft designs were leaping off the drawing board and into mock-up or test-flight stage only months apart. The so-called “Century Series” of USAF fighters had already produced the F-100 Super Sabre, F-102 Delta Dagger, and F-104 Starfighter, each configured with a slightly different aspect of the aerial Cold War in mind.

The Rapier—dubbed the F-108—was conceived to deal with approaching Russian bombers while they were as far away as possible. This was necessary for two reasons: one, to keep the bombers distant so their nuclear weapons couldn't reach the United States, and two, because the Rapiers would have destroyed the attacking bombers with air-to-air missiles also carrying nuclear warheads.

Ideally, those detonations would take place over the Soviet frontier or Arctic

Ocean, not over Canada or the United States.

Today, the idea of arming interceptors with nuclear-tipped missiles seems like overkill. In the 1950s, however, there were no direct-hit guided weapons; air-to-air missiles were still in their infancy. A nuclear blast was considered the only practical way to “clear the air” of enemy bombers. Even missing the target by a wide margin would still get the job done. It was a no-fail mission, and only nuclear weapons offered the needed certainty of success.

As radar and fire-control systems matured and missile performance improved, though, air-to-air missiles were modified to carry high-explosive conventional warheads, alongside nuclear versions of the same missiles.

North American Aviation, builder of the F-86 Sabre and F-100 Super Sabre, won the competition for what would become the F-108 program in June 1957. It had competed hard since 1955 against Lockheed and Northrop for the program then known as the Long-Range Interceptor, Experimental (LRI-X).

*Left: An illustration of the YF-108A flying at high altitude. The aircraft was designed to intercept air-breathing targets from sea level to 100,000 feet. Above: Rapiers return from a training mission in this artist's conception. Had the F-108 entered operational service, it would have gradually replaced the F-106.*



Illustration by Erik Simonsen



North American was also competing for the XB-70 project, the Air Force's planned new Mach 3-plus bomber.

The company operated out of Inglewood, Calif., setting up shop adjacent to Mines Field, the site of present-day Los Angeles Airport. In World War II, North American had produced more than 40,000 aircraft—fully 10,000 more than any other US airplane maker. These included the famed T-6/SNJ Texan trainers, P-51 Mustang fighters, and B-25 Mitchell medium bombers.

With a growing reputation for innovative design, North American proceeded to develop the Sabre. The company's XP-86, the first swept-wing US jet airplane design, took flight at Muroc AAF, Calif., (now Edwards Air Force Base) on Oct. 1, 1947, less than two weeks before

Charles E. "Chuck" Yeager pushed the Bell X-1 to supersonic speed. The F-100 followed only a few years later. North American went on to win the contract to build the X-15, the brutish manned rocketplane that set a slew of aviation speed and altitude records and flew to the edge of space at better than Mach 6.

The company had reached the pinnacle of aerospace technological development. If anyone could build the first Mach 3 interceptor, it was North American.

A sleek, advanced configuration took shape at the Los Angeles Division. North American's F-108 concept would be capable of Mach 3, while operating at more than 75,000 feet, able to zoom-climb to 100,000 feet.

The Air Force specified two flying prototypes, to be called YF-108, with a

follow-on order expected for 30 further prototypes. The service anticipated buying 480 operational models.

In late December 1957, North American was also chosen to build the new B-70 bomber. The pair of awards represented a welcome infusion of cash and boosted morale. Earlier, North American had lost a fighter competition between its YF-107—a further development of the F-100—and Republic Aviation's YF-105, which went on to become the F-105 Thunderchief, a mainstay of the Vietnam War.

The high Mach fighter-interceptor and bomber programs represented a major step forward, however. The Eisenhower Administration was embarking on a new path to ensure US dominance in the Cold War while stimulating technologies to benefit the industrial base. It was all meant to send a message to the Soviet Union and America's allies that the US intended to maintain technological superiority. The flip side of the coin was that adversaries like the Soviets would have to invest heavily to counter American advances.

In May 1958, the F-108 designation was officially applied to the program. North American held a contest to give the airplane a name. SSgt. Charles



Illustration from Boeing archives

*Far left: Two Rapiers initiate a climb in afterburner in this artist's conception. Left: An early rendering of the F-108 design configuration featured canards like those on the forthcoming XB-70. Later in the process, the canards were eliminated.*

Wyon came up with “Rapier,” a two-edged thrusting blade. It echoed North American’s “Sabre” sword theme and won Wyon a \$500 bond and a trip to Las Vegas.

A company press release stated, “The US Air Force F-108 Rapier would be designed to launch an atomic missile 1,000 miles away from its base and be back on the ground an hour later. ... [This] will result in a defensive system for the United States that will permit the atomic destruction far offshore of enemy aircraft or missiles approaching from sea level to extremely high altitudes.”

## DUAL SYSTEMS

North American issued an update regarding its dual interceptor and bomber programs: “No military airplane in the world today even approaches their performance. The F-108 can seek out any enemy and intercept it a thousand miles from our borders. The B-70 is being designed as a successor to the B-52 and is expected to have intercontinental range, while traveling at more than three times the speed of sound.”

To save money, North American decided to develop and fabricate some systems commonly for both aircraft. It announced that Hamilton Standard, a

division of United Aircraft Technologies, would provide the air-conditioning and pressurization systems for the F-108 and XB-70. More fabrication contract announcements followed. In January 1959, Convair was named builder of the F-108 wing, while Lockheed would provide a fuselage section for the XB-70. Chance Vought would design and manufacture the bomber’s vertical stabilizer sections. In March, Sundstrand Corp. was awarded a contract to design and build the secondary power systems for both aircraft.

Other major shared components included the General Electric J93-GE-3AR engine, honeycomb stainless steel materials, and a North American-designed crew escape system. Although final assembly would take place at the company’s Los Angeles division, 70 percent of the development and manufacturing would be performed by subcontractors, including small businesses.

While development proceeded, a movement began to stir to substitute missiles for manned bombers and fighters. In early February 1959, USAF Chief of Staff Gen. Thomas D. White tried to deflect this sentiment, telling the Senate Armed Services Committee, “Manned interceptors are required for long-range

attack on the enemy and are necessary for identification and air policing. In this function, nothing has yet been developed with the judgment, flexibility, and intelligence of the man in the cockpit.”

That same month, North American announced the successful completion of the F-108 mock-up review. Over three weeks, more than 70 Air Force and civilian personnel had scrutinized the Rapier full-scale mock-up, offering comments and suggestions.

“The mock-up gives the Air Force an opportunity to minutely examine what in effect is a three-dimensional blueprint,” Heston Cherry, North American’s F-108 Weapon System manager, explained in 1959. “Built to the measurements of the actual airplane, the mock-up is an essential step before production of the flying article can begin.”

By May, the Air Force was beginning to publicly describe its concept of operations for how future air defenses would work. Lt. Gen. Roscoe C. Wilson, USAF deputy chief of staff for development, said the F-108 and Bomarc surface-to-air missile, “teamed together, will enable our air defenses to reach out over long range to destroy enemy bombers long before they reach their targets. Both the F-108 and Bomarc also offer a very high degree of growth potential to provide us with a highly effective defense against air-breathing missiles.” Not only that, but the F-108 “also shows considerable promise as a tactical fighter-bomber for use in limited conflicts abroad,” said Wilson.

The F-108 was aesthetically pleasing—a graceful and clean aerodynamic design that seemed futuristic. At one point during the configuration stage, engineers considered enlarging the basic design to accommodate more internal fuel, instead of external tanks. They concluded, though, that a smaller aircraft would be less expensive to produce and easier to



*Crew escape capsules were designed for crew members wearing anti-G flight suits.*

maintain and operate. Supersonic drop tanks would remain an option for some missions, to be jettisoned prior to high-Mach flight.

After several iterations, the wingspan was fixed at 57.5 feet. The wing sweep was 58 degrees, narrowing to 32 degrees just short of the wing tips—giving it a cranked-arrow delta shape. The F-108 fuselage length was 89 feet (25 feet longer than today's F-15), with a single 22.1-foot vertical stabilizer. Maximum takeoff weight was about 102,000 pounds.

The YF-108 test flight articles would have a crew of two—a pilot and a weapon systems officer—seated in tandem, and individual high-speed clamshell ejection capsules. Both the twin-engine F-108 and six-engine XB-70 featured variable inlets with unique configurations. A variable intake arrangement similar to the F-108's would later appear on the Navy's RA-5C Vigilante, capable of Mach 2. The MiG-25 Foxbat—developed by the Soviets to counter the B-70—used a similar intake configuration.

Two engines were considered a safety essential for the F-108, given its expected usual operations over the Arctic region and lengthy overwater patrols. Additionally, the Rapier would use onboard electronics to fill in gaps in the Distant Early Warning, or DEW, Line. It could be forward deployed, needing 6,000 feet to take off. Thrust reversers, then considered more efficient than drag chutes, were a late add in the design process. Although this

feature added nearly 700 pounds, operations on icy or snowy runways would be much improved.

After touchdown, the brakes of jet aircraft are usually quite hot, posing a hazard to ground crews. The Rapier, though, was designed with quick-turn refueling and rearming in mind. North American's engineers developed heavy-duty steel cages surrounding the tires on each wheel after landing. In the event of hot brakes causing a tire explosion, the cages would contain the tire and wheel fragments, reducing the risk to ground personnel. This feature was a topic of considerable discussion in the mock-up review, but was retained as a requirement.

A number of historical accounts have suggested the F-108 was intended to be an "escort" for the B-70. Former North American engineers report this was never the case. Keeping a program "sold" is essential, and it would have hurt the case for the B-70 to say it needed an escort fighter. In addition, the intercontinental range of the B-70 would have meant any Rapier escorts would have needed extensive air refueling.

### EMERGING INTELLIGENCE

In 1955, when the F-108 project began, it was thought Russia would be able to field large numbers of nuclear-armed bombers to threaten the US and Canada. A high-speed, long-range interceptor was needed to counter this threat.

U-2 reconnaissance flights indicated, however, that the bomber threat could take some time to materialize. The U-2 overflights of Russia ended when Francis Gary Powers was shot down in May 1960.

Corona spy satellites began turning in useful intelligence shortly thereafter. The Corona Project was the first imaging intelligence satellite operated by the CIA, and after a frustrating teething period, Corona produced its first useful imagery in August 1960. It confirmed a lower count of Soviet bombers and ICBMs.

The intelligence obtained began a shift in US defense strategy, and the perceived need for superinterceptors diminished. Though air defense was still considered a top priority, funding was already migrating toward ICBMs as a faster strike system and improved deterrent.

The bomber threat was still there, though, and still might have materialized as originally envisioned. The Soviet Union could certainly have ratcheted up bomber production and was already developing long-range air-to-ground missiles (eventually evolving into air launched cruise missiles) for deployment on bombers. Had the Soviets pursued that direction more aggressively, it could have dramatically increased the number of incoming targets, potentially overwhelming existing US air defense systems and less capable interceptors.

The handwriting was on the wall by late 1958, however. The Air Force cut the F-108 order from 31 to 20 prototypes.



*The full-scale mock-up under construction at North American Aviation's Los Angeles facility.*

By mid-1959, the F-108 program was placed on an austere funding track.

North American Aircraft engineers working on the project at the time said word was getting around that something was up, particularly those working with Hughes Aircraft on the radar/missile interface. Technical coordination meetings with Hughes were tense, as if Hughes may have had early knowledge the F-108 was to be canceled.

The Eisenhower Administration had set a goal of delivering a balanced budget for its last year in office. National budget director Maurice H. Stans was pressuring Defense Secretary Neil H. McElroy to find big-ticket items to cut. It was something of a Cold War gamble; the Administration had been caught off guard by the October 1957 launch of Sputnik.

Directly as a result of the balanced-budget cuts, the F-108 program officially ended Sept. 23, 1959, with a terse USAF statement: "As of today, the Air Force contract with North American Aviation Inc. of Los Angeles for the development of the F-108 long-range interceptor is being terminated. A total of \$150 million [1959 dollars] has been expended to date."

### THE DOMINO EFFECT

The F-108 cancellation had a direct—and negative—effect on the XB-70. With the F-108 gone, hardware developed for it that was also to be

used on the XB-70 now became an expense borne solely by the Valkyrie program. Some \$180 million (in 1959 dollars) of F-108 costs shifted to the XB-70 budget—a contributing factor in the bomber's eventual termination.

Some 2,000 North American employees were immediately put out of work by the F-108 cancellation, and the full-scale mock-up was scrapped. The advanced Hughes AN/ASG-18 radar/fire-control system, GAR-9/AIM-47 Falcon nuclear/conventional missile technology, and the infrared search and track system meant for the F-108 migrated to the forthcoming Lockheed YF-12 program. The Air Force's F-108 project officer, Col. Kenneth Chilstrom, took over the YF-12A, the developmental forerunner to the SR-71 Blackbird.

Had the original timetable been borne out, the F-108 would have made its first flight in early 1961 and was to be operational by 1963. The Rapier would have provided US air defenses unmatched dash speed, range, and a lookdown/shootdown radar capability. Its support systems were compatible with forward-based logistics, so F-108s could have been an effective power-projection tool in a crisis.

While the F-108 was being developed in the open, there were competitive,

classified programs in the works at the same time. Lockheed was working on the Mach 3-plus single-seat A-12 reconnaissance airplane, as well as the similar YF-12A interceptor prototype. After initial problems, the A-12 was declared mission ready in 1965. The first YF-12A interceptor prototype achieved flight in August 1963.

Though testing of the three prototypes proved the new high-mach jet aircraft a success, Defense Secretary Robert S. McNamara canceled production of the F-12B interceptor at the beginning of 1968. Consequently, no Mach 3 US interceptors would fly.

The Soviet bomber forces never became an overwhelming threat. Variants of the Tu-95 Bear remained a potential menace as standoff weapons platforms, and the Soviets continued development of supersonic bombers with the Tu-22 Blinder, Tu-22M Backfire, and the Tu-160 Blackjack (the latter a scaled-up conceptual cousin to America's B-1 Lancer). But the skies never darkened with Russian bombers, and for those that did probe the edges of NORAD's airspace, the F-106 Delta Dart served admirably, rarely needing to achieve its top speed of Mach 2.2. ■

*Erik Simonsen is a freelance photographer and writer. This article is adapted from his book Project Terminated: Famous Military Aircraft Cancellations of the Cold War and What Might Have Been. A frequent contributor of photos and illustrations, this is Simonsen's first article for Air Force Magazine.*