

WIKIPEDIA

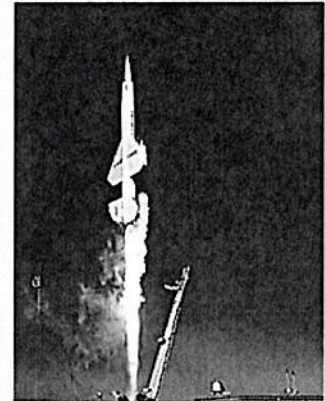
CIM-10 Bomarc

The **Boeing CIM-10 Bomarc** (**IM-99 Weapon System**^[4] prior to September 1962)^[5] was a supersonic long-range surface-to-air missile (SAM) used during the Cold War for the air defense of North America. In addition to being the first operational long-range SAM, it was the only SAM deployed by the United States Air Force.

Stored horizontally in a launcher shelter with movable roof, the missile was erected, fired vertically using rocket boosters to high altitude, and then tipped over into a horizontal Mach 2.5 cruise powered by ramjet engines. This lofted trajectory allowed the missile to operate at a maximum range as great as 430 mi (700 km). Controlled from the ground for most of its flight, when it reached the target area it was commanded to begin a dive, activating an onboard active radar homing seeker for terminal guidance. A radar proximity fuse detonated the warhead, either a large conventional explosive or the W40 nuclear warhead.

The Air Force originally planned for a total of 52 sites covering most of the major cities and industrial regions in the US. The US Army was deploying their own systems at the same time, and the two services fought constantly both in political circles and in the press. Development dragged on, and by the time it was ready for deployment in the late 1950s, the nuclear threat had moved from manned bombers to the intercontinental ballistic missile (ICBM). By this time the Army had successfully deployed their Nike Hercules that filled any possible need through the 1960s, in spite of Air Force claims to the contrary.

CIM-10 Bomarc



A Bomarc missile begins its "climb phase" of launch.^[1]³⁰ The midcourse phase and homing dive used ramjets.

Type	Surface-to-air missile
Place of origin	United States
Service history	
In service	1959 to 1 October 1972 ^[2]
Used by	United States Air Force Royal Canadian Air Force Canadian Forces
Production history	
Manufacturer	Boeing Pilotless Aircraft Division ^[3]
Produced	1958
Specifications	
Guidance system	Initially ground-controlled, active radar homing terminal guidance



As testing continued, the Air Force reduced its plans to sixteen sites, and then again to eight with an additional two sites in Canada. The first US site was declared operational in 1959, but with only a single working missile. Bringing the rest of the missiles into service took years, by which time the system was obsolete. Deactivations began in 1969 and by 1972 all Bomarc sites had been shut down. A small number were used as target drones, and only a few remain on display today.

Contents

Design and development

- Bomarc A
- Operational units
- Bomarc B

Operational history

- United States
 - Bomarc incident
 - Modification and deactivation
- Canada

Variants

Operators

Surviving missiles

Impact on popular music

See also

References

- Bibliography

External links

Design and development

Bomarc A

In 1946, Boeing started to study surface-to-air guided missiles under the United States Army Air Forces project MX-606. By 1950, Boeing had launched more than 100 test rockets in various configurations, all under the designator XSAM-A-1 GAPA (Ground-to-Air Pilotless Aircraft). Because these tests were very promising, Boeing received a USAF contract in 1949 to develop a pilotless interceptor (a term then used by the USAF for air-defense guided missiles) under project MX-1599.^[6]

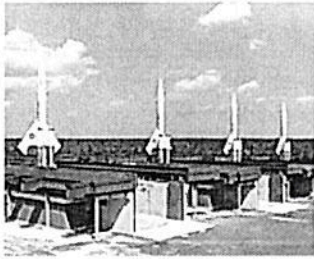
The MX-1599 missile was to be a ramjet-powered, nuclear-armed long-range surface-to-air missile to defend the Continental United States from high-flying bombers. The Michigan Aerospace Research Center (MARC) was added to the project soon afterward, and this gave the new missile its name Bomarc (for Boeing and MARC). In 1951, the USAF decided to emphasize its point of view that missiles were nothing else than pilotless aircraft by assigning aircraft designators to its missile projects, and anti-aircraft missiles received F-for-Fighter designations. The Bomarc became the **F-99**.^[6]

Test flights of XF-99 test vehicles began in September 1952 and continued through early 1955.^[7] The XF-99 tested only the liquid-fueled booster rocket, which would accelerate the missile to ramjet ignition speed. In February 1955, tests of the XF-99A propulsion test vehicles began. These included live ramjets, but still had no guidance system or warhead. The designation YF-99A had been reserved for the operational test vehicles. In August 1955, the USAF discontinued the use of aircraft-like type designators for missiles, and the XF-99A and YF-99A became XIM-99A and YIM-99A, respectively. Originally the USAF had allocated the designation IM-69, but this was changed (possibly at Boeing's request to keep number 99) to **IM-99** in October 1955.

In October 1957, the first YIM-99A production-representative prototype flew with full guidance, and succeeded to pass the target within destructive range. In late 1957, Boeing received the production contract for the IM-99A Bomarc A interceptor missile, and in September 1959, the first IM-99A squadron became operational.^[6]

The IM-99A had an operational radius of 200 miles (320 km) and was designed to fly at Mach 2.5–2.8 at a cruising altitude of 60,000 feet (18,000 m). It was 46.6 ft (14.2 m) long and weighed 15,500 pounds (7,000 kg). Its armament was either a 1,000-pound (450 kg) conventional warhead or a W40 nuclear warhead (7–10 kiloton yield). A liquid-fuel rocket engine boosted the Bomarc to Mach 2, when its Marquardt RJ43-MA-3 ramjet engines, fueled by 80-octane gasoline, would take over for the remainder of the flight. This was the same model of engine used to power the Lockheed X-7, the Lockheed AQM-60 Kingfisher drone used to test air defenses, and the Lockheed D-21 launched from the back of an M-21.^[6]

Operational units



October 1960. BOMARCs in New Jersey (BOMARC Site No. 1)

The operational IM-99A missiles were based horizontally in semi-hardened shelters, nicknamed "coffins". After the launch order, the shelter's roof would slide open, and the missile raised to the vertical. After the missile was supplied with fuel for the booster rocket, it would be launched by the Aerojet General LR59-AJ-13 booster. After sufficient speed was reached, the Marquardt RJ43-MA-3 ramjets would ignite and propel the missile to its cruise speed of Mach 2.8 at an altitude of 66,000 ft (20,000 m).^[6]

When the Bomarc was within 10 mi (16 km) of the target, its own Westinghouse AN/DPN-34 radar guided the missile to the interception point. The maximum range of the IM-99A was 250 mi (400 km), and it was fitted with either a conventional high-explosive or a 10 kiloton W-40 nuclear fission warhead.^[6]

The Bomarc relied on the Semi-Automatic Ground Environment (SAGE), an automated control system used by NORAD for detecting, tracking and intercepting enemy bomber aircraft. SAGE allowed for remote launching of the Bomarc missiles, which were housed in a constant combat-ready basis in individual launch shelters in remote

areas. At the height of the program, there were 14 Bomarc sites located in the US and two in Canada.^[6]

Bomarc B

The liquid-fuel booster of the Bomarc A was no optimal solution. It took two minutes to fuel before launch, which could be a long time in high-speed intercepts, and its hypergolic propellants (hydrazine and nitric acid) were very dangerous to handle, leading to several serious accidents.^[6]

As soon as high-thrust solid-fuel rockets became a reality in the mid-1950s, the USAF began to develop a new solid-fueled Bomarc variant, the IM-99B Bomarc B. It used a Thiokol XM51 booster, and also had improved Marquardt RJ43-MA-7 (and finally the RJ43-MA-11) ramjets. The first IM-99B was launched in May 1959, but problems with the new propulsion system delayed the first fully successful flight until July 1960, when a supersonic KD2U-1/MQM-15A Regulus II drone was intercepted. Because the new booster took up less space in the missile, more ramjet fuel could be carried, increasing the range to 430 mi (700 km). The terminal homing system was also improved, using the world's first pulse Doppler search radar, the Westinghouse AN/DPN-53. All Bomarc Bs were equipped with the W-40 nuclear warhead. In June 1961, the first IM-99B squadron became operational, and Bomarc B quickly replaced most Bomarc A missiles.^[6] On 23 March 1961, a Bomarc B successfully intercepted a Regulus II cruise missile flying at 100,000 ft (30,000 m), thus achieving the highest interception in the world up to that date.

Boeing built 570 Bomarc missiles between 1957 and 1964, 269 CIM-10A, 301 CIM-10B.^[6]

In September 1958 Air Research & Development Command decided to transfer the Bomarc program from its testing at Cape Canaveral Air Force Station to a new facility on Santa Rosa Island, immediately south of Eglin AFB Hurlburt Field on the Gulf of Mexico. To operate the facility and to provide training and operational evaluation in the missile program, Air Defense Command established the 4751st Air Defense Wing (Missile) (4751st ADW) on 15 January 1958. The first launch from Santa Rosa took place on 15 January 1959.^[6]



4751st ADMS
(Training) Emblem

Operational history

In 1955, to support a program which called for 40 squadrons of BOMARC (120 missiles to a squadron for a total of 4,800 missiles), ADC reached a decision on the location of these 40 squadrons and suggested operational dates for each. The sequence was as follows: ... 1. McGuire 1/60 2. Suffolk 2/60 3. Otis 3/60 4. Dow 4/60 5. Niagara Falls 1/61...6 . Plattsburg 1/61 7. Kinross 2/61 8. K. 1. Sawyer 2/61 9. Langley 2/61 10. Truax 3/61 11. Paine 3/61 12. Portland 3/61 ... At the end of 1958, ADC plans called for construction of the following BOMARC bases in the following order: 1. McGuire 2. Suffolk 3. Otis 4. Dow 5. Langley 6. Truax 7. Kinross 8. Duluth 9. Ethan Allen 10. Niagara Falls 11. Paine 12. Adair 13. Travis 14. Vandenberg 15. San Diego 16. - Malmstrom 17. Grand Forks 18. Minot 19. Youngstown 20. Seymour-Johnson 21. Bunker Hill 22. Sioux Falls 23. Charleston 24. McConnell 25. Holloman 26. McCoy 27. Amarillo 28. Barksdale; 29. Williams.^[8]

United States

The first USAF operational Bomarc squadron was the 46th Air Defense Missile Squadron (ADMS), organized on 1 January 1959 and activated on 25 March. The 46th ADMS was assigned to the New York Air Defense Sector at McGuire Air Force Base, New Jersey. The training program, under the 4751st ADW used technicians acting as instructors and was established for a four-month duration. Training included missile maintenance; SAGE operations and launch procedures, including the launch of an unarmed missile at Eglin. In September 1959 the squadron assembled at their permanent station, the Bomarc site near McGuire AFB, and trained for operational readiness. The first Bomarc-A were used at McGuire on 19 September 1959 with Kincheloe AFB getting the first operational IM-99Bs. While several of the squadrons replicated earlier fighter interceptor unit numbers, they were all new organizations with no previous historical counterpart.^{[9][10]}

ADC's initial plans called for some 52 Bomarc sites around the United States with 120 missiles each but as defense budgets decreased during the 1950s the number of sites dropped substantially. Ongoing development and reliability problems didn't help, nor did Congressional debate over the missile's usefulness and necessity. In June 1959, the Air Force authorized 16 Bomarc sites with 56 missiles each; the initial five would get the IM-99A with the remainder getting the IM-99B. However, in March 1960, HQ USAF cut deployment to eight sites in the United States and two in Canada.^[6]

Bomarc incident

Within a year of operations, a Bomarc A with a nuclear warhead caught fire at McGuire AFB on 7 June 1960 after its on-board helium tank exploded. While the missile's explosives did not detonate, the heat melted the warhead and released plutonium, which the fire crews spread. The Air Force and the Atomic Energy Commission cleaned up the site and covered it with concrete. This was the only major incident involving the weapon system.^[6] The site remained in operation for several years following the fire. Since its closure in 1972, the area has remained off limits, primarily due to low levels of plutonium contamination.^[11] Between 2002 and 2004, 21,998 cubic yards of contaminated debris and soils were shipped to what was then known as Envirocare, located in Utah.^[12]

Modification and deactivation

In 1962, the US Air Force started using modified A-models as drones; following the October 1962 tri-service redesignation of aircraft and weapons systems they became CQM-10As. Otherwise the air defense missile squadrons maintained alert while making regular trips to Santa Rosa Island for training and firing practice. After the inactivation of the 4751st ADW(M) on 1 July 1962 and transfer of Hurlburt to Tactical Air Command for air commando operations the 4751st Air Defense Squadron (Missile) remained at Hurlburt and Santa Rosa Island for training purposes.^[6]

In 1964, the liquid-fueled Bomarc-A sites and squadrons began to be deactivated. The sites at Dow and Suffolk County closed first. The remainder continued to be operational for several more years while the government started dismantling the air defense missile network. Niagara Falls was the first BOMARC B installation to close, in December 1969; the others remained on alert through 1972. In April 1972, the last Bomarc B in U.S. Air Force service was retired at McGuire and the 46th ADMS inactivated^[6] and the base was deactivated.^[13]

In the era of the intercontinental ballistic missiles the Bomarc, designed to intercept relatively slow manned bombers, had become a useless asset. The remaining Bomarc missiles were used by all armed services as high-speed target drones for tests of other air-defense missiles. The Bomarc A and Bomarc B targets were designated as CQM-10A and CQM-10B, respectively.^[6]

Following the accident, the McGuire complex has never been sold or converted to other uses and remains in Air Force ownership, making it the most intact site of the eight in the US. It has been nominated to the National Register of Historic Sites. Although a number of IM-99/CIM-10 Bomarcs have been placed on public display, because of concerns about the possible environmental hazards of the thoriated magnesium structure of the airframe several have been removed from public view.^[14]

Russ Sneddon, director of the Air Force Armament Museum, Eglin Air Force Base, Florida provided information about missing CIM-10 exhibit airframe serial 59-2016, one of the museum's original artifacts from its founding in 1975 and donated by the 4751st Air Defense Squadron at Hurlburt Field, Eglin Auxiliary Field 9, Eglin AFB. As of December 2006, the suspect missile was stored in a secure compound behind the Armaments Museum. In December 2010, the airframe was still on premises, but partly dismantled.



A CQM-10B drone launched at Vandenberg Air Force Base, 1977.

Canada

The Bomarc Missile Program was highly controversial in Canada.^[15] The Progressive Conservative government of Prime Minister John Diefenbaker initially agreed to deploy the missiles, and shortly thereafter controversially scrapped the Avro Arrow, a supersonic manned interceptor aircraft, arguing that the missile program made the Arrow unnecessary.^[15]

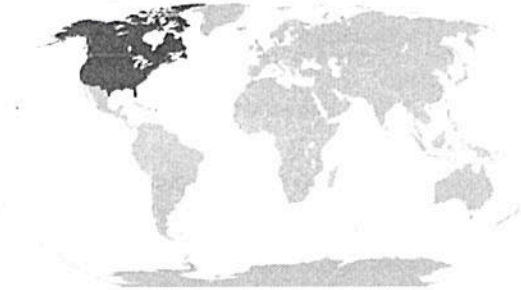
Initially, it was unclear whether the missiles would be equipped with nuclear warheads. By 1960 it became known that the missiles were to have a nuclear payload, and a debate ensued about whether Canada should accept nuclear weapons.^[16] Ultimately, the Diefenbaker government decided that the Bomarcs should not be equipped with nuclear warheads.^[17] The dispute split the Diefenbaker Cabinet, and led to the collapse of the government in 1963.^[17] The Official Opposition and Liberal Party leader Lester B. Pearson originally was against nuclear missiles, but reversed his personal position and argued in favor of accepting nuclear warheads.^[18] He won the 1963 election, largely on the basis of this issue, and his new Liberal government proceeded to accept nuclear-armed Bomarcs, with the first being deployed on 31 December 1963.^[19] When the nuclear warheads were deployed, Pearson's wife, Maryon, resigned her honorary membership in the anti-nuclear weapons group, Voice of Women.^[16]

Canadian operational deployment of the Bomarc involved the formation of two specialized Surface/Air Missile squadrons. The first to begin operations was No. 446 SAM Squadron at RCAF Station North Bay, which was the command and control center for both squadrons.^[19] With construction of the compound and related facilities completed in 1961, the squadron received its Bomarcs in 1961, without nuclear warheads.^[19] The squadron became fully operational from 31 December 1963, when the nuclear warheads arrived, until disbanding on 31 March 1972. All the warheads were stored separately and under control of Detachment 1 of the USAF 425th Munitions Maintenance Squadron. During operational service, the Bomarcs were maintained on stand-by, on a 24-hour basis, but were never fired, although the squadron test-fired the missiles at Eglin AFB, Florida on annual winter retreats.^[20]

No. 447 SAM Squadron operating out of RCAF Station La Macaza, Quebec, was activated on 15 September 1962 although warheads were not delivered until late 1963. The squadron followed the same operational procedures as No. 446, its sister squadron. With the passage of time the operational capability of the 1950s-era Bomarc system no longer met modern requirements; the Department of National Defence deemed that the Bomarc missile defense was no longer a viable system, and ordered both squadrons to be stood down in 1972. The bunkers and ancillary facilities remain at both former sites.^[21]

Variants

- XF-99 (experimental for booster research)
- XF-99A/XIM-99A (experimental for ramjet research)
- YF-99/YIM-99^[22] (service-test)
- IM-99A (initial production)
- IM-99B ("advanced"^[23])
- CQM-10 (target drone)^[24]



Map with CIM-10 operators in blue

Operators

/ Canada

- Royal Canadian Air Force from 1955 to 1968 / Canadian Forces from 1968 to 1972

446 SAM Squadron: 28 IM-99B, CFB North Bay, Ontario 1962–1972^{[20][25]}

Bomarc site located at 46°25'46"N 079°28'16"W

447 SAM Squadron: 28 IM-99B, La Macaza, Quebec (La Macaza – Mont Tremblant International Airport) 1962–1972^{[21][26]}

Bomarc site located at 46°24'41"N 074°46'08"W (Approximately)

United States

- United States Air Force Air (later Aerospace) Defense Command

6th Air Defense Missile Squadron, 56 IM-99A

Activated on 1 February 1959
Assigned to: New York Air Defense Sector
Inactivated 15 December 1964
Stationed at: Suffolk County Air Force Base Missile Annex, New York

Bomarc site located 3 miles SW at 40°50'00"N 072°40'51"W

22d Air Defense Missile Squadron: 28 IM-99A/28 IM-99B

Activated on 15 September 1959
Assigned to: Washington Air Defense Sector
Reassigned to: 33d Air Division, 1 April 1966
Reassigned to: 20th Air Division, 19 November 1969
Inactivated: 31 October 1972
Stationed at: Langley AFB, Virginia

Bomarc site located 3 miles WNW at 37°05'57"N 076°28'47"W

26th Air Defense Missile Squadron: 28 IM-99A/28 IM-99B

Activated 1 March 1959
Assigned to: Boston Air Defense Sector
Reassigned to: 35th Air Division, 1 April 1966
Reassigned to: 21st Air Division, 19 November 1969
Inactivated: 30 April 1972
Stationed at: Otis Air Force Base BOMARC site, Massachusetts

Bomarc site located 1 mile NNW at 41°40'56"N 070°32'21"W

30th Air Defense Missile Squadron: 28 IM-99A

Activated on 1 June 1959
Assigned to Bangor Air Defense Sector

37th Air Defense Missile Squadron: 28 IM-99B

Activated 1 March 1960
Assigned to 30th Air Division
Reassigned to: Sault Sainte Marie Air Defense Sector, 1 April 1960
Reassigned to: Duluth Air Defense Sector, 1 October 1963
Reassigned to: 29th Air Division, 1 April 1966
Reassigned to: 23d Air Division, 19 November 1969
Inactivated 31 July 1972
Stationed at: Kincheloe AFB, Michigan

Bomarc site located 9 miles NW at 46°20'53"N 084°48'18"W

46th Air Defense Missile Squadron: 28 IM-99A/56 IM-99B

Activated 1 January 1959
Assigned to New York Air Defense Sector
Reassigned to: 21st Air Division, 1 April 1966
Reassigned to: 35th Air Division, 1 December 1957
Reassigned to: 21st Air Division, 19 November 1969
Inactivated 31 October 1972
Stationed at: McGuire AFB, New Jersey

Bomarc site located 4 miles ESE at 40°02'06"N 074°26'29"W

74th Air Defense Missile Squadron: 28 IM-99B

Activated 1 April 1960
Assigned to Duluth Air Defense Sector
Reassigned to: 29th Air Division, 1 April 1966
Reassigned to: 23d Air Division, 19 November 1969
Inactivated 30 April 1972
Stationed at: Duluth International Airport, Minnesota

Bomarc site located 10 miles NE at 46°55'56"N 091°53'00"W

Inactivated: 15 December 1964
 Stationed at Dow AFB, Maine

Bomarc site located 4 miles NNE at 44°51'11"N 068°47'11"W

35th Air Defense Missile Squadron: 56 IM-99B

Activated 1 June 1960
 Assigned to Syracuse Air Defense Sector
 Reassigned to: Detroit Air Defense Sector, 4 September 1963
 Reassigned to: 34th Air Division, 1 April 1966
 Reassigned to: 35th Air Division, 15 September 1969
 Inactivated: 31 December 1969
 Stationed at: Niagara Falls Air Force Missile Site, New York

Bomarc site located at 43°07'03"N 078°56'49"W

▪ Air Force Systems Command

Cape Canaveral Air Force Station, Florida

Launch Complex 4 (LC-4) was used for Bomarc testing and development launches 2 February 1956 – 15 April 1960 (17 Launches). 28°27'59"N 080°32'08"W

Vandenberg Air Force Base, California

Two launch sites, BOM-1 and BOM-2 were used by the United States Navy for Bomarc launches against aerial targets. The first launch taking place on 25 August 1966. The last two launches occurred on 14 July 1982. BOM1 49 launches; BOM2 38 launches. 34°48'02"N 120°35'57"W

Locations under construction but not activated. Each site was programmed for 28 IM-99B missiles:

- Camp Adair, Oregon 44°42'08"N 123°12'00"W
- Charleston AFB, South Carolina
- Ethan Allen AFB, Vermont 44°30'38"N 073°09'49"W
- Paine Field, Washington 47°54'43"N 122°15'55"W
- Travis AFB, California 38°29'14"N 121°53'07"W
- Truax Field, Wisconsin 43°11'27"N 089°09'15"W
- Vandenberg AFB, California 34°43'47"N 120°30'15"W

Reference for BOMARC units and locations:^[27]

4751st Air Defense Missile Squadron

Activated 15 January 1959
 Assigned to 73d Air Division (Weapons)
 Reassigned to: 32d Air Division, 1 October 1959
 Reassigned to: Montgomery Air Defense Sector, 1 July 1962
 Reassigned to: Air Defense, Tactical Air Command, 1 September 1979
 Inactivated 30 September 1979
 Stationed at: Eglin Auxiliary Field #9 (Hurlburt Field), Florida

Bomarc site located on Santa Rosa Island at 30°23'18"N 086°48'28"W

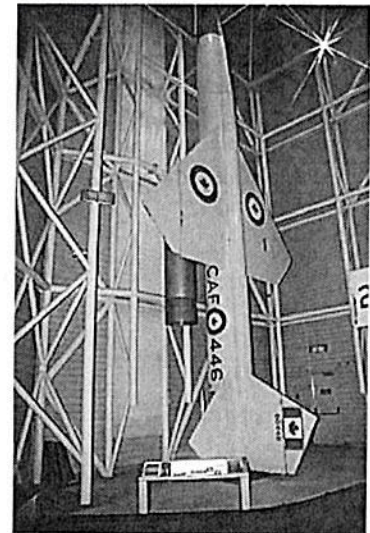
Bomarc site located at Eglin Auxiliary Field #5 (Piccolo Field) at 30°35'37"N 086°37'18"W



Surviving missiles

Below is a list of museums or sites which have a Bomarc missile on display:

- [Air Force Armament Museum, Eglin Air Force Base, Florida](#)
- [Air Force Space & Missile Museum, Cape Canaveral Air Force Station, Florida](#). This pristine artifact is in sequestered storage in Hangar R on Cape Canaveral AFS and cannot be viewed by the general public.
- [Alberta Aviation Museum, Edmonton, Alberta, Canada](#)
- [Canada Aviation and Space Museum, Ottawa, Ontario, Canada](#)
- [Hill Aerospace Museum, Hill Air Force Base, Utah](#)
- [Historical Electronics Museum, Linthicum, Maryland](#) (display of AN/DPN-53, the first airborne pulse-doppler radar, used in the Bomarc)
- [Illinois Soldiers & Sailors Home, Quincy, Illinois](#)
- [Keesler Air Force Base, Biloxi, Mississippi](#)
- [Museum of Aviation, Robins Air Force Base, Warner Robins, Georgia](#)
- [National Museum of Nuclear Science & History, Kirtland Air Force Base, Albuquerque, New Mexico](#)
- [National Museum of the United States Air Force, Wright-Patterson Air Force Base, Ohio](#)^[28]
- [Octave Chanute Aerospace Museum \(former Chanute Air Force Base\), Rantoul, Illinois](#)
- [Peterson Air and Space Museum, Peterson Air Force Base, Colorado](#)
- [Strategic Air and Space Museum, Ashland, Nebraska](#)
- [U.S. Air Force History and Traditions Museum, Lackland Air Force Base, San Antonio, Texas](#)
- [Vandenberg Air Force Base \(Space and Missile Heritage Center\), California](#). Bomarc not for public access.



Bomarc B on display at the Canada Aviation and Space Museum Ottawa, Ontario, Canada, c. 2006.

Impact on popular music

The Bomarc missile captured the imagination of the American and Canadian popular music industry, giving rise to a pop music group, the Bomarcs (composed mainly of servicemen stationed on a Florida radar site that tracked Bomarcs),^{[29][30]} a record label, Bomarc Records,^{[31][32]} and a moderately successful Canadian pop group, The Beau Marks.

See also

Aircraft of comparable role, configuration and era

- Blue Envoy, UK system of very similar performance, cancelled in 1957 in favor of the Bristol Bloodhound.

References

- The SAGE/Bomarc Air Defense Weapons System: An Illustrated Explanation of What it is and How it Works (http://bitsavers.informatik.uni-stuttgart.de/pdf/ibm/sage/SAGE_BOMARC_Defense_System_1958.pdf) (PDF) (Report). New York: International Business Machines Corporation. 1959. Archived from the original (https://books.google.com/books/about/The_SAGE_BOMARC_Air_Defense_Weapons_Syst.html?id=BFdIGwAACAAJ) ("fact sheet") on 23 April 2013. Retrieved 23 April 2013. "BOMARC Crew training was activated January 1, 1958. The operator requests an "engagement prediction point" from the IBM computer. Missile guidance information is relayed via leased lines to Cape Canaveral, and via radio to the BOMARC missile. AN/FPS-20 long-range search radar at Patrick Air Force Base" (cited by *History of Strategic Air and Ballistic Missile Defense: Volume I*, p. 257.)
- Lombardi, Michael. "Reach for the sky" (http://www.boeing.com/news/frontiers/archive/2007/june/i_history.pdf) (PDF). *Boeing Frontiers*. Retrieved 3 November 2018.
- "BOMARC: Boeing's Long-range A.A. Missile" (<http://www.flightglobal.com/FlightPDFArchive/1957/1957%20-%2000681.PDF>) (PDF). *Flight Global*. 687. 24 May 1957. Retrieved 4 August 2013. "Development of the electronic guidance was assisted by simulated IM-99 nose sections, pressurized by nitrogen and cooled by ammonia, fitted to a T-33 and a B-57, the pilot of these aircraft cutting out the guidance and breaking away from the collision course as the target was neared. ... 70 per cent subcontracted); prime contractor, Boeing (assembly of missiles at the main Seattle plant, Pilotless Aircraft Division); cruise propulsion, Marquardt; boost propulsion, Aerojet-General; guidance and control, Westinghouse Air Arm Division; ground control gear, Westinghouse Electronics Division; ground-support and test gear, Farnsworth Division of I.T. and T.; airborne electronic intelligence, Lear (LearCal and Grand Rapids Divisions); nose of missile, Pastushin (glass fibre, leaves radar beams undistorted)."
- IM-99 Weapon System: 26 October – 28 November 1958 (<https://web.archive.org/web/20130218153547/http://www.secretsdeclassified.af.mil/shared/media/document/AFD-100617-111.pdf>) (PDF) (Report). Approved 17 December 1958, declassified. Archived from the original (<http://www.secretsdeclassified.af.mil/shared/media/document/AFD-100617-111.pdf>) (PDF) on 18 February 2013. Retrieved 4 August 2013. "technical training facility at Eglin Air Force Auxiliary Field Number 9. The IM-99A and IM-99B warheads (W-40) The IM-99B had been designed to include a "Pattern Patrol" type operation. Missiles could be launched in multiples, or at very close intervals and guided in a line abreast type formation with target seekers operating in search mode. This would provide a capability to patrol a given area where targets were suspected but where definite tracks had not been established." Check date values in: |date= (help)
- Baugher, Joe. "Boeing/MARC F-99" (http://www.joebaugher.com/usaf_fighters/f99.html). JoeBaugher.com. Retrieved 4 August 2013.
- Gibson 1996, pp. 200–201.
- McMullen, R. F. (15 February 1980). History of Air Defense Weapons 1946–1962 (Report). ADC Historical Study No. 14. Historical Division, Office of information, HQ ADC. p. 312. "Development of a long-range interceptor missile to be known as BOMARC was approved by the Research and Development Board of the Department of Defense in December 1950. BOMARC flight testing got off to a shaky start on 10 September 1952 when the first missile was launched from the Florida test center that later became known as Cape Canaveral. ...the BOMARC Weapons System Project Officer (WSPO), an ARDC official, gave permission for the launching of 12 YIM-99A (the "Y" designated experimental missiles). The first attempt at SAGE control of BOMARC occurred 7 August 1958... Because of split radar returns, SAGE was not able to give the missile the proper commands and [then a] GPA-35 took control. The missile malfunctioned, however, and [crashed] into the Atlantic. Air Force Missile Employment Facility at Hurlburt Field, Florida, Hurlburt (officially designated Eglin Auxiliary Field No. 9) [with launchers] was on a narrow strip of sand known as Santa Rosa Island. In August 1960, the BOMARC Weapons System Project Office (AMC) had assured the BOMARC General Officers Board that \$100,000 would be available to pay for Boeing help. "Bomarc Alternate Boost Program at React ion Motors, Inc.," 3 July 1953 ... Msg, WWXDBE-FA 18-5-47, IM-99 Field Test Sec to USAF, 19 May 1960 [Doc 304 to Hist of ADC, Jan–Jun 1960]."
- McMullen, R. F. (15 February 1980). History of Air Defense Weapons 1946–1962 (Report). ADC Historical Study No. 14. Historical Division, Office of information, HQ ADC. p. 176.
- "46th Air Defense Missile Squadron." (<http://www.radomes.org/museum/documents/McGuireAFBBOMARC/NJ1960NYADShistory.html>) *NYADS 1960 Yearbook*. Retrieved 28 September 2010.

10. Preface by Buss, L. H. (Director) (1 May 1960) *North American Air Defense Command and Continental Air Defense Command Historical Summary: July–December 1959* (<http://www.northcom.mil/FOIA/docs/1959%20NORAD%20CONAD%20History%20Jul-Dec.pdf>) (PDF) (Report). Directorate of Command History: Office of Information Services. "On 7 October 1959, NORAD provided guidance on this to ADC as follows. Gap fillers will be redeployed to provide low altitude coverage (500 feet) 230 nautical J111-s forward and 150 miles to the rear of all BOMARC launch sites ... Criteria for BOMARC coverage is that no lateral gaps exceed 25 nautical miles (normal terrain) at a curve of constant altitude of 300 feet... Directional antennas and high power amplifiers for the **ground-to-air transmitter sites** will be programmed and deployed only as required to support BOMARC operations. NORAO Objective Plan 1961–1965 ... called for an F-101 squadron for Comox AB, Canada, and a BOMARC squadron for Paine AFB, Washington. To control these squadrons, NORAD also provided for an AN/FPS-28 for the Queen Charlotte Islands. ... total off-shore coverage, available from ALRI and land-based sources, would permit use of the BOMARC B only to approximately 70 per cent of its low-altitude and 50 per cent of its high-altitude range capability. In the last six months of 1959, two IM-99A squadrons became operational and assumed an air defense role. The first was the 46th Air Defense Missile Squadron (BOMARC) based at McGuire AFB, New Jersey... activated on 1 January 1959, operational on 1 September 1959 with three missiles. ... the 6th Air Defense Missile Squadron (BOMARC) at Suffolk 6th ADMS activated on 1 February 1959, operational on 1 December 1959. As of 1 January 1960, the McGuire squadron had 24 IM-39A missiles and the Suffolk squadron had four missiles available for air defense. The 26th ADMS, activated at Otis AFB, Massachusetts, on 1 March 1959; the 30th ADMS, activated on 1 June 1959 at Dow AFB, Maine; and the 22nd ADMS, activated on 1 September 1959 at Langley AFB, Virginia. These units were expected to become operational in 1960. NADOP 1959–1963, dated 16 December 1958 [planned for] FY 1963 of 36 IM-99B sites and 2,772 launchers. [32] in the U. S. (excluding Alaska), two in the [Alaska] 64th Air Division area, and two in Canada. In March 1960, the JCS told NORAD that they were considering reducing the BOMARC program to eight U.S. and two Canadian squadrons."
11. Gambardello, Joseph A. "Plutonium Spill Neither Gone Nor Forgotten, 40 Years Later." (http://www.accessmylibrary.com/coms2/summary_0286-5763528_ITM) *The Philadelphia Inquirer*, 1 June 2000, p. A01. Retrieved: 26 December 2009.
12. Rademacher, et al. (28 August 2007). ... *Missile Shelters and Bunkers Scoping Survey Workplan* (<http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA471460>) (Report). ADA471460. Air Force Institute of Operational Health. Retrieved 9 December 2018.
13. THOMAS P. FARNER (23 July 2015). "Nuclear 'Cleanup' Leaves Many Questions" (<http://thesandpaper.villagesoup.com/p/nuclear-cleanup-leaves-many-questions/1378735>). *The Sand Paper (NJ)*. Retrieved 26 July 2015.
14. Young, Gord. "Cold War relic on the move." (<https://archive.today/20130115152342/http://www.northbaynugget.ca/ArticleDisplay.aspx?archive=true&e=1750308>) *North Bay Nugget*, 12 September 2009. Retrieved: 24 December 2009.
15. Buteux, Paul. "Bomarc Missile Crisis" (<https://web.archive.org/web/20130121070255/http://www.thecanadianencyclopedia.com/articles/bomarc-missile-crisis>). *The Canadian Encyclopedia*. Toronto: Historica Foundation, 2012. Archived from the original (<http://www.thecanadianencyclopedia.com/articles/bomarc-missile-crisis>) on 21 January 2013. Retrieved 11 August 2012.
16. CBC Digital Archives. "Voice of Women protest nuclear testing" (<https://web.archive.org/web/20131103063818/http://www.cbc.ca/archives/categories/war-conflict/defence/defence-general/voice-of-women-protest-nuclear-testing.html>). *CBC News*, 26 March 2012. Toronto. Archived from the original (<http://www.cbc.ca/archives/categories/war-conflict/defence/defence-general/voice-of-women-protest-nuclear-testing.html>) on 3 November 2013. Retrieved 11 August 2012. *Italic or bold markup not allowed in: |newspaper= (help)*
17. "The Nuclear Question in Canada (1957–1963)" (https://web.archive.org/web/20120420001736/http://www.usask.ca/diefenbaker/galleries/virtual_exhibit/nuclear_question_in_canada/index.php). *Diefenbaker Canada Centre*. Regina, Saskatchewan: University of Saskatchewan. Archived from the original (https://web.archive.org/web/20120420001736/http://www.usask.ca/diefenbaker/galleries/virtual_exhibit/nuclear_question_in_canada/index.php) on 20 April 2012. Retrieved 11 August 2012.
18. "Cold War Canada: The Voice of Women" (<https://web.archive.org/web/20120102014418/http://www.cbc.ca/history/EPISCONTENTSE1EP15CH1PA4LE.html>). *Canada: A People's History, 2001*. Toronto: CBC. Archived from the original (<http://www.cbc.ca/history/EPISCONTENTSE1EP15CH1PA4LE.html>) on 2 January 2012. Retrieved 11 August 2012.
19. "Special to The Star: Canada's Bomarc's get atom warheads" *The Toronto Daily Star*, 2 January 1964, pp. 1, 4.
20. Nicks et al. 1997, pp. 84–85.
21. Nicks et al. 1997, pp. 85–87.
22. "Bomarc" (<https://web.archive.org/web/20130817173907/http://astronautix.com/lvs/bomarc.htm>). *Encyclopedia Astronautica*. Archived from the original (<http://www.astronautix.com/lvs/bomarc.htm>) on 17 August 2013. Retrieved 7 August 2013. "Promising [GAPA] results led to Boeing receiving a USAF contract in 1949 to develop the exotic MX-1599 ramjet-powered, nuclear-armed long-range surface-to-air missile for defense of the continental United States from high-altitude bombers. The last Bomarc A was phased out in December 1964. In April 1972 the last Bomarc B was retired. Test flights of XF-99 test vehicles began in September 1952 and continued through early 1955. The XF-99 tested only the liquid-fueled booster rocket, which would accelerate the missile to ramjet ignition speed. In February 1955, tests of the XF-99A propulsion test vehicles began. These included live ramjets, but still had no guidance system or warhead. The designation YF-99A had been reserved for the operational test vehicles. In August 1955, the USAF discontinued the use of aircraft-like type designators for missiles, and the XF-99A and YF-99A became XIM-99A and YIM-99A."
23. "IM-99A Bases Manual". *Boeing: Pilotless Aircraft Division* (Seattle, Washington), 12 March 1959.
24. "Factsheets : Boeing XF-99." (<http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=2376>) Archived (<https://web.archive.org/web/20140117024915/http://www.nationalmuseum.af.mil/factsheets/factsheet.asp?id=2376>) 17 January 2014 at the *Wayback Machine* *Nationalmuseum.af.mil*. Retrieved: 18 September 2013.
25. "446 SAM Squadron." (<http://www.radomes.org/cgi-bin/museum/acwinfo2x.cgi?site=%22North+Bay+BOMARC,+ON%22&key=NorthBayBOMARCON>) *radomes.org*. Retrieved: 12 September 2010.
26. "447 SAM Squadron." (<http://www.radomes.org/cgi-bin/museum/acwinfo2x.cgi?site=%22La+Macaza+BOMARC,+QC%22&key=LaMacazaBOMARCQC>) *radomes.org*. Retrieved: 12 September 2010.
27. "Bomarc Missile Sites." (<http://www.radomes.org/museum/bomarc.html>) *radomes.org*. Retrieved: 26 December 2009.
28. "Boeing CIM-10 Bomarc." (<http://www.nationalmuseum.af.mil/Visit/MuseumExhibits/FactSheets/Display/tabid/509/Article/198024/boeing-cim-10-bomarc.aspx>) *National Museum of the US Air Force*. Retrieved: 22 August 2015

29. "The Bomarcs (<https://garagehangover.com/bomarc/>)", *Garage Hangover*, Chris Bishop, 2007-08-22
30. "BOMARCS, THE Records and CDs (<https://www.musicstack.com/records-cds/bomarc%2C+the/>)", *MusicStack*
31. "45 Discography for Bomarc Records (<http://www.globaldogproductions.info/b/bomarc.html>)", *Global Dog Productions*
32. "Bomarc Records (https://rateyourmusic.com/label/bomarc_records/)", *Rate Your Music*

Bibliography

- Clearwater, John. *Canadian Nuclear Weapons: The Untold Story of Canada's Cold War Arsenal*. Toronto, Ontario, Canada: Dundern Press, 1999. ISBN 1-55002-299-7.
- Clearwater, John. *U.S. Nuclear Weapons in Canada*. Toronto, Ontario, Canada: Dundern Press, 1999. ISBN 1-55002-329-2.
- Cornett, Lloyd H., Jr. and Mildred W. Johnson. *A Handbook of Aerospace Defense Organization 1946–1980*. Peterson Air Force Base, Colorado: Office of History, Aerospace Defense Center, 1980. No ISBN.
- Gibson, James N. *Nuclear Weapons of the United States: An Illustrated History*. Atglen, Pennsylvania: Schiffer Publishing Ltd., 1996. ISBN 0-7643-0063-6.
- Jenkins, Dennis R. and Tony R. Landis. *Experimental & Prototype U.S. Air Force Jet Fighters*. North Branch, Minnesota: Specialty Press, 2008. ISBN 978-1-58007-111-6.
- Nicks, Don, John Bradley and Chris Charland. *A History of the Air Defence of Canada 1948–1997*. Ottawa, Ontario, Canada: Commander Fighter Group, 1997. ISBN 0-9681973-0-2.
- *Pedigree of Champions: Boeing Since 1916, Third Edition*. Seattle, Washington: The Boeing Company, 1969.
- Winkler, David F. *Searching the Skies: The Legacy of the United States Cold War Defense Radar Program*. Langley Air Force Base, Virginia: United States Air Force Headquarters Air Combat Command, 1997. ISBN 978-1-907521-91-1.

External links

- RCAF 446 SAM Squadron (<https://web.archive.org/web/20100619012409/http://www.castlearchdale.net/id38.html>)
- BOMARC Missile Sites (<http://www.radomes.org/museum/bomarc.html>)
- Boeing Company History, Bomarc (<https://web.archive.org/web/20061110073809/http://www.boeing.com/history/boeing/bomarc.html>)
- Astronautix.com (<https://web.archive.org/web/20130817173907/http://astronautix.com/lvs/bomarc.htm>)
- Bomarc pictures (<http://www.radomes.org/museum/recent/McGuireAFBBOMARCNJ.html>)
- Bomarc Video Clip (<https://www.youtube.com/watch?v=BRhpjTj36A0>)
- SAGE-BOMARC risks (http://yarchive.net/risks/sage_bomarc.html) – Oral history: Les Earnest talks about air defense system called SAGE and a ground-to-air missile called BOMARC.

Retrieved from "https://en.wikipedia.org/w/index.php?title=CIM-10_Bomarc&oldid=916977527"

This page was last edited on 21 September 2019, at 17:24 (UTC).

Text is available under the [Creative Commons Attribution-ShareAlike License](#); additional terms may apply. By using this site, you agree to the [Terms of Use](#) and [Privacy Policy](#). Wikipedia® is a registered trademark of the [Wikimedia Foundation, Inc.](#), a non-profit organization.