TRIDENT Submarine

Figure 5.16 U.S.S. *Ohio* (SSBN-726), the first TRIDENT submarine.

DESCRIPTION: TRIDENT submarine, designated as the OHIO-class, is the newest and largest of the nuclear powered submarine strategic weapons launchers, fitted with 24 tubes for TRIDENT I C4 or TRIDENT II D5 submarine-launched ballistic missiles.

CONTRACTORS: Electric Boat Division, General Dynamics
Groton, CT; Quonset Point, RI

SPECIFICATIONS:[1]

Length:	560 ft
Diameter:	42 ft
Displacement:	16,600 t (surface), 18,750 t (submerged)
Draught:	36.5 ft
Propulsion:	water-cooled pressurized (S8G) nuclear reactor, 60,000 horsepower[2]
Speed:	20+ knots (submerged)[3]
Crew:	154 personnel[4] (164 berths)
Stores:	90 days
Armament:	4 21-inch torpedo tubes amidships (Mk-48 torpedoes)

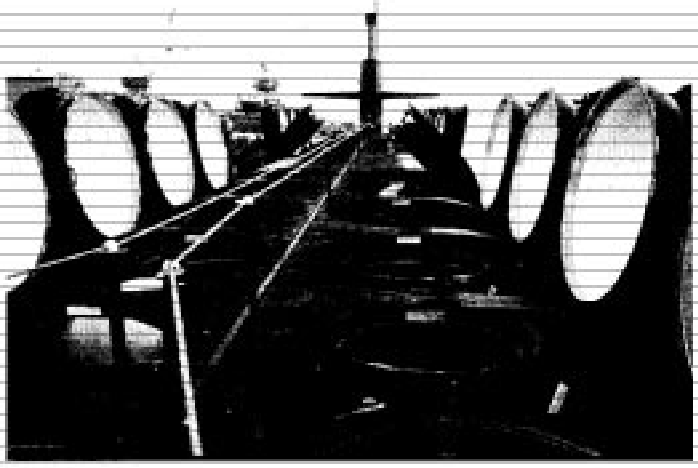

Figure 5.17 Missile hatches open on **TRIDENT** submarine.

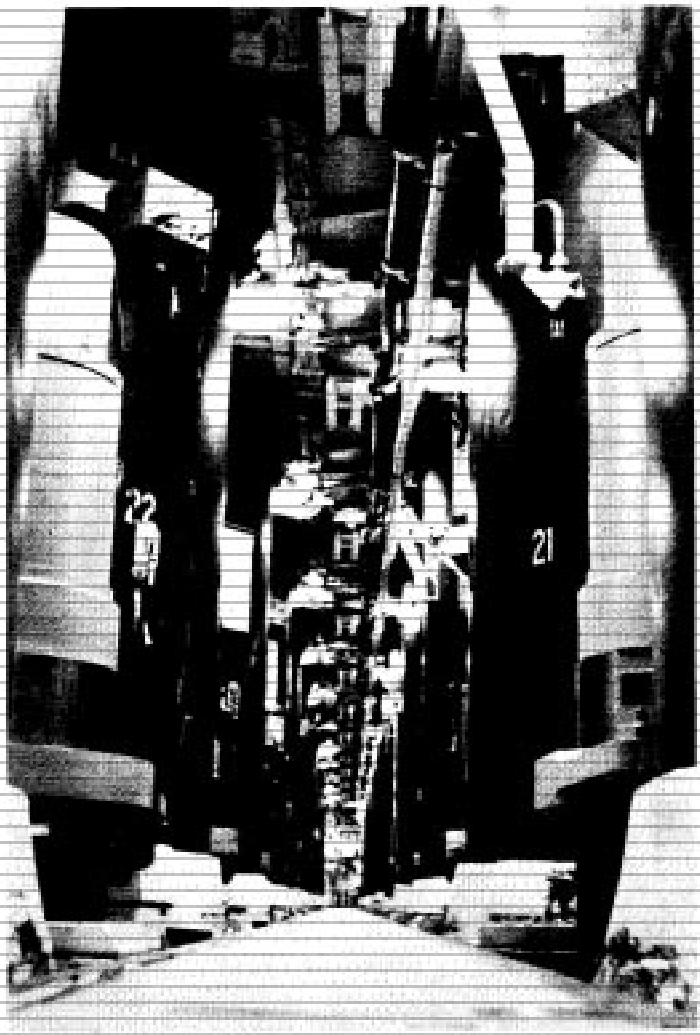

Figure 5.18 Interior of missile compartment, showing vertical launch tubes for **TRIDENT** missiles.

MISSILE SYSTEM: TRIDENT I C4; TRIDENT II D5 starting with SSBN-734, the ninth TRIDENT submarine

Number: 24 missile tubes,[3] each currently with TRIDENT I C4 missiles; ninth TRIDENT submarine will initially have TRIDENT II D5 deployed; first eight TRIDENT submarines will be retrofitted[5]

Nuclear Warheads: W76/Mk-4 MIRV, with 8 warheads, each with yield of 100 Kt

Warheads per Submarine: 192

Fire Control System: Mk-98

Navigation System: 2 Mk-12 Mod-7 Ships Inertial Navigation Systems (SINS), electrostatically supported gyro, satellite receiver

DEPLOYMENT:

Number Planned: 20 submarines are planned by 1998[7] (see Table 5.19); up to 1983 the estimate was 15 submarines[8]

Cycle: 66 percent at-sea availability based on a 25-day refit period, 70-day patrol period, and a 9-year interval between 12-month long overhauls.[9] TRIDENT increases at-sea patrol time of SLBM force by 21 percent.[10]

Homeport: Plans are to deploy the first 10 TRIDENT submarines in the Pacific from a new base at Bangor, WA.[11] Kings Bay, GA, has been chosen as the site for the Atlantic coast base.[12]

Table 5.19

TRIDENT Submarine Construction[1]

Submarine	FY Authorized	Original Contract Delivery Date	Estimated Delivery	Commissioning Date[2]
SSBN-726 *(Ohio)*	74	Apr 1979	Dec 1981	Nov 1981[3]
SSBN-727 *(Michigan)*	75	Apr 1980	Sep 1982	Sep 1982
SSBN-728 *(Florida)*	75	Dec 1980	Sep 1983	Apr 1983
SSBN-729 *(Georgia)*	76	Aug 1981	May 1984	—
SSBN-730 *(Rhode Island)*	77	Apr 1982	Jan 1985	—
SSBN-731 *(Alabama)*	78	Dec 1982	Sep 1985	—
SSBN-732	78	Aug 1983	May 1986	—
SSBN-733	80	May 1986	Jan 1987	—
SSBN-734[4]	81	Dec 1988	Dec 1988	—
SSBN-735	83	Aug 1989	Aug 1989	—
SSBN-736	83	Apr 1990	Apr 1990	—
SSBN-737	84	Dec 1990	Dec 1990	—

1. SASC, FY 1980 DOD, Part 1, p. 323; SASC, FY 1981 DOD, Part 2, p. 561; HASC, FY 1982 DOD, Part 3, p. 158; SASC, FY 1982 DOD, Part 7, p. 4081.
2. By the end of 1986, 6 TRIDENTs are planned for deployment; 8 were previously planned; ACDA, FY 1983 ACIS, p. 37; ACDA, FY 1982 ACIS, p. 77.
3. U.S.S. *Ohio* commissioned 11 November 1981.
4. First TRIDENT submarine to be initially equipped with TRIDENT II D5; GAO, "Information Regarding Trident II (D-5) Missile Configured Trident Submarine Costs and Schedule" (MASAD-82-47), 3 September 1982.

HISTORY:

IOC: November 1981, commissioning of USS Ohio, first TRIDENT submarine (see Table 5.5 for TRIDENT chronology)

COST:

Program Cost: $31,731 m[13]

$14,085.2 m (Dec 1982) (TRIDENT II submarines only)

Annual Operations: $663 m (15 SSBNs) (FY 1980)

FY	Number Procured	Total Appropriation ($ million)
1977 & prior	5	5405.3[14]
1978 & prior	7	7352.8[15]
1979 & prior	7	7930.5[16]
1980	1	1501.1
1981 & prior	9	10,656.5[17]
1981	1	1218.9
1982	0[18]	

COMMENTS: TRIDENT C4 eliminates the need for overseas basing and increases its patrol areas 10 to 20 times.[19] The TRIDENT submarine reduces acoustic observables, improves defensive systems, and decreases dependence on outside electronic navigational aids compared with POLARIS and POSEIDON submarines.[20]

1 See various annual issues of *Jane's Fighting Ships*, 1975-76 to present; SASC, FY 1977 DOD, Part 12, p. 6872; USN, Strategic Systems Project Office, "FBM Facts: Polaris, Poseidon, Trident," 1978.
2 Michael Getler, *Washington Post*, 4 October 1981, p. A28.
3 *Ships and Aircraft of the U.S. Fleet*, 11th Ed., p. 16.
4 Each submarine will be manned by two crews who will conduct alternate patrols consisting of a 25-day refit period followed by a 70-day at-sea period; ACDA, FY 1979 ACIS, p. 29.
5 DOD has reportedly considered dedication of one ballistic missile launcher on each TRIDENT submarine to a small communications satellite with booster to replace Defense communications spacecraft destroyed in wartime; AW&ST, 13 April 1981, p. 15.
6 DOD, FY 1983 Annual Report, p. 222.
7 HAC, FY 1983 DOD, Part 4, p. 599.
8 DOD, Selected Acquisition Report, 30 June 1982.
9 ACDA, FY 1982 ACIS, p. 78; SASC, FY 1980 DOD, Part 5, p. 327.
10 JCS, FY 1981, p. 43.
11 ACDA, FY 1982 ACIS, p. 77.
12 *Ibid.*
13 Estimate of 15 submarine TRIDENT force; SASC, FY 1982 DOD, Part 7, p. 4002.
14 ACDA, FY 1979 ACIS, p. 32.
15 HASC, FY 1979 Mil Con, p. 53; ACDA, FY 1980 ACIS, p. 49.
16 ACDA, FY 1981 ACIS, p. 85.
17 ACDA, FY 1983 ACIS, p. 47.
18 No TRIDENT submarines were funded in FY 1982.
19 HAC, FY 1982 EWDA, Part 7, p. 312.
20 DOD, FY 1981 RDA, p. VI-6.

TRIDENT I C4 Missile System

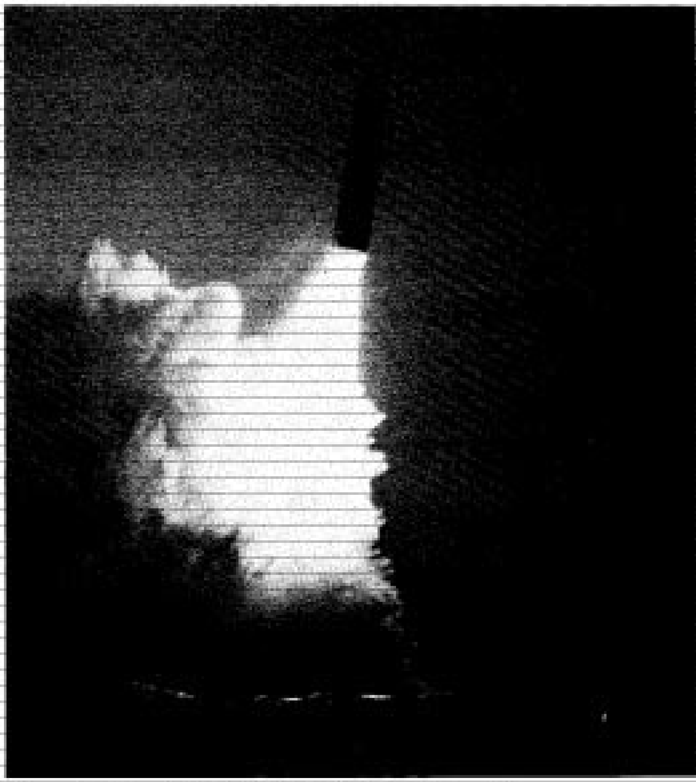

Figure 5.19 TRIDENT I C4 (UGM-93A) missile.

DESCRIPTION: Three-stage, solid propellent, MIRVed SLBM with greater range than POSEIDON C3.

CONTRACTORS: Lockheed Missiles and Space Co.
Sunnyvale, CA
(prime/missile/RV)
GE/Raytheon/MIT
(guidance)
Hercules Inc.
Wilmington, DE
(propulsion)
Thiokol
(propulsion)

SPECIFICATIONS:

Length: 34 ft 1 in (10.4 m)

Diameter: 74 in (1.9 m)

Stages: 3 (Kevlar fiber materials)

Weight at Launch: greater than 65,000 lb

Fuel: advanced, more efficient solid plus post boost system

Guidance: stellar-aided inertial[1] digital computer

Throwweight/ Payload: 2900 lb;[2] 3000+ lb[3]

Range: 4230 nm at full payload;[4] 7400 km at full payload;[5] greater with fewer RVs

DUAL CAPABLE: no

NUCLEAR WARHEADS: 8 W76/Mk-4 MIRV/missile;[6] 100 Kt (see W76)

Future Possibility: TRIDENT I C4 missiles have also been tested with the Mk-500 EVADER MaRV.[7]

DEPLOYMENT:

Launch Platform: First 8 OHIO class SSBNs and 12 converted POSEIDON SSBNs[8]

Number Planned: 740 missiles (Dec 1982); 712 missiles reported to be in original procurement program;[9] 327 (302 operational, 25 development) planned in FY 1982;[10] program reduced by 60 missiles in FY 1984[11]

Location: Longer range of TRIDENT I C4 over POSEIDON and POLARIS missiles eliminates the need for overseas basing of submarines carrying this missile.

HISTORY:

IOC: 20 October 1979 (First POSEIDON SSBN backfitted with TRIDENT I C4) (see Table 5.5 for TRIDENT chronology)

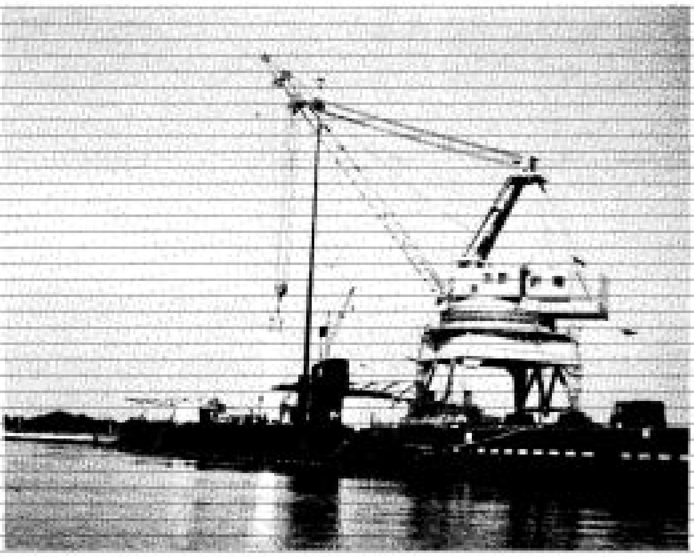

Figure 5.20 TRIDENT I C4 missile being loaded into U.S.S. *Ohio.*

TARGETING:

Types: little hard target capability; "moderately hard"[13] military bases and industry; all targets in the USSR will be in range from submarines operating in the Atlantic, almost all targets from the Pacific;[13] like POSEIDON, TRIDENT RVs will be committed in support of NATO[14]

Selection Capability: unknown

Retargeting: rapid on-board retargeting to another pre-planned target set, more lengthy procedure when submarine is only given coordinates of new aim points[15]

Accuracy/CEP: 0.25 nm;[16] 0.2-0.3 nm[17]

COST: Each backfit of 16 TRIDENT I C4s into POSEIDON submarine cost $200 million.[18]

Program Cost: $17,148.4 m initial program (Dec 1982); $3712.3 m (TRIDENT I C4 backfit program)

Unit Cost: $6.934 m (FY 1980) (flyaway)

FY	Number Procured	Total Appropriation ($ million)
1977 & prior	48[19]	4404.6[20]
1978 & prior	144	5875.3[21]
1979 & prior	230	6959.3
1980	82	809.8
1981 & prior	384	8590.8[22]
1981	72	856.0
1982	72	954.7
1983	62	662.8
1984	43	597.7

COMMENTS: TRIDENT I missile carries a full payload to ranges comparable to maximum range of POSEIDON. This is principally due to more energetic propellants, the addition of a third stage motor, micro-electronics, and lighter materials.[23] Accuracy is on par with POSEIDON as development of TRIDENT I C4 was primarily oriented towards increasing range of SLBMs.

1 The stellar sensor will take a star sight during the post-boost phase of missile flight and will correct the post-boost vehicle flight path based on this star sight; SASC, FY 1980 DOD, Part 5, p. 2488; SASC, FY 1977 DOD, Part 11, p. 6849.
2 Paul H. Nitze, op. cit.
3 Military Balance, 1980-1981, p. 88; John Collins, op. cit.; Adelphi 140, p. 32.
4 ACDA, FY 1982 ACIS, p. 82; 4360 nm is given as range in ACDA, FY 1981 ACIS, p. 77.
5 SASC, FY 1981 DOD, Part 2, p. 509.
6 JCS, FY 1984, p. 16; JCS, FY 1981, p. 45, stated originally that TRIDENT "is capable of carrying a payload of seven RVs," but was followed the next year (JCS, FY 1982, p. 70) with the statement that TRIDENT "has independently targeted RVs" and not mentioning a number. Many sources give 8 as the RV loading (Paul H. Nitze, op. cit., assumed "approximately 8 RVs"; Military Balance, 1980-1981, lists 8, and in FY 1984 the missile was listed with that number). Operational loadings of SLBMs are lower than maximum possible loadings; see ADCA, FY 1981 ACIS, p. 74.
7 Advanced Development work on the Mk-500 EVADER MaRV with acquisition readiness obtained in 1983 should a decision be made to deploy 48the EVADER. (See Reentry Vehicles.) ACDA, FY 1981 ACIS, p. 78; ACDA, FY 1982 ACIS, p. 82; ACDA, FY 1983 ACIS, p. 39.
8 The twelve POSEIDON submarines to be converted (in order) were: SSBN-657, -368, -655, -629, -630, -641, -627, -640, -632, -643, -634, -633.
9 U.S. Missile Data Book, 1980, 4th Ed., pp. 2-121; 288 missiles are being procured to support 12 converted POSEIDON submarines, 160 for launch tubes and 128 for testing and logistic support; ACDA, FY 1979 ACIS, p. 30. By the late 1980s, if SALT II limits on MIRVed launchers (1200 launchers) are extended and are met by reductions on other MIRVed launchers, the U.S. would have ten TRIDENT SSBNs with 240 launchers and 31 POSEIDON SSBNs with 496 launchers. The eventual number of TRIDENT SSBNs may be limited by compliance with the SALT II subceiling of 1200 MIRVed ICBM and SLBM launchers. Assuming 10 TRIDENTS and 12 POSEIDON SSBNs with C4 missiles: 736 launchers; 5888 to 7360 warheads. Operational loadings are lower, however, than maximum possible loadings.
10 DOD, Selected Acquisition Report, 30 June 1982.
11 DOD, FY 1984 Annual Report, p. 222.
12 HASC, FY 1982 DOD, Part 2, p. 789.
13 ACDA, FY 1980 ACIS, p. 44.
14 SAC, FY 1979 DOD, Part 1, p. 535.
15 HASC, FY 1982 DOD, Part 3, p. 130; SASC, FY 1980 DOD, Part 5, p. 2499.
16 Paul H. Nitze, op. cit.; UN Secretary General, op. cit., assumes a CEP of 500 m (0.27 nm).
17 Colin S. Gray, op. cit., p. 32.
18 HASC, FY 1982 DOD, Part 3, p. 128.
19 ACDA, FY 1979 ACIS, p. 32.
20 Ibid.
21 ACDA, FY 1980 ACIS, p. 49.
22 ACDA, FY 1983 ACIS, p. 47.
23 SASC, FY 1980 DOD, Part 5, p. 2499; USN, Strategic Systems Project Office, "FBM Facts: Polaris, Poseidon, Trident," 1978, p. 9.

TRIDENT II D5 Missile

An "improved accuracy program" for submarine-launched ballistic missiles began in Fiscal Year 1975; the program was prompted by the inquiries of the Secretary of Defense concerning the Navy's ability to maintain high accuracy in actual battle conditions. The research program was formulated to predict the type and magnitude of error contributors that limit accuracy, and to explore the conditions of submarine depth and speed within which missile accuracy and reliability could be maintained.

The resulting TRIDENT II missile, scheduled for deployment in TRIDENT submarines beginning in late 1988,[1] will be more accurate and have the capability of carrying more and larger warheads than the current TRIDENT I C4 missile. According to the DOD, "the TRIDENT II missile will nearly double the capability of each TRIDENT submarine."[2] The accuracy of the missile will give sea-based strategic forces the capability to attack any Soviet target; this represents a quantum jump in U.S. offensive nuclear capabilities. DOD plans to accelerate the initial deployment of the system to backfit the new missile into the ninth TRIDENT submarine, particularly as a hedge against late cancellation of the MX missile program.[3]

The purpose of the TRIDENT I missile development was essentially to increase the range of submarine-launched missiles to allow use of a larger patrol area. The purpose of the TRIDENT II is to increase the number of reentry vehicles to the POSEIDON level, so that even at extreme ranges, missiles can be fired with improved accuracy and increased warhead yield.[4]

The Reagan Strategic Program, announced 2 October 1981, stated that a new missile—the TRIDENT II D5—would be deployed in favor of alternative improvements to the present TRIDENT I (see Table 5.20).[5] A minimum of 480 operational missiles is planned for 20 submarines, each missile carrying 10 (or more) high yield warheads.

Table 5.20

Submarine-Launched Ballistic Missile Options[1]

TRIDENT I C4 with improved accuracy package (C4U):	Better CEP
TRIDENT I C4 long version with improved accuracy (C4L):	Better CEP, full length of TRIDENT launch tube, extended range
TRIDENT II D5:	Three stage scaled up TRIDENT I C4 with more warheads and greater accuracy
TRIDENT II D5 Clear Deck (CDD5):	New missile; Hard target kill across full spectrum, higher yield warheads

1 HASC, FY 1982 DOD, Part 3, pp. 135-136; SASC, FY 1981 DOD, Part 6, pp. 3517-3518; HAC, FY 1982 DOD, Part 9, p. 202.

1 The TRIDENT II program is being accelerated under Reagan Administration plans from an IOC of 1989.

2 DOD, FY 1983 RDA, p. VII-7.

3 Ibid.

4 SASC, FY 1980 DOD, Part 1, p. 343.

5 HAC, FY 1982 DOD, Part 9, p. 202.

TRIDENT II D5 Missile

DESCRIPTION: Large submarine-launched ballistic missile with greater range/payload capability and improved accuracy over the present SLBMs.

CONTRACTORS: Lockheed Missiles and Space Co.
Sunnyvale, CA
(prime)

SPECIFICATIONS:

Length:	45.8 ft
Diameter:	74.4 in
Stages:	3
Weight at Launch:	circa 126,000 lb
Fuel:	solid
Guidance:	stellar-aided inertial; NAVSTAR reception in missile;[1] digital computer; options include terminally-guided MaRV.
Throwweight/ Payload:	6000 lb (max)[2]
Range:	4000 nm at full payload,[3] 6000 nm with reduced RVs[4]

DUAL CAPABLE: no

NUCLEAR WARHEADS: high yield (475 Kt) version of W87/Mk-21 ABRV designated Mk-5 by the Navy;[5] W78/Mk-12A[6] and MaRV (designated Mk-600)[7] is also under consideration; capability will be to carry more (and larger) warheads than the current TRIDENT I;[8] most probably 9-10 large warheads/missile;[9] reportedly capable of carrying 10-15;[10] RV of missile is designed to accept different warheads "tailored to the target assignment,"[11] testing of several warheads, of which one might be selected,[12] testing has already been completed;[13] yield in the 150-600 Kt range.[14]

DEPLOYMENT:

Launch Platform:	OHIO class SSBNs starting with SSBN-734, the ninth TRIDENT submarine
Number Planned:	914 total missiles for 20 TRIDENT submarines;[15] 857 missiles[16]
Location:	Bangor, Washington; Kings Bay, Georgia

HISTORY:

IOC:	1988;[17] Dec 1989[18]
1975	improved accuracy technology program initiated
end 1980	advanced development started
Oct 1981	TRIDENT II D5 missile chosen for development
Mar 1982	UK decides to acquire the TRIDENT II rather than the TRIDENT I missile[19]

Jun 1982	plans to install TRIDENT I C4 missile in TRIDENT class submarines pending TRIDENT II backfit modified so that TRIDENT II D5 deployment is the initial equipping[20]
1988	first TRIDENT submarine backfitted with TRIDENT II

TARGETING:

Types:	all hardened targets across the full spectrum (hard silos, command and control facilities)[21]
Selection Capability:	unknown
Retargeting:	instant retargeting

Accuracy/CEP: 400 ft[22]

COST:

Program Cost: $37,645.1 m (Dec 1982);[23] $12,900 m (FY 1983)[24]

FY	Number Procured	Total Appropriation ($ million)
1979 & prior	—	20.0[25]
1980	—	25.6
1981	—	96.5[26]
1981 & prior	—	143.2[27]
1982	—	239.5
1983	—	369.7

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1 SASC, FY 1980 DOD, Part 5, p. 2506; *AW&ST*, 9 March 1981, p. 33.
2 ACDA, FY 1983 ACIS, p. 41; TRIDENT II will have 75 percent greater payload than TRIDENT I C4; HASC, FY 1982 DOD, Part 3, p. 129.
3 ACDA, FY 1982 ACIS, p. 84.
4 See for instance, *Military Balance*, 1980-81, p. 3.
5 ACDA, FY 1982 ACIS, p. 84; *AW&ST*, 17 January 1983, p. 26; see description of W87 under MX missile.
6 *AW&ST*, 22 March 1982, p. 18.
7 *Military Balance*, 1980-81, op. cit.
8 DOD is reportedly considering the option of dedicating one missile launcher on each TRIDENT submarine to a small communication satellite with booster to replace communication satellites destroyed in wartime; *AW&ST*, 13 April 1981, p. 15.
9 HASC, FY 1982 DOD, Part 3, p. 138; DOD, FY 1983 RDA, p. VII-7; *AW&ST*, 22 March 1982, p. 18; The SALT II limit would be 10. The option is being maintained for more than 10 warheads to be carried on the TRIDENT II D5 but actual RV loading is dependent on the size of the type warhead chosen. Fourteen is a common figure mentioned for maximum MIRVing although the pre-SALT figure was generally accepted as 17 (see for instance, *Projected Strategic Offensive Weapons Inventories of the U.S. and U.S.S.R., An Unclassified Estimate* (CRS, 77-59F, 24 March 1977).
10 Richard Halloran, *New York Times*, 6 February 1983, p. 17.
11 SASC, *Strategic Force Modernization Programs*, pp. 166, 172.
12 ACDA, FY 1983 ACIS, p. 38.
13 ACDA, FY 1979 ACIS, p. 31.
14 *Military Balance*, 1980-81, p. 3.
15 HAC, FY 1982 DOD, Part 9, p. 290.
16 HAC, FY 1983 DOD, Part 4, p. 599.
17 *AW&ST*, 22 March 1982, p. 18.
18 HAC, FY 1983 DOD, Part 4, p. 590.
19 SASC, FY 1983 DOD, Part 7, p. 4298.
20 GAO, "Information Regarding Trident II (D5) Missile Configured Trident Submarine Costs and Schedule" (MASAD-82-47), 9 September 1982.
21 SASC, *Strategic Force Modernization Programs*, p. 167.
22 *AW&ST*, 22 March 1982, p. 18; Richard Halloran, *New York Times*, 6 February 1983, p. 7; with stellar inertial guidance system.
23 DOD, SAR Program Acquisition Cost Summary, as of December 31, 1982.
24 HAC, FY 1983 DOD, Part 4, p. 599; this figure is given for 857 missiles at $15 million apiece.
25 ACDA, FY 1979 ACIS, p. 33.
26 SAC, FY 1982 DOD, Part 1, p. 428.
27 ACDA, FY 1983 ACIS, p. 47.

Shallow Underwater Missile System (SUM)[1]

One alternative to the MX missile system is the idea of a Shallow Underwater Missile System (SUM). SUM is a small missile launching submarine that would be used as the vehicle for an externally mounted, encapsulated strategic missile. The SUM force would consist of small, non-nuclear powered diesel electric submarines operating in near-coastal waters off the east and west coasts of the continental U.S. Each submarine would carry two missiles horizontally mounted external to its pressure hull. In this way, 200 missiles could be deployed on 100 small submarines of 500-1000 ton displacement.

Proponents of SUM claim that the system would be less costly, less vulnerable, as accurate (using land-based guidance beacons), and as controllable (with short-range, reliable communications) when compared to the Multiple Protective Shelter version of the MX. Opponents argue that deployment could not occur before the early 1990s, that cost per surviving RV exceeds TRIDENT, that technical risks exist in submarine design, weight, and propulsion, and that manning costs are higher.[2] Furthermore, opponents contend that SUM submarines could not operate on the continental shelf because of a tidal wave phenomenon that would be caused by nuclear weapons, called the "Van Dorn effect," which would allow a few Soviet warheads to destroy all the submarines in a restricted patrol area.

SSBN-X

A SSBN-X program began in FY 1979 to investigate concepts and designs for future nuclear powered ballistic submarines (SSBNs). The program examined two concepts for cost-effective SSBNs in response to the excessive cost of the TRIDENT submarine: first, a new small submarine carrying encapsulated missiles, and second, a less expensive large SSBN, either a reengineered TRIDENT or a new 24-tube SSBN.[3]

In FY 1979-1981, approximately $25 million was appropriated in the SSBN-X program; design studies and preliminary work began in the following areas: alternative ship size and hull design, new propulsion plant, and new strategic weapon design. Much of the design and subsystems of a follow-on attack submarine are being used in the SSBN-X program.

The earliest possible start of SSBN-X work was projected as FY 1985.[4] During the Carter Administration, it was thought that it would not be until FY 1991 that such a ship would be available.[5] The Reagan Administration has not pursued SSBN-X development.

1. Additional sources on SUM include the following: Sidney D. Drell and Richard L. Garwin, "SUM: The Better Approach to ICBM Basing," 25 April 1980; Office of Deputy Undersecretary of Defense for Research and Engineering, "An Evaluation of the Shallow-Underwater Missile (SUM) Concept," 9 April 1980 (reproduced in SASC, FY 1981 DOD, Part 6, pp. 3484-3504); Letters from Richard L. Garwin to Congressman J.F. Seiberling, 4 February 1980, and 7 April 1980.
2. SASC, FY 1982 DOD, Part 7, p. 4067.
3. ACDA, FY 1981 ACIS, pp. 60-61.
4. SASC, FY 1981 DOD, Part 2, p. 565.
5. Ibid., p. 608.

Strategic Bomber Force

B-52 STRATOFORTRESS

Figure 5.21 B-52G bomber.

DESCRIPTION:	Long-range, heavy bomber used by the Strategic Air Command. Presently deployed and modified into three versions: B-52D, G, and H.	**CONTRACTORS:**	Boeing Aerospace Company Seattle, WA; Wichita, KS (prime) Pratt & Whitney (engines) Boeing Witchita (offensive avionics) IBM (navigation and weapons delivery computer) Teledyne Ryan (radar) Honeywell (navigation and radar) ITT Avionics
B-52D:	configured primarily for conventional bombing, being retired		
B-52G:	planned as initial cruise missile carriers		
B-52H:	planned as follow-on cruise missile carrier, most capable penetrator.		

	(ECM) Northrop (ECM) Westinghouse (avionics)
SPECIFICATIONS:[1]	
Dimensions:	
Length:	156 ft (D/H); 158 ft (G)
Height:	48 ft (D); 40 ft 8 in (G/H)
Wingspan:	185 ft (37° fixed)
Takeoff Weight (max):	450,000+ lb (D); 488,000+ lb (G/H)
Takeoff Distance:	10,700 ft (G); 9900 ft (H)[2]
Powerplant:	8 PW J57-P43WB jet engines (G); 8 PW TF33-P-3 turbofans (H)
Ceiling:	50,000+ ft
Speed:	
maximum:	0.95 Mach (at 50,000 ft);[3]
high cruise:	0.77 Mach (B-52G/H)[4]
low penetration:	0.53-0.55 Mach (B-52G/H)[5]
sea level:	0.59 Mach (B-52H)[6]
low withdrawal:	0.55 Mach (B-52G/H)[7]

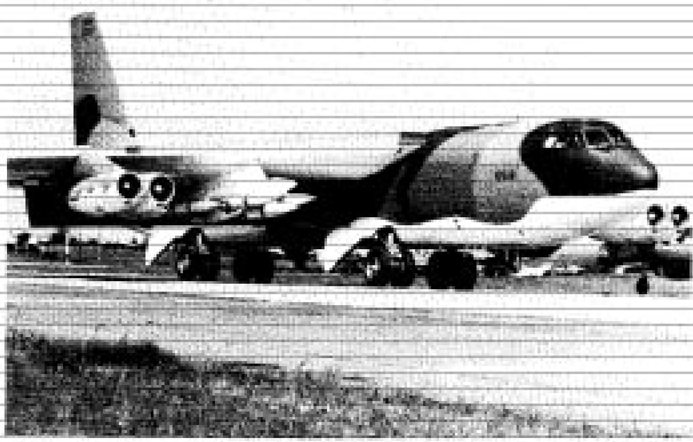

Figure 5.22 B-52G with SRAMs (AGM-69A) loaded under wing.

Range:	(depends on number of aerial refuelings)
B-52D:	5300 mi;[8] more than 6000 mi[9]
B-52G:	4500 nm (nuclear no refuel);[10] 6500 nm (high no refuel);[11] more than 7500 mi[12]
B-52H:	8600 mi;[13] more than 10,000 mi;[14] 7900 nm (high no refuel);[15] 5900 nm (nuclear no refuel)[16]
Aerial Refueling Capability:	yes
Crew:	6 (pilot, copilot, navigator, radar navigator, electronic warfare officer, gunner)
Radar Cross Section:	90-100 sq m[17]
NUCLEAR WEAPONS:	ALCM, SRAM missiles, B28, B43, B53, B57,[18] B61,[19] B83 bombs;[20] maximum load is 24 nuclear weapons. Typical load of B-52G/H would be 4 bombs and 6-8 SRAMs internal;[21] B-52G/Hs can carry up to 20 SRAM missiles, 6 under each wing and 8 in the bomb bay on rotary launcher; drag increase with external missile is approximately 15-25 percent.[22]
B-52D:	4 nuclear bombs, no SRAMs[23]
B-52G:	being modified to carry up to 12 ALCMs, 6 under each wing, plans to deploy ALCM internally cancelled[24]
B-52H:	to be modified to carry 20 ALCMs starting in 1985[25]

5

B-52 STRATOFORTRESS

Table 5.21
B-52 Bomber Force[1]

Model	Total Built	First Delivery	Last Delivery	Active Inventory (1983)	
				Test	SAC
XB	1	1952	—	—	—
YB	1	1953	—	—	—
A	3	1954	1954	—	—
B	50	1955	1956	1	—
C	35	1956	1956	—	—
D	170	1956	1957	0	31
E	100	1957	1958	2	—
F	89	1958	1959	—	—
G	193	1958	1961	4	151
H	102	1961	1962	0	90
	744			7	272

1 SASC, FY 1980 DOD, Part 1, p. 332; JCS, FY 1984, p. 13.

DEPLOYMENT: 272 operational B-52s; 316 total in 20 squadrons, 31 in 3 training squadrons, backup and test; dispersal of alert force B-52s to more bases in peacetime is under consideration;[26] B-52 requires 150 foot wide runways to land, limiting the number of airfields capable of handling the plane.[27]

Number Deployed: 172 B-52G (169 operational, 151 of which are PAA, 4 test); 96 B-52H (90 PAA); 79 B-52D (75 operational (31 PAA));[28] 3 squadrons of B-52D were retired on 1 October 1982, the last two (31 PAA) will follow during 1983-1984.

HISTORY:

IOC:	1955
Sep 1947	Boeing awarded contract for preliminary design of B-52
Nov 1951	first B-52 prototype finished
Apr 1952	first flight of YB-52 prototype
Aug 1954	first flight of production B-52A
Jun 1955	SAC receives first B-52
1956	B-52D deployed
1958	B-52G deployed
1961	B-52H deployed
Oct 1962	delivery of last B-52 (H model)
1974	program to upgrade avionic, weapons delivery, and defenses of bomber force initiated
Sep 1980	first flight of B-52 equipped with offensive avionics system
Sep 1981	first alert capability with one B-52G and 12 ALCMs at Griffiss AFB, NY
Sep 1981	Air Force directs cruise missile deployment on B-52H force
Oct 1981	Reagan strategic program calls for the retirement of B-52D bombers in 1983
Oct 1982	three squadrons of B-52Ds retired[29]
end 1982	first squadron of 14 B-52Gs carrying 12 ALCMs under its wings operational
FY 1986	planned IOC of B-52H with ALCM[30]

Table 5.22

B-52 Modifications

Project	Model	Cost ($ million)
Already accomplished (through FY 1979)	All	3400
Ongoing (FY 1980-FY 1990)	(B-52D/G/H)	3300
Offensive Avionics System	B-52G/H	
Cruise Missile Carriage	B-52G	
ECM/Defensive Systems (ALQ-117 improved, ALQ-122, ALQ-155, ALR-46)	B-52G/H	
Functionally Related Observable Differences	B-52G	
Fuel Savings	B-52G/H	
Tail Warning System	B-52G/H	
Reliability & Maintainability	B-52D/G/H	
Future (FY 1983-FY 1990)	(B-52G/H)	4400
EMP Hardening and Thermal/Blast Protection	B-52G/H	
B-52H Cruise Missile	B-52H	
ECM	B-52G/H	
Reliability & Maintainablity	B-52G/H	
Proposed		
Reengining (with PW2037 turbofan)	B-52G	4200

Sources: AW&ST, 30 November 1981, p. 54; HASC, FY 1981 DOD, Part 4, Book 2, pp. 1886-1887; SAC, FY 1981 DOD, Part 5, pp. 1657-1658.

FY 1987	avionics modification program planned for completion

COST:

B-52 OAS Program:	$1777.9 m (Dec 1982)
B-52 CMI Program:	$611.0 m (Dec 1982) (see Table 5.8, Bomber Forces Funding)
Annual Operations:	$948 m (FY 1980)[31] $1891 m (FY 1982)[32]

FY	Number Procured	Total Appropriation ($ million)
1980	-	479.5[33]
1981	-	597.8[34]
1982	-	615.6

COMMENTS: At least 187 B-52 aircraft are in inactive storage at Davis-Monthan AFB, AZ. The FY 1982 budget request included $12.7 m to install a new monitor and control system for nuclear weapons in B-52 aircraft.

1 Boeing Fact Sheet, "Background Information, Boeing B-52 Stratofortress," November 1981; SASC, *Military Implications of the SALT II Treaty*, Part 4, p. 1908.
2 SASC, FY 1982 DOD, Part 7, p. 4329.
3 Military Balance, 1980-81, p. 90.
4 HAC, FY 1982 DOD, Part 2, p. 389; SASC, FY 1982 DOD, Part 7, p. 4320.
5 Ibid.
6 Ibid.
7 Ibid.
8 Military Balance, 1980-81, p. 90.
9 Air Force Fact Sheet, "B-52," 1 April 1980.
10 SASC, FY 1982 DOD, Part 7, p. 4329.
11 Military Balance, 1980-81, p. 90.
12 Air Force Fact Sheet, op. cit.
13 Military Balance, 1980-81, p. 90.
14 Air Force Fact Sheet, op. cit.
15 SASC, FY 1982 DOD, Part 7, p. 4329.
16 Ibid.
17 CRS, "Bomber Options for Replacing B-52s" (IB 81107), p. 18.
18 AFR 0-2, p. 45.
19 *Military Applications of Nuclear Technology*, Part 1, p. 7.
20 SASC, FY 1983 DOD, Part 7, p. 4242.
21 SASC, FY 1982 DOD, Part 7, p. 4284.
22 SASC, *Strategic Force Modernization Programs*, p. 162.
23 SASC, FY 1982 DOD, Part 7, p. 4284.
24 HAC, FY 1983 DOD, Part 4, p. 588.
25 DOD, FY 1984 Annual Report, p. 223.
26 DOD, FY 1983 RDA, p. VII-7.
27 SASC, *Strategic Force Modernization Programs*, p. 36.
28 SASC, FY 1983 DOD, Part 7, p. 4556.
29 Ibid., p. 4569.
30 ACDA, FY 1983 ACIS, p. 65.
31 Including military personnel; SASC, FY 1982 DOD, Part 7, p. 4002.
32 SASC, FY 1982 DOD, Part 7, p. 4337.
33 B-52 avionics modification for cruise missile.
34 SASC, FY 1982 DOD, Part 7, p. 4289.

FB-111

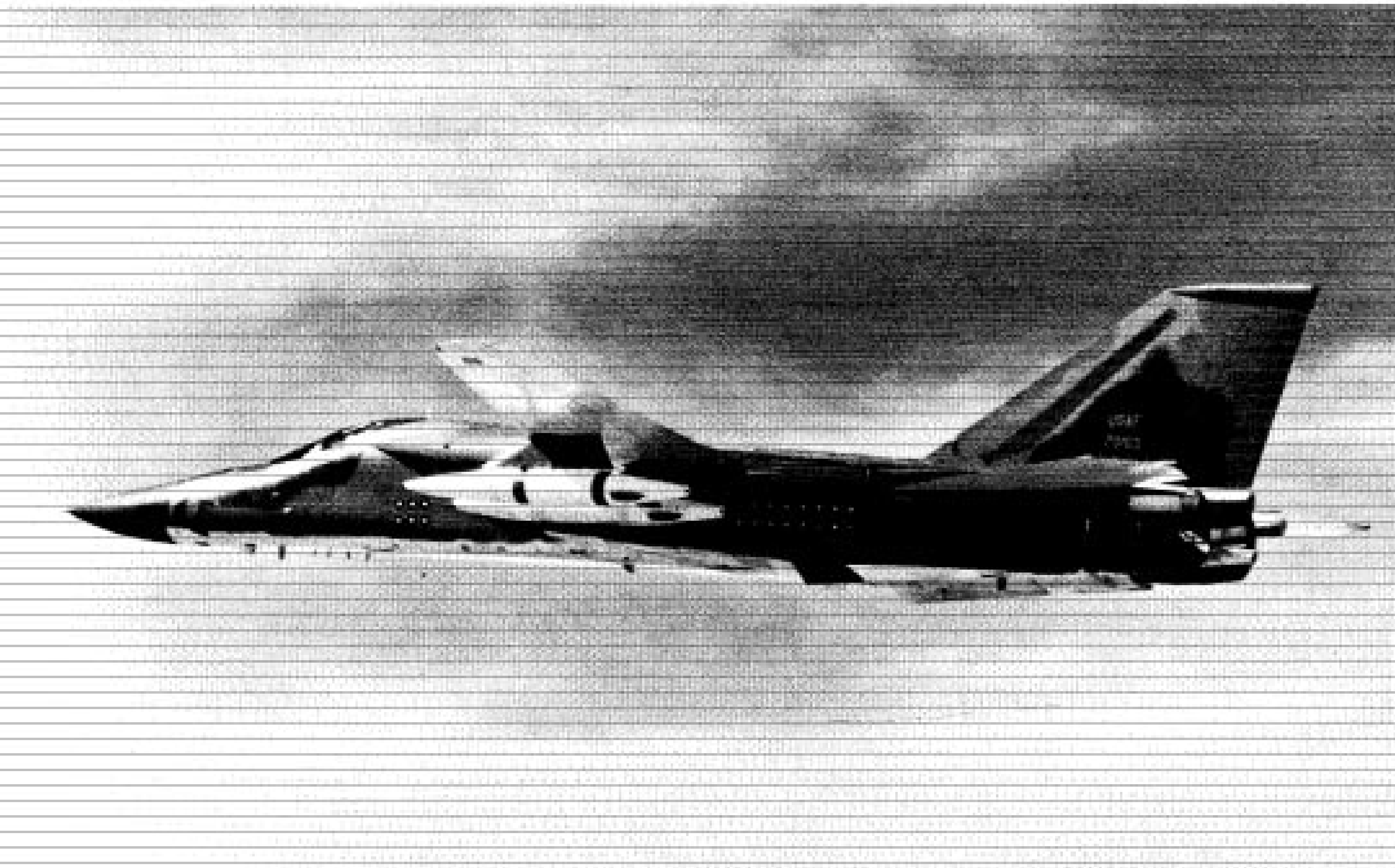

Figure 5.23 FB-111 with SRAMs loaded under wing.

DESCRIPTION:	Variation of the F-111 tactical fighter used by SAC as a medium bomber. It is designed for low altitude, high speed penetration.
MODIFICATIONS:	None
CONTRACTORS:	General Dynamics (prime)
	Pratt & Whitney (engine)
SPECIFICATIONS:[1]	
Dimensions:	
Length:	75 ft 6.5 in
Height:	17 ft
Wingspan:	70 ft at 16° sweep 34 ft at 72.5° sweep
Takeoff Weight (max):	110,600 lb
Takeoff Distance:	6200 ft
Powerplant:	2 PW TF 30-P-7 turbofan jet engines
Ceiling:	60,000+ ft
Speed:	
maximum:	2.5 Mach (36,000 ft)[2]
high cruise:	0.77 Mach[3]
low penetration:	0.85 Mach[4]
low withdrawal:	0.55 Mach[5]

Range:[6]	(depends upon aerial refuelings); 2900 nm (nuclear loaded, no refuel); 3200 nm (high, no refuel); 4300 nm (high, 1 refuel); 5200 nm (nuclear loaded, 1 refuel); 4700 mi[7]
Aerial Refueling Capability:	yes
Crew:	2 (pilot, navigator-bombadier)
NUCLEAR WEAPONS:[8]	SRAM missiles, B43, B61 bombs; B83 (future); maximum load: 6 bombs or 6 SRAM;[9] 4 SRAMs carried on external pylons, capacity for 2 in bomb bay; 6 bombs in bomb bay in lieu of SRAMs; three external stations on each wing, two in the weapons bay; two outboard fixed pylons can carry tanks, but not weapons.[10]
DEPLOYMENT:	Pease AFB, NH; Plattsburgh AFB, NY
Number Deployed:	60+ FB-111A total, 56 in 4 operational squadrons (1983)
HISTORY:	
IOC:	1969[11]
Oct 1969	first FB-111A delivered to SAC
1968-1971	76 FB-111As produced[12]
1990s	FB-111As transferred to tactical inventory as ATB is deployed[13]

COMMENTS:

FB-111 is reportedly used in attacking heavily defended and large-area targets.[14] Unlike other bombers, low-level missions at night, or even adverse weather, can be flown without crew interface. A 30 percent alert rate with 8 FB-111s and 5 KC-135 tanker aircraft is maintained at both bases.[15] The FY 1982 budget request included $2.7 million to install a new nuclear weapons monitoring and control device in FB-111 aircraft. Due to its high speed, small size, and low level terrain following capability, the FB-111 will remain a better penetrator than the B-52 throughout the 1980s.[16]

1 SASC, FY 1982 DOD, Part 7, p. 4329; SASC, *Military Implications of the SALT II Treaty*, p. 1009.
2 External SRAMs limit performance.
3 HAC, FY 1982 DOD, Part 2, p. 269; SASC, FY 1982 DOD, Part 7, p. 4329.
4 *Ibid.*
5 *Ibid.*
6 SASC, FY 1982 DOD, Part 7, p. 4329.
7 *Military Balance*, 1980-1981, p. 90.
8 AFR 0-2, p. 48; FB-111 does not carry the B28.
9 SASC, FY 1982, DOD, Part 7, p. 4329.
10 David R. Griffiths, "FB-111 Bombers Playing Crucial Role," AW&ST, 16 June 80.
11 JCS, FY 1981, p. 42.
12 Of 76 FB-111s built, 11 had crashed as of March 1981.
13 DOD, FY 1984 Annual Report, p. 224.
14 David R. Griffiths, op. cit.
15 *Ibid.*
16 SASC, FY 1980 DOE, Part 2, p. 465.

Short-Range Attack Missile (SRAM) (AGM-69A)[1]

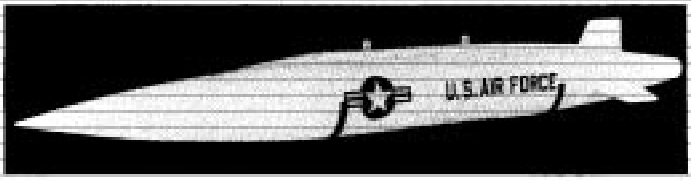

Figure 5.24 Short-Range Attack Missile (SRAM) (AGM-69A).

DESCRIPTION:	Defense suppression, supersonic, ballistic trajectory air-to-surface missile deployed on B-52 and FB-111 bombers. It can reverse directions in flight up to 180 degrees.
CONTRACTORS:	Boeing Aerospace Co. Seattle, WA (prime) General Precision (guidance) Lockheed (propulsion) Thiokol Corp Brigham City, UT (propulsion) Singer-Kearfott Div (guidance) Universal Match Corp, Unidynamics Div (fuse system) Rockwell International, Autonetics Div (aircraft computer) Litton Industries (inertial measurement unit) Stewart-Warner Electronics Div (terrain sensor) Delco Electronics (missile computer)
SPECIFICATIONS:	
Length:	14 ft (4.27 m)
Diameter:	17.7 in
Stages:	1
Weight at Launch:	2240 lb[2] (at launch)
Propulsion:	LPC-415 solid propellant, 2 pulse rocket engines
Speed:	Mach 3.5+
Guidance:	inertial with terrain clearance sensor
Range:	160-220 km at high altitude; 56-80 km at low altitude
DUAL CAPABLE:	no
NUCLEAR WARHEADS:	one W69 (similar to the W68, the warhead on MINUTEMAN III), 170-200 Kt
DEPLOYMENT:	B-52G/H: up to 20 SRAMs, 12 in 3 round clusters under the wing and 8 on a rotary dispenser in the aft bomb bay, typical load is 6-8 SRAMs. FB-111A: up to 6 SRAMs, 4 under the wing and 2 internally; typical load is 2 SRAMs. (See Table 5.7.)
Number Deployed:	1140 operational;[3] some 1500 missiles delivered,[4] with some 1300 remaining in service.
Location:	1020 at B-52G/H bases; 120 at FB-111 bases.[5] (see Chapter Four)
HISTORY:	
IOC:	August 1972
1964	Air Force develops requirement for SRAM
Oct 1966	Boeing selected as prime contractor for SRAM
Jul 1969	first powered flight
Jan 1971	production authorized
Jul 1971	flight test program completed

Mar 1972	first production missile delivered to Air Force
Jul 1975	1500th and final SRAM delivered to the Air Force
Jun 1977	with cancellation of B-1, development of an upgraded B model SRAM was cancelled
1980	1152 SRAMs in 19 B-52 and FB-111 squadrons[6]
Late 1980s	SRAM replaced by Advanced Strategic Air-Launched Missile

TARGETING:

Types:	heavily defended targets; air defense missile sites, radar, airfields, defensive installations
Selection Capability:	air-burst and contact fuze;[7] missile can be launched at subsonic or supersonic speed, from high or low altitude
Retargeting:	can be retargeted aboard the aircraft prior to launch[8]
Accuracy/CEP:	"very good CEP"[9]

COST: $290,000 (FY 1975) (flyaway)

FY	Number Procured	Total Appropriation ($ million)
1980 & prior	1500	1196.7

COMMENTS: Boeing has proposed to add a second solid motor on the end of the missile and upgrade the guidance to include an air-to-air mission to compete with ASALM, to be designated SRAM-L.[10]

1 See Boeing Fact Sheet, "Background Information, SRAM," February 1982.
2 GAO, Draft Study for B-1.
3 "Primary Airvehicle Authorized" as of January 1980; HASC, FY 1981 Mil Con, p. 431.
4 *U.S. Missile Data Book*, 1980, 4th Ed., p. 2-92.
5 HASC, FY 1981 Mil Con, p. 431; HAC, FY 1982 DOD, Part 2, p. 101.
6 HAC, FY 1981 DOD, Part 2, p. 288; Les Aspin, "Judge Not by the Numbers Alone," *The Bulletin of the Atomic Scientists*, June 1980, p. 31, lists 1250 SRAMs and *SIPRI Yearbook 1980*, p. 178, lists 1500 authorized through 1975.
7 *The World's Missile Systems*, 6th Ed., p. 116.
8 SAC, Fact Sheet, "Short Range Attack Missile," August 1981.
9 *Military Applications of Nuclear Technology*, Part 1, p. 9.
10 AW&ST, 10 March 1980, p. 15.

New Bombers

The search for a replacement for the B-52 began almost immediately after the bomber was deployed in the 1950s. Although the supersonic B-58 HUSTLER was developed, it proved unsatisfactory and no more than one hundred were procured. The B-58 was followed by the B-70, a long-range supersonic (Mach 3) bomber. The B-70 never got past the R&D stage because its cost, effectiveness, and vulnerability were not considered to offset any advantages of the emerging MINUTEMAN ICBM force. The B-70 was followed by the RS-70 project which was also cancelled due to excessive cost. This was followed by the Advanced Manned Strategic Aircraft (AMSA) program which continued studies through the 1960s and 1970s to develop a low flying supersonic bomber.

In June 1970, the DOD awarded contracts for the candidate AMSA bomber, the B-1. Although the design of the B-1 was completed by 1978, an uneven R&D program followed in which $6 billion were spent and 4 prototype planes were produced. On 30 June 1977, President Carter announced that production plans for the B-1 would be discontinued and that an upgraded B-52 force and other planes equipped with Air-Launched Cruise Missiles would supplant the need for a new penetrating airplane.

The FY 1981 Defense Authorization Act (P.L. 96-342) directed the Secretary of Defense to develop a strategic "multi-role bomber" for initial deployment by 1987. The program—called Long Range Combat Aircraft (LRCA)—was to consider a number of alternatives (see Table 5.23) both short and long term. On 2 October 1981, the Reagan Administration announced that a modified B-1 (designated the B-1B) would be the LRCA and that an Advanced Technology Bomber ("Stealth") would be developed for the 1990s. The plan is to procure 100 B-1Bs with the first squadron operational in FY 1985 and 135-150 ATBs starting in the early 1990s.

Although a variety of reasons, including the need for conventional bombing capabilities, were given to explain the need for the prospective LRCA. The primary justification for replacing the B-52 is the perceived military requirement for bombers to penetrate Soviet air defenses. But given that the deployment of long-range Air-Launched Cruise Missiles aboard the B-52 Bomber force greatly increases their ability to hit targets due to increased accuracy and defense evasion, the need for a bomber to penetrate the Soviet Union is hotly disputed. The age of the B-52 bomber, its capabilities at low altitudes, and improvements in Soviet defenses are used to justify a new airplane. Other operational requirements

Table 5.23

Candidate Systems for B-52 Bomber Replacement Long-Range Combat Aircraft / Multi Role Bomber

System	Description	Status
Basic B-1	Supersonic, low altitude penetrating bomber	Upgraded to B-1B
B-1B	Improved wings, electronic equipment, longer range, heavier payload than B-1	Chosen as LRCA 2 October 1981, IOC in FY 1985
FB-111B/C	Stretched FB-111A and F-111D with longer fuselage, new engines, with SRAM	Originally favored by Congress and SAC in 1980, $6-8 billion program
Advanced Technology Bomber (Stealth)	Reduced radar cross section penetrating bomber	IOC in early 1990s
Cruise Missile Carrier Aircraft (CMCA)	Wide-bodied new ALCM transport[1]	Evolved into SAL/SWL, dropped in favor of B-1B
Strategic Weapons Launcher (SWL)[2]	Fixed-wing version of B-1 for standoff ALCM delivery as mid-term B-52 replacement	Advocated by Rockwell, dropped by AF in September 1977 in favor of SAL, unfunded by Congress
Strategic ALCM Launcher (SAL)	Fixed-wing version of B-1 for standoff and penetration as interim penetrator	Favored by Air Force and DOD as MRB, dropped for B-1B

1 Candidates included 707, DC-10, 747, L-1011, C-5, YC-14, YC-15 and C-141; ACDA, FY 1979 ACIS, p. 30.

2 AW&ST, 17 September 1979, pp. 14-15.

Table 5.24

New Bomber Funding [$ millions][1]

	FY 1977	FY 1978	FY 1979	FY 1980	FY 1981	FY 1982	FY 1983	FY 1984
Cruise Missile Carrier Aircraft	—	—	—	24.0	—	—	—	—
Bomber Penetration Evaluation	—	—	—	54.9	—	—	—	—
B-1	767.0	443.4	55.0	55.0	—	2083.0	4787.0	6929.5
Long-Range Combat Aircraft	—	—	—	—	260.1	—	—	—

1 HAC, FY 1982 DOD, Part 2, p. 32; DOD, FY 1984 Annual Report, p. 225.

identified are better dispersal capabilities, base escape characteristics, and resistance to nuclear effects.[1]

The B-1B will use essentially the same "active defenses" (electronic countermeasures) as the present B-52, which has been continually updated with the most modern systems. It will incorporate many "passive defense" innovations not available when the B-52 was developed. These include smaller size, more efficient propulsion system, and materials advances which will decrease the aircraft's "radar cross section." This will reduce its susceptibility to detection and greatly aid penetration.

The B-1B, chosen as the near term penetrator, is of the same design as the basic B-1 bomber and is able to perform as either a penetration bomber, a cruise missile launch platform, or conventional bomber. The "core aircraft," which includes 85 percent of the design of the basic B-1, will have the following characteristics:[2]

- greater range, which allows intercontinental missions without aerial refueling,
- increased payload, including adding cruise missile capability, external stores, and enlarged forward weapons bay,
- reduction in supersonic maximum speed at high level (Mach 1.6 to Mach 1.2),
- reduction in maximum altitude (70,000 ft to 42,000 ft),
- abandonment of low level supersonic "dash" capability to high subsonic speeds at lower levels,
- offensive avionics system now being installed in B-52s, including upgraded radar and navigation system from F-15 and F-16,
- improved nuclear weapons effects hardening,
- new defensive avionics to include higher frequency jamming,
- reduced wing sweep (67.5° to 60°) and strengthened landing gear for heavier loadings,
- incorporated signature reduction design changes and ten-fold reduction in radar cross section, and
- increased takeoff gross weight limit (395,000 lb to 477,000 lb).

1 DOD, FY 1983 RDA, p. VII-2.
2 HAC, FY 1982 DOD, Part 9, pp. 82-83; SASC, Strategic Force Modernization Programs, p. 93.

B-1B

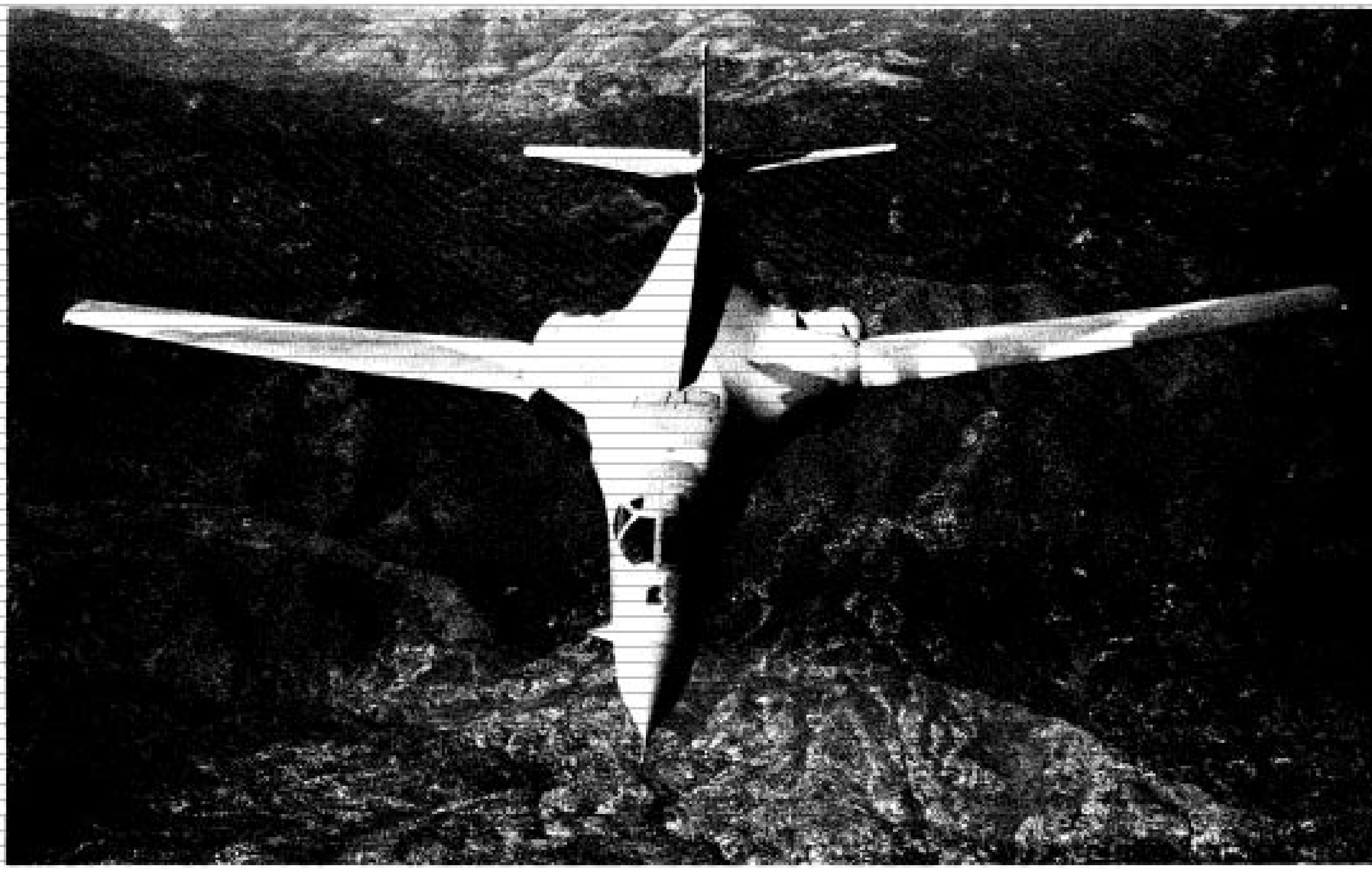

Figure 5.25 B-1 bomber.

DESCRIPTION:	Medium weight, intercontinental, penetrating, four seat, strategic bomber.	Takeoff Distance:	8300 ft (B-1B); 7500 ft (B-1)
		Powerplant:	4 GE F101-100 turbofans
CONTRACTORS:	Rockwell International El Sequndo, CA (prime/airframe) (See Table 5.26 for a list of major B-1B subcontractors)	Ceiling:	42,000 ft (B-1B); 70,000 ft (B-1)
		Speed:	
		low penetration:	0.85 Mach (circa 646 mph)
		high penetration:	Mach 2 (1320 mph); 1596 mph (B-1)
SPECIFICATIONS:		high cruise:	0.72 Mach (B-1/B-1B)
Dimensions:		low withdrawal:	0.42 Mach (B-1B); 0.55 Mach (B1)
Length:	150 ft, 2.5 in		
Height:	33 ft, 7 in		
Wingspan:	136 ft, 8.5 in (15°), 78 ft, 2.5 in (67.5°)	Range:	6100 mi
		Aerial Refueling Capability:	yes
Takeoff Weight (max):	477,000 lb (B-1B); 395,000 lb (B-1)		

Crew:	4 (pilot, copilot, offensive and defensive systems operators)
Radar Cross Section:	1 sq m[7]
NUCLEAR WEAPONS:	B28, B61, B83, SRAM, ALCM;[8] payload approximately twice that of B-52; drag increase with external missiles will be approximately 8 percent.[9] (See Table 5.25 for loading of bombers.)
DEPLOYMENT:	first base will be Dyess AFB, Texas where 26 B-1B will be deployed starting in late 1985[10]
Number Planned:	100 (under Reagan Administration plans) (1983)

HISTORY:

IOC:	1986; FY 1985[11] (B-1B)
Jun 1970:	development of B-1 begins
Dec 1974:	first flight (basic B-1)
Dec 1976:	production of B-1 started
Jun 1977:	basic B-1 cancelled by President Carter
Apr 1981:	flight testing of 4 B-1 R&D aircraft completed
Oct 1981:	decision taken by Reagan Administration to procure 100 B-1B bombers as near term penetrator
Jun 1985:	first B-1B production delivery
1986:	first B-1B squadron operational[12]
1987-1995:	B-1B serves as penetrator
1988:	FOC of 100 B-1B force[13]
1990s:	B-1B begins phase-in as cruise missile carrier as ATB is deployed

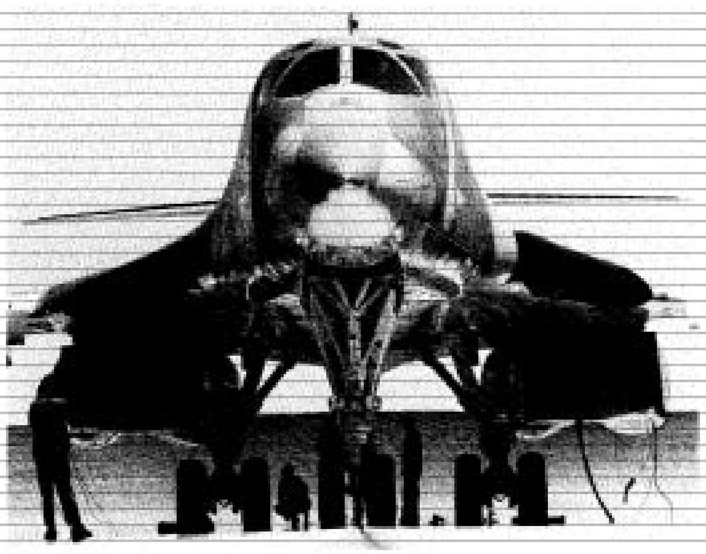

Figure 5.26 B-1 bomber.

COST:

Program Cost: Original B-1: $21.5 billion (244 bombers)
LRCA: $27.9 billion[14]
B-1B (1981) (Administration): $19.7 billion[15]
B-1B (1982) (Administration): $22 billion
B-1B (1982) (CBO): $39.8 billion
B-1B (Dec 1982) (SAR): $28.334 billion

FY	Number Procured	Total Appropriation ($ million)
1970-1980	4 (B-1A)	4758.7[16]
1982 & prior	1	2311.9[17]
1983	7	4787.0
1984	10	6935.4

Table 5.25

Nuclear Weapons Loads for B-1B Bomber

Capable Loadings

Weapon	Weight	Internal Loadings Mod-A[1]	Mod-B[2]	External	Total
B28	2540	12	—	8	20
B61	718	24	—	14	24-38
B83	2408	24	—	14	24-38
SRAM	2240	24	—	14	24-38
ALCM	3300	—	8-16[3]	14	22-30[4]

Typical Operational Loading

	ALCM Internal	SRAM External	Gravity Bombs	
Standoff Mission	8	14	—	—
Penetration Mission	—	—	8	16
Shoot and Penetrate	8	—	4	4

Source: GAO, Draft Study for B-1; HAC, FY 1982 DOD, Part 1, p. 321; SASC, *Strategic Force Modernization Programs*, pp. 91-92.
1 Configured with 3 180-inch internal weapons bays.
2 Configured with 1 265-inch and 1 180-inch weapons bay.
3 Enlarging the aft weapons bay for ALCM carriage allows for internal carriage of an additional 8 weapons.
4 Ibid.

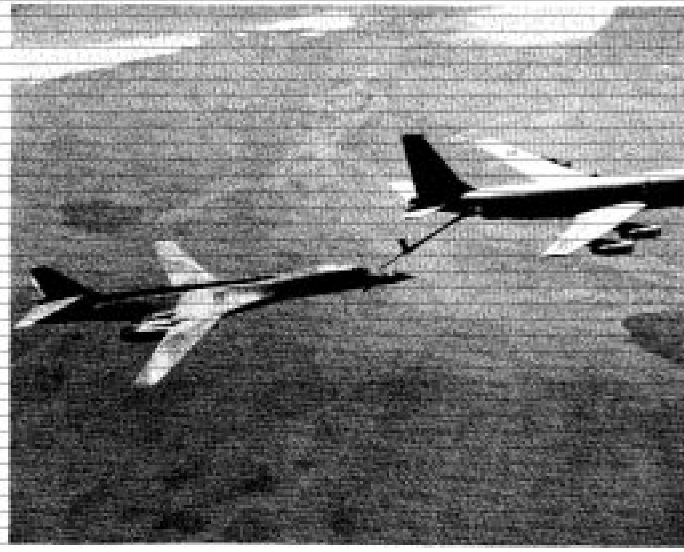

Figure 5.27 B-1 bomber being refueled by KC-135 tanker aircraft.

COMMENTS: Targets for B-1B would cover the entire spectrum, from hard targets, and less than precisely located targets. Nuclear safety devices such as PAL and Command Disable were not part of the original B-1B, as they were not a SAC requirement,[18] but will be added with cruise missile carriage, and will include a new system called a "coded switch system."[19]

1 SASC, FY 1982 DOD, Part 7, p. 4329.
2 HAC, FY 1982 DOD, Part 2, p. 289; SASC, FY 1982, DOD, Part 7, p. 4329.
3 Radar cross section of new B-1B reduced by a factor of ten through the use of absorbtion materials and changes to engine inlets. AW&ST, 23 March 1981, pp.19-21; AW&ST, 11 May 1981, pp. 18-21.
4 *U.S. Military Aircraft Data Book*, 1981, p. 2-25.
5 SASC, FY 1982, DOD, Part 7, p. 4329.
6 Ibid.
7 CRS, "Bomber Options for Replacing B-52," (IB 81107), p. 18.
8 First 18 production B-1Bs will not have complete ALCM capability; HAC, FY 1982 DOD, Part 9, p. 257; SASC, FY 1983 DOD, Part 7, pp. 4333, 4242.
9 SASC, *Strategic Force Modernization Programs*, p. 162.
10 DOD, "Memorandum for Correspondents," 31 January 1983.
11 DOD, FY 1984 Annual Report, p. 281.
12 DOD, FY 1983 RDA, p. VII-6.
13 HAC, FY 1982 DOD, Part 9, p. 256.
14 LRCA baseline cost escalated for inflation; CRS, "Bomber Options for Replacing B-52" (IB 81107), p. 11.
15 HAC, FY 1982 DOD, Part 9, p. 386.
16 RDT&E, investment and operations cost in then year dollars; SASC, FY 1980 DOD, Part 1, p. 398.
17 B-1B funding including procurement of 1 aircraft in FY 1982; SASC, FY 1983 DOD, p. 4868.
18 HAC, FY 1982 DOD, Part 9, p. 220.
19 SASC, *Strategic Force Modernization Programs*, pp. 106, 151.

Table 5.26

Major B-1B Subcontractors

Aeronca, Inc. Middletown, OH	structural subassemblies
AVCO Corp. Nashville, TN	wings
B.F. Goodrich Co. Akron, OH	tires
Bendix Corp. Teterboro, NJ	avionics
Boeing Co.* Seattle, WA; Wichita, KS	avionics systems integration
Brunswick Corp. Marion, VA	redomes
Cleveland Pneumatic Co. Cleveland, OH	landing gear
Cutler Hammer, AIL Division* Deer Park, NY	defensive avionics
General Electric Co.* Binghampton, NY; Evandale, OH	engine components
Goodyear Aerospace Corp. Litchfield, AZ	windows
Goodyear Tire & Rubber Co. Akron, OH	wheel assembly
Hamilton Standard Div., UTC Windsor Locks, CT	air conditioning
Harris Corp. Melbourne, FL	avionics
Hercules, Inc. Taunton, MA	seals
Hughes-Treitler Mfg. Co. Garden City, NY	heat exchangers
Hydroaire Div. of Crane Co. Burbank, CA	anti-skid components
IBM Corp. Oswego, NY	on board computer
Instrument Systems Corp. Telephonics Huntington, NY	test system
Garrett Turbine Engine Co. Phoenix, AZ	power system
AiResearch Mfg. Co., Garrett Corp. Torrance, CA	computer
Kaman Aerospace Corp. Bloomfield, CT	rudders and fairings
Kearfott Div., Singer Co. Little Falls, NJ	avionics
Kelsey Hayes Co. Springfield, OH	launcher components
Martin Marietta Corp. Baltimore, MD	stabilizers
McDonnell Douglas Corp. Long Beach, CA	ejection seats
Menasco, Inc. Burbank, CA	nose gear
Parker Hannifin Irving, CA	avionics
Pittsburgh Plate & Glass Ind., Inc.	windshield
Simmonds Precision, Inc. Vergennes, VT	avionics
Sperry Corp. Phoenix, AZ	avionics
Sperry Vickers Co. Jackson, MS	pumps
Stainless Steel Products Co. Burbank, CA	air ducts
Sierracin Corp. Sylmar, CA	windshield
Sterrer Eng. and Mfg. Co. Los Angeles, CA	steering
Sundstrand Aviation Corp. Rockford, IL	rudder control
Sundstrand Data Control, Inc. Redmond, WA	test system components
TRW, Inc. Cleveland, OH	fuel pumps
United Aircraft Products, Inc. Dayton, OH	heat exchangers
Vickers Aerospace Co. Troy, MI	hydraulic pumps
Vought Corp. Dallas, TX	fuselage
Westinghouse Corp. Lima, OH	avionics

Sources: Council on Economic Priorities; *Aerospace Daily*, 26 October 1981, p. 301; ACDA, FY 1979 ACIS, p. 85; SAC Fact Sheet, "B-1B," December 1981.

* Associate Prime Contractors

Advanced Technology Bomber (ATB) ("Stealth")

On 22 August 1980, the Department of Defense formally announced that a technological advance involving aircraft design, absorbent materials, and electronics had resulted in reducing the detectability of future aircraft to radar, infrared (IR), and optical surveillance systems. The DOD announced that a "Stealth" bomber using such innovations would be developed. Reports of Stealth technology have appeared in *Aviation Week and Space Technology* since 1979 (29 January 1979, 16 June 1980), and a program of "strategic bomber enhancement" had been ongoing for many years.

Stealth was one of the original candidates for the B-52 replacement (LRCA). An "Advanced Technology Bomber," a new airplane design, rather than applying "Stealth" technology to a conventional bomber design, e.g., the B-1, was envisioned for an IOC of 1991.[1] However, the new technology was unable to meet a Congressionally mandated 1987 IOC.

The Air Force hopes to build 100-150 ATBs with an IOC in the early 1990s[2] to replace the B-1B (and remaining B-52s) as a penetrating bomber. The Congressional Budget Office has reported that a force of 132 ATBs will be deployed.[3] The Air Force contends that the ATB is necessary to ensure that the "strategic bomber force will continue to have the ability to penetrate Soviet air defenses into the next century."[4]

Stealth technology combines active and passive methods to reduce radar reflection and energy emissions. These techniques probably would include reductions in weight of aircraft and size of tail, addition of non-metallic and radar absorbing materials, modifying shapes and angles, advanced designs reducing engine exhaust temperatures, optical absorbers, active jammers, decoy transponders, and treating fuels to reduce infrared emissions.[5]

Northrop Corporation is the prime contractor to develop the ATB, with General Electric as a participant.[6] Also reportedly collaborating on Stealth research are Rockwell/Lockheed and Boeing/Northrop. Estimates for a 100-150 ATB program range from $22 billion to $40 billion. A recent DOD cost estimate for a 165 plane ATB force is $36 billion.[7]

COST:

FY	Number Procured	Total Appropriation ($ million)
1982	-	122[8]

1 HAC, FY 1982 DOD, Part 9, p. 217.
2 DOD, FY 1984 Annual Report, p. 224; First operational squadron has been stated as possible in 1990: SASC, FY 1982 DOD, Part 7, p. 3783; 1991 according to Washington Post, 13 March 1982, p. A8.
3 CBO, "Contribution of MX to the Strategic Force Modernization Program," n.d. (1982).
4 DOD, FY 1983 RDA, p. II-23.
5 *Ibid.*
6 SASC, FY 1983 DOD, Part 7, p. 4564.
7 HAC, FY 1982 DOD, Part 1, p. 322.
8 AW&ST, 9 March 1981, p. 23.

Strategic Defensive Systems

Only one nuclear system—the GENIE air-to-air missile—is presently used for the defense of the continental United States. GENIE, a dual-capable aircraft launched unguided rocket, is deployed at alert sites with interceptor aircraft throughout the country. Nuclear armed NIKE-HERCULES surface-to-air missiles, once widely deployed in the United States in the 1960s, have been dismantled and only remain as tactical air defense weapons in Europe. A limited anti-ballistic missile (ABM) system was briefly deployed from 1974-1976. Today ABM research is being greatly accelerated for future deployment in the United States.

Without an ABM system, the interception of bombers attacking the North American continent is the only U.S. nuclear defensive capability. Air defense is provided by U.S. and Canadian fighter interceptor aircraft that are maintained on alert at 23 sites in the continental United States, three in Canada, four in Alaska, one in Hawaii, and one in Iceland.[1] A variety of strategic interceptor aircraft models exist. Some models are designed solely for strategic defensive missions, and other models were selected for strategic air defense missions because of their air-to-air characteristics. Four aircraft are now used for strategic defense: F-106, F-4, F-15, and the Canadian CF-101. Eighteen of the new F-15s were given strategic interception missions in Fiscal Year 1982 and have been placed on peacetime alert at one location in the U.S.[2] The five remaining F-106 squadrons will be replaced with additional F-15s between FY 1983-1986, and the Canadian CF-101 will be replaced by Canadian F-18s. Other Navy, Air Force, and Marine Corps aircraft would be given strategic defensive missions in crisis or wartime.

Figure 5.28 SAFEGUARD complex, where SPARTAN and SPRINT anti-ballistic missiles (ABMs) were deployed.

Figure 5.29 SPARTAN missile test from Meck Island at Kwajalein Missile Range in the Marshall Islands.

Ballistic Missile Defense

The U.S. Army spends several hundred million dollars a year on research and development to maintain a capability for deploying a strategic defensive system to destroy enemy reentry vehicles in flight. This research is presently being conducted within the constraints of the ABM treaty of 1972.[3]

The President's Strategic Program, presented in October 1981, accelerated ABM research and tied the development program closely to land-based MX deployment plans. According to one DOD official, "the more likely ballistic missile defense systems (chosen) to protect the

1 DOD, FY 1979 Annual Report, p. 121.
2 JCS, FY 1981, p. 44.
3 The treaty is one of two agreements signed at Moscow on 26 May 1972, known collectively as the SALT I agreements.

Table 5.27

BMD Funding (RDTE, $ million)

	FY 1981 & Prior[1]	FY 1982[2]	FY 1983[3]	FY 1984[4]	FY 1985[5]
Advanced Technology					
Development	1378.9	126.5	142.8	170.9	183.9
Systems Technology					
Development	1090.6	335.6	396.2	538.4	1380.0

1 ACDA, FY 1983 ACIS, p. 138.
2 *Ibid.*
3 DOD, *Program Acquisition Costs by Weapon System*, 31 January 1983.
4 *Ibid.*
5 DOD, RDT&E Programs (R-1), 31 January 1983.

land-based missiles would require a revision of the ABM treaty."[4] Deployment of an extensive ABM system to defend several fixed sites or a mobile ICBM system would require abrogation or modification of the 1972 ABM treaty, which limits the U.S. and the Soviet Union each to one ABM site.[5]

At the time of the signing of the ABM Treaty, the SAFEGUARD system was being deployed at Grand Forks, North Dakota, to protect the ICBM field there. The system was completed in 1974 at a cost of over $7 billion, but it was deactivated in 1976 because of its high cost and ineffectiveness. Even with the deactivation of the SAFEGUARD system's SPRINT and SPARTAN missiles, they remained Treaty accountable unless dismantled in accordance with the procedures in the Standing Consultative Commission. After dismantling the SAFEGUARD system, missiles and warheads were placed in storage in Army depots.[6] Both weapons will be retired in FY 1983-1985.

The deactivation of the SAFEGUARD system, the termination of interceptor flight tests, and a follow-on BMD system prototype in 1975 have led to a change of focus in the research program. The recent focus has been the definition and demonstration of options for ABM defense of MX and land-based strategic missiles. The Reagan Strategic Program, announced 2 October 1981, further focused research with the decision to deploy the MX in existing fixed silos. The pre-prototype demonstration program, begun in 1980 to provide options for enhancing ICBM survivability and for defending other strategic targets, was reoriented toward terminal defense of ICBM silos.[7] In FY 1985, BMD research will be doubled.[8]

Much of the BMD research program, which deals with radar, sensing, tracking, and guidance, is included in the Advanced Technology Program. The Systems Technology Program is involved in the prototyping and demonstration of potential BMD systems and is currently examining two systems: a nuclear armed Baseline Terminal Defense System (formerly Low-Altitude Defense System (LoADS)), with a missile designated SENTRY, and a non-nuclear "Exoatmospheric Overlay Defense."

4 SASC, *Strategic Force Modernization Programs*, p. 49.
5 The original treaty limited each side to two ABM deployment areas (one national capital area and one ICBM silo area) with restrictions to 100 launchers at each area. A protocol to the treaty signed in 1974 further restricted each side to only one ABM deployment area.
6 ACDA, FY 1982 ACIS, p. 441; HASC, FY 1982 DOE, p. 104.
7 HAC, FY 1982 DOD, Part 8, p. 347.
8 ACDA, FY 1983 ACIS, p. 129.

Table 5.28

Major Ballistic Missile Defense Contractors

Lincoln Laboratory MIT, Lexington, MA	TRW, Inc. Redondo Beach, CA	Rockwell International Corp. Anaheim, CA
Boeing Co. Seattle, WA	General Electric Co. Syracuse, NY	Hughes Aircraft Corp. Culver City, CA
Martin Marietta Corp. Orlando, FL	Lockheed Missiles and Space Co. Sunnyvale, CA	Electronic Space Systems Corp. Concord, MA
McDonnell Douglas Corp. Huntington Beach, CA	Teledyne Brown Engineering Huntsville, AL	Computer Development Corp. Minneapolis, MN
System Development Corp. Huntsville, AL	Raytheon Wyland, MA	IBM Gaithersburg, MD

Although SENTRY received the most attention, it was cancelled in February 1983 "as a result of shifting requirements within the BMD program leading to a change in focus on the technologies of interest."[9] Component development will be completed, but at a slower pace, and the SENTRY system will be kept available for possible deployment at a later date. Current interest is focused on:[10]

- developing operating rules for silo defense,
- developing command and control and operational procedures,
- beginning component preparation of subsystems, and
- selecting subcontractors for radar, vehicle, and support equipment.

The design of ABM warheads reportedly has always favored enhanced radiation designs to destroy incoming RVs with intense radiation. The SPRINT missiles of the SAFEGUARD system reportedly had enhanced radiation designs.[11] The nuclear warhead for the SENTRY missile is probably also an enhanced radiation design. DOD once considered taking the SPRINT missile warheads out of storage, refurbishing them, and using them in the SENTRY missiles.[12] Now, a newer generation warhead is planned. The warhead is described as a "small nuclear defensive warhead," with a "very small" yield.[13]

9 DOD, "Memorandum for Correspondents," 10 February 1983.
10 HAC, FY 1982 DOD, Part 9, p. 347.
11 George B. Kistiakowsky, "Enhanced Radiation Warheads, Alias the Neutron Bomb," Technology Review, May 1978.
12 AW&ST, 30 March 1981, p. 19.
13 HAC, FY 1983 DOD, Part 4, p. 572.

SENTRY

Figure 5.30 SPRINT missile, probably similar in size and characteristics to the newer **SENTRY** missile.

DESCRIPTION: Very high acceleration, high velocity, nuclear armed, anti-ballistic missile.

CONTRACTORS:[1] McDonnell Douglas (prime)
Teledyne Brown (system engineering)
Raytheon (system engagement controller)
TRW (data processing)
GTE/Sylvania (command, control, and communications)
Martin Marietta Orlando, FL (missile)

SPECIFICATIONS:

Length:	17 ft
Diameter:	unknown
Stages:	1
Weight at Launch:	unknown
Fuel:	solid
Guidance:	inertial with external guidance updates
Throwweight/ Payload:	unknown
Range:	unknown

DUAL CAPABLE: no

NUCLEAR WARHEADS: small nuclear warhead;[2] 5 Kt range;[3] likely enhanced radiation warhead. Warhead is in Phase 2 Program Study. Phase 3 Development Engineering is being requested by DOD during FY 1983-84.[4]

DEPLOYMENT: Layered defense initially would be provided with LoADS for intercepts within the atmosphere, with an overlay tier of interceptor missiles armed with non-nuclear warheads for target kills in space.[5]

Launch Platform:	fixed launcher
Number Planned:	some 500, one launcher per missile being protected
Location:	MINUTEMAN fields or MX bases[6]

HISTORY:	
IOC:	1988[7]
1979	LoADS warhead selection working group formed
Feb 1983	SENTRY development terminated
TARGETING:	
Types:	reentry vehicles in flight

1 SASC, FY 1982 DOD, Part 7, p. 4131.
2 SASC, FY 1982 DOD, Part 7, p. 4128; HAC, FY 1983 DOD, Part 4, p. 573.
3 AW&ST, 8 March 1982, p. 28.
4 DOE, Budget Justification, FY 1983, p. 51.
5 AW&ST, 9 March 1981, pp. 24, 27.
6 Most likely option is for initial deployment to be around MINUTEMAN III fields near Grand Forks, ND, starting in the mid-1980s, followed by deployment within the MX basing areas.
7 Prior to termination; SASC, *Strategic Force Modernization Programs*, p. 95.

Bomber Interception
GENIE (AIR-2A)

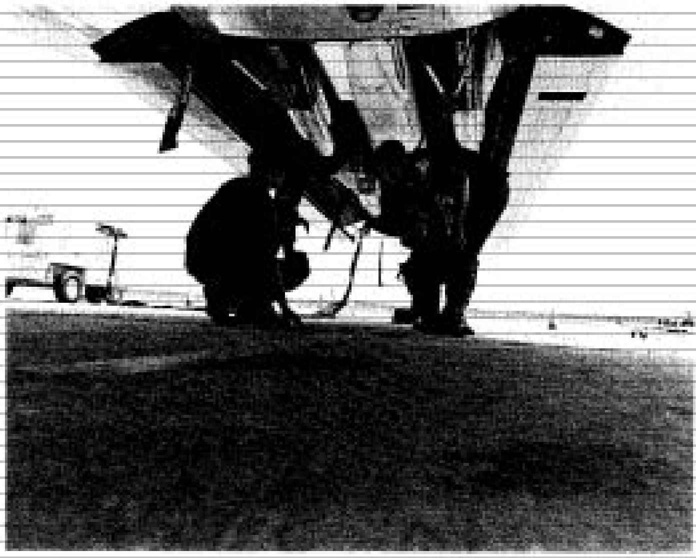

Figure 5.31 **GENIE** rocket, center, loaded into missile bay of F-106.

DESCRIPTION: Short-range, unguided, nuclear capable air-to-air rocket designed for strategic interception of bombers and used by the Air Force.

CONTRACTORS: McDonnell Douglas Astronautics Co. (prime)
Thiokol Chemical Corp. (power plant)
Hughes (fire control system)
Aerojet General Corp.

SPECIFICATIONS:

Length:	9.6 ft
Diameter:	17.4 in
Stages:	1
Weight at Launch:	822 lb[1]
Propulsion:	solid propellant rocket motor
Speed:	Mach 3.0
Guidance:	no guidance system, fins and gyroscope stabilization
Range:	6 mi; 6.8 mi;[2] 6.2 mi[3]

DUAL CAPABLE: yes

NUCLEAR WARHEADS: one W25; 1.5 Kt range[4]

DEPLOYMENT:

Launch Platform:	CF-101, F-106A, F-4, F-15
Number Deployed:	thousands of missiles produced, 200 nuclear versions estimated presently operational (1983)
Location:	(see Table 4.6)

HISTORY:

IOC:	1957
Jul 1957	nuclear GENIE is tested in live firing at Indian Springs, Nevada by launching from F-89J airplane and detonated at 15,000 ft.[5]
1962	production of GENIE ended.

TARGETING:

Types:	bombers
Selection Capability:	GENIE is designed to be fired automatically and detonated by the fire control system in the aircraft.[6]
Accuracy/CEP:	not thought to be very accurate

COMMENTS: flight time varies between 4 and 12 seconds at ranges of 1.5 to approximately 6 miles at speed of 2100 mph (Mach 3).[7] Missile also known as "HIGH CARD," "DING DONG," and "MB-1."

1 *The World's Missile Systems*, 6th Ed., p. 46.
2 Nikolaus Krivinyi, *World Military Aviation* (New York: Arco, 1977), p. 222.
3 The World's Missile Systems, 6th Ed., p. 46.
4 The airborne test of the warhead was part of Operation Plumbob, 19 July 1957, see Michael J.H. Taylor and John W.R. Taylor, Missiles of the World, 6th Ed., p. 44.
5 *Ibid.*
6 Krivinyi, op. cit., p. 222.
7 Fact Sheet prepared by National Atomic Museum, Albuquerque, NM.


6

Chapter Six
Cruise Missiles

Cruise missiles are unmanned, expendable flying vehicles programmed to carry explosives over a non-ballistic trajectory to their target. Using air as an oxidizer, the propulsion system is similar to that of a jet powered airplane. The missiles' engines thus propel cruise missiles in a similar way to aircraft and not over a ballistic path. Cruise missiles fly much slower than ballistic missiles, and thus can also utilize advanced guidance systems which make the present generation missiles extremely accurate.

Cruise missiles had their origin in World War II. The development of more accurate and autonomous ballistic missiles in the 1950s led to a significant reduction in cruise missile research for many years. The United States deployed nuclear armed cruise missiles in the 1950s (REGULUS and SNARK). Due to their large size, inaccuracy, and unreliable performance, they were abandoned in favor of ballistic missiles. Technological advances in the 1960s and 1970s in engine, warhead, and guidance miniaturization gave rise to the potential of a much smaller cruise missile airframe with increased range and higher accuracy. With the sinking of the Israeli destroyer *Eloth* in 1967 by a Soviet SS-N-2 STYX cruise missile, the U.S. increased the pace of development of new cruise missile systems. Development of the first of the present generation of nuclear armed cruise missiles—the TOMAHAWK Sea-Launched Cruise Missile (SLCM)—was started by the Navy in 1972. The Air Force followed with the Air-Launched Cruise Missile (ALCM) in 1973.

Studies for the Navy's TOMAHAWK proceeded through the mid-1970s with the resulting design becoming the basic frame for both sea-launched and ground-launched applications. The Air Force's missile, which evolved from the Subsonic Cruise Armed Decoy (SCAD), resulted in a competition between the TOMAHAWK design by General Dynamics and a Boeing air-launched design (AGM-86B). The Boeing design won the competition and was chosen as the ALCM.

In January 1977, the cruise missile program received a new charter and greater emphasis with the establishment of the Joint Cruise Missile Project Office within the DOD. At the same time, the decision was made to begin full scale engineering development of long-range Air and Sea-Launched Cruise Missiles and to utilize the TOMAHAWK cruise missile for the Ground-Launched as well as Sea-Launched role.

The Air-Launched Cruise Missile, which had received more attention than the other missile programs, began deployment in late 1981. The Ground-Launched Cruise Missile for use in Europe is planned for deployment in late 1983, but it is unlikely that all 464 missiles earmarked for deployment in a December 1979 NATO agreement will be deployed. The Sea-Launched Cruise Missile will begin deployment in mid-1984 and will be fitted with both nuclear and conventional warheads aboard surface ships and submarines.

All long-range cruise missiles will be nuclear armed. The ALCM and SLCM utilize the same nuclear warhead design (W80) with an estimated yield of 200 Kt. These highly accurate missiles will be capable of destroying almost any target type in the Soviet Union. The GLCM warhead (W84) will have a lower (circa 50 Kt) yield, primarily to make its deployment to Europe more palatable to Europeans by decreasing the potential for collateral damage with its use.

The TOMAHAWK GLCM will be carried on transporter-erector-launcher (TEL) vehicles where the ready missile (with the W84 nuclear warhead) will be stored in an aluminum canister in the four tube launcher. Both Ground-Launched and Sea-Launched missiles will be propelled from their launch tubes by a solid-fuel booster engine which is then jettisoned. Retracted wings and control fins will then extend and the air-breathing engine will ignite to provide propulsion to the target. The ALCM is designed for delivery from strategic aircraft, dropped from a bomb bay (internal) or from a pylon mounted on the wing (external).

Almost 9000 cruise missiles are now scheduled for deployment: at least 4348 ALCMs (including Advanced Cruise Missile replacements), 4068 SLCMs, and 565 GLCMs. Approximately 5000 will be armed with nuclear warheads. Only the SLCM will be dual capable. The total cost of the present cruise missile program is estimated at some $25 billion. Each missile will cost from $2-6 million. The nuclear armed ALCMs will go to the Strategic Air Command where they will be carried by B-52G bombers externally, B-52H bombers externally and internally, B-1B bombers, and the future Advanced Technology Bomber ("Stealth"). The SLCM, although conceived as a theater system, will be a strategic

Table 6.1

Major TOMAHAWK Cruise Missile Contractors[1]

Company	**Location**	**Product**
Atlantic Research Corp.		GLCM, SLCM rocket motor
Boeing	Seattle, WA	GLCM, SLCM components
FMC/Northern Ordnance		SLCM armored box launcher
General Dynamics, Convair Div.	San Diego, CA	GLCM prime, SLCM prime/airframe
GTE Sylvania		GLCM LCC
Honeywell International	Minneapolis, MN	GLCM, SLCM radar altimeter
Kollsman Instrument Co.	Merrimach, NH	GLCM targeting, SLCM radar altimeter
Litton Guidance, Inc.	Woodland Hills, CA; Salt Lake City, UT	SLCM reference measurement
Litton Systems Limited	Toronto, Canada	SLCM reference measurement
Lockheed		GLCM, SLCM targeting
M.A.N.	West Germany	GLCM prime mover
Martin Marietta		SLCM VLS cannister
McDonnell Douglas Astronautics	St. Louis, MO	GLCM guidance/system hardware, SLCM guidance/theater mission planning system
Naval Surface Weapons Center	Dahlgren, VA	SLCM VLS software
Teledyne	Toledo, OH	GLCM, SLCM engine
Unidynamics	Phoenix, AZ	SLCM launcher
Vitro Laboratories		GLCM software, SLCM missile control system
Westinghouse		SLCM submarine launcher
Williams International	Walled Lake, MI	GLCM, SLCM engine

1 Information provided by General Dynamics and Joint Cruise Missile Program Office.

system.[1] One thousand nuclear armed SLCMs with ranges in excess of 1500 miles are planned for deployment on attack submarines and surface ships and would "be part of the strategic reserve force and will be available for reconstitution and targeting" after a nuclear war.[2] GLCMs are planned for deployment in Europe for use as a theater system. All GLCMs will be nuclear armed.

The development and deployment of third generation cruise missiles falls under the "Advanced Cruise Missile Technology" (ACMT) program now underway. The program includes four separate elements: modifications to present cruise missiles with new components, development and deployment of a new and upgraded "Stealth" cruise missile, development of a new versatile air-to-air and air-to-ground supersonic cruise missile, and development of an intercontinental cruise missile (see Advanced Cruise Missiles section). Both the Air Force and the Defense Advanced Projects Research Agency (DARPA) have had formal programs for advanced cruise missiles since 1977. The short-range HARPOON cruise missile (described later in this chapter), while currently conventionally armed, is also under consideration to become a nuclear system.

The rapid progress of cruise missile technology and advances in Soviet defenses against low flying objects led to a late 1982 Defense Department decision to end ALCM (AGM-86B) procurement at 1499 missiles after FY 1983 rather than the 4348 planned and to pursue instead an Advanced Cruise Missile with a 1986 IOC to fulfill the remainder of the orders. The cost of the Advanced Cruise Missile program will probably not exceed the cost of the ALCM program. The number of ALCMs (both current design and advanced) to be procured will remain approximately the same.[3]

1 SASC, FY 1983 DOD, Part 7, p. 4354.
2 SASC, FY 1983 DOD, Part 7, p. 4517.
3 HAC, FY 1983 DOD, Part 4, p. 588.

Air-Launched Cruise Missile (ALCM) (AGM-86B)

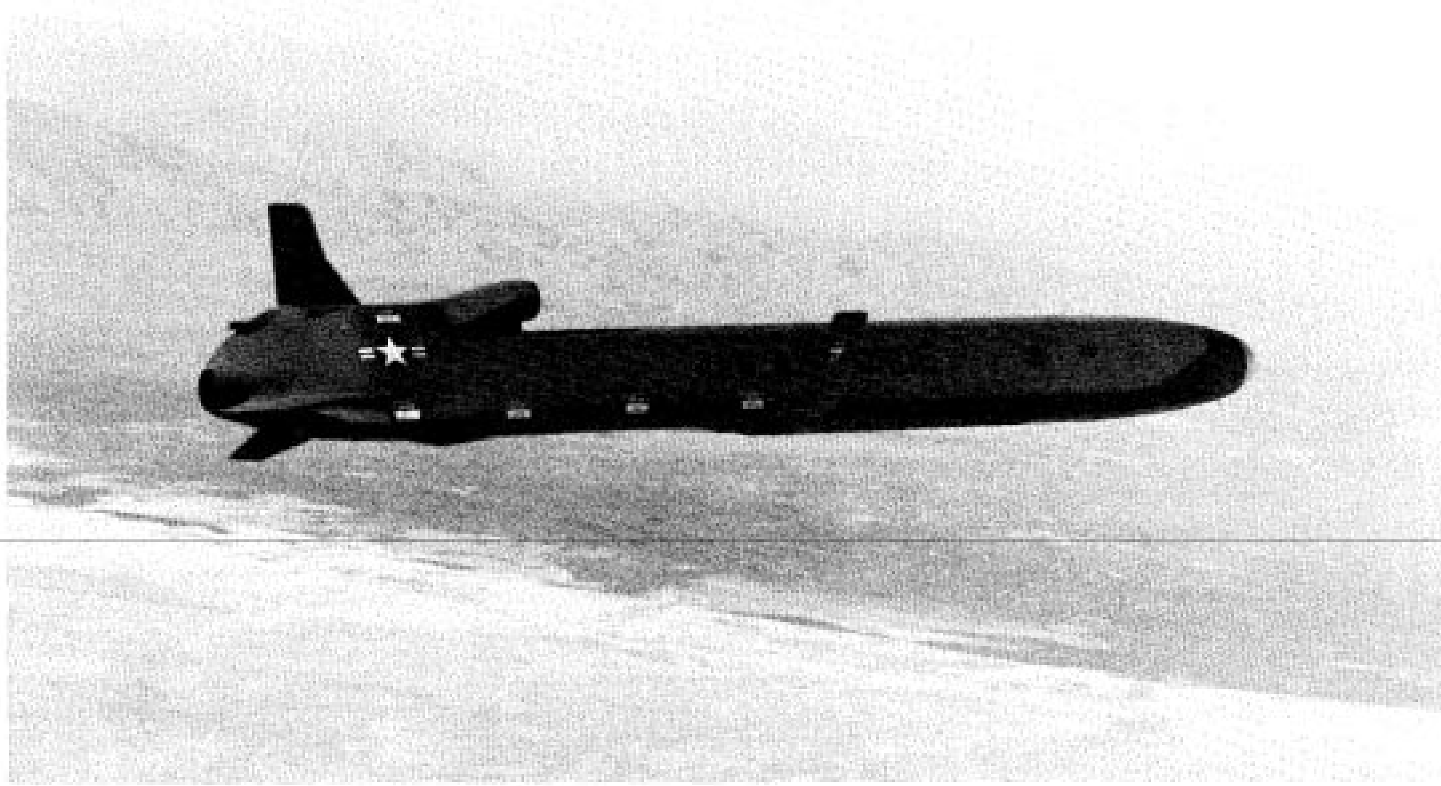

Figure 6.1 Air-Launched Cruise Missile (AGM-86B).

DESCRIPTION:	Small subsonic, winged, long-range, turbofan powered, accurate, air-to-surface missile, for internal and external carriage on B-52 and B-1 strategic bombers.
CONTRACTORS:	Boeing Aerospace Co. Seattle, WA; Kent, WA (prime) (See Table 6.3 for list of major subcontractors for ALCM.)
SPECIFICATIONS:[1]	(AGM-86B)[2]
Length:	20 ft 9 in (249 in)
Diameter:	27.3 in
Stages:	1
Weight at Launch:	3300 lb,[3] 2900 lb[4]
Propulsion:	air breathing F-107-WR-100 turbofan engine, 600 lb thrust
Speed:	500 mph
Flight altitude:	100 ft above ground[5]
Guidance:	inertial navigation system, updated by terrain contour matching
Throwweight/ Payload:	240 lb[6]
Range:[7]	2500 km;[8] 1550 mi; 1350 nm;[9] 1600 nm[10]

Table 6.2
ALCM Chronology

Aug 1973	SCAD program converted with basic airframe and propulsion equipment taken over by the non-decoy ALCM
1976	Establishment of extended range ALCM requirement
Mar 1976	First test of powered flight ALCM (AGM-86A)
Jan 1977	DSARC II approves Boeing ALCM for full scale development
Jul 1977	Cancellation of B-1 increases importance of program; General Dynamics added for competitive full-scale engineering development[1]
Aug 1977	Advanced Cruise Missile Technology program begins
Feb 1978	Boeing AGM-86B and General Dynamics AGM-109 begin ALCM competition
Jun 1978	Limited Operational Capability of June 1980 cancelled by DOD
Jun 1979	First full scale development flight
Feb 1980	Final flight of ALCM competition
Mar 1980	Air Force selects Boeing AGM-86B as ALCM
Dec 1980	Boeing awarded first contract for production of 480 missiles
Jul 1981	First test launch of ALCM from OAS modified B-52G
Sep 1981	first cruise missiles deployed on B-52G at Griffiss AFB, NY (first alert capability)
Oct 1981	ALCM production increased from 3418 to 4348 missiles
Nov 1981	First full production missile completed by Boeing
FY 1982	Reagan Administration accelerates ALCM schedule and adds B-52H to program
Sep 1982	Advanced Cruise Missile proposals solicited by Air Force
Dec 1982	First squadron of 16 B-52Gs carrying 12 missiles fully operational (IOC)
Jan 1983	DOD reveals cancellation of ALCM after 1547 missiles and transfer to Advanced Cruise Missile Technology
Spring 1983	Selection of ACMT contractor expected
1984	Work at Boeing Plant on ALCM ceases
FY 1984	Planned retrofit of ECM package into ALCM to increase survivability[2]
FY 1986	IOC of Advanced Cruise Missile
FY 1989	B-52G/Hs attain a full ALCM capability
May 1989	Last delivery of ALCM planned under 3418 missile program
FY 1990	Final delivery of ALCM spares in 3418 program;[3] 3160-3300 ALCMs[4]

1 SASC, FY 1980 DOD, Part 5, p. 2491.
2 SASC, FY 1983 DOD, Part 7, p. 4569.
3 SASC, FY 1982 DOD, Part 7, p. 3802.
4 DOD, FY 1982 Annual Report, pp. 50, 114, v.

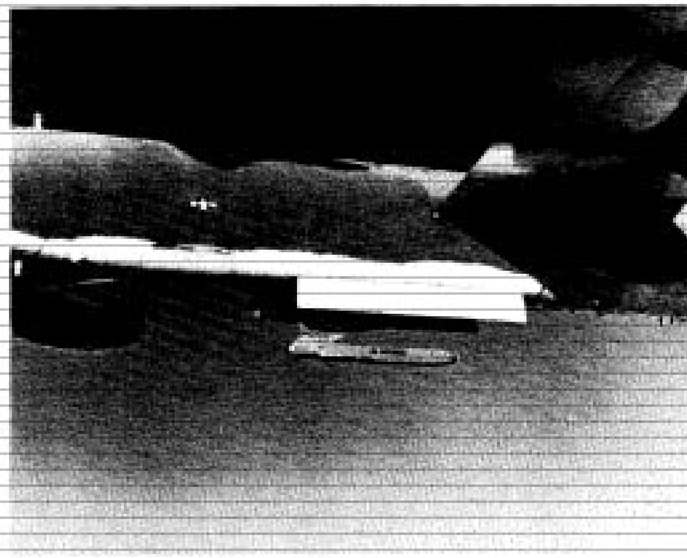

Figure 6.2 ALCM soon after drop from B-52 bomber.

DUAL CAPABLE: no

NUCLEAR WARHEADS: one W80-1, 200 Kt range (see W80 in Chapter Three)

DEPLOYMENT: B-52G: being modified to carry 12 ALCMs on external pylons; B-52H: To be modified to carry 12 ALCMs on external pylons and up to eight internally on rotary launcher;[11] B-1B: Capable of carrying up to 22 ALCMs.[12]

Number Deployed: approximately 350 (1983);[13] 1547 to be procured (Dec 1982); 4348 planned under Reagan Administration before adoption of advanced cruise missile in FY 1984;[14] 5369 planned under previous accelerated procurment program;[15] 3418 previously planned (circa FY 1981-1982) for procurement for B-52 force (FY 1978-FY 1987) including 24 developmental units;[16] 3020 planned before then (FY 1979).

Table 6.3
Major ALCM Subcontractors[1]

AiResearch Manufacturing Co. Torrance, CA	servo assembly
Aluminum Co. of America Corona, CA	airframe castings
Anadyte-Kropp Chicago, IL	forgings
Consolidated Control Corp. El Segundo, CA	arm/disarm device, fuzing
Eagle Picher Industries Joplin, MO	batteries
Explosive Technology Fairfield, CA	tube assembly
G&H Technology Santa Monica, CA	connector assembly components
Gulton Industries Albuquerque, NM	telemetry multiplexers
Hi Shear Corp. Torrance, CA	recovery system
Honeywell	missile radar altimeter
Irvin Industries Gardena, CA	flight termination system
Kollsman Instrument Company	missile radar altimeter
Lear Siegler Maple Heights, OH	generator
Litton* Woodland Hills, CA	guidance
Litton Systems Canada Div.* Toronto, Canada	guidance
McDonnell Douglas Aeronautics East* St. Louis, MO	guidance
Microcom Corp. Warminster, PA	telemetry transmitter
Northrop Corp. El Monte, CA	rate/acceleration sensor
OEA, Inc. Denver, CO	fuel valves
Oklahoma Aerotronics Hartshorne, OK	C2 components
Pyronetics Devices Denver, CO	services
Rosemont Minneapolis, MN	computers
Sundstrand Aviation Rockford, IL	fuel pump
Teledyne CAE* Toledo, OH	engine alternative
Unidynamics/Goodyear Phoenix, AZ	actuator assemblies
United Technologies Windsor Locks, CT	air cycle machines
Wellman Dynamics Corp. Creston, ID	airframe castings
Williams International Research* Walled Lake, MI	engine

* Associate contractors.
1 Under the ALCM program numerous contractors are "associate contractors" with whom the Air Force directly contracts; see AW&ST, 31 March 1980, p. 20.

Location: Griffiss AFB, NY (September 1981)
Wurtsmith AFB, MI (April 1983)[17]
Grand Forks AFB, ND (October 1983)
Ellsworth AFB, SD (January 1984)
Blytheville AFB, AR
Fairchild AFB, WA
Barksdale AFB, LA
Carswell AFB, TX
Castle AFB, CA[18]

HISTORY:

IOC: December 1982 (see Table 6.2, ALCM Chronology

TARGETING:

Types: Broad spectrum, including hard targets, ALCM may be used to deny an ICBM reload capability[19]

Table 6.4

ALCM Program Schedules[1]

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	Total
ALCM Cumulative Deliveries													
Carter Program[2] (FY 1981-82)	—	10	22	209	689	1169	1649	2129	2609	3089	3394	—	3394
Reagan Program[3] (FY 1983)	—	10	22	206	680	1120	NA	NA	NA	NA	NA	NA	4348
Accelerated Program[4] (FY 1983)	—	—	21	319	799	1469	2189	2909	3629	4349	5069	5369	5369
B-52 Conversions													
B-52G:													
Carter[5] (FY 1981)	—	0	1	13	41	40	38	135	—	—	—	—	173
Reagan[6] (FY 1983) External	3	22	40	40	41	26	—	—	—	—	—	—	172
B-52H:													
Reagan[7] (FY 1983)	—	—	—	—	—	3	23	22	22	26	—	—	96

1 Does not take into account possible changes with conversion to Advanced Cruise Missile.
2 HASC, FY 1981 Mil Con, p. 431; HASC, FY 1982 Mil Con, p. 228.
3 SASC, FY 1983 DOD, Part 7, p. 4568.
4 SASC, FY 1982 DOD, Part 7, p. 3802; internal conversions of B-52G cancelled in FY 1983.
5 ACDA, FY 1981 ACS, p. 122.
6 SASC, FY 1982 DOD, Part 7, p. 3802.
7 Ibid.

Selection Capability: reportedly carries instructions for 10 different preselected targets;[20] ALCM can be armed from the bomber cockpit[21]

Accuracy/CEP: reportedly 10-30 m;[22] 300 ft;[23] greater hard target kill capability than ICBMs, even MX[24]

COST:

Total Program Cost:[25] $3170.8 m (base year 1977 cost);[26]
$5232.7 m (then year) (FY 1981)
$9420.0 m (FY 1983)[27]
$4327.6 m (Dec 1982)

Unit Cost: $881,000 (FY 1981) (flyaway), $1.247 m (program)

FY	Number Procured[28]	Total Appropriation ($ million)
1977 & prior	—	268.3[29]
1978	24	381.5
1979	48	433.1
1980	225	477.1
1980 & prior	297	1470.3
1981 & prior	753	2119.7[30]
1982	440	799.3
1983	330	574.5
1984	—	152.5 (request)

6

Air-Launched Cruise Missile

COMMENTS: ALCM-B (AGM-86B) is extended range alternative (20 inch fuel tank segment) of two originally considered concepts, with greater range and weight than ALCM-A (AGM-86A). ALCM has 1/1000th of radar return of B-52 bomber.[31]

1 Boeing Fact Sheet, "Background Information, AGM-86B Air Launched Cruise Missile," April 1982.
2 2500 km is "system operational range" where operational factors are taken into account; propulsion range is greater; HAC, FY 1980 DOD, Part 1, p. 759. Williams Research has designed a new engine that provides 30% thrust increase and possible 300 nm increase in range. Second generation CM is being developed with 800 nm increase in range over first generation AGM-86B.
3 GAO, Draft Study for B-1 (1982).
4 ACDA, FY 1979 ACIS, p. 60.
5 SASC, FY 1981 DOD, Part 2, p. 50.
6 *U.S. Missile Data Book, 1980*, 4th Ed., p. 2-5.
7 Range takes into account all operational limitations of the system to effectively engage the target (operational fuel, allowance for indirect routing, speed and altitude variations).
8 2500 km is "system operational range"; HAC, FY 1980 DOD, Part 1, p. 759.
9 *U.S. Missile Data Book*, *op. cit.*
10 HAC, FY 1982 DOD, Part 9, p. 246.
11 ACDA, FY 1983 ACIS, p. 67.
12 *Ibid.*
13 *AW&ST*, 17 January 1983, p. 101.
14 *Aerospace Daily*, 11 January 1982; DOD, Selected Acquisition Report, 19 March 1982; reports are that with conversion to ACMT, the number of all types of ALCMs to be deployed remains the same; HAC, FY 1983 DOD, Part 4, p. 588.
15 SASC, FY 1982 DOD, Part 7, p. 3802.
16 OSD (PA), "Memorandum for Correspondents," 2 May 1980; HASC, FY 1981 DOD, Part 4, Book 2, p. 1814.
17 First two ALCMs were received 12 June 1982; DOD, Selected Acquisition Report, as of 30 June 1982.
18 SASC, FY 1982 DOD, Part 7, p. 4291.
19 ACDA, FY 1980 ACIS, p. 27.
20 *Armed Forces Journal*, November 1976, p. 22.
21 HAC, FY 1983 DOD, Part 4, p. 588.
22 Senate Foreign Relations Committee/House International Relations Committee, *Analysis of ACIS Submitted in Connection with the FY 1978 Budget Request*, Joint Committee Print, April 1977, p. 43.
23 Kosta Tsipis, "Cruise Missiles," *Scientific American*, February 1977, p. 28.
24 SASC, FY 1981 DOD, Part 2, p. 506.
25 The total program cost for the Boeing ALCM has been reduced with shift to the ACMT; George Wilson, *Washington Post*, 16 February 1983, p. 1, suggests the cost could go to $4.3 billion.
26 SASC, FY 1980 DOD, Part 5, p. 2491.
27 SASC, FY 1980 DOD, Part 7, p. 4566.
28 Planned procurement rate under 3418 program was 480 per year after FY 1982; HASC, FY 1981 DOD, Part 4, Book 2, p. 1822.
29 Includes funds for the SCAD, about half of which is considered directly applicable to ALCM.
30 SASC, FY 1983 DOD, Part 7, p. 4566.
31 SASC, FY 1981 DOD, Part 2, p. 60.

Ground-Launched Cruise Missile (GLCM) (BGM-109)

Figure 6.3 Ground-Launched Cruise Missile (BGM-109) test firing.

DESCRIPTION: Long-range, all weather, accurate, surface-to-surface subsonic cruise missile for use in the European theater. GLCM is a version of the TOMAHAWK BGM-109 cruise missile (the Navy's SLCM).

CONTRACTORS: see Table 6.1, Major TOMAHAWK Cruise Missile Contractors

SPECIFICATIONS:

Length: 20.3 ft;[1] 219 in; (5.56 m)

Diameter: 20.4 in (52 cm);[2] designed to fit standard 54 cm torpedo tube; 2.5 m wingspan

Stages: 1

Weight at Launch: 1200 kg (2650 lb)

Propulsion: solid booster with air-breathing F107-WR-400 turbofan jet engine

Speed: Mach 0.7 (550 mph) (max)

Guidance: inertial navigation with Terrain Contour Matching (TERCOM) updates at periodic intervals, radar altimeter

Throwweight/Payload: 270 lb

Range: 1350 nm;[3] 2000-2500 km (3000 km achieved in tests);[4] 2500 km[5]

DUAL CAPABLE: no

NUCLEAR WARHEADS: one W84/missile, variable yield, low Kt, 10-50 Kt range (see W84)

DEPLOYMENT: GLCM firing unit ("flight") is composed of four transporter-erector-launchers (TELs), 16 missiles, two launch control vehicles (LCCs) (1 primary, 1 backup), 16 support vehicles, and 69 personnel. The ground mobile units will be air transportable (C-130 and C-141 aircraft).

Launch Platform: M.A.N. Tractor-semitrailer with launcher, erected to a 45-degree angle at launch

Number Planned: 565 missiles are planned for procurement; 137 TELs, 116 operational, 79 LCCs[6]

6

Ground-Launched Cruise Missile

Location:	Six bases in Europe; two in United Kingdom: RAF Molesworth (24 launchers) and RAF Greenham Common (16 launchers); one in Italy: Comiso (Sicily) (28 launchers); one base in the Netherlands: Woensdrecht (12 launchers); one base in Belgium: Florennes (12 launchers); one base in Germany: Wueschein (24 launchers)

HISTORY:

IOC:	Dec 1983[7]
Jan 1977	Decision to develop ground-launched cruise missile made[8]
Oct 1977	Development begins
Dec 1979	First flight of prototype
12 Dec 1979	NATO agrees on deployment of 464 Air Force GLCMs to Europe
May 1980	First ground launch from transporter-erector-launcher
end 1980	Full scale engineering development
Feb 1982	Full testing of GLCM begins[9]
Dec 1983	IOC with initial deployment in UK
March 1984	Initial deployment in Italy[10]
end FY 1985	166 GLCM in Europe[11]
end FY 1988	464 GLCM in Europe[12]

TARGETING:

Types:	targets across the entire spre-trum: missile sites, airfields, command and communications sites, nuclear storage sties, air defense centers in the Soviet Union and Eastern Europe[13]
Selection Capability:	Each missile sitting on quick reaction alert (QRA) will hold a series of targets.[14] Targets will be generated at three "mission planning" centers, one in U.K. and two on the continent. Each flight's launch-control center will maintain an additional series of programs for various targets.
Retargeting:	immediate for prepared programs of known target data; longer if target data must be prepared.[15] New program for new target and route is generated by mission planning system equipment.
Accuracy/CEP:	circa 30 m

COST:

Program Cost:	$3595.2 m (Dec 1982); $630 m (warheads) (DOE) (FY 1983)[16]
Unit Cost:	$814,000 (flyaway) (base year 1977)[17] $1.283 m (flyaway) (FY 1981) $2.341 m (program) (FY 1981)

Figure 6.4 Part of **GLCM** convoy in highway test.

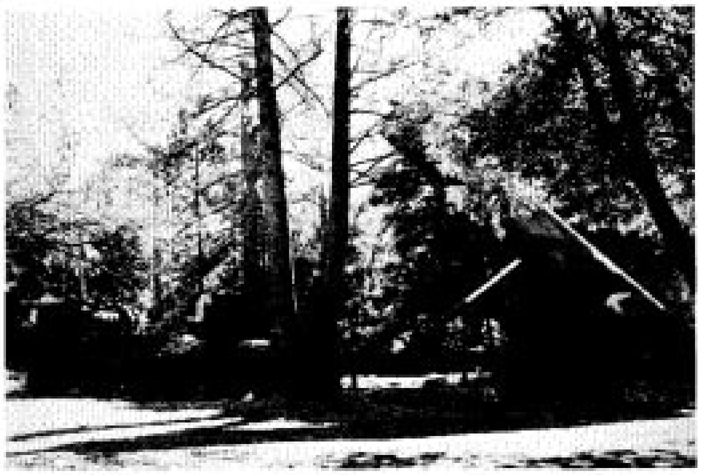

Figure 6.5 Field testing of **GLCM**, with missile launcher erect.

FY	Number Procured	Total Appropriation ($ million)[18]
1979 & prior	—	18.7[19]
1980 & prior	0	254.8[20]
1981	11	293.1[21]
1982	54	505.1
1983	84	562.1
1984	120	825.3
1985	120	637.0

COMMENTS: All-up round (missile, nuclear warhead, booster) is carried in cannister, 4 of which are mounted in a TEL, which weighs 77,900 lb, is 55 ft 8 in long, and has self-contained power. The LCC, which weighs 79,200 lb and is 56 ft 11 in long, contains communications and weapon control system. Peacetime QRA by one GLCM flight will be on Main Operating Base in hardened shelter. Wartime and crisis alert will be to dispersed sites in concealed positions.

1 AW&ST, 23 June 1980, pp. 24-25.
2 *U.S. Missile Data Book*, 1980, 4th Ed., p. 2-17.
3 Cited as nominal operational range. AW&ST, 21 June 1982, pp. 48-50.
4 DOD, FY 1982 Annual Report, p. 66, lists the GLCM range as 2000 km; DOD, FY 1981 RDA, p. VII-6 lists "operational range" at 2500 km.
5 SASC, FY 1980 DOD, Part 5, p. 2492.
6 Information provided by JCMPO; AW&ST, 28 June 1982, pp. 48-50; *Aerospace Daily*, 19 May 1980, p. 100; *U.S. Missile Data Book*, 1981, 4th Ed., p. 2-16; SASC, FY 1980 DOD, Part 5, p. 2493, refer to 696, the number planned prior to the NATO December 1979 decision; HAC, FY 1982 DOD, Part 3, p. 592.
7 SASC, FY 1982 DOD, Part 7, p. 3803; *Aerospace Daily*, 19 May 1980, p. 100; DOD, FY 1983 RDA, p. VII-13; IOC has slipped from May 1983; SASC, FY 1980 DOD, Part 5, p. 2492.
8 HASC, FY 1980 DOD, Part 3, Book 2, p. 2526; The Defense Systems Acquisition Review Council (DSARC) stipulated in January 1977 that an Air Force GLCM was to be adapted from TOMAHAWK and deployed on mobile launchers for the theater nuclear role, and a reprogramming of funds was requested to expedite operational status; see John Newbauer, "U.S. Cruise Missile Development," Astronautics and Aeronautics, September 1979, pp. 24-35.
9 SASC, FY 1983 DOD, Part 7, p. 4397.
10 DOD, FY 1983 RDA, p. VII-13.
11 *Aerospace Daily*, 19 May 1980, p. 100.
12 HASC, FY 1982 DOE, p. 45.
13 HAC, FY 1984 DOD, Part 4, p. 429.
14 HASC, FY 1982 DOD, Part 5, p. 490.
15 SASC, FY 1980 DOD, Part 6, p. 3469.
16 HAC, FY 1982 DOD, Part 7, p. 749; program cost has escalated from a $1109.0 million base year FY 1977 estimate.
17 SASC, FY 1980 DOD, Part 5, p. 2493.
18 Information provided by JCMPO unless otherwise noted, and current as of February 1982.
19 ACDA, FY 1980 ACIS, p. 139.
20 Information provided by JCMPO.
21 Includes increases of $209 million in FY 1981 and $47 million in FY 1982 to fund "cost overruns in the development and procurement of launch control segments" requested by the Reagan Administration.

W84

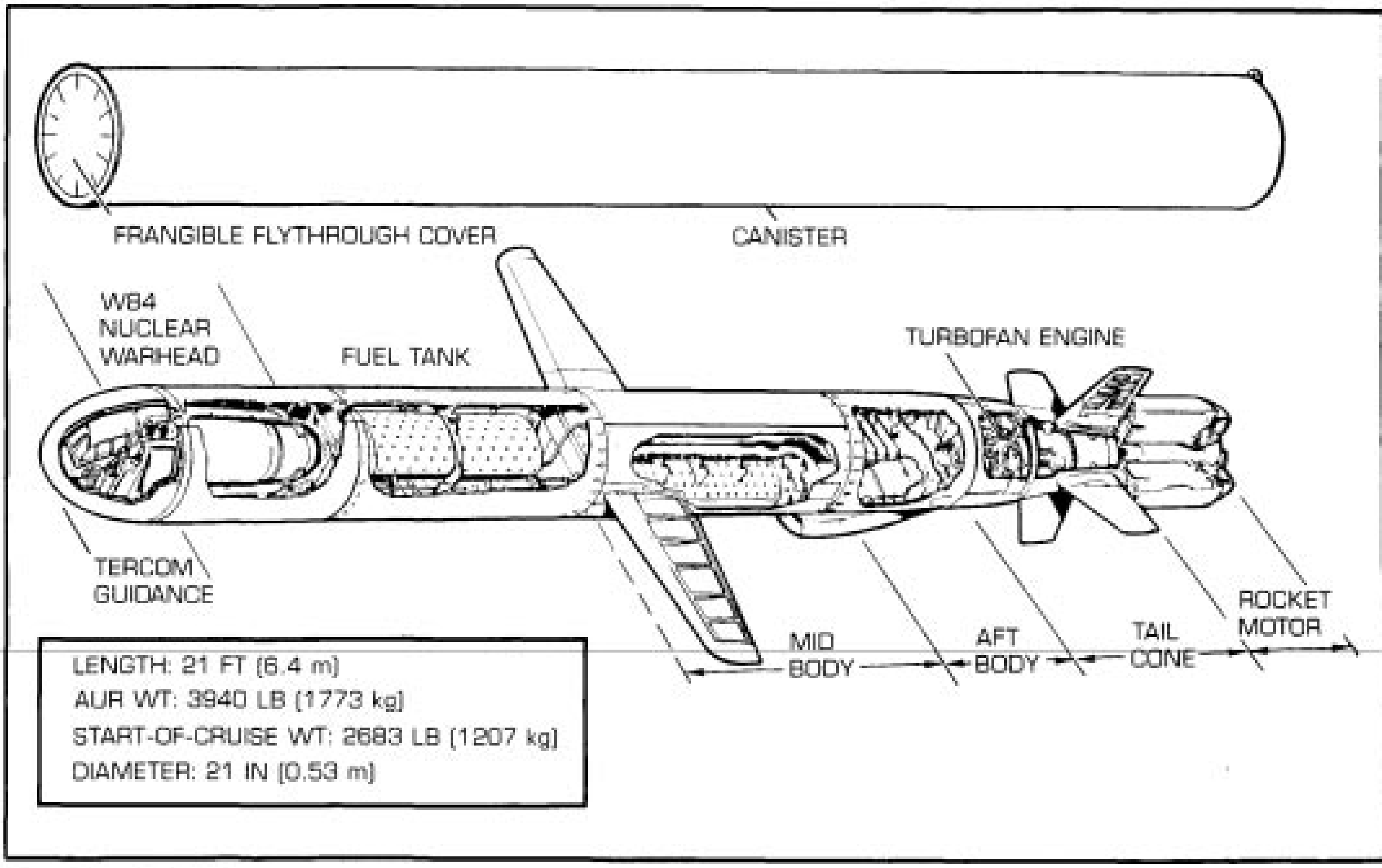

Figure 6.6 BGM-109 cutaway diagram.

FUNCTION: Warhead for the Ground-Launched Cruise Missile (GLCM).

WARHEAD MODIFICATIONS: none known

SPECIFICATIONS:

Yield: variable,[1] low Kt, probably 10-50 Kt range

Weight: light weight

Dimensions: unknown

Materials: oralloy as fissile material; IHE

SAFEGUARDS AND ARMING FEATURES: CAT F PAL, command disable system, steel encased critical components, unique signal generator, final arming of warhead occurs only in target area.[7]

DEVELOPMENT:

Laboratory: LLNL

History:

IOC:	Dec 1983
Sep 1978	Lab assignment[3]
Jan 1979	Phase 3 study initiated[4]
late 1983	initial deployment (Phase 5)[5]

Production Period: 1983-1987[6]

DEPLOYMENT:

Number Planned: 464 operational missiles to be deployed; 565 missiles planned (1983)

Delivery System: TOMAHAWK GLCM (BGM-109) mounted on a four tube truck TEL

Service: Air Force

Allied User: none

Location: Deployment of 464 GLCM at six main bases in Europe is planned to begin in late 1983.

COMMENTS: W84 is presumed to be a modification of the B61 Mod 3/4 nuclear gravity bomb physics package and associated components.[7]

1. HASC, FY 1982 DOD, Part 3, p. 1009.
2. AF, "U.S. Air Force Ground Launch Cruise Missile," n.d. (1982).
3. Entered engineering development: HASC, FY 1980 DOE, p. 95; continued in Phase 3 during FY 1980: SAC, FY 1981 EWDA, p. 618.
4. DOE Budget Justification, FY 1983, p. 51.
5. Funds for production of W84 are included in the FY 1983 DOE Budget.
6. Ibid.
7. ACDA, FY 1979 ACIS, pp. 73, 75.

TOMAHAWK Sea-Launched Cruise Missile (SLCM) (BGM-109)

Figure 6.7 TOMAHAWK Sea-Launched Cruise Missile (BGM-109) in test over Mojave desert.

DESCRIPTION: Long-range cruise missile capable of being deployed from a variety of air, surface ship, submarine, and land platforms.

MODIFICATIONS: (see Table 6.5)

CONTRACTORS: (see Table 6.1, Major TOMAHAWK Cruise Missile Contractors)

SPECIFICATIONS: (BGM-109A)

Length: 219 in; 5.56 m

Diameter: designed to fit standard 21 in torpedo tube

Wingspan: 104.4 in

Stages: 1

Weight at Launch: 1200 kg (2650 lb)[1]

Propulsion: solid booster with air-breathing, F107-WR-400 turbofan jet engine, 600 lb thrust

Speed: Mach 0.7 (550 mph) (max)

Guidance: radar altimeter; inertial navigation with Terrain Contour Matching (TERCOM) which updates at periodic intervals

Throwweight/ Payload:	123 kg
Range:	123 mi (conventional land attack);[2] 2500 km (nuclear land attack)[3]
DUAL CAPABLE:	yes
NUCLEAR WARHEADS:	one W80-0/missile; 200-250 Kt[4] (see W80 in Chapter Three)
DEPLOYMENT:	
Launch Platforms:[5]	armored box launcher or Ex-41 VLS by December 1985;[6] SSN-594, SSN-637, SSN-688 class submarines; test platform is USS *Guitarro* (SSN-665); CALIFORNIA, VIRGINIA class cruisers; SPRUANCE class destroyers, reactivated battleships[7] (See Table 6.6)

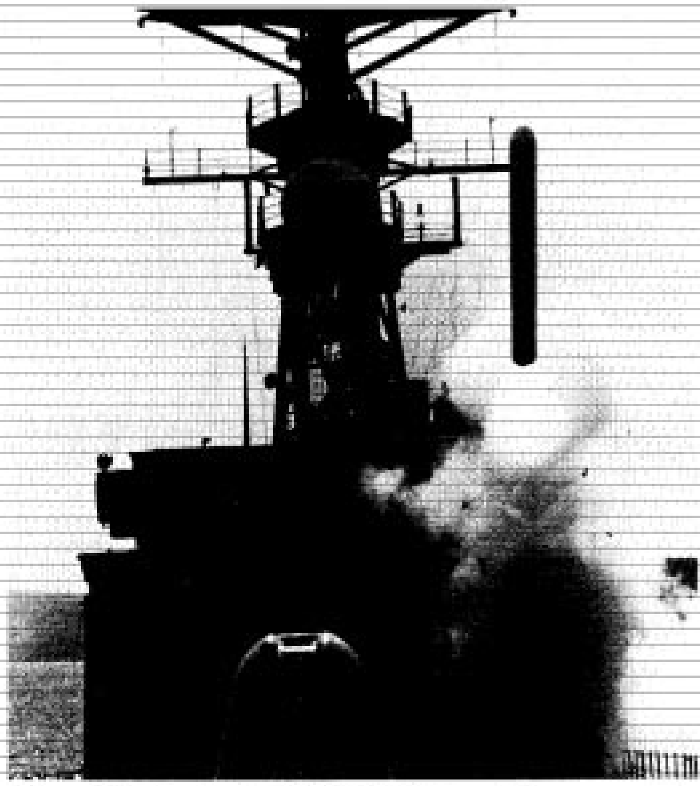

Figure 6.8 First launch of **TOMAHAWK** missile from armored box launcher installed on the deck of U.S.S. *Merrill* (DD-976).

Table 6.5
TOMAHAWK SLCM Types[1]

Designation	Type	IOC	Front End[2]
BGM-109A	Land Attack Nuclear (TLAM/N)	Jun 1984	W80-0 nuclear warhead, INS/TERCOM
BGM-109B	Antiship Conventional	Aug 1984	BULLPUP warhead, active radar terminal seeker, midcourse guidance unit
BGM-109C	Land Attack Conventional (TLAM/C)	Aug 1984	BULLPUP warhead, INS/TERCOM, midcourse guidance terminal area optical scene matching, time delay fuze
BGM-109D	Combined Effects Bomblet		submunition dispenser, INS/TERCOM, midcourse guidance terminal area optical scene matching
BGM-109E	Reactive Case HE		active radar terminal seeker, midcourse guidance unit
BGM-109F	Airfield Attack Munition		INS/TERCOM, terminal area optical scene matching
AGM-109C	Air-Launched	Dec 1984	conventional warhead
AGM-109H	Air Force MRASM (airfield attack)		runway cratering submunitions, midcourse guidance, TERCOM, DSMAC II
AGM-109I	Air-Launched	Apr 1985	conventional warhead
AGM-109L	Navy MRASM dual mission (TOMAHAWK II)		WDU-18B (HARPOON) conventional warhead, IIR seeker, TERCOM, DSMAC II

1 Information provided by Joint Cruise Missile Project Office; SASC, FY 1982 DOD, Part 7, pp. 4088-4089; HAC, FY 1982 DOD, Part 9, p. 292.

2 All missiles use common aft end, same turbofan engine.

Table 6.6

SLCM Deployments

Platform	No. to be Modified[1]	SLCMs
PERMIT (SSN-594) class submarines	unknown	8,[2] 12[3]
STURGEON (SSN-637) class submarines	22[4]	8,[5] 12[6]
LOS ANGELES (SSN-688) class submarines	56[7]	8,[8] 12[9], 31 with VLS
CALIFORNIA (CGN-36) class cruisers		16
	7	
VIRGINIA (CGN-38) class cruisers		16
USS *Long Beach* (CGN-9)	1	16
SPRUANCE (DD-963) class destroyers	24	16 on 2 Ex-41, VLS
Reactivated battleships (BB-61 class)	4	32 in 8 ABL,[10] VLS
TICONDEROGA (CG-47) class cruisers	all	24 on 3 Ex-41
BURKE (DDG-51) class destroyers	all	VLS

1 Programmed launch platforms; HASC, FY 1981 DOD, Part 4, Book 2, p. 1497; HASC, FY 1982 DOD, Part 2, p. 879; HAC, FY 1983 DOD, Part 2, p. 282.
2 Present torpedo tube launching allows for carriage of 8 SLCMs; Modified SSNs with VLS will be able to hold 20 SLCMs; information provided by Joint Cruise Missile Program Office.
3 VLS will allow 12 tubes for TOMAHAWK.
4 SASC, FY 1983 DOD, Part 6, p. 4043.
5 Present torpedo tube launching allows for carriage of 8 SLCMs; Modified SSNs with VLS will be able to hold 20 SLCMs; information provided by Joint Cruise Missile Program Office.
6 VLS will allow 12 tubes for TOMAHAWK.
7 SASC, FY 1983 DOD, Part 6, p. 4043.
8 Present torpedo tube launching allows for carriage of 8 SLCMs; Modified SSNs with VLS will be able to hold 20 SLCMs; information provided by Joint Cruise Missile Program Office.
9 VLS will allow 12 tubes for TOMAHAWK.
10 HASC, FY 1982 DOD, Part 3, p. 107.

Number Planned: 4068 SLCM planned in all versions, 1480 originally programmed; 196 nuclear missiles originally programmed;[8] 384 planned under early Reagan Administration;[9] increased to 1000 nuclear versions;[10] at least 190 planned for surface ships, 194 for submarines[11]

Location: worldwide deployment;[12] one-third of SLCM equipped attack submarines would be at sea on a day-to-day basis[13]

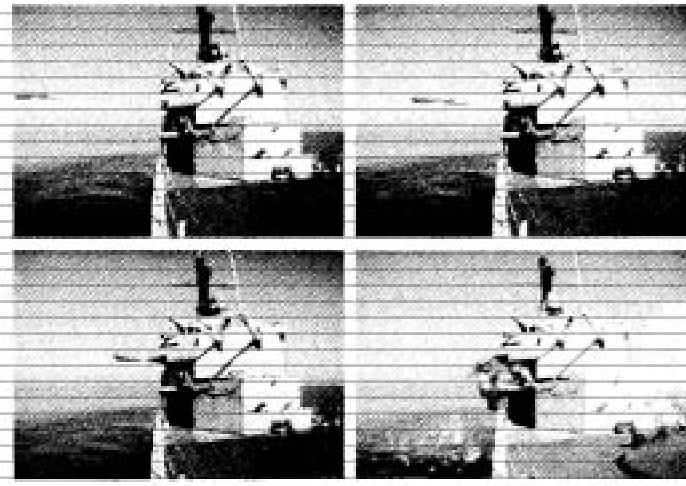

Figure 6.9 TOMAHAWK missile with inert warhead scores direct hit on a Navy ship target.

HISTORY:

IOC:	June 1984[14]
Jun 1972	development begins with direction for a long-range nuclear land attack missile[15]
Jan 1974	Navy selects General Dynamics and LTV to design a SLCM
FY 1976	TERCOM guidance first demonstrated
Jun 1976	first fully guided test flight
Jan 1977	advanced development completed, entered full-scale engineering development
Feb 1978	first successful submarine launch
Oct 1979	limited production begins
Mar 1980	first test launch from a surface ship
1981	60 flight tests through February 1981
Jun 1984	deployment of nuclear armed SLCM begins.[16]

Table 6.7

SLCM Funding and Procurement[1]

($ millions)

	FY 1981 and Prior	1982	1983	1984	Total
Submarine-Launched					
Total Appropriation[2]	1082.8	331.5	434.5	433.7	4969.9
Quantity	46	62	70	165	1255
Surface Ship-Launched					
Total Appropriation	73.2	188.6	282.0	507.1	7859.6
Quantity	10	26	50	147	2739
Nuclear Peculiar Funding[3]	(—)	(8.0)	(15.0)	(32.0)	(?)
SLCM					
Total Appropriation	1156.0	520.1	605.4	940.8	12,829.5
Total Quantity	56	88	120	312	3994

1 Information provided by Joint Cruise Missile Program Office reflecting FY 1983 estimates.

2 Includes R&D, Procurement, and Operations and Maintenance.

3 HASC, FY 1981 DOD, Part 4, Book 2, p. 2313.

TARGETING:

Types: land targets, primarily naval related, ports, bases; also surface ships[17]

Selection Capability: Mission planner at theater level will consult interactive graphic display "theater planning package" to layout route for survivability and accuracy. Disc file present at each launching unit holds 1700-5000 land attack missions.[18]

Accuracy/CEP: circa 30 m

COST: (See Table 6.7)

Program Cost: $11,520.0 m (Dec 1982)
$12,829.5 m (FY 1983)

Unit Cost: $3.167 m (FY 1980) (flyaway); $4.759 m (program)

1 ACDA, FY 1979 ACIS, p. 72.
2 HASC, FY 1982 DOD, Part 3, p. 327.
3 SAC, FY 1980 DOD, Part 4, p. 420; the nuclear warhead is "considerably smaller" than a conventional warhead, thus extending the range of SLCM; Sandia Lab News, 18 September 1981.
4 AW&ST, 22 November 1976, p. 15.
5 For submarine launch, SLCM is loaded into a stainless steel capsule which protects it during handling and underwater launch. For surface ship applications, TOMAHAWK will initially be launched from a specially designed armored box launcher mounted on the deck.
6 SASC, FY 1983 DOD, Part 4, p. 4517.
7 DOD, FY 1981 RDA, p. VII-8.
8 HASC, FY 1981 DOD, Part 4, Book 2, p. 1467.
9 Philadelphia Inquirer, 4 December 1981, p. 1.
10 Michael Getler, Washington Post, 19 January 1983, p. A13.
11 Philadelphia Inquirer, 4 December 1981, p. 1.
12 ACDA, FY 1982 ACIS, p. 234.
13 ACDA, FY 1979 ACIS, p. 73.
14 Submarine-launched and ship-launched; SASC, FY 1982 DOD, Part 7, p. 4066.
15 SASC, FY 1980 DOD, Part 5, p. 2519.
16 DOD, FY 1983 RDA, p. VII-8; HASC, FY 1982 DOE, p. 344; SASC, FY 1983 DOD, Part 7, p. 4817.
17 A nuclear-armed antiship SLCM also could be deployed, but is not part of the current development program; ACDA, FY 1979 ACIS, p. 72.
18 Information provided by Joint Cruise Missile Planning Office.

HARPOON Missile (AGM-84A/RGM-84A/UGM-84A)

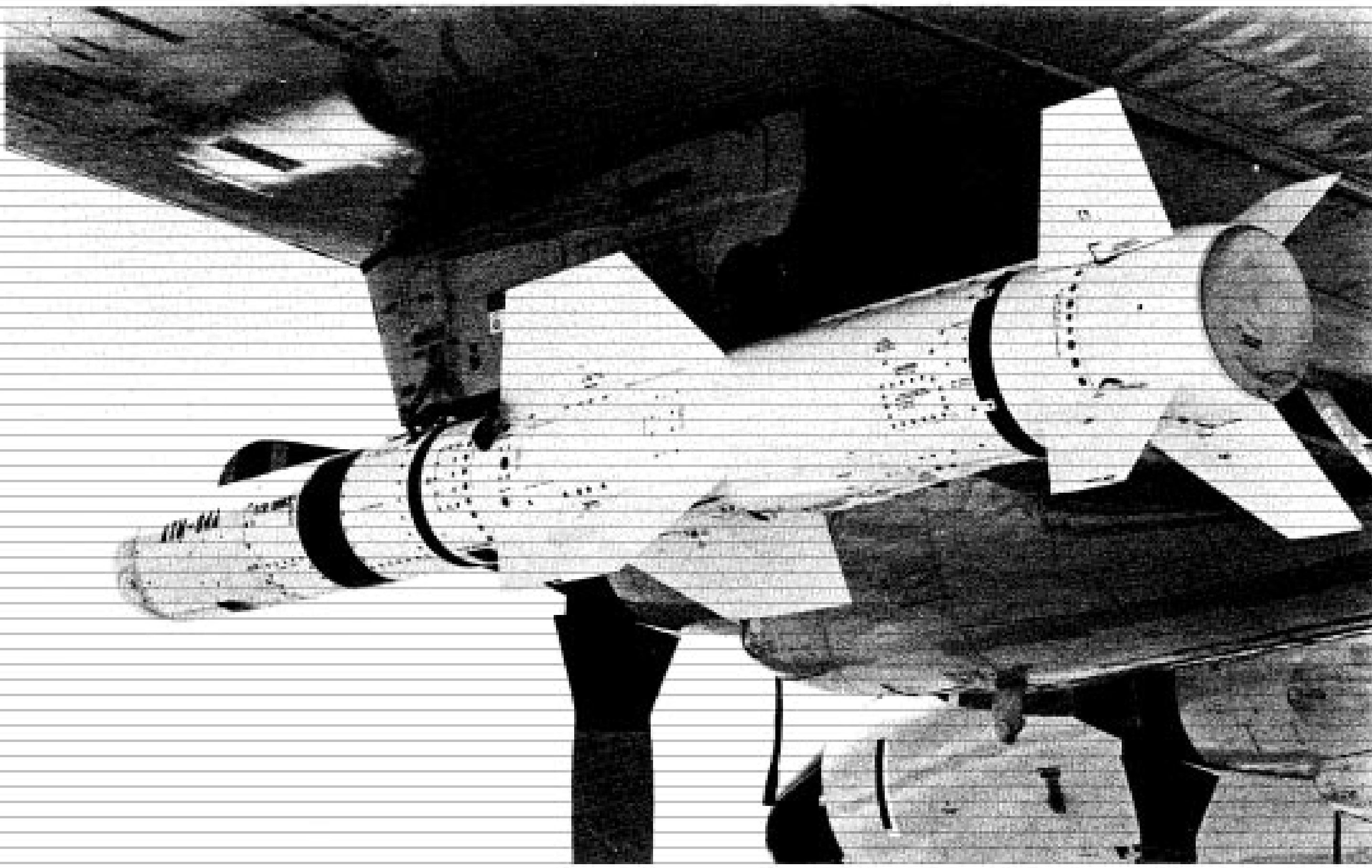

Figure 6.10 Air-launched **HARPOON (AGM-84A)** conventional missile installed on wing of a P-3C ORION patrol aircraft.

DESCRIPTION: Medium range air/surface/sub-surface launched anti-ship cruise missile.

CONTRACTORS:
McDonnell Douglas (prime)
Lear Seigler (cruise guidance)
Texas Instruments (terminal guidance)
Teledyne (turbojet)
Aerojet (booster)
Honeywell (radar altimeter)
IBM (on-board computer)

SPECIFICATIONS:

Length:	air-launched: 151.2 in; ship/sub-launched: 182.2 in (with booster)
Diameter:	13.5 in
Stages:	1
Weight at Launch:	air-launched: 1168 lb; ship/sub-launched: 1470 lb; 2200 lb[1]
Propulsion:	one J402-CA-400 turbojet sustainer engine augmented by a solid booster for ship/sub-launch
Speed:	subsonic (Mach 0.8) (max)

Guidance:	inertial with radar altimeter and active radar mid-course and terminal guidance
Throwweight/ Payload:	510 lb, air and ship/sub launched
Range:	ship/sub-launched: 35 mi; air-launched: 120 mi
DUAL CAPABLE:	currently conventional only; nuclear option has been under consideration but has not been authorized; FY 1981 through FY 1983 budgets have not included any funds for the development or procurement of a nuclear warhead.[4]
NUCLEAR WARHEADS:	one/missile, not yet chosen.

DEPLOYMENT:

Launch Platform:	armored box launchers containing a mix of TOMAHAWK and HARPOON missiles;[5] can be fired from STANDARD / TARTAR / TERRIER / ASROC ship launchers, BB, CG, CGN, DD-963, DDG, FF-1052, FFG-7, PHM class ships; P-3C, S-3, A-6E aircraft; SSN-594, -637 and -688 class nuclear attack submarines;[4] HARPOON will be deployed on B-52G bombers starting in 1984 for "sea control"[3]
Number Deployed:	2230 planned in program[6]

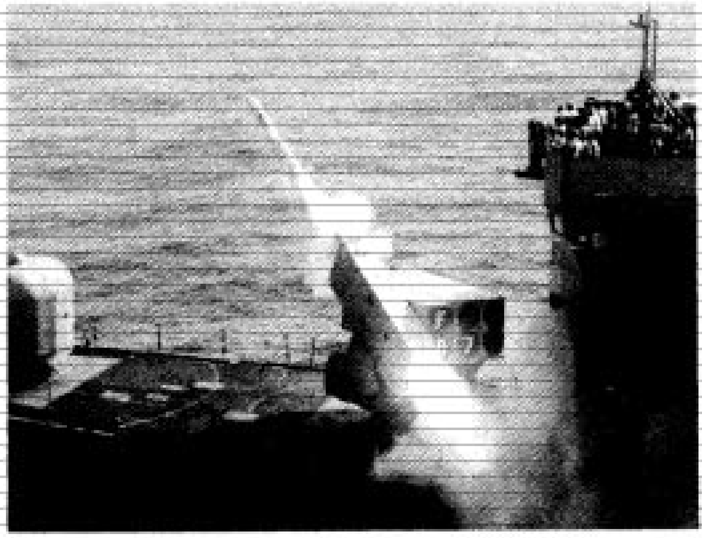

Figure 6.11 Ship-launched **HARPOON (RGM-84A)** missile.

HISTORY:

IOC:	1977
1968	development begins
Dec 1972	first flight
Jul 1973	Phase 1 Weapons Concept Study completed for Nuclear HARPOON[7]
Aug 1975	Phase 2 Weapons Feasibility Study completed[8]
Sep 1977	Phase 2A Advanced Engineering Study completed[9]
FY 1979	update conceptual and feasibility study for HARPOON nuclear warhead conducted[10]
FY 1980	nuclear HARPOON unfunded[11]

6

HARPOON Missile

TARGETING:

Types: cruisers, destroyers, patrol craft, surfaced submarines, other shipping[12]

Selection Capability: unknown

COST:

Unit Cost: $397,000 (FY 1981) (flyaway); $803,000 (FY 1981) (program); $485,000 (FY 1978)

FY	Number Procured	Total Appropriation ($ million)
1979 & prior	699+	940.5
1980	240	151.1
1981	240	219.2
1982	240	230.4
1983	221	227.7
1984	330	305.2

COMMENTS: Nuclear warhead considered for the HARPOON has included a standard design and an "insertable nuclear component" concept.[13] This would be a warhead that could be converted from conventional high explosive to nuclear.[14]

1 When encapsulated for submarine launch: ACDA, FY 1979 ACIS, p. 169.
2 ACDA, FY 1981 ACIS, p. 367; HASC, FY 1980 DOD, p. 95.
3 AW&ST, 10 March 1980, p. 24.
4 ACDA, FY 1981 ACIS, p. 365.
5 AW&ST, 16 August 1982, p. 25.
6 U.S. Missile Data Book, 1980, 4th Ed., p. 2-24.
7 HAC, FY 1980 DOD, Part 2, p. 283.
8 Ibid.
9 Ibid.
10 ACDA, FY 1979 ACIS, p. 170.
11 SASC, FY 1980 DOD, Part 6, p. 2050.
12 ACDA, FY 1979 ACIS, p. 169.
13 ACDA, FY 1979 ACIS, p. 170; an insertable nuclear component would be useful, according to the Navy, for avoiding tradeoff between nuclear and conventional weapons when limited space aboard ships exists; HASC, FY 1980 DOD, p. 61.
14 SASC, FY 1978 ERDA, p. 31.

Advanced Technology Cruise Missiles

Four distinct programs are underway to upgrade the present generation of cruise missiles: modifications to deployed cruise missiles, development and deployment of a new "Advanced Cruise Missile," development of an intercontinental cruise missile, and development of a new bomber weapon to replace the SRAM. The formal "Advanced Cruise Missile Technology" (ACMT) program began in August 1977 to examine the next generation of cruise missiles. The program has the following broad goals:[1]

- increase in range up to 2300-2600 nautical miles, with options for further increases,
- increase in survivability through use of electronic countermeasures,
- use of "Stealth" technology to decrease missile detection ("reduced observables"),[2] and
- incorporation of new software and better "mission planning flexibility."

Modifications to the present cruise missile inventory to obtain these objectives have been under consideration since the beginning of the development program in 1977. In August 1980, the Air Force began an ALCM-L study. On 22 October 1980, DOD provided a program definition for the ACMT program. Boeing now suggests extending the useful life of the 1499 ALCMs already procured through FY 1983 by reducing the radar cross section of the engine inlet and body, upgrading the guidance software, adding an icing sensor, and improving the altimeter.[3]

Engine technology advancements using new fuels and design efficiencies are being studied by Williams International, Garrett Corporation, and Teledyne to obtain reduced fuel consumption, higher performance, and lower detection profiles. One plan is to replace the F107 engine with a new engine—the 14A6—which will provide 35 percent more thrust for 5 percent less fuel consumption and a 10 percent increase in range.[4] Boeing was awarded an engine improvement contract in 1980, but in 1981, DOD cancelled the engine improvement program because costs were too great. Emphasis was then shifted to further development of a new engine.[5]

Airframe design improvements using new materials for lower detection signatures and greater maneuverability are being investigated by General Dynamics and Boeing. The use of radar-absorbent materials and smoother, flatter designs in construction of the airframe would make cruise missiles more difficult to detect with current radar.[6] These so-called "Stealth" technologies could be partially applied to already deployed missiles, but would have the most significant applications in a new missile. The Air Force is also planning to retrofit electronic countermeasures packages aboard ALCMs and GLCMs during the 1985-1987 period.[7] The on-board active countermeasures would be designed to operate against interceptor aircraft and missiles.

Modifications to the present cruise missile force, particularly ALCMs, now seems to have lower priority than procurement of a new "Advanced Cruise Missile" incorporating all the new features. The FY 1984 Defense budget request to Congress ended Boeing ALCM procurement at 1499 of 4348 planned units[8] and shifted program focus to the new missile.

Accelerated development of the Advanced Cruise Missile may mean an IOC of as early as 1986.[9] The Air Force issued "requests for proposals" for an advanced cruise missile in September 1982[10] and expects to select a prime contractor in the spring of 1983.[11] The Air Force competition will be between Boeing, General Dynamics, and Lockheed.[12] Boeing won a competition with General Dynamics to become the ALCM contractor. General Dynamics is the contractor for the TOMAHAWK missile and has been a major participant in the Defense Advanced Research Projects Agency (DARPA) "TEAL DAWN" research program to develop a next-generation missile (see below). Lockheed, one of the major contractors in the secret stealth programs, has reportedly developed a stealth cruise missile.

At least 2000 advanced ALCMs will probably be procured starting in FY 1986 to augment and eventually replace the Boeing ALCM. Whether the new technologies will also be applied to Ground and Sea Launched missiles is still not clear, although it is known that the Navy is also developing a stealth cruise missile.[13] In FY 1981, an Advanced Cruise Missile Technology nuclear warhead Phase 1 conceptual study was underway within DOE to design a warhead to replace the W80 on the next generation of ALCM.

For many years, the DARPA has also been investigating cruise missile technology. Of particular interest is development of a new intercontinental cruise missile

1 HAC, FY 1983 DOD, Part 4, p. 588.
2 AW&ST, 10 March 1980, pp. 12-15.
3 *Defense Week*, 14 February 1983.
4 HAC, FY 1983 DOD, Part 4, p. 593.
5 Information provided the authors by Air Force Systems Command.
6 AW&ST, 8 November 1982.
7 Ibid., p. 38.
8 Richard Halloran, *New York Times*, 16 February 1983, p. 12; *Defense Week*, 1 February 1983, p. 1.
9 AW&ST, 23 August 1982; AW&ST, 1 November 1982, p. 13.
10 *Defense Week*, 14 February 1983.
11 AW&ST, 23 August 1982.
12 Richard Halloran, *New York Times*, 16 February 1983, p. 12.
13 AW&ST, 23 August 1982.

under the "TEAL DAWN" and the Advanced Cruise Missile Programs. In fact, a cruise missile with an intercontinental range of some 6000-8000 miles could compete quite strongly with the Air Force's plans for a quick follow-on. It is not clear whether the new missile will merely incorporate the advances into a new airframe or be completely new. Vought Corporation received a small Air Force contract in late 1982 to research guidance and other components for DARPA's intercontinental range cruise missile.[14]

The new missiles being developed by DARPA will be smaller, incorporate the latest stealth techniques, and have sensors to avoid detection and defensive systems. A new terminal homing unit and additional navigation aids will provide high accuracy. A "regenerative" engine which would channel some of the waste exhaust heat back into the engine cycle is being examined. High energy, jellied fuels could also add fuel savings and greater range. The most significant feature, however, would be the increase to supersonic speeds over 550 mph for the present ALCM. The Fiscal Year 1983-1984 DARPA Advanced Cruise Missile Program requested $63.6 million for the following:[15]

- Autonomous Terminal Homing: development of advanced sensors, day-night and adverse weather, precision guidance system, including an autonomous damage assessment capability.
- Advanced Delivery Concepts: development of techniques to counter threats to cruise missiles including "unconventional vehicle designs," increased range, and flight path optimization systems.
- Advanced Cruise Missile Engines: development of engines using new high energy fuels, increased thrust, and reduced fuel consumption.
- Cruise Missile Detection Technology: development of techniques (radar masking, clutter, propagation data, infrared background data) that limit the capability of defensive systems and enhance the design and countermeasures of cruise missiles, and
- Path Optimization Technology: development of new mission planning and onboard detection and routing systems to enhance the ability of cruise missiles and launching aircraft to evade defenses.

14 AW&ST, 31 January 1983, p. 15.
15 DARPA, "Fiscal Year 1983 Research and Development Program: A Summary Description," 30 March 1982.

Advanced Strategic Air-Launched Missile

The major program for the next generation of attack missiles for U.S. bomber forces is the Advanced Strategic Air-Launched Missile (ASALM), also known as the Lethal Neutralization System.[1] The objective of the ASALM program is to develop a supersonic cruise missile as an improved air-to-ground weapon with an anti-aircraft capability. While the ASALM program is primarily driven by developments in Soviet AWACs and future U.S. bomber forces, it is also influenced by the anticipated obsolescence of motors on the current SRAM missile. The missile technology could be used to provide the basis for a second generation, higher-speed, long-range ALCM.[2] The program was slowed by the Air Force in 1978-79 in order to accomplish a detailed mission analysis called Saber Mission A.[3] The analysis concluded that a multimode missile with air-to-air and air-to-surface capabilities was far superior to the present SRAM air-to-surface missile.

The ASALM program has its origin in the more than ten year old integral-rocket/ramjet propulsion system which can be used as a supersonic air breathing missile. Work on ASALM began in 1968 with competitive studies conducted by Boeing, Hughes/LTV, and Martin Marietta for the Bomber Defense Missile (BDM).[4] BDM evolved into the Multipurpose Missile (MPM) and later into ASALM, for which McDonnell Douglas and Martin Marietta competed for development. Much of the work has included studies and technical development in the areas of high-temperature structures, integral-rocket/ramjet propulsion, and inlet configuration. Prototype missiles have "flown" high velocity and high altitude trajectories in extensive wind tunnel testing and other simulations. Flight testing of the rocket/ramjet vehicle was accomplished from October 1979 to May 1980.

Unlike current generation cruise missiles, ASALM would be supersonic and capable of attacking ground targets as well as directly defending the bomber force. ASALM is seen as a penetration aid for U.S. bomber forces with improved air-to-ground capabilities. Its improved accuracy over the SRAM give it a significant capability to destroy enemy air defenses. ASALM would be designed to maneuver at sustained high speeds to evade enemy air defenses and be capable of flying a variety of trajectory profiles: all-high, all-low, and combination high-low. Finally, ASALM would be designed to maintain high speed in the terminal phase when high speed is essential for penetration of enemy point defenses.

The program has had technical problems and was scaled down for FY 1980-1982 with a refocus on basic technology. The ASALM program is looking at not only missile technology, missile flight testing, and subsystem evaluation, but also at electronic counter measures (ECM), decoys, and communications jamming. A large portion of ASALM funding is directed toward the difficult problem of developing an air-to-air guidance capable of attacking a Soviet AWACs once its radar has been shut down.[5] Martin Marietta is also testing ASALM as an "Outer Air Battle Missile" for the Navy to be used as a long-range anti-cruise missile system fired from the Vertical Launching System (VLS). A nuclear warhead for the ASALM, currently called the New Strategic Air-Launched Missile Warhead (formerly the Lethal Neutralization System), is in Phase 2, Program Study, at DOE laboratories. Another warhead program, the Bomber Defense Missile warhead, is in Phase 1 and thought to be for the ASALM.

The Air Force has also studied the feasibility of a cruise-ballistic missile, which after achieving altitude and speed converts over to a cruise mode.[6] The technology, however, is very difficult and the DOD states that it will be many years before a technology demonstration flight could be accomplished.[7]

1 Program has also been known as Counter SUAWACs.
2 ACDA, FY 1980 ACIS, p. 28.
3 HASC, FY 1981 DOD, Part 4, Book 2, pp. 1701-1702.
4 ASALM background provided by Martin Marietta.
5 SASC, FY 1982 DOD, Part 7, p. 4003.
6 SASC, FY 1981 DOD, Part 5, p. 2709.
7 SASC, FY 1982 DOD, Part 7, p. 3998.

Advanced Strategic Air-Launched Missile (ASALM)

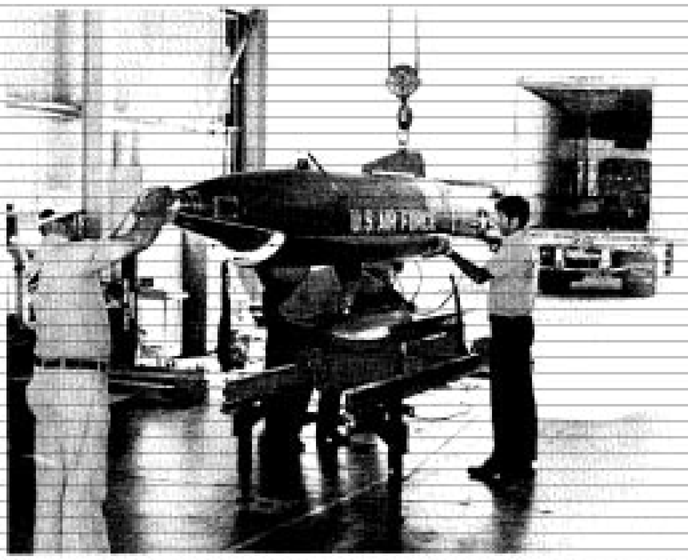

Figure 6.12 Advanced Strategic Air-Launched Missile (ASALM).

DESCRIPTION: Strategic supersonic medium-range cruise missile with air-to-air and air-to-ground capabilities, envisioned as the replacement for SRAM.

CONTRACTORS:
Martin Marietta Aerospace
Orlando, FL
(prime)
Raytheon
(missile/guidance)
McDonnell Douglas
(missile)
Martin Marietta
(airframe)
Hughes
(guidance)
Marquardt Co.
(ramjet propulsion)
United Technologies Corp.
(engine)
Thiokol
(fuel)
Rockwell
(guidance)
Litton Guidance & Control
(inertial navigation)
Delco
(subsystems)
Hercules, Inc.
(rocket propulsion)
Garrett AiResearch Mfg. Co.
(secondary power)

SPECIFICATIONS:

Length:	168 in[1]
Diameter:	25 in,[2] 21 in[3]
Stages:	1
Weight at Launch:	2700 lb;[4] 1800 lb[5]
Propulsion:	integral rocket-ramjet engine
Speed:	Mach 4
Guidance:	passive updated inertial guidance, passive antiradiation homing capability, active radar terminal engagement in aerial intercept mode with frequency agility[6]
Throwweight/ Payload:	unknown
Range:	over 200 mi; considerably less than ALCM but more than SRAM.[7]

DUAL CAPABLE: no

NUCLEAR WARHEADS: one/missile; two warheads possibly under development; W80 is a prospective candidate for use on the ASALM.[8]

DEPLOYMENT:

Launch Platform:	B-52 (up to 7 internal/12 external),[9] FB-111, B-1B, ATB
Number Planned:	1200 (1983)
Location:	bomber bases

HISTORY:

IOC:	1987[10]
Jun 1974	McDonnell Douglas and Martin Marietta awarded contracts for concept formulation of ASALM[11]
Mar 1976	Martin Marietta awarded contract for ASALM propulsion technology vehicle (PTV)[12]
Jul 1979	Phase 2 feasibility study for ASALM warhead completed[13]
Oct 1979	flight testing of supersonic propulsion technology vehicle begins[14]
Dec 1979	program given go ahead
May 1980	propulsion technology validation flight testing completed[15]
FY 1983	captive flight testing

TARGETING:

Types:	Soviet AWACs, interceptor airfields, air defense missile sites, radar
Accuracy/CEP:	accuracy is not expected to be significantly degraded by the missile's high speed[16]

COST:

FY	Number Procured	Total Appropriation ($ million)
1977 & prior	-	38.8[17]
1978	-	37.2[18]
1979	-	39.0[19]

COMMENTS: FY 1982 defense budget changed the ASALM program to the Counter SUAWACS (Soviet Union AWACs) Technology Program (63318F). It was then changed to the Lethal Neutralization System Program in FY 1983.

1 *The World's Missile Systems*, 6th Ed., p. 96.
2 Ibid.
3 ACDA, FY 1980 ACIS, p. 29; ACDA, FY 1981 ACIS, p. 126.
4 ACDA, FY 1980 ACIS, p. 29; ACDA, FY 1981 ACIS, p. 126.
5 *The World's Missile Systems*, 6th Ed., p. 96.
6 AW&ST, 10 March 1980, p. 14.
7 ACDA, FY 1979 ACIS, p. 59; ACDA, FY 1980 ACIS, p. 29; ACDA, FY 1981 ACIS, p. 126; HAC, FY 1980 DOD, Part 6, p. 680; 1985-86.
8 Ibid.
9 Ibid.
10 Depending on the availability of warheads: ACDA, FY 1981 ACIS, p. 125; earliest IOC has also been referred to as 1989: HAC, FY 1980 DOD, Part 6, p. 680; 1985-86; ACDA, FY 1979 ACIS, p. 62.
11 Martin Marietta Release, 10 June 1974.
12 Martin Marietta News, 5 March 1976.
13 ACDA, FY 1980 ACIS, p. 30.
14 USAF, ASD, WPAFB Press Release (PAM #80-170).
15 Ibid.
16 ACDA, FY 1979 ACIS, p. 61.
17 Ibid., p. 63.
18 Ibid.
19 Ibid.