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Chapter Nine
Army Nuclear Weapons

The Army[1] uses a wide variety of nuclear weapon systems—medium range PERSHING 1a and short-range LANCE surface-to-surface missiles, NIKE-HERCULES surface-to-air missiles, 155mm and 8-inch (203mm) artillery, and atomic demolition munitions (nuclear land mines). The HONEST JOHN surface-to-surface rocket, although withdrawn from active U.S. use, is nuclear armed with some NATO allies. Army nuclear weapons are deployed with U.S. combat units throughout the United States, Europe, in South Korea, and among allied military forces. They vary in range from manually emplaced land mines to 460 miles, and in yield from sub (0.01) to 400 kilotons.

The PERSHING 1a is the longest range and highest yield Army nuclear weapon currently deployed. One hundred and eighty launchers, with more than 300 missiles, all armed with W50 nuclear warheads, are deployed in West Germany with the U.S. Army and the West German Air Force. First deployed in 1962 to replace the SERGEANT missile, the PERSHING represented an increase in range, accuracy, and reliability. A replacement system for the PERSHING 1a, the PERSHING II, is now planned for initial deployment in December 1983. Originally designed as a more accurate and reliable missile with similar range to the PERSHING 1a, the PERSHING II was subsequently made long-range (1800 km) with a small yield warhead (W85). The deployment of the new PERSHING II missile has become very controversial. It is uncertain whether the full complement of missiles will eventually be deployed and whether the current West German PERSHING 1a will be replaced. Another PERSHING missile, a short-range and accurate "fallback" system designated PERSHING 1b, is also under development for deployment with the West German Air Force, or for U.S. deployment in Europe should arms control negotiations successfully eliminate the long-range missiles.

More widely deployed than PERSHING is the short-range corps support LANCE 125 km range missile, first deployed in 1972, and equipped with the W70 nuclear warhead (as well as a conventional warhead). Approximately 100 LANCE launchers and 945 nuclear warheads are currently operational in the U.S. Army, and nuclear armed with U.S. warheads in the Belgian, British, Dutch, Italian, and West German armies. LANCE replaced HONEST JOHN in all of these countries, more than doubling the range and accuracy over the older missile, and providing greater mobility and reliability. A new warhead for the LANCE, an enhanced radiation version of the W70 (Mod 3) produced in 1981-1983, is being stored in the U.S. and awaits shipment to Europe. The HONEST JOHN short-range free-flight rocket, first deployed in 1954, remains deployed with W31 nuclear warheads in the Greek and Turkish armies. No plans are currently known for the replacement of HONEST JOHN in the above forces with the LANCE, but they will be obsolete in the late 1980s and impossible to support. A nuclear armed LANCE replacement is under development, called the Corps Support Weapon System, as part of the Army-Air Force Joint Tactical Missile System program to investigate and develop new medium-range battlefield weapons with greater accuracy and flexibility.

The NIKE-HERCULES is the only land-based nuclear armed surface-to-air missile in the U.S. military. Approximately 500 warheads and launchers are deployed in Europe. Nuclear warheads are supplied to the following five countries for their NIKE-HERCULES: Belgium, Greece, Italy, the Netherlands, and West Germany. South Korean NIKE-HERCULES may also be supplied with nuclear warheads. The missile was originally deployed as a strategic system to defend the United States against massed bomber attacks, but has since been withdrawn from that role and is now only deployed in Europe and South Korea to defend the rear area and key installations against tactical aircraft. The NIKE-HERCULES is a dual capable system, armed with conventional warheads or the W31 nuclear warhead. It can also be used in the surface-to-surface role. First deployed in 1958, the NIKE-HERCULES has a number of operational limitations associated with slow rate of fire and guidance and is gradually being withdrawn from use. Some nuclear warheads have already been withdrawn as NIKE-HERCULES batteries are being converted to conventional warheads only. The development of the more accurate and versatile conventionally armed PATRIOT surface-to-air missile, starting in 1984, will completely replace the NIKE-

1 Marine Corps use of nuclear artillery and atomic demolition munitions is indicated throughout this chapter and discussed in more detail in Chapter Four.

HERCULES, initially in U.S. forces and eventually in other NATO forces.

Nuclear artillery is widely deployed within the U.S. Army and Marine Corps and with the following seven NATO armies: Belgium, Greece, Italy, the Netherlands, Turkey, the United Kingdom, and West Germany. Some 5000 nuclear artillery warheads are deployed. Two nuclear projectiles—M422 203mm projectile with W33 nuclear warhead and M454 155mm projectile with W48 warhead—are currently deployed in Europe. One new projectile—M753 203mm projectile with W79 enhanced radiation warhead—is in production, but is being stored in the United States.

Numerous nuclear capable artillery guns are currently operational. The most common are the M109 self-propelled 155mm howitzer and the M110 self-propelled 203mm guns. Originally fielded in 1956, the W33/M422 nuclear projectile is the oldest nuclear warhead deployed. Its safety, reliability, and usefulness have been widely questioned. However, since the replacement for the W33 was finally limited to an enhanced radiation design in 1982, it is unlikely that it will be deployed to Europe. A new 155mm nuclear projectile—the W82/M785—is also under development, with an enhanced radiation yield. It is planned for initial deployment in 1987.

The smallest nuclear weapons are atomic demolition munitions (ADMs) (nuclear land mines). Two types are currently deployed with both the U.S. Army and Marine Corps. A number of NATO units, including at least British, Dutch, and West German units, are also trained to emplace and fire ADMs. The Medium Atomic Demolition Munition (MADM) is the more commonly available. First deployed in 1965, it weighs about 400 pounds, and is assigned to ADM engineer units within combat divisions and corps. The Special Atomic Demolition Munition (SADM) is less common than the MADM, smaller (some 150 pounds), and more portable, designed for use by special forces and commando units for emplacement and detonation behind enemy lines. Although replacements for the ADMs have been discussed occasionally, there is currently no plan to replace them with new nuclear systems.[2]

2. DOD, FY 1983 RDA, p. VII-14.

Missiles and Rockets

HONEST JOHN (MGR-1B)

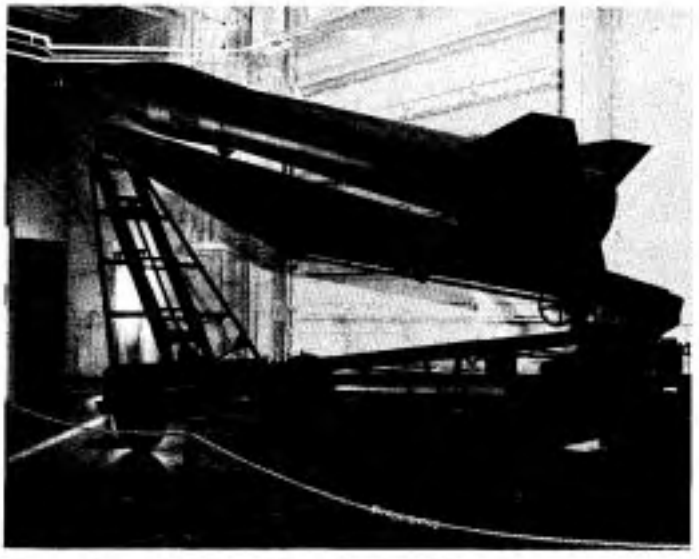

Figure 9.1 HONEST JOHN (MGR-1B) missile.

DESCRIPTION:	Short-range, free-flight (unguided), mobile, nuclear capable surface-to-surface, solid propellant, ballistic rocket used by the Greek and Turkish Armies, and the Army National Guard.
CONTRACTORS:	McDonnell-Douglas (prime/missile) Hercules (rocket motor) Thiokol (stabilization rockets) Emerson Electric (missile)
SPECIFICATIONS:	(MGR-1B)
Length:	24 ft 9.5 in (7.6 m) (297 in)
Diameter:	30 in (762 mm)
Stages:	1
Weight at Launch:	4332 lb[1]
Propulsion:	solid propellant rocket motor
Speed:	Mach 1.5
Guidance:	spin stabilization with two pairs of spin rockets which are ignited automatically as the rocket leaves the launcher[2]
Range:	minimum range approximately 5000-6200 meters; maximum range of B version, 38 km[3]
DUAL CAPABLE:	yes
NUCLEAR WARHEADS:	one W31 in M47 and M48 nuclear warhead sections; 1-20 Kt range (see W31)
DEPLOYMENT:	
Launch Platform:	M386 self-propelled truck launcher, M289 self-propelled launcher and M33 towed launcher
Number Deployed:	about 200 nuclear versions remaining (1983); as many as six reload missiles per launcher estimated deployed
Location:	Greece, Turkey; probably some stored in U.S.; possible nuclear warheads in South Korea[4]
HISTORY:	
IOC:	1954
1951	firing tests of HONEST JOHN began
1906	MGR-1B enters service
TARGETING:	
Types:	tactical targets, headquarters, command post, masses of armor, enemy short range nuclear weapons

Selection Capability:	impact, low air and high air options with capability for selection of height of burst to 2000 meter maximum[3]
Accuracy/CEP:	one nm; low level winds have a considerable effect on both the range and accuracy,[4] large vertical probable error[5]

COMMENTS: HONEST JOHN has been replaced by LANCE missiles in all NATO armies except in Greece and Turkey.[6] MGR-1B modification incorporated reduction in length and improvement in performance. The HONEST JOHN must be warmed with special electric blankets for 24-48 hours prior to firing; this enables it to attain a predetermined temperature (77° F) for proper and even propellant burn.[7]

1 With nuclear warhead; weight at launch of conventional HONEST JOHN is 4719 lb; USACGSC, Selected Readings in Tactics, RB 100-2, Vol VI, June 1977, p. 1-96; The World's Missile Systems, 6th Ed., p. 282; USA, Field Artillery Battalion, Honest John, FM 6-61, April 1966, p. 4.

2 FM 6-61, op. cit., p. 5.

3 USA, Field Artillery Rocket Honest John with Launcher M289, FM 6-60, December 1974, p. 12; Army Magazine, October 1978, p. 148; FM 6-61, op. cit., p. 5.

4 Last active U.S. HONEST JOHN battalion in South Korea retired in 1979 with missiles and equipment turned over to South Korean forces. Presumably nuclear warheads remain in South Korea under U.S. control; HAC, FY 1980 DOD, Part 1, p. 740; HASC, FY 1981 DOD, Part 1, p. 931.

5 USA, Field Artillery Honest John Gunnery, FM 6-40-1, June 1972, pp. 4-38, 4-39, 6-1.

6 FM 6-40-1, op. cit., p. 1-2.

7 FM 6-61, op. cit., p. 14.

8 JCS, FY 1982, p. 76; DOD, FY 1982 Annual Report, p. 127.

9 FM 6-40-1, op. cit., p. 1-1; FM 6-60, op. cit., p. 18; FM 6-61, op. cit., p. 5.

LANCE (MGM-52C)

Figure 9.2 LANCE (MGM-52C) missile on mobile launcher.

DESCRIPTION:	Short-range, Army all-weather, highly mobile, guided nuclear-capable surface-to-surface ballistic missile.
CONTRACTORS:	LTV Corporation Warren, MI (prime/missile) Farm Machinery Corporation (launcher) Rocketdyne (motor) LTV/American Bosch Arma Corp/Systron-Doner Corp. (guidance)
SPECIFICATIONS:	(MGM-52C)
Length:	248 in
Diameter:	22.2 in
Stages:	1
Weight at Launch:	2900 lb (nuclear missile);[1] 2834 lb[2]
Propulsion:	storable prepackaged liquid P8E-6 motor, 46,450 lb thrust (maximum)[3]
Speed:	Mach 3
Guidance:	inertial with mid-course correction made by distance measuring equipment from ground station via radio link; AN/DJW-48 missile guidance set; directional control, automatic meteorological compensation guidance system (DC-AUTOMET) (weight: 36 lb)
Range:	5-125 km[4]
Ceiling:	1350 m (minimum range), 45,700 m (maximum range)[5]
DUAL CAPABLE:	yes
NUCLEAR WARHEADS:	one W70 in M234 nuclear warhead section;[6] five different warhead sections for missile, two tactical (one nuclear, one nonnuclear), two trainers and one practice; 1-100 Kt range (fission mods); circa 1 Kt (ER mod) (see W70)
DEPLOYMENT:	
Launch Platform:	M752 self-propelled launcher tracked launch platform, with 55 km/h speed and amphibious capability, carries one missile; the M740 launcher zero length is a towed launcher with the basic launch fixture of the M752 for use in special operations such as airborne missions
Number Deployed:	approximately 945 nuclear missiles (1983); 2133 missiles procured;[7] 1450 missiles in Army inventory[8]

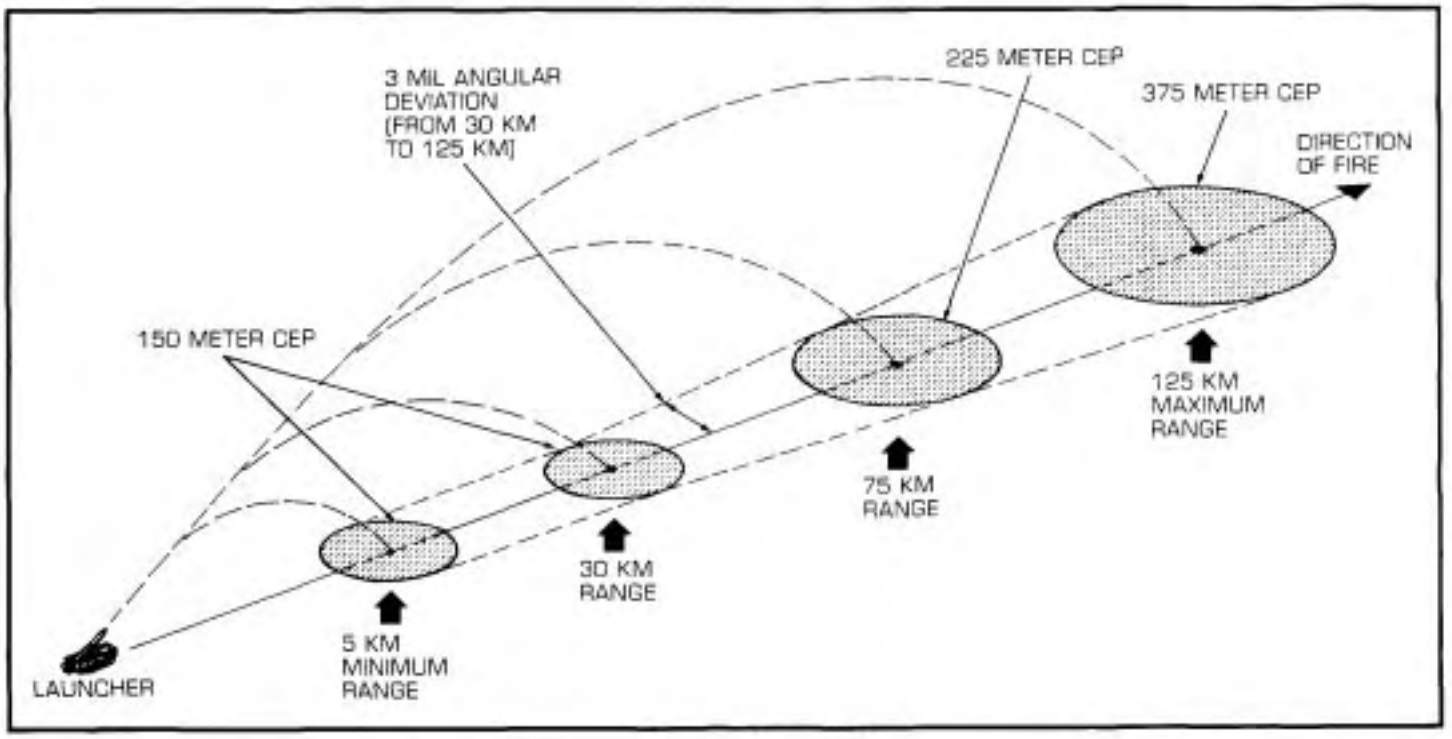

Figure 9.3 The accuracy of a nuclear armed **LANCE** missile is portrayed, showing diminished accuracy at longer ranges.

Location:	six battalions with 6 launchers each deployed with U.S. Army in West Germany; 2 battalions in the U.S. at Fort Sill, OK;[9] with British, Belgian, Dutch, Italian, and West German armies[10]

HISTORY:

IOC:	1972[11]
Nov 1962	basic LANCE program begins
1965	first test firing of basic LANCE
Mar 1967	development of improved LANCE begins
Mar 1969	first test firing of improved LANCE
Sep 1971	production begins
Dec 1972	first firing of conventional LANCE warhead
1976	LANCE begins deployment with NATO armies
1979	adaption kits for installation of Mods 3 and 4 on LANCE procured[12]
1980	production of LANCE missile completed

TARGETING:

Types:	command posts, logistical elements, troop concentrations, transportation elements, chokepoints, missile units, forward airfields, fixed air defense sites, critical terrain features (defiles, bridgeheads, main supply routes).[13] Because of its large CEP, LANCE cannot be effectively used for targets on or near the FEBA.[14]
Selection Capability:	five heights of burst: ground (impact), air low, air low/ground backup, air high, or air high/ground backup[15]

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LANCE Missile

Retargeting: short reaction time (15 minutes) due to storable propellant, simplified prefire checkout;[16] rate of fire is 4 missiles per hour, eight missiles per day[17]

Accuracy/CEP: (see Figure 9.3)

COST:

Unit Cost: $142,000 (FY 1981) (flyaway); $516,000 (FY 1981) (program); $215,300 (FY 1978)

FY	Number Procured	Total Appropriation ($ million)
1977 & prior	1574[18]	1026.8
1978	360	76.9
1979	?	78.2
1980	-	4.1
1981	-	11.4

COMMENTS: LANCE has replaced HONEST JOHN and SERGEANT missiles in the U.S. Army and NATO Armies on a less than one-for-one basis. The FMC M688 auxiliary vehicle carries a load hoist and two reserve missiles. Both the M752 and M688 are mounted on the M667 basic vehicle. LANCE missile is composed of three main subsections: the missile main assemblage, the warhead section, and four control surfaces (fins). The M29 large control surfaces are used with the M234 nuclear warhead and provide aerodynamic stability to the missile by maintaining axial spin during flight. The launcher has an on-carriage traverse limitation of 285 mils with the nuclear warhead. Reliability of system is 90 percent of properly checked ready to fire missiles, 95 percent of properly fired rounds.[19]

1 Weight of nuclear missile; weight of nonnuclear missile is 3400 lb; USACGSC, *Selected Readings in Tactics*, RB-100-2, Vol VI, June 1977, p. 1-66.
2 *The World's Missile Systems*, 6th Ed., p. 284.
3 USA, System Description for Lance Guided Missile System, TM 9-1425-485-10-1, February 1972, CONFIDENTIAL (DECLASSIFIED), p. 1-46.
4 TM 9-1425-485-10-1, op. cit., pp. 1-11, 1-45; in USA, *Field Artillery Battalion, Lance*, FM 6-42, w/Ch. 1, 29 December 1980, p. 2-1, the range is given as 8-75 km in non-nuclear configuration and 8-115 km in the nuclear configuration at sea level. If the launcher altitude is greater than 3000 meters, the maximum ranges are extended to 80 km and 133 km respectively; *Military Balance* lists range as 70-130 km; *The World's Missile Systems*, 6th Ed., p. 284, lists range as 3-70 mi.
5 TM 9-1425-485-10-1, op. cit., pp. 1-61 - 1-63.
6 Warhead section is stored and shipped in the M511 container. The container is environmentally sealed, RF shielded, and pressure and humidity controlled. It has a small door to provide access to the CDS and PAL device without opening the container. FM 6-42, op. cit., p. 2-13.
7 U.S. Missiles Data Book, 1980, 4th Ed., p. 2-36; *Army Magazine*, October 1982, p. 324.
8 *Army Magazine*, October 1978, p. 144.
9 One of these battalions is earmarked for non-European contingencies; ACDA, FY 1980 ACIS, p. 153.
10 ACDA, FY 1982 ACIS, p. 244.
11 "Lance," *Armies & Weapons*, No. 42, April 1978, pp. 55-62.
12 ACDA, FY 1982 ACIS, p. 245.
13 FM 6-42, op. cit., p. V; TM 9-1425-485-10-1, op. cit., p. 1-7.
14 FM 6-42, op. cit., p. 4-8.
15 USA, *Field Artillery Lance Missile Gunnery*, FM 6-40-4, 15 June 1979, p. 2-4; and B-1. Examples of HOBs in feet given in the manual are 232 ft for Air Low and 840 ft for Air High.
16 TM 9-1425-485-10-1, op. cit., pp. 1-7, 2-7.
17 TM 9-1425-485-10-1, op. cit., p. 2-3.
18 U.S. Missile Data Book, 1980, 4th Ed., p. 2-36.
19 TM 9-1425-485-10-1, op. cit., p. 2-4.

NIKE-HERCULES (MiM-14)

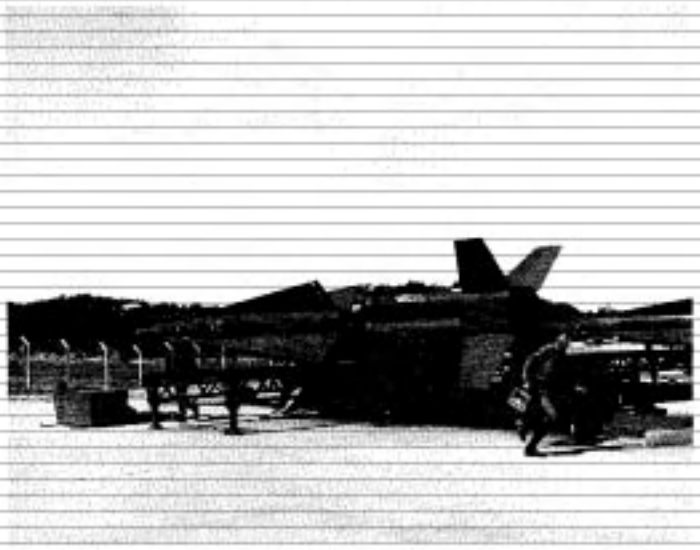

Figure 9.4 NIKE-HERCULES (MiM-14) missile.

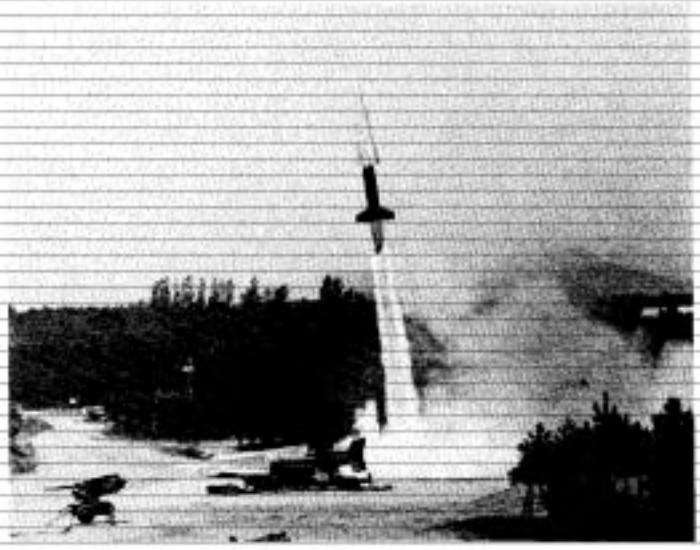

Figure 9.5 NIKE-HERCULES missile launch.

DESCRIPTION:	Medium-range, fixed, guided, surface-to-air nuclear-capable missile used by the Army in West Germany and widely deployed in the following NATO countries: Belgium, Greece, Italy, Netherlands, and West Germany.
CONTRACTORS:	Western Electric Company Burlington, NC (prime/guidance) Thiokol (propellant) Hercules, Inc. (boosters) McDonnell-Douglas (missile airframe)
SPECIFICATIONS:	
Length:	41 ft 6 in (498 in)[1]
Diameter:	31.5 in[2]
Stages:	2
Weight at Launch:	10,400 lb
Propulsion:	solid propellant with four boosters, solid sustainer
Speed:	Mach 3.3
Guidance:	radio command
Range:	75-100 mi;[3] 120-160 km;[4] 140 km surface-to-surface range[5]
DUAL CAPABLE:	yes
NUCLEAR WARHEADS:	one W31, 1 Kt range (see W31)
DEPLOYMENT:	
Launch Platform:	fixed launchers at fixed locations
Number Deployed:	500 nuclear warheads (1983), circa 200 launchers
Location:	Greece, Italy, West Germany (U.S., Belgian, Dutch, and German NIKE-HERCULES are deployed in West Germany)[6]

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NIKE-HERCULES Missile

HISTORY:

IOC: 1958

TARGETING:

Types: aircraft, secondary surface-to-surface missions[1]

Selection Capability: Target is acquired by acquisition radars and then tracked by target tracking radars which issue command, guidance, and detonation instructions to the missile's computer and warhead.

COMMENTS: Conventional warheads can be used, but the system was designed to break up formations of attacking bombers with nuclear warheads. Nuclear warheads are being reduced in Europe.[4] Concurrent with PATRIOT deployment, NIKE-HERCULES will be phased out by FY 1985.[6] Launchers in nuclear role have already been reduced in the German and Greek forces.[10] U.S. NIKE-HERCULES Battalion has 576 men.[11]

1 The *World's Missile Systems*, 6th Ed., p. 204; USA, *ADA Employment - Nike Hercules*, FM 44-95, April 1968, p. 4-1 - 4-6.
2 Ibid.
3 Ibid.
4 USA, *ADA Reference Handbook*, FM 44-1-2, 30 June 1978, p. 3-4.
5 USA, *Fire Support in Combined Arms Operations*, FM 6-20, 30 September 1977, p. F-4.
6 Bases in Florida, Alaska, and other locations overseas have been deactivated; training unit is located at Ft. Bliss, TX.
7 FM 44-95, op. cit., p. 2-15.
8 Walter Pincus, *Washington Post*, 1 November 1981, p. 1.
9 HAC, FY 1983 DOD, Part 4, p. 8.
10 JCS, FY 1981, p. 46.
11 FM 44-1-2, op. cit., p. 3-4.

PERSHING 1a (MGM-31A/B)[1]

Figure 9.6 PERSHING 1a (MGM-31A/B) missile launch.

DESCRIPTION: Medium-range, two-stage guided surface-to-surface, mobile, nuclear ballistic missile used by the Army and the West German Air Force.

CONTRACTORS:
Martin Marietta Corporation
Orlando, FL
(prime/missile)
Thiokol Chemical Corporation
(powerplant)
Oregon Metallurgical
(jet vanes)
Singer
(hydraulic actuator)
Gulton
(static inverter)
Intercontinental
(motor case)
H.I. Thompson
(nozzle)
Bendix
(guidance)
Ford Motor Company
(transporter)
Sperry Rand
(fusing and arming)

SPECIFICATIONS:

Length:	34 ft 6 in (10.39 m)
Diameter:	39.4 in;[2] 1016 mm
Stages:	2
Weight at Launch:	10,273 lb[3]
Propulsion:	solid propellant rocket motors
Speed:	Mach 8
Guidance:	inertially guided from RV separation to target
Range:	up to 460 mi (740 km); 160-720 km;[4] 115-460 mi;[5] 185-740 km[6]

DUAL CAPABLE: no

NUCLEAR WARHEADS: one W50 warhead, in three warhead sections, with three yields: 60, 200, 400 Kt (see W50)

DEPLOYMENT: battalion personnel strength is 1368 men

Launch Platform: M757 truck/TEL (5 ton, 8x8) (originally deployed on M474 tracked vehicles), air transportable in C-130, C-141, and C-5

Number Deployed: some 800+ missiles procured; 180+ launchers deployed (108 U.S. launchers in West Germany and 72 West German launchers); approximately one reload per launcher available; approximately 13 missiles are returned to the U.S. annually from West Germany and fired for training[7]

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PERSHING 1a Missile

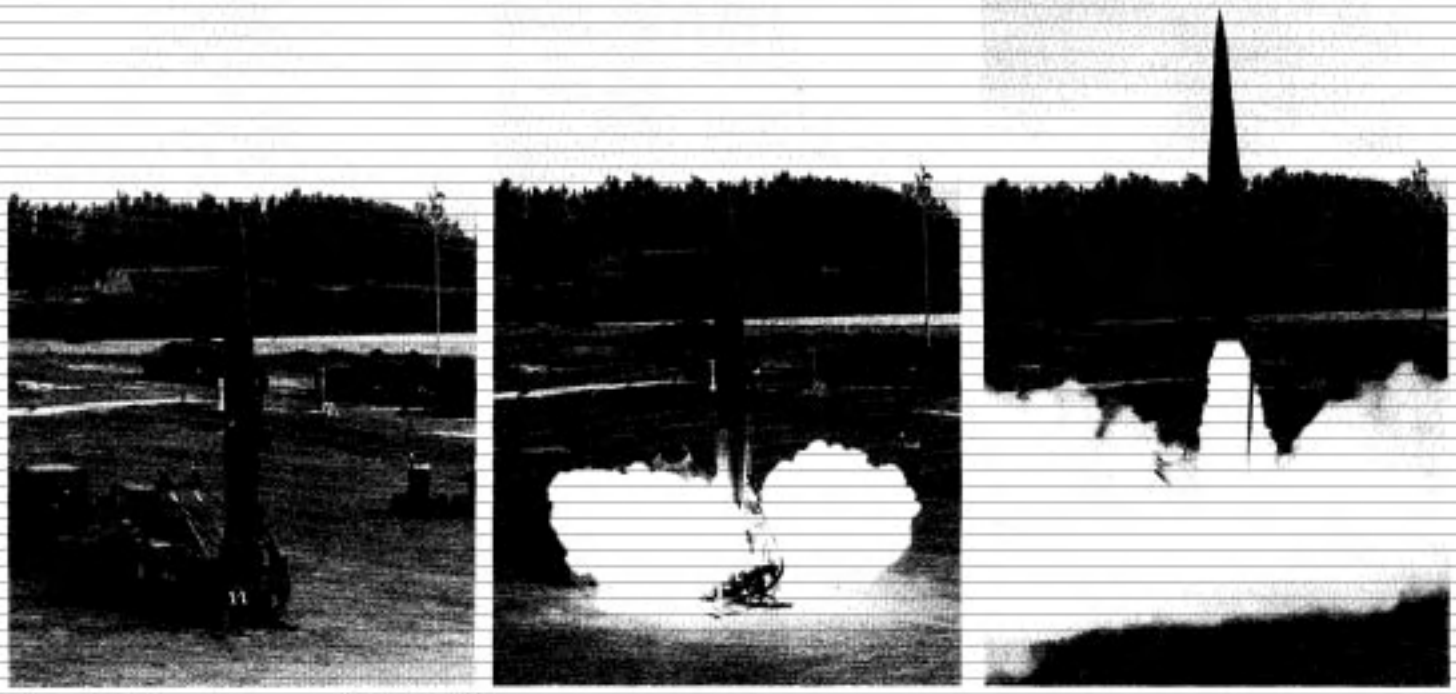

Figure 9.7 Launch sequence of **PERSHING 1a**.

Location:	U.S. Army and West German Air Force battalions/squadrons at Schwaebisch Gmuend (US); Neckars Ulm (US); Neu Ulm (US); Landsberg Lech (FRG); Geilenkirchen/Tevren (FRG); each battalion also includes a permanent "combat alert site" where launchers are on alert.
HISTORY:	
IOC:	1962
Jan 1958	program initiated to replace REDSTONE missile
Jan 1960	testing of PERSHING began
Jun 1962	first PERSHING battalion activated at Fort Sill, Oklahoma
Apr 1964	first battalion deployed to West Germany
1965	PERSHING assigned a limited QRA mission in Europe
1970	changeover from P1 to P1a for U.S. Army units completed and assumption of full QRA mission
1971	changeover from P1 to P1a for West German units completed
1974	missile is outfitted with new digital guidance and high reliability components
1976	sequential launch adaptor, which permits three missiles to be launched before shifting power and air supply cables, and an automatic reference system, is deployed allowing launch from non-presurveyed sites*
Dec 1979	NATO endorses deployment of 108 PERSHING IIs to replace U.S. PERSHING 1s in West Germany

Dec 1983	PERSHING IIs planned for initial deployment in West Germany
TARGETING:	
Types:	nuclear delivery units, command and control posts, airfields, command headquarters
Accuracy/CEP:	0.2 nm (450 m); 0.5 nm; 82 ft;[7] 400 m at max range [10]
COST:	$3.117 m (FY 1978)

FY	Number Procured	Total Appropriation ($ million)
1979	-	78.1
1980	-	79.0
1981	-	11.8

COMMENTS: PERSHING 1a upgrade replaced tracked vehicles with wheeled vehicles, added new support equipment increasing rate of fire, improved erector-launcher and systems reliability. The major innovation was the incorporation of the ability to fire from unsurveyed firing positions. Missile was unchanged. PERSHING 1a is planned to be replaced by the PERSHING II by 1985 in U.S. Forces. The PERSHING missile is the only U.S. delivery system currently dedicated solely to the tactical delivery of nuclear weapons.[11]

1. Much of the descriptive information was provided to the authors by the Pershing Program Office, USAMICOM, Redstone Arsenal, AL.
2. *The World's Missile Systems*, 6th Ed., p. 290.
3. *Ibid.*
4. *Military Balance, 1980-1981*, p. 88.
5. *Missiles of the World*, p. 88.
6. USACGSC, Selected Readings in Tactics, RB 100-2, Vol VI, June 1977, p. 1-66.
7. DOD, FY 1980 RDA, p. VII-8.
8. *Army Magazine*, October 1977, p. 164; October 1978, p. 142.
9. *The World's Missile Systems*, 6th Ed., p. 290.
10. "Pershing II: First Step in NATO Theatre Nuclear Force Modernization?" International Defense Review, August 1979.
11. DOD, FY 1981 RDA, p. 11-23.

9

PERSHING II Missile

PERSHING II

PERSHING II (PII) is a new land mobile surface-to-surface ballistic missile being developed as the follow-on replacement for the medium-range PERSHING 1a (P1a). PII is designed to provide a significant increase in range, greater accuracy, and reduction in yield over the PERSHING 1a missile. With its longer range, it will be capable of striking targets on Soviet territory from its bases in West Germany. Greatly increased accuracy is achieved by using a maneuvering RV equipped with terminal guidance radar.

The major innovation of PERSHING II is its all-weather Radar Area Correlation Guidance (RADAG) which takes radar "pictures" of the target area, compares them with digital information stored in the RV's computer, and makes course adjustments until the pictures correspond and the warhead hits the target.

The PERSHING II missile originated as a short-range design with higher reliability and accuracy than the PERSHING 1a.[1] In 1977, the extended-range missile was adopted with an alternative reduced-range missile (designated PERSHING RR or PERSHING 1b) being maintained as an option.[2] The PERSHING II currently has two configurations: (1) a two-stage missile with a second stage propulsion section and (2) a single-stage missile consisting only of the first stage.

The Air Force has also proposed a Medium Range Ballistic Missile (MRBM)[3] as a competitor or follow-on to the GLCM and PERSHING. The MRBM under consideration was a longer range, road mobile, MIRVed missile. A feasibility study concerning the MRBM was completed by the Air Force in March 1979. A number of systems were considered as an MRBM candidate, including a two-stage MINUTEMAN III with modifications to guidance and reentry systems. The MRBM, however, was shelved in favor of the PERSHING II.

Planned deployment of PII includes a brigade of three U.S. battalions, containing four firing batteries (9 launchers each), which each have three firing platoons. P1a's are currently deployed overseas with U.S. Army and West German Air Force units in West Germany. A total of 108 PII launchers will initially be deployed in West Germany, replacing U.S. launchers on a one-for-one basis.

PERSHING II operations will include one platoon (3 launchers) of each battalion on "quick reaction alert" (QRA) at all times. During wartime, batteries would disperse into wooded areas and launchers would be set up requiring only a clear space of six feet diameter above the missile to fire.[4] After a missile is fired, the unit would quickly relocate to another area and set up again to refire.[5] "Combat alert sites" (QRA sites) are not considered to be survivable and missiles must reach "covert field firing positions" to avoid detection and target acquisition.[6]

In the FY 1982 budget process the W86 earth penetration warhead (EPW) for the PERSHING II was cancelled by DOD. Because the PII had become a long-range system designed to meet NATO requirements, the need for an EPW was no longer thought justified. The short-range system first envisioned five years earlier had different targets for which the EPW was thought important.[7]

1 Martin Marietta began promoting a PERSHING II two-stage 400 nm missile and single-stage variant which would allow two missiles per launcher in 1977; see "Pershing, Pershing 1a, Pershing II: Evolution of a Total Weapon System," November 1977.
2 HAC, FY 1983 DOD, Part 4, p. 427.
3 HAC, FY 1980 DOD, Part 2, pp. 442-444.
4 HAC, FY 1983 DOD, Part 4, p. 402.
5 HASC, FY 1983 DOD, Part 3, p. 764.
6 SASC, FY 1981 DOD, Part 5, p. 2827.
7 HASC, FY 1981 DOD, Part 4, Book 2, p. 2309.

PERSHING II[1]

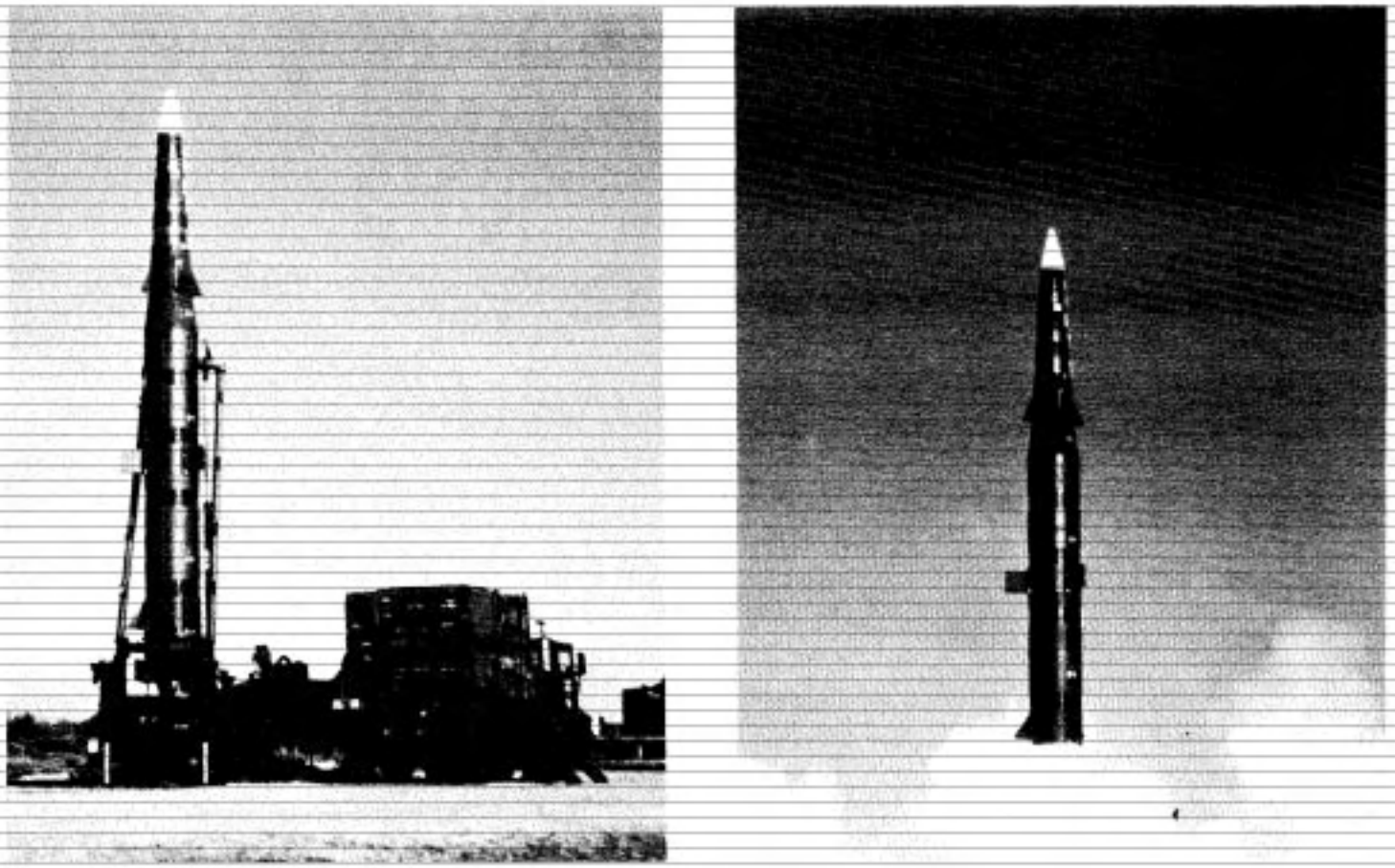

Figure 9.8 PERSHING II missile launch.

DESCRIPTION: Two-stage, solid propellant, medium-range, highly accurate, low yield, ballistic missile for use in Europe.

CONTRACTORS:
Martin Marietta Aerospace
Orlando, FL
(prime)
Goodyear Aerospace
Corporation
Akron, OH
(guidance)
Singer Co., Kearfott Div.
Little Falls, NJ
(inertial measuring system)
Bendix Corporation
Teteboro, NJ
(computers and power supplies)
Hercules, Inc.
Salt Lake City, UT
(propulsion)

SPECIFICATIONS:

Length:	413.5 in
Diameter:	39.4 in[2]
Stages:	2
Weight at Launch:	15,873 lb;[3] 10,143 lb;[4] 16,400 lb[5]
Propulsion:	solid
Speed:	Mach 8

9

PERSHING II Missile

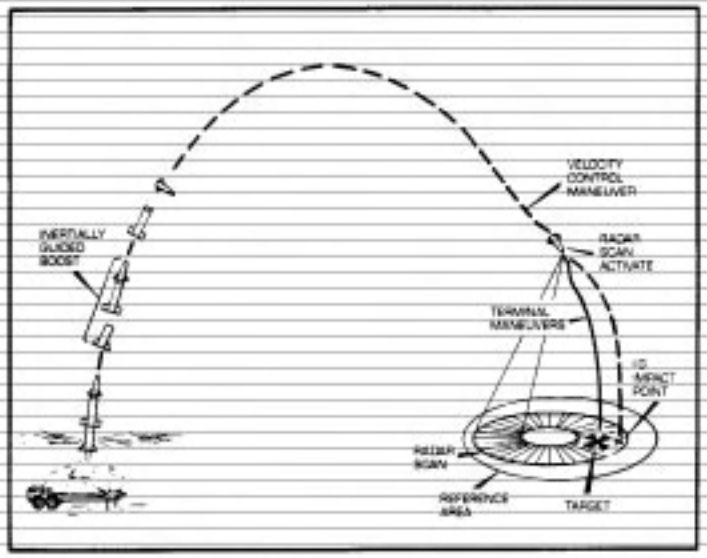

Figure 9.9 Flight sequence of **PERSHING II** missile, showing radar scanning to increase accuracy.

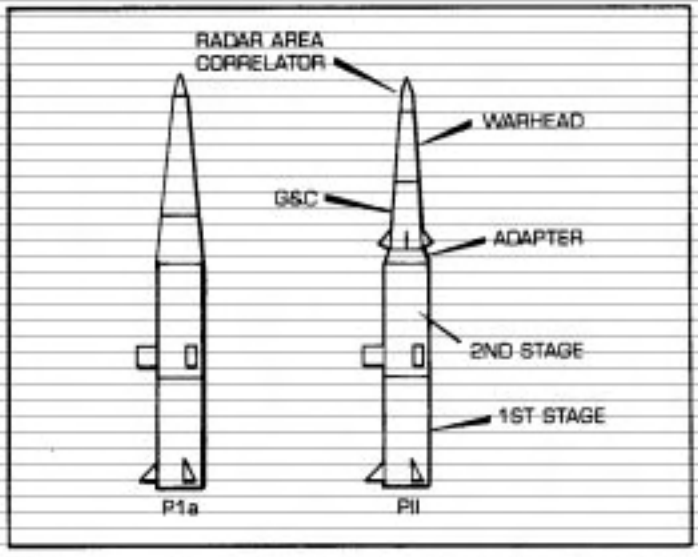

Figure 9.10 Comparison of **PERSHING 1a** and **PERSHING II** missiles.

Guidance:	boost guided phase inertial equipment; all-weather radar area correlation (RADAG) terminal guidance.[6] Radar guidance compares a prestored map of the target area with return signals, generating course changes in the RV.
Throwweight/ Payload:	1470 lb;[7] 650 lb,[8] payload comparable to P1a[9]
Range:	1300 km,[10] 1500-1800 km[11]
DUAL CAPABLE:	no[12]
NUCLEAR WARHEADS:	one W85, 5-50 Kt range (see W85)
DEPLOYMENT:	
Launch Platform:	PERSHING II will use the P1a erector-launcher with upgraded ground support equipment.[13]
Number Planned:	approximately 384 missiles;[14] PII will reportedly replace U.S. P1a missiles on a one-for-one basis[15]
Location:	PII Battalions (12 batteries) will be located at Neu Ulm, Neckars Ulm, and Schwaebisch Gmuend, West Germany; one training battalion (4 and 2/3 batteries) will be located at Fort Sill, OK
HISTORY:	
IOC:	December 1983[16]
Jan 1972	development of PERSHING follow on begins
Apr 1974	Martin Marietta awarded contract to develop more accurant version of PERSHING 1a
FY 1975	PII system requirements document approved and PII Advanced Development initiated[17]
Nov 1977	first flight of new guidance aboard modified P1a
Aug 1978	PII program is directed to work toward the extended-range variant by the Secretary of Defense[18]

Dec 1978	PII program approved to enter FSED and a planned 57-month Engineering Development program[19]
Feb 1979	engineering development begins
Aug 1979	Secretary of Defense directs Army to plan for August 1983 IOC[20]
Dec 1979	NATO endorses deployment of 108 PIIs and readjusts IOC to match GLCM IOC
Feb 1980	President assigns PII DX-status, highest national priority for development[21] President approves Program of Cooperation with West Germany to develop P1a follow-on[22]
Apr 1982	first planned flight test is cancelled
Jun 1982	full production contract awarded in accelerated concurrent development and production program
Jul 1982	first flight test of PII is unsuccessful[23]
Dec 1983	initial deployment in West Germany[24]
end 1986	PII replacement of U.S. P1a's completed[25]

TARGETING:

Types:	hardened and soft missile sites, airfields, naval bases, nuclear, biological and chemical storage sites, command and control centers, headquarters, rail yards, road networks/choke points, ammunition and petroleum storage facilities, troop concentrations and facilities, dams/locks, masonry bridges, and tunnels[26]
Retargeting:	rapid retargeting capability; immediate retargeting with target data available, can generate new target data immediately[27]
Accuracy/CEP:	45 m; 20-45 m CEP objective; RADAG correlates returns from an initial 350 square nm area surrounding the target with a prestored reference map of the target area, obtains several such correlations during terminal descent, and updates the inertial position of the RV[28]

9

PERSHING II Missile

COST:

Unit Cost: $5,475,824 (FY 1983) (unit)[29]

Program Cost:

Development:	$625.7 m
Procurement:	$927.3 m
Operating/Support:	$2781.3 m (FY 1980)[30]
Development:	$691.6 m
Procurement:	$2120.8 m (FY 1983);[31]
	$2737.6 m (Dec 1982)

FY	Number Procured	Total Appropriation ($ million)
1977 & prior	-	63.3[32]
1980 & prior	-	255.7
1981 & prior	-	408.0[33]
1981	-	151.4
		(146.0 requested)
1982	21	372.2[34]
1983	(91)	110.9[35]
1984	95	457.4
1985	104	447.3
1986	77	?

COMMENTS: PII will use same ground support equipment as P1a system. Option for a short-range, single-stage version of PERSHING II (known as PERSHING II RR (reduced-range) or PERSHING 1b to meet requirements to replace West German P1a's is being maintained.[36] The short-range PERSHING II is also considered for deployment to U.S. Army units if the long-range missile is rejected.[37]

1 Much of the descriptive information was provided to the authors by the Pershing Program Office, USAMICOM, Redstone Arsenal, AL.
2 *The World's Missile Systems*, 6th Ed., p. 280.
3 Ibid.
4 *U.S. Missile Data Book, 1980*, 4th Ed., p. 2-65.
5 Pershing Program Office, Redstone Arsenal, AL.
6 ACDA, FY 1979 ACIS, p. 115.
7 *The World's Missile Systems*, 6th Ed., p. 280.
8 *U.S. Missile Data Book, 1980*, 4th Ed., p. 2-65.
9 ACDA, FY 1981 ACIS, p. 235.
10 HAC, FY 1982 DOD, Part 3, p. 522.
11 DOD, FY 1982 Annual Report, p. 66, lists the unclassified PII range as 1000 km. The true range is classified.
12 DOD, FY 1981 RDA, p. VII-7.
13 16-2/3 "battery sets" will be procured consisting 9 launchers, 9 missiles, 4 platoon control centers and other ground support equipment per battery set; HASC, FY 1983 DOD, Part 3, p. 762.
14 Of the approximately 384 missiles planned, approximately 228 will be for operational purposes (basic load and reloads/spares); 24 will be maintenance missiles and the remainder will be for 10 years of weapons testing; HASC, FY 1983 DOD, Part 3, p. 762; 764.
15 HASC, FY 1982 DOD, Part 2, p. 237.
16 SASC, FY 1982 DOD, Part 7, p. 3803; IOC is defined as 9 launchers and 13 missiles; HAC, FY 1983 DOD, Part 4, p. 431.
17 HAC, FY 1980 DOD, Part 2, p. 863; ACDA, FY 1978 ACIS, p. 116.
18 Ibid.
19 Ibid.
20 HASC, FY 1982 DOD, Part 2, p. 237.
21 HASC, FY 1982 DOD, Part 2, p. 238; HAC, FY 1983 DOD, Part 4, p. 408, 444; SASC/SAC, Joint FY 1981 Mil Con, p. 387.
22 Ibid.
23 Walter Pincus, Washington Post, 23 July 1982, p. 8.
24 DOD, FY 1983 RDA, p. VII-13.
25 Ibid.
26 ACDA, FY 1979 ACIS, p. 116.
27 SASC, FY 1980 DOD, Part 6, p. 3499; new radar reference scenes for targets which have not been preplanned will be generated in the field by the battalion Reference Scene Generation Facility, utilizing a Defense Mapping Agency data base; HAC, FY 1982 DOD, Part 3, p. 522.
28 ACDA, FY 1979 ACIS, p. 115.
29 DOD, Procurement Programs (P-1), 8 February 1982, p. A-6.
30 HAC, FY 1980 DOD, Part 2, p. 864; in escalated dollars, through 1986.
31 HASC, FY 1983 DOD, Part 3, p. 775.
32 ACDA, FY 1979 ACIS, p. 117.
33 *Army Weapons Systems*, 80, n.d., p. 19.
34 39 missiles were requested, but only 21 were authorized due to cost overruns; HAC, FY 1983 DOD, Part 4, p. 398.
35 HASC, FY 1983 DOD, Part 3, p. 762; $619.9 m was requested for 91 missiles, but only $110.9 was appropriated; DOD, FY 1984 Annual Report, p. 255.
36 HASC, FY 1982 DOD, Part 2, p. 238.
37 HAC, FY 1983 DOD, Part 4, p. 443.

W85

FUNCTION:	Air burst/surface burst warhead being developed for the PERSHING II long-range theater ballistic missile system.
WARHEAD MODIFICATIONS:	none
SPECIFICATIONS:	
Yield:	selectable;[1] low Kt; 5-50 Kt range; 10-20 Kt[2]
Weight:	less than 1600 lb[3]
Dimensions:	
Length:	41.7 in[4]
Diameter:	12.4 in[5]
Materials:	oralloy warhead;[6] contains IHE[7]
SAFEGUARDS AND ARMING FEATURES:	CAT F PAL; airburst and surface burst; launch requires PAL, warhead intent (safety), and missile ignition enabling coded signals
DEVELOPMENT:	
Laboratory:	LANL
History:	
1979	Lab assignment (Phase 3) (through FY 1983)[8]
1983	initial deployment (Phase 5)
Production Period:	1983-[9]
DEPLOYMENT:	108 PERSHING II launchers are scheduled to be deployed in West Germany beginning in 1983; some 384 missiles will be deployed.
Service:	Army
Allied User:	none[10]
Location:	West Germany
COMMENTS:	W85 will be an adaptation of the already developed B61 Mod 4 bomb.[11] Also considered as possible candidates for PII were an adaptation of the W70 Mod 1 or Mod 2,[12] and W80.[13] Warhead section is a welded aluminum monocoque structure overwrapped with a rubber modified silica phenolic heatshield. Warhead and electrical connections including the safe and arm fuze (SAF) system are mounted inside the warhead section.

1 ACDA, FY 1982 ACIS, p. 203; SASC, FY 1982 DOD, Part 7, p. 3888.
2 *Aerospace Daily*, 3 July 1980, p. 16; *International Defense Review*, August 1979.
3 Weight of reentry vehicle, AWST, 2 August 1982, p. 20.
4 Information provided to authors by Pershing Program Office, USAMSCOM, Redstone Arsenal, AL.
5 Ibid.
6 HASC, FY 1982 DOE, p. 102.
7 HASC, FY 1982 DOE, p. 217.
8 DOE Budget Justification, FY 1983, p. 51; remained in Phase 3 during FY 1980; SASC, FY 1981 EWDA, p. 810.
9 Funds for production of W85 are included in FY 1983 DOE Budget.
10 West Germany, presently equipped with the PERSHING 1 system, has not yet decided on a replacement system.
11 HAC, FY 1980 DOD, Part 2, p. 883; USANCA "Materiel and Safety Significant Activities (1 January 1978-31 December 1978)," n.d., p. 2; "Pershing II: First Step in NATO Theatre Nuclear Force Modernization," *International Defense Review*, August 1979.
12 ACDA, FY 1979 ACIS, p. 115.
13 SASC, FY 1979 DOE, p. 59.

9

Corps Support Weapon System

Corps Support Weapon System

The replacement for the LANCE missile, the Corps Support Weapon System (CSWS), often designated LANCE II or Improved LANCE, is currently under development and planned for the early 1990s.[1] The new missile is envisioned as an all-weather, dual capable, air transportable replacement with an improved CEP and rate of fire.[2] The CSWS would be deployed at the Corps level with the mission of interdicting enemy surface-to-air missile systems and second echelon ground forces at a range of 120-140 miles, with precision conventional, nuclear (enhanced radiation), and chemical warheads.[3] The CSWS will have the capability of striking targets three times further, five times more accurately, and with a higher rate of fire than the present LANCE.[4] An anti-armor capability, by deploying terminally guided submunitions and advanced target acquisition and guidance systems, is also planned.

The CSWS is part of the larger Army-Air Force Joint Tactical Missile System (JTACMS) program to develop standoff weapons to attack moving rear echelon targets deep behind enemy lines. The JTACMS will use Assault Breaker technology, developed under the Defense Advanced Research Projects Agency (DARPA) program, to develop a surface-to-surface weapon system for conventional and nuclear "deep battlefield interdiction."[5] Two delivery modes are under investigation within JTACMS: air-launched (the Air Force's Conventional Standoff Weapon) and ground-launched (the Army's CSWS). The JTACMS program originates with the Assault Breaker program started in 1978 to develop new standoff weapons for second echelon armor strikes. Assault Breaker (and now JTACMS) examined alternatives such as derivatives of Multiple Launch Rocket System (MLRS), PATRIOT, and LANCE as capable of carrying new warheads and being compatible with new guidance and target acquisition systems. The LANCE

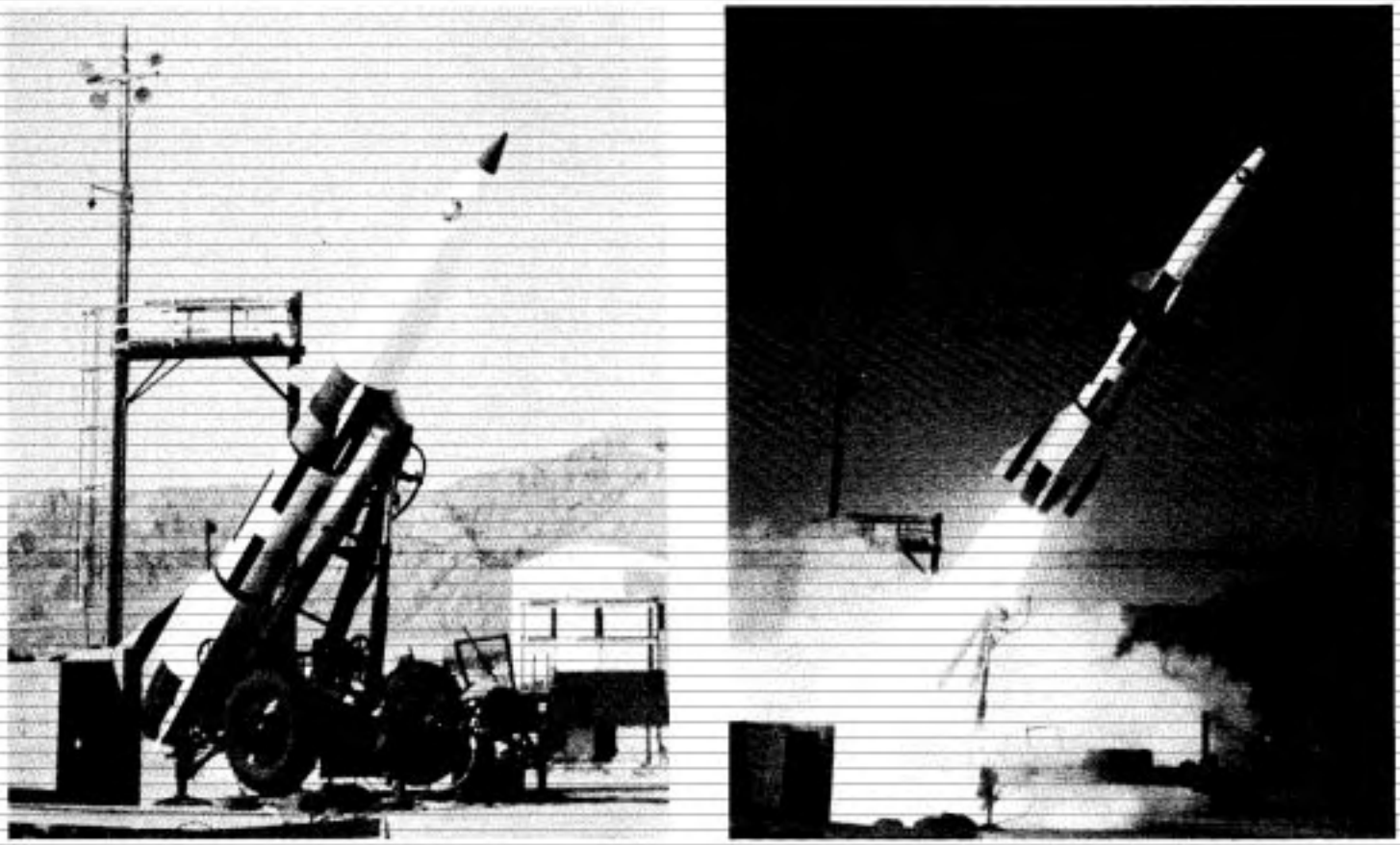

Figure 9.11 U.S. Army Assault Breaker prototype missile, similar in design to the nuclear armed **Corps Support Weapon System**.

1 DOD, FY 1983 RDA, p. VII-12.
2 DOD, FY 1981 RDA, p. VII-6.
3 HASC, FY 1982 DOE, p. 45; AW&ST, 3 November 1982, p. 77.
4 Information provided by Vought Corporation.
5 DOD, FY 1984 Annual Report, p. 132.

replacement, originally designated the Nuclear Corps Support Missile System, was an original part of the Assault Breaker concept.

The merging of the Army and Air Force programs in FY 1982 led to a slowing down of the CSWS program pending a clearer definition of requirements and operational concepts.[6] The joint development program incorporates the Air Force and Army development programs and takes advantage of common guidance, propulsion, conventional warheads, and electronic components.[7] Procurement plans, according to one report, are now for some 5500 missiles for the Army, with an accelerated IOC of 1986-1987.[8]

Competitor missiles for CSWS include the T22, a LANCE missile variant being developed by Vought and first tested in August 1979; the T16, a PATRIOT missile variant being developed by Martin Marietta with a nuclear warhead and surface-to-surface capability;[9] and the T19, a "generic" missile capable of both Army and Air Force use. A nuclear warhead for the CSWS is being developed. According to one report, it would range from 10-40 Kt and would incorporate enhanced radiation features.[10]

COST:

FY	Number Procured	Total Appropriation ($ million)
1981	-	7.6
1982	-	11.8
1983	-	6.1
1984	-	50.2
1985	-	126.5

6. *Aerospace Daily*, 25 August 1982, p. 305.
7. HAC, FY 1982 DOD, Part 9, p. 478.
8. AW&ST, 1 November 1982, p. 77.
9. SASC, FY 1980 DOD, Part 6, p. 3444.
10. AW&ST, 1 November 1982, p. 77.

9

Nuclear Artillery

Nuclear Artillery

Nuclear artillery is one of the most widely dispersed and numerous of weapons. From 1953, when the mammoth 280mm cannon was first sent to West Germany, until today, six nuclear artillery warhead types have been produced, and virtually every large artillery gun has become capable of firing nuclear rounds. Nuclear artillery is now in the midst of a major modernization, with guns and projectiles being upgraded and replaced.

The U.S. Army has over 3500 nuclear capable artillery guns deployed: 748 M114 155mm guns, 2200 M109 155mm guns, and 1046 M110 8-inch (203mm) guns.[1] Nuclear artillery is also used in the Marine Corps. The seven NATO allies with nuclear artillery—Belgium, Greece, Italy, the Netherlands, Turkey, United Kingdom, and West Germany—all use U.S.-designed artillery, particularly the standard M109 and M110 guns, but also deploy a number of obsolete guns (see Table 9.1).

Approximately 5000 nuclear artillery shells are estimated to be deployed, and of these, most are in Europe. Nuclear artillery is low yield, with the explosive capacity of the warheads varying from about 0.1 kiloton (for the W48) to about 12 Kt (for the W33). Three warhead types are currently deployed—the 1-12 Kt W33 8-inch fission warhead, the 0.1 kiloton W48 155mm fission warhead, and the 1-2 Kt W79 8-inch enhanced radiation warhead (see Chapter Three). The projectiles are always fired as air bursts[2] with accuracies (for W48 and W33) of 40, 100, and 172 meters CEP at "short, medium, and long range."[3]

Both 155mm and 203mm guns are being increasingly adapted in military formation, with the replacement of both 105mm and 175mm non-nuclear capable guns. In addition, there has been an increase in the number of guns in combat units both as a measure to generally increase firepower, and as an increase following the retirement of HONEST JOHN rockets from divisions.[4]

Figure 9.12 The first live nuclear artillery test, **Shot Grable**, on 25 May, 1953. A 280mm nuclear artillery shell with an explosive yield of 15 Kt was exploded in an airburst over the Nevada Test Site.

1 HASC, FY 1979 DOD, Part 3, Book 1, p. 773.
2 *Military Applications of Nuclear Technology*, Part 1, p. 13; Part 2, p. 35.
3 Ibid., Part 2, p. 43.
4 JCS, FY 1981, p. 46.

Two new nuclear capable 155mm guns are beginning to enter the U.S. and NATO armies: a new long-range towed howitzer (M198) equipping light Army units and the Marines, and a European-designed and produced gun—FH-70/SP-70—available in towed and self-propelled designs. The SP-70 is the self-propelled design which features a high rate of fire, an automatic loader, and improved survivability and mobility. Older M1, M44, and M109 guns will be withdrawn from Italian, British, and West German units as newer FH-70/SP-70 guns are deployed in the mid-1980s. U.S. production lines for M109A2 and M198 will be open in FY 1984 and beyond, primarily for reserve forces.[5]

The 155mm artillery unit can contain 18-24 guns, organized with three batteries of either six or eight guns. An eight inch artillery unit is organized as either a 12, 18, or 24 howitzer battalion with two or three batteries, and four to six sections of four guns, the basic firing element. Self propelled artillery is assigned to mechanized and armor units for support, while towed artillery is assigned to infantry and other light units. Nuclear artillery warheads are maintained available to the firing element, stored in special two-and-one-half ton trucks, each with a one-and-one-half ton trailer.[6]

The range and design of nuclear artillery is beginning to reach practical limits, with restraints in noise, target acquisition, accuracy, and reliability.[7] The newest guns and barrels have ranges of 30 km, with older M109 and M110 guns being converted with new longer tubes and muzzle brakes (and designated A1 and A2 versions). The new tubes—33 vs. 20 caliber in the M109 and 37 vs. 25 caliber in the M110—increase muzzle velocity and range from 18 to 30 km for 155mm guns and from 14 to 30 km for 8-inch guns. Nuclear artillery projectiles are also becoming more sophisticated (and expensive), incorporating timing and memory assemblies, fuze subcomponents, power supplies, electronic programmers, target sensors, and rocket motors in the shell (see Future Artillery).

Future artillery guns are being examined to provide "important capabilities for responding rapidly and accurately to fire missions" and "reduced emplacement" times.[8] The new weapon is envisioned to have short recoil cycle time, burst rate-of-fire, automatic ammunition handling, loading and resupply, and automated position location and weapons alignment. During 1978, the Defense Nuclear Agency initiated a study to determine the feasibility of Long Range Cannon Artillery, an 8-inch, 80 km, nuclear capable shell for the mid-1980s. A Division Support Weapon System is also being developed by FMC. It will be a 155mm, 45 caliber, automatic loading gun.

Table 9.1
Nuclear Artillery Guns

Type	Country in Use
155mm	
M-2	Italy, Turkey
M59	Turkey
M115 (M1)	Italy (M1A1), Turkey, United States, West Germany
M44 SP	Belgium, Italy, Turkey
M109 SP	Belgium, Greece, Italy, Netherlands (M109A1), Turkey, United Kingdom, United States, West Germany (M109G)
M198	United States
FH-70/SP-70	Italy, United Kingdom, West Germany
8-inch	
M115	Belgium, Greece, Italy, Netherlands, Turkey
M55 SP	Italy
M110 SP	Belgium, Greece, Netherlands, Turkey, United Kingdom, United States, West Germany

Source: DOD, "Rationalization/Standardization Within NATO," Fifth Report, 29 January 1978; Seventh Report, January 1981.

5. DOD, FY 1984 Annual Report, p. 133.
6. U.S. Army, "300 Direct Support Field Artillery Battalion," TC 6-50-1, January 1981, p. 6-2.
7. HASC, FY 1979 DOD, Part 3, Book 1, p. 772.
8. Information provided by the Cannon Artillery Weapons System Project Manager.

M109 155mm Gun[1]

Figure 9.13 M109 155mm self-propelled gun.

DESCRIPTION:	Heavy, self-propelled 155mm artillery gun used by the U.S. Army, Marine Corps, NATO, and allied armies	**SPECIFICATIONS:**[2]	
		Max Range:	14,600 m (initial); 18,100 m (A1); 24,000 m (A2); 30,000 m (A3 and upgraded A2)
MODIFICATIONS:	M109A1(SP), M109A2(SP), M109A3(SP), M109G(SP)	Weight:	52,461 lb (initial); 53,060 lb (A1); 54,700 lb (A2)
CONTRACTORS:	Bowen-McLaughlin-York York, PA (final assembly)	Weight of HE Round:	95-104 lb
		Rate of Fire:	4/min (first 3 min); 1/min thereafter
	Detroit Diesel (engine)		
	Cadillac Division, General Motors Corp. (development)	Crew:	6
		Prime Mover:	armored tracked vehicle, max speed 35 mph (roads), amphibious to 42 inches of water (with kit); air transportable (C-5A)

NUCLEAR WARHEADS: W48, 0.1 Kt yield (see W48); compatible with W82

DEPLOYMENT:

Number Deployed: 1608 (Army) (1978);[3] 2100 (Army);[4] 2200 (Army) (1983)[5]

Location: United States, Europe, South Korea, Japan (Okinawa)

Allied User: West Germany (M109G) (gun modified by Rheinmetall); Italy (M109G), Netherlands, Belgium, South Korea

HISTORY:

IOC: 1969

1953 development of M109 began

COST:[6] M109(A2)

FY	Number Procured	Total Appropriation ($ million)
1980 & prior	?	474.5
1981	0	27.3
1982	0	?

COMMENTS: Basic M109 carried 20 caliber (156 in) gun; A1 and later versions upgraded to 33 caliber (238 in) gun; M109A3 is the name for the retrofitted M109A1; M109A2 improves gun mount design, hydraulic components, safety features, and ammunition stowage (36 rounds),[7] in full scale production; new production M109A1s and later versions contain crew safety and ammunition stowage improvements.

1 USAFGSC, *Selected Readings in Tactics*, RB 100-2, Vol. VI, June 1977, pp. 1-66, 1-84; *Army Magazine*, October 1977, October 1981.
2 USA, *155mm Howitzer, M109, M109A1, Self Propelled*, FM 6-8, June 1974.
3 HASC, FY 1979 DOD, Part 3, Book 1, p. 773.
4 *Army Magazine*, October 1978, p. 197.
5 HASC, FY 1979 DOD, Part 3, Book 1, p. 773.
6 USA, *Army Weapons Systems*, 80, n.d.
7 *Military Review*, May 1980, p. 83.

M198 155mm Gun[1]

Figure 9.14 M198 155mm towed gun.

DESCRIPTION:	Medium, towed 155mm artillery gun used by light units of the Army and Marine Corps	**SPECIFICATIONS:**	
		Max Range:	18,000 m;[2] 30,000 m (rocket assisted projectiles)
MODIFICATIONS:	none	Weight:	15,795 lb
CONTRACTORS:	Rock Island Arsenal IL (gun mounts and final assembly) Condec Corp. Greenwich, CT (carriages) Watervliet Arsenal NY (cannon) Numax Electronics Hauppauge, NY (fire control)	Weight of HE Round:	95-104 lb
		Rate of Fire:	4/min (first 3 min); 20/hr thereafter
		Prime Mover:	M813 5-ton truck, speed 34 mph (roads); helicopter and air transportable; fordable to 30 inches of water
		Crew:	11

NUCLEAR WARHEADS: W48, 0.1 Kt yield (see W48); compatible with W82

DEPLOYMENT:

Number Deployed: 468 (Army) (1983)[2]

Location: United States, Japan (Okinawa), South Korea

Allied User: none known

HISTORY:

IOC: 1979

1968 development of M198 begins

COST:[1]

FY	Number Procured	Total Appropriation ($ million)
1980 & prior	0	138.0
1981	0	44.9
1982	-	?

COMMENTS: M198 is used by United States airborne and light infantry units, replacing the M114.

1 USAOGSC, Selected Readings in Tactics, RB 100-2, Vol. VI, June 1977, pp. 1-63, 1-64; Army Magazine, October 1977, October 1981.
2 With standard ammunition.
3 HASC, FY 1979 DOD, Part 3, Book 3, p. 773.
4 USA, Army Weapons Systems, 80, n.d.

M110 8-inch (203mm) Gun[1]

Figure 9.15 M110 8-inch (203mm) self-propelled howitzer.

DESCRIPTION:	Heavy, self-propelled 8-inch (203mm) artillery howitzer used by the Army, Marine Corps, NATO, and allied armies.	Weight:	58,500 lb (initial); 60,100 lb (A1); 62,500 lb (A2)
		Weight of HE Round:	228 lb
MODIFICATIONS:	M110A1(SP), M110A2(SP)	Rate of Fire:	1 every 2 min
CONTRACTORS:	Bowen-McLaughlin-York York, PA (final assembly) Detroit Diesel (engine) Pacific Car and Foundry Renton, WA (NBC protection system)	Crew:	13
		Prime Mover:	tracked vehicle; speed 9 mph (cross country); 34 mph (roads); fordable to 42 inches of water; air transportable (C-5A)
		NUCLEAR WARHEADS:	W33, sub-12 Kt (see W33); compatible with W79 (see W79)
SPECIFICATIONS:			
Max Range:	16,800 m (initial); 20,600 m (A1); 29,000 m (A2)		

9

M110 8-inch (203mm) Gun

DEPLOYMENT:

Number Deployed:	720 (Army) (1978); 1046 (Army) (1983)[2]
Location:	United States, Europe, South Korea, Japan (Okinawa)
Allied User:	Belgium, Italy, Netherlands, United Kingdom, West Germany

HISTORY:

IOC:	1961
1983	in full scale production (A2)

COST:[3] M110(A2)

FY	Number Procured	Total Appropriation ($ million)
1980 & prior	?	252.3
1981	0	11.3
1982	0	?

COMMENTS: A1 version carried 25 caliber gun, no muzzle brake; A2 gun incorporated muzzle brake, longer (37 caliber) cannon; conversion of M110A1s to A2 configuration by field installation of muzzle brakes is in progress. M110 is deployed with 12-24 guns per battalion.

1 USACGSC, *Selected Readings in Tactics*, RB 100-2, Vol. VI, June 1977, p. 1-68; *Army Magazine*, October 1977, October 1981.

2 HASC, FY 1983 DOD, Part 3, Book 1, p. 773.
3 USA, *Army Weapons Systems*, 80, n.d.

Future Nuclear Artillery

The W82 155mm nuclear artillery projectile is currently under development, with a planned deployment date of late-1986. The development program went largely unfunded during most of the Carter Administration, but has been brought to full funding in the Reagan budgets. The new projectile will have an enhanced radiation capability.[1] The W82 thus will be the third neutron weapon in the stockpile, joining the W70-3 and W79 already in production.

Development of a new 155mm nuclear projectile began in 1969 when the Army argued that a modernized artillery shell was needed to replace the W48. Development of the W74 began that year and continued until 1973 when the Joint Committee on Atomic Energy terminated the program due to excessive cost and the use of obsolete (non "neutron bomb") technology. Army requests to reinitiate the 155mm development were denied by Congress in 1975 and 1976, but in 1977 a new analysis of modernization requirements led to Congressional authorization and appropriation of funds to reinitiate a research program. The new projectile (W82), with an improved fission yield component design, has the technical capability for conversion to enhanced radiation yield in the field. This projectile continued in development until 1979 when Secretary of Defense Brown directed a 67 percent cut in the fiscal year 1981 budget request, and then zeroed out fiscal year 1982 funds.[2] The 155mm nuclear artillery shell presently in research and development, however, has again risen in cost.[3] That factor, along with the political implications of the enhanced radiation yield, make the weapon controversial.

Much controversy within the nuclear weapons program has been created over whether the new warhead should be fission yield, enhanced radiation yield, or both. Although technically the warhead is capable of accepting an ER option,[4] it has been referred to in some official reports as having a fission yield.[5] According to some reports,[6] the proposal to build the warhead as an ER warhead had been dropped, but it appears that planning and development continued with the intent of at least having an ER capability.[7]

Compared to the W74, which was cancelled by Congress in 1973, the features of the W82 are not impressive. W74 was designed for two yields, larger than the 0.1 kiloton W48.[8] The W82 yield also exceeds that of the W48. The W74 reportedly had a CEP of 20, 60, and 110 meters at short, medium and long ranges, comparable to the W82.[9] The W74, when cancelled by Congress, cost $452,000 each,[10] and the W82 cost is now estimated at close to $3 million each. The huge cost can be largely attributed to the more expensive enhanced radiation design, with its tritium requirements.

Table 9.2
Comparison of Old and New 155mm Nuclear Artillery Shells

	W48	W82
Users:	Army, Marine Corps, NATO	Army, Marine Corps, NATO
Yield:	0.1 kiloton	less than 2 kilotons
Type:	pure fission	enhanced radiation
Range:	16 km	30 km
Weight:	128 lb	95 lb
Materials:	plutonium	plutonium and tritium
Cost:	less than $200,000 each	circa $2.5-3.0 million each
Development Began:	Aug 1957	1969
First Deployed:	1963	1984
Number Deployed:	3000	1000+ planned
Locations:	US, Europe, South Korea	US

1 HASC, FY 1983 DOD, Part 5, p. 693.
2 HASC, FY 1982 DOD, Part 2, p. 30; HASC, FY 1982 DOD, Part 1, p. 45.
3 Some estimates put the cost per projectile at $3 million.
4 JCS, FY 1981, p. 47.
5 JCS, FY 1982, p. 78; HASC, FY 1981 DOD, Part 4, Book 2, p. 2305.
6 Walter Pincus, *Washington Post*, 27 October 1981, p. A10.
7 Walter Pincus, *Washington Post*, 11 December 1981, p. A9.
8 *Military Applications of Nuclear Technology*, Part 1, pp. 10, 12.
9 Ibid.
10 *Military Applications of Nuclear Technology*, Part 3, p. 101.

W82

FUNCTION:	Warhead for the XM-785 Artillery Fired Atomic Projectile (AFAP) for 155mm artillery, to replace the current W48/M454 AFAP.
WARHEAD MODIFICATIONS:	Warhead is built in components, allowing easy conversion from fission yield to enhanced radiation yield.
SPECIFICATIONS:	
Yield:	less than 2 Kt;[1] exceeds that of the 0.1 Kt W48;[2] capable of accepting an ER option convertible in the field[3]
Weight:	circa 95 lb, ballistically similar to M549 rocket assist projectile (RAP) conventional round[4]
Dimensions:	
Length:	34.3 in
Diameter:	6 in
Materials:	if fission yield,[5] probably with plutonium, utilizing large amounts of tritium for ER version
SAFEGUARDS AND ARMING FEATURES:	Category D PAL, nonviolent command disable in M617 storage container,[6] improved radar fuzing for more accurate height of burst[7]

DEVELOPMENT:	
Laboratory:	LLNL
History:	
IOC:	1986
May 1976	feasibility study completed (Phase 2)[8]
Sep 1977	Lab assignment (Phase 3) (through FY 1983)[9]
Dec 1980	production engineering (Phase 4) deferred[10]
1986	initial deployment
Production Period:	1986-
DEPLOYMENT:	
Number Planned:	1000 initially (1983); as many as 2500 overall
Delivery System:	dual capable M198 and M109/A1/A2/A3 155mm howitzers; older 155mm howitzers
Service:	Army and Marine Corps[11]
Allied User:	NATO artillery units; the projectile is "compatible with the new family of howitzers being developed by the NATO allies"[12]
Location:	United States, Greece, Italy, West Germany, Turkey, South Korea

9

W82

COMMENTS: Reagan FY 1982 DOD budget requested $44.4 million for the W82.[12] The FY 1982 supplemental request for DOE also requested $7.5 million to initiate construction on W82 production facilities.[13] W82 eliminates "current projectile deficiencies in range, vulnerability, fuzing, and yield."[14] It includes a rocket assist module which extends the range over that of the M-454 AFAP. The range will be up to 30 km (in the new M-198 howitzer) and 24 km in the M-109A1 howitzer, compared to 16 km for the present projectile.[15] It is ballistically similar to a conventional round, precluding the need for a special spotting round.[17] The new projectile is more accurate than the W48, with same accuracy as the current conventional round.[18] Chamberlain Manufacturing Co. received an Army contract on 21 March 1980 for $6 million for development of XM-785 components. Training rounds include XM820 "Type X" and XM841 "Type W."

1 Walter Pincus, Washington Post, 27 October 1981, p. A10.
2 ACDA, FY 1982 ACIS, p. 280.
3 JCS, FY 1981, p. 47.
4 HASC, FY 1981 DOD, Part 4, Book 2, p. 2305.
5 JCS, FY 1982, p. 78; HASC, FY 1981 DOD, Part 4, Book 2, p. 2305; ACDA, FY 1981 ACIS, p. 278.
6 ACDA, FY 1979 ACIS, p. 136; ACDA, FY 1980 ACIS, p. 151.
7 ACDA, FY 1971 ACIS, p. 136; ACDA, FY 1980 ACIS, p. 155.
8 ACDA, FY 1979 ACIS, p. 137.
9 Development engineering requested by DOE; ACDA, FY 1982 ACIS, p. 277; ACDA, FY 1979 ACIS, p. 136. The W82 remained in Phase 3 with no production funds in FY 1979 and FY 1980; SAC, FY 1981 EWDA, p. 618.
10 HASC, FY 1982 DOD, Part 1, p. 45.
11 ACDA, FY 1979 ACIS, p. 136.
12 JCS, FY 1982, p. 78.
13 ACDA, FY 1982 ACIS, p. 278.
14 DOE, FY 1982 Supplemental Request to the Congress, Atomic Energy Defense Activities, March 1982, p. 4.
15 JCS, FY 1982, p. 78.
16 DOD, FY 1981 RDA, p. VII-6.
17 ACDA, FY 1982 ACIS, p. 278.
18 HASC, FY 1981 DOD, Part 4, Book 2, p. 2305.

Atomic Demolition Munitions and Earth Penetration Weapons

The Army (and Marine Corps) currently have two atomic demolitions munitions (ADMs) deployed: the Medium ADM (MADM) and the Special ADM (SADM) (see Chapter Three for technical description). The MADM is a 1-15 Kt nuclear land mine weighing some 400 pounds, first deployed in 1965. The SADM is a sub-1 Kt nuclear land mine weighing some 150 pounds, first deployed in 1964. MADM is emplaced by engineer teams and carried by jeeps and helicopters. SADM is man portable and emplaced by special forces and commandos teams behind enemy lines. Approximately 600 ADMs are estimated to be deployed, mostly in Europe, South Korea, Guam, and the United States. ADM teams are earmarked to provide ADM support in Allied corps sectors in Central Europe and Italy.[1] A number of NATO engineer units (British, Dutch, and West German) are also trained to emplace ADMs.

ADMs are emplaced in chambers in the ground, on bridges, or in tunnels and dams, and are detonated by timer or remote command. They would be used primarily to disrupt the movement of enemy forces and to make them concentrate in a mass to bypass obstacles (and thus create other targets for nuclear weapons). SADMs would be emplaced behind enemy lines, particularly at airfields, command posts, transportation, communications and industrial terminals, and petroleum supplies.

Work on the next generation of earth penetration weapons (EPW)/demolition munition nuclear weapons has been ongoing since the 1970s. High explosive tests that simulate the effects of low yield buried nuclear munitions on structural targets have been conducted to determine future ADM/EPW requirements. A Tactical Earth Penetrator Warhead compatible with Army missiles was proposed in 1976 and was eventually designed as the W86 EPW for the PERSHING II missile.

The W86 earth penetration warhead was a small diameter,[2] single yield[3] design. Laboratory (Phase 3) work began in 1979[4] with the idea of supplementing ADMs by providing a remote delivery capability to create barriers and a means of attacking hard, point, and subsurface targets with maximum damage and minimum fallout.[5] The W86 warhead was designed to dive about nine stories underground before exploding, to destroy point targets that require earthshock or cratering as the primary damage mechanism.[6]

Figure 9.16 Medium Atomic Demolition Munition (MADM) mock-up.

During the PERSHING II DSARC II deliberations (February 1979), the Army conducted a study examining EPW needs and effectiveness and, given its potential benefits, recommended to continue its development.[7] The EPW program was then cancelled in January 1981 because the carrying missile had changed from its original battlefield mission in 1976 to a long-range missile with different targets.[8] Cancellation was also due to budget constraints.[9] Development of the warhead was then completed and the technology was put on the shelf pending a future requirement.[10]

Another weapon, the Shallow Burst Munition—a nuclear device used at shallow depths which would provide air blast kills with reductions in thermal and nuclear radiation—was examined during 1976 but was rejected in Phase 1.

A replacement for the current MADM system has also been considered in the form of a modified B61 bomb, designated the Nuclear Cratering Explosive (NCE).[11] The number of ADMs will be gradually reduced as improved conventional capabilities are achieved. Currently there are no plans to replace them with new nuclear systems.[12] It appears that, at least for the present, there are no plans to produce a new ADM or EPW system.

1 SASC, FY 1983 DOD, Part 7, p. 4386.
2 HASC, FY 1982 DOE, p. 218.
3 ACDA, FY 1981 ACIS, p. 235.
4 Remained in Phase 3 during FY 1980: SAC, FY 1981 EWDA, p. 818.
5 HAC, FY 1980 DOD, Part 2, p. 863.
6 ACDA, FY 1979 ACIS, p. 115; USA, "Equipping the Army of the Eighties: A Statement to the Congress on the FY 1981 ARMY RDTE and Procurement Appropriations," n.d., p. 32.
7 HAC, FY 1982 DOD, Part 2, p. 876.
8 DOD, FY 1982 RDA, p. VII-8; HASC, FY 1981 DOD, Part 4, Book 2, p. 2309.
9 HASC, FY 1981 DOD, Part 4, Book 2, p. 2308.
10 HAC, FY 1982 EWDA, Part 5, p. 34; DOD, FY 1982 RDA, p. VII-8.
11 USANCA, "Materiel and Safety Division Activities, (January 1976 through December 1976)," n.d.; (July 1976 through June 1977), n.d.
12 DOD, FY 1983 RDA, p. VII-34.

GLOSSARY

Glossary of Terms

ABM System:	A system to counter strategic ballistic missiles in flight, and consisting of: 1) ABM interceptor missiles; 2) ABM launchers; 3) ABM radars, which are radars constructed and deployed for an ABM role, or of a type tested in an ABM mode.
Air-Breathing of Missile:	A missile with an engine requiring the intake of air for combustion of its fuel, as in a ramjet or turbojet. (To be contrasted with the rocket-powered missile, which carries its own oxidizer and can operate beyond the atmosphere.)
Airburst:	An explosion of a nuclear warhead above the surface as distinguished from an explosion on contact with the surface or after penetration. Also, the explosion of a nuclear weapon in the air, at height greater than the maximum radius of the fireball.
Air Defense:	Defensive measures designed to destroy attacking enemy aircraft or missiles in the earth's envelope of atmosphere, or to nullify or reduce the effectiveness of such attack.
Air-Launched Cruise Missile (ALCM):	A cruise missile transported aloft by a carrier aircraft and launched from that aircraft in flight.
Air-to-Air Missile (AAM):	A missile launched from an aircraft at a target above the surface.
Air-to-Surface Missile (ASM):	A missile launched from an aircraft to impact on a surface target.
Anti-Ballistic Missile (ABM):	A defense missile used to intercept and destroy or otherwise neutralize an attacking ballistic missile in the upper reaches of the atmosphere and beyond (endoatmosphere and exoatmosphere).
Anti-Submarine Warfare (ASW):	Operations conducted with the intention of denying the enemy the effective use of submarines.
Arming:	As applied to weapons and ammunition, the changing from a safe condition to a state of readiness for initiation.
Atomic Bomb:	An explosive projectile (usually, a gravity bomb) whose warhead contains nuclear-fissionable radioactive materials as the explosive charge, producing nuclear fusion or fission effects to destroy a target. More narrowly, a fission bomb (see), as distinguished from fusion, or hydrogen bomb.
Atomic Demolition Munition (ADM):	Nuclear device designed to be detonated on or below the surface, or under water, to block, deny and/or canalize enemy forces.
Avionics:	The application of electronics to aviation and astronautics.
Ballistic Missile:	Any missile designed to follow the trajectory that results when it is acted upon predominantly by gravity and aerodynamic drag after thrust is terminated. Ballistic missiles typically operate outside the atmosphere for a substantial portion of their flight path and are unpowered during most of the flight.

Ballistic Missile Defense (BMD): Measures for defending against an attack by ballistic missiles; for example, a system composed of antiballistic missiles and radar and control equipment designed to intercept and destroy attacking ballistic missiles before they reach their targets.

Ballistic Trajectory: The trajectory traced after the propulsive force is terminated and the body is acted upon only by gravity and aerodynamic drag.

Beam Rider/Riding:
1. A missile guided by a radar, radio, or laser beam.
2. A missile guided by an electronic beam.

Blast: The brief and rapid movement of air vapor or fluid away from a center of outward pressure, as in an explosion or in the combustion of rocket fuel; the pressure accompanying this movement. This term is commonly used for "explosion," but the two terms may be distinguished.

Bomber (Light, Medium, Heavy):
1. Light: A bomber designed for a tactical operating radius of under 1000 nautical miles at design gross weight and design bomb load.
2. Medium: A bomber designed for a tactical operating radius of between 1000 and 2500 nautical miles at design gross weight and design bomb load.
3. Heavy: A bomber designed for a tactical operating radius over 2500 nautical miles at design gross weight and design bomb load.

Booster: An auxiliary or initial propulsion system which travels with a missile or aircraft and which may or may not be separated from the parent craft when its impulse has been delivered. A booster system may contain or consist of one or more units.

Bus: The projectile of a missile, with multiple reentry vehicles (MRVs), including the RVs, guidance system, propellant, and thrust device for altering the ballistic flight path so that RVs can be ejected sequentially toward respective targets. Also known as post-boost vehicle (PBV).

Circular Error Probable (CEP): A measure of the delivery accuracy of a weapon system. It is the radius of a circle around a target of such size that a weapon aimed at the center has a 50% probability of falling within the circle.

Collateral Damage: Physical harm inflicted by intent or otherwise on persons and property as a result of attack (specifically, nuclear attack) on a primary military target.

Combat Radius: The maximum distance which an operational aircraft characteristically armed for a combat mission can fly unrefueled from its starting point and return safely, allowing for fuel expenditure involved in combat action typical of the mission profile.

Command Disable System (CDS): A device integrated in a storage container to disable a nuclear warhead by destroying critical components. Cannot be activated until a code is inserted.

Counterforce: The employment of strategic air and missile forces in an effort to destroy, or render impotent, military capabilities of an enemy force.

Countervalue: The employment of strategic air or missile forces to attack selected enemy population centers, industries, and resources and installations which constitute the social fabric of the nation.

Glossary

Terms

Cruise Missile: A guided missile which uses aerodynamic lift to offset gravity and propulsion to counteract drag. A cruise missile's flight path remains within the Earth's atmosphere.

Cruise Missile Carrier: An aircraft equipped for launching a cruise missile.

Decoy: A model, electromagnetic reflector, or other device accompanying a nuclear weapon delivery vehicle in order to mislead enemy defensive systems so as to increase the probability of penetration and weapon delivery.

Delivery System: An aerospace vehicle considered as a whole, with all associated components, and integral with launchers and other installations employed in transporting, launching, targeting, guiding, and delivering on target its nuclear weapon(s).

Dual-Capable Weapons: Weapons, weapons systems, or vehicles capable of selective equipage with nuclear or nonnuclear munitions.

Electromagnetic Pulse (EMP): The electromagnetic radiation from a nuclear explosion, caused by Compton-recoil electrons and photoelectrons from photons scattered in the materials of the nuclear device, in a surrounding medium. The resulting electric and magnetic fields may couple with military systems to produce damaging current and voltage source.

Electronic Countermeasures (ECM): Electronic warfare involving actions taken to prevent or reduce the effectiveness of enemy equipment and tactics employing or affected by electromagnetic radiations, and to exploit the enemy's use of such radiations.

Endoatmosphere: From sea level to about 40 nautical miles altitude.

Enhanced Radiation (ER): The effects of and the technology employed in that class of controlled-effects nuclear weapons designed to intensify nuclear radiation in the target area by attenuating blast and heat.

Equivalent Megatonnage (EMT): A measure used to compare the destructive potential of differing combinations of nuclear warhead yield against relatively soft countervalue targets. EMT is computed from the expression: $EMT = NY^x$, where N = number of actual warheads of yield Y; Y = yield of the actual warheads in megatons; and x = scaling.

Exoatmosphere: Higher than about 40 nautical miles above sea level.

Externally Observable Differences: Externally observable design features used to distinguish between those heavy bombers of current types (and air-launched cruise missiles) which are capable of performing a particular SALT-limited function and those which are not. These differences need not be functionally related but must be a physical design feature which is externally observable.

Fallout: The precipitation to earth of radioactive particulate matter from a nuclear cloud; also applied to the particulate matter itself.

Fighter-Bomber: Tactical aircraft configured for ground attack and interdiction as well as for air combat. As dual-capable systems, fighter-bombers (such as F-111s) constitute a non-central system with potential for strategic missions.

Fission: The process whereby the nucleus of a particular heavy element splits into (generally) two nuclei of lighter elements, with the release of substantial amounts of energy.

Fission Weapon: Nuclear warhead whose material is uranium or plutonium which is brought to a critical mass under pressure from a chemical explosive detonation to create an explosion that produces blast, thermal radiation, and nuclear radiation. The complete fission of one pound of fissionable material would have a yield equivalent to 8000 tons of TNT. Commonly known as atomic bomb.

Forward Based Systems: A term introduced by the U.S.S.R. to refer to those U.S. nuclear systems based in third countries or on aircraft carriers and capable of delivering a nuclear strike against the territory of the U.S.S.R.

Fractionation: The division of the payload of a missile into several warheads. The use of a MIRV payload is an example of fractionation.

Functionally Related Observable Differences (FROD): The means by which SALT II provides for distinguishing between those aircraft which are capable of performing certain SALT-limited functions and those which are not. FRODs are differences in the observable features of airplanes which specifically determine whether or not these airplanes can perform the mission of a heavy bomber, or whether or not they can perform the mission of a bomber equipped for cruise missiles of a range in excess of 600 km, or whether or not they can perform the mission of a bomber equipped for Air-to-Surface Ballistic Missiles (ASBMs).

Fusion: The process accompanied by the release of tremendous amounts of energy, whereby the nuclei of light elements combine to form the nucleus of a heavier element.

Fusion Weapon: Nuclear warhead containing fusion materials (e.g., deuterium and tritium) which are brought to critical density and temperature conditions by use of a primary fission reaction (thermonuclear) in order to initiate and sustain a rapid fusion process, which in turn creates an explosion that produces blast, thermal radiation, and nuclear radiation. The complete fusion of one pound of fusion material is equivalent to 36,000 tons of TNT. Commonly known as hydrogen bomb.

Ground Alert: That status in which aircraft on the ground/deck are fully serviced and armed, with combat crews in readiness to take off within a specified short period of time (usually 15 minutes) after receipt of a mission order.

Guidance: The entire process by which target intelligence information received by the guided missile is used to effect proper flight control to cause timely direction changes for effective target interception.

Guided Missile: An unmanned vehicle moving above the surface of the earth, whose trajectory or flight path is capable of being altered by an external or internal mechanism.

Half-Life: The time required for the activity of a given radioactive species to decrease to half of its initial value due to radioactive decay. The half-life is a characteristic property of each radioactive species and is independent of its amount or condition. The half-life of tritium is 12.3 years.

Hard Target: Any weapon site, command and control facility, production center, blast shelter or other strategic target which has been hardened for protection against the effects of nuclear attack.

Glossary

Terms

Height of Burst (HOB): 1. The vertical distance from the earth's surface or target to the point of burst. 2. For nuclear weapons, the optimum height of burst for a particular target (or area) is that at which it is estimated a weapon of a specific energy yield will produce a certain desired effect over the maximum possible area.

High Explosive (HE): Generally applied to the bursting charges for bombs, projectiles, grenades, mines, and demolition charges.

Homing: The technique of tracking along a position line toward the point of origin of a radio, radar or other navigation aid.

Homing Overlay Experiment (HOE): The HOE is designed to demonstrate the ability of optics to acquire targets in flight; isolate RVs from accompanying chaff, penetration aids, and booster fragments; and guide the missile to intercept with a goal of a miss distance small enough to permit RV destruction by other than nuclear means. HOE would demonstrate the capability and illustrate the advantages of exoatmosphere, non-nuclear intercept at relatively long ranges.

Howitzer: A cannon which combines certain characteristics of guns and mortars. The howitzer delivers projectiles with medium velocities, by either low or high trajectories.

Hydrogen Bomb: A nuclear weapon in which part of the explosive energy is obtained from nuclear fusion (or thermonuclear) reaction.

Inertial Confinement: A concept for attaining the density and temperature condition that will produce nuclear fusion by use of lasers or other high power sources to compress and heat small pellets containing fusionable fuel. The energy released is in the form of fast neutrons, X-rays, charged particles, and debris, and can be used in much the same way as the energy output of any other fusion (or fission) process.

Inertial Guidance: A guidance system designed to project a missile over a predetermined path, wherein the path of the missile is adjusted after launch by devices wholly within the missile and independent of outside information. The system measures and converts accelerations experienced to distance traveled in a certain direction.

Initial Operational Capability (IOC): The date when the first combat missile unit is equipped and trained, and logistic support established to permit performance of combat missions in the field. An initial operational capability date is associated with each new missile system as a target date for delivery of combat equipment, repair parts, maintenance equipment, and publications, plus supply of trained personnel.

Intercontinental Ballistic Missile (ICBM): A land-based fixed or mobile rocket-propelled vehicle capable of delivering a warhead to intercontinental ranges. Once they are outside the atmosphere, ICBMs fly to a target on an elliptical trajectory. An ICBM consists of a booster, one or more reentry vehicles, possibly penetration aids, and, in the case of a MIRVed missile, a post-boost vehicle.

Intermediate Range Ballistic Missile (IRBM): A ballistic missile, with a range capability from about 1500 to 3000 nautical miles.

Kiloton (Kt): A unit of measure of a nuclear weapon's yield, equivalent to the explosive energy of one thousand tons of TNT. Thirteen kilotons was the approximate yield of the atomic bomb detonated at Hiroshima.

Kiloton Weapon: A nuclear weapon, the yield of which is measured in terms of thousands of tons of trinitrotoluene (TNT) explosive equivalents, producing yields from 1 to 999 kilotons.

Launch Weight: The weight of the fully loaded missile itself at the time of launch. This would include the aggregate post-boost vehicle (PBV) and the payload.

Laydown: Weapons employment from an aircraft where a delayed fuzing and arming of the warhead permits low level delivery and safe escape.

Mach Number: The ratio of the velocity of a body to that of sound in the surrounding medium.

Maneuverable Reentry Vehicle (MaRV): A reentry vehicle capable of performing preplanned flight maneuvers during the reentry phase.

Maximum Range: The greatest distance a weapon can fire without consideration of dispersion, or the greatest distance a weapon system can fly.

Medium-Range Ballistic Missile (MRBM): A ballistic missile with a range capability from about 600 to 1500 nautical miles.

Megaton (Mt): A unit of measurement for nuclear yield equivalent to the energy released from one million tons of TNT.

Midcourse Guidance: The guidance applied to a missile between termination of the launching phase and the start of the terminal phase of flight.

"Mod" Designator Number: Modifications made to the major assembly design of a weapon system. Mod-0 is the first version of a weapon design, with subsequent modifications of the weapon design numbered consecutively.

Multiple Independently-Targetable Reentry Vehicle (MIRV): Multiple reentry vehicles carried by a ballistic missile, each of which can be directed to a separate and arbitrarily located target. A MIRVed missile employs a post-boost vehicle (PBV) or other warhead dispensing mechanism. The dispensing and targeting mechanism maneuvers to achieve successive desired positions and velocities to dispense each RV on a trajectory to attack the desired target. Alternately, the RVs might themselves maneuver toward their targets after they reenter the atmosphere.

Multiple Reentry Vehicle (MRV): The reentry vehicle of a ballistic missile equipped with multiple warheads where the missile does not have the capability of independently targeting the reentry vehicles—as distinct from a missile equipped for MIRVs.

Nuclear Radiation: Particulate and electromagnetic radiation emitted from atomic nuclei in various nuclear processes. The important nuclear radiations, from the weapons effects standpoint, are alpha and beta particles, gamma rays, and neutrons.

Nuclear Weapon: A device in which the explosion results from the energy released by nuclear reactions involving atomic nuclei; either fission, fusion, or both.

Nuclear Yield: The energy released in the detonation of a nuclear weapon, measured in terms of kilotons or megatons of trinitrotoluene explosive (TNT) required to produce the same energy release. Yields are categorized as: Very Low—less than 1 kiloton; Low—1 kiloton to 10 kilotons; Medium—over 10 kilotons to 50 kilotons; High—over 50 kilotons to 500 kilotons; Very High—over 500 kilotons.

Optimum Height: The height of an explosive which will produce the maximum effect against a given target.

Glossary

Terms

Over Pressure: The pressure resulting from the blast wave of an explosion. It is referred to as "positive" when it exceeds atmospheric pressure and "negative" during the passage of the wave, when resulting pressures are less than atmospheric pressure.

Payload: Weapons and penetration aids carried by a delivery vehicle. In the case of a ballistic missile, the RV(s) and antiballistic missile penetration aids placed on ballistic trajectories by the main propulsion stages or the PBV; in the case of a bomber, those bombs, missiles, or penaids carried internally or attached to the wing or fuselage.

Penetration Aids (Active and Passive): Devices employed by offensive weapon systems, such as ballistic missiles and bombers, to increase the probability of penetrating enemy defenses. They are frequently designed to simulate or to mask an aircraft or ballistic missile warhead in order to mislead enemy radar and/or divert defensive antiaircraft or antimissile fire.

Permissive Action Link (PAL): A coded switch which serves as a mechanical supplement to the administrative controls exercised over nuclear weapons employment. When installed, they make weapon-enabling, or access to the warhead itself, dependent upon possession of the code.

Personnel Reliability Program (PRP): Program in which individuals who have responsibilities in the nuclear release process are kept under scrutiny to determine if behavior affects the conduct of the work.

Post-Boost Vehicle (PBV): That part of a missile which carries the reentry and thrust devices for altering the ballistic flight path so that the reentry vehicles can be dispensed sequentially toward different targets (MIRVs). Ballistic missiles with single RVs also might use a PBV to increase the accuracy of the RV by placing it more precisely into the desired trajectory.

Projectile: An object projected by an applied exterior force and continuing in motion, as an artillery shell.

Propellant: That which provides the energy required for propelling a projectile. Specifically, an explosive charge for propelling a bullet, shell or the like; also a fuel, either solid or liquid, for propelling a rocket or missile.

Radar: *Ra*dio *D*etection *A*nd *R*anging equipment that determines the distance and usually the direction of objects by transmission and return of electromagnetic energy.

Radar Cross-Section (RCS): The image produced by radar signals reflected from a given target surface. Because the size of the image is a function not only of the target's size, but of structural shape and the refractory characteristics of its materials as well, radar cross-section is an important design characteristic for air and space vehicles.

Radius of Action: The maximum distance a ship, aircraft, or vehicle can travel away from its base along a given course with normal combat load and return without refueling, allowing for all safety and operating factors.

Ramjet: A jet propulsion engine containing neither compression nor turbine, which depends for its operation on the air compression accomplished by the forward motion of the engine.

Range:
1. The distance between any given point and an object or target.
2. Extent or distance limiting the operation or action of something, such as the range of an aircraft, ship, or gun.
3. The distance which can be covered over a hard surface by a ground vehicle, with its rated payload, using the fuel in its tank and in cans normally carried as part of the ground vehicle equipment.
4. Area equipped for practice in shooting at targets.

Reduced Blast/Enhanced Radiation Weapon (RB/ER): A nuclear weapon designed to produce significantly more and/or higher energy output(s) of neutron, X-ray, gamma rays, or a combination thereof than a normal weapon of the same total yield.

Reentry Vehicle (RV): That portion of a ballistic missile which carries the nuclear warhead. It is called a reentry vehicle because it reenters the earth's atmosphere in the terminal portion of the missile trajectory.

Residual Radiation: Nuclear radiation caused by fallout, radioactive material dispersed artificially, or irradiation which results from a nuclear explosion and persists longer than one minute after burst.

SAFEGUARD: A ballistic missile defense primarily designed to protect U.S. land-based retaliatory forces against direct attack, and protect the U.S. against a possible accidental launch or small attack. The principal subsystems were the SPRINT and SPARTAN missiles, Missile Site Radar, Perimeter Acquisition Radar, and the Data Processing System.

Short-Range Attack Missile (SRAM): An air-to-surface missile with a range under 600 miles (and generally under 100 miles) carried by U.S. B-52 and FB-111 bomber aircraft as penetration aids for suppression of enemy air defenses.

Short-Range Ballistic Missile (SRBM): Land-based, rocket-propelled vehicle capable of delivering a warhead through space to a target at ranges up to about 600 nautical miles. The U.S. PERSHING and LANCE, and Soviet SCUD, are tactical missile systems classified as SRBMs.

Silo: Hardened, underground facility for a fixed-site ballistic missile and its crew, designed to provide pre-launch protection and to serve as a launching platform. High-yield, precision nuclear weapons are required to destroy a silo construction.

Stockpile: Nuclear storage. Also, the total number of nuclear weapons which a nation maintains in storage at all locations and potentially available for deployment.

Strategic Forces: Nuclear weapons and delivery systems designed for nuclear attack against strategic targets or for active defense against such an attack: bombers, missile systems, and strategic interceptors. Commonly refers to offensive weapons in the U.S. and the U.S.S.R. that can deliver a nuclear strike on each other or a third party.

Strategic Offense: Forces and measures existing to mount a nuclear attack against enemy strategic targets, designed to destroy the enemy's war-making capacity.

Sub-Kiloton Weapon: A nuclear weapon producing a yield below one kiloton.

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Terms

Submarine-Launched Ballistic Missile (SLBM): A ballistic missile carried in and launched from a submarine, which affords mobility and concealment for a missile force. The SALT II Treaty includes the following definition: "submarine-launched ballistic missile (SLBM) launchers are launchers of ballistic missiles installed on any nuclear-powered submarine or launchers of modern ballistic missiles installed on any submarine, regardless of its type." [Article II (2)]

Surface-to-Air Missile (SAM): A surface-launched missile designed to operate against a target above the surface.

Surface-to-Surface Missile (SSM): A surface-launched missile designed to operate against a target on the surface.

Tactical Nuclear (Forces, Weapons): The use of nuclear weapons by land, sea, or air forces against opposing forces. Also supporting installations or facilities, in support of operations, which contribute to the accomplishment of a military mission of limited scope, or in support of the military commander's scheme of maneuver, usually limited to the area of military operations.

Terminal Guidance: The guidance applied to a missile between mid-course guidance and its arrival in the vicinity of the target.

Terrain Contour Matching (TERCOM): Guidance system, presently employed in cruise missiles, which correlates preprogrammed contour map data with the terrain being overflown, in order to take periodic fixes and adjust the flight path accordingly. TERCOM improves the accuracy provided by inertial guidance alone.

Theater: The geographical area outside the continental United States for which a commander of a unified or specified command has been assigned military responsibility.

Thermonuclear Weapon: A weapon in which very high temperatures are used to bring about the fusion of light nuclei, such as those of hydrogen isotopes (e.g., deuterium and tritium), with the accompanying release of energy. The high temperatures required are obtained by means of an atomic (fusion) explosion.

Throw-Weight: Ballistic missile throw-weight is the useful weight which is placed on a trajectory toward the target by the boost or main propulsion stages of the missile. For the purposes of SALT II, throw-weight is defined as the sum of the weight of:

- the RV or RVs;
- any PBV or similar device for releasing or targeting one or more RVs; and
- any antiballistic missile penetration aids, including their release devices.

Transporter-Erector-Launcher (TEL): The vehicle designed to move a land-based mobile missile within its shelter and to break through the overhead cover, raise the missile into firing position, and serve as a platform for the launch of the missile.

Triad: The tripartite U.S. strategic deterrent force, which consists of land-based ICBMs, submarine-launched ballistic missiles, and strategic bombers. The capabilities and characteristics of each system complement the others. Disproportionate reliance on any one system is avoided, so that the ends of deterrence and stability are served, and the risks of technological surprise are reduced.

Turbojet Engine: A jet engine whose air is supplied by a turbine driven compressor, the turbine being activated by exhaust gases.

Warhead: The part of a missile, projectile, torpedo, rocket, or other munition which contains either the nuclear or the thermonuclear system, high explosive system, chemical or biological agents, or inert materials, intended to inflict damage.

Yield: The energy released in an explosion. The energy released in the detonation of a nuclear weapon is generally measured in terms of the kilotons (Kt) or megatons (Mt) of TNT required to produce the same energy release.

Glossary of Abbreviations and Acronyms

AAM	Air-to-Air Missile
AB	Airbase
ABM	Anti-Ballistic Missile
ABRES	Advanced Ballistic Reentry Systems
ABRV	Advanced Ballistic Reentry Vehicle
ACDA	Arms Control and Disarmament Agency
ACIS	Arms Control Impact Statement
ACMT	Advanced Cruise Missile Technology
AD	Destroyer Tender (Ship)
ADCOM	Aerospace Defense Command
ADM	Atomic Demolition Munition
AE	Ammunition Ship
AEC	Atomic Energy Commission
AFAP	Artillery-Fired Atomic Projectile
AFB	Air Force Base
AFM	Air Force Manual
AFR	Air Force Regulation
AGM	Air-to-Surface Missile
AIR	Air-to-Air Missile
AIRS	Advanced Inertial Reference Sphere
ALBM	Air-Launched Ballistic Missile
ALC	Air Logistics Center
ALCM	Air-Launched Cruise Missile
AMAC	Airborne Monitoring and Control System
AMSA	Advanced Manned Strategic Aircraft
ANG	Air National Guard
ANGB	Air National Guard Base
AOE	Ammunition Ship
AP	Airport
AMaRV	Advanced Maneuvering Reentry Vehicle
AS	Submarine Tender (Ship)
ASALM	Advanced Strategic Air-Launched Missile
ASAT	Anti-Satellite
ASBM	Air-to-Surface Ballistic Missile
ASM	Air-to-Surface Missile
ASMS	Advanced Strategic Missile System
ASROC	Anti-Submarine Rocket
ASW	Anti-Submarine Warfare
ASWSOW	Anti-Submarine Warfare Stand-Off Weapon
ATB	Advanced Technology Bomber
ATBM	Anti-Tactical Ballistic Missile
ATP	Advanced Technology Program
AW&ST	*Aviation Week & Space Technology*
AWACS	Airborne Warning and Control System
BB	Battleship
BDM	Bomber Defense Missile
BMD	Ballistic Missile Defense
CANTRAC	Catalog of Navy Training Activities
CDS	Command Disable System
CEP	Circular Error Probable
CG	Guided Missile Cruiser
CGN	Nuclear Powered Guided Missile Cruiser

cm	Centimeter
CMCA	Cruise Missile Carrier Aircraft
CMI	Cruise Missile Integration
CMP	Counter Military Potential
CONUS	Continental United States
CSB	Closely Spaced Basing
CSWS	Corps Support Weapon System
CV	Aircraft Carrier
DARPA	Defense Advanced Research Projects Agency
DD	Destroyer
DDG	Guided Missile Destroyer
DOD	Department of Defense
DOE	Department of Energy
DSARC	Defense Systems Acquisition Review Council
DU	Depleted Uranium
ECM	Electronic Counter Measure
EMP	Electro-Magnetic Pulse
EMT	Equivalent Megatonnage
EPW	Earth Penetrator Weapon/ Warhead
ER	Enhanced Radiation ("Neutron Bomb")
ERB	Extended-Range Bomb
ERDA	Energy Research and Development Administration
EWDA	Energy and Water Development Appropriations
FBM	Fleet Ballistic Missile
FBS	Forward Based Systems
FEBA	Forward Edge of the Battle Area
FF	Frigate
FFG	Guided Missile Frigate
FM	Field Manual
FRG	Federal Republic of Germany
FROD	Functionally Related Observable Difference
ft	Feet
FUFO	Full Fuzing Option
FY	Fiscal Year
GAO	General Accounting Office
GLCM	Ground-Launched Cruise Missile
HAC	House Appropriations Committee
HASC	House Armed Services Committee
HE	High Explosive
HEU	Highly Enriched Uranium
HOB	Height Of Burst
HOE	Homing Overlay Experiment
IAP	Improved Accuracy Program
IAP	International Airport
ICBM	Intercontinental Ballistic Missile
IHE	Insensitive High Explosives
in	Inch
IOC	Initial Operational Capability
IR	Infrared
IRBM	Intermediate-Range Ballistic Missile
JCMPO	Joint Cruise Missile Program Office
JCS	Joint Chiefs of Staff
JTACMS	Joint Tactical Missile System
kg	Kilogram
km	Kilometer
Kt	Kiloton
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LoADS	Low Altitude Defense System
LRCA	Long-Range Combat Aircraft
LRTNF	Long-Range Theater Nuclear Forces
m	Meter, million
MADM	Medium Atomic Demolition Munition
MAPS	Multiple Aim Point System
MaRV	Maneuvering Re-entry Vehicle

Glossary

Abbreviations and Acronyms

MCAS	Marine Corps Air Station
mi	Statute Mile
MIRV	Multiple Independently Targeted Re-entry Vehicle
MLRS	Multiple Launch Rocket System
MPM	Multipurpose Missile
MPS	Multiple Protective Shelter
MRASM	Medium-Range Air-to-Surface Missile
MRBM	Medium-Range Ballistic Missile
MRV	Multiple Re-entry Vehicle
Mt	Megaton
MT	Metric Ton
MX	Missile Experimental
NAS	Naval Air Station
NATO	North Atlantic Treaty Organization
nm	Nautical Mile
NORAD	North American Aerospace Defense Command
OAS	Offensive Avionics System
OSD	Office of the Secretary of Defense
P1a	PERSHING 1a Missile
PII	PERSHING II Missile
PAA	Primary Airvehicle Authorized
PAL	Permissive Action Link
PBV	Post-Boost Vehicle
PGRV	Precision Guided Re-entry Vehicle
POC	Program of Cooperation
POL	Petroleum, Oil, and Lubricants
PRP	Personnel Reliability Program
QRA	Quick Reaction Alert
RADAG	Radar Area Correlation Guidance
RAF	Royal Air Force
RAP	Rocked Assisted Projectile
RB/ER	Reduced Blast/Enhanced Radiation
RCS	Radar Cross Section
RDA	Research, Development, and Acquisition
RDT&E	Research, Development, Test, and Evaluation
RR	Reduced-Range
RV	Re-entry Vehicle
SAC	Senate Appropriations Committee
SAC	Strategic Air Command
SACEUR	Supreme Allied Command Europe
SADM	Special Atomic Demolition Munition
SALT	Strategic Arms Limitation Treaty
SAM	Surface-to-Air Missile
SASC	Senate Armed Services Committe
SICBM	Small Intercontinental Ballistic Missile
SLBM	Submarine-Launched Ballistic Missile
SLCM	Sea-Launched Cruise Missile
SLEP	Service Life Extension Program
SNDV	Strategic Nuclear Delivery Vehicle
SNM	Special Nuclear Materials
SRAM	Short-Range Attack Missile
SRBM	Short-Range Ballistic Missile
SSBN	Nuclear Powered Ballistic Missile Submarine
SSM	Surface-to-Surface Missile
SSN	Nuclear-Powered Attack Submarine
STP	Systems Technology Program
SUAWACS	Soviet Union AWACS
SUBROC	Submarine Rocket
SUM	Shallow Underwater Mobile
TAC	Tactical Air Command

TASM	TOMAHAWK Anti-Ship Missile
TEL	Transporter-Erector-Launcher
TERCOM	Terrain Contour Matching
TLAM/C	TOMAHAWK Land-Attack Missile/Conventional
TLAM/N	TOMAHAWK Land-Attack Missile/Nuclear
TNF	Theater Nuclear Forces
TNW	Theater Nuclear War
TY	Then Year
UE	Unit Equipment
UGM	Underwater-to-Surface Missile
USA	United States Army
USAF	United States Air Force
USN	United States Navy
VHSIC	Very High Speed Integrated Circuits
VLA	Vertical Launch ASROC
VLS	Vertical Launching System
W	Warhead

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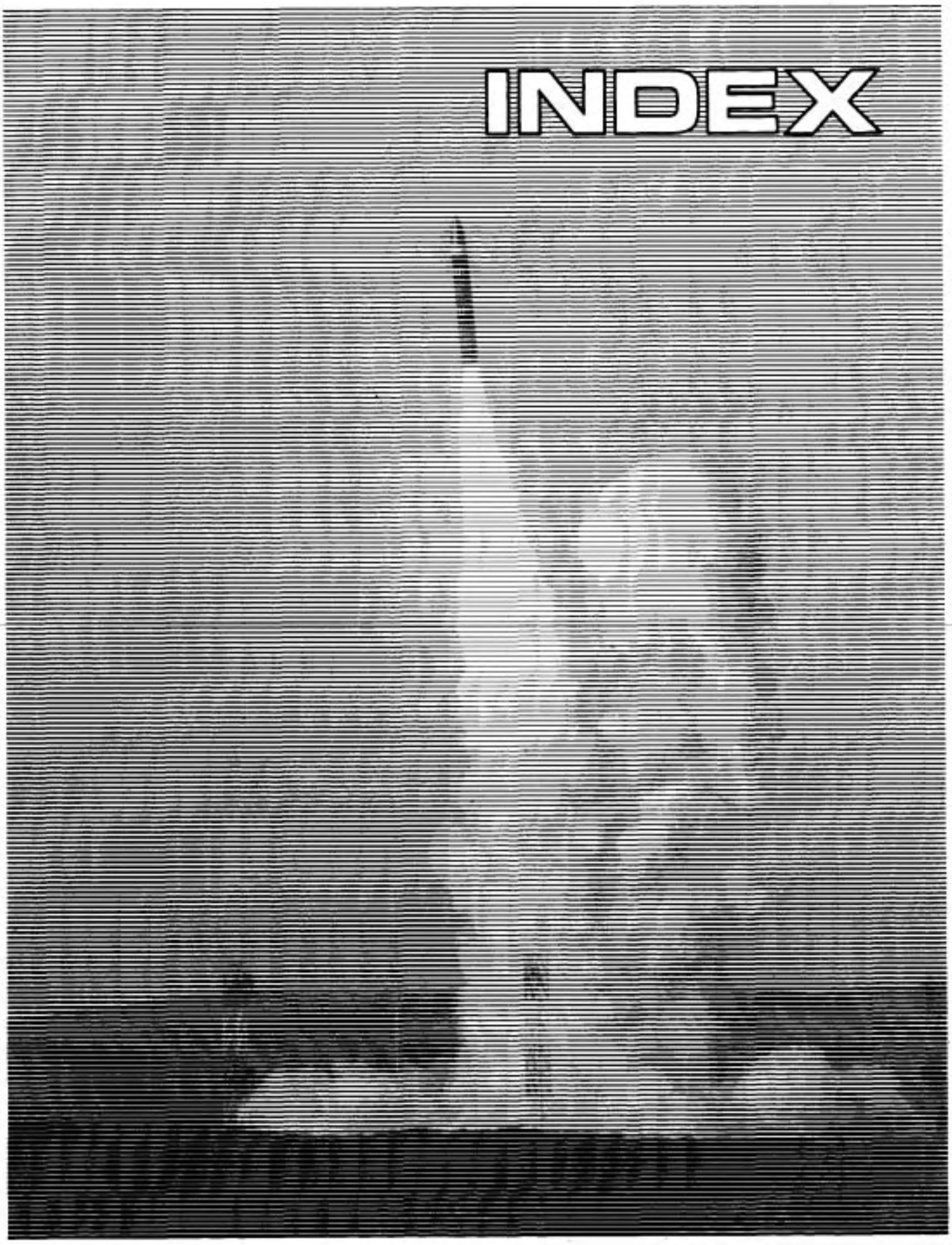

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