

BAS

The B61 family of bombs

The B61 bomb is perhaps the most versatile and abundant nuclear weapon in the U.S. stockpile. Close study of its complex history reveals something that the nuclear weapon labs may not want to admit: After mastering the basics of sub-megaton nuclear bomb design several decades ago, the only subsequent innovations have been marginal improvements to B61 safety and security features. The fact is that many of the original plutonium pits, some more than 30 years old, are still in service—calling into question the need for much of the \$5 billion-a-year Stockpile Stewardship Program and the future \$2 billion–\$4 billion Modern Pit Facility.

We estimate that the total stockpile of intact B61 bombs is approximately 1,925, of which 1,265 are considered operational. All B61 models are scheduled to undergo life extension and retrofit programs over the next decade, and approximately 400 bombs are scheduled to be “consumed” in quality and reliability testing through 2025.

The basic B61 bomb weighs approximately 700 pounds, is slightly over 13 inches in diameter, and is 11.8 feet long from nose to fin-tip. The earth-penetrating version, the B61-11, weighs an additional 450 pounds.

B61 background. The first B61 production unit began in October 1966. Problems stalled the program, and in January 1967 the bomb was withdrawn and changed slightly. Full-scale production started in January 1968. The bomb has been manufactured in six basic modifications, Mods 0 through 5. Three of these versions, Mods 1, 3, and 4, were upgraded with improved characteristics and safety features. Mods 0, 2, and 5 have been retired and dismantled. Programs planned for three other upgrades (Mods 6, 8, and 9) were canceled. The B61-10 is a converted Pershing II missile warhead.

For more than 30 years, the B61 bomb has been the bread and butter of the Los Alamos National Laboratory in New Mexico. A series of underground tests was conducted from 1963–1968 at the Nevada Test Site to certify the bomb’s yield and confirm its military characteristics. “Shot Halfbeak,” one of six B61-associated tests conducted in 1966, is suspected of being fired on June 30 at full yield—about 350 kilotons. Nuclear testing resumed in the mid-1970s to perfect the Mod 3 and 4 versions, which entered the stockpile in 1979.

The bomb can be delivered as a free-fall airburst, a retarded airburst, a free-fall surface burst, or in “laydown” mode from aircraft flying as low as 50 feet. In laydown mode, the bomb must survive ground impact; to do this, a parachute quickly slows the bomb’s descent and controls its trajectory. Originally, a 17-foot diameter nylon parachute was used. Later models switched to a 24-foot diameter nylon/Kevlar version.

The B61 has been deployed on a wide variety of tactical and strategic aircraft. Strategic versions have been carried on B-52, FB-111, B-1, and B-2 bombers. Tactical versions, with lower yield options, have been deployed on a variety of U.S. and NATO air force aircraft, including the F-100, F-104, F-4, F-105, F-15E, F-16, F-111, F-117, and Tornado. The U.S. Navy and Marines have used the B61-2/5s on A-4, A-6, A-7, and F/A-18 aircraft. After the navy terminated the nuclear strike mission from U.S. aircraft carriers in the early 1990s, the bombs were retired and disassembled. According to the Bush administration’s recent Nuclear Posture Review (NPR), some future Lockheed Martin F-35 Joint Strike Fighters may be nuclear capable. They would most likely use the B61 bomb.

The B61 has also served as the basic design for three other warheads: the W80-0 sea-launched cruise missile warhead; the W80-1 warhead for the air-launched cruise missile and the advanced cruise missile; and the W85 warhead for the Pershing II missile. The Intermediate-Range Nuclear Forces (INF) Treaty, signed on December 8, 1987, marked the Pershing II missile (among others) for elimination. Although the missiles and launchers were destroyed by mid-1991, as the treaty

called for, the warheads were retained, converted, and probably returned to European air bases as B61 bombs. The "physics package" (the guts of the nuclear explosive) was removed from the W85 warhead, repackaged in a bomb casing, and re-designated the B61-10. While not technically illegal under the INF Treaty, it can be argued that this violated its spirit (see the November 1990 *Bulletin*, pp. 14–16).

B61 SAFETY AND CONTROL FEATURES									
Bomb type	Control feature	IHE	Type	FRP	ENDS				
B61-0	Cat B PAL/AMAC	No	PBX-9404	No	No				
B61-1	No PAL	No	PBX-9404	No	No				
B61-2	Cat D PAL/AMAC	No	PBX-9404	No	No				
B61-3	Cat F PAL/AMAC	Yes	PBX-9502	No	No				
B61-4	Cat F PAL/AMAC	Yes	PBX-9502	No	No				
B61-5	Cat D PAL/AMAC	No	PBX-9404	No	Yes				
B61-6 (modified B61-0)	Cat D PAL/AMAC	Yes	PBX-9502	No	Yes				
B61-7 (modified B61-1)	Cat D PAL/AMAC	Yes	PBX-9502	No	Yes				
B61-8 (modified B61-2,-5)	Cat D PAL/AMAC	Yes	PBX-9502	No	Yes				
B61-9 (modified B61-0)	Cat F PAL/AMAC	Yes	PBX-9502	No	Yes				
B61-10 (converted W85)	Cat F PAL/AMAC	Yes	PBX-9502	No	Yes				
B61-11 (converted Mod 7)	Cat D PAL/AMAC	Yes	PBX-9502	No	Yes				
<p>PAL (Permissive Action Link): A system included in or attached to a nuclear weapon system to preclude arming or launching until the insertion of a prescribed discrete code or combination. The earliest versions were 5-digit mechanical combination locks. The most modern electrical versions are the six-digit Cat D and the 12-digit Cat F, both with a "limited try" feature that permits a specific number of attempts to enter the correct code, after which the electrical circuits self-destruct, disabling the weapon. Cat B is an earlier electrical version.</p>									
<p>AMAC (Aircraft Monitoring and Control): Equipment installed in an aircraft to permit monitoring and control of the safing, arming, and fuzing functions of a nuclear bomb or missile delivered by the aircraft. It is the avenue for transmission of PALs.</p>									
<p>IHE (Insensitive High Explosive): An improved conventional high explosive designed to be more resistant to shock than earlier types, thus lessening the risk of a detonation and the dispersal of plutonium in an accident.</p>									
<p>PBX (Plastic-Bonded Explosive): Since 1979, the Energy Department has used the Los Alamos-developed PBX.</p>									
<p>FRP (Fire-Resistant Pit): In an FRP, the plutonium is encased in a metal shell with a high melting point designed to withstand exposure to a jet fuel fire of 1,000 degrees Celsius.</p>									
<p>ENDS (Enhanced Nuclear Detonation Safety): The ENDS system, developed at Sandia National Laboratories in 1972, isolates the electrical elements critical to detonation to prevent premature arming of a nuclear weapon subjected to abnormal environments like extreme heat or radiation. It was first used on the B61-5.</p>									

Strategic B61s. There are currently two strategic versions of the B61. The B61-7, produced from 1985–1990, is a variable-yield gravity bomb for the B-52 and B-2. The B61-11 is an earth-penetrating weapon (EPW) for the B-2 with a "single yield," according to the NPR. Full-scale drop tests of the B61-11 were conducted in Nevada and Alaska, initially from F-16, B-1, and B-52 aircraft. After the B-2 Stealth bomber became operational in the Single Integrated Operational Plan (SIOP) in October 1997, it was chosen as the designated carrier of the B61-11. Of its three drop tests conducted in 1998, one involved two unarmed bombs dropped at an air force test range in the Yukon in Alaska. With its hardened steel case and nose cone, the B61-11s

penetrated the frozen tundra to a depth of only two to three meters. Its conventional cousin, the 5,000-pound GBU-28, is said to penetrate about six meters of concrete.

Development of the B61-11 was initially proposed by U.S. Strategic Command, endorsed by the 1994 Nuclear Posture Review, and directed by Presidential Decision Directive 30. The first four production units were delivered to the air force in December 1996. It is estimated that in 1997 some 50 B61-7s were converted to B61-11s and deployed to Whiteman Air Force Base (AFB), Missouri, home of the Stealth bomber wing. B61-7 bombs are stored at four other bases: Barksdale AFB in Louisiana, Minot AFB in North Dakota, Nellis AFB in Nevada, and Kirtland AFB in New Mexico.

The B61-7 "laydown" bomb also served as the basis for the W61 program in the late 1980s and early 1990s, which was an effort to equip the small Midgetman intercontinental ballistic missile with a strategic earth-penetrating warhead. When the Midgetman program was canceled by the first Bush administration, so was authorization for the W61.

The Robust Nuclear Earth Penetrator program, recommended by the latest NPR, could use the B61 (or B83) in an effort to build an earth-penetrating weapon that would be more effective than the B61-11. But a serious flaw in the concept of nuclear earth-penetrating weapons, even those with relatively low yields, is that they cannot penetrate deeply enough to contain a nuclear explosion and its deadly radioactive fallout. If used in an urban environment, such a weapon would cause thousands of casualties (see Robert W. Nelson, *Science and Global Security*, Vol. 10: pp. 1–20, 2002).

The United States fielded two earth-penetrating weapons in the 1950s, the Mark 8 and Mark 11 bombs. The uranium gun-type Mark 8 bomb (nicknamed "Elsie" for LC, or light case) was almost 10 feet long, 14 inches in diameter, 3,250 pounds, and had a yield of approximately 25 kilotons. It was developed by the navy for targeting underground facilities, enemy submarines located in sheltered pens, and armored ship decks. It was in service from 1952 to 1957. The Mark 11 was an improved version of the Mark 8, slightly heavier, and according to the National Atomic Museum, "able to penetrate up to 22 feet of reinforced concrete, 90 feet of hard sand, 120 feet of clay, or five inches of armor plate," and fuzed to detonate 90–120 seconds after penetration. The W86, an earth-penetrating alternative to the W85 Pershing II warhead, was developed in the 1970s but canceled in September 1980.

2002 B61 stockpile/yields			
B61-3	520	.3, 1.5, 60, or 170 kilotons	
B61-4	680	.3, 1.5, 10, or 45 kilotons	
B61-7	470	four yields to 350 kilotons	
B61-10	205	.3, 5, 10, or 80 kilotons	
B61-11	50	"single yield" (according to the NPR)	
Total	1,925		
Original builds (estimates)			
B61-0/1	1,200	January 1968–April 1971	
B61-2	235	March 1975–January 1977	
B61-3	545	May 1979–?? 1989	
B61-4	695	May 1979–?? 1989	
B61-5	265	June 1977–September 1979	

	Subtotal	2,940		
	B61-10	215	circa 1990–1991	
	Total	3,155		
Conversions				
	B61-7	A Mod 1 with CAT D PAL and IHE; about 700 converted from June 27, 1985, to April 9, 1990		
	B61-10	A W85 Pershing II warhead with CAT F PAL and IHE		
	B61-11	A Mod 7, an EPW, weighing about 1,200 pounds; about 50 converted in 1997		
Canceled programs				
	W61	A converted Mod 7 with CAT D PAL and AMAC		
	B61-6	A converted Mod 0 with CAT D PAL and IHE		
	B61-8	A converted Mod 2 with its CAT D PAL and IHE		
	B61-8	A converted Mod 2 and 5 (?) with new CAT F PAL, IHE		
	B61-9	A converted Mod 0 with new CAT F PAL and IHE		
Retirements, dismantlements				
	B61-0	500	August 10, 1995, to June 17, 1996	
	B61-2	215	June 1, 1996, to March 13, 1997	
	B61-5	236	March 13, 1997, to August 22, 1997	

Tactical B61s. The current tactical versions of the B61 are the Mods 3, 4, and 10. Most of these are stored at Nellis and Kirtland; some may be deployed with the 4th Fighter Wing at Seymour Johnson AFB in North Carolina and the 27th Fighter Wing at Cannon AFB in New Mexico. Approximately 150 B61s are deployed with U.S. Air Force units in Britain, Germany, and Turkey, and held in U.S. custody for use by NATO allied air force wings and squadrons in Belgium, Germany, Italy, the Netherlands, and Turkey. Greece has apparently ended its nuclear role in NATO.

The B61 bomb has the unique distinction of being the only remaining nuclear weapon deployed outside U.S. borders (excluding the missile warheads on patrolling nuclear-powered ballistic-missile subs).

Nuclear Notebook is prepared by Robert S. Norris of the Natural Resources Defense Council, Hans M. Kristensen, and Joshua Handler. Direct inquiries to NRDC, 1200 New York Avenue, N.W., Suite 400, Washington, D.C., 20005; 202-289-6868.