Chapter 3
U.S. Nuclear Forces and Weapons

3.1 Overview

On November 14, 2014, following the 2014 *Nuclear Enterprise Reviews* (NERs), Secretary of Defense Chuck Hagel clarified the importance of the nuclear mission and its role in defending the United States. “Our nuclear deterrent plays a critical role in ensuring U.S. national security, and it is DoD’s highest priority mission. No other capability we have is more important,” stated Secretary Hagel. The U.S. nuclear triad deters nuclear attack on the United States and its allies and partners, prevents potential adversaries from trying to escalate their way out of failed conventional aggression, and provides the means for effective response should deterrence fail. While the Secretary was clear America’s nuclear deterrent remains safe, secure, and effective, the reviews found evidence of systemic problems that, if not addressed, could undermine the safety, security, and effectiveness of the elements of the nuclear force in the future. Responding to the NERs concerns, the United States, through the DoD and the DOE/National Nuclear Security Administration (NNSA), seeks to ensure nuclear force modernization, infrastructure upgrades, warhead life extension programs (LEPs), adequate manning, and senior-level

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MESSAGE TO THE FORCE ON OUR NUCLEAR ENTERPRISE
FRIDAY, NOVEMBER 14, 2014

To the men and women of the Department of Defense:

Earlier this year, following revelations about troubling lapses of integrity in our nation's nuclear forces, I ordered comprehensive internal and external reviews of our entire nuclear enterprise. Today at the Pentagon, I announced the reviews' findings and what we are doing to address them – ranging from changes that involve oversight, policies, and culture, to changes that require more funding and resources for the nuclear mission – but I wanted to send a personal message to all of you.

Our nuclear deterrent plays a critical role in assuring U.S. national security, and it is DoD's highest priority mission. No other capability we have is more important. Our nuclear forces stand alone in being able to deter nuclear attack on the United States and our allies.

For too long, we have overlooked career paths, compensation, infrastructure, and small-unit leadership that are mission-critical in the nuclear force. That is changing. It will *continue* to change. What you do every day is critically important to America's national security.

Over the last year, I have heard from many of our people in the nuclear force. I visited missileers at F.E. Warren Air Force Base and called launch control officers underground at Malmstrom. I visited nuclear weapons maintainers at Kirtland Air Force Base, met with STRATCOM senior and junior officers at Offutt, and met with submariners aboard the ballistic missile submarine U.S.S. *Tennessee* at Kings Bay. Today, I am visiting bomber crews, missileers, and support teams at Minot Air Force Base. Despite sometimes insufficient resources and manpower, our airmen, sailors, and Marines have stretched themselves to maintain, guard, and operate the nuclear enterprise every day. They deserve our thanks.

To all these individuals and their colleagues across our nuclear enterprise: You are the heirs to a proud legacy, and it is because of you that our nuclear enterprise is safe, secure, and effective today. We will expect excellence, and the President will expect excellence, because the American people expect excellence. In turn, we will ensure you have the resources and support you need – and we will always be unspeakably grateful to you for carrying out this vital mission.

Thank you all, and your families, for what you do for our country.

Chuck Hagel

attention are the focus toward the nuclear deterrent priority mission. This chapter provides an overview of current U.S. nuclear delivery systems/platforms and the nuclear weapons stockpile, as depicted in **Figure 3.1**.

3.2 Nuclear Weapon Platforms and Delivery Systems

A nuclear weapon delivery system is the military platform by which a nuclear weapon is delivered to its intended target in the event of authorized use. Most nuclear weapons have been designed for specific delivery systems. The United States maintains a nuclear triad, or a system of delivery systems comprised of sea, land, and air based on submarine-launched ballistic missiles (SLBMs), intercontinental ballistic missiles (ICBMs), and heavy bombers. Specifically, the United States deploys a mix of silo-based Minuteman III ICBMs, Trident II SLBMs carried on Ohio-class ballistic missile submarines (SSBNs),[1] and B-2A and B-52H nuclear-capable heavy bombers. Additionally the U.S. nuclear force includes dual-capable aircraft (DCA).

Weapons in the U.S. nuclear arsenal provide a wide range of options that can be tailored to meet desired military and political objectives. Each leg of the triad has advantages that warrant retention and are inextricably linked yet unique. Ballistic missile submarines and the SLBMs they carry represent the most survivable leg of the nuclear triad. ICBMs

Note: B = Bomb W = Warhead

Figure 3.1 Current U.S. Nuclear Deterrent (Delivery Systems and Associated Nuclear Weapons)

[1] The SSBN acronym stands for "Ship, Submersible, Ballistic, Nuclear." However, the SSBN is more commonly referred to as ballistic missile submarine or fleet ballistic missile submarine.

Figure 3.2. U.S. Nuclear Triad

contribute to stability and ensure a secure second-strike capability and, like SLBMs, ICBMs have low vulnerability to air defenses. Unlike ICBMs and SLBMs, bombers can be deployed forward as a visible show of presence in crisis to strengthen deterrence against potential adversaries and provide assurance to allies and partners, while also retaining the possibility for recall after launch or takeoff toward a target. **Figure 3.2** depicts the U.S. nuclear triad.

3.2.1 Sea-Launched

Nuclear-powered Ohio-class SSBNs are designed to deliver Trident II, also referred to as D5, submarine-launched ballistic missiles. SSBNs are considered the most survivable leg of the nuclear triad due to their ability to transit and hide in the ocean depths, coupled with the long range of the missiles. Continuously on patrol, SSBNs provide a worldwide launch capability, with each patrol covering a target area of more than one million square miles.

As the virtually undetectable undersea launch platforms of intercontinental missiles, Ohio-class SSBNs were built by the Electric Boat Division of General Dynamics, based at Groton, Connecticut. Eighteen Ohio-class submarines were built and commissioned between 1981 and 1997.

The SSBNs of the Pacific Fleet are based at Naval Base Kitsap, Washington, and those of the Atlantic Fleet at Naval Submarine Base, King's Bay, Georgia. On average, submarines spend 70 days at sea, followed by 25 days in dock for overhaul.

Under the requirements of the Strategic Arms Reduction Treaty (START II), which was agreed to in June 1992, the number of ballistic missile submarines was limited to 14 from the year 2002 forward. Rather than decommissioning these four submarines, the U.S. Navy has converted them to SSGNs, or conventionally armed nuclear-powered submarines.

By 2020, U.S. Ohio-class submarines (**Figure 3.3**) will be in service longer than any previous submarines. As a prudent hedge, the Navy will retain all 14 SSBNs for the near term. To maintain an at-sea presence for the long term, the Navy is planning 12 Ohio-class replacement (OCR) SSBNs with the first planned for patrol in Fiscal Year (FY) 2031. Maintaining the replacement schedule is important because, as the delivery of the OCR occurs, the original Ohio-class SSBNs start to come off service.

Figure 3.3 USS Pennsylvania

Submarine-launched ballistic missiles have been an integral part of the strategic deterrent for six generations, starting in I956 with the U.S. Navy Fleet Ballistic Missile (FBM) Polaris (A1) program. Since then, the SLBM has evolved through Polaris (A2), Polaris (A3), Poseidon (C3), Trident I (C4), and today's force of Trident II (D5). Each generation has been continuously deployed as a survivable force and has been routinely operationally tested and evaluated to maintain confidence and credibility in the deterrent.

Today's Trident II missiles are launched from Ohio-class submarines, each carrying 24 missiles.[2] The Trident II is a three-stage, solid-propellant, inertially guided ballistic missile with a range of more than 4,000 nautical miles, or 4,600 statute miles. Trident II is launched by the pressure of expanding gas within the launch tube. When the missile attains sufficient distance from the submarine, the first stage motor ignites, the aerospike extends, and the boost stage begins. Within about two minutes, after the third

[2] See **Figure 3.8**, *U.S. Nuclear Force Structure Plan* for impact of New START on Trident future loadouts.

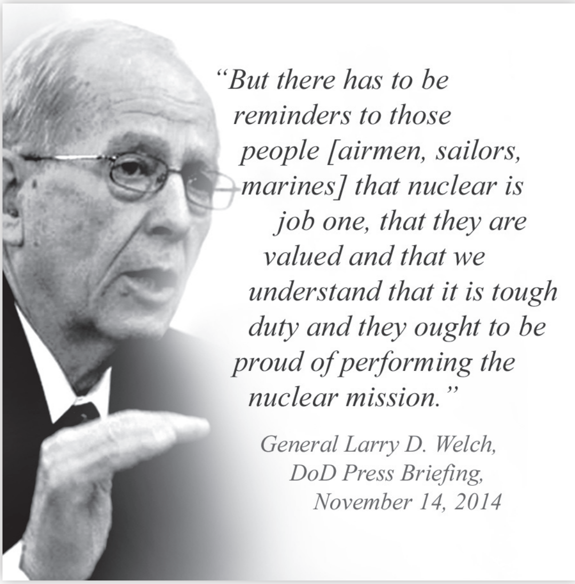
stage motor kicks in, the missile is traveling in excess of 20,000 feet (6,096 meters) per second.

Trident II was first deployed in 1990 and is planned to be deployed past 2020. The Trident II missile is also provided to the United Kingdom, which equips the missile with UK nuclear warheads and deploys the missile on Vanguard Class UK submarines.

3.2.2 Ground-Launched

Intercontinental ballistic missiles, which are launched from stationary silos, are on continuous alert, provide immediate reaction if necessary, and can strike their intended targets within 30 minutes of launch.

Starting in January 1951 when the Air Force directed a $500,000 study for the development of an ICBM capable of delivering an atomic bomb, a project known as "Project Atlas," ICBMs have underpinned the U.S. nuclear deterrent. From 1959–1965, the Atlas was deployed at different Air Force bases stretching from upper New York state all the way to New Mexico. The majority of the Atlas ICBMs were stored vertically in aboveground launchers. The Titan was the largest ICBM ever deployed; and two versions of the Titan, the I and II, were deployed from 1962–1987. The Titan held a nine megaton nuclear warhead, making it one of the most powerful nuclear weapons in American history. When the Minuteman became operational in 1962, it was the first solid-fueled ICBM ever deployed, and this technology brought about a revolution in missile development. There have been four versions of the Minuteman, the IA, IB, II and III. Additionally, the Peacekeeper was deployed from 1987 until 2005 and held up to ten nuclear warheads. It was decided under START II, which never entered into force, to remove the Peacekeeper from the ICBM force.



An unarmed Minuteman III launches during an operational test March 23, 2015, Vandenberg Air Force Base, California

Currently, the U.S. ICBM force consists of Minuteman III (MMIII) missiles. MMIII missile bases are located at F.E. Warren Air Force Base (AFB) in Wyoming, Malmstrom AFB in Montana, and Minot AFB in North Dakota.

The United States has "deMIRVed"[3] all deployed ICBMs, so that each MMIII is single warhead. The United States continues the Minuteman III LEP, with the aim of keeping MMIII in service until 2030. The DoD is undergoing an analysis of alternatives (AoA) for a follow-on ICBM, referred to as the Ground-Based Strategic Deterrent concept. The study considers a range of possible future options, with the objective of defining a cost-effective approach that supports national security objectives while promoting stable deterrence.

3.2.3 Air-Launched

The **U.S. bomber force** serves as a visible, flexible, and recallable national strategic asset. Bombers provide a rapid and effective hedge against technical challenges that might affect another leg of the triad and offsets the risks of geopolitical uncertainties. Furthermore, nuclear-capable bombers are important to maintain extended deterrence against potential attacks on U.S. allies and partners. The ability to forward deploy heavy bombers signals U.S. resolve and commitment in a crisis and enhances the reassurance of U.S. allies and partners, strengthening regional security architectures.

The nuclear B-52H force is located at Barksdale AFB in Louisiana and Minot AFB in North Dakota. The B-52H fleet has been the backbone of the strategic bomber force for more than 50 years. The B-52H "Stratofortress" (**Figure 3.4**) is a heavy, long-range bomber that can perform a variety of missions. It is capable of flying at subsonic speeds at altitudes of up to 50,000 feet and can carry precision-guided conventional ordnance in addition to nuclear air-launched cruise missiles (ALCMs). B-52H bombers carry six AGM-86B/C/D

Figure 3.4 B-52H "Stratofortress"

3 A "MIRVed" ballistic missile is one that carries Multiple Independently Targetable Reentry Vehicles (MIRVs).

ALCM missiles on each of two externally mounted pylons and eight internally on a rotary launcher, giving the B-52H a maximum capacity of 20 missiles per aircraft. ALCMs were developed to increase the effectiveness of B-52H bombers with a stand-off capability.

The B-2 "Spirit" stealth bomber (**Figure 3.5**) entered the force in 1997, enhancing U.S. deterrent forces with its deep penetration capability. The B-2 is a multi-role bomber capable of delivering both conventional and nuclear munitions. The B-2 force is located at Whiteman AFB in Missouri.

Figure 3.5 B-2 "Spirit"

In addition to its strategic nuclear forces that make up the nuclear triad, the United States has CONUS-based and forward-deployed **dual-capable aircraft** in Europe consisting of the F-15 (**Figure 3.6**) and the F-16 (**Figure 3.7**). DCA are able to deliver conventional munitions or B61 nuclear bombs and are available to support the North Atlantic Treaty Organization (NATO) in combined-theater nuclear operations.

Figure 3.6 F-15

Figure 3.7 F-16

NATO's announcements over the last five years reinforce the relevance of the DCA mission. At its November 2010 summit in Lisbon, NATO approved the Strategic Concept making clear the intended duration of its nuclear policy: "Deterrence, based on an appropriate mix of nuclear and conventional capabilities, remains a core element of our overall strategy…As long as nuclear weapons exist, NATO will remain a nuclear alliance.” Furthermore, the Heads of State and Government mandated the *Deterrence and Defence Posture Review,* and in 2012, the results included reaffirmation that nuclear weapons are a core component of NATO’s overall capabilities for deterrence and defence and that allies will ensure that all components of NATO’s nuclear deterrent remain safe, secure, and effective for as long as NATO remains a nuclear alliance.

The Air Force is in the process of replacing the F-16s with the F-35 Lightning II, originally referred to as the Joint Strike Fighter, and plans to retain a dual-capable mission in the F-35. The United States retains the capability to forward deploy non-strategic nuclear weapons in support of its commitments to its NATO allies.

3.2.4 Force Structure

Based on requirements levied in the New START agreement, by February 5, 2018, the DoD will transition today’s nuclear triad composition to the Treaty-compliant force structure, shown in **Figure 3.8**, which fully supports the President’s *National Security Strategy* and *Nuclear Weapons Employment Strategy*:

Existing Types of ICBMs, SLBMs, and heavy bombers	Deployed and Non-Deployed (2014)	Deployed (2018)	Deployed and Non-Deployed (2018)
Minuteman III ICBMs	454	400	454
Trident II SLBMs	336	240	280
B-2A/B-52H Bombers	96	60	66
TOTAL	**886**	**700**	**800**

Figure 3.8 U.S. Nuclear Force Structure Plan

- **400 deployed ICBMs.** The DoD will place 50 currently deployed ICBM launchers into a non-deployed status by removing the ICBMs from these silos. Non-deployed ICBM launchers include four non-deployed test launchers.
- **240 deployed SLBMs on 14 SSBNs.** The DoD will convert four SSBN launch tubes on each of the 14 SSBNs, removing 56 launch tubes from accountability under the Treaty. This will result in a maximum of 12 SSBNs with 20 missiles loaded at any given time, providing 240 deployed SLBMs and SLBM launchers accountable under New START.
- **60 deployed heavy bombers.** The DoD will retain 19 B-2As and 41 B-52Hs as nuclear-capable heavy bombers and will convert 30 B-52H bombers to a

conventional-only role, thereby removing them from accountability under New START. Non-deployed bombers include three non-deployed test bombers.

- **Limit of 1,550 accountable warheads.** The DoD will manage the overall accountable warheads under this force structure to meet the New START central limit of 1,550 warheads on deployed ICBMs, warheads on deployed SLBMs, and nuclear warheads counted for deployed heavy bombers.

3.3 Nuclear Weapons

All nuclear weapons in the U.S. stockpile are designated either as a warhead (W) or as a bomb (B).[4] In this handbook, the term "warhead" denotes individual weapons without distinguishing between "W" or "B" designators, and the terms "weapon" and "warhead" are used interchangeably. Weapons that have different engineering requirements because they must interface with a launch or delivery system are called warheads. Weapons that do not have these interface requirements, such as gravity bombs and retired atomic demolition munitions (ADMs) are called bombs. Using these definitions, the total number of U.S. nuclear weapons is equal to the sum of warheads plus bombs. Additionally, the term warhead-type is used to denote a population of weapons with the same design. Warheads in the current force structure include B61, W76, W78, W80, B83, W87, and W88. **Figure 3.9** is a comprehensive list of U.S. nuclear warhead-types.

Throughout the history of nuclear weapons development, the United States has developed families of warheads based on a single-warhead design. Thus, some weapons in the U.S. stockpile were developed as modifications (Mods) to an already complete design. For example, the B61 bomb has had 12 variations over time. Each variation was designated as a different Mod. Each Mod used the basic design of the B61, but incorporated a few different components that changed the operational characteristics of the weapon in a significant way. Five of these Mods are still in the current stockpile: B61-3, B61-4, B61-7, B61-10, and B61-11. The B61-12 is currently in preproduction phase. Furthermore, this approach is more efficient when conducting quality assurance testing and evaluation because warhead Mods that have common components can be tested as a family of warheads.

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[4] The earliest U.S. nuclear weapons were distinguished by Mark (MK) numbers, derived from the old British system for designating aircraft. In 1949, the MK5 nuclear weapon, intended for the Air Force's surface-to-surface Matador cruise missile and the Navy's Regulus I cruise missile, had interface engineering considerations that were not common to gravity bombs. A programmatic decision was made to designate the weapon as a warhead, using the designation W5. At the programmatic level, the Project Officers Group (POG), and the agencies participating in the POG process, distinguish between warheads and bombs.

Figure 3.9 Comprehensive List of Warhead-Types and Descriptions

FATMAN	Strategic Bomb
LITTLEBOY	Strategic Bomb
B3/MKIII	Strategic Bomb
B4/MKIV	Strategic Bomb
T-4	ADM
B5	Strategic Bomb
W5	Matador/Regulus Missiles
B6	Bomb
B7	Tactical Bomb/Depth Charge
W7	Corporal SSM/Honest John/BOAR ASM/ Betty NDB/Nike-Hercules SAM/ADM
B8	Penetrator Bomb
W9	280mm AFAP
B10	Strategic Bomb*
B11	Hard Target Penetrator Bomb
B12	Tactical Bomb
B13	Strategic Bomb*
B14	Strategic Bomb
B15	Strategic Bomb
B16	Strategic Bomb*
B17	Strategic Bomb
B18	Strategic Bomb
B19	280mm AFAP
B20	Strategic Bomb*
B21	Strategic Bomb
W23	16 in. AFAP
B24	Strategic Bomb
W25	Genie AAM*/Little John Missile/ADM
B26	Strategic Bomb*
B27	Strategic Bomb
W27	Regulus SLCM
B28	Strategic/Tactical Bomb
W28	Hounddog ASM/Mace GLCM
W29	Redstone SSM*
W30	Talos AAW/TADM
W31	Nike-Hercules SAM/Honest John SSM/ ADM
W32	240mm AFAP*
W33	8 in. AFAP
W34	Astor ASW/Hotpoint Tactical Bomb/ Lulu DB
W35	Atlas ICBM/Titan ICBM/Thor IRBM/ Jupiter IRBM*
B36	Strategic Bomb
W37	Nike-Hercules SAM*
W38	Atlas ICBM/Titan ICBM
B39	Strategic Bomb
W39	Redstone Tactical Missile
W40	Bomarc Strategic SAM/ Lacrosse Tactical Missile/ Corvus Antiship Missile*
B41	Strategic Bomb
W42	Hawk/Falcon/Sparrow*
B43	Strategic/Tactical Bomb
W44	ASROC Missile
W45	MADM/Little John SSM/Terrier SAM/ Bullpup ASM

This list is in chronological order according to entry into Phase 2A (when a warhead receives its designated name)

* Never Deployed   Currently in the U.S. force structure

Figure 3.9 [cont.] Comprehensive List of Warhead-Types and Descriptions

W46	Redstone Snark Missile*
W47	Polaris A1/A2 SLBM
W48	155mm AFAP
W49	Atlas/Thor ICBMs, Jupiter/Titan IRBMs
W50	Pershing 1a SSM
W51	Falcon/Davy Crockett/Reevitess Rifle
W52	Sergeant SSM
B53	Strategic Bomb
W53	TITAN II ICBM
B54	SADM
W54	Falcon AAM/Davy Crockett
W55	SUBROC
W56	Minuteman II ICBM
B57	Tactical Depth Charge/Strike Bomb
W58	Polaris A3 SLBM
W59	Minuteman Y1 ICBM
W60	Typhoon*
B61	Strategic/Tactical Bomb
W62	Minuteman III ICBM
W63	Lance SSM
W64	Lance SSM*
W65	Sprint SAM
W66	Sprint SAM
W67	Minuteman III/Poseidon SLBM*
W68	Poseidon C3 SLBM
W69	SRAM ASM
W70	Lance SSM
W71	Spartan SSM
W72	Walleye Tactical Bomb
W73	Condor*
W74	155mm AFAP*
W75	8 in. AFAP*
W76	Trident II SLBM
B77	Strategic Bomb*
W78	Minuteman III ICBM
W79	8 in. AFAP
W80	ALCM/SLCM
W81	Standard Missile-2*
W82	155mm AFAP*
B83	Strategic Bomb
W84	GLCM SSM
W85	Pershing II SSM
W86	Pershing II SSM*
W87	Minuteman III ICBM
W88	Trident II SLBM
W89	SRAM II *
B90	NDSB*
W91	SRAM-T*
W92	Sealance (proposed)
RNEP	Earth Penetrator (proposed)
RRW-1	Reliable Replacement Warhead-SLBM (proposed)
RRW-2	Reliable Replacement Warhead-Bomb (proposed)

This list is in chronological order according to entry into Phase 2A (when a warhead receives its designated name)

* Never Deployed   [shaded] Currently in the U.S. force structure

All nuclear weapons in the U.S. stockpile are designated as strategic or non-strategic. Strategic weapons are those delivered by ICBMs, SLBMs, or heavy bombers. All other nuclear weapons are non-strategic. Non-strategic nuclear weapons, which are sometimes called "tactical" or "theater" nuclear weapons, historically have included bombs delivered by DCA that can be used for both nuclear and conventional missions; warheads in cruise missiles delivered by non-strategic aircraft; warheads on sea-launched cruise missiles (SLCM); warheads on ground-launched cruise missiles (GLCM); warheads on ground-launched ballistic missiles (GLBM) with a maximum range that does not exceed 5,500 kilometers, including air-defense missiles; warheads fired from cannon artillery; ADMs; and anti-submarine warfare nuclear depth bombs (NDBs).

3.4 Stockpile Quantities

As stated in the 2010 *Nuclear Posture Review*, the United States is committed to reducing the role and number of its nuclear weapons. Nuclear weapons stockpile reductions are commensurate with the sustainment of an effective nuclear force that provides continued deterrence and remains responsive to new uncertainties in the international security arena.

Nuclear weapon stockpile quantities are annually authorized by presidential directive. The directive includes specific guidance to the DoD and the DOE/NNSA. The directive also includes a Nuclear Weapons Stockpile Plan (NWSP) that authorizes specific quantities of warheads, by type and by year, for a multi-year period.

As of September 2014, the U.S. nuclear stockpile consisted of 4,717 warheads. This number represents an 85 percent reduction in the stockpile from its maximum (31,255) at the end of FY 1967, and a 78 percent reduction from its level (22,217) when the Berlin Wall fell in late 1989. Furthermore, the number of U.S. non-strategic nuclear weapons has declined by approximately 90 percent since September 30, 1991. **Figure 3.10** shows U.S. stockpile quantities since 1962.

3.5 Stockpile Configuration

The current U.S. stockpile is composed of weapons developed and produced during the Cold War and maintained well-beyond the original planned lives for roles and missions that have evolved significantly since original production. A large part of modern stockpile management involves maintaining aging weapons in an environment where they cannot be replaced once dismantled or become irreparable. Thus, stockpile composition refers

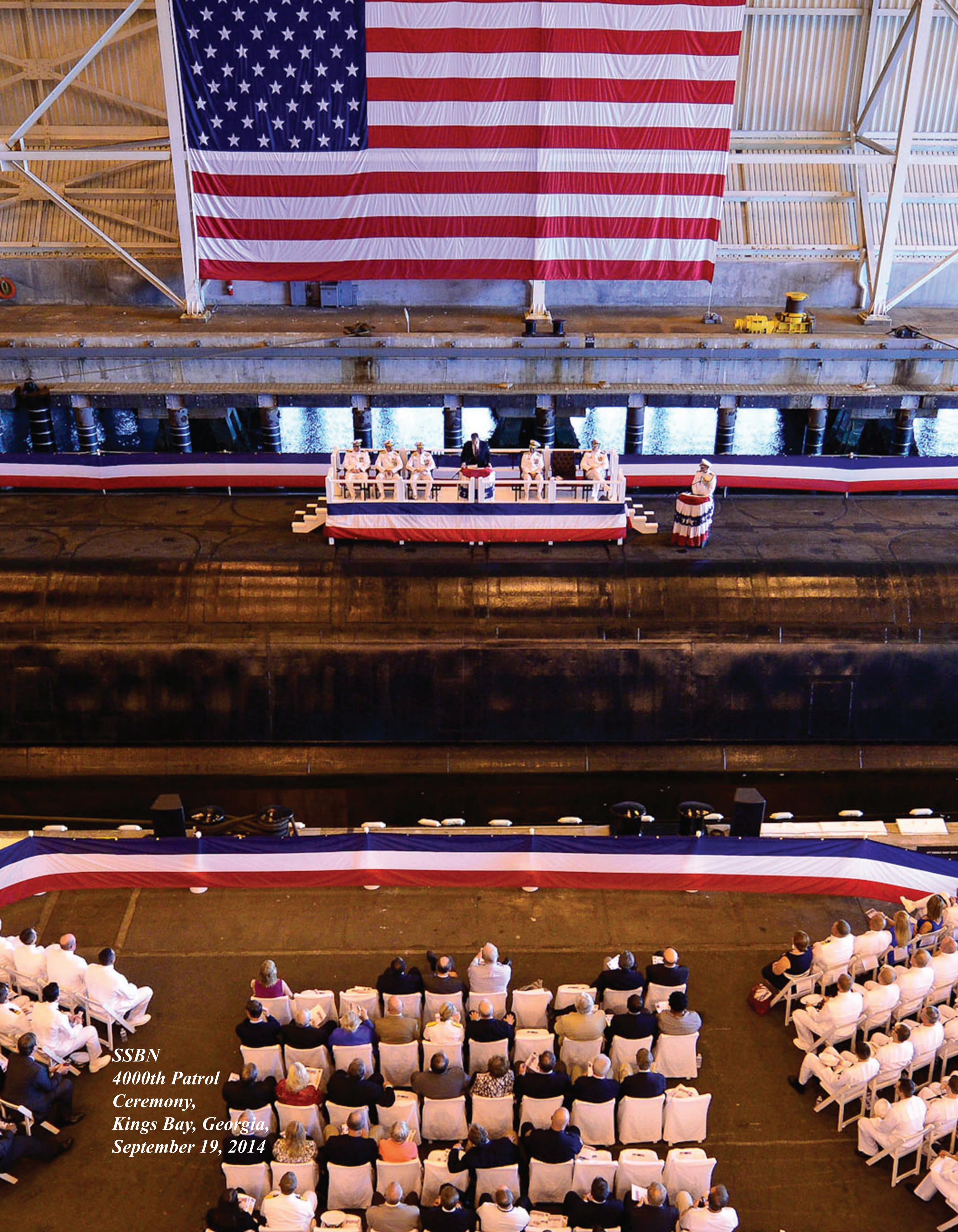
Figure 3.10 Stockpile Numbers – Fiscal Years 1962–2014

1962	25,540	1975	27,519	1988	23,205	2001	10,526
1963	28,133	1976	25,914	1989	22,217	2002	10,457
1964	29,463	1977	25,542	1990	21,392	2003	10,027
1965	31,139	1978	24,418	1991	19,008	2004	8,570
1966	31,175	1979	24,138	1992	13,708	2005	8,360
1967	31,255	1980	24,104	1993	11,511	2006	7,853
1968	29,561	1981	23,208	1994	10,979	2007	5,709
1969	27,552	1982	22,886	1995	10,904	2008	5,273
1970	26,008	1983	23,305	1996	11,011	2009	5,113
1971	25,830	1984	23,459	1997	10,903	2010	5,066
1972	26,516	1985	23,368	1998	10,732	2011	4,897
1973	27,835	1986	23,317	1999	10,685	2012	4,881
1974	28,537	1987	23,575	2000	10,577	2013	4,804
						2014	4,717

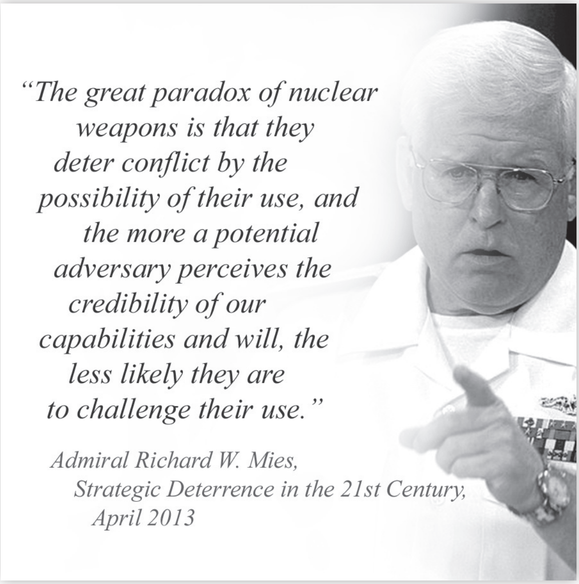
not only to the differences among bombs and warheads or strategic and non-strategic weapons, but also to the various stockpile categories into which the weapons are divided. This enables the United States to maintain the required numbers of operationally deployed weapons, those which could be deployed if ever needed.[5]

As part of stockpile composition management, it is necessary to identify the numbers, types, and configurations of nuclear warheads required to support an array of employment options and address possible contingencies. The United States must maintain the required number of operationally ready weapons to ensure confidence in the credibility of the nuclear deterrent, maintain strategic stability with Russia, and assure U.S. allies and partners of the credibility of the U.S. nuclear umbrella. Because some contingencies are based on strategic warning, meaning the United States would know in advance the need to employ its nuclear weapons to respond to emerging circumstances, not all nuclear weapons must be maintained in an operationally responsive mode. To save

[5] U.S. Strategic Command, the Military Departments, and other Combatant Commanders determine the numbers and types of operational nuclear weapons required to satisfy national security policy objectives. These numbers, combined with DOE/NNSA requirements and capacity to support surveillance, maintenance, and life extension, result in stockpile projections over time. These projections are codified in the annual NWSP issued by the President. See *Appendix A: Nuclear Weapons Council and Annual Reports* for information on the NWSP.



SSBN 4000th Patrol Ceremony, Kings Bay, Georgia, September 19, 2014 resources and preserve limited facilities and capabilities, some weapons are maintained in less-ready modes, requiring maintenance action or component replacement/production to become operationally ready.



Because all U.S. nuclear weapons are not ready for immediate use all of the time, balancing the various operational requirements against physical, logistical, and fiscal realities is challenging. Considering the United States has no current capability to mass produce fissile components for nuclear weapons, U.S. stockpile composition must retain some flexibility to allow options in the event of a technological failure or to augment U.S. nuclear forces in response to geopolitical reversals. Stockpile composition is a function of configuration management, or the categorization of warheads by function and readiness state, and the associated logistical planning.

3.5.1 Configuration Management

Stockpile maintenance is an intricate process involving almost every part of the DOE/NNSA nuclear security enterprise and organizations with nuclear missions within the DoD. This joint DoD-DOE/NNSA process coordinates technical complexities and operational needs associated with the various weapons systems. The Project Officers Group (POG) is at one end of this joint process while the Nuclear Weapons Council (NWC) is at the other. The role of the NWC and the POG in the stockpile management process is discussed in *Chapter 5: Stockpile Management, Processes, and Organizations*.

Operational warheads are called the *active stockpile*. An operational weapon is maintained with functioning limited life components (LLCs). Non-operational warheads are called the *inactive stockpile* and do not maintain LLCs. Based on employment plans, strategic requirements, and logistical requirements the NWSP specifies the number of warheads required to be operational.

3.5.2 Nuclear Weapons Stockpile Hedge

The stockpile is subject to several uncertainties and associated risks, including the possibility of an unforeseen catastrophic failure of a class of delivery vehicles, warhead-type or family, or an unexpected change in the geopolitical situation that requires an increase in the number of weapons available for use. It is vital for the DoD and the DOE/NNSA to have procedures in place designed to mitigate these and other risks with a strategy that accounts for threats to the stability of the nuclear deterrent at lower stockpile levels.

Basic approaches to nuclear stockpile risk mitigation include the existence of a significant warhead production capability, maintenance of warheads designated to counter unforeseen significant events noted above, or some combination of the two. Designating warheads to counter unforeseen events is referred to as a "hedge." During the Cold War, the United States maintained a robust production capability to augment or decrease production, as required. Today, the United States does not have an active, robust nuclear weapon production capability and relies on the maintenance of a warhead hedge to reduce accepted risks.

In the absence of a modernized nuclear infrastructure and the reestablishment of a fissile component production capability, with sufficient capacity, the decision to reduce the quantity of warheads designated to mitigate unforeseen events and dismantle additional weapons is not taken lightly. Even though some components can be maintained, construction and deployment time to a first weapon could take two decades to produce replacement weapons, in quantities, using a qualified production process. Thus, decisions regarding the U.S. nuclear weapons stockpile hedge are more complicated than they might seem and are considered by U.S. policy makers at the highest levels. Hedge weapons are included in both the active and inactive stockpiles.

Active Stockpile

Active stockpile warheads are maintained in an operational status. These weapons undergo regular replacement of LLCs (e.g., tritium components, neutron generators, and power-source batteries), usually at intervals of a few years. Active stockpile warheads are also refurbished with all required LEP upgrades, evaluated for reliability estimates, usually every six months, and validated for safety, usually every year. These warheads may be stored at a depot, operational base, or uploaded on a delivery vehicle (e.g., a reentry body, a reentry vehicle, an air-launched cruise missile, or a delivery aircraft).

Active stockpile warheads include *active ready* warheads which are operational and ready for wartime employment; *active hedge* warheads which serve as part of the technical or geopolitical hedge and can serve as active ready warheads within prescribed activation timelines; and *active logistics* warheads to facilitate workflow and sustain operational status.

Inactive Stockpile

Inactive stockpile warheads are maintained in a nonoperational status. Inactive stockpile warheads have the tritium components removed as soon as logistically practical and the tritium is returned to the national repository.[6] Other LLCs are not replaced until the warheads are reactivated and moved from the inactive to the active stockpile. Some inactive stockpile warheads are refurbished with all required LEP upgrades while others are not upgraded until the refurbishment is required for reactivation. Some inactive stockpile warheads are evaluated for reliability estimates, others may not require a reliability estimate. All inactive stockpile warheads are validated for safety, usually every year, and are normally stored at a depot, rather than an operational base. These warheads are never uploaded on a delivery vehicle.

Inactive stockpile warheads include *inactive hedge* warheads that serve as part of the technical or geopolitical hedge and can serve as active ready warheads in prescribed activation timelines; *inactive logistics* warheads that serve logistical and surveillance purposes; and *inactive reserve* warheads retained as a long-term response for risk mitigation for technical failures in the stockpile.

Readiness States

The annual Requirements and Planning Document (RPD) provides the supporting details upon which the NWSP is based. The RPD uses a system of readiness states (RS) to determine what quantities of warheads require various programmatic activities. For additional information see *Appendix A: Nuclear Weapons Council and Annual Reports*.

3.5.3 Logistical Planning

Logistical planning is necessary for configuration management to ensure components, weapons movements, and locations match as appropriate. Logistical planning includes

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[6] Tritium is a radioactive gas used in U.S. warheads as a boosting gas to achieve required yields. Because tritium is in limited supply and very expensive, special procedures are used to ensure none is wasted in the process of storing, moving, and maintaining warheads. The national repository for tritium is at the Savannah River Site, located near Aiken, South Carolina.

plans for storing, staging, maintaining, moving, testing, and refurbishing weapons. Nuclear weapons logisticians must comply with requirements and restrictions from several sources, including joint DoD-DOE/NNSA agreements and memoranda of understanding, Joint Publications (JPs) published by the Joint Chiefs of Staff, the Joint Nuclear Weapons Publications System (JNWPS),[7] and Military Departments' regulations. The key theme for logistical planning is to ensure weapons are handled or stored in a way that is always safe, secure, and maintained to be reliable, with appropriate controls in place to preclude unauthorized acts or events.

Storage

Storage refers to the placement of weapons in a holding facility for an indefinite period of time. Nuclear weapons are amassed in secure weapons storage areas, most in munitions storage igloos (**Figure 3.11**). Logistical planning for nuclear weapons storage includes several critical considerations: the number of square feet required to store the designated warheads in each igloo so as to avoid criticality concerns; special barriers needed for safe separation of certain types of nuclear warheads; inside traffic flow for access to warheads by serial number for maintenance or movement of a surveillance sample; and procedures for allowing access and security both at the exclusion area and greater distances for the overall storage facility. Currently, storage of nuclear weapons occurs only at DoD facilities operated by the Navy and the Air Force. Storage is also a consideration for retired nuclear weapons awaiting dismantlement.

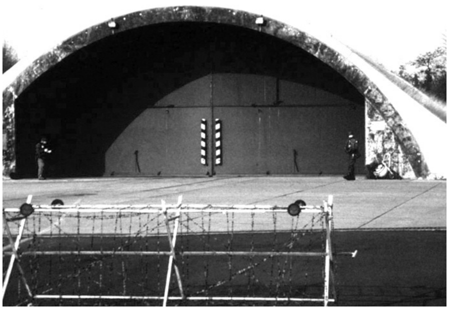

Figure 3.11 Munitions Storage Igloo

Staging

Staging refers to the placement of warheads awaiting some specific function (e.g., transportation, disassembly, or dismantlement) in a holding facility for a limited period of time. Logistical planning for nuclear weapons staging includes all of the considerations mentioned above, as well as the planned flow of warheads in the disassembly or dismantlement queue. Nuclear weapons are usually staged in secure areas awaiting

[7] JNWPS is a system of technical manuals on nuclear weapons, associated materiel, and related components. It includes general and materiel manuals developed by the DoD and the DOE/NNSA to provide authoritative nuclear weapons instructions and data.

disassembly or dismantlement at the DOE/NNSA Pantex Plant near Amarillo, Texas. Many current U.S. nuclear weapons have been staged in the disassembly queue at least once as surveillance samples, where they were disassembled, had components tested and evaluated, and then reassembled for return to the stockpile. Coincidentally, some warheads have been through that process several times.

Maintenance

Nuclear weapons maintenance includes the technical operations necessary to disassemble and reassemble a warhead to whatever extent is required for the replacement of one or more components. Maintenance operations require highly specialized training to qualify maintenance technicians as well as special ordnance tools, technical manuals, and secure and effective maintenance facilities. Most maintenance operations, including limited life component exchanges (LLCEs), are performed by Navy or Air Force technicians at an appropriate military nuclear weapons maintenance facility. Some maintenance operations require the warhead to be disassembled to a greater extent than the military technicians are authorized to accomplish. In the event of such an occurrence, the warhead must be sent back to the Pantex Plant for maintenance.

For each type of warhead, the DOE/NNSA establishes an LLCE schedule. This schedule is managed by individual warhead and serial number and is coordinated with the appropriate military service and DOE/NNSA offices.

Movement

Nuclear weapons are moved for several reasons. Warheads can be moved from an operational base to a depot upon retirement as part of the dismantlement queue and moved again to Pantex for actual dismantlement. Warheads may be moved for maintenance activities or they may be moved within an operational base area. Warheads may also be moved to the Pantex Plant for disassembly or returned from Pantex after re-assembly. On occasion, a warhead will be returned from the Military Department to Pantex because of a special maintenance problem. Normally, all warhead movements from one installation to another within the continental United States are accomplished using DOE/NNSA secure safeguards ground transport vehicles. The Air Force uses its own certified ground vehicles and security for moves within an operational base area. Movements of weapons to and from Europe are accomplished by the Air Force using certified cargo aircraft. LLCs may be transported by special DOE/NNSA contract courier aircraft or by DOE/NNSA secure safeguards transport vehicles. Representatives from agencies with nuclear weapons movement responsibilities meet frequently to coordinate the movement schedule.

Surveillance

The logistics aspects of the surveillance program include downloading, uploading, reactivating, and transporting warheads. For example, an active ready warhead selected at random to be a surveillance sample is downloaded from an ICBM. A logistics warhead is uploaded to replace the active ready warhead with minimum loss of operational readiness. The DOE/NNSA produces LLCs, which are sent to the depot, and a replacement warhead is reactivated and transported by a secure safeguards transport vehicle to the operational base to replace the logistics warhead. The secure safeguards vehicle transports the surveillance sample warhead to Pantex for disassembly. After the surveillance testing is complete, the warhead may be reassembled and returned to the depot as an inactive warhead. Logisticians plan and coordinate the dates and required transport movements for each upload and download operation.

Forward Deployment

The United States remains committed to support NATO forces with nuclear weapons forward-deployed in Europe. Recommendations for forward deployment are sent to the President as a *Nuclear Weapons Deployment Plan*. The President issues a classified *Nuclear Weapons Deployment Authorization* (NWDA) as a directive.

Life Extension Program Activities

Weapon systems are being maintained well beyond their original design lifetime. As these systems age, the DOE/NNSA continues to detect anomalies that may ultimately degrade performance of some nuclear weapons to unacceptable levels. The drivers for life extension activities are addressing aging and performance issues, enhancing safety features, and improving security, while meeting strategic deterrence requirements. Additional goals are to reduce, to the extent possible, materials that are hazardous, costly to manufacture, degrade prematurely, or react with other materials in a manner that affects performance, safety, or security. A well-planned and well-executed stockpile life extension strategy will improve safety and security, while enabling the DoD to implement a deployment and hedge strategy consistent with national security guidance. In addition, because of production constraints, the DOE/NNSA is pursuing both refurbished and reused components from legacy systems. Changing materials, using components from legacy systems in new LEPs, and remanufacturing legacy component designs present significant challenges to today’s stockpile stewards.

Retired Warheads

Warheads are retired from the stockpile in accordance with presidential guidance in the NWSP. Retired weapons shown as zero quantity in the NWSP, covering the FY in which they are retired, are not listed in subsequent NWSPs, and fall into one of two categories:

- Retired warheads released for disassembly are scheduled for disassembly consistent with the throughput available in DOE/NNSA facilities, so as not to impact support for DoD requirements. Currently, there is a backlog of weapons awaiting disassembly. Most of these warheads remain stored at DoD facilities because of limited staging capability in DOE/NNSA facilities.
- Warheads pending approval for disassembly, or weapons in "managed retirement," must be maintained by the DOE/NNSA in such a way they could be reactivated should a catastrophic failure in the stockpile necessitate such action. Weapons in managed retirement cannot be dismantled until approved by the Nuclear Weapons Council Standing and Safety Committee (NWCSSC).

The DOE/NNSA validates the safety of all retired warheads and reports annually to the NWCSSC until the weapons are dismantled. These annual reports specify the basis for safety validation and may require additional sampling from the population of retired warheads.