Congressional Research Service
Informing the legislative debate since 1914

IN FOCUS

Updated December 21, 2021

Defense Primer: Ground Based Strategic Deterrent (GBSD) Capabilities

Figure 1. Notional GBSD Launch

Source: https://www.northropgrumman.com/GBSD/.

The Ground Based Strategic Deterrent (GBSD) is intended to replace the Minuteman III (MMIII) Intercontinental Ballistic Missile (ICBM) in the U.S. nuclear force structure. MMIII has been deployed as the ground-based leg of the U.S. nuclear triad—land-based ballistic missiles, submarine-launched ballistic missiles, and nuclear-capable bombers—since 1970. (For details, see CRS Report RL33640, *U.S. Strategic Nuclear Forces: Background, Developments, and Issues*, by Amy F. Woolf.) The Air Force expects GBSD to begin replacing MMIII in 2029. As the missile moves toward production and deployment, issues for Congress include whether to authorize and appropriate funding for this program and, if so, whether to provide oversight as the program progresses and is implemented.

What Is an ICBM?

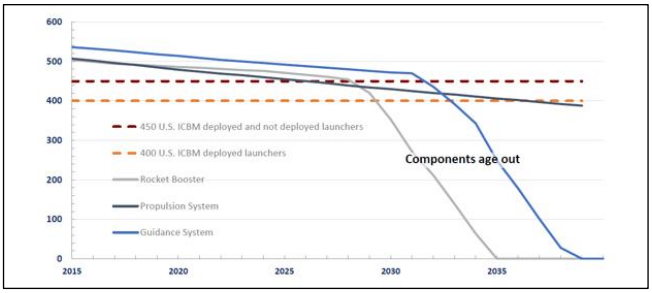
The United States began deploying nuclear-armed intercontinental ballistic missiles in 1959, and it has maintained these systems "on alert" in a position to launch promptly since that time. Missiles designated as ICBMs are those that have been tested to a range greater than 5,500 km, or roughly 3,400 miles. Although some countries use road or rail mobile launchers for their ICBMs, U.S. ICBMs are based in hardened concrete silos, known as launch facilities, located in North Dakota, Montana, Wyoming, Colorado, and Nebraska. An ICBM can reach targets around the globe in approximately 30 minutes after launch. During the first three minutes, the missile's flight is powered by three solid fuel rocket motors. After the powered portion of flight, the missile follows a parabolic trajectory toward its target. It releases its warhead during the mid-course portion of its flight, and the warhead continues to the target.

Once the President authorizes the launch of any U.S. nuclear-armed missile, it cannot be recalled or destroyed in flight. The same is true for nuclear missiles launched from U.S. submarines. In contrast, U.S. bombers could return to their bases after launch, without releasing their weapons, although the weapons could not be recalled after their release from the bomber.

Status of Minuteman III

The U.S. Air Force first deployed Minuteman ICBMs in the 1960s. Minuteman III, the first of the class to carry multiple warheads, entered the force in the early 1970s. The Air Force has replaced and updated many of the component systems on the missile—a process known as life-extension—several times over the past 50 years. The most recent life-extension program occurred in the late 2000s and included, among other things, a replacement booster and a new missile guidance computer. The Air Force has noted that both of these components may face reliability concerns as they reach the end of their intended lifespans over the next decade (see **Figure 2**). After conducting a comprehensive Analysis of Alternatives (AOA) in 2014, the Air Force determined that it would replace MMIII with a new missile system. When compared with a life-extended Minuteman III, the replacement system (the Ground Based Strategic Deterrent, GBSD) would meet current and expected threats, maintain the industrial base, insert more reliable technology, produce a modular weapon system concept, and reduce life cycle cost.

Figure 2. Projected Decrease in Operational Minuteman III Missiles



Source: Mark Gunzinger, Carl Rehberg, and Gillian Evans, Sustaining the U.S. Nuclear Deterrent: The LRSO and GBSD, Center for Strategic and Budgetary Assessments.

Capabilities of GBSD

Modularity: What Is It and Why Is It Important in Lowering Lifecycle Costs?

In contrast with MMIII missiles, the GBSD employs a modular design and open architecture, allowing for the replacement of aging and outdated components. According to the Air Force, this modular approach would reduce the lifecycle cost of GBSD and provide flexibility for

improvements throughout the life of the weapon system. Unlike in many current DOD systems, open systems architectures allow the Air Force to control the intellectual property of the system, including the system's source code. This allows multiple vendors, in addition to the contract winner Northrop Grumman, to compete for and complete future upgrades and improvements to the system. These types of upgrades might become important as technology evolves and could allow for improvements in the safety and reliability of the missile system. They could include better guidance systems or new types of countermeasures that might allow the missile to penetrate an adversary's ballistic missile defensive systems.

Consequently, modularity may provide benefits in the maintenance of a weapon system because it would allow the Air Force to modify and possibly improve the initial design of the missile by upgrading and replacing smaller systems, of modules, without redesigning the entire weapon system. This could potentially be a more cost-effective way to support the missile's intended 50-year life cycle than the life extension programs that replaced aging parts in the MMII. Also, the Air Force would not have to go back and pay the original vendor to open software to add the new piece into the system architecture in the future.

Improved Security

The Air Force has noted that, with MMIII, most of the maintenance conducted on the warhead or the Missile Guidance Computer currently requires that the launcher closure door (the access door directly above the missile) be open. This introduces a security vulnerability by increasing the possibility of unauthorized observation or access. To counter this, during MMIII maintenance operations, the Air Force assigns additional Security Forces to the crew to help protect the warhead. With the modular design of GBSD, much of the maintenance can be conducted with the launcher closure door closed. The Air Force states that deploying the GBSD would mitigate the security risks during maintenance compared to the current MMIII.

Potential Manpower Savings

The three current MMIII bases in the Air Force (Minot AFB, Malmstrom AFB, and FE Warren AFB) require greater numbers of security forces personnel compared with other units in the Air Force. The GSBD's modularity that enables most maintenance to be done with the launcher closure door closed might also allow for a reduction in the number of Security Forces personnel required at the bases. In addition to fewer required Security Forces, the Air Force expects the maintenance needs of a new weapon system to be greatly reduced. Finally, although the final layout of how the system will be set up has not been publicized, there are indications to suggest that fewer Launch Control Centers (LCCs) will be required. Current requirements have 15 LCCs at each of the three missile bases for a total of 45 LCCs. Each LCCs is manned continuously by two missile combat crew members. If fewer LCCs are needed in GBSD, it could lead to the need for fewer missile operators. It is premature to estimate the potential total manpower savings, but it may be reasonable to assume there will be some.

Improved Throw Weight

The MMIII engines use heavy steel casings to house the missile propellant. These casings add to the weight of the missile and affect its flight range and payload capabilities. Modern rocket boosters, like the Navy's D5 Submarine Launched Ballistic Missile, use composite material to save weight and increase potential payload. GBSD's boosters use a composite material, making GBSD significantly lighter than the MMIII. Most notably, this will increase the missile's throw weight, which is a measure of the weight of the payload that the missile can deliver to a particular range. The Air Force asserts that the greater throw weight will allow GBSD to carry different payloads and give it more flexibility for future missions. Specifically, as adversaries develop ballistic missile defensive systems in the future, the increased throw weight could potentially allow the Air Force to develop countermeasures that would help the missile overcome the defenses.

The Air Force plans to deploy the GBSD with one warhead per missile. However, with the greater throw weight available on GBSD, the Air Force could, potentially, deploy it with two or three warheads per missile in response to changes in the international security environment. Moreover, some argue that if the Air Force deployed multiple warheads on each missile, it might be able to meet targeting requirements with a smaller number of deployed missiles. Currently, the United States disperses single-warhead missiles across a large area of the upper Midwest, which both reduces the value of each individual missile and complicates an adversary's ability to attack the entire force. A smaller number of multiple warhead missiles could change this calculus but also might provide a less costly alternative for the GBSD force.

Considerations for Congress

Some Members of Congress have questioned the need to fund and deploy GBSD missiles; some have suggested that the Air Force consider, again, whether it could life extend the Minuteman III instead. They, along with analysts outside government, have argued that a delay in GBSD could ease financial pressures caused by the simultaneous recapitalization of U.S. land-based, sea-based, and air-delivered nuclear weapons. The Congressional Budget Office (CBO) has estimated that the three major programs—the GBSD, the Columbia Class submarines, and the B-1 bomber—could cost $234 billion over the next decade. Some analysts outside government and some former defense officials have also suggested that the United States reduce or eliminate its ICBMs because their vulnerability to attack could make them destabilizing in a crisis. On the other hand, those who support the GBSD program have noted that every Nuclear Posture Review conducted since the end of the Cold War has endorsed the nuclear triad, with President Obama's 2010 NPR stating that "retaining all three Triad legs will best maintain strategic stability at reasonable cost, while hedging against potential technical problems or vulnerabilities."

Benji Johnson, U.S. Air Force Fellow
Amy F. Woolf, Specialist in Nuclear Weapons Policy

IF11681

Disclaimer