



March 2020

DEFENSE NUCLEAR ENTERPRISE

Systems Face
Sustainment
Challenges, and
Actions Are Needed to
Effectively Monitor
Efforts to Improve the
Enterprise

GAO Highlights

Highlights of [GAO-20-296](#), a report to congressional committees

Why GAO Did This Study

In 2014, the Secretary of Defense directed two reviews of DOD's nuclear enterprise. These reviews made recommendations to address problems with leadership, organization, investment, morale, policy, and procedures, as well as other shortcomings that adversely affected the nuclear deterrence mission. In 2015, DOD conducted a review focused on NC3 systems, which resulted in additional recommendations to improve NC3.

The National Defense Authorization Act for Fiscal Year 2017 includes a provision for GAO to review DOD's processes for addressing these recommendations. This report addresses the extent to which DOD has made progress in (1) the implementation and tracking of the recommendations from the 2014 and 2015 nuclear enterprise reviews and (2) addressing sustainment and maintenance-related challenges and planning for the continued sustainment and maintenance of existing defense nuclear enterprise systems. GAO reviewed documents and interviewed DOD officials. This is a public version of a classified report that GAO issued in October 2019. Information that DOD deemed classified has been omitted.

What GAO Recommends

GAO is making two recommendations for DOD to update guidance to require DOD components to keep information on recommendations current and complete. In written comments on the classified report, DOD concurred with these recommendations.

View [GAO-20-296](#). For more information, contact Joseph W. Kirschbaum at (202) 512-9971 or kirschbaumj@gao.gov.

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DEFENSE NUCLEAR ENTERPRISE

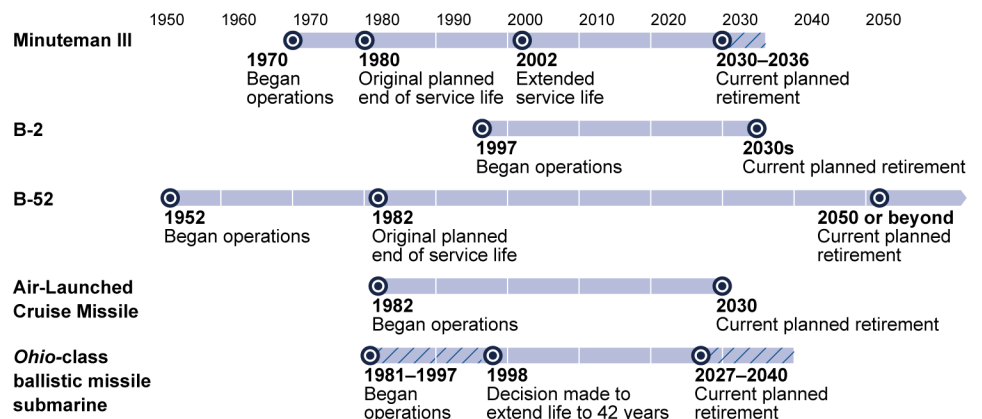
Systems Face Sustainment Challenges, and Actions Are Needed to Effectively Monitor Efforts to Improve the Enterprise

What GAO Found

The Department of Defense (DOD) continues to make progress in implementing recommendations to improve the nuclear enterprise. These recommendations stemmed from DOD's 2014 internal and independent nuclear enterprise reviews, a U.S. Strategic Command 2014 memorandum, and an internal DOD 2015 report on nuclear command, control, and communications (NC3). Since GAO last reported—in November 2018—an additional five of the 247 sub-recommendations from the 2014 reviews have been closed; 91 remain open. In that time, DOD has also closed two more of the 13 recommendations from the 2015 review; six remain open. However, the key tracking tools DOD uses to provide visibility on the status of the recommendations do not provide current and complete information. For example, for those items that are behind schedule, many of the expected completion dates have not been updated to reflect when the items are now expected to be completed. The current DOD guidance for tracking the recommendations' status does not include a specific requirement to keep the information current in the tracking tools. Until DOD addresses these issues, it will not have a complete and accurate picture of when tasks are expected to be finished, whether progress is being made, whether efforts have stalled, or if there are other challenges. Ensuring that there is current and complete information regarding enduring recommendations would also help inform DOD's effort to monitor the health of the defense nuclear enterprise.

DOD and the military services are experiencing challenges related to sustainment and maintenance of nuclear weapon systems and have ongoing and planned initiatives intended to mitigate these challenges. All of the systems we reviewed have been operational since before 1998, making these systems at least 22 years old (see figure). The age of the systems has resulted in maintenance and supply issues. For example, the *Ohio*-class submarine has experienced the failure of parts that were not originally intended to be replaced. DOD and the services have ongoing and planned efforts to mitigate these challenges, such as improving maintenance processes and sources of supply.

Current Expected Operational Lives for Selected Nuclear Weapon Systems



Source: GAO analysis of Department of Defense information. | [GAO-20-296](#)

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Abbreviations

| | |
|-------|--|
| ALCM | Air-Launched Cruise Missile |
| CAPE | Office of Cost Assessment and Program Evaluation |
| CIO | Chief Information Officer |
| DOD | Department of Defense |
| ICBM | Intercontinental Ballistic Missile |
| NAOC | National Airborne Operations Center |
| NC3 | Nuclear Command, Control, and Communications |
| NDERG | Nuclear Deterrent Enterprise Review Group |
| NLC3S | Council on Oversight of the National Leadership Command, Control, and Communications System |
| NLCC | National Leadership Command Capability |
| SSBN | Ballistic Missile Submarine |

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March 26, 2020

Congressional Committees

In 2014, as a response to incidents involving the nation’s nuclear forces and their senior leadership, the Secretary of Defense directed both an internal Department of Defense (DOD) review and an independent review of the DOD nuclear enterprise. The DOD nuclear enterprise includes strategic and nonstrategic nuclear forces, and the supporting infrastructure and personnel to build, maintain, and control these assets. The two reviews examined DOD’s nuclear deterrent mission, and the resulting reports—*Internal Assessment of the Department of Defense Nuclear Enterprise* and *Independent Review of the Department of Defense Nuclear Enterprise*—identified problems with leadership, organization, investment, morale, policy, and procedures, as well as other shortcomings that were adversely affecting the mission.¹ The Commander of U.S. Strategic Command also identified some additional areas for improvement in a memorandum.² Together, the two nuclear enterprise review reports and the Strategic Command Commander’s memorandum (hereafter referred to collectively as the 2014 nuclear enterprise reviews) included hundreds of recommendations to address DOD’s management of nuclear personnel, security requirements for nuclear weapons, and the availability of key equipment and support parts, among other issues. In 2015, DOD conducted a review focused on nuclear command, control, and communications (NC3) systems, which resulted in another report, containing a dozen additional recommendations (hereafter referred to as the 2015 NC3 report).³

The National Defense Authorization Act for Fiscal Year 2017 includes a provision for us to review—during each of fiscal years 2017 through 2021—DOD’s processes for addressing the recommendations of the nuclear enterprise reviews and other assessments of the nuclear

¹Department of Defense, (U) *Internal Assessment of the Department of Defense Nuclear Enterprise* (September 2014) (SECRET//NOFORN), and Department of Defense, *Independent Review of the Department of Defense Nuclear Enterprise* (June 2, 2014).

²U.S. Strategic Command, (U) *USSTRATCOM Observations and Action Plan to Strengthen the Nuclear Enterprise* (2014) (SECRET).

³Department of Defense, (U) *National Leadership Command Capability (NLCC) and Nuclear Command, Control and Communications (NC3) Enterprise Review (NER) Report* (May 2015) (SECRET//NOFORN).

enterprise, including the 2015 NC3 report, and to provide a briefing to the congressional defense committees on the results of our review.⁴ In July 2016, we reported that the process DOD had developed for tracking the 2014 review recommendations generally appeared consistent with relevant criteria from *Standards for Internal Control in the Federal Government*—including using and effectively communicating high-quality information and performing monitoring activities.⁵ In October 2017, we recommended that the Director of the Office of Cost Assessment and Program Evaluation (CAPE) develop additional guidance for the identification of risks and the documentation of these risks in DOD’s centralized tracking tool for the recommendations of the 2014 nuclear enterprise reviews. We also recommended that the DOD Chief Information Officer (CIO) develop guidance to improve the tracking and evaluation of DOD’s progress in implementing the recommendations of the 2015 NC3 report.⁶ In November 2018, we recommended that DOD clarify roles, responsibilities, and methods of communication and collaboration for key defense nuclear enterprise oversight bodies, including the Nuclear Deterrent Enterprise Review Group (NDERG).⁷

⁴See Pub. L. No. 114-328, § 1670 (2016).

⁵GAO, *Defense Nuclear Enterprise: DOD Has Established Processes for Implementing and Tracking Recommendations to Improve Leadership, Morale, and Operations*, [GAO-16-597R](#) (Washington, D.C.: July 14, 2016). A list of related GAO products can be found at the end of this report.

⁶GAO, *Defense Nuclear Enterprise: Processes to Monitor Progress on Implementing Recommendations and Managing Risks Could Be Improved*, [GAO-18-144](#) (Washington, D.C.: Oct. 5, 2017). In January 2018, in response to one of our recommendations, the Director of CAPE issued additional guidance to aid the military departments and other DOD components in identifying, assessing, and documenting risks associated with the 2014 recommendations. In July 2018, in response to another of our recommendations, DOD’s CIO issued guidance to improve tracking and evaluation of progress in implementing the 2015 NC3 report recommendations.

⁷GAO, *Defense Nuclear Enterprise: DOD Continues to Address Challenges but Needs to Better Define Roles and Responsibilities and Approaches to Collaboration*, [GAO-19-29](#) (Washington, D.C.: Nov. 1, 2018). In June 2019, in response to one of our recommendations, the Deputy Secretary of Defense issued a charter for the NDERG that included some information about the roles, responsibilities, and methods of communication and collaboration with other defense nuclear enterprise oversight bodies. See Department of Defense, *Charter of the Nuclear Deterrent Enterprise Review Group (NDERG)* (June 6, 2019). According to DOD officials, they are working to update other applicable guidance related to the NDERG as well as other key defense nuclear enterprise oversight bodies.

DOD has taken steps to implement the recommendations from our October 2017 and November 2018 reports.⁸

In this report we evaluate the extent to which DOD and the military services have made progress in

1. the implementation, tracking, and evaluation of the recommendations from the June 2014 *Independent Review of the Department of Defense Nuclear Enterprise*; the September 2014 *Internal Assessment of the Department of Defense Nuclear Enterprise*; the 2014 Strategic Command Commander's memorandum; the 2015 NC3 report; and any subsequent efforts to improve the health of the nuclear enterprise in support of the NDERG; and
2. addressing sustainment and maintenance-related challenges and planning for the continued sustainment and maintenance of existing defense nuclear enterprise systems through the planned end of their service lives.

This report is a public version of a classified report that we issued on October 24, 2019.⁹ DOD deemed some information on sustainment and maintenance-related challenges to be classified, which must be protected from loss, compromise, or inadvertent disclosure. As a result, this public report omits information that DOD identified as classified, related to (1) mission sets and operational details for certain nuclear capable weapon systems and (2) specific sustainment and maintenance-related challenges for certain nuclear capable weapon systems. Although some information has been omitted from this report, it addresses the same objectives and uses the same methodology as the classified report.

⁸In response to our October 2017 recommendations, CAPE issued additional guidance to improve the identification, assessment, and documentation of risks related to implementing the 2014 nuclear enterprise reviews' recommendations, and DOD CIO issued guidance to improve the tracking and evaluation of DOD's progress in implementing the recommendations of the 2015 NC3 report. In response to recommendations in our November 2018 report, DOD issued a charter for the NDERG that clarified roles and responsibilities for the members of the NDERG and provided information regarding communication and collaboration between the NDERG and other organizations engaged in oversight of the nuclear enterprise. DOD is still in the process of updating applicable guidance to reflect changes in the oversight of NC3 within the department in response to other recommendations in our November 2018 report.

⁹GAO, *Defense Nuclear Enterprise: Systems Face Sustainment Challenges, and Actions Are Needed to Effectively Monitor Efforts to Improve the Enterprise*, GAO-20-9C (Washington, D.C.: Oct. 24, 2019).

For objective one, we reviewed key documents, including the centralized DOD tracking tool and the military services' internal tracking tools for the 2014 recommendations, and the DOD CIO's tracking tool for the 2015 recommendations. We also reviewed the original recommendations found in the 2014 nuclear enterprise reviews and the 2015 NC3 report and applicable guidance, such as the Secretary of Defense's 2014 memo (*Nuclear Enterprise Review Corrective Action Implementation*); the 2016 Deputy Secretary of Defense memo (*Transition of Nuclear Enterprise Review Tracking Responsibilities*, which includes CAPE's *Nuclear Enterprise Review Tracking Analytic Guidance Overview*); and CAPE's January 2018 additional guidance on risk (*Additional Guidance for Nuclear Enterprise Review Recommendation Tracking*).

For objective two, we reviewed key documents associated with sustainment and maintenance-related recommendations and interviewed DOD and service officials. We identified the sustainment and maintenance-related recommendations from among those 2014 recommendations that DOD had categorized as primarily relating to operations and maintenance. We also reviewed other recommendations that we identified as relating to sustainment and maintenance but that DOD had categorized differently—for example, recommendations concerning maintenance-workforce issues. We then reviewed information about these recommendations in the centralized DOD tracking tool for 2014 recommendations and in the military services' internal tracking tools. We selected a nongeneralizable sample of eight nuclear weapon systems managed by the Air Force and Navy to identify sustainment and maintenance-related challenges for these systems and to assess DOD's, the Air Force's, and the Navy's plans for the continued sustainment and maintenance of the systems. This nongeneralizable sample was selected to include the airborne, land-based, and sea-based legs of the strategic deterrent; weapon systems that provide NC3 capabilities; and missiles used to deploy nuclear weapons. For the Air Force, we selected the B-2 Spirit, B-52 Stratofortress, Minuteman III intercontinental ballistic missile (ICBM), AGM-86B air-launched cruise missile (ALCM), and E-4B National Airborne Operations Center (NAOC). For the Navy, we selected the *Ohio*-class ballistic missile submarine (SSBN), D-5 Trident submarine-launched ballistic missile, and E-6B Mercury. We collected additional documentation, such as life-cycle management and sustainment plans, from the program managers for each of the weapon systems in our sample. We interviewed officials from the program offices, maintenance facilities, and operational units involved in the use and field maintenance of these systems about sustainment and maintenance challenges and

their efforts to mitigate these challenges. (See app. I for a complete list of offices we met with during our review.)

The performance audit upon which this report is based was conducted from November 2018 to October 2019 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives. We subsequently worked with DOD from December 2019 to February 2020 to prepare this unclassified version of the original classified report for public release. This public version was also prepared in accordance with these standards.

Background

DOD Nuclear Enterprise

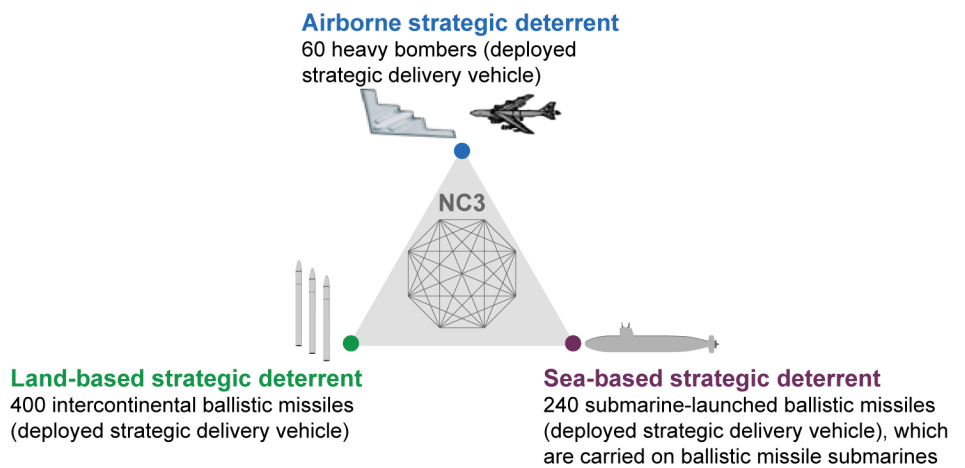
The DOD nuclear enterprise includes strategic and nonstrategic nuclear forces and the supporting infrastructure and personnel to build, maintain, and control these assets. The strategic nuclear forces include a triad of Air Force ICBMs; Air Force nuclear-capable bomber aircraft; and Navy submarine-launched ballistic missiles carried by SSBNs; as well as associated nuclear munitions; air refueling; and NC3 capabilities. NC3 capabilities are a key part of the defense nuclear enterprise, used to support planning, situation monitoring, and communication of force direction between the President and nuclear forces. Consistent with the New Strategic Arms Reduction Treaty (New START), the United States has limited the number of deployed delivery systems for each of the three legs of the strategic nuclear triad (see fig. 1).¹⁰ The 2018 *Nuclear Posture Review* states that the triad's synergy and overlapping attributes help ensure the enduring survivability of deterrence capabilities against attack and the capacity to hold at risk a range of adversary targets throughout a crisis or conflict.¹¹ In addition to the strategic nuclear triad, the defense nuclear enterprise includes nonstrategic nuclear forces: forward-deployed fighters—referred to as dual-capable fighter aircraft—that are able to deliver conventional or nuclear munitions; their associated nuclear

¹⁰Among other things, the New START Treaty limits Russia and the United States to 700 deployed ICBMs, submarine-launched ballistic missiles, and heavy bombers. See *Treaty on Measures for the Further Reduction and Limitation of Strategic Offensive Arms*, U.S.-Russ., Apr. 8, 2010, T.I.A.S. No. 11-205.

¹¹Department of Defense, *Nuclear Posture Review* (February 2018).

weapons; and the supporting infrastructure and personnel to build, maintain, and control nuclear assets.¹²

Figure 1: Deployed Elements of the Strategic Nuclear Triad



Source: GAO analysis of Department of Defense information. | GAO-20-296

NC3 capabilities are fielded through a large and complex system comprising numerous land-, air-, and space-based components used to ensure connectivity between the President and nuclear forces. Responsibilities for managing NC3 are distributed among many DOD components including military departments, combatant commands, defense agencies, the Joint Staff, and the Office of the Secretary of Defense. NC3 capabilities provide the President with the means to authorize the use of nuclear weapons in a crisis.

¹²For more information on dual-capable aircraft, see GAO, (U) *Dual Capable Aircraft: DOD Needs to Develop a Reliable Schedule and Address Risk for Nuclear Certification of the F-35A*, GAO-18-82C (Washington, D.C.: Jan. 31, 2018) (SECRET//FRD//FGI FRA GBR NATO//NOFORN). For more information on nuclear warheads and bombs, see GAO, *Nuclear Weapons: NNSA Has Taken Steps to Prepare to Restart a Program to Replace the W78 Warhead Capability*, GAO-19-84 (Washington, D.C.: Nov. 30, 2018); *B61-12 Nuclear Bomb: Cost Estimate for Life Extension Incorporated Best Practices, and Steps Being Taken to Manage Remaining Program Risks*, GAO-18-456 (Washington, D.C.: May 31, 2018); *Modernizing the Nuclear Security Enterprise: NNSA Is Taking Action to Manage Increased Workload at Kansas City National Security Campus*, GAO-19-126 (Washington, D.C.: Apr. 12, 2019); and *Nuclear Weapons: NNSA Should Adopt Additional Best Practices to Better Manage Risk for Life Extension Programs*, GAO-18-129 (Washington, D.C.: Jan. 30, 2018).

NC3 capabilities support five important functions:

- Force management: assignment, training, deployment, maintenance, and logistics support of nuclear forces and weapons before, during, and after any crisis.
- Planning: development and modification of plans for the employment of nuclear weapons and other operations in support of nuclear employment.
- Situation monitoring: collection, maintenance, assessment, and dissemination of information on friendly forces, adversary forces and possible targets, emerging nuclear powers, and worldwide events of interest.
- Decision making: assessment, review, and consultation that occur when the employment or movement of nuclear weapons is considered.
- Force direction: implementation of decisions regarding the execution, termination, destruction, and disablement of nuclear weapons.¹³

Oversight of 2014 Nuclear Enterprise Reviews' Recommendations

The NDERG is the principle integrated civilian–military governance body for the DOD nuclear enterprise.¹⁴ It was established in 2014 by the Secretary of Defense to ensure the long-term health of the nuclear enterprise by addressing resourcing, personnel, organizational, and enterprise policy issues identified in the 2014 nuclear enterprise reviews. The NDERG also maintains senior-leader awareness of ongoing issues of importance in the nuclear enterprise, ensures effective sustainment of these critical nuclear capabilities, and provides a forum for strategic-level coordination and integration of issues arising from other oversight committees and councils related to the nuclear enterprise. The NDERG consists of a group of senior officials chaired by the Deputy Secretary of

¹³Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, *Nuclear Matters Handbook 2016* (2016).

¹⁴Department of Defense, *Charter of the Nuclear Deterrent Enterprise Review Group (NDERG)*.

Defense with the Vice Chairman of the Joint Chiefs of Staff as vice chair.¹⁵

The NDERG is supported by a Nuclear Deterrent Working Group, which meets biweekly and reviews the status of the implementation of the recommendations of the nuclear enterprise reviews, and a Nuclear Deterrent Senior Oversight Group, which meets quarterly and reviews any recommendations that the Working Group believes are ready for the NDERG to close.¹⁶ The Nuclear Deterrent Senior Oversight Group—co-chaired by the Deputy Assistant Secretary of Defense for Nuclear Matters, the Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy, the Joint Staff Deputy Director for Strategic Stability, and a senior-level representative of the Director of CAPE—also receives annual briefings on DOD components’ assessments of their progress, reviews organizational changes, and discusses other issues related to the management, operations, and health of the nuclear enterprise—including human resources and culture, operational availability, sustainment, and modernization and recapitalization issues not directly addressed in other forums.¹⁷ The Deputy Secretary of Defense updates the Secretary of Defense on the NDERG’s progress as requested.

In November 2014, the Secretary of Defense directed DOD to address the recommendations from the 2014 nuclear enterprise reviews and directed CAPE to track and assess implementation efforts. The Joint Staff, the Navy, the Air Force, offices within the Office of the Secretary of Defense, and U.S. Strategic Command support CAPE’s efforts. CAPE compiled the recommendations from the 2014 nuclear enterprise reviews.

¹⁵Additional members of the NDERG include the Secretary or Under Secretary of each of the military departments; the Chiefs or Vice Chiefs of Staff of the Army and Air Force; the Chief or Vice Chief of Naval Operations; the Commandant or Assistant Commandant of the Marine Corps; the Commanders or Vice Commanders of U.S. Strategic Command and U.S. European Command; and other senior officials from across DOD.

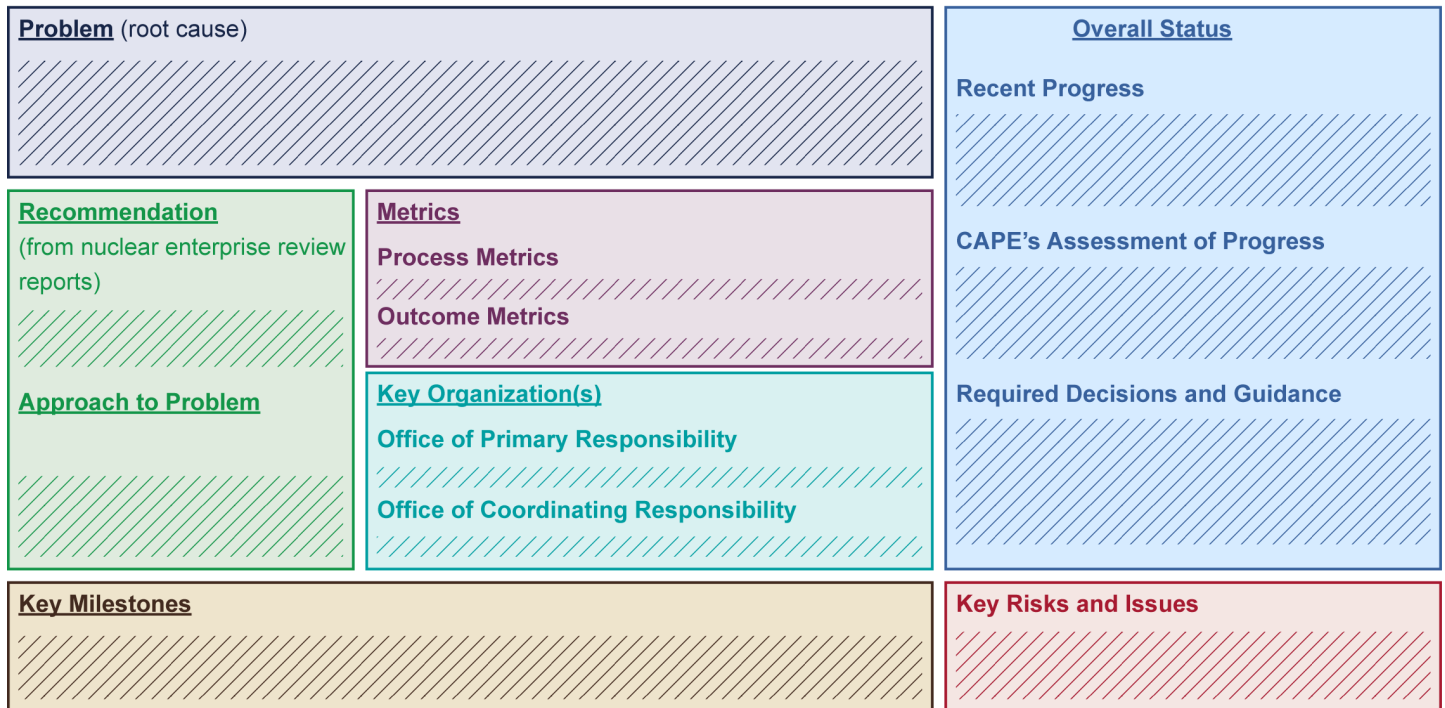
¹⁶In addition to reviewing the status of recommendations of the nuclear enterprise reviews, the Nuclear Deterrent Working Group uses its biweekly meetings to preview component assessments of progress, organizational changes, and issues related to the health of the enterprise. The group also prepares and vets items for the Nuclear Deterrent Senior Oversight Group agendas, including briefings on the status of recommendations as well as recommending completed recommendations for closure.

¹⁷In addition to the four co-chairs, the Nuclear Deterrent Senior Oversight Group consists of other senior civilian and uniformed officials from across DOD. According to a CAPE official, the senior-level CAPE representative on the Nuclear Deterrent Senior Oversight Group is CAPE’s Deputy Director for Capability Enablers.

In total, CAPE identified 175 distinct recommendations from the three documents associated with the reviews. CAPE then identified 247 sub-recommendations within those recommendations, which were directed to multiple military services or other DOD components. For example, if a recommendation was directed to both the Air Force and the Navy, then one sub-recommendation was made to the Air Force and one to the Navy.

CAPE then worked with the military services to identify offices of primary responsibility for implementing actions to address the recommendations, any offices with coordinating responsibility, and any resources necessary to implement each recommendation. CAPE has developed a centralized tracking tool to collect information on progress in meeting milestones and metrics. As shown in figure 2, the tracking tool includes fields for the underlying problem statement, or root cause, and for the recommendation and time frames with milestones for implementing the recommendation. The tracking tool also includes performance measures (referred to as metrics in the tracking tool) to assess both the progress (through “process metrics”) and the effectiveness of the implementation actions (through “outcome metrics”). The outcome metrics aid DOD in determining whether implemented recommendations have addressed the underlying problem that was the impetus for the original recommendation.

Figure 2: Sample Layout of the 2014 Nuclear Enterprise Review Tracking Tool



Source: GAO presentation of Department of Defense information. | GAO-20-296

The tracking tool contains hundreds of unique milestones and metrics, and additional milestones and metrics may be added as they are identified. The Air Force and the Navy also have developed their own methods of tracking their service-specific recommendations. In December 2016, the Deputy Secretary of Defense issued a memorandum that directed the transition of the tracking and analysis responsibilities related to implementing the recommendations of the 2014 nuclear enterprise reviews from CAPE to the military departments and other DOD components.¹⁸ However, CAPE remains responsible for providing guidance to inform the analyses conducted by the military departments and other DOD components, overseeing these analyses, and assessing recommendations for closure. The aim of these changes was to enhance

¹⁸Deputy Secretary of Defense Memorandum, *Transition of Nuclear Enterprise Review Tracking Responsibilities* (Dec. 16, 2016).

ownership and embed the principles of robust analysis, continuous monitoring, and responsibility throughout the department.

In January 2018, in response to a GAO recommendation, CAPE issued additional guidance to aid the military departments and other DOD components in identifying, assessing, and documenting risks associated with the 2014 recommendations.¹⁹ The guidance instructs components to document key risks, defined by CAPE as a risk that requires mitigation by the leadership of the DOD components or a risk that cannot be mitigated within a component's existing authorities and resources—for example, one that cannot be mitigated within the Air Force or Navy and must be raised to a higher authority. As we reported in November 2018, in response to the January 2018 guidance for tracking risks, the Air Force and the Navy included in the centralized tracking tool information on key risks for the recommendations they were responsible for or an indication of the absence of any key risk.²⁰

Oversight of the 2015 NC3 Report's Recommendations

The Council on Oversight of the National Leadership Command, Control, and Communications System (NLC3S Council) was established by statute and is responsible for oversight of the command, control, and communications system for the national leadership of the United States.²¹ Additionally, as recommended in the 2015 NC3 report, the NLC3S Council reviews the recommendations from the report and assesses them for closure. The NLC3S Council is supported by the National Leadership Command Capabilities Executive Management Board, which comprises a Senior Steering Group and four working groups—Stakeholders, Resources, Assessments, and Nuclear Command and Control Issues. The Executive Management Board ensures that the council is informed of and presents issues that require senior leadership-level decisions. In

¹⁹Director, Cost Assessment and Program Evaluation Memorandum, *Additional Guidance for Nuclear Enterprise Review Recommendation Tracking* (Jan. 3, 2018). The guidance instructs the military departments and DOD components to identify, assess, and document key risks for the remaining open recommendations, as well as for closed recommendations that have a continuing reporting requirement.

²⁰[GAO-19-29](#).

²¹Established by the National Defense Authorization Act for Fiscal Year 2014, the Council on Oversight of the National Leadership Command, Control, and Communications System (NLC3S Council) serves as the department's oversight body for all of the National Leadership Command Capability, including DOD's NC3 systems. See National Defense Authorization Act for Fiscal Year 2014, Pub. L. No. 113-66, § 1052(a)(1) (2013) (codified as amended at 10 U.S.C. § 171a).

2018, the Secretary of Defense approved the designation of the Commander of U.S. Strategic Command as the NC3 enterprise lead with increased responsibilities for operations, requirements, and systems engineering and integration. At that time, the Secretary of Defense also approved the designation of the Under Secretary of Defense for Acquisition and Sustainment as the NC3 enterprise capability portfolio manager with increased responsibilities for resources and acquisition.²²

In November 2018, we recommended that DOD update applicable guidance (such as the NLC3S Council's and Executive Management Board's charters) and identify whether there is a need to request changes to statutory or presidential guidance in order to clarify changes to roles and responsibilities for oversight of NC3.²³ According to DOD officials, DOD is in the process of implementing these recommendations, with the intent of having the Commander of U.S. Strategic Command and the Under Secretary of Defense for Acquisition and Sustainment provide leadership with respect to NC3 capabilities, while the Executive Management Board maintains its role for those systems that primarily relate to non-NC3 systems, with all three entities reporting on their respective issues to the NLC3S Council.

The NLC3S Council is co-chaired by the Under Secretary of Defense for Acquisition and Sustainment and the Vice Chairman of the Joint Chiefs of Staff. Members of the council include the Under Secretary of Defense for Policy; the Under Secretary of Defense for Research and Engineering; the Under Secretary of Defense for Intelligence; the Commander, U.S. Strategic Command; the Commander, North American Aerospace Defense Command/U.S. Northern Command; the Director, National Security Agency; and the DOD CIO. The DOD CIO also serves as the Secretariat for the NLC3S Council and tracks the implementation of recommendations from the 2015 NC3 report, among other activities. Additional organizations may participate in the NLC3S Council's meetings to provide subject-matter expertise. Regular participants in the NLC3S Council include the Office of the Under Secretary of Defense (Comptroller); senior leaders from the Army, the Navy, and the Air Force;

²²The National Defense Authorization Act for Fiscal Year 2017 eliminated the position of the Under Secretary of Defense for Acquisition, Technology, and Logistics effective February 1, 2018, dividing the position into the Under Secretary of Defense for Research and Engineering and the Under Secretary of Defense for Acquisition and Sustainment. See Pub. L. No. 114-328, § 901(a), (b) (2016) (codified at 10 U.S.C. §§ 133a, 133b).

²³[GAO-19-29](#).

the Director, Defense Information Systems Agency; the Director, White House Military Office; and Director, CAPE.

Sustainment and Maintenance of the Nuclear Enterprise

The 2014 nuclear enterprise reviews included Operations and Maintenance as 1 of 11 categories.²⁴ Recommendations within this category are primarily related to the sustainment and maintenance of nuclear weapon systems. The reviews identified several Operations and Maintenance core issues related to, among other things, maintenance infrastructure, lack of leadership visibility into sustainment issues, fragmented logistics support, and aging systems and support equipment leading to parts obsolescence issues.

Of the 175 recommendations included in the 2014 nuclear enterprise reviews, 30 were categorized as Operations and Maintenance.²⁵ Other categories in the 2014 reviews, such as Investment and Personnel, also include some recommendations that are related to sustainment and maintenance.²⁶

DOD conducts sustainment and maintenance on nuclear enterprise weapon systems to ensure that these systems are available to support current military operations and maintain the capability to meet future requirements. Sustainment of weapon systems comprises logistics and personnel services required to maintain and prolong operations of the weapon system. DOD conducts maintenance at two levels: field level and depot level. Field-level maintenance is performed at the unit level on the unit's own equipment, requires a relatively fewer number of skill sets, and occurs more frequently. Depot-level maintenance includes the overhaul, upgrade, or rebuilding of equipment, occurs less frequently, and requires a greater number of skill sets. Depot maintenance includes inspection, repair, overhaul, or the modification or rebuild of end items, assemblies, subassemblies, and parts that, among other things, require extensive

²⁴The 11 categories included in the 2014 nuclear enterprise reviews are: Operations and Maintenance, Investment, Readiness, Personnel, Career Development, Policy/Accountability, Visits/Inspections, Public Affairs, Issuances, Personnel Reliability Program, and NC3.

²⁵For example, one of the Operations and Maintenance recommendations was to fully fund increasing maintenance needs as the triad ages.

²⁶For example, sustainment issues can affect future readiness and the ability to meet operational requirements. Additionally, the Personnel category included a specific recommendation to provide Air Force wings with people who can work the supply and sustainment system.

industrial facilities, specialized tools and equipment, or uniquely experienced and trained personnel that are not available in other maintenance activities.²⁷

Key Sustainment and Maintenance Organizations

A number of DOD organizations are involved in the sustainment and maintenance of nuclear weapon systems. Some key organizations include the following:

- **Defense Logistics Agency.** The Defense Logistics Agency manages approximately one-fifth of the value of DOD's overall inventory and provides billions of dollars in consumable items on an annual basis for depot maintenance conducted at defense industrial sites—Army and Marine Corps depots, Navy Fleet Readiness Centers and Navy shipyards, and Air Force Air Logistics Complexes—where combat vehicles, planes, helicopters, and ships are repaired and overhauled.
- **Air Force Materiel Command.** Air Force Materiel Command conducts research, development, test, and evaluation, and provides acquisition management services and logistics support necessary to keep Air Force weapon systems ready for war. One of six centers within Air Force Materiel Command, the Air Force Nuclear Weapons Center is the nuclear-focused center synchronizing all aspects of nuclear materiel management on behalf of the Air Force Materiel Command commander.
- **Naval Sea Systems Command and Naval Air Systems Command.** Naval Sea Systems Command's affiliated Program Executive Offices—including the Program Executive Office for submarines and the Program Executive Office for the *Ohio*-class SSBN and its replacement, the *Columbia*-class SSBN—are responsible for life-cycle management of their assigned programs. Similarly, Naval Air Systems Command provides full life-cycle support of naval aviation aircraft, weapons, and systems.

²⁷The military services operate facilities that perform depot-level maintenance on a wide range of military assets, including most nuclear weapon systems we reviewed. However, depot-level maintenance on the *Ohio*-class SSBNs is performed at the submarines' homeports. Minuteman III ICBMs are also unique in that, because the missile sites are not mobile, depot-level maintenance is performed on site.

DOD and the Military Services Have Made Progress in Implementing Recommendations to Improve the Nuclear Enterprise but Have Not Kept Tracking Information Current

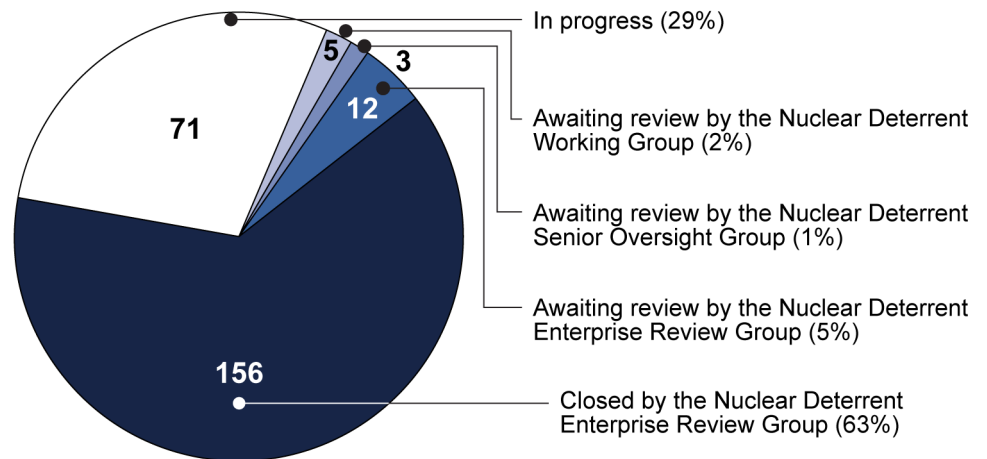
DOD continues to make progress in implementing the recommendations from the 2014 nuclear enterprise reviews and the 2015 NC3 report, but the key tracking tools used to provide visibility on the status of the recommendations from these reviews do not provide current and complete information. For example, expected completion dates for key metrics and milestones—key methods of evaluating the department’s progress—are not up to date. Additionally, the NDERG is working to develop an additional approach for tracking long-term risks and opportunities to monitor the health of the defense nuclear enterprise. Current and complete information regarding the status and metrics for enduring recommendations from the 2014 and 2015 studies would help inform this effort.

Progress in Implementing Recommendations Continues

2014 Nuclear Enterprise Reviews’ Recommendations

DOD continues to make progress in implementing the recommendations of the 2014 nuclear enterprise reviews. As of our last report, in November 2018, DOD had closed 151 sub-recommendations. Based on our review of CAPE’s centralized tracking tool, the NDERG has closed five additional sub-recommendations since then. As a result, as of August 2019, the NDERG has closed 156 of the 247 sub-recommendations (see fig. 3).

Figure 3: DOD Progress in Implementing Sub-Recommendations from the 2014 Nuclear Enterprise Reviews

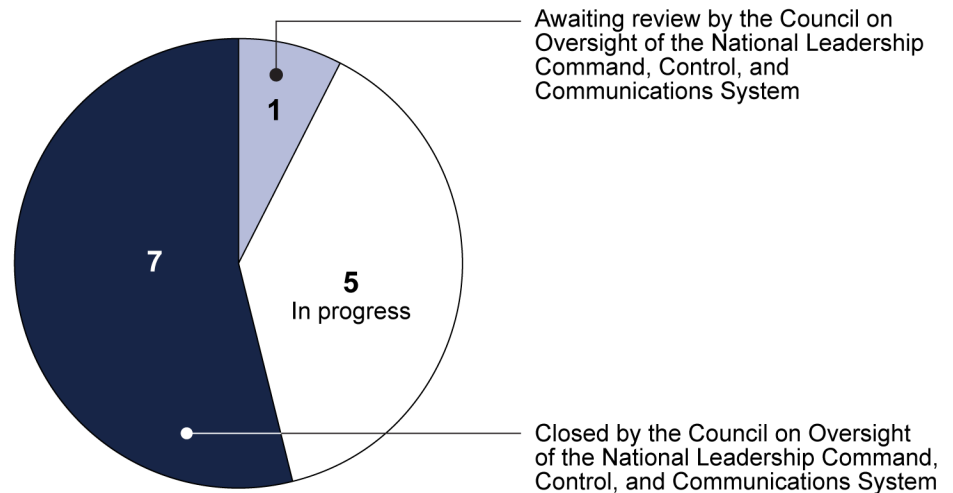


Source: GAO analysis of Department of Defense information. | GAO-20-296

2015 NC3 Report's Recommendations

DOD continues to make progress in implementing the recommendations of the 2015 NC3 report. Since we last reported, in November 2018, DOD has closed two additional recommendations. As of August 2019, the NLC3S Council has closed seven of the 13 recommendations from the NC3 report (see fig. 4). The DOD CIO has provided guidance to improve the tracking and evaluation of DOD's progress in implementing the recommendations of the 2015 NC3 report, in response to our second October 2017 recommendation.

Figure 4: Status of the 13 Recommendations from the 2015 Nuclear Command, Control, and Communications Systems Enterprise Review Report



Source: GAO analysis of Department of Defense information. | GAO-20-296

Note: The Navy has completed its actions to close two additional recommendations; however, until the Air Force also completes its portion of these recommendations and they have been reviewed by the council, neither of the recommendations will be "closed."

Information on Implementation Is Not Kept Current and Complete in DOD Tracking Tools

The military services and other DOD components have not kept information on the implementation status of the 2014 nuclear enterprise reviews' recommendations and 2015 NC3 report's recommendations current and complete. As we have previously reported, CAPE developed a centralized tracking tool to aid in evaluating the actions that have been taken to implement the recommendations from the 2014 nuclear enterprise reviews and inform senior leaders across the defense nuclear enterprise. DOD CIO collects information on the status of the 2015 NC3 report's recommendations in a layout similar to that used for the 2014 recommendations.

Information on 2014 Nuclear Enterprise Reviews' Recommendations Is Not Kept Current

The military departments and other DOD components are responsible for tracking and evaluating the implementation status of the 2014 nuclear enterprise reviews' recommendations; CAPE provides guidance to aid in these efforts.²⁸ CAPE's 2016 guidance indicates that the military departments and DOD components should, as appropriate, use metrics and milestones to analyze progress. The guidance also states that existing data should be used, where possible, to minimize the workload of this effort.

The centralized tracking tool developed by CAPE is the primary means by which progress is tracked. For each of the hundreds of metrics and milestones identified, the tracking tool includes expected completion dates and indicates which have been met and which are behind schedule. The tool identifies both process metrics, to aid in assessing the progress of implementation efforts, and outcome metrics, to aid in determining whether implemented recommendations have addressed the underlying problem that was the impetus for the original recommendation. However our review has found, for those metrics and milestones that are behind schedule, many of the completion dates have not been updated to reflect when they are expected to be completed, even if years have passed since the original completion date lapsed. According to officials from CAPE, the original dates were left in the tracking tool to maintain visibility on how far past their initial expected completion dates these metrics and milestones had gone without being resolved.

We previously found that the Air Force and Navy used their own tracking tools in addition to DOD's centralized tracking tool.²⁹ According to Air Force officials, they still are using their internal tracking tool to help them note progress within the Air Force before providing inputs to DOD's centralized tracking tool. However, according to Navy officials, they are no longer maintaining their internal tracking tool, because they determined that those efforts were unnecessary and redundant with providing inputs to the centralized tracking tool for the relatively few recommendations that the Navy still has open.

²⁸See Deputy Secretary of Defense Memorandum, *Transition of Nuclear Enterprise Review Tracking Responsibilities* (Dec. 16, 2016); *id.*, attachment, *Nuclear Enterprise Review Tracking Analytic Guidance Overview*; Director, Cost Assessment and Program Evaluation Memorandum, *Additional Guidance for Nuclear Enterprise Review Recommendation Tracking* (Jan. 3, 2018).

²⁹[GAO-19-29](#).

CAPE's 2016 guidance indicates that the goals of monitoring the implementation of the 2014 nuclear enterprise reviews' recommendations are to track progress toward addressing systemic issues and to assess changes in the overall health of the enterprise. This information provides stakeholders within the defense nuclear enterprise with key means of monitoring progress and evaluating the outcomes of these efforts. DOD's approach has been to measure the effectiveness of actions taken by gathering supporting data and measuring the effectiveness of each recommendation separately. However, DOD officials have noted that some enduring recommendations—including recommendations associated with changing a service's culture or morale—will take time to evaluate. In some cases, data related to outcome metrics may not be available to evaluate the effectiveness of actions taken until years after a service has taken key actions to address the recommendation. According to DOD officials, this framework was established to avoid prematurely assuming that actions taken have successfully addressed underlying problems.

The need for the military departments and other DOD components to keep information current, particularly estimated dates for the completion of activities, has been emphasized at meetings of the Nuclear Deterrent Working Group. Further, a July 2018 memorandum from the Deputy Secretary of Defense reiterated that the components of the nuclear enterprise, which includes the Air Force and the Navy, will continue to track progress in implementing the recommendations from the 2014 nuclear enterprise reviews through 2020.³⁰ According to officials from the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters and CAPE, the use of the centralized tracking tool is likely to extend beyond 2020, and the Nuclear Deterrent Working Group—which supports the NDERG and its Nuclear Deterrent Senior Oversight Group—is using information from the centralized tracking tool to support additional work. In the context of transitioning from the current centralized tracking tool—which tracks the recommendations of the 2014 nuclear enterprise reviews—to enduring metrics used to characterize the health of the nuclear enterprise, as discussed later in this report, the Deputy Assistant Secretary of Defense for Nuclear Matters stated that it was not a good use of limited personnel resources to request that all metrics and milestones be updated. This is because many of the 2014 recommendations were minor and quickly closed. He noted that improved

³⁰Deputy Secretary of Defense Memorandum, *Chartering the Nuclear Deterrent Enterprise Review Group* (July 26, 2018).

Information on NC3 Report
Recommendations Is
Incomplete

information about critical recommendations transitioning to enduring recommendations would be of use.

The approach that the DOD CIO has established to track the recommendations from the 2015 NC3 report largely mirrors the approach developed for tracking the 2014 nuclear enterprise reviews' recommendations. However, DOD CIO officials have noted that the 2015 NC3 report recommendations are more narrowly scoped than some of the recommendations from the 2014 reviews and therefore their tracking is less extensive.

DOD CIO has issued guidance that requests that DOD components provide quarterly updates on the progress of implementing the recommendations. It specifies that the components should provide current metrics used to track progress, as well as key milestones, at a minimum by quarter, for the next year. The guidance further states that, as appropriate, both process metrics—to measure whether actions taken address a recommendation—and outcome metrics—to measure end results of interest—should be used. However, metric and milestone information for many of the recommendations in the tracking tool is out of date or incomplete. In particular, many of the recommendations do not have outcome metrics identified. DOD CIO's guidance does request quarterly updates from the components and provides some information on content for those updates, but it does not specify that the information should be kept current and complete in the tracking tool. Therefore, information like process and outcome metrics may not be complete and kept current beyond the next year.

Keeping Tracking Tools
Current and Complete Can Aid
DOD

Standards for Internal Control in the Federal Government states that an organization's management should use high-quality information, which is defined as information from relevant and reliable data that is appropriate, current, complete, accurate, accessible, and provided on a timely basis.³¹ CAPE's guidance provides a framework for information that DOD components should consider as they evaluate and track progress made for the 2014 recommendations. The guidance notes that, although the intent of the recommendations is enduring and the systemic issues identified by the 2014 nuclear enterprise reviews should be addressed, the specific approaches to the recommendations can be revised to address the recommendations more effectively. Similarly, the DOD CIO's

³¹GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington, D.C.: September 2014).

guidance provides a framework for information that DOD components should consider as they evaluate and track progress made for the 2015 NC3 report recommendations.

For tracking both the 2014 nuclear enterprise reviews' and 2015 NC3 report's recommendations, DOD's approaches are limited by the quality and completeness of the data collected and tracked in the centralized tracking tools. Specifically, CAPE's general guidance for tracking the 2014 nuclear enterprise reviews' recommendations does not include a specific requirement to periodically update the information to keep it current.³² DOD CIO's guidance for tracking the 2015 NC3 report recommendations does request quarterly updates but does not specifically require information included in the tracking tool be complete. Without current and complete information—including revised dates for when metrics and milestones will be complete—the tracking tools used to track the 2014 and 2015 recommendations do not provide a complete and accurate picture of when tasks are expected to be completed, whether progress is still being made to address the many issues the department has identified, whether any efforts have stalled, or any additional challenges. Additionally, without an accurate picture of the department's progress in addressing these recommendations, the Nuclear Deterrent Working Group has less information to leverage to support additional work to track enduring issues on behalf of the NDERG.³³

DOD Is Working to Develop an Approach to Identifying and Tracking Long-Term Nuclear Risks and Opportunities

In addition to tracking the 2014 recommendations, the July 2018 memorandum from the Deputy Secretary of Defense stated that stakeholders will develop metrics to capture long-term risks and identify opportunities for regular reporting to the NDERG. The NDERG Charter, issued in early June 2019, provides further direction to the Nuclear Deterrent Senior Oversight Group and its Nuclear Deterrent Working

³²Supplemental guidance from CAPE on tracking risks indicates that risk assessments should be updated periodically as progress is made and new data become available. Director, Cost Assessment and Program Evaluation Memorandum, *Additional Guidance for Nuclear Enterprise Review Recommendation Tracking* (Jan. 3, 2018). However, the general guidance from CAPE for tracking the implementation of recommendations does not include a similar specific requirement for updates with respect to metrics and milestones.

³³For example, the 2014 recommendation to “fully fund increasing maintenance needs as the triad ages” presents enduring issues for the NDERG to track over a longer period. This is in contrast to the discrete recommendation to “invest in a second West Coast virtual submarine trainer at the Trident Training Facility,” which can be closed after specific actions are completed.

Group, including that members should develop metrics, data, tools, and briefing materials to support the NDERG efforts to identify, track, and address issues, risks, and opportunities across the nuclear enterprise. The charter further directs the Nuclear Deterrent Senior Oversight Group and Nuclear Deterrent Working Group members to recommend disposition of the long-term recommendations from the 2014 nuclear enterprise reviews and of the long-term efforts to achieve management, operations, and health outcomes directed by the 2018 *Nuclear Posture Review*.

In order to address the direction from the July 2018 Deputy Secretary of Defense memorandum and the June 2019 NDERG Charter, DOD officials stated that the co-chairs of the Nuclear Deterrent Senior Oversight Group have been working with defense nuclear enterprise stakeholders to identify long-term issues that should be tracked to monitor the health of the enterprise.³⁴ According to agency officials, they would like to adjust how long-term issues that relate to the enduring recommendations from the 2014 nuclear enterprise reviews are monitored. Examples include the need to sustain the current weapon systems until they are replaced, providing adequate funding for the acquisition of new systems, and improving the morale of nuclear forces. Since these recommendations are not expected to be closed as completed within the next few years, the Nuclear Deterrent Senior Oversight Group wants to find ways to improve how the recommendations can be tracked to monitor the health of the enterprise. According to DOD officials, they are currently working to identify relevant metrics from the existing tracking tool as well as existing data sources that might be leveraged to support the long-term monitoring of the health of the enterprise. This may be particularly helpful if the use of the existing tool is discontinued at some point after the 2020 time frame.

The efforts of the military services and other DOD components to maintain current and complete information using the existing tracking tools for the 2014 and 2015 recommendations has the potential to aid the department. In particular, existing tools can be helpful for tracking and assessing both enduring recommendations from those reviews as well as additional efforts by the NDERG to assess and monitor the health of the

³⁴These co-chairs are the Deputy Assistant Secretary of Defense for Nuclear Matters, the Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy, the Joint Staff Deputy Director for Strategic Stability, and a senior-level representative of the Director of CAPE. According to a CAPE official, the senior-level CAPE representative on the NDERG is CAPE's Deputy Director for Capability Enablers.

nuclear enterprise. For example, existing outcome metrics can aid in the assessment of whether completed actions have addressed underlying issues that affect the health of the enterprise, identified risks can aid the department in addressing issues as they arise, and the use of the tools themselves can help maintain visibility across the DOD nuclear enterprise, including aiding the communication of timely information to senior leaders.

DOD and the Military Services Are Experiencing Challenges to the Sustainment and Maintenance of Nuclear Systems and Have Various Initiatives to Mitigate Those Challenges

DOD and the military services are experiencing challenges related to sustainment and maintenance of nuclear weapon systems—including challenges identified in recommendations from the 2014 nuclear enterprise reviews—and have ongoing and planned initiatives intended to mitigate these challenges. The military services face challenges related to operating weapon systems beyond their initial design life, parts availability and parts obsolescence, small fleet size, and the maintenance workforce. DOD and the services are mitigating sustainment and maintenance challenges through initiatives to increase parts availability and to improve depot-level maintenance, and through increased tracking of sustainment and maintenance problems.

Challenges to Sustaining and Maintaining Nuclear Weapon Systems

We reviewed sustainment and maintenance for the following nuclear weapon systems:

- **Minuteman III.** The Minuteman III ICBM is a strategic weapon system using a ballistic missile of intercontinental range. Missiles are dispersed in hardened silos to protect against attack and connected to an underground launch control center through a system of hardened cables.
- **B-2 Spirit.** The B-2 Spirit is a multirole bomber capable of delivering both conventional and nuclear munitions.
- **B-52 Stratofortress.** The B-52 Stratofortress is a long-range, heavy bomber that can perform a variety of missions.
- **AGM-86B ALCM.** The AGM-86B ALCM is a long-range, self-guided missile with a nuclear warhead that is carried by the B-52H bomber.
- **E-4B NAOC.** The E-4B NAOC is the primary survivable element of the National Military Command System through which the President, as Commander in Chief, and Secretary of Defense exercise national

and nuclear command and control of military forces in day-to-day and crisis operations. In case of national emergency or destruction of ground command and control centers, the aircraft provides a highly survivable NC3 center to direct U.S. forces, execute emergency war orders, and coordinate actions by civil authorities.

- **E-6B Mercury.** The E-6B Mercury is a communications relay and, when manned, a strategic airborne command post aircraft. It provides survivable, reliable, and enduring airborne NC3 capabilities needed to direct, command, and control U.S. strategic nuclear forces.
- **Ohio-class SSBN.** The *Ohio*-class SSBNs are the most survivable leg of the strategic triad, serving as launch platforms for submarine-launched ballistic missiles. They are designed specifically for stealth and the precise delivery of nuclear warheads.

Table 1 shows examples of sustainment challenges affecting these systems. According to DOD and service officials, while there are acquisition programs under way to replace most of these systems, the current nuclear enterprise systems remain necessary for years to come. The 2014 nuclear enterprise reviews included recommendations to sustain and maintain these systems until they are replaced, such as a recommendation to “fully fund increasing maintenance needs as the triad ages.”³⁵ See appendixes II–VI for additional information and specific sustainment and maintenance challenges and initiatives for select systems.

Table 1: Examples of Nuclear Weapon Systems and Associated Sustainment and Maintenance Challenges

| | Weapon systems operating beyond their initial design life | Parts availability issues and parts obsolescence | Small fleet size | Maintenance workforce issues |
|--|---|--|------------------|------------------------------|
| Air Force systems | | | | |
| Minuteman III | X | X | | X |
| B-2 | | X | X | X |
| B-52 | X | X | | X |
| AGM-86B air-launched cruise missile (ALCM) | X | X | | |
| E-4B | X | X | X | |

³⁵This recommendation is directed at both the Air Force and the Navy as two sub-recommendations. The sub-recommendations remain in progress for both services. To address its sub-recommendation, the Air Force has worked to develop a product support strategy to better support the Minuteman III ICBM weapon system. The Navy added 250 full time personnel at the Trident Refit Facility at Kings Bay to support SSBN maintenance.

| | Weapon systems operating beyond their initial design life | Parts availability issues and parts obsolescence | Small fleet size | Maintenance workforce issues |
|--|---|--|------------------|------------------------------|
| Navy systems | | | | |
| E-6B | X | X | X | |
| <i>Ohio</i> -class ballistic missile submarine (SSBN) ^a | X | X | X | X |

Source: GAO analysis of Department of Defense information. | GAO-20-296

^aFor the purposes of our review, we assessed the D-5 Trident submarine-launched ballistic missile in conjunction with the *Ohio*-class SSBN. The D-5 Trident has recently undergone a service-life extension and does not experience every challenge listed for the *Ohio*-class above.

Weapon Systems Operating Beyond Their Initial Design Life

Almost all of the nuclear weapon systems we reviewed are experiencing challenges related to aging. Specifically, these weapon systems are being deployed beyond their originally intended service lives, which adds to the challenges of sustaining these systems. DOD, along with the Department of Energy, has undertaken an extensive, multifaceted effort to sustain and modernize U.S. nuclear weapons capabilities, including the nuclear weapons stockpile; the research and production infrastructure; and the NC3 system. Some of these sustainment efforts are directly linked to recommendations from the nuclear enterprise reviews of 2014 and the 2015 NC3 report. For example, the 2014 nuclear enterprise reviews recommended that the Air Force establish bomber and ICBM sustainment plans for aging platforms.³⁶ The 2014 nuclear enterprise reviews also resulted in a recommendation to fully fund increasing maintenance needs as the nuclear triad ages. Table 2 provides additional examples of related recommendations from the 2014 reviews.

Table 2: Examples of 2014 Nuclear Enterprise Reviews' Recommendations Related to Aging Weapon Systems

| Recommendation | Service | Status | Example from DOD and military service tracking tools of how the recommendation has been/is being addressed |
|---|-----------|---|--|
| Establish near- and long-term programs of facility upgrades at the two Naval Strategic Weapons Facilities (Atlantic and Pacific) and northern tier Air Force bases. | Navy | In progress | Providing funding and developing a 20-year Strategic Weapons Facility Infrastructure Maintenance Plan. |
| | Air Force | Awaiting review by the Nuclear Deterrent Senior Oversight Group for closure | Allocating funding for weapon storage facilities at various Air Force bases. |

³⁶The Air Force completed this recommendation.

| Recommendation | Service | Status | Example from DOD and military service tracking tools of how the recommendation has been/is being addressed |
|--|-----------|-------------|--|
| Ensure that units are fully equipped with modern tools, test equipment, vehicles, and handling/support equipment. | Navy | Closed | Increased funding for test equipment in the fiscal year 2016 budget. |
| | Air Force | In progress | Monitoring Launch Control Center and Launch Facility health via the Nuclear Weapon System Enterprise Review. |
| Identify and tag all nuclear system support and test equipment and prioritize it commensurate with the high priority of the nuclear mission. | Air Force | In progress | Developing an ICBM product support strategy, which will include establishing the programmed depot maintenance and defining what parts are included in the Minuteman III weapon system. |
| Ensure that nuclear enterprise infrastructure investment includes Navy shipyard and shore installations (e.g., cranes, piers, information technology systems). | Navy | Closed | Increasing investment in a recapitalization plan. |
| Repair nonshipyard maintenance infrastructure. | Navy | In progress | Sustaining funding for refit maintenance facilities over time. |
| Determine costs to bring nuclear repair and sustainment infrastructure to sustainable levels. | Navy | In progress | Increased the rate of sustainment funding to shipyards starting in fiscal year 2016. |

Source: GAO analysis of Department of Defense information. | GAO-20-296

According to DOD officials, as these nuclear weapon systems have aged they have required more maintenance in order to sustain them through their extended service lives, and they will continue to do so until they are replaced by new systems. For example, Air Force officials cited aircraft age as the major factor leading to corrosion and other airframe issues that the B-52 is experiencing. The first B-52 model was initially deployed in 1952, and the B-52H—the model currently in use—became operational in 1962. The Air Force now plans to sustain the B-52 until at least 2050, which will require increased maintenance and a series of modernization programs in the 2020s. The E-4B, first deployed in 1980, is also experiencing significant corrosion in the galley area, necessitating a fleet-wide galley replacement program. Neither the B-52 nor the E-4B have replacement programs identified.³⁷ According to Air Force officials, aging components have also led to structural problems with the Minuteman III

³⁷E-4B recapitalization is part of a comprehensive DOD C-32A/E-4B/E-6B recapitalization effort to evaluate the future configuration of the National Military Command System airborne layer and to explore the realignment of national nuclear command and control missions recapitalized to common platforms. A single analysis of alternatives is being conducted. The analysis of alternatives began in October 2018 and is expected to be completed in spring 2020.

ICBM. The Minuteman III was deployed in 1970 with an original planned service life of 10 years. The Minuteman III is now expected to last until the 2030s, when it will be replaced by the Ground Based Strategic Deterrent system.

In addition to the weapon systems, support components and support infrastructure are also experiencing age-related challenges. For example, according to Air Force officials, the support infrastructure for the Minuteman III in use today, known as the real property installed equipment, is the original infrastructure that was fielded with the Minuteman I weapon system in 1960, which reached operational capability in 1962. These officials stated that challenges at these facilities include corrosion, water intrusion, collapsed conduits, misaligned doors, and bulging walls. The need to sustain nuclear support equipment is reflected in a nuclear enterprise review recommendation to prioritize nuclear support and test equipment.

Parts Availability Issues and Parts Obsolescence

Parts availability issues and parts obsolescence also affect maintenance on existing weapon systems across the nuclear enterprise. In many cases, the industrial base that produced specific parts for a weapon system is no longer active or is no longer producing the part, so when parts break there are no replacements available. For example, Air Force officials working to maintain the B-52 fleet told us that they have trouble finding suppliers who will produce the necessary parts for such an old airframe. Similarly, the *Ohio*-class SSBN program is experiencing challenges in sustaining submarines through their planned 42-year service life. The *Ohio*-class was initially intended to be operational for 30 years. Since it will be in service longer than expected, the Navy is finding that parts not originally intended to be replaced now need replacement. Navy officials stated that obsolescence has a greater impact for these parts that were never expected to fail and therefore do not have an industrial base to support replacements than for parts that the Navy has always planned to replace at some point during the *Ohio*-class service life.

In certain scenarios, maintainers across several weapon systems have had to reengineer parts, because the original blueprints do not exist. Maintainers we spoke to reported long lead times to have parts fabricated and delivered, which extends the time that a system is offline for maintenance. The 2014 nuclear enterprise reviews included multiple recommendations to address parts obsolescence and availability problems in both the Air Force and the Navy, including the examples shown in table 3.

Table 3: Examples of 2014 Nuclear Enterprise Reviews' Recommendations Related to Parts Availability and Obsolescence

| Recommendation | Service | Status | Example from DOD and military service tracking tools of how the recommendation has been/is being addressed |
|--|-----------|-------------|--|
| Aging bombers and intercontinental ballistic missiles (ICBM) require detailed parts and engineering sustainment plans and obsolescence models. | Air Force | In progress | Established a programmed depot maintenance process for the Minuteman III ICBM weapon system. The programmed depot maintenance was introduced in 2014 and transformed processes for ICBM weapon system sustainment into a standardized, integrated planning and support model that performs maintenance to refurbish portions of the weapon system. |
| Create entities in the Air Force and Navy logistics and supply-chain structures that focus on nuclear forces' needs as their top priority and that have the authority to secure resources commensurate with the priority of the nuclear mission. | Navy | Closed | Conducted an evaluation of the Trident Planned Equipment Replacement Program. |
| | Air Force | In progress | Developed a metric to help determine ICBM parts forecasting and funding. |
| Develop a proactive Air Force supply and contract-management system for out-of-production items. | Air Force | In progress | Looking at equipment cannibalization—the process of taking parts from one asset for use in another—over time, which can inform analyses regarding parts needs. |
| Ensure that Air Force obsolescence models predict part failures in time to develop replacements. | Air Force | In progress | Establishing strategy for the Minuteman III ICBM weapon system, including determining what parts are included in the definition of the weapon system. |

Source: GAO analysis of Department of Defense information. | GAO-20-296

Additionally, maintainers may cannibalize parts, a process by which parts are taken from one asset for use in another. This process is conducted during maintenance for both Air Force and Navy nuclear weapon systems. For example, according to Air Force officials, parts are routinely cannibalized from B-2 aircraft that are undergoing modifications so that they can be used on the operational B-2 aircraft. Similarly, Navy officials stated that parts are cannibalized from other classes of submarines to sustain *Ohio*-class SSBNs when replacement parts are not available elsewhere. Parts cannibalization has also occurred during engineered refueling overhauls.³⁸ According to Navy officials, in the past, SSBNs completing refueling overhauls have cannibalized parts from SSBNs that are beginning to be overhauled. The final *Ohio*-class SSBN to undergo an overhaul, the USS *Louisiana*, will not have that option, because there will be no other SSBNs from which to cannibalize parts; all SSBNs except the

³⁸Engineered refueling overhauls are 27-month overhauls that occur once during an *Ohio*-class SSBN's life, at around the 20-year point, and include extensive inspections, structural repairs, and a nuclear reactor refueling to extend the submarine's service life.

USS *Louisiana* and USS *Wyoming* have already completed their overhauls.³⁹ According to officials from the Office of the Chief of Naval Operations, they are not concerned about not being able to cannibalize parts for the remaining overhauls.

Small Fleet Size

Several legacy nuclear systems have a limited number of assets, which can create challenges for meeting operational requirements while at the same time conducting maintenance. In particular, the size of a fleet can create challenges when it becomes difficult or impossible to meet operational requirements. According to Air Force and Navy officials, maintenance challenges stemming from small fleet sizes particularly affect the B-2, E-4B, and E-6B weapon systems. Scheduling maintenance is one such challenge, because taking one aircraft down for maintenance will have a proportionally greater effect on the number of aircraft available for operations than it would for a larger fleet. For example, according to Air Force officials, the B-2 is experiencing challenges related to maintaining aircraft availability during the extensive modernizations that are being conducted, including integration of a new weapon and upgrades to its radar system. Scheduling this modernization process, part of the effort to sustain the B-2, is challenging given that there are only 20 aircraft in the fleet. Taking an aircraft down for maintenance limits the number of aircraft available for operational use by U.S. Strategic Command. Similarly, Air Force officials told us that the time needed for maintenance and modernization efforts on the E-4B was a primary factor leading to decreased aircraft availability of the E-4B, because of the small number of aircraft in the fleet—four in total.⁴⁰ Having only four aircraft means that delays currently experienced during depot maintenance and installation of modifications have larger effects on the overall availability of the fleet. One aircraft unavailable as it undergoes these actions results in one quarter of the fleet being unavailable for operations.

Additionally, unscheduled maintenance could exacerbate the issue of scheduling challenges and conflict with operational requirements. Having a small fleet with some systems in maintenance could also impede the force's ability to surge if needed. The B-52 fleet has experienced a unique challenge, because it has recently been used extensively in conventional

³⁹The USS *Louisiana* was scheduled to begin its engineered refueling overhaul in September 2019 and complete it in 2022. The USS *Wyoming* is currently undergoing its engineered refueling overhaul, which is expected to be complete in July 2020.

⁴⁰Aircraft availability is a metric developed by Air Force Global Strike Command to measure a weapon system's ability to meet operational requirements with unconstrained resources.

Maintenance Workforce Challenges

operations. According to Air Force officials, it takes time to change a B-52 configuration from conventional to nuclear to ready the aircraft for a nuclear mission, which may affect aircraft availability. According to officials from the Office of the Deputy Assistant Secretary of Defense for Nuclear Matters, reduced availability also negatively affects readiness through the reduction of training opportunities.

Security-clearance backlogs for the maintenance workforce are a challenge with respect to certain nuclear weapon systems. Without at least a secret security clearance, maintainers may be limited in the activities they can perform on a nuclear system. For example, an Air Force official explained that without a clearance maintainers are not only limited in the activities they can perform on the B-2, but they cannot complete some of the training they need. To mitigate this challenge, the Air Force sometimes chooses to issue interim clearances. But in so doing unit commanders must accept additional risk. Specifically, since background investigations may not be complete at the time these interim clearances are issued, it is possible that someone who has been issued an interim clearance will ultimately be found ineligible for that security clearance due to information discovered during their background investigation. Similarly, there is a backlog of top secret clearances for missile-wing personnel working with the Minuteman III, including maintainers. Again, the services sometimes choose to issue interim clearances, but leadership must accept that risk, and interim clearances may have limitations. For example, according to officials from one of the missile wings we spoke with, a missileer in that wing with an interim top secret clearance can complete training for the Minuteman III but cannot be certified to be on a two-person alert team.⁴¹ The 2014 nuclear enterprise reviews included several recommendations to improve various issues related to workforce, including the examples shown in table 4.

⁴¹The Minuteman III weapon system consists of launch control centers and launch facilities. Each launch control center controls 10 hardened launch facilities and is manned by a two-person combat crew—also known as a “two-person alert team”—on 24-hour alert.

Table 4: Examples of 2014 Nuclear Enterprise Reviews' Recommendations Related to Maintenance Workforce Challenges

| Recommendation | Service | Status | Example from DOD and military service tracking tools of how the recommendation has been/is being addressed |
|--|----------------|---------------|---|
| Increase workforce at shipyards. | Navy | Closed | Part of the Navy's approach to addressing this recommendation was to increase shipyard manning by 2,200 personnel and move some work on ships other than the ballistic missile submarines to private shipyards. |
| Provide adequate funding and appropriate staff to the Hill Air Force Base, Utah, Intercontinental Ballistic Missile System Program Office. | Air Force | In progress | Recent progress included Air Force Materiel Command hiring additional personnel at Hill Air Force Base. |

Source: GAO analysis of Department of Defense information. | GAO-20-296

We have previously found that problems related to security-clearance backlogs and the resulting delays in determining clearance eligibility and issuing initial clearances can result in millions of dollars of additional costs to the federal government. We have also found that the backlogs can result in longer periods needed to complete national security–related contracts and lost opportunity costs if prospective employees decide to work elsewhere rather than wait to get a clearance. Further, we have found that the backlogs can result in diminishing quality of the work because industrial contractors may be performing government contracts with personnel who have the necessary security clearances but are not the most experienced and best-qualified personnel for the positions involved.⁴² Additionally, we identified the personnel security-clearance process as a high-risk area in March 2019 and we continue to monitor progress addressing the weaknesses in this area.⁴³

⁴²GAO, *High Risk Series: An Update*, [GAO-05-207](#) (Washington, D.C.: January 2005). We more recently reported on security clearances and security-clearance backlogs in GAO, *Personnel Security Clearances: Additional Actions Needed to Ensure Quality, Address Timeliness, and Reduce Investigation Backlog*, [GAO-18-29](#) (Washington, D.C.: Dec. 12, 2017).

⁴³GAO's high-risk program identifies government operations with greater vulnerabilities to fraud, waste, abuse, and mismanagement or the need for transformation to address economy, efficiency, or effectiveness challenges. [GAO-19-157SP](#), *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*; see also [GAO-19-366SP](#), *Priority Open Recommendations: Department of Defense*.

Sustainment and Maintenance Initiatives

Parts Availability and Obsolescence

The services have taken steps to ease the effect of parts availability issues and obsolescence. For example, partly in response to nuclear enterprise review recommendations, the Air Force has broadened the definition of the Minuteman III weapon system—a process the Air Force refers to as demarcation—and instituted programmed depot maintenance for the weapon system. The Air Force’s demarcation effort centralized parts funding and inventory management for all of the essential components of the Minuteman III and integrated the entire weapon system into a standard Air Force supply process. According to Air Force officials, the Air Force is also working with the Defense Logistics Agency to identify and catalog parts that previously had no identification numbers associated with them. Officials said that programmed depot maintenance is expected to result in a steady, predictive demand level for parts, which will help the Air Force ensure that parts are available and incentivize vendors to manufacture parts, including previously obsolete parts for which there was no steady source of supply. Additionally, both of these efforts are expected to reduce the likelihood that parts will be unavailable when needed.

Navy officials explained that for the *Ohio*-class SSBN, when an industrial base supplier is not able to meet the need for certain obsolete parts, the Navy purchases enough parts to “stock the shelf” by including in one contract enough quantities of the part to last for the life of the SSBNs. Additionally, the Navy has developed programs such as the Trident Planned Equipment Replacement Program, which has identified over 300 critical parts and has them manufactured and ready to be used for replacement when SSBNs are undergoing planned maintenance.

The Defense Logistics Agency has increased its support to the nuclear enterprise to help ensure that parts are available when they are needed. In 2015, the Defense Logistics Agency established a Nuclear Support Office from its headquarters staff to synchronize resources to ensure responsive support to the DOD nuclear enterprise. According to Defense Logistics Agency officials, the office has 13 people, three of whom are embedded at U.S. Strategic Command, Air Force Space Command, and

Depot-Level Maintenance Processes

Air Force Global Strike Command.⁴⁴ In the Defense Logistics Agency's 2018–2026 strategic plan, supporting the nuclear enterprise is the top objective. According to Defense Logistics Agency officials, they also have a series of new initiatives to increase materiel availability and accomplish activities such as paying for the cost of reverse engineering to fill in voids that exist in technical data for nuclear enterprise systems; working in additive manufacturing to set the standard for 3D printing and polymers across DOD and subsequently printing parts on demand; and identifying weaknesses in the industrial base and focusing investments in those areas. The focus of the material availability effort is presently to find out how to help the services when they cannot find a part and to address it in one of the initiatives.

The Air Force and Navy have taken steps to improve depot-level maintenance across the nuclear enterprise. For example, the Air Force introduced programmed depot maintenance for the Minuteman III weapon system in 2014 and transformed ICBM weapon system sustainment processes into a standardized, integrated planning and support model. For the E-4B, according to E-4B program officials, the Air Force has initiated incentivized programmed depot maintenance gates that provide contractors additional financial incentive to complete increments of depot maintenance, as well as the entire depot maintenance process, on time or early. The E-4B program office is implementing this incentive structure in an effort to decrease the E-4B's time spent in depot maintenance. Additionally, the Air Force has several initiatives under way to mitigate B-2 sustainment and maintenance challenges, including increasing the intervals between depot-level maintenance and merging modernization and depot maintenance efforts so that the aircraft is down less and available more. In addition, there are multiple ongoing initiatives to improve the B-2's supply chain, including using predictive analysis and forecasting tools to help determine how many spare parts to keep in stock.

To sustain the *Ohio*-class SSBN fleet, the Navy has conducted engineered refueling overhauls on all SSBNs except for the USS *Wyoming* and USS *Louisiana*, the last two SSBNs to enter service.⁴⁵ This

⁴⁴As of April 2019, Defense Logistics Agency officials said they were in the process of hiring one additional person to be embedded at the Air Force Nuclear Weapons Center.

⁴⁵The USS *Wyoming* began its engineered refueling overhaul in March 2018 and is expected to complete it in July 2020. The USS *Louisiana* was scheduled to begin its engineered refueling overhaul in September 2019 and complete it in 2022.

Increased Tracking of
Sustainment and Maintenance
Issues

major maintenance is intended to help sustain the *Ohio*-class SSBN fleet until its service life reaches 42 years and it is replaced by the *Columbia*-class SSBN. These engineered refueling overhauls have taken longer than originally anticipated. Navy officials attribute these delays to the submarines requiring more maintenance work than expected as well as some delays in acquiring parts.

Over the past several years, DOD and the services have increased their attention to and tracking of nuclear weapon systems maintenance and sustainment issues. As we have previously found, DOD and the military services have taken steps to improve oversight of the nuclear enterprise in response to the 2014 reviews. For example, DOD has established or participated in a number of oversight organizations that aid in the management of the defense nuclear enterprise, including the NDERG, which was established in 2014 by the Secretary of Defense to ensure the long-term health of the nuclear enterprise by addressing issues identified in the 2014 nuclear enterprise reviews, including sustainment and maintenance-related issues.⁴⁶

The Air Force and Navy have also taken actions to improve oversight of sustainment and maintenance. For example, the Air Force, through its Nuclear Mission Assessment effort, uses independent analyses of various data sources to recognize challenges within the Air Force nuclear enterprise, including sustainment and maintenance problems. Additionally, the Air Force implemented the Nuclear Weapon System Enterprise Review, which was developed in 2016 by the Air Force Nuclear Weapons Center with support from Air Force Materiel Command. According to Air Force documentation, the review provided timely insight into the comprehensive health of individual nuclear weapon systems and provided an assessment of how well the enterprise is performing. Nuclear weapon systems that were specifically reported on in the Nuclear Weapon System Enterprise Review included ALCM, Minuteman III, and NC3 systems. The Air Force modeled its Nuclear Weapon System Enterprise Review in part on assessment and reporting already completed for all aircraft, including the B-2 and B-52 bombers, through its Weapon System Enterprise Review briefings.⁴⁷ Weapon System

⁴⁶[GAO-19-29](#).

⁴⁷We have previously reported on the Air Force's use of the Weapon System Enterprise Review to monitor aircraft availability and other sustainment metrics. See GAO, *Weapon System Sustainment: Selected Air Force and Navy Aircraft Generally Have Not Met Availability Goals, and DOD and Navy Guidance Need to Be Clarified*, [GAO-18-678](#) (Washington, D.C.: Sept. 10, 2018).

Enterprise Review metrics are tailored to each weapon system and have details on data such as cost, schedule, performance, and funding. These data are compiled into a quarterly briefing report for Air Force major commands and Air Force headquarters. According to Air Force officials, information included in the Nuclear Weapon System Enterprise Review was related to 10 recommendations from the 2014 nuclear enterprise reviews and the 2015 NC3 report.⁴⁸ Tracking this information helped the Air Force to close out the recommendations assigned to Air Force Materiel Command.

According to Air Force officials, as of July 2019 the Air Force had discontinued the use of the Nuclear Weapon System Enterprise Review. The officials said that Air Force Nuclear Weapons Center and Air Force Global Strike Command are currently collaborating on a replacement presentation focused on weapon system availability; however, this effort is not finalized. The officials further stated that the Air Force has transitioned to an Aircraft Availability Improvement Program construct with an aircraft readiness focus and is working to establish an equivalent for the nonflying weapon systems (i.e., Minuteman III and NC3).

The Navy oversees its leg of the nuclear triad using the Navy Nuclear Deterrent Mission Oversight Council. The council is a senior Department of the Navy forum that is responsible for coordinating the Navy's nuclear weapon activities (safety, security, reliability, and nuclear weapons incident response), operations, personnel, policy, material support, and oversight functions. According to Navy officials, the Navy Nuclear Deterrent Mission Oversight Council addresses long-term issues affecting the Navy's nuclear enterprise and identifies and monitors risks associated with those issues, including the actions taken in response to sustainment and maintenance-related recommendations from the 2014 nuclear enterprise reviews. According to Navy officials, the Navy has also established an SSBN Sustainment Working Group and a Trident Planned Equipment Replacement Program Working Group to address *Ohio*-class sustainment and maintenance-related issues.

⁴⁸The Nuclear Weapon System Enterprise Review included information related to the following 2014 nuclear enterprise review recommendations, among others: fully fund increasing maintenance needs as the triad ages; identify and tag all nuclear system support and test equipment and prioritize it commensurate with the high priority of the nuclear mission; and aging bombers and ICBMs require detailed parts and engineering sustainment plans and obsolescence models.

Conclusions

DOD and the military services have made progress in addressing the recommendations from the 2014 nuclear enterprise reviews and the 2015 NC3 report. They have done so partially by establishing and improving a number of processes to aid in the sustainment of defense nuclear enterprise systems. The department is modifying the NDERG's focus from monitoring the status of the 2014 recommendations to monitoring the long-term health of the enterprise. This shift in focus should position the NDERG to better perform its oversight functions as the principal integrated civilian–military governance body for the defense nuclear enterprise. This is important because many of the recommendations that remain open are focused on long-term sustainment of the enterprise or are designed to be closed only after progress in addressing the issues can be meaningfully evaluated. It is important that the department and the military services continue to use the successful tools they have created to monitor these efforts and leverage these tools (and the premises behind them) as they create new mechanisms to maintain senior-leader visibility of the defense nuclear enterprise. Providing current, complete, and relevant information on the status of service and DOD component actions to address recommendations and an understanding of metrics, milestones, and risks will allow senior leadership to maintain oversight of the department's progress. In particular, such visibility will help senior leaders maintain awareness of the progress of efforts to address past failings, determine whether efforts are having the intended effects and achieving the desired outcomes of addressing root problems, and achieve the desired end states of a healthy defense nuclear enterprise. These existing processes can help inform additional processes the department develops to monitor the health of the nuclear enterprise. The collection and assessment of information to maintain the currency and completeness of information in existing tools may also allow the department to identify potential emerging issues that may negatively affect the vital programs, infrastructure, and personnel essential to the maintenance of an effective nuclear deterrent.

Recommendations for Executive Action

We are making the following two recommendations to DOD:

- The Secretary of Defense should ensure that the Director of CAPE, in coordination with the Deputy Assistant Secretary of Defense for Nuclear Matters, the Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy, and the Joint Staff Deputy Director for Strategic Stability, as co-chairs of the Nuclear Deterrent Senior Oversight Group, update the applicable guidance for methods

of tracking and evaluating progress on implementation of the recommendations from the 2014 nuclear enterprise reviews, requiring DOD components to keep information—including any revised time frames—current. (Recommendation 1)

- The Secretary of Defense should ensure that the Under Secretary of Defense for Acquisition and Sustainment updates the applicable guidance for methods of tracking and evaluating progress on implementation of the recommendations of the 2015 NC3 report, requiring DOD components to keep information—including metrics for measuring progress and outcomes as well as any revised time frames that may extend out more than 1 year—complete and current.⁴⁹ (Recommendation 2)

Agency Comments and Our Evaluation

We provided a draft of the classified report to DOD for review and comment. The department's comments on the classified report are reprinted in appendix VII. In its comments, DOD concurred with both of our recommendations. DOD also provided technical comments on the classified report, which we incorporated as appropriate.

In concurring with our first recommendation, DOD stated that the Nuclear Deterrent Senior Oversight Group co-chairs or, as necessary, the Deputy Secretary of Defense as the chair of the NDERG, will update the applicable guidance to ensure that time frames and other information associated with planned actions are kept up to date.

In concurring with our second recommendation, DOD stated that the DOD CIO and, as appropriate, the Under Secretary of Defense for Acquisition and Sustainment as the NC3 capability portfolio manager, will update the applicable guidance to ensure that metrics, time frames, and other information associated with planned actions are kept up to date and complete.

⁴⁹The October 2019 classified version of this report directed this recommendation to DOD CIO. Subsequently, the National Defense Authorization Act for Fiscal Year 2020, enacted in December 2019, transferred NC3 principal staff assistant responsibilities from the CIO to the Under Secretary of Defense for Acquisition and Sustainment. See Pub. L. No. 116-92, § 1662 (2019). According to DOD officials, the Under Secretary of Defense for Acquisition and Sustainment will now track progress on the 2015 NC3 report recommendations. Therefore, we have modified this recommendation to address it to the Under Secretary of Defense for Acquisition and Sustainment. We discussed this modification with DOD officials, who agreed with the change.

We are encouraged that DOD is planning to take these actions to address our two recommendations. We believe that providing current, complete, and relevant information on the status of service and other DOD component actions to address recommendations and an understanding of metrics, milestones, and risks will allow senior leadership to maintain oversight of the department's progress. This may also allow DOD to identify potential emerging issues that may negatively affect the vital programs, infrastructure, and personnel essential to the maintenance of an effective nuclear deterrent.

We are sending copies of this report to the appropriate congressional committees, and to the Secretary of Defense; the Under Secretary of Defense for Acquisition and Sustainment; the Chairman of the Joint Chiefs of Staff; the Secretaries of the Army, of the Navy, and of the Air Force; the Commander, U.S. Strategic Command; the Department of Defense Chief Information Officer; and the Director of the Office of Cost Assessment and Program Evaluation. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

If you or your staff have any questions about this report, please contact me at (202) 512-9971 or kirschbaumj@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix VIII.



Joseph W. Kirschbaum
Director, Defense Capabilities and Management

List of Committees

The Honorable James M. Inhofe
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Richard Shelby
Chairman
The Honorable Dick Durbin
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Adam Smith
Chairman
The Honorable Mac Thornberry
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Pete Visclosky
Chairman
The Honorable Ken Calvert
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Appendix I: Offices That We Contacted

To obtain information for our review, we met with or obtained information from officials from the following organizations from the Department of Defense:

- Office of Cost Assessment and Program Evaluation (CAPE)
- DOD Chief Information Officer (CIO)
- Office of the Deputy Assistant Secretary of Defense for Nuclear Matters
- Office of the Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy
- Joint Staff
- U.S. Strategic Command
- Defense Logistics Agency
- Defense Threat Reduction Agency
- Air Force Headquarters: Strategic Deterrence and Nuclear Integration (A10)
- Air Force Global Strike Command
- Air Force Materiel Command
- Air Force Life Cycle Management Center: B-52 Program Office, B-2 Division, and E-4B Program Office
- Air Force Nuclear Weapons Center
- Air Force Sustainment Center
- 8th Air Force
- 20th Air Force
- 2nd Bomb Wing
- 5th Bomb Wing
- 90th Missile Wing
- 91st Missile Wing
- 341st Bomb Wing
- 448th Supply Chain Management Wing
- 509th Bomb Wing
- 309th Maintenance Group

Appendix I: Offices That We Contacted

- Chief of Naval Operations: Information Warfare (N2N6), Nuclear Policy (N514), and Undersea Warfare (N97)
- U.S. Navy Strategic Systems Programs
- Naval Air Systems Command: E-6 Airborne Strategic Command, Control, and Communications Program Office (PMA-271)
- Naval Sea Systems Command: Program Executive Office Submarines; Submarine Maintenance Engineering, Planning and Procurement; Trident Refit Facility Bangor; and Trident Refit Facility Kings Bay
- Naval Information Forces
- Strategic Communications Wing One
- U.S. Army Chief Information Officer/G-6
- U.S. Army Nuclear and Countering Weapons of Mass Destruction Agency

Appendix II: Challenges for the Sustainment and Maintenance of the Minuteman III through the End of Its Service Life

Minuteman III Overview

Minuteman III is a strategic intercontinental ballistic missile (ICBM) weapon system that represents one leg of the nation's nuclear triad. First deployed in 1970 with a planned service life of 10 years, the Minuteman III weapon system consists of missiles as well as 450 launch facilities and 45 launch control centers. The Minuteman III service life was extended since its deployment by various service-life extension programs. Launch facilities are connected to underground launch control centers through a system of hardened cables. A launch facility is an unmanned site that houses the missile and all equipment required to maintain the missile in a launch-ready configuration. These underground facilities have been considered part of the Minuteman III weapon system since 2014.¹ Missile alert facilities are manned compounds that encompass the launch control center, a launch control support building, and a launch control equipment building. Missile alert facilities are crewed by security personnel, a cook, a facilities manager, and a launch crew. Launch crews, consisting of two officers, perform around-the-clock alert in the underground launch control center. See figure 5 for components of the Minuteman III weapon system.

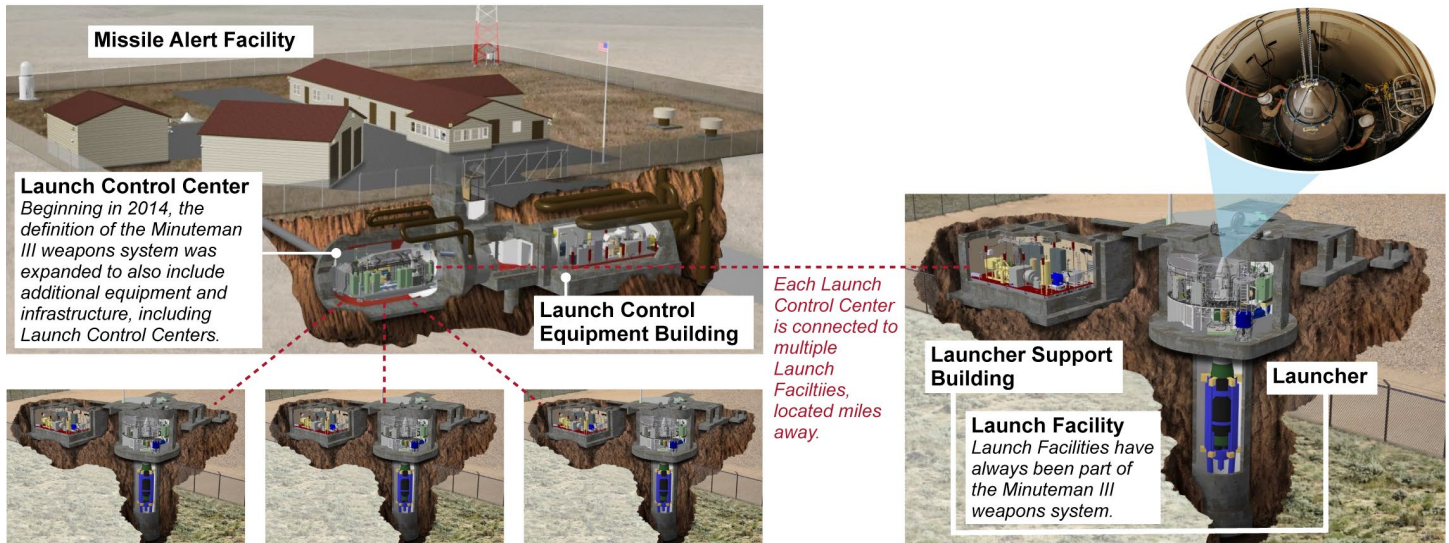
Nuclear command, control, and communications (NC3) systems and related procedures ensure launch crews in the launch control centers can receive and authenticate the President's authorization for the use of nuclear weapons.² In the event that connectivity is lost between a launch control center and an associated launch facility, other NC3 capabilities are available to carry out the direction of the President. For example, launch control centers aside from the one that lost connectivity can communicate with that launch facility as well as numerous other launch facilities. Further, an E-6B aircraft configured as an Airborne Command Post can transmit a launch command to the ICBM force through the Airborne Launch Control System capability.

¹The change in what is included in the Minuteman III weapon system was prompted by a recommendation stemming from the nuclear enterprise reviews in 2014. According to DOD officials, the Defense Logistics Agency is still cataloguing parts added to the weapon system, because the Air Force broadened the definition of the Minuteman III weapon system—a process called demarcation.

²NC3 is a large and complex system comprising numerous land-, air-, and space-based components used to ensure connectivity between the President and nuclear forces. NC3 is managed by DOD entities including the military departments, nuclear force commanders, and defense agencies; it provides the President with the means to authorize the use of nuclear weapons in a crisis. According to DOD officials, replacement programs under way will address challenges with NC3 equipment. Replacement programs include the planned Strategic Automated Command Control System Replacement, and Minimum Essential Emergency Communications Network Minuteman Program Upgrade.

Appendix II: Challenges for the Sustainment and Maintenance of the Minuteman III through the End of Its Service Life

Figure 5: Components of the Minuteman III Weapon System and Supporting Infrastructure



Source: U.S. Air Force (information), U.S. Air Force photo by Airman 1st Class Braydon Williams (photo), and Northrop Grumman (images). | GAO-20-296

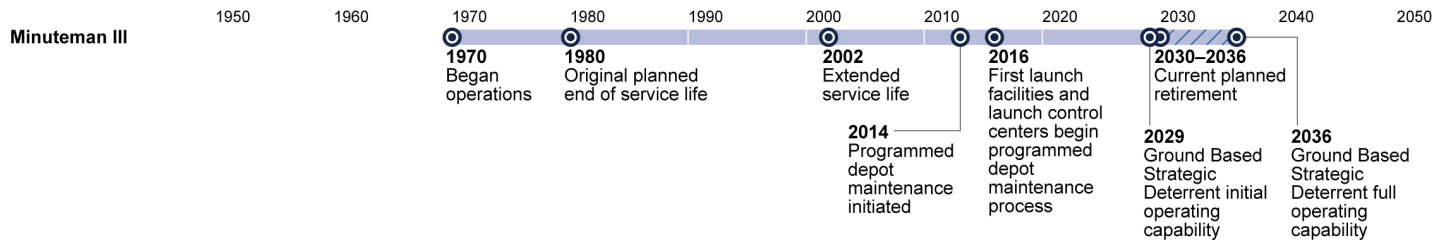
Note: According to Air Force documentation, the Minuteman III weapon system includes all facilities below ground, including the launch control center, launch control equipment building, and launch facility, which encompasses the launcher support building and launcher.

Minuteman III has undergone many life extension sustainment efforts to maintain its warfighting capabilities. The Air Force plans to sustain Minuteman III through 2030—50 years past its initial planned service life—and gradually draw down the weapon system before it is finally retired in 2036, as it is replaced by the Ground Based Strategic Deterrent ICBM weapon system.³ The Ground Based Strategic Deterrent has a planned initial operating capability date of 2029 and is to be fully deployed by 2036. Figure 6 provides a timeline of the expected service life of the Minuteman III ICBM weapon system.

³The Air Force’s Ground Based Strategic Deterrent is replacing the aging Minuteman III, the land-based component of the nuclear triad providing strategic deterrence. The Ground Based Strategic Deterrent will include new missile systems, weapon system command and control, and ground systems, as well as restored and modernized missile silos.

Appendix II: Challenges for the Sustainment and Maintenance of the Minuteman III through the End of Its Service Life

Figure 6: Expected Minuteman III Intercontinental Ballistic Missile Weapon System Service-Life Dates



Source: GAO analysis of Department of Defense information. | GAO-20-296

Minuteman III Challenges

According to Air Force officials, Minuteman III is experiencing challenges related to aging facilities, aging infrastructure, and parts obsolescence. Aging facilities and infrastructure continue to affect the weapon system. According to Air Force officials, most of the real property installed equipment in use today is the original infrastructure that was fielded with the Minuteman I weapon system in 1960, achieving operational capability in 1962, and only slight modifications have been made over the years. Additionally, challenges with critical subsystems also exist, and while there are short-term mitigation strategies for each subsystem, there are no long-term replacements planned for the Minuteman III weapon system except by the fielding of its replacement program: the Ground Based Strategic Deterrent. Examples of facilities and infrastructure challenges include corrosion, water intrusion, collapsed conduits, misaligned doors, and bulging walls.

According to Air Force officials, even attempting to replace small items can be difficult, because multiple subsystems must be replaced to support the modification. Diminishing manufacturing sources, material shortages, and obsolescence issues are additional contributing factors, because they cause difficulties in maintaining a credible supply chain for Minuteman III parts. Additionally, officials said that depot maintenance, interim maintenance, and organizational maintenance have all been affected by parts obsolescence, diminishing manufacturing sources, and material shortages, as has NC3 equipment.

The Minuteman III weapon system is facing continued asset attrition. According to Air Force officials, as a result of the expected attrition of current field assets, the Minuteman III weapon system will be unable to meet full mission requirements after 2026 should full deployment be required. The Air Force expends four Minuteman III ICBMs per year on

testing. According to the officials, continued asset attrition is also affecting the Minuteman III retirement schedule.

Additionally, the Air Force Minuteman III program has experienced personnel challenges. According to Air Force officials, the Air Force has a backlog for top secret clearances for missile wing personnel, including maintainers, and it can take up to 2 years of a missileer's 5-year commitment for a top secret clearance to come through.⁴ The officials told us a missileer can complete training with an interim top secret clearance but cannot be certified under the Personnel Reliability Program and therefore cannot be assigned to a two-person alert team.⁵ This makes it a challenge for missileers with interim clearances to keep up with their peers. Additionally, since commanders cannot assign them to alert duty, it puts additional burden on those missileers who are cleared to perform more alert-duty assignments. According to Air Force officials, they have also identified challenges associated with scheduling maintenance activities, including the need to balance longer working days with the additional risks that maintainers face as a result of these longer days. Officials also said that as launch control centers, launch facilities, and other elements of the Minuteman III weapon system are dispersed over large areas that make up the missile fields, maintainers may need to travel several hours from their base to arrive at the location of the maintenance activity. These increased travel times have resulted in extended workdays for maintainers and security forces or the need to split maintenance jobs between two shifts, which results in decreasing the number of personnel available to work at other locations.

Minuteman III Challenge-Mitigation Efforts

To mitigate challenges associated with the Minuteman III weapon system—including limitations in the availability of parts—the Air Force has broadened the definition of the Minuteman III weapon system, which is a process the Air Force calls demarcation. It was broadened to include some additional facilities related to the Minuteman III weapon system, and programmed depot maintenance was instituted for it. According to Air Force officials, demarcation centralized parts funding and inventory management for all of the essential parts of the Minuteman III and integrated the entire weapon system into the standard Air Force supply

⁴According to Air Force officials, they have taken steps to improve the top secret security clearance backlog, and now there are virtually no missileer officers currently assigned to the missile wings awaiting an adjudicated top secret clearance.

⁵The Personnel Reliability Program is intended to ensure that all personnel working with nuclear weapons are reliable and trustworthy. See [GAO-18-144](#) for a discussion of the Personnel Reliability Program.

Appendix II: Challenges for the Sustainment and Maintenance of the Minuteman III through the End of Its Service Life

process. Additionally, according to the officials, the ICBM System Directorate has established a Weapon System Supply Chain Management office to oversee the commodity and organic support required to meet the daily needs of the warfighter and to sustain Minuteman III throughout Ground Based Strategic Deterrent deployment. The officials said the Weapon System Supply Chain Management office conducts predictive forecasting of the demand for parts through predictive data analysis, which tracks the potential demand for parts as well as parts supportability as an ongoing analysis process. Additionally, the Weapon System Supply Chain Management office does this through an analysis tool that draws on information from multiple supply databases to identify rising request levels in maintenance data systems and mission-capable conditions reported from the field. This tool uses data to identify parts that will be needed.

Additionally, Air Force Global Strike Command conducted an end-to-end review of Minuteman III weapon system maintenance to determine whether ICBM maintenance organizations are organized, trained, and equipped to meet the current and future needs of the weapon system. The review noted that a questionable manpower standard, aging resources and equipment, and organizational inefficiencies have reduced the effectiveness of maintenance and the health of the Minuteman III. Subject-matter experts from various Air Force organizations and the Navy assessed maintenance and provided recommendations on methods, training, resources (supply and equipment), infrastructure, manpower, support, culture, and leadership. For example, the review observed that parts and equipment availability challenges continue to affect the mission. From this observation the review offered several recommendations, including that the Air Force Nuclear Weapons Center set aside all parts for weapon system testing so that they are available when the tests occur, every 5 years. This is intended to ensure that the parts that are set aside are not used at the missile wings. The review also recommended a number of efforts to improve the management of maintenance schedules, including increased coordination and planning of maintenance schedules in advance. According to Air Force officials, this allows maintenance

commanders to make informed decisions, in advance, regarding when longer working days are appropriate.⁶

A number of service-life extension programs are under way to sustain the Minuteman III until the Ground Based Strategic Deterrent arrives. Additionally, ICBM programmed depot maintenance was introduced in 2014 and transformed processes for ICBM weapon system sustainment into a standardized, integrated planning and support model that performs maintenance to refurbish portions of the weapon system. According to Air Force officials, the idea was to have the Minuteman III weapon system undergoing depot maintenance in ways similar to the periodic depot maintenance that aircraft undergo. However, the depot team would have to conduct portions of the maintenance in the missile fields instead of bringing the weapon system to a depot. This new programmed depot maintenance takes individual Minuteman III launch facilities offline to conduct major maintenance. Air Force Nuclear Weapons Center works with the Defense Logistics Agency to procure parts as part of programmed depot maintenance planning. According to Air Force officials, the plan is to have 57 launch facilities go through the programmed depot maintenance process each year, with a plan to refurbish all launch facilities over an 8-year period. Additionally, the current programmed depot maintenance efforts are implementing a standard set of maintenance efforts across all facilities, but some additional issues are also being addressed on a case-by-case basis.

To track the health of the Minuteman III, the Air Force Nuclear Weapon Center assigns predictive health measures to the systems. These predictive health measures estimate when there will be a specific maintenance activity needed for each weapon system part—for example, when a part will likely fail and need to be replaced—based on assessments of historic data and engineering analysis. It emphasizes ICBM sustainment through reliability-centered maintenance, which allows for the continuous evaluation of system performance. Additionally, the

⁶The commander of the 20th Air Force, within Air Force Global Strike Command, issued direction limiting the default workday for maintainers to 12 hours, which, according to Air Force officials, includes the time that missile maintainers spend traveling from their base to locations within the missile field, conducting their work, and returning to base. Maintenance group commanders can waive this requirement in individual instances, at their discretion. According to Air Force officials, it is often less of a risk and less resource intensive to have a maintenance crew work longer than 12 hours instead of having a second crew arrive to relieve the first or to take the time to close up the work site and schedule a second trip to finish the work.

Appendix II: Challenges for the Sustainment and Maintenance of the Minuteman III through the End of Its Service Life

predictive health measures, based on data from Air Force maintenance data-collection systems, are analyzed monthly for all launch facilities and launch control centers across the three missile wings.⁷ According to Air Force officials, predictive health measures enable the Air Force to identify early indications of when systems may need additional maintenance as well as to analyze health trends to identify issues—such as parts failures—across all of the Minuteman III force. Additionally, the use of predictive health measures and reliability-centered maintenance allows the Air Force to better plan for when maintenance activities, and related resources, will be needed to address issues prior to when they arise.

According to Air Force officials, Air Force Global Strike Command also collects and reports on metrics monthly, based on Integrated Maintenance Data System write-ups and predictive health metrics. Officials told us that the Integrated Maintenance Data System is a difficult system to learn and no formal training on the system is available. The data quality in the Integrated Maintenance Data System is highly dependent on the individual expertise of whoever enters it.

⁷Minuteman IIIs are located at F. E. Warren Air Force Base, Wyoming; Malmstrom Air Force Base, Montana; and Minot Air Force Base, North Dakota. In addition, Vandenberg Air Force Base, California, has test launch facilities and launch control centers used during Minuteman III Developmental Test and Evaluation and Operational Test and Evaluation.

Appendix III: B-2 Bomber Faces Challenges Associated with Its Small Fleet Size and Parts Obsolescence Issues

B-2 Overview

The B-2 Spirit is a multirole, dual-capable heavy bomber.¹ The B-2 is the only U.S. aircraft that combines a long-range capability, a large payload, and stealth into a single platform, giving it the ability to project air power globally. The B-2 became operational in 1997, and the current B-2 operational fleet consists of a total of 20 aircraft. The 509th Bomb Wing, located at Whiteman Air Force Base, Missouri, is the sole operational unit for the B-2.² The 509th Bomb Wing usually maintains 15 operationally available B-2s. At any one time, there are two aircraft undergoing sustainment and modernization upgrades, two in programmed depot maintenance, and one designated as a test aircraft. The Air Force plans to sustain the B-2 into the 2030s (see fig. 7). The B-2 will eventually be replaced by the B-21, which will assume the penetrating strike role of the B-2. The B-21 is expected to become operational in the mid-2020s, but no replacement schedule for the B-2 has been identified.

Figure 7: Selected B-2 Bomber Service-Life Dates



Source: GAO analysis of Department of Defense information. | GAO-20-296

The B-2 is undergoing multiple modernization programs, while maintaining existing capabilities through form, fit, and function replacements for components that are obsolete or no longer supportable.

¹Dual-capable refers to the aircraft's ability to carry and deliver both conventional and nuclear weapons.

²The Air National Guard 131st Bomb Wing partners with the 509th Bomb Wing to perform the B-2 mission.

B-2 modernization efforts are ongoing for communications, navigation, defensive management,³ weapons, and the airframe.⁴

B-2 Challenges

Because the B-2 is aging and the fleet is small, parts obsolescence is a challenge. A unique sustainment aspect of the B-2 is the focus on managing its low-observable stealth capability. The B-2 Low Observable Integrated Product Team manages the Low Observable Signature and Supportability Modifications portfolio of projects, which is aimed at maintaining the stealth capability of the B-2 by monitoring, maintaining, and enhancing the radar cross section (or “signature”) of the aircraft. In addition to specific efforts to sustain the low-observable stealth capability, every other sustainment and modernization activity for the B-2 must be assessed early in the planning stages for any effects on this capability.

According to Air Force officials, in addition to maintaining readiness for its nuclear mission, the B-2 platform is also in high demand to support conventional bomber missions. However, the Air Force has a limited number of aircraft to meet this demand. Consequently, the Air Force’s B-2 Division, along with Air Force Global Strike Command and the 509th Bomb Wing, must carefully manage the timing of maintenance activities, aircraft modifications, programmed depot maintenance, assignment of a flight test aircraft, and the flying-hour program. This requires an intricate schedule of availability of aircraft for each effort, while trying to maintain overall operational availability for the B-2 fleet. According to Air Force officials, small-fleet dynamics have led to high costs, diminishing vendor and parts availability, and readiness concerns.

B-2 Challenge-Mitigation Efforts

Various initiatives are under way to improve the availability of B-2s. A cumulative increase of one additional aircraft available for operations is anticipated by fiscal year 2022. Several of these initiatives are directly

³The B-2’s Defensive Management System detects, identifies, and locates enemy radar systems and provides real-time threat avoidance, threat warning, and threat situational awareness information to the aircrew. Shortcomings within the legacy Defensive Management System limit overall B-2 operational capability and survivability. The Defensive Management System–Modernization program will address these limitations and enhance the B-2’s capability to minimize detection in a highly contested anti-access/area-denial environment.

⁴Modernization programs include: Common Very Low Frequency Receiver Increment 1, Adaptable Communications Suite, Cryptographic Modernization, Radar Aided Targeting System, Identification Friend or Foe Mode 5/S, Military Global Positioning System User Equipment Integration, Defensive Management System–Modernization, Flexible Strike Phase 1, B61-12 Integration, Joint Air-to-Surface Missile–Extended Range, and Low Observable Signature and Supportability Modernization.

related to improving sustainment of the B-2 and maintenance processes and procedures. Examples of sustainment and maintenance-related initiatives include the following:

- The B-2 Programmed Depot Maintenance Process Improvement initiative is a collaborative effort between the B-2 program office and Northrop Grumman to increase capacity during the depot maintenance process in order to incorporate modifications during depot maintenance. This initiative is expected to result in reduced downtime at the 509th Bomb Wing by allowing modifications that would normally occur at the wing—making an aircraft unavailable for operations—to occur during planned depot maintenance.
- The B-2 program office increased the interval between programmed depot maintenance periods from 7 years to 9 years. The original B-2 programmed depot maintenance interval of 7 years was driven by the expected life of low-observable coatings. According to B-2 program officials, they have since determined that the expected life of these coatings is 9 years.

Additionally, the Air Force's B-2 Division established the B-2 Obsolescence Integrated Product Team in 2018 to address management oversight of obsolescence. The team convenes monthly to develop a strategic plan to enhance processes, communications, and consolidation of obsolescence issues affecting B-2 modernization and sustainment. A list of obsolete parts, currently totaling over 100, as well as planned mitigation strategies, is consolidated and reviewed quarterly. The integrated product team is also developing a Diminishing Manufacturing and Materiel Shortages Management Plan to define the structure, process, management, and oversight of obsolescence for the life cycle of the B-2. Further, according to Air Force documentation, for each B-2 sustainment and modernization program, the government and prime contractor establish a joint Obsolescence Working Group that is responsible for reviewing the program's strategy to mitigate diminishing manufacturing and materiel shortages.

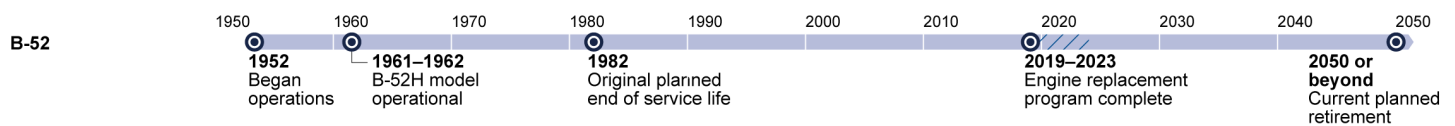
Appendix IV: B-52 Bomber Faces Maintenance Challenges through 2050

B-52 Overview

The B-52 Stratofortress is a dual-capable heavy bomber used to meet the United States’ airborne strategic nuclear deterrence and global precision attack mission and objectives. The B-52 began operations in 1952. Eight models were produced, with a total production quantity of 742. The final version of the B-52, the “H” model, was the last model produced and became operational in 1961. The current B-52 operational fleet consists of a total of 76 aircraft, 46 of which are designated as nuclear capable. B-52 operational units consist of the 2nd Bomb Wing, located at Barksdale Air Force Base, Louisiana, and the 5th Bomb Wing, located at Minot Air Force Base, North Dakota.¹ The B-52 originally had a planned service life of approximately 20 years. However, the Air Force now plans to sustain the B-52 until at least 2050 (see fig. 8). An eventual replacement for the B-52 has not yet been identified.

The B-52 is undergoing several modernization programs planned for completion in the 2020s. The B-52 Commercial Engine Replacement Program will replace the aging TF33-PW-103 engine with new commercial-off-the-shelf engines capable of meeting the needs of the B-52 platform to keep the B-52 viable until 2050 and beyond. The engine replacement program was scheduled to begin in fiscal year 2019 and to be completed in fiscal year 2023. Additional modernization programs include installation of a Global Positioning System Interface Unit and a radar modernization program.

Figure 8: Selected B-52 Bomber Service-Life Dates



Source: GAO analysis of Department of Defense information. | GAO-20-296

B-52 Challenges

According to B-52 maintainers, the biggest maintenance limitation they are experiencing is with the engine. In 2017, an engine fan disk failure on one of eight engines on a B-52 caused the engine to detach from the aircraft while in flight. The Air Force has identified the resulting fan disk inspection and replacement as a serious risk due to the time it will take to complete and expects the inspection, removal, and replacement to have an effect on the fleet into the 2020s. Further, the current TF33 engines

¹The B-52 is also assigned to the Air Force Reserve Command’s 307th Bomb Wing at Barksdale Air Force Base.

are unsupportable beyond 2030. According to Air Force officials, the engine replacement program is expected to negatively affect aircraft availability rates until it is completed in 2023. Air Force officials also expressed concern that, because the new commercial engines have many digital components, their installation could increase the B-52's cybersecurity risk.²

At 60 years old, the B-52 is experiencing structural issues typical of aging aircraft. The extension of the B-52's service life into the 2050s likely imposes additional unforeseen sustainment and modernization challenges. The aging airframe has required increased depot-level maintenance to correct, for example, problems related to stress corrosion and cracking on the airframe. Further, industry is no longer able to support these aging systems, and the systems have experienced declining performance and system failure. According to Air Force officials, it is difficult to maintain suppliers who will produce the necessary parts for such an old airframe.

According to officials at both B-52 wings, a security-clearance backlog limits the number of trained and available B-52 maintainers. Both B-52 wings also have shortages of experienced maintainers. Additionally, the demands of the B-52's conventional mission create challenges to ensuring that they are available for their nuclear mission. The B-52 has been used in operations against the Islamic State in Syria. According to officials at both B-52 wings, the conventional mission is the day-to-day focus of most B-52 operators and maintainers. These officials said that it is sometimes challenging to shift their collective mindset to focus on the nuclear mission. Further, the B-52 requires different configurations for its conventional and nuclear missions. According to B-52 maintenance officials, the time it takes to change the configurations affects how quickly the aircraft can be ready for a nuclear mission. An official from one B-52 operations group expressed concern that if the B-52 continues to be used heavily in conventional operations, it will begin to experience airframe and personnel problems similar to those that have affected the B-1, which has been used extensively in recent conventional bombing operations.

B-52 Challenge-Mitigation Efforts

The B-52 engine replacement program is expected to allow the engines to be sustained until the 2050s, when the B-52 is expected to retire. In addition, the modern engines being installed will increase the B-52's

²According to Air Force officials, cybersecurity will be addressed in overarching B-52 cybersecurity documentation as well as an annex for the commercial engine replacement program.

range by approximately 30 percent, significantly decrease maintenance costs and downtime, provide the additional electrical power required for follow-on systems, and decrease the B-52's dependency on refueling tankers for both conventional and nuclear long-range strike sorties because it will be able to fly longer without being refueled.

The B-52 program office is leading a B-52 Aircraft Availability Improvement Plan, which is an enterprise-wide effort to increase the number of B-52s available to operational units. According to officials, the program office is leading an initiative to reduce the number of aircraft that are at the depot at any given time from 11 to 9. This would increase the availability of aircraft to meet operational requirements. This effort is in the early implementation stages, and the program office has not yet evaluated the results.

The B-52 program office mitigates parts obsolescence issues through active vendor management, selection of vendors who use an open systems approach,³ use of predictive database tools to identify diminishing manufacturing and materiel shortages, and leveraging industry and government reporting systems that track diminishing manufacturing and materiel shortages.

³An open architecture is a technical architecture that adopts open standards supporting a modular, loosely coupled and highly cohesive system structure that includes publishing of key interfaces within the system and full design disclosure.

Appendix V: Air-Launched Cruise Missile Is Experiencing Sustainment Challenges as a Result of Age and Attrition

Air-Launched Cruise Missile (ALCM) Overview

The AGM-86B ALCM is a long-range self-guided missile with a nuclear warhead that is carried by the B-52H Stratofortress bomber.¹ ALCM complements the B-52 heavy bomber in its strategic mission; its primary missions are strategic attack, interdiction, and suppression of enemy air defenses. It is designed to be carried on the internal B-52 common strategic rotary launcher or externally on pylons located underneath each wing (see fig. 9).² The ALCM air vehicle is powered by a low-thrust turbofan engine and flies at subsonic speeds. After release from the carrier aircraft, the ALCM proceeds autonomously to its target.

Figure 9: B-52H with AGM-86B Air-Launched Cruise Missiles Carried by a Pylon on Its Wing



Source: U.S. Air Force photo by Senior Airman J.T. Armstrong. | GAO-20-296

ALCM Challenges

ALCM became operational in 1982 and, according to Air Force officials, had an original planned service life of 10 years; it is on average 25 years

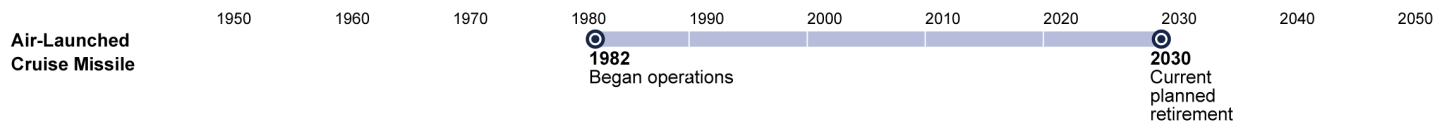
¹When the missile is configured with a conventional warhead, it is designated as a Conventional Air-Launched Cruise Missile.

²A B-52 aircraft can carry up to 20 ALCM missiles: six on each of its two externally mounted pylons and eight in the internal common strategic rotary launcher. According to Air Force officials, as of May 2019 there are 102 common strategic rotary launchers and 57 pylons in active inventory.

Appendix V: Air-Launched Cruise Missile Is Experiencing Sustainment Challenges as a Result of Age and Attrition

beyond its planned service life (see fig. 10). Additionally, ALCM has experienced aging issues with multiple subsystems. For example, the officials told us the Bomber Weapons Integration Equipment, pylons, launcher, common support equipment, ALCM-peculiar support equipment, and automated test equipment all have aging and supportability issues that require assessment and actions that must be taken going forward. Air Force officials stated that because of ALCM's age, diminishing manufacturing sources and material shortage issues occasionally arise that have required requalification of a product line or qualifying a new source. Additionally, they said that ALCM maintenance and analysis trends have highlighted that electrical components and bearings are wearing out.

Figure 10: Selected Air-Launched Cruise Missile (ALCM) Service-Life Dates



Source: GAO analysis of Department of Defense information. | GAO-20-296

According to Air Force officials, the ALCM fleet, made up of approximately 535 missiles in active inventory as of May 2019, is affected by attrition resulting from testing. The ALCM is operationally tested with six force development evaluations and two functional ground tests each year. According to Air Force officials, the testing employs ALCM fleet inventory missiles that are consumed during live launch and destructive testing, thereby reducing the fleet by eight missiles per year. The officials noted that the fleet would be sustainable longer if the decision was made to stop testing. However, this would mean that fewer data—collected during the annual tests—would be available to predict the life of the missile, and the Air Force would lose full confidence that it could execute ALCM's mission.

ALCM Challenge-Mitigation Efforts

According to Air Force officials, the ALCM will be sustained through 2030. Service-life extension programs have been implemented to sustain the weapon system, and maintenance is performed every 6 years to exchange the missile's engine. In order to extend the ALCM's service life until a replacement system is fielded, service-life extension programs were developed through surveillance, studies, and analysis programs that identified numerous components for replacement as a result of aging and

Appendix V: Air-Launched Cruise Missile Is Experiencing Sustainment Challenges as a Result of Age and Attrition

obsolescence issues. Officials said these programs address replacement of aged brittle components, bearings, and circuitry and electronic components within navigation and guidance systems. According to Air Force officials, maintainers are being proactive in identifying parts on the ALCM system that will experience issues in the future. Additionally, continued monitoring through flight tests and aging surveillance programs will enable them to identify new aging issues, which may drive additional service-life extension efforts. To mitigate challenges that arise, there is ongoing coordination between the ALCM and Long-Range Stand Off program offices to develop plans to retire ALCMs as Long-Range Stand Off production is executed through full operational capability and complete deployment.

To mitigate challenges with support equipment, supportability trades are being conducted for the launcher and pylon service-life extension, and a gap analysis is being conducted to identify components, processes, and procedures that need to be modified to ensure service life through 2030. According to Air Force officials, maintainers are looking for ways to be proactive in maintaining support equipment and identifying future issues before parts break, as they are doing for the missile itself. Through the Automatic Test Systems program office, the Electronic System Test Set is also encountering aging and supportability issues that are being addressed through multiyear technical insertion projects. Additionally, predicting new effects of aging on service life grows increasingly challenging as 2030 approaches.

Appendix VI: The Navy Plans to Sustain the *Ohio*-Class Ballistic Missile Submarine until It Is Replaced by the *Columbia*-Class

Ohio-Class Ballistic Missile Submarine (SSBN) Overview

The *Ohio*-class SSBNs constitute the sea-based leg of the strategic triad. Each SSBN is capable of carrying and launching 20 D-5 Trident submarine-launched ballistic missiles, which can deliver multiple nuclear warheads. The first *Ohio*-class SSBN, the USS *Ohio*, entered service in 1981. The last *Ohio*-class SSBN, the USS *Louisiana*, entered service in 1997. The Navy maintains a fleet of 14 *Ohio*-class SSBNs.¹ Eight of the SSBNs are deployed in the Pacific Ocean, homeported in Bangor, Washington, and six are deployed in the Atlantic, homeported in Kings Bay, Georgia. According to a DOD Inspector General report, in a 1998 memorandum from the Commander of the Naval Sea Systems Command to the Chief of Naval Operations, the Navy documented its decision to extend the original 30-year service life of the *Ohio*-class SSBNs to 42 years. The report noted that this decision was supported by a Navy-directed study led by the manufacturer of the *Ohio*-class, General Dynamics Electric Boat Division, which determined that extending the service life of the *Ohio*-class SSBNs to 42 years was technically feasible. Subsequently, in a 2017 memorandum from the Commander of the Naval Sea Systems Command to the Program Executive Office for Submarines, the Commander stated that extensions beyond 2042 were not technically feasible.² However, Navy officials said that they are beginning to consider options in case the replacement program, the *Columbia*-class SSBN, is delayed. As we previously reported, Navy officials noted that the service has never operated a nuclear-powered submarine for as long as 42 years.³

The Navy plans to replace the 14 *Ohio*-class SSBNs with 12 *Columbia*-class SSBNs. The first of the *Ohio*-class SSBNs is scheduled to be retired from active service in 2027. The remaining *Ohio*-class SSBNs will be retired at a rate of one per year, with the last one exiting service in 2040 (see fig. 11). According to Navy officials, they do not have a contingency plan in case the *Columbia*-class SSBN acquisition dates are delayed.

¹In 2003, based on a recommendation in the Secretary of Defense's 2001 Nuclear Posture Review, the Navy decreased the SSBN fleet from 18 to 14 by converting four *Ohio*-class SSBNs to guided-missile nuclear submarines. Guided-missile nuclear submarines carry conventional land-attack cruise missiles and are used to support special operations.

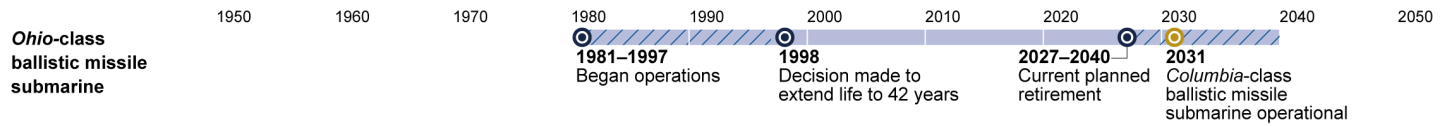
²Department of Defense, *Office of Inspector General, (U) Evaluation of Nuclear Ballistic Missile Submarine (SSBN) Sustainment* (June 15, 2018) (SECRET).

³GAO, (U) *Nuclear Forces Readiness: Incomplete Readiness Reporting, Aging Delivery Systems, and Potential Delays in Replacement Systems Put Deterrent at Risk*, GAO-19-12C (Washington, D.C.: Mar. 20, 2019) (SECRET//FORMERLY RESTRICTED DATA//NOFORN).

Appendix VI: The Navy Plans to Sustain the Ohio-Class Ballistic Missile Submarine until It Is Replaced by the Columbia-Class

However, they said that the fact that 14 *Ohio*-class SSBNs are being replaced by 12 *Columbia*-class SSBNs provides some extra time for replacement in case *Columbia* is delayed. Specifically, there will be an estimated 2 years between when the last *Columbia*-class SSBN is delivered and the last *Ohio*-class SSBN is retired. Navy officials also said that they are trying to gather the necessary data to lay the ground work now to be able to make engineering decisions in 10 years about the feasibility of sustaining the *Ohio*-class SSBNs in the event that the *Columbia*-class is delayed.

Figure 11: Selected *Ohio*-Class Submarine Service-Life Dates



Source: GAO analysis of Department of Defense information. | GAO-20-296

SSBN Challenges

The Navy is experiencing challenges in sustaining the *Ohio*-class SSBN through its planned 42-year service life. According to Navy officials, since the *Ohio* will be in service longer than expected, the Navy is encountering parts that need replacement that were not originally intended to be replaced. There is no industrial base of suppliers to support the replacement of some of these parts. In addition, the overall amount of maintenance required for the SSBNs increases as they age. According to Navy officials, both of these issues contribute to diminishing manufacturing sources and material shortages for the *Ohio*-class SSBNs. According to May 2019 congressional testimony by the Director of the Navy’s Strategic Systems Programs, the D-5 Trident submarine-launched ballistic missile has also been deployed for longer than its original planned service life. Specifically, it has been deployed for over 25 years, and the Navy now plans to operate the D-5 for over 50 years total. It has undergone service-life extension programs and is operating on new rocket motors. However, according to the Director’s testimony, this will be more than double the historical service life of any previous sea-based strategic deterrent system.

Engineered refueling overhauls—major maintenance periods that occur once during an SSBN’s life—have been completed for all except the last two *Ohio*-class SSBNs to enter service, the USS *Wyoming* and the USS

Louisiana.⁴ The USS *Wyoming* is currently undergoing its overhaul and is scheduled to complete it in July 2020. The USS *Louisiana* was scheduled to begin its overhaul in September 2019 and complete it in April 2022. According to Navy officials, in the past SSBNs completing refueling overhauls have cannibalized parts from SSBNs that are beginning to be overhauled. The final *Ohio*-class SSBN to undergo an overhaul, the USS *Louisiana*, will not have that option, because there will be no other SSBNs from which to cannibalize parts. However, these officials noted that they have not encountered any insurmountable issues thus far in planning the *Louisiana*'s overhaul.

The DOD Inspector General reported in June 2018 that the Navy did not have a contingency plan in the event that the *Columbia*-class is delivered late.⁵ The Navy has identified a number of efforts under way to ensure that it reduces risks in both the maintenance of the current *Ohio*-class SSBN and the acquisition schedule of the *Columbia*-class SSBN. However, as we reported in December 2017 and again in March 2019, the *Columbia*-class program is facing more risks than its predecessors from its aggressive and concurrent schedule as a result of the continued and pressing need for it to meet the Navy nuclear deterrent requirements. The first *Ohio*-class SSBN is scheduled to be retired in 2027, and another is to follow each year until 2040. The first *Columbia*-class SSBN is scheduled to enter service in fiscal year 2031, and another is to follow each year thereafter.

SSBN Challenge-Mitigation Efforts

We have previously reported that the Navy also plans to increase investment in its SSBN maintenance facilities, equipment, and workforce to improve the execution of SSBN maintenance. According to Navy officials, they have several strategies to combat diminishing manufacturing sources and material shortages. For example, the *Ohio* program office has made "life of type" purchases for some parts for which the industrial base cannot meet the demand. In other words, according to program officials, the program office purchases in one contract enough of that part to last for the entire life of the SSBN—a large enough order to make it worth the time and cost for a manufacturer to produce the parts. According to the officials, another solution is to retrofit the pieces being

⁴Engineered refueling overhauls are 27-month overhauls that occur once during an *Ohio*-class SSBN's life, at around the 20-year point, and include extensive inspections, structural repairs, and a nuclear reactor refueling to extend the submarine's service life.

⁵DOD, Office of Inspector General, (U) *Evaluation of Nuclear Ballistic Missile Submarine (SSBN) Sustainment* (June 5, 2018) (SECRET).

Appendix VI: The Navy Plans to Sustain the Ohio-Class Ballistic Missile Submarine until It Is Replaced by the Columbia-Class

used to build the *Columbia*-class SSBNs to support the needs for the *Ohio*-class SSBNs. For example, the Navigation Process Unit was retrofitted from the *Columbia* to use on the *Ohio*. This allows the Navy to purchase these components from manufacturers who will already be making them for the *Columbia*.

The Navy has initiated major modernizations on a number of systems on the *Ohio* to upgrade those systems with new capabilities. According to Navy officials, modernization efforts are being planned for navigation, radio, and electronic communications systems, among others. The Navy has also initiated a program to refurbish and extend the service lives of D-5 Trident submarine-launched ballistic missiles to about 2040. As *Columbia*-class SSBNs begin to replace *Ohio*-class SSBNs, refurbished D-5s carried by retiring *Ohio*-class SSBNs will be transferred to new *Columbia*-class SSBNs. *Columbia*-class SSBNs will continue to be armed with these refurbished D-5s until about 2040, at which time the D-5s are to be replaced by a successor submarine-launched ballistic missile. According to Navy officials, maintaining one strategic weapon system configuration during the transition to *Columbia* is beneficial from a cost, performance, and risk-reduction standpoint.

In 2018, the DOD Office of Inspector General reported that the Secretary of the Navy and the Chief of Naval Operations have formally designated strategic nuclear deterrence as the Navy's top priority. According to the report, as a result, the Navy has reduced the time required for engineered refueling overhauls of SSBNs, increased workforce size at shipyards, accelerated and improved shipyard workforce training, and improved SSBN maintenance procedures and schedules.⁶ However, while the Navy was able to reduce the time required for its last two engineered refueling overhauls, it has not hit the target of 27 months since 2010. In addition, according to officials the Navy has created two working groups—the SSBN/Guided Missile Nuclear Submarine Working Group and the Trident Coordination Group—to monitor and mitigate *Ohio*-class sustainment and maintenance challenges.

⁶DOD Office of Inspector General, (U) *Evaluation of Nuclear Ballistic Missile Submarine (SSBN) Sustainment* (SECRET).

Appendix VII: Comments from the Department of Defense



COST ASSESSMENT AND
PROGRAM EVALUATION

OFFICE OF THE SECRETARY OF DEFENSE
1800 DEFENSE PENTAGON
WASHINGTON, D.C. 20301-1800

OCT 07 2019

Dr. Joseph Kirschbaum
Director
Defense Capabilities and Management
United States Government Accountability Office
441 G St, N.W.
Washington, DC 20548

Dear Dr. Kirschbaum:

This is the Department of Defense response to the Government Accountability Office Draft report, GAO-20-9C, "DEFENSE NUCLEAR ENTERPRISE: Systems Face Sustainment Challenges and Actions Are Needed to Effectively Monitor Efforts to Improve the Enterprise," dated August 29, 2019 (GAO Code 103051). We concur with the two recommendations and will take action as described in the enclosure.

The DOD's comments on the draft report recommendations are enclosed.

Sincerely,

A handwritten signature in black ink, appearing to read "John E. Whitley".

John E. Whitley
Acting Director

Enclosure: Department of Defense Comments on the GAO Recommendations

GAO DRAFT REPORT DATED AUGUST 29, 2019
GAO-20-9C (GAO CODE 103051)

“DEFENSE NUCLEAR ENTERPRISE: SYSTEMS FACE SUSTAINMENT
CHALLENGES AND ACTIONS ARE NEEDED TO EFFECTIVELY MONITOR
EFFORTS TO IMPROVE THE ENTERPRISE”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The Secretary of Defense should ensure that the Director, CAPE, in coordination with the Deputy Assistant Secretary of Defense for Nuclear Matters, the Deputy Assistant Secretary of Defense for Nuclear and Missile Defense Policy, and the Joint Staff Deputy Director for Strategic Stability, as co-chairs of the Nuclear Deterrent Senior Oversight Group, update the applicable guidance for methods of tracking and evaluating progress on implementation of the recommendations from the 2014 nuclear enterprise reviews, requiring DoD components to keep information – including any revised time frames – current.

DoD RESPONSE: Concur. The Nuclear Deterrent Senior Oversight Group co-chairs or, as necessary, the Deputy Secretary of Defense as the chair of the Nuclear Deterrent Enterprise Review Group, will update the applicable guidance to ensure that time frames and other information associated with planned actions are kept up to date.

RECOMMENDATION 2: The Secretary of Defense should ensure that the DOD CIO updates the applicable guidance for methods of tracking and evaluating progress on implementation of the recommendations of the 2015 NC3 report, requiring DOD components to keep information – including metrics for measuring progress and outcomes as well as any revised time frames that may extend out more than one year – complete and current.

DoD RESPONSE: Concur. The DOD CIO and, as appropriate, the Under Secretary of Defense for Acquisition and Sustainment as the NC3 capability portfolio manager, will update the applicable guidance to ensure that metrics, time frames, and other information associated with planned actions are kept up to date and complete.

Appendix VIII: GAO Contact and Staff Acknowledgments

GAO Contact

Joseph W. Kirschbaum, (202) 512-9971 or kirschbaumj@gao.gov

Staff Acknowledgments

In addition to the contact named above, key contributors to this report were Penney Harwell Caramia, Assistant Director; R. Scott Fletcher; Jonathan Gill; Susannah Hawthorne; Brent Helt; Joanne Landesman; Amie Lesser; K. Ryan Lester; Ned Malone; Gabrielle Matuzsan; and Michael Shaughnessy.

Related GAO Products

Nuclear Weapons Sustainment: Fiscal Year 2018 Nuclear Forces Budget Estimates. [GAO-19-127R](#). Washington, D.C.: November 2, 2018.

Defense Nuclear Enterprise: DOD Continues to Address Challenges but Needs to Better Define Roles and Responsibilities and Approaches to Collaboration. [GAO-19-29](#). Washington, D.C.: November 1, 2018.

Defense Nuclear Enterprise: Processes to Monitor Progress on Implementing Recommendations and Managing Risks Could Be Improved. [GAO-18-144](#). Washington, D.C.: October 5, 2017.

Nuclear Weapons: DOD Assessed the Need for Each Leg of the Strategic Triad and Considered Other Reductions to Nuclear Force. [GAO-16-740](#). Washington, D.C.: September 22, 2016.

Defense Nuclear Enterprise: DOD Has Established Processes for Implementing and Tracking Recommendations to Improve Leadership, Morale, and Operations. [GAO-16-597R](#). Washington, D.C.: July 14, 2016.

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