United States Government Accountability Office

Report to the Chairman, Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, House of Representatives

March 2017

COAST GUARD CUTTERS

Depot Maintenance Is Affecting Operational Availability and Cost Estimates Should Reflect Actual Expenditures

GAO-17-218

GAO Highlights

Highlights of GAO-17-218, a report to the Chairman, Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure, House of Representatives

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Why GAO Did This Study

The Coast Guard is procuring the FRC and NSC to replace its aging cutters. Both cutters have had operational problems—such as propulsion system issues—that are being addressed through maintenance. Prior GAO work identified issues related to performance and maintenance of these vessels, particularly related to the main diesel engines on both cutters.

The House Subcommittee on Coast Guard and Maritime Transportation, Committee on Transportation and Infrastructure asked that GAO examine maintenance of the FRC and NSC. This report addresses the extent to which (1) maintenance issues are affecting FRC's and NSC's operational status, (2) design changes affect the maintenance of the cutters, and (3) the Coast Guard's cost estimates reflect actual expenditures for maintenance for the FRC and NSC.

To conduct this work, GAO analyzed data on cutter maintenance and operations; analyzed the costs and timing of design changes; reviewed Coast Guard budgets and compared GAO best practices in cost estimating to the Coast Guard's process for estimating depot maintenance costs; and interviewed Coast Guard officials.

What GAO Recommends

To ensure that it effectively uses its resources, the Coast Guard should document cost analyses on the cost and timing of engineering design changes and periodically evaluate and update its depot maintenance cost estimates. The Department of Homeland Security agreed with both recommendations and provided timeframes for actions to address them.

View GAO-17-218. For more information, contact Michele Mackin at (202) 512-4841 or mackinm@gao.gov.

What GAO Found

Maintenance work for the Fast Response Cutter (FRC) and National Security Cutter (NSC) has lowered the operational availability of each fleet. Although both cutters on average have met their minimum mission capable targets over the long term, increased depot maintenance has more recently reduced each cutter's rates below targets. The FRC's rate is lower, in part, because of a series of unanticipated drydock periods to correct issues covered by its 12-month warranty. The NSC's lower rate is primarily because of anticipated 2-year maintenance and system upgrade periods performed on each newly delivered NSC. Both cutters have experienced problems with the diesel engines, which caused lost operational days and hindered operations while underway.

The Coast Guard's 154-foot Fast Response Cutter and 418-foot National Security Cutter

Source: U.S. Coast Guard. | GAO-17-218

The Coast Guard has initiated design changes on the FRC and NSC, but some of the NSC's changes to address maintenance problems will not be installed until after each cutter is delivered. While the Coast Guard plans at least $17 million on FRC design changes, officials estimate the warranty has helped avoid $77 million for repaired systems. This includes about $52 million to replace 20 diesel engines that have degraded FRC operations since first discovered in July 2013. Design changes on the NSCs are expected to cost the Coast Guard at least $260 million. In order to maintain production schedules, several changes will be completed after delivery of each NSC, including the ninth NSC, which has not yet begun construction. Thus, systems with known deficiencies are being installed, only to be replaced later. Officials stated this approach is more cost effective; however, the Coast Guard did not document its cost analyses, in accordance with GAO cost estimating best practices. Without such documentation, the Coast Guard cannot demonstrate that it is making cost-effective decisions.

Since 2010, depot maintenance expenditures for the FRC and NSC have been $106.6 million less than the Coast Guard estimated. This amount remains in a centrally managed account and is made available for other surface assets, such as aging, legacy vessels. Coast Guard officials stated that depot maintenance estimates are not adjusted or updated over the service life of an asset class. Periodically updating depot maintenance cost estimates—in accordance with GAO cost estimating best practices—for each asset class could provide decision makers with much needed information with which to determine future budgets.

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Abbreviations

ABS	American Bureau of Shipbuilding
ASW	Auxiliary Seawater System
DHS	Department of Homeland Security
EAL	Electronic Asset Logbook
FRC	Fast Response Cutter
NSC	National Security Cutter
RCM	Reliability Centered Maintenance
SFLC	Surface Forces Logistics Center

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

March 2, 2017

The Honorable Duncan Hunter
Chairman
Subcommittee on Coast Guard and Maritime Transportation
Committee on Transportation and Infrastructure
House of Representatives

Dear Mr. Chairman:

The acquisition of the Fast Response Cutters (FRC) and National Security Cutters (NSC) is an integral part of the Coast Guard's plan to modernize its aging fleet of cutters to perform its missions that are vital to the security of the United States. These cutters are intended to be more capable than their predecessors—the 110-foot Island Class Patrol Boats and 378-foot High Endurance Cutters—with increased deployments and endurance and enhanced communications and surveillance systems. We reported on the condition of the legacy cutters in July 2012 and found that they had exceeded their expected service lives and their material condition was declining, which resulted in increased maintenance costs and a burden on the Coast Guard's budget.[1] The declining condition of its legacy cutters highlights the need for the Coast Guard to maintain its newer cutters on schedule and within budget so that they are available to conduct operations when needed and can meet or exceed their expected service lives. In May 2016, we found that deferring maintenance can lead to declining ship conditions and longer maintenance periods that can reduce a ship's operational availability.[2]

While the Coast Guard tracks metrics related to the operations of the FRC and NSC, such as days away from home port, those metrics do not shed light on the maintenance issues that have plagued these cutters. We reported on the status of the FRC and NSC in June 2014 and found that problems with the FRC's main diesel engines during initial testing had limited the amount of time that the cutter was available to conduct

[1]GAO, *Coast Guard: Legacy Vessels' Declining Conditions Reinforce Need for More Realistic Operational Targets*, GAO-12-741 (Washington, D.C.: July 31, 2012).

[2]GAO, *Military Readiness: Progress and Challenges in Implementing the Navy's Optimized Fleet Response Plan*, GAO-16-466R (Washington, D.C.: May 2, 2016).

operations to an unacceptable level.[3] In January 2016, we found that maintenance issues with the NSC fleet had caused operational challenges for which the Coast Guard had not yet identified corrective actions.[4] These included problems with the cutter's main diesel engines, which could not reach full power in warm waters, and generators that were overheating. We also found that the Coast Guard planned to conduct retrofits and design changes on the NSC fleet for problems identified during testing and operations.

Given these concerns, you requested that we examine the Coast Guard's maintenance of the FRC and NSC. This report examines the extent to which (1) maintenance issues, equipment failures, and spare parts availability are affecting the asset status of the FRC and NSC; (2) design changes affect the maintenance of the FRC and NSC; and (3) the Coast Guard's cost estimates reflect actual expenditures for maintenance for the FRC and NSC.

To assess the extent to which maintenance issues, equipment failures, and spare parts availability are affecting the asset status of the FRC and NSC, we reviewed Coast Guard mission capability data for both cutters and compared their rates to the target ranges established by the Coast Guard. We also gathered data on the Coast Guard's top operational degraders and top maintenance cost drivers from 2014 to 2016 for the FRC and NSC and reviewed their engineering reports from 2012 to 2015 to determine the top equipment issues the cutters were experiencing from the perspective of the cutter captains. To assess the Coast Guard's design changes and how they are affecting maintenance, we reviewed the planned Coast Guard design changes for both cutters and spoke with program and engineering officials to understand the cost implications of these design changes and how decisions are made regarding when the changes are installed on the cutters. To assess how the Coast Guard's cost estimates reflect actual maintenance expenditures, we reviewed the Coast Guard's standard support levels, which are the estimated costs for depot-level maintenance each year over the course of an asset's life cycle. We compared this information to actual depot-level maintenance expenditures from 2012 to 2016 for the FRC and 2010 to 2016 for the

[3]GAO, *Coast Guard Acquisitions: Better Information on Performance and Funding Needed to Address Shortfalls*, GAO-14-450 (Washington, D.C.: June 5, 2014).

[4]GAO, *National Security Cutter: Enhanced Oversight Needed to Ensure Problems Discovered during Testing and Operations Are Addressed*, GAO-16-148 (Washington, D.C.: Jan. 12, 2016).

NSC.[5] In addition, we spoke with Coast Guard officials to understand how these support levels are determined and what role they have in developing the budget. Appendix I contains more information regarding our scope and methodology.

We conducted this performance audit from February 2016 to March 2017 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 the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

History of the Fast Response Cutter and National Security Cutter

The Coast Guard began a recapitalization effort in the late 1990s to modernize a significant portion of its entire surface and aviation fleets by rebuilding or replacing assets.[6] This effort was formerly known as Deepwater, and included the FRC and NSC programs, among others. In 2006, the Coast Guard acknowledged that it had relied too heavily on contractors and, citing cost increases, took over the role of lead systems integrator. The Coast Guard reorganized the programs that comprised Deepwater and since 2012 has referred to them broadly as the Coast Guard's recapitalization.

The FRC and the NSC are two of the newest assets in the Coast Guard's fleet. First delivered in 2012 and 2008, respectively, the cutters were designed to provide additional capability beyond that possessed by their predecessors. The FRC is intended to replace the current fleet of 49 110-foot Island Class Patrol Boats—which were first built in the 1980s—with 58 FRCs that provide the Coast Guard with additional capabilities, such as advanced intelligence, surveillance, and reconnaissance technology, and cutter boat deployment. The NSC is intended to replace the 12 High Endurance Cutters—which were first built in the 1960s—with a smaller

[5]We used these time frames because these are the dates that the cutters first began using this metric.

[6]The Coast Guard is a component within the Department of Homeland Security. Surface assets include cutters (vessels 65 feet and longer) and boats (vessels under 65 feet).

fleet of NSCs that provides the Coast Guard with additional capabilities, such as the ability to collect, analyze, and transmit classified information as well as to carry, launch, and recover unmanned aerial vehicles, among others. The Coast Guard originally planned eight NSCs to fulfill the capability gap left by retiring the High Endurance Cutter fleet, but Congress directed, in December 2015, that of the funds provided by the Consolidated Appropriations Act, 2016, not less than $640 million be immediately available and allotted to contract for the production of the ninth NSC.[7] Appendix II provides the current delivery schedule of FRCs and NSCs.

The FRCs conduct operations in coastal and high seas conditions up to 200 nautical miles from the coast, enabling them to respond quickly to emerging situations. These cutters are expected to spend no more than 185 days away from their homeport and conduct 2,500 operational hours each year, with each patrol lasting roughly 5 to 7 days.

Due to its larger crew—126 for the NSC compared to 24 for the FRC—and size—418 feet for the NSC compared to 154 feet for the FRC—the NSC is able to patrol worldwide and conduct extended operations beyond the capabilities of the FRC. The NSCs are expected to conduct operations from at least 50 nautical miles from shore including in extreme climates, such as the Arctic. Coast Guard standards dictate that the NSCs will spend no more than 210 days away from their homeport and conduct 3,780 operational hours each year, with each patrol lasting longer than 60 days.[8] Appendix III provides more detail of the FRC and NSC's operational capabilities.

Maintenance of Coast Guard Cutters

The Coast Guard defines the goal of cutter maintenance as ensuring optimal readiness to perform missions at the lowest cost over the asset's service life. As with any ship, maintenance is a major portion of the total ownership costs for Coast Guard cutters. Unnecessary maintenance increases ownership costs and limits a cutter's availability to conduct missions, decreasing its readiness.

[7]Pub. L. No. 114-113 (2015).

[8]The Coast Guard plans to conduct a feasibility study of using rotating crews to increase the NSCs' days away from home port to 230. Plans are to be finalized by December 2017 and the test is scheduled to last for about 2 years, beginning in fiscal year 2019. For more information see GAO, *Coast Guard: Timely Actions Needed to Address Risks in Using Rotational Crews*, GAO-15-195 (Washington, D.C.: Mar. 6, 2015).

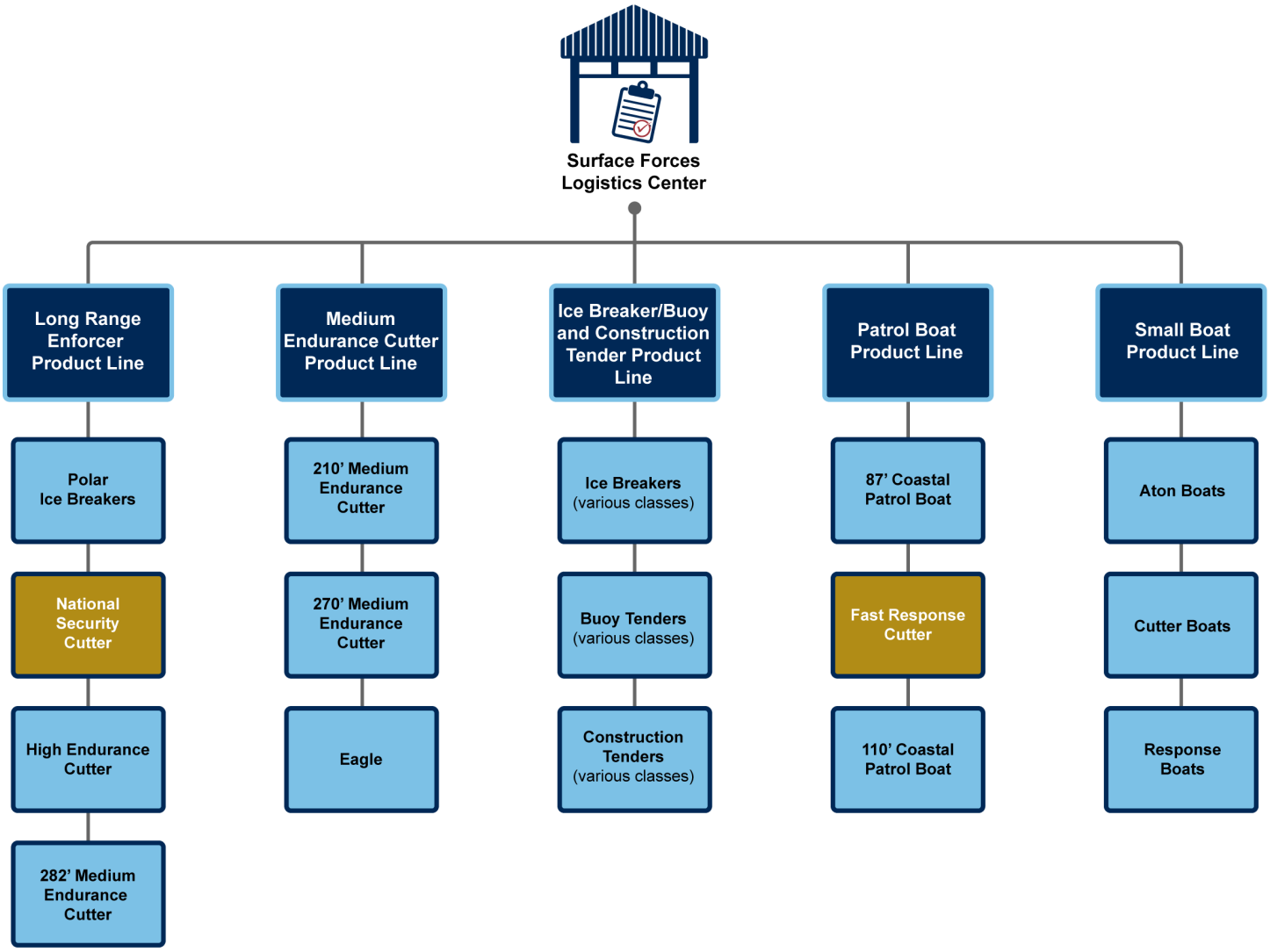
In order to optimize the cutter fleet's mission availability and decrease ownership costs, the Coast Guard employs Reliability Centered Maintenance (RCM), a process used to determine maintenance needs and ensure that maintenance is applicable and effective. RCM is at the center of the Coast Guard's maintenance philosophy and guides maintenance decisions, determining scheduling and resource requirements. The RCM analysis, which is initiated during the program's acquisition phase, is unique to each cutter class and is used to determine preventative maintenance requirements by identifying the likely functional failures of hardware and the failures' impacts. Maintenance procedure cards, which provide detailed instructions on how to complete each maintenance task, including the expected amount of time the task will take to complete as well as the needed tools and parts, are one outcome of the RCM analysis.

The Coast Guard employs a bi-level maintenance strategy to meet the preventative maintenance requirements derived from the RCM analysis. Tasks are separated into either organizational-level maintenance or depot-level maintenance.

- **Organizational-level maintenance:** Maintenance that is performed by the operating units—i.e., the cutter crews. The Coast Guard assigns maintenance requirements at the operating unit level only if it has been determined that the task is within the ability of the crew to complete, taking into account additional demands such as training, and the availability of tools onboard to complete the assigned task.
- **Depot-level maintenance:** Maintenance that is beyond the capability of the crew, including changes and modifications to the cutters deemed too extensive to be performed by the crew.

The Surface Forces Logistics Center (SFLC), in Baltimore, MD, is responsible for completing the RCM analysis and determining the responsibility of maintenance tasks for the boats and cutters, including the FRC and NSC, in sustainment. In addition, SFLC is responsible for managing the supply of spare parts and developing maintenance schedules for each fleet. SFLC is divided into five distinct product lines, each of which acts as the point of contact for various maintenance needs of the Coast Guard fleets. Figure 1 shows the organizational structure of SFLC.

Figure 1: Organizational Structure of the Coast Guard's Surface Forces Logistics Center



Source: GAO presentation of Coast Guard data. | GAO-17-218

The product lines were created after SFLC was established in 2009 to optimize the technical, logistical, and depot-level maintenance support for surface assets. Each product line is intended to provide complete naval engineering and logistics support for all assigned surface assets. In order to plan for the individual maintenance needs of each cutter, SFLC generates and maintains a 5-year maintenance plan for each asset class depicting the major depot-level maintenance tasks. Each year, SFLC updates each cutter's 5-year maintenance schedule to formulate short-

and long-term budgets, project shortfalls, and interface with operational commanders for scheduling purposes. Appendix IV shows the timeline of scheduled major maintenance events for the NSC and FRC.

The Coast Guard also performs unplanned maintenance, which occurs largely as a result of equipment failures, and is corrective in nature. Unplanned maintenance is performed as necessary by the crew, if possible; dockside by shore technicians; or if the unplanned maintenance is beyond the capabilities of the crew and dockside technicians or requires the cutter to be taken out of the water for repair, the cutter will undergo an emergency dockside or drydock event.

In addition to established maintenance procedures, the Coast Guard has several processes by which it can address problematic equipment systems. One such process is the Engineering Change Process, or design change. This process is governed by a process guide that provides detailed instructions on how the Coast Guard should initiate and implement an engineering design change. The Engineering Change Process is the vehicle for implementing changes to assets across the fleet to improve operational capabilities and increase supportability. This process is intended to facilitate configuration control of systems and equipment on all surface assets in an effort to reduce total operating cost over the life of the asset class. The Engineering Change Process includes numerous reviews of relevant product designs, budgets, and procedures and facilitates the delivery of engineering and/or logistics actions to the field.

Mission Capable Rates for Cutters

The Coast Guard uses the Electronic Asset Logbook (EAL) program to record all maintenance and operational activities for surface assets, such as the FRC and NSC, among others. EAL records and tracks equipment failures and mission capable statuses, and is updated in real time by cutter crews to allow for total asset visibility across a cutter class. The EAL process is governed by a process guide that provides detailed instructions to product lines and cutter crews to ensure the EAL system is used uniformly across the fleets. The EAL program provides the product

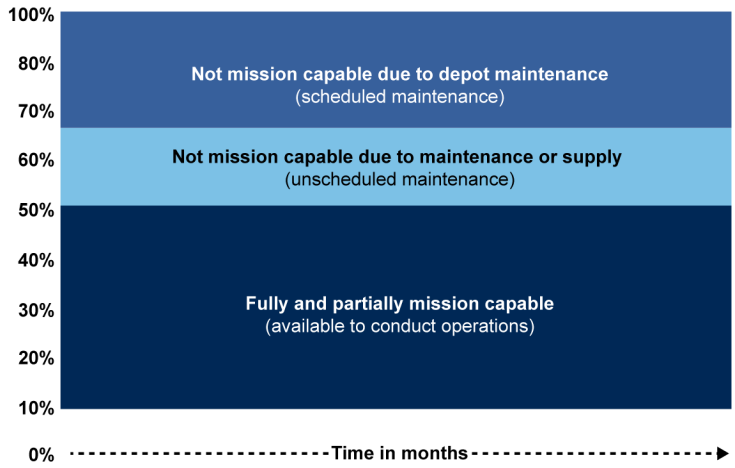
lines insight into the percentage of time each cutter is capable of conducting missions by using five ratings:[9]

- fully mission capable,
- partially mission capable,
- not mission capable due to maintenance,
- not mission capable due to supply, and
- not mission capable due to depot maintenance.

Each cutter class has an acceptable target range for the percentage of time that the Coast Guard expects the asset to be mission capable. The target ranges are determined during the acquisition phase for each fleet using the Coast Guard's employment standards, which dictate the limits for Days Away From Home Port and operational hours as well as the minimum number of depot-level maintenance time needed per year. Figure 2 depicts a notional visualization as to how asset status data is used to assess the health of the fleet from an engineering perspective.

[9]The Coast Guard plans to release revised guidance for designating not mission capable statuses in May 2017 seeking to add fidelity by ensuring that when a cutter is placed into a not mission capable status due to either maintenance or depot-level maintenance that maintenance is actively being performed on the cutter. Prior guidance required cutter crews to enter depot-level maintenance status any time they are not scheduled to be performing operations. This alteration in data entry may impact mission capable rates in the future, but the magnitude of this impact is not yet known. This updated guidance includes a sixth mission capable rating titled "not mission capable due to layup." During our review, the Coast Guard only used the five ratings mentioned above.

Figure 2: Notional Depiction of the Coast Guard's Asset Status



Source: GAO presentation of Coast Guard data. | GAO-17-218

The FRCs are expected to be mission capable 48 to 60 percent of the time, while the NSCs are expected to be mission capable 49 to 61 percent of the time. In order to be considered fully mission capable, the cutter must be able to support all of its assigned missions. In order to be considered partially mission capable, the cutter must be able to effectively execute some of its assigned missions, but be unable to fully respond to at least one assigned mission due to an equipment system failure. Taken together, the fully mission capable status and the partially mission capable statuses comprise the cutter's mission capable rate.

Influencing the mission capable rates are the three "not mission capable" statuses. A cutter is considered not mission capable due to maintenance if it has an equipment failure that requires the cutter to return to port for maintenance during the period that the cutter was originally scheduled to be conducting operations. Once the source of the equipment failure has been determined and if the Coast Guard has to wait for a spare part, the cutter will be placed into the not mission capable due to supply status until the spare part is received and the correction can be implemented. The cutter will be placed in not mission capable due to depot-level maintenance status if the cutter is unavailable to conduct operations due to planned depot maintenance (i.e., non crew conducted maintenance). This can include conducting both anticipated and unanticipated maintenance.

A Warranty or Guaranty Can Affect Program Costs

Warranties and guarantees are contract mechanisms to address the correction of shipbuilder-responsible defects, but they differ in key ways. Warranty provisions are outlined in the Federal Acquisition Regulation and were used for the FRC, whereas the Navy typically uses guaranty provisions, as did the Coast Guard for the NSC contract.[10] We reported on the differences of the FRC's warranty and the NSC's guaranty in March 2016 and found that the FRC's warranty resulted in improved cost and quality by requiring the shipbuilder to pay to repair defects. In contrast, guarantees—such as that for the NSC—did not help improve the cost or quality outcomes of shipbuilding and the government generally paid the shipbuilder to correct problems.[11] Table 1 outlines the differences between a warranty and a guaranty.

Table 1: Differences between a Warranty and a Guaranty

	Warranty	Guaranty
Description	Used to correct shipbuilder-responsible defects after delivery, usually at the shipbuilder's expense.	Used to correct shipbuilder-responsible defects after delivery, but the responsibility for paying for these corrections varies depending on contract terms.
Length	Limited to a specific period of time—typically 12 months.	Limited to a specific period of time, which generally ranges from 8 to 12 months.
Liability limitations	Typically has no cost limits on the shipbuilder's financial responsibility for correcting defect claims.	Uses a limitation of liability: the shipbuilder is not necessary financially responsible for costs associated with the work. Once an agreed-upon threshold is reached, the shipbuilder is no longer contractually obligated to perform additional work to correct any additional defects, even if the ship is still within the guaranty period.

Source: GAO analysis of the Federal Acquisition Regulation and Coast Guard data. | GAO-17-218

[10]The NSC contract uses the term warranty to describe its mechanism, but given that it functions more like a Navy's guaranty, we refer to the NSC's mechanism as a guaranty, rather than a warranty. See also GAO, *Navy and Coast Guard Shipbuilding: Navy Should Reconsider Approach to Warranties for Correcting Construction Defects,* GAO-16-71 (Washington, D.C.: Mar. 3, 2016).

[11]GAO-16-71.

Depot-Level Maintenance Is Lowering the Mission Capable Rates of the Fast Response Cutter and National Security Cutter

Over the past few years, when the FRC and NSC began using their current mission capable metrics, they have both met their minimum targets on average. However, from October 2015 to September 2016, both cutters fell below their minimum targets due to depot-level maintenance. During this time frame, the FRC program began a phased drydock maintenance period for the first 13 cutters, which is primarily intended to address problems with equipment systems still covered by its 12-month warranty. From January 2016 to November 2019, at least one FRC will be completely unavailable to conduct missions at any given time. For the NSCs, an approximate 2-year post-delivery maintenance period is affecting mission capable rates. During this period, the NSCs undergo a series of depot-level maintenance events and system upgrades to bring the cutter to full operational capability, but will limit their ability to conduct missions. Since the Coast Guard will be receiving NSCs until at least the end of year 2020, these post-delivery maintenance periods are expected to affect the NSC's mission capable rates until at least the end of year 2022. In addition, both the FRC and NSC have experienced numerous equipment problems that have hindered operations, but these have not substantially lowered the average fleet mission capable rates.

FRCs Are Meeting Minimum Mission Capable Rates on Average, but Recent Unanticipated Warranty Depot-Level Maintenance Is Affecting Mission Capable Rates

Since March 2012, when the Coast Guard began tracking this metric for the FRC, the cutters have met their minimum mission capable target rate (48 percent), on average. However, from October 2015 to September 2016, the cutters have demonstrated an average mission capable rate below the minimum target. According to Coast Guard officials, this is primarily because of an increase in the amount of time the first 13 cutters are spending in depot maintenance for warranty drydock work, which has reduced the FRC's ability to conduct operations. Table 2 shows the asset status for the FRCs from March 2012 to September 2016.

Table 2: Fast Response Cutter's Average Asset Status from March 2012 to September 2016

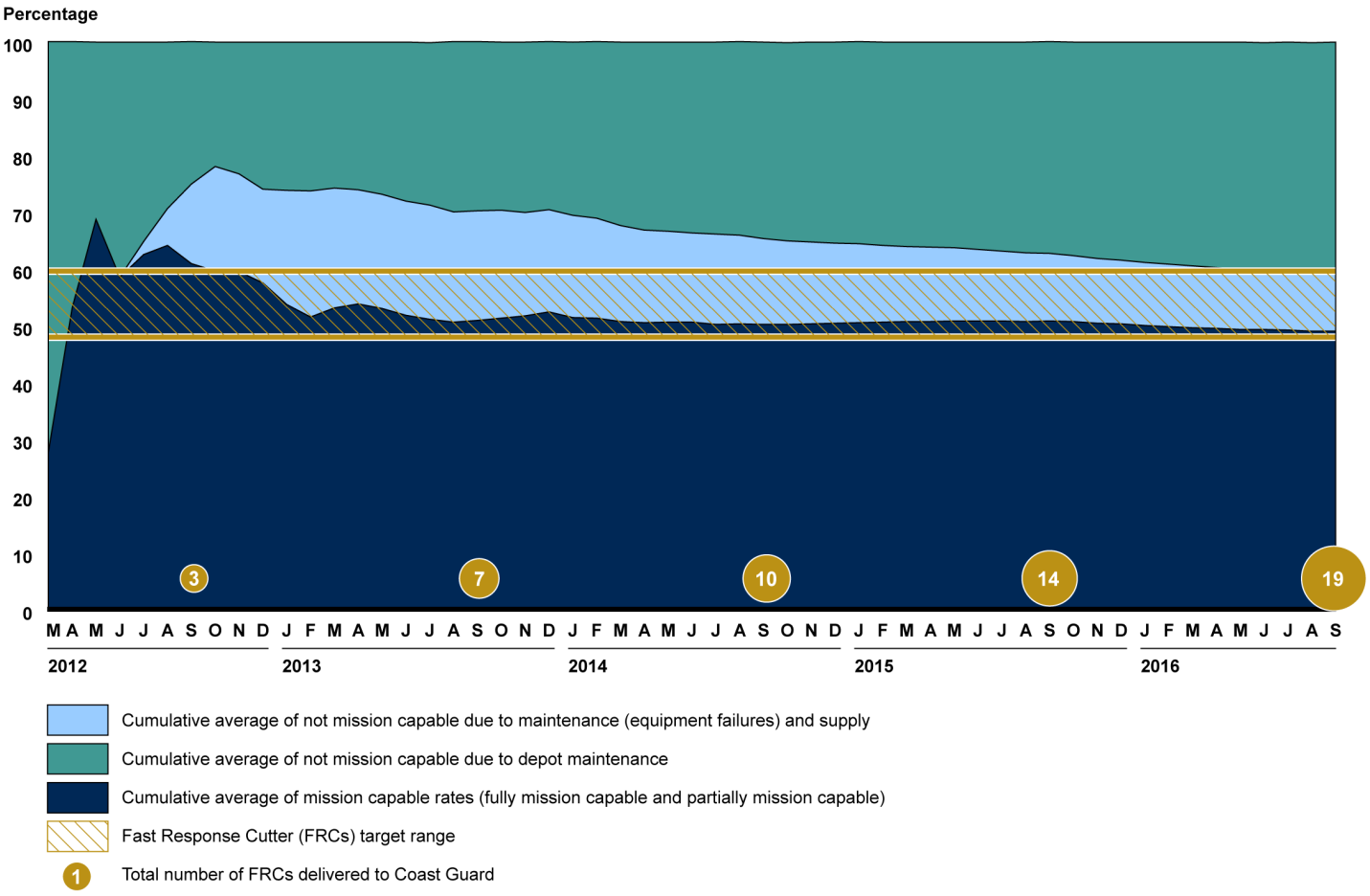
Asset status	Percent of time in asset status March 2012 – September 2016	Percent of time in asset status October 2015 – September 2016
Fully mission capable	47	39.5
Partially mission capable	2.3	3.3
Total mission capable	**49.3**	**42.8**
Not mission capable due to maintenance (equipment failures)	9.9	4.1
Not mission capable due to supply	0.3	0.1
Not mission capable due to depot-level maintenance	40.5	53.0
Total not mission capable	**50.7**	**57.2**

Source: GAO analysis of Coast Guard data. | GAO-17-218

The FRCs Have Met Their Minimum Mission Capable Rate on Average Since 2012

According to Coast Guard data, from March 2012 to September 2016, the FRC fleet had a cumulative average mission capable rating of 49.3 percent, just above the minimum goal of 48 percent. See figure 3.

Figure 3: Fast Response Cutter's Cumulative Mission Capable Rates from March 2012 to September 2016



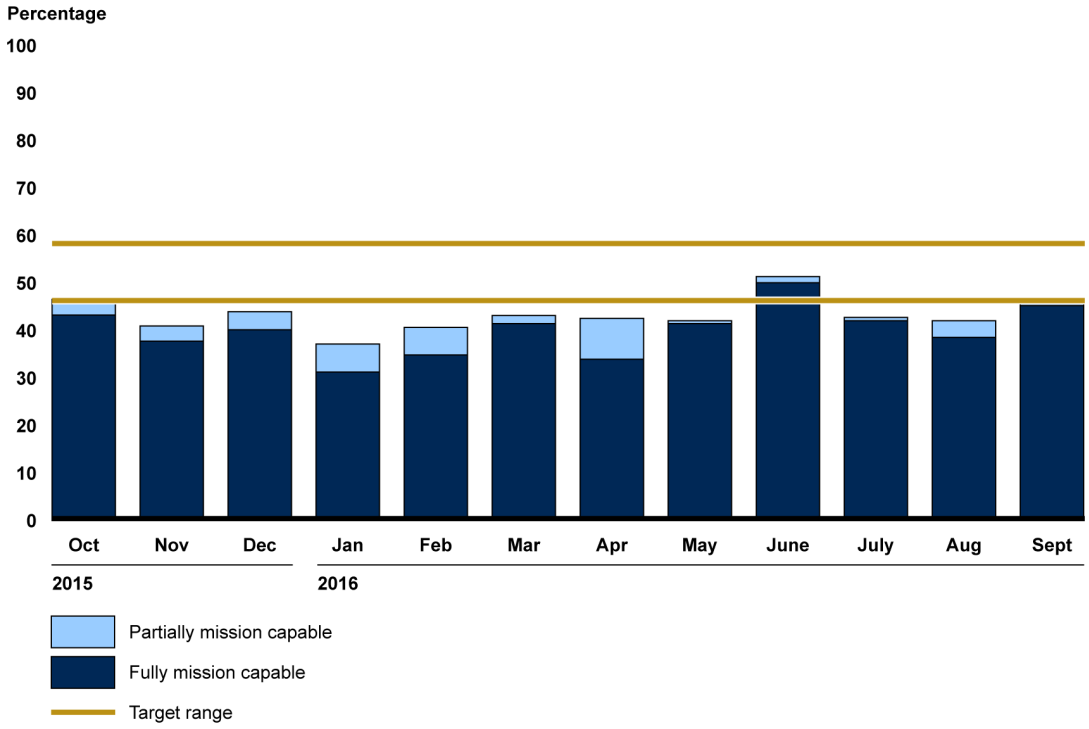
Source: GAO analysis of Coast Guard data. | GAO-17-218

A cutter is deemed mission capable if it operates in either a fully mission capable or partially mission capable status. The FRCs have operated in a partially mission capable status 2.3 percent of the time since March 2012. This is at least partially due to the short duration of the FRC's patrol schedule of roughly 5 to 7 days at sea and the capabilities of the cutter. Additionally, the smaller size of the FRCs as compared to the NSCs limits both the crew size and capabilities aboard the cutter making it less likely that the FRC will be able to meet the criteria for partially mission capable, which is the ability to fulfill at least one of its designated missions. For example, the FRC holds one cutter boat, and Coast Guard safe-to-sail equipment requirements dictate that this cutter boat must be operational or the FRC is deemed not mission capable.

Recent Unanticipated Depot-Level Maintenance Is Causing FRC Mission Capable Rates to Fall below Target

While the cumulative average monthly mission capable rate for the FRC is above the target since March 2012, when we eliminated prior years and analyzed the FRC's cumulative average monthly mission capable rate over a more recent time period—October 2015 to September 2016—we found that the average mission capable rate was 42.8 percent, which is below its minimum target (48 percent). This lower rate can be attributed to increased time spent in depot-level maintenance. Figure 4 shows the monthly mission capable rates for the FRC from October 2015 to September 2016 as well as the Coast Guard's target range.

Figure 4: Monthly Mission Capable Rates for the Fast Response Cutter from October 2015 to September 2016



Source: GAO presentation of Coast Guard data. | GAO-17-218

According to Coast Guard officials, the decrease in monthly mission capable rates below the minimum target is primarily because of a phased warranty repair drydock period that was not initially anticipated. These warranty repair drydocks, affecting cutters 1 through 13, began in January 2016 and are scheduled to conclude in November 2019. The average drydock period will last approximately 15 weeks, with at least one FRC not mission capable due to depot-level maintenance at all times from January 2016 to November 2019. Coast Guard officials stated that while

these warranty repair drydock periods are scheduled in advance, the repairs were not anticipated when the planned major maintenance schedule was first established for the fleet during the acquisition process. Instead, these drydocks were triggered by continuing structural and equipment problems installed during production, including unreliable connectors that provide the structural integrity of the cutter and continued failures with the main diesel engine. The FRCs will undergo repairs on systems that are still covered by the FRC's warranty and remain the financial responsibility of the shipbuilder, Bollinger Shipyards. According to the FRC's contracting officer, Bollinger Shipyards and the FRC program decided to schedule these drydock periods in order to complete several warranty items at one time for each of the 13 cutters. Given that only a few FRCs have completed the warranty drydock to date, it is difficult to determine whether the overall fleet's mission capable rate will meet its target range once the drydocks are completed.

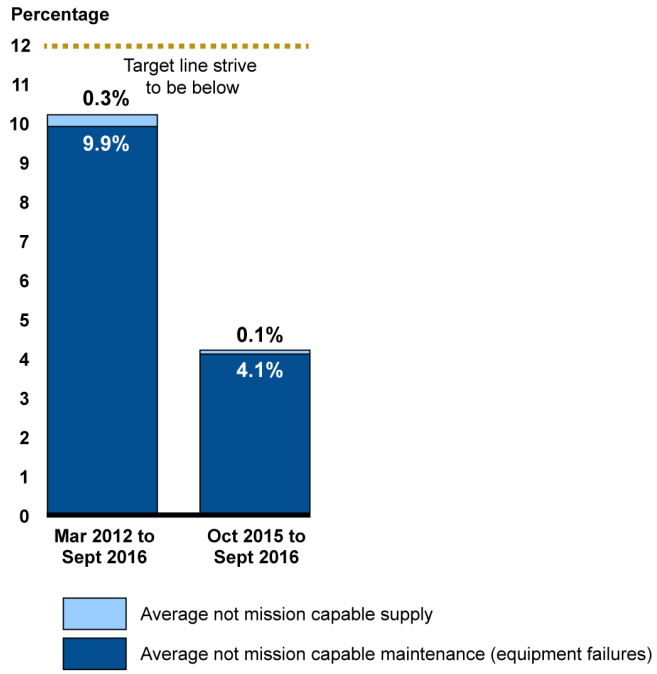
Additionally, Coast Guard officials said that they negotiated an agreement with Bollinger Shipyards to allow the Coast Guard to conduct routine maintenance during these warranty repair drydocks at the Coast Guard's expense.[12] This routine maintenance includes, for example, a main diesel engine overhaul that is scheduled to occur roughly every 6,000 operational hours. According to Coast Guard officials, the Coast Guard plans to complete this overhaul even though, as of July 2016, the engines have yet to be accepted as contractually compliant. Coast Guard officials explained that routine preventative maintenance on warranty covered systems, such as the main diesel engine overhaul, is the responsibility of the Coast Guard so as to not void the FRC's warranty.

Equipment Failures and Difficulties Obtaining Spare Parts Are Minimally Impacting Mission Capable Rates

The time spent correcting equipment failures and awaiting spare parts has been minimal and, unlike depot maintenance, has not significantly affected the FRC's mission capable rate. The FRC's not mission capable rates due to maintenance (equipment failures) and supply have been below the Coast Guard's target of no more than 12 percent on average since March 2012. Figure 5 shows the average rates for these not mission capable rates from March 2012 to September 2016 as well as a breakout of the last year of this time frame.

[12]The Coast Guard estimates that it has avoided about $13 million in potential costs by combining Coast Guard responsible maintenance with the warranty drydock period, which is mostly due to the shipbuilder paying to drydock the cutters for the warranty work.

Figure 5: Fast Response Cutter's Average Rates for Not Mission Capable Due to Maintenance and Supply from March 2012 to September 2016 and October 2015 to September 2016



Source: GAO analysis of Coast Guard data. | GAO-17-218

The Coast Guard has managed its not mission capable rates due to maintenance (equipment failures) by utilizing the RCM approach, which includes a failure analysis used to develop the required maintenance list. According to Coast Guard officials, the required maintenance list is updated if directed by the results of a maintenance effectiveness review, which is completed on a rolling basis for each equipment system aboard the cutter. From the required maintenance list, maintenance procedure cards are developed that ensure maintenance is conducted uniformly across the fleet. Regarding not mission capable for supply, Coast Guard officials stated that the industry standard is 5 percent or less. In order to meet the industry standards, Coast Guard officials report using a complex algorithm to determine the appropriate level of inventory for each spare part, which takes into account failure rates, time required to obtain the part, and Navy historical data for similar fleets. In addition to this algorithm, the Coast Guard ensured the parts needed to complete scheduled maintenance were available to the maintainers, which involved packaging all necessary tools and parts for an upcoming scheduled maintenance event on a particular FRC from the central inventory

warehouse at SFLC. These packages, according to Coast Guard officials, were then shipped in advance of the maintenance to the home port of the cutter. Coast Guard officials expect the percentage of time the FRC fleet spends not mission capable due to supply to increase slightly once the warranty expires, as the Coast Guard will have to rely on the commercial market to obtain parts as opposed to these parts being provided by Bollinger Shipyards. Coast Guard officials noted however, that they do not expect this increase to exceed the industry standard of 5 percent.

Equipment Failures Have Resulted in Lost Operational Days for the FRC

The three equipment systems with the most problems from 2014 to 2016 resulted in about 827 combined lost operational days and partially mission capable days for the FRC. [13] These three equipment systems include:

- the main diesel engine,
- the C4ISR system, and
- the ventilation system.

While the not mission capable rates due to maintenance—from equipment failures—and supply are important metrics in understanding the effectiveness of the Coast Guard's maintenance planning, they alone do not convey the complete health of the FRC fleet. As such, the Coast Guard tracks the equipment systems that result in lost operational days for the cutters. Failures associated with the main diesel engine have been particularly problematic. The engine is still covered by the warranty clause for each FRC, but problems resulted in roughly 355 days spent not mission capable due to maintenance. The FRC's contracting officer stated that as of October 2016, all of the 18 operational FRCs have undergone various corrective repairs on their main diesel engines, including replacing engines on 6 of the cutters. While Coast Guard officials report that Bollinger Shipyards has resolved many of the concerns surrounding the main diesel engines, design changes to satisfy unresolved problems are ongoing. One such problem is the harmful buildup of soot in the exhaust while traveling at low speed. Once an acceptable solution has been determined, the new equipment will be retrofitted onto the other FRCs at the shipbuilder's expense. Coast Guard officials have not identified an anticipated timeframe for a solution.

[13]The Coast Guard classifies lost operational days as the number of days in which a cutter was either not mission capable due to an equipment failure or not mission capable due to a lack of spare parts.

In addition to tracking the systems that resulted in lost operational delays, the Coast Guard also solicits feedback annually from each cutter's crew in an engineering report to identify trends in equipment systems that are hindering the cutters while underway. The engineering reports provide a forum for the cutter's commanding officer to provide his or her opinion of the cutter's top equipment issues, overall summary of the cutter's structural condition, and the top human performance problems experienced by the cutter over the preceding 12 months. Officials at the Patrol Boat Product Line review all of the FRC's engineering reports for the fleet to identify trends and to take corrective action where necessary. The Patrol Boat Product Line then consolidates the top 5 equipment concerns noted by the FRC commanding officers and provides a response explaining the corrective actions to be taken or the rationale for inaction.

Our analysis of FRC engineering reports from 2012 through 2015 found that the top three equipment concerns that occurred most frequently were

- a lack of maintenance procedure cards,
- issues with the Machinery Control and Monitoring System, and
- paint and corrosion on board the cutters.

For example, the engineering reports mentioned that inaccurate or incomplete maintenance procedure cards interfered with the crew's ability to complete maintenance as these maintenance procedure cards provide detailed instructions on how to complete maintenance activities for each of the equipment systems. Coast Guard officials noted that inaccuracies found in maintenance procedure cards are largely due to incorrect part numbers for pieces of equipment as these numbers can change, for example, due to obsolescence. According to Coast Guard officials, as of July 2016, 89 percent of the maintenance procedure cards for the FRC have been published and the majority of those unpublished are conditional cards that have not been published because the triggering condition, most likely a system failure, has not yet occurred in order to validate the maintenance procedure cards.

NSCs Are Meeting Minimum Mission Capable Rates on Average, but Post-Delivery Depot-Level Maintenance Period Has Recently Led to a Downward Trend

Similar to the FRCs, the NSCs have met their minimum mission capable target range (49 percent) on average since the Coast Guard began tracking this metric in November of 2013 until September of 2016. However, over the last 12 months of this timeframe, from October 2015 to September 2016, the cutters demonstrated an average mission capable rate below the minimum target. This is primarily due to the increase in depot maintenance associated with post shakedown availabilities on the newly delivered NSCs (*Hamilton* and *James*).[14] See table 3.

Table 3: National Security Cutter's Average Asset Status from November 2013 to September 2016

Asset status	Percentage of time in asset status November 2013 – September 2016	Percentage of time in asset status October 2015 – September 2016
Fully mission capable	31.8	27.2
Partially mission capable	22.4	9.9
Total mission capable rate	**54.2**	**37.2**
Not mission capable due to maintenance (equipment failures)	2.1	2.8
Not mission capable due to supply	0.2	0.1
Not mission capable due to depot-level maintenance	43.4	60
Total not mission capable rate	**45.8**	**62.8**

Source: GAO analysis of Coast Guard data. | GAO-17-218

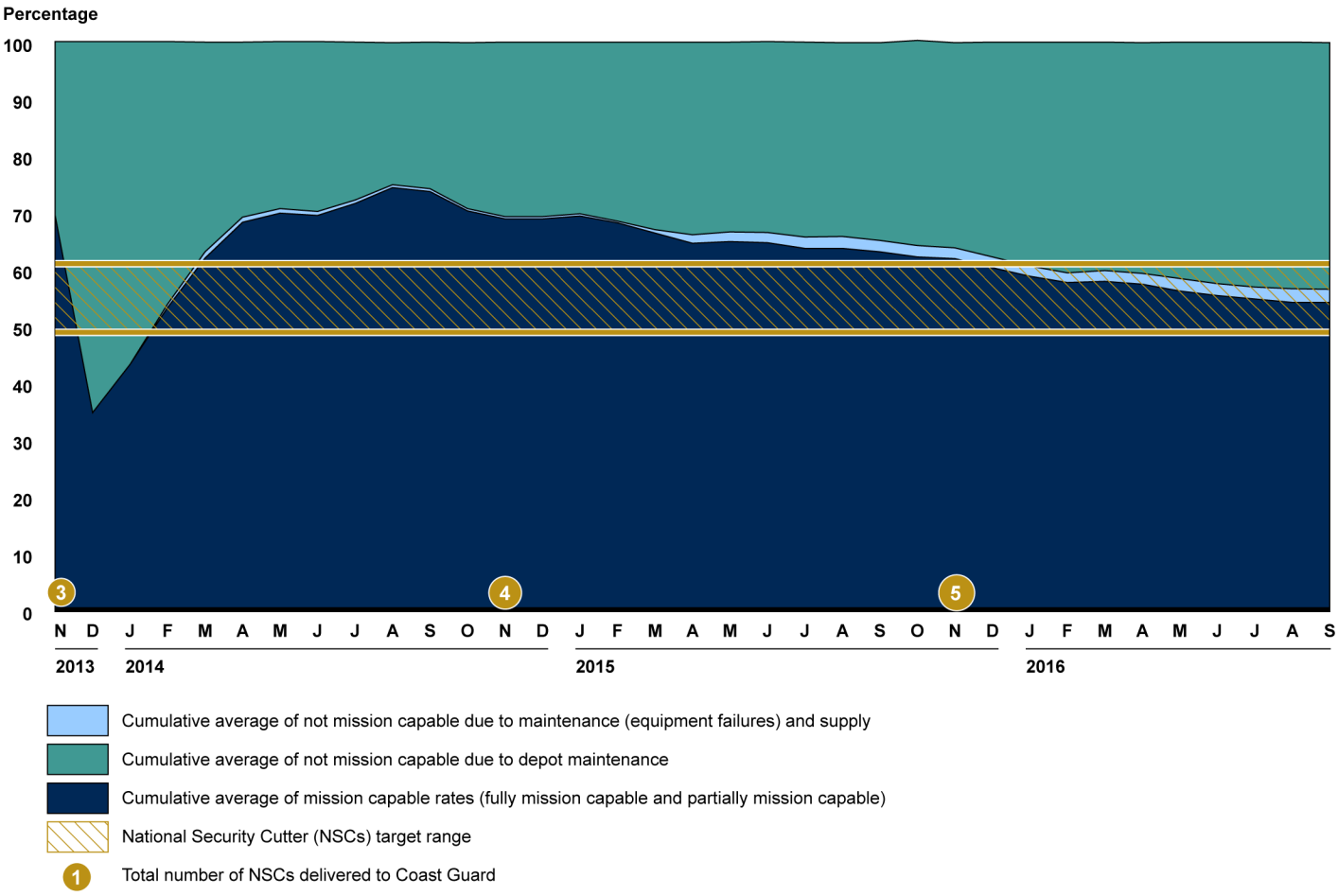
Note: The total percentage may not equal the sum of the individual asset statuses due to rounding.

The NSCs Have Met Their Minimum Mission Capable Rate on Average Since November 2013

According to Coast Guard data, from November 2013 until September 2016, the NSC fleet had a cumulative average mission capable rating of 54.2 percent, above the minimum goal of 49 percent. See figure 6.

[14]The post-delivery shakedown period consists of the planned maintenance where work is performed to install upgrades, perform maintenance, and correct construction deficiencies.

Figure 6: National Security Cutter's Cumulative Mission Capable Rates from November 2013 to September 2016



Source: GAO analysis of Coast Guard data. | GAO-17-218

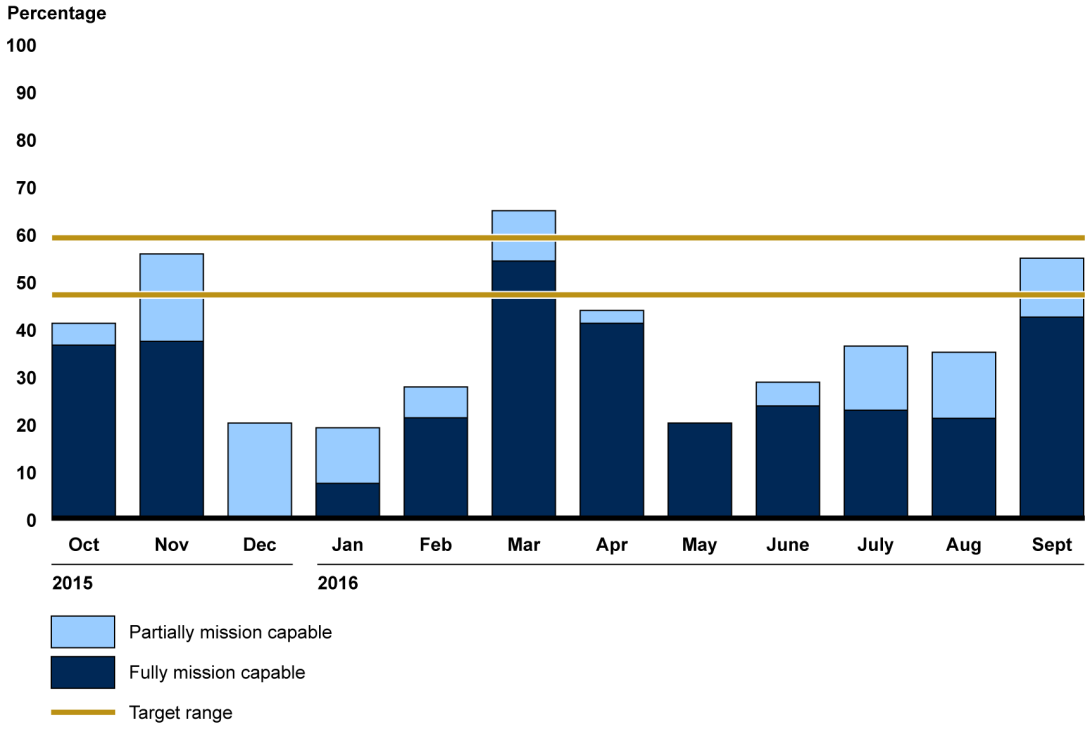
A cutter is deemed mission capable if it operates in either a fully mission capable or partially mission capable status. The NSCs have operated in a partially mission capable status 22.4 percent of the time since November 2013, which is more than the FRC. This is at least partially due to the complexity of the NSC's mission set and operational schedule. For example, the NSC was designed to support 8 of the 11 Coast Guard statutory missions and, if even 1 of the 8 missions is unable to be performed, the NSC will operate under the partially mission capable status. Additionally the NSCs are scheduled for patrols lasting roughly 2 to 3 months in duration as opposed to the FRCs, which are scheduled for patrols lasting about 5 to 7 days, making it much more likely that the NSCs will be conducting missions in a partially mission capable status at

some point during their lengthy patrol. The size of the NSC allows for additional capabilities to be available during patrols. For example, the NSC is equipped with three cutter boats, and known failures with the dual-point davit crane launch system frequently render at least one of the three cutter boats inoperable, causing the NSC to become not fully mission capable. Instead, the NSC becomes partially mission capable as it is able to conduct operations with the remaining two cutter boats.

Recent Anticipated Post Delivery Depot-Level Maintenance Is Reducing the NSC's Mission Capable Rates

While the cumulative average monthly mission capable rate for the NSC is above the target since November 2013, when we eliminated prior years and analyzed the NSC's cumulative average monthly mission capable rate over a more recent time period—October 2015 to September 2016—we found that the NSC's average mission capable rate was 37.2 percent, which is below its minimum target of the range of 49 percent. Figure 7 shows the monthly mission capable rates for the NSC from October 2015 to September 2016.

Figure 7: Monthly Mission Capable Rates for the National Security Cutter from October 2015 to September 2016



Source: GAO presentation of Coast Guard data. | GAO-17-218

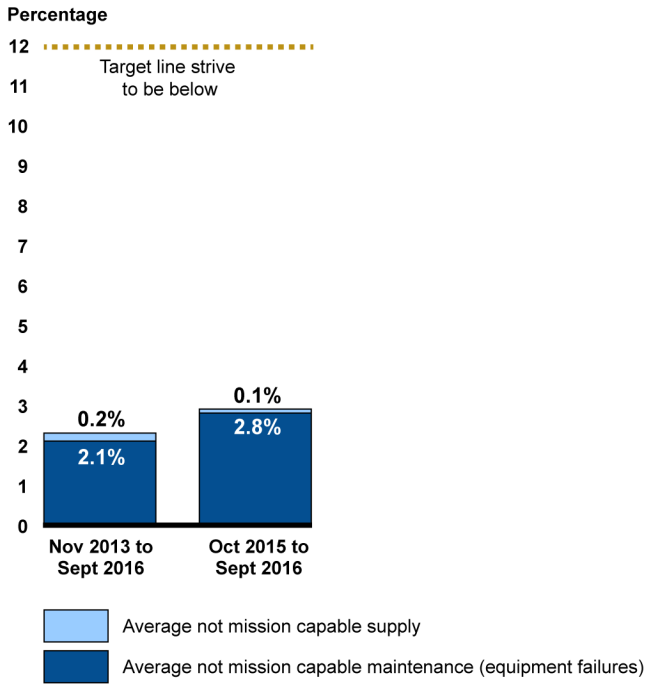
From October 2015 to September 2016, the not mission capable rate due to depot maintenance was 60 percent. While both the FRC's and NSC's inability to meet its mission capable target rate is attributable to the increase in depot-level maintenance, the cause differs. Unlike the FRC's mission capable rates, which are influenced by the warranty repair drydock periods, the NSCs mission capable rates are influenced by the roughly 2-year post-delivery period called the post shakedown availability, which is scheduled for each newly delivered NSC. During this time the cutters will undergo depot-level maintenance and other activities to bring the cutter to full operational capability. Further, whereas the FRC's warranty repair drydock periods were unanticipated, the NSC's shakedown periods were planned during the acquisition phase.

During this shakedown period, the NSC will be rendered not mission capable due to depot-level maintenance for a majority of its time. For example, from January 2015 until September 2016, the *NSC Hamilton* spent 70.9 percent of its time in depot-level maintenance, and the NSC *James* spent 82.6 percent of its time in depot-level maintenance from September 2015 to September 2016. With only five NSCs in operation as of September 2016, having two cutters spend the majority of their time not mission capable due to depot-level maintenance is having a negative effect on the overall fleet's mission capable rates. This will continue as the Coast Guard introduces new NSCs into the fleet and the last cutter completes its 2-year post shakedown period—scheduled for 2022 as the ninth cutter is scheduled for delivery in 2020. While the first three NSCs achieved their mission capable rate targets on average from January 2014 to September 2016, it is uncertain if the overall fleet mission capable rate will increase once all NSCs complete their post shakedown availabilities.

Equipment Failures and Difficulties with Obtaining Spare Parts Have Marginal Effect on NSC Mission Capable Rates

The average time spent correcting equipment failures or waiting for supplies has been below the Coast Guard's target of no more than 12 percent since November 2013. Figure 8 shows the average not mission capable rates due to maintenance— from equipment failures— and supply from November 2013 to September 2016 as well as the last 12 months of this time frame.

Figure 8: National Security Cutter's Average Not Mission Capable Rates Due to Maintenance and Supply from November 2013 to September 2016 and October 2015 to September 2016



Source: GAO analysis of Coast Guard data. | GAO-17-218

From November 2013 to September 2016, the NSC fleet achieved an average not mission capable rate due to maintenance (equipment failures) of 2.1 percent. In the last year of this time frame, the average not mission capable rate due to maintenance (equipment failures) was 2.8 percent. The Coast Guard keeps this metric low by using its RCM analysis and by arranging for the NSC's drydock periods to conduct preventative maintenance based on equipment failure risk. This enables the cutter to receive maintenance that potentially avoids equipment failures while conducting missions. According to the Coast Guard, this is accomplished by performing the drydock in such a way that equipment systems not believed to be in need of repair are included as optional items in the depot maintenance contract. These optional items can be exercised as needed at a previously negotiated fixed price.

The NSC fleet has met the industry standard of less than 5 percent for not mission capable rates due to supply. The Coast Guard employs the same algorithm and pre-positioning of parts as discussed above with regard to

the FRC to meet both its internal and industry standards for not mission capable due to supply rates.

Equipment Failures Have Resulted in Lost Operational Days for the NSC

The three equipment systems with the most problems from 2014 to 2016 resulted in 993 combined lost operational days and partially mission capable days for the NSC over this period of time. These systems include the cutter boat launch and recovery system and the reliability of the ship service diesel generator and the main diesel engine. Unlike the FRC's warranty, the Coast Guard is required to pay a portion of the cost for equipment problems corrected under the NSC's guaranty. Nearly all of these lost operational days resulted from the NSCs operating in a partially mission capable status due to the equipment problems. The cutter boat launch and recovery system, which includes the gantry crane and dual point davit, have rendered the fleet in a partially mission capable status for 278 days from 2014 to 2016.[15] Across the fleet, overheating bearings in the ship service diesel generator have resulted in the crew's inability to use one or more of the generators. According to the Coast Guard policy, the NSC requires at least two (one specific generator and either of the remaining two) of its three generators to be operational in order to conduct missions. The cost to repair this issue is substantial, with each bearing costing roughly $100,000 to resolve.

In addition, the NSCs continue to experience failures associated with the main diesel engines. The main diesel engines used by the NSCs are manufactured by MTU, the same manufacturer responsible for the main diesel engines employed on the FRCs, and have been problematic since the NSC fleet became operational.[16] As we found in January 2016, the engines overheat in waters above 74 degrees Fahrenheit, which constitutes a portion of the NSC's operating area given that they are intended to be deployed worldwide.[17] This can cause the cutters to operate 2 to 4 knots below their top speed of 28 knots, which could hinder the cutter in successfully conducting operations. The NSC's inability to achieve top speed in warm waters has inhibited the cutters' ability to complete their regularly scheduled full power trials, which are periodic

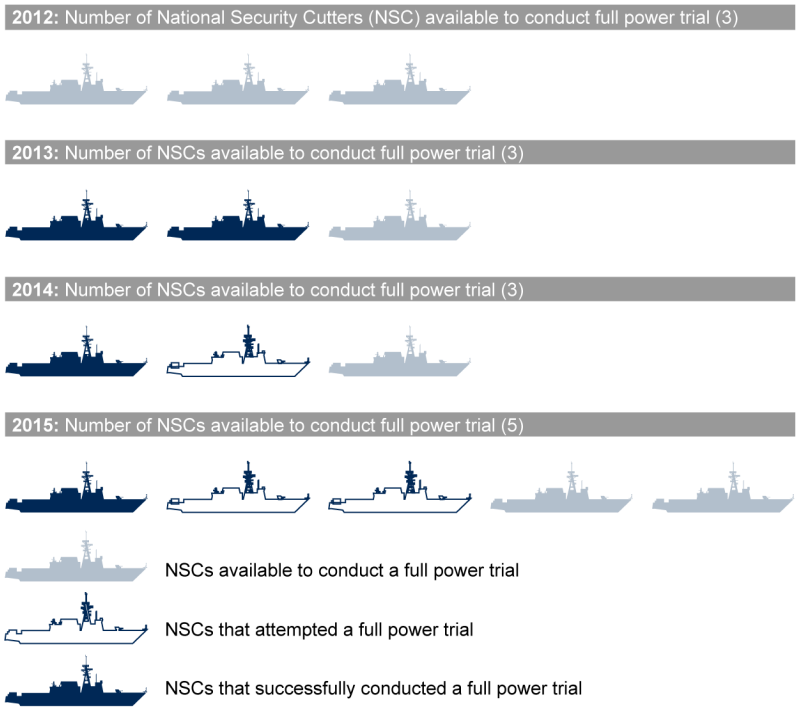
[15]The gantry crane is a crane on the rear of the cutter that aides in deploying the NSC's cutter boat. The dual point davit is used to lift cutter boats for launch and recovery from the side of the cutter.

[16]MTU is a German based manufacturing company that the shipbuilders contracted with to produce the diesel engines on the NSC and FRC.

[17]GAO-16-148.

tests of the propulsion plant operated at maximum rated power. Figure 9 depicts the number of attempted and successful full power trials conducted by the NSCs from 2012 to 2015.

Figure 9: National Security Cutters' Attempted and Successful Full Power Trials from 2012 to 2015



Source: GAO analysis of Coast Guard data. | GAO-17-218

Note: The full power trial is a periodic test of the cutter's propulsion plant operated at maximum rated power.

The full power trial results advise operating and maintenance personnel of the cutter's full power performance characteristics and the results can provide the basis for maintenance activity.[18] From 2012 to 2015, the operational NSCs conducted 7 full power trials out of 14 total possible tests. Of those 7 tests, 4 were considered successful. In order for a full power trial to be considered successful, the cutter must complete the trial requirements, which include testing at a specific engine speed and minimum water depth, while not exceeding design pressures,

[18]The full power trials are annual tests of a cutter's propulsion system.

temperature, and other operating parameters. Performance issues or equipment failures with the propulsion system were listed as the most frequent cause for not conducting the full power trial or for unsuccessful tests.

We previously recommended in January 2016 that the Department of Homeland Security (DHS) conduct an acquisition review board once the Coast Guard concludes a root cause analysis on both the main diesel engines and the generators.[19] DHS concurred with this recommendation and plans to hold an acquisition review board no later than December 2017. In an attempt to resolve the continued propulsion plant problems, DHS issued an Acquisition Decision Memorandum to the Coast Guard in April 2016 directing, among other actions, that the Coast Guard conduct a propulsion study to develop a permanent solution to the main diesel engine failures by December 2017. The Coast Guard has a propulsion study underway with MTU America, Inc. that is on track to meet the Acquisition Decision Memorandum's deadline according to program officials.

Pending the completion of the propulsion study and identification of corrective actions, the Coast Guard issued an engineering advisory to the NSCs in January 2016 in an effort to ensure the main diesel engine service life expectations are met, improve the engine's operational reliability, maximize the engine's performance, and minimize the engine's maintenance costs. This advisory provides actionable steps the NSC crews can take while underway to achieve the aforementioned goals, such as to ensure the quality of the lubricating oil used and monitored regularly, to use harbor mode—which only engages one of the two diesel engines when operating below 10 knots—and to minimize engine idle time, to name a few. The Coast Guard is also in the process of developing prototype components to address issues with the main diesel engine in advance of the completion of the propulsion study.

Similar to the FRC, the Coast Guard also solicits feedback annually from each NSC's crew in an engineering report to identify trends in equipment systems that are hindering the cutters while underway. Officials at the Long Range Enforcer Product Line review all of the engineering reports for the NSC fleet to identify any trends and to take corrective action where necessary. This product line then provides a response to each of the

[19]GAO-16-148.

commanding officers' equipment concerns explaining the corrective actions to be taken or the rationale for inaction. The top three equipment problems that occurred most frequently in the NSC's engineering reports from 2012 to 2015 are the Auxiliary Seawater System (ASW), the propulsion plant reliability, and the stern doors/gantry crane. For example, issues with the ASW included piping failures, ill-fitting valves, and corrosion. To address these issues, the Coast Guard has begun an engineering design change to reduce the flow rate throughout the ASW system that it plans to implement in three phases due to the dispersed nature of the system throughout the cutter.

The Coast Guard Is Addressing Some Maintenance Problems through Engineering Design Changes, but Has Not Documented Key Cost Analysis

During operations and testing, the FRC and NSC have experienced problems that require engineering design changes or repairs. Some of these design changes are being implemented to correct issues discovered during testing, while others are being conducted to make systems less maintenance-intensive or to increase the reliability of the systems. The FRC program has identified several design changes that it is installing on the cutters at the expense of the Coast Guard. The FRC's warranty is also covering several repairs, which the FRC's contracting officer stated avoided at least $77 million in potential maintenance costs. Replacing the FRC's engines, which contributed to the cutter's lost operational days, represented about $52 million of the costs avoided. The NSC program is also implementing several design changes, the cost of which is the Coast Guard's responsibility. The estimated cost for the NSC design changes has increased $57.6 million since January 2016. In addition, at least three design changes on the NSC are being conducted post-delivery for all nine NSCs, meaning that the Coast Guard will have to spend time and money conducting maintenance on systems with known defects until the cutters are retrofitted. Further, the cost analysis supporting the decision to install these three design changes post-delivery was not documented, which entails risk that the Coast Guard may not be choosing the most cost effective path forward.

The FRCs Are Undergoing Several Design Changes and Several Repairs Covered by Warranty

The Coast Guard has encountered several issues on systems aboard the FRC that were discovered during operations and testing and require design changes and retrofits to correct. Some of these design changes are being conducted during the FRC's ongoing warranty repair drydock. According to Coast Guard documentation, the Coast Guard is responsible for paying for these design changes as they are outside the scope of the program's warranty. Table 4 shows the list of design changes for the FRC valued at $1 million or greater.

Table 4: Fast Response Cutter Design Changes with Estimated Costs over $1 Million as of September 2016

Retrofits and design changes	Estimated cost (dollars in millions)
Structural enhancements	6.9
Rudder replacement	5.9
Watertight door replacement	1.8
Escape kick out panels	1.3
Anchor redesign	1.1
Total cost	**17.0**

Source: GAO analysis of Coast Guard data. | GAO-17-218

The cost for some of these design changes, such as the structural enhancements, has already been incurred, while other design changes have only recently begun to be incurred. According to program officials, the structural enhancements were identified early in the production of the FRCs during a review of the standards that were used to build the cutter, which resulted in the Coast Guard increasing the strength of the hull by installing extra supports to ensure its safety.[20] These enhancements were retrofitted on the first seven FRCs and were then included in production beginning with the eighth FRC. The rudder replacement is intended to reduce fuel consumption, reduce paint failures, and lengthen the part's lifespan, which will reduce sustainment costs. This design change is planned to be retrofitted on the first 20 FRCs and then incorporated into production with subsequent cutters.

In addition to the design changes listed above, repairs are being conducted on the FRC that are covered by the program's warranty and are being performed at no additional cost to the Coast Guard. According to the FRC's contracting officer, as of August 2016 the FRC's warranty has avoided about $77 million in potential maintenance costs for the Coast Guard. Table 5 shows the systems on the FRC that have been repaired or replaced under the warranty at no additional cost to the Coast Guard.

[20]The Coast Guard used the American Bureau of Shipbuilding (ABS) Guide for Building and Classing High Speed Naval Craft 2007 for the design, construction, and classification of the FRC. However, the Coast Guard is not maintaining the FRCs according to ABS standards. The NSC was not built using ABS standards.

Table 5: Coast Guard Reported Costs Avoided Due to Fast Response Cutter Warranty as of August 2016

Fast Response Cutter's major warranty items	Number of replaced systems[a]	Coast Guard's estimate of total cost avoidance due to warranty (dollars in millions)
Main diesel engines	20	51.8
Exhaust manifold assembly	32	9.6
Automatic oil filter assembly	32	6.4
Reduction gears	8	5.6
High pressure relief valve modification	32	3.2
Fuel oil injectors	230	0.5
Total cost		**77.0**

Source: GAO presentation of Coast Guard data. | GAO-17-218

Note: The total cost may not equal the total amount of the individual warranty items when added together due to rounding.

[a]This includes a mixture of systems replaced on cutters and replaced spares.

As was mentioned previously, issues with the FRC's main diesel engines were one of the systems that led to the most lost operational days. This problem was first reported in the cutter's Initial Operational Test and Evaluation report in July 2013. The Navy's Commander of Operational Test and Evaluation Force, which serves as the Coast Guard's independent test agent, found multiple problems with the main diesel engines that resulted in 275 lost operational hours during the test event. These problems have continued, with a total of 20 diesel engines being replaced as of August 2016. Most recently, the diesel engines were replaced on the *Joseph Tezanos* (the 18th FRC) and the *Benjamin Dailey* (the 23rd FRC) in May 2016 during production, indicating that the problems with the diesel engines are ongoing. Additionally, the problems with the diesel engines have varied widely, making it difficult and time-consuming for MTU and the Coast Guard to identify a definitive root cause that could solve the issues fleet-wide. Most issues have required fleet-wide retrofits, which can reduce the cutters' mission capable rates due to the increased depot maintenance work required to install corrections. According to Coast Guard officials, the FRC contracting team holds monthly meetings with MTU to review the corrective actions and hold this manufacturer accountable. The program estimates that 60 percent of the current problems have been resolved with retrofits complete. However, the variation in the issues experienced thus far make it difficult for the Coast Guard to predict future failures, and the problem may continue to affect the operational availability of the FRC.

The Coast Guard Is Conducting Design Changes on the NSC, but Not All Design Changes Will Be Incorporated during Production

The NSC is also undergoing several design changes for issues discovered during operations and testing, including those that require additional maintenance above what was expected. The total cost of these changes has increased $57.6 million from the amount we found in January 2016, for a total of almost $260 million.[21] Program officials attributed the increase to the revised cost of structural enhancements on NSCs 1 and 2 based on actual contract values and the addition of the ninth NSC. Table 6 shows the list of design changes for the NSC estimated to cost at least $1 million.

Table 6: National Security Cutter Design Changes with Costs over $1 Million as of September 2016

Design changes	January 2016 estimated costs (in millions)	September 2016 estimated costs (in millions)	Change in estimated costs (in millions)	Percentage cost growth
Structural enhancements	$38.0	$70.6	$32.6	85.8%
C4ISR upgrade[a]	$88.5	$98.3	$9.8	11.1%
Gantry crane replacement	$31.0	$34.9	$3.9	12.6%
Single-point davit replacement	$12.5	$14.0	$1.5	12.0%
Communications upgrade	$12.3	$13.5	$1.2	9.8%
Upgrade two ammunition hoists	$6.3	$7.0	$0.7	11.1%
Update cutter monitoring system	$6.3	$6.6	$0.3	4.8%
Breathing apparatus replacement	$1.6	$1.8	$0.2	12.5%
Remove Aircraft Ship Integrated Secure and Traverse tracks in flight deck[b]	$5.6	$5.6	$0.0	0.0%
Diesel engine modifications to address high engine temperatures	n/a	$3.6	$3.6	n/a
Generator modifications to address overheating bearings	n/a	$2.7	2.7	n/a
Stern ramp boat launch modifications	n/a	$1.1	$1.1	n/a
Total cost	**$202.1**	**$259.7[c]**	**$57.6**	**28.5%**

Source: GAO analysis of Coast Guard data. | GAO-17-218

Note: The Coast Guard reported these numbers for all nine hulls. However, not all retrofit designs are currently being implemented because they have not all been finalized.

[a]C4ISR stands for Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance.

[b]In January 2011, Coast Guard officials canceled the Aircraft Ship Integrated Secure and Traverse—a system intended to automate the procedure to land, lock down, and move the HH-65 helicopter from the deck to the hangar on the National Security Cutter—after significant deficiencies were identified during testing conducted by the U.S. Naval Air Warfare Center. The Coast Guard invested

[21]GAO-16-148.

approximately $27 million to install the system on three National Security Cutters, including putting tracks in the flight deck that were later removed.

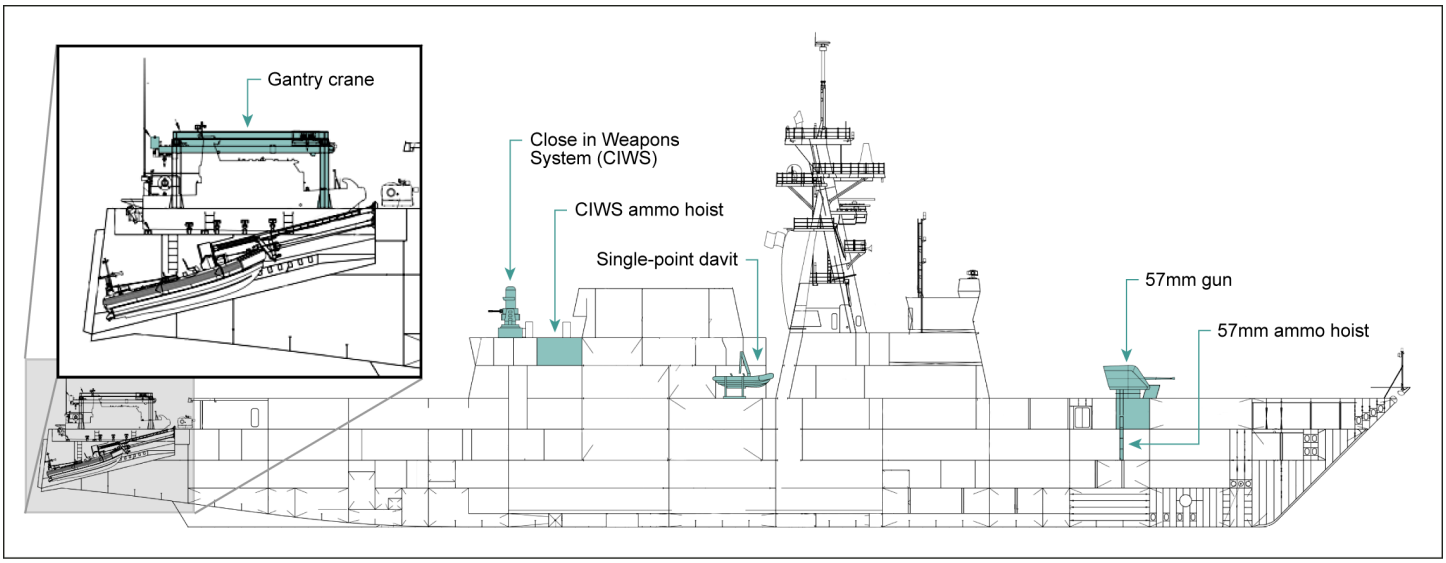
[c]The Coast Guard is using acquisition funding and operations and maintenance funding to pay for these corrections.

The design change with the largest cost increase is the structural enhancements, with a cost estimate of $70.6 million. This involves cutting into large sections of the hull in order to add reinforcing metal so that the first two NSCs are more likely to meet their full 30-year service life. This design change was incorporated into production on the third NSC. The original estimate of $38 million for this work was established in January 2014, and the Coast Guard awarded the contract in February 2016. The current contract value of over $70 million represents a cost increase of about 86 percent from the original estimate. According to NSC program officials, the large cost increase is due to a better understanding of the work that would be required to complete this effort, such as the costs associated with getting the cutter into a drydock, removing sensitive equipment, and the technical complexity of the task. They also stated that the contractor factored risk into its bid for completing this technically difficult work. In order to complete this work, the Coast Guard will place the first two NCSs in a not mission capable due to depot maintenance status for at least 11 months each to correct structural deficiencies.[22] The Coast Guard plans to conduct additional design changes, such as the gantry crane and single-point davit replacements, during this period as well to save money.

In order to minimize the cost increase for some of these design changes and to adhere to their production schedule, the Coast Guard plans to maintain the original equipment during production for all NSCs and then later conduct retrofits after accepting delivery of the cutters. This means that systems with known defects or deficiencies will be installed during production only to be replaced later, requiring maintenance on some of these systems until the retrofits are complete. Figure 10 shows selected systems that will require retrofits after all nine cutters are built.

[22]The Coast Guard plans to place the first two NSCs in not mission capable due to layup status during the structural enhancement work. This is a new mission capable status that will be introduced with the updated EAL guidance, which the Coast Guard plans to issue in May 2017. Not mission capable due to layup means that the asset is laid up in temporary storage or a cutter is in an extended depot maintenance period.

Figure 10: Selected National Security Cutter Systems Requiring Retrofitting after Production



Source: GAO presentation and analysis of U.S. Coast Guard data. | GAO-17-218

The following equipment will be included on the cutters currently being built or under contract and later removed or upgraded:

- **Gantry Crane Replacement:** The gantry crane was not designed for a maritime environment and is inadequately sealed to prevent water intrusion, leading to accelerated corrosion and the need for excessive repairs that are not considered sustainable over the NSC's life cycle. Post-operational reports stated that the gantry crane requires hundreds of man-hours to keep it operational. This design change was initiated in January 2010 and, according to Coast Guard officials, the new crane system has been successfully prototyped on the *Stratton* and has been approved for fleet-wide replacement. However, all of the remaining NSCs to be produced will be built with the gantry crane installed and will then have it removed during their post-shakedown periods when the new crane system will be installed. Problems with the gantry crane have plagued the NSC since it began operations and are expected to continue until all cutters have their gantry crane replaced, which is not planned to be completed for several years. The fleet-wide replacement of the gantry crane is

anticipated to cost $34.9 million, which represents a cost increase of about 13 percent since January 2016.

- **Single-Point Davit Replacement:** The single-point davit, which is used to lift cutter boats for launch and recovery from the starboard side of the cutters, is unable to reliably lift the cutter boats in high seas. This has caused the crews of the NSC to express concern about the safety of the single-point davit system when operating in higher sea state conditions.[23] All of the NSCs have been or will be delivered from the shipbuilder with the single-point davit system installed, despite this design change being initiated in March 2010. The replacement of the single-point davit will be installed during the remaining cutters' post-shakedown period and is expected to cost the Coast Guard $14.0 million, which includes a cost increase of about 12 percent since January 2016.[24]
- **Upgrades to Two Ammunition Hoists:** According to Coast Guard officials, the ammunition hoists are difficult to use in their current configuration, and the crew of the NSC prefers to carry ammunition for the Close-in Weapon System by hand rather than use the hoist. As a result, the Coast Guard plans to modify the design of this equipment. Despite the Coast Guard initiating this design change in October 2012, beginning with NSC 4, the remaining NSCs are being built without ammunition hoists and instead are delivered with a vacant space, which officials stated resulted in savings to the Coast Guard. The Coast Guard is installing the new ammunition hoists post-delivery on all NSCs. These changes are expected to cost the Coast Guard a total of $7.0 million, which represents a cost increase of about 11 percent since January 2016.

The Coast Guard Did Not Document a Key Cost Analysis for Its Design Changes

Coast Guard officials stated that no formal analysis is developed or documented to determine whether a design change should be installed during production or post-delivery. Instead, they used the professional judgment of Coast Guard and shipyard officials to determine the most cost efficient timing of when to install design changes. Keeping the NSC delivery dates on schedule was one of the primary reasons officials gave

[23]Sea state refers to the height, period, and character of waves on the surface of a large body of water.

[24]The replacement for the single-point davit is the dual-point davit, which, as was previously discussed, was one of the systems with the most lost operational days for the NSC.

for not installing the three design changes noted above during production on the NSCs that have not yet been delivered (NSC 6-9). Given that the program has been aware of these three design changes for many years, the Coast Guard had an opportunity to install the design changes during production instead of during the post delivery period.

According to Coast Guard officials, one hindrance to installing systems during production is that the shipyard would likely want to revalidate any engineering work on the design change that was conducted by Coast Guard officials since the shipyard is responsible for delivering a ship that meets the specifications of the contract. This revalidation work could delay the production schedule and lead to cost increases. They also stated that it is more cost effective to install these three design changes post-delivery for all NSCs, but were unable to produce any documents supporting this claim. For example, officials explained that installing replacement systems for the gantry and single-point davit cranes during production would have cost an additional $7 million to $10 million per cutter. This is compared to their estimates of $4.5 million to $5 million to conduct these changes post-delivery. However, officials could not provide documentation supporting their analysis. Further, the Coast Guard's Joint Surface Engineering Change Process Guide, which governs the design change process and provides instructions for how design changes should be planned and installed, does not require such cost analyses to be documented. Federal internal control standards state that significant decisions should be documented in a manner that allows documentation to be available for examination.[25] In addition, GAO best practices state that cost estimates should be documented for management to make an informed decision regarding a program's affordability.[26] With the Joint Surface Engineering Change Process Guide not requiring that a cost analysis be performed and documented to support its decision on when to install design changes, the Coast Guard cannot be certain that it is making the most cost-effective decision when determining the optimal time to install design changes.

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

[26]GAO, *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, GAO-09-3SP (Washington, D.C.: March 2009).

Cost Estimates for FRC and NSC Depot Maintenance Do Not Reflect Actual Expenditures and Estimates Are Not Regularly Updated

The FRC's and NSC's annual depot-level expenditures have generally been well below their estimated levels since 2010. Combined, these cutters have used $106.6 million less than estimated since 2012 and 2010, respectively. The Coast Guard has used this $106.6 million to pay for maintenance on legacy vessels and other assets. The Coast Guard uses its standard support level to estimate the annual depot-level maintenance needs of each asset. However, officials stated that standard support levels are not updated on a regular basis with information on actual expenditures, which can hinder the Coast Guard's ability to determine what its actual depot budget needs are.

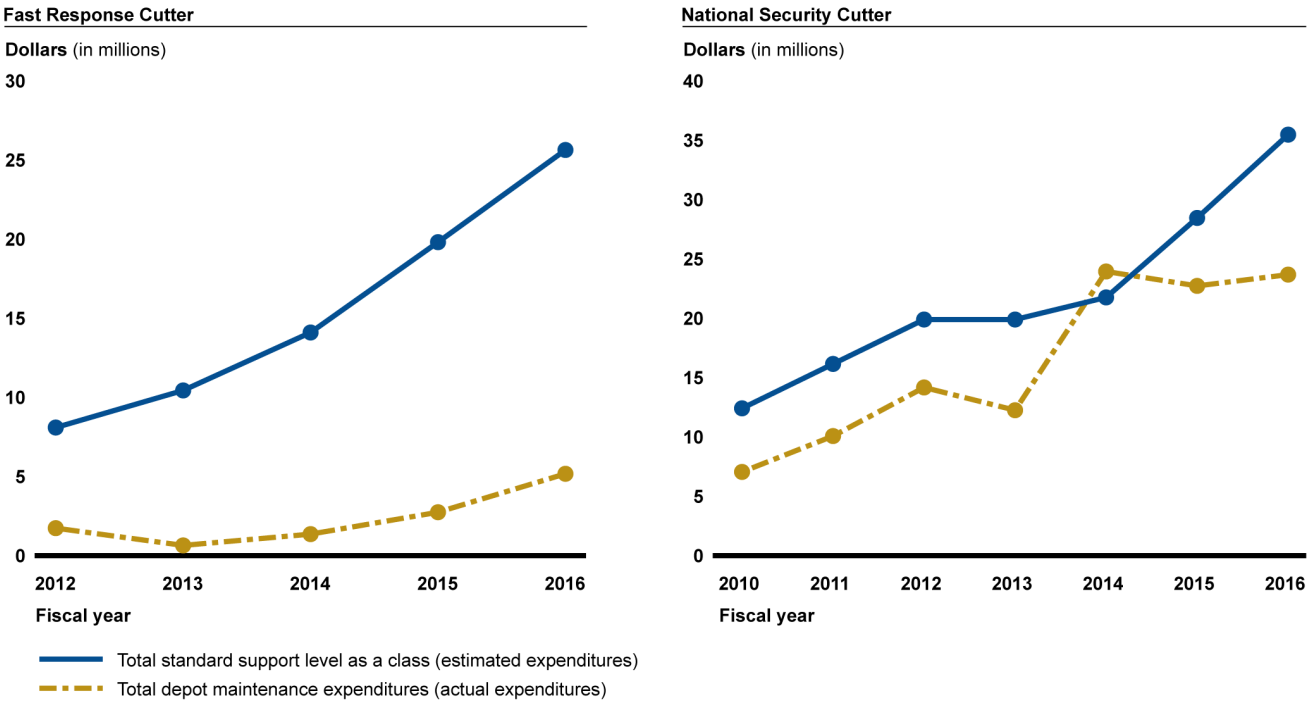
Coast Guard's Annual Depot-Level Maintenance Estimates Do Not Match Expenditures for the FRC and NSC

The Coast Guard's annual estimates for depot-level maintenance—known as standard support levels—consistently do not reflect actual expenditures for the FRC and NSC.[27] Depot maintenance expenditures from 2012 to 2016 for the FRC and 2010 to 2016 for the NSC were $106.6 million less than estimated. Figure 11 shows the estimated and actual maintenance expenditures for the FRC and NSC since 2012 and 2010, respectively.[28]

[27]An expenditure is the actual spending of money; an outlay. GAO, *A Glossary of Terms Used in the Federal Budget Process*, GAO-05-734SP (Washington, D.C.: September 2005).

[28]This figure only includes the expenditures for the hull, mechanical, and electrical systems on the cutters. We attempted to review the Coast Guard's organizational-level maintenance (maintenance conducted by the crew) but were unable to do so because Coast Guard officials stated they do not break out organizational-level maintenance costs from a cutter's operating budget, which, in addition to operational maintenance, includes costs such as fuel and life jackets.

Figure 11: Depot Maintenance Expenditures and Estimates for the Fast Response Cutter and National Security Cutter



Source: GAO analysis of Coast Guard data. | GAO-17-218

Note: The depot maintenance estimates increased as the number of cutters in the fleet increased.

Expenditures for the FRC program from 2012 to 2016 were $66.4 million less than expected for depot maintenance—85 percent under its standard support level—and expenditures for the NSC program from 2010 to 2016 were $40.1 million less—26 percent under its standard support level. Coast Guard officials stated that early in a cutter's life cycle, the depot-level expenditures are expected to be less than what is planned for in the standard support level since the cutters are not conducting all of their regularly scheduled depot-level maintenance yet. Then, as an asset ages, its expenditures will gradually meet or exceed its standard support level in certain years when a cutter has an increased amount of planned depot-level maintenance. The FRC has yet to meet or exceed its estimates and officials attributed the large disparity between the FRC's expenditures and its standard support level to the program's warranty, saying that they are not fully responsible for conducting all maintenance yet. The Coast Guard does not expect the FRC's depot-level expenditures to match its estimates until after the 15-week warranty repair drydock for the first 13 cutters is complete in late 2019.

The NSC exceeded its estimates only one time—in 2014—which coincided with the first scheduled drydock event on the *Bertholf*.[29] NSC officials stated that drydocks are the most expensive depot-level maintenance event. However, the *Stratton* had its first scheduled drydock in fiscal year 2016 and the NSC expenditures did not exceed its standard support level in that fiscal year, indicating that the NSCs estimates may have excess capacity that is not needed in order to conduct all depot maintenance. The NSC fleet had its largest difference between its estimates for depot-level maintenance and actual expenditures in fiscal year 2016, which was also the first year that all five operational NSCs were included in the program's standard support level.

The difference in funds from a cutter's standard support level and its actual expenditures is used by the Coast Guard to help cover the depot maintenance costs of legacy assets. According to Coast Guard officials, the combined difference of $106.6 million in depot maintenance funds from the FRC and NSC remained in a centrally managed surface asset depot maintenance account, which is available for use on other Coast Guard surface assets, such as the High Endurance Cutter, which officials explained requires additional maintenance funding over what was originally planned.[30]

Standard Support Levels Are Not Updated on a Regular Cycle

The standard support levels used to create an asset's annual estimates for depot-level maintenance are created early in an asset's acquisition life cycle and are established as part of the program's life cycle cost estimate. Once the standard support level is established, it is then used as part of the initial budgeting process for the cutter class. However, Coast Guard officials stated that annual depot-level maintenance budgets are based on previous years' enacted appropriations rather than actual expenditures or standard support levels. The previous years' enacted budgets are adjusted for the assets that were added and those that were removed

[29]The *Stratton* had an unscheduled emergency drydock event in 2012 for a hull failure when water was found to be coming into the cutter through small holes in the hull.

[30]In recent years the Coast Guard has provided the total amount of deferred maintenance to Congress. From fiscal year 2014 to fiscal year 2016 the Coast Guard's list of deferred depot maintenance that it reported to Congress totaled $100 million, although the amount decreased from $38 million in fiscal year 2014 to $28 million in fiscal year 2016. Deferred maintenance is the amount of scheduled maintenance on a vessel that must be postponed so funds can be used for unscheduled maintenance. Such deferrals can occur when the Coast Guard does not have enough money to cover unexpected maintenance and still perform all of its scheduled maintenance, thus creating a backlog.

from Coast Guard service and then the budget is submitted to Congress. This means that the annual Coast Guard budgets do not reflect the actual needs of the assets. Further, the surface asset depot-level maintenance budget line in the annual Coast Guard budget submission does not include the details for any asset class. Officials explained that attempting to do so would be unnecessarily difficult and would not help the Coast Guard manage its depot maintenance funds. Officials further explained that the Coast Guard manages its surface asset depot maintenance as a portfolio. The diverse portfolio of surface assets includes brand new vessels under warranty as well as 50-year old vessels that often demand significant unplanned maintenance to keep them operational.

While standard support levels are created early in an asset's acquisition life cycle, Coast Guard officials stated that they are not normally adjusted or updated over the lifespan of an asset class except for major program events, such as a service life extension program.[31] In July 2012, we found that the standard support levels for at least two legacy cutter classes had not been updated in more than 20 years while another cutter's standard support level had not been updated in almost 50 years.[32] According to Coast Guard officials, they plan to update the NSC's standard support level to account for the addition of a ninth NSC, which was not a part of the original program of record. In July 2012 we also found that the Coast Guard's process to create standard support levels did not fully meet best practices. We recommended that this process conform to cost-estimating best practices, with which the Coast Guard concurred. DHS's response raised three issues that we found could limit the Coast Guard's implementation of the recommendation. First, DHS stated that cost estimating best practices are most applicable to new acquisitions. We disagreed, stating that our cost estimating guide is intended to be applicable to programs and assets in all stages of their life cycles, including maintenance and support. Updating standard support levels periodically would lower the Coast Guard's budgetary risk by using actual data to better inform future depot maintenance estimates. Second, DHS described how sustainment and maintenance costs can be uncertain and

[31]The Coast Guard indicated that it increases standard support levels using non-pay inflation, but it does not do so on an annual basis.

[32]GAO-12-741. The High Endurance Cutter's standard support level was last updated around 1992 after the Coast Guard conducted a service life extension program between 1987 and 1992. These cutters were first commissioned in 1967. The standard support level for the Medium Endurance Cutters (first commissioned in 1964) and the 110-foot patrol boat (first commissioned in 1986) had not been updated as of July 2012.

challenging to estimate, which the Coast Guard mitigates through centralized management of its depot-level maintenance funds for all assets. We again disagreed, stating that best practices can help ensure that cost estimates are comprehensive and accurate, which can help ensure that funds will be available when needed. Third, DHS explained that given the fiscal environment, the Coast Guard would focus on improvements that do not require additional resources. We stated that a well-documented cost estimating process and the use of accurate historical data should enable the Coast Guard to operate more efficiently.

By not updating the standard support levels with information on actual expenditures, the Coast Guard does not know what the actual depot-level maintenance needs are of its assets. GAO best practices state that programs should be monitored continuously for their cost effectiveness by comparing planned and actual performance against the approved baseline.[33] Effective program and cost control requires ongoing revisions to the cost estimate, budget, and projected estimates at completion. Further, a competent cost estimate is the key foundation of a sound budget. Not updating the estimated costs with actual expenditures could lead to ineffective planning by those responsible for conducting depot-level maintenance. Coast Guard officials stated that they do not update their depot maintenance estimates with actual expenditures because doing so would cause individual budget line items to constantly change. Nonetheless, by not reviewing and updating the standard support levels for the FRC and NSC, the Coast Guard cannot accurately know what the actual depot maintenance needs are for each asset class. This can hinder decision makers as they seek to wisely spend scarce taxpayer dollars in support of more modern and capable Coast Guard assets.

Conclusions

As the Coast Guard continues to field FRCs and NSCs with improved capabilities over legacy cutters in an effort to modernize its fleet, it is important that these cutters are ready to support the Coast Guard's missions when needed and with the capabilities expected when they were developed. The FRC and NSC both have met their mission capable target rates over the long term, and there are factors that explain the recent declines below their respective target ranges. While Coast Guard officials have stated that these factors are temporary, it is too soon to tell whether the FRC's and NSC's mission capable rates will meet their target ranges

[33]GAO-09-3SP.

once these temporary periods are complete. Further, while maintaining production schedules for the NSC is important, this should not be the overriding factor when considering when to implement design changes. Rather, the Coast Guard should take into account all factors and costs when considering its options. Visibility into decisions on how and when to implement planned design changes on the NSCs—including those not yet constructed—is currently limited because the Coast Guard's guidance does not require programs to perform and document cost analyses that support the cost and timing of when the changes should be incorporated.

The Coast Guard's estimates for depot-level maintenance costs are out of step with actual spending. The difference in estimated and actual depot maintenance costs realized from the FRC and NSC fleets since 2012 and 2010, respectively, indicates that standard support levels should be reviewed and updated to more closely reflect the actual expenditures. Not having an updated assessment of depot maintenance costs for each asset limits the information decision makers have to determine future budget needs, and limits transparency into which of the Coast Guard's many surface assets, such as aging legacy assets that require additional maintenance funding, are benefitting from any differences between depot-level maintenance estimates and actual costs. A more thorough accounting for both the potential costs of design changes and the actual costs of keeping these cutters in service could improve information used by decision makers on how to spend scarce taxpayer dollars in support of a modern, capable Coast Guard surface fleet.

Recommendations for Executive Action

To ensure that the Coast Guard makes effective use of its resources, specifically regarding its budget, we recommend the Secretary of DHS direct the Commandant of the Coast Guard to take the following two actions:

- Update the Joint Surface Engineering Change Process Guide to require a documented cost analysis to provide decision makers adequate data to make informed decisions regarding the expected costs and when it is most cost effective to install design changes.
- Periodically update standard support levels to account for actual expenditures so that the Coast Guard follows best practices and to provide decision makers an understanding of the actual depot-level maintenance funds required for Coast Guard assets.

Agency Comments and Our Evaluation

We provided a draft of this report to DHS for review and comment. DHS concurred with both of our recommendations and provided a date by which the actions will be complete. DHS's written comments are reprinted in appendix V. DHS and the Coast Guard also provided technical comments that we incorporated into the report as appropriate.

As agreed with your office, unless you publically announce the contents of the report, we plan no further distribution of it until 30 days from the date of this letter. We are sending copies of this report to the Secretary of Homeland Security and the Commandant of the Coast Guard. In addition, the report is available on our website at http://gao.gov.

If you or your staff have any questions about this report, please contact me at (202) 512-4841 or mackinm@gao.gov. Contact points for our Office 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 VI.

Sincerely yours,

Michele Mackin
Director, Acquisition and Sourcing Management

Appendix 1: Objectives, Scope, and Methodology

To examine the maintenance, equipment failures, and spare parts availability for the Fast Response Cutter (FRC) and National Security Cutter (NSC), we reviewed the mission capability data provided from the Coast Guard from the Electronic Asset Logbook (EAL) database for both cutters and compared their rates to the target ranges for each cutter established by the Coast Guard over at least a 12-month time frame as Coast Guard officials stated was the most meaningful use of the data. We reviewed this data from when each cutter class first began to use the metric (March 2012 for the FRC and November 2013 for the NSC) to September 2016. We also assessed the reliability of the data from the EAL system to determine the extent to which we could use the data to support our findings and found that it was reliable for our purposes. We gathered data on the Coast Guard top operational degraders (lost operational days) from 2014 to 2016 and reviewed the FRC's and NSC's engineering reports from 2012 to 2015 to determine the top equipment issues the cutters experienced from the perspective of the cutter captains.[1] We also reviewed the Patrol Boat Product Line's response to the FRC's engineering reports and the Long Range Enforcer Product Line's response to the NSC's engineering reports to see how the Coast Guard planned to remedy the issues the cutters were experiencing. We interviewed officials with the Coast Guard Office of Naval Engineering; the Surface Forces Logistics Center in Baltimore, MD; the Long Range Enforcer Product Line in Alameda, CA; and the Patrol Boat Product Line in Norfolk, VA. We also toured the *NSC Stratton* while it was in drydock at Mare Island Drydock in Vallejo, CA; Coast Guard Base Miami Beach to view FRC maintenance; and the Coast Guard Yard in Baltimore, MD to understand the Coast Guard's ability to conduct drydocks and to understand how it plans for, stocks, and ships spare parts to cutters in the deployed locations. We also interviewed officers from the NSC *Stratton*, *FRC Bernard Webber, FRC Margaret Norvell,* and officials at Coast Guard Base Miami Beach that operate and conduct maintenance on the FRCs.

To examine how design changes are affecting the maintenance of the FRC and NSC, we reviewed the list of Coast Guard design changes over $1 million for both cutters. For the FRC, we met with the contracting officer to determine the extent to which the program's warranty covered systems that had design changes and to determine whether the

[1]The 2016 engineering reports were not available until January 2017 at the earliest, which was after our cutoff date to end data collection.

shipbuilder or the Coast Guard was responsible for the costs of the repairs and design changes. For the NSC, we compared the cost of the design changes to the costs we previously found in January 2016 to determine the extent to which costs had changed. In addition, we reviewed the Coast Guard's Joint Surface Engineering Change Process Guide and interviewed officials from FRC and NSC program offices and the Coast Guard's Office of Naval Engineering and the Office of Budget and Programs.[2] We compared the Coast Guard process for designing and implementing engineering changes to GAO's best practices for cost estimating and to the internal control standards for the federal government.[3]

To examine the extent to which the Coast Guard's cost estimates for depot maintenance reflects actual expenditures for the FRC and NSC, we reviewed the Coast Guard's standard support levels, which are the estimated costs for depot-level maintenance each year over the course of an asset's life cycle, and compared that to the depot-level maintenance expenditures for both cutters from fiscal years 2012 to 2016 for the FRC and from 2010 to 2016 for the NSC. We also reviewed the process whereby the Coast Guard creates standard support levels and interviewed officials from the Coast Guard's Office of Budget and Programs to determine how the standard support levels are used in the annual budget development process. We compared the Coast Guard's process for creating and updating standard support levels to GAO's best practices for cost estimating.[4]

We conducted this performance audit from February 2016 to March 2017 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 the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[2]Department of Homeland Security, United States Coast Guard, *Joint Surface Engineering Change Process Guide*, CGTO PG-85-00-900-G (Baltimore, MD: June 1, 2016).

[3]GAO-09-3SP; GAO-14-704G.

[4]GAO-09-3SP.

Appendix II: Fast Response Cutter and National Security Cutter Names and Delivery Dates

As of September 2016, the Coast Guard planned to acquire a total of 58 Fast Response Cutters (FRC) and 9 National Security Cutters (NSC) in an effort to modernize its aging fleet. The Coast Guard took delivery of the first NSC in 2008 with the delivery of the first FRC occurring in 2012. As of September 2016 the Coast Guard has received 5 NSCs and 19 FRCs. Tables 7 and 8 depict the anticipated delivery dates of the first 34 FRCs and all 9 NSCs.

Table 7: Fast Response Cutter Hull Information (First 34 Cutters)

Hull #	Hull name	Delivery date	Hull #	Hull name	Delivery date
1101	Bernard C. Webber	February 2012	1118	Joseph Tezanos	June 2016
1102	Richard Etheridge	May 2012	1119	Rollin Fritch	August 2016
1103	William Flores	August 2012	1120	Lawrence Lawson	October 2016
1104	Robert Yered	November 2012	1121	John McCormick	December 2016
1105	Margaret Norvell	March 2013	1122	Bailey Barco	February 2017
1106	Paul Clark	May 2013	1123	Benjamin Dailey	April 2017
1107	Charles David Jr.	August 2013	1124	Oliver Berry	June 2017
1108	Charles Sexton	December 2013	1125	Jacob Poroo	September 2017
1109	Kathleen Moore	March 2014	1126	Joseph Gerczak	November 2017
1110	Raymond Evans	June 2014	1127	Richard Snyder	January 2018
1111	William Trump	November 2014	1128	Nathan Bruckenthal	April 2018
1112	Isaac Mayo	January 2015	1129	Forrest Rednour	June 2018
1113	Richard Dixon	April 2015	1130	Robert Ward	August 2018
1114	Heriberto Hernandez	July 2015	1131	Terrell Horne	October 2018
1115	Joseph Napier	October 2015	1132	Benjamin Bottoms	January 2019
1116	Winslow Griesser	December 2015	1133	Joseph O. Doyle	March 2019
1117	Donald Horsley	March 2016	1134	William C. Hart	June 2019

Source: GAO presentation of Coast Guard data. | GAO-17-218

Note: The Coast Guard awarded the Phase 2 contract in May 2016 to acquire the remaining 26 FRCs. The Coast Guard only provided hull names and delivery dates for the first two of the cutters under the Phase 2 contract, the Joseph O. Doyle and the William C. Hart.

Table 8: National Security Cutter Hull Information

Hull #	Hull name	Delivery date
750	Bertholf	May 2008
751	Waesche	November 2009
752	Stratton	September 2011
753	Hamilton	September 2014
754	James	June 2015
755	Munro	December 2016
756	Kimball	February 2018
757	Midgett	February 2019
758	Stone	2020

Source: GAO presentation of Coast Guard data. | GAO-17-218

Appendix III: Fast Response Cutter and National Security Cutter Operational Capabilities Compared to Legacy Vessels They Are Replacing

The Fast Response Cutters (FRC) and National Security Cutters (NSC) were designed to provide the Coast Guard with modernized capabilities above those already provided by aging assets. Tables 9 and 10 highlight the capabilities of the FRCs and NSCs in comparison to the legacy vessel the cutters are planned to replace.

Table 9: Operational Capabilities of the Fast Response Cutter Compared to the 110' Patrol Boat

	Fast Response Cutter	110' Patrol Boat
Year Delivered	2012	1986
Number in fleet	58 planned (20 operational)	41 (26 operational)[a]
Crew size	24	16
Length	154 feet	110 feet
Operational tempo	2,500 operational hours per year	1,800 operational hours per year
Maximum time at sea without reprovisioning	5 days	5 days
Range	2,500 nautical miles	1,900 nautical miles
Maximum speed	28 knots	28 knots
Draft	10 feet	7.5 feet
Weapons	One cannon gyro-stabilized remote operated weapon with an optical targeting sensor and four machine guns	One cannon crew-served weapon and two machine guns
Aircraft capabilities	Not flight deck equipped	Not flight deck equipped
Cutter boat capabilities	Carries 1 stem-mounted cutter boat	Carries 1 cutter boat

Source: GAO presentation of Coast Guard data. | GAO-17-218

[a]The 110-foot Island Class Patrol Boat fleet originally included 49 vessels. The Coast Guard converted 8 of the cutters into 123-foot patrol boats, but discontinued further conversions in 2005 and decommissioned the 123 foot patrol boats in 2007 because they were experiencing technical difficulties, such as hull buckling, and were not able to meet post-September 11, 2001 mission requirements.

Table 10: Operational Capabilities of the National Security Cutter Compared to the High Endurance Cutter

	National Security Cutter	High Endurance Cutter
Year Delivered	2008	1967
Number in fleet	9 planned (5 operational)	12 (5 operational)
Crew size	126	166
Length	418 feet	378 feet
Operational tempo	230 days per year[a]	185 days per year
Maximum time at sea without reprovisioning	60 days	45 days
Range	12,000 nautical miles	14,000 nautical miles[b]
Maximum speed	28 knots	29 knots[c]
Draft	22 feet	19 feet
Weapons	Gun weapon system and close-in weapon system, six machine guns, and two countermeasure launching systems	Gun weapon system and close-in weapon system, four machine guns, and two countermeasure launching systems
Aircraft capabilities	Flight deck with 2 aircraft hangars	Flight deck with 1 aircraft hangar
Cutter boat capabilities	Carries 3 cutter boats: 2 astern and 1 starboard side	Carries 2 cutter boats

Source: GAO presentation of Coast Guard data. | GAO-17-218

[a]To achieve 230 days away from homeport, the Coast Guard plans to use a "crew rotational concept" in which four crews staff and operate three cutters on a rotating basis.

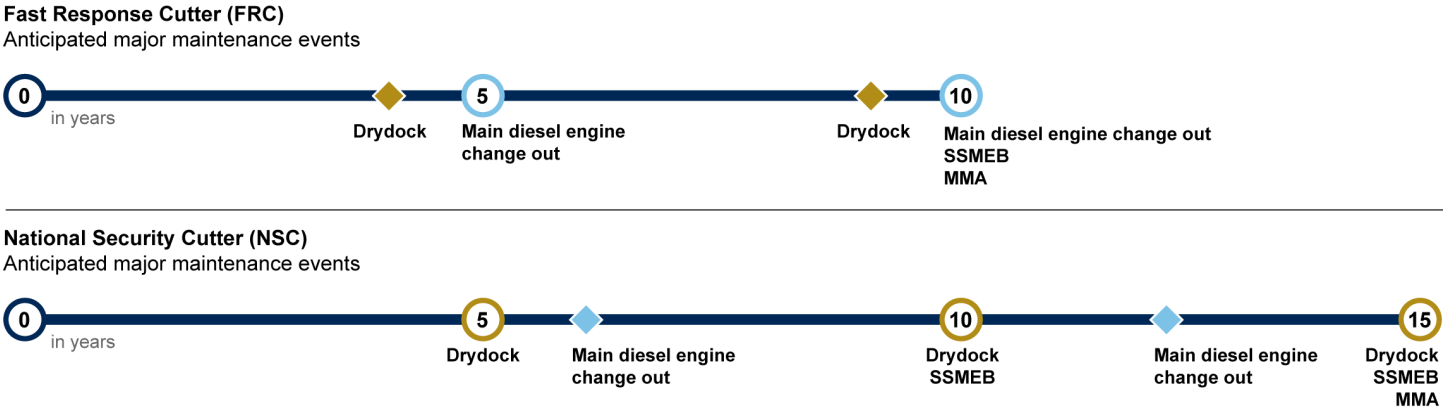
[b]According to the Coast Guard, High Endurance Cutters can achieve a 14,000 nautical mile range only if they ballast their fuel tanks once the tanks are depleted, a procedure that is rarely undertaken. High Endurance Cutters have a range of 9,600 nautical miles under normal circumstances.

[c]According to the Coast Guard, the age and condition of the High Endurance Cutters, coupled with renovation and modernization modifications made to these vessels over the years, make many High Endurance Cutters unable to achieve a maximum speed of 29 knots.

Appendix IV: Major Maintenance Events for the Fast Response Cutter and National Security Cutter

In order to plan for the individual maintenance needs of each cutter, the Coast Guard's Surface Forces Logistics Center (SFLC) generates and maintains a 5-year maintenance plan for each asset class depicting the major depot-level maintenance tasks. Each year, SFLC updates and adds to each cutter's 5-year maintenance schedule to formulate short- and long-term budgets, project shortfalls, and interface with operational commanders for scheduling purposes. Figure 12 shows the timeline of scheduled major maintenance events for the Fast Response Cutter (FRC) and National Security Cutter (NSC).

Figure 12: Timeline of the Major Maintenance Events for the Fast Response Cutter and National Security Cutter



SSMEB = Ship Structure and Machinery Evaluation Board
MMA = Midlife maintenance availability

Source: GAO presentation and analysis of Coast Guard data. | GAO-17-218

Note: The maintenance events on the timelines are different for the FRC and NSC since they have different expected service lives. The FRC is expected to be in service for 20 years while the NSC is expected to be in service for 30 years.

Each cutter has a number of anticipated major maintenance events throughout its life cycle. Some of those include:

- **Drydock:** This refers to a period of time, lasting between 2 to 4 months for the FRCs and NSCs, when the cutter is hoisted out of the water to conduct maintenance. Maintenance conducted during this time period is only capable of being done on dry land and includes items such as repainting of the hull and shaft removal and reinstallation among others. Drydocks for the FRCs occur every 4 years while drydocks for the NSCs occur every 5 years.
- **Main Diesel Engine change out:** This maintenance event involves the replacement of the main diesel engines, which occurs every 12,000 hours of engine operations for the FRC and every 24,000

hours of engine operations for the NSC. Operating the FRCs at no more than 2,500 hours per year would mean the cutters should expect to undergo a main diesel engine change out at a minimum of just under 5 years, while operating at no more than 3,780 hours per year, the NSCs should expect to undergo a main diesel engines change out at a minimum of just over every 6 years.

- **Ship Structure and Machinery Evaluation Board:** This review is designed to examine the cutter's material condition and provide information on the remaining service life of the cutter. The first Ship Structure and Machinery Evaluation Board is completed when the lead ship of the class reaches the 10-year mark and at a 5-year interval thereafter. According to officials, one of the possible outcomes of this review is that a midlife maintenance availability is triggered for the cutter to enable it to reach its expected service life.
- **Midlife Maintenance Availability:** This maintenance event is designed to correct system obsolescence issues and maintain asset reliability and supportability throughout the remainder of the cutter's service life. This is completed near a cutter's midpoint, which would be roughly 10 years into the FRC's planned 20 year operational life and 15 years into the NSC's planned 30-year operational life.

Appendix V: Comments from the U.S. Department of Homeland Security

U.S. Department of Homeland Security
Washington, DC 20528

Homeland Security

February 16, 2017

Michelle Mackin
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Re: Management's Response to Draft Report GAO-17-218, "COAST GUARD CUTTERS: Depot Maintenance Is Affecting Operational Availability And Cost Estimates Should Reflect Actual Expenditures"

Dear Ms. Mackin:

Thank you for the opportunity to comment on this draft report. The U.S. Department of Homeland Security (DHS) appreciates the U.S. Government Accountability Office's (GAO) work in planning and conducting its review and issuing this report.

The Department is pleased to note GAO's positive recognition that the U.S. Coast Guard (USCG) has met "mission capable" metrics for both the Fast Response Cutters (FRC) and National Security Cutters (NSC) during the past few years. The draft report also highlights the USCG's use of warranties to avoid $77 million in potential maintenance costs. DHS is committed to the continuing recapitalization of the USCG fleet's cutters as well as improving the operational availability of these platforms.

The draft report contained two recommendations with which the Department concurs. Attached find our detailed response to each recommendation.

Again, thank you for the opportunity to review and comment on this draft report. Technical comments were previously provided under separate cover. Please feel free to contact me if you have any questions. We look forward to working with you again in the future.

Sincerely,

JIM H. CRUMPACKER, CIA, CFE
Director
Departmental GAO-OIG Liaison Office

Attachment

Attachment: DHS Management Response to Recommendations Contained in GAO-17-218

GAO recommended that the Secretary of Homeland Security direct the Commandant of the Coast Guard to:

Recommendation 1: Update the Joint Surface Engineering Change Process Guide to require a documented cost analysis to provide decision makers adequate data to make informed decisions regarding the expected costs and when it is most cost effective to install design changes.

Response: Concur. The Coast Guard Assistant Commandant for Acquisition (CG-9) and Assistant Commandant for Engineering and Logistics (CG-4) communities will collaborate to determine a consistent, repeatable cost benefit analysis methodology to be considered with other factors such as safety, schedule impacts, operational impacts, crew impacts and technical aspects for making design change decisions. This methodology will be incorporated in the next update to the Joint Surface Engineering Change Process Guide (CGTO PG-85-00-900-S). Estimated Completion Date (ECD): December 31, 2017.

Recommendation 2: Periodically update standard support levels to account for actual expenditures so that the Coast Guard follows best practices and to provide decision makers an understanding of the actual depot-level maintenance funds required for Coast Guard assets.

Response: Concur. The Coast Guard recognizes the value of periodic review of standard support levels against actual maintenance expenditures. CG-4 will establish a formal process to provide actual expenditure data on an annual basis to vessel acquisition program offices (CG-9) to facilitate refinement of their life-cycle cost estimates. For assets in sustainment, CG-4 will develop a plan to periodically review actual expenditures and standard support levels. ECD: October 31, 2017.

2

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

Michele Mackin, (202) 512-4841 or mackinm@gao.gov.

Staff Acknowledgments

In addition to the contact above, Richard A. Cederholm, Assistant Director; Katherine Trimble, Assistant Director; Peter W. Anderson; Charles W. Bausell Jr.; Erin Butkowski; John Crawford; Kristine Hassinger; Jenna Tischler; and Roxanna T. Sun made key contributions to this report.