



July 2017

NAVY SHIPBUILDING

Policy Changes Needed to Improve the Post-Delivery Process and Ship Quality

Accessible Version

GAO Highlights

Highlights of [GAO-17-418](#), Report to the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

The U.S. Navy spends at least \$18 billion per year on shipbuilding—a portion of which is spent after ships are delivered. During the post-delivery period—after delivery from the shipbuilder and before the ships enter the fleet—Navy ships undergo a variety of tests, trials, and construction.

GAO was asked to assess the post-delivery period, including quality and completeness of ships when they are delivered to the fleet. The Senate Report on the National Defense Authorization Act for Fiscal Year 2017 included additional questions about ship status after delivery. This report assesses the extent to which the Navy (1) provides complete and quality ships to the fleet, (2) has a ship delivery policy that supports those efforts, and (3) reports ship quality and completeness to Congress. GAO reviewed a nongeneralizable sample of eight Navy ships, six of which have entered the fleet and two that recently began the post-delivery period. GAO reviewed program documentation and interviewed Navy officials.

What GAO Recommends

The Navy should revise its ship delivery policy to identify what kinds of defects should be corrected and by when and study how to best ensure that INSURV verifies ships. Also, the Navy should reflect in its reports to Congress key milestones and consistent definitions in line with DOD policy. DOD did not concur with two recommendations, partially concurred with a third, and fully agreed with a fourth. GAO stands by its recommendations, which will help ensure that complete and quality ships are provided to the fleet and that Congress is provided with meaningful information on ship status.

View [GAO-17-418](#). For more information, contact Michele Mackin at (202) 512-4841 or mackinm@gao.gov.

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What GAO Found

GAO reviewed six ships valued at \$6.3 billion that had completed the post-delivery period, and found they were provided to the fleet with varying degrees of incomplete work and quality problems. GAO used three quality assurance metrics, identified by Navy program offices, to evaluate the completeness of the six ships—LPD 25, LHA 6, DDG 112, Littoral Combat Ships (LCS) 3 and 4, and SSN 782—at delivery and also at the time each ship was provided to the fleet. Although the Navy resolved many of the defects by the end of the post-delivery period, as the table below shows, quality problems persisted and work was incomplete when the selected ships were turned over to the operational fleet.

Number of Quality Problems or Defects at the Beginning and End of the Post-Delivery Period across Six Selected Ships

	At delivery	At the time the Navy provided the ship to the fleet
Significant construction deficiencies	363	45
Systems not meeting minimal functional standard	139	54
Significant deficiencies in mission-essential equipment	N/A ^a	53

Source: GAO analysis of Navy documents and data. | GAO-17-418

^aThis information is not evaluated at delivery

Fleet officials reported varying levels of concern with the overall quality and completeness of the ships, such as with unreliable equipment or a need for more intense maintenance than expected. For CVN 78 and DDG 1000, the Navy plans to complete significantly more work and testing during the post-delivery period than the other six ships GAO reviewed. As such, these ships are at a greater risk of being provided to the fleet at the end of their post-delivery periods with incomplete construction work and unknowns about quality.

The Navy's ship delivery policy does not facilitate a process that provides complete and quality ships to the fleet and practices do not comport with policy. The policy emphasizes that ships should be defect-free and mission-capable, but lacks clarity regarding what defects should be corrected and by when. Without a clear policy, Navy program offices define their own standards of quality and completeness, which are not always consistent. Further, because the Navy's Board of Inspection and Survey (INSURV) does not inspect ships at the end of the post-delivery period, it is not in a position to verify each ship's readiness for the fleet, as required by Navy policy. The Navy has not assessed the costs and benefits of ensuring INSURV does this. Addressing these policy concerns would improve the likelihood of identifying and correcting deficiencies before fleet introduction and increase consistency in how the Navy defines quality.

The Navy does not use consistent definitions for key milestones in its reports to Congress—such as delivery or Initial Operational Capability (IOC)—and, therefore, these milestones are not as informative as they could be regarding ship quality and completeness. For example, the Navy has routinely declared IOC on new ship classes without having demonstrated that ships are able to perform mission operations—contrary to Department of Defense (DOD) guidance, which, for nearly all acquisition models, generally states that IOC should be declared only after successful operational testing that demonstrates performance.

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Abbreviations

CNO	Chief of Naval Operations
DOD	Department of Defense
DOT&E	Director, Operational Test and Evaluation
INSURV	Navy Board of Inspection and Survey
IOC	initial operational capability
LCS	Littoral Combat Ship
NAVSEA	Naval Sea Systems Command
OPNAVINST	Office of the Chief of Naval Operations Instruction
OWLD	obligation work limiting date
PEO	Program Executive Office
PSA	post-shakedown availability
SCN	Shipbuilding and Conversion, Navy
SUPSHIP	Navy Supervisor of Shipbuilding, Conversion, and Repair

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July 13, 2017

The Honorable John McCain
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The U.S. Navy spends at least \$18 billion per year on its new construction shipbuilding programs, with a portion of this money spent after delivery on work to prepare the ships for the fleet. Over the past several years, we have reported on significant cost growth and quality problems facing several Navy shipbuilding programs. In May 2009, we compared Navy shipbuilding with commercial shipbuilding and generally found that the Navy accepts significantly more risk when it builds ships compared to commercial shipbuilders and buyers. In November 2013, we found significant quality problems with Navy ships at delivery—noting that the Navy regularly accepts ships with numerous deficiencies. In September 2014, we found that Littoral Combat Ship (LCS) 1 and 2, while legally accepted by the government, had quality problems that persisted after delivery. And in November 2014, we found that shifting construction work on the CVN 78 aircraft carrier to the post-delivery period could obscure the total cost of the ship and result in the need for additional funding to complete the ship during post-delivery. Most recently, in March 2016, we found that the Navy pays for the vast majority of shipbuilder-responsible deficiencies discovered after the Navy takes delivery of its ships.¹

Senate Report 114-255 to accompany a bill for the National Defense Authorization Act for Fiscal Year 2017 included a provision for us to review the delivery process from the time the Navy takes custody of ships until they are complete and ready for operations, particularly in light of the Navy’s delivery strategies for the CVN 78-class of aircraft carriers and DDG 1000-class of destroyers.² In addition, you asked us to review the period after ship delivery, including the extent to which and why the Navy defers construction work to the post-delivery period, specifically as it relates to aircraft carrier and lead ship construction. For this review, we

¹A list of our prior reports can be found at the end of this report.

²S. Rep. No. 114-255, at 10 (2016).

assessed: (1) the extent to which the Navy provides complete, quality ships to the fleet that are free of government and contractor deficiencies; (2) the extent to which the Navy's policy governing ship delivery facilitates efforts to deliver complete and quality ships; and (3) the extent to which reports to Congress on the progress of shipbuilding programs consistently define key milestones such as ship delivery and initial operational capability.

To gain an understanding of the post-delivery period for Navy ships, we selected eight ships for review. We identified Navy ships which were either delivered within the last 5 years or were planned to be delivered in 2016, were constructed by a variety of shipyards, and were of different classes or variants. To understand whether ships early in their class experience different issues than later ships, we selected a mix of lead, early, and late-in-class ships. We reviewed the following eight ships:

- DDG 112: Arleigh Burke class guided missile destroyer
- SSN 782: Virginia class submarine
- LPD 25: San Antonio class amphibious transport dock
- LCS 3: Littoral Combat Ship, Freedom variant³
- LCS 4: Littoral Combat Ship, Independence variant
- LHA 6: America class amphibious assault ship
- DDG 1000: Zumwalt class destroyer
- CVN 78: Ford class aircraft carrier

Six of these ships (DDG 112, SSN 782, LPD 25, LCS 3, LCS 4, and LHA 6) have finished their post-delivery periods, while CVN 78 and DDG 1000 (both lead ships) have yet to complete the post-delivery period.⁴ More information about these vessels is contained in appendix I.

We analyzed the post-delivery period, beginning when the Navy accepts delivery of a ship from the shipbuilder, and ending when the ship is provided to the operational fleet, which generally coincides with a milestone called the obligation work limiting date (OWLD). In this report,

³For the Littoral Combat Ship, the Navy is using two contractors to build differently designed seaframes.

⁴DDG 1000 was delivered to the Navy in May 2016 and CVN 78 was delivered in May 2017. Both ships are currently in the post-delivery period.

we refer to OWLD as when the ship was “provided to the fleet,” noting that the fleet has some responsibilities for operating and maintaining the ship prior to this date but that the acquisition program office is still managing construction-related work on the ship up until this point in time. In some cases, we examined significant test and maintenance events that occurred shortly after a ship was provided to the fleet. Once OWLD is reached—which coincides with when the ship is provided to the fleet—shipbuilding construction funding can no longer be obligated and other types of funding must be used, per Navy policy.

To assess the extent to which the Navy provides complete, quality ships to the fleet, free of government and contractor deficiencies, we reviewed key metrics on ship quality and completeness identified by shipbuilding program offices by analyzing data in: the form DD-250 Material Inspection and Receiving Report, Navy Board of Inspection and Survey (INSURV) reports, and a document called the Transfer Book—which catalogues deficiencies and the material condition of a ship when it is provided to the fleet at OWLD—among other documents, for each ship in our review. Further, we evaluated Chief of Naval Operations Instruction 4700.8K (OPNAVINST 4700.8K)—the Navy policy covering trials, delivery and post-delivery activities (referred to in this report as the Navy’s ship delivery policy)—to determine the extent to which it facilitated providing complete and quality ships to the fleet. Lastly, we reviewed the Navy’s fiscal year 2016 and 2017 Selected Acquisition Reports to Congress for the ship classes of the eight ships we reviewed to determine the extent to which these reports define key milestones on the progress of ship completion consistently. We compared these reports to our analyses of delivery dates, test reports, and post-delivery work schedules for each selected ship class. We also assessed the information in the Navy’s reports against relevant statutes, Navy policy and guidance, and the *Standards for Internal Control in the Federal Government*.⁵ We supplemented all analyses by conducting interviews with Navy acquisition and fleet officials. Additional details about our scope and methodology can be found in appendix I.

We conducted this performance audit from February 2016 to July 2017 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain

⁵GAO, *Standards for Internal Control in the Federal Government*, [GAO-14-704G](#) (Washington D.C. Sep. 10, 2014).

sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

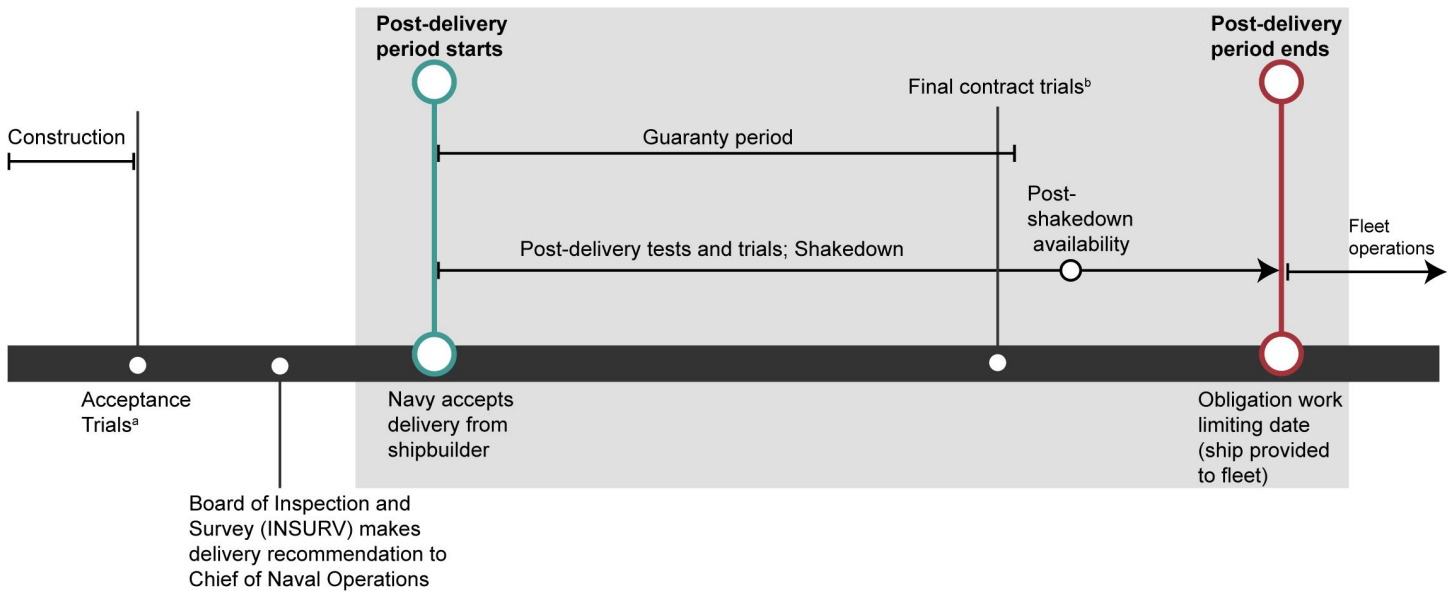
Navy ships undergo a variety of tests, trials, and construction after delivery from the shipbuilder (when the Navy takes custody of the ship) and before the Navy provides the ship to the fleet—a time referred to as the post-delivery period.⁶ The Navy's policy for ship delivery is outlined in OPNAVINST 4700.8K, which establishes

- major milestones including the beginning (delivery) and end (OWLD) of the post-delivery period,
- the expected condition of ships and submarines at these milestones,
- procedures for executing the post-delivery period, and
- the responsibilities of various Navy organizations during the post-delivery period.

Figure 1 provides a notional timeline of the delivery and post-delivery process for new construction ships, per the Navy's ship delivery policy.

⁶Tests, trials, and other work may continue after the post-delivery period, as well. In these cases, we extended our review to examine significant tests, trials, and other work performed after the post-delivery period.

Figure 1: Notional Navy Delivery and Post-Delivery Events



Source: GAO analysis of OPNAVINST 4700.8K | GAO-17-418

^aFor submarines, the trial before preliminary acceptance is called the combined trial.

^bFor submarines, the trial before the post-shakedown availability is called the guaranty material inspection.

Delivery (from shipbuilder): The Navy takes custody of a new construction ship from the shipbuilder at preliminary acceptance, which is also commonly known as delivery. Delivery occurs after the completion of acceptance trials, during which INSURV evaluates the ship and identifies deficiencies (we discuss INSURV’s role in more detail below). The Navy’s Supervisor of Shipbuilding, responsible for ship construction quality, signs a Material Inspection and Receiving Report (Form DD-250) at this time, which includes a list of outstanding construction deficiencies and incomplete work for which the contractor is responsible for completing based upon the terms of the contract.⁷ Delivery is the beginning of the post-delivery period.

Guaranty period: A specified period of time after delivery during which the shipbuilder retains responsibility for correcting construction defects that arise on the ship after the Navy accepts delivery. The specific terms

⁷For Virginia-class submarines, the DD-250 is signed in accordance with the construction contract (typically 60-90 days after the completion of the post-shakedown availability).

of the guaranty period, including its duration and who pays to correct deficiencies, are established in the shipbuilding construction contract.⁸

Final contract trials: INSURV inspectors conduct a second round of sea trials to determine if there are any defects, failures, or deterioration other than that due to normal wear and tear.⁹ Typically, these trials are held prior to the post-shakedown availability.

Post-shakedown availability (PSA): A period of work toward the end of the post-delivery period, during which the Navy's Supervisor of Shipbuilding and other organizations, as appropriate, oversee the correction of deficiencies, installation of class-wide upgrades, and completion of incomplete construction work. The duration and scope varies from ship to ship depending on its material condition at delivery and whether significant alterations must be implemented during the post-delivery period.

OWLD: The date when full financial responsibility for maintaining and operating a ship is transferred from the acquisition command to the operational fleet.¹⁰ In this report, we refer to OWLD as when the ship is provided to the fleet; this date generally concludes the post-delivery period.

In addition to these milestones and events that occur on all new Navy ships, Department of Defense (DOD) acquisition policy also calls for events that usually occur during the post-delivery period on one ship per class, typically the first (or lead) ship:

Initial operational capability (IOC): A key milestone in weapon system acquisitions that typically refers to the point in time when the warfighter (in the Navy's case, the operational fleet) has the ability to employ and maintain a new system.

⁸We recently reported on the Navy's use of a guaranty period in 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).

⁹For submarines, the trial performed at this point in the post-delivery period is called the guaranty material inspection.

¹⁰In some cases, acquisition-related work will be performed after this date, but the work is usually leftover work from PSA, and the construction funding used for the work is obligated before this date. All new work identified after OWLD is the fleet's responsibility to correct using non-construction funding accounts, per Navy policy.

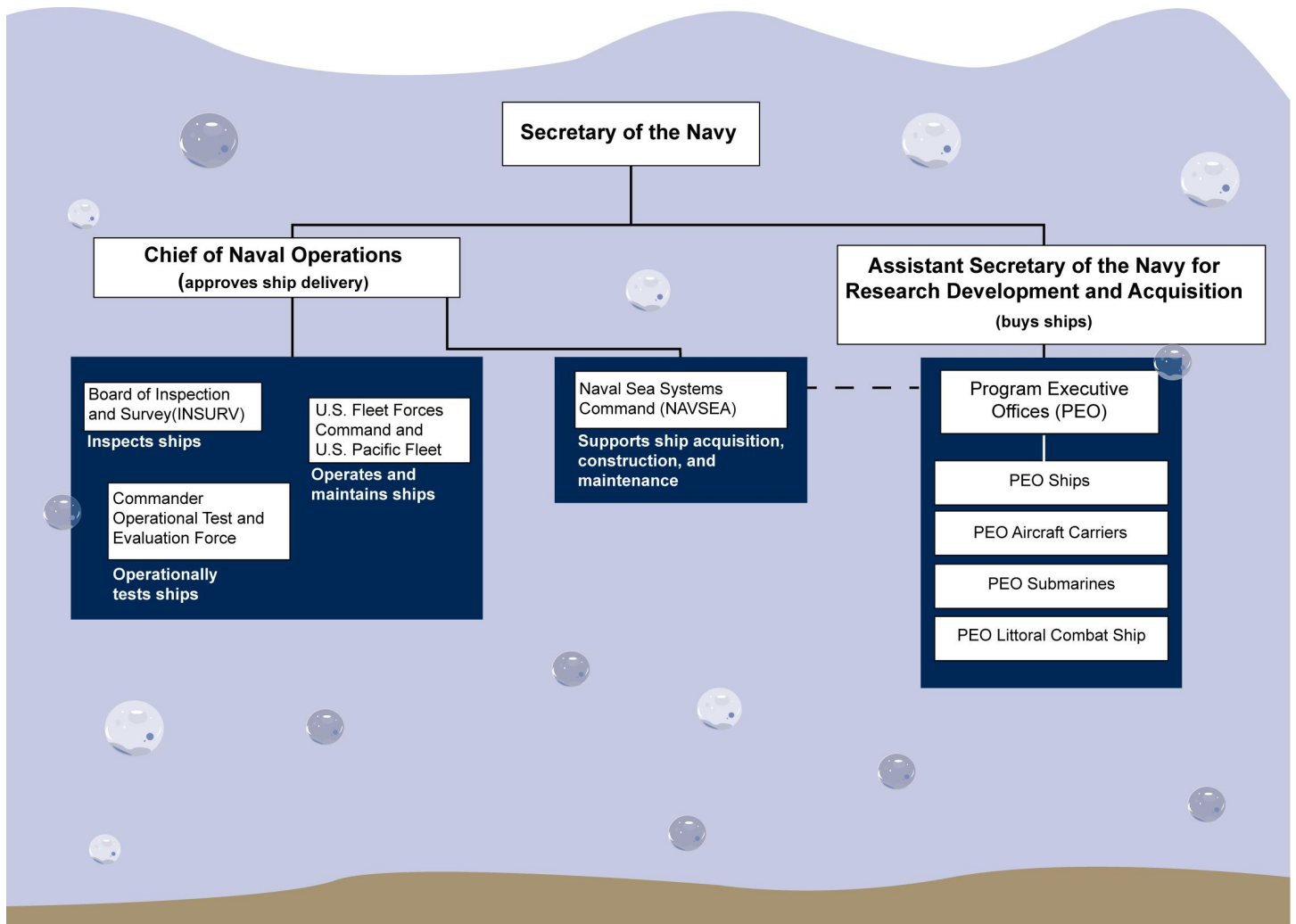
Operational Test and Evaluation: A period of testing to characterize the performance of a ship under realistic operational conditions during a discrete period of time. Testers may also use actual mission performance data and data from fleet exercises in making their assessments. In conducting operational testing, testers make a determination regarding the ship's operational effectiveness and suitability:

- For operational effectiveness, testers determine whether or not a ship can perform its missions when operated by the ship's crew.
- For operational suitability, testers determine whether or not the Navy can logistically support the ship in the field, with consideration given to interoperability, safety, and reliability, among other attributes. Interoperability measures the extent to which information systems and other equipment work with other Navy systems, and other U.S. government agencies, such as the Coast Guard. Reliability measures the probability that the system will perform without failure for a certain period of time and in certain conditions.

Key Stakeholders in the Post-Delivery Process

The post-delivery period requires coordination between many of the Navy's acquisition and fleet organizations. Figure 2 provides an overview of the organizations involved in the post-delivery period and how they fit together within the overall structure of the Navy.

Figure 2: Simplified Organizational Chart of Navy Organizations Involved in the Delivery of New Navy Ships



Source: GAO analysis of Navy data. | GAO-17-418

Note: The dotted line denotes NAVSEA's support role for the PEOs. Solid lines denote direct lines of authority.

The **Chief of Naval Operations (CNO)** is the senior military officer of the Department of the Navy. Among other things, the CNO is responsible for determining when to accept delivery of ships from the shipbuilders. The Navy's ship delivery policy, OPNAVINST 4700.8K, was written and is maintained by the Office of the CNO.

Program Executive Offices (PEO) are responsible for all aspects of their assigned shipbuilding programs, including program initiation, ship design,

construction, testing, delivery, fleet introduction, and maintenance activities. Responsibilities for managing the designing, building, and testing of new ships are assigned to a shipbuilding program office within the PEO. Program offices are responsible for implementing the Navy's delivery and post-delivery process, as prescribed in the CNO's ship delivery policy, OPNAVINST 4700.8K.

Naval Sea System Command (NAVSEA) is responsible for engineering, building, buying, and maintaining ships, submarines, and combat systems to meet the fleet's operational requirements. NAVSEA is organized by specialty, such as contracting, engineering, or quality assurance.

INSURV inspects newly constructed and in-service Navy ships to assess and track the material condition of the Navy's active fleet. For new construction ships, INSURV inspects prior to delivery (during acceptance trials) and again prior to the end of the guaranty period (during final contract trials).

Commander, Operational Test and Evaluation Force conducts operational testing and serves as an independent evaluator of a ship's capabilities and supportability. Its operational testing is overseen by **DOD's Director of Operational Test and Evaluation (DOT&E)**, who issues policy and procedures on operational testing, approves the adequacy of operational test plans, monitors and reviews all operational test and evaluation, and independently evaluates and reports test results.

U.S. Fleet Forces Command and Pacific Fleet are the operational fleet forces of the Navy that assume full financial responsibility for operating and maintaining ships at the end of post-delivery. Fleet officials include port engineers, who are responsible for ship maintenance; ship managers, who oversee all aspects of maintaining and operating the ship; and senior crew members, such as the Commanding Officer and Chief Engineer, who are responsible for operating the ships. During the post-delivery period, key organizations within the fleet are the Type Commands and the ships' crews. The Type Commands provide support during the post-delivery process and manage ship maintenance after ships are provided to the fleet. The ship's crew begins operating the ship shortly before delivery from the shipbuilder or earlier for vessels that are nuclear-powered.

Quality Assurance Metrics

Quality deficiencies are identified throughout the shipbuilding construction process. Navy program managers told us that they assess a ship’s quality and completeness using three primary metrics: (1) trial deficiency correction, (2) certification completion, and (3) casualty report correction.

Trial Deficiencies: During acceptance and final contract trials, INSURV documents deficiencies, which are categorized according to their severity, as explained in table 1.

Table 1: Navy Board of Inspection and Survey (INSURV) Deficiency Categories

Deficiency category	Description
Starred	A starred deficiency significantly degrades a ship’s ability to perform an assigned primary or secondary mission or prevents the crew from living on board in a safe manner. Examples include failures of the propulsion system critical to ship operations and key equipment malfunctions. Because of their importance, starred deficiencies must be corrected or waived by the Chief of Naval Operations prior to delivery. Starred deficiencies resulting from final contract trials must also be corrected, but there is no waiver process since the ship has already been delivered to the Navy.
Part I	A part I deficiency is likely to cause the ship to be unseaworthy or substantially reduce its ability to carry out an assigned mission. An example would be an anchor that, when deployed during testing, could not be retrieved.
Part II	A part II deficiency is a less significant deficiency that should be corrected to restore the ship to required specifications. Examples are wide ranging and can include items such as missing signage and areas of the ship having missing or damaged paint and coatings.
Part III	A part III deficiency prevents the ship from meeting Navy standards but is cost prohibitive to fix. An example is a lifeboat compartment that is too small to fit the size of a lifeboat necessary to meet Navy requirements.

Source: GAO analysis of Navy guidance. | GAO-17-418

The correction of INSURV-identified deficiencies could be the responsibility of the government or the shipbuilder, depending on the nature of the deficiency. If an INSURV deficiency is not resolved before delivery, the Navy usually aims to correct it during the post-delivery period.

Certifications: NAVSEA guidance states that the certification process is a critical tool in the effort to ensure ship systems fully meet design specifications and operational standards.¹¹ There are many different types

¹¹Naval Sea Systems Command Technical Publication S9040-AA-GTP-010/SSCR, Shipboard Systems Certification Requirements for Surface Ships, Rev. 8 (Aug. 1, 2016).

of ship certifications, from potable water to combat systems. Some certifications are common to all ships, while others apply to specific vessels; for instance, only ships with the ability to deploy aircraft or helicopters require aviation certifications, while submarines require certifications to demonstrate the ability to dive safely.

An incomplete certification indicates that required tests are incomplete or that a key system does not meet a specification or standard. The ship's crew cannot operate particular systems or complete certain missions until certifications are complete, though certifications may be partially completed. For example, a Navy ship may have an interim aviation certification, which can mean that the ship's crew can only conduct daytime operations or can fly but not maintain certain aircraft.

Casualty reports: At or around delivery, the fleet begins operating the ship and may document any mechanical issues the crew encounters in casualty reports. These reports represent significant deficiencies to the pieces of equipment that contribute to the ship's ability to perform its missions. Casualty reports demonstrate a deficiency but generally do not identify a cause. Causes could be related to construction defects, operator errors, or equipment malfunction.

Category 3 and 4 casualty reports indicate degradation to critical mission capability that needs immediate repair, while category 2 reports contain issues that are important to the fleet but do not affect the ship's core missions.¹²

Types of Post-Delivery Work

The Navy completes a range of work during the post-delivery period that varies from ship to ship, but generally falls into three categories:

- **Incomplete work** is all work that was planned to be completed during construction, but was not accomplished. There are two primary types of incomplete work:
 1. Deferred work is construction required by the shipbuilding contract but not completed prior to delivery. The Navy may shift completion

¹²The Navy uses a separate process to track minor deficiencies that do not impact operations (in essence, what could be thought of as category 1, though there is no such category).

of this work to the post-delivery period so it can take custody of the ship. In some cases, deferred work remains on the shipbuilding contract; in other cases this work is de-scoped from the original shipbuilding contract to reduce cost and schedule before ship delivery—this work is then completed under a separate contract during the post-delivery period.

2. Contractor and government-responsible deficiencies that are identified during acceptance trials, but not corrected before delivery. These deficiencies can overlap with other incomplete work.
- **Modernizations and upgrades** include work to replace existing systems and equipment either because (1) parts or tools are no longer available to maintain the system—a condition known as obsolescence—or (2) the Navy wants to upgrade the system to improve capability. According to Navy officials, a modernization replaces, but does not increase, current capability, while upgrades replace existing systems with more capable alternatives.
 - **New work** is new ship construction to implement a requirements change or add something to the ship.

Types of Funding

As many Navy organizations are involved in the post-delivery period, so are different appropriations accounts. Table 2 provides a list of appropriations accounts used during the post-delivery period.

Table 2: Types of Appropriations Used to Fund Activities during the Post-Delivery Period

Funding category	Description
Shipbuilding and Conversion, Navy (SCN)	<p>This is the main account used prior to the obligation work limiting date (OWLD), and is used for, among other things, ship construction and system installation (procurement). SCN funding is also used for</p> <ul style="list-style-type: none"> • outfitting, which involves acquiring on-board repair parts, such as valves, and • post-delivery activities such as correcting deficiencies and conducting tests and trials. <p>What is referred to as a ship's "end cost" generally includes funds used for ship construction, deferred work, and change orders.</p>
Operation and Maintenance, Navy	<p>This is the main account used after OWLD and is used for the day-to-day costs of operating naval forces. During the post-delivery period, operations and maintenance funding is used to support the ship's crew and pays for consumables such as fuel and fleet-responsible maintenance.</p>
Research, Development, Test & Evaluation, Navy	<p>This account is used for research, development, test, and evaluation efforts performed by contractors and government installations to develop equipment or purchase materials, weapons, or computer application software. These efforts may include purchases of services (such as engineering), which occur throughout the shipbuilding process, including during the post-delivery period.</p>
Other Procurement, Navy (OPN)	<p>This account finances the procurement, production, and modernization of equipment not otherwise provided for. During post-delivery, OPN is generally used to fund Chief of Naval Operations-sponsored upgrades.</p>

Source: GAO analysis of Navy policy and information from Navy officials. | GAO-17-418

Incomplete Construction Work and Quality Issues Persisted Even after Selected Ships Were Provided to the Fleet, with Lead Ships Particularly at Risk

All six ships we reviewed that had completed the post-delivery period—LPD 25, LHA 6, DDG 112, LCS 3, LCS 4, and SSN 782—were provided to the fleet with varying degrees of incomplete work and quality problems. Although the Navy resolved the majority of construction deficiencies by the end of the post-delivery period, these ships were not fully complete or free from deficiencies when provided to the fleet. Fleet officials responsible for operating and maintaining these ships reported varying degrees of concern about the overall quality of these six ships, noting that two were ready for operations upon being provided to them but that there were particular quality concerns with the other four. We also reviewed two additional ships that had yet to finish the post-delivery period—CVN 78 and DDG 1000—which are lead ships of a new class of carriers and destroyers, respectively. These ships are also at risk of being delivered to

the Navy and, eventually, provided to the fleet with incomplete work and quality problems.

Most Selected Ships Had Incomplete Work and Quality Concerns When Provided to the Fleet

We assessed six selected ships that had been provided to the fleet against metrics that Navy program managers identified as indicators of completeness and quality for new ships at the end of the post-delivery period: numbers of (1) uncorrected deficiencies, (2) incomplete certifications, and (3) open casualty reports. These metrics indicated that DDG 112 was largely complete and had few outstanding quality issues when provided to the fleet. Similarly, fleet maintenance officials stated the fleet was generally satisfied with the ship's condition. Despite some outstanding quality deficiencies, fleet maintenance officials were also satisfied with SSN 782 because the submarine was ready to deploy when it was provided to the fleet and its incomplete work did not hamper the submarine's operations. In contrast, fleet officials expressed concerns about the quality of LPD 25, LHA 6, LCS 3, and LCS 4, which had significant deficiencies when provided to the fleet. Further, fleet engineers and other officials highlighted additional quality issues beyond the scope of these metrics that may have a long-term impact on the maintenance of the ships.

Construction Completeness and Quality Metrics

Construction deficiencies: While the Navy corrected many construction-related deficiencies during the post-delivery period, all six selected ships still had unresolved construction deficiencies to varying degrees when they were provided to the fleet. INSURV identified these construction deficiencies during sea trials before delivery and categorized them by severity—with starred and Part 1 deficiencies being the most serious. Table 3 shows the quantity and severity of uncorrected INSURV-identified deficiencies at the time the ships were delivered to the Navy and at the end of the post-delivery period when the ships were provided to the fleet.

Table 3: Uncorrected Deficiencies on Selected Ships at Delivery and When Provided to the Fleet

Ship	At delivery			When provided to the fleet		
	Starred	Part I	Total ^a	Starred	Part I	Total ^a
LPD 25	0	46	970	0	3	31
LHA 6	0	74	2,420	0	8	186
DDG 112	4	33	1,286	0	0	4
Littoral Combat Ship (LCS) 3	4	107	1,426	0	11	103
LCS 4	4	100	780	2	18	183
SSN 782 ^b	22	3 ^c	293	1	5	253

Source: GAO analysis of Navy data. | GAO-17-418

^aThe total column includes all types of deficiencies (starred, Part I, Part II, and Part III).

^bSSN 782 includes deficiencies identified during combined trials and deficiencies identified during the guaranty material inspection.

^cRepresents the part I deficiencies identified by the program office. The Navy Board of Inspection and Survey identified 17 Part I deficiencies at delivery.

Note: Due to data limitations for the surface ships, this analysis does not include deficiencies from final contract trials.

As reflected in table 3, two ships were provided to the fleet at OWLD with starred deficiencies that had previously been waived by the CNO at delivery—LCS 4 and SSN 782. LCS 4 was provided with two open starred deficiencies. One of these concerned a radar system that did not work properly; this problem could have resulted in unintended countermeasure launches. This deficiency was not corrected until nearly 4 months after the ship was provided to the fleet. The other starred deficiency concerned a system planned to help LCS 4 identify friendly and enemy ships, aircraft, and other platforms. Though this system is used across the Navy, LCS 4 has a unique installation which requires additional testing to determine its capabilities and limitations. This deficiency remained unresolved nearly 1 year after the Navy accepted delivery of the ship. The second ship, SSN 782, was provided to the fleet with one open starred deficiency regarding a mast that is only used in certain operations; the CNO’s waiver allowed the fleet to install this mast rather than having the program office complete this task.

Also as reflected in table 3, five of the six ships had Part I deficiencies when they were provided to the fleet. Examples of the Part 1 deficiencies that were not resolved when these ships were provided to the fleet included

- a deficiency with a system used for refueling at sea on LHA 6,

- incomplete testing on LCS 3’s unmanned aerial vehicle (used for surveillance and minehunting), and
- a discrepancy with the refrigerant leak monitors on LPD 25.

DDG 112 was the only ship among the six that had no significant deficiencies when the ship was provided to the fleet. It had also corrected nearly all of its minor deficiencies.

Certifications: All six of the ships we reviewed had incomplete shipboard system certifications when provided to the fleet. Table 4 provides a summary of incomplete certifications for the six ships we reviewed.

Table 4: Incomplete Shipboard System Certifications on Selected Ships at Delivery and When Provided to the Fleet

	Total system certifications needed for deployment	Incomplete at delivery	Incomplete when provided to the fleet
LPD 25	58	25	14
LHA 6	50	39	7
DDG 112	42	19	1
Littoral Combat Ship (LCS) 3 ^a	44	26	14
LCS 4 ^a	46	29	16
SSN 782	14	1	2

Source: GAO analysis of Navy data. | GAO-17-418

^aThis analysis does not include certifications for the LCS mission packages. LCS 3 and LCS 4 mission package certifications were incomplete when these ships were provided to the fleet.

Navy officials identified several reasons why ship certifications may occur during the post-delivery period—or even after a ship is provided to the fleet—including incomplete installation of critical equipment needed to conduct certifications or challenges in scheduling certification activities, among other things. Among the six selected ships we reviewed, a majority of the required shipboard system certifications were incomplete at delivery, and a large number of these were completed during the post-delivery period. However, in some cases, certifications were not completed before these ships were provided to the fleet, which could have restricted the conduct of certain mission-critical functions. In some cases in which the ship was provided to the fleet with incomplete certifications, the program office continued to oversee the completion of this work shortly after OWLD; in other cases, however, the fleet was responsible for the certifications. For instance, three ships—LCS 3, LCS 4, and LHA 6—were provided to the fleet without full aviation certifications, restricting these ships’ aviation operations until the certification requirements were met. In the case of LHA 6, the ship was

not authorized to fully operate the Joint Strike Fighter when the ship was provided to the fleet, even though the Navy spent \$60 million during the post-delivery period modifying it for Joint Strike Fighter operations. One of the items preventing a full aviation certification on LHA 6 was incomplete work on a lithium-ion battery shop, which charges and stores batteries used by the Joint Strike Fighter for a variety of purposes, including starting the aircraft's integrated power system. According to a senior fleet official, work on the lithium-ion battery shop was not scheduled for completion until December 2016, 9 months after the ship was provided to the fleet. This work is now complete.

Casualty reports: According to officials with two of the program offices, ships should not be provided to the fleet with open category 3 or 4 casualty reports, and some officials stated there should be very few in the less severe categories by the end of the post-delivery period. While the fleet submits casualty reports starting at delivery, the program office is responsible for correcting construction-related problems prior to providing a ship to the fleet. Fleet officials stated that casualty reports submitted within the first 3 months of fleet operations are generally indicative of the ship's quality, since the crew will begin more fully operating the ship's systems and equipment and submitting casualty reports when they identify problems. However, officials from several program offices disagreed with this assessment and stated that some deficiencies after the ship is provided to the fleet are due to operator error and are not related to construction quality. Table 5 summarizes the open casualty reports at the time these six selected ships were provided to the fleet and after their initial 3 months of operation.

Table 5: Category 2 and 3 Casualty Reports on Selected Ships at Key Milestones

	Open when ship provided to fleet		Casualty reports submitted within the first 3 months after the ship was provided to the fleet	
	Category 2	Category 3	Category 2	Category 3
LPD 25	7	0	13	1
LHA 6	17	2	51	2
DDG 112	4	0	6	0
Littoral Combat Ship (LCS) 3	6	0	19	8
LCS 4	12	2	41	19
SSN 782	3	0	16	0

Source: GAO analysis of Navy data. | GAO-17-418

Two of the selected ships had open category 3 casualty reports when the program offices provided the ships to the fleet, and more than half of the ships had casualty reports within the first 3 months of fleet operations. For example, on LHA 6, the program office did not repair an electronic warfare system before the end of the post-delivery period, resulting in a casualty report when the ship was provided to the fleet. In addition, four ships had equipment that failed during the post-delivery period and failed again within 3 months—requiring the fleet to pay for at least a portion of the repair. Furthermore, DOT&E reports confirm that these same pieces of equipment were found to be unreliable during testing, except for the equipment on LHA 6 because this ship has yet to be tested. Examples of equipment that broke during the post-delivery period, after the ship was provided to the fleet, and had issues during testing include

- anchor system and air search radar (LCS 3);
- water jet, radar and propulsion systems (LCS 4); and
- steering system, including steering oil migration (LPD 25).

Fleet Impressions of Overall Ship Quality

Fleet officials, including engineers, maintenance officials, managers, and crew, identified additional issues beyond the ship completeness and quality metrics discussed above that significantly degraded the quality of four of the six ships we reviewed. Fleet officials told us they were generally satisfied with DDG 112 and SSN 782, as these ships were largely complete and ready to deploy when provided to the fleet, did not require significant work, and could be maintained within the fleet’s budget and schedule. For example, while SSN 782 and DDG 112 were provided

to the fleet with incomplete certifications, fleet officials reported that the program offices paid for the work to complete these certifications and there were no other major outstanding construction deficiencies that affected the ships' ability to deploy. In contrast, we found that fleet engineers, operators, and other officials had some quality concerns about LPD 25 and another ship, and significant concerns about the quality of LCS 3 and LCS 4 after these ships were provided to the fleet. Table 6 provides examples of the quality issues identified by fleet officials on these ships.

Table 6: Examples of Fleet-Identified Quality Issues on Three Selected Ships

Ship	Description
Littoral Combat Ship (LCS) 4	The flexible coupling on the starboard main propulsion diesel failed in transit from Hawaii to the ship's forward deployed station. This casualty resulted in loss of propulsion to one of the four engine shafts and the ship returned to Hawaii for repairs. These couplings were intended to last the life of the ship and no spare parts were available, so repairs were made using a different type of coupling. The Navy has since developed an updated measurement method and analysis to ensure satisfactory shaft alignment.
LCS 3 and LCS 4	A contractor-furnished communications system that connects the ship with other platforms frequently fails, with no spare parts available. The fleet has had difficulty maintaining and repairing it and is seeking a replacement.
LPD 25	LPD 25 and other ships in its class were constructed with a contractor-furnished electronics system that controls nearly all systems and equipment on the ship. The system has experienced widespread performance failures and the Navy has been unable to repair the ship efficiently, including during the post-delivery period and after the ship was provided to the fleet. As a result, the Navy is in the process of looking at incorporating a new system.

Source: GAO analysis of Navy documentation and interviews with fleet officials. | GAO-17-418

These additional fleet concerns about quality can stem from differences in how the fleet and the shipbuilding program offices assess the quality of new ships. The program offices generally define quality as the degree to which the ship is constructed according to its contract specifications—that is, the design of the ship. In contrast, according to fleet managers and maintenance officials, the fleet's assessment of quality is based on a ship's operational capability and maintenance considerations. For example, program officials stated that the contractor-furnished communications system on LCS 3 and LCS 4, discussed in table 6, meets quality expectations because it was installed in accordance with the contractor's specifications. However, fleet officials have found this system to be of poor quality because it is unreliable and difficult to maintain. According to fleet officials, not addressing these types of quality issues by the end of the post-delivery period results in shifting costs to the fleet's operations and maintenance funding and contributes to a maintenance backlog from the first day the fleet is responsible for the ship. Our recent work has found that maintenance shortfalls generally

increase throughout the life of a ship, which increase costs and consume time that is needed for training and operations.¹³

Delivery Strategies for CVN 78 and DDG 1000 Mean Navy Will Accept Ships with Incomplete Construction Work and Unknown Quality

DDG 1000 and CVN 78 are technologically complex, first-in-class ships for which the Navy is pursuing delivery and post-delivery plans that deviate significantly from the Navy's process for constructing more typical surface ships. For these two programs, the Navy plans to rely on waivers or exceptions to its policy, allowing it to accept delivery of these ships from the shipbuilder in incomplete condition. This will, in turn, lead to the Navy conducting more work during the post-delivery period than the other ships we reviewed, including deferring a substantial amount of construction work to the post-delivery period to save money, reach delivery more quickly, or incorporate later versions of technology, among other reasons.

For CVN 78, cost growth and delays led the Navy to accept delivery of the aircraft carrier with a substantial amount of incomplete work. In the case of DDG 1000, the Navy has planned a two-phase construction approach in which the hull, mechanical, and electrical systems were delivered first, prior to the combat systems. The Navy is now planning a delivery approach for CVN 79, the second ship in the Ford class, which is similar to that of DDG 1000. For CVN 78 and DDG 1000, the Navy plans to complete significantly more work and testing during the post-delivery period than the other six ships we reviewed. As such, CVN 78 and DDG 1000 are at greater risk of being provided to the fleet at the end of their post-delivery periods with incomplete construction work and unknown quality.

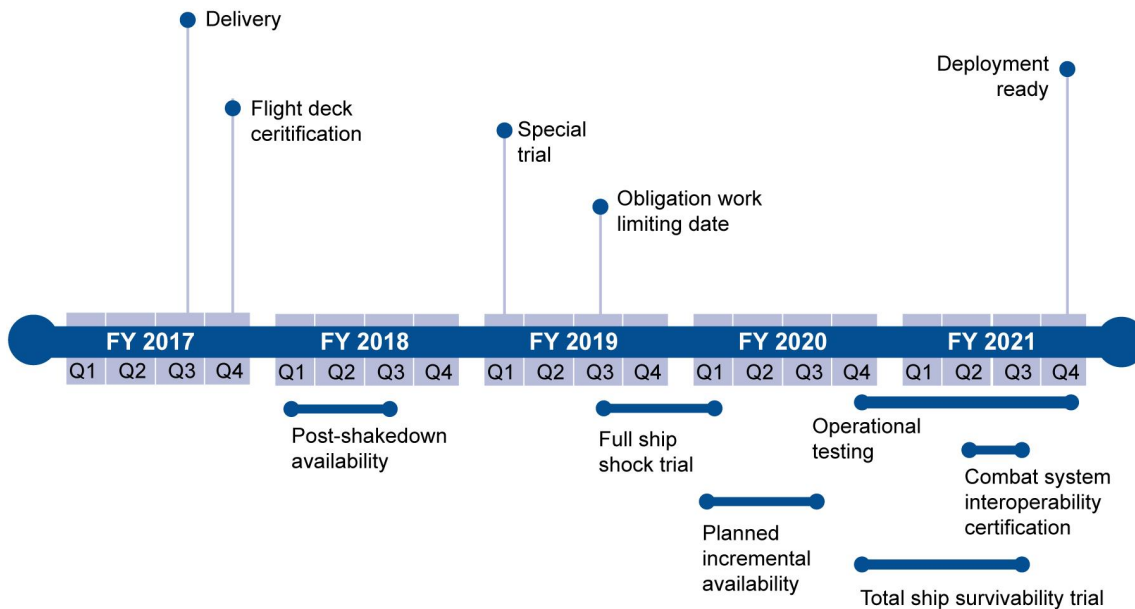
CVN 78

The Navy took delivery of CVN 78 with a significant amount of work scheduled for completion during the post-delivery period, including completing construction and executing a number of tests and trials. Some of this work, particularly several tests and trials, is not scheduled until

¹³GAO, *Military Readiness: Progress and Challenges in Implementing the Navy's Optimized Fleet Response Plan*, [GAO-16-466R](#) (Washington, D.C.: May 2, 2016).

after the ship will have been provided to the fleet (following OWLD). For example, at delivery, the ship will have yet to complete its navigation certification and cybersecurity inspection; in addition, as planned, the carrier will not yet have all of the certifications necessary to conduct aviation operations, among other things. The magnitude of construction work that has been deferred to the post-delivery period has also contributed to the Navy’s decision to schedule combat and warfare systems certification after the ship is provided to the fleet. For this reason, CVN 78 will not be ready for deployment until fiscal year 2021 at the earliest, even though the Navy accepted delivery of the ship in May 2017 and plans to provide it to the fleet in fiscal year 2019, as shown in figure 3.

Figure 3: Major Tests and Trials Planned for CVN 78 Post-Delivery



FY Fiscal Year
Q Quarter

Source: GAO analysis of Navy Documentation. | GAO-17-418

The completion of the aircraft carrier’s outstanding tests and trials, deferred construction, and other work is planned to cost nearly \$780 million and take more than 4 years to complete.¹⁴ For example, the Navy

¹⁴For additional details on how the Navy plans to fund CVN 78’s post-delivery activities, see appendix II.

plans to spend over \$400 million to conduct several years of testing, including full ship shock trials, total ship survivability trial, and operational testing, with associated maintenance to correct deficiencies from these tests and trials. As we have previously found, construction challenges and continuing work on maturing technologies—combined with a \$12.9 billion construction cost cap, which the program office is actively managing to—have resulted in the Navy’s decision to accept delivery of CVN 78 with incomplete work.¹⁵

The timely and successful execution of tests and trials during the post-delivery period remains dependent on the maturity of key technologies, including the advanced arresting gear (used to stop aircraft on the flight deck), dual band radar (used to track aircraft among other tasks), and advanced weapons elevators (used to move ordnance). For instance, program officials reported that only 2 of the 11 advanced weapons elevators will be installed prior to delivery; the installation, testing, and certification of the other 9 elevators have been deferred to the post-delivery period. Additionally, while installation of the advanced arresting gear and dual band radar is complete on CVN 78, the Navy plans to continue testing these systems during the post-delivery period to verify they will perform as intended. It is likely that significant work will be required on all three of these systems during CVN 78’s post-delivery period, particularly because DOD’s Director of Operational Test and Evaluation found in June 2016 that each system continues to have poor or unknown reliability. According to DOT&E’s report, these reliability issues are the most significant risk facing the program.

Beyond the completion of these tests and trials, in November 2014, we found that CVN 78 will have significant incomplete construction work at delivery, which is being deferred to the post-delivery period.¹⁶ This deferred work included building 367 compartments that were de-scoped from the shipbuilding contract, installing 12 government furnished systems not completed during construction, installing 10 modernized systems, and completing at least 147 other work deferral requests. The CVN 78 program office estimates that this deferred work will cost at least

¹⁵GAO, *Ford-Class Aircraft Carrier: Congress Should Consider Revising Cost Cap Legislation to Include All Construction Costs*, [GAO-15-22](#), (Washington, D.C.: Nov. 20, 2014).

¹⁶[GAO-15-22](#).

\$65 million. Table 7 provides examples of construction work on CVN 78 that has been deferred to the post-delivery period.

Table 7: Examples of CVN 78 Deferred Post-Delivery Work

Type of deferred work	Examples of deferred work
De-scoped compartments	Construct berthing spaces; food service spaces; sanitary spaces; mission spaces.
Government-furnished systems	Deliver and install systems to detect chemical weapons and various modernized systems, such as: consolidated afloat network and enterprise services, carrier-tactical support center, distributed common ground station, and surface electronic warfare improvement program.
Work deferral requests	Work on systems that are already scheduled for other post-delivery work; correction of construction deficiencies; and work that would delay completion of shipboard test program if done during construction.

Source: GAO analysis of Navy documents and interviews with program officials. | GAO-17-418

Due to the magnitude of deferred work planned for the CVN 78 post-delivery period, PEO Aircraft Carriers has determined that a final contract trial, which typically occurs before the post-shakedown availability per the Navy’s ship delivery policy, would be of limited utility for CVN 78. Instead, the Navy’s senior aircraft carrier acquisition official has requested the CNO waive the requirement for a final contract trial and grant permission for the program to conduct a special trial after the post-shakedown availability, when the deferred work will be complete and the crew will have completed training on the aircraft carrier’s new systems. When requesting this permission, the official provided the CNO with advance notice that the program would require a waiver at delivery for the work that will be deferred to the post-delivery period.

DDG 1000

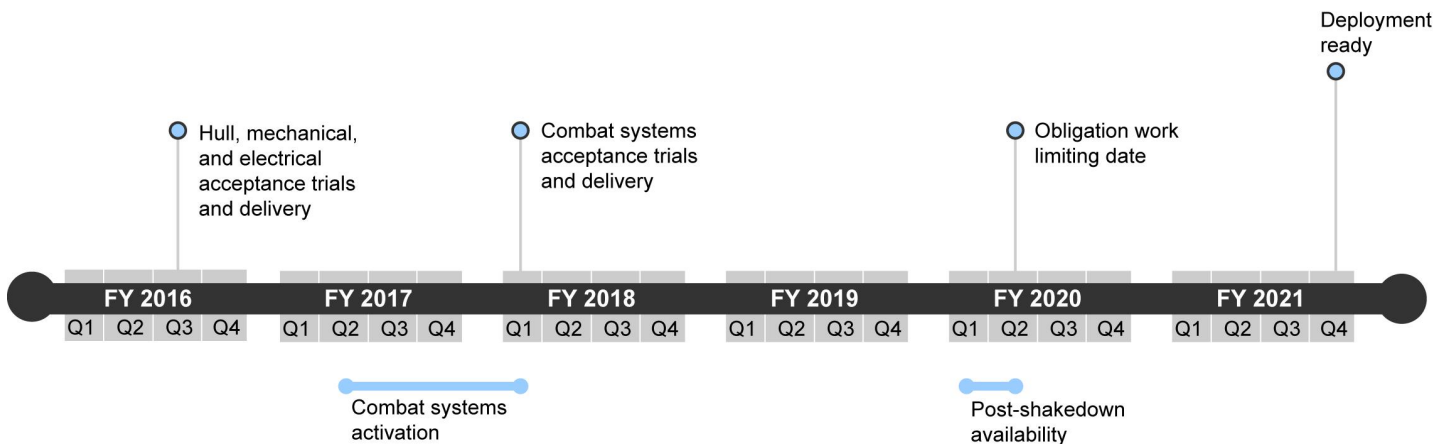
By design, the Navy planned to deliver DDG 1000 in two phases—the first phase included only the hull, mechanical, and electrical systems of the ship, followed by a second phase to activate the combat systems.¹⁷ In May 2016, the Navy accepted delivery of the hull, mechanical, and electrical portion of the ship and is now beginning post-delivery efforts, including combat systems activation and the installation of several shipboard systems, such as the navigation system, the close-in gun system, the communications system, and advanced flight deck lighting. Following combat systems delivery planned for fiscal year 2018, DDG

¹⁷The Navy plans to pursue a similar two-phased delivery approach for CVN 79.

1000 will begin 2 years of tests and trials, during which time the ship will complete various certifications and an operational evaluation.

As a result of delays during construction of the hull and the two-phased approach, 24 required shipboard system certifications were incomplete at delivery, including the certifications for aviation and navigation. For example, testing of the advanced stabilized glide slope indicator, which is a helicopter landing system that previously encountered challenges and delays on LCS 3 and 4, was deferred to the post-delivery period. Given the scope of deferred work and testing, DDG 1000 will not be provided to the fleet until fiscal year 2020 (potentially a delay of more than a year from the Navy’s estimates in 2016), making this the longest post-delivery period of the eight ships we reviewed. Figure 4 provides an overview of the post-delivery schedule for DDG 1000, with hull, mechanical, and electrical delivery occurring approximately 5 years before the ship will be deployment-ready.

Figure 4: DDG 1000 Post-Delivery Schedule as of November 2016



FY Fiscal Year
Q Quarter

Source: GAO analysis of Navy Documentation. | GAO-17-418

When the hull, mechanical, and electrical systems were delivered, DDG 1000 had 32 unresolved starred deficiencies that required CNO waivers and 291 uncorrected Part I deficiencies, out of an overall total of 3,457 trial deficiencies on these systems. For example, INSURV issued a starred card on DDG 1000’s navigation system, which the CNO had to waive before the Navy could accept delivery. At the time of the acceptance trial, the ship was equipped with a temporary navigation

system; its planned navigation system will be installed during the post-delivery period.

INSURV and the DDG 1000 program office plan to hold a second acceptance trial for the ship's combat systems during the post-delivery period. During this second acceptance trial, the program plans to have INSURV re-inspect the hull, mechanical, and electrical deficiencies that have been corrected. Currently, the Navy's program office is not planning on conducting a final contract trial because the two-phased delivery approach calls for post-delivery work well beyond that of the original shipbuilding contract.

The Navy's Ship Delivery Policy Does Not Facilitate a Process That Provides Complete and Quality Ships to the Fleet

The Navy's ship delivery policy emphasizes the importance of ensuring that defect-free and mission capable ships are provided to the fleet. But the policy does not elaborate on which defects it is referring to or when they should be corrected. All Navy program offices we spoke with said that, in general, delivering a ship free from all government and contractor deficiencies is not realistic—for instance, some deficiencies require a disproportionate amount of time or money to correct that do not merit the costs of delaying ship delivery. In addition, while the policy states that ships will be fully mission-capable, it does not define what levels and aspects of performance would meet that objective. Further, the policy identifies INSURV as the independent entity responsible for verifying the quality of Navy ships and making a recommendation for fleet introduction. However, we found that INSURV does not make a recommendation for fleet introduction because its inspections occur well before ships are provided to the fleet. As a result, INSURV does not assess the condition of the ships after the majority of post-delivery work is completed, and therefore cannot ensure that all defects have been corrected prior to ships being provided to the fleet at OWLD.

Delivery Policy Lacks Specificity Regarding Its Goal of Providing Complete and Defect-Free Ships

The Navy's ship delivery policy does not provide sufficient guidance or specificity on (1) what constitutes a defect-free ship, (2) what constitutes

a mission-capable ship, and (3) the timing of when newly constructed ships are to be free from deficiencies and mission-capable. In the absence of clarity, we found that Navy program officials have different interpretations regarding how to meet the policy's goals and by when, resulting in variations in quality among ships provided to the fleet—including deficient and incomplete ships.

Lack of Definition of a Defect-Free Ship

Although the Navy's policy asserts a goal of providing defect-free ships to the fleet, it does not define what types of deficiencies must be corrected in order for a ship to be considered free of deficiencies. Specifically, the policy requires that Navy shipbuilding programs deliver to the Commander of U.S. Fleet Forces Command "complete ships, free from both contractor and government responsible deficiencies."¹⁸ However, the policy does not explain what constitutes a defect-free ship with respect to providing ships to the fleet.¹⁹

A clear and comprehensive definition is important because it provides a framework for measuring performance. According to the *Standards for Internal Control in the Federal Government*, government agencies must create policies that are clear and measurable, and use performance measures to assess whether or not the designed policy objective is being achieved.²⁰ In the absence of a clear definition, ship program offices do not have a consistent view regarding what standards constitute a defect-free ship. We asked each of the seven program offices responsible for constructing the eight ships we reviewed to define what constitutes a complete and quality ship when provided to the fleet. Table 8 illustrates the varying responses we received.

¹⁸OPNAV Instruction 4700.8K, Trials, Acceptance, Commissioning, Fitting Out, Shakedown, and Post Shakedown Availability of U.S. Naval Ships Undergoing Construction or Conversion para. 3 (Oct. 15, 2014). (Hereinafter cited as OPNAVINST 4700.8K (Oct. 15, 2014)).

¹⁹The policy contains definitions for three types of deficiencies—significant construction deficiencies, single-starred deficiencies, and double-starred deficiencies—and requires that any such deficiencies be corrected or waived before certain activities such as trials or delivery to the Navy. The policy does not, however, define what it means for a ship to be defect-free at the time it is provided to the fleet.

²⁰[GAO-14-704G](#).

Table 8: Program Office Views on Work and Defect Correction Necessary for a Ship to Be Considered Complete

Standard(s) that should be achieved when ship is provided to the fleet, according to program officials	Number of program offices that identified each standard (out of 7)
All starred deficiencies corrected	6
All Part 1 deficiencies corrected	4
All, or primary, shipboard systems installed, tested, and certified	3
All contract terms fulfilled by the shipbuilder and other contractors	3
No known deficiencies that would place a significant financial burden on the fleet corrected	2
No open category 3 or higher casualty reports	2
Any major repair work corrected and approved modernizations completed	1

Source: GAO interviews with Navy officials. | GAO-17-418

Note: Some definitions provided by different program offices could overlap. For example, an incomplete modernization could be documented as a starred card and a casualty report.

In addition, officials from every program office we spoke with stated that providing a ship free from all government and contractor deficiencies is simply not realistic. In particular, several of these officials stated that the Navy may decide to leave some deficiencies uncorrected if the repair would be cost-prohibitive or if the deficiency has minimal impact on the capability of the ship. The current ship delivery policy does not account for these situations. In practice, ship program offices balance risk and cost when choosing what deficiencies to correct during the post-delivery period. For example, low-cost items with a high impact on capability or quality will be fixed first, while high-cost items with low impact on quality will be prioritized much lower.

Officials from the Office of the CNO (responsible for the ship delivery policy) reported a similar caveat to the stated goal of providing deficiency-free ships to the fleet. According to these officials, ships are considered to be free from deficiencies as long as all defects have been “adjudicated”—in other words, the deficiencies have been identified and there is a plan to fix them. However, the ship delivery policy does not include this caveat and provides no guidance for how to prioritize deficiencies. In the absence of clear and comprehensive guidance that realistically establishes what it means to provide a defect-free ship to the fleet, including the types of deficiencies that must be corrected, program offices

and fleet representatives will continue to have a conflicting understanding of the policy's goal of providing complete and quality ships to the fleet.

Mission Capability Definition Excludes Ship Performance

While the Navy’s ship delivery policy states that ships should be mission-capable, the policy does not define what levels and aspects of performance would meet that objective. The policy states that ships should be “capable of supporting the Navy’s mission” and “fully mission capable, in the sense that all contractual responsibilities shall be resolved, prior to delivery, except for crew certification, outfitting, or special Navy range requirements which cannot be met until after delivery.”²¹ However, the policy does not define full mission capability in terms of the ship’s operational effectiveness and suitability in general—metrics typically associated with determining mission capability in DOD acquisition guidance. Operational suitability assesses the reliability, maintainability, and availability of a ship, which inform the Navy’s assessment of the probability that the ship will perform without failure for a certain period of time and in certain conditions. While the Navy conducts testing to determine the operational suitability of new ship classes, program offices do not factor these tests into their assessment of full mission capability and therefore do not consider the results of these tests prior to providing new ships to the fleet. For example, the Navy decided to provide LHA 6 to the fleet before it had completed these tests. In addition, CVN 78, also a lead ship, is planned to be provided to the fleet prior to undergoing an operational suitability assessment during testing. The policy does not address the role of operational suitability in a ship’s ability to be mission-capable or whether a ship should be provided to the fleet that has yet to be operationally tested.

Furthermore, the ship delivery policy makes no distinction between early-in-class ships and later-in-class ships, which Navy program and fleet officials identify as a key predictor of completeness and quality, with earlier ships being more likely to experience problems. For example, three of the six ships we reviewed (LCS 3, LCS 4, and LHA 6), all earlier in class, were provided to the fleet either without being tested or after being found unsuitable for fleet operations due to unresolved concerns regarding the equipment reliability, maintainability, crew training, or other aspects crucial to successfully demonstrating adequate mission performance.

²¹OPNAVINST 4700.8K, paras. 3 and 5 (Oct. 15, 2014).

Table 9 illustrates the status of operational suitability of the classes of ships at the time the six ships we reviewed were provided to the fleet.

Table 9: Status of Operational Suitability of the Ship Class When Six Ships We Reviewed Were Provided to the Fleet

Ship/variant	Position in ship class	Ship class tested and found to be operationally suitable
<i>LPD 25</i>	9th	Yes ^a
LHA 6	1st	Not tested
<i>DDG 112 – Flight IIA</i>	62nd	Yes
Littoral Combat Ship (LCS) 3 – Freedom Variant	2nd	No
LCS 4 – Independence Variant	2nd	Inconclusive ^b
<i>SSN 782</i>	9th	Yes

Source: GAO analysis of Navy documentation. | GAO-17-418

Note: Italics indicates that testing was conducted on ships earlier in the class.

^aThe LPD 17 class of ships were initially determined not to be operationally suitable but eventually passed testing after several retests. By that time, 7 ships of the class had been provided to the fleet.

^bThe Navy’s operational testers found LCS 4 to be operationally effective and suitable. However, DOD’s Director, Operational Test and Evaluation found the ship to be neither operationally effective nor suitable. Both evaluators agree that the ship has significant reliability problems.

One reason later-in-class ships are generally better quality than earlier-in-class ships is that the Navy makes corrections based on tests and feedback from operational missions that may be factored into the design and construction of future ships. However, the policy does not articulate mission capability in terms of operational effectiveness and suitability metrics and does not make any distinctions for early or first-in-class ships. *The Standards for Internal Control in the Federal Government* emphasize the importance of clearly defined and specific objectives.²² Incorporating a mission capability definition that includes levels and aspects of ship performance into the Navy’s policy would provide program offices and fleet representatives more clarity about the expected level of capability of ships when they are provided to the fleet.

Unclear Timing for Resolving Defects and Achieving Mission Capability

In addition to a lack of definitional clarity, the Navy’s ship delivery policy does not specify when a ship should be defect-free and mission-capable. The Navy’s ship delivery policy and officials with the Office of the CNO,

²²[GAO-14-704G](#).

who are responsible for the policy, identify two different time frames regarding when ships should be complete, defect-free, and mission capable:

1. at delivery, when the Navy accepts custody of the ships, and
2. at OWLD, when the Navy provides the ship to the fleet.

Consequently, we found confusion among policy makers and program offices as to when a defect-free and mission-capable ship is expected to be achieved. We have identified this issue in our previous work and made recommendations, which have not been addressed to date. Specifically, in November 2013, we found that CNO officials stated that the intention of the ship delivery policy was for ships to be defect-free and fully mission-capable when delivered from the shipbuilder; that is, at the beginning of the post-delivery period. At the same time, however, we also found that program officials believed a ship did not need to be free from deficiencies and fully mission-capable until it was provided to the fleet, that is, at the end of the post-delivery period. We recommended in our November 2013 report that the Navy clarify the policy with regard to the point at which deficiencies are to be fully corrected.²³ DOD partially concurred with this recommendation and stated that the Navy's goal is to reduce the number of deficiencies at delivery to zero "when practical," although the ship delivery policy itself includes no such caveat. The Navy revised its ship delivery policy in October 2014 to clarify roles and responsibilities, among other things, but the timing of defect correction and mission capability was neither clarified nor addressed. Office of the CNO officials stated that they were not aware of our recommendation when revising the policy.

Similarly, in speaking with a range of officials across the Navy for this review, we continued to find conflicting views on when ships are to be deficiency-free and mission-capable. CNO officials responsible for the policy told us that ships should be free of all deficiencies by the time they are provided to the fleet, meaning *at the end* of the post-delivery period at OWLD, which is a change from their previous interpretation of the ship delivery policy that they authored. However, the policy does not include this clarification on the timing. In contrast, INSURV officials told us they believe the policy states that the shipbuilder should deliver defect-free ships *at the beginning* of the post-delivery period, with a few exceptions for items that can only be accomplished during the post-delivery period.

²³GAO, *Navy Shipbuilding: Opportunities Exist to Improve Practices Affecting Quality*. GAO-14-122 (Washington, D.C.: Nov. 19, 2013).

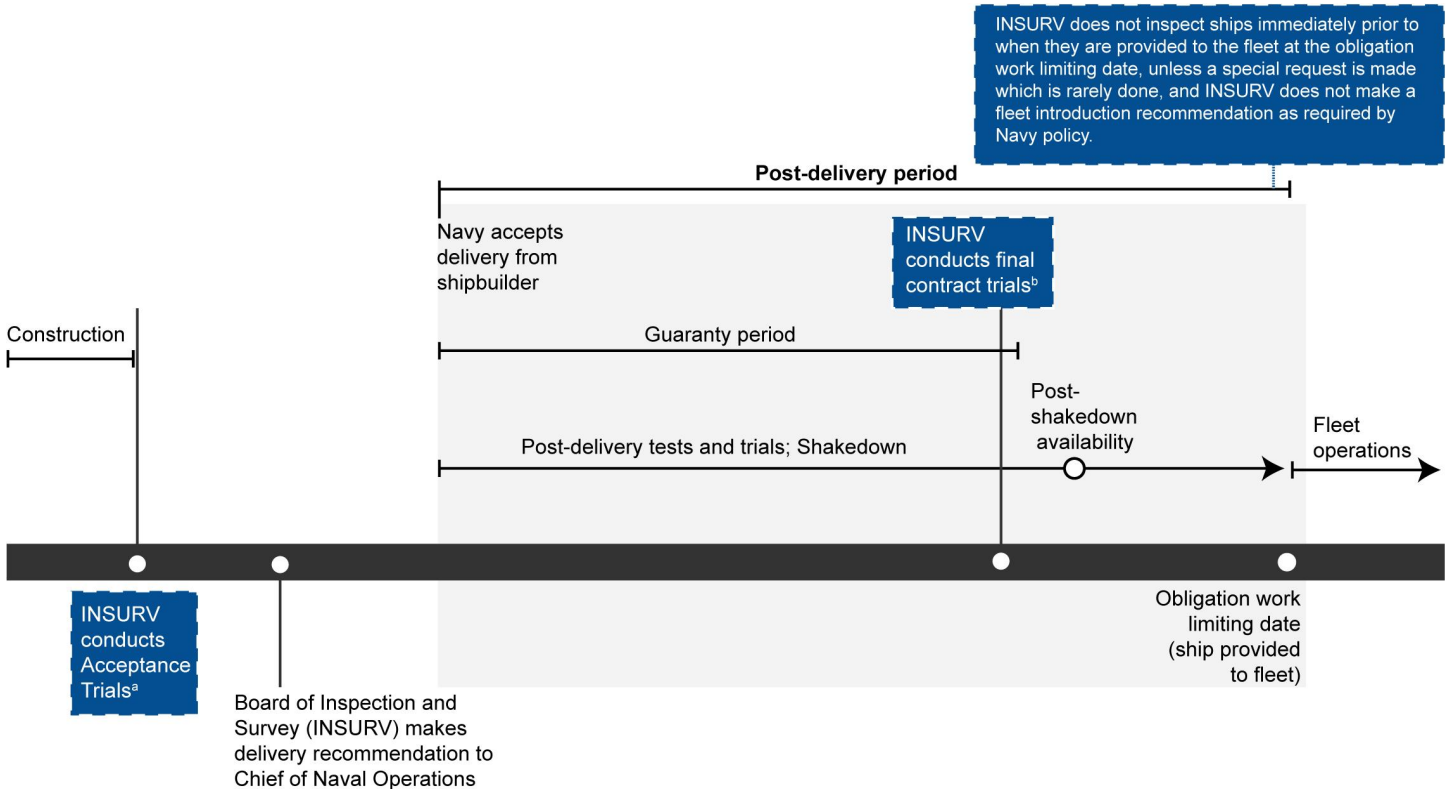
However, as noted above, the Navy often delivers ships with open starred deficiencies, INSURV's most severe category of ship deficiency. For the eight ships we reviewed, INSURV identified a total of 117 starred cards before delivery during acceptance trials. Twelve starred cards were corrected prior to delivery while the remaining 105 were waived by the CNO. Despite these deficiencies, INSURV recommended that the CNO accept the ships. In fact, INSURV officials stated that they have only recommended against delivery one time in 18 years. *Standards for Internal Control in the Federal Government* require objectives to be clear and measureable. Without clarifying when ships should achieve a certain level of completeness and quality, the Navy does not have a clear standard or objective against which it can measure the condition of its ships and ensure quality.²⁴

INSURV Does Not Verify Ship Quality When Ships Are Provided to Fleet, as Required by Policy

The Navy's ship delivery policy identifies INSURV as the independent entity charged with verifying the quality of ships at delivery and recommending introduction to the fleet. But we found a disconnect between the Navy's policy and INSURV's practice. While INSURV makes a recommendation for ship delivery, officials stated that they do not make a recommendation for provision to the fleet because ship trials are not well-timed to independently verify the completeness and quality of ships at the point when they are provided to the fleet. As figure 5 illustrates, INSURV currently conducts acceptance trials and final contract trials prior to delivery and the post-shakedown availability, respectively, but does not conduct a trial between the post-shakedown availability and the end of the post-delivery period (at OWLD)—the point at which ships are provided to the fleet.

²⁴[GAO-14-704G](#).

Figure 5: Timing of INSURV Inspections during the Post-delivery Period



Source: GAO analysis of OPNAVINST 4700.8K and Navy documentation. | GAO-17-418

^aFor submarines, the trial before preliminary acceptance is called the combined trial.

^bFor submarines, the trial before the post-shakedown availability is called the guaranty material inspection.

Significant work is conducted during the post-shakedown availability. For the six ships we reviewed that have completed the post-delivery period, post-shakedown availability costs ranged from approximately \$30 million to \$83 million per ship and ranged in duration from 3 months to 16 months. According to INSURV officials, the post-shakedown availability used to be a minor availability but, increasingly, ships are undergoing higher intensity and more complex activities during this period, including correcting starved INSURV deficiencies, finishing construction, installing new systems, and modernizing equipment. For instance, of the four ships we reviewed that had starved deficiencies waived at delivery, all four had starved cards that remained open during INSURV’s final contract trials because the program office planned to fix these deficiencies during the

post-shakedown availability.²⁵ The correction of these starred deficiencies was therefore not inspected by INSURV. According to INSURV officials, because a significant amount of work is conducted during the post-shakedown availability, the ship's condition at final contract trials is not indicative of the ship's condition when it is provided to the fleet following this availability. Therefore, INSURV cannot make a recommendation for fleet introduction based on the final contract trial—INSURV's last inspection before ships are provided to the fleet.

As a result, the Navy is providing ships to the fleet with systems and equipment that were repaired or changed during the post-shakedown availability and have not been verified by INSURV, creating a greater potential for breakdowns or failures that would be the responsibility of the fleet to repair. For example, INSURV identified leaking couplings during LPD 25's acceptance trial in October 2013. The LPD 17 program repaired the couplings during the ship's post-shakedown availability in June 2015—after INSURV had conducted the final contract trial in November 2014. The ship was then provided to the fleet in July 2015. Shortly after the ship was provided to the fleet, according to fleet engineers and operators, the new couplings—designed to last the life of the ship—failed again, requiring the fleet to pay approximately \$600,000 every 3 months to replace them each time they failed. The root cause remains under investigation, according to fleet engineers, although program officials stated that the leaks were due to a manufacturing defect that has now been corrected. In another example, INSURV identified several issues with LCS 3's anchor that precluded the crew from retrieving it. The LCS program office repaired the anchor during the post-shakedown availability, following final contract trials. Following fleet introduction, the anchor failed again, and the fleet was required to fix it.

Under the current practices, INSURV also does not have an opportunity to inspect ship changes that are implemented during post-shakedown availability. LHA 6, for example, was modified so it can operate with the Joint Strike Fighter—these changes totaled approximately \$60 million—but INSURV did not inspect the changes. Resolving complications from this work, such as issues with the lithium-ion batteries we noted above, will be the fleet's responsibility. Lastly, several programs install new equipment during the post-shakedown availability, such as aviation and information technology systems. In the absence of an INSURV fleet

²⁵The four ships are: DDG 112, SSN 782, LCS 3, and LCS 4.

introduction recommendation, the Navy's current practice does not align with its ship delivery policy, and uninspected equipment is provided to the fleet.

There are some rare cases in which INSURV and the program office have agreed to inspect specific issues after the post-shakedown availability and before the ship is provided to the fleet. For instance, INSURV conducted a limited post-repair trial on LCS 3 that looked at a few specific issues, such as the anchor, and it plans to conduct a special trial on CVN 78 following the aircraft carrier's post-shakedown availability.

Navy program office and INSURV officials cited two factors that influence the timing of final contract trials. First, the final contract trial occurs just prior to the end of the guaranty period, which enables INSURV to identify deficiencies the contractor may be responsible for correcting prior to the expiration of the guaranty period.²⁶ Second, INSURV and program officials stated that final contract trials inform the program office's prioritization of deficiency correction during the post-shakedown availability. Program officials stated that this ensures that construction funding (SCN) is obligated for the highest-priority post-delivery work before OWLD—the final point at which the Navy can obligate shipbuilding and conversion funds before providing the ship to the fleet. While the timing of final contract trials facilitates the prioritization and funding of post-delivery work, it is not optimally aligned to verify that the work completed during post-shakedown availability meets quality standards before a ship is provided to the fleet.

INSURV officials stated that there could be benefits to conducting an additional trial before providing a ship to the fleet. For example, they could re-inspect deficiencies, like the ones noted above, that the program office corrects during the post-shakedown availability. These inspections could, in turn, reduce the likelihood that systems and equipment break down shortly after ships are provided to the fleet. However, INSURV and Navy program officials also pointed out that conducting another trial after the post-shakedown availability would require additional funding. The Navy has not evaluated the cost or quality risks associated with providing the fleet with unverified repairs and equipment—such as the fleet's costs to repair construction defects—against the costs of conducting an

²⁶However, in 2016, we found that the Navy's guaranty mechanism usually results in the government paying for the correction of deficiencies. See [GAO-16-71](#).

additional INSURV trial after the post-shakedown availability. Until the Navy studies this problem and develops a solution that reconciles current practices with its ship delivery policy, the Navy will not know whether the benefits of conducting an additional inspection outweigh the costs.

Ship Delivery and Initial Operational Capability Milestones in Navy Reports to Congress Do Not Provide Accurate Indicators of Ship Progress

The Navy's Selected Acquisition Reports to Congress do not clearly communicate ship progress toward completeness and capability, which can inhibit oversight, particularly in terms of measuring results. Specifically, the Navy's reported delivery dates are not accurate indicators of ship completion because the delivery date for one ship can reflect a much different level of completion than for another ship. Even after ships are reported as delivered, it will still be several years before the ship is fully complete. No other ship completeness milestones—such as when the ship is provided to the fleet (OWLD) or is deemed ready to deploy—are included in the Selected Acquisition Reports to Congress. Recently, Congress has enacted legislation that may better align ship delivery dates with ship completion in these reports by establishing criteria that must be met in order for a ship to be deemed delivered, specifically a determination by the Secretary of the Navy that a vessel is assembled and complete and that custody of the vessel and all systems has been transferred to the Navy. Further, the Navy's criteria for IOC—a milestone associated with ship progress—vary from ship class to ship class and its assessments of IOC do not comport with DOD's guidance. In addition, the IOC milestones for most of the ship classes we reviewed do not reflect demonstrated capability or performance. According to *Standards for Internal Control in the Federal Government*, government managers should externally communicate the necessary quality information to achieve the entity's objectives.²⁷ Without using consistently defined measures in its reporting, such as for delivery or IOC, the Navy is not accurately conveying the completeness and quality of its ships to Congress.

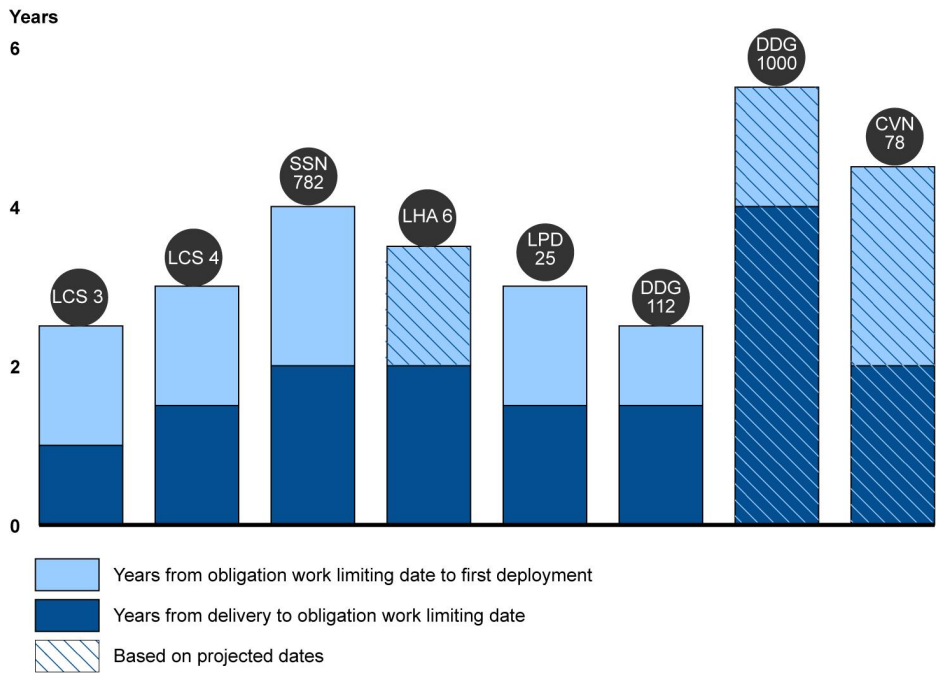
²⁷ [GAO-14-704G](#).

Delivery Dates Reported by the Navy Do Not Denote Ship Completeness

The Navy, in its Selected Acquisition Reports, typically reports delivery as the date that the lead ship in a class or flight is delivered from the shipyard to the Navy.²⁸ However, the delivery milestone is not an accurate indicator of ship completeness. As discussed previously, ships vary in their level of completeness at delivery. In many cases, several years will pass between delivery and provision to the fleet, and even at that point, more time may be required before a ship is ready to deploy. Figure 6 shows, for the eight ships we reviewed, the length of time between the delivery of each ship, when each ship was provided to the fleet (at OWLD), and the ship's first deployment after all planned construction work, tests, and trials were completed.

²⁸The Selected Acquisition Report is a statutorily-mandated comprehensive acquisition summary required for major defense acquisition programs. DOD submits Selected Acquisition Reports to Congress for program oversight purposes. 10 U.S.C. § 2432.

Figure 6: Time between Key Milestones of Delivery, Obligation Work Limiting Date, and First Deployment for Eight Selected Navy Ships



Source: GAO analysis of Navy information. | GAO-17-418.

Note: There are several factors that can impact the time between the obligation work limiting date and when the ship or sub first deploys, such as crew training.

For example, after CVN 78 is provided to the fleet, it will need to undergo shock trials, operational testing, and combat certifications, among other things, before it is ready for its first deployment. Recipients of the Selected Acquisition Reports would not have insight into this situation because the Navy reports the date of delivery but does not include additional important milestones about ship completeness, such as when ships are provided to the fleet at OWLD and when ships are ready for deployment. Without including this additional information, decision makers will not have a clear understanding of when ships are ready for fleet operations.

Current Selected Acquisition Reports on the DDG 1000 and CVN 78 ship classes also illustrate the inconsistency in the Navy’s definition of “delivery.” As discussed earlier, the Navy will complete the construction of DDG 1000 in two phases. In the December 2015 Selected Acquisition Report, the Navy indicated lead ship delivery would be April 2016, and the ship was subsequently delivered in May 2016. Though the report noted that this delivery was focused on hull, mechanical, and electrical

systems, it did not provide an additional indication of when all ship construction—including activation of the combat systems—is planned to be fully complete. It also did not note that the ship is not planned to deploy until fiscal year 2021, 5 years after the reported delivery date. DDG 1001 and 1002, which are later ships in the same class, are planning to use the same approach. The Selected Acquisition Report for the CVN 78-class was clearer about its key milestones. For CVN 79, the December 2015 report reflected the delay in deployment after delivery. The Navy reported the carrier's delivery date as June 2022 in its schedule of events, but stated in the executive summary that the carrier will not be deployable until 2027, after it goes through a second phase of construction. Because policy makers and others rely on the Navy's reports to understand ship progress and review reported ship schedules as an indicator of a potential breach of the agreed-to program baseline, it is important that the information be clearly and consistently communicated.²⁹

Congress included a provision in the National Defense Authorization Act for Fiscal Year 2017 that may address this lack of clarity and consistency in reported delivery dates by establishing criteria that must be met in order for a ship to be deemed delivered. According to this legislation, the delivery of a ship shall occur when (1) the Secretary of the Navy determines the ship is assembled and complete and (2) custody of the ship and all of its systems are transferred to the Navy. The legislation further requires the Navy to review the planned delivery dates for ships under construction and adjust them, if the planned dates did not reflect a level of construction completeness in line with the new criteria. In particular, the legislation directed the Navy to realign the delivery dates for ships with phased delivery strategies—CVN 79, DDG 1000, DDG 1001, and DDG 1002—so that delivery will occur when the Secretary of the Navy determines that each vessel is assembled and complete (that is, when all phases of construction are complete), rather than when the first phase is complete as was previously the case. Congress directed the Navy to certify adjusted delivery dates for all ships under construction to the congressional defense committees by January 1, 2017, and to include these revised dates in the next Selected Acquisition Reports and budget

²⁹Commonly referred to as Nunn-McCurdy, 10 U.S.C. § 2433 establishes the requirements for DOD to submit unit cost reports on major defense acquisition programs or designated major subprograms. Unit costs are tracked against the program's baseline and if certain thresholds are breached (a Nunn-McCurdy breach) then the program is required to notify Congress, among other actions.

documents sent to Congress. In February 2017, the Navy adjusted the delivery dates for these four ships to coincide with the completion of significant construction events following preliminary acceptance, such as the activation of DDG 1000's combat systems.³⁰ As noted above, however, Navy ships are not fully complete until at least OWLD—when a ship is provided to the fleet.

Navy Reports Do Not Use Consistent Criteria to Assess Ship Initial Operational Capability

The Navy's Selected Acquisition Reports to Congress also state when ship classes achieve IOC; however, the reports generally do not state the criteria the Navy used to make these capability determinations, and the criteria used are not consistent with DOD guidance. In January 2015, DOD updated its acquisition guidance to include a number of program models that DOD agencies and military services can use to structure programs for the purpose of attaining knowledge prior to committing to more purchases. In nearly all acquisition program models, DOD guidance states that IOC occurs toward the end of operational testing. Even the most aggressive model of delivering programs, the accelerated acquisition program—which by design accepts significant risk to add capability in a compressed time frame (such as during a time of war)—defines IOC as occurring simultaneously with operational testing, not before testing. DOD acquisition guidance and GAO best practices state that testing provides critical information to make informed production and other acquisition decisions.³¹

The Navy's criteria for declaring IOC differs across ship classes, and none of them require achieving favorable results from operational testing. Of the eight ships we reviewed, program offices had used two sets of

³⁰The Navy originally reported DDG 1000 delivery coinciding with preliminary acceptance in May 2016. As a result of the National Defense Authorization Act for Fiscal Year 2017, the Navy revised the delivery date to May 2018 following combat systems activation. Thus, the Navy has commissioned DDG 1000 and placed the vessel in active service, but it has yet to be delivered in accordance with the current definition of delivery for this particular ship.

³¹Department of Defense Instruction 5000.02, *Operation of the Defense Acquisition System*, Encl. 5 Jan. 7, 2015; and [GAO-09-322](#). The milestone decision authority for a program, the designated individual with overall program responsibility, may tailor requirements in DOD's acquisition guidance to more efficiently achieve program objectives, consistent with statutory requirements.

criteria for IOC, both of which were schedule-driven rather than capability-driven milestones; that is, they did not take into account the successful completion of operational testing. Table 10 shows the ship classes for the eight ships we reviewed, how the programs defined IOC, and the status of operational testing at the time the Navy declared IOC for the class.

Table 10: Navy Initial Operational Capability (IOC) Definitions and the Status of Testing

Ship class ^a	Program definition of IOC	Status of operational testing at IOC declaration
LPD 17	Lead ship finishes post-shakedown availability	Testing not started when IOC declared; after initial failures, testing was completed successfully in 2012, 4 years after IOC declared
LHA 6	Lead ship finishes post-shakedown availability	Testing not started when IOC declared; the Navy plans to complete testing about 15 months after IOC declaration
Littoral Combat Ship (LCS) Seaframe Variants	One mission package installed and tested on a seaframe; logistics support and a trained crew available; lead ship deployable and assigned to an operational commander	Testing completed with the surface warfare mission package when IOC declared though both variants were found to be not operationally suitable by DOT&E ^b
DDG 51 Flight IIA	Lead ship finishes post-shakedown availability	Testing not started when IOC declared; ship subsequently found to be operationally effective but not operationally suitable—testing completed successfully in 2012, 11 years after IOC declaration
SSN 774 Block 2	Lead ship finishes post-shakedown availability	Testing not started when IOC declared; completed successfully 2 years later
CVN 78	Lead ship finishes post-shakedown availability	The Navy plans to complete operational testing about 2 years after IOC
DDG 1000	Lead ship finishes post-shakedown availability	The Navy plans to complete testing prior to IOC declaration

Source: GAO analysis of Navy documentation. | GAO-17-418

^aThe Navy does not conduct operational testing on every ship; rather, the Navy tests each class of ships. The ship class column represents the ship class associated with each of our selected ships.

^bThe Freedom variant was found to be not operationally suitable by the Navy and DOT&E. The Independence variant was found to be operationally suitable by the Navy, but DOT&E found the variant to not be operationally suitable.

For several of the ships we reviewed, the Navy defined and declared IOC for the ship class without ever testing the operational capabilities of, or deploying, the lead ship. As a result, achieving IOC did not provide an indication that the ships could conduct operations as intended, which can provide a false sense of the ships' capabilities. For instance, after the Navy declared IOC for the LPD 17 class, the lead ship suffered a severe engineering casualty during its first deployment that limited its availability for several years. After this incident, the Navy's Commander of Operational Test and Evaluation reported that the LPD 17 class of ships was not operationally suitable and was operationally effective with the exception of the combat system. After nearly 3 years of follow-on tests and a considerable number of design changes to correct problems, the Navy's testers determined in December 2012 that the LPD 17 class was operationally suitable and operationally effective—4 years after the Navy

originally declared IOC for the class, with 10 ships completed or under construction.

Conclusions

Shipbuilding is a complex endeavor, and a certain amount of deficiencies can be expected. However, all of the Navy ships we reviewed were, or likely will be, provided to the fleet with outstanding deficiencies, incomplete certifications, or open casualty reports, among other quality issues—resulting in additional costs that the fleet will have to bear. Moreover, the Navy has made liberal use of the various exceptions to its process for some of its most expensive and technologically sophisticated ships—namely, the CVN 78 and DDG 1000 classes—to allow these ships to be delivered in a substantially incomplete state, placing the fleet at even greater risk of absorbing excessive costs and having to face unknowns about ship quality. While Navy officials offered some reasons that ships are accepted in incomplete states, the ship delivery policy makes no reference to these reasons. The policy states that ships should be defect-free and mission-capable, but these objectives are not defined. Further, INSURV's only post-delivery trial is not well-timed to independently verify the completeness and quality of ships before they are provided to the fleet. As a result, key quality control measures in the Navy's ship delivery policy are not implemented, resulting in uninspected systems and equipment being provided to the fleet, with no verification of completeness and quality at this key milestone.

The Navy's Selected Acquisition Reports to Congress do not clearly communicate its ships' progress and completion, which can inhibit oversight, particularly for measuring results. Simply reporting delivery dates does not signify a ship's completeness or readiness to deploy, as there is considerable variation in the level of completeness of ships at delivery, and it will still be several additional years before ships are ready to deploy. Recent legislation has established criteria for ship delivery dates that, depending on its implementation, may help improve the consistency and clarity of the Navy's reporting to Congress on this milestone. Similarly, IOC is reported but does not signify that ships have successfully demonstrated capability. Without consistent and meaningful capability and schedule milestones, decision makers may not be able to understand the progress toward ship completion or may be surprised to learn of complications after the ship appeared to be delivered or completed, which may require additional funding.

Recommendations for Executive Action

The Secretary of Defense should direct the Secretary of the Navy to take the following four actions:

1. Revise the Navy's ship delivery policy to clarify what types of deficiencies need to be corrected and what mission capability (including the levels of quality and capability) must be achieved at (1) delivery and (2) when the ship is provided to the fleet (at OWLD). In doing so, the Navy should clearly define what constitutes a complete ship and when that should be achieved.
2. Reconcile policy with practice to support INSURV's role in making a recommendation for fleet introduction. Accomplishing this may require a study of the current timing of ship trials, and the costs and benefits associated with adding an INSURV assessment prior to providing ships to the fleet.
3. Reflect additional ship milestones in Selected Acquisition Reports to Congress, including OWLD and readiness to deploy.
4. In Selected Acquisition Reports to Congress, ensure that the criteria used to declare IOC aligns with DOD guidance, and reflect the definition of this milestone in the reports.

Agency Comments and Our Evaluation

We provided a draft of our report to DOD for review and comment. In its written comments, which are reprinted in appendix III of this report, DOD did not concur with two recommendations, partially concurred with a third recommendation, and fully concurred with a fourth recommendation. DOD provided technical comments that we incorporated as appropriate.

With regard to our first recommendation, DOD disagreed with our focus on OPNAVINST 4700.8K as the primary criteria for assessing Navy ship quality and completeness when ships are provided to the fleet, stating that multiple instructions govern this process. This response was puzzling, as we reviewed relevant Navy policies and confirmed with acquisition officials within the Department of the Navy that OPNAVINST 4700.8K is the primary policy governing the quality standards for Navy ships at delivery. The statute and two policies that other policies DOD references in its response are not focused on construction and the post-delivery period and do not provide guidance on the level of quality and

completeness expected when ships are provided to the fleet. Therefore, we focused on OPNAVINST 4700.8K because it is the only Navy instruction that attempts to set a quality standard for Navy ships rather than provide guidance on managing the inspection process. As such we maintain that OPNAVINST 4700.8K should be clarified regarding the level of quality and completeness required of Navy ships at key points in the shipbuilding process. By not acknowledging the importance of OPNAVINST 4700.8K and establishing a clear and comprehensive quality standard, the Department of the Navy is missing an opportunity to improve the quality of its ships and risks continuing to provide ships to the fleet with significant quality problems.

With regard to the second recommendation, DOD did not agree to study the current timing of ship trials or the costs and benefits of conducting an additional INSURV assessment prior to providing ships to the fleet. In particular, DOD stated that the current timing of Navy inspections is deliberate because it enables INSURV to inspect the ship and identify any additional deficiencies for correction during the post-shakedown availability. However, while the timing of final contract trials facilitates the prioritization of post-delivery work, as our report points out, it is not optimally aligned to verify that the work completed during post-shakedown availability meets quality standards before a ship is provided to the fleet. For example, for the eight ships we reviewed, 90 percent of the 117 starred cards identified during acceptance trials were waived by the CNO prior to delivery and we found that many of these cards are corrected during the post-shakedown availability, which is after final contract trials—INSURV’s final review before a ship is provided to the fleet. As a result, INSURV does not have an opportunity to verify that even the Navy’s most significant issues have been corrected before ships are provided to the fleet at the time of OWLD. By refusing to even consider changes to the status quo, the Navy may be missing an opportunity to improve the quality of ships delivered to the operational fleet.

With regard to the third recommendation, DOD agreed to report OWLD in its Selected Acquisition Reports to Congress but disagreed with reporting the ready-to-deploy date for its ships, noting that operational factors outside of acquisition concerns can affect the timing of this milestone. We acknowledge that ready-to-deploy decisions reside with fleet commanders and are independent of acquisition milestones. However, we maintain that this date is important for Congressional oversight because it remains the best milestone for determining when a ship has

achieved a sufficient level of completeness to operate, under the Navy's current framework for ship delivery.

DOD agreed with our fourth recommendation, stating that the criteria for IOC are defined in each ship class' Capability Development Document or Operational Requirements Document and that, for ships that have not achieved IOC, it will include that definition in the Selected Acquisition Reports. The response, however, did not indicate that DOD will ensure that the criteria used to declare IOC aligns with DOD guidance. We continue to believe that such an action would result in more meaningful and consistent information provided to Congress.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Defense, the Secretary of the Navy, and other interested parties. This report will also be available at no charge on GAO's website at <http://www.gao.gov>.

If you or your staff have any questions concerning this report, please contact me at (202) 512-4841 or by e-mail at mackinm@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. Key contributors to this report are listed in appendix IV.



Michele Mackin,
Managing Director
Acquisition and Sourcing Management

Appendix I: Objectives, Scope, and Methodology

This report assesses: (1) the extent to which the Navy provides complete, quality ships to the fleet that are free of government and contractor deficiencies; (2) the extent to which the Navy's policy governing ship delivery facilitates efforts to deliver complete and quality ships; and (3) the extent to which Navy reports to Congress on the progress of shipbuilding programs consistently define key milestones such as ship delivery and initial operational capability.

To gain an understanding of the condition in which shipbuilding programs deliver newly constructed ships to the fleet after accepting these ships from construction shipyards, we reviewed eight case studies. To select case studies for this review, we identified Navy ships which were either delivered within the last 5 years or are likely to be delivered within the next year, and were constructed by a variety of shipyards. We also avoided using multiple ships from the same class or variant, and selected a mix of early- and late-in-class ships. These parameters resulted in reviewing the following ships as a non-generalizable sample: DDG 112, SSN 782, LPD 25, LCS 3, LCS 4, LHA 6, DDG 1000, and CVN 78. Six of these ships (DDG 112, SSN 782, LPD 25, LCS 3, LCS 4, and LHA 6) had finished their post-delivery periods at the time of our review, while CVN 78 and DDG 1000 had not. For the purposes of this review, the delivery date marks the beginning of the post-delivery period and the obligation work limiting date (OWLD) is the end of the post-delivery period. Table 11 provides additional information on the 8 ships selected as case studies for this review.

Table 11: Characteristics of Selected Navy Ships

Ship	Class	Position in class	Shipbuilder	Delivery date	Obligation work limiting date(OWLD)
LPD 25	San Antonio class amphibious transport dock	9th	Huntington Ingalls Industries/Ingalls Shipbuilding	October 2013	June 2015
LHA 6	America class amphibious assault ship	1st	Huntington Ingalls Industries/Ingalls Shipbuilding	April 2014	March 2016
LCS 3	Littoral combat ship, Freedom variant	2nd	Marinette Marine Corporation with Lockheed Martin	June 2012	August 2013
LCS 4	Littoral combat ship, Independence variant	2nd	Austal USA with General Dynamics/Bath Iron Works	September 2013	April 2015
DDG 112	Arleigh Burke class guided missile destroyer	62nd	General Dynamics/ Bath Iron Works	May 2012	September 2013
SSN 782	Virginia class submarine	9th	General Dynamics/ Electric Boat Corporation	May 2012	May 2014
CVN 78	Gerald R. Ford class nuclear aircraft carrier	1st	Huntington Ingalls Industries/Newport News Shipbuilding	May 2017	Fiscal Year 2019 (estimated)
DDG 1000	Zumwalt class destroyer	1st	General Dynamics/ Bath Iron Works	May 2016	Fiscal Year 2020 (estimated) ^a

Source: GAO analysis of Navy documents. | GAO-17-418

^aAccording to acquisition officials, the two-phased delivery of DDG 1000 has led to uncertainty about the precise timing of OWLD for DDG 1000.

To assess the extent to which the Navy provides quality, complete ships to the fleet, free of government and contractor deficiencies, we reviewed Navy documentation related to the delivery and subsequent post-delivery period for selected new construction ships. For each case study, we reviewed such documentation as Chief of Naval Operations waivers for delivery, readiness briefings for Navy Board of Inspection and Survey (INSURV) trials, trial cards and reports, the form DD-250 Material Inspection and Receiving Report, operational assessments, and the Transfer Book, among others. Through our review of this documentation, we assessed what construction work was incomplete or deficient when each case study ship was delivered to the Navy from the shipbuilder; the availabilities, tests, and trials each ship completed during the post-delivery period; and the condition of each ship when it was provided to the fleet following the post-delivery period. In particular, for the selected ships that have already completed the post-delivery period, we assessed the number and type of INSURV-identified deficiencies at the time of ship delivery and tracked these through the post-delivery period to determine whether they were passed to the fleet. Additionally, we identified which shipboard system certifications were required for these ships and evaluated Navy documentation and supplementary program office

information to determine when these certifications were completed. We also reviewed Navy casualty report data at the time ships were passed to the fleet. Senior fleet personnel told us that the first 3 months after a ship is passed to the fleet are indicative of the condition the ship was passed to the fleet as crewmembers gain an understanding and operate these systems. Thus, we aggregated the open category 2 and 3 casualty reports during the three months following OWLD to understand the status of the ship at this time. For CVN 78 and DDG 1000, the two ships which have not yet completed the post-delivery period, we reviewed the Navy's post-delivery plans for these two ships, including proposed schedules and plans to complete deferred construction. To gain additional understanding of how and why the Navy decides to accept delivery from the shipbuilder and provide to the fleet ships that are not free of deficiencies, we interviewed officials from several Navy entities, including the shipbuilding program office for each case study ship, the Supervisor of Shipbuilding, Conversion, and Repair (SUPSHIP), INSURV, Naval Air Systems Command, Space and Naval Warfare Systems Command, and representatives from the fleet, among others. The fleet officials we met with were senior leaders of the Navy commands responsible for operating and maintaining these vessels, as well as port engineers, senior crew members (such as the commanding officer and chief engineer), and other individuals with management and technical responsibilities for maintaining the ships. We generally reported statements that were widely agreed upon.

To evaluate the extent to which the Navy's policy governing ship delivery facilitates efforts to deliver complete and quality ships, we reviewed the Navy's ship delivery policy covering trials, delivery, and post-delivery activities (referred to as the Navy's ship delivery policy)— Office of the Chief of Naval Operations Instruction (OPNAVINST) 4700.8K—and identified the key terms, roles, responsibilities, and processes associated with post-delivery. Through our review of Navy shipbuilding and quality assurance guidance—such as OPNAVINST 4730.5R (Trials and Material Inspections of Ships Conducted by the Board Of Inspection And Survey)—and through interviews with acquisition officials, we determined that OPNAVINST 4700.8K was the primary policy governing ship quality and completeness and the Navy's program offices verified this conclusion. We further examined this policy to determine the objectives, processes, and definitions of key terms that were relevant to the scope of our engagement, and assessed these elements of the policy for both internal consistency and consistency with other Navy and DOD guidance. We conducted interviews with the Office of the Chief of Naval Operations, Navy program officials, Naval Sea System Command directorates,

SUPSHIP, INSURV, Navy general counsel, fleet maintenance officials, and other entities to determine how organizations across the Navy interpret the Navy's ship delivery policy. We also reviewed *Standards for Internal Control in the Federal Government* and determined which standards were relevant to the Navy's post-delivery process. In reviewing the Navy's quality practices, we focused on INSURV and SUPSHIP's respective roles in ensuring quality ships are built. We assessed INSURV and SUPSHIP reports, talked to inspectors, and read the guidance governing these organizations to look at how these organizations improve ship quality. In addition, we evaluated the results against the *Standards for Internal Control in the Federal Government* to assess the extent to which the Navy controls ship quality as an outcome or objective.

To determine the extent to which reports to Congress on the progress of shipbuilding programs consistently define key milestones, we obtained and reviewed the Selected Acquisition Reports and budget justification documents for the ship classes of each of the eight ships we reviewed going back at least two fiscal years. We reviewed the milestones and dates reported in these documents, such as delivery and initial operational capability, and used our other analyses of the completeness and performance of ships to determine the condition and capability of the selected ships at the relevant milestone dates. We obtained and reviewed the high-level requirements documents for the ships in our review, as well as Navy and DOD policies and guidance that define and describe key milestones to determine whether (1) the Navy reported these milestones in accordance with relevant guidance and definitions, and (2) whether the Navy's guidance and definitions were consistent with DOD guidance and meaningful to congressional overseers. We supplemented these analyses with interviews and other data from Navy program offices, where needed.

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

Appendix II: Total Planned Cost for CVN 78 Post-Delivery Activities

The Navy accepted delivery of CVN 78 with a significant amount of outstanding construction, tests, and trials. According to the Navy’s plans, this incomplete work will be completed over the course of more than 4 years and is expected to cost nearly \$780 million. As is typical for most shipbuilding programs, the program office requested post-delivery and outfitting funding for CVN 78, totaling \$216 million; however, the program office’s total planned cost for CVN 78’s post-delivery activities also includes funding to complete deferred work (end cost), prepare training materials (other procurement and operations and maintenance), and execute an extended testing phase (research, development, test, and evaluation)—for a total of at least \$779 million. Table 12 shows the Navy’s planned cost for CVN 78 post-delivery activities.

Table 12: Planned Cost for CVN 78 Post-Delivery Activities


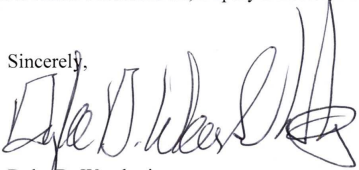
Budget category and subcategory	Amount planned for post-delivery activities (in millions of dollars)
Shipbuilding and Conversion (SCN)	\$279
SCN End Costa	\$63
SCN Post-Delivery	\$77
SCN Outfitting	\$139
Research, Development, Test, and Evaluation	\$417
Operations & Maintenance	\$74
Other procurement	\$9
Total planned cost during post-delivery period	\$779

Source: GAO Analysis of Navy data. | GAO-17-418

^aSCN End Cost total presented here does not include funds that will be withheld for the correction of contractor deficiencies.

Note: For budgetary purposes, the Navy considers post-delivery to be from delivery until the obligation work limiting date. However, this excludes several years of testing, modernization, and deficiency correction prior to the ship’s first scheduled deployment.

Appendix III: Comments from the Department of Defense

	<p>OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE 3015 DEFENSE PENTAGON WASHINGTON, DC 20301-3015</p>
<p>ACQUISITION</p>	<p>JUN 2 2017</p>
<p>Ms. Michele Mackin Director, Acquisition and Sourcing Management U.S. Government Accountability Office 441 G Street NW Washington DC 20548</p>	
<p>Dear Ms. Mackin:</p>	
<p>This serves as the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-17-418, 'NAVY SHIPBUILDING: Policy Changes Needed to Improve the Post-Delivery Process and Ship Quality'.</p>	
<p>The Department acknowledges receipt of the draft report. As more fully explained in the enclosed, the Department does not concur with recommendations one and two, partially concurs with recommendation three, and concurs with recommendation four.</p>	
<p>The Department appreciates the opportunity to comment on the draft report. For further questions concerning this report, please contact Dr. James Moreland Jr., Deputy Director, Naval Warfare, 703-614-3170.</p>	
<p>Sincerely,  Dyke D. Weatherington Performing the Duties of the Assistant Secretary of Defense for Acquisition</p>	
<p>Enclosure: As stated</p>	

GAO DRAFT REPORT DATED APRIL 17, 2017
GAO-17-418 (GAO CODE 100641)

“NAVY SHIPBUILDING: POLICY CHANGES NEEDED TO
IMPROVE THE POST-DELIVERY PROCESS AND SHIP
QUALITY”

DEPARTMENT OF DEFENSE COMMENTS
TO THE GAO RECOMMENDATION

RECOMMENDATION 1: The GAO recommends that the Secretary of Defense should direct the Secretary of the Navy to revise the Navy’s ship delivery policy to clarify what types of deficiencies need to be corrected and what mission capability (including the levels of quality and capability) must be achieved at (1) delivery and (2) when the ship is provided to the fleet (at OWLD). In doing so, the Navy should clearly define what constitutes a complete ship and when that should be achieved.

DoD RESPONSE: Non-concur. The Government Accountability Office reported that they evaluated only one instruction, Chief of Naval Operations (CNO) Instruction 4700.8K; however, inspection and delivery of Navy ships is governed by multiple instructions. Taken together, these instructions provide very detailed requirements regarding ship completion and mission capability in support of providing the Fleet with complete ships, fully capable of supporting the Navy’s mission, at the Obligation Work Limiting Date. In accordance with Title 10 United States Code §7304, SECNAVINST 5040.3A, OPNAVINST 4730.5R, and other Navy policies, the Board of Inspection and Survey (INSURV) performs independent verification of readiness for preliminary acceptance. INSURV, in accordance with Navy policies, assesses each deficiency identified for impact on mission capability and if it must be corrected prior to delivery. INSURV’s findings and recommendations, along with recommendations from the Fleet and Naval Sea Systems Command, are utilized by the CNO in making the determination to accept delivery for all Navy ships.

RECOMMENDATION 2: The GAO recommends that the Secretary of Defense should direct the Secretary of the Navy to reconcile policy with practice to support INSURV’s role in making a recommendation for fleet introduction. Accomplishing this may require a study of the current timing of ship trials, and the costs and benefits associated with adding an INSURV assessment prior to providing ships to the fleet.

DoD RESPONSE: Non-Concur. Current timing of Final Contract Trials (FCT) with the Board of Inspection and Survey (INSURV), Post-Shakedown Availability (PSA), and Delivery is deliberate. FCT is intended to provide the Navy with a final opportunity to inspect the ship to ensure that all contractual obligations have been met, and identify any additional contractor or government responsible defects that require attention before the end of the Obligation Work Limiting Date (OWLD) period. Modifying FCT would preclude this opportunity. PSA is intended to follow FCT to correct the issues discovered during FCT and the post-delivery period. Therefore, all defects should be corrected or properly adjudicated during PSA, and prior to OWLD.

In general, an additional trial by INSURV following PSA is not practical. In most cases, such a trial would not be cost-effective, and could also delay deployment schedules for the fleet. However, if the Navy determines any additional inspections are required after PSA based on the scope of work conducted during the PSA, a targeted INSURV review may be requested prior to fleet transfer.

For CVN 78, an additional trial by INSURV, "Special Trials", following PSA is already in place. This trial ensures all contractual obligations have been met and is timed to provide insight to the Fleet on the readiness of the ship for fleet introduction.

RECOMMENDATION 3: The GAO recommends that the Secretary of Defense should direct the Secretary of the Navy to reflect additional ship milestones in Selected Acquisition Reports to Congress, including OWLD and readiness to deploy.

DoD RESPONSE: Partially-Concur. The Navy will include Obligation Work Limiting Dates for existing ship programs in the Notes section of the next Selected Acquisition Report submitted to Congress. Readiness to deploy decisions reside with the fleet commanders based on operational requirements independent of acquisition milestones. Therefore, it is not appropriate to report deployment dates via Selected Acquisition Reports or acquisition documents.

RECOMMENDATION 4: The GAO recommends that the Secretary of Defense should direct the Secretary of the Navy in Selected Acquisition Reports to Congress, ensure that the criteria used to declare initial operational capability aligns with DOD guidance, and reflect the definition of this milestone in the reports.

DoD RESPONSE: Concur. Initial Operational Capability (IOC) is defined in the ship program Capability Development Document (CDD) or Operational Requirements Document (ORD). For ship programs that have not achieved IOC, that definition will be entered into the Notes section of the next Selected Acquisition Reports submitted to Congress.

Appendix IV: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition the contact named above, the following staff members made key contributions to this report: Diana Moldafsky, Assistant Director; Laurier Fish; Laura Greifner; Samuel Harris; Kristine Hassinger; Chad Johnson; Jillian Schofield; and Robin Wilson.

Appendix V: Accessible Data

Data Tables

Data Table for Figure 3: Major Tests and Trials Planned for CVN 78 Post-Delivery

Milestone	Date (Fiscal Year/Quarter)
Delivery	FY2017 Q3
Flight deck certification	FY2017 Q4
Post-Shakedown Availability	FY2018 Q1 - FY2018 Q3
Special trial	FY2019 Q1
Obligation Work Limiting Date	FY2019 Q3
Full Ship Shock Trials	FY2019 Q3 - FY2020 Q1
Planned Incremental Availability	FY2020 Q1 – FY2020 Q3
Operational testing	FY2020 Q4 – FY2021 Q4
Total Ship Survivability Trial	Fy2020 Q4 – FY2021 Q3
Combat system interoperability certification	FY2021 Q2 – FY2021 Q3
Deployment Ready	FY 2021 Q4

Data Table for Figure 4: DDG 1000 Post-Delivery Schedule as of November 2016

Milestone	Date (Fiscal Year/Quarter)
Hull, Mechanical, and Electrical Acceptance Trials	FY2016 Q3
Combat Systems Activation	FY2017 Q2 – FY2018 Q1
Combat Systems Acceptance Trials and Delivery	FY2018 Q1
Post-Shakedown Availability	FY2020 Q1 – FY2020 Q2
Obligation work limiting date	FY 2020 Q2
Deployment ready	FY2021 Q4

Figure 6: Time between Key Milestones of Delivery, Obligation Work Limiting Date, and First Deployment for Eight Selected Navy Ships

Ship	Years from Delivery to obligation work limiting date (rounded to nearest half year)	Years from obligation work limiting date to First Deployment (rounded to nearest half year)	Total Years from Delivery to First Deployment (rounded to nearest half year)
LCS 3	1	1.5	2.5
LCS 4	1.5	1.5	3
SSN 782	2	2	4
LHA 6	2	1.5	3.5
LPD 25	1.5	1.5	3
DDG 112	1.5	1	2.5
DDG 1000	4	1.5	5.5
CVN 78	2	2.5	4.5

Agency Comment Letter

Text of Appendix III: Comments from the Department of Defense

Page 1

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Director , Acquisition and Sourcing Management

U.S. Government Accountability Office 441 G Street NW

Washington DC 20548

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Performing the Duties of the Assistant Secretary of Defense for Acquisition

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Related GAO Products

Navy Shipbuilding: Need to Document Rationale for the Use of Fixed-Price Incentive Contracts and Study Effectiveness of Added Incentives. [GAO-17-211](#). Washington, D.C.: March 1, 2017.

Littoral Combat Ship and Frigate: Slowing Planned Frigate Acquisition Would Enable Better-Informed Decisions. [GAO-17-279T](#). Washington, D.C.: December 8, 2016.

Littoral Combat Ship and Frigate: Congress Faced with Critical Acquisition Decisions. [GAO-17-262T](#). Washington, D.C.: December 1, 2016.

Navy Ship Maintenance: Action Needed to Maximize New Contracting Strategy's Potential Benefits. [GAO-17-54](#). Washington, D.C.: November 21, 2016.

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

Navy and Coast Guard Shipbuilding: Navy Should Reconsider Approach to Warranties for Correcting Construction Defects. [GAO-16-71](#). Washington, D.C.: March 3, 2016.

DOD Operational Testing: Oversight Has Resulted in Few Significant Disputes and Limited Program Cost and Schedule Increases. [GAO-15-503](#). Washington, D.C.: June 2, 2015.

Ford-Class Carrier: Congress Should Consider Revising Cost Cap Legislation to Include All Construction Costs. [GAO-15-22](#). Washington, D.C.: November 20, 2014.

Weapon Systems Management: DOD Has Taken Steps to Implement Product Support Managers but Needs to Evaluate Their Effects. [GAO-14-326](#). Washington, D.C.: April 29, 2014.

Littoral Combat Ship: Navy Complied with Regulations in Accepting Two Lead Ships, but Quality Problems Persisted after Delivery. [GAO-14-827](#). Washington, D.C.: September 25, 2014.

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Defense Acquisitions: DOD Has Paid Billions in Award and Incentive Fees Regardless of Acquisition Outcomes. [GAO-06-66](#). Washington, D.C.: December 19, 2005.

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