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Report to Congressional Committees

January 2021

COLUMBIA CLASS SUBMARINE

Delivery Hinges on Timely and Quality Materials from an Atrophied Supplier Base

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Highlights

Highlights of GAO-21-257, a report to congressional committees

January 2021

COLUMBIA CLASS SUBMARINE

Delivery Hinges on Timely and Quality Materials from an Atrophied Supplier Base

Why GAO Did This Study

The Navy plans to invest about $128 billion in 12 *Columbia* class nuclear-powered ballistic missile submarines. The shipbuilders will construct the *Columbia* class at the same time as the *Virginia* class attack submarines. They plan to rely on materials produced by a supplier base that is roughly 70 percent smaller than in previous shipbuilding booms.

Congress included a provision in statute for GAO to examine the program's status. This report assesses the Navy's efforts to complete the design for the lead *Columbia* class submarine and actions the shipbuilders and the Navy have taken to prepare for construction and ensure the lead submarine is delivered according to schedule and quality expectations. GAO assessed Navy and shipbuilder design progress against cost and schedule estimates, reviewed documents, and interviewed officials about supplier readiness and quality assurance. This is a public version of a sensitive report that GAO issued in November 2020. Information that the Department of Defense (DOD) deemed sensitive has been omitted.

What GAO Recommends

GAO recommends that the Navy (1) provide Congress with updated cost information, (2) include information on supplier readiness in its annual report to Congress, and (3) reassess when to seek additional inspections at supplier facilities. DOD concurred with the recommendations but disagreed with some of the report's details. GAO incorporated DOD's comments as appropriate and maintains the validity of the findings, as discussed in the report.

For more information on GAO-21-257, contact Shelby S. Oakley at (202) 512-4841 or oakleys@gao.gov.

What GAO Found

The Navy's schedule for constructing the first submarine of the new *Columbia* class is threatened by continuing challenges with the computer-aided software tool that Electric Boat, the lead shipbuilder, is using to design the submarine. These challenges will likely impede construction because the shipbuilder is late in completing design products used for building the submarine. To ensure construction begins on schedule, the Navy modified its design contract with Electric Boat to include an option for constructing the first two submarines and requested sufficient authority from Congress for fiscal year 2021 to exercise it. Navy officials stated, however, that the Navy's budget request is lower than its current cost estimate, and it is not informed by an independent cost assessment. As a result, the program will likely need more funding to reflect the increased estimate.

Quality problems with supplier materials caused delays during early construction. These quality problems included missile tubes (depicted below) with defective welds. As the shipbuilders expand outsourcing to suppliers, quality assurance oversight at supplier facilities will be critical for avoiding further delays.

Quad Pack of Four Submarine Missile Tubes

Source: General Dynamics Electric Boat. | GAO-21-257

However, the Navy has not comprehensively reassessed when to seek additional inspections at supplier facilities that could better position it to identify quality problems early enough to limit delays.

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Abbreviations

CAPE	Office of the Secretary of Defense Cost Assessment and Program Evaluation
COVID-19	Coronavirus Disease 2019
DCMA	Defense Contract Management Agency
DOD	Department of Defense
Electric Boat	General Dynamics Electric Boat
Newport News	Huntington Ingalls Industries Newport News Shipbuilding
SUPSHIP	Naval Sea Systems Command Supervisor of Shipbuilding, Conversion and Repair
TRL	technology readiness level

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441 G St. N.W.
Washington, DC 20548

January 14, 2021

Congressional Committees

Over the next 20 years, the Navy plans to construct and deliver *Columbia* class nuclear-powered ballistic missile submarines, while also constructing *Virginia* class fast attack submarines, at a schedule and pace unmatched since the end of the Cold War. To meet increased construction demand, the nation's two nuclear shipbuilders must rely on a smaller and less mature supplier base than existed during previous shipbuilding booms. The Navy recognizes that the planned construction schedule represents a challenge for the shipbuilders and associated supplier base. Consequently, in advance of the Department of Defense's (DOD) decision to begin formal construction of the lead *Columbia* class submarine, the Navy and shipbuilders engaged in efforts to prepare the shipyards for additional construction activities and bolster the supplier base.

In its fiscal year 2021 President's budget request, the Navy sought sufficient authority from Congress to exercise a contract option for the construction of the lead and follow-on *Columbia* submarines. Over the course of the program, the Navy plans to invest approximately $128 billion to research, develop, construct and deliver 12 *Columbia* class submarines, which will replace the existing 14 *Ohio* class nuclear-powered ballistic missile submarines—the current sea-based leg of the nation's strategic nuclear deterrent. According to the 2018 Nuclear Posture Review, the lead *Columbia* class submarine will need to make its first patrol in fiscal year 2031 to avoid a deterrence gap, and as a result a delay to the delivery of the lead submarine could have far-reaching consequences for the nation's defense.[1]

In light of the criticality of the deterrence mission and the cost and schedule pressures facing the *Columbia* class program, the National Defense Authorization Act for Fiscal Year 2018 included a requirement for the Navy to prepare and submit information on the *Columbia* program's design and construction goals and progress, and included a provision that

[1]DOD, *Nuclear Posture Review* (Washington, D.C.: Feb. 2018).

we assess the information it reports.[2] This report assesses (1) the status of the Navy's efforts to complete the design and conduct advance construction work for the lead *Columbia* class submarine according to cost and schedule expectations; (2) actions that the shipbuilders and the Navy took and are taking to prepare for formal construction of the lead *Columbia* class submarine according to schedule expectations; and (3) actions that the Navy and shipbuilders have taken to oversee and ensure *Columbia* class submarines are delivered according to quality expectations.

This report is a public version of a sensitive report that we issued in November 2020. DOD deemed some of the information in our November report to be sensitive, which must be protected from public disclosure. Therefore, this report omits sensitive information about the status of the program's detailed design, the state of the supplier base, and the status and descriptions of critical technologies. Although the information provided in this report is more limited, the report addresses the same objectives as the sensitive report and uses the same methodology.

To assess the status of the Navy's efforts to complete the design and construct the lead *Columbia* class submarine according to cost and schedule expectations, we reviewed Navy and shipbuilder documents including program briefings, schedules, management reports, design progress reports, cost estimate updates, and contract documents. We compared ship design plans against actual design progress to identify any delays and reviewed the Navy's contract strategy for constructing the lead *Columbia* submarine. Further, we compared the program's current status against the criteria the milestone decision authority established for the program to be able to proceed into formal construction.[3]

To assess actions that the shipbuilders and the Navy are taking to prepare to construct the lead *Columbia* class submarine according to schedule expectations, we reviewed Navy and shipbuilder documentation

[2]We provided an initial assessment of information included in the Navy's February 2020 report in response to the National Defense Authorization Act for Fiscal Year 2018 through a briefing, and include additional information in this report. Pub. L. No. 115-91, § 231 (2017).

[3]The Navy started production of part of the lead submarine before the planned date for the lead ship authorization decision in 2020. This practice, called advance construction, is allowable under the expanded acquisition authorities provided by Congress under the National Sea Based Deterrence Fund. As such, for the purposes of this report we refer to construction activities that will occur after the program has been authorized to begin construction in earnest as formal construction.

to identify and analyze past and future hiring plans at the shipyards, facilities planning and construction efforts, and the extent to which the shipbuilders are developing the supplier base for construction. We also interviewed Navy, shipbuilder, and supplier representatives to understand their plans for outsourcing to the supplier base.

To assess the actions the Navy and shipbuilders have taken to oversee and ensure *Columbia* class submarines are delivered according to quality expectations, we determined the extent to which the Navy and shipbuilders are implementing quality assurance requirements and guidance as described in Federal Acquisition Regulation, as well as Navy, Defense Contract Management Agency (DCMA), Naval Sea Systems Command Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP), and shipbuilder manuals, instructions, and planning documents. We reviewed supporting Navy, shipbuilder, and supplier information related to ongoing quality efforts at the shipyards and suppliers, such as program briefings and internal assessments. We also met with relevant Navy, shipbuilder, DCMA, and SUPSHIP representatives, as well as representatives from three critical suppliers that support the nuclear shipbuilding enterprise, that we selected based on their importance to the program and performance history, to understand their quality assurance practices.

On March 13, 2020, during the course of this engagement, the President declared a nationwide state of emergency as a result of the spread of the Coronavirus Disease 2019 (COVID-19). States and many employers—including locations where work on advance construction activities was ongoing—implemented changes to curb the spread of the virus. This report does not reflect the effects of these COVID-19 measures on the program's cost or schedule, as program officials told us that it was too soon to assess how actions taken in response to the virus would influence the program. Accordingly, the information in this report reflects the status of the *Columbia* class program prior to COVID-19. We will provide updates on the effects, if any, of COVID-19 on this program as we continue to monitor the program in future years. Appendix I provides additional information on the scope and methodology of our review.

We conducted this performance audit from May 2019 to November 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and

conclusions based on our audit objectives. We subsequently worked with DOD from November 2020 to January 2021 to prepare this unclassified version of the original sensitive report for public release. This public version was also prepared in accordance with these standards.

Background

The *Columbia* program expects to begin formal construction of the lead submarine in November 2020 and plans to continue construction and testing activities on this submarine for nearly a decade. In June 2020, the Navy awarded a cost-type contract option that, if exercised, would result in the construction of the first two *Columbia* class submarines—referred to as Build I.[4] The Navy needed sufficient authority from Congress to be able to exercise this contract option. According to Navy documentation, this includes authorization to use incremental funding, which provides funding over several fiscal years, for the Build I submarines. Subsequently, the Navy plans to purchase the remaining 10 follow-on submarines over two additional builds and have all 12 submarines under contract before the program reaches initial capability in 2030.[5] For the *Columbia* class program, initial operational capability is defined as achieving first operational patrol.

We reported on the *Columbia* class program in December 2017 and found that the program's schedule was aggressive, with extensive overlap—or concurrency—between development, design, and construction. As we found in that report, the Navy plans to deliver the lead submarine in a shorter time frame than has been achieved by its four most recent lead submarines, with 84 months planned for construction of the lead submarine. In April 2019, we reported that to enable its aggressive schedule the Navy had requested and received unique statutory authorities for the *Columbia* program from Congress. These

[4]Under a cost-type contract, the government pays allowable costs incurred by the contractor, to the extent prescribed by the contract, such as certain compensation costs for work performed. Incentive arrangements included in the contract can allow the contractor to earn fees tied to performance, such as for performing at lower costs. Under these types of contracts, the government generally assumes the risk of a cost overrun because, although the contractor is to make a good-faith effort to meet contract requirements within the estimated cost, the government is not promised a completed item or service within that cost. Navy officials stated the program recently changed its terminology from a "Block" contracting approach to a "Build" approach to avoid confusion with the term "block buy," which the Navy has used to refer to certain other contracting arrangements.

[5]The Navy plans to have Build III submarines—which includes submarines six through 12—under contract for advance construction activities by 2027.

authorities included the ability to conduct advance construction, which allows for manufacturing and fabrication efforts prior to ship authorization. The program has been conducting advance construction efforts since 2016, in contrast to formal construction, which can only begin after additional authorization through DOD and Congress.[6]

Columbia Design and Lead Submarine Construction

Two U.S. shipbuilders—General Dynamics Electric Boat (Electric Boat) and Huntington Ingalls Industries Newport News Shipbuilding (Newport News)—design and build nuclear submarines. Electric Boat is the prime contractor for design and will be for construction of the *Columbia* class, with Newport News serving as its major subcontractor. Each shipbuilder will construct segments of the submarines. For example, Newport News will be responsible for building the stern, bow, and other major components. In its role as the prime contractor Electric Boat will be responsible for completing final outfitting and delivering the submarines to the Navy.

In January 2017, a board of DOD stakeholders that is chaired by the milestone decision authority—for this program, the Under Secretary of Defense for Acquisition and Sustainment—approved the *Columbia* class program to enter the engineering and manufacturing development phase and award a design contract.[7] The program awarded a detail design contract in September 2017 to Electric Boat for work including completion of the submarine's design, component and technology development, and prototyping efforts. The detail design process for the *Columbia* class program encompasses two activities, which began after the Navy set the technical requirements for the submarine in 2016: (1) development of arrangements; and (2) development of disclosures. These activities are followed by the translation of the design products into work instructions. The program completed arrangements, which outline the steel structure and routes distributive systems—such as electrical or piping systems—throughout the submarine, in September 2019.

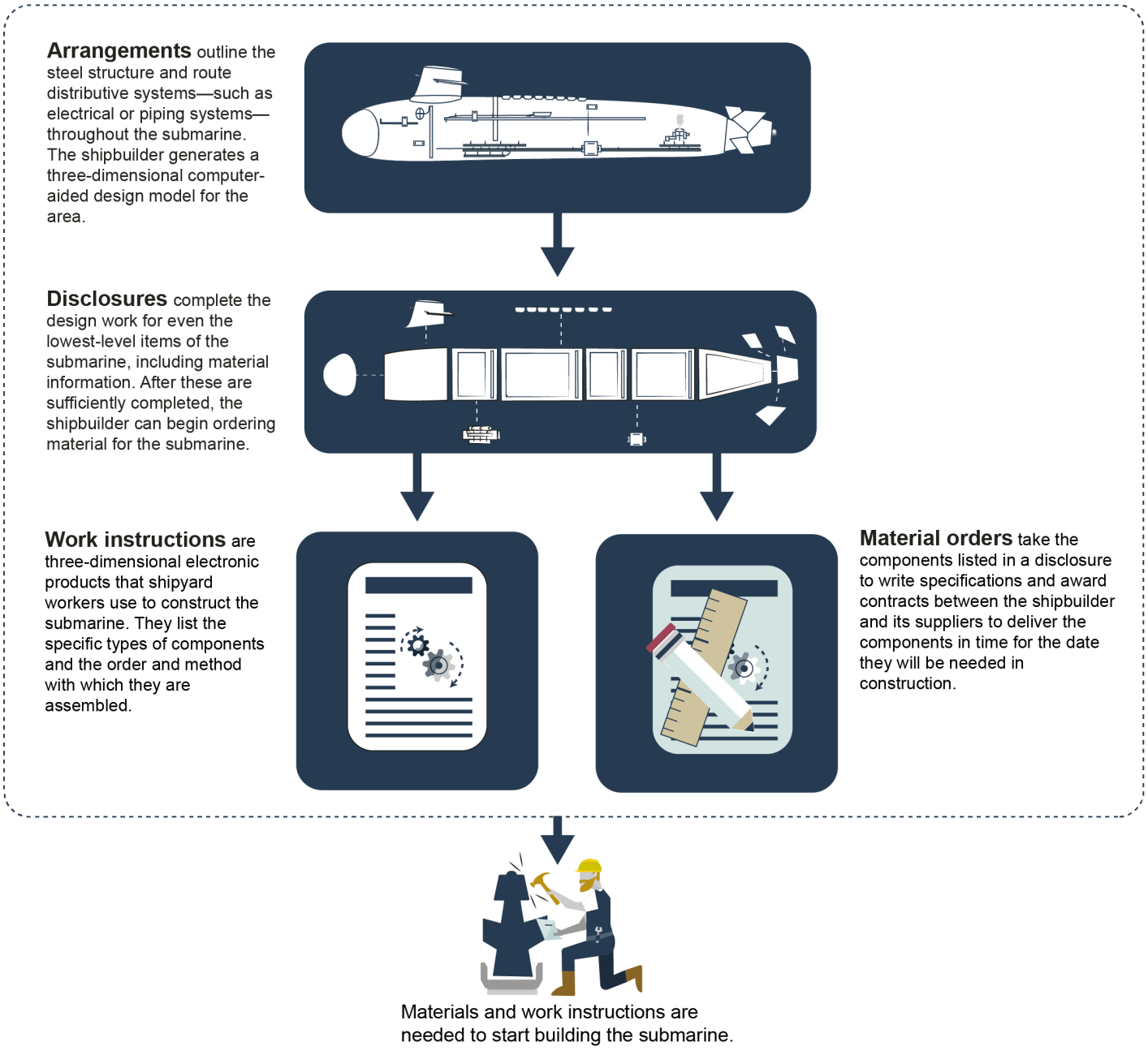
Beginning with the *Columbia* class program, Electric Boat transitioned to a new customized software tool for design and construction because its

[6]In order to proceed with formal construction, the program also requested budget authority from Congress.

[7]The milestone decision authority is a designated individual with overall responsibility for a program and with the authority to approve program entry into the next phase of the acquisition process. At the time of this decision, the role of Under Secretary of Defense for Acquisition and Sustainment was part of the Office of the Under Secretary of Acquisition, Technology, and Logistics.

prior tool was no longer supported by the original developer. Figure 1 illustrates the sequence of the major design phases for the *Columbia* class program that the shipbuilder completes using a computer-aided design tool software program.

Figure 1: Design Process Using Electric Boat's Design Tool Software



Source: GAO presentation of Navy documentation. | GAO-21-257

The shipbuilder is designing and constructing *Columbia* class submarines in six large hull segments, referred to as super modules. By 2019, the shipbuilder began advance construction activities for every super module, with plans to begin formal construction of the lead submarine in November 2020. During formal construction, the shipbuilder outfits the super modules with systems and connections prior to attaching them together during final assembly. According to the shipbuilder, this method is more efficient than outfitting the hull after it is constructed because more workspace is available for shipyard workers to install equipment.

Congress established an annual reporting requirement for the program in the 2018 National Defense Authorization Act. Under this requirement, the Navy must report on key milestones, development events, and performance goals during design and construction. The status of the program's design maturity, technology readiness levels, and manufacturing readiness levels are included among the elements the Navy is to report annually.[8] The Navy submitted its initial annual report in February 2018 and issued its most recent report in February 2020.

Nuclear Shipyards and the Shipbuilding Supplier Base

Electric Boat and Newport News, along with the shipbuilding supplier base, are preparing for the most significant increase in ship construction in over 30 years as part of efforts to enable the Navy's goal of a 355-ship fleet. As part of this effort, the Navy is buying new nuclear-powered vessels, including *Ford* class aircraft carriers, *Virginia* class submarines, and *Columbia* class submarines. Construction for these three acquisition programs is all taking place concurrently at Electric Boat—which has facilities located in Groton, Connecticut and Quonset Point, Rhode Island—and Newport News—which has a facility in Newport News, Virginia—in addition to the various activities necessary to sustain existing ships. Electric Boat and Newport News plan to deliver 39 nuclear submarines during the next 2 decades, which, if achieved, would represent a doubling in output over prior years. The shipyards are basing their plans for shipbuilding on a pace of delivering two *Virginia* class submarines per year through 2033 and one *Columbia* class submarine per year starting in 2026.

[8]Critical technologies are new or novel, or used in a new or novel way, and needed for a system to meet its operational performance requirements within defined cost and schedule parameters. See GAO, *Technology Readiness Assessment Guide: Best Practices for Evaluating the Readiness of Technology for Use in Acquisition Programs and Projects*, GAO-20-48G (Washington, D.C.: Jan. 7, 2020). We discuss critical technology development in appendix II. For a description of each critical technology readiness level used to describe the maturity of critical technologies, see appendix III.

Similarly, the supplier base that supports these shipbuilding programs is facing a surge in demand for materials. However, this supplier base has diminished in size over prior decades. According to the shipbuilders' planning documents and program officials, the number of suppliers that can support Navy shipbuilding programs has shrunk by roughly 70-80 percent since the 1970s and 1980s when the Navy last procured two submarines concurrently. A shipbuilder document states that the number of suppliers has decreased from a prior number of 17,000. Program officials told us that the number of suppliers is now roughly 5,000. According to shipbuilder planning documents, the consequence of this reduction has been an increased reliance on sole-source suppliers and a reduced number of suppliers that compete for contracts. The shipbuilders and Navy deemed a certain subset of suppliers to be critical to shipbuilding programs based on assessments of three primary areas of supplier performance: capability, capacity, and cost.

Since 2017, Congress has provided funds for the expansion and development of the submarine supplier base.[9] In a 2018 conference report on the Fiscal Year 2019 National Defense Authorization Act, congressional conferees stated that the funds provided were intended to ensure that submarine suppliers are able to meet increased production requirements. In fiscal year 2018, Congress provided $225 million in advance procurement funding to the *Virginia* class program—which uses many of the same suppliers as the *Columbia* class program—that the Navy used to expand and develop the supplier base. Subsequently, in fiscal years 2019 and 2020 the Navy received $451.6 million in funding as part of *Columbia* class submarine advance procurement funds that it budgeted to ensure that suppliers can meet increased production requirements. Under the provisions of the program's design contract, Electric Boat is administering the distribution of the majority of this funding on behalf of the Navy. Information about the Navy's plan for utilizing these funds is in table 1.

[9]For the purposes of this report, we refer to submarine industrial base development funding and submarine supplier development funding as supplier development funding. We provide additional information about the Navy's use of supplier development funding in appendix IV.

Table 1: Navy Plans for Use of Fiscal Years 2019 and 2020 Supplier Development Funds

Dollars in millions

Type of effort	Description of purchases	Fiscal year 2019	Fiscal year 2020	Total
Direct investments in suppliers				
Reducing risk from existing sources/establishing new sources	Supplier projects, training, and development of alternate suppliers	127.3	145.4	**272.7**
Material purchases to coordinate demand across Navy shipbuilding programs				
Multi-program material procurements	--	78.4	61.5	**139.9**
Continuous production	Air flasks and associated components, trash disposal unit inserts	1.8	5.8	**7.6**
Production backup units	Potential buys include valves, pumps, and ship's service components	17.5	13.9	**31.4**
Total	**n/a**	**225.0**	**226.6**	**451.6**

Source: GAO presentation of Navy documentation. | GAO-21-257

Note: The appropriations for fiscal year 2020 includes $123 million more than requested in the President's budget for supplier projects, or direct investments in suppliers. Where it appears in the table, n/a = not applicable.

Quality Assurance Oversight

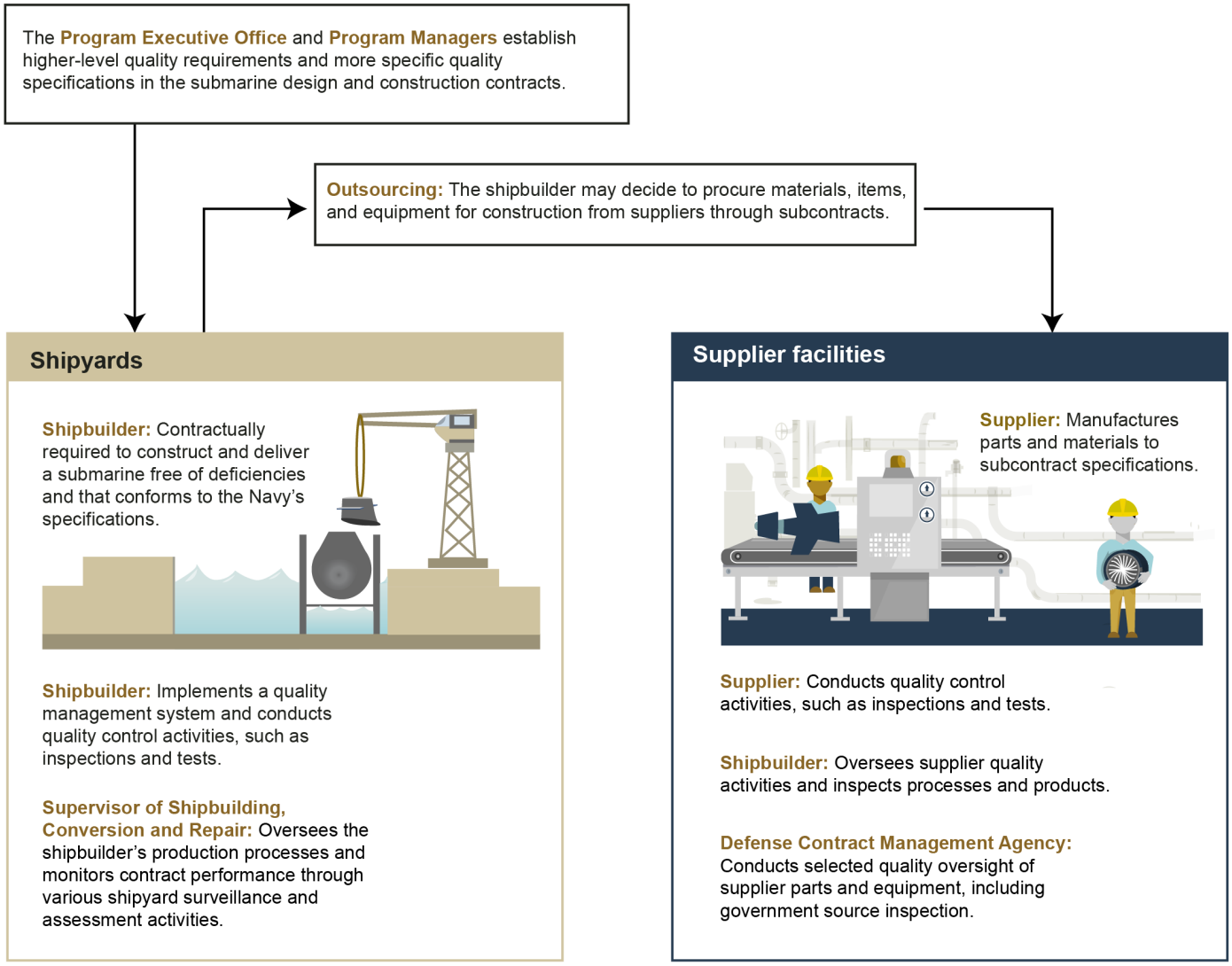
Subject to contract requirements, the shipbuilder is responsible for delivering quality submarines that meet the Navy's specifications. The shipbuilder is tasked with ensuring and monitoring quality based on contract requirements, such as operating a quality management system, and using internal quality oversight activities such as inspections to verify the quality of materials.[10] Further, when procuring materials and equipment from suppliers, the shipbuilder may flow down contract quality requirements in its subcontracts. Both the shipbuilder and its suppliers can conduct inspections, evaluations, audits, self-assessments, and other activities to ensure they are achieving quality requirements and product specifications.

Within the government, several DOD and Navy organizations contribute to the acquisition, construction, and fielding of new ships. Some organizations closely monitor quality through their involvement in the

[10]Federal Acquisition Regulation 46.105. Quality management systems incorporate policies, processes, and procedures for planning and producing materials that meet customer requirements.

Columbia class program's management, presence at the shipyards, and interaction with submarine suppliers, as seen in figure 2.

Figure 2: Department of Defense Quality Assurance for Submarine Construction



Source: GAO analysis of Federal Acquisition Regulation, Department of Defense, Navy, and shipbuilder information. | GAO-21-257

Specifically, the following offices take on distinct roles in quality assurance oversight:

- **The Program Executive Office and Navy Program Managers** that report to them—Program Executive Office *Columbia* and the *Columbia* Class Program Office, respectively—are to manage all aspects of life-cycle management of the *Columbia* program, including program initiation, ship design, construction, testing, delivery, fleet introduction, and maintenance activities.
- **SUPSHIP—including SUPSHIP Groton**—is the Navy's primary on-site representative at the private shipyards that build Navy submarines. SUPSHIP's services include contract administration, project management, engineering surveillance, quality assurance, logistics, and financial administration. Work activities performed by SUPSHIP's quality assurance department include review of the shipbuilders' quality management system and work procedures; inspection and testing of the shipbuilder's completed work; and evaluation of quality data. SUPSHIP also is responsible for determining which items require government source inspections, which typically take place where goods are manufactured or assembled.
- **DCMA** conducts quality assurance oversight activities for Navy programs when SUPSHIP and the contracting office delegate the responsibility for oversight at the supplier-level, including government source inspections of supplier processes and products to ensure they meet contract requirements.[11] Government source inspections can involve comparing parts to specifications, drawings, or other instructions, and they inform the government about how well prime contractors are performing their role in assuring that suppliers are meeting quality expectations.

In general, a quality product performs as expected, can be depended on when needed, and is free of deficiencies. Deficiencies—also called defects or non-conformances—are problems with items that require action to correct the material condition or product performance and bring the item into compliance with required standards.[12]

[11]Federal Acquisition Regulation 46.401-402. For the purposes of this report, we refer to government contract quality assurance at source as government source inspection.

[12]For more on Navy shipbuilding quality practices, see GAO, *Navy Shipbuilding: Past Performance Provides Valuable Lessons for Future Investments*, GAO-18-238SP (Washington, D.C.: June 6, 2018).

Design Delays Signal Cost and Schedule Risk, and Decision Makers Lack Key Information to Inform Upcoming Budget Decisions

Electric Boat faces persistent problems with its design tool leading to cost increases and schedule delays during the design phase. Late completion of design products threatens to impede construction progress and indicates challenges in the *Columbia* class program's ability to achieve the lead submarine's construction schedule. In an effort to start full construction in October 2020, the Navy accelerated its contracting plans and awarded a modification to the design contract in June 2020 that includes an option for the first two *Columbia* class submarines, though the Navy also needed sufficient authority from Congress in order to proceed with exercising this option.[13] A key DOD milestone review occurred in August 2020, and it was informed by an independent review of program costs. Further, the Navy stated that design and construction costs are higher than the program's current budget, meaning the Navy sought authority from Congress to buy the first two submarines with a budget that underestimates the likely total program cost.

Design Tool Problems Have Contributed to Delays in Completing Key Design Products and Resulted in Increased Design Costs

Electric Boat has generally not met its planned design schedule for the lead submarine due, in large part, to persistent inefficiencies associated with its new software-based design tool.[14] The tool integrates new capabilities, such as some enhancements to material ordering and cable routing. The tool was also expected to reduce the average hours needed to complete design disclosures by almost half of the time required for the *Virginia* class program. The program and shipbuilder expected these capabilities to enable greater efficiencies than previously possible. However, problems with the tool's software prevented the program from fully realizing these efficiencies. Consequently, Electric Boat is behind schedule in producing key design products—design disclosures and work instructions—and as a result is experiencing delays in ordering materials needed to support the construction schedule. These delays, in turn, led to cost increases as the shipbuilder requires additional work hours to complete design products. The challenges the shipbuilders experienced with using the design tool appear in table 2.

[13]The program later shifted the planned start of formal construction from October to November 2020.

[14]DOD identified specific information about design tool performance inefficiencies as sensitive. As such, this information was omitted from this report.

Table 2: Challenges Shipbuilders Reported with Meeting Design Tool's Expected Performance

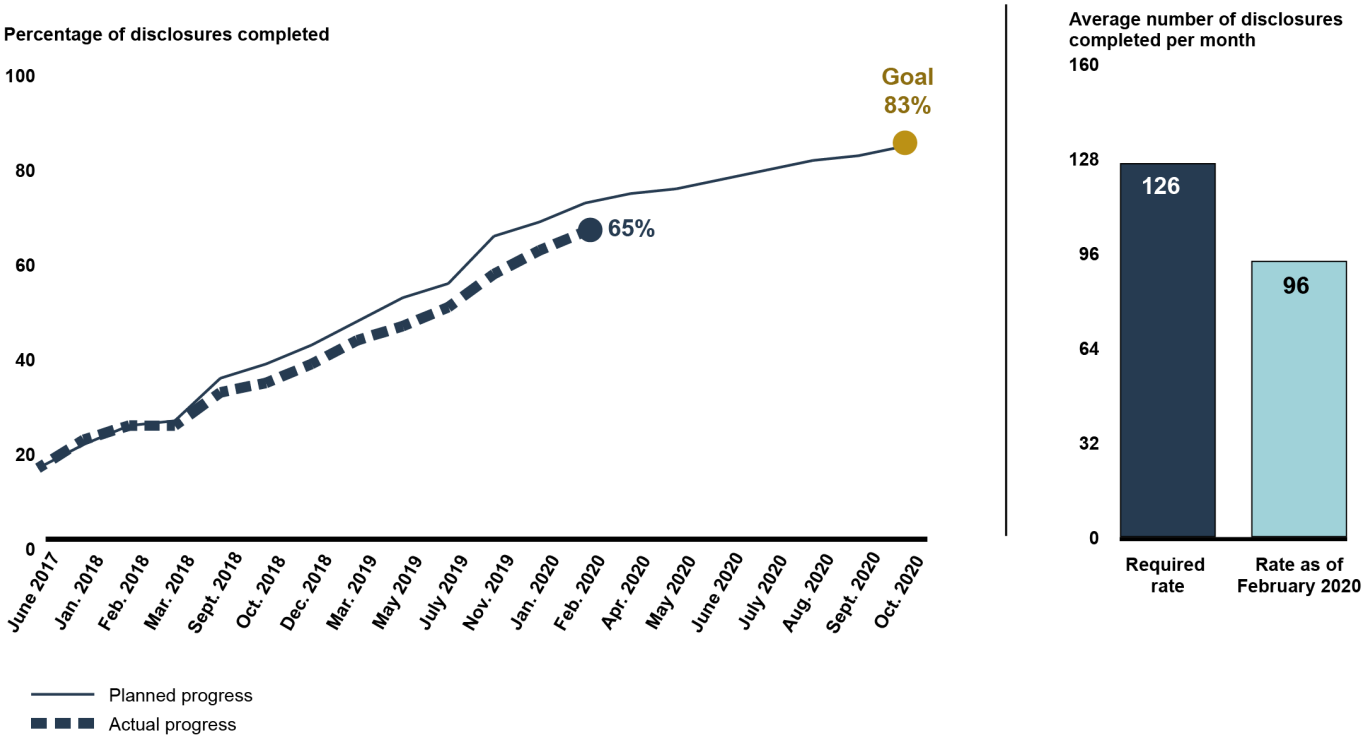
Challenge
Processing design changes
Sharing design data
Efficiently completing work instructions
Ordering materials efficiently from vendors

Source: GAO analysis of Navy data. | GAO-21-257

We reported in April 2019 that Electric Boat was not completing design disclosures—which establish the dimensions and components of materials needed—at the rate necessary to meet its plans to complete 83 percent by the start of lead submarine construction in October 2020.[15] We also reported that the program needs to complete 83 percent of its design disclosures to achieve the savings assumed in its estimate of program cost. Electric Boat remains behind schedule on completing design disclosures and will have to improve performance in the coming months to meet the program's goal. Data provided by Electric Boat shows that it missed its monthly disclosure completion goals in all but one month in 2019. As shown in figure 3, Electric Boat is not on track to meet its disclosure completion goal without increasing the average number of disclosures completed per month by at least 32 percent.

[15]GAO, *Columbia Class Submarine: Overly Optimistic Cost Estimate Will Likely Lead to Budget Increases*, GAO-19-497 (Washington, D.C.: Apr. 8, 2019).

Figure 3: *Columbia* Class Disclosure Completion Progress Was Below the Rate Needed to Reach 83 Percent by October 2020



Source: GAO analysis of Navy data. | GAO-21-257

Program officials told us they expect the rate of disclosure completion to increase throughout 2020 since they completed early design products and have additional staff to focus on disclosures. In an effort to accelerate completion of design products, Electric Boat added 313 more designers to its disclosure completion effort than planned in 2019, and consequently increased the cost to the government per disclosure. However, even with these efforts it has yet to recover the design schedule.

Similarly, Electric Boat and Navy representatives stated that the shipbuilder is adding more staff than planned to develop work instructions to support increasing construction activity. However, in all but one month of 2019 the shipbuilder has been unable to meet monthly completion goals for those products. Electric Boat anticipates that future releases of the design tool capabilities will improve efficiency. Further, the shipbuilder is attempting to accelerate material orders by developing data before the associated disclosures are written, a process that requires effort from the same design staff tasked with completing disclosures and which will

increase their workload. Mitigating delays caused by the design tool with additional staff will likely allow the shipbuilder to complete design products more quickly, but it will also increase the cost of design.

Design Product Delays Impede Construction Progress and Add Risk to the Delivery Schedule of the Lead Submarine

Consistent delays to design disclosures have led to cascading effects for other design products and activities that must be completed to maintain the construction schedule for the lead submarine. Specifically, disclosure delays have hampered the shipbuilders' progress on developing work instructions and ordering materials. Accordingly, the effects of earlier disclosure delays present a risk to achieving the lead submarine's already aggressive delivery date. For example, by January 2020, Electric Boat planned to have completed 6 percent of the work to build the lead submarine during advance construction, but only completed half that amount. Delays to design products and material orders are contributing factors in these construction delays. The program's plan to complete the construction of the lead submarine within 84 months depends on successful advance construction efforts to reduce the amount of work during formal construction to an achievable level.

Electric Boat cannot write work instructions without first completing the disclosures for the related areas of the submarine. Without timely delivery of work instructions, work to build the portions of the submarine cannot begin, because the construction staff will not know the correct method and sequence for assembling the material. Further, the total number of work instructions needed to build the lead submarine has grown 25 percent since February 2018, requiring more effort to meet the same schedule.[16] This growth indicates there will be more work instructions to complete in the same time frame, increasing risk they will not be completed in time to support the construction schedule. Based on data reported by the Navy, we determined that Electric Boat must increase its average work instruction completion rate by 29 percent in 2020 to support the planned construction pace. If Electric Boat is unable to improve the work instruction completion rate, delays in the lead submarine's construction schedule could occur.

[16]Program officials stated that this growth was largely due to work needed to build a replacement segment of the common missile compartment, which became necessary when Electric Boat determined that the first article quad pack—a hull segment containing four of the submarine's 16 missile tubes—contained defective tubes that could not be repaired in time to use on the lead submarine. However, as the Navy reported in September 2018, it still planned to use portions of the original missile compartment segment, but by that time the total number of work instructions had already grown by 5 percent.

Late work instructions are already impeding construction progress. For example, in October 2019, Electric Boat reported that disclosures needed to create work instructions for the missile deck module of the common missile compartment had not been completed on time or had changes that were necessary to support the advance construction schedule. As a result, work instructions necessary for this module were also delayed. By January 2020, the shipbuilder was 60 percent behind schedule for building this module. Program officials stated that they accelerated the super module construction schedules to reduce risk to the delivery schedule. As a result, the schedules for each of the submarine's six super modules have no more than 3 months of schedule margin to their completion dates, beyond which further delays could push out the submarine's final delivery. While the submarine is at an early construction stage and the scale of the shortfall against the planned schedule is relatively small in comparison to the total work to be done, the negative trends in work instructions and material availability are already having a negative effect. These trends indicate that construction delays have the potential to rapidly grow if the underlying problems are unresolved before the program increases its construction pace following formal authorization for construction of the lead submarine.

The *Columbia* program has experienced delays in material availability—timely delivery of components to the shipyard for use in construction—for every super module during advance construction. Program officials told us that delays to disclosures are having a negative effect on timely orders for materials. Since Electric Boat cannot order materials until they are sufficiently defined in a disclosure, construction progress slows because workers must wait for material to arrive. Electric Boat's planning documents for its ongoing Navy shipbuilding efforts stress that material availability is key to meeting the construction schedule and avoiding cost increases. The documents note that delays to even relatively simple commodities can cause major delays and disruptions to efficiently building the submarine. In January 2020, Electric Boat reported that 9 percent of construction activities did not have all material available in time to start work as scheduled. This challenge is more pronounced in some areas of the submarine. Based on our analysis, across the whole submarine, 10 percent of developmental components—unique items being designed and built for the *Columbia* class, in particular—are behind schedule, and 35 percent of commodities are behind schedule. In

February 2020, material availability was behind schedule for each of the submarine's six super modules.[17]

Decision Makers Examined Key Cost and Schedule Risk Information and Authorized the Navy to Exercise the Construction Contract Option

In an effort to ensure that the program will be ready to begin construction of the lead submarine on schedule, the Navy accelerated its plans to negotiate with Electric Boat for construction of the first and second *Columbia* class submarines. In June 2020, the Navy modified the design contract to include a contract option for construction. The Navy took this step before the completion of a key DOD oversight event intended to review program cost and schedule risks. In August 2020, the Under Secretary for Acquisition and Sustainment (the milestone decision authority for the *Columbia* class program) reviewed the program's progress and determined if it has reduced risks sufficiently to authorize construction of the lead submarine. The milestone decision authority approved the program to be funded at Office of the Secretary of Defense's Office of Cost Assessment and Program Evaluation's (CAPE) estimate, and approved the program to proceed with construction. The Navy plans to exercise the contract option in November 2020. According to *Columbia* class program officials, the Navy adopted this approach in an effort to ensure that formal lead submarine construction could start as soon as funding was appropriated at the start of fiscal year 2021, and to avoid delays negotiating the contract option.

However, under this timeline, the program has established a contracting approach—including pricing and performance incentives to mitigate risk—before the milestone decision authority reviewed key information, in particular an independent assessment of program costs from CAPE. Program officials told us that the negotiations for the Build I submarine construction option were informed by internal Navy cost estimates and actual costs from the *Virginia* class program, as well as cost data shared by the shipbuilder. The officials stated that they have taken steps in their negotiations to reduce risk—such as reviewing certified pricing data from Electric Boat and also obtained approval from the office of Defense Pricing and Contracting within the Office of the Secretary of Defense.

According to a program briefing, CAPE provided an update to their independent assessment to the milestone decision authority in August 2020. Completing this assessment of the program's lead ship cost

[17]Program officials told us that the shipbuilder changed its metric for evaluating material availability to reflect actual dates that the shipbuilders need the materials in the yards for construction and, based on this new metric, the material availability for all super modules improved by May 2020. We will continue to monitor these metrics in future work.

estimate was a requirement of the milestone decision authority before the program can enter formal construction. The milestone decision authority reviewed this assessment to help determine if the Build I contract option is based on the most likely cost to build the first two submarines before the Navy plans to exercise those options in November 2020. Updated information resulting from CAPE's assessment was used to alter program cost expectations.[18]

Congress Has Not Been Provided with the Most Likely Cost of Construction Ahead of Decision to Provide Sufficient Authority for First Two Submarines

In the President's fiscal year 2021 budget request, the Navy asked Congress to provide sufficient authority for the construction of the first two submarines and to incrementally fund the two Build I submarines. Program officials, however, told us that the Navy's $14.4 billion budget submission for the cost to construct the lead submarine underestimates the most likely costs in order to preserve a competitive negotiating position with Electric Boat for Build I. The budget request provides information to Congress for consideration as part of the appropriations process. However, the program will likely require additional funding in future budget years to accommodate increased costs that were not communicated to Congress in the Navy's request. We found in April 2019 that the Navy's original estimate of the program's procurement costs was not reliable because it was based on overly optimistic assumptions.[19] Consequently, we recommended that the Navy update its estimate using current cost data to inform its budget request for the lead submarine. DOD concurred with this recommendation and the Navy updated its estimate; however, program officials stated that the fiscal year 2021 budget request does not reflect their updated estimate. Navy officials plan to incorporate additional costs in future budget requests based on an estimate that was completed after it submitted the fiscal year 2021 budget request.

Further, the budget request for Build I was not informed by key information, including CAPE's independent cost assessment, which was completed in August 2020, and changes to the program's cost estimate assumptions. For example, the program's prior cost estimate used to inform the budget request reflects an assumption that it will achieve cost savings by completing 83 percent of disclosures by the start of lead

[18]The milestone decision authority determined that the lead submarine should be funded to CAPE's estimate. While program officials told us that their most recent cost estimate exceeded the amount they submitted in its budget request, we will evaluate the difference, if any, between CAPE's estimate and the budget submission during future reviews.

[19]GAO-19-497.

submarine construction. The program estimated that doing so would avoid the cost growth experienced by other recent shipbuilding programs by avoiding re-work resulting from design changes after construction had started. However, as discussed above, the program is not on track to meet that goal and, as a result, it is unlikely to realize the cost savings it planned. Further undermining this cost assumption, the program has expanded the amount of advance construction work to be completed before the schedule disclosure goal, effectively resulting in more construction work being done with fewer design disclosures completed than assumed. The impact of these unmet assumptions is not reflected in the program's fiscal year 2021 budget request.

The Navy updated its cost estimate in October 2019 and the updated estimate reflects an increase that program officials told us they anticipate as a result of slower-than-expected progress on design completion. However, the Navy briefed us on the findings of their estimate in July 2020, and we plan to examine the estimate's criteria and underlying assumptions in future work. Since the Navy already updated cost and risk information beyond what has been provided to Congress, and received CAPE's independent cost assessment in August 2020, the Navy will be well positioned to provide additional information to Congress following the milestone decision authority's August 2020 review. Without such information, Congress will be making a decision on authorizing the first two submarines absent an understanding of their most likely construction cost.[20]

Lead Submarine Construction Schedule Challenged by Inexperienced Shipyard Workforce and Risks in the Supplier Base

Electric Boat and Newport News face challenges with managing an inexperienced shipyard workforce, but have plans to manage skilled workers and supervisors that are intended to mitigate the limited experience of newer employees. Although the shipbuilders plan to increase outsourcing to the supplier base because they cannot accommodate work for all ongoing shipbuilding programs at the shipyards, they face schedule risk because some of the suppliers they plan to use are not ready to support demand.[21] In working to balance the risks from limited shipyard capacity and supplier base readiness, Electric Boat recently proposed changes to its outsourcing plans. However, by making these changes with limited time to complete planning efforts

[20]The National Defense Authorization Act for fiscal year 2021 became law on January 1, 2021 as this report was being processed for publishing.

[21]DOD identified specific information about the shipyards' workforce and supplier readiness as sensitive. As such, this information was omitted from this report.

before the start of formal construction, the shipbuilder now faces new risks to the program schedule.

Shipbuilders Face Challenges from Limited Worker Experience

The shipbuilders face workforce challenges that, if not addressed, could threaten their ability to achieve the construction schedule and negatively impact the planned first patrol date for the lead submarine in 2030. As the shipyards increase hiring, the experience level of skilled workers is expected to decrease, which can result in construction tasks taking longer to complete. Additionally, although the shipyards plan to mitigate inexperience among skilled workers through supervision, this strategy likely will be challenging to implement because, according to a *Columbia* class program office briefing, supervisors at the shipyards also have limited experience.

The average experience level of the skilled workforce at both shipbuilders is expected to decrease as they increase hiring efforts to accomplish additional workload in the shipyards. According to shipbuilder and Navy documents, the majority of skilled workers are expected to have less than 5 years of experience. A *Columbia* class program briefing states that the shipbuilder's management of anticipated fluctuations in workload is a concern.

Both shipbuilders have exceeded hiring goals for supervisory positions in the past year and plan to steadily hire additional supervisors to meet increased demand during *Columbia* construction. Program officials stated that the shipbuilders plan to hire supervisors internally from among skilled workers, engineers, and designers. However, as hiring increases, more supervisors will have limited experience in their new roles.

The shipbuilders plan to mitigate the risk of an inexperienced workforce through investments in additional training and leadership development for supervisors and by implementing an appropriate balance between the number of skilled workers and supervisory employees based on experience level and complexity of work. *Columbia* class program briefing documents note that supervision at the shipyards remains a concern.

Shipbuilder Proposed Changes in Outsourcing Plans Due to Supplier Readiness Risk, but Navy Does Not Include Information on This Risk in Its Annual Report to Congress

Electric Boat proposed recent changes to its outsourcing plans to reduce the risk of relying on the supplier base for materials. However, the Navy does not include information about the status of supplier readiness in its annual report to Congress, despite risk to the program schedule from supplier readiness problems.

Due to an expected increase in workload at the shipyards, the shipbuilders determined that they lack the physical space to construct both *Virginia* and *Columbia* classes simultaneously. Officials from the shipyards explained that they have limited capital available for facility expansions, and are constrained in the physical space for additional construction activities that would expand their capacity. As a result, the shipbuilders plan to increase outsourcing to suppliers for some materials and components that have been traditionally produced at the shipyards. Specifically, Electric Boat expects to outsource large steel structural fabrications like tanks, decks, large foundations, and assemblies, and Newport News plans to outsource work on the submarines' superstructure, among other things.

However, plans to outsource additional work can create challenges because the shipbuilders need to rely on a strained supplier base. Consequently, Electric Boat made major changes to its initial 2018 outsourcing plans in an effort to address limited shipyard capacity and reduce the risk associated with outsourcing. Electric Boat still plans a significant increase in outsourcing over the present level. Although Electric Boat has determined which items to outsource for the lead submarine, it is not expected to finalize changes to its outsourcing plan until after lead ship construction is expected to begin. As a result of increasing the amount of work expected to occur at the shipyards with little time to plan for and implement this change, the shipbuilder introduced additional risk related to outsourcing efforts.

The shipbuilders are considering new suppliers to conduct some work, which could increase the likelihood of challenges during initial production that could delay materials needed at the shipyards to support construction time frames. *Columbia* program officials told us that new suppliers taking on work that had previously been conducted at the shipyards are generally considered not ready to meet increased demand for materials. Officials from the *Virginia* class program explained that there may be less risk to the *Virginia* class program from increased outsourcing because the shipbuilders have experience with constructing this class of submarines, while *Columbia* class construction will include many components being produced for the first time for this class of submarine. These officials

further explained that the shipbuilders would be better positioned to assist the supplier base with production of materials for the *Virginia* class because of their prior knowledge.

The Navy is required to report on the status of specific performance goals for the design and construction of the *Columbia* class submarine in annual reports to Congress, including on a minimum set of topics including design maturity, manufacturing readiness levels, and manufacturing operations.[22] In the annual reporting requirements included in the National Defense Authorization Act for Fiscal Year 2018, Congress requested information about the status of the program's design and construction goals. The House Committee on Armed Services noted in a 2018 correspondence that this information is important to support its oversight of the program. While the Navy must report on the status of manufacturing operations, it has only included information about manufacturing operations at the shipyards. As noted above, the shipbuilders plan to rely on the supplier base to produce some materials that are normally produced at the shipyards and that would traditionally fall under the purview of manufacturing operations. Supplier readiness to support construction demand affects whether manufacturing operations at the shipyards will be positioned to support the planned delivery schedule. Further, the program's detail design contract includes program goals for increasing supplier readiness by the start of construction, and program officials told us that they seek to maintain supplier readiness throughout construction. Improving supplier readiness is important to the program's ability to retain its planned construction schedule, and information on this topic could bolster Congress's ability to conduct oversight. Without including information about the status of supplier readiness in its report to Congress, the Navy will not be providing full information about the status of manufacturing operations or about the shipbuilders' progress toward meeting one of the program's performance goals.

The recently proposed changes to Electric Boat's outsourcing plan would require the shipbuilders to act quickly to avoid delays during construction. Specifically, Electric Boat's plans for outsourcing will affect key efforts to support construction, including: (1) plans for facility space at the shipyards; (2) workforce planning; and (3) producing outsourcing information to support the timely delivery of supplier materials to the shipyards. *Columbia* program officials told us that Electric Boat does not

[22]The National Defense Authorization Act for Fiscal Year 2018, Pub. L. No. 115-91, § 231 (2017).

anticipate finalizing some elements of its outsourcing plan until December 2020, after the anticipated start of lead ship construction. As a result, the program faces schedule risk in the following areas related to the shipbuilders' outsourcing plans:

- **Plans for facility space at the shipyards.** Program officials told us that Electric Boat is working to accommodate additional work within the space available at the shipyard by considering outsourcing additional items for the *Virginia* class program. However, the shipbuilder's effort to identify opportunities to free up capacity for *Columbia* so that facilities will not be over-utilized is ongoing. As such, the shipbuilder has yet to determine how to optimize use of its facilities considering the additional work planned for the shipyard. The shipbuilders' 2016 facility plan cautions that, based on previous experience, increasing the scope of work before facility space has been identified led to complex adjustments to how facilities were used and resulted in a sub-optimal build plan. By deciding to produce additional items at the shipyards before determining how to accommodate the work within existing facility space, the shipbuilder is increasing the risk that the construction of the lead submarine will take longer than planned. Electric Boat has limited time remaining before the start of lead ship construction to mitigate this risk through additional planning for how facilities will be used. As the Navy does not anticipate the shipbuilder's finalized outsourcing plan until December 2020, we will continue to monitor this issue during future reviews.
- **Workforce planning.** Program officials told us that Electric Boat completed an initial analysis of its workforce plan based on prior experience with the *Ohio* class. Program officials also stated that Electric Boat plans to reevaluate its staffing plan by December 2020 to assure that it is consistent with the updated outsourcing plan. Such an analysis would better position the shipbuilder to avoid the risk of hiring an insufficient number of workers to support lead ship construction, which would likely lead to schedule delays.
- **Preparing outsourcing information for suppliers.** In order to prepare design and ordering information for items that will be outsourced, the shipbuilders need to finalize the list of items they will make at the shipyards and which will be outsourced to the supplier base. Further, these decisions inform the schedule for outsourcing necessary to support on-time delivery of materials from suppliers to the shipyards. The shipbuilders are in the process of developing this information. According to Navy documentation, the shipbuilders' initial outsourcing efforts have been slow to start and fell behind the

targeted rate in 2019, requiring more rapid expansion of these activities in 2020 to meet the schedule for outsourcing. If the shipbuilders continue to fall behind in their efforts to develop information about the materials they plan to outsource, they are likely to have to seek shorter delivery times from the supplier base to maintain the construction schedule. Such compressed timelines can create challenges for suppliers, which could be exacerbated by the supplier base's challenges supporting increased demand for materials.

Supplier Quality Problems Have Persisted, but the Navy Has Not Comprehensively Reassessed When Additional Government Inspections at Suppliers Are Necessary

Since 2017, supplier quality problems that caused delays during advance construction of the lead submarine alerted the Navy and Electric Boat to more widespread challenges with producing quality materials within the supplier base. These challenges in producing materials free from deficiencies persist among suppliers that are expected to produce materials for the *Columbia* program. In response to these issues and the risks they pose to the program's schedule, the shipbuilders took steps to improve their quality assurance practices and are considering additional actions to help manage supplier quality as they plan for additional outsourcing. However, even as Electric Boat prepares to purchase additional materials from suppliers, SUPSHIP—the Navy's on-site quality representative at private shipyards—has yet to more broadly reassess whether additional government inspections are necessary at supplier facilities. Government source inspections, which are conducted by DCMA when delegated this responsibility by SUPSHIP, are a necessary tool in some instances to assure that the Navy has adequate oversight of the shipbuilders' quality assurance efforts at supplier facilities and to identify quality problems before they further impact the *Columbia* program's schedule.

Supplier Quality Problems Caused Early Delays and Highlight Continued Schedule Risk during Formal Construction

Quality problems with materials produced by some critical suppliers—which according to the Navy were discovered by Electric Boat and supplier representatives—have affected the *Columbia* program's advance construction schedule, increasing the risk that formal construction of the lead submarine will not proceed as planned. Going forward, the shipbuilder anticipates having to rely on suppliers that will need improvement to meet quality expectations.[23] Electric Boat has also identified specific products and processes that continue to present quality risks for the supplier base. Ongoing delays resulting from the additional

[23] DOD identified specific information about supplier quality and government source inspections as sensitive. As such, this information was omitted from this report.

time needed to repair or replace any deficient materials highlight the risk that persistent quality problems could further affect the program's schedule and the timely delivery of the lead submarine.

Specifically, quality problems with missile tubes and the integrated power system that occurred during advance construction illustrate the negative effect that poor quality materials and processes can have on the program's schedule. For example, quality problems at all three missile tube suppliers contributed to delays to the common missile compartment's advance construction schedule and, based on the suppliers' ability to recover the schedule to date, are likely to cause continued delays as formal construction begins.

As we previously reported, the shipbuilder identified weld defects in missile tubes from one supplier in 2018.[24] Navy officials attributed these defects to inexperienced welders performing complex welds. Additionally, program officials told us in July 2020 that Electric Boat had ineffective supplier oversight practices and that inspectors hired by the supplier had failed to identify defects at the supplier's facility. In 2019, the shipbuilder identified significant weld defects at a second missile tube supplier. The quality problems at two of the suppliers led to time-intensive repairs and re-work amounting to roughly 50,000 hours of delayed work at the shipyard as of January 2020. This, in turn, narrowed the margin available for the shipbuilder to meet the planned formal construction schedule. Based on our analysis of a December 2019 Navy briefing, the schedule for the common missile compartment has less than 1 month of margin remaining for on-time delivery. Moreover, according to Electric Boat and program briefing documents, the repair and delivery schedules for defective tubes continue to deteriorate at both suppliers, and the Navy expects this will further reduce schedule margin. As a result, there is increasing risk that the common missile compartment will not be available for final outfitting and assembly in July 2024 as planned.

These early schedule delays alerted the Navy and Electric Boat to the impacts of quality problems among the shipbuilding supplier base, and Navy briefing documents indicate that poor supplier quality is a recurring problem that is delaying delivery of materials to the shipyards. Without improvements in the supplier base, such delays are likely to continue during construction.

[24]GAO-19-497.

As the program enters formal construction and Electric Boat prepares to award new subcontracts, the shipbuilder plans to rely on critical suppliers that are, at present, unable to meet quality expectations. As part of the annual readiness assessments described above, the shipbuilder started formally evaluating and reporting on critical supplier quality, taking into account past inspection results, deficiencies in supplier materials and corrective actions requested by the shipbuilder to improve processes and products, and other performance information.

Electric Boat continues to identify problems with non-destructive testing and welding across the supplier base, including at suppliers responsible for non-missile-tube components such as piping, valves, and large mechanical equipment. A 2019 shipbuilder briefing document stated that supplier base performance for non-destructive testing and welding has been inadequate, and ramping up supplier production to meet increasing construction demand could further exacerbate quality challenges. The program reported that through March 2020 the shipbuilder continued to identify unsatisfactory inspection, weld, and non-destructive testing at supplier facilities. Some deficiencies were significant enough to require the supplier to stop all in-process work. For example, program officials told us that the shipbuilder stopped in-process work at a supplier facility where it identified problems with supplier personnel not following correct processes when conducting non-destructive testing.

Shipbuilder Is Taking Actions to Improve Supplier Quality but Has Yet to Finalize Oversight Plans Ahead of Formal Construction

Electric Boat has implemented new quality assurance mechanisms to better oversee and manage suppliers and is developing additional quality improvement efforts following supplier quality problems during advance construction. However, it has yet to fully determine how to adjust oversight to meet the challenges of increased outsourcing to the supplier base as it is still finalizing its outsourcing plan. These additional quality oversight measures will be important as the program enters formal construction because the shipbuilders, as noted above, plan to significantly increase the amount of work they traditionally outsource to their suppliers and because of the potential for quality problems that could result as they ramp up production. If the shipbuilder begins outsourcing more work before determining how to assure that suppliers are able to meet quality expectations, there is a greater likelihood that quality problems and schedule delays will occur.

Documents from Electric Boat indicate that standard quality assurance activities early in the *Columbia* program were not sufficient to manage the diminished supplier base. According to shipbuilder representatives, in response to early problems with supplier quality—especially those related

to the welds on the missile tubes—Electric Boat implemented new quality assurance measures and increased its management and oversight of supplier quality. Since 2018, for example, the shipbuilders have used the previously described critical supplier quality ratings to inform their surveillance activities. In addition, they have implemented the following practices to identify and evaluate supplier quality risks:

- **In-depth assessments.** The shipbuilders began conducting on-site assessments of supplier performance to help it better identify supplier quality problems and areas for improvement. Electric Boat focused its initial 2018 assessments on missile tube suppliers because of common quality risks associated with these suppliers' production practices. The scope of the assessments has since expanded to include suppliers of other materials. According to program documentation, through March 2020 the shipbuilders had conducted 45 in-depth assessments.[25] Over the course of these assessments, the shipbuilder found deficiencies—including weak oversight of welders, weak qualification programs for inspectors, and inadequate flow down of requirements to sub-tier suppliers—and requested suppliers take corrective actions.
- **Internal management.** The shipbuilders established new high-level quality management positions and internal groups to oversee and coordinate supplier quality improvement efforts and to enhance communication among quality officials at supplier facilities and the shipyards. To develop actions and strategies to address quality risks, the shipbuilders have assigned new supervision, contracted with experienced retirees, and reorganized some engineering resources. For example, Newport News has created a new supplier quality director position to oversee supplier surveillance and manage quality subject matter experts.

Electric Boat is also leveraging supplier readiness improvement mechanisms to help address supplier quality problems identified as part of the above efforts. For example, according to program office briefing documents, it is considering quality performance in its development of supplier improvement plans and its use of supplier development funds to address quality problems.

Further, Electric Boat has re-inspected some critical parts following in-depth supplier assessments, and according to the program office the

[25]The total number of assessments includes follow-on assessments of some suppliers as well as assessments conducted for one supplier at separate locations.

shipbuilders have delayed some contracts with suppliers until the suppliers completed corrective actions. However, if the shipbuilder ramps up supplier production before new quality assurance measures are fully in place, it risks further supplier quality problems that could result in schedule delays. Navy officials stated that the shipbuilder plans to fully update its outsourcing plan in December 2020, which will inform quality assurance oversight planning. We will continue to monitor this issue in future reviews.

Navy Has Not Comprehensively Reassessed When to Invoke Additional Government Inspections to Ensure the Quality of Supplier Materials

Based on the *Columbia* class program's acquisition strategy and SUPSHIP documentation, the Navy was aware at the start of advance construction that poor quality performance among suppliers could disrupt shipbuilding programs, but it did not take steps to adjust the use of government inspections at supplier facilities based on considerations unique to the *Columbia* class. These government source inspections are essential for ensuring that some critical supplier materials meet contract quality requirements, and they enable the Navy to gain assistance from DCMA inspectors at supplier facilities to help determine if the shipbuilder is ensuring that items meet contract requirements, including those for quality. The Commander of Naval Sea Systems Command has delegated responsibility for contract administration services to SUPSHIP, which includes government contract quality assurance and determining what items require government source inspection.[26] Even as the *Columbia* program enters into formal construction, the Navy has yet to conduct a more thorough reassessment of which materials require government source inspections despite growing awareness of poor supplier quality performance and the need to limit delays from repairs to deficient materials.

SUPSHIP Groton is relying on a policy memorandum that it produced in 1996 at the start of the *Virginia* class program to provide a list of categories of supplier materials that should have government source inspection. Program and SUPSHIP officials stated that they concluded that the *Columbia* program's suppliers and processes were similar enough to the *Virginia* class program such that SUPSHIP did not need to examine whether additional equipment needed government source inspections to assure quality. According to these officials, the Navy was confident that suppliers could continue to implement the same manufacturing and production processes for the *Columbia* program

[26]Naval Sea Systems Command Instruction 5450.36C, Mission, Functions, and Tasks of the Supervisors of Shipbuilding, Conversion, and Repair, Department of the Navy, September 2017.

without significant quality problems. However, while the SUPSHIP guidance requires government source inspection for the specific list of items, it does not limit inspections to items on the list, and it outlines additional conditions that should be considered. Moreover, under these conditions and the provisions in Federal Acquisition Regulation the program could invoke additional source inspections to its benefit based on new information the program has collected since its inception.

Ensuring that government source inspections are conducted when necessary as the program begins full construction is essential to discovering quality deficiencies at the right time and avoiding schedule delays. Under Federal Acquisition Regulation, government source inspections can be required if considerable loss would result from delays needed to repair deficient materials.[27] However, SUPSHIP has not conducted a full reassessment of which items require government source inspection despite recent experience with problems with critical manufacturing processes and information from the program office about issues with the diminished supplier base.

Despite the imperative for the Navy to deliver the lead submarine on time, SUPSHIP did not identify additional *Columbia* materials that could cause significant loss if they needed repairs and re-work. As discussed above, since the start of advance construction, repairs to missile tube welds have eliminated months of lead submarine schedule margin. Officials at one missile tube supplier explained that repairs for the defective welds are time-intensive because some of the welds must be removed before the supplier can undertake repairs. Even though DCMA officials were conducting oversight of other government contracts at this supplier, SUPSHIP did not direct DCMA to conduct government inspections of the missile tubes.

Officials from DCMA stated that for these types of welds they would typically observe the full weld process over the course of an inspection. DCMA officials also stated that had they been delegated additional responsibilities, they could have conducted other quality assurance activities, such as observation by test and weld experts. These quality assurance steps increase the likelihood that the government can identify defects sooner in production. However, since the Navy did not invoke government source inspection of the missile tubes, government inspectors did not have the opportunity to inspect for quality problems at

[27]Federal Acquisition Regulation 46.402.

the supplier's facilities, and the shipbuilder did not discover the defective welds until some of the tubes had been delivered to the shipyard and were in various stages of outfitting.

SUPSHIP and program officials told us that as of April 2020, SUPSHIP Groton added missile tubes to the list of materials that require government source inspection following recent problems with quality at missile tube suppliers. Further, they said that the program plans to invoke government source inspection, to include activities such as the inspection of manufacturing processes and product quality at various stages of production, as part of a recent missile tube contract option award. However, Navy officials stated that the government is unlikely to conduct source inspections for defective tubes that are already under contract with the shipbuilder because the initial contract did not include government source inspection requirements. Navy officials stated that adding government source inspection requirements now would require the shipbuilder to renegotiate its missile tube contracts with the suppliers, which could include granting schedule relief to suppliers and result in delays.

Although the Navy's experience with missile tubes demonstrates the benefit of determining whether government source inspections are necessary before contracts are awarded, program officials stated that the Navy has not more broadly reassessed whether additional materials require such inspections for the *Columbia* program. An assessment of which items should undergo government source inspection would position the Navy to better limit construction delays, especially as the shipbuilder is preparing to award new subcontracts to support increased outsourcing during formal construction. Conducting an assessment before contracts are awarded would help the Navy avoid renegotiations of contracts between the shipbuilder and suppliers that can result in increased costs or changes to the delivery schedules for materials being procured from the supplier base. *Columbia* program officials are uniquely positioned to inform such an assessment because the program obtains information about critical supplier quality history and performance through the shipbuilder's supplier assessments, and are the authority on program schedule goals and the consequences of delay needed to conduct repairs. Information on these topics would aid SUPSHIP in conducting a review to determine when it is in the government's best interest to conduct government source inspections for the *Columbia* program. Without an assessment of this type by SUPSHIP—with support from the program office—the program has a limited understanding of which supplier materials should undergo government inspections and lacks

reasonable assurance that the shipbuilder is taking steps to limit problems resulting from poor supplier quality and time-intensive repair work.

Conclusions

The on-time delivery of the lead *Columbia* submarine is paramount for maintaining the nation's nuclear deterrent, and the Navy accelerated contracting activities leading up to construction in an effort to ensure that construction begins on time. The Navy now plans to exercise its contract option for the construction of the first two *Columbia* submarines, though the associated budget request underestimated likely program total cost and does not reflect DOD decision makers' review of the program's updated independent cost assessment. As a result, the Navy has not provided Congress with the information necessary to make decisions informed by the program's current cost and schedule outlook. Following the program review in August 2020, the Navy is better positioned to provide Congress with updated information about the program's cost and schedule that is informed by the milestone decision authority's review of the independent cost assessment.

The program faces schedule risk during construction stemming from supplier readiness and quality problems that, if unmitigated, are likely to intensify when the shipbuilders outsource additional materials. Since additional suppliers will produce materials as the shipbuilders enact their plans for outsourcing, manufacturing operations at the shipyards will be increasingly dependent on the timely delivery of these materials. Moreover, the shipbuilders' ability to support risk reduction among suppliers that are currently unable to meet demand will be important for achieving on time delivery of the lead submarine. Consequently, the program's goals for improving and maintaining supplier readiness are an important indicator of the program's performance during construction. Information about the status of the program's goals for supplier readiness would provide Congress with additional insight into the shipbuilders' ability to construct the lead submarine according to schedule expectations.

As the shipbuilders plan to increase outsourcing during the construction of the lead *Columbia* submarine, they will award new subcontracts to suppliers to provide additional materials for the program over the coming years. Should SUPSHIP, supported by the program office, determine through a reassessment that additional material should have government source inspections, the government can invoke its right to conduct these assessments and avoid additional costs or schedule delays that could

result from renegotiating once contracts have been awarded. Accordingly, the Navy has a limited time frame to determine whether additional items for the *Columbia* program should undergo government source inspections before these contracts are awarded. Given the critical importance of receiving timely and quality materials from suppliers to meet the construction schedule, conducting a full assessment of which materials require government source inspection for the *Columbia* class program as soon as practicable will better position SUPSHIP to assist the program with limiting schedule delays caused by supplier quality problems.

Recommendations for Executive Action

We are making three recommendations to the Navy:

- The Secretary of the Navy should provide Congress with information from the milestone decision authority meeting that convened in August 2020. This should include updated cost and schedule information following the milestone decision authority's review of the independent cost assessment and assessment of the program's ability to reduce development risks. (Recommendation 1)
- The Secretary of the Navy should ensure that the Navy includes an update on the status of critical supplier readiness as part of the annual report it provides under the provisions of the 2018 National Defense Authorization Act to further inform Congress on the status of the *Columbia* class program's performance goals during design and construction. (Recommendation 2)
- The Secretary of the Navy should ensure that the Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP), in collaboration with *Columbia* class program management, assesses whether additional materials require government source inspections as soon as practicable and if the Navy believes further government source inspections are required, take action to ensure the shipbuilder includes the inspection clauses in contracts with suppliers. (Recommendation 3)

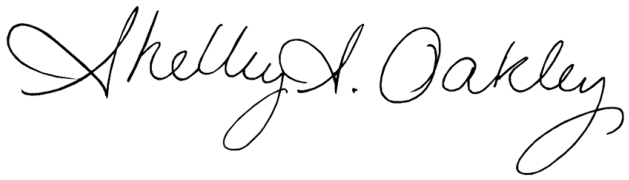
Agency Comments and Our Evaluation

We provided a draft of this report to DOD for review and comment in August 2020. DOD concurred with our recommendations and provided written comments that described actions they have taken or plan to take in response to all three of our recommendations. These comments are reprinted in appendix V. DOD also provided technical comments, which we incorporated as appropriate. We also updated the language in Recommendation 1 because the milestone decision authority review occurred after the draft report was sent to DOD for comment. DOD also

raised a number of issues related to our assessment of the program's design completion and the status of the supplier base, among other things. Our response to these issues also appears in appendix V. Information considered sensitive has been removed from appendix V.

We are sending copies of this report to the appropriate congressional committees, the Acting Secretary of Defense, the Secretary of the Navy, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

Should you or your staff have questions, please contact me at (202) 512-4841 or oakleys@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in appendix VI.



Shelby S. Oakley
Director, Contracting and National Security Acquisitions

List of Committees

Chair
Ranking Member
Committee on Armed Services
United States Senate

Chair
Ranking Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable Adam Smith
Chairman
The Honorable Mike Rogers
Ranking Member
Committee on Armed Services
House of Representatives

Chair
Ranking Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Appendix I: Objectives, Scope, and Methodology

This report assesses the Navy's *Columbia* class submarine program. Specifically, we assessed (1) the status of the Navy's efforts to complete the design and advance construction work for the lead *Columbia* class submarine to cost and schedule expectations; (2) actions that the shipbuilders and the Navy took and are taking to prepare for formal construction of the lead *Columbia* class submarine according to schedule expectations; and (3) actions that the Navy and shipbuilders have taken to oversee and ensure *Columbia* class submarines are delivered according to quality expectations.

This report is a public version of a sensitive report that we issued in November 2020. The Department of Defense (DOD) deemed some of the information in our November report to be sensitive, which must be protected from public disclosure. Therefore, this report omits sensitive information about the status of the program's detailed design, the state of the supplier base, and descriptions of critical technologies. Although the information provided in this report is more limited, the report addresses the same objectives as the sensitive report and uses the same methodology.

To assess the status of the Navy's efforts to design and construct the lead *Columbia* class submarine according to cost and schedule expectations, we reviewed Navy and shipbuilder documents, including program briefings, schedules, and contract status reports. To evaluate the shipbuilder's progress in maturing the *Columbia* class design, we reviewed the Navy's plans for design management and completion, criteria established by DOD stakeholders, and the shipbuilder's design schedule, and compared them against design progress reports to identify any delays. To evaluate the status of advance construction efforts, we analyzed metrics reported in Navy and shipbuilder documents, briefing slides, and other documentation on key dates and estimated construction plans. We also reviewed the matrices submitted by the Navy to Congress in February 2020, to determine the status of the program and identify any changes to the Navy's design and construction goals for the program since our last report in April 2019.[1]

To corroborate documentary evidence and gather additional information in support of our review, we met with officials from the Navy's *Columbia* class submarine program office; *Virginia* class submarine program office; Navy Strategic Systems Program; Naval Foundry and Propeller Center;

[1]GAO-19-497.

Naval Sea Systems Command Supervisor of Shipbuilding, Conversion and Repair (SUPSHIP) Management; SUPSHIP Groton; SUPSHIP Newport News; as well as DOD officials from the office of the Director, Operational Test and Evaluation; Office of Cost Assessment and Program Evaluation; Defense Contract Audit Agency; and the Defense Contract Management Agency (DCMA), Navy Special Emphasis Program. We also met with shipbuilding representatives from General Dynamics Electric Boat (Electric Boat)—the prime contractor—as well as their main subcontractor, Huntington Ingalls Industries Newport News Shipbuilding (Newport News), to understand their role in *Columbia* class design and construction. Additionally, we met with representatives from three of the program's critical suppliers that we selected based on their importance to the *Columbia* class program and their performance history. We also visited two of the suppliers' facilities to gain insight into ongoing supplier readiness and quality initiatives as well as quality assurance oversight activities. Further, to gain important context about the status of advance construction and facility utilization planning efforts at the shipyards, we visited Electric Boat's Quonset Point facility and Newport News.

To assess the actions that the shipbuilders and the Navy are taking to prepare to construct the lead *Columbia* class submarine according to schedule expectations, we reviewed Navy and shipbuilder documentation to identify and analyze hiring plans at the shipyards and compared this information to briefing documents containing information on the level of current staffing. We also reviewed shipbuilder briefings and planning documentation about facilities usage. To determine how the shipbuilders were preparing the supplier base to support construction demand, we reviewed Navy and shipbuilder documentation related to the use of supplier development funds and supplier base risks, and analyzed shipbuilder provided information from 2017 to 2019 on the status of critical supplier readiness. We also reviewed Navy and shipbuilder briefing documents about the shipbuilder's plans for outsourcing to the supplier base. Additionally, we reviewed the matrices submitted by the Navy to Congress to identify any changes to information reported about manufacturing operations. Further, we interviewed Navy, shipbuilder, and supplier representatives to understand their plans for preparing for increased construction demand, staffing, facility utilization, and outsourcing.

To evaluate actions the Navy and shipbuilders have taken to oversee and ensure *Columbia* class submarines are delivered according to quality expectations, we reviewed Navy and shipbuilder documentation about quality assurance oversight activities conducted at the shipyards and at

supplier facilities, including plans for future oversight. We also reviewed Navy and shipbuilder briefing documents containing information about the status of program quality efforts and quality problems identified during advance construction. We reviewed the Navy's internal assessment reports on quality assurance activities conducted at the shipyards. We also analyzed shipbuilder-produced data from 2017 through 2019 about the status of critical suppliers' ability to meet quality expectations. Additionally, we reviewed sections of Federal Acquisition Regulation as well as the Navy's implementing guidance and instructions pertaining to government source inspections and interviewed Navy, shipbuilder, SUPSHIP, DCMA, and selected supplier officials about how they implemented quality assurance activities and oversight for the *Columbia* program.

On March 13, 2020, during the course of this engagement, the President declared a nationwide state of emergency as a result of the spread of Coronavirus Disease 2019 (COVID-19). States and many employers—including locations where work on advance construction activities was ongoing—implemented changes to curb the spread of the virus. This report does not reflect the effects of these COVID-19 measures on the program's cost or schedule, as program officials told us that it was too soon to assess how actions taken in response to the virus would influence the program. Accordingly, the information in this report reflects the status of the program prior to COVID-19.

We conducted this performance audit from May 2019 to November 2020 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

We subsequently worked with DOD from November 2020 to January 2021 to prepare this unclassified version of the original sensitive report for public release. This public version was also prepared in accordance with these standards.

Appendix II: *Columbia* Technology Development Progress

The National Defense Authorization Act for Fiscal Year 2018 included reporting requirements for the *Columbia* class program. As part of these annual reporting requirements, the Navy must submit to Congress matrices that identify (1) key milestones, events, and performance goals for the design and construction of the *Columbia* class program; and (2) costs associated with the design and construction period of the *Columbia* class program. As part of its matrices to Congress, the Navy is required to report on the technology readiness levels of major components, such as the integrated power system, nuclear reactor, propulsor, coordinated stern features, stern area system, and common missile compartment—which are the critical technologies we identified in our prior report. The Act also included a provision that we assess these matrices. The Navy submitted its initial matrices to Congress in February 2018, an update to the matrices in October 2018, and is required to submit an update annually, thereafter, until the lead *Columbia* submarine is delivered. The Navy's most recent matrix was submitted in February 2020. DOD identified specific information about the status and descriptions of critical technologies as sensitive. As such, this information was omitted from this report.

Appendix III: Technology Readiness Levels

Table 3 below defines each technology readiness level and the developmental status they represent.

Table 3: Technology Readiness Levels (TRL)

TRL	Definition	Description
1.	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development. Examples might include paper studies of a technology's basic properties.
2.	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption. Examples are still limited to paper studies.
3.	Analytical and experimental function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Examples include components that are not yet integrated or representative.
4.	Component and/or breadboard validation in a laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is relatively "low fidelity" compared to the eventual system. Examples include integration of "ad hoc" hardware in a laboratory.
5.	Component and/or breadboard validation in a relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Examples include "high-fidelity" laboratory integration of components.
6.	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant environment. Represents a major step up in a technology's demonstrated readiness. Examples include testing a prototype in a high-fidelity laboratory environment or in a simulated realistic environment.
7.	System prototype demonstration in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in a realistic environment, such as an aircraft, vehicle, or space. Examples include testing the prototype in a test bed aircraft.
8.	Actual system completed and qualified through test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of the true system development. Examples include developmental test and evaluation of the system in its intended weapon system to determine if it meets design specifications.
9.	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluations. In almost all cases, this is the end of the last "bug fixing" aspects of true system development. Examples include using the system under operational mission conditions.

Source: GAO. | GAO-21-257

Appendix IV: Use of Supplier Development Funds

Congress provided $451.6 million to the *Columbia* program in fiscal years 2019 and 2020 that the Navy has budgeted to support the expansion and development of the submarine supplier base and help ensure that suppliers will be ready to meet increased production demands. *Columbia* program documentation identifies two types of expenditures that can assist the supplier base with meeting future submarine construction demand:

1. ***Direct investments in suppliers:*** money provided to suppliers to address validated shortfalls in their facilities, machinery, and skilled workers to reduce risk, and;
2. ***Material purchases to signal demand:*** purchases of materials designed to help the supplier base better predict their workload and optimize use of their facilities.

According to our analysis of *Columbia* class program documents, in fiscal years 2019 and 2020, the Navy planned to spend roughly 60 percent of supplier developments funds on direct investments in the supplier base to reduce risks from existing suppliers and establishing new suppliers. To date, a program office document shows plans to use the funds toward the purchase of equipment, to conducting training, and to develop alternative suppliers, among other things.

For the remaining supplier development funding, roughly 40 percent, the *Columbia* program office planned to send a steady demand signal by purchasing materials from suppliers through the following types of purchases:

- **Continuous production:** According to program documentation, funding for continuous production is intended to avoid challenges caused for suppliers by gaps in demand—such as problems related to staffing—and is a mechanism for potential cost savings. Among other items, the program plans to fund the continuous production of hemi-heads, which are part of the spherical air flasks, using supplier development funds. However, according to shipbuilder planning documents, although hemi-heads are needed early in construction, the shipbuilder did not identify a benefit to producing these components though continuous production.
- **Multi-program material purchases:** These purchases are intended to stabilize demand by coordinating purchases across shipbuilding programs when they utilize the same suppliers. According to a program office document, if made early in the *Columbia* program these types of purchases would provide funding that could enable

suppliers to invest in upgraded equipment or hiring.[1] However, a shipbuilder briefing document notes that delays to design maturity can create challenges for achieving the intended benefits of multi-program material procurements because the shipbuilders might need to solicit pricing from suppliers before design requirements and quantities are firm. Additionally, according to program office documents, Electric Boat has not provided the Navy with a report meant to assure that multi-program material procurements are being appropriately managed, with some reporting delayed since 2018.

- **Production-back up units:** A subset of multi-program material purchases, production backup units are long-lead time components and materials that are procured early and kept in reserve in an effort to reduce schedule risk by assuring that materials are available when needed. The Navy plans to procure production back up units and multi-program material purchases for the first and second submarine *Columbia* class submarines simultaneously.

In contrast to direct investments in suppliers that the Navy has used to target risks faced by individual suppliers, these material purchases are intended to assist the supplier base writ-large by assuring that demand for materials is consistent. Like the funding being used for direct investments in suppliers, this assistance to suppliers is being provided to both suppliers that are ready to meet production demands and suppliers that faces challenges in doing so.

[1]Multi-program material purchases necessary for the lead *Columbia* submarine were fully funded in fiscal year 2019. The Navy plans to use supplier development funding for multi-program material purchases for the first follow-on *Columbia* submarine.

Appendix V: Comments from the Department of Defense and Additional GAO Responses

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

[redacted]

ASSISTANT SECRETARY OF DEFENSE
3600 DEFENSE PENTAGON
WASHINGTON, DC 20301-3600

ACQUISITION

OCT 15 2020

Ms. Shelby Oakley
Director, Contracting and National Security
U.S. Government Accountability Office
441 G Street, NW
Washington, DC 20548

Dear Ms. Oakley:

(U)This is the Department of Defense (DoD) response to the Government Accountability Office (GAO) Draft Report, GAO-20-647, "COLUMBIA CLASS SUBMARINE: Delivery Hinges on Timely and Quality Materials from an Atrophied Supplier Base," dated July 2020 (GAO Code 103522). (U) Over the past 15 months, the Navy and shipbuilders have supported GAO audit 103522 and provided or reviewed approximately 400 documents and organized over 20 engagements requiring approximately 10,000 man-hours. (U)The Department's detailed responses to the recommendations and technical comments are enclosed.

(U) The COLUMBIA Class (CLB) program has the highest state of design completion of any lead ship, a GAO best practice (see GAO report GAO-09-322) as it is proven to help lower construction costs and schedule. [redacted]

(U) More importantly, the program successfully achieved its Office of the Secretary of Defense assigned exit criteria of 83 percent design maturity in May of 2020. (U) The Senior Technical Authority and the Chief Systems Engineer for Submarines validated that the Critical Design Review has been completed, and certified that all areas of the shipbuilder's ship design were mature and supported development of production information, that the ship design was stable, and that a configuration control baseline had been maintained.

[redacted]

(U) The Navy notes that this unprecedented level of readiness for construction is in spite of the fact that there have been problems with the development and implementation of the next generation design tool.

(U) The Navy agrees that CLB's top program construction risk is the supplier industrial base; however, the Department disagrees with the GAO's conclusions [redacted]

[redacted]

[redacted]

[redacted] (U) The Navy and shipbuilder are pro-actively applying the Congressional Submarine Industrial Base funding to develop alternate source suppliers, develop strategic sourcing suppliers, and improve capacity, capability, and performance at existing suppliers. (U) The Navy will continue to work with the shipbuilder to drive down the remaining risk with the enhanced oversight and management processes and metrics.

(U)The Department agrees with GAO's assessment that additional government and shipbuilder inspections are required to ensure quality of supplier materials. (U) Beginning in 2018, the shipbuilders significantly improved their supplier management, including improved processes, increased supplier inspections, and the execution of risk-based processes and management of the supplier base. (U) Supervisor of Shipbuilding (SUPSHIP) Groton (SSGR) assessments completed early in the program (2015-2018) to identify areas requiring additional inspections were completed based on the best information available at the time. (U) SSGR has continuously improved oversight and coordination with General Dynamics Electric Boat (GDEB) since the Fall of 2018. (U) This has included improved processes, overseeing the shipbuilders in its increased supplier inspections, and reviewing needs for additional delegation to the Defense Contract Management Agency. (U)SSGR has established the Supplier Quality Management Oversight department dedicated solely to the continuous analysis, review, oversight, and implementation of supplier quality management which feeds the overall risk analysis. (U) One of the outputs of this process is the invoking of Government Contract Quality Assurance on a component when the risk warrants. (U) These new and improved departmental efforts have been resourced and are on schedule to be fully operational and executing in the first quarter of Fiscal Year 2021.

(U) The Navy recognizes that a skilled, experienced industrial base workforce is key to the efficient construction and maintenance of submarines; however, the Navy disputes the GAO's application of data provided during their review. [redacted] (U) Overall staffing and hiring is on track to meet the required workload.

(U) As planned, the Navy updated the CLB cost estimate and has incorporated all of the recommendations from GAO Report, GAO-19-169, "COLUMBIA CLASS SUBMARINE: Overly Optimistic Cost Estimate Will Likely Lead to Budget Increases," dated December 10, 2018. [redacted] (U) The results will be offered in a brief to Congress. (U) The updated cost estimate informed the Navy's negotiations with GDEB and the budget process.

2

[redacted]

Note: We will examine DOD's response to our recommendation on government source inspections (also called Government Contract Quality Assurance) when we receive related documentation.

Note: We revised our statements on the shipbuilders' workforce challenges in response to DOD's technical comments.

Note: We will examine DOD's response to our recommendations in GAO-19-169SU and GAO-19-497 when we receive related documentation.

Note: We revised our statements on the program's contracting strategy in response to DOD's technical comments.

Note: We revised our statements on the milestone decision authority's review, which occurred after we sent our draft to DOD for comment, in response to updated information from the Department.

[redacted]

(U) GAO stated that the contracting strategy was based on schedule pressure. (U) To maximize efficiency and ensure the program will be ready to start construction on schedule, the Navy modified its design contract with GDEB to include a fully priced option that will, when exercised, and based on the availability of funds allow for the start of construction for SSBN 826 in October 2020 and fund advance procurement, advance construction and 2024 construction start of the second CLB submarine (SSBN 827). (U) The Office of Secretary of Defense (OSD) Director for Defense Pricing and Contracting agreed with the plan to award the contract following a thorough peer review process.

(U)The Navy completed the Lead Ship Construction Interim Program Review on August 28, 2020, successfully documenting completion of all Exit Criteria assigned by the MDA. (U) GAO stated the MDA may identify program cost and schedule risk during its review and may direct the Navy to change the contracting strategy in order to ensure adequate risk mitigation. [redacted]

(U) As stated in the DoD Response to GAO Draft Report GAO-18-158, "COLUMBIA CLASS SUBMARINE: Immature Technologies Presents Risks to Achieving Cost, Schedule, and Performance Goals," the CLB program complied with all Navy, DoD, and statutory requirements for conducting its 2015 Technology Readiness Assessment (TRA). (U) The DoD response also explained that proving out CLB technologies to the level GAO prescribes would require Congress to provide a significant amount of additional funding and would delay lead ship construction, thereby threatening U.S. Strategic Command at-sea deterrence requirements.

(U) The CLB Program continues to execute key tenets to promote success in meeting cost, schedule, and performance requirements. The goal continues to be to maintain stable operational and technical requirements, achieve high design maturity at construction start, and ensure manufacturing and construction readiness, and take aggressive action to reduce costs.

(U)The Department appreciates the opportunity to comment on the draft report. For further questions concerning this report, please contact Ms. Sorahi Azarbarzin at 703-614-6485 or via email at sorahi.a.azarbarzin.civ@mail.mil.

Sincerely,

Kevin M. Fahey

Enclosures:
As stated

Controlled by: OUSD(A&S)
Controlled by: ASD(A)
Category: CTI
Distribution: B
POC: Ms. Sorahi Azarbarzin

3

[redacted]

GAO DRAFT REPORT DATED JULY 2020
GAO-20-647 (GAO CODE 103522)

"COLUMBIA CLASS SUBMARINE: DELIVERY HINGES ON TIMELY AND QUALITY MATERIALS FROM AN ATROPHIED SUPPLIER BASE"

DEPARTMENT OF DEFENSE COMMENTS TO THE GAO RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommends that the Secretary of the Navy should provide Congress with information after the milestone decision authority convenes in August 2020 to support the authorization of lead submarine construction. This should include updated cost and schedule information following the milestone decision authority's review of the independent cost assessment and assessment of the program's ability to reduce development risks.

DoD RESPONSE: Concur. The Navy anticipates delivering this report to Congress in October 2020.

RECOMMENDATION 2: The GAO recommends that the Secretary of the Navy should ensure that the Navy includes an update on the status of critical supplier readiness as part of the annual report it provides under the provisions of the 2018 National Defense Authorization Act to further inform Congress on the status of the Columbia class program's performance goals during design and construction.

DoD RESPONSE: Concur. The Navy currently provides an annual report each year to Congress concurrent with delivery of the DoD budget. The next annual report is expected in February 2021, and the Navy will include supplier information in this report.

RECOMMENDATION 3: The GAO recommends that the Secretary of the Navy should ensure that Supervisor of Shipbuilding (SUPSHIP), in collaboration with Columbia class program management, assess whether additional materials require government source inspections as soon as practicable and if the Navy believes further government source inspections are required, take action to ensure the shipbuilder includes the inspection clauses in contracts with suppliers.

DoD RESPONSE: Concur. Additional government and shipbuilder inspections are required to ensure quality of supplier materials. Beginning in 2018, the shipbuilders significantly improved their supplier management, including improved processes, increased supplier inspections, and the execution of risk-based processes and management of the supplier base. Supervisor of Shipbuilding Groton (SSGR) assessments completed early in the program (2015-2018) to identify areas requiring additional inspections were completed based on the best information available at the time. SSGR has continuously improved oversight and coordination with General

1

Dynamics Electric Boat (GDEB) since the Fall of 2018. This has included improved processes, overseeing GDEB in their increased supplier inspections, and reviewing needs for additional delegation to the Defense Contract Management Agency. SSGR has established a new department, consisting of a multidisciplinary team to support Supplier Quality Management Oversight. The team is solely dedicated to do the following:

a. Leverage supply base information/data, vendor health and supplier quality metrics to ensure comprehensive Supply Chain/Component Risk Management processes;

b. Identify high-risk areas to help focus shipbuilder supply base oversight options;

c. Provide oversight and coordination of GDEB executing In-depth Supplier Assessment planning and execution;

d. Maintain Strategic Sourcing Oversight Strategy; and,

e. Implement Multi-Program Material Procurement oversight.

These actions provide data streams that feed overall risk analysis. One of the outputs of this process is the invoking of Government Contract Quality Assurance (GCQA) on a component when the risk warrants. Federal Acquisition Regulation 52.246, which is contractually invoked, allows SUPSHIP to initiate GCQA on any contractor procured material.

This new and improved departmental effort is resourced and on schedule to be fully operational and executing in Quarter 1 Fiscal Year 2021.

2

The following are our comments on the Department of Defense letter dated October 15, 2020.

GAO Comments

In addition to responding with the actions they are taking or have planned in response to our recommendations, the Department of Defense (DOD) also provided observations on a number of issues related to our assessment of the program's design completion, the status of the supplier base, and technology development efforts, among other things. Many of the observations that DOD included in its letter were also previously provided to us as technical comments. We incorporated these comments into the report as appropriate and have made note of some of these instances above alongside DOD's letter. Other comments describe the progress that DOD has made in addressing our current or previous recommendations or reiterate points of disagreement discussed in several of our previous reports—such as DOD's position on technology readiness. Our response to DOD's additional observations follows:

Design Completion

We agree, as DOD notes in paragraph 2 p. 1 of its letter, that a high level of design maturity is essential for preventing the cost and schedule delays that have impacted other shipbuilding programs. As we have previously reported in 2017 and 2019, the Columbia class program aimed to achieve a high level of design completion prior to the start of construction. DOD states in its letter that the program has met its overall goal for design maturity. However, as we explain in the report, the program does not expect to achieve its specific goal for the completion of design disclosures by the start of construction that was established in 2016 as a prerequisite for achieving overarching cost goals. As a result, program officials told us that the program will not achieve the cost savings that they initially projected if they had reached their original design disclosure completion goal.

Appendix VI: GAO Contact and Staff Acknowledgments

GAO Contact

Shelby S. Oakley at (202) 512-4841 or oakleys@gao.gov.

Staff Acknowledgments

In addition to the contact named above, the following staff members made key contributions to this report: Diana Moldafsky, Assistant Director; Lindsey Cross; Laura Durbin; Benjamin Moran; Brendan K. Orino; and Nathaniel Vaught. Other contributions were made by Kurt Gurka; Stephanie Gustafson; and Robin Wilson.

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