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Navy Frigate (FFG[X]) Program: Background and Issues for Congress

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Summary

The FFG(X) program is a Navy program to build a class of 20 guided-missile frigates (FFGs). Congress funded the procurement of the first FFG(X) in FY2020 at a cost of $1,281.2 million (i.e., about $1.3 billion). The Navy's proposed FY2021 budget requests $1,053.1 million (i.e., about $1.1 billion) for the procurement of the second FFG(X). The Navy estimates that subsequent ships in the class will cost roughly $940 million each in then-year dollars.

Four industry teams were competing for the FFG(X) program. On April 30, 2020, the Navy announced that it had awarded the FFG(X) contract to the team led by Fincantieri/Marinette Marine (F/MM) of Marinette, WI. F/MM was awarded a fixed-price incentive (firm target) contract for Detail Design and Construction (DD&C) for up to 10 ships in the program—the lead ship plus nine option ships.

The other three industry teams reportedly competing for the program were led by Austal USA of Mobile, AL; General Dynamics/Bath Iron Works (GD/BIW) of Bath, ME; and Huntington Ingalls Industries/Ingalls Shipbuilding (HII/Ingalls) of Pascagoula, MS.

Under the DD&C contact awarded to F/MM, Navy has the option of recompeting the FFG(X) program after the lead ship (if none of the nine option ships are exercised), after the 10th ship (if all nine of the option ships are exercised), or somewhere in between (if some but not all of the nine option ships are exercised).

All four competing industry teams were required to submit bids based on an existing ship design—an approach called the parent-design approach. F/MM's design is based on an Italian frigate design called the FREMM (Fregata Europea Multi-Missione).

As part of its action on the Navy's FY2020 budget, Congress passed two legislative provisions relating to U.S. content requirements for certain components of each FFG(X).

The FFG(X) program presents several potential oversight issues for Congress, including the following:

- the potential impact of the COVID-19 (coronavirus) situation on the execution of U.S. military shipbuilding programs, including the FGFG(X) program;
- the accuracy of the Navy's estimated unit procurement cost for the FFG(X), particularly when compared to the known unit procurement costs of other recent U.S. surface combatants;
- whether to fund the procurement in FY2021 of one FFG(X) (the Navy's request), no FFG(X), or two FFG(X)s;
- whether to build FFG(X)s at a single shipyard at any one time (the Navy's baseline plan), or at two or three shipyards;
- whether the Navy has appropriately defined the required capabilities and growth margin of the FFG(X).
- whether to take any further legislative action regarding U.S. content requirements for FFG(X)s;
- technical risk in the FFG(X) program;
- the potential industrial-base impacts of the FFG(X) program for shipyards and supplier firms in the context of other Navy and Coast Guard shipbuilding programs.

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Introduction

This report provides background information and discusses potential issues for Congress regarding the Navy's FFG(X) program, a program to procure a new class of 20 guided-missile frigates (FFGs). The Navy's proposed FY2021 budget requests $1,053.1 million (i.e., about $1.1 billion) for the procurement of the second FFG(X).

The FFG(X) program presents several potential oversight issues for Congress. Congress's decisions on the program could affect Navy capabilities and funding requirements and the shipbuilding industrial base.

This report focuses on the FFG(X) program. Other CRS reports discuss the strategic context within which the FFG(X) program and other Navy acquisition programs may be considered.[1]

Background

Navy's Force of Small Surface Combatants (SSCs)

In discussing its force-level goals and 30-year shipbuilding plans, the Navy organizes its surface combatants into *large surface combatants* (LSCs), meaning the Navy's cruisers and destroyers, and *small surface combatants* (SSCs), meaning the Navy's frigates, LCSs, mine warfare ships, and patrol craft.[2] SSCs are smaller, less capable in some respects, and individually less expensive to procure, operate, and support than LSCs. SSCs can operate in conjunction with LSCs and other Navy ships, particularly in higher-threat operating environments, or independently, particularly in lower-threat operating environments.

In December 2016, the Navy released a goal to achieve and maintain a Navy of 355 ships, including 52 SSCs, of which 32 are to be LCSs and 20 are to be FFG(X)s. Although patrol craft are SSCs, they do not count toward the 52-ship SSC force-level goal, because patrol craft are not considered battle force ships, which are the kind of ships that count toward the quoted size of the Navy and the Navy's force-level goal.[3]

At the end of FY2019 the Navy's force of SSCs totaled 30 battle force ships, including 0 frigates, 19 LCSs, and 11 mine warfare ships. Under the Navy's FY2020 30-year (FY2020-FY2049) shipbuilding plan, the SSC force is to grow to 52 ships (34 LCSs and 18 FFG[X]s) by FY2034.

U.S. Navy Frigates in General

In contrast to cruisers and destroyers, which are designed to operate in higher-threat areas, frigates are generally intended to operate more in lower-threat areas. U.S. Navy frigates perform many of the same peacetime and wartime missions as U.S. Navy cruisers and destroyers, but since frigates are intended to do so in lower-threat areas, they are equipped with fewer weapons,

[1] See CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke; CRS Report R43838, *Renewed Great Power Competition: Implications for Defense—Issues for Congress*, by Ronald O'Rourke; and CRS Report R44891, *U.S. Role in the World: Background and Issues for Congress*, by Ronald O'Rourke and Michael Moodie.

[2] See, for example, CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[3] For additional discussion of battle force ships, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

less-capable radars and other systems, and less engineering redundancy and survivability than cruisers and destroyers.[4]

The most recent class of frigates operated by the Navy was the Oliver Hazard Perry (FFG-7) class (**Figure 1**). A total of 51 FFG-7 class ships were procured between FY1973 and FY1984. The ships entered service between 1977 and 1989, and were decommissioned between 1994 and 2015. In their final configuration, FFG-7s were about 455 feet long and had full load displacements of roughly 3,900 tons to 4,100 tons. (By comparison, the Navy's Arleigh Burke [DDG-51] class destroyers are about 510 feet long and have full load displacements of roughly 9,700 tons.[5]) Following their decommissioning, a number of FFG-7 class ships, like certain other decommissioned U.S. Navy ships, have been transferred to the navies of U.S. allied and partner countries.

Figure 1. Oliver Hazard Perry (FFG-7) Class Frigate

Source: Photograph accompanying Dave Werner, "Fighting Forward: Last Oliver Perry Class Frigate Deployment," *Navy Live*, January 5, 2015, accessed September 21, 2017, at http://navylive.dodlive.mil/2015/01/05/fighting-forward-last-oliver-perry-class-frigate-deployment/.

[4] Compared to cruisers and destroyers, frigates can be a more cost-effective way to perform missions that do not require the use of a higher-cost cruiser or destroyer. In the past, the Navy's combined force of higher-capability, higher-cost cruisers and destroyers and lower-capability, lower-cost frigates has been referred to as an example of a so-called high-low force mix. High-low mixes have been used by the Navy and the other military services in recent decades as a means of balancing desires for individual platform capability against desires for platform numbers in a context of varied missions and finite resources.

Peacetime missions performed by frigates can include, among other things, engagement with allied and partner navies, maritime security operations (such as anti-piracy operations), and humanitarian assistance and disaster response (HA/DR) operations. Intended wartime operations of frigates include escorting (i.e., protecting) military supply and transport ships and civilian cargo ships that are moving through potentially dangerous waters. In support of intended wartime operations, frigates are designed to conduct anti-air warfare (AAW—aka air defense) operations, anti-surface warfare (ASuW) operations (meaning operations against enemy surface ships and craft), and antisubmarine warfare (ASW) operations. U.S. Navy frigates are designed to operate in larger Navy formations or as solitary ships. Operations as solitary ships can include the peacetime operations mentioned above.

[5] This is the displacement for the current (Flight III) version of the DDG-51 design.

FFG(X) Program

Meaning of Designation FFG(X)

In the program designation FFG(X), FF means frigate,[6] G means guided-missile ship (indicating a ship equipped with an area-defense anti-air warfare [AAW] system),[7] and (X) indicates that the specific design of the ship has not yet been determined. FFG(X) thus means a guided-missile frigate whose specific design has not yet been determined.[8]

Procurement Quantities and Schedule

Total Procurement Quantity

The Navy wants to procure 20 FFG(X)s, which in combination with the Navy's required total of 32 LCSs would meet the Navy's 52-ship SSC force-level goal. Thirty-five (rather than 32) LCSs were procured through FY2019, but Navy officials have stated that the Navy nevertheless wants to procure 20 FFG(X)s.

The Navy's 355-ship force-level goal is the result of a Force Structure Analysis (FSA) that the Navy conducted in 2016. The Navy conducts a new or updated FSA every few years, and it is currently conducting a new FSA that is scheduled to be released sometime during 2020. Navy officials have stated that this new FSA will likely not reduce the required number of small surface combatants, and might increase it. Navy officials have also suggested that the Navy in coming years may shift to a new surface force architecture that will include, among other things, a larger proportion of small surface combatants.

Figure 2 shows a Navy briefing slide depicting the potential new surface force architecture, with each sphere representing a manned ship or an unmanned surface vehicle (USV). Consistent with **Figure 2**, the Navy's 355-ship goal, reflecting the current force architecture, calls for a Navy with twice as many large surface combatants as small surface combatants. **Figure 2** suggests that the potential new surface force architecture could lead to the obverse—a planned force mix that calls for twice as many small surface combatants than large surface combatants—along with a new third tier of numerous USVs.[9] Such a force mix, in theory at least, suggests that the Navy might increase the total planned number of FFG(X)s from 20 to some higher number.

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[6] The designation FF, with two Fs, means frigate in the same way that the designation DD, with two Ds, means destroyer. FF is sometimes translated less accurately as fast frigate. FFs, however, are not particularly fast by the standards of U.S. Navy combatants—their maximum sustained speed, for example, is generally lower than that of U.S. Navy aircraft carriers, cruisers, and destroyers. In addition, there is no such thing in the U.S. Navy as a slow frigate.

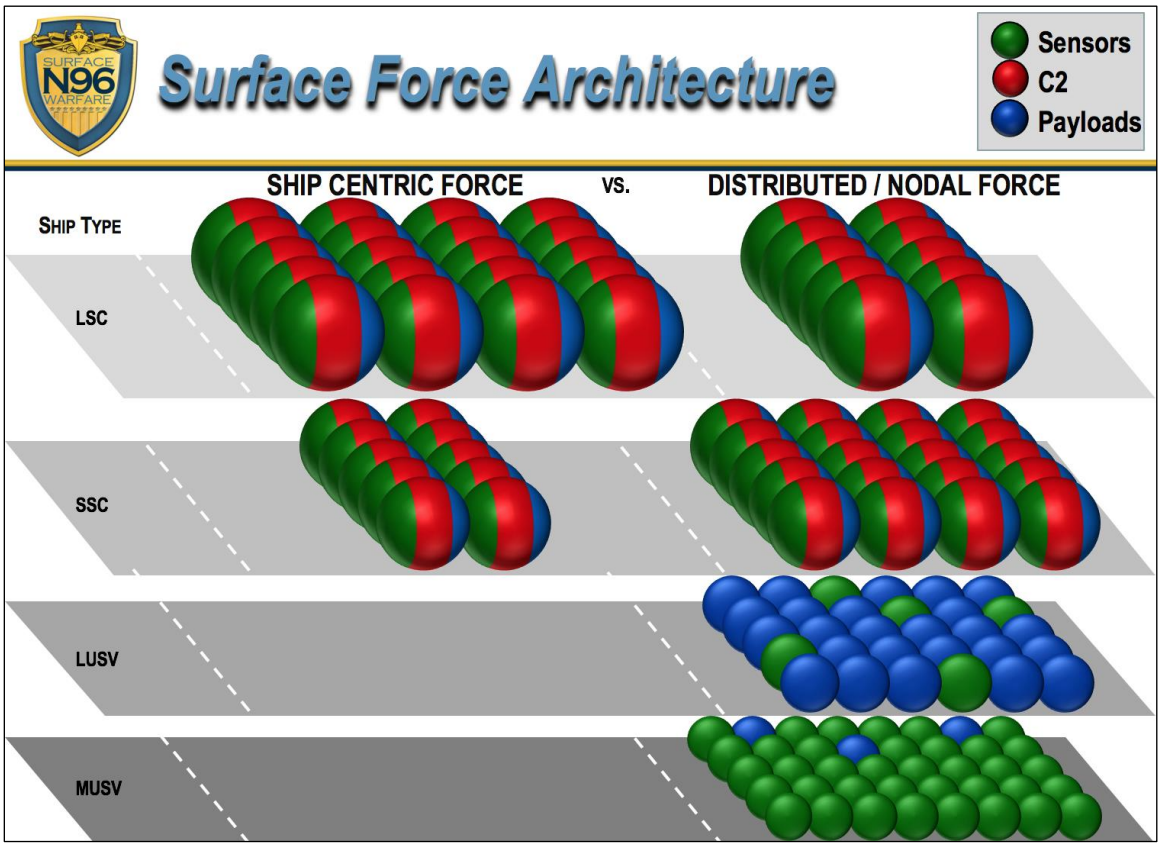
[7] Some U.S. Navy surface combatants are equipped with a point-defense AAW system, meaning a short-range AAW system that is designed to protect the ship itself. Other U.S. Navy surface combatants are equipped with an area-defense AAW system, meaning a longer-range AAW system that is designed to protect no only the ship itself, but other ships in the area as well. U.S. Navy surface combatants equipped with an area-defense AAW system are referred to as guided-missile ships and have a "G" in their designation.

[8] When the ship's design has been determined, the program's designation might be changed to the FFG-62 program, since FFG-61 was the final ship in the FFG-7 program. It is also possible, however, that the Navy could choose a different designation for the program at that point. Based on Navy decisions involving the Seawolf (SSN-21) class attack submarine and the Zumwalt (DDG-1000) class destroyer, other possibilities might include FFG-1000, FFG-2000, or FFG-2100. (A designation of FFG-21, however, might cause confusion, as FFG-21 was used for Flatley, an FFG-7 class ship.) A designation of FFG-62 would be consistent with traditional Navy practices for ship class designations.

[9] For additional discussion of this possible change in surface force architecture, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Figure 2. Navy Briefing Slide on Surface Force Architecture

Each sphere represents a ship or a USV



Source: Illustration accompanying Megan Eckstein, "Sea Hunter Unmanned Ship Continues Autonomy Testing as NAVSEA Moves Forward with Draft RFP," *USNI News*, April 29, 2019. The illustration was also included as Slide 2 in a Navy briefing entitled "Designing & Building the Surface Fleet: Unmanned and Small Combatants," by Rear Admiral Casey Moton at a June 20, 2019, conference of the American Society of Naval Engineers (ASNE).

Notes: Each sphere represents a ship or a USV. LSC means large surface combatant (i.e., cruiser or destroyer); SSC means small surface combatant (i.e., frigate or Littoral Combat Ship); LUSV means large USV; MUSV means medium USV. Spheres with multiple colors (the LSCs and SSCs) are ships equipped with a combination of sensors (green), command and control (C2) equipment (red), and payloads (including weapons) (blue). Spheres with single colors (the USVs) are equipped with either payloads (blue) or sensors (green).

An April 20, 2020, press report stated (emphasis added):

> An internal Office of the Secretary of Defense assessment calls for the Navy to cut two aircraft carriers from its fleet, freeze the large surface combatant fleet of destroyers and cruisers around current levels and add dozens of unmanned or lightly manned ships to the inventory, according to documents obtained by Defense News.
>
> The study calls for a fleet of nine carriers, down from the current fleet of 11, and for 65 unmanned or lightly manned surface vessels. The study calls for a surface force of between 80 and 90 large surface combatants, and **an increase in the number of small surface combatants—between 55 and 70, which is substantially more than the Navy currently operates.**
>
> The assessment is part of an ongoing DoD-wide review of Navy force structure and seem to echo what Defense Secretary Mark Esper has been saying for months: the Defense Department wants to begin de-emphasizing aircraft carriers as the centerpiece of the Navy's

> force projection and put more emphasis on unmanned technologies that can be more easily sacrificed in a conflict and can achieve their missions more affordably….
>
> There are about 90 cruisers and destroyers in the fleet: the study recommended retaining at least 80 but keeping about as many as the Navy currently operates at the high end.
>
> **The Navy's small surface combatant program is essentially the 20 littoral combat ships in commission today, with another 15 under contract, as well as the 20 next-generation frigates, which would get to the minimum number in the assessment of 55 small combatants, with the additional 15 presumably being more frigates.**[10]

Annual Procurement Quantities

Congress funded the procurement of the first FFG(X) in FY2020. The Navy's FY2021 budget submission calls for the next nine to be procured during the period FY2021-FY2025 in annual quantities of 1-1-2-2-3.

Table 1 compares programmed annual procurement quantities for the FFG(X) program in FY2021-FY2025 under the Navy's FY2020 and FY2021 budget submissions. The programmed quantity of three ships in FY2025 under the Navy's FY2021 budget submission suggests that the Navy, perhaps as a consequence of a potential new surface architecture like that shown in **Figure 2**, might increase FFG(X) procurement to a sustained rate of 3 or more ships per year starting in FY2025.

Table 1. Programmed Annual FFG(X) Procurement Quantities

As shown in Navy's FY2020 and FY2021 budget submissions

	FY21	FY22	FY23	FY24	FY25	Total FY21-FY25
FY2020 budget	2	2	2	2	2	10
FY2021 budget	1	1	2	2	3	9

Source: Table prepared by CRS based on Navy's FY2020 and FY2021 budget submissions.

Ship Capabilities, Design, and Crewing

Ship Capabilities and Design

The Navy envisages the FFG(X) as follows:

- The ship is to be a multimission small surface combatant capable of conducting anti-air warfare (AAW), anti-surface warfare (ASuW), antisubmarine warfare (ASW), and electromagnetic warfare (EMW) operations.
- Compared to an FF concept that emerged under a February 2014 restructuring of the LCS program, the FFG(X) is to have increased AAW and EMW capability, and enhanced survivability.
- The ship's area-defense AAW system is to be capable of local area AAW, meaning a form of area-defense AAW that extends to a lesser range than the area-defense AAW that can be provided by the Navy's cruisers and destroyers.

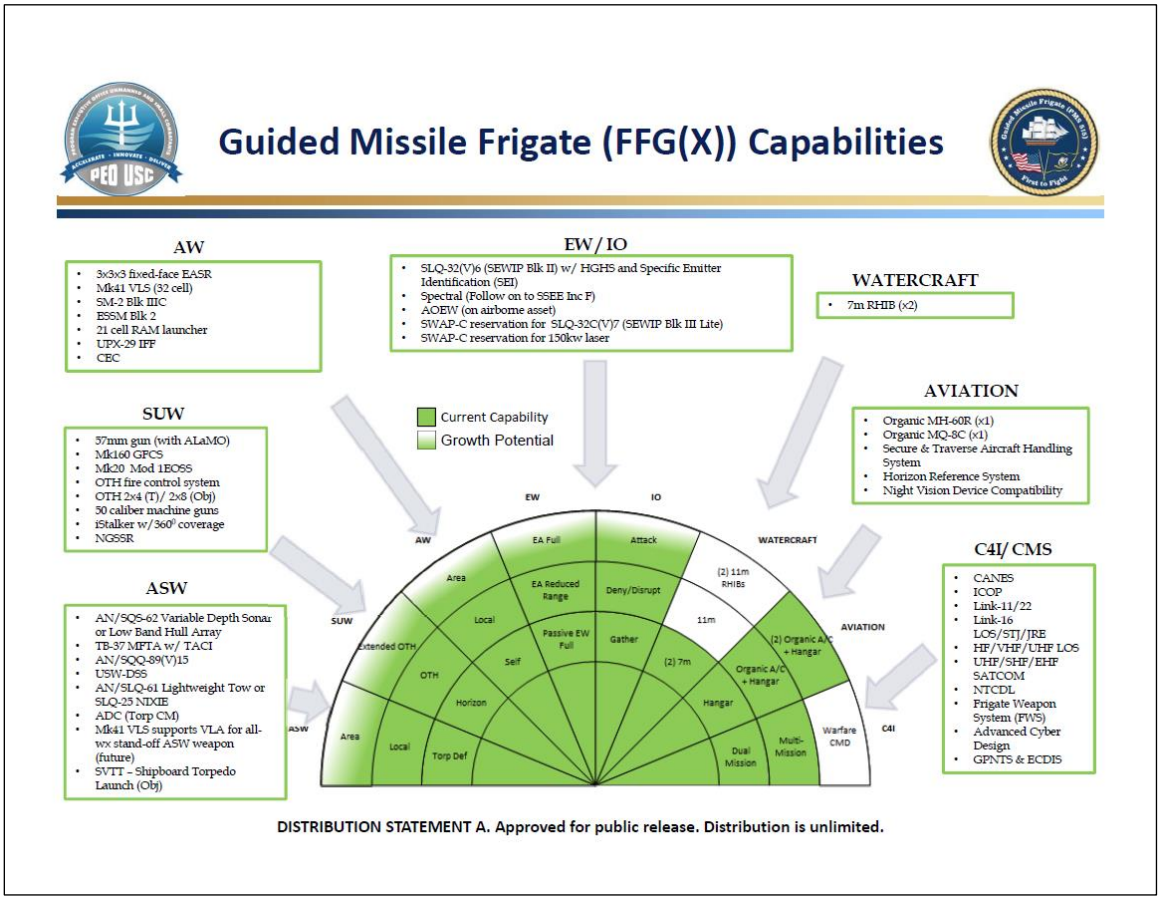
[10] David B. Larter, "Defense Department Study Calls for Cutting 2 of the US Navy's Aircraft Carriers," *Defense News*, April 20, 2020.

- The ship is to be capable of operating in both blue water (i.e., mid-ocean) and littoral (i.e., near-shore) areas.
- The ship is to be capable of operating either independently (when that is appropriate for its assigned mission) or as part of larger Navy formations.

Figure 3 shows a January 2019 Navy briefing slide summarizing the FFG(X)'s planned capabilities. For additional information on the FFG(X)'s planned capabilities, see **Appendix A**.[11]

Figure 3. Navy Briefing Slide on FFG(X) Capabilities

Presented at Surface Navy Association National Symposium, January 2019



Source: Presentation by Dr. Reagan Campbell, "FFG(X) Update, National Symposium—Surface Navy Association," January 15, 2019, briefing slide 3, posted at InsideDefense.com (subscription required), January 22, 2019.

[11] RFI: FFG(X) - US Navy Guided Missile Frigate Replacement Program, accessed August 11, 2017, at https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=d089cf61f254538605cdec5438955b8e&_cview=0.

Dual Crewing

To help maximize the time that each ship spends at sea, the Navy reportedly is considering operating FFG(X)s with dual crews—an approach, commonly called blue-gold crewing, that the Navy uses for operating its ballistic missile submarines and LCSs.[12]

Procurement Cost

Congress funded the procurement of the first FFG(X) in FY2020 at a cost of $1,281.2 million (i.e., about $1.3 billion). The lead ship in the program will be more expensive than the follow-on ships in the program because the lead ship's procurement cost incorporates most or all of the detailed design/nonrecurring engineering (DD/NRE) costs for the class. (It is a traditional Navy budgeting practice to attach most or all of the DD/NRE costs for a new ship class to the procurement cost of the lead ship in the class.)

The Navy wants the follow-on ships in the FFG(X) program (i.e., ships 2 through 20) to have an average unit procurement cost of $800 million to $950 million each in constant 2018 dollars.[13] By way of comparison, the Navy estimates the average unit procurement cost of the three LCSs procured in FY2019 at $523.7 million (not including the cost of each ship's embarked mission package), and the average unit procurement cost of the two DDG-51 class destroyers that the Navy has requested for procurement in FY2021 at $1,918.5 million.

As shown in **Table 3**, the Navy's proposed FY2021 budget requests $1,053.1 million (i.e., about $1.1 billion) for the procurement of the second FFG(X), and estimates that subsequent ships in the class will cost roughly $940 million each in then-year dollars. The Navy's FY2021 budget submission estimates the total procurement cost of 20 FFG(X)s at $19,814.8 million (i.e., about $19.8 billion) in then-year dollars, or an average of about $990.7 million each. Since the figure of

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[12] See, for example, David B. Larter, "The US Navy Is Planning for Its New Frigate to Be a Workhorse," *Defense News*, January 30, 2018.

[13] See Sam LaGrone, "NAVSEA: New Navy Frigate Could Cost $950M Per Hull," *USNI News*, January 9, 2018; Richard Abott, "Navy Confirms New Frigate Nearly $1 Billion Each, 4-6 Concept Awards By Spring," *Defense Daily*, January 10, 2018: 1; Sydney J. Freedberg Jr., "Navy Says It Can Buy Frigate For Under $800M: Acquisition Reform Testbed," *Breaking Defense*, January 12, 2018; Lee Hudson, "Navy to Downselect to One Vendor for Future Frigate Competition," *Inside the Navy*, January 15, 2018; Richard Abott, "Navy Aims For $800 Million Future Frigate Cost, Leveraging Modularity and Commonality," *Defense Daily*, January 17, 2018: 3. The $800 million figure is the objective cost target; the $950 million figure is threshold cost target. Regarding the $950 million figure, the Navy states that

> The average follow threshold cost for FFG(X) has been established at $950 million (CY18$). The Navy expects that the full and open competition will provide significant downward cost pressure incentivizing industry to balance cost and capability to provide the Navy with a best value solution. FFG(X) cost estimates will be reevaluated during the Conceptual Design phase to ensure the program stays within the Navy's desired budget while achieving the desired warfighting capabilities. Lead ship unit costs will be validated at the time the Component Cost Position is established in 3rd QTR FY19 prior to the Navy awarding the Detail Design and Construction contract.
>
> (Navy information paper dated November 7, 2017, provided by Navy Office of Legislative Affairs to CRS and CBO on November 8, 2017.)

The Navy wants the average basic construction cost (BCC) of ships 2 through 20 in the program to be $495 million per ship in constant 2018 dollars. BCC excludes costs for government furnished combat or weapon systems and change orders. (Source: Navy briefing slides for FFG(X) Industry Day, November 17, 2017, slide 11 of 16, entitled "Key Framing Assumptions.")

$19,814.8 million is a then-year dollar figure, it incorporates estimated annual inflation for FFG(X)s to be procured several years into the future.

Acquisition Strategy

Parent-Design Approach

The Navy's plan to procure the first FFG(X) in FY2020 did not allow enough time to develop a completely new design (i.e., a clean-sheet design) for the FFG(X).[14] Consequently, the FFG(X) is to be built to a modified version of an existing ship design—an approach called the parent-design approach. The parent design can be a U.S. ship design or a foreign ship design.[15]

Using the parent-design approach can reduce design time, design cost, and cost, schedule, and technical risk in building the ship. The Coast Guard and the Navy are currently using the parent-design approach for the Coast Guard's Polar Security Cutter (i.e., polar icebreaker) program.[16] The parent-design approach has also been used in the past for other Navy and Coast Guard ships, including Navy mine warfare ships[17] and the Coast Guard's new Fast Response Cutters (FRCs).[18]

No New Technologies or Systems

As an additional measure for reducing cost, schedule, and technical risk in the FFG(X) program, the Navy envisages developing no new technologies or systems for the FFG(X)—the ship is to use systems and technologies that already exist or are already being developed for use in other programs.

Number of Builders

The Navy's baseline plan for the FFG(X) program envisages using a single builder at any one time to build the ships. The Navy has not, however, ruled out the option of building the ships at two or three shipyards at the same time. Consistent with U.S. law,[19] the ship is to be built in a shipyard located in the United States, even if it is based on a foreign design.

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[14] The Navy states that using an acquisition strategy involving a lengthier requirements-evaluation phase and a clean-sheet design would defer the procurement of the first ship to FY2025. (Source: Slide 3, entitled "Accelerating the FFG(X)," in a Navy briefing entitled "Designing & Building the Surface Fleet: Unmanned and Small Combatants," by Rear Admiral Casey Moton at a June 20, 2019, conference of the American Society of Naval Engineers [ASNE].)

[15] For articles about reported potential parent designs for the FFG(X), see, for example, Chuck Hill, "OPC Derived Frigate? Designed for the Royal Navy, Proposed for USN," *Chuck Hill's CG [Coast Guard] Blog*, September 15, 2017; David B. Larter, "BAE Joins Race for New US Frigate with Its Type 26 Vessel," *Defense News*, September 14, 2017; "BMT Venator-110 Frigate Scale Model at DSEI 2017," *Navy Recognition*, September 13, 2017; David B. Larter, "As the Service Looks to Fill Capabilities Gaps, the US Navy Eyes Foreign Designs," *Defense News*, September 1, 2017; Lee Hudson, "HII May Offer National Security Cutter for Navy Future Frigate Competition," *Inside the Navy*, August 7, 2017; Sydney J. Freedberg Jr., "Beyond LCS: Navy Looks To Foreign Frigates, National Security Cutter," *Breaking Defense*, May 11, 2017.

[16] For more on the polar security cutter program, including the parent-design approach, see CRS Report RL34391, *Coast Guard Polar Security Cutter (Polar Icebreaker) Program: Background and Issues for Congress*, by Ronald O'Rourke.

[17] The Navy's Osprey (MCM-51) class mine warfare ships are an enlarged version of the Italian Lerici-class mine warfare ships.

[18] The FRC design is based on a Dutch patrol boat design, the Damen Stan Patrol Boat 4708.

[19] 10 U.S.C. 8679 requires that, subject to a presidential waiver for the national security interest, "no vessel to be constructed for any of the armed forces, and no major component of the hull or superstructure of any such vessel, may

U.S. Content Requirements for Components

FY2020 Legislation

As part of its action on the Navy's FY2020 budget, Congress passed two provisions relating to U.S. content requirements for certain components of each FFG(X).

Section 856 of the FY2020 National Defense Authorization Act (S. 1790/P.L. 116-92 of December 20, 2019) states

> SEC. 856. APPLICATION OF LIMITATION ON PROCUREMENT OF GOODS OTHER THAN UNITED STATES GOODS TO THE FFG–FRIGATE PROGRAM.
>
> Notwithstanding any other provision of law, amounts authorized to carry out the FFG–Frigate Program may be used to award a new contract that provides for the acquisition of the following components regardless of whether those components are manufactured in the United States:
>
> (1) Auxiliary equipment (including pumps) for shipboard services.
>
> (2) Propulsion equipment (including engines, reduction gears, and propellers).
>
> (3) Shipboard cranes.
>
> (4) Spreaders for shipboard cranes.

Section 8113(b) of the FY2020 DOD Appropriations Act (Division A of H.R. 1158/P.L. 116-93 of December 20, 2019) states

> SEC. 8113….
>
> (b) None of the funds provided in this Act for the FFG(X) Frigate program shall be used to award a new contract that provides for the acquisition of the following components unless those components are manufactured in the United States: Air circuit breakers; gyrocompasses; electronic navigation chart systems; steering controls; pumps; propulsion and machinery control systems; totally enclosed lifeboats; auxiliary equipment pumps; shipboard cranes; auxiliary chill water systems; and propulsion propellers: Provided, That the Secretary of the Navy shall in corporate United States manufactured propulsion engines and propulsion reduction gears into the FFG(X) Frigate program beginning not later than with the eleventh ship of the program.

Additional Statute and Legislation

In addition to the two above provisions, a permanent statute—10 U.S.C. 2534—requires certain components of U.S. Navy ships to be made by a manufacturer in the national technology and industrial base.

In addition, the paragraph in the annual DOD appropriations act that makes appropriations for the Navy's shipbuilding account (i.e., the Shipbuilding and Conversion, Navy, or SCN, appropriation account) has in recent years included this proviso:

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be constructed in a foreign shipyard." In addition, the paragraph in the annual DOD appropriations act that makes appropriations for the Navy's shipbuilding account (the Shipbuilding and Conversion, Navy account) typically contains these provisos: " ... *Provided further*, That none of the funds provided under this heading for the construction or conversion of any naval vessel to be constructed in shipyards in the United States shall be expended in foreign facilities for the construction of major components of such vessel: *Provided further*, That none of the funds provided under this heading shall be used for the construction of any naval vessel in foreign shipyards.... "

> … *Provided further*, That none of the funds provided under this heading for the construction or conversion of any naval vessel to be constructed in shipyards in the United States shall be expended in foreign facilities for the construction of major components of such vessel….

10 U.S.C. 2534 explicitly applies to certain ship components, but not others. The meaning of "major components" in the above proviso from the annual DOD appropriations act might be subject to interpretation.

Navy Perspective on FY2020 Legislative Provisions

Regarding the two FY2020 legislative provisions discussed above, the Navy states:

> In order to comply with the law, the FFG(X) Detail Design & Construction (DD&C) Request For Proposal (RFP) Statement of Work (SOW) was amended to include the following requirements:
>
> C.2.21 Manufacture of Certain Components in the United States
>
> "Per Section 8113(b) of P.L. 116-93: Consolidated Appropriations Act, 2020, the Contractor shall ensure that the following components are manufactured in the United States for each FFG(X) ship: air circuit breakers; gyrocompasses; electronic navigation chart systems; steering controls; pumps; propulsion and machinery control systems; totally enclosed lifeboats; auxiliary equipment pumps; shipboard cranes; auxiliary chill water systems; and propulsion propellers."
>
> C.2.22 Engine and Reduction Gear Study (Item 0100 only)
>
> > "The Contractor shall conduct and develop an Engine and Reduction Gear Study (CDRL A019) documenting the impacts of incorporating United States manufactured propulsion engines and propulsion reduction gears into the FFG(X) design starting with the fourth, sixth, eighth, tenth, and eleventh FFG(X) ship."
>
> The Navy has assessed the impact of implementing the first part of Section 8113(b) of P.L. 116-93: Consolidated Appropriations Act, 2020, which states "None of the funds provided in this Act for the FFG(X) Frigate program shall be used to award a new contract that provides for the acquisition of the following components unless those components are manufactured in the United States: Air circuit breakers; gyrocompasses; electronic navigation chart systems; steering controls; pumps; propulsion and machinery control systems; totally enclosed lifeboats; auxiliary equipment pumps; shipboard cranes; auxiliary chill water systems; and propulsion propellers," for prospective shipbuilders and has determined the impact is low. The impact of the second part of Section 8113(b) of P.L. 116-93: Consolidated Appropriations Act, 2020, which states "That the Secretary of the Navy shall incorporate United States manufactured propulsion engines and propulsion reduction gears into the FFG(X) Frigate program beginning not later than with the eleventh ship of the program," is unknown at this time. After DD&C contract award, the impact study from the selected FFG(X) shipbuilder will be delivered to the Navy. The Navy will use these impacts to develop the requested report to Congress no later than six months after contract award.[20]

Competing Industry Teams

As shown in **Table 2**, four industry teams competed for the FFG(X) program. Two of the teams—one including Fincantieri/Marinette Marine (F/MM) of Marinette, WI, and another including

[20] Navy information paper on FFG(X) program dated March 27, 2020, provided to CRS and CBO by Navy Office of legislative Affairs, April 14, 2020.

General Dynamics/Bath Iron Works (GD/BIW) of Bath, ME—used European frigate designs as their parent design. A third team—a team including Austal USA of Mobile, AL—used the Navy's Independence (LCS-2) class Littoral Combat Ship (LCS) design, which Austal USA currently builds, as its parent design. A fourth team—a team including Huntington Ingalls Industries/Ingalls Shipbuilding (HII/Ingalls) of Pascagoula, MS—has not disclosed what parent design it used.

For additional background information on the competing industry teams, see **Appendix B**.

Table 2. Industry Teams Reportedly Competing for FFG(X) Program

Industry team leader	Parent design	Shipyard that would build the ships
Austal USA	Independence (LCS-2) class LCS design	Austal USA of Mobile, AL
Fincantieri Marine Group	Italian Fincantieri FREMM (Fregata Europea Multi-Missione) frigate	Fincantieri/Marinette Marine (F/MM) of Marinette, WI
General Dynamics/Bath Iron Works	Spanish Navantia Álvaro de Bazán-class F100 frigate	General Dynamics/Bath Iron Works (GD/BIW) of Bath, ME
Huntington Ingalls Industries	[Not disclosed]	Huntington Ingalls Industries/ Ingalls Shipbuilding (HII/Ingalls) of Pascagoula, MS

Source: Sam LaGrone and Megan Eckstein, "Navy Picks Five Contenders for Next Generation Frigate FFG(X) Program," *USNI News*, February 16, 2018; Sam LaGrone, "Lockheed Martin Won't Submit Freedom LCS Design for FFG(X) Contest," *USNI News*, May 28, 2019. See also David B. Larter, "Navy Awards Design Contracts for Future Frigate," *Defense News*, February 16, 2018; Lee Hudson, "Navy Awards Five Conceptual Design Contracts for Future Frigate Competition," *Inside the Navy*, February 19, 2018.

Detail Design and Construction (DD&C) Contract

The FFG(X) contract that the four industry teams competed for is a Detail Design and Construction (DD&C) contract for up to 10 ships in the program—the lead ship plus nine option ships. Under such a contract, the Navy has the option of recompeting the program after the lead ship (if none of the nine option ships are exercised), after the 10th ship (if all nine of the option ships are exercised), or somewhere in between (if some but not all of the nine option ships are exercised).

As a means of reducing their procurement cost, the Navy may convert the DD&C contract into a multiyear contract known as a block buy contract to procure the ships.[21] The request for proposals (RFP) for the DD&C contract stated: "Following contract award, the Government may designate any or all of [the nine option ships] as part of a 'Block Buy.' In the event that a Block Buy is enacted under the National Defense Authorization Act in future fiscal years, the Contractor shall enter into negotiations with the Government to determine a fair and reasonable price for each item under the Block Buy. The price of any ship designated as part of the Block Buy shall not exceed the corresponding non-Block Buy price."[22]

[21] For more on block buy contracting, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke.

[22] FFG(X) Guided Missile Frigate Detail Design & Construction, Solicitation Number: N0002419R2300, June 20, 2019, p. 51 of 320, accessed June 25, 2019, at https://www.fbo.gov/index?s=opportunity&mode=form&id=d7203a2dd8010b79ef62e67ee7850083&tab=core&_cview=1.

Contract Award

Under the Navy's FY2021 budget submission, the DD&C contract was scheduled to be awarded in July 2020. The Navy, however, moved up the date for awarding the contract and announced on April 30, 2020, that it had awarded the FFG(X) contract to the industry team led by F/MM. The contract award announcement states:

> Marinette Marine Corp., Marinette, Wisconsin, is awarded a $795,116,483 fixed-price incentive (firm target) contract for detail design and construction (DD&C) of the FFG(X) class of guided-missile frigates, with additional firm-fixed-price and cost reimbursement line items. The contract with options will provide for the delivery of up to 10 FFG(X) ships, post-delivery availability support, engineering and class services, crew familiarization, training equipment and provisioned item orders. If all options are exercised, the cumulative value of this contract will be $5,576,105,441. Work will be performed at multiple locations, including Marinette, Wisconsin (52%); Boston, Massachusetts (10%); Crozet, Virginia (8%); New Orleans, Louisiana (7%); New York, New York (6%); Washington, D.C. (6%), Sturgeon Bay, Wisconsin (3%), Prussia, Pennsylvania (3%), Minneapolis, Minnesota (2%); Cincinnati, Ohio (1%); Atlanta, Georgia (1%); and Chicago, Illinois (1%). The base contract includes the DD&C of the first FFG(X) ship and separately priced options for nine additional ships…. Fiscal 2020 shipbuilding and conversion (Navy) funding in the amount of $795,116,483 will be obligated at time of award and will not expire at the end of the current fiscal year. This contract was competitively procured via the Federal Business Opportunities website and four offers were received. The Navy conducted this competition using a tradeoff process to determine the proposal representing the best value, based on the evaluation of non-price factors in conjunction with price. The Navy made the best value determination by considering the relative importance of evaluation factors as set forth in the solicitation, where the non-price factors of design and design maturity and objective performance (to achieve warfighting capability) were approximately equal and each more important than remaining factors.[23]

Design Selected for FFG(X) Program

Figure 4 shows an artist's rendering of F/MM's design for the FFG(X). As shown in **Table 2**, F/MM's design for the FFG(X) is based on the design of Fincantieri's FREMM (Fregata Europea Multi-Missione) frigate, a ship that has been built in two variants, one for the Italian navy and one for the French navy. F/MM officials state that its FFG(X) design is based on the Italian variant, which has a length of 474.4 feet, a beam of 64.6 feet, a draft of 28.5 feet (including the bow sonar bulb), and a displacement of 6,900 tons.[24] F/MM's FFG(X) design is slightly longer and heavier—it has a length of 496 feet, a beam of 65 feet, a draft of 23 to 24 feet (there is no bow sonar bulb), and an estimated displacement of 7,400 tons, or about 76% as much as the displacement of a Flight III DDG-51 destroyer.[25]

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[23] Department of Defense, "Contracts For April 30, 2020," accessed April 30, 2020, at https://www.defense.gov/Newsroom/Contracts/Contract/Article/2171906/. See also PEO USC Public Affairs, "US Navy Awards Guided Missile Frigate (FFG(X)) Contract," *Navy News Service*, April 30, 2020.

[24] Source: Ministero Della Difesa [Ministry of Defense], "Fregate Europee Multi Missione—FREMM," version archived October 25, 2014, accessed May 3, 2020, at https://web.archive.org/web/20141025045603/http://www.marina.difesa.it/conosciamoci/comandienti/log_amm/marinalles/Pagine/FREMM.aspx.

[25] Sources for length and beam: Fincantieri/Marinette Marine, "FFG(X) Guided Missile Frigate of the Future," undated, accessed May 3, 2020, at https://fincantierimarinegroup.com/products/navy/ffgx/. Source for draft and displacement: Defense & Aerospace Report interview with Chuck Goddard, Senior Vice President, Fincantieri Marine Group, posted January 26, 2020, accessed May 3, 2020, at https://www.youtube.com/watch?v=ObZzcdzIctc . The statement that the ship's draft is 23 to 24 feet and that its displacement is 7,400 tons is at approximately 2:35 to 2:40.

Figure 4. Oliver Hazard Perry (FFG-7) Class Frigate

Artist's rendering of F/MM design

Source: Cropped version of photograph accompanying PEO USC Public Affairs, "US Navy Awards Guided Missile Frigate (FFG(X)) Contract," *Navy News Service*, April 30, 2020.

Program Funding

Table 3 shows procurement funding for the FFG(X) program under the Navy's FY2021 budget submission.

Table 3. FFG(X) Program Procurement Funding

Millions of then-year dollars, rounded to nearest tenth.

	FY21	FY22	FY23	FY24	FY25
Funding	1,053.1	954.5	1,865.9	1,868.8	2,817.3
(Quantity)	*(1)*	*(1)*	*(2)*	*(2)*	*(3)*
Avg. unit cost	*1,053.1*	*954.5*	*933.0*	*934.4*	*939.1*

Source: Table prepared by CRS based on Navy FY2021 budget submission.

Issues for Congress

Potential Impact of COVID-19 (Coronavirus) Situation

One issue for Congress concerns the potential impact of the COVID-19 (coronavirus) situation on the execution of U.S. military shipbuilding programs, including the FFG(X) program. For additional discussion of this issue, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Accuracy of Navy's Estimated Unit Procurement Cost

Another potential issue for Congress concerns the accuracy of the Navy's estimated unit procurement cost for the FFG(X), particularly when compared to the known unit procurement costs of other recent U.S. surface combatants. As detailed by CBO[26] and GAO,[27] lead ships in Navy shipbuilding programs in many cases have turned out to be more expensive to build than the Navy had estimated. If the lead ship in a shipbuilding program turns out to be intrinsically more expensive to build than the Navy estimated, the follow-on ships in the program will likely also be more expensive to build than the Navy estimated.

As discussed earlier, the Navy's FY2021 budget submission estimates that the third and subsequent ships in the FFG(X) program will cost roughly $940 million each in then-year dollars to procure. This equates to a cost of about $127 million per thousand tons of full load displacement, a figure that is

- about 36% less than the cost per thousand tons of full load displacement of the Flight III DDG-51;
- about 15% less than the cost per thousand tons of full load displacement of the Freedom (LCS-1) variant of the Littoral Combat Ship (LCS) that F/MM currently builds; and
- about 15% less than the cost per thousand tons of full load displacement of the Coast Guard's National Security Cutter (NSC).[28]

Put another way, the FFG(X) has

- an estimated full load displacement that is about 76% as great as that of the Flight III DDG-51, and an estimated unit procurement cost that is about 49% as great as that of the Flight III DDG-51;
- an estimated full load displacement that is about 120% greater than that of the LCS-1 variant of the LCS, and an estimated unit procurement cost that is about 80% greater than that of the LCS-1 variant of the LCS; and
- an estimated full load displacement that is about 64% greater than that of the Coast Guard's National Security Cutter (NSC), and an estimated unit procurement cost that is about 40% greater than that of the NSC.[29]

Ships of the same general type and complexity that are built under similar production conditions tend to have similar costs per weight and consequently unit procurement costs that are more or less proportional to their displacements. Setting the estimated cost per thousand tons of displacement of the FFG(X) about equal to those of the LCS-1 variant of the LCS or the NSC would increase the estimated unit procurement cost of the third and subsequent FFG(X)s from the Navy's estimate of about $940 million to an adjusted figure of about $1,100 million, an increase of about 17%. Setting the estimated cost per thousand tons of displacement of the FFG(X) about equal to that of the Flight III DDG-51 would increase the estimated unit procurement cost of the

[26] See Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2019 Shipbuilding Plan*, October 2018, p. 25, including Figure 10.

[27] See Government Accountability Office, *Navy Shipbuilding[:] Past Performance Provides Valuable Lessons for Future Investments*, GAO-18-238SP, June 2018, p. 8.

[28] For more on the NSC program, see CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

[29] Source: CRS analysis of full load displacements and unit procurement costs of FFG(X), Flight III DDG-51, LCS-1 variant of the LCS, and the NSC.

third and subsequent FFG(X)s from the Navy's estimate of about $940 million to an adjusted figure of about $1,470 million, an increase of about 56%.

Potential oversight questions for Congress include the following:

- What is the Navy's basis for its view that the FFG(X)—a ship about three-quarters as large as the Flight III DDG-51, and with installed capabilities that are in many cases similar to those of the DDG-51—can be procured for about one-half the cost of the Flight III DDG-51?
- DDG-51s are procured using multiyear procurement (MYP), which reduces their procurement cost by several percent, while the FFG(X) DD&C contract is a contract with options, which operates as a form of annual contracting and consequently does not achieve the kinds of savings that are possible with an MYP contract.[30] Would adjusting for this difference by assuming the use of annual contracting for procuring DDG-51s mean that the difference between the Flight III DDG-51 and the FFG(X) in cost per thousand tons displacement, other things held equal, is greater than the figure of 36% shown above?
- What is the Navy's basis for its view that the FFG(X)—a ship with a full collection of permanently installed combat system equipment—can be procured for a cost per thousand tons of full load displacement that is about 15% less than that of the LCS-1 variant of the LCS, a ship built by the same shipyard that features only a partial collection of permanently installed combat system equipment?[31]
- What is the Navy's basis for its view that the FFG(X)—a ship built to Navy combat survivability standards and featuring a full collection of installed Navy combat system equipment—can be procured for a cost per thousand tons of full load displacement that is 15% less than that of the NSC, a ship built to a Coast Guard rather than Navy combat-survivability standard and featuring a more-modest collection of combat system equipment?
- To what degree can differences in costs for building ships at F/MM compared to costs for building ships at the shipyards that build DDG-51s and NSCs account for the FFG(X)'s lower estimated cost per thousand tons displacement?
- To what degree can the larger size of the FFG(X) compared to the LCS-1 variant of the LCS or the NSC account for the FFG(X)'s lower estimated cost per thousand tons displacement?
- To what degree will process improvements at F/MM, beyond those that were in place for building LCSs, permit FFG(X)s to be built at the Navy's estimated cost per thousand tons?
- How much might the cost of building FFG(X)s be reduced by converting the FFG(X) contract into a block buy contract (i.e., a multiyear contract)?

[30] For additional discussion of the savings that are possible with MYP contracts, see CRS Report R41909, *Multiyear Procurement (MYP) and Block Buy Contracting in Defense Acquisition: Background and Issues for Congress*, by Ronald O'Rourke.

[31] Some of the combat system equipment of a deployed LCS consists of a modular mission package is not permanently built into the ship. These modular mission packages are procured separately from the ship, and their procurement costs are not included in the unit procurement costs of LCSs. For additional discussion, see CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress*, by Ronald O'Rourke.

Regarding the Navy's estimated cost for procuring FFG(X)s, an August 2019 Government Accountability Office (GAO) report on the FFG(X) program states:

> The Navy undertook a conceptual design phase for the FFG(X) Guided Missile Frigate program that enabled industry to inform FFG(X) requirements, identify opportunities for cost savings, and mature different ship designs. The Navy also streamlined the FFG(X) acquisition approach in an effort to accelerate the timeline for delivering the ships to the fleet…. [H]owever, the Navy has requested funding for the FFG(X) lead ship even though it has yet to complete key cost estimation activities, such as an independent cost estimate, to validate the credibility of cost expectations. Department of Defense (DOD) cost estimators told GAO the timeline for completing the independent cost estimate is uncertain. Specifically, they stated that this estimate will not be finalized until the Navy communicates to them which FFG(X) design is expected to receive the contract award. GAO-identified best practices call for requisite cost knowledge to be available to inform resource decisions and contract awards.[32]

An October 2019 Congressional Budget Office (CBO) report on the cost of the Navy's shipbuilding programs stated the following about the FFG(X) (emphasis added):

> The four shipbuilders in the [FFG(X)] competition are using existing designs that have displacements of between 3,000 tons and almost 7,000 tons.
>
> The Navy's cost goal for the program is currently set at $1.2 billion for the first ship of the class and an average cost of $800 million to $950 million for the remaining 19 ships. Because the 2020 shipbuilding plan estimates an average cost of slightly more than $850 million each for all 20 ships—an amount near the lower end of the Navy's cost goal—actual costs would probably exceed the estimates. Historically, the costs of lead ships have grown by 27 percent, on average, over the Navy's initial estimates…. Taking into account all publicly available information, **CBO's estimate reflects an assumption that the FFG(X) would displace about 4,700 tons**, or the median point of the four proposed ship designs in competition for the program contract. As a result, CBO estimates the average cost of the FFG(X)s at $1.2 billion each, for a total cost of $23 billion, compared with the Navy's estimate of $17 billion. Uncertainty about the frigate design makes that estimate difficult to determine.[33]

Number of FFG(X)s to Procure in FY2021

Another issue for Congress is whether to fund the procurement in FY2021 of one FFG(X) (the Navy's request), no FFG(X), or two FFG(X)s.

Supporters of procuring no FFG(X) in FY2021 could argue that traditionally there has often been a so-called gap year in Navy shipbuilding programs—a year of no procurement between the year that the lead ship is procured and the year that the second ship is procured. This gap year, they could argue, is intended to provide some time to discover through the ship's construction process problems in the ship's design that did not come to light during the design process, and fix those problems before they are built into one or more follow-on ships in the class. Given the Navy's experience with its previous small surface combatant shipbuilding program—the Littoral Combat Ship (LCS) program—they could argue, inserting a gap year into the FFG(X)'s procurement profile would be prudent.

[32] Government Accountability Office, *Guide Missile Frigate[:] Navy Has Taken Steps to Reduce Acquisition Risk, but Opportunities Exist to Improve Knowledge for Decision Makers*, GAO-19-512, August 2019, summary page.

[33] Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2020 Shipbuilding Plan*, October 2019, pp. 252-26.

Supporters of procuring one FFG(X) in FY2021 (rather than none) could argue that although including a gap year is a traditional practice in Navy shipbuilding programs, it has not always been used; that the era of computer-aided ship design (compared to the earlier era of paper designs) has reduced the need for gap years; that the need for a gap year in the FFG(X) program is further reduced by the program's use of a parent design rather than a clean-sheet design; and that a gap year can increase the cost of the second and subsequent ships in the program by causing an interruption in the production learning curve and a consequent loss of learning at the shipyard and supplier firms in moving from production of the first ship to the second. Supporters of procuring one FFG(X) (rather than two) could argue that immediately moving from one ship in FY2020 to two ships in FY2021 could cause strains at the shipyard and thereby increase program risks, particularly given the challenges that shipyards have often encountered in building the first ship in a shipbuilding program, and that the funding needed for the procurement of a second FFG(X) in FY2021 could be better spent on other Navy program priorities.

Supporters of procuring two FFG(X)s in FY2021 could argue that the Navy's FY2020 shipbuilding plan (see **Table 1**) called for procuring two FFG(X)s in FY2021; that procuring one FFG(X) rather than two in FY2021 reduces production economies of scale in the FFG(X) program at the shipyard and supplier firms, thereby increasing unit procurement costs; and that procuring two FFG(X)s rather than one in FY2021 would help close more quickly the Navy's large percentage shortfall in small surface combatants relative to the Navy's force-level goal for such ships.

Number of FFG(X) Builders

Another issue for Congress is whether to build FFG(X)s at a single shipyard (the Navy's baseline plan), or at two or three shipyards. The Navy's FFG-7 class frigates, which were procured at annual rates of as high as eight ships per year, were built at three shipyards.

In considering whether to build FFG(X)s at a single shipyard (the Navy's baseline plan), or at two or three shipyards, Congress may consider several factors, including but not limited to the annual FFG(X) procurement rate, shipyard production capacities and production economies of scale, the potential costs and benefits in the FFG(X) program of employing recurring competition between multiple shipyards, and how the number of FFG(X) builders might fit into a larger situation involving the production of other Navy and Coast Guard ships, including Navy DDG-51 destroyers, Navy amphibious ships, Coast Guard National Security Cutters (NSCs), and Coast Guard Offshore Patrol Cutters (OPCs).[34]

U.S. Content Requirements

Another issue for Congress is whether to take any further legislative action regarding U.S. content requirements for FFG(X)s. Potential options include amending, repealing, or replacing one or both of the two previously mentioned U.S. content provisions for the FFG(X) program that Congress passed in FY2020, passing a new, separate provision of some kind, or doing none of these things.

[34] For more on the DDG-51 program, see CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke. For more on Navy amphibious shipbuilding programs, see CRS Report R43543, *Navy LPD-17 Flight II and LHA Amphibious Ship Programs: Background and Issues for Congress*, by Ronald O'Rourke. For more on the NSC and OPC programs, see CRS Report R42567, *Coast Guard Cutter Procurement: Background and Issues for Congress*, by Ronald O'Rourke.

In considering whether to take any further legislative action on the issue, Congress may consider several factors, including the potential impacts of the two U.S. content provisions that Congress passed in FY2020. Some observers view these two provisions as being in tension with one another.[35] In instances where differences between two enacted laws might need to be resolved, one traditional yardstick is to identify the legislation that was enacted later, on the grounds that it represents the final or most-recent word of the Congress on the issue. Although FY2020 National Defense Authorization Act and the FY2020 DOD Appropriations Act were signed into law on the same day (December 20, 2019), the P.L. numbers assigned to the two laws appear to indicate that the FY2020 DOD Appropriations Act was enacted later than the FY2020 National Defense Authorization Act. It can also be noted that Section 8113(b) of the FY2020 DOD Appropriations Act is a provision relating to the use of FY2020 funds, while Section 856 of the FY2020 National Defense Authorization Act refers to amounts authorized without reference to a specific fiscal year.

Required Capabilities and Growth Margin

Another issue for Congress is whether the Navy has appropriately defined the required capabilities and growth margin of the FFG(X).

Analytical Basis for Desired Ship Capabilities

One aspect of this issue is whether the Navy has an adequately rigorous analytical basis for its identification of the capability gaps or mission needs to be met by the FFG(X), and for its decision to meet those capability gaps or mission needs through the procurement of a FFG with the capabilities outlined earlier in this CRS report. The question of whether the Navy has an adequately rigorous analytical basis for these things was discussed in greater detail in earlier editions of this CRS report.[36]

Number of VLS Tubes

Another potential aspect of this issue concerns the planned number of Vertical Launch System (VLS) missile tubes on the FFG(X). The VLS is the FFG(X)'s principal (though not only) means of storing and launching missiles. As shown in **Figure 3** (see the box in the upper-left corner labeled "AW," meaning air warfare), the FFG(X) is to be equipped with 32 Mark 41 VLS tubes. (The Mark 41 is the Navy's standard VLS design.)

Supporters of requiring the FFG(X) to be equipped with a larger number of VLS tubes, such as 48, might argue that the FFG(X) is to be roughly half as expensive to procure as the DDG-51 destroyer, and might therefore be more appropriately equipped with 48 VLS tubes, which is one-half the number on recent DDG-51s. They might also argue that in a context of renewed great power competition with potential adversaries such as China, which is steadily improving its naval capabilities,[37] it might be prudent to equip the FFG(X)s with 48 rather than 32 VLS tubes, and that doing so might only marginally increase the unit procurement cost of the FFG(X).

Supporters of requiring the FFG(X) to have no more than 32 VLS tubes might argue that the analyses indicating a need for 32 already took improving adversary capabilities (as well as other

[35] See, for example, Ben Werner and Sam LaGrone, "FY 2020 Defense Measures Almost Law; Bills Contain Conflicting Language on FFG(X)," *USNI News*, December 20, 2019.

[36] See, for example, the version of this report dated February 4, 2019.

[37] For more on China's naval modernization effort, see CRS Report RL33153, *China Naval Modernization: Implications for U.S. Navy Capabilities—Background and Issues for Congress*, by Ronald O'Rourke.

U.S. Navy capabilities) into account. They might also argue that F/MM's design for the FFG(X), in addition to having 32 VLS tubes, will also to have separate, deck-mounted box launchers for launching 16 anti-ship cruise missiles, as well as a separate, 21-cell Rolling Airframe Missile (RAM) AAW missile launcher; that the Navy plans to deploy additional VLS tubes on its planned Large Unmanned Surface Vehicles (LUSVs), which are to act as adjunct weapon magazines for the Navy's manned surface combatants;[38] and that increasing the number of VLS tubes on the FFG(X) from 32 to 48 would increase (even if only marginally) the procurement cost of a ship that is intended to be an affordable supplement to the Navy's cruisers and destroyers.

A May 14, 2019, Navy information paper on expanding the cost impact of expanding the FFG(X) VLS capacity from 32 cells to 48 cells states

> To grow from a 32 Cell VLS to a 48 Cell VLS necessitates an increase in the length of the ship with a small beam increase and roughly a 200-ton increase in full load displacement. This will require a resizing of the ship, readdressing stability and seakeeping analyses, and adapting ship services to accommodate the additional 16 VLS cells.
>
> A change of this nature would unnecessarily delay detail design by causing significant disruption to ship designs. Particularly the smaller ship designs. Potential competitors have already completed their Conceptual Designs and are entering the Detail Design and Construction competition with ship designs set to accommodate 32 cells.
>
> The cost is estimated to increase between $16M [million] and $24M [million] per ship. This includes ship impacts and additional VLS cells.[39]

Compared to an FFG(X) follow-on ship unit procurement cost of about $900 million, the above estimated increase of $16 million to $24 million would equate to an increase in unit procurement cost of about 1.8% to about 2.7%.

Growth Margin

Another potential aspect of this issue is whether the Navy more generally has chosen the appropriate amount of growth margin to incorporate into the FFG(X) design. As shown in the **Appendix A**, the Navy wants the FFG(X) design to have a growth margin (also called service life allowance) of 5%, meaning an ability to accommodate upgrades and other changes that might be made to the ship's design over the course of its service life that could require up to 5% more space, weight, electrical power, or equipment cooling capacity. As shown in the **Appendix A**, the Navy also wants the FFG(X) design to have an additional growth margin (above the 5% factor) for accommodating a future directed energy system (i.e., a laser or high-power microwave device) or an active electronic attack system (i.e., electronic warfare system).

Supporters could argue that a 5% growth margin is traditional for a ship like a frigate, that the FFG(X)'s 5% growth margin is supplemented by the additional growth margin for a directed energy system or active electronic attack system, and that requiring a larger growth margin could make the FFG(X) design larger and more expensive to procure.

Skeptics might argue that a larger growth margin (such as 10%—a figure used in designing cruisers and destroyers) would provide more of a hedge against the possibility of greater-than-anticipated improvements in the capabilities of potential adversaries such as China, that a limited

[38] For additional discussion, see CRS Report R45757, *Navy Large Unmanned Surface and Undersea Vehicles: Background and Issues for Congress*, by Ronald O'Rourke.

[39] Navy information paper entitled "FFG(X) Cost to Grow to 48 cell VLS," dated May 14, 2019, received from Navy Office of Legislative Affairs on June 14, 2019.

growth margin was a concern in the FFG-7 design,[40] and that increasing the FFG(X) growth margin from 5% to 10% would have only a limited impact on the FFG(X)'s procurement cost.

A potential oversight question for Congress might be: What would be the estimated increase in unit procurement cost of the FFG(X) of increasing the ship's growth margin from 5% to 10%?

Technical Risk

Another potential oversight issue for Congress concerns technical risk in the FFG(X) program. The Navy can argue that the program's technical risk has been reduced by use of the parent-design approach and the decision to use only systems and technologies that already exist or are already being developed for use in other programs, rather than new technologies that need to be developed. Skeptics, while acknowledging that point, might argue that lead ships in Navy shipbuilding programs inherently pose technical risk, because they serve as the prototypes for their programs.

June 2020 GAO Report

A June 2020 GAO report on the status of various Department of Defense (DOD) acquisition programs states the following about the FFG(X) program:

> **Technology Maturity**
>
> The Navy completed a technology readiness assessment for FFG(X) in March 2019. The assessment, which Navy officials said included a review of about 150 systems, identified no critical technology elements that pose major technological risk during development. DOD has yet to complete an independent technical risk assessment for FFG(X). An official from the Office of the Under Secretary of Defense for Research and Engineering who is participating in the FFG(X) risk assessment said that delays in obtaining required information from the Navy make it unlikely the assessment will be completed before the program's development start decision. If incomplete, information available to inform decision makers on the sufficiency of the Navy's efforts to account for technical risk factors will be diminished.
>
> The FFG(X) design approach includes the use of many existing combat and mission systems to reduce technical risk. However, one key system—the Enterprise Air Surveillance Radar (EASR)—is still in development by another program. EASR, which is a scaled down version of the Navy Air and Missile Defense Radar program's AN/SPY-6(V)1 radar currently in production, is expected to provide long-range detection and engagement of advanced threats. The Navy is currently conducting land-based testing on an EASR advanced prototype, with FFG(X)-specific testing planned to begin in 2022. The Navy also expects to integrate versions of the radar on other ship classes beginning in 2021, which may reduce integration risk for FFG(X) if the Navy is able to incorporate lessons learned from integration on other ships during FFG(X) detail design activities.
>
> **Design Stability**
>
> The Navy used the results from an FFG(X) conceptual design phase to inform the program's May 2019 preliminary design review as well as the ongoing contract award process for detail design and construction of the lead ship. In early 2018, the Navy competitively awarded FFG(X) conceptual design contracts to five industry teams.

[40] See, for example, See U.S. General Accounting Office, Statement of Jerome H. Stolarow, Director, Procurement and Systems Acquisition Division, before the Subcommittee on Priorities and Economy in Government, Joint Economic Committee on The Navy's FFG-7 Class Frigate Shipbuilding Program, and Other Ship Program Issues, January 3, 1979, pp. 9-11.

Conceptual design was intended to enable industry to mature parent ship designs for FFG(X)—designs based on ships that have been built and demonstrated at sea—as well as inform requirements and identify opportunities for cost savings. Navy officials said the specific plan for detail design will be determined based on the winning proposal.

Software and Cybersecurity

According to the FFG(X) acquisition strategy, the program is structured to provide mission systems and associated software to the shipbuilder as government-furnished equipment. These systems, which are provided by other Navy programs, include a new version of the Aegis Weapon System—FFG(X)'s combat management system—to coordinate radar and weapon system interactions from threat detection to target strike. Navy officials said FFG(X)'s Aegis Weapon System will leverage at least 90 percent of its software from the Aegis common source software that supports combat systems found on other Navy ships, such as the DDG 51-class destroyers.

The Navy approved the FFG(X) cybersecurity strategy in March 2019. The strategy states the program's cyber survivability requirement was a large driver in the development of network architecture. The Navy's strategy also emphasizes the importance of the ability of the ship to operate in a cyber-contested environment. The Navy will consider cybersecurity for the systems provided by the shipbuilder—which control electricity, machinery, damage control, and other related systems—as part of selecting the FFG(X) design.

Other Program Issues

In October 2019, DOD confirmed that the Navy did not request that prospective shipbuilders include warranty pricing to correct defects after ship deliveries in their proposals for the competitive FFG(X) detail design and construction contract award, as we previously recommended. Instead, the Navy required that the proposals include guaranty pricing with limited liability of at least $5 million to correct defects, which could allow for a better value to the government than has been typical for recent shipbuilding programs. However, warranty pricing could have provided the Navy with complete information on the cost-effectiveness of a warranty versus a guaranty. Our prior work has found that using comprehensive ship warranties instead of guarantees could reduce the Navy's financial responsibility for correcting defects and foster quality performance by linking the shipbuilder's cost to correct deficiencies to its profit.

Program Office Comments

We provided a draft of this assessment to the program office for review and comment. The program office provided technical comments, which we incorporated where appropriate. The program office stated that the Navy is working to satisfy the requirement for an independent technical risk assessment requirement prior to development start. Regarding warranties, the program office stated the solicitation allows shipbuilders to propose a limit of liability beyond the $5 million requirement. It said this arrangement represents an appropriate balance between price and risk; ensures that the shipbuilder is accountable for the correction of defects that follow acceptance; and allows shipbuilders to use their own judgment in proposing the value of the limit of liability. The program office also said the Navy will evaluate the extent to which any additional liability amount proposed above the minimum requirement provides a meaningful benefit to the government, and will evaluate favorably a higher proposed limitation of liability value, up to an unlimited guaranty.[41]

[41] Government Accountability Office, D*efense Acquisitions Annual Assessment[:] Drive to Deliver Capabilities Faster Increases Importance of Program Knowledge and Consistent Data for Oversight* GAO-20-439, p. 124.

Guaranty vs. Warranty in Construction Contract

Another aspect of this issue concerns the Navy's use of a guaranty rather than a warranty in the Detail Design and Construction (DD&C) contract for the FFG(X) program. An August 2019 GAO report on the FFG(X) program states

> The Navy plans to use a fixed-price incentive contract for FFG(X) detail design and construction. This is a notable departure from prior Navy surface combatant programs that used higher-risk cost-reimbursement contracts for lead ship construction. The Navy also plans to require that each ship has a minimum guaranty of $5 million to correct shipbuilder-responsible defects identified in the 18 months following ship delivery. However, Navy officials discounted the potential use of a warranty—another mechanism to address the correction of shipbuilder defects—stating that their use could negatively affect shipbuilding cost and reduce competition for the contract award. The Navy provided no analysis to support these claims and has not demonstrated why the use of warranties is not a viable option. The Navy's planned use of guarantees helps ensure the FFG(X) shipbuilder is responsible for correcting defects up to a point, but guarantees generally do not provide the same level of coverage as warranties. GAO found in March 2016 that the use of a guaranty did not help improve cost or quality outcomes for the ships reviewed. GAO also found the use of a warranty in commercial shipbuilding and certain Coast Guard ships improves cost and quality outcomes by requiring the shipbuilders to pay to repair defects. The FFG(X) request for proposal offers the Navy an opportunity to solicit pricing for a warranty to assess the cost-effectiveness of the different mechanisms to address ship defects.[42]

As discussed in another CRS report,[43] in discussions of Navy (and also Coast Guard) shipbuilding, a question that sometimes arises is whether including a warranty in a shipbuilding contract is preferable to not including one. The question can arise, for example, in connection with a GAO finding that "the Navy structures shipbuilding contracts so that it pays shipbuilders to build ships as part of the construction process and then pays the same shipbuilders a second time to repair the ship when construction defects are discovered."[44]

Including a warranty in a shipbuilding contract (or a contract for building some other kind of defense end item), while potentially valuable, might not always be preferable to not including one—it depends on the circumstances of the acquisition, and it is not necessarily a valid criticism of an acquisition program to state that it is using a contract that does not include a warranty (or a weaker form of a warranty rather than a stronger one).

Including a warranty generally shifts to the contractor the risk of having to pay for fixing problems with earlier work. Although that in itself could be deemed desirable from the government's standpoint, a contractor negotiating a contract that will have a warranty will incorporate that risk into its price, and depending on how much the contractor might charge for doing that, it is possible that the government could wind up paying more in total for acquiring the item (including fixing problems with earlier work on that item) than it would have under a contract without a warranty.

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[42] Government Accountability Office, *Guide Missile Frigate[:] Navy Has Taken Steps to Reduce Acquisition Risk, but Opportunities Exist to Improve Knowledge for Decision Makers*, GAO-19-512, August 2019, summary page.

[43] See CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[44] See Government Accountability Office, *Navy Shipbuilding[:] Past Performance Provides Valuable Lessons for Future Investments*, GAO-18-238SP, June 2018, p. 21. A graphic on page 21 shows a GAO finding that the government was financially responsible for shipbuilder deficiencies in 96% of the cases examined by GAO, and that the shipbuilder was financially responsible for shipbuilder deficiencies in 4% of the cases.

When a warranty is not included in the contract and the government pays later on to fix problems with earlier work, those payments can be very visible, which can invite critical comments from observers. But that does not mean that including a warranty in the contract somehow frees the government from paying to fix problems with earlier work. In a contract that includes a warranty, the government will indeed pay something to fix problems with earlier work—but it will make the payment in the less-visible (but still very real) form of the up-front charge for including the warranty, and that charge might be more than what it would have cost the government, under a contract without a warranty, to pay later on for fixing those problems.

From a cost standpoint, including a warranty in the contract might or might not be preferable, depending on the risk that there will be problems with earlier work that need fixing, the potential cost of fixing such problems, and the cost of including the warranty in the contract. The point is that the goal of avoiding highly visible payments for fixing problems with earlier work and the goal of minimizing the cost to the government of fixing problems with earlier work are separate and different goals, and that pursuing the first goal can sometimes work against achieving the second goal.[45]

DOD's guide on the use of warranties states the following:

> Federal Acquisition Regulation (FAR) 46.7 states that "the use of warranties is not mandatory." However, if the benefits to be derived from the warranty are commensurate with the cost of the warranty, the CO [contracting officer] should consider placing it in the contract. In determining whether a warranty is appropriate for a specific acquisition, FAR Subpart 46.703 requires the CO to consider the nature and use of the supplies and services, the cost, the administration and enforcement, trade practices, and reduced requirements. The rationale for using a warranty should be documented in the contract file....
>
> In determining the value of a warranty, a CBA [cost-benefit analysis] is used to measure the life cycle costs of the system with and without the warranty. A CBA is required to determine if the warranty will be cost beneficial. CBA is an economic analysis, which basically compares the Life Cycle Costs (LCC) of the system with and without the warranty to determine if warranty coverage will improve the LCCs. In general, five key factors will drive the results of the CBA: cost of the warranty + cost of warranty administration + compatibility with total program efforts + cost of overlap with Contractor support + intangible savings. Effective warranties integrate reliability, maintainability, supportability, availability, and life-cycle costs. Decision factors that must be evaluated include the state of the weapon system technology, the size of the warranted population, the likelihood that field performance requirements can be achieved, and the warranty period of performance.[46]

In response to a draft version of GAO's August 2019 report, the Navy stated

> As a part of the planning for the procurement of detail design and construction for FFG(X), the Navy determined that a guaranty, rather than a commercial-type warranty, will be

[45] It can also be noted that the country's two largest builders of Navy ships—General Dynamics (GD) and Huntington Ingalls Industries (HII)—derive about 60% and 96%, respectively, of their revenues from U.S. government work. (See General Dynamics, *2016 Annual Report*, page 9 of Form 10-K [PDF page 15 of 88]) and Huntington Ingalls Industries, *2016 Annual Report*, page 5 of Form 10-K [PDF page 19 of 134]). These two shipbuilders operate the only U.S. shipyards currently capable of building several major types of Navy ships, including submarines, aircraft carriers, large surface combatants, and amphibious ships. Thus, even if a warranty in a shipbuilding contract with one of these firms were to somehow mean that the government did not have pay under the terms of that contract—either up front or later on—for fixing problems with earlier work done under that contract, there would still be a question as to whether the government would nevertheless wind up eventually paying much of that cost as part of the price of one or more future contracts the government may have that firm.

[46] Department of Defense, *Department of Defense Warranty Guide*, Version 1.0, September 2009, accessed July 13, 2017, at https://www.acq.osd.mil/dpap/pdi/uid/docs/departmentofdefensewarrantyguide[1].doc.

> implemented for the program. As a part of the FFG(X) detail design and construction request for proposals [RFP] released on June 20, 2019, the Navy asked contractors to include a limit of liability of at least $5 million per ship and a guaranty period of 18 months beyond preliminary acceptance of each ship. Further, the solicitation allows offerors to propose as additional limit of liability amount beyond the required $5 million amount, up to and including an unlimited liability. This arrangement represents an appropriate balance between price considerations and risks, ensuring that the shipbuilder is accountable for the correction of defects that follow preliminary acceptance, while allowing each shipbuilder to use its own business judgement in proposing the value of the limit of liability. The Navy released the solicitation prior to this GAO recommendation and is unable to modify the current solicitation because it would cause an unacceptable delay to the FFG(X) program.
>
> To support the GAO recommendation to request pricing for an unlimited warranty, the Navy will request pricing for unlimited warranty before exercising the first ship option and evaluate the business case.[47]

Potential Industrial-Base Impacts of FFG(X) Program

Another issue for Congress concerns the potential industrial-base impacts of the FFG(X) program for shipyards and supplier firms in the context of other Navy and Coast Guard shipbuilding programs, including the Navy's Littoral Combat Ship (LCS), DDG-51 destroyer, and amphibious shipbuilding programs, and the Coast Guard's National Security Cutter (NSC) and Offshore Patrol Cutter (OPC) programs.

Two of the teams that competed for the FFG(X) program involved shipyards (F/MM and Austal USA) that are currently building LCSs, procurement of which ended in FY2019. With the FFG(X) contract having been awarded to F/MM, Austal USA and its associated supplier firms could face a downturn in workloads and employment levels as they work off their backlog of LCS-related work if this work is not replaced by work associated with building other Navy or Coast Guard ships.

The two other teams that competed for the FFG(X) program involved shipyards (GD/BIW and HII/Ingalls) that currently build DDG-51 destroyers and (in the case of HII/Ingalls) Navy amphibious ships. As discussed in the CRS report on the DDG-51 program, the Navy's FY2021 budget submission shows a programmed reduction in the DDG-51 procurement rate starting in FY2023, perhaps as a reflection of a potential change in the surface combatant force architecture.[48] A potential change in the Navy's amphibious ship force architecture might impact the types and quantities of amphibious ships being procured for the Navy.[49] Other things held equal, these two shipyards and their associated supplier firms could face a downturn in workloads and employment levels if the level of DDG-51-related work and (for HII/Ingalls) amphibious-ship-related work is reduced and not replaced by work associated with building other Navy or Coast Guard ships.

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[47] Government Accountability Office, *Guide Missile Frigate[:] Navy Has Taken Steps to Reduce Acquisition Risk, but Opportunities Exist to Improve Knowledge for Decision Makers*, GAO-19-512, August 2019 (revised September 5, 2019 to include an omitted page in the report section, [and] comments from the Department of Defense), pp. 44-45.

[48] See CRS Report RL32109, *Navy DDG-51 and DDG-1000 Destroyer Programs: Background and Issues for Congress*, by Ronald O'Rourke.

[49] See CRS Report R43543, *Navy LPD-17 Flight II and LHA Amphibious Ship Programs: Background and Issues for Congress*, by Ronald O'Rourke.

Legislative Activity for FY2021

Summary of Congressional Action on FY2021 Funding Request

Table 4 summarizes congressional action on the Navy's FY2021 funding request for the LCS program.

Table 4. Congressional Action on FY2021 Procurement Funding Request

Millions of dollars, rounded to nearest tenth.

		Authorization			Appropriation		
	Request	**HASC**	**SASC**	**Conf.**	**HAC**	**SAC**	**Conf.**
Funding	1,053.1						
(Procurement quantity)	*(1)*						

Source: Table prepared by CRS based on FY2021 Navy budget submission, committee and conference reports, and explanatory statements on the FY2021 National Defense Authorization Act and the FY2021 DOD Appropriations Act.

Notes: HASC is House Armed Services Committee; **SASC** is Senate Armed Services Committee; **HAC** is House Appropriations Committee; **SAC** is Senate Appropriations Committee; **Conf.** is conference agreement.

Appendix A. Navy Briefing Slides from July 25, 2017, FFG(X) Industry Day Event

This appendix reprints some of the briefing slides that the Navy presented at its July 25, 2017, industry day event on the FFG(X) program, which was held in association with the Request for Information (RFI) that the Navy issued on July 25, 2017, to solicit information for better understanding potential trade-offs between cost and capability in the FFG(X) design. The reprinted slides begin on the next page.

Slides from Navy FFG(X) Industry Day Briefing

Why FFG(X)?

Evolving threats in the global maritime environment drove the Navy to re-evaluate FF requirements and pursue a guided missile Frigate,

FFG(X)

To address these threats, the ship is intended to:

- Fully support Combatant and Fleet Commanders during conflict by
  - Supplementing fleet undersea and surface warfare capabilities
  - Operating independently in contested environments
  - Extending the fleet tactical grid
  - Hosting and controlling unmanned systems
- Relieve large surface combatants from stressing routine duties during operations other than war, providing a high/low mix of fleet capabilities

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What will FFG(X) be?

FFG(X) is envisioned as a multi-mission Small Surface Combatant intended to be capable of:

- Employing unmanned systems to penetrate and dwell in contested environments
- Establishing a local sensor network using multiple sensor platforms, both on-board and off-board
- Robustly defending itself in contested environments, including against raids by small boats
- Holding adversary warships at risk with over-the-horizon anti-ship missiles
- Performing anti-submarine warfare missions with active and passive undersea sensors
- Serving as a force multiplier to air-defense capable destroyers escorting logistics ships
- Providing electromagnetic sensing and targeting capabilities and contributing to force-level electromagnetic spectrum control
- Providing electromagnetic information exploitation capabilities and intelligence collection
- Conducting common surface combatant missions during operations other than war, such as presence missions, security cooperation activities, and humanitarian assistance/disaster relief support

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FFG(X) Program Schedule

- **Responses due 24 August 2017 at 1500**
- **Conceptual Design phase to mature parent designs to meet Navy requirement will award next calendar year**
  - Parent Design
  - US Shipyard
- **Government will provide *System Specifications* and *Government Furnished Information (GFI)* as part of the Conceptual Design RFP**
- **Full and Open Competition for Detail Design and Construction contract award in FY2020**
- **Notional procurement profile (for cost estimating purposes), starting in FY2020:**

1/1/2/2/2/2/2/2/2/2

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Objectives of the RFI

The **Navy** desires to:

- **Understand Industry's parent designs and their ability to integrate both the warfare system elements and the threshold requirements into the new FFG(X) design**
- **Understand the sensitivities to the parent design for integrating either the warfare systems or the threshold requirements**
- **Understand the drivers in non-recurring engineering, recurring engineering, production schedule, and operations and supports costs**

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Key Program Assumptions

The **Navy**…

- **Envisions a FY2020 competition that will consider existing parent designs for a Small Surface Combatant that can be modified to accommodate FFG(X) requirements**
- **Plans for the FFG(X) program to use the same crewing, training, and maintenance concepts as LCS**
  - Blue/Gold Crewing: 2 crews for 1 ship
  - Training: Train to Certify/Train to Qualify (T2C/T2Q)
  - Maintenance: Crew PMS and some O-Level Maintenance
- **Desires to drive down life cycle costs:**
  - The threshold manning requirement identified is the maximum acceptable manning value
  - Use common Navy systems across the radar, combat system, C4ISR systems, and launcher elements while encouraging hull, mechanical, and electrical system commonality with other US Navy platforms

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Key FFG(X) Attributes

The **Navy** considers the following tiers and their values to be the **minimum** acceptable level of performance for the corresponding FFG(X) attributes:

TIER	Attributes	Threshold
1	**Material Availability**	**> 0.64** (as defined by number of operational end items / total end items)
	Operational Availability	**> 0.72** (as defined by uptime **/ (uptime + downtime))**
	Service Life	**25 years**
	Vulnerability (as defined by the capability to withstand initial damage effects and to continue to perform primary missions)	**Grade A Shock Hardening** for Propulsion, Critical Systems, and Combat System Elements to retain full Air Defense and Propulsion capabilities
2	**Manning Accommodations**	**200 personnel crew max** (including all detachments)
	Range (minimum distance the ship can sail without replenishment when using all of its burnable fuel)	**3000 NM @ 16 kts**
	SWaP-C reservation for future Directed Energy and Active EA	**26 MT, 600 kW, 300 GPM**
3	Space, weight, power, and cooling **service life allowance**	**5%**
	Sustained Speed (as defined by the achievable speed at full-load displacement, normal trim, and clean bottom)	**28 kts at 80% MCR**

[RFI Table 1]

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FFG(X) Notional Warfare Systems

The following is a list of notional warfare systems that the **Navy** plans to provide as **Government Furnished Equipment** for the **FFG(X)**:

TIER	Warfare Systems
1	**C4I suite** (with accompanying HF/UHF/EHF/SATCOM antennas/CANES)
	COMBATSS-21 Mod Combat Management System (CMS) (Aegis derivative leveraging the common source library)
	Enterprise Air Surveillance Radar (EASR) 3 face fixed array (3x3x3 Radar Modular Assembly)
	MH-60R x 1
	Mk53 Decoy Launching System (Nulka)
	OTH Weapon with FCS (2x4) – canister launched
	SeaRAM Mk15 Mod 31
	***Self Defense Launcher Capability**
	SLQ-32(V)6 (SEWIP Blk II) – Note requirement in previous table for SWaP-C reservation for EA
	Tactical Cryptological System (TCS)
	UAV (1 x MQ-8C) or future similarly sized UAS

TIER	Warfare Systems
2	**7m RHIBs x 2**
	AN/SLQ-61 Light Weight Tow (LWT)
	AN/SQS-62 Variable Depth Sonar (VDS)
	AN/SQQ-89F Undersea Warfare / ASW Combat System
	Cooperative Engagement Capability (CEC)
	Integrate 360 degree EO/IR
	Mission Control System (MCS) (MD-4A)
	Mk110 57mm Gun (with ALaMO)
	Mk160 Gun Fire Control System (GFCS)
	Next Generation Surface Search Radar (NGSSR)
	Surface-to-Surface Missile Module (SSMM Longbow Hellfire)
	TB-37 Multi-Function Towed Array (MFTA)
	UPX-29 Identification Friend/Foe (IFF)

*Ability to support Evolved Sea Sparrow Missile Block 2 and/or Standard Missile-2 Active missiles

[RFI Table 2]

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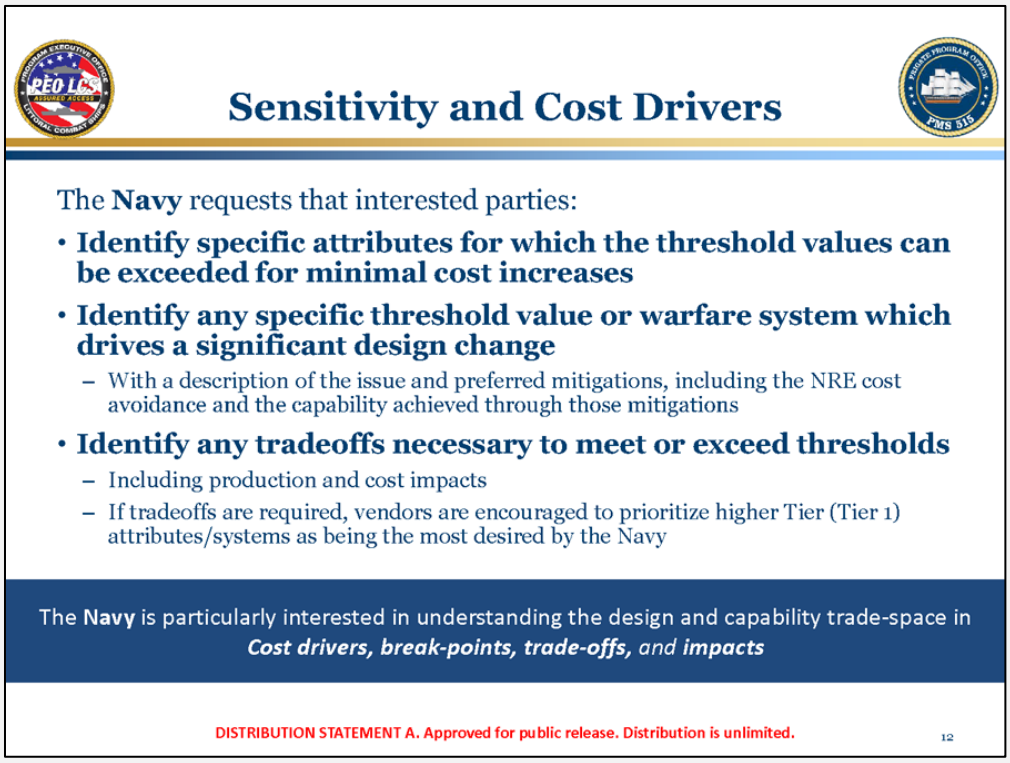

Source: Slides from briefing posted on July 28, 2017, at RFI: FFG(X) - US Navy Guided Missile Frigate Replacement Program, https://www.fbo.gov/index?s=opportunity&mode=form&tab=core&id=d089cf61f254538605cdec5438955b8e&_cview=0, accessed August 11, 2017.

Appendix B. Competing Industry Teams

This appendix presents additional background information on the industry teams competing for the FFG(X) program.

February 16, 2018, Press Report About Five Competing Industry Teams

A February 16, 2018, press report about the five competing industry teams reportedly competing for the FFG(X) program (i.e., the five industry teams shown in **Table 2**) stated the following:

> The Navy would not confirm how many groups bid for the [FFG(X)] work. At least one U.S.-German team that was not selected for a [conceptual] design contract, Atlas USA and ThyssenKrupp Marine Systems, told USNI News they had submitted for the [DD&C] competition....
>
> During last month's Surface Navy Association [annual symposium], several shipbuilders outlined their designs for the FFG(X) competition.
>
> **Austal USA**
>
> Shipyard: Austal USA in Mobile, Ala.
>
> Parent Design: Independence-class [i.e., LCS-2 class] Littoral Combat Ship
>
> One of the two Littoral Combat Ship builders, Austal USA has pitched an upgunned variant of the Independence-class LCS as both a foreign military sales offering and as the answer to the Navy's upgunned small surface combatant and then frigate programs. Based on the 3,000-ton aluminum trimaran design, the hull boasts a large flight deck and space for up to 16 Mk-41 Vertical Launching System (VLS) cells.
>
> **Fincantieri Marine Group**
>
> Shipyard: Fincantieri Marinette Marine in Marinette, Wisc.
>
> Parent Design: Fincantieri Italian FREMM
>
> As part of the stipulations of the FFG(X) programs, a contractor can offer just one design in the competition as a prime contractor but may also support a second bid as a subcontractor. Fincantieri elected to offer its 6,700-ton Italian Fregata europea multi-missione (FREMM) design for construction in its Wisconsin Marinette Marine shipyard, as well as partner with Lockheed Martin on its Freedom-class pitch as a subcontractor. The Italian FREMM design features a 16-cell VLS as well as space for deck-launched anti-ship missiles.
>
> **General Dynamics Bath Iron Works**
>
> Shipyard: Bath Iron Works in Bath, Maine
>
> Parent Design: Navantia Álvaro de Bazán-class F100 Frigate
>
> The 6,000-ton air defense guided-missile frigates fitted with the Aegis Combat System have been in service for the Spanish Armada since 2002 and are the basis of the Australian Hobart-class air defense destroyers and the Norwegian Fridtjof Nansen-class frigates. The Navantia partnership with Bath is built on a previous partnership from the turn of the century. The F100 frigates were a product of a teaming agreement between BIW, Lockheed Martin and Navantia predecessor Izar as part of the Advanced Frigate Consortium from 2000.

Huntington Ingalls Industries

Shipyard: Ingalls Shipbuilding in Pascagoula, Miss.

Parent Design: Unknown

Out of the competitors involved in the competition, HII was the only company that did not present a model or a rendering of its FFG(X) at the Surface Navy Association symposium in January. A spokeswoman for the company declined to elaborate on the offering when contacted by USNI News on Friday. In the past, HII has presented a naval version of its Legend-class National Security Cutter design as a model at trade shows labeled as a "Patrol Frigate."

Lockheed Martin

Shipyard: Fincantieri Marinette Marine in Marinette, Wisc.

Parent Design: Freedom-class [i.e., LCS-1 class] Littoral Combat Ship

Of the two LCS builders, Lockheed Martin is the first to have secured a foreign military sale with its design. The company's FFG(X) bid will have much in common with its offering for the Royal Saudi Navy's 4,000-ton multi-mission surface combatant. The new Saudi ships will be built around an eight-cell Mk-41 vertical launch system and a 4D air search radar. Lockheed has pitched several other variants of the hull that include more VLS cells.

"We are proud of our 15-year partnership with the U.S. Navy on the Freedom-variant Littoral Combat Ship and look forward to extending it to FFG(X)," said Joe DePietro, Lockheed Martin vice president of small combatants and ship systems in a Friday evening statement.

"Our frigate design offers an affordable, low-risk answer to meeting the Navy's goals of a larger and more capable fleet."[50]

May 28, 2019, Press Report About One Industry Team Deciding to Not Submit a Bid

On May 28, 2019, it was reported that one of the five industry teams that had been interested in the FFG(X) program had informed the Navy on May 23 that it had decided to not submit a bid for the program. The May 28, 2019, press report about this industry team's decision stated:

> Lockheed Martin won't submit a bid to compete in the design of the Navy's next-generation guided-missile (FFG(X)) frigate competition, company officials told USNI News on Tuesday [May 28].
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> The company elected to focus on its involvement developing the frigate combat system and other systems rather than forward its Freedom-class LCS design for the detailed design and construction contract Naval Sea Systems Command plans to issue this summer, Joe DePietro, Lockheed Martin vice president of small combatants and ship systems, told USNI News.
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> "We reviewed the entire program and obviously, given some of the stuff that has already happened that is outside of the contract for the program—that includes the designation of our combat management system, COMBATSS 21, derived off of Aegis; we have the

[50] Sam LaGrone and Megan Eckstein, "Navy Picks Five Contenders for Next Generation Frigate FFG(X) Program," *USNI News*, February 16, 2018. See also David B. Larter, "Navy Awards Design Contracts for Future Frigate," *Defense News*, February 16, 2018; Lee Hudson, "Navy Awards Five Conceptual Design Contracts for Future Frigate Competition," *Inside the Navy*, February 19, 2018.

> Mk-41 vertical launch system; the processing for our anti-submarine warfare area; advanced [electronic warfare] and platform integration," he said.
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> "As we evaluated all of those different areas, we determined not to pursue, as a prime contractor, the FFG(X) detailed design and construction."
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> The company informed the Navy on May 23 it would not join the other bidders for the hull design, two sources familiar with the notification told USNI News.
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> While the design passed two Navy reviews, the company told the service it felt the Freedom design would be stretched too far to accommodate all the capabilities required, one source told USNI News….
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> While Lockheed is moving away from leading a frigate team, the company will be heavily involved with whoever wins. The FFG(X)'s COMBATSS-21 Combat Management System will be derived from the company's Aegis Combat System, and Lockheed Martin makes the ship's vertical launch system.[51]

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[51] Sam LaGrone, "Lockheed Martin Won't Submit Freedom LCS Design for FFG(X) Contest," *USNI News*, May 28, 2019.