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Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress

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Summary

The aircraft carriers CVN-78, CVN-79, CVN-80, and CVN-81 are the first four ships in the Navy's new *Gerald R. Ford* (CVN-78) class of nuclear-powered aircraft carriers (CVNs). The Navy's proposed FY2021 budget requested $2,714.1 million (i.e., about $2.7 billion) in procurement funding for CVN-78 class ships, including $71.0 million for CVN-78, $997.5 million for CVN-80, and $1,645.6 million for CVN-81. Congress, as part of its action on the Navy's FY2021 budget, provided a total of $2,565.4 million (i.e., about $2.6 billion), including $71.0 million for CVN-78, $958.9 million for CVN-80, and $1,606.4 million for CVN-81.

CVN-78 (*Gerald R. Ford*) was procured in FY2008. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $13,316.5 million (i.e., about $13.3 billion) in then-year dollars. The ship was commissioned into service on July 22, 2017. The Navy is currently working to complete construction, testing, and certification of the ship's 11 weapons elevators and to correct other technical problems aboard the ship.

CVN-79 (*John F. Kennedy*) was procured in FY2013. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $11,397.7 million (i.e., about $11.4 billion) in then-year dollars. The ship is being built with an improved process that incorporates lessons learned from the construction of CVN-78. CVN-79 is scheduled for delivery to the Navy in September 2024.

CVN-80 (*Enterprise*) was procured in FY2018. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $12,321.3 million (i.e., about $12.3 billion) in then-year dollars. The ship is scheduled for delivery to the Navy in March 2028.

CVN-81 (*Doris Miller*) is treated in this report as a ship that was procured in FY2019, consistent with congressional action on the Navy's FY2019 budget. The Navy's FY2021 budget submission shows CVN-81 as a ship that was procured in FY2020. The Navy's FY2021 budget submission estimates the ship's procurement cost at $12,450.7 million (i.e., about $12.5 billion) in then-year dollars. The ship is scheduled for delivery to the Navy in February 2032.

CVN-80 and CVN-81 are being procured under a two-ship block buy contract that was authorized by Section 121(a)(2) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/P.L. 115-232 of August 13, 2018). The use of the two-ship block buy contract reduced the combined estimated procurement cost of the two ships. Oversight issues for Congress for the CVN-78 program include the following:

- the future aircraft carrier force level;
- the procurement of aircraft carriers after CVN-81;
- a delay in CVN-78's first deployment due to the need to complete work on the ship's weapons elevators and correct other technical problems aboard the ship;
- the potential impact of the COVID-19 pandemic on the execution of U.S. military shipbuilding programs, including the CVN-78 program;
- cost growth in the CVN-78 program, Navy efforts to stem that growth, and Navy efforts to manage costs so as to stay within the program's cost caps; and
- additional CVN-78 program issues that were raised in a January 2021 report from the Department of Defense's (DOD's) Director of Operational Test and Evaluation (DOT&E) and a June 2020 Government Accountability Office (GAO) report on DOD weapon systems.

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Introduction

This report provides background information and potential oversight issues for Congress on the *Gerald R. Ford* (CVN-78) class nuclear-powered aircraft carrier (CVN) aircraft carrier program. The Navy's proposed FY2021 budget requested $2,714.2 million (i.e., about $2.7 billion) in procurement funding for the program. Congress's decisions on the CVN-78 program could substantially affect Navy capabilities and funding requirements and the shipbuilding industrial base.

Background

Current Navy Aircraft Carrier Force

The Navy's current aircraft carrier force consists of 11 CVNs,[1] including 10 Nimitz-class ships (CVNs 68 through 77) that entered service between 1975 and 2009, and one Gerald R. Ford (CVN-78) class ship that was commissioned into service on July 22, 2017.[2]

Statutory Requirements for Numbers of Carriers and Carrier Air Wings

Requirement to Maintain Not Less Than 11 Carriers

10 U.S.C. 8062(b) requires the Navy to maintain a force of not less than 11 operational aircraft carriers.[3] The requirement for the Navy to maintain not less than a certain number of operational aircraft carriers was established by Section 126 of the FY2006 National Defense Authorization Act (H.R. 1815/P.L. 109-163 of January 6, 2006), which set the number at 12 carriers. The requirement was changed from 12 carriers to 11 carriers by Section 1011(a) of the FY2007 John Warner National Defense Authorization Act (H.R. 5122/P.L. 109-364 of October 17, 2006).[4]

[1] The Navy's last remaining conventionally powered carrier (CV), *Kitty Hawk* (CV-63), was decommissioned on January 31, 2009.

[2] The commissioning into service of CVN-78 on July 22, 2017, ended a period during which the carrier force had declined to 10 ships—a period that began on December 1, 2012, with the inactivation of the one-of-a-kind nuclear-powered aircraft carrier *Enterprise* (CVN-65), a ship that entered service in 1961.

[3] 10 U.S.C. 8062 was previously numbered as 10 U.S.C. 5062. It was renumbered as 10 U.S.C. 8062 by Section 807 of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/P.L. 115-232 of August 13, 2018), which directed a renumbering of sections and titles of Title 10 relating to the Navy and Marine Corps. (Sections 806 and 808 of P.L. 115-232 directed a similar renumbering of sections and titles relating to the Air Force and Army, respectively.)

[4] As mentioned in footnote 2, the carrier force dropped from 11 ships to 10 ships between December 1, 2012, when *Enterprise* (CVN-65) was inactivated, and July 22, 2017, when CVN-78 was commissioned into service. Anticipating the gap between the inactivation of CVN-65 and the commissioning of CVN-78, the Navy asked Congress for a temporary waiver of 10 U.S.C. 8062(b) to accommodate the period between the two events. Section 1023 of the FY2010 National Defense Authorization Act (H.R. 2647/P.L. 111-84 of October 28, 2009) authorized the waiver, permitting the Navy to have 10 operational carriers between the inactivation of CVN-65 and the commissioning of CVN-78.

Prohibition on Retiring Nuclear-Powered Aircraft Carriers Prior to Refueling

Section 1054 of the FY2021 National Defense Authorization Act (NDAA) (H.R. 6395/P.L. 116-283) amended 10 U.S.C. 8062 to create a new subsection (f) stating: " A nuclear powered aircraft carrier may not be retired before its first refueling."

Requirement to Maintain a Minimum of Nine Carrier Air Wings

10 U.S.C. 8062(e), which was added by Section 1042 of the FY2017 National Defense Authorization Act (S. 2943/P.L. 114-328 of December 23, 2016), requires the Navy to maintain a minimum of nine carrier air wings.[5]

Navy Force-Level Goal

Current 12-Carrier Force-Level Goal within 355-Ship Plan of December 2016

In December 2016, the Navy released a force-level goal for achieving and maintaining a fleet of 355 ships, including 12 aircraft carriers[6]—one more than the minimum of 11 carriers required by 10 U.S.C. 8062(b).

Given the time needed to build a carrier and the projected retirement dates of existing carriers, increasing the carrier force from 11 ships to 12 ships on a sustained basis would take a number of years.[7] Under the Navy's FY2020 30-year shipbuilding plan, carrier procurement would shift from 5-year centers (i.e., one carrier procured each five years) to 4-year centers after the procurement of CVN-82 in FY2028, and a 12-carrier force would be achieved on a sustained basis in the 2060s.[8]

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[5] 10 U.S.C. 8062(e) states the following:

> The Secretary of the Navy shall ensure that-
>
> (1) the Navy maintains a minimum of 9 carrier air wings until the earlier of-
>
> (A) the date on which additional operationally deployable aircraft carriers can fully support a 10th carrier air wing; or
>
> (B) October 1, 2025;
>
> (2) after the earlier of the two dates referred to in subparagraphs (A) and (B) of paragraph (1), the Navy maintains a minimum of 10 carrier air wings; and
>
> (3) for each such carrier air wing, the Navy maintains a dedicated and fully staffed headquarters.

[6] For more on the 355-ship force-level goal, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

[7] Procuring carriers on 3-year centers would achieve a 12-carrier force on a sustained basis by about 2030, unless the service lives of one or more existing carriers were substantially extended. Procuring carriers on 3.5-year centers (i.e., a combination of 3- and 4-year centers) would achieve a 12-carrier force on a sustained basis no earlier than about 2034, unless the service lives of one or more existing carriers were substantially extended. Procuring carriers on 4-year centers would achieve a 12-carrier force on a sustained basis by about 2063—almost 30 years later than under 3.5-year centers—unless the service lives of one or more existing carriers were substantially extended. (Source for 2063 date in relation to four-year centers: Congressional Budget Office (CBO), in a telephone consultation with CRS on May 18, 2017.)

[8] The projected size of the carrier force in the Navy's FY2020 30-year (FY2020-FY2049) shipbuilding plan reflected the Navy's now-withdrawn FY2020 budget proposal to not fund the RCOH for the aircraft carrier CVN-75 (Harry S. Truman), and to instead retire the ship around FY2024. With the withdrawal of this budget proposal, the projected size of the carrier force became, for the period FY2022-FY2047, one ship higher than what is shown in the Navy's FY2020 budget submission. The newly adjusted force-level projection, reflecting the withdrawal of the proposal to retire CVN-75 around FY2024, were as follows: The force is projected to include 11 ships in FY2020-FY2021, 12 ships in

December 9, 2020, Documents Presents Potential New Goal of 8 to 11 Large Carriers and Up to 6 Light Carriers

The Navy and the Department of Defense (DOD) since 2019 have been working to develop a new Navy force-level goal to replace the current 355-ship force-level goal. On December 9, 2020, the outgoing Trump Administration released a document that can be viewed as its own vision for future Navy force structure and/or a draft version of the FY2022 30-year Navy shipbuilding plan. The document presents an envisioned Navy force-level goal for achieving by 2045 a Navy with a more distributed fleet architecture, including 382 to 446 manned ships and 143 to 242 large unmanned vehicles (UVs). Within the total of 382 to 446 manned ships, the document calls for a total of 8 to 11 CVNs and 0 to 6 smaller aircraft carriers called light aircraft carriers (CVLs). The Navy does not currently operate CVLs. In establishing its force-level goal for the Navy, the Biden Administration can choose to adopt, revise, or set aside the December 9, 2020, document.

March 2021 Press Report About Potential Reduction in Aircraft Carrier Force

A March 10, 2021, press report stated

> The Pentagon is again considering a reduction in aircraft carrier force structure as part of the upcoming Fiscal Year 2022 budget submission to Congress, according to two sources familiar with the discussions.
>
> In order to meet a proposed $704 billion to $708 billion topline for the first Biden Defense Department budget—the Trump administration's FY 2022 budget proposed $722 billion—the Office of the Secretary of Defense is weighing how it could build in savings by reducing the carrier force, the two sources familiar with the ongoing internal discussion told USNI News on Wednesday [March 10]….
>
> The search for cost savings could include revisiting a 2019 Trump administration proposal to take aircraft carrier USS Harry S. Truman (CVN-75) out of the inventory rather than conduct a mid-life refit and refueling, a legislative source told USNI News.
>
> A separate source familiar with the carrier review said that, additionally, the entire scope of the shipbuilding budget was under scrutiny.
>
> The idea of retiring an active carrier has circulated on Capitol Hill to the point where House Armed Services seapower and projection forces ranking member Rep. Rob Wittman (R-Va.) asked a senior admiral on Wednesday if retiring an aircraft carrier ahead of the overhaul was a good idea.
>
> "In your best professional military judgment, do you believe—considering the current stress on the aircraft carrier force—that taking out an aircraft carrier from service just before its mid-life refueling would be a smart thing to do?" Wittman asked U.S. Indo-Pacific Command commander Adm. Phil Davidson on Wednesday.
>
> Davidson responded, "there is no capability that we have that can substitute for an aircraft carrier in my view. You can see by the strain of the deployments over the course of the last year that they are in high demand by all the combatant commanders, and sustaining that capability going forward in my view is critically important. I'm in support of the law which calls for the number of carriers in the United States."

FY2022-FY2024, 11 ships in FY2025-FY2026, 10 ships in FY2027, 11 ships in FY2028-FY2039, 10 ships in FY2040, 11 ships in FY2041, 10 ships in FY2042-FY2044, 11 ships in FY2045, 10 ships in FY2046-FY2047, 9 ships in FY2048, and 10 ships in FY2049.

> When asked about the exchange between Wittman and Davidson and if cutting carriers was a consideration, Pentagon spokesman John Kirby told USNI News on Wednesday that DoD would not comment on the budget ahead of its rollout.[9]

Incremental Funding Authority for Aircraft Carriers

In recent years, Congress has authorized DOD to use incremental funding for procuring certain Navy ships, most notably aircraft carriers.[10] Under incremental funding, some of the funding needed to fully fund a ship is provided in one or more years after the year in which the ship is procured.[11]

Aircraft Carrier Construction Industrial Base

All U.S. aircraft carriers procured since FY1958 have been built by Huntington Ingalls Industries/Newport News Shipbuilding (HII/NNS), of Newport News, VA. HII/NNS is the only U.S. shipyard that can build large-deck, nuclear-powered aircraft carriers. The aircraft carrier construction industrial base also includes roughly 2,000 supplier firms in 46 states.[12]

Gerald R. Ford (CVN-78) Class Program

Overview

The *Gerald R. Ford* (CVN-78) class carrier design (**Figure 1**, **Figure 2**, and **Table 3**) is the successor to the *Nimitz*-class carrier design. The *Ford*-class design uses the basic *Nimitz*-class hull form but incorporates several improvements, including features permitting the ship to generate more aircraft sorties per day, more electrical power for supporting ship systems, and features permitting the ship to be operated by several hundred fewer sailors than a *Nimitz*-class ship,

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[9] Sam LaGrone and Mallory Shelbourne, "Pentagon Mulling Aircraft Carrier Reduction as Part of FY 2022 Budget Review," *USNI News*, March 10 (updated March 11), 2021.

[10] The provisions providing authority for using incremental funding for procuring CVN-78 class carriers are as follows:

Section 121 of the FY2007 John Warner National Defense Authorization Act (H.R. 5122/P.L. 109-364 of October 17, 2006) granted the Navy the authority to use four-year incremental funding for CVNs 78, 79, and 80. Under this authority, the Navy could fully fund each of these ships over a four-year period that includes the ship's year of procurement and three subsequent years.

Section 124 of the FY2012 National Defense Authorization Act (H.R. 1540/P.L. 112-81 of December 31, 2011) amended Section 121 of P.L. 109-364 to grant the Navy the authority to use five-year incremental funding for CVNs 78, 79, and 80. Since CVN-78 was fully funded in FY2008-FY2011, the provision in practice originally applied to CVNs 79 and 80, although as discussed in the footnote to **Table 1**, the Navy made use of the authority in connection with an FY2020 reprogramming action that reprogrammed $86.0 million of funding into FY2012 for CVN-78.

Section 121 of the FY2013 National Defense Authorization Act (H.R. 4310/P.L. 112-239 of January 2, 2013) amended Section 121 of P.L. 109-364 to grant the Navy the authority to use six-year incremental funding for CVNs 78, 79, and 80. Since CVN-78 was fully funded in FY2008-FY2011, the provision in practice applies to CVNs 79 and 80.

Section 121(c) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/P.L. 115-232 of August 13, 2018) authorized incremental funding to be used for making payments under the two-ship block buy contract for the construction of CVN-80 and CVN-81. This provision does not limit the total number of years across which incremental funding may be used to procure either ship.

[11] For more on full funding and incremental funding, see CRS Report RL31404, *Defense Procurement: Full Funding Policy—Background, Issues, and Options for Congress*, by Ronald O'Rourke and Stephen Daggett, and CRS Report RL32776, *Navy Ship Procurement: Alternative Funding Approaches—Background and Options for Congress*, by Ronald O'Rourke.

[12] Source for figures of 2,000 supplier firms in 46 states: Jennifer Boykin, president of HII/NNS, as quoted in Marcus Weisgerber, "US Navy Places First 2-Carrier Order in Three Decades," *Defense One*, January 31, 2019.

reducing 50-year life-cycle operating and support (O&S) costs for each ship by about $4 billion compared to the *Nimitz*-class design, the Navy estimates. Navy plans call for procuring at least four Ford-class carriers—CVN-78, CVN-79, CVN-80, and CVN-81.

Figure 1. USS *Gerald R. Ford* (CVN-78)

Source: U.S. Cropped version of U.S. Navy photograph 170408-N-WZ792-198, showing CVN-78 on April 8, 2017. Accessed March 17, 2021, at https://www.navy.mil/Resources/Photo-Gallery/igphoto/2001728935/.

Figure 2. USS *Gerald R. Ford* (CVN-78)

Source: U.S. Navy photograph 200515-N-QI093-1151, showing CVN-78 on May 15, 2020, with the oiler *USNS Patuxent* (T-AO 201) alongside. Accessed March 17, 2021, at https://allhands.navy.mil/Media/Gallery/igphoto/2002340124/.

Figure 3. USS *Gerald R. Ford* (CVN-78)

Source: Cropped version of photograph accompanying Megan Eckstein, "Navy Removes Ford Carrier Program Manager, Citing Performance Over Time," *USNI News*, July 2, 2020. The caption credits the photograph to the U.S. Navy and states that it shows CVN-78 on June 4, 2020.

CVN-78 (Gerald R. Ford)

CVN-78, which was named *Gerald R. Ford* in 2007,[13] was procured in FY2008. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $13,316.5 million (i.e., about $13.3 billion) in then-year dollars. The ship was commissioned into service on July 22, 2017. The Navy is currently working to complete construction, testing, and certification of the ship's 11 weapons elevators and to correct other technical problems aboard the ship.

[13] §1012 of the FY2007 defense authorization act (H.R. 5122/P.L. 109-364 of October 17, 2006) expressed the sense of Congress that CVN-78 should be named for President Gerald R. Ford. On January 16, 2007, the Navy announced that CVN-78 would be so named. CVN-78 and other carriers built to the same design are consequently referred to as Ford (CVN-78) class carriers. For more on Navy ship names, see CRS Report RS22478, *Navy Ship Names: Background for Congress*, by Ronald O'Rourke.

CVN-79 (John F. Kennedy)

CVN-79, which was named *John F. Kennedy* on May 29, 2011,[14] was procured in FY2013. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $11,397.7 million (i.e., about $11.4 billion) in then-year dollars. The ship is being built with an improved shipyard fabrication and assembly process that incorporates lessons learned from the construction of CVN-78. The ship is scheduled for delivery to the Navy in September 2024.

CVN-80 (Enterprise)

CVN-80, which was named *Enterprise* on December 1, 2012,[15] was procured in FY2018. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $12,335.1 million (i.e., about $12.3 billion) in then-year dollars. The Navy's proposed FY2021 budget estimates the ship's procurement cost at $12,321.3 million (i.e., about $12.3 billion) in then-year dollars. The ship is scheduled for delivery to the Navy in March 2028.

CVN-81 (Doris Miller)

CVN-81 on January 20, 2020, was named *Doris Miller*, for an African American enlisted sailor who received the Navy Cross for his actions during the Japanese attack on Pearl Harbor on December 7, 1941.[16] CVN-81 is treated in this report as a ship that was procured in FY2019, consistent with congressional action on the Navy's FY2019 budget. The Navy's FY2021 budget submission shows CVN-81 as a ship that was procured in FY2020. Prior to the awarding of the two-ship block buy contract for CVN-80 and CVN-81 that is discussed in the next section, CVN-81 was scheduled to be procured in FY2023. The Navy's FY2021 budget submission estimates CVN-81's procurement cost at $12,450.7 million (i.e., about $12.5 billion) in then-year dollars. The ship is scheduled for delivery to the Navy in February 2032.

Two-Ship Block Buy Contract for CVN-80 and CVN-81

CVN-80 and CVN-81 are being procured under a two-ship block buy contract that was authorized by Section 121(a)(2) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/P.L. 115-232 of August 13, 2018). The provision permitted the Navy to add CVN-81 to the existing contract for building CVN-80 after DOD made certain certifications to Congress. DOD made the certifications on December 31, 2018, and the Navy announced the award of the contract on January 31, 2019.

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[14] See "Navy Names Next Aircraft Carrier USS John F. Kennedy," *Navy News Service*, May 29, 2011, accessed online on June 1, 2011, at http://www.navy.mil/search/display.asp?story_id=60686. See also Peter Frost, "U.S. Navy's Next Aircraft Carrier Will Be Named After The Late John F. Kennedy," *Newport News Daily Press*, May 30, 2011. CVN-79 is the second ship to be named for President John F. Kennedy. The first, CV-67, was the last conventionally powered carrier procured for the Navy. CV-67 was procured in FY1963, entered service in 1968, and was decommissioned in 2007.

[15] The Navy made the announcement of CVN-80's name on the same day that it deactivated the 51-year-old aircraft carrier CVN-65, also named *Enterprise*. ("Enterprise, Navy's First Nuclear-Powered Aircraft Carrier, Inactivated," *Navy News Service*, December 1, 2012; Hugh Lessig, "Navy Retires One Enterprise, Will Welcome Another," *Newport News Daily Press*, December 2, 2012.) CVN-65 was the eighth Navy ship named *Enterprise*; CVN-80 is to be the ninth.

[16] For further discussion of the naming of CVN-81 for Doris Miller, see CRS Report RS22478, *Navy Ship Names: Background for Congress*, by Ronald O'Rourke.

Compared to the estimated procurement costs for CVN-80 and CVN-81 in the Navy's FY2019 budget submission, the Navy estimated under its FY2020 budget submission that the two-ship block buy contract will reduce the cost of CVN-80 by $246.6 million and the cost of CVN-81 by $2,637.3 million, for a combined reduction of $2,883.9 million (i.e., about $2.9 billion).[17] (DOD characterized the combined reduction as "nearly $3 billion."[18]) Using higher estimated baseline costs for CVN-80 and CVN-81 taken from a December 2017 Navy business case analysis, the Navy estimated under its FY2020 budget submission that the two-ship contract will reduce the cost of CVN-80 by about $900 million and the cost of CVN-81 by about $3.1 billion, for a combined reduction of about $4.0 billion.[19] These figures are all expressed in then-year dollars, meaning dollars that are not adjusted for inflation. For additional background information on the two-ship block buy contract, see **Appendix A**.

Program Procurement Cost Cap

Congress has established and subsequently amended procurement cost caps for CVN-78 class aircraft carriers.[20]

Program Procurement Funding

Table 1 shows procurement funding for CVNs 78, 79, 80, and 81 through FY2028, the final year of funding programmed for CVN-81, under the Navy's FY2021 budget submission. As shown in

[17] Source: CRS calculation based on costs for single-ship purchases as presented in Navy's FY2019 budget submission and costs for two-ship purchase as presented in the Navy's FY2020 budget submission.

[18] Source: Navy information paper on estimated cost savings of two-ship carrier buy provided to CRS by Navy Office of Legislative Affairs on June 20, 2019.

[19] Navy information paper provided to CRS by Navy Office of legislative Affairs on June 20, 2019.

[20] The provisions that established and later amended the cost caps are as follows:

Section 122 of the FY2007 John Warner National Defense Authorization Act (H.R. 5122/P.L. 109-364 of October 17, 2006) established a procurement cost cap for CVN-78 of $10.5 billion, plus adjustments for inflation and other factors, and a procurement cost cap for subsequent Ford-class carriers of $8.1 billion each, plus adjustments for inflation and other factors. The conference report (H.Rept. 109-702 of September 29, 2006) on P.L. 109-364 discusses Section 122 on pages 551-552.

Section 121 of the FY2014 National Defense Authorization Act (H.R. 3304/P.L. 113-66 of December 26, 2013) amended the procurement cost cap for the CVN-78 program to provide a revised cap of $12,887.0 million for CVN-78 and a revised cap of $11,498.0 million for each follow-on ship in the program, plus adjustments for inflation and other factors (including an additional factor not included in original cost cap).

Section 122 of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015) further amended the cost cap for the CVN-78 program to provide a revised cap of $11,398.0 million for each follow-on ship in the program, plus adjustment for inflation and other factors, and with a new provision stating that, if during construction of CVN-79, the Chief of Naval Operations determines that measures required to complete the ship within the revised cost cap shall result in an unacceptable reduction to the ship's operational capability, the Secretary of the Navy may increase the CVN-79 cost cap by up to $100 million (i.e., to $11.498 billion). If such an action is taken, the Navy is to adhere to the notification requirements specified in the cost cap legislation.

Section 121(a) of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017) further amended the cost cap for the CVN-78 program to provide a revised cap of $12,568.0 million for CVN-80 and subsequent ships in the program, plus adjustment for inflation and other factors. (The cap for CVN-79 was kept at $11,398.0 million, plus adjustment for inflation and other factors.) The provision also amended the basis for adjusting the caps for inflation, and excluded certain costs from being counted against the caps.

Section 121 of the FY2020 National Defense Authorization Act (S. 1790/P.L. 116-92 of December 20, 2019) further amended the cost cap for the CVN-78 program to provide revised caps of $13,224.0 million for CVN-78, $11,398.0 million for CVN–79, $12,202.0 million for CVN–80, and $12,451.0 million for CVN–81. The provision directs the Navy to exclude from these figures costs for CVN–78 class battle spares, interim spares, and increases attributable to economic inflation after December 1, 2018.

the table, the Navy's proposed FY2021 budget requested $2,714.1 million (i.e., about $2.7 billion) in procurement funding for CVN-78 class ships, including $71.0 million for CVN-78, $997.5 million for CVN-80, and $1,645.6 million for CVN-81.

Table 1. Procurement Funding for CVNs 78, 79, 80, and 81 Through FY2028

(Millions of then-year dollars, rounded to nearest tenth)

FY	CVN-78	CVN-79	CVN-80	CVN-81	Total
FY01	21.7 (AP)	0	0	0	21.7
FY02	135.3 (AP)	0	0	0	135.3
FY03	395.5 (AP)	0	0	0	395.5
FY04	1,162.9 (AP)	0	0	0	1,162.9
FY05	623.1 (AP)	0	0	0	623.1
FY06	618.9 (AP)	0	0	0	618.9
FY07	735.8 (AP)	52.8 (AP)	0	0	788.6
FY08	2,685.0 (FF)	123.5 (AP)	0	0	2,808.5
FY09	2,687.0 (FF)	1,210.6 (AP)	0	0	3,895.2
FY10	851.3 (FF)	482.9 (AP)	0	0	1,334.2
FY11	1,848.1 (FF)	902.5 (AP)	0	0	2,677.7
FY12	86.0 (FF)**	554.8 (AP)	0	0	554.8
FY13	0	491.0 (FF)	0	0	491.0
FY14	588.1 (CC)	917.6 (FF)	0	0	1,505.7
FY15	663.0 (CC)	1,219.4 (FF)	0	0	1,882.4
FY16	123.8 (CC)	1,569.5 (FF)	862.4 (AP)	0	2,555.7
FY17	0	1,241.8 (FF)	1,370.8 (AP)	0	2,612.6
FY18	20.0 (CC)	2,557.4 (FF)	1,569.6 (FF)	0	4,147.0
FY19	0	0	930.2 (FF)	643.0 (FF)	1,573.2
FY20	0	0	1,062.0 (FF)	1,214.5 (FF)	2,276.5
FY21 (requested)	*71.0 (CC)*	*0*	*997.5 (FF)*	*1,645.6 (FF)*	*2,714.1*
FY22 (programmed)	*0*	*74.0 (CC)*	*1,014.1 (FF)*	*1,307.0 (FF)*	*2,395.1*
FY23 (programmed)	*0*	*0*	*1,166.1 (FF)*	*760.0 (FF)*	*1,926.1*
FY24 (programmed)	*0*	*0*	*1,047.9 (FF)*	*667.0 (FF)*	*1,714.9*
FY25 (programmed)	*0*	*0*	*2,300.6 (FF)*	*591.0 (FF)*	*2,891.6*
FY26 (projected)	*0*	*0*	*0*	*2,171.0 (FF)*	*2,171.0*
FY27 (projected)	*0*	*0*	*0*	*1,851.0 (FF)*	*1,851.0*
FY28 (projected)	*0*	*0*	*0*	*1,600.7 (FF)*	*1,600.7*
Total	**13,316.5**	**11,397.7**	**12,321.3**	**12,450.7**	**49,486.2**

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

Notes: Figures may not add due to rounding. "AP" is advance procurement funding; "FF" is full funding; "CC" is cost-to-complete funding (i.e., funding to cover cost growth), which is sometimes abbreviated in Navy documents as CTC. The funding figures shown in the CVN-78 column reflect reprogramming under the FY2021 budget submission of $161.5 million of additional funding into FY2009, FY2011, and FY2012. Regarding the ** notation for the FY2012 funding figure for CVN-78, even though FY2012 is after FY2011 (CVN-78's original final year of full funding), the Navy characterizes the $86.0 million reprogrammed into FY2012 as full funding rather than cost-to-complete funding on the grounds that in the years since FY2011, as discussed earlier in this report (see footnote 10), the authority to use incremental funding for procuring aircraft carriers has been expanded by Congress to permit more than the four years of incremental funding that were permitted at the time that CVN-78 was initially funded.

Changes in Estimated Unit Procurement Costs Since FY2008 Budget

Table 2 shows changes in the estimated procurement costs of CVNs 78, 79, 80, and 81 since the budget submission for FY2008—the year of procurement for CVN-78.

Table 2. Changes in Estimated Procurement Costs of CVNs 78, 79, 80, and 81

(As shown in FY2008-FY2020 budgets, in millions of then-year dollars)

Budget	CVN-78		CVN-79		CVN-80		CVN-81	
	Est. proc. cost	Scheduled FY of proc.	Est. proc. cost	Scheduled FY of proc.	Est. proc. cost	Scheduled FY of proc.	Est. proc. cost	Scheduled FY of proc.
FY08	10,488.9	FY08	9,192.0	FY12	10,716.8	FY16	n/a	FY21
FY09	10,457.9	FY08	9,191.6	FY12	10,716.8	FY16	n/a	FY21
FY10	10,845.8	FY08	n/a	FY13	n/a	FY18	n/a	FY23
FY11	11,531.0	FY08	10,413.1	FY13	13,577.0	FY18	n/a	FY23
FY12	11,531.0	FY08	10,253.0	FY13	13,494.9	FY18	n/a	FY23
FY13	12,323.2	FY08	11,411.0	FY13	13,874.2	FY18	n/a	FY23
FY14	12,829.3	FY08	11,338.4	FY13	13,874.2	FY18	n/a	FY23
FY15	12,887.2	FY08	11,498.0	FY13	13,874.2	FY18	n/a	FY23
FY16	12,887.0	FY08	11,347.6	FY13	13,472.0	FY18	n/a	FY23
FY17	12,887.0	FY08	11,398.0	FY13	12,900.0	FY18	n/a	FY23
FY18	12,907.0	FY08	11,377.4	FY13	12,997.6	FY18	n/a	FY23
FY19	12,964.0	FY08	11,341.4	FY13	12,601.7	FY18	15,088.0	FY23
FY20	13,084.0	FY08	11,327.4	FY13	12,335.1	FY18	12,450.7	FY19
FY21	13,316.5	FY08	11,397.7	FY13	12,321.3	FY18	12,450.7	FY19
Annual % change								
FY08 to FY09	-0.3		0%		0%		n/a	
FY09 to FY10	+3.7		n/a		n/a		n/a	
FY10 to FY11	+6.3		n/a		n/a		n/a	
FY09 to FY11					+26.7%			
FY11 to FY12	0%		-1.5%		-0.1%		n/a	
FY12 to FY13	+6.9%		+11.3%		+2.8%		n/a	
FY13 to FY14	+4.1%		-0.6%		0%		n/a	
FY14 to FY15	+0.5%		+1.4%		0%		n/a	
FY15 to FY16	0%		-1.3%		-2.9%		n/a	
FY16 to FY17	0%		+0.4%		-4.2%		n/a	
FY17 to FY18	+0.2%		-0.2%		+0.7%		n/a	
FY18 to FY19	+0.4%		-0.3%		-3.0%		n/a	
FY19 to FY20	+0.9%		-0.1%		-2.1%		-17.5%	
FY20 to FY21	+1.8%		+0.6%		-0.1%		0%	
Cumulative % change through FY21								
Since FY08	+27.0%		+24.0%		+15.0%		n/a	
Since FY13	+8.1%		-0.1%		-11.2%		n/a	
Since FY18	+3.2%		+0.2%		-5.2%		n/a	
Since FY19	+2.7%		+0.5%		-2.2%		-17.5%	

Source: Table prepared by CRS based on FY2008-FY2020 Navy budget submissions. n/a means not available.

Notes: The FY2010 budget submission did not show estimated procurement costs or scheduled years of procurement for CVNs 79 and 80. The scheduled years of procurement for CVNs 79 and 80 shown here for the

FY2010 budget submission are inferred from the shift to five-year intervals for procuring carriers that was announced by Secretary of Defense Gates in his April 6, 2009, news conference regarding recommendations for the FY2010 defense budget.

Issues for Congress for FY2021

Future Aircraft Carrier Force Level

One issue for Congress concerns the future aircraft carrier force level. Decisions on this issue could have implications for the service lives of existing aircraft carriers and/or plans for procuring new aircraft carriers. The future aircraft carrier force level has been a frequent matter of discussion over the years, and (correctly or not) is often the starting point or the center of broader discussions over the future size and composition of the Navy. Factors involved in discussions about the future aircraft carrier force level include but are not limited to the following:

- the capabilities and costs (including procurement costs and life-cycle operation and support [O&S] costs) of aircraft carriers and their embarked air wings, and how those capabilities and costs compare to those of other U.S. military forces;
- the prospective survivability of aircraft carriers in conflicts against adversaries (such as China) with highly capable anti-ship missiles;
- the numbers of carriers needed to support policymaker-desired levels of day-to-day aircraft carrier forward presence in various regions around the world; and
- the utility of carriers for purposes other than high-end combat, including deterrence of potential regional adversaries, reassurance of allies and partners, signaling U.S. commitment and resolve, and noncombat operations such as humanitarian assistance/disaster response (HA/DR) operations.

As discussed earlier, the December 9, 2020, shipbuilding document submitted by the outgoing Trump Administration called for a future fleet with 8 to 11 CVNs and 0 to 6 smaller aircraft carriers called light aircraft carriers (CVLs). As also discussed earlier, a March 2021 press report stated that the Biden Administration is considering a reduction in aircraft carrier force structure as part of its FY2022 budget submission. A reduction in the planned number of CVNs could lead to Navy proposals for one or more of the following:

- accelerated retirements for one or more Nimitz-class carriers that have already received their mid-life nuclear refueling overhauls (which are called Refueling Complex Overhauls, or RCOHs);
- the cancellation of one or more planned RCOHs for Nimitz-class carriers that have not yet received RCOHs, and the consequent early retirement of one or more of these ships;
- a deferral or cancellation of the procurement of CVN-82, which under the Navy's FY2020 30-year shipbuilding plan was scheduled for FY2028; and/or
- the deferral or cancellation of the construction of CVN-81, which could require modifying the current two-ship construction contract for CVN-80 and CVN-81.

Procurement of Aircraft Carriers After CVN-81

A related issue for Congress concerns the procurement of aircraft carriers after CVN-81. The question of whether the Navy should shift at some point from procuring CVNs like the CVN-78

class to procuring smaller and perhaps nonnuclear-powered aircraft carriers has been a recurrent matter of discussion and Navy study over the years, and is currently an active discussion in the Navy.

The Navy's FY2020 30-year shipbuilding plan calls for procuring the next carrier in FY2028, and for that carrier to be a CVN, which would make it CVN-82. As discussed earlier, the December 9, 2020, Navy force structure and shipbuilding document submitted by the outgoing Trump Administration calls for a total of 8 to 11 CVNs and 0 to 6 smaller aircraft carriers called light aircraft carriers (CVLs). The 30-year shipbuilding profile presented in the December 9, 2020, document includes the projected procurement of an aircraft carrier in FY2028.

The Navy does not currently operate CVLs. As discussed in another CRS report, however, the Navy in recent years has experimented with the concept of using an LHA-type amphibious assault ship with an embarked group of F-35B Joint Strike Fighters as a CVL.[21] A February 1, 2021, press report states

> The Navy's engineering community has already started conducting light carrier design and engineering studies, even as the Navy and the joint force still consider whether they'd even want to invest in a CVL to supplement supercarriers to bring more distributed capability to the fleet for less cost.
>
> The idea of a light carrier resurfaced last summer as a Pentagon-led Future Naval Force Study was nearing its completion. The idea hadn't appeared in Navy and Marine Corps plans, but then-Defense Secretary Mark Esper had a growing interest in the topic as he sought ways to keep future shipbuilding and sustainment costs down and as he worried about the Navy's ability to conduct maintenance on its nuclear-powered aircraft carriers at Navy-run public shipyards.
>
> The FNFS and the plan it produced, Battle Force 2045, ultimately recommended between zero and six light carriers and noted much more study would need to be done.
>
> That work is already happening at Naval Sea Systems Command within the engineering and logistics directorate (SEA 05).
>
> Rear Adm. Jason Lloyd, the SEA 05 commander and deputy commander for ship design, integration and engineering, said last week that his Cost Engineering and Industrial Analysis team has been studying different options to understand what operational utility the Navy would get out of each design and for what cost compared to the Ford-class carrier, "and then let the operators really, and the Navy, decide, hey, do we want that capability for that cost?"
>
> "We have looked at an America-class possibility,[22] we have looked at a Ford-class-light,[23] we've looked at various different options and done cost studies on all those options. There are also capabilities studies on all those options," Lloyd said last week while speaking at a virtual event hosted by the American Society of Naval Engineers.[24]

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

[22] This is a reference to a CVL whose design is based on that of the America (LHA-6) class amphibious assault ship.

[23] This is a reference to a carrier whose design is similar to that of the CVN-78 design, but with some of the CVN-78 design's features reduced or removed, resulting in a ship whose procurement cost and capability are less than that of the CVN-78 design.

[24] Megan Eckstein, "Light Carrier Studies Already Underway As Navy Considers Role for CVLs in Future Fleet," *USNI News*, February 1, 2021. See also Joseph Trevithick, "Navy Looking At America And Ford Class Derivatives In New Light Aircraft Carrier Studies," *The Drive*, February 2, 2021.

Advocates of smaller carriers traditionally have argued that they are individually less expensive to procure, that the Navy might be able to employ competition between shipyards in their procurement (something that the Navy cannot do with large-deck, nuclear-powered carriers like the CVN-78 class, because only one U.S. shipyard, HII/NNS, can build aircraft carriers of that size), and that today's aircraft carriers concentrate much of the Navy's striking power into a relatively small number of expensive platforms that adversaries could focus on attacking in time of war.

Supporters of CVNs traditionally have argued that smaller carriers, though individually less expensive to procure, are less cost-effective in terms of dollars spent per aircraft embarked or aircraft sorties that can be generated; that it might be possible to use competition in procuring certain materials and components for large-deck, nuclear-powered aircraft carriers; and that smaller carriers, though perhaps affordable in larger numbers, would be individually less survivable in time of war than CVNs.

Section 128(d) of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015) required the Navy to submit a report on potential requirements, capabilities, and alternatives for the future development of aircraft carriers that would replace or supplement the CVN-78 class aircraft carrier. The report, which was conducted for the Navy by the RAND Corporation, was delivered to the congressional defense committees in classified form in July 2016. An unclassified version of the report was then prepared and issued in 2017 as a publicly released RAND report.[25] The question of whether to shift to smaller aircraft carriers was also addressed in three studies on future fleet architecture that were required by Section 1067 of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015).

Delay in CVN-78's Deployment Due to Weapon Elevators and Other Challenges

Overview

Another oversight issue for Congress concerns a delay in CVN-78's first deployment due to the need to complete the construction, testing, and certification of the ship's weapons elevators and to correct other technical problems aboard the ship. Challenges in completing the construction, testing, and certification of CVN-78's weapon elevators were first reported in November 2018,[26] and the issue has been a matter of continuing oversight attention since then.

Weapons Elevators

The ship's 11 weapons elevators—referred to as Advanced Weapons Elevators (AWEs)—move missiles and bombs from the ship's weapon magazines up to the ship's flight deck, so that they can be loaded onto aircraft that are getting ready to take off from the ship. A lack of working weapons elevators can substantially limit an aircraft carrier's ability to conduct combat operations. The Navy has struggled since November 2018 to meet promises it has repeatedly made to the defense oversight committees to get the elevators completed, tested, and certified. For much of 2019, the Navy continued to report that two of the 11 weapon elevators were

[25] Bradley Martin and Michael McMahon, *Future Aircraft Carrier Options*, Santa Monica, CA, RAND Corporation, 2017, 87 pp.

[26] See Anthony Capaccio, "U.S. Navy's Costliest Carrier Was Delivered Without Elevators to Lift Bombs," *Bloomberg*, November 2, 2018.

completed, tested, and certified.[27] On October 23, 2019, the Navy reported that the figure had increased to four of 11.[28] On April 22, 2020, the Navy announced that the fifth elevator had been certified, that the sixth was scheduled to be certified in the fourth quarter of FY2020, and that the remaining five were scheduled to be certified by the time that the ship undergoes Full Ship Shock Trials (FSSTs) in the third quarter of FY2021.[29] On July 23, 2020, the Navy announced that the sixth elevator had been certified.[30] In November 2020, it was reported that the seventh elevator was scheduled to be certified before the end of calendar year 2020, and that the remaining four would be completed by the end of April 2021.[31] On March 16, 2021, it was reported that seventh elevator had been delivered in early March, that the eighth elevator was in testing and was scheduled to be delivered in April, that work on all the elevators considered together was 93% or 94% complete, and that the remaining three elevators would be completed during 2021.[32] On

[27] Sam LaGrone, "Carrier Ford Will Only Have Two Weapon Elevators Ready When it Leaves Shipyard," *USNI News*, October 9, 2019. See also Anthony Capaccio, "On Costliest U.S. Warship Ever, Navy Can't Get Munitions on Deck," *Bloomberg*, July 30, 2019. (The article was also published by *Bloomberg* with the title "Flawed Elevators on $13 Billion Carrier Miss Another Deadline.") Ben Werner, "Navy Says More Experts Coming to Work Ford Carrier Elevator Delays," *USNI News*, July 5, 2019; Navy Research, Development and Acquisition Public Affairs Office, "Navy Full Court Press on USS Gerald R. Ford Weapons Elevators," *Navy News Service*, July 1, 2019; Mark D. Faram, "The Navy's New Plan to Fix Ford's Elevators Failures," *Navy Times*, July 1, 2019; Paul McLeary, "Navy Calls In Outsiders To Fix Troubled Ford Carrier," *Breaking Defense*, July 1, 2019; Ben Werner and Sam LaGrone, "USS Gerald R. Ford Weapons Elevator Certifications Will Extend Pat October," USNI News, May 29, 2019. See also Paul McLeary, "Will Trump Fire SecNav? Super Carrier USS Ford Suffers New Setback," *Breaking Defense*, May 29, 2019; Rich Abott, "Ford Elevator Work Prioritized And Extending Past October," *Defense Daily*, June 3, 2019; Megan Eckstein, "Navy Building a Land-Based Test Site for Ford-Class Weapons Elevators, But Timing Won't Help CVN-78," *USNI News*, May 31, 2019.

For earlier press reports, see Anthony Capaccio, "U.S. Navy's Costliest Carrier Was Delivered Without Elevators to Lift Bombs," *Bloomberg*, November 2, 2018; Anthony Capaccio, "Flawed Bomb Elevators Leave Inhofe Leery of Buying Two Carriers," *Bloomberg*, December 5, 2019; Megan Eckstein, "SECNAV to Trump: Ford Carrier Weapons Elevators Will Be Fixed by Summer, or 'Fire Me,'" *USNI News*, January 8, 2019; USS Gerald R. Ford Public Affairs, "USS Gerald R. Ford Accepts First Advanced Weapons Elevator," *Navy News Service*, January 16, 2019; Christopher Woody, "The Navy's Newest Aircraft Carrier Got a Long-Missing Piece of Gear in December, Helping to Solve a Problem the Navy Secretary Has Bet His Job on Fixing," *Business Insider*, January 20, 2019; Richard Sisk, "Navy Finally Has One Weapons Elevator Working on Its Newest Carrier," *Military.com*, January 22, 2019; Mark D. Faram, "Once Beleaguered by Critics, the Ford Gets a Lift," *Navy Times*, January 23, 2019; USS Gerald R. Ford (CVN 78) Public Affairs, "USS Gerald R. Ford Accepts Second Advanced Weapons Elevator," *Navy News Service*, March 6, 2019; Mark D. Faram, "Why the Once-Maligned Flattop Ford Is Finally Getting a Lift (or 11)," *Navy Times*, March 7, 2019; Rich Abott, "Carrier Elevator Test Site Will Procure New Elevator, Ford Accepts Second Elevator," *Defense Daily*, March 7, 2019; Rich Abott, "Navy To Build Land-Based Carrier Elevator Test Site," *Defense Daily*, February 21, 2019.

[28] Wesley Morgan, "Navy Secretary Accuses Congressional Critics of 'Disinformation' on Ford Carrier," *Politico Pro*, October 23, 2019. See also Sam LaGrone, "Carrier Ford May Not Deploy Until 2024, 3rd Weapons Elevator Certified," *USNI News*, October 22, 2019; Anthony Capaccio, "Trump Lets Navy's Chief Off the Hook Over an Offer to 'Fire Me,'" *Bloomberg*, November 2, 2019.

[29] Program Executive Office Aircraft Carriers Public Affairs, "Fifth Advanced Weapons Elevator certified aboard USS Gerald R. Ford (CVN 78)," *Navy News Service*, April 22, 2020. See also Megan Eckstein, "Ford's 5th Weapons Elevator Done With Testing; All 11 Should Be Done By Next Summer's Shock Trials," *USNI News*, April 16, 2020.

On January 16, 2020, a Navy official reportedly stated that work on all 11 elevators will be completed by May 2021, although the official acknowledged that there is some risk in that schedule. (Mallary Shelbourne, "Navy Confident CVN-78 Will Have All Weapons Elevators by May 2021," *Inside Defense*, January 16, 2020.)

[30] Gina Harkins, "Supercarrier Ford Could Soon Have More Than Half of Its Weapons Elevators Working," *Military.com*, June 19, 2020.

[31] Mallory Shelbourne, "USS Gerald R. Ford Making Steady Progress Ahead of Deployment," *USNI News*, November 24, 2020.

[32] Michael Fabey, "US Navy Reports Progress on Key Carrier Ford Systems," *Jane's Navy International*, March 16, 2021; Megan Eckstein, "As USS Gerald R. Ford Nears Shock Trials, Carrier Remains Busy With Testing, Fleet

March 23, 2021, Navy Admiral John Aquilino testified that 9 of the 11 elevators had been "repaired."[33]

The Navy states that lessons learned in building, testing, and certifying CVN-78's AWEs will be applied to the AWEs of subsequent CVN-78 class carriers.[34] In November 2020, it was reported that HII/NNS had formed a single team to fix and install the elevators on both CVN-78 and CVN-79.[35]

Other Technical Challenges

In addition to challenges in building, testing, and certifying the ship's weapon elevators, the Navy reportedly has been working to address problems with other systems on the ship, including its propulsion and electrical systems. Technical issues regarding the weapon elevators and other ship systems have delayed the ship's first deployment to 2022 at the earliest, which would be about five years after the ship was commissioned into service.[36] The delay in the ship's first deployment is lengthening a period during which the Navy is attempting to maintain policymaker-desired levels of carrier forward deployments with its 10 other carriers—a situation that can lead to operational strains on those 10 carriers and their crews.

Change in Program Manager

A July 2, 2020, press report stated

> The Navy removed its program manager for the first-in-class USS Gerald R. Ford (CVN-78), as Navy acquisition chief James Geurts looks to boost performance in the new carrier program.
>
> Capt. Ron Rutan has been moved from the program office to the Naval Sea Systems (NAVSEA) staff, and Capt. Brian Metcalf has taken over the program office. Metcalf previously served as the San Antonio-class amphibious transport dock (LPD-17) program manager and was working as the executive assistant to the commander of NAVSEA prior to his reassignment to the CVN-78 program office (PMS 378).
>
> "Readiness of USS Gerald R. Ford (CVN-78) is the Navy's top priority, and the progress the team made during the Post Shakedown Availability (PSA) met requirements while the subsequent eight months of CVN 78's post-delivery test and trials (PDT&T) period has been impressively ahead of plan. Even in the face of a global pandemic, the team has kept a lightning pace, and we will continue to do so, for our Navy and our nation, until USS

Support," *USNI News*, March 12, 2021. See also Kara Dixon, "USS Gerald R. Ford Moving Toward Completion of Post-Delivery Tests and Trials, *WAVY.com*, March 10, 2021.

[33] See Rich Abott, "Aquilino Says Nine Of 11 Ford Elevators Finished," *Defense Daily*, March 23, 2021; Aidan Quigley, "Aquilino: Ford 'Through' Technological Challenges, All But Two Elevators Finished," *Inside Defense*, March 23, 2021.

[34] See, for example, David B. Larter, "US Navy Makes Progress on Aircraft Carrier Ford's Bedeviled Weapons Elevators," *Defense News*, July 23, 2020; Mallory Shelbourne, "Navy Verifies USS Gerald R. Ford's Sixth Advanced Weapons Elevator," *USNI News*, July 23, 2020; Rich Abott, "Navy Certifies Second [Lower-Stage] Ford Magazine Elevator," *Defense Daily*, July 23, 2020; Gina Harkins, "Navy Carrier Ford Now Has 6 Working Weapons Elevators," *Military.com*, July 24, 2020.

[35] Michael Fabey, "Newport News Shipbuilding Forms One Team for Ford-class Weapons Elevators," *Jane's*, November 23, 2020.

[36] An October 25, 2019, press report stated that Navy officials were "taking a hard look at what's next and if there's enough time for Ford to meet remaining milestones and necessary to deploy sometime in 2022—which as of now is still the target…." (Mark D. Faram, "Carrier Ford Underway For Tests as Navy Mulls Future Schedule," *Defense & Aerospace Report*, October 25, 2019.)

> Gerald R. Ford completes her post-delivery obligations and is fully available and ready for tasking by the Fleet," NAVSEA spokesman Rory O'Connor told USNI News.
>
> Still, he said, "with 10 months left in PDT&T, followed by full-ship shock trials in [Fiscal Year 2021], we must ensure that the team takes the opportunity to recharge and allow for fresh eyes on upcoming challenges as required. While there is no perfect time for leadership transitions, it is prudent to bring in renewed energy now to lead the CVN 78 team through the challenges ahead. Capt. Metcalf's proven program management acumen and extensive waterfront experience will be a tremendous asset to the CVN 78 team in the months ahead."
>
> Metcalf took command of the program office on July 1.
>
> O'Connor reiterated that there was no specific incident or causal factor that led to Geurts' decision to remove Rutan from the office and bring Metcalf in, but rather it was reflective of the program's performance over time.[37]

Navy Efforts to Address Technical Challenges

In a December 6, 2019, memorandum, then-Acting Secretary of the Navy Thomas Modly stated that one of his five immediate objectives would be to "put all hands on deck to make [CVN-78] ready as a warship as soon as practically possible."[38] In a December 20, 2019, memorandum, Modly elaborated on this effort, stating that "With the successful completion of CVN 78's Post Shakedown Availability and subsequent Independent Steaming Events, finishing work [on the ship] and delivering this capability to the fleet as quickly and effectively as possible is one of my highest priorities." The memorandum established a series of specific tasks to be completed by certain dates, stated that "The Program Executive Office (PEO) Aircraft Carriers, RADM [Rear Admiral] Jim Downey, will be accountable for this Vector as supported activity," and stated that "Our first 'Make Ford Ready' summit will occur on January 9, 2020, with every stakeholder in government and industry present."[39]

A September 14, 2020, press report stated

> The U.S. Navy is working to improve the reliability of the new aircraft launch and recovery systems as the service pushes its newest and most expensive aircraft carrier toward its first deployment, the head of Naval Air Forces Atlantic said Sept. 12.
>
> Rear Adm. John Meier told a virtual audience at the annual Tailhook symposium that while reliability concerns were at the top of the agenda, the carrier Ford is on track to be ready for tasking in 2022.
>
> "The issue we are working closely on is building out of the gate reliability, making sure [the Electromagnetic Aircraft Launch System] and [Advanced Arresting Gear] has the right sparing, parts and equipment in the event that something breaks," Meier said. "But its also making sure we have the right procedures and methodologies so those things don't break.
>
> "We're still not where we want to be, but we've made great strides and we're getting better every year."[40]

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[37] Megan Eckstein, "Navy Removes Ford Carrier Program Manager, Citing Performance Over Time," *USNI News*, July 2, 2020. See also Geoff Ziezulewicz, "Navy Fires Program Manager for Troubled Ford Aircraft Carrier," *Navy Times*, July 7, 2020.

[38] Thomas B. Modly, memorandum for distribution, subject "SecNav [Secretary of the Navy] Vector 1," December 6, 2019, p. 1.

[39] Thomas B. Modly, memorandum for distribution, subject "SecNav [Secretary of the Navy] Vector 3," December 20, 2019.

[40] David B. Larter, "Here's When the US Navy Thinks the Carrier Ford Will Be Ready to Deploy," *Defense News*, September 14, 2020.

A November 24, 2020, press report stated

> USS Gerald R. Ford (CVN-78) has been in and out of port for more than a year as the Navy continues to wring out the bugs from the new technologies on the next-generation carrier. While progress is steady, the program still has several milestones to achieve before it's ready for its inaugural deployment.
>
> Ford is slated to finish its post-delivery test and trials period and certify all of its weapons elevators, which have caused delays to the ship's schedule, before starting full-ship shock trials in May.
>
> During a USNI News trip last week aboard Ford, crew members were optimistic about the possibilities the first-in-class carrier holds for the Navy's future and the progress the crew has made in recent at-sea periods. But with a few more months to go in the testing stage, the crew is still working to increase the reliability of multiple new technologies aboard the ship….
>
> After facing criticism from lawmakers in both parties over delays to the lead ship, officials say Ford's time at sea over the last year has allowed sailors to experiment with the new systems—like the Advanced Weapons Elevators, Advanced Arresting Gear (AAG), and Electromagnetic Aircraft Launch System (EMALS)—while also beginning to practice strike group operations.
>
> "These are enormous undertakings. There's been some problems. There's been some cost issues. Most of that's history," Rear Adm. James Downey, the Navy's program executive officer for aircraft carriers, told reporters aboard Ford last week….
>
> Downey said he could not pinpoint an exact timeframe for Ford's first deployment, but Commander of Naval Air Force Atlantic Rear Adm. John Meier in September said Ford is on track to deploy in 2022.
>
> "I can't tell you the deployment date is this or that. The issue is we're about 15 percent ahead of our maintenance, modernization and ship completion schedule," Downey said. "And now we've pulled up [i.e., accelerated the schedule for testing] command and control activities. That's where we are overall."[41]

A December 22, 2020, press report states

> [USS] Ford has spent much of the past year alternating between being in port and at sea, giving its sailors the chance grow their proficiency on new technologies and refine procedures for using them while also qualifying pilots and re-certifying its flight deck—all while navigating challenges imposed by COVID-19.
>
> That work is all part of Ford's 18-month post-delivery test and trials period, which assesses the ship's overall readiness. This phase, which is part of readying Ford for its first deployment, is scheduled to wrap up in spring 2021.
>
> The flattop has completed about 5,500 aircraft launches and recoveries, Ford's commanding officer, Capt. J.J. "Yank" Cummings, told Insider.
>
> In November, Ford operated for the first time as part of a carrier strike group, allowing battlegroup commanders and the crew to get a feel for how Ford will function as a warship.
>
> "Every underway we get smarter and learn more about our systems and what's required to be successful on deployment," Cummings said.

[41] Mallory Shelbourne, "USS Gerald R. Ford Making Steady Progress Ahead of Deployment," *USNI News*, November 24, 2020.

> Ford was designed and built to require less manpower while being able to launch as many as 160 aircraft during a 12-hour fly day, as opposed to the 120 sortie-generation rate of the Nimitz-class.
>
> Capt. Joshua "Flipper" Sager, who commands Ford's embarked Carrier Air Wing 8, said the crew is maxing out its ability to launch aircraft.
>
> Because Ford has three times the electrical capacity as Nimitz-class carriers, EMALS is limited more by its operators, who work with safety procedures and other restrictions, than by its technical components, Sager said.
>
> "We're rapidly arriving at the point where the human factor is going to be the limiting factor for how fast we can launch aircraft, which really means that the ship is not limited at all in its capability to launch and recover aircraft," Sager told Insider.
>
> During late-stage workups, the goal for the air wing will be to be able to recover an aircraft every 45 to 50 seconds, Sager said.
>
> "We brought a very experienced air wing contingent out and then we operated with standard fleet procedures," Sager said. "Ford was able to handle everything we were throwing at it from an air wing perspective."
>
> Along with minor software tweaks to Ford's Advanced Arresting Gear, or AAG, which is its system for landing aircraft, and to its electromagnetic catapults, work continues on four of Ford's 11 weapons elevators, which are about 92% complete, Rear Adm. James Downey, program executive officer for aircraft carriers at Naval Sea Systems Command, told Insider….
>
> Each of Ford's elevators is different and runs on a redesigned electromagnetic system, an upgrade from the pulley-based elevators on the Nimitz class, Downey said.
>
> "Just like the EMALS or AAG, we find some obsolescence issues and on switches and things like this," Downey said. "But we don't have an issue where the elevator just doesn't work in certain situations."
>
> Downey said increased involvement by the Navy and by the ship's builders, including daily progress reviews, has helped Ford pick up its stride. That has also included establishing a greater presence from his office in Norfolk, where Ford is homeported, and putting more industrial workers on the ship while at sea so work can continue uninterrupted….
>
> Ford is scheduled for full-ship shock trials around early summer 2021, followed by a maintenance period to address any issues discovered.
>
> Ford was once set to deploy in 2024, which would've been years behind schedule, but Downey said the carrier may be ready for its first deployment sooner than that.
>
> "We still have to go through our reviews with Navy leadership and in the larger tasking of carriers, but it's ... trending to the left [i.e., earlier]," Downey said of the timeline.[42]

A February 2, 2021, opinion column by two Navy admirals states

> As the USS Gerald R. Ford (CVN 78) steamed off the coast of Virginia last week—qualifying naval aviators from fleet replacement squadrons—The Virginian-Pilot and Daily Press published a Jan. 28 editorial offering a dated and inaccurate assessment of the aircraft carrier's performance and operational accomplishments over the last several months. Ford is in month 16 of its Post-Delivery Test and Trials (PD&T) period, testing a

[42] Courtney Mabeus, "The Navy's Newest Carrier, Once Criticized as a 'Floating Barge,' May Be Ready for Action Sooner than Expected," *Business Insider*, December 22, 2020. See also Robbin Laird, "Aboard USS Ford: More Weapons, More Launches, Faster & Safer," *Breaking Defense*, November 25, 2020.

host of combat systems, while serving as the primary East Coast carrier qualification platform for fleet naval aviators.

The ship has conducted nine underway periods since beginning PDT&T in November 2019, and yet the editorial cited a "new assessment," which omitted data from the last three underways logged in late 2020—a critical period in the development of both the ship's systems and the crew.

In November, for instance, Ford was at sea with her entire Carrier Strike Group (CSG) for integrated operations. During this underway, CSG-12, Carrier Air Wing (CVW) 8, Destroyer Squadron Two and elements from the group's Air and Missile Defense and Information Warfare teams conducted operations consistent with a CSG's pre-deployment training cycles. As previously reported in the newspaper, Ford was "averaging some 50 sorties a day," with a partial air wing of roughly 35 aircraft flying, approximately 50% of a fully outfitted air wing using Electromagnetic Aircraft Launch System (EMALS) and Advanced Arresting Gear (AAG) with great success.

Ford has successfully launched and recovered aircraft nearly 6,500 times, and in December, the crew completed more than 840 launches and arrestments while qualifying 58 new aviators. The ship also recorded a new single-day record of 170 launches and 175 arrestments in an eight-and-a-half-hour period, eclipsing Ford's previous record set in April. In 2020, FORD completed 5,700 aircraft launches and recoveries across six at-sea periods, which was a sevenfold increase from the ship's totals in 2018.

The editorial also overlooked Ford's progress in testing the ship's command and control systems during strike group readiness exercises, which play a crucial role in preparing Ford's crew and systems for operational employment well ahead of the timeline stated in the editorial. These integrated strike group operations were conducted in parallel with planned ship testing and trials, accelerating the Navy's ability to exercise the ship's command and control capability prior to full ship shock trials scheduled for this summer and the follow-on planned incremental availability.

As the hard-working shipbuilders of Newport News Shipbuilding and countless citizens of this region have likely seen in local news reports, Ford and her exceptional crew have been marking significant planned milestones since completing the aircraft carrier's Post-Shakedown Availability in October 2019. These milestones include certifying the flight deck, completing aircraft compatibility testing, embarking the strike group and airwing, qualifying more than 400 naval aviators, and conducting combat systems certification preparations during approximately 200 days underway.

Ford is providing significant operational readiness to the fleet commanders, even while in a test and trial status. In each of Ford's at-sea periods, the ship's crew and embarked squadrons continue to validate and to refine Ford's technological innovations—technologies never realized before on any combatant of its kind….

While the editors are right that it is not unusual for the first ship of a class to have unexpected challenges and delays, Ford is vigorously testing its new technology and aggressively resolving issues. Ford-class aircraft carriers will serve as the centerpiece of strike group operations through the 21st century, supporting national strategic objectives.[43]

Potential Oversight Questions

Potential oversight questions for Congress include the following:

[43] John Meier and Craig Clapperton, "Opinion: Cutting-Edge USS Ford Cruising Toward Certification," *Virginian-Pilot*, February 2, 2021.

- Why did the Navy accept delivery of CVN-78 from the shipbuilder and commission the ship into service if most or all of its weapon elevators were not completed, tested, and certified?
- What steps has the Navy taken since CVN-78 was delivered to the Navy on May 31, 2017, to keep Congress informed of challenges regarding the ship's weapon elevators and other ship systems?
- Why is it taking so long to complete, test, and certify the weapon elevators?
- How much is it costing to complete, test, and certify the weapon elevators, and will the Navy include all of this cost in the ship's total reported procurement cost?
- When will the ship start its first deployment, and how much of a delay will that represent compared to the ship's original schedule for starting its first deployment?
- How much additional operational stress is the delay in CVN-78's first deployment placing on the Navy's 10 other aircraft carriers?
- What steps is the Navy taking to ensure that a similar situation does not arise regarding the construction and initial deployments of CVN-79, CVN-80, and CVN-81?

Potential Impact of COVID-19 Pandemic

Another issue for Congress concerns the potential impact of the COVID-19 pandemic on the execution of U.S. military shipbuilding programs, including the CVN-78 program. An August 13, 2020, press report stated

> The Navy's top acquisition official said the service is reassessing the timeline for the future aircraft carrier USS John F. Kennedy (CVN-79) due to both the COVID-19 pandemic and the switch from a dual to single-phase delivery plan.
>
> James Geurts told reporters during a phone press roundtable Wednesday [August 12] that "obviously we are watching with some concern, the workforce levels at all our shipyards, but in particular at Newport News there, given the relatively high number of cases in there."…
>
> Geurts said the Navy is trying to understand the impacts from both COVID and moving to a single-phase delivery for CVN-79 and then "understanding the opportunity that going to a single phase delivery puts together and then leveraging that opportunity to build a more efficient schedule from here on out for that ship."[44]

Another August 13, 2020, press report stated

> Geurts told reporters during a telephone news conference that he was particularly worried about Newport News Shipbuilding, the Huntingtin Ingalls Industries (HII) yard in Virginia, "given the relatively high number of cases in there"….
>
> The USN is trying to assess what the impacts of the workforce reductions will mean to the schedule of the aircraft carrier John F. Kennedy (CVN 79), the Ford-class ship recently launched at Newport News Shipbuilding….

[44] Rich Abott, "Navy Reassessing CVN-79 Schedule Due To Pandemic And Phase Change," *Defense Daily*, August 13, 2020.

> After the media call, Geurts told Janes, "While we still are seeing major reductions in labour hours in CVN 79 versus CVN 78, we are also looking for opportunities to mitigate some of the Covid impacts as we shift to a single-phase delivery plan for that ship. Single-phase delivery will allow us to adjust some of the manpower and trade skill phasing to take into account the Covid impacts to date. We are working on those adjustments."[45]

For additional discussion of the potential impact of the pandemic on the execution of U.S. military shipbuilding programs, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by Ronald O'Rourke.

Cost Growth and Managing Costs within Program Cost Caps

Overview

Another issue for Congress concerns cost growth in the CVN-78 program. Navy efforts to stem that growth and manage costs so as to stay within the program's cost caps have been a continuing oversight issue for Congress several years. Congress in recent years has passed legislation on the issue that is in addition to the earlier-mentioned legislation that established and amended cost caps for the ships.[46]

As shown in **Table 2**, the estimated procurement costs of CVN-78, CVN-79, and CVN-80 have grown 27.0%, 24.0%, and 15.0%, respectively, since the submission of the FY2008 budget. As shown in **Table 1**, cost growth on CVN-78 required the Navy to program $1,394.9 million in cost-to-complete (CC) procurement funding for the ship in FY2014-FY2016 and FY2018,[47] to request another $71.0 million in CC funding for CVN-78 for FY2021, and to program another $74 million in CC funding for CVN-79 for FY2022.

As also shown in **Table 2**, however, cost growth on CVN-78, CVN-79, and CVN-80 has slowed since FY2013 and FY2014:

- while the estimated cost of CVN-78 grew considerably between the FY2008 budget (the budget in which CVN-78 was procured) and the FY2014 budget, since the FY2014 budget, it has grown by only a small amount (3.8%);

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[45] Michael Fabey, "Covid-19: Virus Impacts Force US Navy Schedule Reassessments for Carrier Kennedy and Other Programmes," *Jane's Navy International*, August 13, 2020.

[46] This additional legislation includes the following:

Section 128 of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015), which established a limitation on availability of funds for CVN–79 until certain conditions were met;

Section 126 of the FY2017 National Defense Authorization Act (S. 2943/P.L. 114-328 of December 23, 2016), which established a limitation on availability of funds for procurement of CVN–80 until certain conditions were met;

Section 121(b) of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017), which provided for a waiver on the limitation of availability of funds for CVN–79; and

Section 122 of the FY2020 National Defense Authorization Act (S. 1790/P.L. 116-92 of December 20, 2020), which modified the above-listed Section 126 of P.L. 114-328 regarding an annual report on cost targets for CVN-78 class carriers.

[47] The Navy's FY2021 budget submission reflects the reprogramming of $161.5 million of additional funding for CVN-78 into FY2009, FY2011, and FY2012, including $86.0 million reprogrammed into FY2012. As discussed earlier in the note to **Table 1**, even though FY2012 is after FY2011 (CVN-78's original final year of full funding), the Navy characterizes the $86.0 million reprogrammed into FY2012 as full funding rather than cost-to-complete funding on the grounds that in the years since FY2011, as discussed earlier in this report (see footnote 10), the authority to use incremental funding for procuring aircraft carriers has been expanded by Congress to permit more than the four years of incremental funding that were permitted at the time that CVN-78 was initially funded.

- while the estimated cost of CVN-79 grew considerably between the FY2008 budget and the FY2013 budget (in part because the procurement date for the ship was deferred by one year in the FY2010 budget),[48] since the FY2013 budget it has declined by a small amount (0.11%); and
- while the estimated cost of CVN-80 grew considerably between the FY2008 budget and the FY2013 budget (in part because the procurement date for the ship was deferred by two years in the FY2010 budget),[49] since the FY2013 budget it has declined by 11.2%.

CVN-78

Past Sources of Cost Growth

A primary source of past cost growth on CVN-78 appears to have been an unrealistically low original cost estimate for the ship in the FY2008 budget submission, which might have reflected an underestimate of the intrinsic challenges of building the then-new Ford-class design compared to those of building the previous and well understood Nimitz-class design.[50]

In addition to this general cause of past cost growth, additional and more-specific past risks of cost growth for CVN-78 included certain new systems to be installed on the ship. These included a new type of aircraft catapult called the Electromagnetic Launch System (EMALS), a new

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[48] Deferring the ship's procurement from FY2012 to FY2013 put another year of inflation into the ship's estimated cost in then-year dollars (which are the type of dollars shown in **Table 2**), and may have reduced production learning curve benefits in shifting from production of CVN-78 to production of CVN-79.

[49] Deferring the ship's procurement from FY2016 to FY2018 put additional years of inflation into the ship's estimated cost in then-year dollars (which are the type of dollars shown in **Table 2**), and may have reduced production learning curve benefits in shifting from production of CVN-79 to production of CVN-80.

[50] The Congressional Budget office (CBO) in 2008 and GAO in 2007 questioned the accuracy of the Navy's cost estimate for CVN-78. CBO reported in June 2008 that it estimated that CVN-78 would cost $11.2 billion in constant FY2009 dollars, or about $900 million more than the Navy's estimate of $10.3 billion in constant FY2009 dollars, and that if "CVN-78 experienced cost growth similar to that of other lead ships that the Navy has purchased in the past 10 years, costs could be much higher still." CBO also reported that, although the Navy publicly expressed confidence in its cost estimate for CVN-78, the Navy had assigned a confidence level of less than 50% to its estimate, meaning that the Navy believed there was more than a 50% chance that the estimate would be exceeded. (Congressional Budget Office, Resource Implications of the Navy's Fiscal Year 2009 Shipbuilding Plan, June 9, 2008, p. 20.) GAO reported in August 2007 that

> Costs for CVN 78 will likely exceed the budget for several reasons. First, the Navy's cost estimate, which underpins the budget, is optimistic. For example, the Navy assumes that CVN 78 will be built with fewer labor hours than were needed for the previous two carriers. Second, the Navy's target cost for ship construction may not be achievable. The shipbuilder's initial cost estimate for construction was 22 percent higher than the Navy's cost target, which was based on the budget. Although the Navy and the shipbuilder are working on ways to reduce costs, the actual costs to build the ship will likely increase above the Navy's target. Third, the Navy's ability to manage issues that affect cost suffers from insufficient cost surveillance. Without effective cost surveillance, the Navy will not be able to identify early signs of cost growth and take necessary corrective action.
>
> (Government Accountability Office, *Defense Acquisitions[:] Navy Faces Challenges Constructing the Aircraft Carrier Gerald R. Ford within Budget*, GAO-07-866, August 2007, summary page. See also Government Accountability Office, *Defense Acquisitions[:] Realistic Business Cases Needed to Execute Navy Shipbuilding Programs*, Statement of Paul L. Francis, Director, Acquisition and Sourcing Management Team, Testimony Before the Subcommittee on Seapower and Expeditionary Forces, Committee on Armed Services, House of Representatives, July 24, 2007 (GAO-07-943T), p. 15.)

aircraft arresting system called the Advanced Arresting Gear (AAG), and the ship's primary radar, called the Dual Band Radar (DBR). Congress followed these and other sources of risk of cost growth on CVN-78 for years.

Press Reports

An October 25, 2019, press report stated

> The Navy's most expensive vessel is getting even costlier, as the service says it needs to add as much as $197 million more to correct deficiencies with the USS Gerald R. Ford aircraft carrier.
>
> That includes completing the installation and certification of 11 elevators to lift munitions and other equipment from below decks that were supposed to be ready more than two years ago.
>
> The previously undisclosed notification to Congress is on top of an extra $120 million identified in May 2018 to correct earlier deficiencies. The move last year caused the carrier to breach a $12.9 billion cost cap set by Congress in an effort to stop spiraling cost increases. The new request takes the carrier's estimated cost to $13.22 billion.
>
> The latest funding is needed "to correct deficiencies identified during testing to ensure the safety of the ship and personnel and to deliver an operational ship to the fleet," Captain Danny Hernandez, a Navy spokesman, said in a statement….
>
> More money also is needed to pay for "additional labor to address and correct technical issues, completing deferred work," and "there are also time charges associated with a longer repair period," the Pentagon comptroller said in an Oct. 7 document to Congress requesting permission for the Navy to shift $40 million from prior-year programs. The remaining $157 million would come from funds this fiscal year and 2021, Hernandez said.[51]

An October 28, 2019, press report stated

> A congressionally-imposed cost cap remains in place on the Ford, however, and the Navy in late September received permission to add $197 million to the ship's acquisition cost, for a new total of $13.224 billion. The new monies were needed, the Navy said in a statement, "in order to correct deficiencies identified during testing, to ensure the safety of the ship and personnel, and to deliver an operational ship to the fleet."
>
> The additional money also includes more for work on the elevators. The new money will come from the current 2019 budget and the future fiscal 2020 and 2021 budgets.[52]

An October 30, 2019, press report stated that Secretary of the Navy Richard Spencer, at a press roundtable on that date,

> said he has "medium confidence" that a recent $197 million reprogramming request to Congress to fund more Ford fixes will be enough, simply because "first of classes is tough."
>
> "I'd be remiss if I said that was the last, to be very frank. I'd rather have the option to say we're going to come for more than saying no we're capped off now. I feel good on what we're finally learning on the end of this birthing process," Spencer said.[53]

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[51] Anthony Capaccio, "Navy's $13 Billion Carrier Needs Another $197 Million in Fixes," *Bloomberg*, October 25, 2019.

[52] Christopher P. Cavas, "Heady Days for US Navy's Carrier Program," *Defense & Aerospace Report*, October 28, 2019.

[53] Rich Abott, "SECNAV: Ford Issues Due To Cost Cap, Explains Timeline," *Defense Daily*, October 30, 2019. See

CVNs 79, 80, and 81

Confidence Levels

The Navy states that it is working to control cost growth on CVNs 79, 80, and 81. Even so, the Navy states that its confidence levels for its estimated procurement costs (not including costs for class-wide spare parts) for CVNs 79, 80, and 81 were 36%, 22%, and 20% as of June 2019, respectively, meaning that the Navy as of June 2019 estimated that the risk of future cost growth on CVNs 79, 80, and 81 were 64%, 78%, and 80%, respectively.[54]

October 2019 CBO Report

An October 2019 CBO report on the potential cost of the Navy's 30-year shipbuilding plan states the following regarding the CVN-78 program:

> The Navy's current estimate of the total cost of the USS Gerald R. Ford, the lead ship of the CVN-78 class, is $13.1 billion in nominal dollars appropriated over the period from 2001 to 2018. CBO used the Navy's inflation index for naval shipbuilding to convert that figure to $16.2 billion in 2019 dollars, or 25 percent more than the corresponding estimate when the ship was first authorized in 2008. Neither the Navy's nor CBO's estimate includes the $5 billion in research and development costs that apply to the entire class.
>
> Because construction of the lead ship is finished, CBO used the Navy's estimate for that ship to estimate the cost of successive ships in the class. But not all of the cost risk has been eliminated; in particular, the ship's power systems, advanced arresting gear (the system used to recover fixed-wing aircraft landing on the ship), and weapons elevators are not yet working properly. It is not clear how much those problems will cost to fix, but current Navy estimates suggest that it will be several tens of millions of dollars or more. CBO does not have enough information to independently estimate those final repair costs.
>
> The next carrier after the CVN-78 is the CVN-79, the John F. Kennedy, which is expected to be completed in 2024 and deployed in 2026. Funding for the ship began in 2007, the Congress officially authorized its construction in 2013, and the planned appropriations for it were completed in 2018. The Navy estimates that the ship will cost $11.3 billion in nominal dollars (or $11.9 billion in 2019 dollars). The Navy's 2014 selected acquisition report on the CVN-79 states that "the Navy and shipbuilder have made fundamental changes in the manner in which the CVN 79 will be built to incorporate lessons learned from CVN 78 and eliminate the key contributors to cost performance challenges realized in the construction of CVN 78." Nevertheless, the Navy informed CBO that there is a greater than 60 percent chance that the ship's final cost will be more than the current estimate. Although CBO expects the Navy to achieve a considerable cost reduction in the CVN-79 compared with the CVN-78, as is typical with the second ship of a class, CBO's estimate is higher than the Navy's. Specifically, CBO estimates that the ship will cost $12.4 billion in nominal dollars (or $12.9 billion in 2019 dollars), about 9 percent more than the Navy's estimate.
>
> In 2018, the Congress authorized the third carrier of the class, the Enterprise (CVN-80). Appropriations for that ship began in 2016 and are expected to be complete by 2025. In 2019, the Congress authorized the Navy to purchase materials jointly for the CVN-80 and the next ship, the CVN-81, to save money by buying in greater quantity. It also authorized the Navy to change the sequencing involved in building the ships to gain greater

also Megan Eckstein, "SECNAV Spencer: Carrier Ford Challenges Tied to Costs Caps, Requirements Process," *USNI News*, October 30, 2019; Paul McCleary, "SecNav Again Blasts Huntington Ingalls On Ford Carriers," *Breaking Defense*, October 30, 2019.

[54] Source: Navy information paper provided to CRS by Navy Office of legislative Affairs on June 20, 2019.

> efficiencies in their construction. Although that legislative action is known as a "two-carrier buy," the Navy would not be building both ships at exactly the same time. Purchasing the two ships together would accelerate the CVN-81's construction by only one year compared with buying the ships individually as envisioned in the 2019 shipbuilding plan.
>
> In the 2020 budget, the Navy estimated that the CVN-80 would cost $12.3 billion in nominal dollars (or $11.4 billion in 2019 dollars). That represents a savings of $300 million compared with the Navy's estimate in the 2019 budget. In contrast, CBO estimates that the CVN-80 would cost $13.6 billion in nominal dollars (or $12.4 billion in 2019 dollars), about 9 percent more than the Navy's estimate. In information provided to CBO as part of the 2019 budget presentation, the Navy indicated that there was a greater than 60 percent chance that the ship's final cost will be more than it estimated; in contrast, with the 2020 budget, the Navy puts that figure at 78 percent. Thus, it is not clear whether the service's 2020 estimates incorporate savings stemming from a two-carrier buy or simply an acceptance of increased risk of future cost growth.
>
> With respect to the CVN-81, the pattern is similar. In the 2019 budget, the Navy estimated the CVN-81 at $15.1 billion in nominal dollars. In the 2020 budget with the two-carrier buy, the Navy estimated the cost of the ship at $12.6 billion in nominal dollars (or $10.5 billion in 2019 dollars), for a savings of $2.5 billion. However, the Navy also told CBO that there is an 80 percent chance that the final cost will be higher than the current estimate, compared with the roughly 40 percent chance indicated in the 2019 budget. CBO estimates that the CVN-81 would cost $14.4 billion in nominal dollars (or $11.9 billion in 2019 dollars), or 14 percent more than the Navy's estimate.
>
> Overall, the Navy estimates an average cost of $12.7 billion (in 2019 dollars) for the 7 carriers (CVN-81 through CVN-87) in the 2020 shipbuilding plan. CBO's estimate is $13.0 billion per ship….[55]

CVN-79

Navy officials have stated that they are working to control the cost of CVN-79 by equipping the ship with a less expensive primary radar,[56] by turning down opportunities to add features to the ship that would have made the ship more capable than CVN-78 but would also have increased CVN-79's cost, and by using a build strategy for the ship that incorporates improvements over the build strategy that was used for CVN-78. These build-strategy improvements, Navy officials have said, include the following items, among others:

- achieving a higher percentage of outfitting of ship modules before modules are stacked together to form the ship;
- achieving "learning inside the ship," which means producing similar-looking ship modules in an assembly line-like series, so as to achieve improved production learning curve benefits in the production of these modules; and
- more economical ordering of parts and materials including greater use of batch ordering of parts and materials, as opposed to ordering parts and materials on an individual basis as each is needed.

[55] Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2020 Shipbuilding Plan*, October 2019, pp. 17-19.

[56] See, for example, Megan Eckstein, "PEO Carriers: CVN-79 Will Have a New Radar, Save $180M Compared to [CVN-78's] Dual Band Radar," *USNI News*, March 17, 2015; Christopher P. Cavas, "Dual Band Radar Swapped Out In New Carriers," *Defense News*, March 17, 2015; Christopher P. Cavas, "New US Carrier Radar Enters the Picture," *Defense News*, March 23, 2015.

An August 5, 2020, press report stated

> The Navy vowed that a runaway budget wouldn't be allowed again after the USS Gerald Ford, the first in a new class of aircraft carriers, cost a record $13.3 billion. Now, the price for the second ship is creeping up.
>
> The service's estimate for shipbuilder Huntington Ingalls Industries Inc. to design and construct the USS John F. Kennedy has increased to $3.58 billion, up 7% from the $3.35 billion contract awarded in 2015, according to the carrier program's Selected Acquisition Report for fiscal 2021.
>
> That underscores previous warnings that the fully outfitted carrier may exceed an $11.4 billion cost cap imposed by Congress. The contractor is falling short by a key measure of labor efficiency, the Navy said in the report obtained by Bloomberg News.
>
> Its workforce performed 91 cents of work for every Navy dollar spent in the last year, down from the more acceptable level of 95 cents per dollar over the same timeframe, according to the report.
>
> Huntington Ingalls also is falling short of a Navy goal to reduce cumulative labor hours by at least 18% from the first ship. With the vessel 69% complete, the Kennedy is performing at a 16% improvement over the Ford at the same point, Captain Danny Hernandez, a Navy spokesman, said in an email.
>
> Hernandez said the cost report's figures stem in part from changes such as improvements in warfare capability and lessons learned from the Ford's recent post-delivery "shakedown" sea trials. There are additional costs "from congressional direction" requiring that the Kennedy be capable of deploying with F-35 jets by mid-2025, he said.
>
> The cost increases are also "due to delays relating to electrical, sheet metal, painting and platform engineering work," the Navy said in the Selected Acquisition Report. The JFK is expected to be delivered in 2024….
>
> But the report warned that "if the current cost performance continues, then the budget will be exhausted prior to the completion" of the carrier. That could force the Defense Department to make the case to lawmakers for easing the cost cap.
>
> Beci Brenton, a spokeswoman for Newport News, Virginia-based Huntington Ingalls, said the carrier's construction is about 72% complete. The company "continues to see the benefits associated with significant build strategy changes and incorporation of lessons learned" from its predecessor.
>
> "We track cost and schedule trends continuously and share that information with our customer," the Navy, Brenton said.[57]

A November 7, 2019, press report states

> It was a joyous day for Mike Butler and his enormous crew of shipyard workers who have labored for the past four years to build America's next super carrier.
>
> The program director for CVN-79, the future aircraft carrier John F. Kennedy, donned a hardhat and briefed assembled members of the press on Oct. 29, eager to tout the progress he and his colleagues made.
>
> "Today we're going to flood the dock, it's the first time the ship will be in the water since we started construction, since we started in August 2015," Butler said. "It will take about 10 hours. Dock holds about 160 million gallons of water, so it will take some time to get in here. … And we're flooding the dock about three months ahead of schedule, so that's a great accomplishment for our folks."

[57] Anthony Capaccio, "Next Carrier's Cost Creeps Up After First One Hit $13.3 Billion," *Bloomberg*, August 5, 2020.

Kennedy is about 1,300 tons heavier than the aircraft carrier Gerald R. Ford was at the same point in its life span, and Butler said that's an indication of Kennedy's solid progress.

"There was a significant amount of change and improvements in how we built this ship that are helping us build this ship cheaper than we have on CVN-78," he said, referring to the Ford.

For Butler and his workforce at Huntington Ingalls Industries' Newport News, Virginia, shipyard, the Kennedy is a chance to right the ship and demonstrate the yard can learn from its challenges with Ford, even as the first-in-class aircraft carrier has become embroiled in yet another controversy over delays.…

"The main thing we did was shift more work earlier in the process," Butler said. "We moved a lot of work traditionally done on the ship to our final assembly platen, and that moved it to an area more conducive to better efficiency and better cost. We got a lot of that work done earlier than we had done before.

"That allows us to build larger super-lifts and put more outfitting in before we erected them on the ship."

The new approach at Newport News has been empowered by digital renderings that allow workers to build out spaces with a greater level of detail before piecing together the ship.

"The main difference is with the product model, early on with the 3D-designed product model—without that we could not have moved so much work earlier. For example, with Nimitz class, we had a lot of hole cuts in bulkheads for piping and electrical to pass through. On Nimitz class, most of that was cut on the ship. Here, we cut virtually all those holes in the shop. We mounted a lot of equipment in the shop. We could have never done that without the product model.

"And without the product model, we would have never been able to do the digital work packages and things that we are able to do electronically."

One of the major issues facing Newport News has been its relatively inexperienced labor force. Many of the older, most skilled workers are retiring. That, coupled with a reduction in the Navy's overall shipbuilding needs in past decades, has put pressure on the remaining pool of skilled labor from which shipyards like Newport News can draw.

That's prompted hiring of new workers and training of a new generation of skilled workers in places such as Connecticut's General Dynamics Electric Boat and in Hampton Roads, Virginia. However, the delays associated with training new workers who perform tasks more slowly than a more experienced workforce can impact the final cost of a ship, either sticking the Navy with a higher bill or taking a bite out of company profits, depending on how a contract is structured.

"Big picture is that it's not really a challenge [having a green workforce]," Butler said. "We've hired about 8,000 people in the last couple of years. Of course, that means we have to bring them in and train them to be shipbuilders, which takes some time, but there is an advantage to having a new and younger workforce.

"Especially as we move to more digital, electronic work packages. The younger workforce is much more adept at that, and it's working very well."[58]

Issues Raised in January 2021 DOT&E and June 2020 GAO Reports

Another oversight issue for Congress concerns CVN-78 program issues raised in a January 2021 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual

[58] David B. Larter, "Amid the Latest Ford Controversy, a Green Workforce Is Making Rapid Progress on Its Sister Ship," *Defense News*, November 7, 2019.

report for FY2020—and the 2020 edition of the Government Accountability Office's (GAO's) annual report surveying selected DOD weapon acquisition programs, which was published in June 2020.

January 2021 DOT&E Report

Regarding the CVN-78 program, the January 2021 DOT&E report stated the following in part:

> **Assessment**
>
> • As noted in previous annual reports, the test schedule has been aggressive. The extension in PSA [post-shakedown availability][59] delayed both phases of initial operational testing until FY22.
>
> • TEMP [test and evaluation master plan] Revision D outlines the Navy's cybersecurity strategy to test CVN 78, but has not translated the strategy into an actionable test plan.
>
> **Reliability**
>
> • Four of CVN 78's new systems stand out as critical to flight operations: EMALS, AAG, DBR, and AWE. Overall, the low reliability demonstrated by AAG, EMALS, and DBR, along with the uncertain reliability of AWE, could further delay the CVN 78 IOT&E [initial operational test and evaluation]. Reliability estimates derived from test data for EMALS, AAG, and DBR are discussed in following subsections. For AWE, preliminary reliability estimates have been provided on 6 of the 11 elevators, the only ones certified.
>
> **EMALS[60]**
>
> • The delivery of the EMALS launch bulletins allows CVN 78 to launch all aircraft in the ship's Air Wing.
>
> • During the 3,975 catapult launches conducted post PSA through ISE [independent steaming event] 11, EMALS demonstrated an achieved reliability of 181 mean cycles between operational mission failure (MCBOMF), where a cycle is the launch of one aircraft. This reliability is well below the requirement of 4,166 MCBOMF.
>
> • During ISE 8, two separate failures caused individual EMALS catapults to go down for 3 days. One of the failures was attributed to a legacy component.
>
> • The reliability concerns are exacerbated by the fact that the crew cannot readily electrically isolate EMALS components during flight operations due to the shared nature of the Energy Storage Groups and Power Conversion Subsystem inverters on board CVN 78. The process for electrically isolating equipment is time-consuming; spinning down the EMALS motor/generators takes 1.5 hours by itself. This inability precludes EMALS high power maintenance during flight operations.
>
> **AAG**

[59] A post-shakedown availability is a maintenance availability (i.e., a maintenance period) that takes place after a ship's shakedown cruise, which an initial cruise that is intended in part to identify problems with the ship's construction and equipment.

[60] For additional discussion regarding the reliability of EMALS, see Sam LaGrone, "USS Gerald Ford EMALS Launching System Suffers Fault During Testing Period," *USNI News*, June 8 (updated June 12), 2020; Rich Abott, "Ford EMALS Went Down During Testing At Sea," *Defense Daily*, June 8, 2020; Mallory Shelbourne, "EMALS Aboard Ford Went Out, Interrupting Flight Operations," *Inside Defense*, June 9, 2020; Gina Harkins, "Navy Carrier Ford's High-Tech EMALS Catapult System Breaks During Sea Trials," *Military.com*, June 11, 2020; Mallory Shelbourne, "Geurts: Navy Still Working to Diagnose Problem That Caused EMALS Failure on Ford," *Inside Defense*, June 18, 2020; Megan Eckstein, "Navy Unsure If Recent EMALS Fault Was Equipment or Procedure Problem, But Workaround Has Been Validated," *USNI News*, June 19, 2020.

• Through the first 3,975 recoveries, AAG demonstrated an achieved reliability of 48 MCBOMF, where a cycle is the recovery of a single aircraft. This reliability estimate falls well below the requirement of 16,500 MCBOMF.

• While in port prior to ISE 9, during maintenance troubleshooting, the AAG system experienced a failure of an Energy Storage Capacitor Bank, which rendered all three engines inoperative. It took the Navy 7 days to investigate the failure and bring AAG back into service by mechanically isolating the failed capacitor bank. The failed parts were repaired during a later in-port period.

• The reliability concerns are magnified by the current AAG design that does not allow electrical isolation of the Power Conditioning Subsystem equipment from high power buses, limiting corrective maintenance on below-deck equipment during flight operations.

Combat System

• Post-PSA sea-based developmental test events show the DBR still experiences clutter tracks, but to a smaller extent and of a different origin than previously reported. The events also show that CEC [cooperative engagement capability],[61] in certain conditions, provides inaccurate tracking of air contacts. During these events, SEWIP [surface electronic warfare improvement program][62] Block 2 created undesired emitter tracks that could cause the ship to expend more ESSMs [Evolved Sea Sparrow Missiles] and RAMs [Rolling Airframe Missiles] than necessary to destroy incoming threats.

• The Navy is satisfied with the DBR track support for Air Traffic Control (ATC) after post-PSA at-sea testing. The DBR successfully suppresses the disclosure of the majority of environmental tracks when it sends tracks to [the] TPX-42 [shipboad air traffic control (ATC) system]. The Navy does not plan to conduct any further ATC-type aircraft flights during sea-based developmental testing.

• During the August 2020 missile firing operational test on SDTS [self-defense test ship], the system demonstrated good tracking performance of the targets by MFR [multi-function radar] and CEC, and good engagement support by the SSDS [ship self-defense system] MK 2 Mod 6 element, which correctly provided scheduling and weapon assignments. SEWIP Block 2 emitter reporting interfered with optimal engagements against threats. Several problems contributed to the failure of some ESSMs and RAMs to destroy their intended targets.

• Results of live testing completed to date indicate that CVN 78 has limited self-defense capability against ASCM [anti-ship cruise missile] surrogates, but several challenges persist with respect to the efficacy of the ship's combat system.

• Post PSA through ISE 11, DBR demonstrated a mean time between operational mission failures (MTBOMF) of 100 hours, below the requirement of 339 hours.

• Preliminary results of EASR's [enterprise air surveillance radar][63] early developmental testing indicate that electromagnetic interference, tracking performance, electronic protection, and power compliance testing are focal areas for ongoing system developmental work and improvements. Until operationally relevant reliability data are supplied to DOT&E, system reliability remains a significant risk area for EASR. EASR's combat system integration remains untested.

[61] The CEC system permits data from sensors on multiple ships to be fused together, so as to improve radar tracking and target engagement.

[62] The SEWIP system is the Navy's new surface-ship electronic warfare system.

[63] The use of the word *enterprise* in this context is not a reference to the name of CVN-80; it is instead a reference to the surface ship community, or enterprise. The use term in the radar's name denotes that the Navy envisages installing the radar on multiple ship classes within the community.

• Planned operational tests of the CVN 78 combat system continue to be delayed or have been canceled. In the 2006 Capstone Enterprise Air Warfare Ship Self-Defense TEMP, the Navy planned to leverage commonality between the DDG 1000 [destroyer] and CVN 78 combat systems to reduce the number of operational test events conducted on each ship. However, subsequent changes to the DDG 1000 combat system reduced commonality between the two ships and negated the ability to leverage testing and resources across the two combat systems.

• DOT&E recognizes that the CVN 78 Air Warfare test program is resource-limited because the Enterprise Air Warfare approach was not executable due to the divergence of the DDG 1000 and CVN 78 combat systems. DOT&E accepts this limitation expecting that the Navy will plan and execute an adequate air warfare test program for CVN 79. The CVN 79 test campaign is also intended to inform CVN 78 combat system performance once it is retrofitted with planned changes.

SGR

• CVN 78 is unlikely to achieve its SGR [sortie generation rate] requirement. The target threshold is based on unrealistic assumptions including fair weather and unlimited visibility, and that aircraft emergencies, failures of shipboard equipment, ship maneuvers, and manning shortfalls will not affect flight operations. During the 2013 operational assessment, DOT&E conducted an analysis of past aircraft carrier operations in major conflicts. The analysis concludes that the CVN 78 SGR threshold requirement is well above historical levels.

• DOT&E plans to assess CVN 78 performance during IOT&E by comparing it to the SGR requirement, as well as to the demonstrated performance of the Nimitz-class carriers.

• Poor reliability of key systems that support sortie generation on CVN 78 could cause a cascading series of delays during flight operations that would affect CVN 78's ability to generate sorties. The poor or unknown reliability of these critical subsystems represents the most risk to the successful completion of CVN 78 IOT&E.

Manning

• Reduced manning requirements drove the design of CVN 78. The berthing capacity is 4,660, or 1,100 fewer than Nimitz-class carriers. Based on current expected manning, the berthing capacity for officers and enlisted will be exceeded with some variability in the estimates depending on the specific scenario examined.

Electromagnetic Compatibility

• Developmental testing identified significant electromagnetic radiation hazard and interference problems. The Navy implemented some mitigation measures and conducted follow-on characterization testing during ISEs, but some operational limitations and restrictions are expected to persist into IOT&E and deployment. The Navy will need to develop capability assessments at differing levels of system use in order for commanders to make informed decisions on system employment.

Live Fire Test & Evaluation

• In FY20, the Navy continued with the shock qualification testing of CVN 78 components to support the survivability evaluation of CVN 78 to underwater threat engagements. Due to scarcity of test assets, some components and systems (e.g., DBR) will not be shock qualified before the FSST [full-ship shock trial].

• Adequate use of M&S [modeling and simulation] in the vulnerability evaluation of the ship against underwater threats is at risk. Challenges with the Navy Enhanced Sierra Mechanics M&S tool prompted the Navy to switch back to the Dynamic Systems Mechanics Advanced Simulation M&S tool to complete the vulnerability assessment

report. While necessary, the change will require additional verification and validation to ensure the credibility of the survivability evaluation.

Recommendations

The Navy should:

1. Continue to characterize the electromagnetic environment on board CVN 78 and develop operating procedures to maximize system effectiveness and maintain safety. As applicable, the Navy should use the lessons learned from CVN 78 to inform design modifications for CVN 79 and future carriers.

2. Implement the required software changes to multiple combat system elements to allow cueing from external sources necessary to conduct one of the two remaining SDTS test events.

3. Conduct both remaining SDTS combat system test events for CVN 78.

4. Correct the cause of combat system failures that led to ESSMs and RAMs missing their intended targets, and demonstrate the correction in a future phase of operational testing.

5. Fund the CVN 78 lead ship combat system operational testing and the M&S suite required to support assessment of the CVN 78 PRA [probability of raid annihilation][64] requirement.

6. Conduct an operational assessment of EASR at Wallops Island, Virginia. This testing should evaluate EASR's contributions to the air traffic control and self-defense missions, as well as provide an early assessment of electromagnetic interference and radiation hazard concerns.

7. Update TEMP 1610 to include cybersecurity testing on CVN 78 and CVN 79 testing driven by the changes to the ship's combat system, including the introduction of EASR.

8. Complete validation of the M&S tools supporting the LFT&E [live-fire test and evaluation] assessment, including comparison of the FSST data to relevant M&S predictions.

9. Continue to improve availability and reliability for EMALS, AAG, DBR, and AWE.[65]

June 2020 GAO Report

The June 2020 GAO report, which covers some issues previously discussed in this CRS report, stated the following:

Technology Maturity, Design Stability, and Production Readiness

This year the Navy reported that all 12 of the Ford Class's critical technologies were fully mature, an increase from the nine technologies that were mature at delivery. However, while the Navy assessed the advanced weapons elevators as mature, it ended the first post-delivery maintenance period in October 2019 with only four of the 11 elevators certified to operate. Further, none of the elevators that operate between the main deck and the lower decks are currently operational, which means the elevators are still not capable of bringing munitions to the flight deck. The Navy is working with the shipbuilder to complete all elevator work by Spring 2021—an 18-month delay from the schedule we reported last year.

[64] PRA is a measurement of the ship's ability to defeat (i.e., annihilate) an attack (i.e., raid) consisting of multiple enemy anti-ship missiles.

[65] Department of Defense, Director, Operational Test & Evaluation, *FY2020 Annual Report*, January 2021, pp. 137-139.

The Navy also constructed a land-based site to test the performance and reliability of the elevators, which is expected to be ready in early 2021.

Despite maturing its critical technologies, the Navy is still struggling to demonstrate the reliability of key systems, including the electromagnetic aircraft launch system (EMALS); Advanced Arresting Gear (AAG); and dual band radar (DBR). The Navy is continuing shipboard testing for these systems but has delayed operational testing by 18 months while it revises the test schedule to coordinate test schedules and complete deployment preparations. Although the Navy is testing EMALS and AAG on the ship with aircraft, the reliability of those systems remains a concern. If these systems cannot function safely by the time operational testing begins, CVN 78 will not be able to demonstrate it can rapidly deploy aircraft—a key requirement for these carriers.

Challenges in maturing CVN 78's critical technologies has led to their redesign or replacement on later ships in some cases. CVN 79 repeats the CVN 78 design with some modifications and replaces DBR with the Enterprise Air Surveillance Radar (EASR), which is in development. The Navy plans to procure two EASR units for CVNs 79 and 80 and install the CVN 79 unit during that ship's second phase of delivery. CVNs 80 and 81 will repeat the design of CVN 79.

Software and Cybersecurity

Software development for CVN 78's critical technologies is managed through separate program offices. For example, a separate program office manages AAG and EMALS, which rely on a mix of commercial and custom software. According to program officials, the Navy assessed these systems for cybersecurity vulnerabilities in August and October 2019. According to CVN 78 program officials, other ship systems have also undergone, or are scheduled to undergo, cybersecurity penetration or adversarial testing. The program is scheduled to complete an evaluation for potential cybersecurity vulnerabilities connected with section 1647 of the National Defense Authorization Act for Fiscal Year 2016 in May 2022.

Other Program Issues

In September 2019, the Navy increased the CVN 78 cost cap by $197 million to $13.2 billion in part to correct deficiencies in the advanced weapons elevators. This is the Navy's third adjustment to the cost cap since 2017. CVN 78's procurement costs increased by over $2.7 billion from its initial cost cap. Continuing technical deficiencies mean the Navy may still require more funding to complete this ship.

Further, the Navy is unlikely to obtain planned cost savings and construction efficiencies on the next three ships in the Ford class. We previously reported on the optimistic cost and labor assumptions for CVN 79, based on a projected 18 percent labor hour reduction compared to hours to construct CVN 78. In 2019 the shipbuilder increased the estimated cost at completion due to using more labor hours for CVN 79 than expected. In addition, the Navy awarded a contract to buy two carriers simultaneously—CVNs 80 and 81—based on the assumption that this strategy will save the Navy over $4 billion. However, the Navy's cost analysis showed that CVN 80 and 81 have a high likelihood of experiencing cost overruns, and it is uncertain whether the Navy can achieve the expected savings. The Navy assumed a further reduction in labor hours compared to CVN 79—about 25 percent fewer labor hours than CVN 78—will contribute to cost savings for these ships.

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 CVN 78 is in an 18-month post-delivery testing phase; completed over 2,000 aircraft launches and recoveries since delivery in May 2017; and completed numerous test events and certifications. According to the program office, the

Navy certified four elevators and plans to certify two more in April and September of 2020, and five remaining elevators are on track for certification in fiscal year 2021. The program stated that the Navy launched CVN 79 2 months ahead of schedule in December 2019, and construction is 70 percent complete. It also said Navy leadership approved a change for CVN 79 from a two-phase acquisition to a single phase delivery strategy and released a request for proposals for this new approach in January 2020. Additionally, the program stated that the Navy awarded the CVNs 80 and 81 detail design and construction contract in January 2019 and projected savings of over $4 billion compared to a single ship contract; CVN 80 construction is 3 percent complete and scheduled for delivery in 2028; and CVN 81 has begun material procurement and is scheduled for delivery in 2032.[66]

Shock Trial

An earlier oversight issue for Congress for the CVN-78 program was whether to conduct the shock trial for the CVN-78 class in the near term, on the lead ship in the class, or years later, on the second ship in the class. For background information on that issue, see **Appendix B**.

Legislative Activity for FY2022

The Navy's proposed FY2022 budget will be submitted to Congress later this year.

Legislative Activity for FY2021

Summary of Congressional Action on FY2021 Funding Request

Table 3 summarizes congressional action on the FY2021 procurement funding request for the CVN-78 program.

Table 3. Congressional Action on FY2021 Procurement Funding Request

Millions of dollars, rounded to nearest tenth.

		Authorization			Appropriation		
	Request	HASC	SASC	Conf.	HAC	SAC	Conf.
CVN-78	71.0	71.0	71.0	71.0	71.0	71.0	71.0
CVN-79	0	0	0	0	0	0	0
CVN-80	997.5	907.5	997.5	907.5	904.8	997.5	958.9
CVN-81	1,645.6	1,465.6	1,645.6	1,606.4	1,606.4	1,645.6	1,606.4
Total above	**2,714.1**	**2,444.1**	**2,714.1**	**2,584.9**	**2,582.2**	**2,714.1**	**2,565.4**

Source: Table prepared by CRS based on Navy's FY2021 budget submission, committee and conference reports, and explanatory statements on FY2021 National Defense Authorization Act and FY2020 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.

[66] Government Accountability Office, *Defense Acquisitions Annual Assessment[:] Drive to Deliver Capabilities Faster Increases Importance of Program Knowledge and Consistent Data for Oversight*, GAO-20-439, June 2020, p. 120. See also Anthony Capaccio, "Navy's Priciest Carrier Ever Struggles to Get Jets On, Off Deck," *Bloomberg*, January 9, 2021.

FY2021 National Defense Authorization Act (H.R. 6395/S. 4049/P.L. 116-283)

House

The House Armed Services Committee, in its report (H.Rept. 116-442 of July 9, 2020) on H.R. 6395, recommended the funding levels shown in the HASC column of **Table 3**. The recommended reductions of $90.0 million for CVN-80 and $180.0 million for CVN-81 are for " Full funding early to need." (Page 344)

Section 1042 of H.R. 6395 as reported by the committee states

> SEC. 1042. PROHIBITION ON RETIREMENT OF NUCLEAR POWERED AIRCRAFT CARRIERS BEFORE FIRST REFUELING.
>
> Section 8062 of title 10, United States Code, is amended by adding at the end the following new subsection:
>
> ''(f) A nuclear powered aircraft carrier may not be retired before its first refueling.''.

Senate

The Senate Armed Services Committee, in its report (S.Rept. 116-236 of June 24, 2020) on S. 4049, recommended the funding levels shown in the SASC column of **Table 3**.

Section 126 of S. 4049 as reported by the committee states

> SEC. 126. TREATMENT OF SYSTEMS ADDED BY CONGRESS IN FUTURE PRESIDENT'S BUDGET REQUESTS.
>
> A procurement quantity of a system authorized by Congress in a National Defense Authorization Act for a given fiscal year that is subsequently appropriated by Congress in an amount greater than the quantity of such system included in the President's annual budget request submitted to Congress under section 1105 of title 31, United States Code, for such fiscal year shall not be included as a new procurement quantity in future annual budget requests.

Regarding Section 126, S.Rept. 116-236 states

> **Treatment of weapon systems added by Congress in future President's budget requests (sec. 126)**
>
> The committee recommends a provision that would preclude the inclusion in future annual budget requests of a procurement quantity of a system previously authorized and appropriated by the Congress that was greater than the quantity of such system requested in the President's budget request.
>
> The committee is concerned that by presenting CVN–81 as a ship that was procured in fiscal year 2020 (instead of as a ship that was procured in fiscal year 2019), LPD–31 as a ship requested for procurement in fiscal year 2021 (instead of as a ship that was procured in fiscal year 2020), and LHA–9 as a ship projected for procurement in fiscal year 2023 (instead of as a ship that was procured in fiscal year 2020), the Department of Defense, in its fiscal year 2021 budget submission, is disregarding or mischaracterizing the actions of Congress regarding the procurement dates of these three ships. (Page 11)

Section 127 of S. 4049 as reported by the committee states

> SEC. 127. REPORT ON CARRIER WING COMPOSITION.

(a) REPORT.—Not later than May 1, 2021, the Secretary of the Navy, in consultation with the Chief of Naval Operations and Commandant of the Marine Corps, shall submit to the congressional defense committees a report on the optimal composition of the carrier air wing in 2030 and 2040, as well as alternative force design concepts.

(b) ELEMENTS.—The report required under subsection (a) shall include the following elements:

(1) An analysis and justification used to reach the 50-50 mix of 4th and 5th generation aircraft for 2030.

(2) An analysis and justification for the optimal mix of carrier aircraft for 2040.

(3) A plan for incorporating unmanned aerial vehicles and associated communication capabilities to effectively implement the future force design.

Conference

The conference report (H.Rept. 116-617 of December 3, 2020) on H.R. 6395/P.L. 116-283 of January 1, 2021, recommends the funding levels shown in the authorization conference column of **Table 3**. The recommended reduction of $90.0 million for CVN-80 and the recommended reduction of $39.174 million for CVN-81 are for "Full funding early to need." (PDF page 4276 of 4517)

Section 126 of the conference version of H.R. 6395 states

SEC. 126. TREATMENT IN FUTURE BUDGETS OF THE PRESIDENT OF SYSTEMS ADDED BY CONGRESS.

In the event the procurement quantity for a system authorized by Congress in a National Defense Authorization Act for a fiscal year, and for which funds for such procurement quantity are appropriated by Congress in the Shipbuilding and Conversion, Navy account for such fiscal year, exceeds the procurement quantity specified in the budget of the President, as submitted to Congress under section 1105 of title 31, United States Code, for such fiscal year, such excess procurement quantity shall not be specified as a new procurement quantity in any budget of the President, as so submitted, for any fiscal year after such fiscal year.

Regarding Section 126, H.Rept. 116-617 states

Treatment in future budgets of the President of systems added by Congress (sec. 126)

The Senate amendment contained a provision (sec. 126) that would preclude the inclusion in future annual budget requests of a procurement quantity of a system previously authorized and appropriated by the Congress that was greater than the quantity of such system requested in the President's Budget request.

The House bill contained no similar provision.

The House recedes with an amendment that would limit the effect of this provision to the Shipbuilding and Conversion, Navy account. (PDF page 3734 of 4517)

Section 1054 of the conference version of H.R. 6395 states

SEC. 1054. PROHIBITION ON RETIREMENT OF NUCLEAR POWERED AIRCRAFT CARRIERS BEFORE FIRST REFUELING.

Section 8062 of title 10, United States Code, is amended by adding at the end the following new subsection:

''(f) A nuclear powered aircraft carrier may not be retired before its first refueling.''.

H.Rept. 116-617 also states

> *Report on carrier wing composition*
>
> The Senate amendment contained a provision (sec. 127) that would direct the Secretary of the Navy, in consultation with the Chief of Naval Operations and Commandant of the Marine Corps, to submit a report to the congressional defense committees, not later than May 1, 2021, on the optimal compositions of the carrier air wing in 2030 and 2040, as well as alternative force design concepts.
>
> The House bill contained no similar provision.
>
> The Senate recedes. (PDF page 3752 of 4517)

FY2021 DOD Appropriations Act (H.R. 7617/S. XXXX/Division C of H.R. 133/P.L. 116-260)

House

The House Appropriations Committee, in its report (H.Rept. 116-453 of July 16, 2020) on H.R. 7617, recommended the funding levels shown in the HAC column of **Table 3**. The recommended reductions of $92.744 million for CVN-80 and $39.174 million for CVN-81 are for "Hardware procurements early to need." (Page 184)

Senate

The Senate Appropriations Committee, in the explanatory statement for S. XXXX that the committee released on November 10, 2020, recommended the funding levels shown in the SAC column of **Table 3**.

Conference

The explanatory statement for the final version of the FY2021 DOD Appropriations Act (Division C of H.R. 133/P.L. 116-260 of December 27, 2020), the Consolidated Appropriations Act, 2021) provides the funding levels shown in the appropriation conference column of **Table 3**. The reductions of $38.611 million for CVN-80 and $39.174 million for CVN-81 are for "Hardware procurements early to need." (PDF page 203 of 469)

Appendix A. Background Information on Two-Ship Block Buy for CVN-80 and CVN-81

This appendix presents additional background information on the two-ship block buy contract for CVN-80 and CVN-81.

The option for procuring two CVN-78 class carriers under a two-ship block buy contract had been discussed in this CRS report since April 2012.[67] In earlier years, the discussion focused on the option of using a block buy contract for procuring CVN-79 and CVN-80. In more recent years, interest among policymakers focused on the option of using a block buy contract for procuring CVN-80 and CVN-81.

On March 19, 2018, the Navy released a request for proposal (RFP) to Huntington Ingalls Industries/Newport News Shipbuilding (HII/NNS) regarding a two-ship buy of some kind for CVN-80 and CVN-81. A March 20, 2018, Navy News Service report stated the following:

> The Navy released a CVN 80/81 two-ship buy Request for Proposal (RFP) to Huntington Ingalls Industries—Newport News Shipbuilding (HII-NNS) March 19 to further define the cost savings achievable with a two-ship buy.
>
> With lethality and affordability a top priority, the Navy has been working with HII-NNS over the last several months to estimate the total savings associated with procuring CVN 80 and CVN 81 as a two-ship buy.
>
> "In keeping with the National Defense Strategy, the Navy developed an acquisition strategy to combine the CVN 80 and CVN 81 procurements to better achieve the Department's objectives of building a more lethal force with greater performance and affordability," said James F. Geurts, Assistant Secretary of the Navy, Research Development and Acquisition. "This opportunity for a two-ship contract is dependent on significant savings that the shipbuilding industry and government must demonstrate. The Navy is requesting a proposal from HII-NNS in order to evaluate whether we can achieve significant savings."
>
> The two-ship buy is a contracting strategy the Navy has effectively used in the 1980s to procure Nimitz-class aircraft carriers and achieved significant acquisition cost savings compared to contracting for the ships individually. While the CVN 80/81 two-ship buy negotiations transpire, the Navy is pursuing contracting actions necessary to continue CVN 80 fabrication in fiscal year (FY) 2018 and preserve the current schedule. The Navy plans to award the CVN 80 construction contract in early FY 2019 as a two-ship buy pending Congressional approval and achieving significant savings.[68]

Section 121(a)(2) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (H.R. 5515/P.L. 115-232 of August 13, 2018) permitted the Navy, after DOD made certain certifications to Congress, to add CVN-81 to the existing contract for building CVN-80. DOD provided the required certification on December 31, 2018. On January 31, 2019, the Navy

[67] See the section entitled "Potential Two-Ship Block Buy on CVN-79 and CVN-80" in the April 4, 2012, version of CRS Report RS20643, *Navy Ford (CVN-78) Class Aircraft Carrier Program: Background and Issues for Congress*, by Ronald O'Rourke. In more recent years, this section was modified to discuss the option in connection with CVN-80 and CVN-81.

[68] Naval Sea Systems Command Public Affairs, "Navy Seeks Savings, Releases Two-Carrier RFP," *Navy News*, March 20, 2018. See also Megan Eckstein, "UPDATED: Navy, Newport News Taking Steps Towards Two-Carrier Buy," *USNI News*, March 19, 2018.

announced that it had awarded a two-ship fixed-price incentive (firm target) (FPIF) contract for CVN-80 and CVN-81 to HII/NNS.[69]

The two-ship contract for CVN-80 and CVN-81 can be viewed as a block buy contract because the two ships are being procured in different fiscal years (CVN-80 was procured in FY2018 and CVN-81 is shown in the Navy's FY2020 budget submission as a ship procured in FY2020).[70] The Navy's previous two-ship aircraft carrier procurements occurred in FY1983 (for CVN-72 and CVN-73) and FY1988 (for CVN-74 and CVN-75). In each of those two earlier cases, however, the two ships were fully funded within a single fiscal year, making each of these cases a simple two-ship purchase (akin, for example, to procuring two Virginia-class attack submarines or two DDG-51 class destroyers in a given fiscal year) rather than a two-ship block buy (i.e., a contract spanning the procurement of end items procured across more than one fiscal year).

Compared to DOD's estimate that the two-ship block buy contract for CVN-80 and CVN-81 would produce savings of $3.9 billion (as measured from estimated costs for the two ships in the December 2017 Navy business case analysis), DOD states that "the Department of Defense's Office of Cost Assessment and Program Evaluation (CAPE) developed an Independent Estimate of Savings for the two-ship procurement and forecast savings of $3.1 billion ([in] Then-Year [dollars]), or approximately 11 percent.... The primary differences between [the] CAPE and Navy estimates of savings are in Government Furnished Equipment[71] and production change orders."[72] Within the total estimated combined reduction in cost, HII/NNS reportedly expects to save up to $1.6 billion in contractor-furnished equipment.[73]

A November 2018 DOD report to Congress that was submitted as an attachment to DOD's December 31, 2018, certification stated the following regarding the sources of cost reduction for the two-ship contract:

> The CVN 80 and CVN 81 two-ship buy expands and improves upon the affordability initiatives identified in the Annual Report on Cost Reduction Efforts for JOHN F. KENNEDY (CVN 79) and ENTERPRISE (CVN 80) as required by section 126(c) of the National Defense Authorization Act for Fiscal Year 2017 (P.L. 114-328). Production saving initiatives for single-ship buys included use of unit families in construction, pre-outfitting and complex assemblies which move work to a more efficient workspace environment, reduction in the number of superlifts,[74] and facility investments which improve the shipbuilder trade effectiveness. A two-ship buy assumes four years between

[69] See Office of the Navy Chief of Information, "Navy Awards Contract for Construction of Two Carriers," Navy News Service, January 31, 2019; Megan Eckstein, "UPDATED: Navy Awards 2-Carrier Contract to Newport News Shipbuilding," *USNI News*, January 31, 2019; Marcus Weisgerber, "US Navy Places First 2-Carrier Order in Three Decades," *Defense One*, January 31, 2019; David B. Larter, "US Navy Signs Mammoth Contract with Huntington Ingalls for Two Aircraft Carriers," *Defense News*, January 31, 2019; Rich Abott, "Navy Awards HII $15 Billion In Two Carrier Buy," *Defense Daily*, February 1, 2019.

[70] 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.

[71] Government-furnished equipment (GFE) is equipment that the government purchases from supplier firms and then provides to the shipbuilder for incorporation into the ships.

[72] Department of Defense, FORD Class Aircraft Carrier Certification, CVN 80 and CVN 81 Two Ship Procurement Authority, as Required by Section 121(b) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (P.L. 115-232), November 2018, pp. 8-9.

[73] Rich Abott, "Navy Awards HII $15 Billion In Two Carrier Buy," *Defense Daily*, February 1, 2019. Contractor-furnished equipment (CFE) is equipment that the contractor (in this case, HII/NNS) purchases from supplier firms for incorporation into the ships.

[74] A superlift is the use of a crane to move a very large section of the ship from the land into its final position on the ship.

> ship deliveries which allows more schedule overlap, and therefore more shop-level and assembly-level production efficiencies than two single-ship buys.
>
> Procuring two ships to a single technical baseline reduces the requirement for engineering labor hours when compared to single-ship estimates. The ability to rollover production support engineering and planning products maximizes savings while recognizing the minimum amount of engineering labor necessary to address obsolescence and regulatory changes on CVN 81. The two-ship agreement with the shipbuilder achieves a 55 percent reduction in construction support engineering hours on CVN 81 and greater than 18 percent reduction in production support and planning hours compared to single ship procurements.
>
> The two-ship procurement strategy allows for serial production opportunities that promote tangible learning and reduced shop and machine set-up times. It allows for efficient use of production facilities, re-use of production jigs and fixtures, and level loading of key trades. The continuity of work allows for reductions in supervision, services and support costs. The result of these efficiencies is a production man-hours step down that is equivalent to an 82 percent learning curve since CVN 79.
>
> Key to achieving these production efficiencies is Integrated Digital Shipbuilding (iDS). The Navy's Research, Development, Test, and Evaluation (RDT&E) and the shipbuilder's investment in iDS, totaling $631 million, will reduce the amount of production effort required to build FORD Class carriers. The two-ship buy will accelerate the benefits of this approach. The ability to immediately use the capability on CVN 81 would lead to a further reduction in touch labor and services in affected value streams. The two-ship agreement with the shipbuilder represents a production man-hours reduction of over seven percent based on iDS efficiencies. Contractual authority for two ships allows the shipbuilder to maximize economic order quantity material procurement. This allows more efficient ordering and scheduling of material deliveries and will promote efficiencies through earlier ordering, single negotiations, vendor quotes, and cross program purchase orders. These efficiencies are expected to reduce material costs by about six percent more when compared to single-ship estimates. Improved material management and flexibility will prevent costly production delays. Furthermore, this provides stability within the nuclear industrial base, de-risking the COLUMBIA and VIRGINIA Class programs. The two-ship buy would provide economic stability to approximately 130,000 workers across 46 States within the industrial base.
>
> Change order requirements are likewise reduced as Government Furnished Equipment (GFE) providers will employ planning and procurement strategies based on the common technical baseline that minimize configuration changes that must be incorporated on the follow ship. Change order budget allocations have been reduced over 25 percent based on two-ship strategies.
>
> In addition to the discrete savings achieved with the shipbuilder, the two-ship procurement authority provides our partner GFE providers a similar opportunity to negotiate economic order quantity savings and achieve cross program savings when compared to single-ship estimates.[75]

An April 16, 2018, press report stated the following:

> If the Navy decides to buy aircraft carriers CVN-80 and 81 together, Newport News Shipbuilding will be able to maintain a steady workload that supports between 23,000 and 25,000 workers at the Virginia yard for the next decade or so, the shipyard president told reporters last week.

[75] Department of Defense, FORD Class Aircraft Carrier Certification, CVN 80 and CVN 81 Two Ship Procurement Authority, as Required by Section 121(b) of the John S. McCain National Defense Authorization Act for Fiscal Year 2019 (P.L. 115-232), November 2018, pp. 6-7.

> Part of the appeal of buying the two carriers together is that the Navy would also buy them a bit closer together: the ships would be centered about three-and-a-half or four years apart, instead of the five-year centers for recent carrier acquisition, Newport News Shipbuilding President Jennifer Boykin told reporters.
>
> Boykin said the closer ship construction centers would allow her to avoid a "labor valley" where the workforce levels would dip down after one ship and then have to come back up, which is disruptive for employees and costly for the company.
>
> If this two-carrier buy goes through, the company would avoid the labor valley altogether and ensure stability in its workforce, Boykin said in a company media briefing at the Navy League's Sea Air Space 2018 symposium. That workforce stability contributes to an expected $1.6 billion in savings on the two-carrier buy from Newport News Shipbuilding's portion of the work alone, not including government-furnished equipment....
>
> Boykin said four main things contribute to the expected $1.6 billion in savings from the two-carrier buy. First, "if you don't have the workforce valley, there's a labor efficiency that represents savings."
>
> Second, "if you buy two at once, my engineering team doesn't have to produce two technical baselines, two sets of technical products; they only have to produce one, and the applicability is to both, so there's savings there. When we come through the planning, the build plan of how we plan to build the ship, the planning organization only has to put out one plan and the applicability is to both, so there's savings there."
>
> The third savings is a value of money over time issue, she said, and fourth is economic order quantity savings throughout the entire supply chain.[76]

Discussions of the option of using a block buy contract for procuring carriers have focused on using it to procure two carriers in part because carriers have been procured on five-year centers, meaning that two carriers could be included in a block-buy contract spanning six years—the same number of years originally planned for the two block buy contracts that were used to procure mnay of the Navy's Littoral Combat Ships.[77]

It can be noted, however, that there is no statutory limit on the number of years that a block buy contract can cover, and that the LCS block buy contracts were subsequently amended to cover LCSs procured in a seventh year. This, and the possibility of procuring carriers on 3- or 3.5-year centers, raises the possibility of using a block buy contract to procure three aircraft carriers: For example, if procurement of aircraft carriers were shifted to 3- or 3.5-year centers, a block buy contract for procuring CVN-80, CVN-81, and CVN-82 could span seven years (with the first ship procured in FY2018, and the third ship procured in FY2024) or eight years (with the first ship procured in FY2018 and the third ship procured in FY2025).

The percentage cost reduction possible under a three-ship block buy contract could be greater than that possible under a two-ship block buy contract, but the offsetting issue of reducing congressional flexibility for changing aircraft carrier procurement plans in coming years in response to changing strategic or budgetary circumstances could also be greater.

[76] Megan Eckstein, "Newport News Would Save $1.6 Billion, Maintain Stable Workforce of 25,000 Under 2 Proposed Carrier Buy," *USNI News*, April 16, 2018. See also Rich Abott, "HII Sees Two Carrier Buy Saving $1.6 Billion Before GFE," *Defense Daily*, April 11, 2018: 10-11.

[77] For more on the LCS block buy contracts, see CRS Report RL33741, *Navy Littoral Combat Ship (LCS) Program: Background and Issues for Congress*, by Ronald O'Rourke.

Appendix B. Shock Trial

An earlier oversight issue for Congress for the CVN-78 program was whether to conduct the shock trial for the CVN-78 class in the near term, on the lead ship in the class, or years later, on the second ship in the class. This appendix presents background information on that issue.

A shock trial, known formally as a full ship shock trial (FSST) and sometimes called a shock test, is a test of the combat survivability of the design of a new class of ships. A shock trial involves setting off one or more controlled underwater charges near the ship being tested, and then measuring the ship's response to the underwater shock caused by the explosions. The test is intended to verify the ability of the ship's structure and internal systems to withstand shocks caused by enemy weapons, and to reveal any changes that need to be made to the design of the ship's structure or its internal systems to meet the ship's intended survivability standard. Shock trials are nominally to be performed on the lead ship in a new class of ships, but there have also been cases where the shock trial for a new class was done on one of the subsequent ships in the class.

The question of whether to conduct the shock trial for the CVN-78 class in the near term, on the lead ship in the class, or years later, on the second ship in the class, has been a matter of disagreement at times between the Navy and the office of the Secretary of Defense (OSD). The Navy has wanted to perform the shock trial on the second ship in the class, because performing it on the lead ship in the class, the Navy has argued, will cause a significant delay in the first deployment of the lead ship, effectively delaying the return of the carrier force to an 11-ship force level and increasing the operational strain on the other 10 carriers. The Navy has argued that the risks of delaying the shock trial on the CVN-78 to the second ship in the class are acceptable, because the CVN-78 class hull design is based on the Nimitz (CVN-68) class aircraft carrier hull design, whose survivability against shocks is understood, because systems incorporated into the CVN-78 design have been shock tested at the individual component level, and because computer modeling can simulate how the CVN-78 design as a whole will respond to shocks.

OSD has argued that the risks of delaying the CVN-78 class shock trial to the second ship in the class are not acceptable, because the CVN-78 design is the first new U.S. aircraft carrier design in four decades; because the CVN-78 design has many internal design differences compared to the CVN-68 design, including new systems not present in the CVN-68 class design; and because computer modeling can only do so much to confirm how a complex new platform, such as an aircraft carrier and all its internal systems, will respond to shocks. The risk of delaying the shock trial, OSD has argued, outweighs the desire to avoid a delay in the first deployment of the lead ship in the class. OSD in 2015 directed the Navy to plan for conducting a shock trial on the lead ship. The Navy complied with this direction but has also sought to revisit the issue with OSD.

The issue of the shock trial for the CVN-78 class has been a matter of legislative activity—see, for example, Section 121(b) of the FY2018 National Defense Authorization Act (H.R. 2810/P.L. 115-91 of December 12, 2017).

An April 5, 2018, press report states the following:

> The Pentagon's No. 2 civilian has said the Navy should perform shock-testing soon to determine how well its new $12.9 billion aircraft carrier—the costliest warship ever—could withstand an attack, affirming the service's recent decision to back down from a plan for delay.
>
> "We agree with your view that a test in normal sequence is more prudent and pragmatic," Deputy Defense Secretary Patrick Shanahan said in a newly released March 26 letter to Senate Armed Services Committee Chairman John McCain. The Arizona Republican and

Senator Jack Reed, the panel's top Democrat, pressed for the shock-testing to go ahead as originally planned.

James Guerts, the Navy's chiefs weapons buyer, told reporters last month that the Navy was acquiescing to the testing after initially asking Defense Secretary James Mattis to delay it for at least six years. In its push to maintain an 11-carrier fleet, the Navy wanted to wait and perform the test on a second carrier in the class rather than on the USS Gerald Ford.[78]

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[78] Anthony Capaccio, "Pentagon Endorses Shock-Testing Carrier After Navy Backs Down," *Bloomberg*, April 5, 2018. See also Craig Hooper, "The Navy Obfuscates On Shock Testing The $13 Billion USS Ford," *Forbes*, October 23, 2019; Jason Sherman and Lee Hudson, "Navy to Conduct Full Ship Shock Trials of CVN-78 in '19 or '20," *Inside the Navy*, March 26, 2018; Anthony Capaccio, "Navy Presses Mattis to Delay 'Shock Testing' Costliest Carrier," *Bloomberg*, February 7, 2018; Jason Sherman, "Lawmakers Rraise Ford-Class Carrier Cost Cap, Grant Navy Wiggle Room to Avoid Shock Testing," *Inside the Navy*, November 13, 2017.