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

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Summary

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). CVN-78 was fully funded in prior fiscal years. The Navy's proposed FY2016 budget requests procurement for CVN-79 and advance procurement (AP) funding for CVN-80.

CVN-78 was procured in FY2008. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $12,887.0 million (i.e., about $12.9 billion) in then-year dollars. The ship received advance procurement funding in FY2001-FY2007 and was fully funded in FY2008-FY2011 using congressionally authorized four-year incremental funding. To help cover cost growth on the ship, the ship received an additional $1,374.9 million in FY2014-FY2016 in FY2015 in so-called cost-to-complete procurement funding. The Navy's proposed FY2017 budget does not request any additional funding for the ship. The Navy has postponed the ship's delivery date repeatedly to accommodate delays in its construction and testing process. As of January 2017, the ship was scheduled to be delivered to the Navy in April 2017.

CVN-79 was procured in FY2013. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $11,398.0 million (i.e., about $11.4 billion) in then-year dollars. The ship received advance procurement funding in FY2007-FY2012, and the Navy plans to fully fund the ship in FY2013-FY2018 using congressionally authorized six-year incremental funding. The Navy's proposed FY2017 budget requests $1,291.8 million in procurement funding for the ship. The ship is scheduled for delivery to the Navy in June 2022.

CVN-80 is scheduled to be procured in FY2018. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $12,900.0 million (i.e., $12.9 billion) in then-year dollars. The Navy wants to use AP funding for the ship in FY2016 and FY2017, and then fully fund the ship in FY2018-FY2023 using congressionally authorized six-year incremental funding. The Navy's proposed FY2017 budget requests $1,370.8 million in AP funding for the ship.

CVN-81 is scheduled to be procured in FY2023. Under current plans, the Navy would use AP funding for the ship in FY2021 and FY2022, and then fully fund the ship in FY2023-FY2028 using congressionally authorized six-year incremental funding. The Navy's FY2017 budget submission programs the initial increment of AP funding for the ship in FY2021.

Oversight issues for Congress for the CVN-78 program (and other carrier-related issues) include the following:

- whether to approve, reject, or modify the Navy's FY2017 procurement and advance procurement (AP) funding requests for the CVN-78 program;
- whether to provide advance procurement (AP) funding in FY2017 for the purchase of materials for CVN-81, so as to enable a combined purchase of materials for CVN-80 and CVN-81 (the Navy's proposed FY2017 budget does not request any AP funding for the procurement of materials for CVN-81);
- whether to approve, reject, or modify the Navy's proposal in its FY2017 budget submission to deactivate one of the Navy's carrier air wings;
- 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;
- CVN-78 program issues that were raised in a December 2016 report from the Department of Defense's (DOD's) Director of Operational Test and Evaluation (DOT&E); and

- whether the Navy should shift at some point from procuring large-deck, nuclear-powered carriers like the CVN-78 class to procuring smaller aircraft carriers.

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Introduction

This report provides background information and potential oversight issues for Congress on the Gerald R. Ford (CVN-78) class aircraft carrier program. The Navy's proposed FY2017 budget requests a total of $2,662.6 million in procurement and advance procurement (AP) funding for CVN-79 and CVN-80, the second and third ships in the program. Congress's decisions on the CVN-78 program could substantially affect Navy capabilities and funding requirements and the shipbuilding industrial base.

Background

Strategic and Budgetary Context

For an overview of the strategic and budgetary context in which the CVN-78 class program and other Navy shipbuilding programs may be considered, see CRS Report RL32665, *Navy Force Structure and Shipbuilding Plans: Background and Issues for Congress*, by (name redacted) .

The Navy's Aircraft Carrier Force

The Navy's current aircraft carrier force consists of 10 nuclear-powered Nimitz-class ships (CVNs 68 through 77) that entered service between 1975 and 2009.[1] Until December 2012, the Navy's aircraft carrier force included an 11th aircraft carrier—the one-of-a-kind nuclear-powered *Enterprise* (CVN-65), which preceded the Nimitz-class ships and entered service in 1961. CVN-65 was inactivated on December 1, 2012, reducing the Navy's carrier force from 11 ships to 10. The *Gerald R. Ford* (CVN-78), the lead ship in the CVN-78 class, was scheduled as of January 2017 to be delivered to the Navy in April 2017.[2] It will likely be commissioned some months after it is delivered, returning the Navy's carrier force to a total of 11 ships.

Statutory Requirement to Maintain Not Less Than 11 Carriers

Origin of Requirement

10 U.S.C. 5062(b) requires the Navy to maintain a force of not less than 11 operational aircraft carriers. 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).

Waiver for Period Between CVN-65 and CVN-78

As mentioned above, the carrier force dropped from 11 ships to 10 ships when *Enterprise* (CVN-65) was inactivated on December 1, 2012. The carrier force is to return to 11 ships when its

[1] The *George H. W. Bush* (CVN-77), the final Nimitz-class ship, was procured in FY2001 and commissioned into service on January 10, 2009. CVN-77 replaced *Kitty Hawk* (CV-63), which was the Navy's last remaining conventionally powered carrier. (The *Kitty Hawk* was decommissioned on January 31, 2009.)

[2] Sydney J. Freedberg, "Navy Will Get Supercarrier USS Ford In April—Finally," *Breaking Defense*, January 11, 2017.

replacement, *Gerald R. Ford* (CVN-78), is 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. 5062(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.

Legislative Provision Regarding Number of Carrier Air Wings

In addition to the above-discussed statutory requirement for maintaining not less than 11 operational aircraft carriers, there is a legislative provision regarding the number of carrier air wings. Section 1093 of the FY2012 National Defense Authorization Act (H.R. 1540/P.L. 112-81 of December 31, 2011) states:

> SEC. 1093. NUMBER OF NAVY CARRIER AIR WINGS AND CARRIER AIR WING HEADQUARTERS.
>
> The Secretary of the Navy shall ensure that the Navy maintains--
>
> (1) a minimum of 10 carrier air wings; and
>
> (2) for each such carrier air wing, a dedicated and fully staffed headquarters.

This provision was codified as 10 U.S.C. 5062 note—that is, as a note (i.e., footnote) to 10 U.S.C. 5062.

New Navy Force-Level Goal of 12 Carriers

In December 2016, the Navy released a new force-level goal for achieving and maintaining a fleet of 355 ships, including 12 aircraft carriers[3]—one more than the minimum of 11 carriers required by 10 U.S.C. 5062(b).

Given the time needed to build a carrier, increasing the carrier force from 11 ships to 12 ships on a sustained basis will take a number of years. For example, increasing aircraft carrier procurement from the currently planned five-year centers to three-year centers—that is, increasing aircraft carrier procurement from the currently planned rate of one ship every five years (i.e., FY2018, FY2023, and so on) to a rate of one ship every three years (i.e., FY2018, FY2021, and so on)—would achieve a 12-carrier force on a sustained basis by about 2030, while increasing aircraft carrier procurement to 3.5-year centers (i.e., a combination of three- and four-year centers) would achieve a 12-carrier force on a sustained basis by about 2034.

Increasing aircraft carrier procurement from five-year centers to three- or 3.5-year centers would substantially increase average annual funding requirements for aircraft carrier procurement while reducing somewhat aircraft carrier unit procurement costs due to greater spreading of fixed overhead costs and improved production learning curve benefits at the shipyard and component manufacturers.

[3] 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 (name redacted) .

Funding and Procuring Aircraft Carriers

Some Key Terms

The Navy *procures* a ship (i.e., orders the ship) by awarding a full-ship construction contract to the firm building the ship.

Part of a ship's procurement cost might be provided through *advance procurement (AP) funding*. AP funding is funding provided in one or more years prior to (i.e., in advance of) a ship's year of procurement. AP funding is used to pay for long-leadtime components that must be ordered ahead of time to ensure that they will be ready in time for their scheduled installation into the ship. AP funding is also used to pay for the design costs for a new class of ship. These design costs, known more formally as *detailed design/non-recurring engineering (DD/NRE) costs*, are traditionally incorporated into the procurement cost of the lead ship in a new class of ships.

Fully funding a ship means funding the entire procurement cost of the ship. If a ship has received AP funding, then fully funding the ship means paying for the remaining portion of the ship's procurement cost.

The *full funding policy* is a Department of Defense (DOD) policy that normally requires items acquired through the procurement title of the annual DOD appropriations act to be fully funded in the year they are procured. In recent years, Congress has authorized DOD to use *incremental funding* for procuring certain Navy ships, most notably aircraft carriers. 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.[4]

Incremental Funding Authority for Aircraft Carriers

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 applied to CVNs 79 and 80.

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.

[4] For more on full funding, incremental funding, and AP funding, see CRS Report RL31404, *Defense Procurement: Full Funding Policy—Background, Issues, and Options for Congress*, by (name redacted) and (name redacted) , and CRS Report RL32776, *Navy Ship Procurement: Alternative Funding Approaches—Background and Options for Congress*, by (name redacted) .

Aircraft Carrier Construction Industrial Base

All U.S. aircraft carriers procured since FY1958 have been built by Newport News Shipbuilding (NNS), of Newport News, VA, a shipyard that is part of Huntington Ingalls Industries (HII). 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 hundreds of subcontractors and suppliers in various states.

Gerald R. Ford (CVN-78) Class Program

The Gerald R. Ford (CVN-78) class carrier design (**Figure 1**) is the successor to the Nimitz-class carrier design.[5] The Ford-class design uses the basic Nimitz-class hull form but incorporates several improvements, including features permitting the ship to generate 33% 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, 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. Navy Illustration of CVN-78

Source: Navy image accessed at http://www.navy.mil/management/photodb/photos/060630-N-0000X-001.jpg on April 20, 2011.

[5] The CVN-78 class was earlier known as the CVN-21 class, which meant nuclear-powered aircraft carrier for the 21st century.

CVN-78

CVN-78, which was named for President Gerald R. Ford in 2007,[6] was procured in FY2008. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $12,887.0 million (i.e., about $12.9 billion) in then-year dollars. The ship received advance procurement funding in FY2001-FY2007 and was fully funded in FY2008-FY2011 using congressionally authorized four-year incremental funding. To help cover cost growth on the ship, the ship received an additional $1,374.9 million in FY2014-FY2016 in FY2015 in so-called cost-to-complete procurement funding. The Navy's proposed FY2017 budget does not request any additional funding for the ship. The Navy has postponed the ship's delivery date repeatedly to accommodate delays in its construction and testing process. As of January 2017, the ship was scheduled to be delivered to the Navy in April 2017.[7]

CVN-79

CVN-79, which was named for President John F. Kennedy on May 29, 2011,[8] was procured in FY2013. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $11,398.0 million (i.e., about $11.4 billion) in then-year dollars. The ship received advance procurement funding in FY2007-FY2012, and the Navy plans to fully fund the ship in FY2013-FY2018 using congressionally authorized six-year incremental funding. The Navy's proposed FY2017 budget requests $1,291.8 million in procurement funding for the ship. The ship is scheduled for delivery to the Navy in June 2022.

CVN-80

CVN-80, which was named *Enterprise* on December 1, 2012,[9] is scheduled to be procured in FY2018. The Navy's proposed FY2017 budget estimates the ship's procurement cost at $12,900.0 million (i.e., $12.9 billion) in then-year dollars. The Navy wants to use AP funding for the ship FY2016 and FY2017, and then fully fund the ship in FY2018-FY2023 using congressionally authorized six-year incremental funding. The Navy's proposed FY2017 budget requests $1,370.8 million in AP funding for the ship.

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[6] §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 will consequently be 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 (name redacted) .

[7] Sydney J. Freedberg, "Navy Will Get Supercarrier USS Ford In April—Finally," *Breaking Defense*, January 11, 2017.

[8] 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.

[9] 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.

CVN-81

CVN-81 is scheduled to be procured in FY2023. Under current plans, the Navy would use AP funding for the ship in FY2021 and FY2022, and then fully fund the ship in FY2023-FY2028 using congressionally authorized six-year incremental funding. The Navy's FY2017 budget submission programs the initial increment of AP funding for the ship in FY2021.

Program Procurement Funding

Table 1 shows procurement funding for CVNs 78, 79, 80, and 81 through FY2021.

Table 1. Procurement Funding for CVNs 78, 79, 80, and 81 Through FY2021

(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	2,684.6 (FF)	1,210.6 (AP)	0	0	3,895.2
FY10	737.0 (FF)	482.9 (AP)	0	0	1,219.9
FY11	1,712.5 (FF)	902.5 (AP)	0	0	2,615.0
FY12	0	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)	1,569.6 (FF)	862.4 (AP)	0	2,555.8
FY17 (requested)	*0*	*1,291.8 (FF)*	*1,370.8 (AP)*	*0*	*2,662.6*
FY18 (programmed)	*0*	*2,581.7 (FF)*	*1,779.5 (FF)*	*0*	*4,361.2*
FY19 (programmed)	*0*	*0*	*1,650.2 (FF)*	*0*	*1,650.2*
FY20 (programmed)	*0*	*0*	*1,734.5 (FF)*	*0*	*1,734.5*
FY21 (programmed)	*0*	*0*	*2,126.8 (FF)*	*968.4 (AP)*	*3,095.2*
FY22-FY23 (projected)	*0*	*0*	*3,375.8 (FF)*	*n/a*	*n/a*
Total	**12,887.0**	**11,398.0**	**12,900.0**	**n/a**	**n/a**

Source: Table prepared by CRS based on FY2017 Navy 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). The $3,375.8 million in full funding for CVN-80 is to be divided between FY2022 and FY2023. Under current plans, CVN-81 would be funded with AP funding in FY2021 and FY2022, and full funding in FY2023-FY2028.

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-FY2017 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[a]	FY13[b]	n/a[a]	FY18[b]	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[c]	13,874.2	FY18[c]	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
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	
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	
Cumulative % change through FY17								
Since FY08 (CVN-78 year of proc.)	+22.9%		+24.0%		+20.4%		n/a	
Since FY13 (CVN-79 year of proc.)	+4.6%		-0.1%		-7.0%		n/a	

Source: Table prepared by CRS based on FY2008-FY2017 Navy budget submissions.

a. n/a means not available; the FY2010 budget submission did not show estimated procurement costs for CVNs 79 and 80.

b. The FY2010 budget submission did not show scheduled years of procurement for CVNs 79 and 80; the dates 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.

c. Although the FY2013 budget did not change the scheduled years of procurement for CVN-79 and CVN-80 compared to what they were under the FY2012 budget, it lengthened the construction period for each ship by two years (i.e., each ship is scheduled to be delivered two years later than under the FY2012 budget).

Program Procurement Cost Cap

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 128 of S. 1356/P.L. 114-92 states:

> SEC. 128. Limitation on availability of funds for U.S.S. John F. Kennedy (CVN–79).
>
> (a) Limitation.—Of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2016 for procurement for the U.S.S. John F. Kennedy (CVN–79), $100,000,000 may not be obligated or expended until the date on which the Secretary of the Navy submits to the congressional defense committees the certification under subsection (b)(1) or the notification under paragraph (2) of such subsection, as the case may be, and the reports under subsections (c) and (d)....
>
> (c) Report on costs relating to CVN–79 and CVN–80.—
>
> (1) IN GENERAL.—Not later than 90 days after the date of the enactment of this Act, the Secretary of the Navy shall submit to the congressional defense committees a report that evaluates cost issues related to the U.S.S. John F. Kennedy (CVN–79) and the U.S.S. Enterprise (CVN–80).
>
> (2) ELEMENTS.—The report under paragraph (1) shall include the following:
>
> (A) Options to achieve ship end cost of no more than $10,000,000,000.
>
> (B) Options to freeze the design of CVN–79 for CVN–80, with exceptions only for changes due to full ship shock trials or other significant test and evaluation results.
>
> (C) Options to reduce the plans cost for CVN–80 to less than 50 percent of the CVN–79 plans cost.
>
> (D) Options to transition all non-nuclear Government-furnished equipment, including launch and arresting equipment, to contractor-furnished equipment.
>
> (E) Options to build the ships at the most economic pace, such as four years between ships.
>
> (F) A business case analysis for the Enterprise Air Search Radar modification to CVN–79 and CVN–80.
>
> (G) A business case analysis for the two-phase CVN–79 delivery proposal and impact on fleet deployments.

Issues for Congress

FY2017 Funding Request

One issue for Congress is whether to approve, reject, or modify the Navy's FY2017 procurement and advance procurement (AP) funding requests for the CVN-78 program. In assessing this question, Congress may consider various factors, including whether the Navy has accurately priced the work to be funded in FY2017.

Potential for Combined Material Purchase for CVNs 80 and 81

Another potential issue for Congress is whether to provide advance procurement (AP) funding in FY2017 for the purchase of materials for CVN-81, so as to enable a combined purchase of materials for CVN-80 and CVN-81. The Navy's proposed FY2017 budget does not request any AP funding for the purchase of materials for CVN-81; as shown in **Table 1**, the Navy projects that the initial increment of AP funding for CVN-81 will be requested for FY2021.

Supporters of providing funding in FY2017 for the purchase of materials for CVN-81 could argue that doing so would increase economies of scale in the procurement of materials for the two ships, reducing the costs of these materials (and thus the combined procurement cost of the two ships) by potentially hundreds of millions of dollars. They could also argue that purchasing materials for CVN-81 would send a signal to industry that the government is committed to procuring CVN-81, which could give HII/NNS and CVN-78 class component manufacturers the confidence needed to make investments for optimizing their work forces and capital plants for building and making components for CVN-81, which in turn might further reduce the cost of CVN-81.

Opponents of providing funding in FY2017 for the purchase of materials for CVN-81 could argue that the resulting savings in materials costs for CVN-80 and CVN-81, when calculated on a net present value (NPV) basis (i.e., when calculated so as to capture the time value of money), are relatively small, and would consequently provide a relatively low return on the investment that would be made by providing the additional FY2017 funding. They could also argue that providing this funding could result in reductions in funding for other Navy or DOD programs that are of higher priority or which would provide a higher return on investment.

An August 5, 2016, press report states:

> The Navy is formally investigating the possibility of a two-aircraft carrier block buy—lashing procurement of CVN-80 and CVN-81 together across more than a decade—as part of an effort to identify potential options for reducing the total price tag for new Ford-class mega warships, according to the service.
>
> The Navy outlined this potential option, along with others the service is considering to reduce end-costs of new aircraft carrier within mandated cost caps, in a report to Congress delivered on April 22, according to a service spokeswoman.[10]

A March 18, 2016, press report states:

[10] Jason Sherman, "Navy Formally Exploring Two-Carrier Block Buy for CVN-80 and CVN-81," *Inside the Navy*, August 5, 2016.

> The Aircraft Carrier Industrial Base Coalition [ACIBC] has asked lawmakers for "design for affordability" research and development dollars to reduce the cost of building carriers and for advance procurement funding for a block buy of CVN-80 and 81 materials.
>
> The organization, and employees of companies from all tiers of the aircraft carrier supply chain, made five requests during a two-day visit to Capitol Hill, which included private meetings with lawmakers and an open-mic breakfast during which a dozen congressmen expressed support for aircraft carriers and the companies that build them....
>
> The dual-ship buy is one of the five ACIBC talking points for this year's event. Coalition chairman Richard Giannini told USNI News at the breakfast that the organization is asking for $293 million to be pulled forward into the Fiscal Year 2017 budget to support advance procurement for both CVN-80, the future Enterprise, and 81.
>
> That will help us to consolidate the buying efforts," said Giannini, who is also president and CEO of Milwaukee Valve Company.
>
> "They're going to start with this first block on the real long lead time stuff, the bigger equipment, and then over the next several years we'll do the same thing with the suppliers that have shorter lead times. And what that will do is save about $400 to $500 million off the cost of the carrier."
>
> The group is also asking for $20 million in research in development money for a "design for affordability" initiative, which aims to find more efficient ways to build the ship. A similar effort for the Virginia-class attack submarine program saw a five-to-one return on investment, he said.[11]

The possibility of a combined materials purchase for CVN-80 and CVN-81 was discussed at a February 25, 2015, hearing on Department of the Navy acquisition programs before the Seapower and Projection Forces subcommittee of the House Armed Services Committee. At this hearing, the following exchange occurred:

> REPRESENATIVE WITTMAN (continuing):
>
> Secretary Stackley, traditionally, as you look at aircraft carrier advice, we've done them in two-ship procurements....[12]
>
> We've seen with Arleigh Burke-class destroyers as we purchase ships in groups [i.e., under multiyear procurement contracts], we've seen about 15 percent savings when we do that just because of certainties especially for our suppliers for those ships especially aircraft carriers.
>
> Is there any consideration given to grouping advance procurement on CVN 80 and CVN 81...?
>
> SEAN STACKLEY, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, DEVELOPMENT, AND ACQUISITION:
>
> Let me start with the advance procurement for CVN 80 and CVN 81. There's strong argument for why that makes great sense. When you're procuring an aircraft carrier about once every five years and you're relying on a very unique industrial base to do that what you don't want to do is go through the start-stop-start-stop cycle over a stretched period of time and that's a big cost impact.

[11] Megan Eckstein, "Industry Pushing Congress for CVN-80 and 81 Block Buy, Research for Shipbuilding Efficiency," *USNI News*, March 18, 2016.

[12] This appears to be a reference to the two-ship aircraft carrier buys of FY1983 (CVNs 72 and 73) and FY1988 (CVNs 74 and 75).

But the challenge is by the same token, the build cycle for our carrier is greater than 10 years. So CVN 79, for example, she started her advance procurement in [FY]2009 and then she will be delivering to the Navy in 2022. So that's a 13-year period.

So when you talk about doubling down and buying material to support two carriers five years apart that have a 13-year build span, you're trying to buy material as much as 18 years ahead of when the carrier went through the fleet.

So it's a—it makes great sense looking at just from the program's perspective on why we want to do that to drive the cost of the carrier down, there's risk associated with things like not necessarily obsolescence but change associated with the carrier because the threat changes and that brings change.

And then the investment that far in advance when the asset actually interests the fleet. As the acquisition guy, I will argue for why we need to do that but getting through -- carrying that argument all the way through to say that we're going to take the [CVN] 80 which is in [FY]2018 ship, the [CVN] 81 which is at [sic:an] [FY]2023 ship, buy material early for that 2023 ship delivering to the Navy in the mid 2030s. That's going to be a hard—it's going to be hard for me to carry the day in terms of our budget process.

WITTMAN:

So we have to have the compelling case for the specific things that from industrial base perspective from a move the needle from a cost perspective justify the combined buys of [CVN] 80 and [CVN] 81 together.

Well, it seems like even if the scale is an issue as far as how much you've have to expand to do that and manage that within the budget, you could at least then identify those critical suppliers and look for certainty to make sure that they can continue providing those specialty parts and if you can at least pair it down, again, at a critical mass where you can demonstrate economies scale saving that you get at least say, these are the areas we need to maintain this industrial base especially for small scale suppliers that rely on certainty to continue that effort.

So have you all given any thoughts to be able to scale at least within that area maybe not to get 15 percent savings but still create certainty, make sure the suppliers are there but also gain saving.

STACKLEY:

Yes, sir. We have a very conservative effort going on for the Navy and Newport News [Shipbuilding] on all things cost related to the CVN 78 class for all the right reasons. We are looking ahead at [CVN] 80 which is a 2016— the advance procurement starts in 2016 for the [CVN] 80, most of that could be nuclear material.

But Newport News [Shipbuilding] has bought the initiative to the table in terms of combined buys from material and now we have to sort out can we in fact come up with the right list of material that make sense to buy early, to buy combined, to get the savings and not just savings people promising savings in the (inaudible) but to actually to be able to book the savings so we can drive down the cost to those carriers.

So we are—I would say that we're working with industry on that. We've got a long way to go to be able to carry the day inside the budget process. First inside the building and then again, I will tell you, we're going to have some challenges convincing some folks on the Hill that this makes sense to invest this early in the future aircraft carrier.[13]

[13] Source: transcript of hearing. Earlier versions of this CRS report discussed the possibility for reducing the procurement costs of CVN-79 and CVN-80 through the use of a block buy of the two ships. See also Lara Seligman and Marjorie Censer, "Huntington Ingalls Touts Cost Savings On CVN-79, Pushes Two-Ship Buy," *Inside the Navy*, (continued...)

Proposal to Deactivate Carrier Air Wing

Another aircraft carrier-related oversight issue for Congress for FY2017 is whether to approve, reject, or modify the Navy's FY2017 budget submission to deactivate a carrier air wing. Implementing this proposal would reduce the number of carrier air wings from 10 to 9, which would not be consistent with the above-noted legislative provision regarding the number of carrier air wings that has been codified at 10 U.S.C. note. The Navy, as part of its proposal to deactivate the air wing, may seek legislative relief from this provision.

In recent years, the number of carrier air wings has usually been one less than the number of carriers—a difference intended to account for the fact that in recent years, one carrier typically has been unavailable due to being in a lengthy mid-life refueling overhaul, known as a refueling complex overhaul (RCOH). Since, as noted earlier, the commissioning into service of the *Gerald R. Ford* is to bring the Navy's carrier force back to 11 ships, deactivating a carrier air wing would mean that the number of carrier air wings would now be two less than the number of carriers.

As shown in **Table 3**, the Navy estimates that deactivating the air wing would save a net $926 million over the five-year period FY2017-FY2021. Stated the other way, this is the funding that would need to be added back to the Navy's budget to preserve the air wing during this five-year period.

Table 3. Estimated Net Savings of Deactivating Carrier Air Wing

Millions of dollars, rounded to nearest tenth

Appropriation account	FY17	FY18	FY19	FY20	FY21	Total
Operation and maintenance, Navy (OMN)	85.5	89.1	106.6	111.7	73.4	466.3
Military Personnel, Navy (MPN)	46.1	94.1	96.2	98.5	101.1	436.0
Defense Health Agency—Navy (DHAN)	2.3	4.9	5.2	5.5	5.8	23.7
TOTAL	**134.0**	**188.1**	**208.0**	**215.7**	**180.3**	**926.0**

Source: Table prepared by CRS, based on data received from Navy Office of Legislative Affairs, March 15, 2006.

Notes: Totals may not add due to rounding. DHAN is the Navy's acronym for its Medicare Eligible Retiree Health Care Fund account.

A Navy point paper about the proposal to deactivate the air wing, organized in a question-and-answer format, states:

> **Q: Why was the decision made to deactivate the 10th CVW?**
>
> A: The requirement for 10 CVWs was reassessed in the Navy's PB17 budget [President's budget for FY2017—the Navy's proposed FY2017 budget] for a number of reasons including efficiencies gained through implementation of the Optimized Fleet Response Plan [the Navy's plan for managing ship operational cycles and deployments], the predictability of aircraft carrier CVN maintenance schedules and deliveries, increasing readiness of carrier air wing squadrons through all phases of training, and fiscal constraints. We continue to assess our requirements, balancing today's need with future priorities.
>
> **Q: Will this cause increased stress on the force?**

(...continued)

June 15, 2015.

A: No. The Navy is committed to easing the transition for our affected personnel while maintaining ability to meet future requirements. The Navy continually assesses and accounts for risk by balancing today's need with all future operational priorities and requirements through 2025.

Q: What happens to our ability to surge our carrier air wings on short notice if the need arose?

A: The Navy will be able to meet the CVW surge requirement as planned for within the OFRP cycle.

Q: What's the cost savings of deactivation the 10th CVW?

A: The Navy performed a cost benefit analysis and expects a savings of $926M [million] across the Future Years Defense Plan [FY2017-FY2021], based on anticipated operational requirements.

Q: When will this proposal go into effect?

A: The units will begin deactivation starting October 2016.

Q: What does a current operational carrier air wing consist of?

A: A carrier air wing consists of one fully staffed headquarters, four strike fighter squadrons (VFA or VMFA; 44 F/A-18A/C/E/F aircraft), one airborne early warning squadron (VAW; four E-2C or five E-2D aircraft), one electronic warfare squadron (VAQ; five or six EA-18G aircraft), one helicopter sea combat squadron (HSC; eight MH-60S aircraft), one helicopter maritime strike squadron (HSM; 11 MH-60R aircraft), one carrier onboard delivery detachment (VRC; two C-2A aircraft).

Q: What squadrons will be deactivated?

A: The units the Navy proposed for deactivation are:

-CVW-14 staff (NAS [Naval Air Station] Lemoore).

-VFA-15 (NAS Oceana) oldest legacy F/A 18C squadron. This removes the requirement to move a squadron from Oceana to Lemoore in 2017 as was originally planned.

-VAQ 134 (NAS Whidbey Island) this squadron is being transitioned to become an expeditionary Growler squadron and is being funded with PB-14. This alleviates the requirement to stand up a new expeditionary squadron.

-VAW-112 (NAS Pt. Mugu) identified as the best squadron based on time in the training cycle and proposed transition to E-2D.

-HSC-15 (NAS North Island) identified as best squadron based on time in the training cycle.

-HSM-76 (NAS Jacksonville) will not stand up, it was funded in FY-17 (part of PB-16).

Q: How were the proposed squadrons chosen?

A: CNAF [Commander, Naval Air Forces] conducted an extensive review of operational squadrons and units to determine which assets should be deactivated while meeting all mission requirements. Considerations included: when squadrons are scheduled to transition to a new airframe, where the squadron will be in their training cycle, as well as trying to balance the impacts on geographic locations.

Q: What will happen to the aircraft from the eliminated squadrons?

A: Where applicable, the aircraft will be redistributed within existing squadrons in order to support enduring Fleet requirements.

Q: What will happen to the Sailors from the deactivated squadrons?

A: As with any deactivation, the Sailors assigned to VFA-15, HSC-15 and VAW-112 will be reassigned to other operational billets and requirements. With the introduction of a new distribution system for our enlisted Sailors, they will be re-distributed within the Type Model Series [of aircraft] they were trained in. There would a gradual decrease in the number of Sailors assigned to the squadrons (i.e. as sailors detach, they would not be replaced) until the units are officially disestablished. Careful planning has been done to ensure minimal impact on our personnel.

Q: Will air wings have a sufficient buffer to maintain, train and deploy with the deactivation of the 10th CVW?

A: Yes. The Navy's proposal alleviates excessive time between deployments for carrier air wings while improving warfighting readiness posture across the force. Our forces will remain healthy and ready to provide presence to ensure security and stability in the world.

Q: Won't the aircraft in remaining air wings be used at a higher rate increasing the stress on the force?

A: Readiness requirements will not change for the remaining squadrons during their training and readiness cycles. The level loading of air wings to carriers provides squadrons a more stable and predictable cycle.

Q: What happens when USS Gerald R. Ford (CVN 78) and USS John F. Kennedy (CVN 79) come online?

A: The proposed plan matches the number of complete carrier air wings to the number of operationally available carriers (nine) through 2025. This accounts for one carrier in refueling and complex overhaul (RCOH) and one to two carriers in major scheduled maintenance periods. The Navy will continue to assess requirements based on Global Force Management Allocation Plan (GFMAP) changes in coming years.

Q. What do you mean by deactivation, how is that different from decommissioning?

A. Deactivation allows the administrative codes within our personnel and data systems to remain in a holding status, while disestablishment or decommissioning is more final and requires historical archiving of the unit. If requirements change in the future and we need to reactivate a 10th air wing, it will require a less rigorous administrative process.[14]

Potential oversight issues for Congress include the following:

- The Navy states that the proposal to deactivate the carrier air wing "accounts for one carrier in refueling and complex overhaul (RCOH) and one to two carriers in major scheduled maintenance periods." Will this be a sustained higher level of carrier maintenance than in recent previous years? If not, why did the Navy not propose to deactivate the air wing until now?
- What impact, if any, would deactivating the carrier air wing have on operational risk in combat situations, particularly in a scenario of overlapping major regional contingencies?
- If Congress were to provide the additional funding needed to retain the air wing without reducing funding for other Navy programs, would the Navy prefer to retain the air wing?
- If the next Administration, which takes office in January 2017 (i.e., in the fourth month of FY2017) were to decide that it wanted to retain rather than deactivate

[14] Source: Email received by CRS from Navy Office of Legislative Affairs, March 14, 2016.

the air wing, perhaps as part of a plan to enlarge the size of the Navy, how easy would it be to reverse early FY2017 actions to deactivate the air wing, and how would the costs of stopping and then reversing a plan to deactivate the air wing compare with the costs of retaining the air wing during FY2017?

Cost Growth and Managing Costs Within Program Cost Caps

For the past several years, 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 have been continuing oversight issues for Congress on the CVN-78 program.[15] As shown in **Table 2**, the estimated procurement costs of CVNs 78, 79, and 80 have grown 22.9%, 24.0%, and 20.4%, respectively, since the submission of the FY2008 budget. Cost growth on CVN-78 required the Navy to program $1,374.9 million in cost-to-complete procurement funding for the ship in FY2014-FY2016 (see **Table 1**). As also shown in **Table 2**, however,

- 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, it has remained stable in the FY2015, FY2016, and FY2017 budgets;
- 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),[16] it has fluctuated a bit but remained more or less stable since the FY2013 budget; and

[15] The Congressional Budget office (CBO) in 2008 and the Government Accountability Office (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.)

[16] 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.

- while the estimated cost of CVN-79 grew considerably between the FY2008 budget and the FY2011 budget (in part because the procurement date for the ship was deferred by two years in the FY2010 budget),[17] it has decreased a bit since the FY2011 budget.

Section 121 of the FY2014 National Defense Authorization Act (H.R. 3304/P.L. 113-66 of December 26, 2013), in addition to amending the procurement cost cap for the CVN-78 program (see previous section), requires the Navy to submit

> on a quarterly basis a report setting forth the most current cost estimate for the aircraft carrier designated as CVN-79 (as estimated by the program manager). Each cost estimate shall include the current percentage of completion of the program, the total costs incurred, and an estimate of costs at completion for ship construction, Government-furnished equipment, and engineering and support costs.

Section 121 also states that

> The Secretary [of the Navy] shall ensure that each prime contract for the aircraft carrier designated as CVN-79 includes an incentive fee structure that will, throughout the period of performance of the contract, provide incentives for each contractor to meet the portion of the cost of the ship, as limited by subsection (a)(2) and adjusted pursuant to subsection (b) [i.e., the amended procurement cost cap for the program], for which the contractor is responsible.

Sources of risk of cost growth on CVN-78 in the past have included, among other things, certain new systems to be installed on CVN-78 whose development, if delayed, could delay the completion of the ship. These systems include a new type of aircraft catapult called the Electromagnetic Launch System (EMALS), a new aircraft arresting system called the Advanced Arresting Gear (AAG), and the ship's primary radar, called the Dual Band Radar (DBR). Congress has followed these and other sources of risk of cost growth for years. The Navy in March 2015 stated that of these sources of risk of cost growth, the one that it was watching the most closely was the AAG, because of the discovery in testing of a problem that required the redesign of key component of the AAG called the water twister. As a result of the need to redesign the water twister, the Navy said in 2015, the effort to complete testing of the AAG fell about two years behind schedule, adding risk to the Navy's ability to meet its delivery date for CVN-78.[18]

More generally, the Navy states, now that construction of CVN-78 is mostly complete,[19] the primary remaining risk of further cost growth on CVN-78 relates to the testing of equipment that has been installed on the ship. If that testing reveals problems in the performance of equipment, fixing those problems may add to the ship's cost.

[17] 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.

[18] See, for example, Sam LaGrone, "NAVSEA: Advanced Arresting Gear Design Flaw Delayed Testing Schedule Two Years, Adds Risk to On Time Ford Carrier Delivery," *USNI News*, March 19, 2015; Mike McCarthy, "New Landing System Biggest Challenge To Ford's Delivery Date, Admiral Says," *Defense Daily*, March 20, 2015: 1-2.

[19] The Navy states that construction of CVN-78 was about 96% complete as of February 25, 2015; see Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition), and Vice Admiral Joseph P. Mulloy, Deputy Chief of Naval Operations for Integration of Capabilities and Resources, and Lieutenant General Robert S. Walsh, Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, before the Subcommittee on Seapower and Projection Forces of the House Armed Services Committee on Department of the Navy Seapower and Projection Forces Capabilities, February 25, 2016, p. 9.

In July 2016, the DOD Inspector General issued a report critical of the Navy's management of the AAG development effort.[20]

In September 2016, press reports stated that CVN-78 was experiencing an electrical power problem involving the ship's main turbine generators.[21]

In January 2017, it was reported that after conducting a review of potential alternative systems, the Navy had decided to continue stay with its plan to install EMALs and AAG on the first three Ford-class carriers.[22]

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,[23] 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.

The Navy states that

> The Navy is committed to delivering the lead ship of the class, Gerald R Ford (CVN 78) within the $12.887 billion congressional cost cap. Sustained efforts to identify cost reductions and drive improved cost and schedule performance on this first-of-class aircraft carrier have resulted in highly stable cost performance since 2011. Based on lessons learned on CVN 78, the approach to carrier construction has undergone an extensive affordability review and the Navy and the shipbuilder have made significant changes on CVN 79 to reduce the cost to build the ship. The benefits of these changes in build strategy and resolution of first-of-class impacts experienced on CVN 78 are evident in early production labor metrics on CVN 79. These efforts are ongoing and additional process improvements continue to be identified.

[20] Inspector General, U.S. Department of Defense, *Advanced Arresting Gear Program Exceeded Cost and Schedule Baselines*, Report No DODIG-2016-107, July 5, 2016, 29 pp. For press reports about the DOD IG report, see Justin Doubleday, "DOD IG: Navy Mismanaged Development, Testing of Advanced Arresting Gear," *Inside the Navy*, July 11, 2016; Christopher P. Cavas, "Pentagon Finds Navy Mismanaged Arresting Gear Program," *Defense News*, July 11, 2016.

[21] See Hugh Lessig, "Memo: Carrier Gerald R. Ford Has Persistent Electrical Problem," *Military.com*, September 20, 2016; and Christopher P. Cavas, "Carrier Ford Has Serious Power Problem," *Defense News*, September 18, 2016.

[22] Sydney J. Freedberg Jr., "Navy Commits To High-Tech Catapults, Arresting Gear For All 3 Ford Carriers," *Breaking Defense*, January 17, 2017. See also Sam LaGrone, "NAVSEA: Ford Carrier Advanced Arresting Gear Testing Shows Promise," *USNI News*, November 2, 2016.

[23] 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.

> Alongside the Navy's efforts to reduce the cost to build CVN 79, the FY 2016 National Defense Authorization Act reduced the cost cap for follow ships in the CVN 78 class from $11,498 million to $11,398 million. To this end, the Navy has further emphasized stability in requirements, design, schedule, and budget, in order to drive further improvement to CVN 79 cost. The FY 2017 President's Budget requests funding for the most efficient build strategy for this ship and we look for Congress' full support of this request to enable CVN 79 procurement at the lowest possible cost....
>
> ... The Navy will deliver the CVN 79 within the cost cap using a two-phased strategy wherein select ship systems and compartments that are more efficiently completed at a later stage of construction - to avoid obsolescence or to leverage competition or the use of experienced installation teams - will be scheduled for completion in the ship's second phase of production and test. Enterprise (CVN 80) began construction planning and long lead time material procurement in January 2016 and construction is scheduled to begin in 2018. The FY 2017 President's Budget request re-phases CVN 80 funding to support a more efficient production profile, critical to performance, below the cost cap. CVN 80 planning and construction will continue to leverage class lessons learned to achieve cost and risk reduction, including efforts to accelerate production work to earlier phases of construction, where work is more cost efficient.[24]

For additional background information on 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, see **Appendix A**.

Issues Raised in December 2016 DOT&E Report

Another oversight issue for Congress concerns CVN-78 program issues raised in a December 2016 report from DOD's Director, Operational Test and Evaluation (DOT&E)—DOT&E's annual report for FY2016. The report stated the following in its section on the CVN-78 program:

> **Assessment**
>
> **Test Planning**
>
> • A TEMP [test and evaluation master plan] 1610 revision is under development to address problems with the currently-approved TEMP 1610, Revision B. The Program Office is in the process of refining the post-delivery schedule to further integrate testing and to include the FSST.
>
> • The Navy has not finalized how it intends to extrapolate the live SGR [sortie generation rate] testing (six consecutive 12-hour fly days followed by two consecutive 24-hour fly days) to the 35-day design reference mission on which the SGR requirement is based. COTF [Commander, Operational Test and Evaluation Force] is working with the Program Office to identify required upgrades for the Seabasing/Seastrike Aviation Model to perform this analysis.
>
> • The schedule to deliver the ship has slipped to December 2016 "under review," meaning the Navy is currently evaluating the power plant problems and repair timeline and is determining a new date for delivery. This new date is planned to be announced in

[24] Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition), and Vice Admiral Joseph P. Mulloy, Deputy Chief of Naval Operations for Integration of Capabilities and Resources, and Lieutenant General Robert S. Walsh, Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, before the Subcommittee on Seapower and Projection Forces of the House Armed Services Committee on Department of the Navy Seapower and Projection Forces Capabilities, February 25, 2016, pp. 8-9.

mid-December 2016. Further slips in the delivery are likely to affect schedules for the first at-sea OT&E of CVN 78. Currently, the Program Office is planning for two phases of initial operational testing. The first phase examines basic ship functionality as the ship prepares for flight operations; the second phase focuses on flight operations once the ship and crew are ready. The Navy plans to begin the first phase of testing in late FY18 or early FY19 before CVN 78's FSST. The FSST is followed by CVN 78's first Planned Incremental Availability (PIA), an extended maintenance period. The Navy then plans to complete the second phase of operational testing after the PIA in FY21, subsequent to when the ship would first deploy. To save resources and lower test costs, the test phases are aligned with standard carrier training periods as CVN 78 prepares for its first deployment. Further delays in the ship delivery are likely to push both phases of testing until after the PIA. As noted in previous annual reports, the CVN 78 test schedule has been aggressive, and the development and testing of EMALS, AAG, DBR, and the Integrated Warfare System are driving the ship's schedule independent of the requirement to conduct the FSST [full ship shock trial]. Continued delays in the ship's delivery will compress the ship's schedule and are likely to have ripple effects. Given all of the above, it is clear that the need to conduct the FSST is not a key factor driving the first deployment to occur in FY21.

Reliability

• CVN 78 includes several systems that are new to aircraft carriers; four of these systems stand out as being critical to flight operations: EMALS, AAG, DBR, and the Advanced Weapons Elevators (AWEs). Overall, the poor reliability demonstrated by AAG and EMALS and the uncertain reliability of DBR and AWEs pose the most significant risk to the CVN 78 IOT&E. All four of these systems are being tested for the first time in their shipboard configurations aboard CVN 78. The Program Office provided updates on the reliability of these systems in April 2016. Reliability estimates derived from test data for EMALS and AAG are discussed below. For DBR and AWE, only engineering reliability estimates have been provided to date.

EMALS

• EMALS testing to date has demonstrated that EMALS should be able to launch aircraft planned for CVN 78's air wing. However, present limitations on F/A-18E/F and EA-tim18G configurations, as well as the system's demonstrated poor reliability during developmental testing, suggest operational difficulties lie ahead for meeting requirements and in achieving success in combat.

• With the current limitations on EMALS for launching the F/A 18E/F and EA-18G in operational configurations (e.g., wing-mounted 480-gallon EFTs [external fuel tanks] and heavy wing stores), CVN 78 will be able to fly F/A-18E/F and EA-18G, but not in configurations required for normal operations. Presently, these problems substantially reduce the operational effectiveness of F/A-18E/F and EA-18G flying combat missions from CVN 78. The Navy has developed fixes to correct these problems, but testing with manned aircraft to verify the fixes has been postponed to 2017.

• As of April 2016, the program estimates that EMALS has approximately 400 Mean Cycles Between Critical Failure (MCBCF) in the shipboard configuration, where a cycle represents the launch of one aircraft. While this estimate is above the rebaselined reliability growth curve, the rebaselined curve is well below the requirement of 4,166 MCBCF. At the current reliability, EMALS has a 7 percent chance of completing the 4-day surge and a 67 percent chance of completing a day of sustained operations as defined in the design reference mission. Absent a major redesign, EMALS is unlikely to support high-intensity operations expected in combat.

• 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 onboard CVN 78. The process for electrically isolating equipment is time-consuming; spinning down the EMALS motor/generators takes 1.5 hours by itself. The inability to readily electrically isolate equipment precludes EMALS maintenance during flight operations, reducing the system's operational availability.

AAG

• Testing to date has demonstrated that AAG should be able to recover aircraft planned for the CVN 78 air wing, but the poor reliability demonstrated to date suggests AAG will have trouble meeting operational requirements.

• The Program Office redesigned major components that did not meet system specifications during land-based testing. In April 2016, the Program Office estimated that the redesigned AAG had a reliability of approximately 25 Mean Cycles Between Operational Mission Failure (MCBOMF) in the shipboard configuration, where a cycle represents the recovery of one aircraft. This reliability estimate is well below the rebaselined reliability growth curve and well below the requirement of 16,500 MCBOMF specified in the requirements documents. At the current reliability, AAG has an infinitesimal chance of completing the 4-day surge and less than a 0.2 percent chance of completing a day of sustained operations as defined in the design reference mission. Without a major redesign, AAG is unlikely to support high intensity operations expected in combat.

• The reliability concerns are worsened by the current AAG design that does not allow Power Conditioning Subsystem equipment to be electrically isolated from high power buses, limiting corrective maintenance on below-deck equipment during flight operations. This reduces the operational availability of the system.

DBR

• Previous testing of Navy combat systems similar to CVN 78's revealed numerous integration problems that degrade the performance of the Integrated Warfare System. Many of these problems are expected to exist on CVN 78. The DBR testing at Wallops Island is typical of early developmental testing with the system still in the problem discovery phase. Current results reveal problems with tracking and supporting missiles in flight, excessive numbers of clutter/ false tracks, and track continuity concerns. The Navy recently extended DBR testing at Wallops Island until 4QFY17; however, more test-analyze-fix cycles are likely to be needed to develop and test DBR fixes so that the DBR can properly perform air traffic control and engagement support on CVN 78.

• Currently, the Navy has only engineering analysis of DBR reliability. The reliability of the production VSR equipment in the shipboard DBR system has not been assessed. While the Engineering Development Model (EDM) VSR being tested at Wallops Island has experienced failures, it is not certain whether these EDM VSR failure modes will persist during shipboard testing of the production VSR. Reliability data collection will continue at Wallops Island and during DBR operations onboard CVN 78. The Navy has identified funding shortfalls that are likely to delay important developmental testing of DBR and the Integrated Warfare System. Test delays are likely to affect CVN 78's readiness for IOT&E. Delays in the development and testing of these systems at Wallops Island have significantly compressed the schedule for self-defense testing of DDG 1000 and CVN 78 on the SDTS. This testing is essential for understanding these ships' capabilities to defend themselves and prevail in combat. The completion of self-defense testing for CVN 78, and the subsequent use of Probability of Raid Annihilation test bed for assessing CVN 78 self-defense performance, are dependent upon future Navy decisions that could include canceling MFR component-level shock qualification or deferring the availability of the SDTS MFR for installation on DDG 1002.

SGR

• CVN 78 is unlikely to achieve its SGR 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. 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.

• 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 requirement is well above historical levels and that CVN 78 is unlikely to achieve that requirement.

• There are also concerns with the reliability of key systems that support sortie generation on CVN 78. Poor reliability of these critical systems could cause a cascading series of delays during flight operations that would affect CVN 78's ability to generate sorties, make the ship more vulnerable to attack, or create limitations during routine operations. DOT&E assesses the poor or unknown reliability of these critical subsystems will be the most significant risk to CVN 78's successful completion of IOT&E. The analysis also considered the operational implications of a shortfall and concluded that as long as CVN 78 is able to generate sorties comparable to Nimitz-class carriers, the operational capabilities of CVN 78 will be similar to that of a Nimitz‑class carrier.

Electric Plant

• A full-scale qualification unit of the shipboard component was manufactured and tested in a land-based facility in 2004. This test revealed no problems with the design of the original transformers or any other part of the main turbine generator. The design issues revealed during troubleshooting of the failed main turbine generator voltage regulating system transformer were introduced with the design changes incorporated following the transformer failure. Once alternate transformers were selected, the Navy did not perform sufficient land-based testing to validate that no system design flaws or vulnerabilities with the revised voltage regulating system design existed. The Navy considered the risk was low and did not want to further delay ship delivery for the testing. However, due to the failure, ship delivery continues to be delayed.

Manning

• Based on earlier Navy analysis of manning and the Navy's early experience with CVN 78, several areas of concern have been identified. The Navy is working with the ship's crew to resolve these problems.

• During some exercises, the berthing capacity for officers and enlisted will be exceeded, requiring the number of evaluators to be limited or the timeframe to conduct the training to be lengthened. This shortfall in berthing is further exacerbated by the 246 officer and enlisted billets (roughly 10 percent of the crew) identified in the Manning War Game III as requiring a face-to-face turnover. These turnovers will not all happen at one time, but will require heavy oversight and will limit the amount of turnover that can be accomplished at sea and especially during evaluation periods.

• Manning must be supported at the 100 percent level, although this is not the Navy's standard practice on other ships and the Navy's personnel and training systems may not be able to support 100 percent manning. The ship is extremely sensitive to manpower fluctuations. Workload estimates for the many new technologies such as catapults, arresting gear, radar, and weapons and aircraft elevators are not yet well-understood. Finally, the Navy is considering placing the ship's seven computer networks under a single department. Network management and the correct manning to facilitate continued operations is a concern for a network that is more complex than historically seen on Navy ships.

LFT&E [live fire test and evaluation]

• CVN 78 has many new critical systems, such as EMALS, AAG, AWE, and DBR that have not undergone shock trials on other platforms. Unlike past tests on other new classes of ships with legacy systems, the performance of CVN 78's new critical systems is unknown. Inclusion of data from shock trials early in a program has been an essential component of building survivable ships. The current state of modeling and component-level testing are not adequate to identify the myriad problems that have been revealed only through full ship shock testing. DOT&E has requested that the Navy provide the status of the programs component shock qualification at a minimum on a semi-annual basis to understand the vulnerability and recoverability of the ship.

Recommendations

• Status of Previous Recommendations. The Navy should continue to address the nine remaining FY10, FY11, FY13, FY14, and FY15 recommendations.

1. Finalize plans that address CVN 78 Integrated Warfare System engineering and ship's self-defense system discrepancies prior to the start of IOT&E.

2. Provide scheduling, funding, and execution plans to DOT&E for the live SGR test event during the IOT&E.

3. Continue to work with the Navy's Bureau of Personnel to achieve adequate depth and breadth of required personnel to sufficiently meet Navy Enlisted Classification fit/fill manning requirements of CVN 78.

4. Conduct system-of0systems developmental testing to preclude discovery of deficiencies during IOT&E.

5. Address the uncertain reliability of EMALS, AAG, DBR, and AWE. These systems are critical to CVN 78 flight operations, and are the largest risk to the program.

6. Aggressively fund and address a solution for the excessive EMALS holdback release dynamics during F/A-18E/F and EA-18G catapult launches with wing-mounted 480-gallon EFTs.

7. Begin tracking and reporting on a quarterly basis systems reliability for all new systems, but at a minimum for EMALS, AAG, DBR, and AWE.

8. The Navy should ensure the continued funding for component shock qualification of both government- and contractor-furnished equipment.

9. Submit a TEMP for review and approval by DOT&E incorporating the Deputy Secretary's direction to conduct the FSST before CVN 78's first deployment.

• FY16 Recommendations. The Navy should:

1. Ensure adequate funding of DBR and Integrated Warfare System developmental testing to minimize delays to the test schedule.

2. Provide DOT&E with component shock qualification program updates at a minimum of semi-annually, and maintain DOT&E's awareness of FY19 shock trial planning.[25]

[25] Department of Defense, Director, Operational Test & Evaluation, *FY2016 Annual Report*, December 2016, pp. 223-226.

Navy Study on Smaller Aircraft Carriers

Another oversight issue for Congress is whether the Navy should shift at some point from procuring large-deck, nuclear-powered carriers like the CVN-78 class to procuring smaller aircraft carriers. The issue has been studied periodically by the Navy and other observers over the years. To cite one example, the Navy studied the question in deciding on the aircraft carrier design that would follow the Nimitz (CVN-68) class. At a March 18, 2015, hearing on Navy shipbuilding programs before the Seapower subcommittee of the Senate Armed Services Committee, the Navy testified that it has initiated a new study on the question.[26]

Advocates of smaller carriers argue 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 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 large-deck, nuclear-powered carriers argue 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 large-deck, nuclear-powered carriers.

At the March 18, 2015, hearing on Navy shipbuilding programs, the following exchange occurred:

> SENATOR ROGER WICKER, CHAIRMAN:
>
> Well, Senator McCain expressed concern about competition. And I think that was with, in regard to aircraft carriers.
>
> SEAN J. STACKLEY, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, DEVELOPMENT,AND ACQUISITION,
>
> Yes, Sir.
>
> WICKER:
>
> Would you care to respond to that?
>
> STACKLEY:
>
> He made a generic comment that we need competition to help control cost in our programs and we are absolutely in agreement there. With specific regards to the aircraft carrier, we have been asked and we are following suit to conduct a study to look at alternatives to the Nimitz and Ford class size and type of aircraft carriers, to see if it make sense.
>
> We've done this in the past. We're not going to simply break out prior studies, dust them off and resubmit it. We're taking a hard look to see is there—is there a sweet spot, something different other than today's 100,000 ton carrier that would make sense to provide the power projection that we need, that we get today from our aircraft carriers, but at the same time put us in a more affordable position for providing that capability.

[26] Spoken testimony of Sean Stackley, Assistant Secretary of the Navy for Research, Development, and Acquisition, in response to a question from Senator John McCain, as reflected in transcript of hearing.

> WICKER:
>
> OK. But right now, he's—he's made a correct factual statement with regard to the lack of competition.
>
> STACKLEY:
>
> Yes, Sir. There is—yes, there is no other shipyard in the world that has the ability to construct a Ford or a Nimitz nuclear aircraft carrier other than what we have in Newport News and the capital investment to do that is prohibitive to set up a second source, so obviously we are—we are content, not with the lack of competition, but we are content with knowing that we're only going to have one builder for our aircraft carriers.[27]

On March 20, 2015, the Navy provided the following additional statement to the press:

> As indicated in testimony, the Navy has an ongoing study to explore the possible composition of our future large deck aviation ship force, including carriers. There is a historical precedent for these type[s] of exploratory studies as we look for efficiencies and ways to improve our war fighting capabilities. This study will reflect our continued commitment to reducing costs across all platforms by matching capabilities to projected threats and Also [sic] seeks to identify acquisition strategies that promote competition in naval ship construction. While I can't comment on an ongoing study, what I can tell you is that the results will be used to inform future shipbuilding budget submissions and efforts, beyond what is currently planned.[28]

Section 128 of the FY2016 National Defense Authorization Act (S. 1356/P.L. 114-92 of November 25, 2015) states:

> SEC. 128. Limitation on availability of funds for U.S.S. John F. Kennedy (CVN–79).
>
> (a) Limitation.—Of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2016 for procurement for the U.S.S. John F. Kennedy (CVN–79), $100,000,000 may not be obligated or expended until the date on which the Secretary of the Navy submits to the congressional defense committees the certification under subsection (b)(1) or the notification under paragraph (2) of such subsection, as the case may be, and the reports under subsections (c) and (d)....
>
> (d) Report on future development.—
>
> (1) IN GENERAL.—Not later than April 1, 2016, the Secretary of the Navy shall submit to the congressional defense committees 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.
>
> (2) ELEMENTS.—The report under paragraph (1) shall include the following:
>
> (A) A description of fleet, sea-based tactical aviation capability requirements for a range of operational scenarios beginning in the 2025 timeframe.
>
> (B) A description of alternative aircraft carrier designs that meet the requirements described under subparagraph (A).
>
> (C) A description of nuclear and non-nuclear propulsion options.
>
> (D) A description of tonnage options ranging from less than 20,000 tons to greater than 100,000 tons.
>
> (E) Requirements for unmanned systems integration from inception.

[27] Transcript of hearing.

[28] As printed in Sam LaGrone, "Navy Conducting Alternative Carrier Study," *USNI News*, March 23, 2015.

(F) Developmental, procurement, and lifecycle cost assessment of alternatives.

(G) A notional acquisition strategy for the development and construction of alternatives.

(H) A description of shipbuilding industrial base considerations and a plan to ensure opportunity for competition among alternatives.

(I) A description of funding and timing considerations related to developing the Annual Long-Range Plan for Construction of Naval Vessels required under section 231 of title 10, United States Code.

Legislative Activity in 2016 and 2017

Summary of Congressional Action on FY2016 Funding Request

Table 4 summarizes congressional action on the FY2017 procurement and advance procurement funding request for the CVN-78 program.

Table 4. Congressional Action on FY2017 Funding Request

Millions of dollars, rounded to nearest tenth.

		Authorization			Appropriation		
	Request	HASC	SASC	Conf.	HAC	SAC	Conf.
Procurement	1,291.8	1,291.8	1,291.8	1,291.8	1,271.2	1,275.8	1,255.8
Advance procurement	1,370.8	1,633.8	1,370.8	1,370.8	1,370.8	1,370.8	1,370.8

Source: Table prepared by CRS based on Navy's FY2017 budget submission and committee reports, authorization conference report, and appropriations conference explanatory statement.

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.

FY2017 National Defense Authorization Act (H.R. 4909/S. 2943/P.L. 114-328)

House (Committee Report)

The House Armed Services Committee, in its report (H.Rept. 114-537 of May 4, 2016) on H.R. 4909 of the 114th Congress, recommends the funding levels shown in the HASC column of **Table 4**.

Section 121 of H.R. 4909 as reported states:

SEC. 121. Procurement authority for aircraft carrier programs.

(a) Procurement authority in support of construction of Ford class aircraft carriers.—

(1) AUTHORITY FOR ECONOMIC ORDER QUANTITY.—The Secretary of the Navy may procure materiel and equipment in support of the construction of the Ford class aircraft carriers designated CVN–80 and CVN–81 in economic order quantities when cost savings are achievable.

(2) LIABILITY.—Any contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract is subject to the availability of appropriations for that purpose, and that total liability to the Government

for termination of any contract entered into shall be limited to the total amount of funding obligated at time of termination.

(b) Refueling and complex overhaul of Nimitz class aircraft carriers.—

(1) IN GENERAL.—The Secretary of the Navy may carry out the nuclear refueling and complex overhaul of each of the following Nimitz class aircraft carriers:

(A) U.S.S. George Washington (CVN–73).

(B) U.S.S. John C. Stennis (CVN–74).

(C) U.S.S. Harry S. Truman (CVN–75).

(D) U.S.S. Ronald Reagan (CVN–76).

(E) U.S.S. George H.W. Bush (CVN–77).

(2) USE OF INCREMENTAL FUNDING.—With respect to any contract entered into under paragraph (1) for the nuclear refueling and complex overhaul of a Nimitz class aircraft carrier, the Secretary may use incremental funding for a period not to exceed six years after advance procurement funds for such nuclear refueling and complex overhaul effort are first obligated.

(3) CONDITION FOR OUT-YEAR CONTRACT PAYMENTS.—Any contract entered into under paragraph (1) shall provide that any obligation of the United States to make a payment under the contract for a fiscal year after fiscal year 2017 is subject to the availability of appropriations for that purpose for that later fiscal year.

Section 122 of H.R. 4909 as reported states:

SEC. 122. Sense of Congress on aircraft carrier procurement schedules.

(a) Findings.—Congress finds the following:

(1) In a report submitted to Congress on March 17, 2015, the Secretary of the Navy indicated the Department of the Navy has a requirement of 11 aircraft carriers.

(2) In the Congressional Budget Office report titled "An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan", the Office stated as follows: "To prevent the carrier force from declining to 10 ships in the 2040s, 1 short of its inventory goal of 11, the Navy could accelerate purchases after 2018 to 1 every four years, rather than 1 every five years".

(b) Sense of Congress.—It is the sense of Congress that—

(1) the plan of the Department of the Navy to schedule the procurement of one aircraft carrier every five years will reduce the overall aircraft carrier inventory to 10 aircraft carriers, a level insufficient to meet peacetime and war plan requirements; and

(2) to accommodate the required aircraft carrier force structure, the Department of the Navy should—

(A) begin to program construction for the Ford class aircraft carrier designated CVN–81 in fiscal year 2022; and

(B) program the required advance procurement activities to accommodate the construction of such carrier.

H.Rept. 114-537 states:

CVN–81 advance procurement

The budget request contained no funds for advance procurement associated with the CVN–81 Carrier Replacement Program.

> The committee believes that the Ford-class carrier replacement program is tracking to deliver more efficiently with each proceeding aircraft carrier. For example, the committee is anticipating a savings of over $1.40 billion between CVN–78 and CVN–79. The committee notes the second year of advance procurement for CVN–80 has been included in the budget request. While the committee believes that a more efficient learning curve will be obtained with CVN–80 that will provide more savings, the committee also believes additional savings could be obtained by procuring economic order quantity material for CVN–80 and CVN–81.
>
> Therefore, the committee recommends $263.0 million for advance procurement associated with CVN–81 Carrier Replacement Program in Shipbuilding and Conversion, Navy, to procure CVN–81 economic order quantity material. (Pages 20-21)

H.Rept. 114-537 also states:

> *Aircraft carrier design*
>
> The budget request [for the Navy's research and development account] contained $30.1 million in PE [Program Element] 64567N to support improved affordability for new construction aircraft carriers by providing additional design for affordability support.
>
> The committee supports continued efforts by the Department of the Navy and the shipbuilder to better manage total ownership costs and reduce manning requirements and believes additional efforts will result in additional CVN 80/81 cost savings.
>
> The committee recommends $50.1 million, an increase of $20.0 million, in PE 64567N for new construction aircraft carrier affordability initiatives. (Page 59)

H.Rept. 114-357 also states:

> Carrier Air Wing Force Structure
>
> The budget request would deactivate the Navy's 10th carrier air wing and its associated squadrons. The committee notes that the Navy wishes to pursue deactivating the 10th carrier air wing currently assigned to Naval Air Station Lemoore, which is in contravention to the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112–81) to maintain 10 carrier air wings and associated headquarters. The committee does not believe the Navy has sufficient analysis to support the risk associated with a reduction from ten to nine carrier air wings.
>
> Therefore, the committee recommends $134.0 million, an increase of $2.3 million, in PE87732N, and an increase of $131.7 million in Operations and Maintenance, Military Personnel Navy, Reserve Personnel Navy, and Medicare Eligible Retiree Health Fund Contribution Reserve Navy, in order to retain the 10th carrier air wing. (Pages 213-214)

A statement of Administration policy regarding H.R. 4909 as reported states:

> Reduction in the Number of Navy Carrier Air Wings: The Administration objects to Carrier Air Wing Restoration in section 4303 [the section with the funding table that shows the funding that has been added for retaining the air wing in FY2017]. The elimination of the tenth Carrier Air Wing proposed in the FY 2017 President's Budget optimizes Carrier Air Wing force structure to meet Global Force Management Allocation Plan demand, sustains the health and wholeness of Naval Aviation, and generates $926 million in FYDP savings. Additionally, if forced to retain the tenth Carrier Air Wing, the Navy would require an additional $48 million in FY 2017 for military personnel and an additional increase of 1,167 in end strength above the objectionable end strength increase already in the bill.[29]

[29] Executive Office of the President, *Statement of Administration Policy*, H.R. 4909—*National Defense Authorization* (continued...)

House (Floor Consideration)

On May 18, 2016, as part of its consideration of H.R. 4909 of the 114th Congress, the House agreed to by voice vote H.Amdt. 1038, an en bloc amendment that included, inter alia, amendment 59 printed in H.Rept. 114-571 of May 17, 2016, a rule providing for further consideration of H.R. 4909. The text of the amendment is as follows:

> SEC. 1070. REPORT ON CARRIER AIR WING FORCE STRUCTURE.
>
> Not later than 180 days after the date of the enactment of this Act, the Secretary of Defense shall submit to Congress a report on the impact of changes to existing carrier air wing force structure and the impact a potential reduction to 9 carrier air wings would have on overall fleet readiness if aircraft and personnel were to be distributed throughout the remaining 9 air wings.

Senate

The Senate Armed Services Committee, in its report (S.Rept. 114-255 of May 18, 2016) on S. 2943 of the 114th Congress, recommends the funding levels shown in the SASC column of **Table 4**.

Section 123 of S. 2943 as reported states:

> SEC. 123. Certification on ship deliveries.
>
> (a) In general.—The delivery of the USS JOHN F. KENNEDY (CVN–79), the USS ZUMWALT (DDG–1000), and any other new construction ship that employs a multiple phase delivery scheme shall be deemed to occur at the completion of the final phase of construction.
>
> (b) Certification requirement.—Not later than January 1, 2017, the Secretary of the Navy shall certify that ship delivery dates have been adjusted in accordance with subsection (a). The certification shall include the ship hull numbers and delivery date adjustments. The adjustments shall be reflected in the budget of the President submitted under section 1105(a) of title 31, United States Code, as well as Department of Defense Selected Acquisition Reports.

Regarding Section 123, S.Rept. 114-255 states:

> **Certification on ship deliveries (sec. 123)**
>
> The committee recommends a provision that would require the Secretary of the Navy to deem ship delivery to occur at the completion of the final phase of construction. The Secretary would be required to submit a certification to the congressional defense committees not later than January 1, 2017 that certifies ship delivery dates have been adjusted, including the ship hull numbers and delivery date adjustments. The adjustments would be reflected in the budget of the President submitted under section 1105(a) of title 31, United States Code, as well as Department of Defense Selected Acquisition Reports.
>
> The committee notes that justification materials, which accompanied the President's fiscal year 2016 and 2017 budgets, as well as Department of Defense Selected Acquisition Reports for the CVN–78 class aircraft carrier program, list the delivery date of USS John F. Kennedy (CVN–79) as June 2022. However, the Navy plans to deliver this ship in two phases. Phase I delivery, scheduled to complete in June 2022, will deliver

(...continued)

Act for Fiscal Year 2017, May 16, 2016, p. 6.

> the ship with full propulsion capability, aircraft launch and recovery systems, and safe to sail navigation systems. Phase II delivery, scheduled to complete in September 2024, will add the remaining electronics and ordnance equipment, including the Ship Self-Defense System, weapons systems, and Enterprise Air Search Radar. The committee believes CVN–79 delivery should be deemed to occur at the end of Phase II delivery.
>
> Similarly, the committee understands all three ships in the Zumwalt-class will employ a dual delivery approach with hull, mechanical, and electrical (HM&E) systems delivery at the shipbuilder in Maine and combat systems activation in California. In the case of USS Zumwalt (DDG–1000), HM&E delivery is scheduled for 2016 and combat systems activation is scheduled for 2018. The committee notes the President's fiscal year 2017 budget lists April 2016 as the delivery date. The committee believes Zumwalt-class delivery should be deemed to occur at the completion of the dual delivery approach, following combat systems activation.
>
> The committee is concerned the variance in the Navy's definition of ship delivery may obscure oversight of the program's schedule, including whether or not a project has breached its threshold delivery date. The committee is also concerned Navy ships are being delivered in various degrees of completion and then, after a period of availabilities and shakedowns, possibly several years later, the ship is delivered to the fleet for operations. CVN–79 and the Zumwalt-class programs illustrate this practice.
>
> Therefore, the committee also directs the Comptroller General of the United States to submit a report, not later than March 1, 2017, that includes analysis and recommendations regarding the Navy's process for fully delivering ships from the time the Navy takes custody of the vessel until the vessels are fully complete and ready for operations. This review should examine the Navy's cost and schedule milestones throughout this process and how these milestones are reported to decision makers and oversight agencies. The review should also propose a common definition and criteria for Navy ship deliveries, including the associated dates. (Pages 9-10)

Section 125 of S. 2943 as reported states:

> SEC. 125. Limitation on availability of funds for the Advanced Arresting Gear program.
>
> (a) Limitation on funds.—None of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for research and development, design, procurement, or advanced procurement of materials for the Advanced Arresting Gear to be installed on USS ENTERPRISE (CVN–80) may be obligated or expended until the Secretary of Defense submits to the congressional defense committees the report described under section 2433a(c)(2) of title 10, United States Code, for the Advanced Arresting Gear program.
>
> (b) Baseline Estimate.—The Secretary of Defense shall deem the 2009 Advanced Arresting Gear acquisition program baseline as the original Baseline Estimate and execute the requirements of sections 2433 and 2433a of title 10, United States Code, as though the Department had submitted a Selected Acquisition Report with this Baseline Estimate included.

Regarding Section 125, S.Rept. 114-255 states:

> **Limitation on availability of funds for the Advanced Arresting Gear program (sec. 125)**
>
> The committee recommends a provision that would restrict the obligation or expenditure of amounts authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for research and development, design, procurement, or advanced procurement of materials for the Advanced Arresting Gear (AAG) to be installed on USS Enterprise (CVN–80) until the Secretary of Defense submits to the congressional defense

committees the report required under section 2433a(c)(2) of title 10, United States Code, commonly referred to as a Nunn-McCurdy certification, for the AAG program.

The provision would also direct the Secretary of Defense to deem the 2009 AAG acquisition program baseline as the original baseline estimate and to execute the requirements of sections 2433 and 2433a of title 10, United States Code, as though the Department had submitted a Selected Acquisition Report with this baseline estimate included. This subsection provides clarity on the original baseline estimate, which is a necessary element of a Nunn-McCurdy review.

The committee remains concerned with the current cost, schedule, and performance of the AAG program, which is on the critical path for the Navy's newest aircraft carrier, USS Gerald R. Ford (CVN–78). The committee finds the AAG program has exceeded the program acquisition unit cost (PAUC) critical cost growth thresholds as prescribed in section 2433 of title 10, United States Code.

In 2009, the Navy reported what the committee understands to have been the last AAG acquisition program baseline (APB), which estimated AAG costs of: $331.0 million for development, $145.0 million for procurement, and a program acquisition unit cost of $123.0 million.

In 2013, the program breached the major defense acquisition program (MDAP) threshold at which time the program should have been re-designated as an MDAP with a new APB. However, the Department did not take these actions. According to the Government Accountability Office (GAO), AAG breached the MDAP development threshold by November 2013 with estimated costs of: at least $480.0 million for development, $503 million for procurement, and a program acquisition unit cost of $246.0 million. Although the Navy re-designated AAG as an MDAP (ACAT 1C) in July 2015, the Navy still has not updated the APB or begun submitting Selected Acquisition Reports.

In February 2016, the President's budget request for fiscal year 2017 estimated AAG costs of: $927.0 million for development, and $483.0 million for procurement, from which the committee calculated a program acquisition unit cost of $353.0 million.

In April 2016, Navy officials provided the committee with an update, estimating AAG costs of: $1.3 billion for development, from which the committee calculated a program acquisition unit cost of $446.0 million.

For the purposes of this provision, the committee considers the 2009 APB to constitute the original baseline estimate and the November 2013 GAO reporting to constitute the current baseline estimate. As a result, through February 2016, the committee finds the program acquisition unit cost has risen $230.0 million, or 186 percent compared to the original baseline estimate, and $107.0 million, or 43 percent, compared to the current baseline estimate. Based on both percentage increases, the committee finds the AAG program has exceeded the PAUC critical cost growth thresholds as prescribed in section 2433 of title 10, United States Code, warranting a Nunn-McCurdy review.

The committee is also concerned by other elements of the AAG program.

First, the system development and demonstration contract schedule for delivery has more than quadrupled in length, while the AAG promised capability has yet to materialize.

Second, a critical element of the Navy's business case for AAG was an ability to land the next generation of aircraft, both heavier and lighter than those in service today. A more sensitive braking system—featuring a water twister to absorb 70 percent of the force—would recover these new aircraft safely and with less unnecessary stress. Facing persistent delays in software development, the committee notes that in February 2016, the Navy authorized an easing of these requirements to: (1) meet just the legacy Mark 7 operating envelope, (2) eliminate the requirement to backfit Nimitz-class carriers with AAG, and (3) redefine what constitutes initial operational capability for AAG.

Third, the committee understands a fatigue life review of the water twister is on-going and may result in the need for a significant re-design of components in order to meet the requirement for a service life of 25 years, which Navy officials acknowledge it cannot currently meet. The Navy has already procured AAG systems for the first two Ford-class ships, which will require additional effort and cost to re-design and fix.

Fourth, the committee is concerned by the 18-month delay to redesignate AAG as an MDAP and the continued delay updating the APB and issuing Selected Acquisition Reports.

Fifth, delays at the AAG land-based test site and with software development for recovering the full range of carrier air wing aircraft are unacceptable. In September 2015, Navy officials informed the committee that aircraft would be landing at the test site by the end of 2015. As of April 2016, this event has yet to occur.

Sixth, as the Director of Operational Test and Evaluation has noted in his annual reports, the reliability data the Navy is collecting is still not sufficient to determine if the mean time between failures will be acceptable. Additionally, the committee is concerned that high cycle testing—which is necessary to understand system performance under more realistic operational tempo—will not occur at the land-based test site until fiscal year 2018.

Seventh, the committee understands that in January 2015 the Navy considered using the legacy Mark 7 arresting gear for USS John F. Kennedy (CVN–79) instead of AAG, but decided to continue with AAG, in part because the installation of the Mark 7 was estimated to cost $87.0 million more than AAG. This appears to be a shortsighted decision given the extraordinary and continuing development delays and cost growth, including more than $500.0 million since this decision was made in February 2015.

The committee believes the Navy must pause and reconsider the way ahead, including the best business case, for the arresting gear on CVN–79 and CVN–80, and notes the Navy has already begun such a review. The committee believes returning to a variant of the Mark 7 arresting gear is a viable option that should be considered. The committee encourages the Navy to maximize competition and ensure government data rights of AAG, as well as of any other arresting gear that may be pursued.

Therefore, the committee directs the Secretary of Defense to conduct a reassessment of the AAG program, in accordance with sections 2433 and 2433a of title 10, United States Code. (Pages 11-13)

Section 126 of S. 2943 as reported states:

SEC. 126. Limitation on procurement of USS JOHN F. KENNEDY (CVN–79) and USS ENTERPRISE (CVN–80).

(a) Limitation.—Of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for advance procurement or procurement of USS JOHN F. KENNEDY (CVN–79) or USS ENTERPRISE (CVN–80), not more than 25 percent may be obligated or expended until the Secretary of the Navy and the Chief of Naval Operations submit to the congressional defense committees the report required under subsection (b).

(b) Report on CVN–79 and CVN–80.—Not later than December 1, 2016, the Secretary of the Navy and the Chief of Naval Operations shall submit to the congressional defense committees a report on alternatives, including de-scoping requirements if necessary, to achieve a CVN–80 procurement end cost of $12,000,000,000. In addition, the report shall describe all applicable CVN–80 alternatives that could be applied to CVN–79 to enable an $11,000,000,000 procurement end cost.

(c) Annual report on CVN–79 and CVN–80.—

(1) IN GENERAL.—The Secretary of the Navy and the Chief of Naval Operations shall annually submit, with the budget of the President submitted to Congress under section 1105(a) of title 31, United States Code, a progress report describing efforts to attain the CVN–79 and CVN–80 procurement end costs specified in subsection (b).

(2) ELEMENTS.—The report under paragraph (1) shall include the following elements:

(A) A description of progress made toward achieving the procurement end costs specified in subsection (b), including realized cost savings.

(B) A description of specific low value-added or unnecessary elements of program cost that have been reduced or eliminated.

(C) Cost savings estimates for current and planned initiatives.

(D) A schedule including a spend plan with phasing of key obligations and outlays, decision points when savings could be realized, and key events that must take place to execute initiatives and achieve savings.

(E) Instances of lower estimates used in contract negotiations.

(F) A description of risks to achieving the procurement end costs specified in subsection (b).

(G) A description of incentives or rewards provided or planned to be provided for meeting the procurement end costs specified in subsection (b).

Regarding Section 126, S.Rept. 114-255 states:

Limitation on procurement of USS John F. Kennedy (CVN–79) and USS Enterprise (CVN–80) (sec. 126)

The committee recommends a provision that would limit more than 25 percent of funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for advance procurement or procurement of USS John F. Kennedy (CVN–79) or USS Enterprise (CVN–80) from being obligated or expended until the Secretary of the Navy and Chief of Naval Operations submit a report to the congressional defense committees.

The committee notes the progress that has been made in controlling the cost of the Ford-class aircraft carrier program. In fiscal year 2008, the cost estimate of CVN–78 was $10.5 billion, CVN–79 was $9.2 billion, and CVN–80 was $10.7 billion. In fiscal year 2015, these estimates had risen to $12.9 billion, $11.5 billion, and $13.9 billion, respectively. In the fiscal year 2017 budget request, the estimates stood at $12.9 billion, $11.4 billion, and $12.9 billion, respectively.

The Navy has largely attributed the progress made in arresting cost growth to "design for affordability" initiatives, which will improve efficiency and cost effectiveness in aircraft carrier construction. These initiatives require an investment of tens of millions of dollars to yield savings in excess of one billion dollars. The committee expects these initiatives to yield the projected savings and believes the Navy and industrial base are capable of achieving greater savings through these initiatives coupled with increased savings from: the Ford-class learning curve, CVN–80 repeating the design of CVN–79, and increased competition. To this end, the committee supported a series of provisions in the National Defense Authorization Act for Fiscal Year 2016 (Public Law 114–92) that required reports on cost reduction opportunities for CVN–79 and CVN–80 (sec. 128), alternatives for the future development of aircraft carriers (sec. 128), and independent studies of fleet platform architectures (sec. 1067). The committee expects the Navy to leverage these reports in identifying further cost reduction options for aircraft carriers.

Therefore, the committee directs the Secretary of the Navy and Chief of Naval Operations to submit a report no later than December 1, 2016 that provides alternatives to achieve a CVN–80 procurement end cost of $12.0 billion. In addition, the report shall

describe all applicable CVN–80 alternatives that could be applied to CVN–79 to enable an $11.0 billion procurement end cost. The provision also requires the Secretary of the Navy and Chief of Naval Operations to provide annual progress reports compared to these end cost goals with the President's budget request. (Pages 13-14)

Section 1088 of S. 2943 as reported states:

SEC. 1088. Reduction in minimum number of Navy carrier air wings and carrier air wing headquarters required to be maintained.

(a) Codification and reduction.—Section 5062 of title 10, United States Code, is amended by adding at the end the following new subsection:

"(e) The Secretary of the Navy shall ensure that the Navy maintains—

"(1) a minimum of 9 carrier air wings; and

"(2) for each such carrier air wing, a dedicated and fully staffed headquarters.".

(b) Repeal of superseded requirement.—Section 1093 of the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112–81; 125 Stat. 1606; 10 U.S.C. 5062 note) is repealed.

Regarding Section 1088, S.Rept. 114-255 states:

Reduction in minimum number of Navy carrier air wings and carrier air wing headquarters required to be maintained (sec. 1088)

The committee recommends a provision that would amend section 5062 of title 10, United States Code, to reduce the number of air wings required to be maintained and fully staffed from 10 to 9.

While the committee does not believe cutting naval aviation infrastructure is advisable in the current security environment, inadequate funding for defense prevents the Department of the Navy from funding all necessary requirements. Should adequate funding become available, the committee intends to repeal this provision. (Page 282)

Conference

The conference report (H.Rept. 114-840 of November 30, 2016) on S. 2943/P.L. 114-328 of December 23, 2016, recommends the funding levels shown in the authorization conference column of **Table 4**.

Section 125 of S. 2943/P.L. 114-328 states:

SEC. 125. Limitation on availability of funds for the Advanced Arresting Gear Program.

(a) Advanced arresting gear for U.S.S. Enterprise.—None of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for the research and development, design, procurement, or advanced procurement of materials for advanced arresting gear for the U.S.S. Enterprise (CVN–80) may be obligated or expended until the Secretary of Defense submits to the congressional defense committees the report described in section 2432 of title 10, United States Code, for the most recently concluded fiscal quarter for the Advanced Arresting Gear Program in accordance with subsection (c)(1).

(b) Advanced arresting gear for U.S.S. John F. Kennedy.—None of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for the research and development, design, procurement, or advanced procurement of materials for advanced arresting gear for the U.S.S. John F. Kennedy (CVN–79) may be obligated or expended unless—

(1) the decision to install advanced arresting gear on the vessel is determined by the milestone decision authority for the Program; and

(2) the milestone decision authority for the Program submits notification of such determination to the congressional defense committees.

(c) Additional requirements.—

(1) TREATMENT OF BASELINE ESTIMATE.—The Secretary of Defense shall deem the Baseline Estimate for the Advanced Arresting Gear Program for fiscal year 2009 as the original Baseline Estimate for the Program.

(2) UNIT COST REPORTS AND CRITICAL COST GROWTH.—

(A) Subject to subparagraph (B), the Secretary shall carry out sections 2433 and 2433a of title 10, United States Code, with respect to the Advanced Arresting Gear Program, as if the Department had submitted a Selected Acquisition Report for the Program that included the Baseline Estimate for the Program for fiscal year 2009 as the original Baseline Estimate, except that the Secretary shall not carry out subparagraph (B) or subparagraph (C) of section 2433a(c)(1) of such title with respect to the Program.

(B) In carrying out the review required by section 2433a of such title, the Secretary shall not approve a contract, enter into a new contract, exercise an option under a contract, or otherwise extend the scope of a contract for advanced arresting gear for the U.S.S. Enterprise (CVN–80), except to the extent determined necessary by the milestone decision authority, on a non-delegable basis, to ensure that the Program can be restructured as intended by the Secretary without unnecessarily wasting resources.

(d) Definitions.—In this section:

(1) BASELINE ESTIMATE.—The term "Baseline Estimate" has the meaning given the term in section 2433(a)(2) of title 10, United States Code.

(2) MILESTON DECISION AUTHORITY.—The term "milestone decision authority" has the meaning given the term in section 2366b(g)(3) of title 10, United States Code.

(3) ORIGINAL BASELINE ESTIMATE.—The term "original Baseline Estimate" has the meaning given the term in section 2435(d)(1) of title 10, United States Code.

(4) SELECTED ACQUISITION REPORT.—The term "Selected Acquisition Report" means a Selected Acquisition Report submitted to Congress under section 2432 of title 10, United States Code.

Regarding Section 125, H.Rept. 114-840 states:

Limitation on availability of funds for the Advanced Arresting Gear Program (sec. 125)

The Senate bill contained a provision (sec. 125) that would limit funds for the Advanced Arresting Gear (AAG) to be installed on USS Enterprise (CVN–80) until the Secretary of Defense submits to the congressional defense committees the report described under section 2433a(c)(2) of title 10, United States Code, for the AAG program.

The provision would also direct the Secretary of Defense to deem the 2009 AAG acquisition program baseline as the original baseline estimate and to execute the requirements of sections 2433 and 2433a of title 10, United States Code, as though the Department had submitted a Selected Acquisition Report with this baseline estimate included. This action would provide clarity on the original baseline estimate, which is a necessary element of a Nunn-McCurdy review.

The House amendment contained no similar provision.

The House recedes with an amendment that would:

(1) Require the Navy to report on the AAG program in accordance with section 2432 of title 10, United States Code, which deals with Selected Acquisition Reports, instead of reporting in accordance with section 2433a(c) (2) which deals with critical cost growth in major defense acquisition programs;

(2) Add a limitation of funds for the AAG to be installed on USS John F. Kennedy (CVN–79) unless the Milestone Decision Authority (MDA) determines that AAG should be installed on that ship, and the MDA submits notification of such determination to the congressional defense committees;

(3) Establish the original baseline estimate for the AAG program and require the Secretary of Defense to execute the requirements of sections 2433 and 2433a of title 10, United States Code, but exempt the Department from having to rescind the milestone decision approval for the AAG program during the review required by those provisions; and

(4) During the review required by section 2433a of title 10, United States Code, allow the Secretary of Defense to approve contract action or actions to enter a new contract, exercise an option under an existing contract, or otherwise extend the scope of an existing contract under the AAG program for CVN–80 only if the MDA, on a non-delegable basis, were to determine that such action would be needed to appropriately restructure the program as intended by the Secretary of Defense.

The conferees note that, although the AAG program is now being managed as a Major Defense Acquisition Program, it began more than 10 years ago as an Acquisition Category II program, which limited transparency and insight of the Navy's acquisition and contract management. In 2015, the Comptroller General reported that the Department of Defense needed a better approach to manage Acquisition Category II programs, particularly those programs that have the potential to become Major Defense Acquisition Programs.

Therefore, the conferees direct the Comptroller General to review no fewer than five Navy aircraft launch and recovery equipment (ALRE) Acquisition Category II programs to determine:

(1) The roles and responsibilities for acquiring ALRE systems for major ship programs, and the relationship of these programs to the Navy's overall acquisition of the ship platform;

(2) How the acquisition and contracting practices for these programs compare to guidance, regulations, and best practices for acquisition management;

(3) How the Navy manages cost, schedule, and performance to meet ship delivery schedules, and what mechanisms, if any, are in place to periodically reassess assignment of such programs to a particular acquisition category;

(4) Recommendations to improve the Navy's performance in managing ALRE and other Acquisition Category II programs; and

(5) Any other observations of the Comptroller General.

The conferees request a briefing to the congressional defense committees no later than June 1, 2017, to be followed by a report. (Pages 979-980)

Section 126 states:

SEC. 126. Limitation on availability of funds for procurement of U.S.S. Enterprise (CVN–80).

(a) Limitation.—Of the funds authorized to be appropriated by this Act or otherwise made available for fiscal year 2017 for advance procurement or procurement for the U.S.S. Enterprise (CVN–80), not more than 25 percent may be obligated or expended

until the date on which the Secretary of the Navy and the Chief of Naval Operations jointly submit to the congressional defense committees the report under subsection (b).

(b) Initial report on CVN–79 and CVN–80.—Not later than December 1, 2016, the Secretary of the Navy and the Chief of Naval Operations shall jointly submit to the congressional defense committees a report that includes a description of actions that may be carried out (including de-scoping requirements, if necessary) to achieve a ship end cost of—

(1) not more than $12,000,000,000 for the CVN–80; and

(2) not more than $11,000,000,000 for the U.S.S. John F. Kennedy (CVN–79).

(c) Annual report on CVN–79 and CVN–80.—

(1) IN GENERAL.—Together with the budget of the President for each fiscal year through fiscal year 2021 (as submitted to Congress under section 1105(a) of title 31, United States Code) the Secretary of the Navy and the Chief of Naval Operations shall submit a report on the efforts of the Navy to achieve the ship end costs described in subsection (b) for the CVN–79 and CVN–80.

(2) ELEMENTS.—The report under paragraph (1) shall include, with respect to the procurement of the CVN–79 and the CVN–80, the following:

(A) A description of the progress made toward achieving the ship end costs described in subsection (b), including realized cost savings.

(B) A description of low value-added or unnecessary elements of program cost that have been reduced or eliminated.

(C) Cost savings estimates for current and planned initiatives.

(D) A schedule that includes—

(i) a plan for spending with phasing of key obligations and outlays;

(ii) decision points describing when savings may be realized; and

(iii) key events that must occur to execute initiatives and achieve savings.

(E) Instances of lower Government estimates used in contract negotiations.

(F) A description of risks that may result from achieving the procurement end costs specified in subsection (b).

(G) A description of incentives or rewards provided or planned to be provided to prime contractors for meeting the procurement end costs specified in subsection (b).

Section 127 states:

SEC. 127. Sense of Congress on aircraft carrier procurement schedules.

(a) Findings.—Congress finds the following:

(1) In the Congressional Budget Office report titled "An Analysis of the Navy's Fiscal Year 2016 Shipbuilding Plan", the Office stated as follows: "To prevent the carrier force from declining to 10 ships in the 2040s, 1 short of its inventory goal of 11, the Navy could accelerate purchases after 2018 to 1 every four years, rather than 1 every five years".

(2) In a report submitted to Congress on March 17, 2015, the Secretary of the Navy indicated the Department of the Navy has a requirement of 11 aircraft carriers.

(b) Sense of congress.—It is the sense of Congress that—

> (1) the plan of the Department of the Navy to schedule the procurement of one aircraft carrier every five years will reduce the overall aircraft carrier inventory to 10 aircraft carriers, a level insufficient to meet peacetime and war plan requirements; and
>
> (2) to accommodate the required aircraft carrier force structure, the Department of the Navy should—
>
> (A) begin to program construction for the next aircraft carrier to be built after the U.S.S. Enterprise (CVN–80) in fiscal year 2022; and
>
> (B) program the required advance procurement activities to accommodate the construction of such carrier.

Section 1042 states:

> SEC. 1042. Reduction in minimum number of Navy carrier air wings and carrier air wing headquarters required to be maintained.
>
> (a) Codification and reduction.—Section 5062 of title 10, United States Code, is amended by adding at the end the following new subsection:
>
> "(e) 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.".
>
> (b) Repeal of superseded requirement.—Section 1093 of the National Defense Authorization Act for Fiscal Year 2012 (Public Law 112–81; 125 Stat. 1606; 10 U.S.C. 5062 note) is repealed.

FY2017 DOD Appropriations Act (H.R. 5293/S. 3000/H.R. 244/P.L. 115-31)

House

The House Appropriations Committee, in its report (H.Rept. 114-577 of May 19, 2016) on H.R. 5293 of the 114th Congress, recommends the funding levels shown in the HAC column of **Table 4**. The recommended reduction of $20.6 million in procurement funding includes a reduction of $2.1 million for "Surface ship torpedo defense system cost growth," a reduction of $9.4 million for "EMALS cost growth," and a reduction of $9.1 million for "Advanced arresting gear cost growth." (Page 155)

A June 14, 2016, statement of Administration policy on H.R. 5293 as reported states:

> *Restoration of Tenth Navy Carrier Air Wing*. The Administration strongly objects to restoration of the Carrier Air Wing in Title IX of the bill. The tenth Carrier Air Wing is no longer needed, and results in ineffective use of the aircraft and pilot inventory in the Navy. The plan proposed in the FY 2017 Budget request optimizes Carrier Air Wing force structure to meet the Global Force Management Allocation Plan demand in a sustainable way. As an additional benefit, the plan also generates $926 million in FYDP

> savings. Furthermore, if forced to retain the tenth Carrier Air Wing, the bill's current military personnel funding levels are insufficient. The Navy would require an additional $48 million in FY 2017 for military personnel above the levels already in the bill, as well as an end strength increase of 1,167 above the Navy end strength in the bill.[30]

Senate

The Senate Appropriations Committee, in its report (S.Rept. 114-263 of May 26, 2016) on S. 3000 of the 114th Congress, recommends the funding levels shown in the SAC column of **Table 4**. The recommended reduction of $16 million in procurement funding is for "Restoring acquisition accountability: Reduction in change orders growth." (Page 98)

Conference

The final version of the FY2017 DOD appropriations act is Division C of H.R. 244/P.L. 115-31 of May 5, 2017, the Consolidated Appropriations Act, 2017. The explanatory statement for Division C of H.R. 244/P.L. 115-31 provides the funding levels shown in the appropriations conference column of **Table 4**. The reduction of $36 million from the requested amount of procurement funding includes a reduction of $20 million for "Excess cost growth" and a reduction of $16 million for "Reduction in change orders growth." (PDF page 152 of 372)

12 Carrier Act (H.R. 941)

House

H.R. 941 of the 115th Congress, introduced on February 7, 2017, states:

> SECTION 1. Short title.
>
> This Act may be cited as the "12 Carrier Act".
>
> SEC. 2. Sense of Congress.
>
> (a) Findings.—Congress finds the following:
>
> (1) The aircraft carrier can fulfill the Navy's core missions of forward presence, sea control, ensuring safe sea lanes, and power projection as well as providing flexibility and versatility to execute a wide range of additional missions.
>
> (2) Forward airpower is integral to the security and joint forces operations of the United States. Carriers play a central role in delivering forward airpower from sovereign territory of the United States in both permissive and nonpermissive environments.
>
> (3) Aircraft carriers provide our Nation the ability to rapidly and decisively respond to national threats, as well as conducting worldwide, on-station diplomacy and providing deterrence against threats to the United States allies, partners, and friends.
>
> (4) Since the end of the cold war, aircraft carrier deployments have increased while the aircraft carrier force structure has declined.
>
> (5) Considering the increased array of complex threats across the globe, the Navy aircraft carrier is operating at maximum capacity, increasing deployment lengths and decreasing maintenance periods in order to meet operational requirements.

[30] Executive Office of the President, *Statement of Administration Policy, H.R. 5293—Department of Defense Appropriations Act, 2017*, June 14, 2016, p. 3.

(6) To meet global peacetime and wartime requirements, the Navy has indicated a requirement to maintain two aircraft carriers deployed overseas and have three additional aircraft carrier capable of deploying within 90 days. However, the Navy has indicated that the existing aircraft carrier force structure cannot support these military requirements.

(7) Despite the requirement to maintain an aircraft carrier strike group in both the United States Central Command and United States Pacific Command, the Navy has been unable to generate sufficient capacity to support our combatant commanders and has developed significant carrier gaps in these critical areas.

(8) Because of continuing use of a diminished aircraft carrier force structure, extensive maintenance availabilities result which typically exceed program costs and increase time in shipyards. These expansive maintenance availabilities exacerbate existing carrier gaps.

(9) Because of maintenance overhaul extensions, the Navy is truncating basic aircraft carrier training to expedite the deployment of available aircraft carriers. Limiting aircraft carrier training decreases operational capabilities and increases sailor risk.

(10) Despite the objections of the Navy, the Under Secretary of Defense for Acquisition, Technology, and Logistics directed the Navy on August 7, 2015, to perform shock trials on the U.S.S. Gerald R. Ford (CVN–78). The Assistant Deputy Chief of Naval Operations for Operations, Plans and Strategy indicated that this action could delay the introduction of the U.S.S. Gerald R. Ford (CVN–78) to the fleet by up to two years, exacerbating existing carrier gaps.

(11) The Navy has adopted a two-phase acquisition strategy for the U.S.S. John F. Kennedy (CVN–79), an action that will delay the introduction of this aircraft carrier by up to two years, exacerbating existing carrier gaps.

(12) Developing an alternative design to the Ford-class aircraft carrier is not cost beneficial. A smaller design is projected to incur significant design and engineering cost while significantly reducing magazine size, carrier air wing size, sortie rate, and on-station effectiveness among other vital factors when compared to the Ford-class. Furthermore, a new design will delay the introduction of future aircraft carriers, exacerbating existing carrier gaps and threatening the national security of the United States.

(13) The 2016 Navy Force Structure Assessment states "A minimum of 12 aircraft carriers are required to meet the increased warfighting response requirements of the Defense Planning Guidance Defeat/Deny force sizing direction."

(b) Sense of Congress.—It is the sense of Congress that—

(1) the United States should expedite delivery of 12 aircraft carriers;

(2) an aircraft carrier should be authorized every three years;

(3) shock trials should be conducted on the U.S.S. John F. Kennedy (CVN–79), as initially proposed by the Navy;

(4) construction for the U.S.S. John F. Kennedy (CVN–79) should be accomplished in a single phase;

(5) the United States should continue the Ford-class design for CVN–81; and

(6) bulk procurement initiatives for CVN–80 and CVN–81 should be pursued.

SEC. 3. Shock trials for CVN–78.

Section 128(b)(1) of the National Defense Authorization Act for Fiscal Year 2016 (Public Law 114–92; 129 Stat. 751) is amended by striking "prior to the first deployment of such ship".

SEC. 4. Increase in number of operational aircraft carriers of the Navy.

(a) Increase.—Section 5062(b) of title 10, United States Code, is amended by striking "11 operational aircraft carriers" and inserting "12 operational aircraft carriers".

(b) Effective date.—The amendment made by subsection (a) shall take effect on September 30, 2023.

Appendix A. Cost Growth and Managing Costs Within Program Cost Caps

This appendix presents additional background information on 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.

October 1, 2015, Senate Armed Services Committee Hearing

Cost growth and other issues in the CVN-78 program were reviewed at an October 1, 2015, hearing before the Senate Armed Services Committee. Below are excerpts from the prepared statements of the witnesses at the hearing.

OSD ASD Testimony

The prepared statement of the Assistant Secretary of Defense (Acquisition) within the Office of the Secretary of Defense (OSD) states in part:

> By 2000, the CVN(X) Acquisition Strategy that had been proposed by the Navy was an evolutionary, three-step development of the capabilities planned for the CVN. This evolutionary strategy intending to mature technology and align risk with affordability originally involved using the last ship of the CVN 68 NIMITZ Class, USS GEORGE H. W. BUSH (CVN 77), as the starting point for insertion of some near term technology improvements including information network technology and the new Dual Band Radar (DBR) system from the DD(X) (now DDG 1000) program, to create an integrated warfare system that combined the ship's combat system and air wing mission planning functions.
>
> However, the then incoming Secretary of Defense Donald Rumsfeld in 2002 directed re-examination of the CVN program, among others, to reduce the overall spend of the department and increase the speed of delivery to the warfighters. As a result of the SECDEF's direction, the Navy proposed to remove the evolutionary approach and included a new and enlarged flight deck, an increased allowance for future technologies (including electric weapons), and an additional manpower reduction of 500 to 800 fewer sailors to operate. On December 12, 2002, a Program Decision Memorandum approved by then Deputy Secretary of Defense Paul Wolfowitz codified this Navy proposal and gave this direction back to the DOD enterprise. The ship was renamed the CVN-21 to highlight these changes. By Milestone B in April 2004, the Navy had evaluated the technologies intended for three ships, removed some of them, and consolidated the remaining ones into a single step of capability improvement on the lead ship. The new plan acknowledged technological, cost, and schedule challenges were being put on a single ship, but assessed this was achievable. The Acting USD AT&L (Michael Wynne) at that milestone also directed the Navy to use a hybrid of the Service Cost Position and Independent Cost Estimate (ICE) to baseline the program funding in lieu of the ICE, (although one can easily argue even the ICE was optimistic given these imposed circumstances).
>
> By 2004, DOD and Congressional leadership had lost confidence in the acquisition system, and Deputy Secretary of Defense Gordon England established the Defense Acquisition Performance Assessment (DAPA) panel to conduct a sweeping and integrated assessment of "every aspect" of acquisition. The result was the discovery that the Industrial Base had consolidated, that excessive oversight and complex acquisition processes were cost and schedule drivers, and a focus on requirements stability was key to containing costs. From this, a review of the requirements of the CVN resulted in a

revised and solidified "single ship" Operational Requirements Document (ORD) for the FORD Class as defined today, with the CVN 78 as lead ship.

On the heels of a delay because of the budgetary constraints in 2006, the start of the construction of CVN 78 was delayed until 2008, but the schedule for delivery was held constant, further compounding risks and costs. The Navy's testimony covers these technical and schedule risks and concurrency challenges well.

By 2009, this Committee had issued a floor statement in support of the Weapon Systems Acquisition Reform Act (WSARA). Congress was now united in its pursuit of acquisition reform and, in concert, USD AT&L re-issued and updated the Department of Defense's acquisition instruction (DoDI 5000.2) in 2008. WSARA included strengthening of the 'Nunn-McCurdy" process with requires DOD to report to Congress when cost growth on a major program breaches a critical cost growth threshold. This legislation required a root-cause assessment of the program and assumed program termination within 60 days of notification unless DOD certified in writing that the program remained essential to national security.

WSARA had real impact on the CVN 78, as by 2008 and 2009 the results of all the previous decisions were instantiated in growth of cost and schedule. Then USD AT&L John Young required the Navy to provide a list of descoping efforts and directed the Navy to have an off-ramp back to steam catapults if the Electromagnetic Aircraft Launching System (EMALS) remained a problem for the program. He also directed an independent review of all of the CVN 78 technologies by a Defense Support Team (DST). Prior to the DST, the Navy had chartered a Program Assessment Review (PAR) with USD (AT&L) participation of EMALS/Advanced Arresting Gear (AAG) versus steam. One of the key PAR findings was converting the EMALS and AAG production contracts to firm, fixed price contracts to cap cost growth and imposed negative incentives for late delivery.

The Dual Band Radar (DBR) cost and risk growth was a decision by-product of the DDG 1000 program Nunn-McCurdy critical unit cost breach in 2010. Faced with a need to reduce cost on the DDG 1000 program and the resultant curtailment of the program, the expectation of development costs being borne by the DDG 1000 program was no longer the case and all of the costs associated with the S-band element development and a higher share of the X-band element then had to be supported by the CVN 78 program.

The design problems encountered with AAG development have had the most deleterious effects on CVN 78 construction of any of the three major advanced technologies including EMALS and DBR. Our view of AAG is that these engineering design problems are now in the past and although delivery of several critical components have been delayed, the system will achieve its needed capabilities before undergoing final operational testing prior to deployment of the ship. Again, reliability growth is a concern, but this cannot be improved until a fully functional system is installed and operating at the Lakehurst, New Jersey land based test site, and on board CVN 78.

With the 2010 introduction by then USD AT&L Ashton Carter (now in its third iteration by under USD AT&L Frank Kendall) of the continuous process improvement initiative that was founded in best business practices and WSARA called "Better Buying Power," the CVN underwent affordability, "Should Cost," and requirements assessment. Navy's use of the "Gate" process has stabilized the cost growth and reset good business practices. However, there is still much to do. We are in the testing phase of program execution prior to deployment and we had been concerned about the timing of the Full Ship Shock Trial (FSST). After balancing the operational and technical risks, the Department decided to execute FSST on CVN 78 prior to deployment.

EMALS and AAG are also a concern with regard to final operational testing stemming from the development difficulties that each experienced. The Navy still needs to

> complete a significant amount of land-based testing to enable certification of the systems to launch and recover the full range of aircraft that it is required to operate under both normal and emergency conditions. This land-based testing is planned to complete before the final at-sea operational testing for these systems begins....
>
> USD AT&L continues to work with Navy to tailor the program and ensure appropriate oversight at both the Navy Staff level as well as OSD. Our review of the Navy's plan for maintaining control of the cost for CVN 79 included an understanding of the application of lessons learned from the construction of CVN 78 along with the application of a more efficient construction plan for the ship including introduction of competition where possible. We have established an excellent relationship with the Navy to work together to change process and policies that have impacted the ability of the program to succeed, to include revitalizing the acquisition workforce and their skills.
>
> We are confident in the Navy's plan for CVN 79 and CVN 80 and, as such, Under Secretary Kendall recently authorized the Navy to enter into the detail design and construction phase for CVN 79 and to enter into advanced procurement for long lead time materials for CVN 80 construction. OSD and the Navy are committed to delivering CVN 79 within the limits of the cost cap legislated for this ship.[31]

OSD DOT&E Testimony

The prepared statement of the Director, Operational Test & Evaluation (DOT&E), within OSD states in part:

> The Navy intends to deliver CVN 78 early in calendar year 2016, and to begin initial operational test and evaluation (IOT&E) in late calendar year 2017. However, the Navy is in the process of developing a new schedule, so some dates may change. Based on the current schedule, between now and the beginning of IOT&E, the CVN 78 program is proceeding on an aggressive schedule to finish development, testing, troubleshooting, and correction of deficiencies for a number of new, complex systems critical to the warfighting capabilities of the ship. Low or unknown reliability and performance of the Advanced Arresting Gear (AAG), the Electromagnetic Aircraft Launch System (EMALS), the Dual Band Radar (DBR), and the Advanced Weapons Elevators (AWE) are significant risks to a successful IOT&E and first deployment, as well as to achieving the life-cycle cost reductions the Navy has estimated will accrue for the Ford-class carriers. The maturity of these systems is generally not at the level that would be desired at this stage in the program; for example, the CVN 78 test program is revealing problems with the DBR typical of discoveries in early developmental testing. Nonetheless, AAG, EMALS, DBR, and AWE equipment is being installed on CVN 78, and in some cases, is undergoing shipboard checkout. Consequently, any significant issues that testing discovers before CVN 78's schedule-driven IOT&E and deployment will be difficult, or perhaps impossible, to address.
>
> Resolving the uncertainties in the reliability and performance of these systems is critical to CVN 78's primary function of conducting combat operations. CVN 78 has design features intended to enhance its ability to launch, recover, and service aircraft. EMALS and AAG are key systems planned to provide new capabilities for launching and recovering aircraft that are heavier and lighter than typically operated on Nimitz-class carriers. DBR is intended to enhance radar coverage on CVN 78 in support of air traffic control and ship self-defense. DBR is planned to reduce some of the known sensor

[31] Statement of Hon Katharina McFarland, Assistant Secretary of Defense (Acquisition), Before the Senate Armed Services Committee on Procurement, Acquisition, Testing and Oversight of the Navy's Gerald R. Ford Class Aircraft Carrier Program, October 1, 2015, 5 pp.

limitations on Nimitz-class carriers that utilize legacy radars. The data currently available to my office indicate EMALS is unlikely to achieve the Navy's reliability requirements. (The Navy indicates EMALS reliability is above its current growth curve, which is true; however, that growth curve was revised in 2013, based on poor demonstrated performance, to achieve EMALS reliability on CVN 78 a factor of 15 below the Navy's goal.) I have no current data regarding DBR or AWE reliability, and data regarding the reliability of the re-designed AAG are also not available. (Poor AAG reliability in developmental testing led to the need to re-design components of that system.) In addition, performance problems with these systems are continuing to be discovered. If the current schedule for conducting the ship's IOT&E and first deployment remain unchanged, reliability and performance shortfalls could degrade CVN 78's ability to conduct flight operations.

Due to known problems with current aircraft carrier combat systems, there is significant risk CVN 78 will not achieve its self-defense requirements. Although the CVN 78 design incorporates several combat system improvements relative to the Nimitz-class, these improvements (if achieved) are unlikely to correct all of the known shortfalls. Testing on other ships with similar combat systems has highlighted deficiencies in weapon employment timelines, sensor coverage, system track management, and deficiencies with the recommended engagement tactics. Most of these limitations are likely to affect CVN 78 and I continue to view this as a significant risk to the CVN 78's ability to defend itself against attacks by the challenging anti-ship cruise missile and other threats proliferating worldwide.

The Navy's previous decision to renege on its original commitment to conduct the Full Ship Shock Trial (FSST) on CVN 78 before her first deployment would have put CVN 78 at risk in combat operations. This decision was reversed in August 2015 by the Deputy Secretary of Defense. Historically, FSSTs for new ship classes have identified for the first time numerous mission-critical failures the Navy had to address to ensure the new ships were survivable in combat. We can expect that CVN 78's FSST results will have significant and substantial implications on future carriers in the Ford-class and any subsequent new class of carriers.

I also have concerns with manning and berthing on CVN 78. The Navy designed CVN 78 to have reduced manning to reduce life-cycle costs, but Navy analyses of manning on CVN 78 have identified problems in manning and berthing. These problems are similar to those seen on other recent ship classes such as DDG 1000 and the Littoral Combat Ship (LCS)....

There are significant risks to the successful completion of the CVN 78 IOT&E and the ship's subsequent deployment due to known performance problems and the low or unknown reliability of key systems. For AAG, EMALS, AWE and DBR, systems that are essential to the primary missions of the ship, these problems, if uncorrected, are likely to affect CVN 78's ability to conduct effective flight operations and to defend itself in combat.

The CVN 78 test schedule leaves little or no time to fix problems discovered in developmental testing before IOT&E begins that could cause program delays. In the current program schedule, major developmental test events overlap IOT&E. This overlap increases the likelihood problems will be discovered during CVN 78's IOT&E, with the attendant risk to the successful completion of that testing and to the ship's first deployment.

The inevitable lessons we will learn from the CVN 78 FSST will have significant implications for CVN 78 combat operations, as well as for the construction of future

carriers incorporating the ship's advanced systems; therefore, the FSST should be conducted on CVN 78 as soon as it is feasible to do so.[32]

Navy Testimony

The prepared statement of the Navy witnesses at the hearing states in part:

> In June 2000, the Department of Defense (DOD) approved a three-ship evolutionary acquisition approach starting with the last NIMITZ Class carrier (CVN 77) and the next two carriers CVNX1 (later CVN 78) and CVNX2 (later CVN 79). This approach recognized the significant risk of concurrently developing and integrating new technologies into a new ship design incrementally as follows:
>
> • The design focus for the evolutionary CVN 77 was to combine information network technology with a new suite of multifunction radars from the DDG 1000 program to transform the ship's combat systems and the air wing's mission planning process into an integrated warfare system.
>
> • The design focus for the evolutionary CVNX1 (future CVN 78) was a new Hull, Mechanical and Electrical (HM&E) architecture within a NIMITZ Class hull that included a new reactor plant design, increased electrical generating capacity, new zonal electrical distribution, and new electrical systems to replace steam auxiliaries under a redesigned flight deck employing new Electromagnetic Aircraft Launch System (EMALS) catapults together with aircraft ordnance and fueling "pit-stops". Design goals for achieving reduced manning and improved maintainability were also defined.
>
> • The design focus for the evolutionary CVNX2 (future CVN 79) was a potential "clean-sheet" design to "open the aperture" for capturing new but immature technologies such as the Advanced Arresting Gear (AAG) and Advanced Weapons Elevators (AWE) that would be ready in time for the third ship in the series; and thereby permit the experience gained from design and construction of the first two ships (CVN 77 and CVN 78) to be applied to the third ship (CVN 79).
>
> Early in the last decade, however, a significant push was made within DOD for a more transformational approach to delivering warfighting capability. As a result, in 2002, DOD altered the program acquisition strategy by transitioning to the new aircraft carrier class in a single transformational leap vice an incremental three ship strategy. Under the revised strategy, CVN 77 reverted back to a "modified-repeat" NIMITZ Class design to minimize risk and construction costs, while delaying the integrated warfare system to CVN 78. Further, due to budget constraints, CVN 78 would start construction a year later (in 2007) with a NIMITZ Class hull form but would entail a major re-design to accommodate all the new technologies from the three ship evolutionary technology insertion plan.
>
> This leap ahead in a single ship was captured in a revised Operational Requirements Document (ORD) in 2004, which defined a new baseline that is the FORD Class today, with CVN 78 as the lead ship. The program entered system development and demonstration, containing the shift to a single ship acquisition strategy. The start of CVN 78 construction was then delayed by an additional year until 2008 due to budget constraints. As a result, the traditional serial evolution of technology development, ship concept design, detail design, and construction – including a total of 23 developmental systems incorporating new technologies originally planned across CVN 77, CVNX1, CVNX2 - were compressed and overlapped within the program baseline for the CVN 78.

[32] Statement by J. Michael Gilmore, Director, Operational Test and Evaluation, Office of the Secretary of Defense, Before the Senate Armed Services Committee, [October 1, 2015], 19 pp.

Today, the Navy is confronting the impacts of this compression and concurrency, as well as changes to assumptions made in the program planning more than a decade ago....

Given the lengthy design, development, and build span associated with major warships, there is a certain amount of overlap or concurrency that occurs between the development of new systems to be delivered with the first ship, the design information for those new systems, and actual construction. Since this overlap poses cost and schedule risk for the lead ship of the class, program management activities are directed at mitigating this overlap to the maximum extent practicable.

In the case of the FORD Class, the incorporation of 23 developmental systems at various levels of technical maturity (including EMALS, AAG, DBR, AWE, new propulsion plant, integrated control systems) significantly compounded the inherent challenges associated with accomplishing the first new aircraft carrier design in 40-years. The cumulative impact of this high degree of concurrency significantly exceeded the risk attributed to any single new system or risk issue and ultimately manifested itself in terms of delay and cost growth in each element of program execution; development, design, material procurement (government and contractor), and construction....

Shipbuilder actions to resolve first-of-class issues retired much of the schedule risks to launch, but at an unstable cost. First-of-class construction and material delays led the Navy to revise the launch date in March 2013 from July 2013 to November 2013. Nevertheless, the four-month delay in launch allowed increased outfitting and ship construction that were most economically done prior to ship launch, such as completion of blasting and coating operations for all tanks and voids, installation of the six DBR arrays, and increased installations of cable piping, ventilation, electrical boxes, bulkheads and equipment foundations. As a result, CVN 78 launched at 70 percent complete and 77,000 tons displacement – the highest levels yet achieved in aircraft carrier construction. This high state of completion at launch enabled improved outfitting, compartment completion, an efficient transition into the shipboard test program, and the on-time completion of key milestones such as crew move aboard.

With the advent of the shipboard test program, first time energization and grooming of new systems have required more time than originally planned. As a result, the Navy expects the sea trial schedule to be delayed about six to eight weeks. The exact impact on ship delivery will be determined based on the results of these trials. The Navy expects no schedule delays to CVN 78 operational testing and deployability due to the sea trials delay and is managing schedule delays within the $12.887 billion cost cap.

Additionally, at delivery, AAG will not have completed its shipboard test program. The program has not been able to fully mitigate the effect of a two-year delay in AAG equipment deliveries to the ship. All AAG equipment has been delivered to the ship and will be fully installed on CVN 78 at delivery. The AAG shipboard test and certification program will complete in time to support aircraft launch and recovery operations in summer 2016....

The Navy, in coordination with the shipbuilder and major component providers, implemented a series of actions and initiatives in the management and oversight of CVN 78 that crossed the full span of contracting, design, material procurement, GFE, production planning, production management and oversight. The Secretary of the Navy directed a detailed review of the CVN 78 program build plan to improve end-to-end aircraft carrier design, material procurement, production planning, build and test, the results of which are providing benefit across all carriers. These corrective measures include:

• CVN 78 design was converted from a ‘level of effort, fixed fee’ contract to a completion contract with a firm target and incentive fee. Shipbuilder cost performance has been on-target or better since this contract change.

• CVN 78 construction fee was reduced, consistent with contract provisions. However, the shipbuilder remains incentivized by the contract shareline to improve upon current cost performance.

• Contract design changes are under strict control; authorized only for safety, damage control, and mission-degrading deficiencies.

• Following a detailed "Nunn-McCurdy-like" review in 2008-2009, the Navy converted the EMALS and AAG production contract to a firm, fixed price contract, capping cost growth to each system.

• In 2011, Naval Sea Systems Command completed a review of carrier specifications with the shipbuilder, removing or improving upon overly burdensome or unneeded specifications that impose unnecessary cost on the program. Periodic reviews continue.

Much of the impact to cost performance was attributable to shipbuilder and government material cost overruns. The Navy and shipbuilder have made significant improvements upon material ordering and delivery to the shipyard to mitigate the significant impact of material delays on production performance.

These actions include:

• The Navy and shipbuilder instituted optimal material procurement strategies and best practices (structuring procurements to achieve quantity discounts, dual-sourcing to improve schedule performance and leveraging competitive opportunities) from outside supply chain management experts.

• The shipbuilder assigned engineering and material sourcing personnel to each of their key vendors to expedite component qualifications and delivery to the shipyard.

• The shipbuilder inventoried all excess material procured on CVN 78 for transfer to CVN 79.

• The Program Executive Officer (Carriers) has conducted quarterly Flag-level GFE summits to drive cost reduction opportunities and ensure on-time delivery of required equipment and design information to the shipbuilder.

The CVN 78 build plan, consistent with the NIMITZ Class, had focused foremost on completion of structural and critical path work to support launching the ship on-schedule. Achieving the program's cost improvement targets required that CVN 78 increase its level of completion at launch, from 60 percent to 70 percent. To achieve this and drive greater focus on system completion:

• The Navy fostered a collaborative build process review by the shipbuilder with other Tier 1 private shipyards in order to benchmark its performance and identify fundamental changes that are yielding marked improvement.

• The shipbuilder established specific launch metrics by system and increased staffing for waterfront engineering and material expediters to support meeting those metrics. This ultimately delayed launch, but drove up pre-outfitting to the highest levels for CVN new construction which has helped stabilize cost and improve test program and compartment completion performance relative to CVN 77.

• The shipbuilder linked all of these processes within a detailed integrated master schedule that has provided greater visibility to performance and greater ability to control cost and schedule performance across the shipbuilding disciplines.

These initiatives, which summarize a more detailed list of actions being implemented and tracked as a result of the end-to-end review, were accompanied by important management changes.

• In 2011, the Navy assigned a second tour Flag Officer with considerable carrier operations, construction, and program management experience as the new Program Executive Officer (PEO).

• The new PEO established a separate Program Office, PMS 379, to focus exclusively on CVN 79 and CVN 80, which enables the lead ship Program Office, PMS 378, to focus on cost control, schedule performance and the delivery of CVN 78.

• In 2012, the shipbuilder assigned a new Vice President in charge of CVN 78, a new Vice President in charge of material management and purchasing, and a number of new general ship foremen to strengthen CVN 78 performance.

• The new PEO and shipyard president began conducting bi-weekly launch readiness reviews focused on cost performance, critical path issues and accomplishment of the targets for launch completion. These bi-weekly reviews will continue through delivery.

• Assistant Secretary of the Navy (Research, Development, and Acquisition) (ASN (RD&A)) conducts quarterly reviews of program progress and performance with the PEO and shipbuilder to ensure that all that can be done to improve on cost performance is being done.

The series of actions taken by the Navy and the shipbuilder are achieving the desired effect of arresting cost growth, establishing stability, and have resulted in no changes in the Government's estimate at completion over the past four years. The Department of the Navy is continuing efforts to identify cost reductions, drive improved cost and schedule performance, and manage change. The Navy has established a rigorous process with the shipbuilder that analyzes each contract change request to approve only those change categories allowed within the 2010 ASN(RD&A) change order management guidance. This guidance only allows changes for safety, contractual defects, testing and trial deficiencies, statutory and regulatory changes that are accompanied by funding and value engineering change proposals with instant contract savings. While the historical average for contractual change level is approximately 10 percent of the construction cost for the lead ship of a new class, CVN 78 has maintained a change order budget of less than four percent to date despite the high degree of concurrent design and development.

Finally, the Navy has identified certain areas of the ship whose completion is not required for delivery, such as berthing spaces for the aviation detachment, and has removed this work from the shipbuilder's contract. This deferred work will be completed within the ship's budgeted end cost and is included within the $12,887 million cost estimate. By performing this deferred work in the post-delivery period using CVN 78 end cost funding, it can be competed and accomplished at lower cost and risk to the overall ship delivery schedule....

The CVN 79 cost cap was established in 2006 and adjusted by the Secretary of the Navy in 2013, primarily to address inflation between 2006 and 2013 plus $325 million of the allowed increase for non-recurring engineering to incorporate design improvements for the CVN 78 Class construction.

The Navy and the shipbuilder conducted an extensive affordability review of carrier construction and made significant changes to deliver CVN 79 at the lowest possible cost. These changes are focused on eliminating the largest impacts to cost performance identified during the construction of CVN 78 as well as furthering improvements in future carrier construction. The Navy outlined cost savings initiatives in its Report to Congress in May, 2013, and is executing according to plan.

Stability in requirements, design, schedule, and budget, are essential to controlling and improving CVN 79 cost, and therefore is of highest priority for the program. Requirements for CVN 79 were "locked down" prior to the commencement of CVN 79 construction. The technical baseline and allocated budget for these requirements were

agreed to by the Chief of Naval Operations and ASN(RD&A) and further changes to the baseline require their approval, which ensures design stability and increases effectiveness during production. At the time of construction contract award, CVN 79 has 100 percent of the design product model complete (compared to 65 percent for CVN 78) and 80 percent of initial drawings released. Further, CVN 79 construction benefits from the maturation of virtually all new technologies inserted on CVN 78. In the case of EMALS and AAG, the system design and procurement costs are understood, and CVN 79 leverages CVN 78 lessons learned....

A completed FORD Class design enabled the shipbuilder to fully understand the "whole ship" bill of materials for CVN 79 construction and to more effectively manage the procurement of those materials with the knowledge of material lead times and qualified sources accrued from CVN 78 construction. The shipbuilder is able to order ship-set quantities of material, with attendant cost benefits, and to ensure CVN 79 material will arrive on time to support construction need. Extensive improvements have been put in place for CVN 79 material procurement to drive both cost reductions associated with more efficient procurement strategies and production labor improvements associated with improved material availability. Improved material availability is also a critical enabler to many construction efficiency improvements in CVN 79.

The shipbuilder has developed an entirely new material procurement and management strategy for CVN 79. This new strategy consists of eight separate initiatives....

The shipbuilder and the Navy have performed a comprehensive review of the build strategy and processes used in construction of CVN 78 Class aircraft carriers as well as consulted with other Navy shipbuilders on best practices. As a result, the shipbuilder has identified and implemented a number of changes in the way they build aircraft carriers, with a dedicated focus on executing construction activities where they can most efficiently be performed. The CVN 79 build sequence installs 20 percent more parts in shop, and 30 percent more parts on the final assembly platen, as compared to CVN 78. This work will result in an increase in pre-outfitting and work being pulled to earlier stages in the construction process where it is most efficiently accomplished....

In conjunction with the Navy and the shipbuilder's comprehensive review of the build strategy and processes used in construction of CVN 78 Class aircraft carriers, a number of design changes were identified that would result in more affordable construction. Some of these design changes were derived from lessons learned in the construction of CVN 78 and others seek to further simplify the construction process and drive cost down....

In addition to the major focus discussed above, the shipbuilder continues to implement capital improvements to facilities that serve to reduce risk and improve productivity....

To enhance CVN 79 build efficiency and affordability, the Navy is implementing a two-phase delivery plan. The two-phase strategy will allow the basic ship to be constructed and tested in the most efficient manner by the shipbuilder (Phase I) while enabling select ship systems and compartments to be completed in Phase II, where the work can be completed more affordably through competition or the use of skilled installation teams....

The CVN 80 planning and construction will continue to leverage class lessons learned in the effort to achieve cost and risk reduction for remaining FORD Class ships. The CVN 80 strategy seeks to improve on CVN 79 efforts to frontload as much work as possible to the earliest phases of construction, where work is both predictable and more cost efficient....

While delivery of the first-of-class FORD has involved challenges, those challenges are being addressed and this aircraft carrier class will provide great value to our Nation with unprecedented and greatly needed warfighting capability at overall lower total ownership

cost than a NIMITZ Class CVN. The Navy has taken major steps to stem the tide of increasing costs and drive affordability into carrier acquisition.[33]

GAO Testimony

The prepared statement of the GAO witness at the hearing states in part:

> The Ford-class aircraft carrier's lead ship began construction with an unrealistic business case. A sound business case balances the necessary resources and knowledge needed to transform a chosen concept into a product. Yet in 2007, GAO found that CVN 78 costs were underestimated and critical technologies were immature—key risks that would impair delivering CVN 78 at cost, on-time, and with its planned capabilities. The ship and its business case were nonetheless approved. Over the past 8 years, the business case has predictably decayed in the form of cost growth, testing delays, and reduced capability—in essence, getting less for more. Today, CVN 78 is more than $2 billion over its initial budget. Land-based tests of key technologies have been deferred by years while the ship's construction schedule has largely held fast. The CVN 78 is unlikely to achieve promised aircraft launch and recovery rates as key systems are unreliable. The ship must complete its final, more complex, construction phase concurrent with key test events. While problems are likely to be encountered, there is no margin for the unexpected. Additional costs are likely.
>
> Similarly, the business case for CVN 79 is not realistic. The Navy recently awarded a construction contract for CVN 79 which it believes will allow the program to achieve the current $11.5 billion legislative cost cap. Clearly, CVN 79 should cost less than CVN 78, as it will incorporate lessons learned on construction sequencing and other efficiencies. While it may cost less than its predecessor, CVN 79 is likely to cost more than estimated. As GAO found in November 2014, the Navy's strategy to achieve the cost cap relies on optimistic assumptions of construction efficiencies and cost savings—including unprecedented reductions in labor hours, shifting work until after ship delivery, and delivering the ship with the same baseline capability as CVN 78 by postponing planned mission system upgrades and modernizations until future maintenance periods.
>
> Today, with CVN 78 over 92 percent complete as it reaches delivery in May 2016, and the CVN 79 on contract, the ability to exercise oversight and make course corrections is limited. Yet, it is not too late to examine the carrier's acquisition history to illustrate the dynamics of shipbuilding—and weapon system—acquisition and the challenges they pose to acquisition reform. The carrier's problems are by no means unique; rather, they are quite typical of weapon systems. Such outcomes persist despite acquisition reforms the Department of Defense and Congress have put forward—such as realistic estimating and "fly before buy." Competition with other programs for funding creates pressures to overpromise performance at unrealistic costs and schedules. These incentives are more powerful than policies to follow best acquisition practices and oversight tools. Moreover, the budget process provides incentives for programs to be funded before sufficient knowledge is available to make key decisions. Complementing these incentives is a marketplace characterized by a single buyer, low volume, and limited number of major sources. The decades-old culture of undue optimism when starting programs is not the

[33] Statement of The Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition), Rear Admiral Donald E. Gaddis, Program Executive Officer, Tactical Aircraft, Department of the Navy, Rear Admiral Thomas J. Moore, Program Executive Officer, Aircraft Carriers, Department of the Navy, Rear Admiral Michael C. Manazir, Director, Air Warfare (OPNAV), Before the Senate Armed Services Committee on Procurement, Acquisition, Testing, and Oversight of the Navy's Gerald R. Ford Class Aircraft Carrier Program, October 1, 2015, 22 pp.

consequence of a broken process, but rather of a process in equilibrium that rewards unrealistic business cases and, thus, devalues sound practices.[34]

Additional Navy, CBO, and GAO Testimony, Reports, and Other Documents

This section presents additional discussions of 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 from the Navy, CBO, and GAO, starting with the most recent item.

March 2017 GAO Report

A March 2017 GAO report assessing major DOD weapon acquisition programs stated the following regarding the status of the CVN-78 program:

> **Technology, Design, and Production Maturity**
>
> The Navy reported 9 of the program's 13 critical technologies are mature, though testing continues to reveal issues. CVN 78 began construction with immature technologies and an incomplete design, leading to cost and schedule growth. The Navy completed deadload testing of the electromagnetic aircraft launch system from the ship's deck in 2016. The advanced arresting gear (AAG) began shipboard testing in July 2015, with projected completion in March 2017. The dual band radar (DBR) also began shipboard testing in 2015, despite known problems that could affect air traffic control functionality. Both the AAG and DBR are engaged in concurrent land-based testing. The advanced weapons elevators are also experiencing problems, and, as of January 2017, the Navy projected that only 2 of the 11 elevators would be built and tested by ship delivery. In June 2016, a turbine generator in the ship's propulsion plant experienced a catastrophic failure, likely due to a manufacturing defect. A follow-on review revealed additional problems requiring design modifications to the voltage regulator and protection systems, which has delayed the propulsion plant testing schedule. As a result of key subsystem deficiencies, the Under Secretary of Defense for Acquisition, Technology and Logistics directed an independent review team to identify and mitigate potential technology risks for follow-on ships.
>
> The Navy recently reported additional schedule delays for CVN 78 delivery and major post-delivery test events. Construction continues on CVN 79, which is 23 percent complete. This ship uses the CVN 78 design with some modifications, namely replacing DBR with the Enterprise Air Surveillance Radar suite. The Navy awarded the detail design and construction contract for CVN 79 in June 2015 and the advance procurement contract for CVN 80 in May 2016.
>
> **Other Program Issues**
>
> In 2007, Congress established a procurement cost cap of $10.5 billion for CVN 78, and lead ship procurement costs have since increased by 23 percent to the current cost cap of $12.9 billion. While CVN 78 construction is nearly complete, the Navy identified $48 million in cost risk and more recent technical issues suggest additional costs, meaning that the current cost cap likely does not represent necessary funding to deliver a complete ship. The National Defense Authorization Act for Fiscal Year 2016 reduced the cap for

[34] Government Accountability Office, *Ford Class Aircraft Carrier[:] Poor Outcomes Are the Predictable Consequences of the Prevalent Acquisition Culture*, GAO-16-84T, October 1, 2015, summary page. (Testimony Before the Committee on Armed Services, U.S. Senate, Statement of Paul L. Francis, Managing Director Acquisition and Sourcing Management.)

follow-on ships, including CVN 79's to $11.4 billion, though costs for this ship may also increase. The Office of the Secretary of Defense projected CVN 79 would exceed the program's cost estimate by about $235 million. We also found that the funds the Navy has budgeted based on CVN 79's cost estimate are likely to be insufficient to complete ship construction. The Navy has expressed confidence that CVN 79 will deliver within its cost cap, which assumes unprecedented efficiency gains in construction—namely that CVN 79 production hours will be significantly lower than CVN 78. The Navy adopted a two-phase acquisition approach for CVN 79 to shift some construction to a post-delivery period. This strategy results in a less capable and complete ship at delivery, and transfers the costs of known capability upgrades to other accounts by deferring work to future maintenance periods—obscuring CVN 79's actual costs.

Program Office Comments

With 93 percent of the CVN 78's test program complete, the Navy has made progress resolving first-of-class issues and has resumed critical-path testing to support delivery in April 2017. The Navy is managing the $48 million cost risk associated with extended shipboard testing and the costs for schedule delay to delivery. The Navy continues to pursue cost mitigation within the program to offset this cost risk to deliver the ship within the cost cap. According to the program, with 26 percent of CVN 79's construction complete, cost performance to- date remains aligned with the contract target to realize an 18 percent reduction in production labor hours from CVN 78. The Navy will deliver a complete and deployable ship at the end of Phase II, with the construction costs from both phases accounted within the cost cap.

GAO Response

Navy cost mitigation plans will not reduce actual CVN 78 costs; instead, the costs will be shifted to follow-on ships or to other support accounts. CVN 79 cost performance is degrading, and, if trends continue, the ship is at risk of exceeding its cost cap.[35]

February 2017 CBO Report

A February 2017 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 lead ship of the CVN-78 class is $12.9 billion in nominal dollars appropriated over the period from 2001 to 2016, an amount that is equal to the cost cap set in law. CBO used the Navy's inflation index for naval shipbuilding to convert that figure to $14.9 billion (in 2016 dollars), or 23 percent more than the President requested in his budget proposal when the ship was first authorized in 2008. The Navy's estimate does not include $4.8 billion in research and development costs that apply to the entire class.
>
> Because construction of the lead ship is nearly finished, CBO used the Navy's estimate for that ship to estimate the cost of successive ships in the class. That does not, however, mean that all of the cost risk has been eliminated. In particular, the ship's power systems and its advanced arresting gear (that is, the system used to recover aircraft landing on the ship) are not yet working properly. It is not clear how much money will be required to fix those problems, and CBO does not have enough information to make an estimate.
>
> The next carrier after the CVN-78 will be the CVN-79, the John F. Kennedy. Funding for that ship began in 2007, the Congress officially authorized its construction in 2013, and appropriations for it are expected to be complete by 2018. The Navy estimates that the

[35] Government Accountability Office, *Defense Acquisitions[:] Assessments of Selected Weapon Programs*, GAO-17-333SP, March 2017, p. 96.

ship will cost $11.4 billion in nominal dollars (or $11.1 billion in 2016 dollars). The Navy's 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." Although CBO expects the Navy to achieve a considerable cost reduction in the CVN-79 compared with the CVN-78, the agency's estimates are somewhat higher than the Navy's. Specifically, CBO estimates that the ship will cost $11.8 billion in nominal dollars (or $11.5 billion in 2016 dollars), about 4 percent more than the Navy's estimate.

The Navy estimates an average cost of $11.4 billion for the 6 carriers in the 2017 shipbuilding plan (the CVN-80 through the CVN-85). CBO's estimate is $12.3 billion per ship. Both estimates are essentially the same for the 2017 plan as they were for the 2016 plan. The Navy's current estimate incorporates the effects of efforts to reduce costs for the CVN-79 and subsequent ships in the class. CBO's estimate is based on the Navy's estimate for the final cost of the CVN-78. Its estimate is still greater than the Navy's, however, because CBO projects smaller reductions in price than the Navy expects and because CBO anticipates real cost growth in the naval shipbuilding industry.[36]

February 2015 Department of the Navy Testimony

At a February 25, 2015, hearing on Department of the Navy acquisition programs, Department of the Navy officials testified:

The Navy is committed to delivering CVN 78 within the $12.887 billion Congressional cost cap. Sustained efforts to identify cost reductions and drive improved cost and schedule on this first-of-class aircraft carrier have resulted in highly stable performance since 2011.

Parallel efforts by the Navy and shipbuilder are driving down and stabilizing aircraft carrier construction costs for the future John F Kennedy (CVN 79) and estimates for the future Enterprise (CVN 80). As a result of the lessons learned on CVN 78, the approach to carrier construction has undergone an extensive affordability review. The Navy and the shipbuilder have made significant changes on CVN 79 to reduce the cost to build the ship as detailed in the 2013 CVN 79 report to Congress. The benefits of these changes in build strategy and resolution of first-of-class impacts on CVN 79 are evident in metrics showing significantly reduced man-hours for completed work from CVN 78. These efforts are ongoing and additional process improvements continue to be identified.

The Navy extended the CVN 79 construction preparation contract into 2015 to enable continuation of ongoing planning, construction, and material procurement while capturing lessons learned associated with lead ship construction and early test results. The continued negotiations of the detail design and construction (DD&C) contract afford an opportunity to incorporate further construction process improvements and cost reduction efforts. Award of the DD&C contract is expected in third quarter FY 2015. This will be a fixed price-type contract.

Additionally, the Navy will deliver the CVN 79 using a two-phased strategy. This enables select ship systems and compartments to be completed in a second phase, wherein the work can be completed more efficiently through competition or the use of skilled installation teams responsible for these activities. This approach, key to delivering CVN 79 at the lowest cost, also enables the Navy to procure and install shipboard electronic systems at the latest date possible.

[36] Congressional Budget Office, *An Analysis of the Navy's Fiscal Year 2017 Shipbuilding Plan*, February 2017, p. 23.

> The FY 2014 NDAA adjusted the CVN 79 and follow ships cost cap to $11,498 million to account for economic inflation and non-recurring engineering for incorporation of lead ship lessons learned and design changes to improve affordability. In transitioning from first-of-class to first follow ships, the Navy has maintained Ford class requirements and the design is highly stable. Similarly, we have imposed strict interval controls to drive changes to the way we do business in order to ensure CVN 79 is delivered below the cost cap. To this same end, the FY 2016 President's Budget request aligns funding to the most efficient build strategy for this ship and we look for Congress' full support of this request to enable CVN 79 to be procured at the lowest possible cost.
>
> Enterprise (CVN 80) will begin long lead time material procurement in FY 2016. The FY 2016 request re-phases CVN 80 closer to the optimal profile, therefore reducing the overall ship cost. The Navy will continue to investigate and will incorporate further cost reduction initiatives, engineering efficiencies, and lessons learned from CVN 78 and CVN 79. Future cost estimates for CVN 80 will be updated for these future efficiencies as they are identified.[37]

March 2013 Navy Report to Congress (Released May 2013)

A March 2013 report to Congress on the Navy's plan for building CVN-79 that was released to the public on May 16, 2013, states in its executive summary:

> As a result of the lessons learned on CVN 78, the approach to carrier construction has undergone an extensive affordability review and the Navy and the shipbuilder have made significant changes on CVN 79 that will significantly reduce the cost to build the ship. These include four key construction areas:
>
> — CVN 79 construction will start with a complete design and a complete bill of material
>
> — CVN 79 construction will start with a firm set of stable requirements
>
> — CVN 79 construction will start with the development complete on a host of new technologies inserted on CVN 78 ranging from the Electromagnetic Aircraft Launch System (EMALS), the Dual Band Radar, and the reactor plant, to key valves in systems throughout the ship
>
> — CVN 79 construction will start with an 'optimal build' plan that emphasizes the completion of work and ship outfitting as early as possible in the construction process to optimize cost and ultimately schedule performance.
>
> In addition to these fundamentals, the Navy and the shipbuilder are tackling cost through a series of other changes that when taken over the entire carrier will have a significant impact on construction costs. The Navy has also imposed cost targets and is aggressively pursuing cost reduction initiatives in its government furnished systems. A detailed accounting of these actions is included in this report.
>
> The actions discussed in this report are expected to reduce the material cost of CVN 79 by 10-20% in real terms from CVN 78, to reduce the number of man-hours required to

[37] Statement of the Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition) and Vice Admiral Joseph P. Mulloy, Deputy Chief of Naval Operations for Integration of Capabilities and Resources and Lieutenant General Kenneth J. Glueck, Jr., Deputy Commandant, Combat Development and Integration & Commanding General, Marine Corps Combat Development Command, Before the Subcommittee on Seapower and Projection Forces of the House Armed Services Committee on Department of the Navy Seapower and Projection Forces Capabilities, February 25, 2015, pp. 5-6.

> build the CVN 79 by 15-25% from CVN 78, and to reduce the cost of government furnished systems by 5-10% in real terms from CVN 78.[38]

For the full text of the Navy's report, see the **Appendix B**.

May 2013 Navy Testimony

In its prepared statement for a May 8, 2013, hearing on Navy shipbuilding programs before the Seapower subcommittee of the Senate Armed Services Committee, the Navy stated that

> In 2011, the Navy identified spiraling cost growth [on CVN-78] associated with first of class non-recurring design, contractor and government furnished equipment, and ship production issues on the lead ship. The Navy completed an end-to-end review of CVN 78 construction in December 2011 and, with the shipbuilder, implemented a series of corrective actions to stem, and to the extent possible, reverse these trends. While cost performance has stabilized, incurred cost growth is irreversible....
>
> As a result of lessons learned on CVN 78, the approach to carrier construction has undergone an extensive affordability review; and the Navy and the shipbuilder have made significant changes on CVN 79 that will reduce the cost to build the ship. CVN 79 construction will start with a complete design, firm requirements, and material economically procured and on hand in support of production need. The ship's build schedule also provides for increased completion levels at each stage of construction with resulting improved production efficiencies....
>
> Inarguably, this new class of aircraft carrier brings forward tremendous capability and life-cycle cost advantages compared to the NIMITZ-class it will replace. However, the design, development and construction efforts required to overcome the technical challenges inherent to these advanced capabilities have significantly impacted cost performance on the lead ship. The Navy continues implementing actions from the 2012 detailed review of the FORD-Class build plan to control cost and improve performance across lead and follow ship contracts. This effort, taken in conjunction with a series of corrective actions with the shipbuilder on the lead ship, will not recover costs to original targets for GERALD R. FORD [CVN-78], but should improve performance on the lead ship while fully benefitting CVN 79 and following ships of the class.[39]

In the discussion portion of the hearing, Sean Stackley, the Assistant Secretary of the Navy for Research, Development and Acquisition (i.e., the Navy's acquisition executive), testified that

> First, the cost growth on the CVN-78 is unacceptable. The cost growth dates back in time to the very basic concepts that went into take in the Nimitz-class and doing a total redesign of the Nimitz class to get to a level of capability and to reduce operating and support cost for the future carrier. Far too much risk was carried into the design of the first of the Ford-class.
>
> Cost growth stems to the design was moving at the time production started. The vendor base that was responsible for delivering new components and material to support the ship

[38] *Aircraft Carrier Construction, John F Kennedy (CVN 79), Report to Congress*, March 2013, p. 3. An annotation on the report's cover page indicates that the report was authorized for public release on May 16, 2013. The report was posted at InsideDefense.com (subscription required) on June 21, 2013. See also Megan Eckstein, "Navy Plan To Congress Outlines New Strategies To Save On CVN-79," *Inside the Navy*, June 24, 2013.

[39] Statement of The Honorable Sean J. Stackley, Assistant Secretary of the Navy (Research, Development and Acquisition) and Vice Admiral Allen G. Myers, Deputy Chief of Naval Operations for Integration of Capabilities and Resources and Vice Admiral Kevin M. McCoy, Commander, Naval Sea Systems Command, Before the Subcommittee on Seapower of the Senate Armed Services Committee on Department of the Navy Shipbuilding Programs, May 8, 2013, p. 8.

> production was (inaudible) with new developments in the vendor base and production plan do not account for the material ordering difficulties, the material delivery difficulties and some of the challenges associated with building a whole new design compared to the Nimitz....
>
> Sir, for CVN-79, we have—we have held up the expenditures on CVN-79 as we go through the details of—one, ensuring that the design of the 78 is complete and repeated for the 79s [sic] that we start with a clean design.
>
> Two, we're going through the material procurement. We brought a third party into assessment material-buying practices at Newport News to bring down the cost of material. And we're metering out the dollars for buying material until it hits the objectives that we're setting for CVN-79 through rewriting the build plan on CVN-79.
>
> If you take a look at how the 78 is being constructed, far too much work is being accomplished late in the build cycle. So we are rewriting the build plan for CVN-79, do more work in the shops where it's more efficient, more work in the buildings where it's more efficient, less work in the dry dock, less work on the water. And then we're going after the rates—the labor rates and the investments needed by the shipbuilder to achieve these efficiencies.[40]

Later in the hearing, Stackley testified that

> the history in shipbuilding is since you don't have a prototype for a new ship, the first of class referred to as the lead ship is your prototype. And so you carry a lot of risk into the construction of that first of class.
>
> Also, given the nature that there's a lengthy design development and build span associated with ships, so there is a certain amount of overlap or concurrency that occurs between the development of new systems that need to be delivered with the first ship, the incorporation of the design of those new systems and the actual construction. And so to the extent that there is change in a new ship class then the risk goes up accordingly.
>
> In the case of the CVN-78, the degree of change compared to the Nimitz was fairly extraordinary all for good reasons, good intentions, increased capability, increased survivability, significant reduction in operating and support costs. So there was a determination that will take on this risk in order to get those benefits, and the case of the CVN-78, those risks are driving a lot of the cost growth on the lead ship.
>
> When you think about the follow ships, now you've got a stable design, now your vendor base has got a production line going to support the production. Now you've got a build plan and a workforce that has climbed up on the learning curve to drive cost down. So you can look at—you can look at virtually every shipbuilding program and you'll see a significant drop-off in cost from that first of class to the follow ships.
>
> And then you look for a stable learning curve to take over in the longer term production of a ship class.
>
> Carriers are unique for a number of reasons, one of which we don't have an annual procurement of carriers. They're spread out over a five and, in fact, in the case of 78 as much as seven-year period. So in order to achieve that learning, there are additional challenges associated with achieving that learning. And so we're going at it very deliberately on the CVN-79 through the build plan with the shipbuilder to hit the line that we've got to have—the cost reductions that we've got to have on the follow ships of the class.[41]

[40] Transcript of hearing.

[41] Transcript of hearing.

March 2012 Navy Letter to Senator McCain

Secretary of the Navy Ray Mabus, in a letter with attachment sent in late March 2012 to Senator John McCain on controlling cost growth in CVN-78, stated:

> Dear Senator McCain:
>
> Thank you for your letter of March 21, 2012, regarding the first-of-class aircraft carrier, GERALD R. FORD (CVN 78). Few major programs carry greater importance or greater impact on national security, and no other major program comprises greater scale and complexity than the Navy's nuclear aircraft carrier program. Accordingly, successful execution of this program carries the highest priority within the Department of the Navy.
>
> I have shared in the past my concern when I took office and learned the full magnitude of new technologies and design change being brought to the FORD. Requirements drawn up more than a decade prior for this capital ship drove development of a new reactor plant, propulsion system, electric plant and power distribution system, first of kind electromagnetic aircraft launching system, advanced arresting gear, integrated warfare system including a new radar and communications suite, air conditioning plant, weapons elevators, topside design, survivability improvements, and all new interior arrangements. CVN 78 is a near-total redesign of the NIMITZ Class she replaces. Further, these major developments, which were to be incrementally introduced in the program, were directed in 2002 to be integrated into CVN 78 in a single step. Today we are confronting the cost impacts of these decisions made more than a decade ago.
>
> In my August 29, 2011 letter, I provided details regarding these cost impacts. At that time, I reported the current estimate for the Navy's share of the shipbuilder's construction overrun, $690 million, and described that I had directed an end-to-end review to identify the changes necessary to improve cost for carrier design, material procurement, planning, build and test. The attached white paper provides the findings of that review and the steps we are taking to drive affordability into the remaining CVN 78 construction effort. Pending the results of these efforts, the Navy has included the 'fact of life' portion of the stated overrun in the Fiscal Year 2013 President's Budget request. The review also highlighted the compounding effects of applying traditional carrier build planning to a radically new design; the challenges inherent to low-rate, sole-source carrier procurement; and the impact of external economic factors accrued over 15 years of CVN 78 procurement—all within the framework of cost-plus contracts. The outlined approach for ensuring CVN 79 and follow ship affordability focuses equally upon tackling these issues while applying the many lessons learned in the course of CVN 78 procurement.
>
> As always, if I may be of further assistance, please let me know.
>
> Sincerely, [signed] Ray Mabus
>
> Attachment: As stated
>
> Copy to: The Honorable Carl Levin, Chairman
>
> [Attachment]
>
> Improving Cost Performance on CVN 78
>
> CVN 78 is nearing 40 percent completion. Cost growth to-date is attributable to increases in design, contractor furnished material, government furnished material (notably, the Electromagnetic Aircraft Launching System (EMALS), Advanced Arresting Gear (AAG), and the Dual Band Radar (DBR)), and production labor performance. To achieve the best case outcome, the program must execute with zero additional cost growth in design and material procurement, and must improve production performance. The Navy and the shipbuilder have implemented a series of actions and initiatives in the management and oversight of CVN 78 that cross the full span of contracting, design,

material procurement, government furnished equipment, production planning, production, management and oversight.

CVN 78 is being procured within a framework of cost-plus contracts. Within this framework, however, the recent series of action taken by the Navy to improve contract effectiveness are achieving the desired effect of incentivizing improved cost performance and reducing government exposure to further cost growth.

- CVN 78 design has been converted from a 'level of effort, fixed fee' contract to a completion contract with a firm target and incentive fee. Shipbuilder cost performance has been on-target or better since this contract was changed.
- CVN 78 construction fee has been retracted, consistent with contract performance. However, the shipbuilder is incentivized by the contract shareline to improve upon current performance to meet agreed-to cost goals.
- Contract design changes are under strict control; authorized only for safety, damage control, mission-degrading deficiencies, or similar. Adjudicated changes have been contained to less than 1 percent of contract target price.
- The Navy converted the EMALS and AAG production contract to a firm, fixed price contract, capping cost growth to that system and imposing negative incentives for late delivery.
- Naval Sea Systems Command is performing a review of carrier specifications with the shipbuilder, removing or improving upon overly burdensome or unneeded specifications that impose unnecessary cost on the program.

The single largest impact to cost performance to-date has been contractor and government material cost overruns. These issues trace to lead ship complexity and CVN 78 concurrency, but they also point to inadequate accountability for carrier material procurement, primarily during the ship's advance procurement period (2002-2008).

These effects cannot be reversed on CVN 78, but it is essential to improve upon material delivery to the shipyard to mitigate the significant impact of material delays on production performance. Equally important, the systemic material procurement deficiencies must be corrected for CVN 79. To this end, the Navy and shipbuilder have taken the following actions.

- The Navy has employed outside supply chain management experts to develop optimal material procurement strategies. The Navy and the shipbuilder are reviewing remaining material requirements to employ these best practices (structuring procurements to achieve quantity discounts, dual-sourcing to improve schedule performance and leverage competitive opportunities, etc.).
- The shipbuilder has assigned engineering and material sourcing personnel to each of their key vendors to expedite component qualifications and delivery to the shipyard.
- The shipbuilder is inventorying all excess material procured on CVN 78 for transfer to CVN 79 (cost reduction to CVN 78), as applicable.
- The Program Executive Officer (Carriers) is conducting quarterly flag-level government furnished equipment summits to drive cost reduction opportunities and ensure on-time delivery of required equipment and design information to the shipbuilder.

The most important finding regarding CVN 78 remaining cost is that the CVN 78 build plan, consistent with the NIMITZ class, focuses foremost on completion of structural and critical path work to support launching the ship on-schedule. This emphasis on structure comes at the expense of completing ship systems, outfitting, and furnishing early in the build process and results in costly, labor-intensive system completion activity during

later; more costly stages of production. Achieving the program's cost improvement targets will require that CVN 78 increase its level of completion at launch, from current estimate of 60 percent to no less than 65 percent. To achieve this goal and drive greater focus on system completion:

- the Navy fostered a collaborative build process review by the shipbuilder with other Tier 1 private shipyards in order to benchmark its performance arid identify fundamental changes that would yield marked improvement;
- the shipbuilder has established specific launch metrics by system (foundations, machinery, piping, power panels, vent duct, lighting, etc.) and increased staffing for waterfront engineering and material expediters to support meeting these metrics;
- the shipbuilder has linked all of these processes within a detailed integrated master schedule, providing greater visibility to current performance and greater ability to control future cost and schedule performance across the shipbuilding disciplines;
- the Navy and shipbuilder are conducting Unit Readiness Reviews of CVN 78 erection units to ensure that the outfitted condition of each hull unit being lifted into the dry-dock contains the proper level of outfitting.

These initiatives, which summarize a more detailed list of actions being implemented and tracked as result of the end-to-end review, are accompanied by important management changes.

- The shipbuilder has assigned a new Vice President in charge of CVN 78, a new Vice President in charge of material management and purchasing, and a number of new general shop foreman to strengthen CVN 78 performance.
- The Navy has assigned a second tour Flag Officer with considerable carrier operations, construction, and program management experience as the new Program-Executive Officer (PEO).
- The PEO and shipyard president conduct bi-weekly launch readiness reviews focusing on cost performance, critical path issues and accomplishment of the target for launch completion.
- The Assistant Secretary of the Navy (Research, Development, and Acquisition) conducts a monthly review of program progress and performance with the PEO and shipbuilder, bringing to bear the full weight of the Department, as needed, to ensure that all that can be done to improve on cost performance is being done.

Early production performance improvements can be traced directly to these actions, however, significant further improvement is required. To this end, the Navy is conducting a line-by-line review of all 'cost to-go' on CVN 78 to identify further opportunity to reduce cost and to mitigate risk.

Improving Cost Performance on CVN 79

CVN 79 Advance Procurement commenced in 2007 with early construction activities following in 2011. Authorization for CVN 79 procurement is requested in Fiscal Year 2013 President's Budget request with the first year of incremental funding. Two years have been added to the CVN 79 production schedule in this budget request, afforded by the fact that CVN 79 will replace CVN 68 when she inactivates. To improve affordability for CVN 79, the Navy plans to leverage this added time by introducing a fundamental change to the carrier procurement approach and a corresponding shift to the carrier build plan, while incorporating CVN 78 lessons learned.

The two principal 'documents' which the Navy and shipbuilder must ensure are correct and complete at the outset of CVN 79 procurement are the design and the build plan.

Design is governed by rules in place that no changes will be considered for the follow ship except changes necessary to correct design deficiencies on the lead ship, fact of life changes to correct obsolescence issues, or changes that will result in reduced cost for the follow ship. Exceptions to these rules must be approved by the JROC, or designee. Accordingly, the Navy is requesting procurement authority for CVN 79 with the Design Product Model complete and construction drawings approximately 95 percent complete (compared to approximately 30 percent complete at time of lead ship authorization).

As well, first article testing and certification will be complete for virtually all major new equipments introduced in the FORD Class. At this point in time, the shipbuilder has developed a complete bill of material for CVN 79. The Navy is working with the shipbuilder to ensure that the contractor's material estimates are in-line with Navy 'should cost' estimates; eliminating non-recurring costs embedded in lead ship material, validating quantities, validating escalation indices, incorporating lead ship lessons learned. The Navy has increased its oversight of contractor furnished material procurement, ensuring that material procurement is competed (where competition is available); that it is fixed priced; that commodities are bundled to leverage economic order quantity opportunities; and that the vendor base capacity and schedule for receipt supports the optimal build plan being developed for production.

In total, the high level of design maturity and material certification provides a stable technical baseline for material procurement cost and schedule performance, which are critical to developing and executing an improved, reliable build plan.

In order to significantly improve production labor performance, based on timely receipt of design and material, the Navy and shipbuilder are reviewing and implementing changes to the CVN 79 build plan and affected facilities. The guiding principles are:

- maximize planned work in the shops and early stages of construction;
- revise sequence of structural unit construction to maximize learning curve performance through 'families of units' and work cells;
- incorporate design changes to improve FORD Class producibility;
- increase the size of erection units to eliminate disruptive unit breaks and improve unit alignment and fairness;
- increase outfitting levels for assembled units prior to erection in the dry-dock;
- increase overall ship completion levels at each key event.

The shipbuilder is working on detailed plans for facility improvements that will improve productivity, and the Navy will consider incentives for capital improvements that would provide targeted return on investment, such as:

- increasing the amount of temporary and permanent covered work areas;
- adding ramps and service towers for improved access to work sites and the dry-dock;
- increasing lift capacity to enable construction of larger, more fully outfitted super-lifts:

An incremental improvement to carrier construction cost will fall short of the improvement necessary to ensure affordability for CVN 79 and follow ships. Accordingly, the shipbuilder has established aggressive targets for CVN 79 to drive the game-changing improvements needed for carrier construction. These targets include:

- 75 percent Complete at Launch (15 percent> [i.e., 15 percent greater than] FORD);
- 85-90 percent of cable pulled prior to Launch (25-30 percent> FORD);

- 30 percent increase in front-end shop work (piping details, foundations, etc);
- All structural unit hot work complete prior to blast and paint;
- 25 percent increase to work package throughput;
- 100 percent of material available for all work packages in accordance with the integrated master schedule;
- zero delinquent engineering and planning products;
- resolution of engineering problems in < 8 [i.e., less than 8] hours.

In parallel with efforts to improve shipbuilder costs, the PEO is establishing equally aggressive targets to reduce the cost of government furnished equipment for CVN 79; working equipment item by equipment item with an objective to reduce overall GFE costs by ~$500 million. Likewise, the Naval Sea Systems Command is committed to continuing its ongoing effort to identify specification changes that could significantly reduce cost without compromising safety and technical rigor.

The output of these efforts comprises the optimal build plan for CVN 79 and follow, and will be incorporated in the detail design and construction baseline for CVN 79. CVN 79 will be procured using a fixed price incentive contract.[42]

Press Reports

A July 2, 2015, press report states:

> The Navy plans to spend $25 million per year beginning in 2017 as a way to invest in lowering the cost of building the services' new Ford-class aircraft carriers, service officials said.
>
> "We will use this design for affordability to make new improvements in cost cutting technologies that will go into our ships," said Rear Adm. Michael Manazir, Director, Air Warfare....
>
> "We just awarded a contract to buy long lead item materials [for CVN-79] and lay out an allocated budget for each of the components of that ship. We want to build the ship in the most efficient manner possible," Rear Adm. Thomas Moore, Program Executive Officer, Carriers, said.
>
> Navy leaders say the service is making positive strides regarding the cost of construction for the USS Kennedy and plans to stay within the congressional cost cap of $11.498 billion....
>
> The $25 million design for affordability initiative is aimed at helping to uncover innovative shipbuilding techniques and strategies that will accomplish this and lower costs.
>
> Moore said the goal of the program is to, among other things, remove $500 million from the cost of the third Ford-class carrier, the USS Enterprise, CVN 80.
>
> "It is finding a million here and a million there and eventually that is how you get a billion dollars out of the ship from (CVN) 78 to (CVN) 79. The goal is to get another $500 million out of CVN 80. The $25 million dollars is a pretty prudent investment if we can continue to drive the cost of this class of ship down," Moore told reporters recently.

[42] Letter and attachment from Secretary of the Navy Ray Mabus to Senator John McCain, undated but posted at InsideDefnse.com (subscription required) on March 27, 2012. InsideDefense.com's description of the letter states that it is dated March 26, 2012.

> Moore explained that part of the goal is to get to the point where a Ford-class carrier can be built for the same amount of man-hours it took to build their predecessor ships, the Nimitz-class carriers.
>
> "We want to get back to the goal of being able to build it for historical Nimitz class levels in terms of man hours for a ship that is significantly more capable and more complex to build," Moore added.
>
> The money will invest in new approaches and explore the processes that a shipyard can use to build the ship, Moore added.
>
> "They've made a significant investment in these new welding machines. These new welding machines allow the welder to use different configurations. This has significantly improved the throughput that the shipyard has," Moore said, citing an example of the kind of thing the funds would be used for.
>
> The funds will also look into whether new coatings for the ship or welding techniques can be used and whether millions of feet of electrical cabling can be installed in a more efficient manner, Moore added.
>
> Other cost saving efforts assisted by the funding include the increased use of complex assemblies, common integrated work packages, automated plate marking, weapons elevator door re-design and vertical build strategies, Navy officials said.
>
> Shipbuilders could also use a new strategy of having work crews stay on the same kind of work for several weeks at a time in order to increase efficiency, Moore said. Also, some of the construction work done on the USS Ford while it was in dry dock is now being done in workshops and other areas to improve the building process, he added.[43]

A June 29, 2015, press report states:

> Newport News Shipbuilding will see cost reduction on the order of 18 percent fewer man hours overall from the first Ford-class aircraft carrier to the second, according to a company representative.
>
> Ken Mahler, Newport News vice president of Navy programs, touted the shipyard's cost savings on the John F. Kennedy (CVN-79) during a June 15 interview with *Inside the Navy*. This reduction was facilitated by the investments the shipyard is making in carrier construction, as well as lessons learned from the first ship, the Gerald R. Ford (CVN-78), which will deliver next year.[44]

A June 23, 2015, press report states:

> The Pentagon's cost-assessment office now says the Navy's second aircraft carrier in a new class will exceed a congressionally mandated cost cap by $235 million.
>
> That's down from an April estimate that the USS John F. Kennedy, the second warship in the new Ford class, would bust a $11.498 billion cap set by lawmakers by $370 million.[45] The Navy maintains that it can deliver the ship within the congressional limit.
>
> "The original figure was a draft based on preliminary information," Navy Commander Bill Urban, a spokesman for the Pentagon's Cost Assessment and Program Evaluation

[43] Kris Osborn, "Navy Launches New Affordability Plan for Ford-Class Carriers," *DOD Buzz*, July 2, 2015.

[44] Lara Seligman, "Newport News See 18 Percent Fewer Man Hours On Second Ford Carrier," *Inside the Navy*, June 29, 2015.

[45] See Anthony Capaccio, "Aircraft Carrier $370 Million Over Congressional Cost Cap," *Bloomberg News*, May 19, 2015.

> office, said in an e-mail. As better information, such as updated labor rates, became available, the office "revised its estimate to a more accurate number," he said.[46]

A June 15, 2015, press report states:

> [Rear Admiral Tom] Moore [program executive officer for aircraft carriers]. said the program would save a billion dollars by decreasing the man hours needed to construct the ship by 18 percent from CVN-78 to 79—down to about 44 million manhours. He said this reduction is only a first step in taking cost ouot of the carrier program. The future Enterprise (CVN-80) will take about 4 million manhours out, or another 10 percent reduction, for a savings of about $500 million.
>
> But beyond seeking ways to take cost out, the contract itself reduces the risk to the government, Moore said.
>
> "The main construction of the ship is now in a fixed price environment, so that switchover really limits the government's liability," he said.
>
> Without getting into specific dollar amounts due to business sensitivities, Moore explained that "this is the lowest target fee we've ever had on any CVN new construction. Look at tghe shape of the share [government-contractor cost] share lines, because the share lines at the end of the day are a measure of risk. So where we'd like to get quickly to [a] 50/50 [share line], in past carrier contracts we've been out at 85/15, 90/10—which basically means for every dollar over [the target cost figure, up to the ceiling cost figure], the government picks up 85 cents on the dollar. And this contract very quickly gets to 50/50. The other thing is ceiling price—on a fixed-price contract, the ceiling price is the government's maximum liability. And on this particular contract, again, it is the lowest ceiling price we've ever had [for a CVN]."[47]

[46] Anthony Capaccio, "Second New Carrier Now Seen Busting a Cost Cap by $235 Million," *Bloomberg News*, June 23, 2015.

[47] Megan Eckstein, "Navy: CVN-79 Contract Has Lowest Ceiling Price Ever; R&D Investment Will Take Out Further Cost," *USNI News*, June 15, 2015.

Appendix B. March 2013 Navy Report to Congress on Construction Plan for CVN-79

This appendix reprints a March 2013 Navy report to Congress on the Navy's construction plan for CVN-79.[48]

[48] *Aircraft Carrier Construction, John F Kennedy (CVN 79), Report to Congress*, March 2013, 17 pp. An annotation on the report's cover page indicates that the report was authorized for public release on May 16, 2013. The report was posted at InsideDefense.com (subscription required) on June 21, 2013. See also Megan Eckstein, "Navy Plan To Congress Outlines New Strategies To Save On CVN-79," *Inside the Navy*, June 24, 2013.

AIRCRAFT CARRIER CONSTRUCTION
JOHN F KENNEDY (CVN 79)
Report to Congress

March 2013

The estimated cost of report or study for the Department of Defense is approximately $13,000.00. This includes $0.00 in expenses and $13,000.00 in DoD labor.

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PUBLIC RELEASE
AUTHORIZED ON MAY 16, 2013

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AIRCRAFT CARRIER CONSTRUCTION
JOHN F KENNEDY (CVN 79)
Report to Congress

The National Defense Authorization Act for FY 2013, Public Law 112-239 contained specific language regarding acquisition of the JOHN F KENNEDY (CVN 79). The language follows:

SEC. 124. LIMITATION ON AVAILABILITY OF AMOUNTS FOR SECOND FORD CLASS AIRCRAFT CARRIER.

(a) LIMITATION.-Of the funds authorized to be appropriated or otherwise made available for fiscal year 2013 for shipbuilding and conversion for the second Ford class aircraft carrier, not more than 50 percent may be obligated or expended until the Secretary of the Navy submits to the congressional defense committees a report setting forth a description of the program management and cost control measures that will be employed in constructing the second Ford class aircraft carrier.

(b) ELEMENTS.-The report described in subsection (a) shall include a plan with respect to the Ford class aircraft carriers to-

(1) maximize planned work in shops and early stages of construction;
(2) sequence construction of structural units to maximize the effects of lessons learned;
(3) incorporate design changes to improve producibility for the Ford class aircraft carriers;
(4) increase the size of erection units to eliminate disruptive unit breaks and improve unit alignment and fairness;
(5) increase outfitting levels for assembled units before erection in the drydock;
(6) increase overall ship completion levels at each key construction event;
(7) improve facilities in a manner that will lead to improved productivity; and
(8) ensure the shipbuilder initiates plans that will improve productivity through capital improvements that would provide targeted return on investment, including-

(A) increasing the amount of temporary and permanent covered work areas;
(B) adding ramps and service towers for improved access to work sites and the drydock; and
(C) increasing lift capacity to enable construction of larger, more fully outfitted superlifts.

This document constitutes the report requested by Congress.

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Executive Summary

The GERALD R FORD (CVN 78) Class, the first new aircraft carrier design in over 40 years, represents a quantum advance in operational capability, survivability, and flexibility to accommodate future improvements in technology and war fighting capability over a 50-year service life, all while lowering total ownership costs by $4B when compared to the standard-bearing NIMITZ class. However, the scope of the CVN 78 "clean sheet" design, which touched virtually every element of the ship has presented challenges to the designer, supplier and shipbuilder for the lead ship both in terms of cost and schedule. The scope and volume of first of class issues on CVN 78 has been the primary factor driving growth in ship construction cost and schedule performance.

As a result of the lessons learned on CVN 78, the approach to carrier construction has undergone an extensive affordability review and the Navy and the shipbuilder have made significant changes on CVN 79 that will significantly reduce the cost to build the ship. These include four key construction areas:

- CVN 79 construction will start with a complete design and a complete bill of material
- CVN 79 construction will start with a firm set of stable requirements
- CVN 79 construction will start with the development complete on a host of new technologies inserted on CVN 78 ranging from the Electromagnetic Aircraft Launch System (EMALS), the Dual Band Radar, and the reactor plant, to key valves in systems throughout the ship
- CVN 79 construction will start with an 'optimal build' plan that emphasizes the completion of work and ship outfitting as early as possible in the construction process to optimize cost and ultimately schedule performance.

In addition to these fundamentals, the Navy and the shipbuilder are tackling cost through a series of other changes that when taken over the entire carrier will have a significant impact on construction costs. The Navy has also imposed cost targets and is aggressively pursuing cost reduction initiatives in its government furnished systems. A detailed accounting of these actions is included in this report.

The actions discussed in this report are expected to reduce the material cost of CVN 79 by 10-20% in real terms from CVN 78, to reduce the number of man-hours required to build the CVN 79 by 15-25% from CVN 78, and to reduce the cost of government furnished systems by 5-10% in real terms from CVN 78. The following table provides an executive summary of the cost reductions anticipated in the key focus areas described in this report.

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Focus Area	Anticipated reduction from CVN 78 to CVN 79
Improvements in material availability and pricing	10-20% in material cost
Major changes in build strategy and processes	10-15% in man-hours to build ship
Design changes for greater producibility	5-10% in man-hours to build ship
Government furnished equipment	5-10% in system costs

Detailed Discussion

IMPROVEMENTS IN MATERIAL AVAILABILITY AND PRICING
(10-20% Reduction in material cost)

As previously discussed, many of the first in class issues experienced during construction of CVN 78 were driven by material availability, vendor qualifications, and material costs. A completed Class design enables the shipbuilder to fully understand the whole ship bill of materials for CVN 79 construction and more effectively manage the procurement of those materials with the knowledge of material lead times and qualified sources accrued from CVN 78 construction. The myriad of vendor first article testing and certification issues which contributed to delays in material delivery on CVN 78 should not recur for CVN 79. The shipbuilder is able to order complete ship-set quantities of material, with attendant cost benefits, and to ensure CVN 79 material will arrive on time to support construction need. Extensive improvements have been put in place for CVN 79 material procurement to drive both cost reductions associated with more efficient procurement strategies and production labor improvements associated with improved material availability. The improved procurement strategies being employed on CVN 79 are expected to yield in real terms a material cost reduction as compared to the CVN 78 of 10-20%. Improved material availability is also a critical enabler to many construction efficiency improvements in CVN 79 discussed later in this report.

In order to maximize material availability and minimize material costs the shipbuilder has developed an entirely new material management strategy for CVN 79. This new strategy consists of eight separate initiatives:

a. **Define the "whole ship" bill of material -** This allows the shipbuilder to maximize opportunities for economic order quantity buy of material items from sub vendors. Reduced material costs will be realized and procurement effort is reduced – with an estimated 30% reduction in total number of purchase order lines as compared with CVN 78.
b. **Establish a "ship view" of equipment by supplier to help incentivize suppliers and correlate supplier priorities based on construction progress and need -** Some sub vendors produce multiple types of components in different geographic locations. Grouping orders by component type and sub vendor subdivision and location helps the shipbuilder define and communicate material priorities to the sub vendor across his enterprise, thereby improving material availability and reducing cost. This also reduces shipbuilder procurement support effort.

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c. **Accelerated production cost avoidance** - The shipbuilder has identified key components that can be purchased earlier than just-in-time construction need, allowing suppliers to level load their production lines and avoid incurring fees for accelerated production.
d. **Multi-ship material buys to leverage economic order quantity pricing** - The shipbuilder is investigating opportunities to procure parts common to multiple ship programs (e.g. CVN 79, Virginia Class Submarines, NIMITZ Class Refueling Complex Overhaul) in a grouped manner to leverage better pricing for all programs. This concept could further be expanded to pursue grouped procurement of material for more than one FORD Class carrier at a time (such as CVN 80 and CVN 81).
e. **Improved material ordering schedule** - Development of, and management to, a comprehensive material procurement plan that considers construction, sequencing, timing, and most recent experience with vendor procurement lead time to schedule a bundled or combined procurement to ensure material is available at the first instance of use.
f. **Soliciting and implementing vendor cost reduction ideas** - The shipbuilder is working with its suppliers to identify cost reduction ideas that may simplify material production and reduce procurement cost. An example is encouraging vendors to recommend changes to ship specification requirements to achieve technical equivalency at reduced cost.
g. **Leveraging supplier competition for cost avoidance** - An example is developing competition for steel supply by establishing a new supplier/source for non-armor steel plate.
h. **Procuring commodity equipment from the original equipment manufacturer** - In many cases the shipbuilder can bulk order commodity equipment for a lower price than an individual sub vendor due to a larger order quantity. The shipbuilder would then provide the commodity material back to the sub vendor to assemble into the finished product at a lower cost. An example would be bundled procurement of motor controllers at a reduced price, some of which would then be provided to a system manufacturer such as the provider of air conditioning plants.

The shipbuilder has undertaken these initiatives in a multi-faceted approach with the objective of driving material cost down, and material availability up to support an optimized construction schedule, within the constraints of the funding available for each fiscal year. In addition the shipbuilder has an ongoing process to inventory all excess material procured on CVN 78 for transfer to CVN 79.

The Navy has also employed outside supply chain management experts to help develop additional optimal CFE material procurement strategies. Furthermore, the Navy has increased its oversight of contractor furnished material procurement, ensuring that material procurement is competed (where competition is available); that it is fixed priced; that commodities are bundled to leverage economic order quantities; and that the vendor base capacity and schedule for receipt supports the optimal build plan being developed for production of CVN 79. The increased oversight has included visits to several key vendors to ensure a deeper, first hand understanding of cost drivers and issues.

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MAJOR CHANGES IN BUILD STRATEGY AND PROCESSES
(10-15% Reduction in man-hours to build ship)

The shipbuilder and the Navy have performed a comprehensive review of the build strategy and processes used in construction of Ford Class aircraft carriers as well as consulted with other Navy shipbuilders on best practices. As a result, the shipbuilder has identified and is implementing a number of changes in the way they build aircraft carriers, with a determined focus on executing construction activities where they can most efficiently be performed. This tends to result in moving production effort earlier in the value stream and in grouping similar work to enhance the effects of learning. Improved material availability as discussed above is a critical element to the success of this approach. The major changes in build strategy and process described below and being employed on CVN 79 are expected to yield a man-hour reduction as compared to the CVN 78 of 10-15%.

1. Maximizing planned work in shops and early stages of construction

Ship construction is most efficiently performed in a shop environment due to ease of access, lifting and handling gear, and environmental controls. The goal for CVN 79 is a 30% increase in front end shop work as compared to CVN 78. This work will result in an increase in pre-outfitting and work pulled to an earlier point in the construction process. It can be broken into two different measureable categories:

a. Work that was originally planned to be performed in the shop on CVN 78, but was deferred due to late material, design maturity, etc. Implementation of lessons learned, a mature design, whole ship bill of materials ordering and more timely delivery of CFE all enable this work to be moved back into the shops on CVN 79 as part of the optimal build strategy.
b. Work that was originally planned in the drydock on CVN 78 that will be moved to an earlier stage of construction for CVN 79 as an improvement to the optimal build strategy. CVN 79 superlift reviews are ongoing to determine what outfitting work should be moved earlier in the construction process. The results of this continuing effort will move a significant amount of work from the drydock back into the platen area (area where module assembly occurs) or the shops.

As part of this strategy, the shipbuilder has begun the shop construction of complex assemblies. These are assemblies of piping, valves, pumps, etc., that would previously have been 'stick built' on the final assembly platen or on the ship. Building these assemblies in a shop environment is far more efficient, allows shop testing and painting currently being done on the platen or ship to be done in the shop environment, and optimizes the eventual transportation of the complex assembly to the ship. The ship design is being reviewed to identify candidates for this complex assembly process with an expectation that over 1,000 assemblies could be shop built shifting hundreds of thousands of hours of work into more efficient shop construction areas. As an example, the first of these assemblies moved to the shop for CVN 79 are fire pumps. On CVN 78, fitting out a fire

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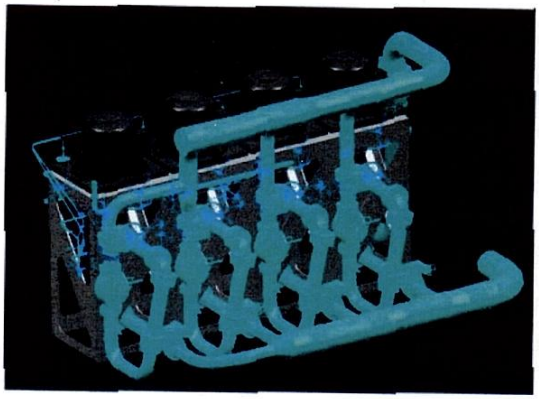
pump room consisted of stick building multiple pumps, valves, actuators, pipe details, and foundations (approximately 250 pieces of material) in a constrained shipboard environment. The goal on CVN 79 is to build out the pump room as a complex assembly in the shop and then land, install, and connect the complex assembly as a single unit into the ship (see figure below).



Example of Complex Assembly – Fire Pumps

2. Sequence construction of structural units to maximize the effects of lessons learned

The shipbuilder has developed a 'family of units' concept to maximize the effects of lessons learned within construction of CVN 79 (in addition to lessons learned from construction of CVN 78). This concept is enabled on CVN 79 by the level of design completion and material availability present at the start of ship's construction. Currently, structural units are built in numerous locations and are sequenced to support the ship's schedule, not to best utilize the structural shop footprint and resources. By building units in families, the ship's schedule will still be met, but the structural shop will be better able to shop-load their limited footprint, better utilize equipment, and better assign skilled resources.

The family of units concept allows two distinct execution methods. First, units of a similar construction are set up into flow lanes such that the unit is moved from station to station as various repeated work items are completed, very similar in concept to an assembly line of large components. This concept allows workers to perform repeated tasks on similar units, maximizing learning within a work cell. Unit family production reduces set-up time between units because the jigs and fixtures which support the unit and/or facilitate its construction do not have to be set up again until a new unit family is started. In addition, by organizing into an assembly line process structure, many of the 'lean manufacturing' assembly line controls can be implemented further increasing the efficiency of the process.

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Some structural units in CVN construction are too large to be efficiently moved in an assembly line fashion, but have similar construction methodologies. In these cases, the shipbuilder has established a process where a work cell of individuals is moved from unit to unit to accomplish the same repeatable work in a unit's build cycle, thereby maximizing the learning curve within the individual work cells. Many of the same benefits of the flow lane concept will be realized via this methodology as well.

3. Increase outfitting levels for assembled units before erection in the drydock

Pre-outfitting is a key element for driving cost out of ship construction. This occurs prior to ship erection or ship launch. Installation efficiency increases and construction costs are reduced the earlier in production that piping, valves, ventilation, foundations, cabling, and other outfitting type items can be installed. This plan offers several advantages from easier installation access, to improved trade coordination, to the ability to load more complete assemblies into each unit prior to erection.

The shipbuilder has formed a team consisting of construction, planning, engineering and government personnel to challenge every item installed (or planned to be installed) in the dry-dock or after launch on CVN 78, and to incorporate all lessons learned into the build plan for CVN 79. To date these reviews have resulted in 12% of pipe and ventilation items in the units (totaling about 200 thousand hours) assessed being moved back to the pre-outfitting period on the final assembly platen or in the shop. The shipbuilder also expects to achieve improved performance in pre-outfitting by improving material availability.

4. Increase overall ship completion levels at each key construction event

Fundamental changes to the build processes for CVN 79 and beyond, as described in the preceding paragraphs, are all designed to support accomplishment of work in a more efficient manner and lead to increased overall ship completion levels at each key construction event. The following paragraphs describe additional affordability initiatives being implemented that also facilitate this key focus area:

a. **Batch manufacturing -** An additional benefit of the completed ship design is that the shipbuilder is able to plan for ship set quantity batched production of like items that are used in construction of the ship. The batched production leads to increased efficiency and decreased cost through reductions in planning, production control, material movement, and set up/ tear down times. An example of this is filter housings that are installed in the ship's ventilation system. A filter housing is a relatively simple structure that is inserted into ventilation ducting to retain an air filter. With the class design completed the shipbuilder has an exact requirement for the type and quantity of filter housings needed and can set up small assembly lines to produce these efficiently, whereas on CVN 78 many of these housings were built on

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an as needed basis as the design developed. The total number of work packages for CVN 79 filter housings will be reduced from 88 to 10.

b. **Common Integrated Work Package** - One of the areas the shipbuilder is implementing to drive production costs out of CVN 79 is the common integrated work package. In the current state multiple work packages are developed to construct a single portion of the ship, there may be design, engineering, and production work packages that are all used to describe the assembly process. This system forces many handoffs between the various departments within the shipyard, increasing the likelihood of inefficiency, transcription errors, and production problems. The goal of integrating the various work packages into a common document is to provide the shipyard mechanic doing the actual work the information they need in a user-friendly, producible format to improve first time quality, overall productivity, innovation and job knowledge capture and transfer.

c. **Flexible Infrastructure** - Flexible infrastructure is rapidly-reconfigurable, modular open systems and standards used in the design and construction of ship's spaces. It facilitates equipment installation, reconfiguration, technology insertion, and improved mission flexibility, while decreasing acquisition and life cycle costs. Flexible infrastructure, including flexible decking, overhead, and bulkhead mounting elements are being employed in the combat systems spaces in the FORD Class design. The shipbuilder is currently studying areas where flexible infrastructure for bulkhead installation of items such as electrical panels can be used in other areas of the ship to drive out construction costs.

d. **Improved cable installation** - The FORD Class design has substantially more electrical cable than NIMITZ Class carriers (9.1M feet for CVN 78 versus 5.5M feet for CVN 77). The shipbuilder is working to improve the various processes associated with cable installation to allow as much cable as possible to be installed at each phase of construction. This includes employing additional analysis to accurately identify cabling with routes wholly contained within units or superlifts to ensure cable installation on platen. Also, analysis is being done to identify logical candidates for "coil and stow" options for cables runs not wholly confined to a unit or superlift. This would allow installation of much of the cable, with the portion crossing the erection break being coiled up and stowed for final installation after erecting the unit. The shipbuilder is also leveraging efforts to improve material availability and increase pre-outfitting of items such as hangers, shell-banks, and wireways to increase the amount of cable that can be installed during each phase of construction.

e. **Pre-outfitting panels** - Steel bulkhead panels and decks are currently fabricated in the shop and then assembled to create units and superlifts. Once they are welded in place, holes are cut in the bulkheads and decks to install a wide variety of components such as coamings, penetrations and hangers. This requires hotwork on the ship, which is accomplished in a poor ergonomic work condition and impacts the start of outfitting. Pre-outfitting bulkheads and decks with these items before they are assembled into units and decks will allow the

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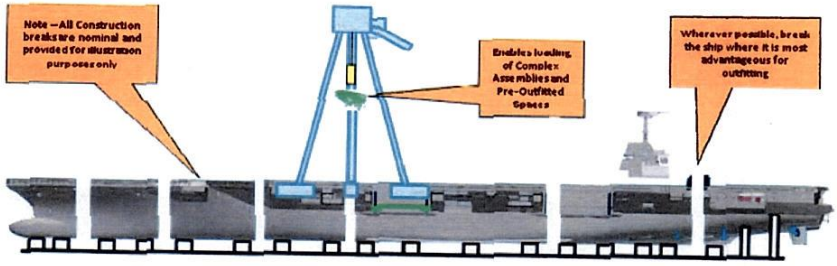
work to be accomplished in a shop environment, instead of on the ship, and will significantly improve the shipbuilder's ability to start outfitting work earlier.

f. **Further advancing CVN construction** - There is a steady strain on identification and implementation of producibility enhancements targeted for CVN 79. There are also some additional initiatives under consideration whose developmental timelines or infrastructure requirements preclude implementation on CVN 79, but are expected to yield marked shipbuilder construction cost reductions for CVN80 and follow FORD Class ships. An example is the Vertical Build Methodology - a methodology which will achieve full potential for shipbuilding cost reduction in CVN 80 and follow ships. When fully implemented, the Vertical Build Methodology will erect the ship in vertical sections thereby allowing easier access for installation of systems, components, equipment, and complex assemblies into the erection units which comprise each vertical section. When the vertical sections are complete, they will be "slid" together to complete assembly of the ship. The graphic below illustrates the concepts of Vertical Build Methodology.



Vertical Build Methodology

Overall, the efforts described in the preceding sections and above serve to move more work into the areas in which it can be most efficiently performed. For CVN 79 construction, an aggressive target has been established to increase the percent complete at launch above that of the CVN 78. The following table shows the planned increase in front end shop and platen work for CVN 79 construction.

Manufacturing & Assembly		
SFA	**CFA**	**FAP**
5-10%	20-30%	5-10%
SFA = Steel Fabrication and Assembly CFA = Component Fabrication and Assembly FAP = Final Assembly Platen		

Estimated Increase in CVN 79 Front End Work

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DESIGN CHANGES FOR GREATER PRODUCIBILITY
(5-10% Reduction in man-hours to build ship)

In conjunction with the Navy and the shipbuilder's comprehensive review of the build strategy and processes used in construction of Ford Class aircraft carriers a number of design changes were identified that would result in more affordable construction. Some of these design changes were derived from lessons learned in the construction of CVN 78 and others seek to further simplify the construction process and drive cost down. The design changes described below and being employed on CVN 79 are expected to yield a man-hour reduction as compared to the CVN 78 of 5-10%.

1. Incorporate design changes to improve producibility for FORD Class aircraft carriers

The completion of the FORD Class design and ongoing construction experience on CVN 78 has allowed the shipbuilder to examine ways to improve the producibility of CVN 79. As a part of the design rollover from CVN 78 to CVN 79, shipbuilder design engineers are identifying specific improvements based on these lessons learned to reduce the cost of CVN 79.

One such example addresses CVN 78 producibility problems stemming from the use of thinner plate scantling decks and bulkheads as compared with those of NIMITZ Class. Thinner, lighter weight plate was selected as part of a design objective to reduce overall ship weight and restore growth margin in the ship's lifecycle – a KPP for the ship class. Use of the thinner steel plate has necessitated unplanned use of temporary bracing, as shown in the illustration below, to allow handling of modules during assembly as well as causing rework to flame straighten plates. While a normal evolution in shipbuilding, a greater degree of flame-straightening has been required on CVN 78. The thinner steel plate has also required additional work and structural reinforcement associated with some large heavy component and equipment foundations to achieve proper fit up. Light scantlings also detract from greater outfitting prior to module erection without incurring further deformation. The thinner plate has caused nearly twice the hours in installing temporary bracing and supports as compared to the CVN 77, and incurred indirect additional rigging costs associated with the added difficulty in moving and erecting units. The interference of the temporary bracing is also delaying planned elements of pre-outfitting from being installed on platen.

A multitude of efforts will be utilized on CVN 79 and future hulls to mitigate these disruptions to include: increased thicknesses of platforms and decks, redesigned elevator trunks reducing welding volume and parts, optimized temporary backing structure during lifting and handling, and improved straightening methods (induction heating). These changes will also enable increased pre-outfitting and joining of construction units to build more and larger superlift modules which will reduce the number of erectable modules and improve outfitting of those units. The additional weight associated with these changes can be accommodated within the design margin reserve such that the class KPP for weight service life allowance will still be met.

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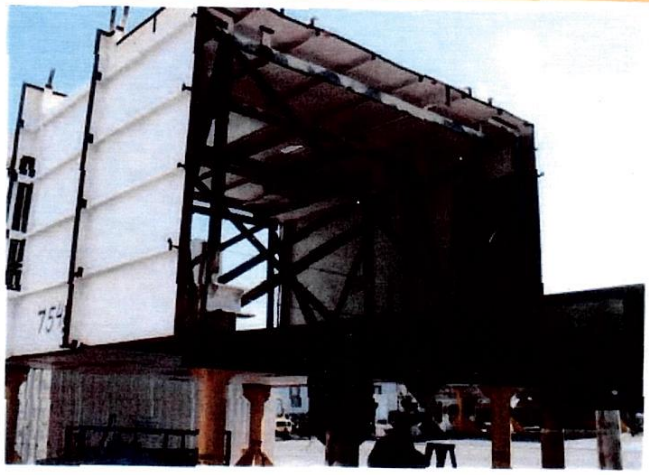

Example of Temporary Bracing Required During Erection Due to Thin Scantling

Another example of design changes improving producibility is associated with a seawater piping system. The original ship design called for a 3 degree bend in a particular pipe to route it around an obstruction. When construction trades tried to produce this section of piping on CVN 78, they found the 3 degree bend extraordinarily hard to produce and properly fit into the piping assembly. Upon completion of the work, the shop foreman suggested the particular piping run be extended by two inches so that a more typical 45 degree piping bend could be inserted into the system. This suggestion is incorporated into the CVN 79 design, making it more producible. In another example, some of the seawater inlets on CVN 78 were produced via a casting process, which resulted in some downstream manufacturing challenges. For CVN 79, the shipbuilder is now producing these seawater inlets via a forging process which has resulted in a more efficient production of this component.

In addition to making design changes to address producibility issues encountered on CVN 78, the CVN 79 design is being reviewed for opportunities to drive out further cost through producibility enhancing design changes. One such opportunity being exploited on CVN 79 is in reducing the number of welded fittings required in the ship's piping systems. Below is a graphic which highlights this concept.

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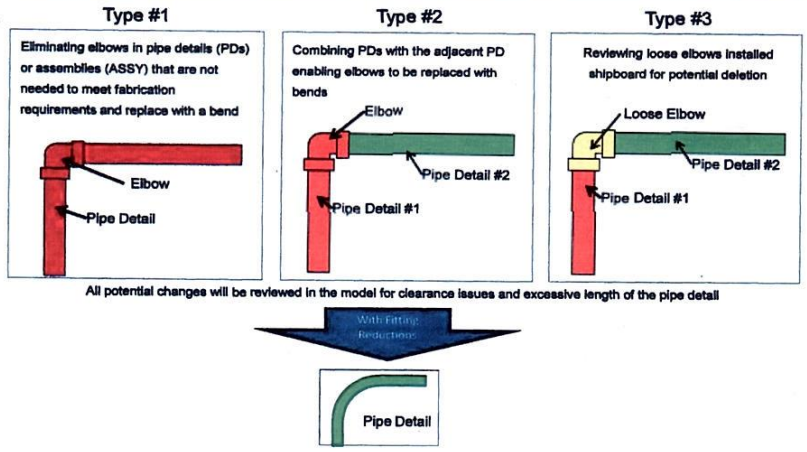

Illustration of Fitting Elimination Concept

Due to the incompleteness of the design during initial construction of CVN 78, many piping systems were built with temporary terminations, with a fitting added later to complete the piping as the follow on compartment was designed/built out. Now that the class design is complete, the shipbuilder is examining where fittings were used in piping systems with the goal of removing as many as possible by replacing the fitting with a bend. To date, more than 30 percent of the total number of elbows has been evaluated, with nearly 2,000 elbows being eliminated from the design, which in turn eliminates nearly 4,000 welds and reduces construction hours by 6 hours per joint on average. Each fitting eliminated removes the requirement for procuring and tracking the fitting as well as for performing two welds and a broad range of production activities.

Shipbuilder producibility reviews are not limited to the outfitting areas, but include structural and welding areas. As shown in the below graphic illustrating a portion of the island, 56 ft of butt weld joint is eliminated from this one area by simply extending thicker plate. There are numerous opportunities like this throughout the ship. These types of seemingly simple ideas when taken over the entire carrier have a significant impact on construction manhours and costs.

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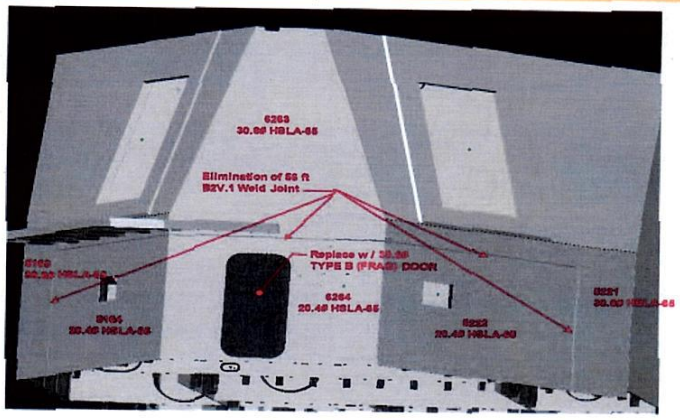

Illustration of Welding Reduction Studies Using 3D Product Model

2. Increasing the size of erection units to eliminate disruptive unit breaks and improve unit alignment and fairness

A completed class design allows the shipbuilder to evaluate the placement of 'construction breaks' between units that will eventually be erected into the drydock. In an ideal scenario, these construction breaks are minimized to allow for additional outfitting of material into construction units during preassembly and on the platen prior to their erection into the drydock. In reality, construction breaks are forced into construction by realistic limits on how much of a unit module can be transported around the shipyard and the weight of a unit module that can be lifted by the gantry crane into the drydock. However, on CVN 78, more construction breaks were used in the original design because of unknowns associated with the first of class build than were actually needed. For CVN 79, the shipbuilder has reduced the number of construction breaks by approximately 5% to allow piping, cabling and ventilation trunks to be extended to the maximum extent feasible. These efforts are raising the level of pre-outfitting on CVN 79 well above that for CVN 78.

As part of the study to remove unnecessary construction breaks from the design, the shipbuilder is evaluating where previously first and final erectable units can be combined onto existing superlifts or combined together to create new superlifts. Creating new superlifts has multiple benefits. A superlift is built from multiple smaller units, and contains piping, machinery, electrical, and ventilation. Each new superlift thus lowers the number of units that need to be independently erected into the drydock, helping to alleviate demands on the gantry drydock crane and decreasing the number of times welders have to work in a constrained environment to weld construction units into the ship. Superlifts allow for more pre-outfitting on the final assembly platen and shops, prior to ship erection, thereby increasing ship construction efficiency.

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CVN 79 superlift reviews are ongoing and will continue. To date, the shipbuilder has decreased the number of erectable units from CVN 78 by 20 –nearly a 5% reduction. Decreasing the number of erectable units has multiple benefits including reducing the number of lifts required by the 1,050 ton crane – a natural bottleneck in the CVN construction process. Fewer erectable units also reduces the number of unit breaks between sections thereby allowing additional outfitting and improving unit alignment and fairness.

FACILITIES

In addition to the material procurement improvements, build strategy and construction process changes, and design changes described in the preceding sections, the shipbuilder is evaluating capital improvements to facilities that would serve to reduce risk and improve productivity.

Improve facilities in a manner that will lead to improved productivity; and ensure the shipbuilder initiates plans that will improve productivity through capital improvements that would provide targeted return on investment

The shipbuilder is considering what additional facilities, or modifications to existing facilities could be employed to further enhance efficient manufacturing and construction. The shipbuilder has developed a plan to renovate existing facilities to support shop manufacture and assembly of small complex assemblies as well as building a new facility to accomplish the same for large complex assemblies. Additional facilities are also being considered for pre-outfitting structural panels and decks and possibly for increasing the covered work areas on the Final Assembly Platen. Due to the amount of welding involved in carrier construction, the shipbuilder continues to add to its mechanized welding capability.

The shipbuilder is studying capital investment opportunities that could result in reduced risk and additional cost reductions for CVN 79 and/or follow ships in the class. Some initiatives include:

a. **Increasing the Amount of Temporary and Permanent Covered Work Areas** - The shipbuilder has identified the need to increase the amount of covered workspace for the construction of CVN 79. This supports build strategy changes that will move significant outfitting work from the ship to the final assembly platen. These facilities could include both permanent and temporary (moveable) structures. This would include a facility for pre-outfitting structural panels and decks before they are used to build units and superlifts. A recent improvement was made where the shipbuilder tripled the amount of space they had available for blast and coat of assembly units by building two additional blast and coat facilities.

b. **Adding Ramps and Service Towers for Improved Access to Work Sites and the Drydock** - The shipbuilder has added a drydock elevator to allow easier access to drydock num-

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ber 12. This addition was done toward the later stages of CVN 78 drydock construction and therefore had limited benefit for CVN 78, but is expected to increase the efficiency of movement of material into the drydock for CVN 79 and alleviate the bottleneck imposed by the limited number of lifting cranes. Additional ramps and elevators could further improve the movement of material from material laydown areas to the ship as well as reducing the number of required crane lifts.

c. **Increasing Lift Capacity to Enable Construction of Larger, More Fully Outfitted Superlifts** - Prior to construction of CVN 78, the lifting capacity of the gantry crane used to erect superlifts was increased from 900 to 1050 tons. While this upgrade did show some benefit on CVN 78, many of the superlifts for CVN 78 were not able to fully utilize the capacity increase due to the incompleteness of the design. With the class design complete and the true weight of erectables determined, the shipbuilder is able to plan more efficient combinations of erectables into superlifts to allow for fuller utilization of this increased capacity.

GOVERNMENT FURNISHED EQUIPMENT (GFE)
(5-10% Reduction in GFE cost)

In addition to the substantial improvements being implemented to address shipbuilder costs, aggressive measures have been put in place for cost control in GFE. Recurring engagement and review at the Flag Officer level between Program Executive Officer Aircraft Carriers (PEO CV) and those executives responsible for providing GFE to CVN 79 establishes and maintains the framework in which this occurs.

a. **"Will Cost" / "Should Cost" Management** – For providers of platform GFE (non-reactor plant GFE), "should cost" targets are established at the system level. Specific initiatives to drive cost out of the GFE systems, as well as timelines for realization of the savings for each of the initiatives, are identified and captured on scorecards. These scorecards are evaluated and reviewed between the CVN 79 Program Office and the GFE providers on a routine, recurring basis to ensure actions are on track realize the identified cost reduction opportunities and to identify additional opportunities. Examples of these opportunities include: bundling of procurements with other ship programs, refurbishment of assets recovered from decommissioning ships in lieu of procurement of new assets, reductions in projected systems engineering and installation support based on anticipated lessons learned from CVN 78 installations, and continued or expanded use of fixed price production contracts where appropriate.

b. **Ship Project Directives** – Detailed agreements are being established between the CVN 79 Program Office and platform GFE providers to provide a greater degree of control in management of on-time delivery of expected equipment, critical for avoiding shipbuilder disruption, and for control of cost.

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c. **Stringent restrictions on change** – Changes from the CVN 78 baseline are being minimized to limit their disruption to the shipbuilder and the potential impact on cost. Where change is unavoidable, such as in the case of systems no longer being available due to obsolescence, a rigorous change control process is in place to fully explore alternatives and mitigate potential cost impacts. Where a GFE system change is proposed to provide additional capability to the ship, a disciplined resource and requirements review process at the senior Flag Officer level within the Pentagon is followed to thoroughly vet the proposed change.

The FORD Class aircraft carrier brings tremendous new capability to 21st century naval aviation with reduced manpower and sustainment requirements leading to a substantially reduced total ownership cost. This is in large part due to advanced government furnished systems incorporated in the design. As described in the preceding paragraphs, the Navy is focused on delivering these capabilities with costs reduced 5-10% in real terms from CVN 78.

COMPARISON TO CVN 77 AND CVN 78

After accounting for the $3.2B non-recurring cost to design the FORD Class aircraft carrier, the cost of the first of class CVN 78 is, in real terms, 18% more than the tenth NIMITZ Class aircraft carrier, the CVN 77, for a class of ship that will provide a 33% increase in warfighting capability, unmatched flexibility for future missions, and cost the taxpayer approximately $4B per ship less than a NIMITZ class carrier over its 50-year service life. Recognizing the responsibility to build aircraft carriers in the most affordable way possible, the Navy and shipbuilder have taken the actions described in this report to drive down the construction cost for CVN 79. These actions are expected to reduce the material costs for CVN 79 by 10-20% in real terms from CVN 78, and to reduce the man-hours required to build the CVN 79 by 15-25% from CVN 78. The man-hours required to build CVN 79, the second ship of the FORD Class, are expected to be 5-10% less than those required to build CVN 77.

Conclusion

The Navy and HII-NNS have made fundamental changes in the manner in which the JOHN F KENNEDY (CVN 79) will be built to eliminate the key roadblocks that were realized and were the largest impacts to cost performance during the construction of CVN 78. Simply addressing lessons learned and working harder is not good enough. The approach to carrier construction has undergone an extensive affordability review. As described in this report, the Navy and HII-NNS are committed to making the fundamental changes necessary to drive down and stabilize aircraft carrier construction costs for CVN 79 and beyond.

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