United States Government Accountability Office

Report to Congressional Committees

April 2016

# PRESIDENTIAL HELICOPTER

# Program Progressing Largely as Planned

GAO-16-395

April 2016

# PRESIDENTIAL HELICOPTER

## Program Progressing Largely as Planned

GAO Highlights

Highlights of GAO-16-395, a report to congressional committees

## Why GAO Did This Study

The mission of the presidential helicopter fleet is to provide safe, reliable, and timely transportation for the President, Vice President, foreign heads of state, and other official parties as directed by the White House Military Office. The Navy plans to acquire VH-92A helicopters to replace its aging fleet. Initial delivery of VH-92A presidential helicopters is scheduled to begin in fiscal year 2020 with production ending in fiscal year 2023. Total program acquisition cost is estimated to be $5.1 billion.

This is GAO's seventh report on the program since 2011. The National Defense Authorization Act for Fiscal Year 2014 included a provision that GAO report annually on the acquisition of the VH-92A aircraft. This report discusses (1) the program's cost, schedule, and performance status; (2) challenges it faces in system development; and (3) its adherence to acquisition best practices. To conduct the review, GAO examined program documents, including Navy, contractor, and on-site government program monitor reports. GAO also interviewed officials, reviewed the earned value management system, and assessed the integrated master schedule against GAO best practices.

## What GAO Recommends

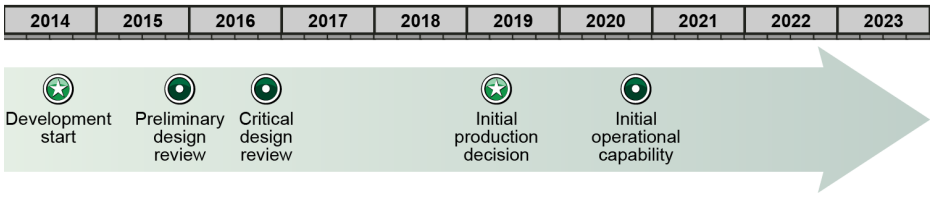
GAO is not making recommendations in this report. In commenting on a draft of this report, DOD stated that it believes its efforts on this program are aligned with GAO's best practices and it will continue to monitor the program and ensure that mitigations are in place to address potential risk areas. GAO will also continue to monitor the program as it moves forward.

View GAO-16-395. For more information, contact Michael J. Sullivan, (202) 512-4841 or sullivanm@gao.gov

## What GAO Found

Since 2014, the VH-92A presidential helicopter program has generally progressed as planned. Through November 2015, the contractor accomplished approximately $239.0 million (22 percent) in development work—leaving about $863.9 million (78 percent) in estimated work over the next 5 years. As of December 2015, the prime contractor had accomplished nearly all of the expected developmental tasks at only slightly greater cost than anticipated. The program is currently on track to accomplish key development milestones as planned. In the past year, the program successfully conducted its preliminary design review and carried out a number of other significant development activities, including: continued development of the mission communications system, delivery and initial testing of aircraft for risk-reduction activities, and initiation of the conversion of Sikorsky S-92A helicopters into VH-92A developmental models.

**VH-92A Presidential Helicopter Program Schedule**




Source: GAO analysis of VH-92A Program data. | GAO-16-395

As expected with a major system development effort, the program faces a number of design and technical challenges, some preexisting and others realized during the course of development. Those challenges include designing passenger doors, incorporating titanium framing in the two initial aircraft, meeting requirements relating to electromagnetic environmental effects, and cybersecurity. The program took advantage of capability and testing trades that produced cost and schedule savings. For example, the program was able to reduce physical testing by relying on existing information about the aircraft's performance, supplemented by additional information collected during testing and through modeling.

When assessed against best practices, GAO found that the contractor's earned value management system, a project management tool for investment planning and control, fully or substantially met the three characteristics for a reliable earned value management system. Similarly, in assessing the program's integrated master schedule against best practices, GAO found that it substantially met all four of the characteristics required for a reliable schedule.

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**ABBREVIATIONS**

| | |
|---|---|
| DOD | Department of Defense |
| E3 | electromagnetic environmental effects |
| EDM | engineering and developmental model |
| EMP | electromagnetic pulse |
| EVM | earned value management |
| FAA | Federal Aviation Administration |
| ICS | inter-communication system |
| IMS | integrated master schedule |
| MCS | mission communications system |
| PDR | preliminary design review |

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
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Congressional Committees

The mission of the presidential helicopter fleet is to provide safe, reliable, and timely transportation for the President, Vice President, foreign heads of state, and other official parties as directed by the White House Military Office. The VH-92A Presidential Helicopter program is to replace existing, aging aircraft with a modern aircraft utilizing advanced technologies that provide capability improvements. The Navy's acquisition strategy is based on the integration of mature technologies and an executive interior into an existing helicopter while minimizing aircraft modifications in order to avoid costly airworthiness recertification. The Navy plans to acquire a VH-92A fleet of 23 helicopters to replace the existing fleet of 23 legacy helicopters. Initial delivery of VH-92A Presidential Helicopters is scheduled to begin in fiscal year 2020 with production ending in fiscal year 2023. Total program acquisition cost is estimated to be $5.1 billion (then-year dollars).

We have reported on this program since 2011.[1] In 2013, the House Armed Services Subcommittee on Tactical Air and Land Forces requested that we continue to monitor the VH-92A presidential helicopter acquisition through a series of reviews, with each review tailored to where the program is in the acquisition process. The National Defense Authorization Act for 2014 subsequently included a provision that we continue reporting on the program annually to the congressional defense committees.[2] This report discusses (1) the cost, schedule, and performance status of the program, (2) challenges it faces in system development, and (3) its adherence to acquisition best practices.

To determine how the program is progressing in terms of its cost, schedule, and performance, we analyzed program documents (including the acquisition strategy and contractor progress reports) and plans. To

[1]The Ike Skelton National Defense Authorization Act for Fiscal Year 2011 required that GAO review and report annually to the congressional defense committees on the program beginning in 2011 and ending in 2013. Pub. L. No. 111-383, § 233.

[2]Pub. L. No. 113-66, § 252 (2013).

understand potential program challenges, and steps taken to address those challenges, we examined the Department of Defense's (DOD) risk management planning guidance and reviewed a copy of the program's draft risk management plan and the contractors' latest risk assessment. We discussed risk management with VH-92A program officials as well as officials from Sikorsky Aircraft Corporation and Lockheed Martin (the prime contractor and principal subcontractor, respectively, for the program). We reviewed the program's Integrated Master Schedule (IMS)[3] and compared it against best practices criteria in the GAO Schedule Assessment Guide.[4] We also reviewed Sikorsky's earned value management (EVM)[5] system and compared it to the GAO Cost Estimating and Assessment Guide.[6] Our research has identified a number of best practices, which result in reliable and valid data that can be used for making informed decisions. To learn more about Sikorsky's EVM system we met with officials from the Defense Contract Management Agency, the government agency responsible for, among other things, ensuring the integrity of the contracting process, and reviewed their reports on the program to determine if it produced reports that met the criteria establishing a comprehensive EVM system, ensuring the data from the EVM system are reliable, and ensuring that the program management team is using the earned value data for decision making purposes. We interviewed program officials from the Navy's Presidential Helicopter Program Office, as well as officials from the offices of the Director of Operational Testing and Evaluation and Deputy Assistant Secretary of Defense for Developmental Test and Evaluation to better understand the test and evaluation aspects of the program. Appendix I contains additional details about our scope and methodology.

[3]An Integrated Management Schedule connects all the scheduled work of the government and the contractor in a network, or collection of logically linked sequences of activities. The sequences clearly show how related portions of work depend on one another, including the relationships between the government and contractors. Although the IMS includes all government, contractor, and external effort, the government program management office is ultimately responsible for its development and maintenance.

[4]GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G, (Washington, D.C.: December 2015)

[5]EVM measures the value of work accomplished in a given period and compares it with the planned value of work scheduled for that period and with the actual cost of work accomplished.

[6]GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs,* GAO-09-3SP, (Washington, D.C.: March 2009)

We conducted this performance audit from July 2015 to April 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

## Background

The program's acquisition approach involves the conversion of Sikorsky S-92A helicopters into VH-92A presidential helicopters by incorporating a unique mission interior that accommodates government-provided equipment such as, communications and mission systems. The program is limiting modifications to the aircraft to avoid a costly airworthiness recertification and reduce investment costs, delivery timelines, and execution risks. As we reported in March 2015,[7] the Navy's approach is to use mature technology; however, a fully configured mission communication system[8] has yet to be tested in an aircraft.[9]

We reported last year that the VH-92A program continued to make progress by establishing a knowledge-based business case for entry into system development that included an approved cost, schedule and performance baseline based on actions substantively in line with acquisition best practices.[10] Demonstrating technology maturity, making trade-offs, having reasonable cost and schedule estimates, and holding a system-level preliminary design review (PDR) by the start of system development are all best practices. While the Navy's deferral of a system-level preliminary design review until after the start of system development

[7]GAO, *Defense Acquisitions: Assessments of Selected Weapon Programs*, GAO-15-342SP (Washington, D.C.: Mar. 12, 2015.)

[8]The mission communications system consists of existing analog radios and encryption equipment and a digital Internet Protocol based network architecture using currently available hardware.

[9]Knowledge-based acquisition practices recommend that programs fully mature technologies and demonstrate them in an operational environment prior to starting system development.

[10]GAO, *Presidential Helicopter Acquisition: Program Established Knowledge-Based Business Case and Entered System Development with Plans for Managing Challenges,* GAO-15-392R (Washington, D.C.: Apr. 14, 2015.). For a list of GAO reports on the Presidential Helicopter Program see appendix II.

deviated from acquisition best practices, we reported last year that a number of factors, such as the program's reliance on mature technologies, selection of an in-production aircraft, and award of a fixed price incentive type contract reflect reduced risk in the deferral. A significant risk mitigation factor the Navy has in its favor is its contract with Sikorsky which includes a ceiling price that would limit how much the Navy would have to pay under the contract. To maintain this advantage, the Navy will have to ensure that no requirements changes are made that would require it to negotiate a supplemental agreement for equitable adjustment to the contract. In the past, DOD has typically used cost-reimbursement contracts in which the government generally pays all allowable costs incurred by the contractor. Recent legislation and defense policy now emphasize the use of fixed price development contracts, where warranted, to limit the government's exposure to cost increases.

## Development Has Generally Progressed as Planned

Since the start of development in 2014, the VH-92A program has generally progressed as planned. Through November 2015, Sikorsky has accomplished approximately $239.0 million (22 percent) in development work–leaving about $863.9 million (78 percent) in estimated work to go over the next 5 years. As of December 2015, Sikorsky indicated that, nearly all of the developmental tasks expected to be accomplished by that point had been accomplished at only slightly greater cost than anticipated.

The program's current estimates for total program cost suggest shows no overall cost growth. Table 1 compares the program's current estimated quantities and total costs (fiscal year 2016 dollars) to the program's estimates at the start of development.

**Table 1: VH-92A Estimated Costs and Quantities (fiscal year 2016 dollars in millions)**

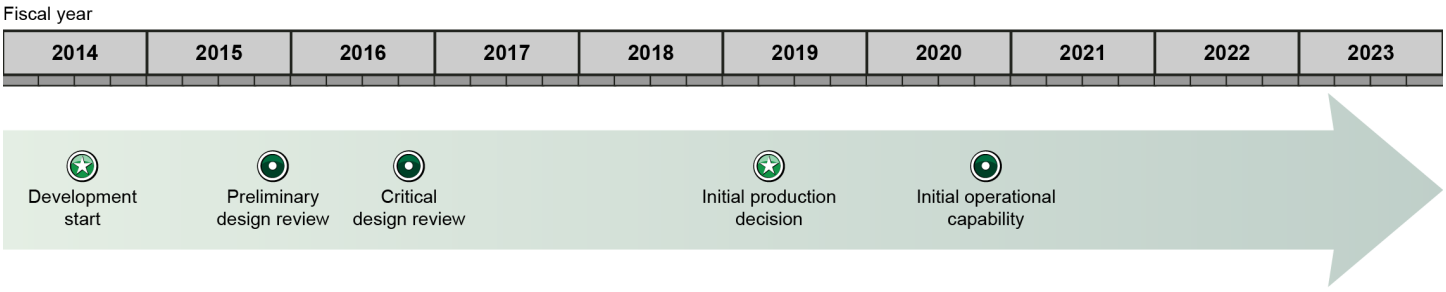
| | As of developmental start 04/2014 | As of 12/2015 | Percent change |
|---|---|---|---|
| Research and development cost | $2,684.8 | $2,494.7 | -7.1% |
| Procurement cost | 2,104.8 | 2,271.5 | 7.9 |
| **Total program cost** | **4,789.5** | **4,766.2** | **-0.5** |
| Program unit cost | 208.241 | 207.227 | -0.5 |
| **Total quantities** | **23** | **23** | |

Source: GAO analysis of VH-92A program data: GAO-16-395

The contractor's November 2015 estimate of the most likely cost at completion for its development efforts, which represent a portion of the program's total research and development cost, suggest a final contract price slightly over the contract's target price (by less than 2 percent) but below its ceiling price. We evaluated the contractor's data through October 1, 2015 and found that the contractor's most likely estimate at completion based on the data at that time was not overly optimistic. In fact, it was slightly higher than our highest estimate.

In addition, the program is currently on schedule. In the past year, the program successfully conducted its PDR and carried out a number of other significant development activities including continued development of the mission communications system, prime contractor taking custody of two S-92A aircraft, initial testing of one engineering and developmental model (EDM) aircraft, and initiation of S-92A to VH-92A developmental model helicopter conversions. Though the program is early in development with significant system integration and testing ahead, it currently is on track to accomplish key milestones including completion of a critical design review in July 2016, making an initial production decision, and establishing an initial operational capability as planned, see figure 1.

**Figure 1: VH-92A Presidential Helicopter Program Schedule**




Source: GAO analysis of VH-92A Program data. | GAO-16-395

The program passed a significant schedule milestone in August 2015 when it conducted its system-level PDR.[11] The purpose of the PDR was

[11]The PDR ensures the preliminary design and basic system architecture are complete, and that there is technical confidence the capability need can be satisfied within cost and schedule goals.

to evaluate the VH-92A preliminary design, assess the likelihood of that design to meet requirements and readiness to move forward into detailed design. The PDR occurred 16 months after development start–1 month ahead of the contractual date for the event.[12] Among other issues, there were 12 requests for actions identified during the review, for example the need to achieve complete alignment in weight management processes between the Naval Air Systems Command and the contractor. All of those requests were subsequently deemed successfully closed after review by Naval Air Systems Command personnel and concurrence of the submitters of those requests. On January 26, 2016 the PDR chairman closed the event stating that PDR was successful in presenting the program status and identifying areas of concern.

During the past year, the program continued development of the VH-92A Mission Communications System (MCS), an executive communications suite utilizing existing off-the-shelf components that is to provide passengers and crew with access to on-board and off-board communications services. The government is developing and providing the MCS design and some government furnished equipment to the contractor for integration into the presidential helicopters. Hardware components and architecture were previously defined and the ongoing MCS efforts principally relate to developing communications and monitoring software and integration of the system into the aircraft. Last year, version 0.6 of MCS software was provided to the Navy's systems integration lab and to Lockheed Martin for use in setting up MCS wiring.[13] The program subsequently released version 0.8 of MCS software that includes nearly full functionality (except for that relating to an inter-communications subsystem) and in December 2015, contractor engineers started loading the software at the contractor's system integration lab for

[12]The PDR was carried out by a technical review board of Naval Air Warfare Center research and engineering, test and evaluation, and logistics representatives and was chaired by the Technical Director of the Naval Air Warfare Center Training Systems Division. It included participation by the program office, Sikorsky and Lockheed Martin, Naval Air System Command subject matter experts, and external stakeholders such as HMX-1 (the Marine Corps unit that operates the presidential helicopter fleet and that is also responsible for operational test and evaluation of new flight systems for Marine Corps helicopters), the White House Military Office, United States Marine Corps Headquarters Aviation, Resource Sponsor (N98), the Federal Aviation Administration, and the Defense Contract Management Agency.

[13]As a subcontractor, Lockheed Martin is responsible for integrating certain components of the mission communications system into the aircraft.

testing. Two more MCS software releases are currently anticipated: version 1.0, which is to provide full functionality including the inter-communications subsystem, is expected in April 2016 and at least one follow-on release that will address and incorporate subsequently identified corrections.

In addition, the first of two EDM aircraft, arrived at the subcontractor Lockheed Martin's Owego, New York facility in December 2014, underwent subcontractor-led, risk-reduction efforts, including installation of antennas and interference testing and planning for the placement of the wiring needed for the government-furnished mission communications system. The subcontractor used radios and antennas for the mission communications system, power supplies, and instrumentation in support of contractor testing. According to Sikorsky, the testing validated capability predictions. This testing consisted of 89.6 flight test hours and 44.6 ground test hours. Table 2 provides a profile of the total, to date, anticipated test effort that is to utilize the two EDM aircraft and four subsequently developed system demonstration test article aircraft.

**Table 2: Profile of Presidential Helicopter Program Testing**

| Test description | Planned start/end | Planned Test Site | Planned Hours | Aircraft Involved |
|---|---|---|---|---|
| EDM Airworthiness | First quarter Fiscal year (FY) 2015-Second quarter FY 2018 | Owego, New York<br><br>Stratford, Connecticut<br><br>Naval Air Station, Patuxent River, Maryland | 300 | Engineering and developmental model (EDM) |
| Continued Integration & Operational Assessment | Second quarter FY 2018-First quarter FY 2019 | Naval Air Station, Patuxent River, Maryland<br><br>Marine Corps Air Facility, Quantico, Virginia | 150<br><br>30 | EDM |
| Qualification | First quarter FY 2019-Fourth quarter FY 2019 | Naval Air Station, Patuxent River, Maryland | 70 | EDM & System demonstration test article |
| Qualification & Operational Test Training | Fourth quarter FY 2019-First quarter FY 2020 | Naval Air Station, Patuxent River, Maryland<br><br>Marine Corps Air Facility Quantico, Virginia | 120 | EDM & System demonstration test article |
| Initial Operational Test & Evaluation | First quarter FY 2020-Second quarter FY 2020 | Marine Corps Air Facility, Quantico, Virginia<br><br>Naval Air Station, Patuxent River, Maryland | 160 | System demonstration test article |

Source: U. S. Navy, Presidential Helicopters Program Office. | GAO-16-395

In September 2015, the program's first S-92A aircraft, which was utilized by Lockheed Martin in its risk reduction efforts, and a second S-92A aircraft were transferred to Sikorsky's Stratford, Connecticut for modifications to become the two planned EDM aircraft. The modification process was started ahead of schedule, reducing schedule risk.

## Program is Managing Design, Integration, and Technical Challenges

As to be expected with a major system development effort, as the program has progressed it has faced a number of design, integration, and technical challenges, some preexisting and others realized during the course of development. Examples of the challenges the program is currently managing include design of the passenger doors, incorporation of titanium framing in the two initial aircraft, and meeting requirements relating to electromagnetic environmental effects (E3) and electromagnetic pulse (EMP), and cybersecurity.[14]

**Aircraft Door Design:** Design of the VH-92A forward and rear doors has proven more challenging and taken longer than the contractor anticipated. For the VH-92A, the forward passenger door in Sikorsky's S-92A helicopter's configuration is being modified to include dual hand rails and timed entry lights. In addition, the VH-92A aircraft requires a second entrance and exit, requiring the design of a new passenger door and stairs in the aircraft to replace the current S-92A rear ramp. Realization of the head clearance requirement for that door necessitated a larger door, increasing its weight. In addition, the weight of both doors went up in the process of redesigning the aircraft to meet other requirements. The increase in the doors' weight in combination with a requirement for a single-person manual open and close capability necessitated an unanticipated redesign of the doors' counterbalance systems and also complicated latch design. Extensive design and structural analysis for the door efforts were needed to resolve those design issues and ensure the

[14]Electromagnetic environmental effects refer to the impact of the electromagnetic environment on the operational capability of military forces, equipment, systems, and platforms. System electromagnetic effects can interfere with other systems, specifically causing undesirable responses, malfunctions, degradation of performance, or premature and undesired location, detection, or discovery by enemy forces. An electromagnetic pulse is a burst of high power electromagnetic radiation resulting from the detonation of nuclear and non-nuclear devices that are designed to intentionally disrupt or destroy electronic equipment. The purpose of cybersecurity is to ensure that DOD systems can resist and continue to operate during cyber-attacks by managing risks and implementing safeguards.

new design would not affect the overall airworthiness certification for the aircraft. According to Sikorsky, as of February 2016, 90 out of 105 design drawings for the doors were completed and improvements to the schedule have begun and should continue as the drawings continue to be released.

**Titanium Framing:** The two EDM aircraft are being retrofitted with titanium frames and the remainder of the VH-92A fleet will come with the titanium frames incorporated as part of the Sikorsky S-92A production process. This will improve aircraft performance and fatigue life. As of January 2016, the machining of titanium frames for the first EDM aircraft had been completed and installation had begun. The frames for the second EDM aircraft are in the machining process and are expected to be completed by the end of the second quarter of 2016. The machining process, which involves drilling critical alignment holes into the titanium, has taken longer than anticipated. The contractor realized that this effort would cause schedule delays and worked to mitigate this schedule risk by approving additional engineering and shop hours to insure that the frames were properly machined, finished, and can fit the aircraft upon installation.

**E3 and EMP:** VH-92A aircraft must comply with both commercial and military standards pertaining to electromagnetic environment effects. Achieving those standards involves consideration of the electromagnetic compatibility of equipment used on the aircraft and mitigation of electromagnetic interference caused by that equipment. In addition, developers of military systems, such as the presidential helicopters, may face additional requirements relating to the ability to survive the effects of an electromagnetic pulse. A number of techniques exist to harden aircraft from the effects of an EMP, for example, increasing shielding on equipment and wiring, which are being considered and utilized by the VH-92A program.[15] As the program has progressed a greater understanding of the effort required to meet the level of EMP survivability required has resulted in increased EMP-related efforts. According to an official from the

[15]VH-92A design for electromagnetic protection features conductive shielding to surround key electronic components and wiring, grounding to the airframe. With the high concentration of electronics and wiring within the cockpit, the entire VH-92A cockpit is protected with shielding. Significant modifications are required to ensure EMP survivability, taking into account the fuselage and all points of entry including antennas, doors, panel, seals etc. The VH-92A customization includes design guidelines and methods to enable rapid incorporation of mature EMP technologies. These EMP technologies were used to develop the existing, legacy presidential helicopters.

office of the Director of Operational Testing and Evaluation, the program has been working to help identify what additional measures are needed for EMP survivability. EMP related testing is underway to determine the exact additional measures needed, such as increased shielding or use of EMP limiters that protect electronics from EMP resulting power surges. As of December 2015, one area of concern relating to these efforts was that some of the initially identified EMP limiters may not have provided the needed level of protection. However, the program has continued to work on this issue and believes it has identified workable solutions. According to the program office, they believe these efforts have now resulted in a compliant design for protecting critical systems.

**Cybersecurity:** VH-92A aircraft and systems must meet cybersecurity requirements. In 2014, after the program's initial (June 2013) Test and Evaluation Master Plan was approved, a revised DOD cybersecurity policy and risk management framework were released.[16] The program has subsequently been working to address the changes necessitated by the revised policy and framework including actively pursuing a contract change to migrate from the certification required under the contract to the current certification standard. In addition, changes have been made to the program's Test and Evaluation Master Plan to reflect the changed policy and framework. In his January 2016 PDR closeout assessment, the PDR Chairman stated a cost and scope analysis of the needed migration has occurred and the change will be incorporated into the program baseline with minor impact. He further noted, however, that future evolution in the definition of cyber threats will remain a risk to the program as additional mandates are defined.

The program's efforts relating to a sub-component of the government developed VH-92A MCS, the Inter-Communication System (ICS), reflect the challenges associated with meeting updated requirements in support of airworthiness certifications. The ICS supplier is in the process of addressing a Federal Aviation Administration (FAA) standard on software considerations in airborne systems and equipment certifications that changed. The standard is the primary means for meeting airworthiness requirements and obtaining approval of software used in civil aviation

[16]Department of Defense Instruction (DODI) 8500.01, "Cybersecurity" (Mar. 14, 2014) and DODI 8510.0, "Risk Management Framework (RMF) for DoD Information Technology (IT)" (Mar. 12, 2014).

products.[17] In November 2015, the Navy, contractor and subject matter experts focused on possible approaches for the ICS supplier to successfully meet the updated standard. In this case, it was determined that the supplier's previous efforts demonstrated the ability to provide the needed capability and additional issue papers that covers the difference between the old and revised standard would be sufficient. The ICS supplier revised their development schedule and the ICS baseline software delivery to Sikorsky and the Navy's MCS system integration laboratory is now set for March 2016.

**Cost and Performance Trades:** The program has been helped looking for opportunities to save cost and schedule to offset increased efforts such as those discussed above. For example, program officials explained that they've identified an opportunity to remove a contractually-required capability as the Marine Corps decided it provided no appreciable advantage. That capability is not inherent in the S-92A aircraft and would have needed to have been designed and integrated into the aircraft. It was a requirement that existed prior to the selection of the replacement helicopter. Subsequent consideration of the requirement based on the operators' concept of operations and the capabilities of the S-92A aircraft led to a determination that the requirement did not provide an appreciable benefit. They explained that given the desire to maximize the overall performance of the aircraft (range, power, etc.), and decrease the overall risk associated with integrating the associated capability, the requirement was removed from the contract. The contractor estimated that dropping this requirement resulted in the elimination of about 20 percent of the total testing for the affected subsystem. Additionally, the Navy and contractor are currently in discussions on a downward adjustment to the contract price to reflect elimination of the requirement.

Similarly, the contractor identified an opportunity to save time and money through a change in planned contractor testing. The VH-92A must be certified by the FAA and approved by the Navy for flight in moderate icing conditions, a certification the S-92A baseline aircraft already holds. It was

[17]The international standard titled *DO-178C - Software Considerations in Airborne Systems and Equipment Certification* is the primary standard for commercial avionics software development. It provides recommendations for the production of airborne systems and equipment software and compliance with its objectives as the primary means for meeting airworthiness requirements and obtaining approval of software used in civil aviation products.

originally thought, though, that icing-related flight testing would be needed to reflect changes made to the baseline aircraft's outer body such as the addition of antennas. However, based on the existing S-92A certifications and data gathered during testing done with the antennas on the first EDM aircraft at Lockheed Martin's Owego facility, Sikorsky and FAA representatives subsequently determined that analysis would suffice toward obtaining FAA certification. This revised approach resulted in a savings of approximately 2 months of schedule and $3 million in cost—both of which will be applied to other activities within the contract.

## Earned Value Management System and Master Schedule Met Best Practices

An earned value management (EVM) system is a project management tool that integrates the technical scope of work with schedule and cost elements for investment planning and control. A well-planned schedule is another management tool that can help government programs use public funds effectively by specifying when work will be performed in the future and measuring program performance against an approved plan. During our review of the program, we compared the prime contractor's EVM system and its Integrated Master Schedule (IMS) to best practices. We found that Sikorsky's EVM system and IMS substantially or fully met best practices.

To determine if a contractor is executing the work planned within the funds and time budgeted, the prime contractor produces monthly reports detailing cost and schedule performance in an EVM system. Our research has identified a number of best practices and characteristics that are the basis of effective earned value management and which should result in reliable and valid earned value management data that can be used for making informed decisions. We examined Sikorsky's EVM system in the context of the best practices from the GAO Cost Estimating and Assessment Guide,[18] and overall found that it that it fully or substantially met the three characteristics identified for a reliable EVM system. Specifically, that the EVM system was comprehensive, that data resulting from the system was reliable, and that program management utilized that data for decision-making purposes. See appendix III for a summary assessment of the Sikorsky's EVM practices compared to best practices.

[18]GAO-09-3SP

We also found that the program's IMS substantially met the best practices for a reliable schedule. The success of programs depend, in part, on having an integrated and reliable master schedule that defines when and how long work will occur and how each activity is related to the others. Such a schedule is necessary for government acquisition programs for many reasons. It provides not only a road map for systematic project execution but also the means by which to gauge progress, identify and resolve potential problems, and promote accountability at all levels of the program. An IMS provides a time sequence for the duration of a program's activities and helps everyone understand both the dates for major milestones and the activities that drive the schedule. A program's IMS is also a vehicle for developing a time-phased budget baseline. Moreover, it is an essential basis for managing tradeoffs between cost, schedule, and scope. Among other things, scheduling allows program management to decide between possible sequences of activities, determine the flexibility of the schedule according to available resources, predict the consequences of managerial action or inaction on events, and allocate contingency plans to mitigate risks. Our research has identified 10 best practices associated with effective schedule estimating that can be collapsed into 4 general characteristics (comprehensive, well-constructed, credible and controlled) for sound schedule estimating. Overall, we found the program's IMS is reliable as it substantially met all four of the characteristics. See appendix IV for a more detailed assessment of the VH-92A program's schedule estimate compared to best practices.

While the program had made good progress, it is still early in development with significant system integration and testing ahead. We will continue to monitor the presidential helicopter acquisition as it progresses.

## Agency Comments

We are not making any recommendations in this report. DOD provided written comments on a draft of this report, which are reprinted in appendix V. In its written comments, DOD stated that it believes its efforts on this program are aligned with our best practices and it will continue to monitor the program and ensure that mitigations are in place to address potential risk areas. We will also continue to monitor the program as it moves forward. DOD also provided technical comments that were incorporated, where appropriate.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Defense; the Under Secretary of Defense

for Acquisition, Technology, and Logistics; and the Secretary of the Navy. In addition, this report will be available at no charge on GAO's Web site at http://www.gao.gov.

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

Michael J. Sullivan
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# Appendix I: Scope and Methodology

To conduct this work, we analyzed program documents (including the acquisition strategy and contractor progress reports) and plans to determine how the program is progressing in terms of its cost, schedule, and performance, and how well the program is adhering to best practices. We interviewed program officials from the Navy's Presidential Helicopter Program Office, as well as officials from the office of the Director of Operational Testing and Evaluation and the office of the Deputy Assistant Secretary of Defense for Developmental Test and Evaluation to discuss the status of the program. To develop the numbers on the cost and cycle time of the VH-92A program in table 1, we obtained and analyzed cost, quantity, and schedule data from the program's Selected Acquisition Report and other information provided by the program. We converted all cost information to fiscal year 2016 dollars using conversion factors from the Department of Defense (DOD) Comptroller's National Defense Budget Estimates for Fiscal Year 2016. Through discussions with DOD officials responsible for the database and confirming selected data with the program office, we determined that the information obtained was sufficiently reliable for the purposes of this report.

To understand potential program challenges and steps taken to address those challenges, we examined program and contractor documents and other reports relating to the development effort. We also examined DOD's risk management planning guidance and reviewed a copy of the program's draft risk management plan and the contractors' latest risk assessment. We discussed development challenges and risk management with VH-92A program officials and officials from the Sikorsky Aircraft Corporation and Lockheed Martin.

To learn more about the program's earned value management (EVM) system we met with officials from the Defense Contract Management Agency, the government agency responsible for, among other things, ensuring the integrity of the contracting process, and reviewed their Program Assessment Reports on the program to determine if the prime contractor's (Sikorsky), EVM system produced reports that met the criteria for reliable and valid EVM data. Our EVM analysis focused on Sikorsky's Integrated Program Management Report data from September 2014 through October 2015 and the Integrated Master Schedule (IMS) dated October 2015, as well as interviews with the program office, and supporting documentation. Specifically, we compared project

documentation with EVM best practices as identified in GAO's Cost Estimating and Assessment Guide.[1]

Our research has identified a number of best practices that are the basis of effective earned value management and should result in reliable and valid earned value management data that can be used for making informed decisions. These best practices have been collapsed into three high level characteristics of a reliable earned value management system which are:

- ***Establish a comprehensive EVM System:*** If the EVM data is to be used to manage a program, the contractor's (and subcontractors') EVM system should be certified to ensure that it complies with the agency's implementation of the American National Standards Institute guidelines. In addition to a certified system, an integrated baseline review must be conducted to ensure that the performance measurement baseline accurately captures all of the work to be accomplished.[2] In order to develop the performance measurement baseline, an integrated network schedule should be developed and maintained. This schedule should reflect the program's work breakdown structure, clearly show the logical sequencing of activities, and identify the resources necessary to complete the activities in order to develop the time-phased budget baseline.[3] Lastly, there should be a rigorous EVM system surveillance program in place. Effective surveillance ensures that the contractor is following its own corporate processes and procedures and confirms that the contractor's processes and procedures continue to satisfy the American National Standards Institute guidelines.

[1]GAO, *Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs,* GAO-09-3SP, (Washington, D.C.: March 2009).

[2]A performance measurement baseline is used in EVM to detect deviations from the plan and to give insight into problems and potential impacts.

[3]The time-phased budget baseline, against which performance is measured, is formed from the performance measurement baseline, which is essentially the resource consumption plan for the program. Deviations from the baseline identify areas where management should focus attention. A performance measurement baseline represents the cumulative value of a program's planned work over time. It takes into account the program activities that occur in a sequenced order, based on finite resources, with budgets representing those resources spread over time.

- ***Ensure that the data resulting from the EVM system are reliable:*** To ensure the data are reliable, it is important to make sure that the Integrated Program Management Report data make sense and do not contain anomalies that would make them invalid. If errors are not detected, then the data will be skewed, resulting in bad decision-making. In addition to checking for data anomalies, the integrated program management report data between the different formats should be consistent.[4] Reliable EVM data is important in order to generate estimates at completion. Managers should rely on EVM data to generate estimates at completion at least monthly. Estimates at completion are derived from the cost of work completed along with an estimate of what it will cost to complete all unaccomplished work.

- ***Ensure that the program management team is using earned value data for decision-making purposes:*** For EVM data to be useful it must be reviewed regularly. Cost and schedule deviations from the baseline plan give management at all levels information about where corrective actions are needed to bring the program back on track or to update completion dates and estimates at completion. Management should focus on corrective actions and identify ways to manage cost, schedule and technical scope to meet program objectives. Management also needs to ensure that the performance measurement baseline is updated accordingly as changes occur. Because changes are normal, the American National Standards Institute guidelines allow for incorporating changes to the performance measurement baseline. However, it is imperative that changes be incorporated into the EVM system as soon as possible to maintain the validity of the performance measurement baseline.

See appendix III for our summary assessment of the VH-92A program's EVM data and practices compared to best practices. EVM data are considered reliable if the overall assessment ratings for each of the three characteristics are substantially or fully met. If any of the characteristics are not met, minimally met, or partially met, then the EVM data cannot be considered reliable.

[4]The Integrated Program Management Report contains data for measuring contractors' cost and schedule performance on Department of Defense acquisition contracts. The Integrated Program Management Report is the primary means of communicating program cost and schedule information between the prime contractor and the Government.

We reviewed the program's IMS and compared it to the GAO Schedule Assessment Guide.[5] Our research has identified 10 best practices associated with effective schedule estimating that can be collapsed into 4 general characteristics for sound schedule estimating:

- ***Comprehensive:*** A comprehensive schedule includes all activities for both the government and its contractors necessary to accomplish a project's objectives as defined in the project's work breakdown structure. The schedule includes the labor, materials, travel, facilities, equipment, and the like needed to do the work and depicts when those resources are needed and when they will be available. It realistically reflects how long each activity will take and allows for discrete progress measurement.

- ***Well-constructed:*** A schedule is well-constructed if all its activities are logically sequenced with the most straightforward logic possible. Unusual or complicated logic techniques are used judiciously and justified in the schedule documentation. The schedule's critical path represents a true model of the activities that drive the project's earliest completion date and total float accurately depicts schedule flexibility.

- ***Credible:*** A schedule that is credible is horizontally traceable—that is, it reflects the order of events necessary to achieve aggregated products or outcomes. It is also vertically traceable: activities in varying levels of the schedule map to one another and key dates presented to management in periodic briefings are in sync with the schedule. Data about risks and opportunities are used to predict a level of confidence in meeting the project's completion date. The level of necessary schedule contingency and high priority risks and opportunities are identified by conducting a robust schedule risk analysis.

- ***Controlled:*** A schedule is controlled if it is updated periodically by trained schedulers using actual progress and logic to realistically forecast dates for program activities. It is compared against a designated baseline schedule to measure, monitor, and report the project's progress. The baseline schedule is accompanied by a baseline document that explains the overall approach to the project,

[5]GAO, *Schedule Assessment Guide: Best Practices for Project Schedules*, GAO-16-89G, (Washington, D.C.: December 2015)

defines ground rules and assumptions, and describes the unique features of the schedule. The baseline schedule and current schedule are subject to a configuration management control process.

For our evaluations of the schedule estimates, when the tasks associated with the leading practices that define a characteristic were mostly or completely satisfied, we considered the characteristic to be substantially or fully met. When all four characteristics were at least substantially met, we considered a schedule estimate to be reliable. In addition, we interviewed agency and contractor officials to determine the methodology used to develop the IMS. To assess the schedule, we obtained and reviewed documentation, including the work breakdown structure.[6]

See appendix IV for our summary assessment of the VH-92A program's schedule estimate compared to best practices.

We conducted this performance audit from July 2015 to April 2016 in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

[6]An integrated master plan provides an event-based hierarchy of program events, with each event supported by accomplishments and each accomplishment associated with specific criteria to be satisfied for its completion. When used, the integrated master plan is typically contractually binding.

# Appendix II: GAO Reports on the Presidential Helicopter Replacement Program

*Presidential Helicopter Acquisition: Program Established Knowledge-Based Business Case and Entered System Development with Plans for Managing Challenges* (GAO-15-392R, April 14, 2015)

*Presidential Helicopter Acquisition: Update on Program's Progress toward Development Start* (GAO-14-358R, April 10, 2014)

*Department of Defense's Waiver of Competitive Prototyping Requirement for the VXX Presidential Helicopter Replacement Program* (GAO-13-826R, September 6, 2013)

*Presidential Helicopter Acquisition: Program Makes Progress in Balancing Requirements, Costs, and Schedule* (GAO-13-257, April 9, 2013)

*Presidential Helicopter Acquisition: Effort Delayed as DOD Adopts New Approach to Balance Requirements, Costs, and Schedule* (GAO-12-381R, February 27, 2012)

*Defense Acquisitions: Application of Lessons Learned and Best Practices in the Presidential Helicopter Program* (GAO-11-380R, March 25, 2011)

# Appendix III: Summary Assessment of the VH-92A Program's Earned Value Management (EVM) Data and Practices Compared to Best Practices

| Characteristic | Overall assessment | Best practice | Assessment |
|---|---|---|---|
| Establish a comprehensive EVM System: | **Met** | The program has a certified EVM system | **Substantially Met:** The contractor's EVM system has been rated acceptable, indicating that it generally complies with EVM system guidelines. |
| | | An Integrated Baseline Review was conducted to ensure the performance measurement baseline captures all of the work | **Met:** An Integrated Baseline Review was conducted in November 2014 that assessed the technical, schedule, resource, and cost risk associated with the program's various control accounts. |
| | | The schedule reflects the work breakdown structure, the logical sequencing of activities, and the necessary resources | **Substantially Met:** The schedule has a consistent and well-defined work breakdown structure and is complex with few missing logic links; however, the schedule is not fully resource loaded. |
| | | EVM surveillance is being performed | **Met:** The Defense Contract Management Agency performs monthly reports regarding the prime contractor and their major subcontractor to the program office. |
| Ensure that the data resulting from the EVM system are reliable: | **Substantially Met** | EVM data do not contain any anomalies | **Partially Met:** While the cost and schedule performance data is consistent between reporting formats, there are many data anomalies that are not explained in the Integrated Program Management Report narrative (Format 5). |
| | | EVM data are consistent among various reporting formats | **Met:** There are no inconsistencies between the cost and schedule performance data and between the Integrated Program Management Report formats reported. |
| | | Estimate at completion is realistic | **Substantially Met:** The contractor estimate at completion is not overly optimistic; in fact, it is greater than the GAO estimate at completion range. |
| Ensure that the program management team is using earned value data for decision-making purposes: | **Met** | EVM data, including cost and schedule variances, are reviewed on a regular basis | **Met:** The program office and contractor review the cost and schedule and variances and use that information to determine corrective actions for potential cost and schedule overruns. |
| | | Management uses EVM data to develop corrective action plans | **Met:** The program office uses the EVM data and variances as a basis to request additional resources. |

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| The performance measurement baseline is updated to reflect changes | **Substantially Met:** While the performance management baseline change process is clearly defined and changes are documented in the contractor's monthly reports, there is no explanation for the change in the budget at complete in January 2015. |

Source: GAO analysis of the VH-92A Program's EVM data: | GAO-16-395

Note: "Not met" means the program provided no evidence that satisfies any of the best practice criteria. "Minimally met" means the program provided evidence that satisfies a small portion of the criteria. "Partially met" means the program provided evidence that satisfies about half of the criteria. "Substantially met" satisfies a large portion of the criteria. "Met" means the program provided evidence that completely satisfies the criteria.

# Appendix IV: Summary Assessment of the VH-92A Program's Schedule Estimate Compared to Best Practices

| Characteristic | Overall assessment | Best practice | Individual assessment |
|---|---|---|---|
| Comprehensive<br>• all activities as defined in the project's work breakdown structure<br>• the labor, materials, travel, facilities, equipment, and the like needed to do the work and whether<br>• those resources will be available when needed<br>• how long each activity will take, allowing for discrete progress measurement with specific start and finish dates | **Substantially Met** | 1. Capturing all activities | **Substantially Met:** While the work breakdown structure has a dictionary that defines all the tasks and is consistent between the program management documents and reports, there are cases of tasks that do not have unique names. |
| | | 3. Assigning Resources to all activities | **Partially Met:** While the schedule contains some resources, the program office stated that the IMS is not fully resource loaded since this is not a requirement of the Integrated Program Management Report instructions. However, the program office stated that they assess the resources (labor and materials) at the weekly integrated product team meetings. |
| | | 4. Establishing the durations of all activities | **Substantially Met:** The durations were established taking into account available resources, productivity and past experience. Additionally, the schedule accounts for holidays and the contractor and subcontractor non-work periods. |
| Well-constructed<br>• all activities logically sequenced with predecessor and successor logic<br>• limited amounts of unusual or complicated logic techniques that are justified in the schedule documentation<br>• a critical path that determines which activities drive the project's earliest completion date<br>• total float that accurately determines the schedule's flexibility | **Substantially Met** | 2. Sequencing all activities | **Substantially Met:** The schedule is complex with few missing logic links. For the most part, extensive documentation of the logic anomalies exists; however, any dangling logic can interfere with network analysis and the forecasting ability of the schedule. Thus, the small relative number of dangling logic, but high absolute number precludes a fully met score. |
| | | 6. Confirming that the critical path is valid | **Substantially Met:** Clear waterfalls of driving paths to engineering development model (EDM) 1 and EDM 2 deliveries as well as Milestone C and program finish exist within the schedule. Detailed documentation of how the critical path is derived is also discussed in the program reviews. However, long duration testing activities are present in the EDM 1 and Milestone C paths and there are some dangling activities that keep this best practice from being fully met. |

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| | | 7. Ensuring reasonable total float | **Partially Met:** The IMS does not have any negative float and all float values are calculated as days. Although the schedule reflects many activities with high float values, valid justification exists for many. In some cases, it is clear why float is so large, such as high-level program milestones or level of effort activities not having a successor. However, there are instances of high float values that are derived from complete network logic that the program office ignores; in these cases, unreasonable float should be documented and explained. |
| Credible<br>• the order of events necessary to achieve aggregated products or outcomes<br>• varying levels of activities, supporting activities, and subtasks<br>• key dates that can be used to present status updates to management<br>• a level of confidence in meeting a project's completion date based on<br>• data about risks and opportunities for the project<br>• necessary schedule contingency and high priority risks based on conducting a robust schedule risk analysis | **Substantially Met** | 5. Verifying that the schedule is traceable horizontally and vertically | **Partially Met:** The schedule aligns vertically with the contractor integrated program management reports. However, changes in dates for specific tasks do not show that the schedule is horizontally traceable. |
| | | 8. Conducting a schedule risk analysis | **Substantially Met:** Schedule risk analyses have been performed. However, logic issues cause the schedule risk assessment to not be completely reliable. |
| Controlled<br>• updated periodically by schedulers trained in critical path method scheduling<br>• statused using actual progress and logic to realistically forecast dates for program activities<br>• compared against a documented baseline schedule to determine variances from the plan<br>• accompanied by a corresponding baseline document that explains the overall approach to the project, defines assumptions, and describes unique features of the schedule<br>• subject to a configuration management control process | **Substantially Met** | 9. Updating the schedule with actual progress and logic | **Partially Met:** While the schedule has no date anomalies, it does not maintain a document to track changes in the schedule's logic or provide a schedule narrative that includes key details regarding how the schedule is updated. |

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| 10. Maintaining a baseline schedule | **Substantially Met:** While the schedule's government tasks are baselined and have an established process for variance measurement, there is no evidence of a schedule baseline document. |

Source: GAO analysis of the VH-92A Program's schedule data. | GAO-16-395

Note: "Not met" means the program provided no evidence that satisfies any of the best practice criteria. "Minimally met" means the program provided evidence that satisfies a small portion of the criteria. "Partially met" means the program provided evidence that satisfies about half of the criteria. "Substantially met" satisfies a large portion of the criteria. "Met" means the program provided evidence that completely satisfies the criteria.

# Appendix V: Comments from the Department of Defense

OFFICE OF THE ASSISTANT SECRETARY OF DEFENSE
3015 DEFENSE PENTAGON
WASHINGTON, DC 20301-3015

ACQUISITION

MAR 22 2016

Mr. Michael J. Sullivan
Director, Acquisition and Sourcing Management
U.S. Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Mr. Sullivan:

This is the Department of Defense response to the Government Accountability Office (GAO) Draft Report, GAO-16-395, "PRESIDENTIAL HELICOPTER: Program Progressing Largely as Planned," dated February 29, 2016 (GAO Code 100235). The Department appreciates the effort of the GAO and the opportunity to comment on the draft report.

The Department has conducted a security review of GAO Draft Report, GAO-16-395, and found no "FOR OFFICIAL USE ONLY" (FOUO) information in the report. The Department finds that the report is UNCLASSIFIED and cleared for open publication, and recommends the removal of all FOUO markings. Enclosed is a copy of the Department's official security review.

We believe our efforts on this program are aligned with GAO's best practices and will continue to monitor the program and ensure that mitigations are in place to address potential risk areas.

My point of contact for this effort is Mr. Georg Contag, georg.r.contag.civ@mail.mil or 703-697-2767.

Sincerely,

James A. MacStravic
Deputy Assistant Secretary of Defense
Tactical Warfare Systems
Performing the Duties of the ASD(A)

Enclosure:
As stated

# Appendix VI: GAO Contact and Acknowledgments

## GAO Contact

Michael J. Sullivan, (202) 512-4841 or sullivanm@gao.gov

## Staff Acknowledgments

In addition to the contact named above, Bruce H. Thomas, Assistant Director; Bonita J. P. Oden, Analyst-in-Charge; William C. Allbritton; Stephanie M. Gustafson; Ozzy Trevino; Jennifer V. Leotta; Juana S. Collymore; Karen A. Richey; Hai V. Tran; Marie P. Ahearn; and Katherine S. Lenane made key contributions to this report.