

IG-99-037

**AUDIT
REPORT**

**EARNED VALUE MANAGEMENT AT NASA —
ECS PERFORMANCE MEASUREMENT BASELINE**

September 10, 1999



National Aeronautics and
Space Administration

OFFICE OF INSPECTOR GENERAL

Additional Copies

To obtain additional copies of this audit report, contact the Assistant Inspector General for Auditing at (202) 358-1232, or visit <http://www.hq.nasa.gov/office/oig/hq/issuedaudits.html>.

Suggestions for Future Audits

To suggest ideas for or to request future audits, contact the Assistant Inspector General for Auditing. Ideas and requests can also be mailed to:

Assistant Inspector General for Auditing
NASA Headquarters
Code W, Room 8V69
300 E Street, SW
Washington, DC 20546-0001

NASA Hotline

To report fraud, waste, abuse, or mismanagement contact the NASA OIG Hotline at (800) 424-9183, (800) 535-8134 (TDD), or at <http://www.hq.nasa.gov/office/oig/hq/hotline.html#form>, or write to the NASA Inspector General, P.O. Box 23089, L'Enfant Plaza Station, Washington, DC 20026. The identity of each writer and caller can be kept confidential, upon request, to the extent permitted by law.

Acronyms

DoD	Department of Defense
ECS	EOSDIS Core System
EOS	Earth Observing System
EOSDIS	EOS Data and Information System
ESDIS	Earth Science Data and Information System
EVM	Earned Value Management
FAR	Federal Acquisition Regulation
NPD	NASA Program Directive
NPG	NASA Procedures and Guidelines
OIG	Office of Inspector General

W

September 10, 1999

TO: B/Chief Financial Officer
Y/Associate Administrator for Earth Science
100/Director, Goddard Space Flight Center

FROM: W/Assistant Inspector General for Auditing

SUBJECT: Final Report on the Audit of Earned Value Management at NASA —
ECS Performance Measurement Baseline Redacted Report*
Assignment Number A-HA-98-042
Report Number IG-99-037

The subject final report is provided for your use and comment. Please refer to the finding paragraph for the overall audit results. Our evaluation of your response is incorporated into the body of the report. Management did not specify the corrective action planned, ongoing, and completed or an estimated completion date for the recommended corrective action for recommendations 1 and 2. We request that information by October 12, 1999, in response to the final report. The corrective actions taken or planned for recommendation 3 were responsive. All recommendations will remain open for reporting purposes until corrective actions are completed. Please notify us when action has been completed on the recommendations, including the extent of testing performed to ensure corrective actions are effective.

If you have questions concerning the report, please contact Mr. Lorne A. Dear, Program Director, Procurement Audits, at (818) 354-3360; Mr. Tony A. Lawson, Audit Program Manager, at (301) 286-6524; or Ms. Sandra L. Laccheo, Auditor-in-Charge, at (757) 864-3458. We appreciate the courtesies extended to the audit staff. The final report distribution is in Appendix D.

[original signed by]

Russell A. Rau

Enclosure

cc:

B/Comptroller

BF/Director, Financial Management Division

BR/NASA EVM Focal Point

G/General Counsel

JM/Director, Management Assessment Division

GSFC/423/ESDIS Project Manager

GSFC/153/Earned Value Focal Point

MSFC/DD01/Chair, Program Management Council Working Group

MSFC/BJ01/Lead Center Earned Value Focal Point

bcc:

GSFC/190/Mr. T. Lawson

GSFC/201/Audit Liaison Representative

JPL/W/Mr. L. Dear

KSC/OIG/Ms. B. Armstrong

LaRC/292/Ms. S. Laccheo

MSFC/BJ01/Audit Liaison Representative

NASA Office of Inspector General

IG-99-037
A-HA-98-042

September 10, 1999

Earned Value Management at NASA — ECS Performance Measurement Baseline

Introduction

The NASA Office of Inspector General (OIG) is performing an audit of earned value¹ management (EVM). Details on EVM are in Appendix B. The overall audit objective is to evaluate how effectively NASA managers are using earned value to manage NASA contracts. We are issuing this report to emphasize the importance of integrated baseline reviews, which are an integral part of EVM. During the audit, we identified a condition related to the Earth Observing System (EOS) Data and Information System (EOSDIS²) Core System (ECS) contract, which is currently valued at \$868.6 million. Due to pending negotiations on a major contract modification, we are providing this report for management's attention. See Appendix A for details on our objectives, scope, and methodology.

Results in Brief

NASA can improve the use of EVM on the ECS contract by performing an integrated baseline review to substantiate the validity of the contractor's performance measurement baseline. The ECS contractor has experienced more than \$100 million in cost growth and has encountered schedule delays since the contract was awarded. The contractor has not maintained an adequate baseline, and a baseline review is not scheduled for the pending major contract modification to restructure the project. An accurate and reliable baseline is essential for the contractor to adequately define, schedule, and assign sufficient resources to the remaining contract work. However, NASA policy does not require integrated baseline reviews when major contract modifications are made. Without a valid baseline, variances may not be detected and addressed with corrective action plans.

* We have redacted portions of this report due to references to process information. The redacted passages do not affect the validity of this report or management's response.

¹ Earned value is an objective measurement of how much work has been accomplished on a contract.

² EOSDIS is part of EOS, a long-term program designed to study Earth's land, oceans, atmosphere, ice, and life as a total integrated system.

Background

NASA policy establishes the basis for applying EVM to NASA contracts.³ NASA has not finalized EVM implementation guidance, including guidance on integrated baseline reviews. EVM is a tool available to NASA program and project managers for insight into contractor performance. One key to effective contract management using EVM techniques is a reliable performance measurement baseline. The baseline is the total, time-phased budget against which contract cost and schedule performance is measured. Successful implementation of the baseline is verified through a baseline review. An integrated baseline review is a formal review by the Government and contractor intended to improve the use of cost and schedule performance data. Through the baseline-review process, the Government project team:

- ensures that the baseline accurately and adequately reflects the work required to complete the contract,
- gets an understanding of the earned value methods that the contractor uses for measuring accomplishment, and
- confirms that objective and meaningful performance data are provided.

The project manager is responsible for the timeliness and successful execution of the baseline review. Therefore, the primary team members for the review should come from the project manager's staff to emphasize planning for the technical effort. The project manager is also responsible for ensuring that project team members are adequately trained.⁴

NASA awarded contract NAS5-60000 to Hughes Aircraft Company⁵ in March 1993 for \$766.0 million. The 10-year cost-plus-award-fee contract is for the development and operation of the ECS. The ECS will be a geographically distributed system that will receive, process, archive, and distribute all data, and the results of research using the data, from EOS and other Earth science flight missions. The ECS consists of a flight system⁶ and a science system.⁷ The current contract value is \$868.6 million, an increase of \$102.6 million from the original contract value. Earth Science Data and Information System (ESDIS) project officials are evaluating the contractor's proposal for the contract modification. The contractor has proposed an increase of ****Deliberative process information omitted.**** to the contract, but the Government has not entered into negotiation with the contractor.

³ NASA Program Directive 9501.3, "Earned Value Performance Management," February 18, 1997, and NASA Procedures and Guidelines 7120.5A, "NASA Program and Project Management Processes and Requirements," April 3, 1998.

⁴ Draft NASA Procedures and Guidance 9501.4, "Earned Value Management Implementation on NASA Contracts," states that EVM focal points are responsible for providing EVM training.

⁵ The Raytheon Systems Company has since acquired Hughes Aircraft Company.

⁶ The flight system will command and control the EOS spacecraft and instruments.

⁷ The science system will produce EOS standard data products, using science production software. The ECS science system will archive data products and make the products available to users through an information management system.

Need for an Integrated Baseline Review

Finding. NASA can improve the use of EVM by performing an integrated baseline review on the ECS contract. The ECS contract has sustained continuous cost overruns and delays since contract award in 1993. The ESDIS project office has not scheduled a baseline review to be performed after the current major contract modification is completed. However, current NASA policy does not specify the need for a baseline review after a major modification. Without a review, NASA has no assurance the contractor has adequately addressed contractual requirements, logically scheduled remaining work activities, assigned adequate resources to complete the contract, and identified inherent risks. As a result, the ECS contract may continue to realize cost growth and encounter delays. Other NASA programs and projects may experience similar problems if integrated baseline reviews are not required.

NASA Policy. NASA Procedures and Guidelines (NPG) 7120.5A, “NASA Program and Project Management Processes and Requirements,” establishes the management system for the formulation, approval, implementation, and evaluation of all Agency programs and projects. NPG 7120.5A addresses EVM; however, the policy contains no specific requirement for a baseline review. NPG 7120.5A states the program and project managers shall ensure proper use of EVM on all required contracts according to NASA Policy Directive (NPD) 9501.3, “Earned Value Management,” and NPG 9501.4, “Earned Value Management Implementation on NASA Contracts.” NPD 9501.3 and NPG 9501.4 are incorporated into NPG 7120.5A, section 4.3.1, by reference.

In July 1997, NASA drafted NPG 9501.4 to provide uniform guidance for implementing EVM on NASA contracts.

Deliberative process information omitted.

Draft NPG 9501.4 is to be used in conjunction with the “Earned Value Management Implementation Guide.”⁸ The guide provides instructions for understanding EVM concepts, defines objective criteria for EVM systems, and provides guidance in interpreting the criteria for use on large, high-risk, cost-based contracts. Part II, “Procedures for Government Use of Earned Value,” section 4-2, of the guide provides information on the baseline-review process. The guide states that the baseline review is conducted following contract award or when work on a production option of a development contract begins. When a major modification or event significantly shifts the content or time phasing of the baseline, the program or project manager may also conduct a baseline review. In our opinion, the baseline review should be required with full consideration given to pre-award efforts to evaluate the contractor’s proposal, which can determine the scope of the post-award review.

⁸ The guide was developed jointly by the DoD, Federal Aviation Administration, and NASA.

NASA awarded the ECS contract before Agency-wide EVM policy⁹ was issued. However, on March 5, 1999, NASA changed the NASA Federal Acquisition Regulation (FAR) Supplement to apply EVM to significant NASA contracts¹⁰ by establishing a clause compatible with that used by the Department of Defense (DoD). The clause indicates that a baseline review may be conducted after major contract modifications. The NASA FAR Supplement clause 1852.242-75, “Earned Value Management Systems,” states:

The Government may require integrated baseline reviews. Such reviews shall be scheduled as early as practicable and should be conducted within 180 calendar days after contract award, exercise of significant contract options, or **incorporation of major contract modifications**. [Emphasis added]

Prior OIG Report. The OIG issued a Rapid Action Report on August 22, 1994,¹¹ stating that the ESDIS project office had not performed the required review of the contractor’s EVM system. Early indications were that the contractor’s performance measurement data were not reliable. The project office questioned the accuracy and reliability of the contractor’s data during the first two award-fee evaluation periods. The OIG recommended that the ESDIS project office perform a review of the contractor’s system at the earliest possible date.

EVM Review. The ESDIS project office reviewed the contractor's EVM system in 1995 and determined that the contractor’s system met the needs of the ESDIS project.¹² During the review, the team also determined whether the contractor established and was maintaining an accurate, integrated baseline. This review identified problems with the contractor’s scheduling system; nonetheless, the team concluded the baseline was acceptable. Since that review, the contractor has had difficulty maintaining an accurate and reliable baseline. During contract performance, significant delays and cost overruns occurred on the ECS science system. In August 1996, NASA learned that the ECS science system would not be available in time to support the Tropical Rainfall Measuring Mission.¹³ As a result, the first science system version of the ECS was cancelled and the functions were added to other EOSDIS components. In March 1998, the

⁹ When the ECS contract was awarded, policy was in Goddard Handbook 5112.1, “Performance Measurement System Handbook.” Performance measurement systems are now referred to as earned value management systems.

¹⁰ Significant contracts are research, development, test, and evaluation contracts with an estimated, final value of \$60 million or more and a period of performance greater than 1 year or production contracts with an anticipated, final value of \$250 million or more.

¹¹ Rapid Action Report GO-94-006, “Subcontract Management of the EOSDIS Core System Contract, Award Fee Determinations.”

¹² The ESDIS project team reviewed the contractor's EVM system in May 1995, more than 2 years after contract award. The delay was to allow the contractor time to implement its integrated team approach and to prepare a new baseline reflecting the EOS restructure. Prior to contract award, the EOS program was restructured to focus the EOS objectives on global climate change and to fly fewer instruments on multiple, smaller platforms.

¹³ The Tropical Rainfall Measuring Mission is a joint mission between NASA and Japan to improve the scientific understanding of climate processes related to the heat released by tropical rainfall. The mission was launched in October 1997.

contractor failed to deliver an acceptable flight system. In a December 8, 1998, memorandum for the record, the contracting officer stated, “The failure was so dramatic that [NASA] had to delay the launch of [*Terra*¹⁴].”

Need for a Baseline Review. Since December 1996, the contractor's EVM system has not provided meaningful performance indicators. The contract has been modified nine times because of significant functional, cost, and schedule changes. In December 1998, NASA issued another modification for the contract restructure. The restructure reduces the scope for the ECS science system, defines science requirements for future missions, and transfers the responsibility for producing higher level data products to some instrument teams and principal investigators.

The ESDIS project team has not scheduled a baseline review because the team may have adequate insight into the contractor's cost estimate and technical approach to complete the ECS contract after the team evaluates the contractor's proposal. Therefore, project office officials stated there may be minimal value to performing a formal baseline review.

When a contract has experienced continual cost overruns and delays, a formal baseline review should be conducted after a major modification. Based on ECS contract performance to date, NASA would benefit by conducting a formal review. Without a review, the revised baseline may not be reliable, accurately contain the technical content and integrated schedules, or have adequate resources assigned to complete the contract. Without an adequate baseline, the objective of an EVM system to promptly identify cost and schedule variances for corrective action is not fully achieved. Further, performance measurement data will continue to be unreliable if the baseline is unrealistic and does not reflect actual work content. Based on contract experience to date, it is critical that a baseline review be conducted as early as possible.

Recommendations, Management's Response, and Evaluation of Response

- 1. The Chief Financial Officer should revise draft NPG 9501.4 to require an integrated baseline review within 180 days after contract award, the exercise of significant contract options, or the incorporation of major contract modifications. Pre-award activities that focus on ensuring the adequacy of the performance measurement baseline should be considered in determining the scope of the baseline review.**

Management's Response. The CFO will consider the recommendation to modify the directive. The complete text of management's response is in Appendix C.

Evaluation of Management's Response. Management's comment is not fully responsive because it does not specifically state whether it would modify the directive or provide a completion date for corrective action. Therefore, we request that management further review its

¹⁴ *Terra* was scheduled to be launched in June 1998. Because of contractor delays, *Terra* is now scheduled to be launched no earlier than October 1999. *Terra* was previously known as EOS AM-1.

position on this matter and provide its decision on modifying NPG 9501.4. The recommendation is unresolved and will remain undispositioned and open until corrective actions are completed.

- 2. The Chief Financial Officer should issue NPG 9501.4 in final as soon as practical so that project managers have guidance on implementing EVM.**

Management's Response. Concur. Management intends to issue the directive as soon as possible. The complete text of management's response is in Appendix C.

Evaluation of Management's Response. Management's comment is not fully responsive because it did not provide the completion date for corrective action. The recommendation is unresolved and will remain undispositioned and open until agreed-to actions are completed.

- 3. The Goddard Center Director should direct the ESDIS Project Manager to conduct an integrated baseline review as soon as practical after modifying the ECS contract.**

Management's Response. Concur. The ESDIS Project Manager will perform a baseline review of the contract. The baseline review is planned to begin in January 2000. The complete text of management's response is in Appendix C.

Evaluation of Management's Response. The action planned by management is responsive to the recommendation. The recommendation is resolved but will remain undispositioned and open until agreed-to actions are completed.

Appendix A. Objectives, Scope, and Methodology

Objectives

The overall objective is to evaluate how effectively NASA managers are using earned value to manage NASA contracts. Specifically, we will determine whether:

- earned value management is properly implemented on contracts,
- NASA managers effectively use the Defense Contract Management Command for EVM system surveillance.
- performance measurement baselines are adequately assessed and maintained, and

Our results to date address only the need to adequately assess and maintain a performance measurement baseline through an integrated baseline review. The first two objectives are discussed in another report (draft assignment number A9905500).

Scope and Methodology

For this report, we focused on NASA EVM policy and guidance and NASA and Goddard Space Flight Center procedures for the ECS contract. To understand the requirements for a baseline review, we:

- examined guidance in the “Earned Value Management Implementation Guide” and
- reviewed EVM presentations by DoD officials.

To determine how EVM was implemented on the ECS contract, we:

- interviewed members of the ESDIS project office and
- reviewed the results of the ESDIS project office’s May 1995 evaluation of the contractor’s EVM system and other project and contractual documents.

Audit Field Work

We conducted field work from August 1998 through April 1999 at NASA Headquarters and Goddard. We conducted the audit in accordance with generally accepted government auditing standards.

Appendix B. Earned Value Management

NPD 9501.3, “Earned Value Performance Management,” establishes the basis for applying EVM to NASA contracts. Earned value is an objective measure of how much work has been accomplished on a contract. It is a management technique that integrates cost, schedule, and technical scope of work and allows for the continuous measurement of integrated performance throughout the contract. The basic purpose of earned value as a management tool is to ensure that contractors use effective internal cost, schedule, and technical control systems that provide the Government with reliable, timely, and auditable contract status.

A target value (budget) is established for each scheduled element of work. As contractors complete these elements of work, the target values are “earned.” The earned value becomes a metric against which to measure what was scheduled to be accomplished and what was spent to perform the work. The difference between the planned and actual performance results in a variance.

The EVM system identifies variances that have either exceeded or failed to meet identified thresholds of performance by work element. Variance analysis is an effective control against further cost and schedule problems that may jeopardize the successful completion of the contract. EVM does not eliminate cost overruns or schedule slippage. However, when properly implemented, EVM does provide the project manager with a basis for making corrective management decisions to improve overall contract performance. Additionally, EVM provides project managers a means to better estimate the total contract cost and total duration of contracts.

An initial and critical step in applying earned value to a contract is the establishment of a performance measurement baseline. The assignment of budgets to scheduled work produces the baseline against which actual performance can be compared. The baseline must capture the entire technical scope of work, consistent with contract schedules, and must have adequate resources assigned. Valid cost and schedule data depend on developing a meaningful baseline for controlling internal performance and reporting valid contract status information to the Government. Proper maintenance of the baseline prevents performance measurement against an outdated or unauthorized plan. Project managers are responsible for ensuring the accuracy of the baseline.

The Government and contractor substantiate the validity of the baseline through an integrated baseline review. The review:

- Benefits the project manager and technical staff in understanding the contractor’s integrated management system, monitoring contract performance, and developing confidence in the performance data.
- Provides the Government project manager a better understanding of where the risk is in the contractor’s approach for completing the contract.
- Provides an opportunity for both NASA and contractor managers to better understand the contract.

- Contributes in the establishment of a strong working relationship between the Government and contractor.
- Assures the entire team has a consistent set of objectives and an appropriate expectation of success.
- Provides project managers a level of involvement and insight into the contractors' baseline planning and internal management tools used for contract cost and schedule control.
- Should be a continuous part of contract and project management by both the Government and the contractor to ensure that baseline integrity is maintained.

Appendix C. Management's Response

National Aeronautics and
Space Administration
Headquarters
Washington, DC 20546-0001



AUG 12 1999

MEMORANDUM

BR

TO: W/Assistant Inspector General for Auditing

FROM: B/Chief Financial Officer

SUBJECT: IG Draft Report on the Audit of Earned Value Management at
NASA – ECS Performance Measurement Baseline (A-HA-98-042)

We agree, as does the Project, that the ESDIS Project would benefit from conducting an Integrated Baseline Review on the subject contract. It is our understanding that the Project Office plans to do so following the completion of negotiations on the current contract modification and closure of their critical Terra support period. All other things being equal, the project has indicated that they plan to conduct the IBR shortly after the first of the year.

The Office of the Chief Financial Officer (CFO) will consider your recommendation that we modify the NPG 9501.4 to require Integrated Baseline Reviews as it completes closure of Agency inputs on NPG 9501.4. It is our intent to complete modification of the draft NPG as soon as possible.

A handwritten signature in black ink, appearing to read "Arnold G. Holz".

Arnold G. Holz

cc
AE/Chief Engineer
100/Director, Goddard Space Flight Center
423/Deputy Project Manager for Resources

Recommendation 3

Recommendation 1

Recommendation 2

Appendix D. Report Distribution

National Aeronautics and Space Administration (NASA) Headquarters

A/Administrator
AI/Associate Deputy Administrator
AE/Chief Engineer
B/Chief Financial Officer
B/Comptroller
BR/Director, Financial Management Division
BR/NASA EVM Focal Point
G/General Counsel
H/Associate Administrator for Procurement
J/Associate Administrator for Management
JM/Director, Management Assessment Division
Y/Associate Administrator for Earth Science

NASA Centers

Director, Goddard Space Flight Center
ESDIS Project Manager, Goddard Space Flight Center
Earned Value Focal Point, Goddard Space Flight Center
Chief Counsel, John F. Kennedy Space Center
Chair, Program Management Council Working Group, Marshall Space Flight Center
Lead Center Earned Value Focal Point, Marshall Space Flight Center

Non-NASA Federal Organizations and Individuals

Assistant to the President for Science and Technology Policy
Deputy Associate Director, Energy and Science Division, Office of Management and Budget
Branch Chief, Science and Space Programs Branch, Energy and Science Division,
Office of Management and Budget
Associate Director, National Security and International Affairs Division, Defense Acquisitions
Issues, General Accounting Office
Professional Assistant, Senate Subcommittee on Science, Technology, and Space

Appendix D

Chairman and Ranking Minority Member - Congressional Committees and Subcommittees

Senate Committee on Appropriations

Senate Subcommittee on VA, HUD, and Independent Agencies

Senate Committee on Commerce, Science, and Transportation

Senate Subcommittee on Science, Technology, and Space

Senate Committee on Governmental Affairs

House Committee on Appropriations

House Subcommittee on VA, HUD, and Independent Agencies

House Committee on Government Reform and Oversight

House Subcommittee on National Security, Veterans Affairs, and International Relations

House Committee on Science

House Subcommittee on Space and Aeronautics

Congressional Member

Honorable Pete Sessions, U.S. House of Representatives

Major Contributors to this Report

Lorne A. Dear, Program Director, Procurement Audits

Tony A. Lawson, Audit Program Manager

Sandra L. Laccheo, Auditor-in-Charge

Bonnie J. Armstrong, Auditor

Nancy C. Cipolla, Report Process Manager

Christina D. Head, Program Assistant