Audit Report

OFFICE OF THE INSPECTOR GENERAL

FUNCTIONAL AND PHYSICAL CONFIGURATION AUDITS OF THE AIR FORCE NAVIGATION SYSTEM TIME AND RANGING GLOBAL POSITIONING SYSTEM

Report No. 97-011 October 28, 1996

Department of Defense

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Acronyms

DCMC	Defense Contract Management Command
ECP	Engineering Change Proposal
GPS	Global Positioning System
ICD	Interface Control Document
ITT	International Telephone and Telegraph
JPO	Joint Program Office

INSPECTOR GENERAL
DEPARTMENT OF DEFENSE
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ARLINGTON, VIRGINIA 22202-2884

October 28, 1996

MEMORANDUM FOR ASSISTANT SECRETARY OF THE AIR FORCE
(FINANCIAL MANAGEMENT AND COMPTROLLER)

SUBJECT: Audit Report on Functional and Physical Configuration Audits of the Air Force Navigation System Time and Ranging Global Positioning System (Report No. 97-011)

We are providing this audit report for information and use. This report is the fourth in a series of reports resulting from our audit of functional and physical configuration audits of Defense systems. We considered the Air Force comments on a draft of this report in preparing the final report.

As a result of the Air Force comments, we redirected Recommendation B.2. to the Director of Contracting, Air Force Navigation System Time and Ranging Global Positioning System. The comments on the draft of this report, including Recommendation B.2., conformed to the requirements of DoD Directive 7650.3 and left no unresolved issues. Therefore, no additional comments are required.

We appreciate the courtesies extended to the audit staff. Questions on the audit should be directed to Mr. John E. Meling, Audit Program Director, at (703) 604-9091 (DSN 664-9091) or Mr. Jack D. Snider, Audit Project Manager, at (703) 604-9087 (DSN 664-9087). See Appendix G for the report distribution. The audit team members are listed inside the back cover.

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Office of the Inspector General, DoD

Report No. 97-011 October 28, 1996
(Project No. 5AE-0032.03)

Functional and Physical Configuration Audits of the Air Force Navigation System Time and Ranging Global Positioning System

Executive Summary

Introduction. The Air Force Navigation System Time and Ranging Global Positioning System (the GPS) is an around-the-clock, space-based radio positioning, navigation, and time-distribution system with military and commercial applications. The GPS consists of a space segment (satellites), a ground control segment (one master control station, five monitoring stations, and four ground antennae), and user equipment (GPS receivers). With the Air Force designated the lead Service, the Army, the Navy, and the Air Force are acquiring the GPS. The GPS Joint Program Office (the Joint Program Office) plans to acquire a total of 118 satellites and 161,000 GPS receivers through FY 2016, for an estimated program cost of $12.6 billion. As of September 1996, the Joint Program Office had accepted delivery of 40 satellites and about 60,000 GPS receivers. Of the 40 satellites, 24 are operational in the GPS constellation.

Audit Objective. The primary audit objective was to evaluate the adequacy of the functional and physical configuration audit process for the acquisition of the GPS. Specifically, we evaluated whether functional and physical configuration audits verified and documented that configuration items agreed with their configuration identifications, were complete and accurate, and satisfied program requirements. We also evaluated the management control program as it related to our audit objective. The GPS Program is one of five programs included in our ongoing audit of management of functional and physical configuration audits of Defense systems.

Audit Results. Overall, the functional and physical configuration audit processes for the GPS were well managed. We noted two areas that need improvement.

o The contractor for mission-processor software used incomplete interface control documents to perform formal qualification tests on Block IIR satellite components. The Joint Program Office used those test results to certify the successful completion of functional configuration audits of Block IIR satellite components. As a result, the Joint Program Office had to establish an operational baseline and obligate an additional $15.6 million to modify satellite software, conduct additional system tests, and establish an interface control agreement (Finding A).

o For 11 of the 24 waivers, deviations, and engineering changes reviewed, the Joint Program Office did not document what cost reductions or other consideration were appropriate and did not obtain such consideration from the contractor for 6 of the 11 actions. As a result, the Joint Program Office had no assurance that it received adequate consideration for waivers and deviations approved for the miniaturized airborne GPS receivers; for engineering changes approved for the Block IIR satellite; and for future waivers, deviations, and engineering changes (Finding B).

Recommendations in this report, if implemented, will improve the functional and physical configuration audit process for the GPS and would correct the material management control weakness identified in the report (Appendix A).

Summary of Recommendations. We recommend that the GPS System Program Director require approval and certification of complete interface control documents before future critical design reviews and formal qualification tests, designate the interface control process as a high risk management control function in the management control program, and require GPS project officers and the Joint System Configuration Control Board to document their recommendations for equitable contract price adjustments or other consideration for pending and future waivers, deviations, and engineering changes. We also recommend that the Director of Contracting, Air Force Navigation System Time and Ranging Global Positioning System (the Director of Contracting, GPS), modify applicable contracts for approved pending and future waivers, deviations, and engineering changes to obtain an equitable price adjustment or other consideration after considering recommendations from the Joint Program Office.

Management Comments. We received comments on a draft of this report from the GPS System Program Director. He nonconcurred with statements in the findings; however, he concurred with the recommendations concerning approval and certification of complete interface control documents, designation of the interface control process as a high risk management control function, and documentation of project officer and Joint System Configuration Control Board recommendations. In response to the recommendation concerning the modification of applicable contracts for waivers, deviations, and engineering changes, the System Program Director indicated that the recommendation, which we had made to the System Program Director in our draft report, should be redirected to the Director of Contracting, Space and Missile Systems Center, because the Director of Contracting has the authority and responsibility for ensuring that all contract actions comply with the Federal Acquisition Regulation. Subsequent discussions with the System Program Director's designated action officer indicated that the recommendation should be redirected to the Director of Contracting, GPS, instead of Director of Contracting, Space and Missile Systems Center. See Part I for a summary of management comments responding to the recommendations, Part II for our response to the management comments addressing the findings, and Part III for the complete text of management comments.

Audit Response. The GPS System Program Director's comments were responsive to our recommendations. As a result of the System Program Director's comments on the findings and the recommendations, we made appropriate changes to the finding on managing waivers, deviations, and engineering changes; made appropriate changes to our draft report recommendation concerning the modification of applicable contracts for waivers, deviations, and engineering changes; and redirected the recommendation to the Director of Contracting, GPS. The Deputy Director of Contracting, GPS, concurred with the recommendation and provided actions taken and planned in response to the agreed-upon recommendation. Therefore, no additional comments are required in response to this report.

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Part I - Audit Results

Audit Background

This report discusses the adequacy of the functional and physical configuration audit process for the Air Force Navigation System Time and Ranging Global Positioning System (the GPS). A functional configuration audit is the formal examination of functional characteristics of test data for configuration items to verify that the items have achieved the performance specified in their functional or allocated baselines. A physical configuration audit is a formal examination to verify that configuration items "as built" conform to the technical documentation that defines those items. Appendix B provides definitions of technical terms used in this report.

The GPS is an around-the-clock, space-based radio positioning, navigation, and time-distribution system with military and commercial applications. The GPS consists of a space segment (satellites), a ground control segment (one master ground control station, five monitoring stations, and four ground antennae), and user equipment (GPS receivers). With the Air Force designated as the lead Service, the Army, the Navy, and the Air Force are acquiring the GPS. The GPS Joint Program Office (the JPO) plans to acquire a total of 118 satellites and 161,000 GPS receivers through FY 2016, for an estimated program cost of $12.6 billion. The JPO is acquiring the satellites in incremental block upgrades. Through October 1996, the JPO had accepted delivery of 41 satellites (12 Block I, 28 Block II and IIA, and 1 Block IIR) and about 60,000 GPS receivers. Of the 41 satellites, 24 are operational in the GPS constellation.

In June 1989, the JPO awarded a contract, currently valued at $846.6 million, to the Lockheed Martin Astro Space,[1] King of Prussia, Pennsylvania, for the design, production, launch, and on-orbit support of 21 Block IIR satellites. The contractor delivered the first satellite in September 1996 and is scheduled to deliver the last in October 2000. In November 1989, the JPO also awarded a contract, currently valued at $126.5 million, to Lockheed Martin Federal Systems,[2] Gaithersburg, Maryland, for software upgrades and modifications to the ground control segment software that commands and controls the satellite constellation. In June 1995, the contractor delivered the "Operational Release 6.A" version of the software. Appendix C shows a diagram of the Block IIR satellite.

From August 1990 through March 1993, the JPO awarded production contracts, currently totaling about $251.5 million, to two contractors for various versions of the GPS receivers. The contractors are SCI Technology Incorporated, Huntsville, Alabama (two- and five-channel airborne receivers and five-channel

[1] In 1993, Martin Marietta Corporation acquired General Electric Company, Astro Space Division. In 1995, Martin Marietta Corporation merged with Lockheed Corporation to form a new company called Lockheed Martin Astro Space.

[2] In 1994, Loral Corporation acquired International Business Machines, Federal Systems Sector Division. In 1996, Lockheed Martin Corporation acquired Loral Corporation and named the company Lockheed Martin Federal Systems.

shipboard receivers), and Avionics and Communications Division, Rockwell Collins, Cedar Rapids, Iowa (miniaturized airborne GPS receivers and hand-held precision lightweight GPS receivers and accessories).

Audit Objective

The audit objective was to evaluate the adequacy of the functional and physical configuration audit processes for the acquisition of the GPS. Specifically, we determined whether functional and physical configuration audits:

- o verified and documented that configuration items agreed with their configuration identifications,
- o were complete and accurate, and
- o satisfied program requirements.

We also evaluated the management control program as it related to our audit objective. The GPS Program is one of five programs included in our ongoing audit of management of functional and physical configuration audits of Defense systems. In Appendix A, we discuss the scope and methodology used to accomplish the objective as well as management controls and prior audit coverage.

Finding A. Completing Interface Control Documents

The contractor for mission-processor software used incomplete interface control documents to perform formal qualification tests on Block IIR satellite components. To certify the successful completion of functional configuration audits of Block IIR satellite components, the JPO relied on the results of the formal qualification tests, which included the incomplete interface control documents. The contractor used incomplete documents because the JPO placed a low priority on maintaining and incorporating complete interface control documents into contracts before critical design reviews and formal qualification tests. Without complete interface control documents in the formal qualification tests, the test results did not verify required satellite communication and operation capabilities. As a result of incomplete interface control documents, the JPO had to:

o obligate about $1.1 million to modify mission-processor software to include required operational requirements,

o establish an operational baseline in addition to the product baseline for mission-processor software,

o obligate about $1.3 million to incorporate operational requirements into mission-processor software production documentation,

o obligate $6.3 million for additional system tests for the modified mission-processor software, and

o obligate about $6.9 million to establish an interface control agreement between the satellite and ground-control-segment software contractors.

Configuration Audit and Interface Control Background

Configuration Management and Interface Control Requirements. The DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs," March 15, 1996, establishes requirements for configuration management and interface control. The contracts for the GPS Block IIR satellites and the operational software require the contractors to comply with interface control procedures in Military Standard 483A, "Configuration Management Practices for Systems, Equipment, Munitions, and Computer Programs," June 4, 1985, and with functional and physical configuration audit guidance in Military Standard 2167A, "Defense Systems Software Development," June 4, 1985.

DoD Regulation. The DoD Regulation 5000.2-R, subpart 4.3, "Systems Engineering," requires that program managers establish interface controls to ensure that all internal and external interface requirement changes are properly recorded and communicated to all affected configuration items.

Military Standard 483A. Military Standard 483A requires that interface control documents be:

o completed and approved by the originator in time to support the participating contractor's preliminary design review;

o released by the originating contractor, signed by the interfacing participants, and approved by the Interface Control Working Group Chairman before the critical design review; and

o completed, approved, and released before the physical configuration audit.

Military Standard 2167A. Military Standard 2167A requires the contractor to verify that:

o the configuration status accounting system provides for the traceability of all changes from the initial baseline documentation of each configuration item,

o the interface requirements for the system and its configuration items are a part of the system engineering process, and

o the various hardware and software configuration items are compatible and interoperable with the interface specified in the allocated baseline configuration documentation.

Configuration Audits. The JPO used formal qualification test results of configuration items to conduct functional configuration audits. For mission-processor software on the GPS Block IIR satellite, the JPO and Lockheed Martin Astro Space, through its subcontractor, Aerospace and Communications Division, International Telephone and Telegraph (ITT), Clifton, New Jersey, used the formal qualification test results to assist in determining whether the mission-processor software configuration item had successfully completed its functional configuration audit. To accomplish the formal qualification testing, the JPO and ITT used contractual interface control documents that showed the configuration of mission-processor software.

Completion of Functional Configuration Audits

The contractor for mission-processor software used incomplete interface control documents to perform formal qualification tests on Block IIR satellite components. The JPO used the test results to certify the successful completion

of functional configuration audits of Block IIR satellite components. The contractor used incomplete documents because the JPO placed a low priority on maintaining and incorporating complete interface control documents into mission-processor software contracts before critical design reviews and formal qualification tests.

In June 1989, the JPO awarded Lockheed Martin Astro Space the contract for the design, production, launch, and on-orbit support of the Block IIR satellites. At that time, the contract showed the status of Interface Control Document (ICD) 401 as to-be-determined. ICD 401 is to show the required interface configuration for mission-processor software to communicate successfully between the satellite and the ground control segment. In June 1994, Lockheed Martin Astro Space, through ITT, conducted the formal qualification tests to meet the Block IIR satellite delivery schedule. Because of the low priority for completing interface control documents, the JPO released an incomplete version of ICD 401 to ITT for incorporation into the contract and for use during the test. Therefore, ITT had to base the test results on interface control assumptions that simulated the requirements of ICD 401.

From November 1994 through February 1995, the JPO conducted interface initialization tests between the "Operational Release 6.A" version of the ground control segment software developed by Lockheed Martin Federal Systems and the Block IIR satellite space telecommunications simulator. The simulator included mission-processor software that ITT designed. The JPO conducted the test to ensure that the interface between the ground control segment software and the Block IIR satellite functioned properly before satellite launch. The test results showed that the space telecommunications simulator and the ground control segment could not communicate in accordance with current interface control document requirements. The communications failure occurred because the JPO Interface Control Working Group placed a low priority on maintaining and incorporating in the contract with Lockheed Martin Astro Space a complete ICD 401 before the critical design reviews and formal qualification tests for mission-processor software.

Effect of Using Incomplete Interface Control Documents

Because the JPO had not completed the interface control documents in a timely manner, it had to obligate an additional $1.1 million to Lockheed Martin Astro Space to make 32 modifications to the product baseline for mission-processor software. The modifications were necessary to enable the mission-processor software to meet operational requirements. Also, the contractor had to establish an operational baseline in addition to the product baseline to enable mission-processor software to meet operational requirements. As a result of the modifications, the JPO had to obligate an additional $1.3 million to incorporate the updated operational requirements into mission-processor software baseline documentation. In September 1996, the JPO obligated another $6.3 million to Lockheed Martin Astro Space to perform additional system tests for the modified mission-processor software.

In addition to the $8.7 million for modifications discussed above, the JPO had to obligate about $6.9 million to establish a contractual agreement between ITT and Lockheed Martin Federal Systems, which developed the "Operational Release 6.A" version of the ground control segment software. The contractual agreement established communication channels through which the contractors held interface control discussions to resolve problems before future formal qualification tests and functional configuration audits.

Conclusion

Normal satellite constellation operations depend on complete interface control document specifications to successfully accomplish their intended mission. Without complete interface control documents, satellite operators would not be able to effectively control the operation of the navigational systems within the constellation of satellites on-orbit, the ground control segment, and the receivers. Further, the present emphasis within DoD is to upgrade its current weapon systems instead of procuring new systems. Therefore, the JPO must maintain complete interface control documents for normal satellite constellation operations, including satellite, ground control, and receiver communications, as well as for configuration item upgrades, future critical design reviews, and formal qualification testing for configuration items used to support the successful accomplishment of functional configuration audits.

To improve interface communications between the GPS satellite and the ground control station, the JPO established a contractual agreement between the GPS contractors. Also, the JPO established an integrated product team to discuss interface and other issues. The JPO incorporated the agreement and integrated product team approach into the Block IIF GPS contract awarded in April 1996.

However, the JPO should further strengthen the interface control process because of the potential effects of failure in communications between the satellites and ground control stations. The JPO Interface Control Working Group should specifically approve and certify complete interface control documents before future critical design reviews and formal qualification tests. Also, the Systems Engineering and Integration Division, JPO, should designate the interface control process a high risk management control function and review the process as part of the management control program.

Management Comments on the Finding and Audit Response

The GPS System Program Director commented on the finding. See Appendix D for a summary of the comments and the audit response.

Recommendations and Management Comments

A. We recommend that the System Program Director, Navigational System Time and Ranging Global Positioning System:

1. Require the Joint Program Office Interface Control Working Group to approve and certify complete interface control documents before future critical design reviews and formal qualification tests.

Management Comments. The GPS System Program Director (the Director) concurred and agreed to implement the recommendation as stated. Further, the Director stated that JPO Operating Instruction 800-2, "Configuration Control Boards (CCB)," May 1993, is being revised to address the certification of the interface control documents and to ensure that consideration is addressed at the configuration control boards. The Director stated that the revised JPO Operating Instruction 800-2 should be approved by November 26, 1996.

2. Designate the interface control process as a high risk management control function to be reviewed as part of the Joint Program Office management control program and conduct management control reviews of the interface control process.

Management Comments. The Director concurred with the recommendation, stating that the interface control process has been designated a high risk management control function and will be reviewed as part of the GPS management control program. Further, the Director stated that the revised JPO Operating Instruction 800-2 will also address the need for the JPO Executive Steering Committee to review the interface control process on an annual basis.

Finding B. Managing Waivers, Deviations, and Engineering Changes

For 11 of the 24 waivers, deviations, and engineering changes reviewed, the JPO did not document what cost reductions or other consideration were appropriate and did not obtain such consideration from the contractor for 6 of the 11 actions. That condition occurred because:

o the GPS project officers did not include recommended contractual consideration in their briefing charts to the Joint System Configuration Control Board (Control Board);

o the Control Board did not document its recommendations for contract adjustments considered appropriate for proposed waivers, deviations, and engineering changes;

o the procuring contracting officer (contracting officer) did not request recommendations for equitable contract price adjustments or other consideration from the Control Board; and

o the contracting officer did not routinely modify the applicable contract to obtain an equitable price adjustment or other consideration.

As a result, the JPO had no assurance that it received adequate consideration for waivers and deviations approved for the miniaturized airborne GPS receivers; for engineering changes approved for the Block IIR satellite; and for future waivers, deviations, and engineering changes.

Waivers, Deviations, and Engineering Changes

Federal Acquisition Regulation Requirements. The Federal Acquisition Regulation, subpart 46.407, "Nonconforming Supplies or Services," allows the contracting officer to accept nonconforming supplies when doing so is in the Government's best interest. The contracting officer can accept the nonconforming supplies based on:

o advice from technical experts that the item is safe to use and will perform its intended purpose;

o information regarding the nature and extent of the nonconformance;

o a request from the contractor for acceptance of the item;

o a recommendation for acceptance or rejection with supporting documentation; and

o contract adjustments considered appropriate, including any adjustment offered by the contractor.

The cognizant contract administration office, or other Government organization directly involved, provides the written information to the contracting officer. The Federal Acquisition Regulation subpart also requires the contracting officer to modify the contract for which nonconforming items are accepted to provide for an equitable price reduction or other consideration. The Federal Acquisition Regulation does not define "other consideration." For purposes of this audit, we define "other consideration" as compensation or services that the contractor gave to the Government in exchange for approving the waivers, deviations, and engineering changes.

Military Standards Requirements. The GPS contracts for the Block IIR satellite and the miniaturized airborne GPS receiver refer to Military Standard 480A, "Configuration Control-Engineering Changes, Deviations, and Waivers," April 12, 1978, and Military Standard 480B, "Configuration Control-Engineering Changes, Deviations, and Waivers," July 15, 1988, respectively. The military standards require that a contractor initiate requests for waivers, deviations, and engineering changes when contract items have not been, or will not be, built according to contract requirements. The request must include any estimated price adjustment to the contract or, if no change in contract price is warranted, the contractor must explain the lack of any price adjustment. The military standards also require that the applicable Defense Contract Management Command (DCMC) office indicate its recommended technical approval or disapproval of waivers, deviations, and engineering change proposals (ECPs) to the program office.

Configuration Management Plan. The JPO Configuration Management Plan, April 14, 1993, assigns the Control Board responsibility for reviewing waivers, deviations, and engineering change proposals. The Control Board is composed of personnel from the JPO. The Control Board evaluates and approves or disapproves contractor requests for major and critical waivers and deviations, and class I ECPs that affect configuration item functional, allocated, or product baselines.

Operating Instruction. The JPO Operating Instruction 800-2, "Configuration Control Boards," May 1993, establishes procedures for the Control Board. The instruction requires project officers to use standard briefing charts to present proposed waivers, deviations, or ECPs to the Control Board. In the charts, the project officers are to include technical factors to be considered in the evaluation process, such as impacts on safety; software and hardware interfaces; logistics; and form, fit, and function. However, the instruction did not require project officers to address contract consideration in the charts. The Control Board is to notify the contracting officer of approval or disapproval of the waiver, deviation, or ECP after completing its review of the submitted charts. The contracting officer then provides written direction to the contractor indicating formal approval or disapproval and any conditions deemed appropriate.

Advance Change Adjustment Agreement Clause. The JPO included an advance change adjustment agreement ("swing") clause in its contracts that allows the JPO and contractors to agree to changes to the contract without contract price adjustments when proposed changes do not exceed a specified dollar amount and the proposed change does not affect contract delivery or performance schedules. The specified dollar amounts for waivers, deviations, and ECPs that do not require contract price adjustments for the GPS receivers and Block IIR satellite contracts are $15,000 and $100,000, respectively.

Analysis of Waivers, Deviations, and Engineering Changes

For 11 of the 24 waivers, deviations, and engineering changes reviewed, the JPO did not document what cost reductions or other consideration were appropriate and did not obtain such consideration from the contractor for 6 of the 11 actions.

As of January 1996, Avionics and Communications Division, Rockwell Collins, (Rockwell) had submitted seven waivers and deviations for the miniaturized airborne GPS receivers on contract F04701-91-C-0003, and Lockheed Martin Astro Space (Astro Space) had submitted 39 class I ECPs for the Block IIR satellite on contract F04701-89-C-0073 for JPO review. To determine whether the JPO had complied with waiver, deviation, and ECP processing requirements, we reviewed all seven waivers and deviations (Appendix E) and a judgmental sample of 17 approved ECPs out of the 39 class I ECPs (Appendix F).

Waivers and Deviations Reviewed. For the seven waivers and deviations submitted, the Control Board approved four waivers and two deviations, and Rockwell withdrew one waiver. Rockwell did not propose equitable contract price adjustments or other consideration for the waivers and deviations. Further, the GPS project officers did not include recommendations for contract consideration in their briefing charts, and the Control Board did not document for the contracting officer its recommendations for contract consideration.

With the exception of Waiver W004R3, the contracting officer did not modify the applicable contract to obtain an equitable price adjustment or other consideration for the waivers and deviations granted. The contracting officer held discussions with Rockwell to obtain other consideration from Rockwell for Waiver W004R3. However, the contracting officer did not document the basis for the consideration.

Engineering Changes Reviewed. Of the 17 class I ECPs that the Control Board approved, seven involved changes that reduced contract requirements. Those ECPs were numbers 8, 10, 14, 15, 28, 38, and 39. With the exception of ECPs 15 and 38, the contracting officer did not obtain a documented recommendation from project officers or the Control Board supporting the adequacy of the consideration to be obtained from Astro Space for approving the ECPs. For ECP 15, the Control Board determined that no consideration

was warranted because the ECP eliminated an unneeded requirement. For ECP 38, the contracting officer conducted and documented a cost and benefit analysis to support the adequacy of the consideration obtained. For ECP 14, the contracting officer did not obtain equitable contract price adjustments or other consideration when modifying the Block IIR satellite contract. The contracting officer stated that she obtained other consideration for the ECP by accepting consideration that Astro Space offered in a November 2, 1993, letter; however, she did not modify the contract to identify the consideration obtained from Astro Space.

Further, for ECPs 8, 10, 28, and 39, the contracting officer and JPO technical personnel believed that the contracting officer did not need to obtain consideration because either the ECPs eliminated an unneeded requirement or the estimated value of savings of each ECP fell below the threshold of the advance change adjustment agreement clause in contract F04701-89-C-0073. However, neither the contracting officer nor the JPO technical personnel could provide briefing charts from the project officers or Control-Board-documented recommendations stating that consideration was not to be requested from the contractor. Subsequently, the GPS System Program Director provided documentation invoking the advance change adjustment agreement clause.

Effect on Waiver, Deviation and Engineering Change Review and Approval Process

Because the Control Board did not document its assessments and recommendations concerning the need for and amount of equitable contract price adjustments or other consideration when evaluating proposed waivers, deviations, and engineering changes, the contracting officer did not have a basis for determining whether the contractors were proposing adequate consideration for the waivers, deviations, and engineering changes. Further, the contracting officer, by not documenting the applicable contracts as required, had not assured the JPO that it obtained adequate consideration from the contractors for granting the waivers, deviations, and engineering changes.

Conclusion

To ensure that the JPO obtains equitable price adjustments or other consideration for waivers, deviations, and engineering changes, the GPS project officers and the Control Board should document their assessments and recommendations for contract adjustments considered appropriate for proposed waivers, deviations, and engineering changes, and the contracting officer should modify the applicable contracts, after considering the GPS project officers and the Control Board recommendations, to show the equitable price adjustment or other consideration obtained.

Management Comments on the Finding and Audit Response

The GPS System Program Director commented on the finding. See Appendix D for a summary of the comments and the audit response.

Recommendations, Management Comments, and Audit Response

Redirected Recommendation. As a result of the GPS System Program Director comments, we redirected Recommendation B.2. to the Director of Contracting, Air Force Navigation System Time and Ranging Global Positioning System (the Director of Contracting, GPS).

B.1. We recommend that the System Program Director, Navigation System Time and Ranging Global Positioning System, revise Joint Program Office Operating Instruction 800-2, "Configuration Control Boards," May 1993, to require that:

a. The Navigation System Time and Ranging Global Positioning System project officers include recommended equitable price adjustments or other consideration for pending and future waivers, deviations, and engineering changes in their briefing charts to the Joint System Configuration Control Board.

b. The Joint System Configuration Control Board document its recommendations for contract adjustments considered appropriate for pending and future waivers, deviations, and engineering changes and provide its recommendations to the procuring contracting officer.

Management Comments. The GPS System Program Director concurred with Recommendations B.1.a. and B.1.b., stating that JPO Operating Instruction 800-2 is being revised to ensure that:

o the Control Board discusses consideration,

o the Control Board minutes are documented, and

o all resulting contracting officer modifications and correspondence are made part of the Control Board files.

The GPS System Program Director stated that the revised JPO Operating Instruction 800-2 should be approved by November 26, 1996.

B.2. We recommend that the Director of Contracting, Navigation System Time and Ranging Global Positioning System, modify the applicable contracts for approved pending and future waivers, deviations, and engineering changes to obtain an equitable price adjustment or other consideration in accordance with the Federal Acquisition Regulation, subpart 46.407, "Nonconforming Supplies or Services," after considering documentation resulting from Recommendation B.1.

Management Comments. The GPS System Program Director nonconcurred with the draft audit report recommendation that he direct the contracting officer to modify the applicable contracts for approved pending and future waivers, deviations, and engineering changes to obtain an equitable price adjustment or other consideration in accordance with the Federal Acquisition Regulation, subpart 46.407. The Director stated that the Director of Contracting, Space and Missile Systems Center, has the authority and responsibility for ensuring that all contract actions comply with the Federal Acquisition Regulation.

Subsequent discussions with the GPS System Program Director's designated action officer indicated that the recommendation should be redirected to the Director of Contracting, GPS, instead of the Director of Contracting, Space and Missile Systems Center. The Deputy Director of Contracting, GPS, concurred with the redirected recommendation and stated that JPO Operating Instruction 800-2 will be modified by November 26, 1996, to require the Control Board to address the issue of major versus minor nonconformance as part of the official Control Board files.

Audit Response. In response to management comments, we redirected our recommendation to the Director of Contracting, GPS, and made appropriate changes to the recommendation.

Part II - Additional Information

Appendix A. Scope and Methodology

This appendix discusses the scope and methodology used to accomplish the objective as well as management controls and prior audit coverage.

Scope

We conducted this audit from January through May 1996 and reviewed data dated from June 1989 through May 1996. To accomplish the audit objective, we examined the following contracts, including statements of work, contract data requirements lists, contract line items, and related correspondence:

o contract F04701-89-C-0073, valued at about $846.6 million, with Lockheed Martin Astro Space, King of Prussia, Pennsylvania, for the design, production, launch, and on-orbit support of 21 Block IIR satellites;

o contract F04701-90-C-0009, valued at about $126.5 million, with Lockheed Martin Federal Systems, Gaithersburg, Maryland, for software upgrades and modifications to the ground control segment software;

o production contract F04701-90-C-0086, valued at about $63.7 million, with SCI Technology Incorporated, Huntsville, Alabama, for two- and five-channel airborne receivers and five-channel shipboard receivers; and

o production contracts F04701-91-C-0003 and F04701-93-D-0001, valued at about $80.3 million and $107.5 million, respectively, with Avionics and Communications Division, Rockwell Collins, Cedar Rapids, Iowa, for miniaturized airborne GPS receivers and hand-held precision lightweight GPS receivers and accessories.

Further, to accomplish the audit objective, we:

o reviewed the GPS Configuration Management Plan and other program planning documents for each of the GPS program segments, including the critical design review minutes;

o reviewed engineering change notices, ECPs, contract modifications, deficiency reports, waivers, deviations, and Air Force configuration directives;

o reviewed documentation for functional and physical configuration audits on the Block IIR satellites, the "Operational Release 6.A" version of the

software for the Block IIR satellites, and the GPS receivers under contracts F04701-90-C-0086 and F04701-91-C-0003 and action items generated during those audits;[1]

o reviewed warranty claim data and operational test reports for the precision lightweight GPS receiver; and

o discussed issues relating to the effectiveness of the functional and physical configuration audit process for the GPS hardware and software with personnel from the Office of the Secretary of Defense and with program, technical, and contracting officials at the GPS Joint Program Office, the Air Force Space Command, DCMC offices, and four contractors.

Methodology

We conducted this program audit in accordance with auditing standards issued by the Comptroller General of the United States, as implemented by the Inspector General, DoD, and accordingly included such tests of management controls as we deemed necessary. We did not rely on computer-processed data to develop conclusions on this audit. Technical experts from the Technical Assessment Division of the Analysis, Planning, and Technical Support Directorate, Inspector General, DoD, assisted in the review of functional and physical configuration audit documentation for the GPS.

Organizations and Individuals Visited or Contacted

We visited or contacted individuals and organizations within the DoD and Aerospace Corporation, International Telephone and Telegraph, and Lockheed Martin. Further details are available on request.

Management Control Program

Requirement for Management Control Review. DoD Directive 5010.38, "Internal Management Control Program," April 14, 1987,[2] requires DoD

[1]We did not review documentation for functional and physical configuration audits for configuration items in the Block IIR satellite that were under the cognizance of the Department of Energy.

[2]DoD Directive 5010.38 has been revised as "Management Control (MC) Program," August 26, 1996. The audit was performed under the April 1987 version of the Directive.

managers to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of those controls.

Scope of Review of Management Control Program. We limited our review because of relevant coverage in Inspector General, DoD, Report No. 96-028, "Implementation of the DoD Management Control Program for Major Defense Acquisition Programs," November 28, 1995. The report discusses the effectiveness of the management control program that the Defense Acquisition Executive and the Component Acquisition Executives used for major Defense acquisition programs. The report concludes that the acquisition community had not effectively integrated DoD Management Control Program requirements into its management assessment and reporting processes. As a result of the report recommendations, the Under Secretary of Defense for Acquisition and Technology integrated DoD Directive 5010.38 requirements into the March 15, 1996, revisions to DoD Directive 5000.1, "Defense Acquisition," and DoD Regulation 5000.2-R. Acquisition managers are now to use program cost, schedule, and performance parameters as control objectives to implement the DoD Directive 5010.38 requirements. The managers are to identify material weaknesses through deviations from approved acquisition program baselines and exit criteria in the "Defense Acquisition Executive Summary" report. Accordingly, we limited our review to management controls of the functional and physical configuration audit process at the GPS Joint Program Office; DCMC Lockheed Martin-Delaware Valley, King of Prussia, Pennsylvania; DCMC Springfield, New Jersey; and DCMC Baltimore, Maryland. Those DCMC offices provide contract administration services for the GPS and are field organizations of the Defense Contract Management District East, Boston, Massachusetts.

Adequacy of Management Controls. We identified a material management control weakness for the GPS configuration control process as defined by DoD Directive 5010.38. Management controls for the GPS configuration control process were not adequate to ensure that interface control documents contained complete GPS interface control requirements for conducting formal qualification tests on Block IIR satellite components. Also, the JPO did not always obtain consideration for waivers, deviations, and engineering changes and document the reasons for not obtaining consideration. Because of the potentially significant consequences of a failure in communications between the satellites and ground control stations, the failure to maintain complete interface control documents is a material management control weakness for the JPO. Recommendation A., if implemented, will ensure that interface control documents used in critical design reviews, formal qualification tests, normal operations, and configuration item upgrades contain complete GPS interface control requirements. Recommendation B., if implemented, will ensure that recommendations for equitable contract price adjustments or other consideration for pending and future waivers, deviations, and engineering changes are documented and applicable contracts are modified. We will provide a copy of this report to the senior official responsible for management controls in the Office of the Assistant Secretary of the Air Force (Financial Management and Comptroller).

Adequacy of Management's Self-Evaluation. The JPO designated each of its 11 divisions as assessable units. The functional and physical configuration audit process was part of the Systems Engineering and Integration Division assessable unit. The JPO conducted a risk assessment of the Systems Engineering and Integration Division assessable unit and rated the unit as low risk. Consequently, the JPO did not conduct a management control review on the functional and physical configuration audit process. The Defense Contract Management District East did not designate functional and physical configuration audits as part of an assessable unit; therefore, the DCMC subordinate offices did not conduct assessments of the configuration audit process.

Prior Audit Coverage

During the last 5 years, the General Accounting Office; the Office of the Inspector General, DoD; and the Air Force Audit Agency have not issued reports on the GPS addressing functional and physical configuration audit issues.

Appendix B. Definitions of Technical Terms

Action Item. A document requiring correction of a deficiency in the functional characteristics or technical documentation associated with a configuration item resulting from a functional or physical configuration audit.

Allocated Baseline. The initially approved documentation describing a configuration item's functional and interface characteristics that are allocated from those of a higher level of configuration item. The allocated baseline consists of the development specifications that define functional requirements for each configuration item. The program office normally establishes the allocated baseline at the preliminary design review, but no later than the critical design review.

Configuration Control Board. A Government or contractor board composed of technical and administrative representatives who recommend approval or disapproval of proposed engineering changes to a configuration item's current approved configuration documentation. The board also recommends approval or disapproval of proposed waivers and deviations from a configuration item's current approved configuration documentation.

Configuration Identification. The process of establishing and describing the contractual baselines and related configuration items.

Configuration Item. An aggregation of hardware, firmware, or computer software or any of their discrete portions that satisfies an end use function and is designated by the Government for separate configuration management.

Configuration Management. Technical and administrative direction and surveillance actions taken to identify and document functional and physical characteristics of an item, to control changes to a item and its characteristics, and to record and report change processing and implementation status.

Configuration Management Plan. A document defining how configuration management will be implemented, including policies and procedures, for a particular acquisition or program.

Critical Design Review. A review conducted to:

o determine that the detailed design satisfies performance and engineering requirements of the development specification;

o establish the detailed design compatibility requirements of the development specification;

o establish the detailed design compatibility among the item and other items of equipment, facilities, computer program, and personnel;

- o assess producibility and risk areas; and
- o review the preliminary product specifications.

Deviation. A written authorization, granted before the manufacture of an item, to depart from a particular performance or design requirement of a specification, drawing, or other document for a specific number of units or a specified period.

Engineering Change Proposal. A contractor document that describes and justifies a proposed engineering change and applicable costs and that is submitted to the Government for approval or disapproval.

Formal Qualification Test. A system level test to verify that the configuration item meets the performance requirements of the system specification.

Functional Baseline. Documentation describing a system's or a segment's functional characteristics and the verification required to demonstrate the achievement of those specified functional characteristics. The required system or segment specification establishes the functional baseline.

Functional Configuration Audit. A formal examination of functional characteristics of test data for configuration items to verify that the item has achieved the performance specified in its functional or allocated identification. If the item was developed at Government expense, the functional configuration audit must be performed before acceptance of the item. The functional configuration audit must be performed on a prototype or the configuration to be released for production of the operational quantities.

Interface Control Document. A technical agreement required to successfully develop interoperable configuration items designed independently by technical engineers.

Low-Rate Initial Production. The production of a system in limited quantity to provide articles for operational test and evaluation and to establish an initial production rate sufficient to lead to full-rate production upon successful completion of operational testing.

Mission-Processor Software. Software that allows the GPS satellite to process and transmit navigational data to and from the master ground control station.

Operational Baseline. The product baseline as updated with subsequent software modifications to make the product baseline satisfy operational requirements for current and future satellite operations.

Physical Configuration Audit. A formal examination to verify that the configuration item "as built" conforms to the technical documentation that defines the item. The physical configuration audit includes a detailed audit of engineering drawings, specifications, technical data, and tests used in production of the item. The physical configuration audit may be conducted on the first full-rate production or the first low-rate initial production item.

Approval by the Government program office of the product specification and satisfactory completion of the physical configuration audit establishes the product baseline. A contractor is required to process all subsequent changes to the product baseline by the formal engineering change proposal process.

Preliminary Design Review. A review conducted for each configuration item to evaluate the progress, technical adequacy, and risk resolution of the selected design approach; to determine its compatibility with performance and engineering requirements of the development specification; and to establish the existence and compatibility of the physical and functional interfaces among the item and other types of equipment, facilities, computer programs, and personnel. After successful completion of the review, the preliminary design is made into a detailed design.

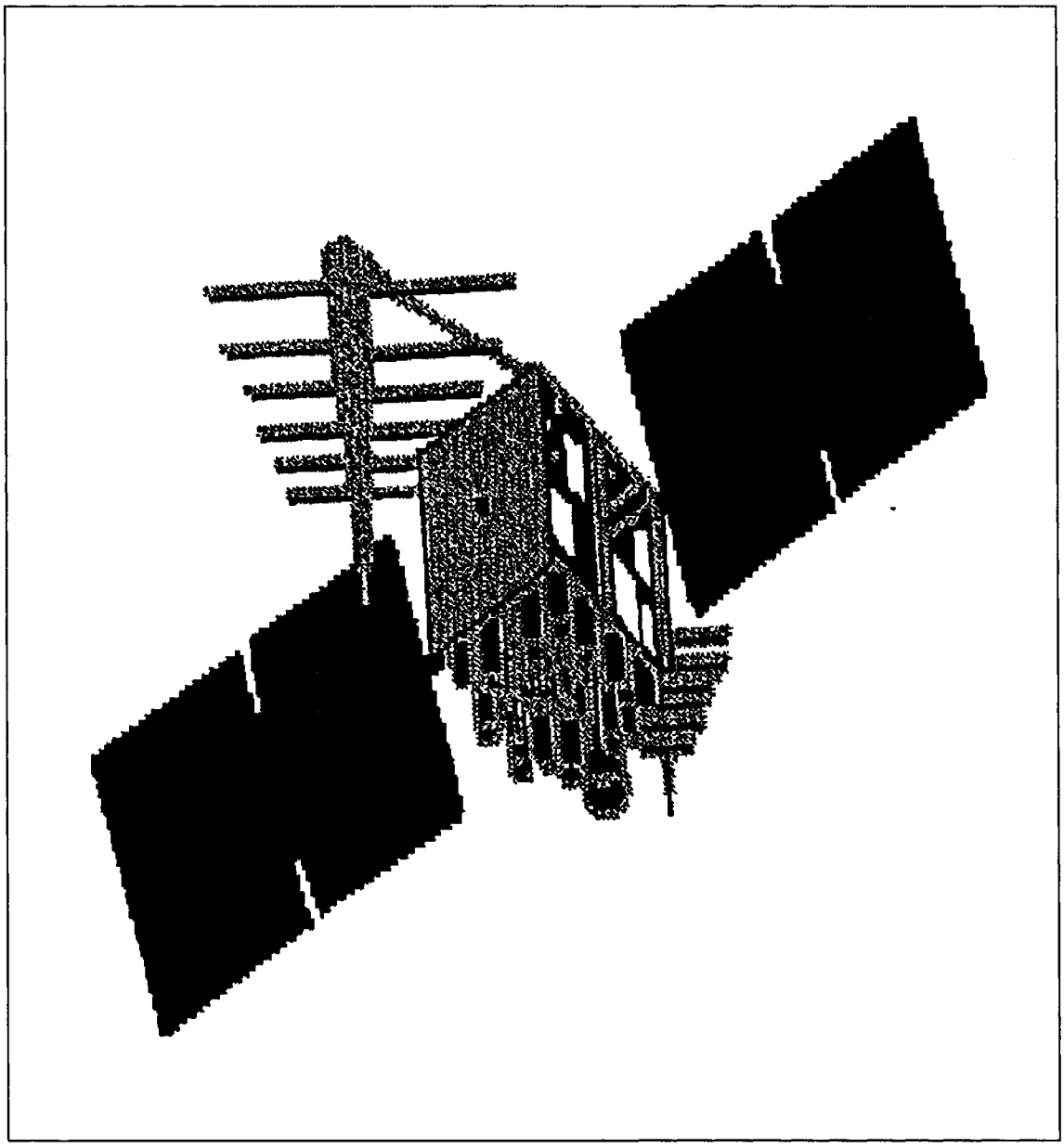
Product Baseline. The baseline established at the physical configuration audit that includes product, process, and material specifications and engineering drawings. Approval of the configuration item product specification by the Government program office and satisfactory completion of the physical configuration audit establish the product baseline.

Prototype. An original or model on which a later item is formed or based.

Specifications. A document intended primarily for use in procurement that clearly and accurately describes the essential technical requirements for items, materials, or services, including the procedures for determining whether the requirements have been met.

Waiver. A written authorization to accept a configuration item that departs from specified requirements. The item may be considered suitable "as is" or after rework by an approved method.

Appendix C. Navigation System Time and Ranging Global Positioning System Block IIR Satellite



Appendix D. Audit Response to the System Program Director, Navigation System Time and Ranging Global Positioning System, Comments Concerning the Findings

Our detailed response to the GPS System Program Director (the Director) comments on statements in the draft report regarding Findings A and B follows. Also included are the Deputy Director of Contracting, GPS, comments concerning documentation and contract modifications for engineering change proposals.

Management Comments on Finding A, Completing Interface Control Documents. The Director nonconcurred with the finding, stating that the draft report incorrectly stated that the mission-processor software used incomplete interface control documentation to perform functional qualification tests. Further, the Director did not believe that:

o an additional $9.3 million was required to modify the software and establish an interface control agreement and

o the GPS Joint Program Office had to conduct additional qualification testing to establish an operational baseline.

The Director stated that the GPS Configuration Control Board (the Control Board) baselined and approved ICD 401 at the time of the formal qualification test for the mission data unit that includes the mission-processor software. He further stated that the disconnects between the mission data unit and the "Operational Release 6.A" version of the ground control segment software occurred because of different interpretations of ICD 401. To achieve the required performance, he stated that the JPO had to hold both contractors contractually responsible for the complete integration of the mission data unit and the ground control segment software. Accordingly, both contractors had to do testing and analysis to fully understand the technical design of the interface and to reduce program risk. In reference to the additional testing performed, he stated that it was not additional qualification testing but system level testing required for developmental test and evaluation. Further, he stated that the ICD 401 documentation was complete based on the contractual situation at the time. He also stated that the JPO took steps to enhance the connection between the two contractors to reduce major schedule risks and cost impacts.

Audit Response. Even though the Control Board baselined and approved ICD 401 at the time of the formal qualification tests, ICD 401 was not complete because it did not include the required interface testing requirements for the mission data unit and the ground control segment software. Consequently, the contractors had to make interpretations of the interface testing requirements that resulted in disconnects between the mission data unit and the ground control segment software. Similarly, the contractors' ability to integrate the mission data unit and the ground control segment software to achieve the required

performance as contractually required was dependent on the JPO, the program integrator. As program integrator, the JPO was responsible for ensuring that the contractors' interpretations of ICD 401 satisfied the interface testing requirements and objectives. As stated in the report, however, the JPO did not recognize until after the critical design reviews and the formal qualification tests that the contractors had different interpretations of ICD 401. Consequently, the space telecommunications simulator and the ground control segment could not communicate in accordance with current interface control document requirements. To correct the situation, the JPO had to make modifications to the mission-processor software and establish communication channels through which the contractors subsequently held interface control discussions to integrate the system.

In reference to the additional testing, we modified the report to state that the JPO requested Lockheed Martin Astro Space (Astro Space) to conduct additional system testing instead of additional formal qualification tests. Further, since our draft report, the JPO obligated an additional $6.3 million to Astro Space to perform the additional system tests for the modified mission-processor software. The obligation occurred on September 27, 1996. Consequently, we modified the report accordingly.

Management Comments on Finding B, Managing Waivers, Deviations, and Engineering Changes. The Director nonconcurred with the finding statements concerning adequate consideration for waivers and deviations, written documentation and contract modifications for engineering change proposals, and consideration addressed at the Control Board.

Consideration for Waivers and Deviations. The Director stated that the JPO did obtain consideration and that Avionics and Communications Division, Rockwell Collins, (Rockwell) did propose equitable contract price adjustments or other consideration for waivers and deviations. The Director added that the auditors were provided verbal and written information that indicated that adequate consideration was offered and received for all waivers and deviations for the miniaturized airborne GPS receivers.

Audit Response. We disagree that the JPO did obtain consideration and that Rockwell did propose equitable contract price adjustments or other consideration for waivers and deviations. During our audit, the JPO provided us with a document, "Deviation/Waiver Consideration Justification," undated, that addressed the consideration offered by Rockwell and received by the Government for the waivers and deviations in question. The JPO prepared the document in response to the audit. The document described the waivers and deviations and addressed consideration derived following Rockwell's initial proposals for the waivers and deviations. However, as discussed in the report, the procuring contracting officer (contracting officer) did not modify the applicable contract to obtain and document consideration for the approved waivers and deviations, except for Waiver W004R3.

In response to the Director's comments concerning whether Rockwell proposed equitable contract price adjustments or other consideration, the JPO official files indicated that Rockwell did not propose equitable contract price adjustments or

other consideration in its waiver and deviation proposals. For example, after reviewing Rockwell's proposal for Deviation D002, JPO officials stated that "Consideration should be requested. The contractor has already been paid a great deal of money to perform these measures." For Deviation D003, JPO officials questioned, "What consideration is R/C [Rockwell Collins] to provide to the government?" For Waiver W001, JPO officials questioned and stated, "Are we going to request for [sic] any consideration? I need to document in my files if it was even considered." Similar statements are in the files for Waivers W004 and W005.

Accordingly, written information in the JPO files did not indicate that the contractor offered and the Government received adequate consideration for all waivers and deviations for the miniaturized airborne GPS receivers.

Documentation and Contract Modifications for Engineering Change Proposals. The Director acknowledged that the Control Board records did not initially discuss the consideration for ECPs 8, 10, 28, and 39, but stated that documentation was produced during the auditors' visit and added to the official Control Board records. He also stated that the documentation indicated that the cost of the ECPs was below the threshold of the advance change adjustment agreement clause.* For ECP 14, the Director disagreed that a contract modification was required. He stated that the consideration that was received was appropriately documented in a contractual letter to Astro Space. The Director stated that the Federal Acquisition Regulation, subpart 46.407, states that a contract modification is required for documentation of consideration if the supplies were accepted as a result of a major nonconformance. The Director stated that ECP 14 was not a major nonconformance as defined by the DoD Federal Acquisition Regulation Supplement, subpart 246.407, "Nonconforming Supplies or Services," stating that a "Major nonconformance is a nonconformance, other than critical, that is likely to result in failure, or to materially reduce the usability of the supplies or services for their intended purpose." Therefore, the Director concluded that a contract modification was not required because the nonconformance was considered minor.

Audit Response. At the time of our audit, the JPO prepared and provided us with "memorandums for the file" addressing ECPs 8, 10, and 28 but not ECP 39. Of the three memorandums provided, only the memorandum for ECP 28 addressed the advance change adjustment agreement clause. The memorandum stated that "costs were perceived to be minimal (that is, much below the value of the 'Swing Clause' [advance change adjustment agreement clause])." However, neither the memorandum nor any documentation in the official Control Board records indicated an estimate of the ECP value.

For ECP 8, the memorandum discussed the engineering change and stated that the contractor performed a full-scale mock-up test at no cost to the Government to verify an analysis of the engineering change on the satellites. The memorandum stated that the mock-up test could have been but was not

*See page 11 of this report for a discussion of the advance change adjustment agreement clause.

documented as consideration to the Government for the engineering change. However, the memorandum did not address the cost of the test or the advance change adjustment agreement clause.

For ECP 10, the memorandum stated that the engineering change improved the operation of the ground control segment and reduced the segment's implementation costs. The memorandum stated that, in light of those benefits, the JPO decided that the Government was not due consideration. However, the memorandum did not address the cost of the improvements, the reduced cost, or the advance change adjustment agreement clause.

As stated in the report, neither the contracting officer nor the JPO technical personnel could provide briefing charts from the project officers or Control-Board-documented recommendations stating that consideration was not to be requested from the contractor for ECPs 8, 10, 28, and 39. However, because the Director stated in his comments that the cost of those engineering changes was below the threshold of the advance change adjustment agreement clause, we revised the finding accordingly. By invoking the advance change adjustment agreement clause, the contracting officer does not need to modify the contract associated with the engineering changes as long as the JPO and the contractor agree to the changes and the JPO properly documents the agreement.

In reference to ECP 14, the ECP was a major nonconformance, requiring a contract modification. The ECP changed the number of circuit wires from two to one that carried normal and redundant electrical signals for GPS Block IIR satellite components. According to Astro Space engineering personnel, the ECP was needed to avoid redesign of numerous GPS Block IIR satellite components because the original requirements stated that redundant circuit wires or signals shall not be routed through the same connector. Without approval of the ECP, redesign of the components would have severely impacted program schedule and cost. Further, the JPO files indicated that the Control Board recommended approval of ECP 14 contingent upon additional testing to verify proper operation of the affected components. The Control Board approved the ECP with the provision that Astro Space conduct additional space-vehicle system-level tests and analyses to ensure that the ECP did not compromise reliability. Without approval of the ECP, the Control Board concluded that a major GPS Block IIR satellite redesign would be required.

The contracting officer modified the Astro Space contract to include ECP 14 along with the additional system-level tests and analyses that the Control Board recommended. The modification also required the contractor to provide the results of the tests and analyses to the Government for review and verification to ensure that the contractor carried out proper verification testing after implementation of ECP 14. In the modification, however, the contracting officer did not obtain consideration from Astro Space for approving ECP 14. Instead, the contracting officer issued a contractual letter to Astro Space. The contracting officer's modification of the contract to include ECP 14 along with the additional system-level tests and analyses indicates that the nonconformance was not considered minor. Therefore, the modification should have included consideration from the contractor for the Government's approval of ECP 14.

Consideration Addressed at the Control Board. The Director stated that, although JPO intends to revise JPO Operating Instruction 800-2, "Configuration Control Boards (CCB)," May 1993, to address consideration, the Control Board does not have the responsibility or authority to approve the amount of consideration or the amount of an equitable adjustment for ECPs. Specifically, the contracting officer has the responsibility and authority to determine what is a fair and reasonable settlement of any contract action, whether cost or no cost.

Audit Response. We did not intend to imply that the Control Board had the responsibility or authority to approve the amount of consideration or the amount of an equitable adjustment for ECPs. We intended to state that the Control Board should provide the contracting officer documented assessments and recommendations for equitable contract adjustments or other consideration for proposed engineering changes for the contracting officer's use in determining a fair and reasonable settlement, whether cost or no cost. We have clarified the report to that effect.

Deputy Director of Contracting, GPS, Response Concerning Engineering Change Proposals. As discussed in Finding B, we redirected Recommendation B.2. to the Director of Contracting, GPS. The Deputy Director of Contracting, GPS, (the Deputy Director) concurred with the recommendation and provided additional comments concerning documentation and contract modifications for engineering change proposals.

Deputy Director Comments. Concerning documentation and contract modifications for engineering change proposals, the Deputy Director stated that:

> FAR 46.407 [Federal Acquisition Regulation, subpart 46.407] only requires that the contract be modified for the consideration received when the change is a major non-conformance. FAR 46.407 makes no reference (or correlation) as to implementation/incorporation of the actual change in the contract (i.e. the ECP). Therefore, although ECP 0014 was incorporated into the contract, that was not the defining criteria for incorporation of any consideration that might have been received. That determination was based solely on the criteria in DFARS 246.407 [DoD Federal Acquisition Regulation Supplement, subpart 246.407]. In addition, as shown in P0067, ECP 0014 was added to Annex A to Attachment 4 (Reference and Compliance Documents) along with a number of other ECP's. This attachment is intended to contain a list of ALL proposed ECP's regardless of whether they are major or minor or whether they were approved or not (ECP's not approved are so indicated). However, to alleviate any misunderstandings in the future, we will modify the OI [JPO Operating Instruction 800-2] to ensure that the issue of major versus minor non-conformance are also addressed as part of the official CCB [Configuration Control Board] file.

Audit Response. We stand by our previous comments. The Deputy Director's planned corrective action to modify JPO Operating Instruction 800-2 will alleviate any future misunderstandings concerning whether ECPs are major or minor nonconformance. For ECPs categorized as a major nonconformance,

the Director of Contracting, GPS, will have documentation from the Control Board to use in determining and obtaining an equitable price adjustment or other consideration through modification of the applicable contract.

Appendix E. Waivers and Deviations Reviewed for the Miniaturized Airborne Global Positioning System Receiver

Waiver or Deviation Number	Approved[1]	Title
W001A1	Yes	Use of Prototype Part and Environmental Stress Screening Substitution
W002	Yes	Built-in-Test Threshold Tuning
W004R3	Yes	Modification Wire Color
W005	N/A[2]	Number of Circuit Changes
W006	Yes	Circuit Card Modification
D002	Yes	Deviation From 100 Parts per Million for Initial Units
D003	Yes	Deviation From Environmental Stress Screening Requirement and Use of Bid Sample Input/Output Processor

[1]Neither the JPO nor the contractor estimated a dollar value for consideration.
[2]Not applicable. The contractor withdrew the waiver.

Appendix F. Engineering Change Proposals Reviewed for the Block IIR Satellite

Proposal Number	Approved	Value (thousands)	Title
GPSE002	Yes[1]	$51,600	Operate Through Requirements
GPSE008	Yes[2,3]	0	Change Telemetry, Tracking, and Command S-Band Communication Requirements
GPSE010	Yes[2,3]	0	Uncertainty Requirements for Acceleration Force Model
GPSE014	Yes[2,4]	0	Change Requirements for Signal Routing of Redundant Circuits
GPSE015	Yes[2,3]	0	Modify Cesium Atomic Frequency Standard Pyroshock Test Requirements
GPSE018	Yes[5]	0	Miscellaneous Updates to the Requirement Documents for Spacecraft Processor Unit Software Required for Formal Qualification Testing (FQT)
GPSE019	Yes[5]	0	Miscellaneous Updates to the Requirement Documents for Spacecraft Processor Unit Software Required for FQT
GPSE021	Yes[5]	0	Additional Miscellaneous Updates to the Requirement Documents for Spacecraft Processor Unit Software Required for FQT
GPSE027	Yes[5]	0	Update Mission-Processor Software Requirements Specification
GPSE028	Yes[2,3]	0	Space Vehicle Harness Test Voltage Modification
GPSE030	Yes[5]	0	Model 12 Requirements Update to the Mission Unique Software
GPSE031	Yes[1]	451	Battery Reconditioning for the GPS IIR Space Vehicle
GPSE035	Yes[5]	0	Miscellaneous Updates to the Requirement Documents for the Spacecraft Processor Unit Software
GPSE036	Yes[5]	0	Movement of Compliance Documentation Tailoring From Specifications to Global Positioning IIR Satellite Contract Listing

Note: See the footnotes at the end of the appendix.

Appendix F. Engineering Change Proposals Reviewed for the Block IIR Satellite

Proposal Number	Approved	Value (thousands)	Title
GPSE037	Yes[5]	0	Miscellaneous Updates to the Mission-Processor Software Requirements Specification
GPSE038	Yes[6]	450	Permit Space Vehicle Thermal Cycling Test in Vacuum
GPSE039	Yes[2,3]	0	Correct Apogee Kick Motor Static and Dynamic Imbalance

[1]The ECP added requirements and increased the contract cost.
[2]The ECP reduced contract requirements; however, the contractor did not propose a cost saving to the Government.
[3]JPO personnel stated that no consideration was requested for the ECP because the requirement that was reduced by the ECP was unneeded.
[4]The procuring contracting officer obtained other consideration; however, she did not modify the contract.
[5]The ECP did not affect contract requirements, and consideration was not warranted.
[6]The ECP reduced contract requirements. The contractor did not propose a cost benefit to the Government; however, the JPO required the contractor to provide consideration.

Appendix G. Report Distribution

Office of the Secretary of Defense

Under Secretary of Defense for Acquisition and Technology
  Deputy Under Secretary of Defense for Space
  Director, Defense Logistics Studies Information Exchange
Under Secretary of Defense (Comptroller)
  Deputy Chief Financial Officer
  Deputy Comptroller (Program/Budget)
Assistant to the Secretary of Defense (Public Affairs)

Department of the Army

Auditor General, Department of Army

Department of the Navy

Assistant Secretary of the Navy (Financial Management and Comptroller)
Auditor General, Department of Navy

Department of the Air Force

Assistant Secretary of the Air Force (Acquisition)
  Program Executive Officer, Space and Missile Systems Center
    Systems Program Director, Joint Program Office, Navigation System Time and Ranging Global Positioning System
Assistant Secretary of the Air Force (Financial Management and Comptroller)
Auditor General, Department of the Air Force
Commander, Air Force Space Command, Second Satellite Operations Squadron
Director of Contracting, Space and Missile Systems Center

Other Defense Organizations

Director, Defense Contract Audit Agency
Director, Defense Logistics Agency
  Commander, Defense Contract Management Command
    Commander, Defense Contract Management District East
      Commander, Defense Contract Management Command Baltimore
      Commander, Defense Contract Management Command Lockheed Martin-Delaware Valley
      Commander, Defense Contract Management Command Springfield
Director, National Security Agency
  Inspector General, National Security Agency
Inspector General, Defense Intelligence Agency

Non-Defense Federal Organizations and Individuals

Office of Management and Budget
Technical Information Center, National Security and International Affairs Division, General Accounting Office

Chairman and ranking minority member of each of the following congressional committees and subcommittees:

Senate Committee on Appropriations
Senate Subcommittee on Defense, Committee on Appropriations
Senate Committee on Armed Services
Senate Committee on Governmental Affairs
House Committee on Appropriations
House Subcommittee on National Security, Committee on Appropriations
House Committee on Government Reform and Oversight
House Subcommittee on National Security, International Affairs, and Criminal Justice, Committee on Government Reform and Oversight
House Committee on National Security

Part III - Management Comments

System Program Director, Navigation System Time and Ranging Global Positioning System, Comments

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS SPACE AND MISSILE SYSTEMS CENTER (AFMC)
LOS ANGELES, CA

16 SEP 1996

MEMORANDUM FOR Inspector General
Department of Defense
400 Army Navy Drive
Arlington VA 22202-2884
ATTENTION: Chris Johnson

FROM: SMC/CZ
2435 Vela Way, Suite 1613
Los Angeles AFB, CA 90245-5500

SUBJECT: Management Comments to Audit of Functional and Physical Configuration Audits of the Air Force Navigation Time and Ranging Global Positioning System (Project No. 5AF-0032.03), dated 24 Jul 96

Attached are the management comments to the subject report. Direct any questions concerning this matter to my action officers Ms Jan Merkle, DSN 833-1903, or Major Sam Sablan, DSN 833-3612.

JAMES B. ARMOR, JR., Colonel, USAF
System Program Director
NAVSTAR GPS Joint Program Office

Attachment:
Management Comments

Final Report Reference

Management Comments
to
Audit Report on Functional and Physical Configuration Audits of the Air Force Navigation System Time and Ranging Global Positioning System Draft, dated 24 Jul 96, (Project No. 5AE-0032.03)

Finding A. Completing Interface Control Documents.

Finding - **Do not concur.** The audit report states that the mission-processor software used incomplete interface control documentation to perform functional qualification test (FQT). As a result, an additional $9.3M was required to modify the software and establish an interface control agreement. Also, the JPO had to conduct additional qualification testing to establish an operational baseline. This is not correct. At the time of the mission data unit (MDU) FQT, which includes the mission processor software, interface control document (ICD) 401 was baselined and approved by the GPS configuration control board (CCB). The disconnects between the MDU and ground control software (OR 6.A) occurred due to different interpretations of the agreed to ICD 401. In order to achieve the required performance, both parties must be contractually responsible for the complete integration of the MDU and OR 6.A software. It required intimate testing and analysis by both sides to fully understand the technical design of the interface and to reduce risk to the program. The additional testing performed by the JPO was not qualification testing but the system level testing required for Developmental Test and Evaluation.

Revised

Based on the contractual situation during that timeframe, the documentation was complete. The program office took steps to enhance the linkages between the two contracts to reduce the risk of major schedule and cost impacts.

A. Recommendation 1. **Concur.** We agree that the program office Interface Control Working Group (ICWG) should approve and certify ICDs before future critical design reviews (CDRs) and formal qualification tests (FQTs). The current Joint Program Office (JPO) Operating Instruction (OI) 800-2, "Configuration Control Boards (CCB)," May 1993 is being revised. This revision will address the certification of the ICDs. (See management comments to Finding B recommendations for other changes being incorporated into the CCB OI)

Recommendation 2. **Concur.** The interface control process has been designated a high risk management control function and will be reviewed as part of the GPS management control program. The CCB OI being revised will also address the need for the JPO Executive Steering Committee to review the interface control process on at least an annual basis.

Final Report Reference

Finding B. Managing Waivers, Deviations, and Engineering Changes.

Finding - **Do not concur.** We disagree with the assertion that the program office did not obtain consideration and Rockwell did not propose equitable contract price adjustments or other consideration. During the auditors' visit, verbal and written information was provided which indicated that adequate consideration was offered and received for all waivers and deviations to the miniaturized airborne GPS receiver contract which were reviewed by the auditors.

In the case of Lockheed Martin ECPs, specifically numbers 8, 10, 28 and 39, although we agree with the assertion that the CCB records did not initially discuss the issue of consideration, we disagree with the assertion that written documentation was not provided during the auditors' visit (and added to the official CCB records) to indicate that the cost of these items fell below the threshold of the advance changes adjustment clause. For ECP 14, we do not concur in the auditors' findings that a contract modification was required. The consideration that was received was appropriately documented in a contractual letter to Lockheed Martin. FAR 46.407(f) states that a contract modification is required for documentation of consideration if the supplies were accepted as a result of a non-minor (i.e. major) nonconformance as discussed under paragraph 46.407(c)(1). ECP 14 did not fit the definition of a major nonconformance as defined in DFARS 246.407 - "a nonconformance, other than critical, that is likely to result in failure, or to materially reduce the usability of the supplies or services for their intended purpose," therefore, a contract modification was not required.

Revised

Although we intend to modify the CCB OI to ensure that the issue of consideration is addressed at the CCB, it is not the responsibility or authority of the CCB to approve the amount of consideration. Furthermore, it is not the responsibility or authority of the CCB to approve the amount of an equitable adjustment for cost ECPs. The determination of what a fair and reasonable settlement of any contract action, whether cost or no cost, is the responsibility and authority of the procuring contracting officer. In addition, it is not SMC's contracting policy nor GPS JPO's to enter into negotiations with the contractor for consideration (cost or no cost) or issue a contract modification prior to 1) receiving authorization to make the change, which is usually given by the CCB, 2) authorization from the appropriate party to begin negotiations, which is given by the business clearance approving authority and 3) authorization to sign the contract action which is given by the contract clearance approving authority. As stated in AFFARS 5301.9002 as revised by Air Force Acquisition Policy Letter 96A006, the Buying Office Contracting Official (BOCO), SMC/CZK, is the contract clearance reviewing and approving authority for all actions up to $50M (previously $5M/$25M).

B. Recommendation 1. **Concur.** The current Joint Program Office Operating Instruction 800-2, "Configuration Control Boards," May 1993, is being revised. These revisions will ensure discussion of consideration at the CCB and documentation in the CCB minutes. Furthermore, the revision will ensure that all resulting contracting officer

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documentation (modification/correspondence) be made part of the official CCB file. The revised OI should be approved no later than 26 Nov 96.

Revised

Recommendation 2. We do not concur with the need for the GPS System Program Director to direct the contracting officer to modify the contract in accordance with FAR 46.407. The authority and responsibility for ensuring that all contract actions are handled in accordance with the appropriate FAR provisions is the responsibility of SMC/PK and its contracting directorates (including contracting officers) as defined in FAR 1.602.

Audit Team Members

The Acquisition Management Directorate, Office of the Assistant Inspector General for Auditing, DoD, prepared this report.

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