January 22, 2003

Information Technology

Development Testing of Prophet Mission-Critical Software
(D-2003-051)

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Office of the Inspector General

Quality　　　　　　*Integrity*　　　　　　*Accountability*

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Abstract

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Acronyms

DITSCAP	Department of Defense Information Technology Security Certification and Accreditation Process
EMD	Engineering and Manufacturing Development
MMI	Man Machine Interface
PEO IEWS	Program Executive Office for Intelligence, Electronic Warfare and Sensors
PSIU	Processor System Interface Unit

January 22, 2003

MEMORANDUM FOR PROGRAM EXECUTIVE OFFICER FOR INTELLIGENCE, ELECTRONIC WARFARE AND SENSORS

SUBJECT: Report on the Development Testing of Prophet Mission-Critical Software (Report No. D-2003-051)

We are providing this report for your review and comment. We considered management comments on a draft of this report when preparing the final report.

The Army Program Executive Officer for Intelligence, Electronic Warfare and Sensors comments were responsive to the intent of the recommendations. However, we request that the Program Executive Officer provide additional information showing completion of Recommendations A. and B. by March 21, 2003.

We appreciate the courtesies extended to the evaluation staff. Questions on the evaluation should be directed to Mr. Kenneth H. Stavenjord at (703) 604-8952 (DSN 664-8952) or Mr. Peter C. Johnson at (703) 604-9601 (DSN 664-9601). See Appendix C for the report distribution. The team members are listed inside the back cover.

David K. Steensma
Deputy Assistant Inspector General
for Auditing

Office of the Inspector General of the Department of Defense

Report No. D-2003-XXX   **January XX, 2003**
  (Project No. D2001PT-0104)

Evaluation of Development Testing of Prophet Mission-Critical Software

Executive Summary

Who Should Read This Report and Why? This report concerns developmental testing of DoD acquisition programs, which should be of particular interest to program managers and acquisition professionals.

Background. This report is a review of the development testing of mission-critical software for the U.S. Army Prophet Engineering and Manufacturing Development (EMD) System and the Prophet Block I System. Prophet is a Division-Level ground based electronic surveillance system, which provides protection in a direct support role to the maneuver brigade; either stationary, or while on the move. The system monitors and exploits signals of interest and determines the area of signal origin by providing direction finding and line-of-bearing in the frequency range of 20 Megahertz to 2000 Megahertz. Prophet is operated in either the dismounted or mounted mode. In the dismounted mode Prophet is man-packed with a portable antenna. In the mounted mode Prophet is installed in an equipment enclosure carried on a High Mobility Multi-Purpose Wheeled Vehicle with the antennas attached to a retractable mast.

Prophet EMD was developed to validate the operational performance of the system prior to a decision for full rate production and deployment. Prophet EMD developmental testing was completed in September 2000 and in general met the test criteria. Prophet Block I is the full rate production system and has identical electronics to Prophet EMD but also includes the Man Machine Interface. Prophet Block I First Article Performance testing was from February 2002 to May 2002 and as a result some errors were found and are being corrected. After First Article Performance Testing, three Prophet Block I systems are to be refurbished and sent to Titan System Corporation, Melbourne, Florida, for final sell off and acceptance. The first production contract was awarded to Titan Systems Corporation in June 2001. The contract obligates $7.7 million for non-recurring engineering work and six pre-production systems. Additionally, the program office plans to procure an additional 83 systems at a recurring cost of approximately $300,000 per system.

Results. Prophet Block I with the Man Machine Interface will be fielded without ensuring that the system meets operational needs and that it retains its effectiveness and suitability for the typical user in an operational environment. For details of this evaluation result see finding A of this report.

Independent security certification analysis, testing, and evaluation are not planned. Prophet will be fielded without knowing the extent to which the systems meet information assurance requirements. For details of this evaluation result see finding B of this report.

Management Comments. The Army Program Executive Officer for Intelligence, Electronic Warfare and Sensors (PEO IEWS) partially concurred with finding A and finding B. In finding A, PEO IEWS agreed that an operational test assessment was required for Prophet Block I with Man Machine Interface (MMI) and that it was scheduled for October 2002 but disagreed that it was not planned. In finding B, PEO IEWS agreed that both Prophet Engineering Manufacturing and Development (EMD) and Prophet Block I should be designated at certification Level 2 but differed on the IG DoD selection of the system characteristic alternatives used in the System Security Authorization Agreement, and disagreed that Prophet Block I certification level had not been designated. Although it was not required to comment, PEO IEWS strongly non-concurred that a management control weakness existed relating to the planning of the operational test assessment for Prophet Block I with MMI.

Evaluation Response. Although Army PEO IEWS only partially concurred with finding A and finding B, the comments were responsive. PEO IEWS agreed with the recommendation that an operational test assessment of Prophet Block I with MMI was required and they had scheduled the test for October 2002. PEO IEWS also agreed with the recommendation that both Prophet EMD and Prophet Block I should be redesignated at certification Level 2. Both systems are required to undergo information assurance analysis and testing commensurate with Level 2 requirements. Even though, it was not required to comment, PEO IEWS strongly non-concurred with the comment regarding the adequacy of management control in Appendix A related to finding A. However, we determined that a management control weakness was justified based on DoD Instruction 5010.40 "Management Control Program Procedures," August 28, 1996. Specifically, the weakness found was that an operational test assessment for Prophet Block I with MMI was not adequately planned and the relative impact of the weakness on testing, deployment, and use of the system required the attention of the next higher level of management. We request that PEO IEWS provide the test report documenting the results of the operational test assessment for Prophet Block I with MMI. We also request PEO IEWS provide a copy of an updated System Security Authorization Agreement for Prophet Block I documenting the certification level of Prophet Block I and Prophet EMD as well as the security certification analysis and tests performed. Both documents should be provided no later than February XX, 2003.

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Background

Army Regulation 73-1, "Test and Evaluation Policy," February 27, 1995, and DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs," April 5, 2002, govern the Prophet program development testing policy. Army Regulation 73-1 describes development testing such as engineering-type tests used to verify that design risks are minimized, substantiate technical performance, and certify system readiness for operational test and evaluation. DoD 5000.2-R, states that development test and evaluation shall: 1) Identify the technological capabilities and limitations; 2) Identify and describe design technical risks; 3) Stress the system under test; 4) Address the potential of satisfying Operational Test and Evaluation requirements; 5) Analyze the capabilities and limitations of alternatives; 6) Assess progress toward meeting Key Performance Parameters and other Operational Requirements Document requirements; 7) Assess technical progress and maturity against critical technical parameters; 8) Provide data and analytic support to the decision process; 9) In the case of Information Technology systems, support the information systems security certification process; and, 10) Prior to full rate production, demonstrate the maturity of the production process.

Prophet is a Division-Level ground based electronic surveillance system, which provides protection in a direct support role to the maneuver brigade; either stationary, or while on the move. The system monitors and exploits signals of interest and determines the area of signal origin by providing direction finding and line-of-bearing. Prophet is designed to detect line-of-sight radio signals in the frequency range of 20 Megahertz to 2000 Megahertz, which is in the High Frequency, Very High Frequency and Ultra High Frequency bands. Prophet is operated in either the dismounted or mounted mode. In the dismounted mode Prophet is man-packed with a portable antenna. In the mounted mode Prophet is installed in an equipment enclosure carried on a High Mobility Multi-Purpose Wheeled Vehicle with the antennas attached to a retractable mast.

The program office has performed testing on two systems, Prophet Engineering and Manufacturing Development (EMD) and Prophet Block I. Prophet EMD and Prophet Block I have identical electronics with the exception that Prophet EMD does not include a subsystem called the Man Machine Interface (MMI). Prophet EMD was developed and tested to validate system performance. The results from those tests were used in the decision to proceed with full rate production and deployment of Prophet Block I. During the evaluation we selected three subsystems in Prophet Block I that contain mission-critical software. They are the MD-405A Receiver/Processor, the Processor System Interface Unit (PSIU), and the MMI.

During direction finding operation the MD-405A Receiver/Processor records and reports a line-of-bearing for each received signal or frequency at the end of the selected integration period. The MD-405A Receiver/Processor is operated either by the front panel or through a remote host connected to the serial interface port. The unit has the capability to scan up to 400 normal channels and 20 priority channels. With the Prophet antennas, the unit is capable of performing direction finding on

line-of-sight radio frequency emitters in the range of 20 Megahertz to 2000 Megahertz. The MD-405A Receiver/Processor is already in use as part of the Special-Operations Command AN/PRD-13(V)2, a man-packed radio frequency direction finding system. All software in the MD-405A Receiver/Processor is controlled by Titan Signal Products Division's configuration management process. The MD-405A Receiver/Processor has approximately 73,000 lines of Assembly source code of which 450 additional lines were added for the Prophet mission.

PSIU is a message exchanger and process monitor. The PSIU receives, transmits and monitors serial data streams between subsystems. The PSIU has approximately 13,000 lines of Assembly source code of which 9,500 lines were reused from software in the MD-405A Receiver/Processor.

MMI is a laptop computer remotely interfaced to the MD-405A Receiver/Processor through the PSIU. The MMI provides a central control center for system and receiver, a signal map display, a signal parameter list display, and tools to store, sort and create signal parameter and voice traffic files. MMI application code is a combination of commercial software, and custom developed software written in C++. The MMI has over 200,000 lines of C++ source code of which 110,000 lines were reused, 40,000 lines were modified and 50,000 lines were developed.

Software development testing for Prophet EMD was done at the unit and system level. Unit level testing focused on the correct execution of software as determined by correct data flow and hardware control operations. System level testing was done to measure the technical performance of Prophet EMD in the mounted and dismounted modes. In general, software development testing of Prophet EMD at both the unit level and system level met the test criteria. During development testing, two software errors were found. One error resulted in a change of software in the PSIU and the other error required software changes in the Tactical Navigation System. Both errors were corrected and retested.

Since Prophet EMD and Prophet Block I are almost identical, additional development testing on the full rate production system was not performed. To validate whether Prophet Block I meets the contractual performance requirements a First Article Performance test is being conducted. First Article Performance testing includes unit and system level testing. Unit level testing consists of tracing the execution of the MMI controller, application program interface and driver level software; reviewing the data messages being passed between the MMI, the MD-405A Receiver/Processor and the PSIU; and validating the operations of the MD-405A Receiver/Processor and MMI. After completion of unit level testing, Prophet Block I will undergo system level technical and environmental verification tests. According to the program office, Prophet Block I First Article Performance testing was completed in May 2002 and as a result some errors were found and are being corrected.

The first production contract was awarded to Titan Systems Corporation in June 2001. The contract obligates $7.7 million for non-recurring engineering work and six pre-production systems. Additionally, the program office plans to procure an additional 83 systems at a recurring cost of approximately $300,000 per system.

Objectives

Our objective was to evaluate development testing of mission-critical software for Prophet EMD and Prophet Block I. Specifically, we evaluated the completeness and adequacy of the development testing of mission-critical software in the MD-405A Receiver/Processor, the PSIU, and the MMI in the areas of planning, execution, and reporting. We also evaluated the adequacy of responses to test results of Prophet EMD and Prophet Block I, as well as how testing deficiencies affected the program.

A. Operational Test Assessment of Prophet Block I with the Man Machine Interface

Prophet Block I with the MMI will not have an operational test assessment or a follow-on operational test performed prior to fielding. Initial operational testing of Prophet EMD did not include the MMI. The program office has not planned any additional operational tests prior to fielding because key criteria were met. As a result, Prophet Block I with MMI will be fielded without ensuring that the system meets operational needs and that it retains its effectiveness and suitability for the typical user in an operational environment.

Requirements for Operational Test Assessment

Prophet acquisition management and strategy are governed by Army acquisition policy contained in Army Regulation 70-1, "Army Acquisition Policy," December 15, 1997. Army Regulation 70-1 follows the guidance and procedures contained in DoD Directive 5000.1, "The Defense Acquisition System," October 23, 2000, and DoD Regulation 5000.2-R, "Mandatory Procedures for Major Defense Acquisition Programs (MDAPS) and Major Automated Information System (MAIS) Acquisition Programs," April 5, 2002. DoD 5000.2-R requires an operational test assessment when there are "hardware and software alterations that materially change system performance (operational effectiveness and suitability), which includes system upgrades and changes to correct deficiencies identified during test and evaluation."

Prophet test and evaluation is also governed by the requirements in Army Regulation 73-1, "Test and Evaluation Policy," February 27, 1995. Army Regulation 73-1 requires follow-on operational tests to "refine the estimates made during initial operational testing, provide data to evaluate changes, verify that deficiencies in materiel, training, or concepts have been corrected, and provide data to ensure that the system continues to meet operational needs and that it retains its effectiveness in a new environment or against a new threat."

Initial Operational Testing of Prophet Engineering and Manufacturing Development without Man Machine Interface

An operational test requires testing in realistic operational environments with users who represent those expected to operate and maintain the system when it is fielded or deployed. Initial operational testing was done with Prophet EMD in two phases. The first phase was used to measure system effectiveness, suitability and limited survivability when employed by a unit in an operational matching environment. Phase 1 testing also included an assessment used to validate the mechanics of the overall information processing architecture in the

areas of tasking, reporting and collection management. Phase 2 was a field test exercise in conjunction with a planned brigade-level exercise. The objective of Phase 2 was to collect data on operational effectiveness and suitability. Data collected from those tests determined the system operational effectiveness, suitability, and survivability and were used as input to a Milestone III full rate production and fielding decision. But those tests were only performed on Prophet EMD and did not include the MMI.

Prophet Block I First Article Performance Testing with the Man Machine Interface

Prophet Block I First Article Performance testing with the MMI is being performed at the contractor facility and at selected subcontracted laboratories and test ranges with the participation of a government or quality assurance witness. According to the program office, First Article Performance testing was completed in May 2002 and as a result some errors were found and are being corrected. During those tests, Prophet Block I had system performance and environmental verification tests using manual and automated methods. System performance testing includes demonstrating MMI mapping, display and control functions, signal monitoring, signal detection and direction finding accuracy. Environmental verification testing includes demonstrating reliability, maintainability and survivability. Manual testing was done using standard test equipment. Automated testing was conducted for the direction finding tests. After First Article Performance testing, three systems are to be refurbished and sent to Titan System Corporation, Melbourne, Florida, for final sell off and acceptance. First Article Performance testing of Prophet Block I with the MMI did not include an operational test with the typical user in an operational environment.

Operational Testing of the Man Machine Interface

Prophet Block I and Prophet EMD system electronics are the same with the exception that Prophet Block I also includes MMI. The MMI provides primary control and display of system and receiver. Additionally, MMI provides the operator with a map and list display as well as tools to analyze, sort, and record data. If the MMI is unavailable, the system can be operated using manual controls. Because Prophet EMD initial operational tests met the key performance parameter criteria, the program office decided not to perform any additional operational test assessments or follow-on operational tests prior to fielding of Prophet Block I.

The MMI is a laptop computer running the Microsoft Windows NT 4.0 operating system and contains over 200,000 lines of source code developed for electronic surveillance control. The electronic surveillance control software consists of three modules that are used for control interface, application program interface, and receiver driver interface. The MMI also contains a set of commercial-off-the-shelf software modules used for mapping, data tabling, digital reporting, databasing, and support. In comparison with the other

subsystems in Prophet Block I, MMI has the largest collection of commercial-off-the-shelf and custom developed software. When MMI was added to Prophet, the PSIU software was modified to distribute data to and from MMI and other subsystems.

Prophet Block I with MMI does improve system operational performance and effectiveness. MMI allows easier control of the MD-405A Receiver/Processor and system, has better displays and analysis tools for examining signals of interest, and has the capability to store, sort, and transfer signal data. In fact the Prophet system manager recognizes the operational benefits of having MMI because planned product improvements include the requirement for Prophet Block III to have MMI for intelligence digital reporting and databasing. Even though Prophet can perform its mission without MMI, the addition of MMI improves system performance and effectiveness. If an operational test assessment or a follow-on operational test is not performed with MMI, possible operational deficiencies or unsuitable features may not be detected and corrected.

Summary

The Product Manager, Prophet has not planned for Prophet Block I with MMI to have an operational test assessment or a follow-on operational test performed prior to fielding. Even though Prophet can perform its mission without MMI, an operational test assessment should be performed because with MMI, the system performance and effectiveness are changed. Specifically, MMI allows easier control of the MD-405A Receiver/Processor and system; has better displays and analysis tools for examining signals of interest; and has the capability to store, sort, and transfer signal parameters. As a result, without an operational test assessment or follow-on operational test of Prophet Block I, no operational data will validate the performance, effectiveness, and suitability of MMI for the typical user in an operational environment.

Recommendations, Management Comments and Evaluation Response

A. We recommend that the Product Manager, Prophet plans and performs an operational test assessment of Prophet Block I by updating the Test and Evaluation Master Plan and executing the test prior to fielding.

Management Comments. The Army Program Executive Officer for Intelligence, Electronic Warfare and Sensors (PEO IEWS) partially concurred with the finding. PEO IEWS agreed that an operational test assessment of Prophet Block I with MMI was required prior to fielding. PEO IEWS disagreed that an operational test assessment of Prophet Block I with MMI was not planned prior to fielding. PEO IEWS stated that based on testing to date, the Army Test and Evaluation Command recommended a conditional material release for fielding of Prophet Block I with MMI, and further testing was planned prior to its initial fielding. Specifically, PEO IEWS stated that an operational test assessment of Prophet Block I with MMI was scheduled for October 2002.

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Evaluation Response. Although PEO IEWS only partially concurred with the recommendations, the comments were responsive. We agree with the PEO IEWS statement that an operational test assessment of Prophet Block I with MMI was required. However, we disagree with the PEO IEWS comment that an operational test assessment of Prophet Block I with MMI was planned. We concluded this because an operational test assessment of Prophet Block I with MMI was not documented in the Prophet Ground Block I Test and Evaluation Master Plan Revision 5.0 or the Titan Prophet Production Block 1 First Article Performance Test Plan. We were also told during the evaluation that for acceptance and first article tests prior to fielding, the Army Test and Evaluation Command only planned to participate as a reviewer and commenter. We request that PEO IEWS provide the test report documenting the results of the Prophet Block I with MMI operational testing.

B. Certification Level 2 for Prophet Systems

The certification of the Prophet EMD system was incorrectly designated as Level 1 instead of Level 2 because the alternatives chosen for mission-reliance and integrity did not match the system characteristics. In addition the Prophet Block I production system certification level is not yet determined. As a result, independent security certification analysis, testing, and evaluation normally conducted for Level 2 systems are not planned. Prophet will be fielded without knowing the extent to which it will meet information assurance requirements.

Information Assurance for Prophet Systems

Information Assurance. Information assurance is information operations that protect and defend information and information systems by ensuring their availability, integrity, authentication, confidentiality, and non-repudiation. It includes providing for the restoration of information systems by incorporating protection, detection, and reaction capabilities. An information system can be any computer related equipment or interconnected system or subsystems of equipment that is used in the acquisition, storage, manipulation, management, movement, control, display or reception of voice and or data and includes software, firmware, and hardware. The information systems contained in the Prophet systems are the MD-405A Receiver/Processor, the PSIU, the MMI, and the Tactical Navigation System. In order to ensure that the Prophet information systems function properly, security features that support information assurance must be implemented and tested.

Prophet System Requirements for Availability, Integrity, Authentication, Confidentiality, and Non-Repudiation. Availability is the timely and reliable access to data and information services for authorized users. All Prophet information systems must be timely and reliable. If the MD-405A Receiver/Processor and the PSIU are untimely or unavailable the Prophet systems will not be able to meet their technical performance requirements. Also, if either the MMI, or the Tactical Navigation System is untimely or unavailable, the Prophet Block I performance and effectiveness will be degraded.

Integrity is the condition existing when data is unchanged from its source and has not been accidentally or maliciously modified, altered, or destroyed. Without data integrity the Prophet systems would not be able to accurately report the direction, level, and frequency of signals being measured. Therefore, all Prophet information systems must ensure that the integrity of data used or provided is unchanged.

Authentication is a security measure designed to establish the validity of a transmission, message, user, or system or a means of verifying an individual's

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authorization to receive specific categories of information. Prophet Block I with MMI must have authentication measures established to prevent typical users from inadvertently altering data.

Confidentiality is an assurance that information is not disclosed to unauthorized persons, processes, or devices. Non-repudiation is the assurance that the sender of data is provided with proof of delivery and the recipient is provided with proof of origin, so neither can later deny having processed the data. Since the Prophet systems are stand-alone, confidentiality and non-repudiation are not applicable.

Requirements for System Certification Level

DoD 5000.2-R, "Mandatory Procedures For Major Defense Acquisition Programs (MDAPS) and Major Automated Information Systems (MAIS) Acquisition Programs," April 5, 2002. DoD 5000.2-R Chapter 3.4.1 states that development test and evaluation shall, in the case of IT systems, support the information systems security certification process, and DoD 5000.2-R Chapter 3 Section 6.1.3 states that information assurance testing shall be conducted on information systems to ensure that planned and implemented security measures satisfy Operational Requirements Document and System Security Authorization Agreement requirements when the system is installed and operated in its intended environment.

DoD 5200.40, "Department of Defense Information Technology Security Certification and Accreditation Process Instruction (DITSCAP)," December 30, 1997. DITSCAP defines a process that standardizes the activities leading to system security accreditation, and applies to the acquisition, operation and sustainment of any DoD system that collects, stores, transmits, or processes unclassified or classified information. Both Prophet EMD and Prophet Block I are required to use DITSCAP since both contain information technology systems that collect store, transmit, and process data. The DITSCAP process consists of four phases: Phase 1, Definition; Phase 2, Verification; Phase 3, Validation; and Phase 4, Post Accreditation. Information collected during Phase 1 is used to determine the certification level. The certification level establishes the activities that are performed on a system for security certification and accreditation.

DoD 8510.1-M, "Department of Defense Information Technology Security Certification and Accreditation Process (DITSCAP) Application Manual," July 31, 2000. The Application Manual supports DITSCAP by presenting a detailed approach to the activities comprising the certification and accreditation process. Chapter 3, Phase 1 definition provides a task description on how to determine the appropriate certification level of a system. Using that process a certifier determines the degree of confidentiality, integrity, availability, and accountability required for a system by selecting weighted alternatives associated with each system characteristic. The weights selected are then totaled in order to determine the appropriate certification level of the system.

Certification Level 2 Security Test and Evaluation. Depending on the total score derived from Phase 1, the possible certification levels for a system are Level 1, which requires completion of the minimal security checklist that either a system user or an independent certifier may complete; Level 2, which requires the completion of the security checklist and an independent certification analysis; Level 3, which requires the completion of the security checklist and a more in-depth independent analysis; and Level 4, which requires the completion of the security checklist and the most extensive independent analysis. If a system is certified at Level 2, a system security test and evaluation is required during Phase 3 validation. The purpose of the security test and evaluation is to validate the proper integration and operation of all security features.

Assessment of Prophet Systems Security Certification Level

Prophet Systems Characteristic Alternatives. During the system security definition phase, the program office performed a certification level assessment of Prophet EMD. Using the DITSCAP Application Manual the program office selected system characteristic alternatives for interface, processing, attribute, mission-reliance, availability, integrity, and information categories. The mission-reliance alternative chosen was "partial" and the integrity alternative chosen was "not applicable." After the alternatives were selected their corresponding weights were added and compared to the application manual certification level table. The program office total of 12 designated Prophet EMD at certification Level 1. The program office did not assess Prophet Block I.

During our evaluation we reviewed the characteristic alternatives selected and determined that the Prophet EMD and Prophet Block I alternative for mission-reliance is "total" instead of "partial" and the alternative for integrity is "exact" instead of "not applicable."

Mission-Reliance. Mission-reliance relates the degree to which the success of the mission relies on the operation, data, infrastructure, or system. The program office determined that Prophet mission-reliance is "partial" because it concluded that the mission "can be accomplished without Prophet Block I but with greater risk to personnel equipment and mission accomplishment." Our assessment determined that Prophet mission-reliance is "total" because the mission of the system is totally dependent upon the specific aspects of system, operation, and data. In particular, Prophet is totally dependent on the operation and data of the MD-405A Receiver/Processor system, Prophet mounted is totally dependent on the operation and data of the PSIU system, and when MMI is being used to control the system and receiver as well as map and store signals Prophet Block I is totally dependent on the operation and data of MMI. With the alternative being "total" instead of "partial" the weight for the mission-reliance characteristic is seven instead of three.

Integrity. Integrity relates the degree in which the integrity of operation, data, infrastructure, or system is needed from unauthorized modification or destruction of information. The program office determined that Prophet integrity is "not applicable" since there is "no Prophet operation that would risk

the security of the data of Prophet and that no malfunction of Prophet would result in sending data out of the system that from a security standpoint, should be sent out." We determined that Prophet integrity is "exact" because the specific integrity aspects of system, operation, and data must be exact in order for the system to accurately report the direction, level, and frequency of signals being measured. In particular, the integrity of the operation and data of the MD-405A Receiver/Processor must be exact or else Prophet would not be able to perform its mission. Also the integrity of the system, operation, and data as it applies to PSIU must be exact or else Prophet mounted would not be able to perform its mission, and the integrity of the system, operation, and data as it applies to MMI must be exact or else Prophet Block I performance will be degraded. With the alternative being "exact" instead of "not applicable," the weight for the integrity characteristic is six instead of zero.

The following table depicts the evaluation that was done and the difference in score with the adjusted values in mission-reliance and integrity.

System Characteristic Comparison Table for Prophet Systems

System Characteristic	SSAA Alternative	Adjusted Alternative	SSAA Weight	Adjusted Weight
Interface Mode	Passive	Passive	2	2
Processing Mode	Dedicated	Dedicated	1	1
Attribute Mode	None	None	0	0
Mission-Reliance*	Partial	Total	3	7
Availability	ASAP	ASAP	4	4
Integrity*	Not-Applicable	Exact	0	6
Information Categories	Sensitive	Sensitive	2	2
		Total*	**12**	**22**

Denotes a difference*

Certification Level. The total score determines the certification level of the system. A score of less then 16 designates a system at certification Level 1. A score between 12 and 32 designates a system at certification Level 2. Because the total is 22 both Prophet EMD and Prophet Block I should be at certification Level 2.

Because both Prophet EMD and Prophet Block I certification levels should be at Level 2, the Prophet Program Office is required to complete a minimal security checklist, perform an independent certification analysis and during Phase 3

validation, implement a security test and evaluation. By implementing those procedures, system security features for availability, integrity, and authentication would be verified and Prophet would operate at an acceptable level of residual risk.

Summary

Both Prophet EMD and Prophet Block I information systems require information assurance security features to ensure system availability, integrity, and authentication. The Prophet Program Office performed a system security assessment of Prophet EMD and designated it at certification Level 1. The program office has not performed an assessment of Prophet Block I. Certification Level 1 system security assessment only requires a minimal security checklist. During our assessment we determined that Prophet EMD and Prophet Block I should be at certification Level 2. Our result was based on Prophet EMD and Prophet Block I mission-reliance being "total" instead of "partial" and the degree of integrity being "exact" instead of "not applicable." Because the Prophet systems certification is not Level 2, an independent security certification analysis, testing, and evaluation is not planned. Prophet will be fielded without knowing the extent to which the systems meet information assurance requirements.

Recommendations, Management Comments and Evaluation Response

B. We recommend that the Product Manager, Prophet designate Prophet EMD and Prophet Block I at system security certification Level 2 and implement an independent security certification analysis that includes a security test and evaluation during Phase 3 validation as specified in Department of Defense Information Technology Security Certification and Accreditation Process (DITSCAP) Application Manual 8510.1-M, July 31, 2000.

Management Comments. The Army PEO IEWS partially concurred with the finding. PEO IEWS agreed that both Prophet EMD and Prophet Block I should be redesignated at certification Level 2. PEO IEWS also agreed that both Prophet EMD and Prophet Block I are required to have information assurance analysis and testing commensurate with Level 2 requirements. PEO IEWS analysis of Prophet EMD system characteristics alternatives differed with the system characteristic alternatives selected by the IG DoD. PEO IEWS disagreed that the Prophet Block I certification level had not been determined.

Evaluation Response. Although Army PEIO IEWS only partially concurred, the comments were responsive. We agree that both Prophet EMD and Prophet Block I should be redesignated at certification Level 2. We also agree that the appropriate information analysis and testing should be performed commensurate with that level. The differences in the Army PEO IEWS and IG DoD selection of system characteristic alternatives is not an issue since both analysis resulted in the determination that Prophet EMD is designated at certification Level 2. We disagree with the PEO IEWS statement that Prophet Block I was designated

at certification Level 2 during the evaluation because it was not documented in Phase 1 of the System Security Authorization Agreement for Prophet Block I. We request that PEO IEWS provide the updated System Security Authorization Agreement for Prophet Block I documenting the certification level of Prophet Block I as well as the security certification analysis and tests performed.

Appendix A. Scope and Methodology

To accomplish the evaluation objective, we examined program management of Prophet Developmental Testing process of mission-critical software and its related documentation.

We reviewed the organizational structure, software development process and software development testing of Prophet EMD. We obtained and reviewed the Prophet Test and Evaluation Master Plan, Developmental Test Plan, and Test Reports. We selected three of the six subsystems in Prophet that contain mission-critical software for our evaluation. We visited the Prophet Program Office, the developmental and operational test sites, and the contractor software developmental test facilities to verify and validate test process and test results. Results of this evaluation provided insight into the completeness and adequacy of the developmental software testing done for Prophet EMD and Prophet Block I.

We performed this evaluation from October 2001 to May 2002 according to standards implemented by the Inspector General of the Department of Defense. Our scope was limited in that we did not include tests of management controls.

We visited or contacted individuals and organizations within DoD, Titan System Corporation, Santa Clara, California, and Tera Research Incorporated, Sunnyvale, California.

Use of Computer-Processed data. We relied on computer-processed data from the Command, Control, Communications, Computers and Intelligence Test Division Final Report for the Production Verification Test of the Prophet Block I, March 2000, of the Army Electronic Proving Ground to determine the completeness and adequacy of the testing. We reviewed the computer hardware and software configurations used. We observed the operations of the test computer, which generated the test signals, as well as examined the test signal data files. Although, we did not perform a formal reliability assessment of the computer-processed data, nothing came to our attention as a result of the procedures that caused us to doubt the reliability of the computer-processed data.

General Accounting Office High Risk Area. The General Accounting Office has identified several high-risk areas in the DoD. This evaluation report provides coverage of the Defense Systems Modernization high-risk area.

Management Control Program Review

DoD Directive 5010.38, "Management Control (MC) Program," August 26, 1996, and DoD Instruction 5010.40, "Management Control (MC) Program Procedures," August 28, 1996, require DoD organizations to implement a comprehensive system of management controls that provides reasonable assurance that programs are operating as intended and to evaluate the adequacy of the controls.

Scope of Review of Management Controls. Management control was not an announced objective of this evaluation. However, we reviewed the management control program related to the overall evaluation objectives and determined that the pertinent management controls concerning Developmental and Operational Testing of Mission-Critical Software for Prophet Block I system were inadequate (See the finding A).

Adequacy of Management Control Program. We identified a material management control weakness at Prophet Program Office as defined by DoD Instruction 5010.40. The Product Manager, Prophet has not planned for Prophet Block I with MMI to have an operational test assessment or a follow-on operational test performed prior to fielding. Product Manager, Prophet should plan and perform an operational test assessment test because with MMI, the system performance and effectiveness are changed. If management implements all recommendations, the management control weakness will be corrected. A copy of the report will be provided to the senior official responsible for management controls within Program Management Office for Signal Warfare.

Adequacy of Management's Self-Evaluation. Prophet Program Office did not identify the need to perform the operational assessment test as an assessable unit and, therefore, did not identify or report the material management control weaknesses identified by the audit.

Management Comments on Management Control. The Army PEO IEWS strongly non-concurred with the IG DoD opinion that a management control weakness existed because an operational test assessment was not planned for Prophet Block I with MMI. PEO IEWS stated that an operational test assessment of Prophet Block I with MMI has always been planned. PEO IEWS also stated that management controls are in place at both the Program Management and Program Executive Office levels, which include program reviews, planning, and an acquisition memorandum that requires follow-on-testing of any differences from the Prophet EMD to production configuration.

Evaluation Response. DoD 5010.40 "Management Control Program Procedures," August 28, 1996 states, weaknesses in management control should be reported if they are deemed to be material. A material weakness in management control must satisfy two conditions: management controls are not in place, or are not used or are inadequate; and the weakness identified requires the attention of the next higher level of management. During the evaluation a material weakness in management control related to finding A was identified because it satisfied the two conditions. First of all, management controls in place did not adequately plan for the operational test assessment. This was determined because the Prophet Ground Block I Test and Evaluation Master Plan Revision 5.0 and the Titan Prophet Production Block 1 First Article Performance Test Plan did not document the planning of an operational test assessment and discussions with Army Test and Evaluation Command representatives revealed that for the acceptance and first article tests prior to fielding of Prophet Block I, the Army Test and Evaluation Command only

planned to participate as a reviewer and commenter. Secondly, the attention of the next higher level of management, PEO IEWS, was required. This was determined because of the relative impact of the material weakness on the testing, deployment, and use of Prophet Block I with MMI.

Prior Coverage

No prior coverage has been conducted on the subject for the last 5 years.

Appendix B. Definitions of Technical Terms

AN/PRD-13(V)2 - Special Operations Command radio frequency direction finding system consisting of the MD-405A Triple Receiver/Processor, direction finding and intercept antennas, cables and power accessories.

Assembly - A programming language that is once removed from a computer's machine language.

C++ - A high-level programming language, developed by Bjarne Stroustrup at Bell Labs. C++ adds object-oriented features to its predecessor, C.

Line-Of-Bearing – A line extending in the direction of a bearing.

Line-Of-Sight - A straight line between an observer and a target.

MD-405A - An integrated, programmable, intercept/direction finding processor that supports highly automated signal intercept and direction finding functions over the frequency range from 100 kHz to 2000 MHz.

Megahertz - A unit of frequency equal to one million cycles per second.

Prophet Engineering and Manufacturing Development (EMD) - Prophet System without the MMI that was used for developmental and operational testing.

Prophet Block I - Prophet Full Rate Production System that has identical electronics to Prophet EMD with the addition of the MMI.

Root mean square - The square root of the mean value of the sum of the squares.

System Level Testing - Tests used to assess if the system meets the overall performance objectives of the software requirements and system specifications.

Unit Level Testing - The lowest level developer test of software. The purpose of unit testing is to validate requirements expressed in the detailed design descriptions and software requirements specifications. In addition, unit testing is performed to ensure that all source statements in a unit have been executed, each conditional branch has been taken, and that all boundary values (for example, minimum-maximum values) and edit criteria are tested.

Appendix C. Report Distribution

Office of the Secretary of Defense

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Army Program Executive Office for Intelligence, Electronic Warfare and Sensors Comments

DEPARTMENT OF THE ARMY
PROGRAM EXECUTIVE OFFICE
INTELLIGENCE, ELECTRONIC WARFARE AND SENSORS
FORT MONMOUTH, NEW JERSEY 07703-5301

REPLY TO
ATTENTION OF

SFAE-IEW&S

MEMORANDUM FOR United States Department of Defense, Office of the Inspector General, ATTN: Mr. David A. Brinkman, Room 801, 400 Army Navy Drive, Arlington, VA 22202

SUBJECT: Response to Draft DoD IG Report: "Evaluation of Developmental Testing of Prophet Mission-Essential Software (Project No. D2001PT-0104)"

1. PEO IEW&S appreciates the opportunity to review and comment on the draft audit report on Prophet. As requested, enclosed are management comments on the DoD IG findings and recommendations.

    a. I partially concur with A – Operational Test Assessment of Prophet Block I with the Man Machine Interface. I non-concur with the finding that PM Prophet had not planned for Prophet Blk I with Man Machine Interface (MMI) to have an operational test assessment of the prior to system fielding. Based on testing conducted to date, the Army Test & Evaluation Command (ATEC) supports a conditional materiel release for fielding of the Prophet Blk I with MMI, and further testing is planned prior to its initial fielding. I concur with the recommendation that an operational test assessment is required prior to fielding, and this is being done.

    b. I partially concur with B – Certification Level 2 for Prophet Systems. I concur with the finding that the Prophet EMD system should be designated as certification level 2, but for different reasons than the DoD IG. The PM has re-looked the Information Assurance certification levels and had input changes to the SSAA. I non-concur with the finding that the Prophet Block I certification level is not yet determined, and that it will be fielded without knowing the extent to which it will meet information assurance requirements. Prophet Blk I is certification level 2, and appropriate security certification analysis and accreditation testing has been performed. I concur with the recommendation that both EMD and production configurations should be designated at system security level 2, and that IA analysis and testing commensurate with that level be performed.

2. I strongly non-concur with the audit determination that identified a management control weakness based on the DoD IG finding related to operational test assessment of Prophet Blk I with MMI. Management controls are in place both at the PM and PEO level. These include TIWG participation for test planning, frequent program reviews with the PEO that include test program status, PM monthly significant activity reports, and an acquisition decision memorandum that requires conduct of follow-on testing of any differences from the Prophet EMD to production configuration.

3. The point of contact for this matter is LTC Bill Stevenson, Product Manager, Prophet, at commercial 732-427-1479, DSN 987-1479 or email: Bill.Stevenson@iews.monmouth.army.mil.

Encl
as

EDWARD T. BAIR
Program Executive Officer
Intelligence, Electronic Warfare and Sensors

PM Prophet Comments on
Draft DoDIG Report: Evaluation of Developmental Testing of
Prophet Mission-Essential Software (Project No. D2001PT-0104)

<u>Finding A Summary</u>: **Operational Test Assessment of Prophet Block I with the Man Machine Interface.** The Product Manager, Prophet has not planned for Prophet Block I with MMI to have an operational test assessment or follow-on operational test performed prior to fielding. Even though Prophet can perform its mission without MMI, an operational test assessment should be performed because with MMI, the system performance and effectiveness are changed. Specifically, MMI allows easier control of the MD-405A Receiver/Processor and system; has better displays and analytical tools for examining signals of interest; and has the capability to store, sort, and transfer signal parameters. As a result, without an operational test assessment or follow-on operational test of Prophet Block I, no operational data will validate the performance, effectiveness, and suitability of MMI for the typical user in an operational environment.

<u>Recommendation:</u> We recommend that Product Manager, Prophet plan and perform an operational test assessment of Prophet Block I by updating the Test and Evaluation Master Plan and executing the test prior to fielding.

<u>PM Prophet Position:</u> **Partially Concur.** Follow-On Test and Evaluation of the Prophet Blk I production system with MMI was in fact planned prior to fielding. An operational evaluation of the MMI was scheduled for 8-12 July 02 with the Operational Test Command. However, soldiers slated to support the operational evaluation were unavailable as they were redirected to the Prophet EMD Quick Reaction Capability (QRC) fieldings in support of real-world counter-terrorism operations. Due to this reason operational testing was postponed. An operational assessment of the MMI is planned in Oct-Nov 02 prior to the first scheduled Prophet Blk I fielding. DT testing of the production Prophet system was successfully performed from 17 June to 12 July 02. Subsequent to this, a Prophet Logistics/Maintenance Demo was successfully conducted and US Army Test and Evaluation Center (ATEC) logistics and sustainability evaluators assessed maintenance BIT and diagnostic functions of the MMI. The ATEC Material Release memo dated 20 September 02 states that "ATEC supports a Conditional Material Release (CMR) for Prophet Block I (AN/MLQ-40(v)3, which is configured with the MD-405A receiver set, sensor vehicle(s) and MMI laptop computer."

The current plan is to address Prophet Blk I operational test requirements via a continuous system evaluation test strategy of Prophet system upgrades. This strategy has been coordinated within the Prophet Test and Integration Working Group (TIWG). The first part of the test strategy includes an operational assessment of the MMI with soldiers at Fort Huachuca (Electronic Proving Grounds) using Prophet in a tactically relevant environment and is currently scheduled for October 2002, prior to initial fielding of Prophet. After operation of the system, soldiers will complete a survey from the U.S. Army Test and Evaluation Command's (ATEC) Prophet system Evaluator and MANPRINT evaluator. This survey asks soldiers to compare the effectiveness and suitability of the AN/PRD-13 (v) 2 front panel interface to the new laptop based MMI in supporting the operator's performance of the Prophet SIGINT. Next, in January 2003 in conjunction with fielding to the First Stryker Brigade Combat Team (SBCT) at Fort

Lewis, operators will again be surveyed at the conclusion of the three-week training and a field exercise period. The SBCT soldiers have had Prophet EMD systems for two years and as such are highly qualified to assess the effectiveness and suitability of the MMI upgrade in the Prophet Production system.

The Training and Doctrine Command System Manager Prophet (TSM Prophet) and the Product Manager Prophet are currently updating the Test and Evaluation Master Plan (TEMP). This update is required to incorporate the ATEC agreed upon Prophet Continuous System Evaluation Strategy and changes from the Annual TSM Prophet ORD update. This revised test strategy will require and evaluate the MMI at least three times in the next eight months as well as in units as the systems are fielded to the Army.

PM Prophet is supporting ATEC's performance of an operational assessment of the MMI and feels that adequate testing of the MMI has and is being performed albeit delayed slightly from that which was originally planned.

Finding Summary B: Certification Level 2 for Prophet Systems. Both Prophet EMD and Prophet Blk I information systems require information assurance features to ensure system availability, integrity, and authentication. The Prophet Program Office performed a system security assessment of Prophet EMD and designated it at certification Level 1. The program office has not performed an assessment of Prophet Blk I. Certification Level 1 system security assessment only requires a minimal security checklist. During our assessment we determined that Prophet EMD and Prophet Blk I are at certification Level 2. Our result was based on Prophet EMD and Prophet Blk I mission-reliance being "total" instead of "partial" and the degree of integrity being "exact" instead of "not applicable." Because the Prophet system's certification is not Level 2, an independent security certification analysis, testing, and evaluation is not planned. Prophet will be fielded without knowing the extent to which the systems meet information assurance requirements.

Recommendation: We recommend that Product Manager, Prophet designate Prophet EMD and Prophet Blk I at system security level 2 and implement an independent security certification analysis that includes a security test and evaluation during Phase 3 validation as specified in Department of Defense Information Technology Security Certification and Accreditation Process (DITSCAP) Application Manual 8510.1-M, July 31, 2000.

PM Prophet Position: Partially Concur. Prophet will be fielded with sufficient confidence that the system meets its information assurance requirements. The Prophet Blk I SSAA provided to the DoDIG was for the Prophet EMD system, which operates at the sensitive but unclassified (SBU) level. This original certification level 1 determination aligned with the operational classification of SOCOM's Improved SOF SIGINT Manpack System (ISSMS) also known as the AN/PRD-13(v)2 which is the SIGINT sensor component of the current Prophet system. The Prophet EMD configuration (without the tape recorder) is operating today at SBCT Ft. Lewis and at QRC sites at the SBU level. PM Prophet has since recognized that, in accordance with NSA classification guidance and the new Prophet Security Classification Guide (SCG), the system must be accredited at the collateral SECRET level to allow for inclusion of a tape recorder in the system. The Prophet EMD systems are currently operating under an "Interim

Approval to Operate" (IATO), and will be accredited as part of the final Production SSAA accreditation in 1Q FY03.

The Prophet EMD configuration (without the tape recorder) was originally scored a 12 (certification level 1). The entire scoring for both the Prophet EMD and Production systems was re-looked when the SSAA was updated for Blk I Production. The level 1 certification for Prophet EMD configuration (without the tape recorder) did not change and remains appropriate with a modified score of 15 (an increase of 3 based on Integrity). To allow for inclusion of a tape recorder in either the EMD or production configurations, PM Prophet determined the score to be an 18, which places the system at certification level 2. The DoDIG, upon review; scored the EMD system a 22, also certification level 2, which is consistent with the PM. The classification scoring table below compares the updated SSAA scoring against the DoDIG recommendation.

System Characteristic	SSAA Scoring	DoDIG Recommendation
Interface Mode	Passive – 2	Passive – 2
Processing Mode	Dedicated – 1	Dedicated – 1
Attribution Mode	None – 0	None – 0
Mission Reliance [1]	Partial – 3	Total – 7
Availability	ASAP – 4	ASAP – 4
Integrity [2]	Approximate – 3	Exact – 6
Information Category [3]	Secret – 5	Sensitive – 2
	Total – 18	**Total - 22**

The Prophet Production system SSAA documents the process by which the Production system was analyzed, tested and evaluated as required for a Level 2 system, including an independent security certification analysis. Security accreditation testing was performed April - June '02.

Finding in Appendix A. **Management Control Program Review.** The audit identified the lack of planning on the PM's part and failure to identify the need for an operational test assessment of Prophet Blk I MMI as a material management control weakness.

PM Prophet Position: **Non-Concur.** PM Prophet has adequate management controls and had always planned for operational testing of the MMI prior to fielding. As discussed above in the response to the DoDIG's Finding A, PM Prophet has been continually working with ATEC through the Prophet Test and Integration Working Group (TIWG) to plan, define, resource, and execute its test requirements. PM Prophet feels that adequate coordination has been done with ATEC to ensure necessary testing is performed.

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[1] Mission Reliance. The PM rating remains unchanged. The original PM designation of mission reliance level as Partial remains appropriate, reflecting that the mission is partially dependent on the system, and that a unit could accomplish their Force Protection mission if needed without Prophet.

[2] Integrity. The PM rating has been revised. The Prophet system provides approximate measurement of the parametrics including DF of a signal, PM Prophet believes that "Approximate", rather than "Exact" is the most appropriate rating.

[3] Information Category. The PM rating has been revised. In order to incorporate the voice tape recorder into the system, PM Prophet has raised the operational security level from Sensitive but unclassified (SBU) to Secret.

Team Members

The Technical Assessment Division Directorate, Office of the Assistant Inspector General for Auditing of the Department of Defense prepared this report. Personnel of the Office of the Inspector General of the Department of Defense who contributed to the report are listed below.

David A. Brinkman
Kenneth H. Stavenjord
Peter C. Johnson
Anh H. Tran
Cindy L. Gladden
Ann A. Ferrante