United States General Accounting Office

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Briefing Report to the Chairman
Committee on Armed Services
House of Representatives

November 1987

STRATEGIC FORCES

Testing of Air Launched Cruise Missile Components Questioned

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GAO

United States
General Accounting Office
Washington, D.C. 20548

National Security and
International Affairs Division

B-207053

November 24, 1987

The Honorable Les Aspin
Chairman, Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

On August 4, 1987, you asked us to monitor the Air Force's investigation of alleged improper testing of flight data transmitters (FDTs) installed in Air Launched Cruise Missiles (ALCMs). FDTs help keep the missile in stable flight as it follows its preprogrammed flight path. They were assembled and tested by Northrop's Precision Products Division under subcontract to the Boeing Aerospace Company, the prime contractor for the ALCM system.

We reviewed available information developed by various Air Force components and others concerning the alleged improper testing, Air Force assessments concerning the potential impact of faulty FDTs on ALCM effectiveness, the plans being considered for additional FDT testing, and quality assurance at the Northrop plant. Our work was limited to determining the status of the ongoing investigations. The results of our work are summarized below and more detailed information is provided in appendixes I through V.

ALLEGATIONS OF IMPROPER TESTING

To assure FDTs met specifications and were reliable, the Boeing subcontract required Northrop to perform a comprehensive set of tests on each FDT. However, informants told Air Force special investigators in January 1987 that some of the FDTs produced were not tested according to the contract test specifications and that test records were falsified. As a result, Air Force officials were concerned that some FDTs installed in operational ALCMs might not function properly. The Air Force's Office of Special Investigations (OSI) is leading the criminal investigation associated with the allegations. The information developed by OSI was turned over to the Department of Justice, which has directed that any information that could prejudice the investigation should not be released to anyone. Therefore,

the Air Force is not currently able to use the information developed by OSI from the informants and thus assumes all FDTs are suspect.

Upon notification of the allegations, Northrop conducted an internal evaluation of FDT production and testing processes and of FDT records in July 1987. Northrop officials told us their investigation disclosed some testing irregularities occurred during FDT production, affecting an estimated 29 FDTs. Northrop has disciplined the employees responsible for the improper testing and requested that the Air Force return the suspect FDTs to the company for retesting at no cost to the government. Additionally, Northrop officials told us that they are cooperating fully with the Department of Justice on its investigation of the allegations.

IMPACT ON ALCM EFFECTIVENESS

The ALCM system manager is examining the potential impact improperly tested FDTs could have on the ALCM force. In order to assess this impact, the system manager analyzed FDT failure data and conducted special, nonscheduled depot testing of several FDTs in April and May 1987. The ALCM system manager at the Oklahoma City Air Logistics Center (ALC) completed this investigation in August 1987 and concluded that the ALCM force is reliable and will perform its intended mission. The system manager bases this conclusion on the following data:

-- ALCM mission readiness has been reported at 96 to 97 percent for the past 3 years.

-- FDT field failure rates are considered acceptable for this type of component. All ALCMs are frequently tested at Strategic Air Command (SAC) bases and the system manager believes these tests would identify FDTs that are not functioning properly.

-- FDTs have performed satisfactorily during ALCM operational test launches conducted several times each year. Only 2 FDTs failed during 113 pre-flight tests conducted between 1982 and 1987, and none failed during the 55 actual operational test launches.

-- FDT repair records revealed no unusual failure trends.

-- An ALCM computerized flight simulation conducted by Boeing using out-of-specification FDT values showed the

missile would still have flown its intended mission and arrived on target.

During special tests, however, conducted at the Air Force's Warner-Robins ALC depot test facility during April and May of 1987, 10 of 11 FDTs did not meet specifications for some parameters. The validity of those test results is being questioned by Air Force officials because a subsequent investigation showed the depot test methodology did not duplicate the tests Northrop was required to conduct. Air Force and Boeing officials told us that, once the test is modified, the depot will be able to identify the FDTs that do not meet original specifications. But they also said it will be difficult to determine whether an FDT's failure to meet specifications at the time of the depot test is related to age, normal use, or other causes.

ADDITIONAL TESTING IS PLANNED

The ALCM system manager is planning to conduct additional special tests on some FDTs to eliminate any doubt about the ALCM's reliability. Initially, 125 randomly selected FDTs were to be tested against original factory specifications at either Northrop or Warner-Robins ALC. However, Oklahoma City ALC officials later decided an alternate approach could evaluate FDT performance at lower cost and with less disruption to SAC operations. The revised plan, which has not been fully defined, calls for (1) testing 125 FDTs at SAC bases during 1988, (2) testing approximately 38 FDTs annually at Warner Robins ALC, and (3) returning 29 suspect FDTs identified by Northrop to the company for retesting. This approach differs from the original plan in that the 125 FDTs are to be tested for functional performance, not whether they meet original specifications. Also, because the FDTs to be tested will not be randomly selected, the results cannot be statistically projected to all FDTs. However, a few Air Force officials we interviewed questioned the value of any additional FDT testing, citing their confidence in the ability of the Air Force ground test equipment to detect any FDT that might jeopardize ALCM mission success and the FDTs' satisfactory field performance.

QUALITY ASSURANCE AT THE NORTHROP PLANT

The Air Force's investigation does not include an evaluation of the effectiveness of quality control/assurance at the Northrop plant during FDT production. Neither the Defense

Contract Administrative Service (DCAS) nor Boeing officials were aware of any improper testing at the Northrop plant before the informants' allegations were revealed. Northrop's quality control system was approved by Boeing and reviewed by DCAS and both told us they considered Northrop's overall quality performance satisfactory.

Early in the production program, however, quality problems led Boeing to change the status of its quality assurance inspector at Northrop from part-time to full-time. Boeing told us the quality problems were resolved by late-1983 and in 1985, their inspector resumed part-time oversight. DCAS said that its inspectors provided limited quality assurance oversight because they were unaware of significant quality problems and because of the presence of an on-site Boeing quality inspector.

After the allegations were made public in 1987, DCAS officials reviewed their oversight at Northrop's plant. Their July 1987 report noted that DCAS's current contract quality assurance program was unsatisfactory and needed improvement. The report concluded, however, that increased oversight might not have been adequate to detect the fraudulent activities alleged to have occurred at the Northrop plant.

Northrop officials told us their FDT production facility was a small, satellite operation which did not have the level of supervision and quality control oversight present in their larger production facilities. They said their internal review shows that production problems and the resulting pressures to meet contract schedules may have led some employees to omit certain FDT tests and falsify records. They said they have taken measures to assure proper quality controls are present in all current Precision Product Division programs. Further, they have decided to close their satellite facility and transfer these operations to their Norwood, Massachusetts, headquarters.

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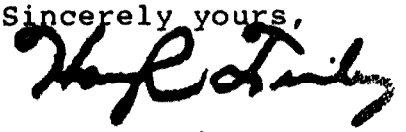
The information in this report was obtained from the Air Force organizations involved in the FDT investigation, DCAS, the Northrop Corporation, and the Boeing Aerospace Company. We interviewed officials from these organizations and reviewed the documents they provided. The scope our review was limited to monitoring the status of the ongoing Air Force FDT investigation and impact assessment. Accordingly, we did not verify all the statements and opinions provided by these officials. Additionally, some of the source

documents were not available to us because of the ongoing investigations. Information in this report was discussed with representatives of the organizations contacted and their comments were incorporated where appropriate. Further information on our objectives, scope, and methodology are described in appendix VI.

As arranged with your office, unless you publicly announce its contents earlier, we will not distribute this report until 30 days after its issue date. At that time, copies will be made available to appropriate congressional committees; the Secretaries of Defense and the Air Force; the Director, Office of Management and Budget; and other interested parties. If you have any questions, please contact me at 275-4268.

Sincerely yours,



Harry R. Finley
Senior Associate Director

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ABBREVIATIONS

AFPRO	Air Force Plant Representative
ALC	Air Logistics Center
ALCM	Air Launched Cruise Missile
DCAS	Defense Contract Administrative Service
FDT	Flight Data Transmitter
OSI	Office of Special Investigations
PRVT	product reliability verification test
SAC	Strategic Air Command

BACKGROUND

The Air Force awarded the first Air Launched Cruise Missile (ALCM) production contract to the Boeing Aerospace Company in May 1980. This and subsequent contracts required Boeing to deliver a total of 1,715 missiles between 1981 and 1986. Boeing subcontracted the development and production of the flight data transmitter (FDT), a key flight control component, to the Northrop Corporation's Precision Products Division. The FDT aids the ALCM's flight control system electronics in keeping the missile in a stable pre-planned flight path.

Northrop delivered the first FDT in September 1981 and was to deliver between 30 and 40 FDTs per month to Boeing. Northrop was generally late in delivering the FDTs, and Boeing officials told us they expressed their dissatisfaction on several occasions regarding late deliveries to Northrop's management. In October 1985, the scheduled completion date of the final subcontract, Northrop had not yet delivered 127 of the FDTs to Boeing.

Boeing's subcontract required Northrop to subject each FDT to a series of tests to demonstrate compliance with specifications and to ensure quality workmanship and component reliability. Boeing officials told us these tests, particularly the product reliability verification test, identify weak components that might fail in the field shortly after deployment. These tests include operations in both hot and cold temperatures and under random vibration and take about 110 hours. They also said that the FDTs that pass such tests are expected to be more reliable in the field. After receipt at Boeing, no testing was done on the FDTs until the completed ALCM underwent its final test before delivery to the Air Force. If, in final tests, Boeing identified the cause of an ALCM test failure as being the FDT, the FDT was sent back to Northrop for retesting and repairs.

According to Oklahoma City Air Logistics Center (ALC) officials, FDT performance has been satisfactory to date. During the FDT production (1981 to 1986) about 5 percent of the FDTs produced failed during Northrop final testing. Northrop repaired and retested these FDTs before delivery to Boeing. Of the FDTs delivered to Boeing and installed in ALCMs, about 7 percent did not operate properly when Boeing tested the ALCM prior to delivery to the Air Force. These FDTs were returned to Northrop for testing and repair. Accordingly, all FDTs installed in ALCMs by Boeing should have functioned properly when the ALCMs were delivered to the Air Force. From March 1985 through October 1987, the Strategic Air Command (SAC) returned 171 FDTs which did not operate properly to the Warner-Robins ALC, Georgia, depot facility for repair.

According to the system manager, the rate of FDT field failures is not unusual for components of this type. Additionally, officials at Warner-Robins ALC stated that they observed no unusual failure trends in the units they have repaired.

Primary responsibility for repair of FDTs rested with Northrop until March 1985 when responsibility shifted to Warner-Robins ALC.

ALLEGED IMPROPER TESTING

Informants told Air Force special investigators in January 1987 that some FDTs delivered to Boeing by Northrop were not properly tested, some that failed tests were not reported or repaired, and others that were repaired were not fully retested. These informants also said that production test records were falsified to conceal these improper practices. As a result, an undetermined number of FDTs, which may not meet contract specifications, may be installed in ALCMs deployed at SAC bases.

Few details about these allegations were made available to us. Because the Department of Justice is investigating these allegations, the assistant U.S. attorney responsible for this case directed the Air Force's Office of Special Investigations (OSI) not to release any of the evidence or specific details they have obtained.

Although the Air Force is uncertain how many FDTs may have been improperly tested, a Northrop review of all the FDT production records identified test data inconsistencies or missing data items in records for 29 FDTs. On this basis, Northrop told Boeing that up to 29 of the FDTs produced may have been improperly tested.

Following public disclosure of the allegations of FDT testing irregularities, Northrop conducted an internal evaluation of their FDT production operations. They interviewed current and former employees, and analyzed assembly and testing procedures and records. Northrop employees stated that testing of some FDTs was not properly performed from late-1983 to the end of FDT production in mid-1986. Northrop's analysis of FDT test records showed that for approximately 29 FDTs, certain records were missing and others were falsified. This and subsequent analyses has led Northrop to conclude that these FDTs may not have been properly tested as required in Boeing's subcontract.

Northrop has dismissed four employees and disciplined one other for their participation in the alleged improper testing. Northrop notified Boeing of the suspect FDTs and requested that the FDTs be returned to the company for retesting at no cost to the government.

IMPACT ON ALCM FLEET EFFECTIVENESS

The ALCM system manager has concluded there is no evidence indicating that the ALCM system's reliability and effectiveness have been jeopardized, despite allegations of improper FDT testing. The system manager bases his position on (1) the ALCM's high mission readiness, (2) confidence in the accuracy of Air Force ground test equipment used to test ALCMs, (3) satisfactory FDT failure rates and maintenance data, (4) analysis of flight test data, and (5) results of special computer simulations of out-of-specification FDTs in ALCMs. Additionally, special tests of several FDTs were performed to determine whether these FDTs met original specifications. While these tests disclosed an unusually high number of failures, a subsequent review showed that some Air Force test equipment and procedures were not appropriate and needed modification. There is, however, a minor concern that FDT performance under very cold temperatures is not tested by SAC. The Air Force is addressing this concern by including cold temperature testing in their special FDT testing plan.

After learning of the allegations in February 1987, Oklahoma City, ALC officials initiated a review of ALCM testing and FDT failure and maintenance data. They told us that ALCM is one of the most reliable missiles managed by the Air Force, having a 96 to 97 percent mission readiness over the last 3 years. Each ALCM is tested at SAC bases frequently to assure it is ready to perform its mission. Figure III.1 identifies the various maintenance tests SAC personnel performed on ALCMs.

The system manager and Boeing officials are confident that the multiple tests performed periodically by SAC on ALCMs would detect any FDT that would jeopardize ALCM's flight performance. During 1985 and 1986, SAC performed 2,465 level I tests the most comprehensive field ground test--on ALCM missiles and found 103 FDTs (4.2 percent) were not functioning properly.

A May 1987 Air Force analysis of FDT depot repair records revealed no specific failure trends. As part of this analysis, the Air Force compared FDT failure rates with those of similar components used on the Short Range Attack Missile and concluded that the FDT failure rate was comparable and typical for this type of component.

Figure III.1: Air Force Maintenance Tests Performed on FDTs

Type of Test	Location of Test	Description of Test
Level I	SAC integrated maintenance facilities	The most comprehensive of Air Force field ground tests. It assures that the ALCM is functioning properly and is mission ready. It is performed a) when the ALCM is delivered to a SAC base; b) when the ALCM's engine is recertified, approximately every 36 months; and c) whenever maintenance action requires that the ALCM be opened up. The level I is conducted at room temperature.
Level II	SAC integrated maintenance facilities	A diagnostic test that determines the cause of an ALCM failure. If the failure is confirmed, the defective unit is subjected to further testing. The level II is conducted at room temperature.
Level III	Northrop and Warner-Robbins ALCs depot repair facilities	A detailed analysis of an individual component, such as the FDT, and is undertaken whenever a failed component is identified. The test identifies individual subcomponent failures and tests repaired components before they are returned to the field. The level III tests FDTs at room, hot, and cold temperatures.
Loaded Pylon	SAC integrated maintenance facilities	Approximately every 18 months, a fully loaded pylon carrying 6 ALCMs is tested for its readiness. If one or more missiles fails an interface test with the pylon, the missile(s) will be off-loaded and subjected to a level I/II testing to determine cause of failure. The loaded pylon tests FDTs at ambient temperatures.
System Interface	Flight line	Each time a pylon of six missiles is loaded onto an alert aircraft, both a ground test of the pylon and a similar total aircraft system test are performed, which occurs approximately every 3 months. If any missile fails one of these tests, the missile is then subjected to level I/II testing. The System Interface tests FDTs at ambient temperatures.
Operational Test Launch	In flight	Each year, SAC launches a small number of ALCMs to test their capabilities. Each missile is subjected to a ground test, a systems interface test and two pre-launch tests. An ALCM failing any one of these tests is returned to the base for level I/II testing. Operational test launch tests FDTs at ambient temperatures.

The ALCM system manager also reviewed ALCM operational flight test reports. Each year SAC conducts several operational test launches of ALCM missiles. Prior to launch, one or more pre-flight tests are performed to ensure the missile is ready for launching. Of the 113 pre-launch tests performed, only 2 ALCMs were found to have malfunctioning FDTs. No FDTs have failed during the 55 actual ALCM operational test launches.

Due to the possibility that records were falsified, the Oklahoma City ALC considers all FDTs suspect. Oklahoma City ALC officials initially believed they could identify defective FDTs by having the Warner-Robins ALC subject them to the same final acceptance test as required to be performed by Northrop. Accordingly, Warner-Robins ALC performed special depot tests on 4 FDTs that informants identified as being improperly certified by Northrop as meeting all contract specifications. Three of these FDTs failed to meet contract specifications for several parameters. These results seemed at the time to validate the allegations.

Conclusions drawn from these tests may, however, have to be reconsidered. In July 1987, following subsequent testing in which seven other FDTs failed to meet contract specifications, Air Force, Boeing, and Northrop officials performed a comprehensive review of Warner-Robins ALC's test equipment and procedures. These officials determined that Warner-Robins test equipment and procedures did not accurately duplicate Northrop's tests and needed modification. The Air Force is now resolving these differences and told us the Warner-Robins tests will accurately duplicate Northrop's tests by late December 1987.

An evaluation of the test data for the 11 FDTs, performed at our request by Warner-Robins ALC officials and based on the assumption that all necessary changes to the equipment and test procedures has been made, showed that 7 of the 11 FDTs would have passed. Northrop officials disagree with this assessment. They stated that this is a complex issue and cited numerous problems identified with Warner-Robins test equipment and procedures. Northrop officials stated that they have been working with Boeing and the Air Force to resolve these problems, and, while significant progress has been made, the issue has not been completely resolved.

Once modifications to the Warner Robins ALC's test equipment and procedures are made, Air Force officials believe the tests will be able to identify FDTs that do not meet original specifications. Air Force and Boeing engineers stated, however, that it would be difficult to determine the reason FDTs fail to meet specifications. They stated that FDTs contain sensitive, precision components, and performance can change with time and use, particularly under the

conditions encountered at an operational Air Force base. These factors could lead an FDT to fail a depot test as being out-of-specification, without necessarily indicating whether the cause was due to age, usage, or other factors.

Following Warner Robins ALC's testing of the suspect FDTs, the system manager asked Boeing to determine what would have happened if these FDTs were in ALCMs that were actually launched. Using its ALCM flight simulation computer, Boeing found the out-of-specification values recorded from the suspect FDTs were not serious enough to have caused a mission failure. According to Boeing, the missiles would have flown to their preprogrammed targets. Boeing performed other simulations with even greater out-of-specification values and concluded that FDTs with such values would not have affected ALCM mission success.

The system manager believes, however, that FDT performance under very cold temperatures still poses a minor concern because:

-- FDTs are known to be sensitive to cold temperature. Boeing officials told us that 22 of the 79 FDTs that failed Northrop's final tests failed during very cold temperature testing.

-- SAC bombers, which launch ALCMs, flying at the 32,000-52,000 feet required for strategic missions, could encounter temperatures as low as below 116 degrees F.

-- In two different operational test launch attempts, an FDT malfunctioned during the pre-launch test due to the effects of cold temperature. Both FDTs appeared to function properly when tested on the ground at ambient temperatures, but, when later chilled in a laboratory, both failed.

None of the SAC's ground test equipment evaluates FDT performance under very cold temperature. Level I and Level II tests, the most comprehensive of those tests, are conducted at room temperature. The other ground tests are performed under ambient temperatures, which can involve cold weather during winter at northern air bases. Accordingly, the Air Force's plan for additional testing of FDTs is to include cold temperature tests.

PLANS FOR ADDITIONAL TESTING

The ALCM system manager is planning to conduct special tests on some FDTs to eliminate any doubt about the ALCM's reliability. At first, 125 randomly selected FDTs were to be tested against original factory specifications at either Northrop or the Warner-Robins ALC. After further consideration, the Oklahoma City ALC officials decided an alternate approach could evaluate FDT performance at lower cost and with less disruption to SAC operations. However, a few of the officials we interviewed questioned the value and cost effectiveness of any additional FDT testing, citing their confidence in the ability of the Air Force ground test equipment to identify any defective FDT that would jeopardize ALCM mission success, and the FDTs satisfactory field performance.

ORIGINAL TEST PLAN

Initially, the ALCM system manager had considered special depot testing of a sample of FDTs to assess how well all FDTs were performing. Statisticians at the Oklahoma City ALC determined that by testing 125 randomly selected FDTs, a statistically valid assessment of all FDTs could be obtained with a 95 percent confidence level. The testing was to start in April 1988 and was to take about a year to complete. If more than 10 of the 125 FDTs failed to meet specifications, Oklahoma City ALC officials told us that all FDTs would most likely be tested at a cost of $1 million to $1.7 million.

This plan would have required removing some ALCMs from the operational force solely to conduct the FDT testing. Oklahoma City ALC officials estimated that it would take SAC personnel 7,000 overtime hours to support the testing. Also, because the FDTs were to be tested at Northrop or Warner-Robins ALC, a sufficient number of spare FDTs--approximately 50--were needed to replace those FDTs removed from ALCMs and sent to the depot for testing. Sufficient spare FDTs were not expected to be available until April or May 1988.

REVISED TEST PLAN

Oklahoma City ALC officials told us further consideration of the costs, operational impacts, and logistics of the proposed FDT testing led them to adopt an alternate approach. This plan was approved by the ALCM system manager in October 1987. The revised

plan, which has not been fully defined, calls for (1) testing of 125 FDTs at SAC bases during 1988 using a portable environmental chamber for both hot and cold temperature testing, (2) annual depot testing of approximately 38 FDTs and (3) returning the 29 suspect FDTs identified by Northrop to the company for retesting. This approach differs from the original plan in that the 125 FDTs are to be tested for functional performance, not whether they meet original specifications. Also, because the FDTs to be tested will not be randomly selected, the results cannot be statistically projected to all FDTs.

As now planned, testing of the 125 FDTs is to begin in February 1988, when the additional spare FDTs needed to support these tests are expected to be delivered by Northrop. At an expected rate of 10 to 15 FDT tests per month, the tests will continue for about a year. Because the 125 FDTs will be obtained from ALCMs undergoing scheduled 36-month engine recertification, the FDT test is not expected to disrupt SAC operations or require the large amount of overtime effort estimated under the initial test plan. Performing these tests in this manner eliminates the need to remove an ALCM from the operational force solely for the FDT test. Should the results of the FDT testing show that a higher than expected number of FDTs are not functioning properly, all FDTs may be tested. This would take an additional 2 years.

In addition to special testing of 125 FDTs, the plan calls for depot testing of about 38 FDTs drawn from the ALCM analytical condition inspection and operational test launch programs. Each year, Oklahoma City ALC officials remove 30 ALCMs from the active force and subject them to a complete tear down and functional inspection. This analytical condition inspection is performed to identify any emerging condition, which if undetected could jeopardize ALCM performance. In the past, the FDT was not included in the analytical condition inspection because of its low failure rate. Under the revised test plan, it will be included. In addition, Oklahama City ALC plans to include in this test program the FDTs used in SAC operational test launch missiles.

The revised plan calls for SAC to subject the FDTs to a level I functional test at SAC bases rather than a factory specification test at the depot. The level I test is routinely performed on ALCMs, but under the revised plan, the FDT will be removed from the missile and placed in an environmental test chamber to test under both hot and cold temperature conditions. The level I test evaluates all of the ALCM's electronic subsystems to determine whether the missile is ready to perform its mission. This test is

less comprehensive than the depot test for an individual subsystem such as the FDT. It utilizes a less demanding set of performance standards than the original contract specifications used by Northrop and Warner-Robins ALC depot level tests. Thus, an FDT could pass the level I test at a SAC base but fail the depot test. Oklahoma City ALC and Boeing officials told us they are confident that the Level I tests performed by SAC maintenance personnel will identify any FDT that is not performing adequately. From an operational perspective, they believe that ensuring satisfactory FDT performance is the key issue for ALCM reliability.

Since testing is performed at the SAC bases rather than the depot, logistical impacts are reduced. Fewer spare FDTs are needed because only those FDTs which do not pass the tests will be sent to the depot. In contrast, under the initial plan, all FDTs to be tested would be sent to the depot, thereby requiring numerous spares. Also, combining FDT testing with the ALCMs' scheduled 36-month engine maintenance cycle eliminates the operational impact of removing ALCMs from the active force solely because of the FDT tests. However, since the FDTs to be tested are not randomly selected, the results of these tests cannot be statistically projected to all FDTs in the ALCM force. In essence, these results will only show how well the 125 FDTs are performing.

By selecting the FDTs to be tested from ALCM missiles undergoing scheduled 36-month engine maintenance in 1988, the tests will be limited for the most part to the FDTs manufactured in either 1982 or 1985. Our analysis of FDT failure data shows FDTs manufactured in those years have failed less often than those manufactured in 1983. (See Table IV.1.) The high incidence of FDT field failures for those units manufactured from August 1982 through February 1984 may not be related to the allegations of improper testing. Nevertheless, because the revised test plan would mainly test FDTs manufactured in two of the six years of production, there is some uncertainty about the statistical validity of the test results.

When we discussed the original test plan with Air Force and Boeing officials, a few questioned whether any additional special testing is needed or cost effective. They said they remain confident in the ability of SAC's ground test equipment to identify any FDTs which would jeopardize ALCM mission success. Additionally, they told us field failure data obtained from these tests show FDTs are performing satisfactorily despite allegations of improper testing. Moreover, they stated, that testing some or all FDTs against original specifications is both costly and time consuming, and in terms of ALCM reliability, would provide no better results than

APPENDIX IV

would the functional testing routinely performed at SAC bases. After considering Oklahoma City ALC's revised FDT test plan, these officials still question the need for special FDT testing. They agree, however, that this approach will have a minimum impact on SAC operations, logistics support, and cost.

Table IV.1: FDT Field Failures By Date of FDT Delivery to Boeing

Date Manufactured Year/ Quarter	Number of FDTs delivered	Initial FDT failures	As a percent of FDTs delivered	Total FDT failures[a]	As a percent of FDTs delivered
1981 III	12	1	8.3	1	8.3
IV	35	0	0.0	0	0.0
1982 I	72	5	6.9	6	8.3
II	111	10	9.0	10	9.0
III	121	14	11.6	18	14.9
IV	141	23	16.3	33	23.4
1983 I	144	34	23.6	42	29.2
II	89	18	20.2	23	25.8
III	78	16	20.5	20	25.6
IV	108	12	11.1	13	12.0
1984 I	99	11	11.1	13	13.1
II	157	9	5.7	12	7.6
III	103	6	5.8	6	5.8
IV	61	0	0.0	0	0.0
1985 I	104	2	1.9	2	1.9
II	56	1	1.8	1	1.8
III	79	0	0.0	0	0.0
IV	46	1	2.2	1	2.2
1986 I	43	0	0.0	0	0.0
II	43	0	0.0	0	0.0
III	13	0	0.0	0	0.0
Total	1715	163	9.5	201	11.7

[a]Some FDTs failed more that once during their operating life.

Additionally, there are an undetermined number of other FDTs which failed for which delivery dates, serial numbers and/or dates of failure are not currently avaliable. These FDTs were generally delivered and subsequently repaired by Northrop prior to March 1985, when primary repair responsibility was shifted to Warner-Robins ALC.

QUALITY CONTROL

Several parties were responsible for assuring that FDTs met contract specifications. The Air Force Plant Representative Office (AFPRO) at Boeing, which has contract administrative responsibility for the ALCM, delegated quality assurance oversight to DCAS. Among its responsibilities, DCAS was required to review Northrop's planning and testing procedures and verify that test data packages were complete. Boeing, as the prime ALCM contractor, was to ensure that Northrop, the subcontractor, maintained an acceptable quality control system meeting military standards. DCAS and Boeing officials told us that Northrop met all quality system requirements.

AFPRO, DCAS, and Boeing officials told us that they were unaware of any improper testing by the Northrop employees at the plant. These officials said that they assume a major defense contractor has integrity and its employees are honest. The quality assurance function, in their view, is to identify unintentional human errors or mechanical problems. They said if one or more individuals wishes to assemble and/or test a component improperly and to conceal this activity, it would be difficult for a Boeing or government inspector to discover.

Our discussions with Air Force, DCAS, and contractor officials indicates that quality assurance oversight varied in intensity during FDT production. Early in the production program Boeing monitored FDT production more closely because quality problems were present. Later, when they believed these quality problems were resolved, quality assurance oversight was reduced. Boeing and DCAS officials told us they believe Northrop's overall quality performance was satisfactory. However, we were told that intentional improper testing and falsification of test records would be very difficult to detect under conditions of normal quality assurance oversight. In retrospect, DCAS officials stated that if they had known of the extent of FDT failures and delivery schedule problems they would have increased their quality assurance effort at the plant.

The Boeing quality assurance inspector told us FDT final testing at Northrop was generally performed by one technician using primarily analog test equipment. The test equipment has numerous dials and gauges from which the test technician monitored, read, and recorded the test results. Therefore, he stated, there is more opportunity for human influence on the results than occurs on automatic test equipment like that installed at Warner-Robins ALC. Boeing officials also said that it is not unusual in a small plant to have one test technician and minimal checks by the manufacturer's

quality control personnel. Under such conditions, if a technician wanted to overlook or ignore readings indicating a failure, there was no obvious way to detect it.

The Boeing inspector observed all phases of FDT assembly and testing. He told us that he witnessed PRVT and final acceptance testing a minimum of once every 30 days. He also inspected and approved each FDT before its cover was installed and again before it was shipped to the Boeing plant.

Under the AFPRO's delegation authority, DCAS could either witness the FDT testing or verify that the test data packages were complete. Early in production the DCAS inspector observed acceptance tests and PRVT testing during weekly visits. Also, he evaluated Northrop's quality control system and monitored actions taken by the company to resolve soldering and component quality problems.

In early 1983, Boeing inspections identified more defective FDT parts than Boeing believed was acceptable. Boeing performed a quality assurance technical review and found that production and testing records were not being properly prepared on a timely basis. Subsequently, in mid-1983, Boeing conducted a hardware quality assurance review, a detailed manufacturing analysis at the Northrop plant. This review identified several workmanship problems, including improper wiring, soldering, and component installation. In response to these findings, Northrop conducted additional training of manufacturing personnel in 1983. Also, during this period, Northrop experienced unusually high rejection rates for gyroscopes and accelerometers supplied by their Norwood, Massachusetts, factory. On the basis of their reviews, Boeing assigned a full-time quality inspector to the plant from August 1983 until July 1985.

Boeing officials told us that Northrop resolved these quality problems by late 1983. Beginning in July 1985, the Boeing representative began making only periodic visits to the plant to review assembly and testing procedures. Similarly in early 1985, because of the presence of the Boeing quality inspector and the absence of quality problems reported by either Boeing or the Air Force, the DCAS inspector stopped witnessing tests and limited his review to the test data during weekly visits to the plant.

DCAS officials stated they were not told of FDT failure rates at the Boeing assembly plant. Boeing records show that 115 of the FDTs delivered by Northrop did not work properly when tested in an ALCM. The AFPRO inspector for ALCM at Boeing told us that ALCMs often failed final factory testing due to defective FDTs. While he

reported the problem to his supervisor, he said no action was taken by the AFPRO, probably because other ALCM components had significantly higher failure rates and required more immediate attention. Boeing officials said they reported the FDT test failures to the Air Force in monthly program management reviews. However, Boeing did not highlight the failures as a cause of concern because the failures were not affecting the ALCM delivery schedule. Consequently, the AFPRO did not request DCAS to increase surveillance at the Northrop plant.

Following public disclosure of alleged improper FDT testing, a DCAS internal review team evaluated the current DCAS quality assurance operation at Northrop's plant and issued a report in July 1987. The report stated that problems were noted in all major areas of DCAS responsibility--planning, procedures review, procedures evaluation, product verification inspection, and corrective action. It stated that product verification inspections were practically nonexistent and in view of the indicators of returned failed units, it would have been prudent to set up a system for witnessing a portion of acceptance and PRVT tests. The report concluded, however, that even had the improvements been implemented, it was doubtful that DCAS personnel would have detected the alleged improper testing.

Between 1982 and 1986, DCAS did not issue any quality deficiency reports, aside from minor defects that could be resolved without formal reporting. However, since being informed of the alleged FDT testing irregularities in April 1987, DCAS has issued five deficiency reports for quality problems, including one involving an electronic gyroscope assembly.

DCAS officials told us Northrop's test technicians reported to the quality control manager, who in turn reported to the plant manager. Northrop changed the organizational structure at the plant in July 1987 to eliminate apparent internal control problems. The quality control personnel now report directly to the Norwood, Massachusetts, quality control manager, not the local plant manager. This change, according to Northrop officials, increases the independence of the quality control personnel.

Northrop officials told us their plant where the FDTs were produced is a small, satellite facility which did not have the level of supervision and quality control oversight present in their larger production facilities. The plant has about 30 employees, of which 8 to 10 assembled and tested FDTs under the supervision of a quality control supervisor and the plant manager. Northrop officials said their internal review disclosed production problems, including poor workmanship and defective components. These

problems, as well as the lengthy testing specified by Boeing, slowed production and delayed FDT deliveries. They believe that the pressure to meet schedule requirements and receive payments for completed units may have led some employees to omit certain tests and falsify records.

Northrop officials told us they have reviewed their quality control procedures at the plant and realigned the organizational structure so that the quality control supervisor now reports to the division manager's office, instead of to the plant manager. A senior quality assurance supervisor and a new plant manager have been assigned to the plant to assure full compliance with Northrop quality control procedures and product specifications. Moreover, full attention to product quality control oversight has been reemphasized throughout the Precision Products Division. Finally, by the end of 1987, their satellite plant will be closed and the operations performed there will be transferred to the division headquarters in Norwood, Massachusetts.

OBJECTIVES, SCOPE, AND METHODOLOGY

The Chairman, House Committee on Armed Services, asked us to monitor the Air Force's investigation of alleged testing irregularities occurring during the production of FDTs at Northrop's Precision Products plant. The Chairman asked us to review the scope and status of the investigation and whether the alleged improper testing would affect ALCM readiness or mission success.

In performing our review, we obtained documents and interviewed officials within the Air Force from

-- OSI at Norton Air Force Base, California, who have responsibility for developing criminal evidence in this matter;

-- the Oklahoma City ALC at Tinker Air Force Base, Oklahoma, who have responsibility for ALCM systems management;

-- the Warner-Robins ALC at Robins Air Force Base, Georgia, who have responsibility for the repair of faulty FDTs;

-- the Aeronautical Systems Division at Wright-Patterson Air Force Base, Ohio, who had responsibility for the acquisition of the ALCM system; and

-- the Air Force Plant Representative Office at Kent, Washington, who had oversight responsibility during the production and testing of the ALCM weapon system.

Additionally, we interviewed officials in the Defense Contract Administration Services, Ontario, California, who had oversight responsibility during the production and testing of FDT.

We also interviewed officials from the Northrop Corporation's Precision Products Division and the Boeing Aerospace Company's ALCM program office.

We also contacted the U.S. Attorney's Office for the District of Los Angeles, which is investigating the allegations of FDT testing irregularities.

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