United States General Accounting Office

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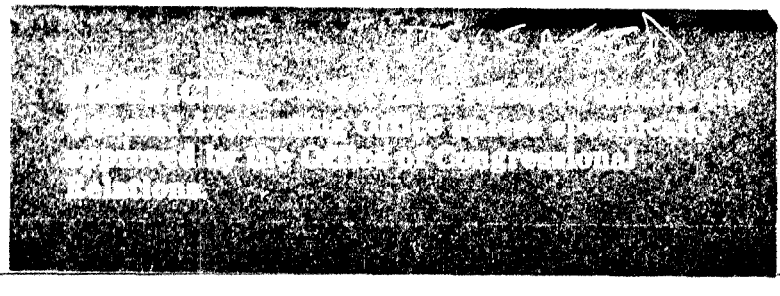
Report to the Chairman, Committee on Armed Services, House of Representatives

March 1991

ELECTRONIC WARFARE

Early Production of Tacit Rainbow Missile Not Warranted



GAO/NSIAD-91-71

GAO

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

National Security and
International Affairs Division

B-242726

March 8, 1991

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

Dear Mr. Chairman:

As you requested, we reviewed the Tacit Rainbow missile program to determine whether the system has demonstrated in testing that it meets the Air Force's established criteria for beginning a preproduction verification phase. This phase, which was proposed by the Air Force to precede low-rate initial production, would have marked the initiation of Tacit Rainbow's production since it would include the manufacture of up to 30 missiles at a new production facility. Consequently, we also reviewed the test results to evaluate the system's readiness to begin production.

However, after we completed work on this assignment the Department of Defense informed us that the Secretary of Defense had terminated the Tacit Rainbow program. Nevertheless, we are issuing this report to provide information to Congress on the Tacit Rainbow's status should the program be resurrected.

Results in Brief

Tacit Rainbow did not fully meet the Air Force's criteria for beginning the preproduction verification phase because the production configured system was not flight tested. In addition, this phase could no longer be executed as originally planned because of continued schedule delays and unexpected cost growth in the program. More importantly, Tacit Rainbow was unreliable in its flight test program and did not demonstrate its readiness to begin production. In over one-half of the 16 flight tests, the missiles did not hit the target because of guidance system failures and other performance problems, and only 2 successful flight tests occurred out of the last 10 attempts.

The Air Force planned to make an early commitment to Tacit Rainbow's production without demonstrating satisfactory performance during operational testing. This increased the risk of becoming committed to producing a deficient system requiring costly modifications to correct problems found during later phases of the test program.

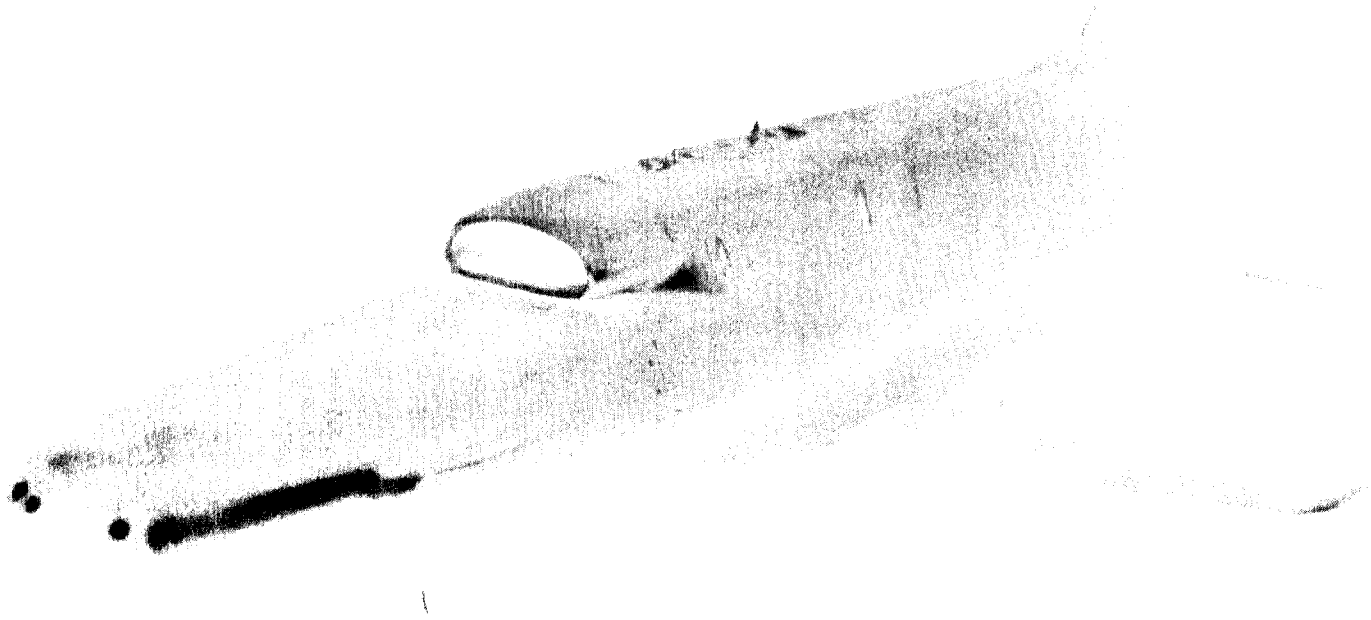
Our past work on other electronic warfare programs has shown that the Air Force often begins producing systems before demonstrating that their performance will be satisfactory. This practice has also frequently resulted in adverse consequences, such as the deployment of defective systems to the operational forces.

Our work has also shown that once a production commitment was made, even though limited, production continued despite the subsequent discovery of major performance problems. Because of this and because of the Tacit Rainbow system's unsatisfactory performance during testing, particularly the more recent tests, an early commitment to production did not appear to be warranted.

Background

The Tacit Rainbow missile was intended to suppress enemy air defense weapons by attacking the radars used in their operation. The missile was supposed to fly to a designated area, loiter until an enemy radar signal was detected, and then attack the radar. (See fig. 1.)

Figure 1: Tacit Rainbow



Source: Air Force

The Tacit Rainbow full-scale development program began in 1981, and in 1982, it became a joint-service effort. An air-launched version of the system was being developed for the Air Force, while a ground-launched version was being developed for the Army.

In 1988, because of continuing technical and schedule problems and the resulting delay in completing contractor flight testing, the Air Force restructured the Tacit Rainbow program. The restructured program called for delaying the start of low-rate initial production by 14 months, from June 1989 to August 1990.

The Air Force instituted a preproduction verification phase as a part of the restructured program to obtain additional missiles for testing and because of concern that the delay of low-rate initial production would adversely affect the vendor base. This phase was to start in September 1989 and was to fill the gap between then and the start of low-rate initial production in August 1990. The preproduction verification phase was also to include setting up the production line in a new facility and manufacturing 90 missiles.

The initiation of the preproduction verification phase was to be contingent on the Tacit Rainbow system meeting certain Air Force criteria. One of the criteria provided that the system must achieve at least five successful flights during the first eight test flights. Successful flights were to include launch, stabilized flight, navigation to the target area, and identification and attack of the target. Another criterion required the successful flight test of a production configured system.

Criteria for Preproduction Verification Phase Not Met

Tacit Rainbow did not fully meet the Air Force's criteria for initiating the preproduction verification phase. The system achieved five successful flights during the first eight tests, but the flight test of a production configured system was not done.

The flight test of a production configured Tacit Rainbow did not occur because contractor delivery of the system was delayed. This test was considered an important criterion for initiating preproduction verification because the system was to incorporate design modifications to the engine, system computer, and fuel pump.

Preproduction Verification Phase Could Not Be Executed as Planned

The preproduction verification phase originally intended by the Air Force could not be executed because of continued program delays and unexpectedly high program costs proposed by the contractor.

Since 1988, when the Air Force conceived the preproduction verification phase, continuing technical and test problems delayed its planned start from September 1989 to April 1991. Because low-rate initial production was then scheduled to begin in January 1992, the original gap between preproduction verification and low-rate initial production decreased to about 9 months.

In addition, proposed program costs were much higher than the Air Force expected. The contractor's proposal for the preproduction verification phase amounted to $251.6 million, or about three times the Air Force's budget of $84 million.

Because the preproduction verification phase could not be executed as originally planned, the Air Force then planned to initiate a smaller scale production phase before beginning low-rate initial production. This phase was scheduled to begin no sooner than April 1991 and was to include the manufacture of 20 to 30 missiles for use during subsequent phases of the test program. The missiles were to be manufactured in the new production facility to be opened for Tacit Rainbow's production phase. At most, only about one-third of the missiles originally planned to be procured could have been purchased with the funds available. This indicates that the total program cost would have been much higher than originally estimated.

Tacit Rainbow Did Not Demonstrate Readiness for Production

The Air Force originally planned to initiate Tacit Rainbow production before demonstrating in operational testing[1] that the missile's performance was satisfactory. Instead, the Air Force had intended to begin production after conducting only developmental flight tests,[2] most of which were not successful.

The test program that the system underwent during our review was considered developmental testing and was to include a total of 25 test flights. The Air Force originally planned for 15 of these flights to be operational tests but decided that Tacit Rainbow had not demonstrated its readiness to begin operational testing. Nevertheless, the Air Force planned to begin the smaller scale preproduction verification phase in April 1991 and to make the decision to begin low-rate initial production in July 1991. Operational testing was to be deferred until fiscal year 1994.

As shown in table 1, 9 of the first 16 developmental flight tests conducted as of October 1, 1990, experienced performance problems, and only 2 of the last 10 tests were successful.

[1]Operational testing is a field test done under realistic combat conditions to determine a weapon system's operational effectiveness and suitability.

[2]Developmental testing is done to assist in the engineering design and development process and to verify that technical performance specifications are met.

Table 1: Results of Tacit Rainbow Developmental Flight Tests

Date of test	Results
3/30/89	Engine malfunctioned
5/17/89	Success
5/31/89	Success
8/17/89	Success
8/31/89	Success
9/15/89	Success
10/5/89	Guidance system failed
11/3/89	Guidance system failed
12/1/89	Guidance system failed
2/8/90	Success
2/23/90	Engine caught fire
3/8/90	Multiple component failures
6/1/90	Missile wings malfunctioned
6/29/90	Computer system failed
9/12/90	Navigation system failed
10/1/90	Success

Satisfactory Performance Should Be Demonstrated Before Production

Our work on other Air Force electronic warfare programs has shown that starting production before systems have demonstrated satisfactory performance during operational testing frequently results in adverse consequences. These consequences have included deployment of deficient systems to the operational forces and costly modification and retrofit programs to solve problems detected in later testing.

For example, our recent review[3] of Air Force electronic warfare jammers showed that as a result of prematurely committing to production, the Air Force deployed jammers that were not capable of enhancing aircraft survivability as required. Some jammers were placed in storage pending redesign to solve problems, while others were being flown by tactical forces in a potential combat zone with inoperative components. In another review, we found that the Air Force experienced similar consequences as a result of producing radar warning receivers before the receivers had satisfactorily completed operational testing.[4]

[3]Electronic Warfare: Need to Strengthen Controls of Air Force Jammer Programs (GAO/NSIAD-90-168, July 11, 1990).

[4]Electronic Warfare: Navy/Air Force Still Developing Separate, Costly Radar Warning Receivers (GAO/NSIAD-87-167, July 1, 1987).

Our work has also shown that once a production commitment is made, even though categorized as limited or low-rate, production continues despite the subsequent discovery of major system performance problems. For example, in the previously cited review of Air Force jammer programs, we found that the Air Force initiated production of one jammer by ordering a limited quantity. After later operational testing revealed major performance deficiencies, the Director of Defense Operational Test and Evaluation recommended that production be stopped. However, the Air Force chose to continue production and start a costly design modification and retrofit program to correct the problems. The jammers deployed to operational forces were not ready for use.

Despite these experiences, the Air Force planned to initiate Tacit Rainbow production in a new facility before completing system development. This preproduction verification phase was to be followed by several years of low-rate initial production pending successful completion of initial operational testing to begin in fiscal year 1994. The plan called for producing a large quantity of missiles, significantly more than required for testing, before the system's performance was to be demonstrated in operational testing. (The specific quantities that were to be produced are classified.)

The Air Force's approach significantly increased the cost risk on the Tacit Rainbow program, as evidenced by experiences on Air Force jammer and radar warning receiver programs. This risk could have been minimized by retaining the system in the development phase until it demonstrated satisfactory performance in operational tests.

Recommendations and Agency Action

In a draft of this report, we made recommendations to the Secretary of Defense that were aimed at preventing the Air Force's premature commitment to Tacit Rainbow production. In responding to the draft report, the Department of Defense agreed with our recommendations but stated that the Secretary of Defense had canceled the Tacit Rainbow program.

Matter for Congressional Consideration

At the time of the Secretary of Defense's decision to cancel the program, $84 million in unobligated procurement funds was available. Congress may wish to direct the Air Force to determine funding required to terminate the program. The remaining funds could be rescinded or reprogrammed to meet other needs.

Agency Comments

The Department of Defense agreed with our findings. The Department's detailed comments are reprinted in appendix I.

Scope and Methodology

To accomplish our objectives, we reviewed test plans, reports on the results of tests, performance requirements documents, program schedules, and other records bearing on our objectives. We also discussed various aspects of the program with responsible Department of Defense and Air Force officials.

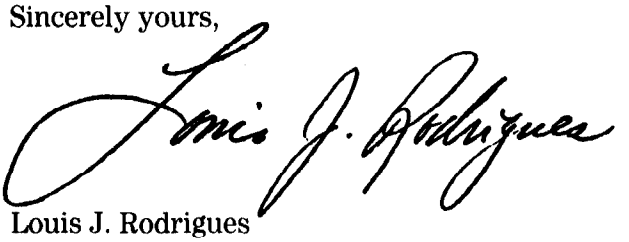
Our work was done primarily at the Office of the Secretary of Defense and Air Force Headquarters in Washington, D.C.; the Tacit Rainbow System Program Office at Wright-Patterson Air Force Base, Ohio; the Air Force Flight Test Center at Edwards Air Force Base, California; and the Naval Weapons Center at China Lake, California.

Our review was performed from November 1989 through October 1, 1990, in accordance with generally accepted government auditing standards.

Unless you publicly announce it contents earlier, we plan no further distribution of this report until 10 days from its issue date. At that time, we will send copies to interested congressional committees; the Secretaries of Defense, the Air Force, the Army, and the Navy; the Director, Office of Management and Budget; and other interested parties. We will make copies available to others upon request.

Please contact me at (202)-275-4841 if you or your staff have any questions concerning this fact sheet. Other major contributors are listed in appendix II.

Sincerely yours,



Louis J. Rodrigues
Director, Command, Control, Communications,
and Intelligence Issues

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

30 JAN 1991

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Conahan:

See comment 1.

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "ELECTRONIC WARFARE: Early Production of TACIT RAINBOW Missile Not Warranted," dated December 10, 1990 (GAO Code 395119/OSD Case 8526). The DoD agrees with the report findings, recommendations, and matter for Congressional consideration.

Further DoD comments are provided in the enclosure. An annotated copy of the report reflecting factual and technical corrections was provided separately. The Department appreciates the opportunity to comment on the draft report.

Sincerely,

Charles M. Herzfeld

Charles M. Herzfeld

Enclosure

GAO DRAFT REPORT - DATED DECEMBER 10, 1990
(GAO CODE 395119) OSD CASE 8526

"ELECTRONIC WARFARE: EARLY PRODUCTION OF TACIT RAINBOW MISSILE NOT WARRANTED"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

● FINDING A: Criteria for Pre-Production Verification Not Met. The GAO reported that, because of technical and schedule problems and the resulting delay in completing contractor flight testing, the Air Force restructured the TACIT RAINBOW program. The restructuring delayed the start of low-rate initial production by 14 months--from June 1989 to August 1990--and instituted a pre-production verification phase that included setting up the TACIT RAINBOW production line in a new facility and manufacturing 90 missiles. The GAO found, however, that notwithstanding the restructuring, TACIT RAINBOW has not fully met the Air Force criteria for initiating pre-production verification testing. The GAO reported that those criteria included (1) five successful flights during the first eight test flights and (2) the successful flight test of a production configured system. The GAO asserted that the second criteria has not been met because contractor delivery of the system has been delayed. (pp. 4-5/GAO Draft Report)

Now on pp. 1, 4.

DoD Response: Concur. The GAO report should include a discussion on the origin of the pre-production verification effort. Without that background, the reader cannot appreciate the factors which led the Air Force and the Office of the Secretary of Defense to adopt the pre-production approach. From the beginning, development test problems caused significant slips in the TACIT RAINBOW Milestone IIIA decision. These delays adversely affected the TACIT RAINBOW vendor base, as purchase orders slowed awaiting the start of a production effort. In addition, the Air Force procured only enough missiles to conduct the 25-flight Development Test and Evaluation/Initial Operational Test and Evaluation program; initial production assets were required to conduct follow-on operational testing. Therefore, the Air Force proposed a pre-production verification effort to the Office of the Secretary of Defense to both protect the existing vendor base and to produce the missiles needed to continue operational testing. The Office of the Secretary of Defense approved the pre-production verification approach in December 1988.

See comment 2.

Enclosure

Now on p. 4.

- FINDING B: Pre-Production Verification Cannot Be Executed As Planned. The GAO concluded that the pre-production verification phase intended by the Air Force can no longer be executed. The GAO found that continued program delays have now decreased the time gap, which pre-production verification was supposed to fill--and program cost estimates are much higher than originally expected. The GAO noted that the contractor proposal for pre-production verification amounted to $251.6 million, or about three times the Air Force budget of $84 million (for verification). (pp. 5-6/GAO Draft Report)

  DoD Response: Concur.

Now on p. 5.

- FINDING C: A Smaller Scale Production Effort Now Planned. The GAO observed that, because the pre-production verification phase cannot be executed as planned, the Air Force now plans to initiate a smaller production effort before beginning low-rate initial production. The GAO found that the smaller effort, scheduled to begin in December 1990, is to include the manufacture of 20 to 30 missiles for use during subsequent phases of the test program. The GAO also observed that, since only one-third or fewer missiles are to be procured, compared with the original plan, the cost per missile is about three times the original estimate. The GAO concluded that as a result, the program costs will be significantly higher than originally estimated. (pp. 6-7/GAO Draft Report)

  DoD Response: Concur. The smaller production effort was an unapproved Air Force proposal to provide a bridge to the full production effort to buy additional test assets within the available budget.

Now on pp. 2, 5-6.

- FINDING D: TACIT RAINBOW Has Not Demonstrated Readiness for Production. The GAO found that the Air Force plans to initiate TACIT RAINBOW Production before demonstrating in operational testing that its performance will be satisfactory. The GAO further found that the Air Force will begin production after conducting only developmental flight tests--most of which have not been successful. The GAO observed that nine of the first 16 developmental flight tests conducted as of October 1, 1990 experienced performance problems, and only two of the last 10 tests were successful. The GAO concluded that, because of the TACIT RAINBOW system unsatisfactory performance during testing--particularly the more recent tests--an early commitment to production does not appear warranted. (p. 2, pp. 7-9/GAO Draft Report)

Enclosure

DoD Response: Concur. The GAO expressed concern that, with the pre-production verification phase, the Air Force makes an early commitment to TACIT RAINBOW production without demonstrating satisfactory performance during operational testing. In fact, the Air Force has made an early commitment by investing approximately $150 Million in a nonrecurring program (e.g., tooling, special test equipment) to ready the vendors for production. Therefore, the GAO concerns already have been realized: the impact on the vendor base of not proceeding with pre-production verification is comparable to incurring a production break downstream. Given the nonrecurring investment, pre-production verification lessens program risk by smoothing the transition from development to production (e.g., line proofing, producibility improvements). The fundamental dilemma was that the Air Force could not conduct the necessary operational testing without initiating production of some kind to obtain test assets. Whether the Air Force were to build those assets under the full scale development program or call it pre-production verification, the impact on the vendor base would have been the same. The Air Force investigated the advantages/disadvantages of producing the missiles at various contractor locations and did not perceive any significant increase in risk from producing at the Perry, Georgia, facility.

- FINDING E: Satisfactory Performance Should Be Demonstrated Before Production. The GAO reported that its previous work on Air Force electronic warfare programs has demonstrated that starting production before demonstrating satisfactory performance during operational testing frequently results in adverse consequences, including costly modification and retrofit programs--and the deployment of deficient systems to the operational forces. The GAO also asserted that history shows once the production commitment is made, even though categorized as limited or low-rate--production continues despite the subsequent discovery of major system performance problems.

The GAO also found that the current Air Force plans call for production of a substantial quantity of missiles--significantly more than required for testing--before system performance is to be demonstrated in operational testing. The GAO concluded that as clearly shown in electronic warfare programs, the Air Force approach significantly increases the cost risk of the TACIT RAINBOW program. In summary, the GAO concluded that the risk could be minimized by retaining the system in the development phase until successful operational testing justifies a production contract. (pp. 2-3, pp. 9-11/GAO Draft Report)

Now on pp. 2, 6-7.

DoD Response: Concur.

Enclosure

* * * * *

RECOMMENDATIONS

- RECOMMENDATION 1. The GAO recommended that the Secretary of Defense prohibit the Air Force from initiating the pre-production verification phase and permit low-rate initial production to begin only after TACIT RAINBOW has demonstrated satisfactory performance during operational testing. (p. 12/ GAO Draft Report)

See comment 1.

DoD Response: Concur. This recommendation is moot, however, as the Secretary of Defense cancelled the TACIT RAINBOW Program on December 6, 1990.

- RECOMMENDATION 2. The GAO recommended that additional missiles needed to conduct initial operational testing be built under the TACIT RAINBOW developmental program until successful operational testing justifies a production contract. (p. 12/GAO Draft Report)

See comment 1.

DoD Response: Concur. The DoD agrees if the program were to continue. Shifting funding from production to development would be necessary to build the additional test assets. The recommendation is moot, however, inasmuch as the Secretary of Defense cancelled the TACIT RAINBOW program on December 6, 1990

* * * * *

MATTER FOR CONGRESSIONAL CONSIDERATION

- SUGGESTION: The GAO suggested that, in order to minimize the risk associated with prematurely committing to TACIT RAINBOW production, the Congress permit the Air Force to reprogram currently available production funds of $84 million to the system's development program to acquire missiles needed for testing. (p. 12/GAO Draft Report)

Now on p. 7.

DoD Response: Concur. The DoD agrees, if the program were to continue. The suggestion is moot, however, inasmuch as the Secretary of Defense cancelled the TACIT RAINBOW Program as of December 6, 1990.

See comment 1.

Enclosure

The following are GAO's comments on the Department of Defense's letter dated January 30, 1991.

GAO Comments

1. Because the Secretary of Defense canceled the Tacit Rainbow program, we deleted the recommendations and revised the matter for congressional consideration in this report.

2. We modified the report to reflect the Air Force's concern about the vendor base and the need for additional missiles.

Major Contributors to This Report

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