United States General Accounting Office

GAO

Report to Congressional Requesters

August 1991

MUNITIONS PROCUREMENT

Resolve Questions Before Proceeding With Sensor Fuzed Weapon Production

GAO/NSIAD-91-235

GAO

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

National Security and
International Affairs Division

B-244258

August 16, 1991

The Honorable Daniel K. Inouye
Chairman, Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable John P. Murtha
Chairman, Subcommittee on Defense
Committee on Appropriations
House of Representatives

The Air Force's budget request for fiscal year 1992 includes about $109 million for the low-rate initial production of the Sensor Fuzed Weapon—a program estimated to cost about $3.5 billion. The weapon was designed to be used against multiple enemy tanks and armored vehicles during a single aircraft pass. In June 1990 we reported[1] that the program had been restructured for the second time because of test failures, which caused schedule slips and significant cost increases. In September 1991 the Defense Acquisition Board will review the weapon's readiness for low-rate initial production. You asked us to review key inputs to the Board's decision, namely (1) the status of developmental and operational testing; (2) the adequacy of the cost and operational effectiveness analysis, including the criterion used to measure effectiveness; and (3) the status of the threat that the weapon is to counter.

Results in Brief

The Sensor Fuzed Weapon's test results indicate that technical problems with the weapon's operations have been overcome and that the weapon can damage or kill multiple tanks and armored vehicles as designed. Moreover, the Air Force plans to complete all critical developmental and operational tests by the September 1991 low-rate initial production decision.

Although the Air Force also plans to use this weapon on missions against targets near friendly forces (close support missions), it plans to use it primarily on missions against enemy follow-on forces before they can reinforce or replace troops at the front (interdiction missions). The Air Force's cost and operational effectiveness analysis that is to be available for the September production decision will focus on the

[1] Defense Acquisition Programs: Status of Selected Programs (GAO/NSIAD-90-159, June 27, 1990).

weapon's effectiveness in the close support mission because (1) an effectiveness criterion exists for weapons used in that mission and (2) an effectiveness criterion for interdiction weapons is still under development. Whereas the effectiveness of a close support weapon is measured by its damage to individual vehicles, the effectiveness criterion that is being developed for an interdiction weapon will measure the delay that the weapon causes in an enemy unit's advance to the battle. Moreover, the analysis will be incomplete in that it will not compare the weapon's cost and operational effectiveness to the full range of weapons that can be used to interdict enemy forces, such as Air Force mines and Army surface-to-surface and air-to-surface missiles.

A comprehensive cost and operational effectiveness analysis is critical to the weapon's production decision because the Warsaw Pact, the primary threat for which the weapon was developed, has disintegrated. While defense analysts see the weapon as valuable against a more limited threat, other existing interdiction weapons may be effective in countering such a reduced threat. Moreover, the Department of Defense, confronted with declining budgets and competing needs, must make difficult decisions on future weapons' needs.

Background

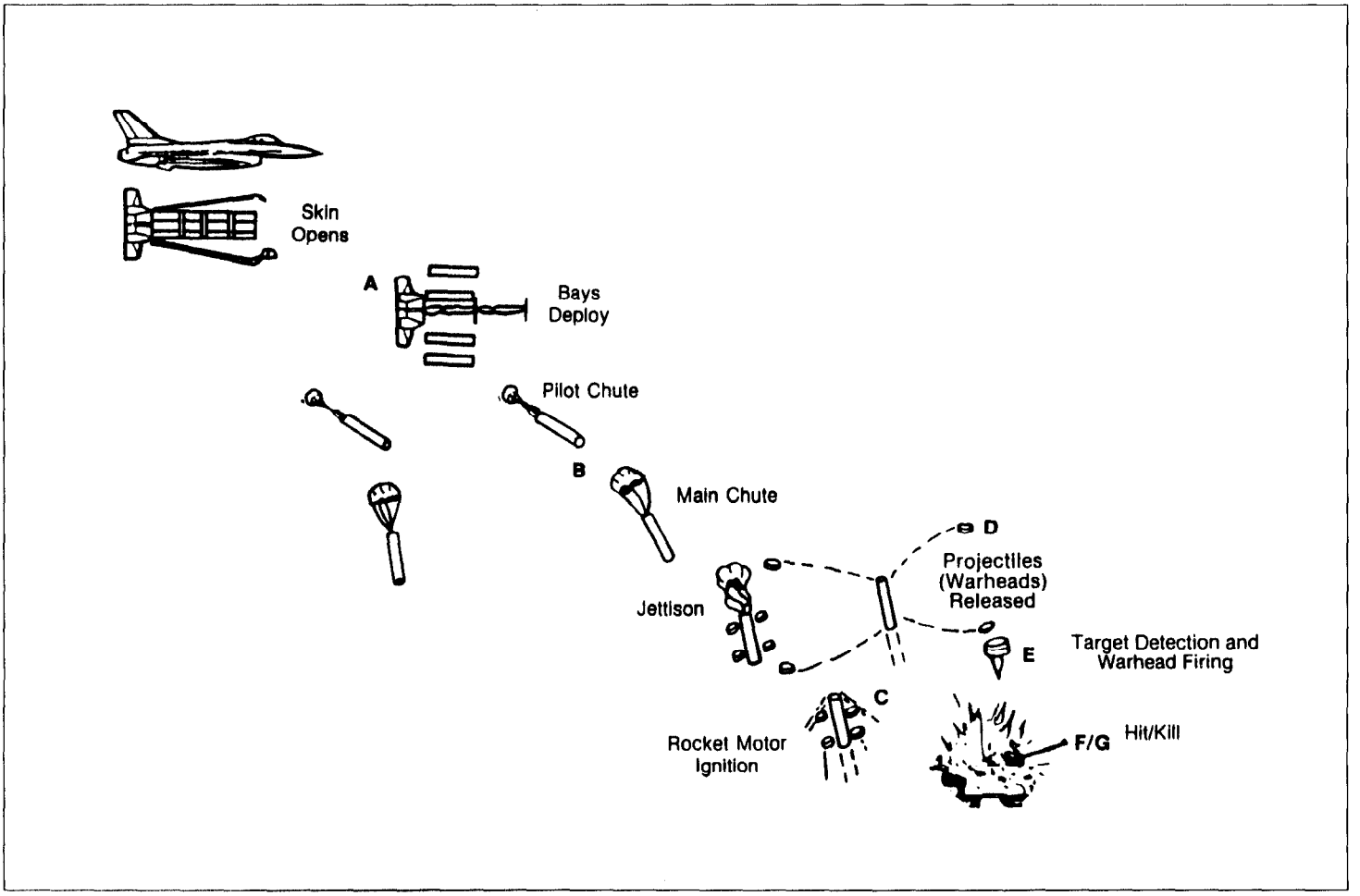
The Sensor Fuzed Weapon was designed to meet the Tactical Air Command's[2] requirement for a capability to destroy multiple enemy tanks and armored vehicles during a single aircraft pass. That capability was needed to overcome the large numerical imbalance of Warsaw Pact armor, and it is needed to reduce exposure of friendly aircraft to enemy fire. It is to operate against a variety of idling or moving tanks and vehicles during the day or at night and in all-weather conditions.

The Sensor Fuzed Weapon is a cluster-type weapon consisting of a munitions dispenser containing 10 submunitions. Each submunition contains four individual projectiles, or warheads. The delivery aircraft is to launch the dispenser once it reaches the target area. At a preset time or altitude, the dispenser will release the submunitions. Parachutes will deploy from the submunitions to stabilize their descent. At a predetermined distance from the ground, a rocket motor fires to elevate and spin the submunitions to dispense their projectiles. An infrared sensor in each projectile scans the target area, and once the sensor detects a heat source of a vehicle such as an engine compartment, the projectile will

[2]The Command represents operational units that would use the weapon in combat.

fire an armor-piercing penetrator into the heat source. Because the penetrator does not explode to completely destroy a tank or an armored vehicle, it has greater probability of inflicting damage that stops a vehicle, a mobility kill. Figure 1 illustrates the weapon and its operational sequence.

Figure 1: Sensor Fuzed Weapon Deployment Events



The Air Force is developing the weapon to be launched from several aircraft, including the F-15E, F-16, A-10, F-111, and several allied nations' aircraft. It plans to use the weapon against massed enemy tanks and armored vehicles over the full range of the battlefield from close to friendly forces to enemy rear areas. However, it is being developed primarily for interdiction missions against second echelon formations to

provide multiple kills per aircraft pass in order to delay the enemy's advance and resupply for several hours. It will not replace any existing weapon but will supplement other Air Force weapons that can be used for interdiction missions, including the Maverick missile, the 30 millimeter gun, the Combined Effects Munition, the Rockeye, and the Gator mines.[3]

In November 1985 the Air Force awarded a fixed-price incentive fee contract for this weapon's full-scale development to Textron Defense Systems. Because of test failures and cost and schedule problems, the Air Force restructured the program in June 1986.

In 1989 schedule slips and test failures forced the Air Force to temporarily suspend contractor testing. In April 1989 the Air Force's contracting officer notified Textron that development performance was not satisfactory and that the Air Force would consider terminating the contract for default if the situation was not remedied within 60 days. One serious problem was that the detonation of one warhead often caused premature detonation of nearby warheads. In June 1989 the Air Force accepted Textron's corrective action plan, which included tests to collect more data on the operation and sensitivity of the weapon's sensor, and restructured the program a second time. The Air Force resumed developmental testing in July 1989 and began operational testing in September 1990. The testing followed a master plan developed by the Program Office, the test organizations independent of the Program Office, the Tactical Air Command, and the Defense Intelligence Agency.

The weapon's operational effectiveness is being evaluated against the Reinforced Regimental Advanced Guard main force, a target set derived by the U.S. Army Training and Doctrine Command as a representative interdiction target. Vehicles in the force include main battle tanks, armored personnel carriers, trucks, armored artillery, and other armored command and reconnaissance vehicles.

The Air Force plans to procure 16,726 Sensor Fuzed Weapons from fiscal years 1992 through 2002. Total program cost in escalated dollars

[3]The Maverick is an air-launched missile designed to destroy tanks, command posts, and other hard targets. It can be guided electro-optically or by laser. The Combined Effects Munition, the Rockeye, and the Gator mines, like the Sensor Fuzed Weapon, deploy multiple submunitions from dispensers. The Combined Effects Munition dispenses some 200 antitank and antipersonnel submunitions, the Rockeye dispenses over 200 armor-piercing shaped-charged bomblets, and the Gator mine dispenses about 100 antitank and antipersonnel mines.

is estimated to be about $3.5 billion: $202 million for research and development and $3.3 billion for procurement. The program is managed at the weapon's Program Office, Eglin Air Force Base, Florida.

Testing Has Demonstrated Improved Performance

At the completion of our review in May 1991, the Air Force had completed 35 of 38 planned developmental tests. Test results and Program Office test officials indicated that 33 were successful, with the 2 failures occurring before the program restructuring.

The Air Force had also completed 14 of 30 planned initial operational tests by May 1991. According to the test manager for the Air Force's Operational Test and Evaluation Center, the operational tests were conducted principally with the F-16 aircraft, which is the Tactical Air Command's preferred aircraft for delivering the weapon, using the Command's preferred tactic of overflying the target at high speed and at low altitude. Results showed that 11 tests were successful and 3 were unsuccessful. Two of the unsuccessful tests were to demonstrate delivery of two Sensor Fuzed Weapon dispensers per aircraft pass. In both tests, one dispenser failed to open and release its submunitions while the other dispenser successfully deployed its submunitions. During the third test, the single dispenser drifted off target because its fins failed to open. Preliminary analyses by the test manager indicated that the three unsuccessful tests were caused by problems with the delivery aircraft, not with the weapons. According to the analyses, the aircraft's bomb release unit vibrated due to unusual air currents, which caused the aircraft's arming components to not function properly.

Of the 49 completed developmental and operational tests, 36 used live warheads and 13 were conducted without warheads to test submunition deployment. The Air Force's analyses of 27 live warhead tests showed that the weapon's average kill per aircraft pass exceeded requirements by about 60 percent. The analyses also showed that the weapon did not achieve the required number of kills per pass in only five tests.

The weapon is required to function in an environment where enemy countermeasures could potentially reduce its effectiveness. For example, smoke and flares could potentially reduce the infrared sensor's effectiveness. Through May 1991 the Air Force had conducted 10 tests against multiple countermeasures designed to confuse the weapon's sensor and altimeter. The Program Office had completed its analysis of only three tests that showed that the weapon's performance exceeded the kills per pass requirement.

According to the current test plan, the Air Force will conduct six additional operational tests before the September 1991 low-rate initial production decision. The tests are to assess the weapon's effectiveness against multiple countermeasures or under varying climatic conditions. Also, according to the plan, 3 of 38 developmental and 10 of 30 operational tests will not be completed by the September production decision. Two developmental tests are to assess the functioning of sensors produced through an improved process, and the remaining test is to demonstrate the weapon's performance after 2 years of storage. The 10 operational tests are primarily to demonstrate the weapon's performance at various delivery angles.

According to the Program Manager for the weapon and the test manager for the Air Force's Operational Test and Evaluation Center, the current plan provides for all critical tests to be completed by the September 1991 Defense Acquisition Board's review. Also, the Air Force's tests will be sufficient to show whether the weapon will meet its performance requirements.

During testing, the weapon will be released primarily at low altitudes and high speeds where it is most effective and, according to test officials, where the delivery aircraft is most survivable. However, to measure the weapon's effectiveness over the full required range of delivery altitudes (200 to 20,000 feet) and speeds (200 to 700 knots), the Program Office plans to use a model that will provide statistical kill probabilities using available test data as inputs. Simulations show that the weapon's effectiveness generally decreases as altitude increases and speed decreases. According to the Program Office, however, the weapon will meet or exceed its stated requirement for kills per aircraft pass if its performance is averaged over all required delivery altitudes and speeds.

Sensor Fuzed Weapon's Cost and Operational Effectiveness in Its Primary Mission Is Unknown

Defense regulations state that cost and operational effectiveness analyses are essential in the decision-making process for acquisition programs. These analyses should aid decisionmakers in judging whether systems to be procured are cost-effective in that they offer sufficient military benefit over alternatives to be worth the cost. These analyses would appear to be especially important in times of tight or declining budget when difficult decisions must be made on competing needs.

In May 1987, to support the Department of Defense's low-rate initial production decision on the weapon, then scheduled for November 1988, the Air Force's Center for Studies and Analyses analyzed the weapon's

cost and operational effectiveness in relation to other weapons that were available for attacking enemy armored formations. The analysis showed that the weapon's cost-effectiveness was greater than that of existing weapons. The Air Force's Tactical Air Command later contracted for another cost and operational effectiveness analysis to support the September 1991 low-rate initial production decision. Both analyses used an effectiveness criterion for close support weapons because a criterion does not exist for interdiction weapons. Moreover, the current analysis will not include the full range of interdiction weapons. Because of these limitations, the weapon's cost-effectiveness as an interdiction weapon in relation to other interdiction weapons will be unknown for the production decision.

Interdiction Effectiveness Criterion Is Being Developed

The Joint Technical Coordinating Group for Munitions Effectiveness, under the direction of the military services' logistics commands, is responsible for developing the effectiveness criteria for nonnuclear weapons, including interdiction weapons. According to the Group's coordinator, the interdiction criterion has been under consideration for 3 years and should be approved in fiscal year 1992. Moreover, a key factor that has delayed the Group's development of the criterion has been the need to develop the methodology to assess the repair and logistical support available to the enemy's advancing units.

Repair and logistical support capabilities are critical factors in measuring mobility kills because the objective of an interdiction weapon is to delay the enemy's advance to the battle, a delay which is measured in hours. Repair and logistical support, such as available maintenance personnel and spare parts, can have a considerable effect on the time to repair damage and the delay caused by the attack. A unit's repair capability is not factored into the current close support criterion because enemy vehicles under direct fire cannot be easily repaired by crew members, and repair and logistical support personnel and equipment routinely remain in the rear areas, away from the front lines. Therefore, close support weapons are considered effective if they destroy or seriously degrade a vehicle's mobility or firepower within 10 to 20 minutes after the vehicle is hit.

While the close support criterion is directed toward assessing the damage to individual vehicles, the interdiction criterion is to be directed toward estimating the delay caused by the interdiction weapon. The same damage may have different consequences depending on whether it is sustained under close combat or interdiction conditions. Officials we

spoke with provided the following example. A damaged radiator or engine coolant line in an enemy's armored vehicle engine compartment could immediately immobilize it. Under close combat conditions, the crew's inability to make repairs in the combat environment and the lack of support repair capabilities would likely result in the vehicle being considered a mobility kill because it was immobilized after being hit. For analysis purposes, the enemy's attacking force would effectively be reduced by one vehicle. However, under an interdiction scenario, the enemy's column could continue while the crew or maintenance personnel make repairs on the damaged vehicle. Depending on the extent of damage and the road march conditions, the vehicle could rejoin the column without delaying the advance or reducing the strength of the attacking force. Under the interdiction criterion, the enemy's attacking force would not be reduced.

Other Interdiction Weapons Will Not Be Analyzed

The May 1987 analysis compared the weapon's cost and operational effectiveness to the infrared Maverick missile, the 30 millimeter gun pod, and the Combined Effects Munition. Although the analysis for the September 1991 decision will again compare the weapon's cost and operational effectiveness to the Combined Effects Munition, the Maverick (single missile launch), and the 30 millimeter gun pod, it will also evaluate an improved Maverick capability (whereby two missiles can be launched per pass) and the Rockeye. However, the analysis will not include other weapons that can be used to interdict and delay forces behind enemy lines. For example:

- Air Force delivered Gator mines, when used at strategic points in the enemy's advance, can delay and disrupt the movement of troops by forcing them to clear the mines or maneuver around a mine field.
- Army surface-to-surface rocket systems, such as the Multiple Launch Rocket System, can saturate enemy rear echelon forces with artillery rockets that can kill personnel and destroy or damage armor, artillery, and air defense equipment.
- Army air-to-surface rocket systems, such as the Hellfire missile, can be fired from Apache helicopters to interdict armored vehicles as demonstrated in Operation Desert Storm.

Threat Changes Could Affect the Need for the Sensor Fuzed Weapon

The Air Force developed the Sensor Fuzed Weapon primarily to counter the Warsaw Pact's numerical advantage in tanks in Central Europe. However, this primary threat has changed considerably over the last year with the dissolution of the Warsaw Pact and, according to intelligence agencies, the defensive posture adopted by the Soviet Union. Although the weapon was primarily designed for Central European scenarios, the Defense Intelligence Agency envisions many more limited scenarios in Europe and other parts of the world where the weapon could be used against combat vehicles moving in large groups from the second echelons to the primary battle zones. Although the weapon may be useful in other more limited theaters of operation because of its multiple kills per aircraft pass capability, other existing weapons could counter the more limited threat, as demonstrated in Operation Desert Storm.

Recommendation

We recommend that the Secretary of Defense (1) direct the Joint Technical Coordinating Group for Munitions Effectiveness to expedite its development of an effectiveness criterion for interdiction weapons, (2) direct the Secretary of the Air Force to assess the Sensor Fuzed Weapon's cost and operational effectiveness in comparison to the full range of interdiction weapons using an approved interdiction criterion, and (3) not approve the Sensor Fuzed Weapon for production until the Air Force conclusively demonstrates that the weapon is cost-effective in its primary mission.

Matter for Congressional Consideration

The Congress should deny production funds for the Sensor Fuzed Weapon program until the Department of Defense reassesses the weapon's cost and operational effectiveness in relation to other interdiction weapons in the Department of Defense's inventory.

Agency Comments and Our Evaluation

The Department of Defense disagreed with our interpretation of the requirement for the Sensor Fuzed Weapon, and it believes that our interpretation has led to erroneous conclusions about the criterion being used to measure the effectiveness of the weapon for the cost and operational effectiveness analysis. The Air Force's Statement of Operational Requirements Document states that the weapon's program objective is to provide the tactical air forces with the capability to achieve multiple kills per aircraft pass against massed armor in order to delay the enemy's advance and resupply for several hours. The Department

believes that we have focused on the delay requirement whereas the requirement is for the weapon to achieve multiple kills per aircraft pass.

We agree that the weapon is required to achieve multiple kills per aircraft pass. However, the requirements document clearly states that the multiple kills are in order to delay the enemy's advance and resupply. This requirement is consistent with the objectives of interdiction missions, the primary missions for which the Air Force plans to use the weapon, which are to delay, disrupt, divert, or destroy the enemy's potential before it can be used against friendly forces. Moreover, the Joint Munitions Test and Evaluation Project Office, which is responsible for evaluating munitions effectiveness, determined in the mid-1980s that there was a need for a new kill criterion to evaluate the effectiveness of weapons in development, such as the Sensor Fuzed Weapon, that do not destroy their targets and are intended to be used against enemy forces to disrupt and delay their movement to the front. That perceived need led to the Joint Technical Coordinating Group's efforts to develop an interdiction criterion.

The Department also disagreed with our position that the Sensor Fuzed Weapon's cost and operational effectiveness analysis should include the Air Force's Gator mines and the Army's surface-to-surface and air-to-surface weapons. According to the Department, the mines are used to "shape the battlefield" and channel the enemy and are not considered direct attack weapons, such as the Sensor Fuzed Weapon. Moreover, Army systems are not considered appropriate for inclusion in the analysis because each service has a valid complementary requirement to engage enemy armored targets and must procure weapons to kill those targets.

As stated above, we believe that the Sensor Fuzed Weapon's primary objective is to disrupt and delay the enemy's advance to the front and that Gator mines can be effective for that purpose. We also believe that other systems, such as Army surface-to-surface and air-to-surface weapons, should be included in the analysis. Although we recognize that the services need a mix of weapons to counter the various threats, both the Air Force and the Army clearly demonstrated in Operation Desert Storm that they have weapons that can kill enemy tanks and armored vehicles. Moreover, the Army demonstrated that its systems can reach further behind enemy lines into areas of the battlefield traditionally allocated to air interdiction missions. Therefore, we believe that the Department's cost and operational effectiveness analyses need to look beyond traditional service roles to see if new weapons, such as the

Sensor Fuzed Weapon, offer sufficient military benefit over alternatives to be worth their projected costs.

Our scope and methodology are described in appendix I.

As arranged with your offices, we are sending copies of this report to appropriate congressional committees; the Secretaries of Defense and the Air Force; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others upon request.

Please contact me at (202) 275-4268 if you or your staff have any questions concerning this report. Other major contributors to this report are listed in appendix II.

Nancy R. Kingsbury

Nancy R. Kingsbury
Director
Air Force Issues

Scope and Methodology

To determine the status of the Sensor Fuzed Weapon's testing, we reviewed relevant program documents, such as operational requirements, operational effectiveness analyses, test schedules, and test reports. We also discussed the test program and the results with Air Force officials in the Sensor Fuzed Weapon Program Office and the Air Force's Operational Test and Evaluation Center. We also witnessed several developmental tests.

To assess the adequacy of the weapon's cost and operational effectiveness analysis, we reviewed relevant Air Force reports, regulations, and manuals. We discussed the analysis with Program Office officials, contractor personnel who are performing the current analysis, and a representative of the Joint Technical Coordinating Group for Munitions Effectiveness.

To obtain information on the status of the threat that the weapon is to counter, we reviewed operational requirements documents, selected acquisition reports, System Threat Assessment Reports, and congressional testimony and committee reports. We also discussed the threat with officials of the Defense Intelligence Agency and reviewed their threat estimates.

We conducted our work at the Program Office; Defense Intelligence Agency, Washington, D.C.; Air Force Operational Test and Evaluation Center, Kirtland Air Force Base, New Mexico; Joint Technical Coordinating Group for Munitions Effectiveness, Aberdeen Proving Grounds, Maryland; Joint Munitions Test and Evaluation Project Office, Eglin Air Force Base, Florida; Office of the Director, Operational Test and Evaluation, Washington, D.C.; and Office of the Director, Live Fire Test, Washington, D.C.

We performed our work from December 1990 through May 1991 in accordance with generally accepted government auditing standards.

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