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STRATEGIC BOMBERS:

Issues Related to the B-1B Aircraft Program

Statement of
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Before the
Legislation and National Security Subcommittee
Committee on Government Operations
House of Representatives

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Mr. Chairman and Members of the Subcommittee:

We are pleased to be here today to assist the Subcommittee in its oversight of the capabilities of the Air Force's B-1B bomber.

As you know, the B-1B is one part of a two-bomber modernization program developed as a result of the Air Force's 1981 Bomber Study--the other, of course, being the B-2 program. The B-1B is intended to be a multipurpose, all-weather aircraft with both strategic penetrating capabilities and conventional capabilities. The Air Force declared the B-1B operational in September 1986. One hundred of these aircraft have been delivered; three were subsequently destroyed in accidents.

In response to your request, we have reviewed our past work on the B-1B and collected additional information on recent events. As you know, we have reported on a variety of B-1B problems over the years, ranging from fuel leaks to problems with flight controls. Progress has been made in addressing some of these problems, although full fleet-wide implementation of the technical solutions is still ongoing in some cases.

I am focusing my remarks today on (1) the lack of an effective defensive avionics system for the B-1B fleet, (2) the lack of a long-term solution to minimize the occurrence of engine blade failures, and (3) the lack of an effective anti-icing capability.

These three problems are not close to being solved. While the Air Force is not yet in a position to give an official estimate of the additional funds needed to overcome these problems, the total could be over $1 billion.

DEFENSIVE AVIONICS SYSTEM

The poor performance of the defensive avionics system has been the most publicized and debated aspect of the B-1B program. Four years ago, we discussed the deficiencies of that system in testimony before the House Armed Services Committee. The Air Force has spent about $3.2 billion and has reduced the system's specifications, but has not yet conclusively demonstrated that the system will meet its reduced specifications.

The B-1B defensive avionics system consists of (1) a receive function, which should warn crew members if they are being tracked by enemy radars; (2) a jammer, which ideally would prevent a radar-guided missile from being launched or, if a missile is launched, should prevent the missile from hitting the aircraft; (3) a tail warning function, which is expected to provide detection of a missile behind the aircraft and to activate an eject signal to chaff and/or flare dispensers; (4) expendable countermeasures, consisting of chaff and flares, that are intended to decoy radar- and infrared-guided missiles; (5) a radio frequency signal management system, which prevents offensive and defensive avionics interference; (6) the Central Integrated Test System, a diagnostic system intended to monitor the defensive system's performance and identify equipment failures; and (7) controls and displays that are supposed to provide the defensive system operator with information needed to locate threats.

The defensive avionics system has experienced development and production problems from the beginning. The full-scale development and production contracts were both signed in June 1982. Under this concurrent approach, when a production lot was due to start, the contractor (AIL) used the most current design configuration for that lot. System design then continued until the next production decision was due. As a result, not all production lots were configured alike, meaning that the systems being flight tested did not represent what was being manufactured and installed in the fleet.

To correct this situation, in October 1986 the Air Force directed the contractor to freeze the production configuration as it was in August 1986. The contractor was to evaluate that configuration and make whatever software and hardware changes were necessary to meet the 1982 contract specifications. By August 1987 the Air Force and the contractor acknowledged that, because of a combination of schedule, technical and fiscal constraints, the system would not meet the 1982 specifications.

In February 1988 the Air Force restructured the defensive avionics program. This revised effort, generally referred to as the "global restructure," reduced the original specifications and added some additional capability against newer threats. Subsequently, flight tests demonstrated that the system could not meet even the reduced specifications. On June 22, 1988, the Air Force issued a stop-work order to the contractor and devised a new plan, called the Recovery Program, which is the Air Force's current effort to get a workable defensive avionics system.

For purposes of this testimony, we define the Recovery Program as consisting of (1) a CORE program, (2) the addition of a radar warning receiver, and (3) an improved antenna for jamming some threats.

CORE Program

The objectives of the CORE program are to install the tail warning function, put a commonly configured system into all the aircraft, improve the Central Integrated Test System, complete logistic support efforts, and improve the reliability of the system's receive and jam capabilities against the top Soviet threats. We issued a classified report in October 1990 on the progress being made at that time under the B-1B Recovery Program. In that report we identified certain elements of the Program that, based on flight tests, were given less than satisfactory ratings. A copy of that classified report has been made available to your Subcommittee. Since that report, changes have been made to the defensive avionics system in an attempt to improve its performance.

Laboratory and flight testing of the changes have been completed. The laboratory test results indicate that the defensive avionics system will meet the current contract specifications with a few exceptions. For example, testing has shown that under certain conditions the system could interfere with some on-board offensive avionics systems. The Air Force does not consider these interference problems to be significant.

However, the actual capabilities of the system can only be demonstrated through flight testing. The flight test results may not be as favorable as laboratory test results have been. Degradation could result from flight vibrations and dynamically changing, less precise threat radar signals.

Flight testing of the CORE program started on September 26, 1990, but was interrupted twice for about 2 months while the B-1B fleet was grounded due to engine problems, which I will discuss later. At the end of February, the CORE testing was completed. However, it will take several months for the test data to be analyzed. According to the Air Force, preliminary analysis is confirming the results of the laboratory testing.

Although the CORE program testing has been completed, a software fix to the controls and displays system still has to be flight tested. These tests are scheduled from July 26, 1991, through December 28, 1991, with the software scheduled to be released to the Strategic Air Command by mid-February 1992.

Finally, it is noteworthy that new intelligence data have identified the capability of a threat radar system that the defensive avionics system was not designed to counter. I can not discuss the details of this in an open hearing.

As you know, recent funding problems caused the Air Force to decide to terminate the production segment of the CORE contract. According to the program office, this means that the Central Integrated Test System will not be improved as previously planned, and planned improvements to the defensive system's receive and jam capabilities against the top Soviet threats will not be done.

Radar Warning Receiver and
Improved Antenna

The addition of a radar warning receiver, the second part of the Recovery Program, is expected to increase the number of threat radar systems the aircraft will be able to detect in carrying out its mission. No work is currently being done to add the receiver to the B-1B, because Congress has not yet funded the effort. The total cost of adding a receiver is estimated to be at least $489 million. In the fiscal year 1992 budget, DOD is requesting $7.8 million to do installation studies.

The improved antenna, the final segment of the Recovery Program, is intended to provide increased frequency coverage. Development has been completed, and the total cost of producing and installing the new antenna is estimated to be about $50.7 million, of which $8.6 million is included in DOD's fiscal year 1992 budget request.

AIRCRAFT ENGINE

Before I discuss what we have learned about the causes and potential fixes to the engine problems that temporarily grounded the B-1B fleet, some basic information on the engine may be useful. Each B-1B has four engines. Each engine has a first and second stage rotor fan. The first stage rotor fan, which is the one that had the problems, contains 50 blades, held in place by a retainer ring. According to officials at the Oklahoma City Air Logistics Center, the breakage of a single blade causes the fan to vibrate wildly which places extreme forces against the retainer ring. If the retainer ring functions as intended, it will prevent the other blades from escaping the fan. The breaking of a single blade will cause the engine to shut down; however, if additional blades are released, the results are more catastrophic.

Between October 1988 and December 1990, five aircraft in the fleet experienced engine failures as a result of broken engine blades. Two of the failures occurred during attempted takeoffs, one while the aircraft was being operated on the ground, and two while the plane was in flight. The two in-flight engine failures were catastrophic because a blade broke and several other blades became detached from the engine, resulting in damage to areas surrounding the engines, fire, and subsequent engine shutdown.

The first catastrophic failure occurred in flight on October 4, 1990. When an engine blade broke, it caused spontaneous vibrations in the engine's first stage fan. These vibrations put extreme pressure on the retainer ring, causing it to break and release all 50 of the fan's blades. The engine separated from the fuselage and fell to the ground.

The second catastrophic engine failure occurred on December 19, 1990. Once again the broken blade caused vibrations and the retainer ring broke, releasing several of the blades. One of the blades broke through the engine and cut the main fuel line, causing the engine to catch fire. Fortunately, no lives were lost in either of these incidents.

After the first catastrophic engine failure in October 1990, the Air Force and General Electric, the engine manufacturer, began testing to identify the causes. It was determined in November

1990 that, in addition to cracks in the engine blades, the retainer ring was deficient. The November test showed that the retainer ring would fail at 2,100 pounds of pressure, which is one-half the pressure that occurs during blade failure. Based on a risk analysis by the Oklahoma City Air Logistics Center, which showed a low probability of another catastrophic failure, the Air Force continued to fly B-1Bs until the second catastrophic failure occurred. At that time, the fleet was grounded for safety reasons for peacetime operations.

In January 1991, the contractor developed a thicker and stronger retainer ring, which is currently being installed on all B-1B engines. On February 5, 1991, all aircraft equipped with the new retainer ring were allowed to return to flying status.

The decision to develop and install a new retainer ring was based on results from tests performed by General Electric and the Air Force's Oklahoma City Air Logistics Center. On the basis of those tests, the Air Force concluded that the new retainer ring would prevent future catastrophic engine failures. If a blade breaks, the Air Force expects that it will be ingested into the engine. But the new retainer ring will not allow additional blades to separate from the engine, as occurred with the old rings during the two catastrophic incidents. It is expected that ingestion of a blade will cause almost instantaneous engine shutdown; however, collateral damage, such as engines falling off or main fuel lines being severed, is not expected to occur.

While the Air Force appears to have a fix in hand to prevent the retainer ring from breaking, the basic problem of blades breaking may not be resolved for several years. In the near term, the Air Force has implemented intense maintenance measures to detect cracks in the blades so that they can be replaced before they break. Maintenance technicians will visually inspect each of the engine's 50 first-stage fan blades after each flight. Additionally, an electric current test will be performed on each engine after 25 hours of operation. By implementing these maintenance measures, the Air Force expects to reduce the number of undetected cracked blades. These procedures, while prudent, will increase maintenance time and reduce the aircraft's operational availability. The precise effects of these procedures have not been estimated by the Air Force.

The maintenance procedures I have just described are an interim measure. The Air Force has established an Independent Review Team to assess potential solutions to the blade problem. A final solution to the problem of blade failure will, at a minimum, require a rework or redesign of the fan blade to prevent cracking and subsequent breakage. The design, development, and acquisition of a new blade is not expected to be completed until about July 1994. Should the redesign require significant change in the weight, shape, and size of the blade, additional modifications may be required in other segments of the engine. Testing is currently ongoing to assess the vulnerabilities of the blade and to derive a solution to the problem of blade failures. The Oklahoma City Air Logistics Center's unofficial estimates indicate that the costs for correcting the engine blade failure problems could be from $10 million for a rework of the existing blades to as much as $500 million if the blades and other engine parts have to be redesigned.

ANTI-ICING SYSTEM

Ice ingested into the B-1B engine has caused damage to the fan blades. In an attempt to limit the damage, Air Force operating instructions require that the aircraft's engines not be operated when the temperature is 47 degrees fahrenheit or less and there is at least 50-percent humidity, when the engines are over standing water, or when visible moisture like sleet or rain is present. These limitations compromise the Strategic Air Command's ability to train aircrews to operate in all weather conditions.

The B-1B aircraft has an anti-icing system. As we have pointed out in prior reports, the system has never worked. However, it remains on all 97 B-1Bs.

In the 1988-89 time frame, the Air Force installed a prototype engine inlet icing protection system on one B-1B for testing. The test showed that the system could reduce ice damage to the engine but that several problems needed to be resolved: (1) The system overheated. (2) The heating material had to be placed on the aircraft with adhesive and, when the system failed, maintenance crews had to use a hammer and chisel to remove the material from the aircraft--an intolerable maintenance practice. And (3) the system required so much electrical power that there was concern that some of the aircraft's other electrical components would have to be shut down while the anti-icing system was in use. The Air Force has put development of this system on hold.

In 1990, the Air Force began work on an alternative, lower power anti-icing system for the B-1B. This system would use electronic impulses to "thump" ice from the engine inlets. If found to be feasible during testing, the system will require about 3 years of development prior to production and, under the current plan, installation would not begin until about the year 2000.

Neither of these anti-icing systems address the on-ground icing problems that prohibit operating the engines in low temperatures when moisture is present. These systems are for use while the aircraft is in flight. A separate system will be needed for the on-ground icing problems. The Air Force said that work is underway to determine the feasibility of such a system.

The lack of an effective anti-icing system is resulting in the decreased peacetime availability of the aircraft. Air Force officials estimate that 15 percent of planned B-1B training flights are being canceled because of icing and weather problems. An increase in maintenance is also resulting from damage caused by icing. As of November 1989, the Strategic Air Command reported that 109 B-1B engines had been damaged by ice, costing $1.6 million and requiring 4327 hours to repair.

While no official cost estimate has been made, preliminary Air Force estimates by the Oklahoma City Air Logistics Center indicate that a system or systems to resolve both in-flight and on-ground icing problems are expected to cost about $200 million, with installation occurring about the year 2000 and beyond.

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This concludes my formal statement, Mr. Chairman. We will be happy to answer any questions you or Members of the Subcommittee may have at this time.

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