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United States General Accounting Office

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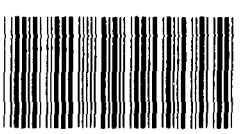
Briefing Report to the Chairman, Committee on Armed Services, House of Representatives

December 1987

PROCUREMENT

Delivery Problems With Inertial Measurement Units



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GAO

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

National Security and
International Affairs Division

B-223636

December 18, 1987

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

Dear Mr. Chairman:

As requested in your April 23, 1987, letter, we have reviewed the Air Force's acquisition of inertial measurement units (IMUs), a major component of the Peacekeeper missile guidance and control system. The IMU acquisition program is managed by the Air Force's Ballistic Missile Office. The Northrop Electronics Division, under contract to the Air Force, manufactures the IMU. In July 1987, we provided you an interim report[1] on IMU delivery delays, failures, and operational status, and the missile's status and accuracy. This report updates that information and provides additional information on your request.

Northrop has not delivered operational IMUs on time. The average delay has been about 4-1/2 months. As a result, there are insufficient IMUs to support the Peacekeeper deployment schedule. As of September 30, 1987, the Strategic Air Command had 28 Peacekeeper missiles available for operations, but only 18 were on alert because of the shortage of IMUs.

Northrop expects to be back on contract schedule in April 1988. However, the Air Force believes it is more realistic to expect recovery in October 1988. Northrop has improved its IMU delivery capability but has yet to demonstrate the capability to sustain an acceptable delivery rate for an extended period of time. Recovery by April 1988 appears optimistic while recovery by at least October 1988 appears achievable, unless unforeseen problems occur.

Late IMU deliveries have been due to a combination of events. The beginning of IMU production was deferred from 1983 to 1984 without the Air Force changing the initial

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[1]Procurement: Inertial Measurement Units for Peacekeeper Missiles (GAO/NSIAD-87-194BR, July 31, 1987).

Additional details on our work are presented in the appendixes. Unless you publicly announce its contents earlier, we plan no further distribution of 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

DELIVERY PROBLEMS WITH INERTIAL MEASUREMENT UNITS FOR THE PEACEKEEPER MISSILES

IMU DEVELOPMENT AND PROCUREMENT

The IMU acquisition program, managed by the Air Force's Ballistic Missile Office (BMO), involves a full-scale development phase, which includes procuring 41 IMUs for developmental purposes, and a production phase, which includes procuring 239 IMUs for operational deployment and testing. The Air Force Logistics Command will procure an additional 25 IMUs for use as operational spares. As of September 30, 1987, the Air Force had awarded six contracts to the Northrop Electronics Division amounting to about $1.66 billion for the delivery of 174 IMUs--41 developmental units, 113 operational deployment and testing units, and 20 operational spares. Appendix II lists the IMU contracts awarded to Northrop.

ACQUISITION ENVIRONMENT

Deployment of the first 10 operational Peacekeeper missiles by late 1986, referred to as initial operational capability (IOC), has been a program acquisition goal since 1981.[1] In order to achieve IOC in late 1986, the Air Force planned to begin missile production in fiscal year 1983. However, in December 1982, the Department of Defense was not able to convince the Congress that it had a suitable mode of basing for the Peacekeeper missile, and funds to begin production were not appropriated. This resulted in a reassessment of basing options for intercontinental ballistic missiles by the President's Commission on Strategic Forces. The Commission's recommendation for basing Peacekeeper missiles in Minuteman silos at F. E. Warren Air Force Base was subsequently approved by the Congress in May 1983. In December 1983, fiscal year 1984 funds for Peacekeeper missile production were appropriated.

Although the start of missile production was delayed, the IOC date was not changed. The combination of these factors reduced the time available to deliver the first guidance and control set to the deployment site from about 44 months to about 29 months. In turn, the time available to deliver the first IMU to Rockwell Autonetics for integration into the guidance and control set was reduced from 29 months to 21 months, 8 months less than the lead

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[1]An IOC date of late 1986 was established by the President in 1981 when he announced his strategic modernization program and was reaffirmed by the Congress in the Department of Defense Authorization Act, 1982.

June to November 1985, after production of 45 operational IMUs were in-process.

-- The Air Force began installation of IMUs into operational Peacekeeper missiles before a formal qualification review was completed. This review was contractually required in order to verify, through testing, that the IMU would perform in its intended environment. According to military standards, at the end of the formal qualification review, the Air Force certifies that a configuration item is ready for acceptance into the Air Force inventory. BMO conducted the IMU formal qualification review from July 1986 to February 1987. Before BMO completed this review, 28 operational IMUs had been delivered and IOC had been achieved.

In addition, other actions facilitated BMO's efforts to obtain sufficient IMUs to meet IOC. For example, long-lead materials procured for developmental units were transferred to the production program. Northrop began procurement of the long lead materials in May 1983 to support the potential buy of an additional 20 developmental IMUs to support new guidance and control ground tests that BMO felt might be needed. BMO established the need for these new test requirements in January 1983. However, because of the success of the first 3 Peacekeeper test flights, BMO decided in February 1984 that the additional tests were not needed and directed that the long-lead materials procured for the 20 developmental IMUs be transferred to the production program.

DELAYS IN IMU DELIVERIES

As of September 30, 1987, Northrop Electronics Division had delivered all 41 developmental IMUs and 62 operational IMUs (including 6 spares), of which almost all were delivered late. For example, the 62 operational IMUs were delivered an average of 136 days late (see app. III). In response to Northrop's failure to correct management deficiencies and deliver IMUs on time, the Air Force began withholding partial progress payments in April 1986 and full progress payments in March 1987. As of September 30, 1987, the Air Force had withheld $108.9 million in progress payments.

Schedule recovery and costs

During our earlier review, Northrop said it expected to be back on contract schedule in February 1988 by delivering six IMUs each month from May 1987 through January 1988. Although this delivery rate was substantially higher than the rate the contract requires, Northrop was able to deliver 29 IMUs (about six per

incorporated the design changes until September 1984, 5 months after IMU production began. The first full-scale development unit (pre-production prototype) incorporating the producibility enhancements was not delivered until October 1985, 18 months after Northrop began production of operational IMUs.

-- When production of the operational IMU configuration began, the producibility of certain critical subcontractor manufactured components, such as flex harnesses, heat exchangers, and pressure transducers had not been fully demonstrated. The flex harnesses were one of the newly introduced producibility enhancements and the operational IMU had to be built with these components. However, according to Northrop officials, flex harnesses for the IMU, which were produced by a subcontractor for Northrop, represented a substantial advancement in manufacturing technology and, as such, posed an extremely difficult manufacturing challenge. BMO officials stated that the difficulties encountered in manufacturing flex harnesses were a major reason why IMU deliveries were delayed.

-- When IMU production began, the timely availability of nuclear hardened electronic parts, such as diodes and transistors, had not been assured. The capability of vendors to produce certain nuclear hardened electronic parts had not been fully demonstrated, and some vendors encountered problems in producing sufficient qualified electronic parts that would meet the nuclear hardness specifications. According to Northrop officials, the vendor producibility problems resulted in low manufacturing yields of parts that met the nuclear hardness specifications, causing shortages of electronic parts which, in turn, delayed IMU deliveries.

According to Northrop officials, considering the complexity of the specifications, the difficulties encountered by subcontractors and vendors in producing IMU components was not unexpected. Moreover, the officials stated that the IMU delivery schedule did not allow time for the Northrop subcontractors and vendors to work out the normal engineering and production problems associated with manufacturing such complex parts.

Another factor contributing to late deliveries, according to the Air Force, has been Northrop's inability to effectively manage the IMU manufacturing process. Since May 1982, when BMO conducted the first production readiness review at Northrop, BMO and the Air Force Plant Representative Office (AFPRO) responsible for oversight of Northrop's performance have continually been

BMO also identified deficiencies in Northrop's manufacturing management which have contributed to late deliveries. For example, in a 1986 BMO corrective action team briefing to the BMO Commander, it was noted that Northrop workmanship problems resulted in low yields and part defects, which in turn delayed IMU production.

Northrop officials acknowledged their management deficiencies but discounted the argument that these deficiencies contributed to late IMU deliveries. Northrop has made progress in correcting its manufacturing management deficiencies, but problems were still occurring 3-1/2 years after IMU production began. Northrop's inability to correct system deficiencies was partially responsible for the Air Force decision in March 1987 to stop all progress payments.

An example of Northrop's management problems that has recently surfaced relates to procedures followed in testing hybrids. Northrop test technicians were making decisions to retest, on different equipment, hybrids that had failed acceptance testing. This was done without formal management approval and without an engineering analysis to confirm that retesting was appropriate. Northrop contends its test procedures have not allowed bad hybrids to be accepted. The Air Force's Scientific Advisory Board stated in its October 1987 report that it found no direct evidence that bad hybrids are in the field. The Air Force, however, rejected the Northrop procedures because they were slowing down the hybrid production process and did not reflect sound management practices. The Air Force directed that corrective action be taken. As a result, Northrop may deliver only 6 of 18 IMUs it planned to deliver from October through December 1987.

IMU FAILURES

As of September 30, 1987, 62 production and 2 full-scale development IMUs configured for operational use had been delivered. Of these, 35 IMUs have had 54 failures after delivery to the Air Force--28 in operational missiles and 26 prior to installation in missiles (referred to in this report as preoperational failures). Fifteen of the IMUs failed more than once, accounting for 34 of the 54 failures. IMU failures are summarized in table I.2.

The following are important in using BMO's reliability statistics.

-- Even though IMU reported reliability is better than expected, it excludes IMU failures which occur prior to installation and activation in an operational missile and 26, or almost half, of IMU failures have occurred before installation and activation in an operational missile. According to Air Force officials, BMO's reliability calculation criteria is consistent with military standards.

-- BMO is also reporting achieved mean time between failure for the total IMU as 3,441 operating hours--10 percent better than the planned rate. However, of the 28 verified IMU failures, only 5 exceeded the planned reliability rate of 3,126 hours at the time of failure and 11 failed at less than 1,000 hours, as shown in table I.3. Air Force officials stated that these type of reliability results are not unusual for a weapon system in the early stages of its operational life. These officials expect that IMU reliability will continue to improve.

IMU OPERATIONAL STATUS

While sufficient IMUs were available to support deployment of the first 10 Peacekeeper missiles on schedule (December 1986), the late IMU deliveries have limited the number of missiles on alert. As of September 30, 1987, 28 Peacekeeper missiles were in silos at F. E. Warren Air Force Base and available for operational status, but only 18 missiles were on alert because guidance and control systems were not available due to IMU shortages. A 90th Strategic Missile Wing[3] official stated that, in the near term, the Wing wants to maintain 3 spare IMUs for every 10 missiles on alert. In the long term, the Wing expects IMU reliability to improve and the number of spares in relation to on-alert missiles to decline.

As of September 30, 1987, the status of the 64 IMUs, which are configured for installation in operational missiles, was as follows:

-- 18 installed in on-alert missiles,

-- 28 being repaired,

-- 1 installed in a missile not yet put on alert,

-- 5 at F. E. Warren Air Force Base for use as spares,

-- 5 in acceptance testing,

-- 3 being used to support test activities,

-- 3 at Northrop to support production, and

-- 1 expended on flight test missile #16.

MISSILE STATUS AND ACCURACY

As of September 30, 1987, a total of 28 Peacekeeper missiles had been turned over to the Strategic Air Command--18 missiles are in on alert status and 10 are not operational due to IMU shortages. Six IMUs at Warren Air Force Base (including one in an off-alert missile) are designated as spares and could be used to bring additional Peacekeepers to operational status.

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[3]The 90th Strategic Missile Wing is responsible for operating and maintaining the Peacekeeper missiles of F. E. Warren Air Force Base.

NORTHROP CONTRACT AWARDS FOR

IMU DEVELOPMENT AND PRODUCTION
(As of September 30, 1987)

Contract number	Effective date	Purpose	Contract amount	No. of IMUs
			(millions)	
F04704-80-C-0003	Dec. 1979	Full-Scale Development Phase I	$ 384.3	23
F04704-83-C-0023	Jun. 1983	Full-Scale Development Phase II	520.5	18
Total			904.8	41
F04704-84-C-0041	Apr. 1984	Production Contract (Buy A)	338.8	52
F04704-85-C-0082	Jun. 1986	Production Contract (Buy B)	164.5	30
F04704-86-C-0198	Mar. 1987	Production Contract (Buy C/D)	188.5	31
Total			691.8	113
F04704-84-C-0020		Provisional Spares --Buy A	20.7	6
		--Buy B	25.2	8
		--Buy C/D	22.0	6
Total			67.9	20
Total			$1,664.5	174

APPENDIX III

IMU NO.	Delivery dates Contract	Actual	Days late
P41	02/20/87	06/30/87	130
P42	02/27/87	06/17/87	110
P43	03/06/87	06/17/87	103
P44	03/13/87	06/25/87	104
P45	03/20/87	06/30/87	102
P46[a]	09/30/86	07/25/87	298
P47[a]	10/31/86	07/25/87	267
P48[a]	11/30/86	08/11/87	254
P49	03/27/87	07/11/87	106
P50[a]	12/31/86	09/26/87	269
P51	04/03/87	08/11/87	130
P52	04/10/87	07/31/87	112
P53	04/17/87	08/13/87	118
P54	04/24/87	08/10/87	108
P55	05/08/87	08/17/87	101
P56	05/15/87	08/31/87	108
P57[a]	01/31/87	08/21/87	202
P58[a]	02/28/87	09/25/87	209
P59	05/30/87	09/30/87	123
P60	05/30/87	09/30/87	123
P63	06/30/87	09/30/87	92
P65	07/31/87	09/30/87	61

Average days late--all units136

[a]Operational spares.

Schedule date	Monthly rate Contract	Monthly rate Actual/Plan[b]	Cumulative deliveries Contract	Cumulative deliveries Actual/Plan[b]	Cumulative Difference
1988					
January	3	6	98	84	-14
February	2	8	100	92	-8
March	3	8	103	100	-3
April	3	6	106	106	0

[a]Includes 10 full-scale development units which are of the operational configuration.

[b]This represents Northrop's plan for IMU deliveries to recover to contract schedule. The Air Force does not expect Northrop to recover to contract schedule until October 1988.

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