

GAO

Report to the Chairman, Subcommittee on
Procurement and Military Nuclear
Systems, Committee on Armed Services,
House of Representatives

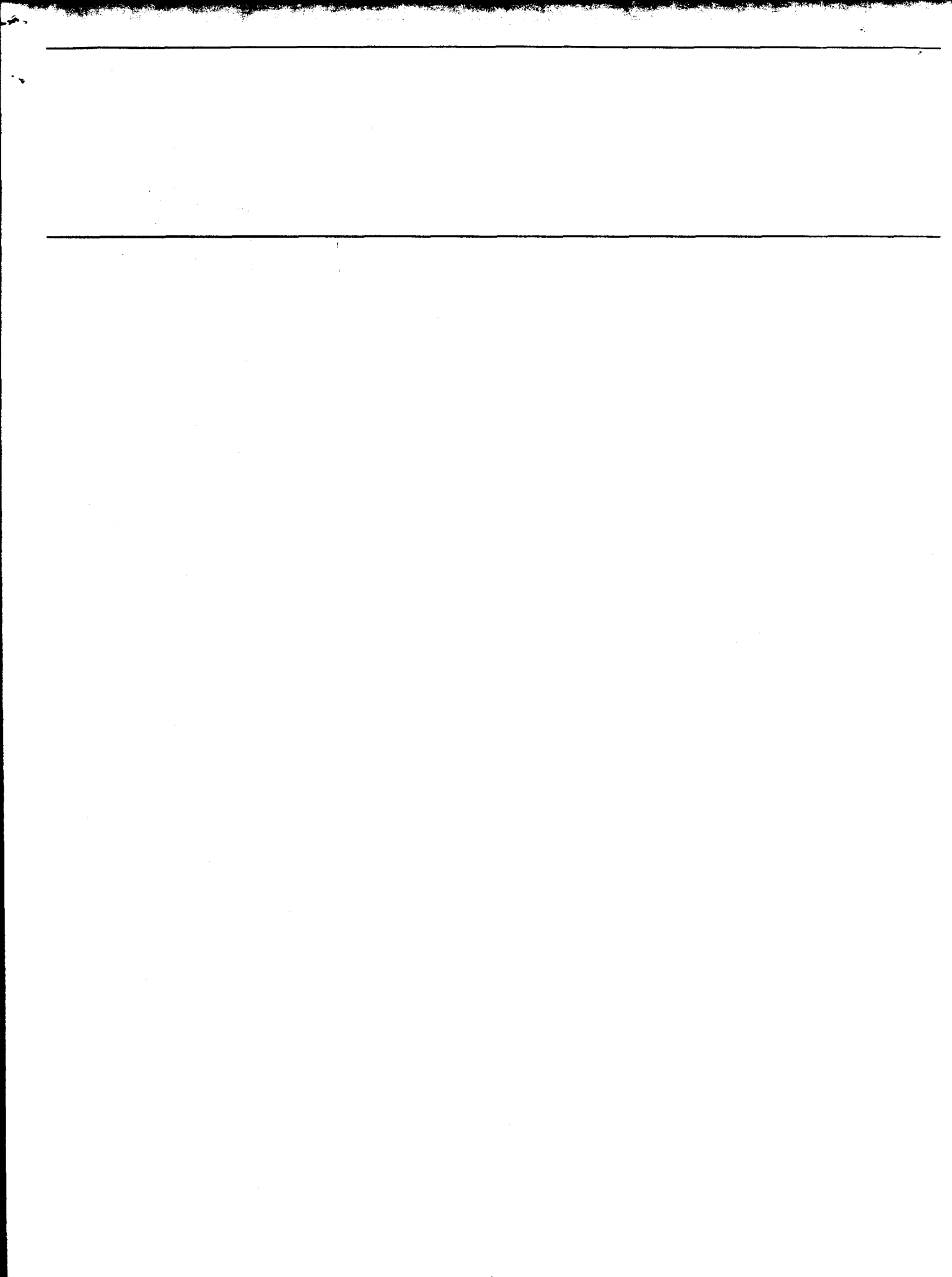
May 1989

ARMY AMMUNITION

The Mississippi Plant Will Be Closed After Demonstrating Its Production Capability



545312





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

National Security and
International Affairs Division

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May 4, 1989

The Honorable Les Aspin
Chairman, Subcommittee on Procurement
and Military Nuclear Systems
Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

As requested by the former Subcommittee Chairman, we examined selected activities at the Mississippi Army Ammunition Plant. The objectives of our review were to determine the history and costs of the plant, the status of the Army's actions to correct deficiencies that limited the mobilization production capability at the plant, and the Army's plans for the plant.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report for 30 days. At that time we will send copies to the Secretaries of Defense and the Army; the Director, Office of Management and Budget; and other interested parties. Copies will also be made available to others upon request.

GAO staff members who made major contributions to this report are listed in appendix I.

Sincerely yours,

A handwritten signature in cursive script that reads 'Richard Davis'.

Richard Davis
Director, Army Issues

Executive Summary

Purpose

The former Chairman of the Subcommittee on Procurement and Military Nuclear Systems, House Committee on Armed Services, asked GAO to examine selected activities at the Mississippi Army Ammunition Plant. GAO reviewed the history and costs of the plant, the status of the Army's actions to correct deficiencies that limited the mobilization production capability at the plant, and the Army's plans for the plant.

Background

The Mississippi Army Ammunition Plant, near Picayune, Mississippi, is the only new ammunition plant that the Army has built since World War II. Mason Chamberlain, Incorporated, which operates the plant for the Army, is responsible for integrating the construction effort; purchasing and installing the equipment; demonstrating the capabilities of the production lines; and operating the plant to produce 155-mm M483A1 artillery rounds. The plant was designed to produce 120,000 M483A1 rounds per month during mobilization.

Plant construction began in January 1978, and the Army expected to complete the plant by December 1983, at an estimated cost of about \$400 million. The plant experienced numerous start-up problems and is not yet fully operational. In September 1986, the Army reported that deficiencies in plant processes and other problems had prevented the plant from fully meeting its designed mobilization production rate.

The Congress provided \$123 million in fiscal year 1987 funds to correct the identified deficiencies. As directed by the House Committee on Appropriations, the Army assembled an independent panel, which validated the plan. The Army has awarded a \$117.7 million firm fixed-price contract (the "mobilization contract") to Mason Chamberlain, Incorporated, to correct the problems by August 31, 1990.

Results in Brief

The Mississippi plant has experienced increased construction costs, construction delays, missed production schedules, high production costs, and product quality problems. Production costs are decreasing, but some problems with quality persist. Many of the critical projects under the Mississippi mobilization contract—intended to correct plant deficiencies—were behind their original schedules as of September 1988. Nonetheless, the Army's independent panel believes that the mobilization contract is generally proceeding well and should be completed on schedule. Also by that time, the contractor is required to demonstrate the plant's capability to produce 120,000 M483A1 rounds a month; however, the Army's plan for testing the plant's capability has limitations.

The Army had planned to continue producing M483A1 rounds at the Mississippi plant following completion of the mobilization contract. However, due to funding constraints, it did not request fiscal year 1990 funds to procure additional M483A1 rounds. Consequently, the Army now plans to place the plant in standby status following completion of the contract.

Principal Findings

Increased Construction Costs and Construction Delays

In 1978, the Army estimated that the Mississippi facility would require an investment of about \$397.8 million and that it would be completed by December 1983. The Army's latest estimate is that the plant will cost about \$622 million and will not be completed before August 1990. The \$622 million cost estimate includes the \$123 million provided for the mobilization contract.

Early Production Problems

Because of construction delays and start-up difficulties, the contractor could not produce as many M483A1 rounds as the Army planned to produce at the Mississippi plant for fiscal years 1982 through 1986. The Army requested funding for 910,000 M483A1 rounds to be produced at the Mississippi plant but had to allocate 630,000, or about 69 percent, to other plants.

Higher Production Costs and Product Quality Problems

The Mississippi plant has incurred higher production costs than other Army ammunition plants. While the average unit production costs at the Mississippi plant are decreasing, unit costs are still somewhat higher than they are at the other plants. In addition to the higher unit costs, the plant has experienced and continues to experience product quality problems.

Mobilization Projects Are to Be Completed by August 1990

According to the contractor's records, as of September 30, 1988, 46 of 141 mobilization projects, or about one-third, were completed within their negotiated amounts, and 40 of the 46, or about 87 percent, were completed early or on time. Of the remaining 95 projects that were still in progress, 60 (or about 63 percent) were on time or ahead of their original schedules, and 35 were behind schedule.

Of the 37 projects that were categorized by the independent panel as critical to achieving the planned mobilization production capability, 6 had been completed by September 30, 1988, and 31 were still in progress. Although 28 of the 31 uncompleted critical projects were behind their original schedules, the contractor's project manager believes that even with the delays the overall mobilization contract will be completed on time. The independent panel agreed with the project manager's assessment.

Limitations of the Army's Test Plan

The contractor has contractually guaranteed that the Mississippi plant will be capable of producing 120,000 acceptable M483A1 rounds per month and that this capability will be demonstrated by August 31, 1990. The contractor is only required to demonstrate the capability to produce 20,000 rounds in 30 days, using a single 8-hour shift, 5 days a week and operating half of the available equipment. This demonstration will be performed on a subsystem basis, which does not involve operating the plant in a continuous production mode. Selected subsystems (grouped sets of similar machine operations) will be tested in isolation for periods not exceeding 30 consecutive days.

The planned tests will demonstrate the output capability of the tested subsystems; however, because the tests will be performed under controlled conditions, the tests may not establish the capability of the subsystems to operate together or to produce 120,000 acceptable rounds. In addition, the maximum production capacity for an Army ammunition plant is normally considered to be 2.5 times the one-shift rate. Based on the 20,000 round test, this equates to a maximum production capability of 100,000 rounds per month if all the available equipment is used. Thus, the planned test will not be sufficient to demonstrate that the Mississippi plant can achieve its 120,000-rounds-per-month design capability.

The Army had planned to continue producing M483A1 rounds at the Mississippi plant following completion of the mobilization contract. However, due to funding constraints, it did not request fiscal year 1990 funds to procure additional M483A1 rounds. Since the Army has decided to place the plant in a standby status and certain equipment tends to deteriorate during storage, GAO concluded that additional tests to better define production capability are probably not warranted.

The Army Plans to Place the Plant in a Standby Status

Although the Army has a continuing need for M483A1 rounds, it did not request fiscal year 1990 funds to procure additional quantities. According to Army officials, the total ammunition budget is decreasing, and the Army wanted to use available funding to procure other higher priority ammunition items, such as new 155-mm M864 artillery rounds. They said that, while the Army currently has less than half the M483A1 inventory it is authorized to procure, it has virtually no M864 inventory.

Although the production lines could be modified to produce other ammunition items at the plant, the Army does not consider this option feasible because modifying the production lines would hinder the plant's ability to achieve maximum production of the M483A1 during mobilization. Modifying the production lines, therefore, could negate the goal of the mobilization contract. In addition, the Army has invested time and money at other plants scheduled to produce the ammunition.

The Army plans to begin placing the Mississippi plant in a standby status in fiscal year 1990. This will result in layoffs at the Mississippi plant. The Army's preliminary estimate of the total cost to lay away the plant is \$50 to \$75 million. The Army requested \$20.8 million in its fiscal year 1990 budget to lay away equipment at the plant.

Recommendations

GAO's report makes no recommendations.

Agency Comments

As requested, GAO did not obtain agency comments on its report; however, GAO discussed the report with responsible agency officials and included their comments where appropriate.

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Abbreviations

AMCCOM	Armament, Munitions and Chemical Command
CICA	Competition in Contracting Act
GAO	General Accounting Office
LAP	load, assemble, and pack
PBMA	Production Base Modernization Activity

Introduction

The Army's ammunition production base includes 28 government-owned ammunition plants located throughout the country. Seventeen of the 28 ammunition plants are in operation (including the Mississippi Army Ammunition Plant, located 10 miles southeast of Picayune, Mississippi), and the remaining 11 are semi-active or on standby for possible use during mobilization.

The Army awards contracts to the private sector for operating and maintaining its government-owned, contractor-operated ammunition plants. Such contracts are awarded for both active and inactive plants and usually cover a 5-year period—1 year with 4 option years. The Competition in Contracting Act (CICA) of 1984 (P.L. 98-369) mandates competition for all procurements exceeding \$25,000 unless one of seven specific statutory exceptions is met. CICA applies to contracts for operating and maintaining Army ammunition plants. Therefore, the Army will have to either open the contract for operating and maintaining the Mississippi plant to competition or justify its exemption before the current contract expires in April 1991.

The Mississippi plant is the only ammunition plant the Army has built since World War II. Construction of this government-owned, contractor-operated facility began in January 1978, and production started in April 1984. The plant is operated by Mason Chamberlain, Incorporated.

The plant was designed to produce 120,000 M483A1 artillery rounds per month during mobilization while employing the latest in automated technology. When fully operational, the plant's maximum capability is expected to represent about 40 percent of the Army's total mobilization production capability for M483A1 rounds.

Plant Configuration

For a typical artillery item, the various components are produced in a number of different ammunition plants and then shipped to a load, assemble, and pack plant for assembly into a complete round. The Mississippi plant complex is somewhat unique in that it only produces one ammunition item (the M483A1), and it manufactures projectile and cargo metal parts as well as loads, assemblies, and packs (LAP) completed rounds.

The Mississippi Army Ammunition Plant consists of an administration facility and three relatively independent manufacturing facilities: (1) a projectile metal parts facility where the shell body, base, and ogive (nose cone) are fabricated; (2) a cargo metal parts facility where M42

and M46 grenades are fabricated; and (3) a LAP facility where the projectile and cargo parts are assembled into the final round. The propellants and explosives are produced at other locations and shipped to the Mississippi plant for the LAP operation.

Description of the M483A1 Round

The completed M483A1 projectile contains a cargo of 88 dual-purpose grenades (64 M42 grenades and 24 M46 grenades). A propelling charge is used to force the projectile out of the gun and propel it to the target, and a time fuzed spotting charge is used to eject the grenades from the rear of the projectile and disperse the grenades over the target area. The grenades explode on impact with the ground.

Congressional Concerns and Army Response

During the fiscal year 1986 defense appropriation process, the House and Senate Committees on Appropriations expressed concern about the production problems that the Army was experiencing at the Mississippi plant and the Army's plans for manufacturing M483A1 rounds. The Conference Committee report on defense appropriations for fiscal year 1986 (House Report 99-450) concluded that the plant must be brought fully on line and directed that the Army conduct a thorough investigation of the plant and report on specific problems, proposed solutions, and implementation plans and schedules.

Based on the Army's subsequent report in September 1986, the Congress provided \$130.2 million in the fiscal year 1987 budget to address the reported problems. This amount was later reduced by \$7.3 million, leaving about \$123 million for the project. In providing the funds, the Conference Committee (House Report 99-1005) specified that no more than \$50 million could be obligated for projects at the Mississippi plant until the Army had assembled an independent panel of experts in manufacturing and production to validate the Army's plan for establishing the full mobilization production rate at the plant.

In December 1986, the Secretary of the Army established an independent outside panel of experts to validate the plan, which consists of 141 projects. The panel divided the projects into two groups: those projects considered most critical to achieving the mobilization rate of 120,000 artillery rounds per month and those projects for mobilization safety and cost reduction. The panel identified 37 projects that they deemed most critical to achieving the mobilization rate and investigated these

projects in detail. Based on its investigation, the panel reported in February 1987 that the Army's plan was valid and recommended obligation of the funds for completing the facility.

The Army awarded a firm fixed-price contract (the "mobilization contract") totaling about \$117.7 million to Mason Chamberlain, Incorporated—the operating contractor since 1976—to correct the identified shortfalls and bring the plant up to its designed mobilization rate capability by the end of August 1990.

While corrections to the plant are being made, the contractor is continuing to produce ammunition and is using this ammunition production to demonstrate the plant's capability. Following the completion of the mobilization contract in August 1990, the Army plans to discontinue producing ammunition at the plant and to place the plant in standby status for possible use during mobilization.

Army's Responsibility for the Plant

As the Department of Defense's designated single manager for conventional ammunition, the Army is responsible for maintaining an industrial base to produce ammunition to meet peacetime and mobilization requirements. These responsibilities are performed by the U.S. Army Armament, Munitions and Chemical Command (AMCCOM), Rock Island, Illinois, a subordinate command of the U.S. Army Materiel Command, Alexandria, Virginia. Specific AMCCOM responsibilities regarding the Mississippi plant include planning, developing, and acquiring the production facility, as well as contracting for ammunition production at the plant.

Within AMCCOM, the Army's Production Base Modernization Activity (PBMA) in Dover, New Jersey, manages the Army's program for establishing, modernizing, and expanding ammunition production facilities. PBMA was responsible for the overall development and management of the expansion project for building and equipping the Mississippi plant. It is currently responsible for managing the installation of equipment, testing the equipment involved in the mobilization contract, and evaluating the performance of the equipment when demonstrating the plant's production capability.

The Army commander at the plant acts as the contracting officer's representative, supervises the on-site government staff at the plant, and

monitors the performance of the operating contractor. The staff performs security, safety, contract administration, quality assurance, engineering, equipment management, and operation review functions. As of August 10, 1988, the contracting officer representative's staff consisted of 49 people—1 military officer and 48 civilians.

Contractor's Responsibility for the Plant

Mason Chamberlain, Incorporated, a joint venture of Chamberlain Manufacturing Corporation and Mason and Hanger-Silas Mason Company, Incorporated, has been the prime operating contractor for the Mississippi Army Ammunition Plant since August 1976. The operating contractor is responsible for integrating the plant's construction effort; purchasing and installing production and other equipment; demonstrating the capability of the production line; and producing ammunition. As of August 10, 1988, the contractor employed 1,758 people at the plant.

Objectives, Scope, and Methodology

The objectives of our review were to determine (1) the history and cost of the Mississippi Army Ammunition Plant, (2) the status of corrective actions planned for the plant, and (3) the Army's plans for using the plant.

To determine the history and costs of the plant, we reviewed the Army's historical documents on the plant's operations and costs. We reviewed records to establish the total funding provided for constructing the plant, producing ammunition at the plant, and administering the mobilization contract. The total funding included funds to design, build, and operate the plant and to correct construction shortfalls. We obtained original cost and schedule estimates for the plant and documented subsequent changes, examined production requirements and capabilities for the plant, compared the cost of items produced at the Mississippi plant with the cost of items produced at other ammunition plants, and examined the quality of ammunition produced at the Mississippi plant and other plants.

To determine the status of specific corrective actions being taken to bring the plant to its designed mobilization rate capability, we obtained cost and schedule data as of September 30, 1988, for the 141 projects contained in the mobilization contract. We identified how the Army monitors the contractor's progress on the mobilization projects and examined the planned methodology for demonstrating the plant's production capability.

To determine the Army's plans for the plant, we reviewed the Army's plans for procuring M483A1 rounds and for placing the plant in a standby status. We also reviewed an Army study on alternative items considered for production at the plant and examined the Army's plans for opening the plant's contract to competition when the current operating contract expires, as required by the Competition in Contracting Act of 1984.

We performed work at AMCCOM, PBMA, and the Mississippi plant. At AMCCOM, we interviewed the Commanding General; the Procuring Contracting Officer; and various officials in the Comptroller's Office and in the Production, Industrial Readiness, Procurement, and Product Assurance Directorates. At PBMA, we interviewed the Commander, the Deputy Director, and selected engineers. At the Mississippi plant, we interviewed the Commander, the Executive Officer, the Chief Contract Administrator, the Engineering and Operations Chief, and the Quality Assurance Chief. We also interviewed Mason Chamberlain, Incorporated, officials including the President and General Manager, the Vice President and Mobilization Project Manager, plant managers, the Training Supervisor, and selected engineers.

We reviewed various Army and contractor studies and documents. For example, we reviewed the contractor's February 1986 proposal to correct deficiencies at the plant and the independent panel's February 1987 and June 1988 reports on the mobilization projects. We also examined the mobilization contract and its modifications; ammunition acceptance test results; reports on project status and management, contract accounting, cost and production history, ammunition quality, and quality deficiency; and various Department of the Army and Defense Contract Audit Agency reports on the Mississippi plant.

We performed our work from February to October 1988 in accordance with generally accepted government auditing standards. The views of responsible agency officials were sought during the course of our work and are incorporated where appropriate. As requested, we did not obtain formal agency comments on this report.

History and Cost of the Mississippi Plant

The history of the Mississippi plant can be characterized as one of increased construction costs, construction delays, missed production schedules, high production costs, and product quality problems. Production costs are decreasing, but some problems with quality persist.

Increased Costs and Schedule Slippages

In 1978, the Army estimated that the Mississippi plant would require an investment of about \$397.8 million and that it would be completed by December 1983. The Army's latest estimate is that the plant will cost about \$622 million, including the \$123 million for the mobilization contract. It also estimates that the plant will not be completed before August 1990. The Army's original and latest investment cost estimates for the Mississippi plant are shown in table 2.1.

Table 2.1: The Army's Original and Latest Investment Cost Estimates for the Mississippi Plant

Dollars in millions		
Item	Original cost estimate (1978)	Latest cost estimate (1988)
Equipment	\$216.6	\$395.7
Construction	181.2	212.6
Design	a	7.8
Engineering support	a	5.8
Total	\$397.8	\$621.9

^aA separate breakout is not available.

Army studies attribute the cost increase of about \$224.1 million to build the plant (\$397.8 million versus \$621.9 million) and the almost 7-year delay in the scheduled plant completion date (December 1983 versus August 1990) to numerous factors. These include the complexity of building a completely new plant incorporating state-of-the-art manufacturing techniques, the failure of equipment to operate as designed, inflation, and inadequate management by both the operating contractor and the Army.

In addition to the increase in construction costs, the estimated costs to demonstrate the plant's production capability, which the Army calls "prove-out" costs, have also increased. Prove-out usually takes place within a few months after completing a production line to demonstrate its capacity to produce items at the design rate. In 1978, the Army estimated that prove-out would be completed by December 1983 at an estimated cost of about \$15 million. However, in 1988 the Army estimated that it had spent \$137.9 million since 1982 in prove-out costs and that

the total prove-out costs could reach \$151.1 million by August 1990 when the mobilization contract is scheduled to be completed.

The increase in prove-out costs is primarily due to the continuing higher cost to produce ammunition at the Mississippi plant. The Army's prove-out cost estimate includes the additional cost to produce ammunition at the Mississippi plant as compared to the estimated costs to produce the same items at other plants. The cost differential has been substantial. For example, in May 1985 the Army reported that the average unit cost for an M483A1 round produced at the Mississippi plant was about \$1,100 and that the average unit cost at its other two plants was about \$400, a difference of \$700 per unit.

Missed Production Schedules

Because of construction delays and start-up difficulties, the contractor has not been able to produce as many M483A1 rounds as the Army planned to produce at the Mississippi plant. In its budgets for fiscal years 1982 through 1986, the Army requested funding for 910,000 M483A1 rounds to be produced at the Mississippi plant. However, primarily due to production problems, 630,000 rounds, or about 69 percent, had to be allocated to other plants, as shown in table 2.2.

Table 2.2: Budgeted and Actual Quantities of 155-mm M483A1 Rounds Produced at the Mississippi Plant

Fiscal year program	Budgeted quantity	Quantity produced	Quantity reallocated to other plants
1982	40,000	40,000	0
1983	150,000	17,000	133,000
1984	240,000	138,000	102,000
1985	240,000	85,000	155,000
1986	240,000	0	240,000
Total	910,000	280,000	630,000

The contractor's inability to produce quantities as planned resulted in a large production backlog of M483A1 rounds. We reported this backlog in our reports on the Department of Defense's ammunition budgets for fiscal years 1985, 1986, and 1987 and recommended that the House and Senate Committees on Appropriations reduce the budgets for M483A1 rounds because of the production backlog.¹

¹Results of GAO's Review of DOD's Fiscal Year 1985 Ammunition Procurement and Production Base Programs (GAO/NSIAD-85-12, Oct. 23, 1984), DOD's Fiscal Year 1986 Ammunition Procurement and Production Base Programs (GAO/NSIAD-85-141, Sept. 16, 1985), and Defense Budget: Potential Reductions to DOD's Ammunition Budget (GAO/NSIAD-86-188, Sept. 30, 1986).

According to Army budget guidance, ammunition program quantities for which funds are being requested should be delivered within the fiscal year's funded delivery period. The funded delivery period for an ammunition item is the time in months from first delivery of the ammunition item to last delivery for a specific fiscal year's procurement. It begins the last month of the procurement lead time and ends 12 months later. For example, since the procurement lead time for the M483A1 round is 13 months and 12 months are allowed for production, the Mississippi plant should have produced the fiscal year 1984 production quantity by September 30, 1985. However, the plant was experiencing production delays and did not finish producing the fiscal year 1984 quantity until August 1988.

The plant was still experiencing production delays in calendar year 1988. Table 2.3 shows that the actual production quantities of cargo metal parts, projectile metal parts, and projectile LAP were less than the scheduled quantities during the first half of calendar year 1988.

Table 2.3: Scheduled and Actual Production at the Mississippi Plant From January 1, 1988, Through June 30, 1988

Item	Scheduled production	Actual production	Production backlog
Cargo metal parts	9,594,926	7,006,737	2,588,189
Projectile metal parts	94,453	92,660	1,793
Projectile LAP	90,805	66,955	23,850

High Production Costs

In addition to the production backlog, the Mississippi plant has incurred higher costs for producing ammunition components and loading, assembling, and packing projectiles than the Army's other plants that produce the same items. It is not unusual to incur higher-than-normal production costs for initial production quantities. Therefore, it would not be meaningful to compare the unit costs for producing the initial quantities at the Mississippi plant to costs at other plants. However, the plant has been producing ammunition since February 1984, and its production costs were still somewhat higher than those at other plants in calendar year 1988.

Through June 1988, the Army had accepted 15,285,718 cargo metal parts produced at the Mississippi plant; 425,437 projectile metal parts produced at the plant; and 205,506 M483A1 rounds loaded, assembled, and packed at the plant. As shown in table 2.4, the average unit costs have decreased substantially since initial production in calendar year 1984.

Table 2.4: Production Quantities and Costs for Items Produced at the Mississippi Plant

Item	Calendar year	Quantity produced	Total cost	Average unit cost
Cargo metal parts	1984	a	a	a
	1985	a	a	a
	1986	790,567	\$17,113,274	\$21.65
	1987	7,834,280	17,907,207	2.29
	1988 ^b	6,660,871	9,391,829	1.41
Total		15,285,718	44,412,310	
Projectile metal parts	1984	8,252	34,419,044	4,171.00
	1985	61,451	34,441,180	560.47
	1986	100,536	35,969,403	357.78
	1987	162,538	41,818,516	257.28
	1988 ^b	92,660	18,404,131	198.62
Total		425,437	165,052,274	
LAP	1984	8,494	8,491,008	999.65
	1985	56,116	10,492,088	186.97
	1986	25,094	7,058,266	281.27
	1987	48,607	12,951,251	266.45
	1988 ^b	67,195	6,585,110	98.00
Total		205,506	\$45,577,723	

^aBecause of production problems during calendar years 1984 and 1985, no cargo metal parts were produced at the plant.

^bThrough June 1988.

While the average unit production costs at the Mississippi plant are decreasing, unit costs are still somewhat higher than they are at the Army's other ammunition plants. For example, while the unit cost to LAP an M483A1 round averaged \$98 at the Mississippi plant during the first half of calendar year 1988, the costs for similar operations at the Milan (Tennessee) and Kansas Army Ammunition Plants have been less than \$55 for several years, and the Army has been buying cargo metal parts for about \$1 each from other producers. The costs for projectile metal parts, however, are comparable to other producers' costs.

Problems in Product Quality

In addition to the contractor's inability to meet production schedules and the relatively high production costs, some M483A1 rounds produced at the Mississippi plant have had quality problems. Of the 425,437 projectile shells produced at the Mississippi plant, about 154,488, or one-third, produced between March 1986 and February 1987 will have to be reworked because the fiberglass wrapping has been separating from the projectile. This problem has not occurred at other plants producing the

shells. The Army estimates that it will cost about \$40 per projectile, or about \$5.67 million, to remove the fiberglass wrap and rewrap 141,755 projectile shells located at the Mississippi plant. An additional 12,733 projectile shells that were produced at the Mississippi plant and shipped to various Army installations will also have to be reworked because of fiberglass separation problems. The fiberglass wrap separation problem is not prevalent in projectile shells currently being produced at the plant.

Most recently, the Army has encountered another problem with the M483A1 round—nose cones' splitting when the projectiles are fired during ballistics testing. Such failures have occurred with M483A1 projectiles produced at all three of the Army's ammunition plants that load, assemble, and pack M483A1 rounds (i.e., the Kansas, Milan, and Mississippi plants). However, the frequency of failures has been greater for M483A1 rounds produced at the Mississippi plant. For example, eight consecutive production lots produced at the Mississippi plant from January through March 1988 failed ballistics tests because of split nose cones. On the other hand, failures of lots produced at Milan and Kansas have been fewer and more random. The Army is attempting to determine the causes of the failures.

Because of these and other quality-related problems, less than half of the M483A1 rounds that have been loaded, assembled, and packed at the Mississippi plant since calendar year 1984 had passed ballistics testing as of June 30, 1988. The plant had produced 205,506 rounds, and only 84,660 rounds, or 42.3 percent, had passed the tests.

Conclusions

The Mississippi plant has cost more and taken longer to complete than the Army originally estimated. Because of production problems, the Army has had to allocate a large portion of the planned production to other ammunition plants. For those items produced at the Mississippi plant, the costs have been higher than expected, and some items have had quality problems. Although unit costs have been decreasing, the ammunition produced at the Mississippi plant still costs more than ammunition at other plants and, in some cases, has been of lower quality.

Status of the Army's Efforts to Establish the Designed Mobilization Production Capability

The Congress provided the Army with \$123 million in fiscal year 1987 funds to correct identified deficiencies in plant processes, which have prevented the Mississippi plant from fully meeting the designed mobilization production rate of 120,000 155-mm M483A1 artillery rounds per month. The Army has awarded a \$117.7 million firm fixed-price contract to the operating contractor to correct the problems. This contract is scheduled to be completed by August 31, 1990. The Army is withholding \$10.4 million of the contract price pending successful demonstration that the plant can produce at its designed mobilization production rate of 120,000 rounds a month.

As of September 30, 1988, the contractor had completed 46, or about one-third, of the 141 mobilization projects, and the completed projects had generally been completed within negotiated costs. Delays were experienced on six, or 13 percent, of the completed projects. Of the remaining 95 projects still in progress, 60 were on schedule, and 35 were late. Most of the 35 late projects (28, or 80 percent) were among the 37 projects that the independent panel categorized as critical to achieving the required mobilization production capability.

Although most critical projects were behind the contractor's original schedule, the contractor's mobilization project manager does not believe that the delays will affect the mobilization contract's scheduled completion.

Reasons for the Mobilization Contract

In September 1986, the Army reported that the Mississippi plant could produce everything that it was supposed to produce, but not at the design rate. For example, the Army estimated that it could only load, assemble, and pack 9,000 rounds per month. The major problem was with the grenade assembly machines. These machines did not perform to specifications, and engineering analyses disclosed that they had inherent design deficiencies that would prevent them from ever reaching their design rate of 120 parts per minute per machine. Because of these deficiencies, new machines are being procured for the Mississippi plant as part of the mobilization contract.

Other problems limited the capabilities of the projectile and cargo metal parts facilities. For example, problems with the material handling system and equipment hampered the production of cargo metal parts. The Army estimated that cargo production was limited to the rate of 2,446 round equivalents (250,000 grenade bodies) per month and that the projectile facility could produce at a maximum rate of 44,000 rounds per

month. The projectile production was limited by the inability of the slow cool ovens to achieve the correct hardness on some of the projectile body forgings. These and other problems are being addressed during the mobilization contract.

In total, the mobilization contract consists of 141 projects that are intended to correct the identified deficiencies and to allow the plant to achieve its designed mobilization rate of 120,000 rounds per month.

Projects Most Critical to Mobilization Are Behind Schedule

As of September 30, 1988, the contractor reported that it had completed 46, or about one-third, of the 141 mobilization projects and that 95 projects were still in progress. Table 3.1 provides a breakout of the number of projects that have been completed on time or late, the number in progress that are on time or late, and the estimated costs for the projects.

Table 3.1: Status and Costs of All Mobilization Projects as of September 30, 1988

Status	Total projects	Negotiated amount	Cost to date
Completed			
On time	40	\$3,790,300	\$3,592,158
Late	6	528,952	508,825
Total	46	4,319,252	4,100,983
In progress			
On time	60	81,500,221	33,651,328
Late	35	21,297,640	11,529,937
Total	95	102,797,861	45,181,265
Total^a	141	\$107,117,113	\$49,282,248

^aThe total negotiated amount was \$117.7 million. This table excludes the negotiated amounts of \$185,536 for general engineering and administration costs and \$10.4 million for profit.

Of the 37 projects the independent panel considered to be most critical to correcting shortfalls that would prevent the Mississippi plant from achieving its mobilization production rate of 120,000 M483A1 projectiles a month, 6, or 16 percent, had been completed by September 30, 1988: 4 had been completed on time or early, and 2 had been completed later than scheduled.

Of the remaining 31 critical projects, the contractor was 7.5 to 22.5 months behind its original schedule on 28, or 90 percent, of them. According to the contractor, 25 of the 28 late projects are 7.5 months behind their originally planned completion dates, and the other 3 are 10,

20, and 22.5 months late. Most of the late projects (22 of them) have to do with the cargo material handling system. Although these projects are late according to the original plan's schedule, they are still scheduled to be completed before August 30, 1990, when the mobilization contract is to be completed. The independent panel concluded in its June 1988 report that the mobilization effort was generally proceeding well and is likely to be completed on schedule.

The number of critical mobilization projects completed on time or late, the number in progress that are on time or late, and project cost information are shown in table 3.2.

Table 3.2: Status and Costs of Critical Mobilization Projects as of September 30, 1988

Status	Total projects	Negotiated amount	Cost to date
Completed			
On time	4	\$1,094,494	\$1,133,681
Late	2	2,278,920	1,782,475
Total	6	3,373,414	2,916,156
In progress			
On time	3	26,392,884	15,141,464
Late	28	13,653,320	8,653,231
Total	31	40,046,204	23,794,695
Total^a	37	\$43,419,618	\$26,710,851

^aThese totals do not include engineering and administration costs.

Demonstration of the Plant's Production Capability

The desired goal of the mobilization project is to make the Mississippi plant capable of producing 120,000 acceptable rounds per month. If Mason Chamberlain, Incorporated, successfully demonstrates this capability, it will receive a profit of \$10.4 million, as specified in the mobilization contract.

The Army's acceptance of the plant will be based on a determination that individual subsystems (i.e., grouped sets of similar machine operations) within the projectile metal parts, cargo metal parts, and LAP facilities have each produced sufficient component parts to assemble 20,000 acceptable rounds within the specified time period. The Department of Defense's fiscal year 1989 budget includes \$110.2 million for 236,000 M483A1 rounds—\$103.2 million to procure 221,000 rounds for the Army and \$7 million to procure 15,000 rounds for the Marine Corps. These rounds are being produced at the Mississippi plant to demonstrate its production capability.

The planned acceptance tests will demonstrate the output capability of the tested subsystems; however, because the tests will be performed under controlled (i.e., ideal) conditions, the tests may not establish the capability of the subsystems to operate together or to produce 120,000 acceptable rounds. In addition, the demonstration test plan does not specify and the Army and the contractor have not contractually agreed on the number of acceptable component parts considering loss rates (i.e., performance criteria) that each subsystem selected for testing must produce to unequivocally prove the plant's capability.

Limitations of the Army's Test Plan

The plant will be tested by the contractor and accepted by the Army on a one shift, 8-hours per shift, 5 days per week (1-8-5) subsystem-by-subsystem basis. A total of 32 subsystems have been identified for acceptance testing within the plant—17 in the projectile metal parts facility, 10 in the cargo metal parts facility, and 5 in the LAP facility. In addition, 51 production support mobilization projects that directly affect production operations have been identified for acceptance testing.

To demonstrate the plant's capability, half the production equipment within each subsystem will be utilized to produce the components and parts for 20,000 acceptable rounds per month using a single 8-hour shift, 5 days a week. The test period for each subsystem cannot exceed 30 consecutive days. For the tests, half of the machines within each subsystem are to be randomly selected and operated to estimate the total mobilization capability. The assumption is that if 20,000 acceptable rounds can be produced during a 30-day period using half of one shift's capability, then 120,000 acceptable rounds can be produced during three shifts using all the production equipment.

The Army selected this subsystem test methodology because it allows capability demonstrations to occur while newly installed equipment is still under warranty, and it allows for early identification of problems and corrective actions. However, the planned demonstration tests will not simulate production under actual conditions because the quantity and quality of input material can be chosen, the subsystems do not have to be operated at the same time, and maintenance can be concentrated on the subsystem being tested. Under actual mobilization production conditions, the quality and quantity of input materials might vary; the subsystems would be operated together; and maintenance would be spread throughout the plant. These conditions could significantly affect the outcome of the plant's capability demonstration.

Even though the Army's test plan has limitations, we are not recommending that the Army conduct additional tests. In order to better demonstrate the plant's production capability, the plant would have to be operated on an integrated basis at a fixed production rate after the mobilization contract has been completed. The Army estimates that it would need about \$121.4 million for M483A1 rounds to operate the Mississippi plant for a year at a rate of 20,000 M483A1 rounds a month and that additional funds would be required for fuzes and propelling charges used with the M483A1.

The Army had planned to continue producing M483A1 rounds at the Mississippi plant following completion of the mobilization contract. However, due to funding constraints, it did not request fiscal year 1990 funds to procure additional M483A1 rounds and no longer plans to operate the plant after the contract has been completed. Instead, the plant will be placed in layaway. In view of this Army decision to lay away the plant and since certain types of equipment tend to deteriorate during storage, additional tests to better define production capability are probably not warranted.

Performance Criteria Is Being Developed

The contractor is required to gather test results on the performance of each subsystem and submit them to the Army for analysis and acceptance of the subsystem. As of October 14, 1988, the contractor had collected and submitted data on five projectile metal parts subsystems to PBMA for analysis, but none of the subsystems had been accepted because the Army and the contractor had not agreed to the subsystem performance criteria needed for Army engineers to evaluate the data collected. However, in some instances, the subsystems are still being procured and installed as part of the mobilization effort.

The performance criteria become benchmarks against which subsystem outputs are measured. The performance criteria should vary, depending on the anticipated production capability, loss rates, and inefficiencies within each subsystem. According to AMCCOM officials, the maximum production capacity for any plant is normally considered to be 2.5 times the one-shift rate. For the Mississippi plant, this would mean that to demonstrate the ability to produce 120,000 rounds a month, the plant would have to be capable of producing 48,000 acceptable rounds for one shift, or 24,000 acceptable rounds during a half shift. This is 4,000 rounds more than the Mississippi test plan currently requires.

During a November 15, 1988, meeting, the Army and the contractor reached tentative agreement on the criteria that will be used to evaluate the performance output of the tested subsystems, and the contractor has submitted the agreed-upon criteria to the Army for formal approval. However, as of January 26, 1989, the mobilization contract had not been amended to incorporate the performance criteria.

Conclusions

The mobilization contract, including tests to demonstrate the plant's production capability, is scheduled to be completed in August 1990. The Army's test plan has limitations and may not be sufficient to demonstrate the actual maximum production capabilities of the plant. However, additional tests are probably not warranted since the Army plans to begin placing the plant in layaway during fiscal year 1990.

The Army Plans to Close the Mississippi Plant

Because of funding constraints, the Army no longer plans to procure the M483A1 during peacetime and therefore plans to shut down the Mississippi plant, placing it in a standby status after producing the fiscal year 1989 program quantity. This action will require layoffs at the Mississippi plant. The Army studied the possibility of producing other ammunition items at the plant, such as the new 155-mm M864 artillery round, but rejected this alternative because the production lines would have to be modified, thus hindering the plant's ability to achieve maximum production of the M483A1 during mobilization. Modifying the production lines could negate the goal of the mobilization contract. In addition, the Army has invested time and money at other plants scheduled to produce the ammunition.

The Mississippi Plant Will Be Placed in a Standby Status

The Army plans to place the Mississippi plant in a standby status to meet projected mobilization production requirements. This planned action complies with Army guidelines, which specify that ammunition plants should be closed and maintained in a standby status when production quantities are insufficient to operate the plant efficiently. According to Army preliminary estimates, it will cost \$50 to \$75 million to lay away the plant and about \$13.5 million annually to maintain the plant in layaway.

If the Army were to keep the Mississippi plant in production for another year, the Army estimates that it would need about \$121.4 million for 240,000 M483A1 rounds. The Army would also need to procure fuzes and propelling charges used with M483A1 rounds. The Army estimates that it would cost about \$28.6 million for fuzes and about \$15 million for propelling charges.

Army officials said that the Army had not requested funds for procuring the M483A1 round (the only item produced at the Mississippi plant) in fiscal years 1990 and 1991 because the total ammunition budget is decreasing and the Army wanted to use available funding for other higher priority ammunition items, such as the new M864 round. They said that, while the Army's current inventory of 3.8 million M483A1 rounds is less than half the size the Army is authorized to procure, the Army has virtually no M864 inventory.

When an ammunition plant is placed in standby, steps are supposed to be taken to prevent the deterioration of the plant and its equipment. For example, equipment should be cleaned, and a protective coating applied

to prevent rust. The Army requested \$20.8 million in its fiscal year 1990 budget to lay away equipment at the plant:

- \$10.6 million to lay away the projectile metal parts production line,
- \$5.1 million to lay away the cargo metal parts production line, and
- \$5.1 million to lay away the LAP facility and support facilities.

Although the Army plans to lay away the Mississippi plant for use during mobilization, it may not be able to quickly start up the production lines after they have been in storage for an extended period of time because, according to an Army official, electronic process control system components are not designed for layaway and may have to be replaced before the lines can be restarted. In addition, in the event of mobilization, a work force would have to be hired to operate the plant.

Alternative Items Considered for Production at the Plant

The Army considered the possibility of producing other ammunition items at the plant. A January 1986 Army study identified alternative items that could be produced at the plant. The M864 round appears to be the most viable alternative item for production at the plant because it is similar to the M483A1 round, but the Army has already invested time and money at the Scranton, Pennsylvania; Louisiana; and Milan Army Ammunition Plants for the capability to produce this item. In addition, the Army's planned procurements of the M864 will not support another producer. In fact, the Army requested \$8.14 million in its fiscal year 1991 budget to lay away M864 production lines at locations to be determined.

Table 4.1 shows the items that the Army considered as candidates for production at the Mississippi plant and the Army's estimated costs to convert the production facilities in order to produce the items.

Chapter 4
The Army Plans to Close the
Mississippi Plant

Table 4.1: The Army's Estimated Costs to Establish Production Capacity for Alternative Items at the Mississippi Plant

Cost in millions	
Item and production operation	Conversion Cost ^a
Projectiles	
LAP M864 projectiles	\$0.40
Produce M864 projectile shells	6.90
Produce M864 base plates and nose cones	21.00
Produce M42 and M46 grenades for the M864	0
Produce M804 projectile metal parts	8.90
LAP XM898 projectiles	1.05
Produce M731 projectile metal parts	0.05
Produce M915 and M916 projectile shells	8.70
Produce M915 and M916 base plates and nose cones	2.10
Mortar cartridges	
Produce M929 and M930 projectile metal parts	11.40
Produce M932, M933, and M934 projectile metal parts	19.40
Grenades	
LAP XM77 grenades	0.30
Produce XM77 grenade metal parts	0.54
Produce XM80 grenade metal parts	1.20

^aThese cost estimates are in constant fiscal year 1986 dollars.

The Army's 1986 report pointed out that (1) production of any of the alternative items would reduce the Mississippi plant's production capability to less than 120,000 M483A1 rounds a month and (2) shifting production scheduled at other plants to the Mississippi plant would adversely affect the plants scheduled to produce the items.

Even though the Army could invest additional funds to modify the production lines at the Mississippi plant to produce other items, there would be no guarantee that the plant could produce the other items quicker, better, or at a lower cost than other plants. In fact, Mississippi's production record seems to indicate the opposite.

Conclusions

The Army does not plan to procure additional quantities of the M483A1 round due to funding constraints and, therefore, will place the Mississippi plant on standby for possible mobilization production requirements. It does not plan to produce other ammunition items at the plant because of concern that producing alternative items would adversely affect the M483A1 production capability required during mobilization, negating the goal of the mobilization contract.

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