

GAO

Report to the Honorable
Edward M. Kennedy, U. S. Senate

September 1989

SOUTH AFRICA

Feasibility of Imposing Additional Sanctions on Gold



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National Security and
International Affairs Division

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September 25, 1989

The Honorable Edward M. Kennedy
United States Senate

Dear Senator Kennedy:

On November 23, 1988, you requested that we review South Africa's role in the world gold and diamond markets and the feasibility of imposing sanctions on these South African commodities. As agreed with your office, we are providing you with an interim report covering the results of our work on South African gold.

Background

In response to South Africa's policy of apartheid, the United States has imposed economic sanctions on selected products and transactions. In 1985, the President issued Executive Orders 12532 and 12535, which, among other things, administratively banned: imports of South African Krugerrands (gold coins); exports of computers to apartheid-enforcing agencies and nuclear goods and technology; and new loans to the South African government. Subsequently, the Congress, over the President's veto, passed the Comprehensive Anti-Apartheid Act of 1986, which legislatively banned

- imports into the United States of South African coal, textiles, uranium, agricultural products, iron and steel, and products from South African government-owned or controlled entities;
- exports of oil, arms, nuclear goods and technology, and computers to apartheid-enforcing agencies;
- new U.S. loans and investment in South Africa; and
- air transportation between the two countries.

Since 1986, debate in Congress has focused on the effectiveness of these existing sanctions and whether more should be imposed. Because gold mining and exporting is critical to South Africa's economy, sanctions against gold have been proposed as a possible additional method of pressure. This report describes South Africa's role in the world's gold market and analyzes the potential effects on South Africa, the United States, and other countries of adopting various proposals to impose sanctions on South African gold.

Results in Brief

Gold accounts for 45 percent of South Africa's export earnings, about 13 percent of its Gross Domestic Product, and 10 percent of its government tax revenues. The United States already has sanctions against imports of South African gold bullion through the Comprehensive Anti-Apartheid Act's ban on imports from South African government-owned or controlled entities. Proposals to further sanction South African gold include

- banning imports of jewelry containing South African gold,
- releasing gold from the central bank reserves of anti-apartheid governments to depress the price,
- banning imports of gold and gold products (including jewelry) containing South African gold and releasing gold from central bank inventories to offset any price increases caused by reduced supply to the market or market uncertainty caused by sanctions,
- forcing U.S. investors to divest all holdings in South African gold mining shares.

Enforcement of sanctions on South African gold may be more difficult than sanctions on other products but it may not be impossible. However, even if enforcement were perfect, most sanctions against South African gold might fail to generate substantial direct economic pressure because South Africa has many opportunities to develop new markets and/or because imposing any sanction on the world's largest gold producer may result in unintended price increases caused by speculative buying in the market. Any collateral price increases could unintentionally increase revenues from South African gold exports. The exception might be forced divestment from South African gold mining shares but this option would only hurt the South African economy at the margins.

South Africa could legally avoid the two sanctions on imports of gold and/or gold products by developing alternative markets and might benefit from unintentional speculative price increases. Initial price decreases resulting from releasing gold might be difficult to sustain in the long term because of unintended price increases. Also, releasing gold might harm other gold producing nations at least in the short term.

However, sanctions on this critical South African industry, even when failing to generate substantial direct economic pressure, could still have political, symbolic, and psychological effects. For example, sanctions on South Africa's largest export could have the psychological effect of chilling business confidence in the economy, lowering foreign and domestic investment in South Africa.

South Africa's Role in the World Gold Market

Despite its falling market share, South Africa still mined 35 percent (621 metric tons) of the 1,796 metric tons of gold produced worldwide in 1988. This large share, however, does not translate into much South African influence over the world price, according to industry analysts and economists. The price of gold is primarily determined by the demand for it as an investment asset rather than the supply of new production. Any attempt by South Africa to withhold supplies from the market to increase the price would eventually cause private investors and central banks to sell gold from their large stocks, thus pushing the price back down. Central bank stocks are 20 times greater than annual world gold production and private investment holdings are 30 to 36 times as great. In addition, the price of gold is affected by forces unrelated to South African production, namely expectations of inflation and economic and political uncertainty. (Appendix I contains additional information on South Africa's role in the world gold market.)

Feasibility of Imposing Sanctions on South African Gold

We recently reported that although most market analysts and many U.S. government officials were unaware of it, the Comprehensive Anti-Apartheid Act banned imports of South African gold bullion into the United States under the prohibition on imports from South African government-owned or controlled entities¹. All South African gold is marketed internationally by the Reserve Bank of South Africa, a South African government entity. Because the United States imported only \$79 million in gold bullion (about 6 metric tons) directly from South Africa in 1986² before the sanctions took effect and because knowledge of the ban was not widespread, the prohibition had little adverse effect on South Africa's gold exports or the price of gold.

Policymakers who want to impose further sanctions on South African gold should consider several major issues. First, because gold is more easily smuggled than most commodities due to its high value relative to its weight (gold in September 1989 was trading at about \$360 an ounce) and because gold from all countries appears the same visually, enforcing sanctions on gold may be more difficult than for other commodities. Nevertheless, these difficulties might not render enforcement impossible. It is possible to determine where gold bullion was mined by physical and chemical testing and, as in other situations, enforcement may be

¹South Africa: Enhancing Enforcement of the Comprehensive Anti-Apartheid Act (GAO/NSIAD-89-184) July 1989.

²The United States bought over half of its gold bullion imports from Canada.

helped by leads on illegal imports supplied by informants. While the predominant view of market participants in the gold industry is that there is no test to determine gold's origin, a research chemist at the National Institute of Standards and Technology has successfully determined the origin of refined gold by a test that analyzes trace metals in gold. According to the chemist, the test might be used to identify South African gold for sanctions enforcement. Moreover, most geochemists we interviewed said that such trace element tests are conclusive enough to be used in court to prosecute violators of the sanction. However, according to the chemist, it may be more difficult to use the test effectively to determine the country of origin of jewelry. Metals combined with gold in jewelry manufacturing may render the tests ineffective. To enforce sanctions on jewelry, enforcement authorities would need to rely on leads generated from documentation accompanying jewelry imports and tips from informants. (See Appendix II for more information).

Second, even if there were no smuggling and some other nations began to adopt a ban on imports of bullion, South Africa could sell its gold to many alternative markets. For commodities in which all that is produced is consumed, sanctions can cause a shift in traditional relationships, with the sanctioned country selling to non-sanctioning consuming countries and other suppliers exporting to sanctioning countries. For gold, in which annual consumption and production are about 2-3 percent of existing central bank and private investment stocks, the potential for such market shifts or "reordering" is even greater. Non-South African gold in central banks and investment stocks could be sold to consumers while being replaced in the stocks by new South African production.

Third, any sanction on the largest gold producer (35 percent of the market), in a market where psychological or speculative influences are powerful, might cause enough uncertainty to cause unintended price increases helpful to South Africa. If sanctions imposed to reduce South African gold revenues significantly raised gold prices, South Africa's total income could be maintained or even rise despite any decline in the quantity of shipments. The magnitude of these speculative effects is hard to predict and so, therefore, are the effects of sanctions on gold. On the other hand, any sanction imposed on South Africa's most important industry might chill business confidence in the country, leading to reduced foreign and domestic investment. The magnitude of this effect is also hard to predict.

Fourth, if gold sanctions were severe enough to shut down some South African mines, there might be great difficulty reopening them in any

post-apartheid society. South African gold mines are deep and are subject to great geological pressure within the earth. Once mines are shut down and no longer maintained, the geologic forces close up the mine shafts. Some representatives from the mining industry said reopening a closed mine would be impossible and others said it would cost hundreds of millions of dollars.

Fifth, according to a quantitative economic analysis done by an economist knowledgeable about the South African economy, sanctions on South African gold would inflict greater dollar costs on white mine owners in South Africa than on white and black miners. As a group, black miners would experience a greater loss than white miners because they greatly outnumber them. White miners would lose more per capita income than black miners because they have higher wages.

Appendix II contains additional detail on these issues.

Options for Further Sanctioning South African Gold

Several proposals have been made by sanctions advocates to take further action against South African gold. The possible effects of imposing these sanctions are discussed below.

- Banning imports of jewelry containing South African gold and requiring certificates for jewelry imports stating that they are made with non-South African gold.

Most South African gold enters the United States in the form of jewelry, particularly Italian jewelry. About \$800-\$900 million of South African gold is used in Italian jewelry imported annually into the United States. This proposed sanction would address more imports into the United States of South African gold than the existing U.S. sanction on gold bullion. Obviously, banning jewelry imports made with South African gold would stop more South African gold from reaching the market in the form of jewelry if other nations also adopted it. Great potential exists, however, for market reordering that would allow new South African production to replace non-South African gold in central bank and private investment stocks, which would be sold to jewelry producers.

- Selling gold from reserves to depress gold prices.

Initially, selling gold from U.S. or foreign central bank reserves would decrease the price but whether it could be held down over the long-term is uncertain. Because U.S. gold stocks are about 4 times annual world

production and world central bank stocks are 20 times this amount, central banks could sell gold into the market for some time to hold the price down. The amount of gold sold and the initial price decrease would depend on the number of central banks participating and how much they were willing to deplete their reserves. But because gold is both an asset and a store of value, investors and other governments might expect the price to rise over time. They may buy up what they perceive as cheap central bank gold to take advantage of any long-term potential for price appreciation after central banks finish their release. Such speculative buying might bid up the price of gold and tend to offset any initial price decreases from releasing gold. To avoid such speculative effects, the selling of central bank stocks would have to convince investors that gold was an asset whose price would not rise in the future.

In the late 1970s, the initial price decrease caused by U.S. Treasury and International Monetary Fund sales of small quantities of gold was more than offset by longer term price rises attributed by some analysts to investors purchasing gold to hedge against the substantial inflation of the period. Inflation is now less severe but the example illustrates how unpredictable macroeconomic circumstances can affect the policy.

If the gold price were depressed by releasing gold, the gold price would hurt gold producers in the United States, Canada, Australia, the Soviet Union, and several third world countries. It would also reduce the value of countries' central bank reserves, including those of developing countries. Disagreement exists between those who believe large sales of gold from reserves would destabilize the international financial system and those who see no such effect.

- Banning South African gold bullion and products containing it, while releasing gold from reserves to offset any price increases.

This proposal attempts to guard against the possibility that speculative price increases could more than offset the negative effect on South Africa's revenues resulting from lower quantities of gold exports caused by a ban on its gold. Although no speculative price increases occurred when the United States banned South African gold bullion because of the small quantity of U.S. imports and because the market was largely unaware of the U.S. ban, they might occur if the boycott became multi-lateral. But South Africa may not lose gold sales because new South African production could displace non-South African gold in the central bank and private investment stocks of non-sanctioning countries. In

addition, as noted above, no guarantee exists that releasing gold from reserves will push the price back down over the long term.

The proponent of the proposal argues that if the price is stabilized by releasing gold from central banks, the market will discourage efforts to circumvent the ban on South African gold. According to the argument, if market participants fear that South Africa's additional smuggled supplies would depress the price even further from the stabilized value, they would be encouraged to assist in enforcing the ban. But if releasing gold does not hold back price increases and stabilize the price, market incentives for enforcement may be mitigated.

- Forcing U.S. holders to divest ownership of South African gold mining shares.

The Comprehensive Anti-Apartheid Act bans investment in South African gold mining shares issued after its passage but allows U.S. investors to retain and trade shares issued prior to enactment. Divestment, unlike the other proposals, would not try to reduce South African gold revenues, but would attempt to reduce the funds available for South African mining companies to invest in exploring for and producing gold. According to a representative from a mutual fund investing in gold, U.S. contribution to new capital formation in the South African gold mining sector already has been stopped because investment in new shares is already banned; the trading of old shares merely changes ownership in the companies. U.S. investors currently own 14 percent of South African gold mining shares.

Forced divestment, however, could further depress the share price of South African mining stocks, already selling below the prices of other countries' mining shares because of perceived risk, making it more expensive for the companies to raise capital. U.S. divestment may also help to chill the business climate in South Africa, discouraging new investment from domestic and other foreign sources.

Appendix II provide more detailed information on these possible sanctions and appendix III describes the objectives, scope, and methodology of the review.

As agreed, we did not obtain agency comments on this report. However, officials of the State Department and the Department of Commerce's National Institute of Standards and Technology reviewed the results of

our work and any comments they made were incorporated as appropriate.

Unless you announce its contents earlier, we plan no further distribution of the report until 30 days after its issue date. At that time, we will send copies to the Secretaries of State, Commerce, and Treasury; the Commissioner of Customs; the Director, Office of Management and Budget; congressional committees responsible for overseeing implementation of the Act; and to other interested parties upon request.

This report was prepared under the direction of Allan I. Mendelowitz, Director, Trade, Energy and Finance Issues. The principal GAO staff members responsible for this review were Steven Sternlieb, Assignment Manager, Ivan Eland, Evaluator-in-Charge, and Bruce Kutnick, Economic Advisor.

Sincerely yours,



Frank C. Conahan
Assistant Comptroller General

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South Africa's Role in the World Gold Industry

Gold is unique because it is both a commodity and an asset or store of value. As a commodity, it is used in making jewelry, electronic circuitry, and dental fillings. Although gold's role as money in the international financial system was diminished in 1973 when the gold-exchange standard was abandoned, allowing the price of gold and the value of world currencies formerly tied to it to float freely, gold still remains an asset and store of value in the stocks of private investors and central banks.

Share of World Production

South Africa is the world's largest gold producer, accounting for 35 percent of the world's 1988 supply of 1,796 metric tons; this share has declined, however, from its peak in the early 1970s because its mines are aging and producing less gold while Canada, Australia, the United States, and other nations are increasing their gold production. (See table I.1.)

Table I.1: The Five Major Gold Producing Countries

| Country | Metric tons produced in 1988 | Percent of world production |
|---------------|------------------------------|-----------------------------|
| South Africa | 621 | 35 |
| Soviet Union | 280 | 16 |
| United States | 205 | 11 |
| Australia | 152 | 8 |
| Canada | 129 | 7 |

Several third world countries are emerging as gold producers, including Brazil (100 metric tons), the Philippines (43 metric tons), and Colombia and Papua New Guinea (each with 33 metric tons).

South Africa once had the world's lowest production costs but has now slipped to fifth place behind Canada, the United States, the Philippines, and Australia because its mines are deep—as much as a mile below the earth's surface—and have lower grades of ore remaining.

Ability to Control Gold Price

According to many gold analysts and economists, South Africa has little control over the world price. First, unlike many other primary commodities, which are used exclusively for consumption, not all of the gold produced is consumed (in jewelry, electronics, and dentistry). The price of gold is primarily determined by the demand for it as an asset rather than by the amount of new production. Substantial quantities of gold are held in the stocks of private investors and central banks; gold held by central banks is about 20 times annual world production and private

investment holdings are 30 to 36 times as great. If South Africa withheld gold from the market, the increased price might eventually stimulate sales from these stocks, thus pushing the price back down. But because gold is also an asset and store of value and its price is heavily influenced by psychological or speculative factors, South Africa might be able to increase the price for short periods by withholding gold to create uncertainty in the market. But South Africa is constrained from withholding supplies for longer periods because it needs export earnings to pay its foreign debt and because the large world gold inventories limit the effect any producer can have on the price for long periods.

Second, South Africa has difficulty manipulating the price of gold because global macroeconomic conditions can have substantial effects on that price. Although investors have decreased their use of gold as a hedge against political and macroeconomic calamities in recent years because a wider variety of financial investments are available, they still buy more gold when they expect substantial inflation and economic and political instability.

Demand for and Marketing of Gold

In 1988, the fabrication of jewelry, electronic circuitry, and dental fillings consumed 1,844 metric tons of raw gold¹. The major consuming nations were Italy (274 metric tons), the United States (204 metric tons), India (188 metric tons), Japan (174 metric tons), Taiwan (93 metric tons), and South Korea (79 metric tons).

Jewelry consumes over 80 percent of this worldwide fabrication demand. In 1988, the largest consumers of gold for jewelry were Italy (262 metric tons), India (187 metric tons), the United States (101 metric tons), Japan (95 metric tons), Taiwan (90 metric tons), and Hong Kong (75 metric tons). According to an official of the Italian Statistical Bureau (ISTAT) and the statistics he generated, 91 percent of all gold entering Italy originates in South Africa. The Italian industry ultimately consumes at least one-third of all South African gold exports.

According to many analysts and market participants, South Africa markets most of its gold through the major gold markets in Switzerland and London, with much going through Switzerland. South African gold that is used in Italian jewelry passes through Switzerland on its way to the jewelry factories. South Africa refines its gold only to 99.5 percent

¹With the supply of recycled gold (scrap) (324 metric tons) added to the 1,796 metric tons of new gold supplied by mining countries, total supply exceeds total consumption.

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purity; it is then shipped to Switzerland, where some is merely reexported and some is remelted and rerefined to 99.99 percent purity.

Feasibility of Imposing Sanctions on South African Gold

Gold mining is critical to the South African economy, accounting for about 13 percent of its Gross Domestic Product and 10 percent of government tax revenues. The industry employs over a half million workers. As the country's largest export, gold provides 45 percent of its foreign exchange earnings. Because South Africa had difficulty servicing its foreign debt, which led its government to reach an agreement with creditor banks on partial debt rescheduling, revenues from gold exports are especially important to meet loan payments.

Whether pressures on the economy of South Africa from gold sanctions will induce the South African government to reform its political and social system is a matter of debate between those who advocate economic sanctions and those who oppose them. Those who advocate sanctions believe that the government would institute reforms to alleviate economic pressure. Some of those who oppose sanctions say that economic pressure would not create enough economic pain to cause reform and would cause a backlash among whites against foreign interference that would impede reform.

Whether successful or not in pressuring the government economically, such economic sanctions might have the symbolic effect of showing increasing opposition to apartheid. Also, many opposition groups within South Africa favor sanctions so such economic pressure might help to cultivate better U.S. relations with them.

Issues to Be Addressed When Considering Sanctions on Gold

There are several issues that should be addressed in considering sanctions, including identifying South African gold, the impact on the gold market, the long-term effect on a post-apartheid government, and the effect on South African miners.

Distinguishing South African Gold From That of Other Countries

A major issue for policymakers imposing sanctions on gold is whether South African gold or articles containing it can be distinguished from gold produced in other nations. Most of the participants in the gold industry we interviewed said the country of origin could not be determined by physical properties. South African gold bullion is engraved with a seal from the Rand Refinery, the only one in South Africa, but the bullion could be easily disguised by remelting and remarking. Some metallurgists and geochemists doubted that chemical tests could be made on gold refined to a high purity, because tests for country of origin

are made on the trace elements of gold and highly refined gold has few trace elements left.

Other geochemists, however, believe that effective chemical tests could be made and one research chemist at the National Institute of Standards and Technology in the Commerce Department has reported developing a methodology for testing refined gold for its origin. According to the chemist, gold that is up to 99.99 percent pure can be successfully tested. The chemist analyzed trace elements in gold from coins to determine where they were mined. The test he used analyzes a sample of gold for the ratio of the various chemical forms of the trace element lead. Gold deposits from different mines have different lead ratios (signatures). He said that the only additional requirement for testing refined gold is taking a larger sample.

According to the research chemist, to test gold bullion for South African origin, a catalog of lead signatures from gold producing countries would be needed to compare with the signature of any sample. Startup costs would be incurred creating this catalog and developing a methodology for the testing, according to the Director of the Research Division of the Customs Service. The director said the costs for developing a methodology might be mitigated because the National Institute has already done testing on gold. After the catalog and methodology were complete, the chemist estimated that the costs would be \$100 to \$200 per gold sample tested. New testing equipment being developed might reduce the cost of testing and allow it to be done faster.

Some geochemists and market analysts we interviewed spoke of possible efforts by South Africa to render the test of gold bullion ineffective (for example, mixing its gold with that of other nations). According to the research chemist, such efforts might be thwarted by making an additional test called "trace element fingerprinting." This test analyzes the sample for the relative abundance of 20 different trace elements. Gold from different geologic locations has different signatures caused by different ratios. The methodology for the test is already highly developed. Once the catalog of signatures is developed, according to the chemist, the per sample cost of this testing program would be \$30 to \$40 per test.

Using more than one test might make it almost prohibitively expensive, although not impossible, for South Africa to render the tests ineffective, according to the research chemist. If the South Africans mixed their gold with that of another country to defeat one test, two tests would be more likely to detect properties of South African gold. If South Africa

tried to add trace elements to its gold to imitate that of another country, the use of two tests would make it harder to do because it would be more difficult to get an exact match on all the trace elements.

Most geochemists we interviewed said that all such trace element tests are conclusive enough to be used in court as evidence against alleged violators of the sanction. The test will not, however, distinguish newly mined gold from gold that has been in investor and central bank stocks for some time. This would make it difficult to impose sanctions only on South African gold mined after the sanctions law takes effect.

It may be more difficult to identify the origin of gold in jewelry, according to the research chemist. In jewelry-making other metals are combined with gold to form a gold alloy. If lead and the other trace elements detected by the tests were added when a particular shipment of jewelry was manufactured, testing the gold contained in the jewelry for its origin may be more difficult. The added metals could change the ratios of trace elements measured by the test.

Even if an accurate chemical test for gold were implemented, a sanction against imports of South African gold might be somewhat harder to enforce than measures against other South African exports. Smuggling gold, which has a long history, is easier than for many other products because it has a high value-to-weight ratio. South Africa's annual gold production can be flown out of the country on a few jet aircraft. Yet, as in other situations, enforcement may be helped by leads on illegal imports supplied by informants.

Psychological Effects of Sanctions on the Gold Market

Because gold is an asset and store of value as well as a commodity, speculative effects may have a greater influence on the outcome of gold sanctions than on boycotts of other commodities. Any sanction aimed at harming South African gold production or export revenues might be perceived by the market as threatening the producer of 35 percent of the world's annual gold supply. Investors might anticipate that any gold sanction would cause a price rise and buy gold to profit from it, thus enhancing the speculative demand for the metal. If sustained, this increase in demand might become a self-fulfilling prophecy, increasing the price. Any long term gold price increase might offset any negative effect of sanctions on South African gold. This is because significantly higher gold prices could allow South Africa to maintain or even increase its gold revenue despite any decline in the volume of shipments. It is difficult to predict the magnitude or duration of the speculative effect.

especially when other factors important in determining the value of gold are also changing, but figure II.1 demonstrates how gold prices increased during the debate and passage of the Comprehensive Anti-Apartheid Act in the summer and fall of 1986. It is possible that investors saw sanctions as indirectly threatening the largest producer of gold, thus creating uncertainty about future South African supplies and leading to the price rise. This speculative effect occurred even though the market was largely unaware that imports of gold bullion were covered by the sanctions.

Speculative demand for gold can also be caused by poor economic and political conditions in the world. Traditionally, investors have invested in gold as a hedge against inflation or economic or political instability. According to some market analysts, however, this demand may have weakened in recent years because many new investment opportunities are now available, as demonstrated by the failure of gold prices to rise immediately after the stock market crash of October 1987. The price of gold did not peak until two months after the crash.

On the other hand, sanctions on South Africa's most vital export might lessen both foreign and domestic confidence in the South African economy. This might lead to less foreign and domestic investment in the economy and lower future rates of economic growth. This chilling effect on business confidence is hard to quantify.

Long-Term Effect of Severe Sanctions

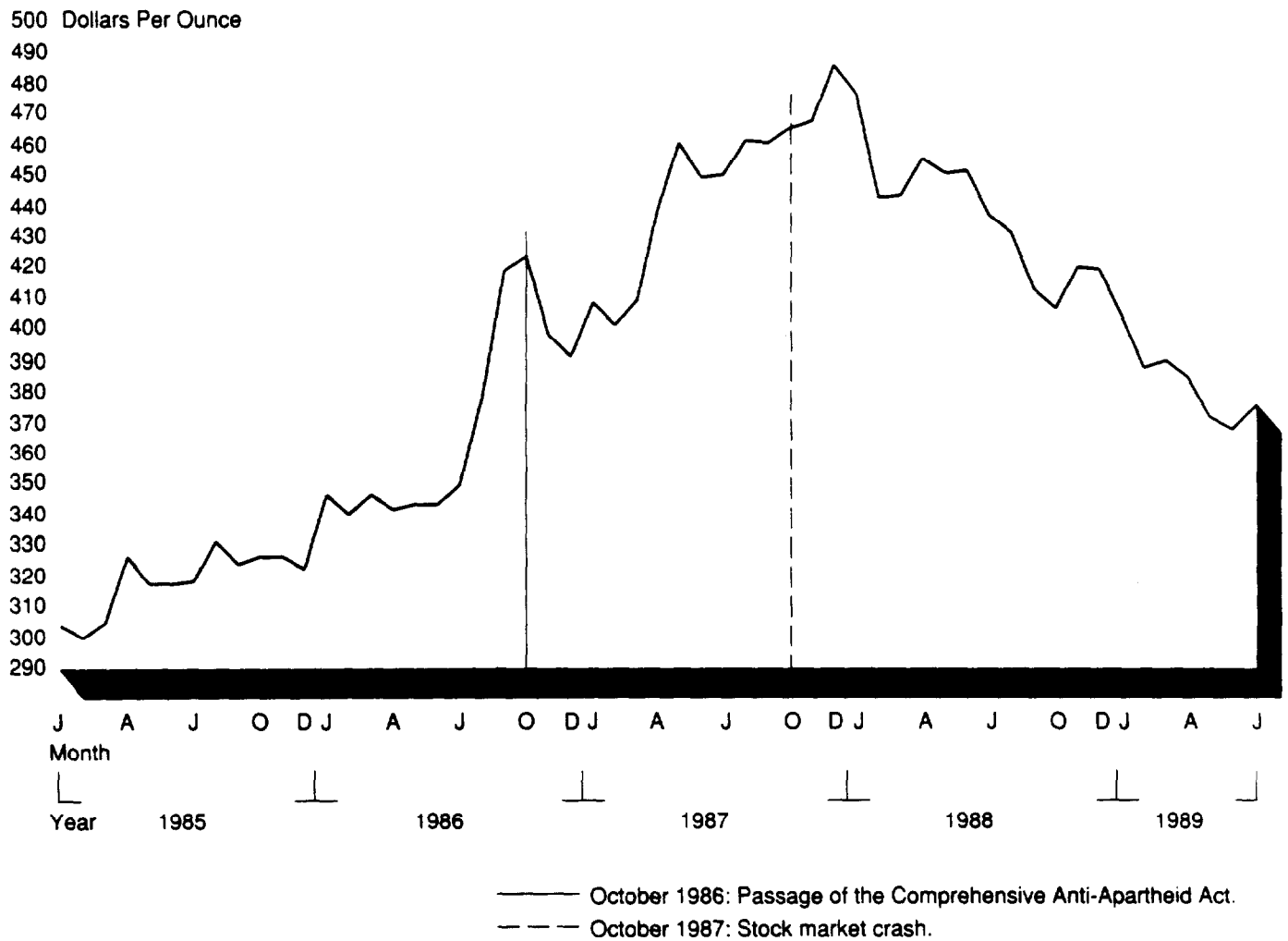
If sanctions against South African gold became so effective that mines began to close, it would be difficult to reopen them in any post-apartheid society. South African gold mines are the deepest in the world, as much as a mile beneath the earth's surface, and subject to great geological pressure. According to many people we spoke with in the gold industry, because South African mines are so deep, inactive mines must be maintained to prevent geologic forces inside the earth from closing up the mine shafts. And, it is expensive to maintain a mine while on inactive status. Some representatives from the mining industry said that reopening a closed mine would be impossible while others said that it could cost hundreds of millions of dollars.

The South African government currently subsidizes mines that have high production costs, hoping that gold prices will rise and once again make such mines profitable. If severe sanctions were imposed on gold, the government might also subsidize the mines, hoping to preserve them

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until it weathered the sanctions. This policy might preserve the mines for a post-apartheid government.

Figure II.1: Price of Gold



Source: International Monetary Fund, International Financial Statistics.

Effect of Sanctions on Blacks and Whites

According to a quantitative economic analysis¹ done by an economist knowledgeable about the South African economy, sanctions on South African gold would inflict greater dollar costs on white mine owners in South Africa than on white and black miners. Although, as a group, black miners would experience a greater loss than white miners because they outnumber them, white miners would lose more per capita income than black miners because they have higher wages. A \$1 million cut in South African gold export revenues because of sanctions would cost mine owners as a class an estimated \$665,000, white miners about \$72,000, and black miners about \$156,000. But because black miners greatly outnumber white miners, per capita losses for white miners exceed those of black miners.²

Existing Ban on Imports of South African Gold Into the United States

Our July 1989 report concluded that imports of South African gold bullion into the United States were made illegal by the Comprehensive Anti-Apartheid Act of 1986. Such imports are prohibited because they fall under the ban on imports from South African government-owned or controlled entities. South African gold bullion is currently marketed internationally by the Reserve Bank of South Africa, a government entity. Some discussion has subsequently occurred in South Africa about allowing private mining companies to market their own gold, which would remove South African gold bullion from this sanction and insulate it from potentially similar sanctions by other countries. Marketing the gold, however, allows the South African government to control foreign exchange earnings derived from its largest export.

Because little gold bullion was imported into the United States directly from South Africa prior to the ban and because knowledge of the boycott in the gold market was not widespread, the ban has had little actual impact reducing South African gold revenues or on the world price. In 1986, the last full year prior to the ban, only \$79 million in bullion imports came into the United States directly from South Africa. Loss of these revenues was more than offset by increased earnings from increasing gold prices. Even with U.S. sanctions, South Africa increased its gold revenues \$1.4 billion from 1986 to 1987.

¹Haider Ali Kahn, "Impact of Trade Sanctions on South Africa: A Social Accounting Matrix Approach," Contemporary Policy Issues, Volume VI, October 1988.

²The ratio of black miners to white miners is about 9 to 1 and therefore per capita income losses of white miners would exceed those of black miners by about 3 to 1.

If the United States obtained multilateral cooperation for the ban, the effects would be difficult to estimate because the number of countries that would adopt the measure is difficult to predict. If a small number of nations followed the U.S. lead, the market would be likely to eventually reorder itself, with South Africa selling to those countries with no sanctions against it and other gold producers exporting to nations with sanctions. Until the market reordered, South Africa might lose sales of gold.

Many more opportunities for market reordering exist in the gold market than in the markets for other commodities. Unlike markets for many commodities, for which all that is produced is consumed, central banks and private investors, whose large stock of gold is 50 to 56 times annual world production, provide an alternative market for South African gold. Non-South African gold in the stocks of non-sanctioning countries could be displaced by new South African production. Such market reordering would probably not cause South African gold to sell significantly below the world price because differences in transportation costs for gold, unlike many other commodities, are small.

In the extreme case, if enough countries imposed sanctions so that significant numbers of investors and consumers either could not or were unwilling to take South African gold, a two-tier price structure might then develop, with South African gold selling at a discount relative to non-South African gold because of lower demand.

Furthermore, any two-tier price structure might be eroded by South African attempts to smuggle its gold into prohibited markets by masking its origin. This would effectively raise the demand for South African gold. To reduce smuggling into the United States of steel containing Cuban nickel, the United States entered into government-to-government agreements with major steel producing nations whose companies use Cuban nickel not to export steel containing such nickel to the United States. The United States requires exporters from those countries to have certificates stating that the exported steel contains only nickel of non-Cuban origin. The foreign governments issue the certificates and are responsible for ensuring that their companies comply with them.

Because gold is also an asset and store of value for investors as well as a commodity, however, multilateral sanctions could raise the psychological uncertainty in the gold market enough to increase the speculative demand for and therefore the price of all gold. Even if, in the extreme case, multilateral sanctions limited markets for South African gold and reduced demand for it, speculative demand in the remaining markets

might increase to make up for the loss. If the increase in speculative demand is less than the impact of the sanctions, the price of South African gold would decrease. If the increase in speculative demand were greater than the decrease in demand from sanctions, the price of South African gold exports would increase. Because of market reordering and therefore lower reduction in demand, the latter case might be more likely than the former. If the price increases, South African revenue from gold exports might increase if the price increase offset the loss of revenue from lower quantities of gold exports due to the boycott.

Other gold producing nations would benefit in either case. A demand decrease for South African gold would increase the demand for gold from other producers. If net market demand increased because of uncertainty, the price of gold for all producers would increase. Swiss and other refiners might incur greater costs if, during the refining process, South African gold had to be separated from that of other nations.

A multilateral ban on South African gold would affect the United States in any case. If sanctions did reduce demand for South African gold, U.S. gold producers might increase sales. Price rises from the speculative effect would help U.S. mining companies and increase the value of jewelry stores' inventories and investors' stocks, although jewelers may be hurt if higher prices reduce the demand for gold jewelry. Higher prices would hurt American gold jewelry producers and customers, electronics firms, and dentists, which would face increasing costs.

Analysis of Proposals for Further Sanctions on South African Gold

Sanctions advocates have proposed several further sanctions against South African gold. We analyzed the possible effects and implications of adopting these proposals.

Banning Imports of Jewelry Containing South African Gold

The main route of South African gold into the United States is through imports of Italian jewelry. Of the \$1.8 billion in gold jewelry imported into the United States in 1988, 58 percent, or \$1 billion, came from Italy.³ Although South Africa initially exports most of its gold to Switzerland, a large portion eventually arrives in Italy because it is the dominant gold jewelry producer in the world. South Africa is a traditional and special supplier for the Italian jewelry industry. Italy buys about

³Both the \$1 billion and \$1.8 billion figures contain some platinum and other precious metal jewelry.

one-third of South Africa's gold exports and ISTAT, the government statistical office in Italy, estimates that 91 percent of the legal gold imports into Italy originate in South Africa.

One proposed gold sanction would prohibit gold jewelry imports into the United States that contain South African gold. U.S. importers of gold jewelry might be required to sign a certificate stating that the jewelry was not made with South African gold. Ultimately, if importers did not make false representations on the certificate, they probably would turn to the foreign jewelry manufacturer to make sure the items were not made with prohibited gold. This would begin a chain reaction of questions about the gold's origin from the jewelry manufacturer through a bank or bullion dealer to the refiner.

If the United States required the certificate and no one in the chain made false representations, the ultimate burden to demonstrate the gold was not South African would pass from the importer to the Italian jewelry-maker, to an Italian bank where most jewelry producers buy their gold, and finally to Swiss refiners. To certify that the gold bars they were making contained no South African gold, the Swiss might have to change the way they refine gold. The Swiss refineries receive gold bars at 99.5 percent purity from many producing nations, including South Africa. Depending on the buyer's wishes, the Swiss reexport bars at the existing purity or remelt and rerefine them into bars or ingots of 99.99 percent purity. A demand exists for 99.99 percent gold in banking and for industrial applications, including electronics and jewelry-making. Gold that is remelted and rerefined to higher purity in Switzerland is a mixture of gold from various countries. To certify which gold bars, if any, were free from South African gold, Swiss refineries might need to refine South African gold separately from that of other countries.

Even refining South African gold separately might not allow the Swiss to make their other gold completely free of the South African-origin metal because they regularly recycle (remelt and rerefine) gold of unknown origin previously used in jewelry and other gold articles (known as gold scrap). Refineries in other countries that recycle scrap might have a similar problem certifying non-South African origin.

Because the United States is the largest market for gold jewelry in the world and a customer for over 50 percent of Italy's jewelry exports, it might be able to exert some leverage on jewelry-makers to use non-South African gold. But because the boycott would be directed at imports from jewelry producing countries rather than directly at South African gold

Appendix II
Feasibility of Imposing Sanctions on South
African Gold

bullion, some chance exists that imposing the measure might expose the United States to proceedings under the General Agreement on Tariffs and Trade for violating its principles of free trade, according to one of the foremost authorities on the agreement.

Detecting false claims of using non-South African gold by bullion dealers, banks, and jewelry-makers in the supply chain might be rendered difficult because of the aforementioned difficulty in identifying the origin of the gold contained in jewelry. To enforce the ban, Customs would need to rely on investigative leads generated from import documentation accompanying jewelry shipments and tips from informants.

In 1988, the United States imported \$1.8 billion in gold jewelry. Because the amount of such imports containing South African gold is unknown, the effect of a U.S. ban cannot be quantified. This ban, however, would address more imports of South African gold than the \$79 million eliminated by the ban on gold bullion. The approximately \$800-\$900 million of South African gold contained in U.S. imports of Italian jewelry alone far exceeds this figure. South Africa probably would not lose all this revenue if sanctions were imposed because it could find alternative markets for some of the gold and some of the remainder might be smuggled into the United States.

If other nations also imposed the measure, the effect would depend on whether South Africa could find alternative buyers for its gold. If only a few jewelry-makers stopped using South African gold, the market might reorder itself, with South Africa selling to all those that would still accept its gold and other producers selling to those that would not. If many jewelry-makers stopped using South African gold, the market might still reorder because South Africa might sell its new production to displace non-South African gold in central bank and private investment stocks, which would be sold to the jewelers. Speculative effects leading to price increases in the bullion market might be less when imposing sanctions indirectly on jewelry rather than directly on South African bullion but little reduction in South African revenues will probably occur to offset these effects because of market reordering.

A U.S. ban on jewelry containing South African gold might increase costs to foreign jewelry-makers that had to change traditional suppliers of gold or separate South African gold from that of other nations in the jewelry-making process. The Swiss and other refiners who supply jewelry-makers could also incur increased costs if they chose to separate South African gold in the refining process. Other gold producers and

other holders of stocks of gold, including those in the United States, might be helped if, because of market uncertainty, the demand and price for all gold went up.

In the United States, such a measure would increase the price of jewelry to retail jewelers and the consuming public as foreign refiners and jewelry-makers passed along the increased costs of separating South African from non-South African gold. If the price of gold went up because of uncertainty in the market, American jewelry-makers, electronics firms, and dentists would face increased costs. While retail jewelers' current inventories would increase in value, the amount of gold jewelry that consumers buy could decline due to higher prices.

Release of Gold From Reserves

The Economist magazine and some economists advocate releasing gold from U.S. or foreign central bank reserves to depress the world price and hurt the South African economy. The proponents of this option argue that unlike sanctions banning imports of South African gold or jewelry containing it, the option does not require enforcement because no evasion can occur. They argue that when the price drops, South Africa will lose more revenue than any other producing nation because it is the largest gold producer. They also argue that because the United States uses more gold than it produces and is therefore a net importer, it and other net gold consuming nations would benefit from a reduction in the price. American jewelers and customers, electronics firms, and dentists would benefit from any price decrease and gold mining companies and private investors would be hurt. The proponents believe that a net gain would accrue to U.S. society, with the value of gains by groups that consume gold exceeding the losses by mining companies and investors but they had no quantitative evidence to support this view.

The leading proponents of this option argue that the effects on South Africa add benefits to a measure that should be adopted for other reasons. They believe that gold should no longer be regarded as possessing any properties of money and should be looked upon as just another commodity. Despite gold's reduced monetary role after the gold-exchange standard was abandoned, allowing the values of gold and world currencies to fluctuate freely, gold still retains some of its monetary characteristics, such as an asset and store of value for private investors and central banks. To help achieve the goal of completely "demonetizing" gold by eroding its role as an asset and store of value, proponents advocate the sale of gold held by central banks.

Gold now held by central banks reduces the supply currently available for the market and keeps the price artificially high. Proponents argue that efficient use of an exhaustible resource requires that cheaper sources of the material be exploited before more expensive sources. The gold now being mined and sold has costs of about \$150 to \$600 per ounce to produce while the costs of producing the gold bullion stored in central banks have already been incurred. They argue that more expensive gold is being mined and consumed now and cheaper gold is being stored for future consumption. They believe cheaper central bank gold should be sold and used first.

Opponents of releasing gold from U.S. reserves either want to maintain gold's current role in the international monetary system or want to return to the gold standard (reimposing a fixed price for gold in dollars or another major currency and pegging other world currencies to it at fixed exchange rates). Opponents regard gold as an asset and a store of value, as well as a commodity, and believe that the United States should retain its gold reserves rather than sell them. Some of the opponents also believe that U.S. action to depress the gold price could cause instability in the international financial system. Other economists we talked to did not regard this possibility as likely.

Opponents also focus on the collateral economic damage that depressing gold prices would have on U.S. and other gold producers. Some of these producers are major U.S. allies (Canada and Australia), one is a major adversary (the Soviet Union), and the remainder are third world nations (Brazil, the Philippines, Papua New Guinea, and Colombia). One opponent said that depressing the price would reduce a valuable source of foreign exchange for the Soviet Union during attempts at economic reform. Depressing the price of gold would also reduce the value of many countries' central bank holdings, including those of developing countries.

Some opponents believe that once the price was lowered by releasing gold, it might be hard to hold it down in the long term. One analyst says that the significant portions of total world gold stocks held by major central banks could be used by any one of them to initially hold the price down. Of the 90,000 to 100,000 metric tons of gold held in world stocks, about 36,000 metric tons (about 20 times annual world production) are held by central banks and the balance by private investors. U.S. gold stocks are about 4 times annual world production. The United States or another major gold holding country could sell gold into the market for some time to initially hold the price down. The amount of gold sold and

the initial price decrease would depend on the number of central banks participating and how much they were willing to deplete their reserves. But if private investors and other governments believed that gold prices would increase over the long term after central banks finished their release, they might buy up central bank reserves sold at what they perceive as discounted prices. This speculative demand itself might establish a floor under the price or even cause it to increase past its initial level. To avoid such speculative effects, the selling of central bank stocks would have to convince investors that gold was an asset whose price would not rise in the future.

In the mid and late 1970s, the U.S. Treasury and the International Monetary Fund sold small quantities of gold into the market. Upon announcement of the sales the price of gold decreased, but over the long term it increased past its initial level. Some analysts attributed this increase to gold's attractiveness as an investment hedge against substantial worldwide inflation during this time. Inflation is now less severe but the episode illustrates the effect that macroeconomic circumstances can have on the policy.

Banning All South African Gold and Releasing Gold

One sanctions proposal by an anti-apartheid activist advocates banning South African gold and products containing it (including jewelry) and releasing only enough gold from U.S. reserves or foreign central banks to help offset any price increase. As noted earlier, the United States already banned the imports of South African gold bullion but it was not widely known because the boycott was covered under the prohibition on imports from South African state owned or controlled entities. Because only \$79 million in direct imports from South Africa were terminated and speculative effects were dampened by insufficient knowledge of the sanction, the measure's effect on the gold price was negligible.

If some nations banned imports of South African gold and gold products, South African gold could displace non-South African gold in the private investment and central bank stocks of non-sanctioning countries. This could reduce or eliminate South Africa's revenue losses from the sanctions. If the price went up because multilateral sanctions created uncertainty in the world market, releasing gold from the U.S. Treasury or foreign central banks might initially bring the price back down and eliminate any short term windfalls in revenue for South Africa. However, as noted above, no guarantee exists that the price can be held down in the long term by releasing gold. It is hard to estimate the magnitude or direction of the long term effect on price of releasing gold, especially

when unpredictable macroeconomic factors can significantly affect the outcome.

The proponent of the proposal argues that if the price is stabilized by releasing gold from central banks, the market will discourage efforts to circumvent the ban on South African gold. According to the argument, if participants in the bullion market fear that South Africa's additional smuggled supplies would depress the price even further from the stabilized value, they would be encouraged to assist in enforcing the ban. But if releasing gold does not hold back price increases and stabilize the price, market incentives for enforcement may be mitigated.

As noted earlier, if the United States or any other nation banned gold products (including jewelry) from third countries, for example Italy, containing South African gold, some chance exists that imposing the measure might expose them to proceedings under the General Agreement on Tariffs and Trade.

If South African gold and gold products were banned and price increases were offset by selling gold from central banks stocks, demand for gold produced by U.S. and other foreign gold producers would probably not increase because selling central bank gold into the market would replace any lost South African sales. A constant price for gold, however, would probably dampen worldwide private investment demand for gold, which is usually held for its appreciation in value. This might cause private investors to sell gold and invest in assets that were likely to appreciate. But investors consider the price of gold relative to the price of other assets; if the price of other assets declines while the price of gold remains constant, investor demand for gold might rise.

If South African gold and gold products were prohibited and the release of gold did not hold back price increases, U.S. and foreign non-South African mining companies and private investors would be helped. U.S. and foreign jewelry-makers, electronics firms, dentists, and the customers of these industries would be hurt.

Mandatory Divestment of Shares in South African Gold Mining Companies

The Comprehensive Anti-Apartheid Act bans new U.S. investments in South Africa. This provision prohibits U.S. investors from buying shares in South African gold mining companies issued after passage of the Act but allows them to retain and trade shares issued prior to enactment. The proposed sanction would require the liquidation of such investments. According to a study done by a major mutual fund investing in

gold stocks, U.S. shareholders hold 14 percent of South African gold mining shares outstanding.

Unlike the other proposed sanctions, which attempt to reduce South African gold revenues, this measure tries to limit the amount of capital the South African gold mining industry has available for its operations and expansion, including mineral exploration.

Proponents of divestment argue that limiting the access of South African industry to capital inflow impedes economic growth and exacerbates South Africa's balance of payments problems caused by its foreign debt. They believe that divestment will force the South African government to reform its political system to alleviate the pressure.

Some opponents of divestment are skeptical that it significantly impedes growth and believe it may lead to a backlash that rallies South African whites around the government, slowing reform.

The vice president of a mutual fund investing in gold stated that because U.S. investment in new South African mining shares is already prohibited, no new capital is provided for business expansion and exploration in the South African mining sector. He argued that trading old shares on secondary markets merely changed the ownership of the mining companies.

If Americans were required to divest old shares and South Africans bought them, however, they would be using money that they could have used for other purposes. More important, widespread divesting of American shares could further depress the price of South African mining stocks and make it more expensive for the companies to raise capital. South African gold mining shares already sell at a discount because the perceived risk is higher than investing in other countries' gold mining stocks.

The most important effect of divestment might be to chill business confidence in South Africa; it might reduce domestic and other foreign investment in the economy and thus slow future economic growth rates.

A study commissioned by the gold mutual fund estimates a one time loss of at least \$1.2 billion for U.S. investors if they were required to divest. The losses would occur because sellers would get lower prices for the shares when buyers knew the U.S. government required owners to sell within a certain time period. Others believe this figure to be too high.

Objectives, Scope, and Methodology

In a November 23, 1988 letter, Senator Edward M. Kennedy asked us to examine South Africa's role in the world gold and diamond markets, the feasibility of sanctioning South African gold and diamonds, the impact of sanctions on Namibia, and the implications of removing sanctions on Namibia for continued enforcement of those on South Africa. On July 14, 1989, we reported findings developed during the course of our work on U.S. government enforcement of the ban on imports from South African government-owned or controlled entities contained in the Comprehensive Anti-Apartheid Act. As agreed with Senator Kennedy's office, we are providing an interim report on the results of our work on gold. A final report on diamonds and Namibia will be issued later.

To obtain information about the international gold market, South Africa's role in it, and the feasibility of imposing sanctions on South African gold, we interviewed and obtained documentation from knowledgeable private sector representatives and U.S. and foreign government officials. We talked with gold mining analysts in major brokerage houses in London; officials from the London and New York gold markets; representatives from U.S. trade associations for gold mining, refining, and trading interests and retail jewelry stores; a representative from the South African Chamber of Mines; representatives from the Italian gold jewelry-manufacturing industry and its trade unions; academic economists and private researchers knowledgeable about world gold markets; U.S. and foreign anti-apartheid groups that advocate sanctions on South African gold; British and Italian government officials; and representatives of the State Department's Office of Southern African Affairs, Interior's Bureau of Mines, and Treasury's Office of Foreign Assets Control and Customs Service. We also obtained information from the Swiss government about its gold refining industry.

To obtain information on whether gold from South Africa can be distinguished from that of other countries through chemical testing, we interviewed chemists and geochemists from private research organizations, the U.S. Geological Survey, and the National Institute for Standards and Technology.

To measure gold imports into the United States from South Africa and third countries, we used the Department of Commerce's data base on U.S. trade flows. We conducted our work from December 1988 to August 1989 in accordance with generally accepted government auditing standards.

United States General Accounting Office

GAO

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

September 1989

DEPOT MAINTENANCE

Air Force Defines Backlog Better, but Additional Efforts Are Needed



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National Security and
International Affairs Division

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September 26, 1989

The Honorable Earl Hutto
Chairman, Subcommittee on Readiness
Committee on Armed Services
House of Representatives

Dear Mr. Chairman:

This report, which was prepared at the former Chairman's request, discusses our evaluation of the Air Force depot maintenance backlog for fiscal years 1988 and 1989. It discusses efforts by the Department of Defense and the Air Force to improve the credibility of depot maintenance backlog estimates, requirements, and funding requests. We make a recommendation to the Secretary of the Air Force to improve backlog identification and reporting.

As arranged with your Office, 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 we will send copies to appropriate congressional committees; the Director, Office of Management and Budget; the Secretaries of Defense and the Air Force; and other interested parties.

This report was prepared under the direction of Harry R. Finley, Director, Air Force Issues. Other major contributors are listed in appendix III.

Sincerely yours,

Frank C. Conahan
Assistant Comptroller General

Executive Summary

Purpose

Depot maintenance involves complex repairs including major overhauls and complete rebuild of parts. The total Air Force depot maintenance backlog was relatively small and considered manageable until the Air Force began preparing estimates to be included in the budget requests for fiscal years 1988 and 1989. These estimates, which were submitted to the Congress in February 1988, showed a substantial increase in the projected Air Force depot maintenance backlog. In fiscal years 1988 and 1989, the projected backlog was \$1 billion and \$1.5 billion, respectively.

The Chairman, Subcommittee on Readiness, House Committee on Armed Services, requested that GAO evaluate the Air Force's reported backlog for fiscal years 1988 and 1989 and determine whether (1) backlog estimates are identified to specific repairs and overhauls, (2) effects of the backlog on the readiness and sustainability of Air Force units are measured, and (3) changes are underway that would better identify requirements and the backlog.

Background

The Air Force spends about \$3 billion annually for depot-level maintenance. The Air Force Logistics Command manages the depot maintenance program, and most repairs are accomplished at the five Air Logistics Centers and contractor facilities.

Needed repairs that were not accomplished were referred to as backlog. The backlog estimates for several fiscal years before fiscal year 1988 were relatively small. However, the large increases in the backlog estimates for fiscal years 1988 and 1989 caused questions to be raised by the Congress, the Office of the Secretary of Defense, and the Air Force about the credibility of the estimates.

Results in Brief

Before fiscal year 1988, the Air Force could not identify the individual items that composed the reported backlog because the backlog was the calculated difference between total requirements and available funding. In December 1987 the Logistics Command introduced the term "unfunded backlog," which requires the Logistics Centers to identify the individual items specifically.

The establishment of this new term and definition resulted in the Logistics Centers providing improved data on individual items needing repair. Based on the new definition, the Logistics Centers reported that the unfunded backlog at the end of fiscal year 1988 was \$185.7 million.

Although the new definition resulted in a substantially lower reported backlog, the Logistics Command did not establish adequate implementing procedures for determining and reporting the unfunded backlog. Additional efforts are needed to ensure accuracy of the reported unfunded backlog because the Logistics Centers, in determining the reported fiscal year 1988 backlog, included some items that should not have been reported and did not verify the accuracy of reported data.

The Air Force cannot currently measure the effect of maintenance backlog on readiness and sustainability but is working to quantify these effects. The Air Force has acted to minimize adverse effects on readiness. Indicators used to measure logistical support to operational forces generally remained high in fiscal year 1988. In late fiscal year 1988, some operating commands reported parts shortages that could eventually degrade capability.

The Air Force and the Office of the Secretary of Defense are taking actions to better identify valid requirements and improve budget submissions, but additional efforts are needed. The Air Force is addressing the validity of the process for determining depot maintenance requirements, not just the relatively small portion identified as backlog. Because the Air Force recognized that its requirements computation systems generally overstate needed repairs, it did not rely on the systems to determine requirements for fiscal years 1989 and 1990.

Principal Findings

Backlog Better Identified, but Inaccuracies Exist

The Air Force defines the total depot maintenance backlog as the gross difference between yearly requirements and available funding. In December 1987 Logistics Command officials introduced the term unfunded backlog, which is more restrictive than the difference between total requirements and funding. The unfunded backlog is to include only on-hand items at Logistics Centers and contractor facilities for which a valid repair requirement exists but are not repaired because of a lack of funding. Since the Logistics Command did not establish implementing procedures to determine the unfunded backlog, the Logistics Centers developed procedures based on the definition. The Logistics Centers reported that \$185.7 million was needed at the end of fiscal year 1988 to repair items in the unfunded backlog. This was substantially less than previous estimates.

Air Force actions resulted in improved data on individual items needing repair. However, the Air Force's reported unfunded backlog data contains inaccuracies due to a lack of adequate implementing procedures for identifying and calculating the unfunded backlog. GAO determined that the Logistics Centers included some items that should not have been reported as backlog, did not verify data on items in the backlog, and relied on depot and contractor inventory records that GAO and others have found to be questionable.

At two Logistics Centers, GAO reviewed 20 items with estimated repair costs totaling \$23 million in the unfunded backlog and questioned the accuracy of reported data for 15 of these items. For example, the use of an incorrect unit repair cost for one item overstated the fourth quarter unfunded backlog by more than \$1 million. GAO also noted that one Logistics Center added \$16.1 million to the reported unfunded backlog. The Logistics Center added this amount because it believed the Logistics Command definition of backlog was too restrictive. The \$16.1 million should not have been reported as part of the unfunded backlog because, even if funds had been available, repairs could not be accomplished, since needed repair parts were not available.

Readiness and Sustainability Effects Unclear

The Air Force is working to better link repair requirements to readiness and sustainability levels and to quantitatively assess the extent that the backlog degrades capability. Furthermore, to mitigate potential readiness problems, the Air Force prioritized the depot maintenance work load and allocated funds to repair items needed to support peacetime operations and maintain readiness, transferred some of the depot work load to the operating commands, and used parts from grounded aircraft or war reserve stock to continue operations.

Readiness indicators, such as the percent of time aircraft are mission capable, remained high during fiscal year 1988. For example, the Tactical Air Command reported that operational fighters were mission capable 88 percent of the time, an all-time high. However, in late fiscal year 1988, operating commands began reporting some shortages in repair parts that could degrade capability.

Improvements Underway

Better-supported Air Force depot maintenance budget requests would assist the Congress and the Department of Defense in effectively allocating funds. In 1988 the Office of the Secretary of Defense began developing uniform measures of depot maintenance requirements as a basis for

establishing and monitoring funding priorities. It is revising budget guidance and requiring reporting formats to define terms and present information more consistently and clearly.

The Air Force is improving its requirements computation process and modernizing its logistics management information systems. Air Force officials acknowledge that existing systems generally overstate requirements that can be accomplished and have undertaken studies to determine the reasons for the overstatement. The Air Force reestimated requirements for fiscal years 1988 and 1989 and projected budgeted requirements for fiscal years 1990 and 1991 without relying on those systems. The reestimated projections were based on fiscal year 1988 funding plus estimates of future unfunded requirements. These estimates of total requirements and unfunded requirements were lower than earlier estimates computed by the requirements determination system.

Recommendation

GAO recommends that the Secretary of the Air Force direct the Commander of the Air Force Logistics Command to prescribe the procedures and processes to be used in determining and verifying reported unfunded repairs.

Agency Comments

The Department of Defense agreed with GAO's findings and recommendation and said the Secretary of the Air Force or his designee will issue a memorandum to the Commander of the Air Force Logistics Command by September 30, 1989, directing the implementation of GAO's recommendation (see app. II).

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Abbreviations

| | |
|------|------------------------------------|
| AFLC | Air Force Logistics Command |
| ALC | Air Logistics Center |
| GAO | General Accounting Office |
| OSD | Office of the Secretary of Defense |
| TAC | Tactical Air Command |
| WRM | war reserve material |

Introduction

The Air Force conducts depot-level maintenance—its most complex maintenance tasks—at five Air Logistics Centers (ALC) and at hundreds of defense contractor facilities. The Air Force Logistics Command (AFLC), which manages the depot maintenance program, spends about \$3 billion annually for depot-level maintenance. AFLC estimates the amount of depot-level maintenance needed by computing requirements by categories, such as aircraft, missiles, and reparable parts.¹ Historically, depot-level requirements have exceeded funding levels, resulting in unaccomplished needed repairs, often referred to as the depot maintenance backlog. From 1980 to 1987, the depot maintenance backlog was small and considered manageable. However, in February 1988 Air Force projected backlog estimates for fiscal years 1988 and 1989 were much larger than estimates from previous fiscal years, and raised concerns about the credibility of these estimates.

Air Force Depot Maintenance

The Air Force services and repairs its aircraft and equipment to maintain and improve its war fighting capability. Aircraft, weapon systems, and equipment in the Air Force's inventory require maintenance throughout their useful life spans. Required maintenance ranges from routine oil changes to inspections, calibrations, and component replacement to modification or complete rebuild.

The Air Force has a three-level system for conducting maintenance, and the complexity of the maintenance task determines which level is employed. The least complex maintenance tasks, which include inspecting and servicing aircraft on the flight line and replacing damaged or unserviceable parts, are performed in the field by the using organization. More complex tasks, such as repairing and replacing components and parts, are performed at the intermediate level by military, Department of Defense civilian, or contract personnel in shops at the main operating bases. The most complex maintenance tasks, known as depot maintenance, include major aircraft overhauls, modifications, and complete rebuilds of reparable parts and end items. These tasks typically require more extensive shop facilities, equipment, and more technically skilled personnel and are performed at the ALCs (also referred to as depots), contractor facilities, or by specialized depot or contractor teams deployed to operational sites.

¹Parts can be divided into two categories: those that are thrown away after they are used and fail and those that are repaired and reused. The latter category is referred to as "reparable parts."

AFLC manages the Air Force's depot maintenance program and spends about \$3 billion annually to maintain, modify, repair, and overhaul aircraft, missiles, engines, support equipment, and related parts. Funding for Air Force depot maintenance supports more than 2 million flying hours; 6,000 aircraft; thousands of aircraft engines, gas turbine engines, and gear boxes; and \$28 billion worth of reparable parts.

Depot maintenance directly contributes to Air Force readiness (its ability to go to war today) by modernizing weapon systems, maintaining aircraft and engines in an operational status, and repairing parts needed to keep aircraft flying. Peacetime operations are structured to maintain a desired level of readiness. Depot maintenance also contributes to Air Force sustainability (its ability to sustain war fighting capability) through the repair of parts needed to fill war reserve material stocks. These stockpiles include equipment, parts, and material needed to maintain wartime operations. Repairs and maintenance not accomplished could adversely impact readiness by decreasing the availability of equipment and reparable parts. Sustainability could be degraded if parts are not repaired for war reserve material and by increased withdrawals of war reserve material stock to satisfy peacetime operations.

Determining Requirements and Funding Requests

AFLC determines depot maintenance requirements by using specific methodologies to compute requirements for aircraft, missiles, engines, reparable parts, and others. These methodologies employ engineering reviews, computer models, and estimates based on past experience. Flying hours and the number, age, and type of aircraft in the inventory are common factors driving overall requirements.

The Air Force's process to determine depot maintenance requirements is complex and lengthy, involving the calculation and validation of data from several data management systems for thousands of individual repair items. The process involves predicting the quantities of items that will fail and be returned to the depot by the users and how many will be needed to support future operations. The prediction is made years in advance and based on factors for each individual item including past usage, the expected rate at which an item fails, and the number of items that will not be economical to repair. Other factors that are also considered in determining total requirements for an item include serviceable items on hand, base and depot repair capacities, and required time to repair items. The total requirements include pipeline requirements (the number needed in the base and depot supply systems to keep end items fully operational), safety level requirements (the number needed in

stock in case of unusual or unexpected demands), and war reserve material requirements.

Air Force requirements for a specific program year are recalculated and revalidated many times between the initial computation and the completion of the work several years later. During this time changes in the program, funding, policies, and factors used to compute requirements cause significant fluctuations in both the total requirement and its composition. As a result, repairs accomplished during a fiscal year might be significantly different than the projected repairs for that year.

To prepare its budget request, the Air Force tabulated its total depot maintenance requirements based on computed requirements for the upcoming fiscal year plus a carryover of those requirements not funded in the previous fiscal year. The carryover of requirements occurs because estimated repair requirements exceeded available funding, creating unfunded requirements, also referred to as depot maintenance backlog. Air Force officials then determined how much of the unfunded requirement was considered valid for the budget request. Air Force officials reduced the unfunded requirement by about 20 percent to recognize changed or eliminated requirements and added the balance into the next fiscal year's program.

Depot Maintenance Requirement and Backlog Estimates Questioned

The depot maintenance backlog indicates that needed repairs are not being accomplished, which can affect the Air Force's war fighting capability. From 1980 through 1986 the Air Force depot maintenance backlog was relatively small, ranging from \$0 to about \$180 million, and was generally considered manageable. In fiscal year 1987 the backlog increased to \$435 million. However, in February 1988 the Air Force estimated that total depot maintenance requirements would exceed available funding by about \$1 billion and \$1.5 billion in fiscal years 1988 and 1989, respectively. This projected large backlog raised questions about the credibility of how the depot maintenance backlog and requirements were determined.

The Congress and the Office of the Secretary of Defense (OSD) have questioned the accuracy of depot maintenance requirements and backlog estimates from the Air Force and the other services. These concerns arose because the services

- made large and frequent changes in computed requirements with resulting repairs differing from those projected in the budget;

- reported a decline in planned work from initial estimates to completion;
- frequently reprogrammed and shifted funds from the depot maintenance account to other accounts;
- did not link requirements to expected levels of readiness and sustainability, which could demonstrate the consequences of having a backlog;
- did not identify those individual items needing repair that were part of the unfunded requirements; and
- was not consistent in how unfunded requirements were carried forward from one fiscal year into the requirements for subsequent years.

In fiscal year 1989 congressional actions addressing concerns about the depot maintenance backlog included (1) establishing a minimum amount to be spent on depot maintenance by the Air Force and other military services, (2) directing the Department of Defense to review the system used to determine the depot maintenance backlog to produce a verifiable backlog, instead of a calculated backlog that is adjusted each year based on funding, and (3) requiring the Assistant Secretary of Defense (Comptroller) and the Assistant Secretary of Defense (Production and Logistics) to review and approve service depot maintenance backlog estimates annually.

Objectives, Scope, and Methodology

The Chairman, Subcommittee on Readiness, House Committee on Armed Services, requested that we review the Air Force's reported backlog for fiscal years 1988 and 1989 and determine whether (1) backlog estimates are identified to specific repairs and overhauls, (2) effects of the backlog on readiness and sustainability of Air Force units are measured, and (3) changes are underway that would better identify requirements and the backlog.

Our work focused on the aircraft depot purchased equipment maintenance accounts, which comprise about 90 percent of the total depot maintenance program. We performed our work at OSD and Air Force Headquarters, Washington, D.C.; AFLC Headquarters and the Logistics Operations Center, Wright-Patterson Air Force Base, Ohio; San Antonio ALC, Texas; Warner Robins ALC, Georgia; and Headquarters and 1st Tactical Fighter Wing, Tactical Air Command, Langley Air Force Base, Virginia. We interviewed officials, obtained reports, identified program policies and procedures, reviewed readiness and sustainability data on capability, and identified OSD and Air Force efforts to modernize logistics management systems and reporting.

To determine whether needed repairs were identified in the backlog, we obtained data on total requirements, funding, and the backlog for fiscal years 1988 and 1989 and determined the major reasons for changes shown by these data. We reviewed AFLC actions, which redefined the backlog, thereby affecting its size and composition. We discussed the procedures used to implement the newly defined backlog with ALC officials. We obtained data on the items in the fiscal year 1988 backlog. We also selected the 10 reparable items with the largest total repair costs at the two ALCS visited from the ending fiscal year 1988 reported backlog and determined how, when, and why these items became part of the backlog. Our results are applicable to the items we reviewed and might not represent all items reported in the depot maintenance backlog.

To identify potential impacts on readiness and sustainability, we reviewed Air Force reports on and projections of capability. We identified Air Force assessment systems and reviewed management indicators of logistics support. We interviewed officials at Air Force Headquarters, AFLC, and the Tactical Air Command to obtain their perspectives on operational experiences and problems attributed to the backlog. We also reviewed data from the Strategic Air Command and Military Airlift Command regarding operational experiences and problems attributed to the backlog.

To document Air Force and Department of Defense efforts either underway or planned, we reviewed several Department of Defense and contractor studies identifying deficiencies and problems in requirements, budgets, and the backlog. We discussed plans with Air Force and OSD officials to improve budget presentations, increase the accuracy of requirements, and modernize logistics management systems.

We performed our work between September 1988 and June 1989 in accordance with generally accepted government auditing standards. The Department of Defense's official comments on a draft of this report are in appendix II.

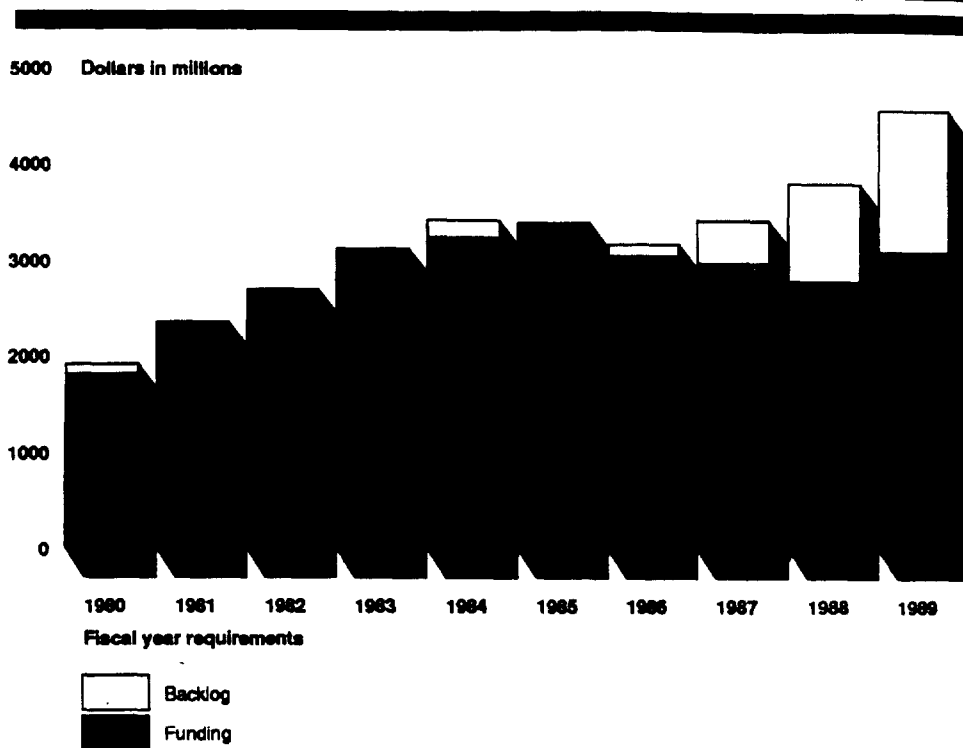
Actions to Identify and Define Backlog Better

In response to backlog estimates that were generally viewed as unrealistic, OSD and the Air Force have taken actions that would better identify and define parts that need repairs but remain unrepaired because of a lack of funding. OSD is implementing uniform terms and definitions that would better identify needed depot maintenance repairs. In December 1987 AFLC established a new term and definition to better identify and track individual items needing repair. The ALCS used this new definition to report an unfunded backlog of \$185.7 million at the end of fiscal year 1988—substantially less than previous estimates of the backlog. The establishment of the new term and definition provided improved data on individual items needing repair. However, AFLC did not establish specific implementing procedures for identifying and calculating the backlog. Additional efforts are needed to ensure accuracy of the reported backlog because items included in the backlog did not meet AFLC's definition and data on included items were not verified and were based on inventory records, which we and others have found to be questionable.

Backlog Estimates Viewed as Unrealistic

The total Air Force depot maintenance backlog was relatively small and considered manageable until the Air Force began preparing estimates to be included in the budget requests for fiscal years 1988 and 1989. These estimates, which were submitted to the Congress in February 1988, showed a substantial increase in the projected Air Force depot maintenance backlog. In fiscal years 1988 and 1989, the projected backlog was \$1 billion and \$1.5 billion, respectively. These amounts are much greater than the backlog in previous fiscal years, as shown in figure 2.1.

Figure 2.1: Air Force Total Backlog
 (Unfunded Requirements)



Note: Data shown are actual for fiscal years 1980 through 1987 and estimated for fiscal years 1988 and 1989.

While Air Force systems projected unprecedented increases in unfunded requirements, Air Force officials did not believe these estimates of computed requirements were realistic or credible. Accordingly, officials revised requirements based on an executable level of work for fiscal years 1988 and 1989, which reduced unfunded requirements. Table 2.1 shows the change in the estimated backlog for fiscal years 1988 and 1989 when constrained by a level of work believed to be executable—\$3.2 billion annually.

Table 2.1: Revision of Estimated Backlog

| Dollars in millions | | |
|---------------------|------------------------|----------------------|
| Fiscal year | Unconstrained estimate | Constrained estimate |
| 1988 | \$1,017 | \$773 |
| 1989 | \$1,464 | \$559 |

Air Force officials stated that the constrained estimates represented the Air Force's best known assessment at the time of the amended budget submission. Individual items needing repair were still not identified in the constrained estimate.

Changed Definition Improves Backlog Identification

As revisions of estimated fiscal years 1988 and 1989 requirements were being made, AFLC addressed concerns about the credibility of backlog estimates and the need to identify individual items requiring repair in a December 1987 letter to the ALCS. The letter defined backlog more restrictively and instituted a new format for reporting fiscal year 1988 backlog. As a result, the ALCS identified more realistic unfunded repair requirements and specifically identified individual items needing repairs.

AFLC's letter introduced the term "unfunded backlog" to be used for reporting backlog instead of the total unfunded requirement (i.e., the difference between the cumulative requirement and budgeted funding). Unfunded backlog is defined as the verifiable on-hand reparable items, either at an ALC or contractor's facility, for which a valid repair requirement exists but cannot be repaired due to a lack of funds. The letter also prescribed a quarterly reporting format but did not establish specific implementing procedures for identifying and calculating the unfunded backlog. Therefore, ALC officials developed and implemented procedures to identify and calculate the unfunded backlog. Generally, for reparable parts the ALCS

- identified the quantities to be repaired based on computed and validated requirements,
- subtracted the quantities funded and inducted for repair to determine total unfunded repair quantities,
- compared unfunded repair quantities to the recorded on-hand quantities at depot and contractor facilities,
- recorded the lesser amount as the unfunded backlog quantities, and
- multiplied the reported backlog quantities by unit repair cost to compute total repair costs.

Table 2.2 shows the total repair costs reported by AFLC for the ending fiscal year 1988 unfunded backlog.

Table 2.2: Unfunded Backlog as of September 30, 1988

| Dollars in millions | | | | | | |
|---------------------|---------------|---------------|---------------|---------------|---------------|----------------|
| | ALC | | | | | Total* |
| | Oklahoma City | Ogden | San Antonio | Sacramento | Warner Robins | |
| Aircraft | \$0.6 | \$0 | \$1.0 | \$0.4 | \$1.3 | \$3.2 |
| Missiles | 0 | 6.0 | 0 | 0 | 0 | 6.0 |
| Engines | 22.0 | 0 | 8.0 | 0 | 0 | 30.0 |
| Other equipment | 0 | 0 | 0.5 | 0 | 0 | 0.5 |
| Reparables | 25.0 | 14.5 | 42.6 | 20.0 | 44.0 | 146.0 |
| Total* | \$47.5 | \$20.5 | \$52.0 | \$20.4 | \$45.3 | \$185.7 |

*Totals may not add due to rounding.

The unfunded backlog is not static and can change throughout the year. For example, Warner Robins reported unfunded backlog for reparables of \$38.6 million and \$44 million for the third and fourth quarter, respectively. Although the costs increased, the number of different items in the backlog declined from 1,652 to 1,302. The third quarter backlog included 1,049 items with a repair cost of \$21 million that were not in the fourth quarter backlog, whereas the fourth quarter backlog included 698 items with a repair cost of \$9.9 million that were not in the third quarter backlog.

Additional Effort Needed to Identify Unfunded Backlog Better

We identified inaccuracies in the reported unfunded backlog for the end of fiscal year 1988. Some items included in the backlog did not meet AFLC's definition, and some items and amounts were not verified. We reviewed the 10 reparable items in the unfunded backlog with the largest repair cost at the end of fiscal year 1988 at Warner Robins and San Antonio ALCs—the items at Warner Robins had repair costs of \$6.6 million and those at San Antonio had a repair cost of \$16.4 million (see app. I for details). We identified inaccuracies in the quantities and associated repair costs included for 15 of the 20 items. The reported quantities for 7 of the items were inaccurate because some parts were not repaired for reasons other than a lack of funds. In addition, we noted that data on the items included in the ending fiscal year 1988 reported backlog had not been verified and were based on inventory records of questionable accuracy. Adequate data verification could have changed the information in the reported backlog for 11 items, including 3 items that were included in the 7 items discussed above.

Inappropriate Items Included in the Unfunded Backlog

AFLC defined the unfunded backlog to include only those items not repaired due to a lack of funds. Items not repaired due to systemic capability constraints, such as a lack of repair capacity, facilities, parts, or personnel, were not to be included in the reported backlog. Air Force officials said these items should not be included in the backlog because, even if funds were available, they could not be repaired. The officials added that such items should have been eliminated by earlier reviews and not included in the budget request.

Of the 20 items that we reviewed at Warner Robins and San Antonio ALCS, some quantities for 7 items were not repaired because of capability constraints as opposed to lack of funds. ALC officials could not always identify the portion of these quantities that could not be repaired due to capability rather than funding constraints. Examples are discussed below.

- San Antonio officials reported an unfunded fourth quarter backlog of 237 nozzle controls with a repair cost of \$977,333. This has been a critical item since 1980 because of parts shortages, lack of organic test capability, and lack of funds. ALC officials said that in fiscal year 1988 they experienced problems with two of the three contractors used to repair the nozzle control—one was unable to produce as required and had its contract quantity reduced, and the other experienced parts problems and did not produce until September 1988. Documents indicate that the third contractor did not have the capability to increase its production enough to compensate for the other two contractors in fiscal year 1988.
- Warner Robins ALC officials computed a third and fourth quarter requirement of 419 parts for a C-130 hub blade and negotiated repairs of 169 parts, leaving a unfunded repair balance of 250. Because only 160 reparable hub blades were on-hand at the depot at the end of the fourth quarter, officials reported an unfunded backlog of the 160 blades with a repair cost of \$1.5 million. During fourth quarter negotiations, however, an official noted that 154 blades could not be repaired due to parts shortages, not because of a lack of funding. The official confirmed that this item had parts problems and that these 154 blades should not have been included in the unfunded backlog.
- San Antonio ALC officials reported an unfunded backlog of 216 engine combustion chambers with repair costs of about \$2.5 million. The total requirement was 888 chambers, and the negotiated funded repair was 672. The combustion chamber has been a critical item since 1980 because of parts shortages. ALC officials stated they experienced problems with one contractor during fiscal year 1988 due to underproduction and inaccurate technical data. Although additional repairs were ordered

from this contractor in September 1988, they were later reduced because of the contractor's unsatisfactory production schedule. Another contractor was not qualified until June 1988 and did not produce the items until mid-September 1988. However, ALC officials believed that if 100 percent of the funds had been available at the beginning of the fiscal year, they could have pursued additional sources to meet requirements.

- Warner Robins ALC officials reported an unfunded backlog of 1,111 bomb-rack ejectors with repair costs of about \$560,000. This backlog was based on requirements for 1,945 ejectors and negotiated repairs for 834. An official originally negotiated repairs for the fourth quarter for the full requirement of 1,241 ejectors—indicating that funds were available for this item—but later reduced the quantity to 550 because of shortages in the parts needed to repair these items. Accordingly, the backlog would appear to be attributable more to a shortage of repair parts instead of funding.

In addition to the 20 items reviewed in detail, we determined that the unfunded backlog reported by Warner Robins ALC to AFLC included \$16.1 million of reparable items awaiting parts. These include items that have been inspected for repair, but the parts needed to repair them are not available and have not been available for at least 90 days. In its fourth quarter report, Warner Robins ALC included items totaling about \$161 million in acquisition costs with estimated repair costs of \$16.1 million (10 percent of acquisition costs). In the previous three quarters, Warner Robins did not include those items in its reported backlog. AFLC officials expressed concern about including items awaiting parts because these items would overstate the backlog and, if carried forward, might result in these items being counted twice in the next year's requirements.

The Deputy Director of the Resources Management Division at Warner Robins, who submitted the fourth quarter backlog report, agreed that those items included in the \$16.1 million do not meet AFLC's definition of unfunded backlog because the items could not have been inducted for repair even if funds had been available. However, the Deputy Director stated that AFLC's definition is too restrictive and does not accurately reflect unfunded requirements. He noted that if the needed repair parts become available during the next year, and the requirement for these repairs still exists, the \$16.1 million will be required for repairs. He also said \$16.1 million was included because the fourth quarter backlog is used as carryover to justify funds for fiscal year 1989 and could increase Warner Robins' funding. He said that AFLC officials know his position on the inadequacy of the backlog definition.

Reported Backlog Was Not Verified

AFLC defines the unfunded backlog as verifiable on-hand assets, either at the ALCs or contractor facilities, for which a valid requirement exists but cannot be repaired due to lack of funds. Even though verification may have occurred at some level, ALC officials responsible for reporting the unfunded backlog to AFLC said they did not verify the accuracy of the information used in backlog reports and did not adjust backlog reports when requirements changed.

Our review showed inaccuracies in the reported amounts for 11 items at Warner Robins and San Antonio ALCs. Examples are discussed below.

- At Warner Robins ALC, fourth quarter data on three of the items we reviewed had not been updated from the third quarter report. The backlog for two items had decreased, and one had increased since the third quarter report. Because requirements and on-hand quantities had changed, the reported fourth quarter backlog was inaccurate, resulting in a net \$350,000 overstatement of the reported unfunded backlog.
- At San Antonio ALC, an incorrect unit repair cost was used to calculate the unfunded backlog for the combustion chamber, overstating the fourth quarter unfunded backlog by \$1,161,000. The information used to calculate the unfunded backlog shows a unit repair cost of \$6,136, but officials used a unit repair cost of \$11,511 by mistake.
- At Warner Robins ALC, a fourth item, a radome for a C-130 aircraft, was incorrectly reported. The backlog report showed requirements of 298 units, 60 of which were negotiated for repair, leaving a total backlog of 238. After allowances were made for capacity problems and repair part shortages, the report showed an unfunded backlog of 173 items with a repair cost of \$437,344. However, source documents showed requirements of 108 units, 4 of which were negotiated for repair, for a total backlog of 104 and a repair cost of \$262,912. Capacity problems could have further reduced the reported unfunded backlog. An official agreed the reported backlog was incorrect and could not identify a source for the numbers shown on the backlog report.
- At San Antonio ALC, seven jet engine test stands with repair costs of \$758,758 were included in the unfunded backlog. ALC officials agreed that these items should not have been reported as backlog, because this type of test stand is to be replaced by a new model in 1990 or later. The existing test stands are to be repaired in the field and only returned to the ALC when no longer needed. ALC officials also stated that test stands will not be reported as backlog in 1989 because they are not valid depot maintenance requirements.

AFLC officials also did not conduct a physical inventory to verify the quantities of on-hand assets at the ALCs and contractor plants. AFLC officials stated that they discussed conducting physical inventories of the items in the fourth quarter unfunded backlog with ALC officials. Each ALC reported to AFLC its physical inventories of 10 items included in its third quarter backlog. However, the ALCs did not conduct complete inventories of fourth quarter backlogs because of time, expense, and lack of staff. Instead, the ALCs used inventory records for determining on-hand assets at the ALCs and contractor-reported data for on-hand assets at contractor facilities to calculate the unfunded backlog.

The Air Force's problems with records accuracy—how often the inventory record and the on-hand balances agree—and inventory control have been previously reported by us and others. In May 1988 we reported² that even though the Air Force has made considerable progress in improving inventory control, record accuracy continues to be a problem. In November 1987 we reported³ on questionable control and records accuracy of items at contractor facilities. The Department of Defense and the Air Force Inspectors General and the Air Force Audit Agency have also reported⁴ on accuracy and control problems in ALC and contractor inventories. According to AFLC data, physically verified on-hand assets did not agree with the inventory records for 18 percent of the items reviewed during fiscal year 1988. In addition, AFLC officials questioned the accuracy of inventory data maintained at contractor facilities. According to AFLC records, about one-third of the reported unfunded backlog at the end of fiscal year 1988 was at contractor facilities.

²Inventory Management: Air Force Inventory Accuracy Problems (GAO/NSIAD-88-133, May 12, 1988).

³Inventory Management: Air Force Items Being Returned for Repair but Not Promptly (GAO/NSIAD-88-21, November 25, 1987).

⁴Report on the Audit of Controls Over Property At Repair and Overhaul Contractor Plants. Department of Defense Inspector General Audit Report, No. 85-013, October 25, 1984. Special Inspection of Supply System Vulnerability, Office of Air Force Inspector General, February 26, 1986. Management of Wholesale Inventory Adjustment, Air Force Audit Agency, September 12, 1984.

Further Changes in Backlog Definitions Planned

In addition to Air Force efforts to define the backlog better, OSD has studied backlog terms and definitions used by the Air Force and other military services. In an October 1988 report,⁵ the Under Secretary of Defense (Acquisition) recommended that use of the term backlog be discontinued because it is misleading. The report states that the term is misleading because many think it refers to equipment awaiting repair at the maintenance shop, when actually a large portion of the backlog represents maintenance that is deferred due to capacity constraints at the depot, operational commitments in the field, or lack of funding. The Deputy Secretary of Defense has accepted this recommendation and is in the process of implementing uniform terms and definitions (see table 2.3).

Table 2.3: OSD Recommended Terms and Definitions

| Term | Definition |
|--|---|
| 1. Total depot maintenance requirement | Valid requirements regardless of constraint. |
| 2. Operationally deferred requirement | Unexecutable depot maintenance requirements that are deferred because of operational commitment of assets. |
| 3. Capability deferred requirement | Unexecutable depot maintenance requirements that are deferred because of capability constraints such as lack of organic or contractor facilities, equipment, personnel, or parts. |
| 4. Other unexecutable requirement | Unexecutable depot maintenance requirements that are deferred for reasons other than operational or capability constraints. |
| 5. Executable requirement | Total requirement that could be executed if funds were available. (Term 1 minus terms 2, 3, and 4.) |
| 6. Funded requirement | That portion of the executable requirement for which funding is programmed. |
| 7. Unfunded deferred requirement | Executable depot maintenance requirements that are deferred solely because of lack of funding. (Term 5 minus term 6.) |

The impact of these proposed changes on the unfunded backlog that the Air Force reported for fiscal year 1988 is not known; however, AFLC's definition of unfunded backlog and OSD's definition of unfunded deferred requirement are similar.

⁵Enhancing the Credibility of Depot Maintenance Requirements Process: A Report to the Deputy Secretary of Defense, Under Secretary of Defense (Acquisition), October 1988.

Conclusion and Recommendation

The Air Force has made progress in better identifying the backlog of needed repairs; however, terms and definitions without adequate implementing procedures can result in reported inaccuracies. In addition, further changes in definition and reporting may occur due to proposed changes by OSD. To prepare for the planned OSD and subsequent Air Force changes and to ensure that the backlog is consistently and accurately reported by the ALCS, we recommend that the Secretary of the Air Force direct the Commander, AFLC, to prescribe the procedures and processes to be used in determining and verifying reported unfunded repairs.

Agency Comments

The Department of Defense agreed with our recommendation and stated that the Secretary of the Air Force or his designee will issue a memorandum to the Commander, AFLC, by September 30, 1989, directing that specific procedures and processes be used, incorporating some procedures already in place, to determine and verify reporting of unfunded repairs.

Readiness and Sustainability Effects Are Unclear

Effects on readiness and sustainability caused by the fiscal year 1988 depot maintenance backlog are unclear because (1) the Air Force took actions at the ALCS and operating bases intended to reduce or delay potential effects, (2) readiness and sustainability indicators did not show significant logistics support problems throughout fiscal year 1988, and (3) Air Force officials said that parts shortages and supply problems began to emerge at operating bases in late 1988. Other factors also make it difficult to measure directly and assess the effects of the depot maintenance backlog on readiness and sustainability. For example, maintenance funding shortfalls might not be manifested as a supply problem for a number of months. In addition, isolating specific effects due to the backlog from other supply factors is difficult. The Air Force has studies underway to improve its capability to measure the effects of depot maintenance backlog.

Air Force Actions to Reduce Effects

Faced with shortfalls in fiscal year 1988 depot maintenance funding, AFLC officials prioritized the depot maintenance work load and allocated funds to support peacetime operations and maintain readiness. Officials at the operating commands increased base-level repairs, including depot tasks that had been transferred to the field. Also, the bases retained more reparable items, previously returned to the depots, that could not be repaired because needed repair parts were not available. Officials said these actions helped reduce operational effects from the funding shortfalls and maintained readiness levels for the short term by allowing the depots to accomplish higher priority work.

AFLC Prioritizes Work

In an October 1, 1987, letter and in subsequent correspondence, AFLC officials asked the ALCS to review repair requirements and determine those that could be deferred or eliminated. The ALCS were asked to defer or eliminate tasks for aircraft and missiles that were not essential or safety related and establish reduced funding levels for engines, other major equipment items, and depot maintenance support to bases. The ALCS were also asked to identify the different segments comprising the total requirement for each reparable item so certain segments could be eliminated. For example, the total repair requirement for a reparable item includes some repair items used to support peacetime operations, for safety levels (stock levels of an item needed only in case of unusual or unexpected demands), and to fill war reserve material (WRM) stocks.

AFLC used this information to prioritize repairs and develop a strategy for allocating funds. AFLC's primary goal was to maintain readiness by

supporting peacetime operations. AFLC took the following actions to achieve this goal.

- AFLC's funding priorities for aircraft maintenance eliminated certain tasks such as painting and inspections, extended intervals for some scheduled maintenance, and deferred some modifications and some aircraft damage repair.
- AFLC's priorities provided that repairs to other major equipment items and depot support to bases would be funded at 75 percent of the budgeted requirement. Stock-levels increases for engines were deferred, and only a portion of the spare engine requirement needed to meet wartime requirements was to be repaired.
- AFLC gave priority to reparable parts needed to support the peacetime flying hour program, critical items, and problem parts causing aircraft to be grounded. Safety levels and parts needed to add to WRM were given low priorities.

Although officials said that using depot maintenance funds on high-priority items enabled the Air Force to maintain daily operations at required levels despite funding shortfalls, they also acknowledged that sustainability might be hurt by forcing units to use WRM.

Maintenance Work Shifted to Operating Commands

The operating commands also helped mitigate the problems caused by the backlog. During fiscal year 1988 a portion of the depot work load was shifted to operating bases. Operating commands reported accomplishing depot-level tasks that they had not previously been authorized to do. Bases also retained more reparable items that could not be repaired because needed repair parts were not available. Instead of sending these reparable items to the ALCs for repair, the bases retained the items and ordered the needed repair parts.

Efforts by the Tactical Air Command (TAC) to reduce or delay the effects of depot maintenance funding shortfalls included retaining and repairing some items previously repaired at the depots. In January 1988 TAC decided to perform maximum maintenance at the field level because, according to TAC officials, sending items to the depot did not make sense if these items would have to wait to be repaired. Thus, officials decided to keep more broken items at bases. TAC units reported holding, on average, twice as many reparable items awaiting parts in November 1988 as in 1987. As a result, TAC officials reported a significant increase in the percent of problems that were satisfied by base repair of an item awaiting

parts; for example, F-15 base-level repairs increased from 3 to 9 percent during fiscal year 1988.

TAC also accomplished some programmed depot maintenance work, modification work, and other repairs previously done by the ALCS. For example, in fiscal year 1987 TAC submitted 443 repair requests for unscheduled maintenance—primarily for structural failures—to AFLC, which spent \$8.4 million to make the repairs. In fiscal year 1988 TAC accomplished some of these repairs in the field. Although the number of repair requests in the field increased to 514, AFLC repair cost was reduced to about \$4.1 million.

TAC officials said bases might take longer to perform some of the tasks previously done by depots, but base repairs saved depot funds and allowed AFLC to concentrate depot maintenance repair dollars on high-priority items. On the other hand, TAC officials said these actions have increased TAC's repair costs and also created a significant work load to store and manage these parts.

The Strategic Air Command and the Military Airlift Command also reported increased repairs and retention of broken items during fiscal year 1988. Air Force officials said that the logistics system has a substantial degree of "elasticity," which gives the Air Force flexibility in reacting to and coping with changes in depot maintenance funding and work load. The officials said that elasticity helped reduce the problems caused by fiscal year 1988 funding shortfalls but that a continued backlog could strain the system.

Air Force Assessments of Readiness and Sustainability Effects

Air Force officials said the fiscal year 1988 depot maintenance backlog had degraded readiness and sustainability, but specific measures of degradation do not exist. The Air Force is developing the assessment capability to link depot maintenance requirements more directly to levels of readiness and sustainability and determine how specific quantities of unrepaired parts would degrade the Air Force's capability. The Air Force has contracted for ongoing studies to (1) relate depot maintenance funding shortfalls to readiness and sustainability and (2) assess the requirements determination process.

In the absence of specific measures, effects of and problems stemming from shortfalls may be reflected in the indicators used by the Air Force to measure logistics support and assess combat capability. Indicators generally remained high throughout fiscal year 1988; however, officials

reported some slight declines late in the fiscal year. Operating commands reported increasing parts shortages and supply problems, which officials attributed in part to the fact that needed parts were not being repaired. Officials expect the problems to continue during fiscal year 1989 but believe that improved funding for 1989 will help alleviate some of the problems caused by the fiscal year 1988 funding shortfalls.

Indicators Show Improved Readiness

AFLC's Weapon Systems Management Information System is an automated management tool for assessing the capability of weapons systems to conduct effective combat missions. The system makes readiness and sustainability assessments based on assets currently available to Air Force units. Readiness assessments include reporting current aircraft status, flying hours, mission capable rates (the percent of available aircraft capable of performing their mission), and problem parts that affect mission capability. Sustainability assessments project aircraft availability during combat and identify wartime limiting factors (the specific items that might limit aircraft availability). Sustainability assessments evaluate operating units' WRM assets on hand, project logistical support through the first 30 days of a conflict, and estimate aircraft status on day 30. The assessments indicate capability problems when available peacetime assets and WRM available to Air Force units decrease substantially.

AFLC officials who operate the Weapon Systems Management Information System said that the readiness and sustainability assessments during fiscal year 1988 for TAC, the Strategic Air Command, and the Military Airlift Command had not indicated any significant effects or problems that might be attributed to depot maintenance funding shortfalls. Our review of Air Force reports substantiates these statements. For example, mission capable rates were high: the total Air Force mission capable rate was over 80 percent, an increase from prior years. In addition, Air Force reports on sustainability assessments showed no significant decrease in the staying power of operational units.

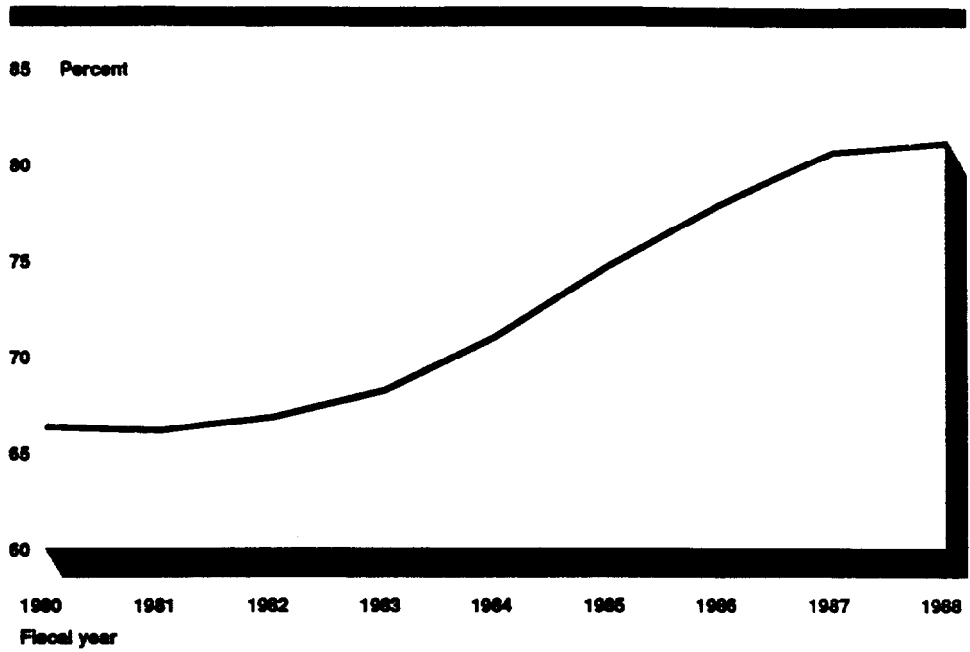
However, some indicators started to decline in late fiscal year 1988, according to AFLC officials. For example, the officials said the B-52 aircraft mission capable rate held steady at about 80 percent, but they noted some increases in the numbers of problem parts affecting capability, some decrease of stock levels, and some increases in the use of WRM. One assessment projected the B-52 mission capable rate would decline to about 77 percent in fiscal year 1989 with increased supply problems.

Data for the C-141 showed a similar pattern; although the mission capable rate remained high, cannibalization rates (using parts from a grounded aircraft on another aircraft to keep it operational) were increasing, and WRM assets were decreasing. Cannibalization and WRM withdrawals are ways that operating units acquire needed spare parts when they are not readily available.

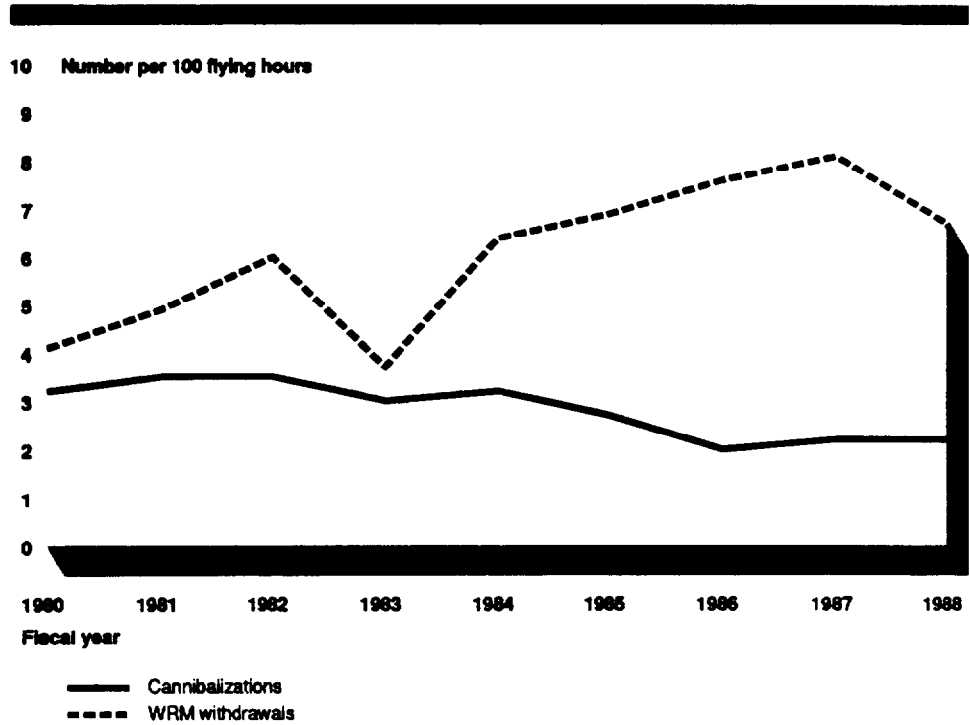
Air Force officials agreed that it was difficult to assess specific effects due to depot maintenance funding shortfalls because (1) the Weapon Systems Management Information System is not designed to assess the effects on combat capability caused by a backlog of maintenance and repairs, (2) indicators may be kept high by field workarounds, including base-level repairs, using WRM, and cannibalizing, (3) other factors such as shortfalls in spare parts procurement and transportation also effect capability, and (4) a time lag (possibly 1 to 3 years) occurs before the effects of maintenance funding shortfalls might be reflected in the indicators.

Air Force Headquarters officials provided data aggregated for the total Air Force to measure logistics support to flying operations. Aggregated data included mission capable rates, WRM withdrawals, and cannibalization rates. For example, mission capable rates during fiscal year 1988 were slightly higher than fiscal year 1987 rates, continuing the favorable upward trend experienced during the 1980s. Cannibalization rates were essentially unchanged from fiscal year 1987 rates and also reflect favorable trends during the 1980s. The overall trend in WRM use is upward; however, the use of WRM decreased in 1988 compared to 1987. According to officials, the overall upward trend in use of WRM may be due to giving units increased authority to use WRM assets to meet current needs. Figure 3.1 shows data on these indicators from fiscal years 1980 through 1988.

Figure 3.1: Air Force Readiness and Sustainability Indicators
 Mission Capable Rates



Cannibalizations and WRM Withdrawals



Readiness Problems Reported by Operating Commands

Air Force officials said that parts shortages and supply problems began to emerge at operating bases in late fiscal year 1988. Officials said that operational units had not been affected by the shortages and the problems through most of fiscal year 1988 because the units had been adequately supported by the first two quarters of depot maintenance production (which had been at normal levels) and by existing stocks. However, in late fiscal year 1988, problems became more evident and were expected to continue during fiscal year 1989. The officials attributed the problems partly to the effects of the backlog but acknowledged that other factors, such as funding shortfalls for spare parts procurement and transportation, may have contributed.

AFLC's strategy for fiscal year 1989 is essentially the same as for 1988, although Air Force officials believe the increased funding for 1989 will enable them to meet current needs and begin to complete work deferred or not done in 1988. Funding for fiscal year 1989 is \$3,134 million, which is \$378 million more than fiscal year 1988 funding. The primary goal in fiscal year 1989 is to maintain readiness through support of peacetime operations, just as in fiscal year 1988.

AFLC Observations

An AFLC team visited the headquarters and operating units of TAC, the Strategic Air Command, and the Military Airlift Command in November 1988 to determine the operational effects due to the fiscal year 1988 funding shortfalls and investigate methods for measuring effects from future funding shortfalls. The team reported that the three operating commands were experiencing increased problems and downturns in certain indicators in late 1988, including increased cannibalization rates, increased use of WRM, reduced stock inventories, and increased carcasses (assemblies and engines stripped of parts) and hangar queens (aircraft grounded in not mission capable status used to obtain needed parts for other aircraft).

The team also reported that other indicators such as mission capable rates and combat readiness ratings were not indicating logistics support problems and that some indicators were at record high levels. However, an official said these were lagging indicators that may not timely show the effects of depot maintenance funding shortfalls. The official also said that units will cannibalize and use WRM to maintain good ratings.

Air Force officials partly attributed these parts and supply problems to the effects of depot maintenance funding shortfalls. An AFLC official said specific effects are difficult to assess because there is not a direct

link between requirements and capability, and the problems caused by depot maintenance funding shortfalls cannot be easily isolated from other contributing factors, such as funding shortfalls in spare parts procurement and transportation budgets. He also said that the maintenance and supply systems have great elasticity and can absorb some problems while adequately maintaining readiness. The operating commands were able to do more repairs and accomplish other workarounds by "working harder and smarter." Commands reported that some elasticity was still left but that a continued backlog would strain them.

TAC Reports Emerging Problems

TAC officials said TAC's readiness had greatly improved during the 1980s and was the best it had ever been in fiscal year 1988. For example, TAC's mission capable rates for its operational fighters was at an all-time high of 88.2 percent in fiscal year 1988 compared to 59.1 percent in 1980. Also, the percent of fighters assessed as fully mission capable by combat readiness ratings increased from 67 to 77 percent between October 1987 and September 1988.

According to TAC officials, although overall readiness was at an all-time high, the effects from depot maintenance funding shortfalls were becoming more evident in late fiscal year 1988. Some indicators at the unit level were showing that spare parts problems were affecting readiness. For example, cannibalization rates for operational fighters increased from 6.3 percent in May 1988 to 15.3 percent in September 1988. Overall, TAC's fiscal year 1988 cannibalization rate was 8.9 percent, up from 7.8 percent in fiscal year 1987. TAC officials cited other indications, including

- the probability of finding a needed part, as measured by the stock and issue effectiveness indicators, was declining,
- the length of time needed to obtain a part was increasing, and
- the use of WRM was increasing and depleting sustainability assets.

TAC officials attributed these problems partly to the effects from depot maintenance funding shortfalls. For example, they said that 7 of the top 20 problem parts affecting the F-15 were the result of depot maintenance funding shortfalls. They felt the unit-level indicators were better, more timely measures of problems than the higher-level indicators such as mission capable rates and combat readiness ratings. TAC officials said it takes time before supply and parts problems affect higher-level indicators, if ever. Units will cannibalize and use WRM to maintain high

rates. Intensive management and field workarounds can mask these indications of readiness problems in the short term.

The TAC Commander summarized TAC's performance in an October 27, 1988, letter to the Air Force Chief of Staff. He reported that fiscal year 1988 marked new all-time highs for TAC and that TAC was in its best shape ever. However, he also reported that leading logistics indicators were turning downward after years of steady improvement and cited increased cannibalization, reduced serviceable stock, and slower response time to fix problem parts as reasons for this decline. He said that lagging indicators (such as mission capable rates) had not yet changed due to TAC's ability to absorb much of the funding shortfall through an increased work load and cannibalization. He thought unfavorable trends due to the fiscal year 1988 funding shortfall would continue through much of 1989 but that the 1989 fiscal year budget provides more adequate funding.

Reports From Other Commands Indicate Emerging Problems

In a December 19, 1988, letter, the Commander of the Military Airlift Command also reported to the Air Force Chief of Staff that the effects of aircraft parts shortages were just beginning to surface. He said that top-line indicators such as mission capable rates and combat readiness ratings of WRM remained good with no downward trends, but, in the last 6 months, Military Airlift Command units had experienced decreases in stock effectiveness and WRM fill rates and increases in cannibalization, WRM use, and the numbers of items meeting critical item criteria. He was concerned that the logistics system was beginning to lose its elasticity and believed that the Air Force needed to take actions to address problems before mission capable rates and the flying hour program were affected.

Conclusion

Although indicators did not show significant logistics support problems during fiscal year 1988, the Air Force will continue assessing effects from the backlog during fiscal year 1989. Operating commands reported increased problems in late 1988 that officials attributed partly to the backlog. Officials stated that indicators may not show the effects from the backlog in a timely manner and that management workarounds may mask the effects.

Improving Requirements Process and Budget Requests

OSD and the Air Force have questioned the validity of the depot maintenance requirements estimates used to request funding. The general consensus is that the AFLC requirements computation systems generally overstate requirements that can be accomplished, especially for reparable. OSD and the Air Force have efforts underway to improve the depot maintenance requirements determination process and enhance the credibility of budget requests. An accurate, supportable, and executable requirement results from emphasizing the front end of the process—requirements determinations—instead of the relatively small back end of the process—unfunded requirements. The key to enhancing the credibility of the requirements determination process is to improve the accuracy of the initial requirements computation and to validate subsequent computations. Better-supported requirements could assist the Congress and the Department of Defense in reviewing funding requests and allocating funds effectively.

OSD Begins Implementing Improvements

At the prompting of the Congress, OSD began efforts in July 1988 to develop uniform measures of depot maintenance requirements as a basis for establishing and monitoring funding priorities. In an October 1988 report,⁶ the Under Secretary of Defense (Acquisition) recommended revising planning instructions and budget guidance to make terms and definitions uniform and reporting formats consistent and more informative. The Under Secretary also recommended improvements for estimating executable and unfunded deferred requirements. As discussed earlier, these improvements included discontinuing the use of the term backlog because of its varied and misleading connotations.

The study recommended improving procedures for estimating total requirements and categories of these requirements. The study also recommended that the military services develop improved procedures for estimating requirements that are not accomplished solely because of a lack of funding. In that regard, the services should develop the capability to quickly reflect changes in their estimates of unfunded requirements as the amount of available funds change, and they should empirically determine how much of the unfunded requirement in the current year will still be valid in the subsequent year. For example, if the repair requirement for an item will not be valid in the subsequent year because the item becomes obsolete and will be removed from the inventory, the estimate should be reduced. Also, if maintenance is deferred because of a lack of funds, the depot maintenance schedule for

⁶See footnote 5.

the item should be adjusted in the item's future requirements. A November 1988 memorandum to the Deputy Secretary of Defense from the Under Secretary of Defense (Acquisition) states that the recommendation to use empirical data for determining unfunded requirements to be carried forward to the subsequent year by the services is significant and is the "hub of the credibility issue."

In January 1989 the Deputy Secretary of Defense accepted the recommendations of the October 1988 report. In a March 1989 memorandum the Under Secretary of Defense (Acquisition) asked the Secretaries of the Air Force, the Army, and the Navy to review the report and comment on the proposed changes. The Air Force is in the process of reviewing the changes.

According to OSD officials, a defined timetable for the implementation of the recommendations has not been established; however, they plan to use revised planning instructions and budget guidance in the next planning cycle and to eliminate the term backlog from the fiscal year 1990 budget submission. The March 1989 memorandum also noted that OSD will continue efforts to develop a baseline for establishing depot maintenance funding priorities and a means for monitoring compliance and a macro-level planning model that relates depot maintenance funding levels to effects on readiness.

Air Force Efforts Underway

The Air Force has efforts underway to improve depot maintenance requirements determination and budget requests. It is modernizing AFLC's logistics management system, studying the current requirements determination process, and developing linkages between funding requests and readiness and sustainability. However, until these efforts are further along, the Air Force will be using estimates as its basis for budget requests instead of detailed requirements computed from its systems. For example, requirements for fiscal years 1990 and 1991 are based on fiscal year 1988 experience.

Modernizing Logistics Management Systems

The Air Force's Logistics Management Systems Modernization Program is intended to correct many of the serious deficiencies in AFLC's automated systems for computing requirements, managing the depot maintenance work load, budgeting, and assessing results. We recently reported⁷

⁷Air Force ADP: Logistics Systems Modernization Costs Continue to Increase (GAO/IMTEC-89-7FS, December 28, 1988).

costs for the program have continued to increase, the overall schedule for completing the program has been extended by 4 years, and the program's scope has been reduced since the program was established in 1984. Completion of the entire program is now scheduled for September 1994. The last project to be completed—the Requirements Data Bank—is one of the most important to improving the requirements determination process. The Requirements Data Bank system is to be used to compute worldwide requirements, budgets, and plans for spare and repair parts and equipment needs. This system is being designed to have the capability to simulate options or possible results through “what if” scenarios. These simulations are expected to provide Air Force managers with accurate readiness assessments and the impacts of these assessments.

Studying Aspects of the Requirements Determination Process

AFLC is studying ways to identify and change inaccurate factors used to compute requirements and determine why requirements decline. AFLC has continuing efforts to identify “dirty data” (inaccurate estimating factors used to compute repairable repair requirements) and to replace these factors with more accurate and realistic ones. AFLC and ALC officials are also determining why fiscal year 1988 executable requirements declined from budget estimates. Reasons for decreases, as reported by the ALCS in January 1989, include

- decreased or delayed weapon system programs and modifications;
- overestimated computational factors, such as the rate at which failed items are returned to the depot;
- phased-down older systems, such as the F-4 aircraft, being replaced by newer, more reliable and maintainable aircraft, such as the F-16;
- decreased stock levels and reduced WRM requirements;
- overestimated repair costs for new items entering the inventory; and
- delayed contracting efforts.

AFLC is also developing better methods for estimating and prioritizing repair requirements. These efforts focus more attention on maximizing depot maintenance support to weapon systems and war-fighting capability rather than on a more supply-oriented system with an emphasis on management of items. One AFLC model prioritizes repairs and distributes assets to maximize aircraft availability, and another model component computes WRM requirements to maximize aircraft availability. Another software program identifies requirements segments (e.g., base and depot safety stocks) and allocates funds based on priority of needs.

Linking Funding Requests to Readiness and Sustainability

As discussed previously, the Air Force is working to link depot maintenance requirements more directly to levels of readiness and sustainability and to measure quantitatively the impact of backlog caused by funding shortfalls. Air Force officials said that these capabilities would be extremely useful for preparing budgets and supporting funding requests. The Air Force has study contracts and in-house efforts underway to develop these capabilities.

The Air Force and OSD have undertaken studies with the Logistics Management Institute, Synergy, and the Rand Corporation to relate depot maintenance funding shortfalls to readiness and sustainability and assess the requirements determination process. The Logistics Management Institute and Synergy are both pursuing how funding shortfalls affect operational capability. According to an Air Force official, the Institute is taking a micro-level approach by relating funding shortfalls to specific items, whereas Synergy is approaching the issue from a macro-level or system perspective. The Rand Corporation is analyzing the reasons depot-level requirements and expenditures change over time. An Air Force official estimated that the Air Force probably would not have a reliable model to predict the impact of depot maintenance funding on readiness for 1 or 2 years.

Without such linkages and related assessment capabilities, it is difficult for the Congress, OSD, and the Air Force to evaluate depot maintenance budget requests and make funding decisions based on the levels of readiness and sustainability that can be afforded. There appears to be some level of backlog that the Air Force can accrue and still maintain adequate capability. The AFLC Commander said that a backlog in the \$300 million to \$500 million range was acceptable and could be quickly worked in a crisis. Air Force Headquarters officials said they were developing the fiscal years 1990/1991 budget with the assumption that a depot maintenance backlog under \$500 million was manageable.

Revised Projections of Requirements

In past budget submissions, the Air Force budgeted for depot maintenance based on data from AFLC's requirement computation systems and subsequent management reviews. However, for the fiscal years 1990/1991 budget submission, the Air Force estimated requirements primarily based on a projection of fiscal year 1988 funding and backlog rather than using substantiated, detailed data from the requirements computation systems. As discussed earlier, Air Force officials considered computed requirements to be overstated.

These revised Air Force projections resulted in significantly reduced estimates of fiscal years 1988 and 1989 requirements in the fiscal years 1990/1991 budget and reduced fiscal years 1990 and 1991 requirements from earlier estimates. Table 4.1 shows changes in fiscal years 1988 and 1989 total requirements from three successive budget submissions.

Table 4.1: Changes in Fiscal Years 1988 and 1989 Budgeted Requirements

| | President's budget submission for fiscal year | | |
|-------------------------------|---|------------------------|------------------------|
| | Amended | | |
| | 1988/1989 | 1988/1989 ^a | 1990/1991 ^b |
| Fiscal year 1988 requirements | \$3,358 | \$3,809 | \$3,030 |
| Fiscal year 1989 requirements | \$3,305 | \$4,570 | \$3,404 |

^aThe amended fiscal year 1988/1989 budget was submitted in February 1988.

^bThe amounts shown in this budget for fiscal years 1988 and 1989 are to provide a historical perspective on prior year's requirements.

To determine the fiscal year 1988 requirement of \$3,030 million, Air Force officials added the work accomplished during the year, as measured by total fiscal year 1988 funds applied to depot maintenance (\$2,756 million), to their estimate of the unfunded requirements (\$274 million). The unfunded requirements, as shown in table 4.2, includes AFLC's reported unfunded backlog, unfunded requirements in maintenance accounts for interim contractor support and a classified program, and other projected unfunded requirements.

Table 4.2: Estimated Fiscal Year 1988 Unfunded Requirements

| Element | Amount |
|------------------------------|--------------|
| Unfunded backlog | \$185 |
| Other maintenance | 18 |
| Other projected requirements | 71 |
| Total | \$274 |

^aAir Force officials used \$185 million rather than the \$185.7 million reported by AFLC and shown in table 2.2.

In preparing the September 1988 budget estimate submission, the Air Force reported an unfunded requirement of \$274 million. This budget estimate was prepared before the ending unfunded backlog of \$185 million was identified by the ALCs. To support the earlier estimate of \$274 million, Air Force officials stated they added an estimate of \$71 million for reparable items in transit from operating bases to depots at the end of fiscal year 1988 and other reparable items that could have been

returned to the depots but were not returned because of other funding shortfalls.

According to Air Force officials when they reduced the 1989 requirements estimate from \$4,570 to \$3,404 million, they used the fiscal year 1988 funding and backlog to revise the estimated fiscal year 1989 requirements, adjusted for inflation, and added the unfunded requirements from fiscal year 1988. They then subtracted estimated available funds for fiscal year 1989 from this estimated fiscal year 1989 requirement to compute an estimated unfunded requirement for fiscal year 1989 of \$269 million. The Air Force used this same method to estimate total requirements and unfunded requirements for fiscal years 1990 and 1991. Air Force officials told us that these calculated estimates for fiscal years 1990 and 1991 unfunded requirements were reduced from earlier estimates computed by using the requirements computation systems.

In commenting on a draft of this report, the Department of Defense acknowledged that depot maintenance requirement projections made in calendar year 1987 and early 1988 were overstated, but added that the causes of these overstatements have been corrected. Our work showed that while the Air Force has revised computed requirements to compensate for overstatements and is working to correct problems in the requirements determination process, all the causes for the overstatements have not been identified and corrected.

Conclusions

The key to enhancing the credibility of depot maintenance requirements determination process is improving the accuracy of the initial requirements computation and validating subsequent computations of depot maintenance requirements. Although OSD and the Air Force are working to enhance the credibility of depot maintenance requirements and resolve related issues such as backlog, the fiscal year 1990 budget request is based on estimates of requirements and backlog rather than substantiated, detailed repair data as generated by requirements determination systems. Furthermore, these estimates include a projection of future unfunded requirements based on the fiscal year 1988 unfunded backlog, which was also partly estimated. Our work raised questions about the validity of the \$185 million unfunded backlog reported by AFLC, and we were not able to identify a sound basis for the Air Force's addition of \$71 million to the unfunded backlog. Better-supported Air Force depot maintenance requirements would assist the Congress and Department of Defense in reviewing budget requests and effectively allocating funds.

Data on 20 Items From Ending Fiscal Year 1988 Backlog

| Warner Robins ALC | Quantities | | | | Reported backlog ^b | Repair costs of reported backlog |
|------------------------|--------------------------|-----------------------------|------------------|---------|-------------------------------|----------------------------------|
| | Requirement ^a | Repairs funded ^a | Repairs unfunded | On hand | | |
| Hub blade | 419 | 169 | 250 | 160 | 160 | \$1,531,680 |
| Aft cowl | 150 | 34 | 116 | 74 | 74 | 1,301,364 |
| Fighter aircraft gun | 129 | 0 | 129 | 274 | 129 | 638,808 |
| Petal door | 14 | 5 | 9 | 27 | 9 | 601,443 |
| Ejector (bombrack) | 1,945 | 834 | 1,111 | 2,289 | 1,111 | 559,944 |
| TV camera | 165 | 138 | 27 | 53 | 27 | 466,749 |
| Radome | 298 | 60 | 238 | 173 | 173 | 437,344 |
| Aft cowl | 164 | 37 | 127 | 26 | 26 | 388,622 |
| Cowl ring | 229 | 109 | 120 | 67 | 67 | 354,296 |
| Power supply | 315 | 0 | 315 | 315 | 315 | 340,515 |
| Total | | | | | | \$6,620,765 |
| San Antonio ALC | | | | | | |
| Turbine rotor | 715 | 480 | 235 | 116 | 116 | \$3,860,596 |
| Fan rotor | 235 | 60 | 175 | 80 | 80 | 2,650,880 |
| Combustion chamber | 888 | 672 | 216 | 904 | 216 | 2,486,376 |
| Nozzle segment | 6,429 | 7 | 6,422 | 6,149 | 6,422 | 1,589,445 |
| Turbine blade | 25,221 | 15,709 | 9,512 | 10,756 | 9,512 | 1,455,336 |
| Augmenter liner | 758 | 512 | 246 | 389 | 246 | 1,023,904 |
| Nozzle control | 1,568 | 1,331 | 237 | 664 | 237 | 977,333 |
| Fuel control | 433 | 356 | 77 | 74 | 74 | 844,192 |
| Test stand | 7 | 0 | 7 | 17 | 7 | 758,758 |
| Fan blade | 1,743 | 400 | 1,343 | 2,404 | 1,343 | 749,394 |
| Total | | | | | | \$16,396,214 |

^aThe backlog report shows requirements and repairs funded for the last two quarters of fiscal year 1988, although in some cases it shows requirements and repairs funded for four quarters.

^bReported backlog is the amount of either repairs unfunded or quantities on hand, whichever is less.

Comments From the Assistant Secretary of Defense for Production and Logistics



ASSISTANT SECRETARY OF DEFENSE
WASHINGTON, D.C. 20301-8000

September 5, 1989

PRODUCTION AND
LOGISTICS

(L/MD)

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

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) Draft Report, "DEPOT MAINTENANCE: Air Force Better Defines Backlog, But Additional Efforts Are Needed," dated June 30, 1989 (GAO Code 392445, OSD Case 8050). The Department concurs with the GAO findings and recommendation.

The Air Force recognizes the need for reporting accurate and credible figures concerning depot maintenance requirements. In 1987, the Air Force Logistics Command introduced the term "unfunded backlog," which led to improved reporting of Fiscal Year 1988 requirements. The Air Force Logistics Command is also working to improve the link between repair requirements and readiness and sustainability levels, as well as modernizing its logistics management information systems. The Office of the Secretary of Defense is revising budget guidance and requiring reporting formats to define terms and present information more consistently and clearly. Although some improvements are still needed, the DoD is well underway towards achieving better requirements reporting.

Detailed DoD comments are provided in the enclosure. The Department appreciates the opportunity to comment on the draft report.

Sincerely,

R.L. Beckwith
Major General, USMC
Military Deputy to ASD(P&L)

Enclosure

GAO DRAFT REPORT - DATED JUNE 30, 1989
(GAO CODE 392445) OSD CASE 8050

"DEPOT MAINTENANCE: AIR FORCE BETTER DEFINES BACKLOG, BUT ADDITIONAL
EFFORTS ARE NEEDED"

DEPARTMENT OF DEFENSE COMMENTS

* * * * *

FINDINGS

- **FINDING A: Background: Air Force Depot Maintenance.** The GAO reported that the Air Force spends about \$3 billion annually for depot-level maintenance to maintain and improve its war fighting capability. The GAO explained that the Air Force Logistics Command manages the depot maintenance program, with most repairs being accomplished at the five Air Logistics Centers and at contractor facilities. The GAO described the process used by the Air Force to determine depot maintenance requirements and commented that, historically, total depot maintenance requirements have exceeded available funding, resulting in a depot maintenance backlog. The GAO observed that postponing needed repairs could adversely affect readiness and sustainability by decreasing the availability of equipment and parts. The GAO found that, during the period FY 1980 through FY 1986, the depot maintenance backlog ranged from \$0 to about \$180 million and was generally considered manageable. According to the GAO, in 1987, however, the backlog increased to \$435 million and was estimated to exceed available funding by about \$1 billion in FY 1988 and \$1.5 billion in FY 1989. The GAO indicated that these increases raised congressional concerns about the credibility of how the depot maintenance backlog and requirements were determined. (p. 2, pp. 9-14/GAO Draft Report)

DoD RESPONSE: Concur.

- **FINDING B: Backlog Estimates Viewed As Unrealistic.** The GAO reported that the total Air Force depot maintenance backlog was relatively small and considered manageable until estimates were prepared to be included in the budget requests for FY 1988 and FY 1989. According to the GAO, the estimates that were submitted to the Congress in February 1988 showed a substantial increase in the projected depot maintenance backlog when compared to the actual backlog in previous years. The GAO further reported that the Air Force projected an unprecedented unfunded requirement of

Enclosure

Now on pp. 2, 8-11.

Now on pp. 2, 13-15.

\$3.3 billion in FY 1994. The GAO observed that these estimates were not considered to be realistic or credible and were revised for FY 1988 and FY 1989, based on an executable level of work of \$3.2 billion annually. The GAO reported that, as a result of that constraint the FY 1988 depot maintenance estimated backlog decreased from \$1.0 billion to \$773 million, while the FY 1989 estimated backlog was reduced from \$1.5 billion to \$559 million. The GAO noted that individual items needing repair were not identified in the constrained estimate. (pp. 2-3, pp. 16-18/GAO Draft Report)

DoD RESPONSE: Concur.

- **FINDING C: Changed Definition Improves Backlog Identification.** The GAO reported that, in December 1987, the Air Force Logistics Command introduced the term "unfunded backlog," which was to be used for reporting backlog instead of the total unfunded requirement. According to the GAO, the unfunded backlog is the verifiable on-hand repairable items, either at an Air Logistics Center or at a contractor facility, for which a valid repair exists but which cannot be repaired due to a lack of funds. The GAO noted that, while the Air Force Logistics Command established a quarterly reporting format, specific implementing procedures for identifying and calculating the unfunded backlog were not provided. The GAO found that the Air Logistics Centers developed and implemented procedures to identify and calculate the unfunded backlog. The GAO concluded that, as a result, more realistic unfunded requirements and individual items needing repair were identified for FY 1988. (pp. 3-4, pp. 18-20/ GAO Draft Report)

Now on pp. 3-4, 15-16.

DoD RESPONSE: Concur.

- **FINDING D: Additional Effort Needed To More Accurately Identify Unfunded Backlog.** The GAO found that the Air Logistics Centers reported that \$185.7 million was needed at the end of FY 1988 to repair items in the unfunded backlog. The GAO reviewed 20 repairable items in the unfunded backlog, with the largest repair cost at the end of FY 1988 at the Warner Robins and San Antonio Air Logistics Centers--the items at Warner Robins had repair costs of \$6.6 million and those at San Antonio had repair costs of \$16.4 million. The GAO identified inaccuracies in the quantities and associated repair costs included for 15 of the 20 items, noting that the reported quantities for seven of the items were inaccurate because some parts were not repaired for reasons other than a lack of funds. The GAO found that some of the items included were not repaired because of systemic capacity constraints, such as a lack of repair capacity, facilities, parts,

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Comments From the Assistant Secretary of
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or personnel. The GAO concluded that, in these cases, even if funds were available, the items could not be repaired.

The GAO also determined that, in addition to the 20 items reviewed in detail, the unfunded backlog reported by the Warner-Robins Air Logistics Center included \$16.1 million of reparable items awaiting repair, but the parts needed to repair them were not available and had not been available for at least 90 days. (The GAO observed that, although not included in the previous three quarters, the Warner-Robins Air Logistics Command included these items in its fourth quarter report.) The GAO reported that Air Force Logistics Command officials expressed concern about including items awaiting parts because the items would overstate the backlog and, if carried forward, might result in double counting in the next year's requirements. While the Deputy Director of the Resources Management Division at Warner-Robins (who submitted the fourth quarter backlog report) agreed that those items included in the \$16.1 million do not meet the Air Force Logistics Command definition of unfunded backlog (because the items could not have been inducted for repair even if funds had been available), he contended that the definition of unfunded backlog was too restrictive and, thus, did not accurately reflect unfunded requirements. He pointed out to the GAO that, if the needed repair parts become available during the next year and the requirement for the repairs still exists, the \$16.1 million will be required for repairs. The Deputy Director further advised the GAO that his position on the inadequacy of the backlog definition is well known to Air Force Logistics Command officials. The GAO noted that the \$16.1 million was not identified to individual parts, but instead was a percent of the acquisition cost of those items not being repaired because needed repair parts were not available.

The GAO further found that the Air Force Logistics Command officials did not conduct a physical inventory to verify the quantities of assets on hand at the Air Logistics Centers and contractor plants. According to the GAO, a complete inventory of fourth quarter backlogs was not completed; instead, inventory records and contractor reported data was used to calculate the unfunded backlog. The GAO pointed to Air Force problems with

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Now on pp. 3-4, 16-20.

records accuracy that have been reported in the past.^{1/} The GAO further pointed out that Air Force Logistics Command data indicated that physically verified on-hand assets did not agree with the inventory records for about 18 percent of the items inventoried by the Command in FY 1988. In addition, the GAO noted that the Air Force Logistics Command questioned the accuracy of inventory data maintained at contractor facilities. (The GAO explained that about one-third of the reported unfunded backlog at the end of FY 1988 was at contractor facilities.) The GAO concluded that, while verification may have occurred at some level, the overall unfunded backlog was not verified for accuracy and was based on data of questionable accuracy. (p. 4, pp. 20-26/ GAO Draft Report)

DoD RESPONSE: Concur. It should be recognized, however, that the Air Force Logistics Command does not require a special inventory for backlog reports, due to the time and expense involved and the lack of staff. Each Air Logistics Center was tasked to perform a physical inventory on sample items included in the third quarter backlog report. The results of this sampling validated that report and a decision was made not to conduct a special inventory for the fourth quarter backlog report. The May 1988 GAO report indicated that the Air Force had made substantial improvements in inventory control. In addition, routine operating procedure requires the Air Logistics Centers to perform a physical inventory every three years for every National Stock Numbered item managed by the Air Force.

- **FINDING E: Planned Changes in Backlog Definition.** The GAO reported that, in addition to Air Force efforts, the DoD has studied backlog terms and definitions used by the Services and has recommended discontinued use of the term "backlog" because of the connotation that it refers to equipment awaiting repair at the maintenance shop, when in actuality it represents in large part

^{1/} GAO/NSIAD-88-133, "INVENTORY MANAGEMENT: Air Force Inventory Accuracy Problems" dated May 12, 1988, OSD Case 7526; and

GAO/NSIAD-88-21, "INVENTORY MANAGEMENT: Air Force Items Being Returned for Report but Not Promptly" dated November 25, 1987, OSD Case 7400.

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maintenance that is deferred because of (1) capacity constraints at the depot, (2) operational commitments in the field, or (3) lack of funding. The GAO explained that the DoD is in the process of implementing uniform terms and definitions, which the GAO listed. The GAO observed, however, that the impact of the proposed changes on the unfunded backlog reported by the Air Force for FY 1988 is undetermined. (pp. 26-28/GAO Draft Report).

DoD RESPONSE: Concur.

- **FINDING F: Air Force Actions to Reduce Effects of the Depot Maintenance Backlog.** The GAO reported that, to help mitigate potential readiness problems caused by the FY 1988 depot maintenance funding shortfall, the Air Force Logistics Command prioritized the depot maintenance workload. Specifically, the GAO reported that:

- funding priorities for aircraft maintenance eliminated certain tasks, such as (1) painting and inspections, (2) extended intervals for some scheduled maintenance, and (3) deferred some modifications and some aircraft damage repair;
- repairs to other major equipment items and depot maintenance support to bases was funded at 75 percent of the budgeted requirement;
- stock-level increases for engines were deferred and only a portion of the spare engine requirement needed to meet wartime requirements was to be repaired; and
- priority was given to (1) repairable parts needed to support the peacetime flying hour program, (2) critical items, and (3) problem parts causing an aircraft to be grounded.

The GAO noted that operating commands also increased base-level repairs, including depot tasks that had been transferred to the field, and retained more repairable items (which had previously been returned to the depots but which could not be repaired because needed repair parts were not available). The GAO concluded that these actions helped to reduce the operational effects from the funding shortfalls and maintained readiness levels for the short term by allowing the depots to accomplish higher priority work. (p. 4, pp. 29-32/GAO Draft Report)

Now on pp. 4, 23-25.

DoD RESPONSE: Concur.

- **FINDING G: Air Force Assessments of Readiness and Sustainability Effects.** The GAO reported that readiness indicators such as the percent of time that aircraft are mission capable, remained high during FY 1988. The GAO further reported, however, that late in the fiscal year, some slight declines in the indicators were reported. The GAO commented that it is difficult to assess specific effects due to depot maintenance shortfalls because:
 - the Weapon Systems Management Information System is not designed to assess the effects on combat capability caused by a backlog of maintenance and repairs;
 - indicators may be kept high by field workarounds, including base-level repairs, using war reserve material and cannibalization;
 - other factors, such as shortfalls in spare parts procurement and transportation, also effect capability; and
 - a time lag of 1 to 3 years can occur before the effects of a maintenance funding shortfall is reflected in the indicators.

The GAO reported that the Air Force is developing the assessment capability (1) to link depot maintenance requirements to levels of readiness and sustainability more directly and (2) to determine how specific quantities of unrepaired parts would degrade capability. The GAO noted that the Air Force has contracted for studies to relate depot maintenance funding shortfalls to readiness and sustainability and assess the requirements determination process. (p. 5, pp. 33-36/GAO Draft Report)

DoD RESPONSE: Concur.

- **FINDING H: Readiness Problems Reported By Operating Commands.** The GAO found that operating commands began reporting increasing parts shortages and supply problems late in FY 1988. The GAO reported that the problems were attributed, in part, to the effects of the maintenance backlog, but it was also acknowledged that other factors, such as funding shortfalls for spare parts procurement and transportation, may have contributed to the problems. The GAO observed that the problems are expected to continue during FY 1989, but that improved funding for 1989 will permit the Air Force to meet current needs and begin to complete work deferred or not done in FY 1988. (p. 5, pp. 36-40/GAO Draft Report)

DoD RESPONSE: Concur.

Now on pp. 4, 25-28.

Now on pp. 4, 29-31.

- **FINDING I: The DoD Begins Implementing Improvements.** The GAO reported that, at the prompting of the Congress, the Department of Defense took steps to develop uniform measures of depot maintenance requirements as a basis for establishing and monitoring funding priorities. According to the GAO, in an October 1988 report entitled, Enhancing the Credibility of Depot Maintenance Requirements Process: A Report to the Deputy Secretary of Defense, the Under Secretary of Defense (Acquisition) recommended revising planning instructions and budget guidance to make terms and definitions uniform and reporting formats consistent and more informative. The GAO reported that, although a defined timetable for the implementation of the report recommendations had not been established, the Department plans to use revised planning instructions and budget guidance in the next planning cycle and to eliminate the term backlog from the FY 1990 budget submission. The GAO also noted that the DoD will continue efforts to develop a baseline (1) for establishing depot maintenance funding priorities, (2) for monitoring compliance, and (3) for developing a macro-level planning model that will relate depot maintenance funding levels to effects on readiness. (p. 5, pp. 41-43/GAO Draft Report)

Now on pp. 4-5, 32-33.

DoD RESPONSE: Concur.

- **FINDING J: Air Force Efforts Underway.** The GAO reported that the Air Force is (1) improving the requirements computation process, (2) modernizing the Air Force Logistics Command logistics management system, and (3) developing linkages between funding requests and readiness and sustainability. The GAO commented that the Air Force Logistics Management Systems Modernization Program is intended to correct many of the serious deficiencies in the Air Force Logistics Command automated systems for computing requirements, managing the depot maintenance work load, budgeting, and assessing results. The GAO pointed out, however, it had recently reported that, since the program was established (1) the costs for the program have continued to increase, (2) the overall schedule for completing the program has been extended, and (3) the scope has been reduced.^{2/} The GAO observed that existing systems

^{2/} GAO/IMTEC-89-7FS, "AIR FORCE ADP: Logistics Systems Modernization Costs Continue to Increase" dated December 28, 1988, OSD Case 7885

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generally overstate requirements that can be accomplished. The GAO reported that, as a result, the Air Force re-estimated requirements for FY 1988 and and FY 1989 and projected budgeted requirements for FY 1990 and FY 1991 without relying on the existing systems. They explained that the re-estimated projections were based on FY 1988 funding, plus estimates of future unfunded requirements, and were lower than earlier estimates computed using the requirements determination systems. (p. 5, pp. 45-49/GAO Draft Report)

DoD RESPONSE: Concur. The Department of Defense acknowledges that improvements in automated requirements systems are needed. The Air Force uses the automated requirements system primarily to compute operational requirements, as well as budgetary requirements. Operational requirements are the actual requirements needed to support Air Force activities, while a budgetary requirement is a request for funding. It excludes items that cannot be repaired due to parts problems, capacity constraints, or any reason other than funds. The Air Force routinely excludes requirements that cannot be repaired for the reasons stated and sends forward only budgetary requirements it believes are fully executable. These adjustments are made normally as part of the transition from the comprehensive operational requirements to the stated budgetary request. The Air Force acknowledges that requirements projections made in the CY 1987 and early CY 1988 time frame were overstated. The causes for the overstatements have been corrected.

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RECOMMENDATION

- **RECOMMENDATION:** The GAO recommended that the Secretary of the Air Force direct the Commander, Air Force Logistics Command, to prescribe the procedures and processes to be used in determining and verifying reported unfunded repairs. (p. 28/GAO Draft Report)

Now on pp. 5, 22.

DoD RESPONSE: Concur. The Secretary of the Air Force or his designee will issue a memorandum to the Commander, Air Force Logistics Command, by September 30, 1989, directing that specific procedures and processes be used, incorporating some procedures already in place to determine and verify reporting of unfunded repairs.

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