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Report to Congressional Committees

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EXPORT CONTROLS

National Security Issues and Foreign Availability for High Performance Computer Exports

GAO/NSIAD-98-200

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Congressional Committees

In January 1996, the executive branch revised controls on the export of U.S.-manufactured high performance computers (HPC) by raising thresholds of computer performance for which exporters must obtain a license. The revised regulation established a four-tiered system as a basis for controlling HPC exports to all countries; tier 3 includes some countries that may pose national security and proliferation risks to the United States. HPC exports to terrorist countries in tier 4 were essentially prohibited.

Section 1214 of the Fiscal Year 1998 National Defense Authorization Act (P.L. 105-85) required that we review the national security risks relating to the sale of computers with a composite theoretical performance of between 2,000 and 7,000 millions of theoretical operations per second (MTOPS)[1] to end users in tier 3 countries. To accomplish this, we focused on efforts by the executive branch to determine national security risks associated with such HPC sales. As required by the act, we also reviewed the foreign availability of computers with performance levels at 2,000 to 7,000 MTOPS and the impact on U.S. exporters of foreign sales of these computers to tier 3 countries.

Background

The U.S. export control system is about managing risk; exports to some countries involve less risk than to other countries and exports of some items involve less risk than others. Under United States law, the President has the authority to control and require licenses for the export of items that may pose a national security or foreign policy concern. The President also has the authority to remove or revise those controls as U.S. concerns and interests change.[2]

In 1995, as a continuation of changes begun in the 1980s, the executive branch reviewed export controls on computer exports to determine how changes in computer technology and its military applications should affect U.S. export control regulations. In announcing its January 1996 change to HPC controls, the executive branch stated that one goal of the revised

[1]MTOPS is the composite theoretical performance of a computer measured in millions of theoretical operations per second. In principle, higher MTOPS indicates greater raw performance of a computer to solve computations quickly, but not the actual performance of a given machine for a given application.

[2]In this report, revision of export controls refers to removal of licensing requirements for groups of countries based on the performance levels of HPCs.

export controls was to permit the government to tailor control levels and licensing conditions to the national security or proliferation risk posed at a specific destination.

According to the Commerce Department, the key to effective export controls is setting control levels above the level of foreign availability of materials of concern. The Export Administration Act (EAA) of 1979 describes foreign availability as goods or technology available without restriction to controlled destinations from sources outside the United States in sufficient quantity and comparable quality to those produced in the United States so as to render the controls ineffective in achieving their purposes. Foreign availability is also sometimes associated with the indigenous capability of foreign sources to produce their own HPCs, but this meaning does not meet all the EAA criteria.

The 1996 revision of HPC export control policy removed license requirements for most HPC exports with performance levels up to 2,000 MTOPS—an increase from the previous level of 1,500 MTOPS. For purposes of export controls, countries were organized into four "computer tiers," with each tier after tier 1 representing a successively higher level of concern to U.S. security interests. The policy placed no license requirements on tier 1 countries, primarily Western European countries and Japan. Exports of HPCs above 10,000 MTOPS to tier 2 countries in Asia, Africa, Latin America, and Central and Eastern Europe would continue to require licenses. A dual-control system was established for tier 3 countries, such as Russia and China. For these countries, HPCs up to 7,000 MTOPS could be exported to civilian end users without a license, while exports at and above 2,000 MTOPS to end users of concern for military or proliferation of weapons of mass destruction reasons required a license. Exports of HPCs above 7,000 MTOPS to civilian end users also required a license. HPC exports to terrorist countries in tier 4 were essentially prohibited.

Results in Brief

The executive branch has identified high performance computing as having applications in such national defense areas as nuclear weapons programs, cryptology, conventional weapons, and military operations. However, except for nuclear weapons, the executive branch has not identified how and at what performance levels specific countries of concern may use HPCs for national defense applications—an important factor in assessing risks of HPC sales.

A Department of Energy (DOE) study on nuclear weapons was completed in June 1998. The study shows that nuclear weapons programs in tier 3 countries, especially those of China, India, and Pakistan, could benefit from the acquisition of HPC capabilities. The executive branch has only recently begun to identify how specific countries of concern would use HPCs for nonnuclear national defense applications. To date, a Department of Defense (DOD) study on this matter begun in early 1998 is not completed.

With regard to foreign availability of HPCs,[3] we found that subsidiaries of U.S. computer manufacturers dominate the overseas HPC market and they must comply with U.S. controls. Three Japanese companies are global competitors of U.S. manufacturers, two of which told us that they had no sales to tier 3 countries. The third company did not provide data on such sales in a format that was usable for our analysis. Two of the Japanese companies primarily compete with U.S. manufacturers for sales of high-end HPCs at about 20,000 MTOPS and above. Two other manufacturers, one in Germany and one in the United Kingdom, also compete with U.S. HPC suppliers, but primarily within Europe. Only the German company has sold HPCs to tier 3 countries. Japan, Germany, and the United Kingdom each have export controls on HPCs similar to those of the United States, according to foreign government officials. Because there is limited competition from foreign HPC manufacturers and U.S. manufacturers reported no lost sales to foreign competition in tier 3 countries, we concluded that foreign suppliers of HPCs had no impact on sales by U.S. exporters. In addition, Russia, China, and India have developed HPCs, but the capabilities of their HPCs are believed to be limited. Thus, our analysis suggests that HPCs over 2,000 MTOPS are not available to tier 3 countries without restriction from foreign sources.

HPC Proliferation and National Security Risks Not Assessed

The executive branch has determined that HPCs are important for designing or improving advanced nuclear explosives and advanced conventional weapons capabilities. It has identified high performance computing as having applications in such national defense areas as nuclear weapons programs, cryptology, conventional weapons, and military operations. According to DOD, high performance computing is an enabling technology for modern tactical and strategic warfare and is also important in the development, deployment, and use of weapons of mass destruction. It has also played a major role in the ability of the United States to maintain and increase the technological superiority of its

[3]We used a description of foreign availability in the EAA as our criteria.

warfighting support systems. HPCs have particular benefits for military operations, such as battle management and target engagement, and they are also important in meeting joint warfighting objectives like joint theater missile defense, information superiority, and electronic warfare. However, the executive branch has not, with the exception of nuclear weapons, identified how or at what performance levels, countries of concern may use HPCs to advance their own military capabilities.

The House Committee on National Security in December 1997 directed DOE and DOD to assess the national security risks of exporting HPCs with performance levels between 2,000 and 7,000 MTOPS to tier 3 countries. In June 1998, DOE concluded its study on how countries like China, India, and Pakistan can use HPCs to improve their nuclear programs. According to the study, the impact of HPC acquisition depends on the complexity of the weapon being developed and, even more importantly, on the availability of high-quality, relevant test data. The study concluded that "the acquisition and application of HPCs to nuclear weapons development would have the greatest potential impact on the Chinese nuclear program—particularly in the event of a ban on all nuclear weapons testing." Also, India and Pakistan may now be able to make better use of HPCs in the 1,000 to 4,000 MTOPS range for their nuclear weapons programs because of the testing data they acquired in May 1998 from underground detonations of nuclear devices, according to the DOE report. The potential contribution to the Russian nuclear program is less significant because of its robust nuclear testing experience, but HPCs can make a contribution to Russia's confidence in the reliability of its nuclear stockpile. An emerging nuclear state is likely to be able to produce only rudimentary nuclear weapons of comparatively simple designs for which personal computers are adequate. We were told that DOD's study on national security impacts has not been completed.

We attempted to identify national security concerns over other countries' use of HPCs for conventional weapons development. However, officials from DOD and other relevant executive branch agencies did not have information on how specific countries would use HPCs for missile, chemical, biological, and conventional weapons development.

Current Foreign Availability of HPCs

Based on EAA's description of foreign availability, we found that subsidiaries of U.S. companies dominate overseas sales of HPCs. According to U.S. HPC exporters, there were no instances where U.S. companies had lost sales to foreign HPC vendors in tier 3 countries. The U.S. companies

primarily compete against one another, with limited competition from foreign suppliers in Japan and Germany. We also obtained information on the capability of certain tier 3 countries to build their own HPCs and found it to be limited. Tier 3 countries are not as capable of producing machines in comparable quantity and of comparable quality and power, as the major HPC-supplier countries.

The only global competitors for general computer technology are three Japanese companies, two of which compete primarily for sales of high-end computers—systems sold in small volumes and performing at advanced levels. Two of the companies reported no exports to tier 3 countries, while the third reported some exports on a regional, rather than country basis.[4] One German company sells HPCs primarily in Europe but has reported a small number of sales of its HPCs over 2,000 MTOPS to tier 3 countries. One British company said it is capable of producing HPCs above 2,000 MTOPS, but company officials said it has never sold a system outside the European Union.

Our findings in this regard were similar to those in a 1995 Commerce Department study of the HPC global market, which showed that American dominance prevailed at that time, as well. The study observed that American HPC manufacturers controlled the market worldwide, followed by Japanese companies. It also found that European companies controlled about 30 percent of the European market and were not competitive outside Europe.

Other HPC suppliers also have restrictions on their exports. Since 1984, the United States and Japan have been parties to a bilateral arrangement, referred to as the "Supercomputer Regime," to coordinate their export controls on HPCs. Also, both Japan[5] and Germany, like the United States, are signatories to the Wassenaar Arrangement[6] and have regulations that generally appear to afford levels of protection similar to U.S. regulations for their own and for U.S.-licensed HPCs. For example, both countries place export controls on sales of computers over 2,000 MTOPS to specified

[4]One of the three Japanese companies—Fujitsu—reported some of its HPC sales on a regional, rather than country, basis. Therefore, we could not determine whether that company has provided any HPC exports to tier 3 countries.

[5]We also obtained information from the Japanese government and HPC vendors. We identified controls in force but did not assess their implementation.

[6]The 1996 Wassenaar Arrangement of Export Controls for Conventional Arms and Dual-Use Goods and Technologies is an arrangement to share export information among 33 states with the purpose of contributing to regional and international security by enhancing cooperation among export control systems and international regimes.

destinations, according to German and Japanese officials. However, foreign government officials said that they do not enforce U.S. reexport controls on unlicensed U.S. HPCs. A study of German export controls noted that regulatory provisions specify that Germany has no special provisions on the reexport of U.S.-origin goods. According to German government officials, the exporter is responsible for knowing the reexport requirements of the HPC's country of origin. We could not ascertain whether improper reexports of HPCs occurred from tier 1 countries.

Only one German company reported several sales to tier 3 countries of HPCs over 2,000 MTOPS, and U.S. HPC subsidiaries reported no loss of sales due to foreign competition. Officials of U.S. HPC subsidiaries explained that they primarily compete for sales in local markets with other U.S. HPC subsidiaries. None of these officials identified lost HPC sales to other foreign vendors in those markets. Further, none claimed to be losing sales to foreign vendors because of delays in delivery resulting from the subsidiary's compliance with U.S. export control regulations.

Because some U.S. government and HPC industry officials consider indigenous capability to build HPCs a form of foreign availability, we examined such capabilities for tier 3 countries. Based on studies and views of specialists, we found that the capabilities of China, India, and Russia to build their own HPCs still lag well behind those of the United States, Japan, and European countries. Although details are not well-known about HPC developments in each of these tier 3 countries, most officials said and studies show that each country still produces machines in small quantities and of lower quality and power than U.S., Japanese, and European computers. For example:

- China has produced at least two different types of HPCs, the Galaxy and Dawning series, both based on U.S. technology and each believed to have an initial performance level of about 2,500 MTOPS. Although China has announced its latest Galaxy's capability at 13,000 MTOPS, U.S. government officials have not confirmed this report.
- India has produced a series of computers called Param, which are based on U.S. microprocessors and are believed by U.S. DOE officials to be capable of performing at about 2,000 MTOPS. These officials were denied access to test the computers' performance.
- Over the past 3 decades Russia has endeavored to develop commercially viable HPCs using both indigenously developed and U.S. microprocessors, but has suffered economic problems and lacks customers. According to one DOE official, Russia has never built a computer running better than

2,000 MTOPS, and various observers believe Russia to be 3 to 10 years behind the West in developing computers.

Agency Comments and Our Evaluation

Commerce and DOD each provided one set of general written comments for both this report and our report entitled, Export Controls: Information On The Decision to Revise High Performance Computer Controls (GAO/NSIAD-98-196, Sept. 16, 1998). Some of those general comments do not relate to this report. Therefore, we respond to them in the other report. General comments relevant to this report are addressed below. Additional specific comments provided by Commerce on this report are addressed in appendix II.

In its written comments, Commerce said that the report's scope should be expanded to better reflect the rationale that led to the decision to change computer export control policy "from a relic of the Cold War to one more in tune with today's technology and international security environment." This report responds to the scope of work required by Public Law 105-85 (Nov. 18, 1997), that we evaluate the current foreign availability of HPCs and their national security implications. Therefore, this report does not focus on the 1995 decisions by the Department of Commerce. Our companion report, referred to above, assesses the basis for the executive branch's revision of HPC export controls.

Commerce commented that our analysis of foreign availability as an element of the controllability of HPCs was too narrow, stating that foreign availability is not an adequate measure of the problem. Commerce stated that this "Cold War concept" makes little sense today, given the permeability and increased globalization of markets. We agree that rapid technological advancements in the computer industry have made the controllability of HPC exports a more difficult problem. However, we disagree that foreign availability is an outdated Cold War concept that has no relevance in today's environment. While threats to U.S. security may have changed, they have not been eliminated. Commerce itself recognized this in its March 1998 annual report to the Congress, which stated that "the key to effective export controls is setting control levels above foreign availability." Moreover, the concept of foreign availability, as opposed to Commerce's notion of "worldwide" availability, is still described in EAA and Export Administration Regulations as a factor to be considered in export control policy.

Commerce also commented that the need to control the export of HPCs because of their importance for national security applications is limited. It stated that many national security applications can be performed satisfactorily on uncontrollable low-level technology, and that computers are not a "choke point" for military production. Commerce said that having access to HPCs alone will not improve a country's military-industrial capabilities. Commerce asserted that the 1995 decision was based on a variety of research leading to the conclusion that computing power is a secondary consideration for many applications of national security concern. We asked Commerce for its research evidence, but it cited only a 1995 Stanford study used in the decision to revise HPC export controls.

Moreover, Commerce's position on this matter is not consistent with that of DOD. DOD, in its Militarily Critical Technologies List,[7] has determined that high performance computing is an enabling technology for modern tactical and strategic warfare and is also important in the development, deployment, and use of weapons of mass destruction. High performance computing has also played a major role in the ability of the United States to maintain and increase the technological superiority of its war-fighting support systems. DOD has noted in its High Performance Computing Modernization Program[8] annual plan that the use of HPC technology has led to lower costs for system deployment and improved the effectiveness of complex weapon systems. DOD further stated that as it transitions its weapons system design and test process to rely more heavily on modeling and simulation, the nation can expect many more examples of the profound effects that the HPC capability has on both military and civilian applications. Furthermore, we note that the concept of choke point is not a standard established in U.S. law or regulation for reviewing dual-use exports to sensitive end users for proliferation reasons.

In its comments, DOD stated that our report inaccurately characterized DOD as not considering the threats associated with HPC exports. DOD said that in 1995 it "considered" the security risks associated with the export of HPCs to countries of national security and proliferation concern. What our

[7]The Militarily Critical Technologies List, required by EAA, is a compendium of the technologies DOD assesses as critical to maintaining superior U.S. military capabilities. According to DOD, it should be used as a reference for evaluating potential technology transfers and to determine if the proposed transaction would permit potential adversaries access to technologies with specific performance levels at or above the characteristics identified as militarily critical.

[8]The High Performance Computing Modernization Program is the major force designed to improve DOD's ability to exploit the computation necessary to sustain technological superiority on the battlefield. Managed by the Director, Defense Research and Engineering, the program is intended to establish a nationwide integrated infrastructure to support the defense research, development, test, and evaluation communities.

report actually states is that (1) except for nuclear weapons, the executive branch has not identified how and at what performance levels specific countries of concern may use HPCs for national security applications and (2) the executive branch did not undertake a threat analysis of providing HPCs to countries of concern. DOD provided no new documentation to demonstrate how it "considered" these risks. As DOD officials stated during our review, no threat assessment or assessment of the national security impact of allowing HPCs to go to particular countries of concern and of what military advantages such countries could achieve had been done in 1995. In fact, an April 1998 Stanford study on HPC export controls also noted that identifying which countries could use HPCs to pursue which military applications remained a critical issue on which the executive branch provided little information.

The Arms Control and Disarmament Agency (ACDA) provided oral comments on this report and generally agreed with it. However, it disagreed with the statement that "according to the Commerce Department, the key to effective export controls is setting control levels above the level of foreign availability of materials of concern." ACDA stressed that this is Commerce's position only and not the view of the entire executive branch. ACDA said that in its view (1) it is difficult to determine the foreign availability of HPCs and (2) the United States helps create foreign availability through the transfer of computers and computer parts.

The Departments of State and Energy had no comments on a draft of this report.

Our scope and methodology are in appendix I. Commerce's and DOD's comments are reprinted in appendixes II and III, respectively, along with an evaluation of each.

We conducted our review between December 1997 and June 1998 in accordance with generally accepted government auditing standards.

Please contact me on (202) 512-4128 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix IV.

Harold J. Johnson, Associate Director
International Relations and Trade Issues

List of Recipients

The Honorable Alfonse M. D'Amato
Chairman
The Honorable Paul Sarbanes
Ranking Minority Member
Committee on Banking, Housing and Urban Affairs
United States Senate

The Honorable Strom Thurmond
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The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Benjamin A. Gilman
Chairman
The Honorable Lee Hamilton
Ranking Minority Member
Committee on International Relations
House of Representatives

The Honorable Floyd D. Spence
Chairman
The Honorable Ike Skelton
Ranking Minority Member
Committee on National Security
House of Representatives

Contents

Abbreviations

ACDA	Arms Control and Disarmament Agency
DOD	Department of Defense
DOE	Department of Energy
EAA	Export Administration Act
HPC	high performance computer
MTOPS	millions theoretical operations per second

Scope and Methodology

Section 1214 of the Fiscal Year 1998 National Defense Authorization Act (P.L. 105-85) required that we review the national security risks relating to the sale of computers with a composite theoretical performance of between 2,000 and 7,000 millions of theoretical operations per second (MTOPS) to end users in tier 3 countries. Accordingly, we examined the executive branch's actions to assess the risks of these sales. As required by the act, we also reviewed the foreign availability of computers with performance levels at 2,000 to 7,000 MTOPS and the impact on U.S. exporters of foreign sales of these computers to tier 3 countries.

To determine the executive branch's actions to assess or analyze the national security risks of allowing high performance computers (HPC) to be provided to countries of proliferation and military concern, we reviewed the Department of Defense (DOD) and the Department of Energy (DOE) documents on how HPCs are being used for nuclear and military applications. We discussed high performance computing for both U.S. and foreign nuclear weapons programs with DOE officials in Washington, D.C., and at the Lawrence Livermore, Los Alamos, and Sandia National Laboratories. We also met with officials of the DOD HPC Modernization Office and other officials within the Under Secretary of Defense for Acquisition and Technology, the Office of the Secretary of Defense, the Joint Chiefs of Staff, and the intelligence community to discuss how HPCs are being utilized for weapons design, testing and evaluation, and other military applications. Additionally, we met with DOD and Institute of Defense Analyses officials to discuss the basis for identifying high performance computing on the Militarily Critical Technologies List, a compendium of technologies identified by DOD as critical for maintaining U.S. military and technological superiority. We also reviewed intelligence reports on the use of high performance computing for developing weapons of mass destruction.

To determine foreign availability of HPCs, we reviewed the Export Administration Act (EAA) and the Export Administration Regulations for criteria and a description of the meaning of the term. We then reviewed market research data from an independent computer research organization. We also reviewed lists, brochures, and marketing information from major U.S. and foreign HPC manufacturers in France (Bull, SA), Germany (Siemens Nixdorf Informationssysteme AG and Parsytec Computer GmbH), and the United Kingdom (Quadrics Supercomputers World, Limited), and met with them to discuss their existing and projected product lines. We also obtained market data, as available, from three Japanese HPC manufacturers. Furthermore, we met

with government officials in China, France, Germany, Singapore, South Korea, and the United Kingdom to discuss each country's indigenous capability to produce HPCs. We also obtained information from the Japanese government on its export control policies. In addition, we obtained and analyzed from two Commerce Department databases (1) worldwide export licensing application data for fiscal years 1994-97 and (2) export data from computer exporters provided to the Department for all American HPC exports between January 1996 and October 1997. We also reviewed a 1995 Commerce Department study on the worldwide computer market to identify foreign competition in the HPC market prior to the export control revision.[1] To identify similarities and differences between U.S. and foreign government HPC export controls, we discussed with officials of the U.S. embassies and host governments information on foreign government export controls for HPCs and the extent of cooperation between U.S. and host government authorities on investigations of export control violations and any HPC diversions of HPCs to sensitive end users. We also reviewed foreign government regulations, where available, and both foreign government and independent reports on each country's export control system. To obtain information on the impact of HPC sales on U.S. exporters, we interviewed officials of American HPC firms and their subsidiaries and U.S. and foreign government officials.

[1]Part III, Global Supercomputer Industry and Market Assessment, June 2, 1995, Department of Commerce, Bureau of Export Administration, Office of Strategic Industries and Economic Security, Economic Analysis Division.

Comments From the Department of Commerce

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

THE SECRETARY OF COMMERCE
Washington, D.C. 20230

AUG - 7 1998

Mr. Harold J. Johnson
Associate Director
International Relations and Trade Issues
General Accounting Office
Washington, D.C. 20548

Dear Mr. Johnson:

Thank you for the opportunity to comment on the draft GAO reports on the 1995 decision to revise export controls for high performance computers (HPCs). My general view is that the reports are too limited in their scope and should be expanded to reflect better the rationale that led to the President's decision to change computer export policy from a relic of the Cold War to one more in tune with today's technology and international security environment. The President based his decision on several factors -- rapid technological change, wide availability, limited controllability, and limited national security application -- that played critical roles in the Administration's decision to create an effective export policy for computers at various performance levels. Instead of analyzing this rationale, the reports focus on an outdated, Cold War concept of "foreign availability."

The United States currently dominates the high performance computer market, in part because of the computer export policy adopted by this Administration in 1995. That policy was carefully crafted and was realistic in designating what could be controlled. The 1995 computer review was a model for how export controls should be approached and adjusted in the Post-Cold War security environment. I have provided recommendations to expand the reports and make them more reflective of this discussion. I ask that you include the following comments in your reports and that you consider our recommended changes to the text.

Thank you again for soliciting the Department's views on the draft reports.

Sincerely,

William M. Daley

Enclosures

Comments and Recommended Changes
GAO Draft Report
"National Security Issues and Foreign Availability for High Performance Computer Exports"

General Comment

While many factors contributed to the decision to liberalize export controls on computers, four major factors stand out -- technological progress, availability, controllability, and the strategic applications of HPCs. Each of these factors play a critical role in determining the viability of imposing export controls on computers at various computing levels. The principal flaw in this study, and its conclusions, is its narrow and selective focus on computer applications and foreign availability.

Rapid Technological Change

Four years ago, the United Sates controlled as "supercomputers" machines with a performance of 195 millions of theoretical operations per second (MTOPS). Today, the average personal computer on a desk is more powerful. We could not afford in 1995 to ignore market trends and technology advancements that were affecting the development of computers. Rapid progress in microprocessor architecture was a critical element. Improvements in microprocessor design made HPCs smaller, cheaper, and faster. Computer chips are produced in the millions in plants in the United States and overseas. A 1995 report prepared by the Institute for Defense Analysis for the Defense Department projected correctly, based on reliable historical trends and industry projections, that microprocessor performance would double by 1997. Performance increases were the result of both improved design and improved manufacturing techniques that continue to drive down the prices of computers, making them more affordable and more practical for an ever-increasing variety of uses. By 1995, rapid advances in microprocessors and software meant that the performance levels once associated with giant machines could be obtained by smaller and relatively inexpensive computers marketed around the world by the tens-of-thousands. HPCs are smaller, cheaper, simpler to install and maintain, and more reliable. These attributes, desirable in the marketplace, constrain our ability to control the export of many HPCs.

Availability of HPCs

The GAO report focuses primarily on foreign availability as it relates to the indigenous production capabilities of foreign producers. This is not an adequate measure of the problem. Foreign availability -- the availability of high performance computers built by foreign manufacturers with foreign parts and technology -- was a key determinant of our export policy during the Cold War. A Cold War concept of foreign availability makes little sense today in determining policy for commodities like computers, given the permeability and increased globalization of markets. Assessments of the global market for computers in 1995 indicated that roughly 25 percent of HPCs were sold outside the United States, primarily to Japan and Europe, with a smaller percentage of exports targeted at East European, Asian, and Latin American markets. In 1994 alone, over a half million HPCs, as they were then defined, were sold

worldwide. Considering a huge installed base of computers, we realized early in our analysis that requiring a license for thousands of HPCs would not prevent their spread.

Controllability

The feasibility of effectively controlling items is an important consideration in the development of export control policy. To set controls in 1995 at a level that could not realistically be enforced would have been irresponsible and hurt U.S. industry when foreign suppliers make comparable products. This is particularly true for systems below 4,000 MTOPS, where European and Japanese manufacturers produce quality systems that can compete with U.S. companies. The Internet has also complicated computer controllability by facilitating the market in used HPCs and making remote access easy. Many Internet sites offer powerful HPCs for resale. This market is accessible to anyone throughout the world. Many of our European allies do not enforce U.S. reexport controls, as they consider them to be extraterritorial. In light of this, we cannot realistically expect to keep the organizations responsible for weapons development in states of concern, organizations that are technically sophisticated, well-funded and which enjoy strong government support, from clandestinely, or even openly, obtaining HPCs with performance levels up to 7,000 MTOPS.

The nature of the computer market has strong implications for export controls, and the Administration took into account the global availability of HPCs and their components in our assessment of those controls. The old style HPC, with its extensive requirements for support equipment and for maintenance, was easily controllable. This is, however, not the case----HPCs. We concluded in 1995 that given the computers that were then available worldwide (taking into account computing power, salability, size, production levels, availability of basic technologies and the number and form of distribution channels), governments could not effectively control the international diffusion of computing systems at the licensing thresholds then in effect. These thresholds were far too low. The 1995 decision to raise control thresholds, and the thresholds associated with that decision, were thus based on a realistic assessment of the ability to control the global distribution of computers.

Applications

In 1995, the Administration concluded, based on a variety of research, that computer power is a secondary consideration for many applications of national security concern. Many national security applications can be performed in a satisfactory manner based on uncontrollable, low-level technology. In our analysis, countries of national security concern cannot threaten U.S. military superiority by gaining access to HPCs below the levels defined by the Administration's 1995 policy. The military services identified only a few high end applications of concern in developing the new policy. Information provided by the Department of Defense as part of the 1995 policy review confirmed the conclusion that most military research and development applications require fewer than 1,000 MTOPS of computational power. Performance levels around 1,000 MTOPS can be achieved with affordable computer systems widely available today.

Computers are not a choke point for military production. The weapon systems found in the U.S. arsenal today -- the tanks, airplanes, weapons, missiles and ships -- were designed and built with computers whose performance was below 1,000 MTOPS -- in many cases with only 500 MTOPS. These were supercomputers in the 1980's, but by 1995 one could find single microprocessors which were more powerful, such as the 64-bit Alpha EV5, individually capable of more than 700 MTOPS of processing power.

Having access to high performance computers alone will not provide improved military-industrial capabilities. The amount of computing power needed to design and manufacture modern weapons, once one exceeds a few hundred MTOPS, is not significant. Other factors -- skill in software design, access to sophisticated manufacturing techniques, experience and test data in weapons design -- are much more important than computer performance. The level of computational power used to develop all the bombs in the current U.S. nuclear arsenal, for example, is less than that found today in many workstations. An HPC is only one piece of the puzzle to create a strategic weapon. There are many other pieces (e.g., knowledge, skill, equipment, etc.) that are essential in the manufacturing process.

See comment 1.

Specific Comments

Page 3, line 9. Replace the first sentence of the 2nd paragraph with the following: "According to the Commerce Department, one key to effective export controls is setting control limits of items of concern above that which is widely available throughout the world. The extent to which an item is available for export from suppliers outside the United States can significantly affect the feasibility of implementing export controls on that item. The widespread availability of computers, via suppliers in Europe and Asia, and via an expanding secondary market easily accessible over the Internet, was recognized early in the decision process as an issue that could not be ignored and one that could severely cripple the implementation of export controls if not set at realistic levels.

"In addition to worldwide availability, which factors in the installed base of computers outside the United States, foreign availability is also capable of influencing export control policy. The Export Administration Act (EAA) describes...."

Page 4, line 17. Amend to read: "... the executive branch did not identify how and at what performance levels specific countries of concern may use HPCs for national defense applications, primarily due to the fact that computers are not a "choke point" for military production. In essence, computers are not essential to defense production efforts -- they primarily provide a quicker means to an end, but are not the solution to the problem. Other factors, such as skill in software design, access to sophisticated manufacturing techniques, and experience are much more important to building a strategic weapon.

Now on p. 8.

Rationale: Factual. There are many factors that are necessary to build a strategic weapon, and a computer is one of the least important ones.

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See comment 2.

Page 5, line 5. Replace the first sentence of the 2nd paragraph with the following: "With regard to foreign availability of HPCs, a number of computer manufacturers exist outside the United States. In addition to subsidiaries of U.S. computer manufacturers, other manufacturers are located in Canada, Japan, Europe, and Asia. In Europe, Germany, France, the United Kingdom and Switzerland indigenously manufacture computers that compete with those of the United States. In Asia, India is a significant producer and capabilities also exist in Taiwan and Singapore, where export controls resembling those of the United States do not exist.

It is important to note, however, that for proliferators, the issue is not a mass market capability to compete with U.S. producers but rather the capacity to make a small number of HPCs, regardless of the costs, to meet national needs. India is a prime example of this situation. In the late 1980's, India sought a HPC from the United States but was denied an export license. Bent on proving that it could still satisfy its computing desires despite our refusals, India invested millions of dollars in the creation of the Param computer. Although the Param is not as sophisticated as U.S. computers, it can provide the processing capability needed for weapons of mass destruction applications. After the introduction of the Param, India publicly stated that it created this capability only after we refused to sell the country an HPC and in order to evade our controls.

Most of the systems indigenously produced in Europe and Asia have computing powers that are less than 5,000 MTOPS to target a portion of the HPC market that is large and affordable. The Japanese have concentrated on manufacturing higher end HPCs that compete directly with those of the United States. Yet, for more powerful HPCs over 5,000 MTOPS, the United States dominates the world market. However, the threat of competition is strong for lower end systems below 5,000 MTOPS, which provides some insight to the types of systems for which the United States is most vulnerable to lose market share if it is unable to compete in the world market. The evidence supports the conclusion that the United States is not a monopolist in this industry. Others have the capability to produce, and will likely improve on this capability if afforded the opportunity to do so. This supports the findings of the 1995 Stanford University study."

Rationale: Not enough attention is given to the existence of foreign producers that have the ability to produce high level computers indigenously These systems are typically not captured by U.S. controls. It is also important to realize that the computer market is driven largely by demand. If the United States does not supply computers at satisfactory levels, foreign producers will pick up the slack.

See comment 2.

Page 7, line 12. Following ".... according to the DOE report." insert, "It is important to note, however, that prior to the President's 1995 decision to liberalize computer export controls, India had already developed the Param HPC. Research and information from U.S. Government sources and U.S. computer manufacturers indicate that Param computing capabilities range from 4,000 MTOPS to 10,000 MTOPS of performance power."

4

Rationale: Factual.

See comment 3.

Page 8, line 15. Add a new 2nd paragraph as follows: "Worldwide availability of computers, however, indicates there is a large installed base of systems with availability in the tens of thousands and even millions for smaller systems. This complicates and severely limits the ability of the U.S. Government to control the export of all computers effectively. License requirements will not prevent diversion of HPCs unless realistic control levels are set that can be enforced effectively."

Rationale: The installed base of computers worldwide also plays an important role in the consideration of the availability of computers outside the United States.

See comment 4.

Page 10, line 2. Following "U.S.-origin goods." insert, "The United Kingdom Government's authorities instruct their exporters to ignore U.S. reexport controls. The European Union believes our reexport controls are extraterritorial and therefore most EU countries will not enforce them. These facts support the findings of the Stanford University study with regard to the difficulty of controlling computers effectively throughout the life of the product."

Rationale: Factual.

See comment 2.

Page 11, line 10. Insert at the end of the 2nd bullet: "Research and information from U.S. Government sources and U.S. computer manufacturers indicate that Param computing capabilities range from 4,000 MTOPS to 10,000 MTOPS of performance power.

Rationale: Additional factual evidence. The Param system has been reported to be more powerful than the GAO report reveals.

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The following are GAO's comments on the Department of Commerce's letter, dated August 7, 1998. Commerce provided one set of written comments for this report and for a companion report, in which we discuss our analysis of the basis for the 1995 executive branch decision to revise export controls for HPCs.[1] We addressed Commerce's general comments relevant to this report on page 9 and its specific comments below.

GAO Comments

1. Commerce stated that one key to effective export controls is setting control limits of items of concern above that which is widely available throughout the world. However, this wording is a change that contrasts with documentary evidence previously provided to us and to the Congress. In successive Export Administration Annual Reports, the Commerce Department stated that "the key to effective HPC export controls is setting control levels above foreign availability. . ." In addition, Commerce has provided us with no empirical evidence to demonstrate the "widespread availability" of HPCs, either through suppliers in Europe and Asia or a secondary market.

2. Commerce commented that a number of foreign manufacturers indigenously produce HPCs that compete with those of the United States. Our information does not support Commerce's position on all of these manufacturers. For example, our visit to government and commercial sources in Singapore indicated that the country does not now have the capabilities to produce HPCs. We asked Commerce to provide data to support its assertion on foreign manufacturers, but it cited studies that were conducted in 1995 and that did not address or use criteria related to "foreign availability." As stated in our report, we gathered data from multiple government and computer industry sources to find companies in other countries that met the terms of foreign availability. We met with major U.S. HPC companies in the United States, as well as with their overseas subsidiaries in a number of countries we visited in 1998, to discuss foreign HPC manufacturers that the U.S. companies considered as providing foreign availability and competition. We found few. Throughout Europe and Asia, U.S. computer subsidiary officials stated that their competition is primarily other U.S. computer subsidiaries and, to a lesser extent, Japanese companies. In addition, although requested, Commerce did not provide documentary evidence to confirm its asserted capabilities of India's HPCs and uses.

[1]Export Controls: Information on the Decision to Revise High Performance Computer Controls (GAO/NSIAD-98-196, Sept. 16, 1998).

3. Commerce stated that worldwide availability of computers indicates that there is a large installed base of systems in the tens of thousands or even millions. Commerce further stated that license requirements will not prevent diversion of HPCs unless realistic control levels are set that can be enforced effectively. While we agree, in principle, that increasing numbers of HPCs makes controllability more difficult, as our recommendation in our companion report suggests, a realistic assessment of when an item is "uncontrollable" would require an analysis of (1) actual data, (2) estimated costs of enforcing controls, and (3) pros and cons of alternatives—such as revised regulatory procedures—that might be considered to extend controls. Commerce did not perform such an analysis before revising export controls in 1995. In addition, although we requested that Commerce provide documentary evidence for its statement that there is a large installed base of HPCs in the millions, it did not provide such evidence.

4. Commerce stated that most European governments do not enforce U.S. export control restrictions on reexport of U.S.-supplied HPCs. We agree that at least those European governments that we visited hold this position. However, although requested, Commerce provided no evidence to support its statement that the government of the United Kingdom has instructed its exporters to ignore U.S. reexport controls.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

DEFENSE TECHNOLOGY SECURITY ADMINISTRATION
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Mr. Benjamin D. Nelson
Director, International Relations and Trade Issues
National Security and International Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Nelson:

Thank you for the opportunity to comment on the General Accounting Office (GAO) draft reports, "More Information Needed for Decision to Revise High Performance Computer Controls" and "National Security Issues and Foreign Availability for High Performance Computer Exports," dated July 1998 (GAO/NSIAD-98-196 and 200/OSD Case # 1648/1648-A). The Department of Defense has reviewed the reports and has the following comments:

- The Stanford University study referred to in the GAO report was just one of many inputs considered by the Executive Branch in its 1995 assessment of computer export controls. Information and analysis was also provided by various Defense components as well as other USG agencies, including the Intelligence Community.

- The GAO draft report inaccurately states that DoD did not consider the threats associated with high performance computer (HPC) exports. DoD did take into account the security risks associated with the export of HPCs to countries of national security and proliferation concern. DoD identified numerous national security applications that require various levels of computing power, which helped to determine licensing policies for the various country groups and to establish specific safeguards on computer exports. Countries of greatest national security and proliferation concern are subject to the most stringent licensing and safeguard requirements.

- The GAO recommends that the Secretary of Defense assess how and at what performance levels countries of concern use HPCs for military modernization and proliferation activities. These factors were taken into account by DoD and the interagency process in the 1995 review of computer export controls, and will be part of any future review. As pointed out in the Stanford University study, there are a wide

variety of national security applications that can benefit in one form or another from computers with performance levels well below current thresholds for export licensing. For example, the F-117 military aircraft was designed, developed, and produced using computers well below 500 million theoretical operations per second. However, it is equally important to assess the degree of controllability of computers. In the 1995 computer export control review, we determined that computers with performance below the current license threshold for Tier III countries are widely available globally and are easily scalable so that attempts to control them would be ineffective. In short, the President decided in 1995 on a system of graduated controls that reflects both the controllability of computers at various thresholds and the national security/proliferation risks for each destination.

- The GAO recommends that the USG consider certain additional options to safeguard exports of high performance computers. The Administration will be conducting a review of computer controls and these suggestions will be considered in the course of that review.

If you have any questions, please contact Dr. Oksana Nesterczuk or Mr. Richard Soskin of my staff at (703) 604-8038.

Sincerely,

Dave Tarbell
Director

The following is GAO's comment on DOD's letter dated July 16, 1998.

GAO Comment

1. DOD provided one set of written comments for this report and for a companion report, in which we discuss our analysis of the basis for the 1995 executive branch decision to revise export controls for HPCs.[1] We addressed DOD's comments relevant to this report on page 8.

[1]Export Controls: Information on the Decision to Revise High Performance Computer Controls (GAO/NSIAD-98-196, Sept. 16, 1998).

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