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HIGH PERFORMANCE COMPUTER EXPORT CONTROLS

HEARING

BEFORE THE

COMMITTEE ON
GOVERNMENTAL AFFAIRS
UNITED STATES SENATE

ONE HUNDRED SEVENTH CONGRESS

FIRST SESSION

MARCH 15, 2001

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THURSDAY, MARCH 15, 2001

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HIGH PERFORMANCE COMPUTER EXPORT CONTROLS

THURSDAY, MARCH 15, 2001

U.S. SENATE,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, DC.

The Committee met, pursuant to notice, at 9:35 a.m., in room SD–342, Dirksen Senate Office Building, Hon. Fred Thompson, Chairman of the Committee, presiding.

Present: Senators Thompson, Collins and Bennett.

OPENING STATEMENT OF SENATOR THOMPSON

Chairman THOMPSON. Good morning. The Committee will come to order, please. I would welcome everyone to the hearing this morning, of the Committee on Governmental Affairs, to assess recent changes to our export control policy with regard to high-performance computers. I will have a statement that I will make a part of the record, and Senator Bennett, you or any others, if you have any statements, we will make those a part of the record.

I think, rather than read my statement, I will just briefly state the reason why we are here this morning and a little bit of the background. It seems to me like there are two or three very important things that are converging here. One is our increased concern about proliferation. We can hardly pick up the paper nowadays without reading about a new agreement between Russia and Iran, something Iraq is doing, or something North Korea has done, and wondering whether or not they will stop.

Most serious commentators on the subject say that the proliferation of weapons of mass destruction is the biggest threat that this country faces. More and more, it has become obvious that a couple of the main sources for these items, some of which are dual-use items, some of which are missile parts, some of which have to do with nuclear technology, some of which have to do with nuclear power plants, all of that, bits and pieces and parts, some of which we know, a lot of which we probably do not know, are coming from China and Russia. We get our biannual intelligence reports that remind us time and time again, year after year, that proliferation is a very big problem; that the world's greatest suppliers of the rogue nations are China and Russia.

Another phenomenon that has taken place is our appreciation for the fact that high-performance computers are dual-use items, and can play a part in this problem. The Cox Report pointed out that it was possible, first of all, that high-performance computers have many military applications, that it is possible that these computers

have been diverted for unauthorized uses by other countries, which could include the following, and they list several things here: Upgrading and maintaining nuclear and chemical weapons; equipping mobile forces with high-technology weapons; building a modern fleet of combat aircraft and submarines; conducting anti-submarine warfare; developing a reliable, accurate ballistic cruise missile force; improving command and control communications; and that there have been instances where the People's Republic of China has used high-performance computers for nuclear weapons applications, nuclear weapons design, using them to improve and maintain their nuclear weapons, and on and on and on.

Recognizing the proliferation problem, and recognizing the sensitivity of high-performance computers as one of the things that could be used in the proliferation activity, and recognizing that one of our major new trading partners, China, was doing things with them for the inherent activity of improving their nuclear stockpile and so forth. This was troublesome to us, and that their side activity of handing off technology and other things to rogue nations. As a result, Congress, in 1998, as a part of the Defense Authorization Act, said that when we as a Nation—the Department of Commerce particularly—that when you look at these high-performance computer export situations, that Congress needs to be involved in the process.

We use MTOPS levels in this country, and without getting into too much detail, it has to do with the computing power of these machines. And we have had a regime in this country for some time now that related our export policies with regard to these high-performance computers to that MTOPS capability. That has come under question now and we will be talking about that today, but that has been our policy; the idea being that the greater the MTOPS level, the greater the power of the machine and the more likely it would be for China, for example, to utilize this capability—for example, their nuclear weapons production enhancement.

Without testing, it is very important to nuclear weapons countries, for example, to be able to simulate tests, improve their stockpile, maintain their stockpile. We do that. They do that. High-performance computers assist you in doing that; many applications that the Cox Report and others have pointed this out. So, an additional phenomenon to add to this story is that we have greatly liberalized our export policy with regard to high-performance computers over the last few years.

Again, we will get into a discussion of whether or not that is wise or not, but there is no question that that has happened. Within 1 year, the MTOPS level went from 2,000 to 85,000 under President Clinton's directives. So, backing up a bit, in 1998, Congress, looking at all this, says that when you raise those MTOPS levels, you need to make an assessment as to what this is doing to national security, if anything. You need to make an assessment as to the foreign availability of these things. You need to make an assessment and report to Congress as to the military applications of high performance computers at the increased level.

In other words, I might have an opinion on whether MTOPS is a smart way to go. You might have a different opinion. But let's really do an assessment as to the significance of what it is that we

are about to do. Well, we now have kicked in at the 85,000 level. Under President Clinton's directives, we no longer have the notification requirement that we had before. We have abrogated a notice requirement that used to kick in at below the MTOPS level.

Even though you might not need a license to export a high-performance computer, at least we want to know; we want to be able to have an audit trail at a lower level, and that was the way we operated up until just recently. The MTOPS levels kicked in. The notice requirement will kick in shortly. So now we are at the 85,000 level with no notice requirement for any computer exports less than the 85,000 MTOPS level. So we are saying at that level, Mr. Exporter, we not only do not need you to have a license, we do not need to know what you are doing for our audit purposes or whatever.

And this is at a time, incidentally, and the Cox Report points this out, that our post-shipment verification situation is virtually nil. I think for a long period of time we had one post-shipment verification of a Chinese supercomputer. Then, there have been some more since then, but they would not even let us in there to check for a long period of time. That is the background of what we are doing here. With that, the President makes his report. The 2001 law required that the GAO take a look at the President's report and to give Congress an opportunity to look—a very brief opportunity, I might add—quickly look and see what the GAO says about the President's report in order for Congress to have a chance to act if it wanted to.

That is what we are about here today. The President has made his report. It is obvious that the President's report does not make an assessment as to all of the military applications that we know are out there, and it is clear that the President's report has not made an adequate determination or assessment in terms of the national security implications of what has just been done. That is what this is about, within the context of a much broader debate that we have had going on for some time now and will continue, I'm sure. It is the assessment of the President's report in compliance or lack of compliance with the 1998 Defense Authorization Act, which required the President—you have got the right, Mr. President—to raise these MTOPS levels. You have got the right to cut off the notice below the 85,000 level, if you want to, but tell Congress what the significance of that is, so we are not flying blind.

My conclusion is that we are still flying blind, and that we do not have anyone in this Nation who has made an independent, unbiased assessment of the significance of our greatly liberalized export policy with regard to dual-use items and, in particular, high-performance computers. My colleague, Senator Bennett, here, will eloquently point out that the genie is out of the bottle and everybody has got everything, etc. He may be right, but we have 100 folks around here with 100 different opinions about that. What I am interested in is having professionals, having folks who know this stuff to take a look at it and make a determination and recommendation to us as to whether or not MTOPS are outmoded. If so, what does that mean, that we abandon everything? I think clearly not.

There is a lot of potential other things that we can do. Nobody has taken a look at them. So, we continue, because nothing is exploding at the moment, we continue to go down the same path blindly, each of us, with our various opinions as the extent of which we ought to control or decontrol, or regulate or deregulate, with industry pounding on our doors every day, trying to liberalize export controls further, arguing that there is no need to try to control anything, ever, anymore, anywhere. We are talking about Tier 3 countries here. If really you cannot control anything anymore, why control Tier 4 countries? Why not go ahead and send computers to Syria and Libya, if, in fact, there is nothing we can do at any stage? So those are the issues that we have here today.

[The prepared statement of Chairman Thompson follows:]

PREPARED STATEMENT OF SENATOR THOMPSON

Good Morning. Today, the Governmental Affairs Committee is holding a hearing on the recent changes to our export control policy with regard to high performance computers. These changes were made by former President Clinton in January 2001, before he left office.

High-Performance Computers (or HPCs) represent a special challenge for our export control regime, because in many ways they are the King of "dual-use" technologies—that is, technologies that are subject to national security export controls because they are easily usable for important civilian purposes as well as dangerous military ones. High performance computers are particularly sensitive because they are enabling technologies that have important applications to national security. HPCs can be used to design more powerful nuclear weapons, more capable ballistic missiles, quieter submarines, and high performance jet aircraft. Computers are critical to our intelligence agencies. They are used in cryptology, reconnaissance satellites, and electronic eavesdropping. High performance computers are also key to modern warfare. They are used in precision-guided munitions, theater missile defense, battle management, and information superiority. In short, computers are the technical keystone of our national security apparatus; they are also important to our potential adversaries.

Given the military importance of high performance computers, and reports at the time that foreign entities had illegally acquired U.S.-made HPCs for military purposes, the Congress inserted language into the FY 1998 National Defense Authorization Act that was designed to strengthen HPC export controls. Among other things, this legislation required the administration to provide a report to the Congress on three factors when proposing a modification of the export control notification thresholds for high performance computers. First, the report is to address the availability of high performance computers from other countries. Second, it is to address all potential uses of military significance at the new control thresholds. And third, the report is to assess the impact of such uses on U.S. national security interests. It is important to note that the purpose of the law was not to fetter international trade or hurt the computer industry, but to ensure that the government conducted a thorough assessment of the risks and reasons underlying any change to our HPC export control policies.

Two years later, the Cox Committee stated in its July 1999 report that the Peoples' Republic of China was diverting U.S.-built HPCs for unlawful military applications. Specifically, it was using American-made computers to design, model, test, and maintain advanced nuclear weapons. The committee clearly stated that "The illegal diversion of HPCs for the benefit of the PRC military is facilitated by the lack of effective post-sale verifications of the locations and purposes for which the computers are being used. HPC diversion for PRC military use is also facilitated by the steady relaxation of U.S. export controls over sales of HPCs." The committee added that U.S.-origin HPCs had been obtained by PRC organizations involved in the research and development of missiles, satellites, spacecraft, submarines, and military aircraft, to name a few.

Despite this report and others, the Clinton Administration further relaxed export controls on high performance computers. In January 2000, the licensing threshold for HPCs was set at 2,000 MTOPS. Over the course of a year additional changes were made—including removing distinctions between civilian and military end-users—culminating in the January 2001 decision to raise the licensing level to

85,000 MTOPS—over a 40-fold increase in a 12-month period! These changes, and others, were made to our HPC export control policies without conducting a thorough national security risk assessment. I might add that a risk assessment not only would have been the responsible and prudent thing to do, it was required by law.

It also appears that the Clinton Administration couldn't justify these changes on economic and commercial grounds. HPCs of similar capability are not "foreign available" despite industry claims that they are "widely available." Additionally, while the administration and industry cited computer "clustering" and other techniques as making computer controls ineffective, we will hear otherwise today from the General Accounting Office. Even the Cox Committee reported 2 years ago that "while the PRC might attempt to perform some HPC functions by other means, these computer work-arounds remain difficult and imperfect."

Surprisingly, however, little money appears to be at stake in the decisions over HPC export controls to China and other Tier 3 countries. Let me be clear. HPCs can be sold license-free to most countries in the world. With regard to Tier 3 countries—China, India, the former Soviet Union, all of the Middle East, Vietnam, and most of Eastern Europe—computers under 85,000 MTOPS can be sold license-free. Computers over 85,000 MTOPS require a license, but even then, over 90% are approved for sale. HPCs cannot be exported to any of the rogue states. In short, given that sales to tier 3 countries represent less than 10% of all HPC sales abroad, and HPC sales don't appear critical to the economic health of most U.S. computer companies, it is hard to justify the national security risks simply to sell a few hundred more of them to China and other "high risk" destinations. It is even more difficult to believe the computer industry's argument that the U.S. military will be harmed if U.S. firms can't reinvest these marginal profits gained from Tier 3 sales back into R&D programs that might produce military-ready "off the shelf" technology. According to this line of reasoning, the United States must jeopardize its national security in order to improve its national security. This makes little sense.

The bottom line is that the computer industry is not concerned about current sales because these sales are not as significant as we were led to believe; however, the industry is concerned about future sales. Any government efforts to regulate the sale of HPCs on national security grounds is summarily and automatically rejected. The problem with this approach is that our country faces serious threats today. Despite the fact that the Cox Committee identified several alternative methods to safeguard U.S.-made HPCs, the bipartisan Deutch Commission made several recommendations to strengthen our export control regime, and the GAO recently listed nearly a dozen alternatives to the current MTOPS metric, we can't seem to find any consensus within the government or private sector that export controls on computer hardware are either needed or effective. I strongly disagree.

Given sufficient political will, ingenuity, and leadership, I am confident that we can find a system that accommodates commerce while protecting our national security. The first step in that process, however, is finding an honest broker that can conduct the research, present the facts, outline the costs and benefits, and analyze the risks to our national security and economic prosperity of each policy option. I am confident we will hear from such an honest broker today when we hear from the GAO.

The Committee has been closely involved with nonproliferation policy and export control issues for many years. In legislation passed by the Congress last year at my urging, the General Accounting Office was tasked to assess the President's compliance with the reporting requirements outlined in the FY 98 NDAA, and to evaluate the adequacy of the stated justification for any proposed changes to HPC export controls. This hearing, therefore, will ask the GAO to report on its findings pursuant to these taskings.

I look forward to hearing today, therefore, from our witnesses, who can shed some much-needed light on the complex, yet critical, issue of high performance computer export controls.

Senator THOMPSON. Senator Bennett.

OPENING STATEMENT OF SENATOR BENNETT

Senator BENNETT. Thank you, Mr. Chairman.

Chairman THOMPSON. Would you like to state your own case?

Senator BENNETT. Well, my case is not that much different from yours. The only other item that I would put on the record before we hear from the witnesses is that other countries have been involved in the manufacture of these same devices. Particularly,

when you get into the issue of MTOPS, which are a function of the speed and excellence of individual chips—there are individual chips being manufactured in France, Japan, Germany, and, interestingly, China itself, that have the same computing power of some of the chips that we previously sought to control.

Part of the problem facing American manufacturers is that if we restrict them from exporting into the world, on the basis that some of their products can be used by these rogue countries, we also cut them out of competing in the world in benign areas, with other countries who have the ability to manufacture the same level of capability that we have. The Chinese will use their own chips, instead of ours, to do some of the things that we might not want them to do. Then, with that same manufacturing capability, come into our markets, take our markets away from us, and we have, therefore, accomplished little or nothing in terms of our concern.

Aside from putting that statement into the record, Mr. Chairman, I agree with you completely that the proliferation of weapons of mass destruction is the most serious challenge we face in the world today, in terms of our national security, and I welcome your initiative in getting the GAO involved in doing an analysis and study of this. As I said, we may not be quite as far apart as you might think or as we may have appeared to be in the past.

Chairman THOMPSON. Thank you very much.

Senator Collins, do you have an opening comment.

OPENING STATEMENT OF SENATOR COLLINS

Senator COLLINS. Thank you very much, Mr. Chairman. I first want to thank you for holding this hearing on this very important issue on which you have been a real leader in the Senate.

It is often observed that we live today in the information economy, one in which our individual and collective economic success depends increasingly upon the ability of computer systems to store and retrieve data, to control sophisticated manufacturing processes, to perform complex mathematical calculations, and to connect us together, seamlessly, without regard to the bounds of geography. Ever faster computer processing power is, in many respects, the backbone of this information economy. As a result, the health of our computer industry, which currently leads the world, should be of very great concern to all of us. At the same time, however, we cannot forget that the very processing speed that makes computers so useful in the private sector also makes them crucial enabling technologies for advanced military developments.

The atomic bomb was designed by scientists using slide rules, and it only took a comparatively primitive computer to design the first Stealth bomber. The sophisticated weapons systems of tomorrow and the complex command and control schemes into which they will all be fitted, however, require state-of-the-art technology. For countries seriously attempting to take advantage of what many military theorists have described as the information-driven revolution in military affairs now underway, acquiring more and better high-performance computers is an absolute necessity. We encourage such developments in potential adversary countries only at our great peril. High-performance computers are, thus, the classic dual-

use technology. They are, indeed, useful for numerous legitimate purposes, but they can be very dangerous in the wrong hands.

The same computing power that can model complex atmospheric weather patterns on a continental scale, for example, might be just as useful in modeling critical aspects of a nuclear explosion, perhaps thus helping a country improve its nuclear stockpile or develop sophisticated nuclear weapons without telltale test explosions.

This is the source of the real tension in national security export control law. To be sure, export control restrictions can do real harm to high-tech, highly competitive sectors of our economy, by making overseas sales slower, more difficult and less certain, ceding ground to our foreign competitors. At the same time, however, it is imperative that our understandable eagerness to promote commercial sales not lead us to permit American companies to help arm actual or potential foreign adversaries.

That is why today's topic is so interesting. We saw the actions taken by the previous administration, which I am describing in some detail in my statement, and which I would ask be put within the record in the interest of time. This is clearly a significant issue and it is one that Chairman Thompson has been closely involved with for some time. As a Member of this Committee myself and as a new Member of the Committee on Armed Services, I feel strongly that we can strike an appropriate balance.

So, with that, Mr. Chairman, I would ask that the remainder of my statement be included in the record and I look forward to the hearing today.

[The prepared statement of Senator Collins follows:]

PREPARED STATEMENT OF SENATOR COLLINS

It is often observed that we live today in an "Information Economy," one in which our individual and collective economic success depends increasingly upon the ability of computer systems to store and retrieve data, to control sophisticated manufacturing processes, to perform complex mathematical calculations, and to connect us seamlessly together without regard to the bounds of geography. Ever-faster computer processing power is in many respects the backbone of this information economy. As a result, the health of our computer industry—which currently leads the world—should thus be of very great concern to all of us.

At the same time, however, we cannot forget that the very processing speed that makes computers so useful in the private sector also makes them crucial "enabling technologies" for advanced military developments. The atom bomb was designed by scientists using slide rules, and it took only comparatively primitive computers to design the first Stealth bomber. The sophisticated weapons systems of tomorrow and the complex command-and-control schemes into which they will be fitted, however, require the state of the art. For countries seriously attempting to take advantage of what many military theorists describe as the information-driven "Revolution in Military Affairs" now getting underway, acquiring more and better high-performance computers is an absolute necessity. We encourage such developments in potential adversary countries only at our great peril.

High-performance computers are thus the classic "dual-use" technology: They are useful for innumerable legitimate purposes, but they can be very dangerous in the wrong hands. The same computing power that can model complex atmospheric weather patterns on a continental scale, for example, might be just as useful in modeling crucial aspects of a nuclear explosion—perhaps thus helping a country improve its nuclear stockpile or develop sophisticated thermonuclear weapons without tell-tale test explosions.

This is the source of the real tension behind national security export control law. To be sure, export control restrictions can do real harm to high-tech, highly-competitive sectors of our economy by making overseas sales slower, more difficult, and less certain—ceding ground to our foreign competitors. At the same time, however, it is

imperative that our eagerness to promote commercial sales not lead us to permit American companies to help arm actual or potential foreign adversaries.

This is why today's topic is so interesting. On several occasions, the previous administration saw fit to dramatically loosen the export control restrictions that govern sales of high-performance computers to so-called "Tier 3" countries such as Russia and the People's Republic of China. Last year, in fact, the Clinton Administration eliminated the distinction between "civilian" and "military" end-users for Tier 3 computer sales—with the effect that military research laboratories and intelligence agencies in these countries can now freely buy American computers at the same high performance level at which we permit license-free sales for less dangerous end-user such as banks or hospitals. Moreover, the performance level of computers available without any export license at all has steadily been raised in lockstep not with the actual availability of such equipment from foreign competitors but rather with the American computer industry's anticipated marketing strategy for ever more powerful processors.

Less than 2 years ago an export license was required in order to sell computers to military end-users in a country such as Russia or China at performance levels of more than 2,000 Million Theoretical Operations Per Second (MTOPS). This, I should emphasize, did not mean that sales above that level were barred—merely that in order to sell such a computer to such an end-user, one had to obtain permission from the U.S. Government, which reserved the right to object on national security grounds. As of January this year, however, the export license threshold level stood at 28,000 MTOPS. With President Clinton's last minute decision on January 18, 2001 to implement yet another loosening of export controls, this level is rising to 85,000 MTOPS. That amounts to more than a 40-fold increase in less than 2 years! Some of these changes, moreover, have been made over the objection of our allies and in violation of our government's commitment to observe export licensing levels agreed upon by the multilateral Wassenaar Arrangement headquartered in Vienna.

These have been remarkable changes. But have the previous administration's dramatic relaxation of computer export controls managed to strike an appropriate balance between commerce and security? Disturbingly, it is remarkably hard to tell. The unanimously-adopted Cox Report of 2 years ago discussed some of these issues in one of its chapters, warning of the many military uses to which the PRC is putting high-performance computers purchased from the United States. Press accounts have also reported the appearance of U.S. machines in Russian nuclear weapons design laboratories—an occurrence about which the head of Russia's weapons program actually boasted publicly. Remarkably, however, a thorough assessment of the national security implications of specific decisions to loosen computer export controls has never been done.

This is very troubling. Despite repeated GAO studies and Congressional hearings highlighting this fact and urging corrective action, not one of the previous administration's repeated relaxations of computer export control thresholds was accompanied by a serious analysis of the national security implications of the change. Fortunately, Congress saw fit last year to require such a national security assessment by GAO. Our witnesses today will present us with the GAO's findings pursuant to this Congressional requirement.

According to conference report language adopted late last year, Congress expects that GAO will provide an assessment of the adequacy of the stated justifications for a change in computer export license threshold levels, as well as an evaluation of this change's likely impact upon our national security and foreign policy interests, the security of our friends and allies, upon multilateral regimes such as Wassenaar, and upon our nonproliferation policy. That is quite a tall order, but I have great faith in our experts who join us from GAO today. This is apparently the first time such factors have ever formally been assessed in connection with a change to computer licensing rules, so I am pleased that this Committee is providing this opportunity for them to testify.

This is clearly a significant issue, and one with which Chairman Thompson has been closely involved for some time. As a Member of this Committee for some time, and as a new Member of the Armed Services Committee, I feel that it is possible to strike an appropriate balance between commerce and security. Today's hearing will contribute to these debates in important ways, and should help ensure that these national security issues receive the attention they deserve. I look forward to hearing the testimony of our witnesses.

Thank you, Mr. Chairman.

Chairman THOMPSON. Without objection, it will be made a part of the record. Thank you very much, Senator.

At this time I would like to recognize our panel. We are pleased to have three witnesses with us today from the General Accounting Office, Dr. Susan Westin, Managing Director of International Affairs and Trade Division. She will present the GAO's findings with regard to former President Clinton's January 2001 changes to the United States high-performance computer export control policy.

Dr. Westin will be joined by Steve Lord, Assistant Director of the International Affairs and Trade Division, and Jeff Phillips, a senior analyst also in the International Affairs and Trade Division. I would like to read the resumes of all you folks. It would be extremely impressive, I assure you, if you have not already read them, but unless you insist, we will just skip those and just say that you are, obviously, highly qualified in these very technical, complex areas. We thank you for being with us today.

Dr. Westin, would you please proceed with your testimony?

TESTIMONY OF SUSAN S. WESTIN,[1] Ph.D., MANAGING DIRECTOR, ACCOMPANIED BY STEPHEN M. LORD, ASSISTANT DIRECTOR, AND JEFFREY D. PHILLIPS, INTERNATIONAL SECURITY ANALYST, INTERNATIONAL AFFAIRS AND TRADE DIVISION, U.S. GENERAL ACCOUNTING OFFICE

Ms. WESTIN. Yes, thank you, Senator. Mr. Chairman, I ask that my entire written statement be put into the hearing record, but I will just summarize my remarks.

Chairman THOMPSON. Without objection.

Ms. WESTIN. I am pleased to be here today to discuss export control issues for high-performance computers. As you know, export controls continue to be a contentious part of our national security debate. Over the past several years, there has been continuing congressional concern over the rationale for revising these controls, and their effect on our national security.

U.S. policy with respect to the export of high-performance computers seeks to balance the national interest in promoting economic growth in trade against the essential national security requirement to prevent the proliferation of technologies related to weapons of mass destruction, missiles, and advanced conventional weapons. The United States has long controlled the export of high-performance computers to sensitive destinations, such as Russia and China. Recent technological advancements in computing power have been rapid. The regulations for high-performance computer control thresholds are currently based on a computer's composite theoretical performance, as measured in millions of theoretical operations per second, or MTOPS.

We recently reported that the growing ability of other countries to cluster lower performance computers has made the current computer export control system ineffective in limiting countries of concern from obtaining high-performance computing capabilities for military applications. In that report, we also reported that MTOPS is an outdated and invalid means for determining whether individual high-performance computers should be licensed for export.

On January 10, 2001, President Clinton announced a significant relaxation in export control licensing and notification thresholds for

[1] The prepared statement of Ms. Westin appears in the Appendix on page 23.

high-performance computers, and a proposal to eliminate almost all controls on exports of computer hardware. Today, I will first discuss our evaluation of the President's justification for changing the computer control thresholds. I will then turn to our evaluation of the support of the President's policy proposal to shift the emphasis of controls from hardware to software controls. Finally, I will discuss some of the implications of these changes.

The main message of my testimony this morning is that the inadequate justification for the relaxation of export controls for high-performance computers demonstrates the need for a comprehensive study of export controls. As we have previously recommended, a panel of experts is needed to conduct a comprehensive assessment of available options to address weaknesses of computer export controls, as well as to determine what U.S. countermeasures might be necessary to respond to computer-related enhancements of military or proliferation capabilities in sensitive countries.

Turning to the first point, the President's January 2001 changes in the export control thresholds for high-performance computer exports are not adequately justified. While the President's report recognizes that high-performance computing capabilities will become increasingly available to other countries through computer clustering, the report fails to address all militarily significant uses for computers at the new thresholds, and assess the national security impact of such uses as required by law. The inadequacies of the President's report are further compounded by continued use of a flawed measure, MTOPS, for assessing computer performance.

Second, the President's policy proposal for relaxed U.S. computer controls also is not adequately supported. Although the new policy was based on a conclusion that computer hardware exports can no longer be controlled, the Executive Branch has failed to adequately assess alternative control options. In addition, the new policy would focus more attention on using new software controls to protect U.S. national security interests, even though such controls have yet to be identified and developed.

Finally, we identified several implications of the changes to the control thresholds and the proposed change in U.S. computer export control policy related to increased risk for U.S. national security. I would like to emphasize three of these implications. The first implication is that the inadequacies of the President's justifications again demonstrate the need for a comprehensive study of the issues involved. In our December 2000 report on high-performance computers, we recommended that Executive Branch agencies comprehensively assess ways of addressing the shortcomings of computer export controls, including the development of new performance measures and of countering the negative effects on U.S. national security of increased availability of high-performance computing. Although the Departments of Defense and Commerce did not agree with this recommendation, we believe this recommended course of action is still valid. Without such a comprehensive study, the United States will not be prepared to fully assess and mitigate the risks that it may face by revising U.S. high-performance export controls.

The second implication is that the new rules effectively eliminate prior U.S. Government review of any computer exports below the

licensing threshold to sensitive countries. The National Defense Authorization Act of 1998 requires computer exporters to notify the Commerce Department in advance of any proposed high-performance computer exports to sensitive countries, such as China, Russia and India that pose a concern for military or proliferation reasons.

Since the threshold for notifications was set lower than the threshold for licensing, it served as a tripwire for triggering advanced U.S. Government review of exports to potentially sensitive end-users. Under this procedure, exporters must apply for a license if any Executive Branch agency in the licensing process objects to a proposed computer export. Next week, the threshold for notification takes effect at 85,000 MTOPS. This will be the first time that the notification threshold is the same as the licensing threshold for computer exports to sensitive countries.

In the past, the notification threshold lower than the licensing threshold allowed the U.S. Government to deny or defer some exports, or make other exports conditional on additional safeguards. There were over 3,700 notifications of intent to export computers between February 1998 and September 2000. Of the 204 notifications that required subsequent license applications, 165 were not approved, while the remaining 39 were approved with conditions. Reasons for non-approval included concerns over end-users.

Admittedly, only a small percentage of the notifications were not approved for licenses to export. Commerce and Defense officials point to this small percentage as evidence that the notification process has not been useful. However, we are not able to assess the significance of the non-approved licenses, in part because of lack of the national security analysis of the impact of these exports to sensitive countries.

The third implication is the U.S. Government will have to rely more heavily on computer vendors to know your customers, and assess their intentions to use computers for proliferation purposes. Past evidence has shown this reliance may be misplaced. In summary, we recognize the need for U.S. policy on the export of sensitive technology to balance economic and trade interests against national security interest. However, the justification for relaxing the export controls did not address all computer uses of military significance, to which high-performance computers could be applied at the new thresholds, and did not assess the national security impact of such uses. The lack of justification makes it difficult to determine if the appropriate balance between economic interest and national security interests has been achieved.

Mr. Chairman, Members of this Committee, this concludes my prepared remarks. My colleagues and I will be pleased to respond to any questions you may have.

Chairman THOMPSON. Thank you, Dr. Westin. I appreciate that very much and I especially appreciate GAO's attention to this in a short period of time. The legislative framework that we set up for your getting involved and doing this was short, and our review period is short. In fact, I think we have to act by tomorrow as a Congress, and I think the whole process is very deficient in my mind, but it is what it is, and you are doing your part and we are trying to do ours.

Let me see if I can basically summarize your testimony and see if I am accurate. First, is that with regard to three basic requirements under the 1998 Defense Authorization Act, that two of those requirements were not fulfilled, or were deficient in the President's report; that is, the requirement to assess the military applications and the other requirement to assess the national security implications. Is that basically correct?

Ms. WESTIN. That is right, the justifications that were to be included, according to the NDAA, were not there.

Chairman THOMPSON. All right. Also, next week will be the first time that the notification level is the same as the license level at 85,000 MTOPS. Is that correct?

Ms. WESTIN. That is right.

Chairman THOMPSON. And you point out the significance of that, in that in times past notification has been lower, and we have been able, as a country, to catch some, presumably, that should not be approved that, otherwise, would have been approved had it not been for a lower notification level. You mentioned 165, I believe, licenses were denied that otherwise, presumably, would have been approved.

Ms. WESTIN. Yes, Senator, 165 were not approved. I think it is 12 that were outright denied and the others were returned without action.

Chairman THOMPSON. Sometimes I think that is done for national security purposes and people do not want to talk about, in too much detail, why they are doing what they are doing. They just do not get their license. You also say that you believe that the MTOPS metric is no longer very useful in making these determinations, primarily, as I take it, because of the clustering capability that countries have now. Is that basically correct? I know I am paraphrasing.

Ms. WESTIN. That is basically right, that it is an outdated measure.

Chairman THOMPSON. It is an outdated measure. I am also correct, though, in concluding that you are not suggesting that, therefore, we should have no measure, or that we should have no control; are you?

Ms. WESTIN. No, definitely, that is not part of our conclusion, nor, Senator, are we concluding that 85,000 MTOPS is an appropriate level or not an appropriate level. Our analysis was to look at the justifications that were behind changing these export control levels.

Chairman THOMPSON. Justification in these two important categories simply are not there. We are continuing to liberalize our export policy without the knowledge of the national security impact it might have, or without an assessment as to all of the military applications that such a raising of MTOPS-level licensing might have.

Ms. WESTIN. That is right.

Chairman THOMPSON. I think it is important to remind ourselves, too, that when we are talking about 85,000 MTOPS, that does not mean anybody is cut off at 85,000. That just means that when you get below 85,000, you do not even have to have a license, but when you get to the 85,000 and above, 90-something percent

of the license applications—I think that is correct—are approved. The Cox Report suggested several alternative ways of measuring these computers, in terms of their significance. The Deutch report had several possible suggestions. Your report in December of last year had almost a dozen possible suggestions as to different ways that we could possibly control or have a control regime, which would really keep the stuff we wanted out of the bad guys' hands, or potential bad guys, in terms of end-users—I am not talking about countries necessarily—that there were options out there, but that nobody has really sat down and gone through and made a determination as to which one of these might be viable and which ones might not be; is that correct?

Ms. WESTIN. That is right, and we include ourselves in that, Senator. GAO did not do that.

Chairman THOMPSON. Nobody has done that. We are flying blind, essentially, with regard to that. Some of those suggested possibilities are hardware-type solutions, counting of processors instead of MTOPS, things of that nature; but suffice it to say, there are a variety of suggestions out there from Cox to Deutch to GAO, things that are on the table, that knowledgeable people have said, "We might ought to take a look at this. This might work."

All kinds of ideas are out there. None of us are wed forever to the MTOPS criteria or anything else. We just know that whatever the criteria is, it is becoming more and more liberal. It went from 2,000 MTOPS to 85,000 MTOPS in 1 year. The notice requirement has been liberalized, shall we say, or there is less and less notice, less time for Congress—Congress used to have 6 months to review this. Now we have 60 days.

Ms. WESTIN. 60 days.

Chairman THOMPSON. Everything is being pushed toward more high-performance computers out the door to Russia and China. As I said, we might conclude, someday, that we might as well do that and we might as well go ahead to give them to Iran and Iraq, while we are at it, but we were not there yet, because nobody, including the President, even though the law required it, has made a national security assessment or an assessment of all the military applications that might have significance in terms of the MTOPS level being raised. Is that essentially correct, a summary?

Ms. WESTIN. Yes, that is a good summary, Senator.

Chairman THOMPSON. I noticed here in your September 1998 report on export controls, national security issues and foreign availability for high-performance computer exports, GAO has done a lot of good work in this area. It is unfortunately under the radar screen. Nobody pays a whole lot of attention to it now, except the people in the business, but it is very important and one of the things that you have looked at is how we stand in comparison to other countries.

I noticed here on page four, it said, "Based on EAA's description of foreign availability, we found that subsidiaries of U.S. companies dominate overseas sales of high-performance computers." According to U.S. high-performance computer exporters, there were no instances where U.S. companies had lost sales to foreign high-performance computer vendors in Tier 3 countries. We also obtained information on the capability of certain Tier 3 countries to build

their own high-performance computers, and found it to be limited. Tier 3 countries are not as capable of producing machines of comparable quantity and of comparable quality and power as major high-performance computer supply countries.

I think that one of the issues we are going to have to deal with as a Congress is that even acknowledging the world is a smaller place, and many of the technological genies are certainly out of the bottle, is there anything to be derived from still trying to keep certain things out of the hands of certain people for certain lengths of time, with a full concession that maybe eventually everybody will have everything? If not, why not send it to Saddam Hussein right now and make the profit off of it and put it back into our system, so that we can strengthen our own system over here? Obviously, nobody would advocate that. Where I think we come to is that there is something to be said for certain reasonable restrictions that comport with reality, but that, if nothing else, slows down this process that, among other things, has caused us to conclude we need a national missile defense system. That is the debate we are having here and I think you have made an important contribution to it. Thank you.

Senator Bennett.

Senator BENNETT. Thank you, Mr. Chairman.

Thank you, Dr. Westin. I agree, absolutely, there must be careful study of this, further study of it. The primary challenge in this world is how rapidly it is changing. A report that comes out is obsolete almost as fast as the product that it examines. Let me share with you and the Committee a press release that came out on the 1st of February, so it is 45 days old now, a company I had never heard of until this was called to my attention, called Juno Online Services. Are you familiar with that? Are any of you familiar with that?

Ms. WESTIN. Yes, I have my chief scientist here and he is familiar with that.

Senator BENNETT. Here is what it says, and is pretty staggering in its implications: "Preliminary studies recently completed by the company suggest that if the computers of all of Juno's active free subscriber base were simultaneously working on a single computational problem, they would together represent the world's fastest supercomputer and might approach or break the petahertz barrier." I have never heard of the petahertz barrier, but things keep coming at us in this world all the time—that is a hypothetical effective processor speed in the order of a billion megahertz.

Then you go on in the press release, and this is fascinating to contemplate, it says, "Applications will run as screen savers on the computers of participating subscribers when their machines would otherwise be idle, performing calculations when the computer is on, but not in use." Now, I have a screen saver on my computer that shows the beautiful scenery of the State of Utah and changes every few seconds from one magnificent vista to the next, but that is obviously not taxing the computer very much to put those pictures up there. So, apparently, if I am connected with Juno, while my screen saver is on, they will get in and use the computing power to work on this problem. It says Juno's free, basic service may ultimately be required to make their unused computing power available to the

project as a condition for using that service. In other words, if you subscribe to Juno, you have to say while we have our screen saver up, you have access to the computing power in our computer, and Juno has enough subscribers that altogether, they would represent computing power greater than the world's existing supercomputer, the biggest supercomputer. This is an idea that is 45 days old as far as the public is concerned.

I bring this up to illustrate how rapidly everything is changing. This is a circumstance that was not in the debate when the Congress met in the year 2000. We did not have any concept—at least I did not have any concept—I do not know about my colleagues, but I did not have any kind of concept that this kind of connection could even be conceived of, let alone discussed in early 2001 as a legitimate situation. Whether or not Saddam Hussein would somehow plug into this and take advantage of it, without anything being exported at all, no physical box ever shows up in Iraq, he just makes an electronic connection with a subscriber somewhere, and then makes use of it, is a further demonstration of how badly we need the study that you are talking about, and it needs to be an ongoing study; that the conclusions arrived at by July of this year will be obsolete by October of this year.

Maybe that is an issue, Mr. Chairman, we should raise with Condoleeza Rice as an ongoing thing in the National Security Council. I have talked to her about the whole issue of critical infrastructure protection, because I think that the next war will not be fought with kinetic weapons. It will be fought with computers. If I were somebody who wished this country ill, I would not try to take on the U.S. military, because I would lose. Instead, I would hire the best hackers I could find, and say let's find a way to get into the telephone system and shut down the Fed wire, so that the American economy comes to its knees overnight, because no checks can clear, no money can pass and so on.

I think that is where the next war is being fought, and I was delighted that Condoleeza Rice not only understood that, but she had thought very deeply about it and was ahead of me. That is all a little humbling, for a Senator, to have somebody come to your office, and you are going to raise an issue, and have that individual know more about the issue than you do.

I think your recommendation here is a very sound one and we clearly need to pay attention to it, and the only amendment I would add is the one I have suggested, that it not just be a single date and the report issued and then you go onto other things; that we find some way that this is an ongoing assessment, because the Juno announcement demonstrates how rapidly moving and changing everything is all of the time. Now, if you have any comment or reaction to that, I would be happy to hear it.

Ms. WESTIN. Senator, I was going to say that I think you really have given an excellent example that does back our recommendation, because our recommendation for this expert panel is really twofold; to address any weaknesses in export control measures—but I think what your example was pointing to—to make a determination of what U.S. countermeasures are necessary to deal with these weaknesses.

It may very well be that advances in technology are occurring so quickly that there is not going to be a good measure for controlling the export of computers, which is why I think the second part of the recommendation, as I have said, is equally important, to determine what countermeasures are we going to take. It all does hinge on having an analysis of the military uses of high-performance computers, and what impact these uses have on our national security interest.

Senator BENNETT. The only other comment I would make, Mr. Chairman, that I would like the panel's reaction to, when Dr. Hamre testified in a hearing on the Export Controls Act, he was no longer the Deputy Secretary of Defense, but testified in his position as the President of CSIS, but he talked about his own transition on this issue, how, as an official of the Department of Defense, he was firmly opposed to export of any of these items. And then he said he woke up one night and realized that what is happening around the world, in terms of other countries developing these capabilities, could mean a situation where the United States might be dependent on a foreign manufacturer, because the foreign manufacturer would have access to markets that the American manufacturer would not.

He said I began to change my position pretty clearly because I did not want to run the risk of American manufacturers falling behind foreign manufacturers, so that we might eventually, at DOD, have to turn to a foreign source. Would you comment on that or give us your reactions to that?

Mr. PHILLIPS. That is a legitimate concern. There is another trend, a market trend, that in some ways contradicts that. In the computer area the trend has been toward DOD acquiring more mass-market commercially available components and systems, and relying less and less on specially designed, specially built computers. As a result, it may be that at some point DOD will be relying on foreign suppliers, at any rate, because those commercially available mass-market systems that they are getting will become more and more available from everybody.

The idea that by keeping the U.S. computer industry competitive overseas is going to allow money to come back and be reinvested in R&D, may well be true. But the kind of high-end, state-of-the-art systems that DOD used to be getting from the more traditional computer companies, like Cray and Silicon Graphics, it is moving away from, into the more commercially available lower-end systems and linking those together.

Senator BENNETT. Yes, because where the competition is coming is in the lower-end, where you are seeing French machines and Japanese machines competing with the Americans, and it is not a question of the money coming back to fund R&D. It is a question of the company drying up because they cannot get market share.

Mr. PHILLIPS. Well, at this point, based on the last work that we did, the market share situation still fairly well favors the United States.

Senator BENNETT. That is true, and Dr. Hamre wants to keep it that way.

Chairman THOMPSON. I might add, do you have any figures on the high-performance computer sales to Tier 3 countries?

Mr. PHILLIPS. We do not have any updated numbers on those, but——

Senator BENNETT. From any source, if I might add, Mr. Chairman, not just American sales, but any sales.

Mr. PHILLIPS. I will start with U.S. sales. You can think of them as a sort of inverted pyramid. The vast majority of U.S. sales has been to the European countries—and of course, in the United States—to the Tier 1 countries, then to the Tier 2 countries, Tier 3 sales as a relative proportion of overall sales, has been very, very small. I think we talked about five or six percent as of a few years ago. Tier 3 has been a growing market, but I think those ratios are still fairly constant.

As far as overseas suppliers, the Japanese are usually considered our next biggest competitors, and we have an arrangement with them where they are supposed to report to us any sales of their high-performance computers to Tier 3 countries. We have been told by the State Department that they have received no reports in the past several years, perhaps as many as 5 years, of sales to Tier 3 countries.

Senator BENNETT. Thank you, Mr. Chairman. My time has expired.

Chairman THOMPSON. Senator Collins.

Senator COLLINS. Thank you, Mr. Chairman.

Dr. Westin, like the Chairman, I am very troubled by the fact that the GAO found that the Clinton Administration failed to conduct a serious national security analysis before making the decision to loosen national security export controls upon high-performance computers. Does the GAO know why the administration failed to conduct the kind of in-depth review that many in Congress urged be conducted?

Ms. WESTIN. Senator, if the officials from the Defense Department and Commerce Department were here, I am sure they would tell you they disagree with us. They would say that the justification was adequate in the President's report. We look at what was written in the law, and the law says for the second and third requirements, the President's report should include a list of all the militarily significant uses of high-performance computers, and conduct an analysis of the impact on national security of all of these uses. That was clearly not there.

In the written statement, we have given a few examples of things we would have expected to be included in having a national security impact of those examples.

Senator COLLINS. Just for the record, GAO's finding is that the Clinton Administration failed to comply with the legal requirement to conduct a thorough review of the national security implications; is that correct?

Ms. WESTIN. Yes.

Senator COLLINS. Could you give us some idea of what kinds of military uses computers at the 85,000 MTOPS level could be put to, for those of us who are not as expert in this area as the Senator from Utah? For example, could they be used in nuclear weapons design? Are they powerful enough to process radar or other sensor information from multiple sources, in order to help a country build up its air defense system against stealth aircraft? Could you give

us some idea of what the potential military uses of computers at that level could be, Mr. Phillips?

Mr. PHILLIPS. There are several—again, we can base this in part on the studies that DOD and Commerce commissioned in 1995 and 1998, which did have a list of about 194 known militarily significant applications at that time. At about 85,000 MTOPS or so, they talk about global ocean modeling and weather forecasting. They talk about on-board data processing for UAVs (Unmanned Aerial Vehicles).

There are physics simulations, three-dimensional modeling, three-dimensional simulations of submarines, submarine modeling. There are a number of things on that list which we understand, has grown since then in militarily useful applications. So there are a lot more than what are on that list at different levels.

Senator COLLINS. With regard to the examples that I gave of probably helping to develop nuclear weapons design, probably the answer to that is yes; is that fair?

Mr. PHILLIPS. Nuclear weapons design, typically, can be done at fairly low levels. We reported in 1998, based on Department of Energy information, that a country like China could use computers as low as, I believe, 6,000 or 7,000 MTOPS, to help design new nuclear warhead designs.

Senator COLLINS. So, at 85,000 MTOPS, we are talking about very powerful computers, then.

Mr. PHILLIPS. Right, and the kinds of uses that would lend itself to are stockpile stewardship uses, that the United States is trying to be able to simulate without nuclear weapons testing.

Senator COLLINS. Does the GAO know how the Clinton Administration arrived at the 85,000 MTOPS level, Mr. Lord?

Mr. LORD. Sure. The Department of Defense officials we met with indicated they extrapolated—or they projected through the end of this year what they thought the foreign availability was going to be. So, basically by December of this year, according to their calculations, Tier 3 countries would be able to achieve that capability. They had some modeling. We have not looked at their assumptions in great detail, but that was their analysis at the Department of Defense—with clustering, they could achieve that capability. So, they have a unit over there who performed those calculations.

Senator COLLINS. As I recall, there was previous GAO testimony before this Committee that suggested that the levels were set, not by ascertaining what was actually available from foreign computer makers, but rather according to what new processors U.S. manufacturers might hope to be able to market, but did not currently market at the time the decision was announced. Mr. Phillips, is that accurate?

Mr. PHILLIPS. That is correct. The process, until this last go-around, was that the administration would contact the vendors and identify, within about a 6-month period, what their production schedules would be for the next state-of-the-art processors. Then they would base their projections on the MTOPS levels of those processors and different configurations.

Senator COLLINS. So, in some ways, this is a prospective——

Mr. PHILLIPS. Right, they have intended it to be that way. Their reasoning has been they wanted the export control system to not lag behind the technical capabilities that the companies could achieve.

Senator COLLINS. Dr. Westin, the United States helped to build, and concurrently participates in, a multilateral export control regime that is called Wassenaar. As I understand it, under that multilateral system, there is a requirement for export license controls on high-performance computers; is that correct?

Ms. WESTIN. To the Tier 3 countries, right.

Senator COLLINS. To the Tier 3 countries.

Ms. WESTIN. I will let Jeff clarify that.

Mr. PHILLIPS. They do not normally have tiers of countries in Wassenaar. It is not a system where there is a requirement, per se. Wassenaar attempts to have common standards, common guidelines, common control lists among its members, but it is left to the national discretion of the countries to put into their own laws and regulations the standards that Wassenaar agrees to.

Senator COLLINS. Given those common controls and that cooperative regime, I am curious whether the United States consulted with the members of Wassenaar, for example, with our NATO allies or with the Japanese, before announcing that decontrol measure in January 2001. Do you know whether there was consultation?

Mr. PHILLIPS. We have talked to the State Department about that. I am not quite sure of the sequence, whether they were consulted ahead of time or were told that this is the decision we are about to make. They did notify in December 2000 at a regular session of Wassenaar, at which the United States was convincing Wassenaar to go along with the more recent U.S. changes. Levels were changed in August to 28,000 MTOPS. Either late December or January, the State Department made it known to Wassenaar that the U.S. was going to raise the levels up to 85,000 MTOPS.

Senator COLLINS. So it went from 28,000 MTOPS to 85,000 MTOPS in a period of 6 months or so.

Mr. PHILLIPS. Less than 6 months.

Senator COLLINS. Less than 6 months. Are you aware of reports that there was friction with our allies, who adhered to the regime because of the United States moving unilaterally in this area?

Mr. PHILLIPS. Yes, we have heard things—and this is sort of secondhand information—but the State Department officials have told us that there was some concern among the members of Wassenaar. I cannot say it was because they did not want, necessarily, the levels to change, but at least they were concerned because the levels had recently changed and, now, in such a short time, were being changed again to a rather high level.

Senator COLLINS. Thank you very much. I very much appreciate GAO's excellent work in this area. Thank you, Mr. Chairman.

Chairman THOMPSON. Thank you very much, Senator Collins. Let me add to that report, Senator Collins, if I may. Some of us went over and talked to our Wassenaar allies last year, about this very thing, and I can add to your assessment. You are getting your information from the State Department. It sounds like they have been pretty candid with you, and I just want to back that up. Folks that we talked to over there were pretty consistent in being con-

cerned that the United States, after having so many of us complain about our efforts to get us out of COCOM, and how that Wassenaar was not tight enough, and there were no under-cutting rules or anything like that. It was much too loose.

Here we are, in their eyes, always pushing the envelope in terms of high-performance computers, and I think we are doing it strictly to get a competitive advantage. I can verify that the ones we talked to were not pleased with it at all and they think we are quite hypocritical in complaining to want to have control of sensitive items and have a multilateral approach to it on the one hand and continue to push the envelope past where they are willing or capable, I guess, of going on the other hand.

Let me get back to another point, and maybe we can take advantage of your expertise while we have you here, in more of a technical area. It seems to me from what I have read, from the work that the GAO has done and others, that the computing power of these high-performance computers obviously is very important. If you string that power together, you get more power. But there are two things that seems to me like we need to say about that.

First, is that clustering at the 70,000 MTOPS level does not give you the same situation or the capability as having a high-performance computer at the 70,000 MTOPS level, because clustering is more difficult to operate. It is more difficult to maintain. The power is not exactly the same. The application is different. Is that a correct assessment?

Ms. WESTIN. Yes, as I understand it, Senator, not all applications will run the same on a high-performance computer that is 70,000 MTOPS, as opposed to a system where the computers have been clustered to achieve the 70,000 MTOPS level.

Chairman THOMPSON. As a matter-of-fact, is it not true that, as far as we can determine, the clustering ceiling, as best we can determine, is at about the 70,000 MTOPS level capability?

Mr. PHILLIPS. Yes, that is with the caveat that is using mass-market commercially available components. That is how we have tried to address the question. There are higher levels, sometimes considerably higher levels of performance you can achieve through clusters, that have been achieved. But that higher level sometimes is reached using items that would be controlled by export controls or would be proprietarily controlled.

Chairman THOMPSON. All right. So, if they are able to get—a clustering country is able to get a higher MTOPS level computer, they can cluster more?

Mr. PHILLIPS. That is possible.

Chairman THOMPSON. We are at the 70,000 MTOPS cluster level with the caveat, and we are about to decontrol altogether at the 85,000 MTOPS level. We are decontrolling at a level higher than what we believe they can cluster at right now.

Mr. PHILLIPS. That is correct. The projections we have seen from the Defense Department are based on projections of availability in the last quarter of 2001, not now.

Chairman THOMPSON. The second thing it seems to me we can say about this is that while the power—and this is used in layman's terms, but hopefully, one of the things we can do is help the general public understand this better, and I am a heck of a lot clos-

er to the general public than I am an expert on this stuff. While the computing power is very important and stringing it together is very important, and is evidently unlimited, it seems to me like there is a big difference between that and a military application, for example—that how you use that state of facts that has just been described, in terms of application, in terms of your ability to maintain it, in terms of your ability to repair it—the software that you use—it seems to me, from all I can tell, that there is an awful lot of stuff that goes into an ultimate ability to have, say, a battlefield application other than just the raw power of the computer; is that not correct? Could you elaborate on that somewhat?

Mr. PHILLIPS. Again, depending on the application, sometimes you want enhanced graphics capability, sometimes you want enhanced communications capability. If you are dealing with real-time or near real-time command and control communications capabilities, clearly, you need to have real-time or near real-time computing. You have to have that processing done when you need it, as opposed to research and development projects, which is what most high-performance computers have traditionally been used for. There is flexibility in R&D in waiting longer for your results with a clustered system than you might otherwise have needed with a vendor-supplied system.

Chairman THOMPSON. In terms of all of that, the applications and so forth, can anyone in Tier 3 or Tier 4 countries touch the United States in terms of that ability right now?

Mr. PHILLIPS. We have not done any recent work on that, but traditionally their computing capabilities have been lower, sometimes considerably lower, than the U.S. capabilities.

Chairman THOMPSON. You are talking about not just the power of the MTOPS power, but all of the applications and all of that we have been talking about. You made another distinction, and that is in terms of the usefulness of, say, using clusters and things of that nature; that if you are in an R&D application, that timing is not that important. You can wait longer for more results and so forth. But if you are in a battlefield application, you have got to have results pretty quickly. So when—it is not just if you get the capability; it is when you get the capability might be very important. Is that a correct assessment?

Mr. PHILLIPS. That is right.

Chairman THOMPSON. Senator Bennett, do you have anything?

Senator BENNETT. Mr. Chairman, I have nothing further, but I appreciate the panel and your expertise, and I think, Mr. Chairman, you were on the right track again on this last series of questions, because it is not just the box. You can have the box and it can have all of this capability, and if you do not have the intellectual capability to program it properly or use it properly, you are going to be in real trouble.

The only other comment that I would make—that comes to me as I sit here and listen to this. I remember my interview with General Horner, who was the head of the Air Force war in the Gulf War, and then became the Commanding General of the Space Command, he told me something that I think applies here, that I found fascinating. He said the Gulf War was the first war fought from space. All of the command and control was done from space. They

used satellites to direct tanks. He said we so filled up all of the military satellites that we had to go out and lease space on commercial satellites, because we did not have enough space. Then with a grin he said one of the commercial satellites we leased was leasing the other half of its capability to Saddam Hussein. I think that is kind of a precursor of what we are going to be seeing here.

Again, back to Juno. They may end up—somebody comes in and says they want to buy "X" amount of time and they turn out to be buying it for and on behalf of somebody else, but the main protection we have in America is not just the ability to produce a better box, but all of the other things, Mr. Chairman, that you were going through that have an impact on how the box is used. Again, I am grateful to the panel and for the expertise.

Chairman THOMPSON. Thank you, Senator, for your expertise. I think you are right, implicitly, in what you have always said, and that is that among the important things, probably the most important thing has to do with our ability to run faster as a Nation, that the world does not stand still, and we have to continue to run faster and outstrip the other guys. The question here is whether or not we want to assist them to run faster, too, even though they are going to be behind us or whether or not we can do some things that might slow them down a bit.

I hope this has not been a session to beat up on the prior administration. I am hopeful that we can look forward from here, and that the current administration, can, over a period of time, when they are able to get all the people in that they need to get—I can only imagine what they are going through over there in trying to get their people confirmed and so forth—will take these issues into consideration and conduct a thorough national security risk assessment. Get some people together, take a little time, start from scratch. If MTOPS needs to go, let it go, but look and see what else is available. Instead of concentrating on the hardware, maybe concentrate on the software. Maybe there are other things that we can do, or if we are just to throw up our hands and decontrol everything to everybody, let us do it on top of the table and quit claiming that we have an expert control system, when really we do not have any system at all, because whatever we can manufacture, we are going to exceed that MTOPS level under the assumption everybody is going to get it.

At least we can do it honestly and after having made an assessment, and I believe that they will do that and that is basically, I think, all we can ask.

Thank you very much for being with us. The Committee is adjourned.

[Whereupon, at 10:52 a.m., the Committee was adjourned.]

APPENDIX

United States General Accounting Office

GAO

Testimony

Before the Committee on Governmental Affairs,
U.S. Senate

For Release on Delivery
At 9:30 AM, March 15, 2001

EXPORT CONTROLS:

Inadequate Justification for Relaxation of Computer Controls Demonstrates Need for Comprehensive Study

Statement of Susan S. Westin, Managing Director,
International Affairs and Trade

GAO-01-534T

Mr. Chairman and Members of the Committee:

I am pleased to be here today to discuss export control issues for high performance computers. My testimony is based on work we have conducted over the past few years, particularly our December 2000 report,[1] and work we are currently completing for the Congress.

As you know, export controls continue to be a contentious part of our national security debate. Over the past several years, there has been continuing congressional concern over the rationale for revising these controls and their effect on our national security. U.S. policy with respect to the export of sensitive technology, including computers, seeks to balance the national interest in promoting economic growth and trade against the essential national security requirement to prevent the proliferation of technologies related to weapons of mass destruction, missiles, and advanced conventional weapons.

The United States has long controlled the export of high performance computers[2] to sensitive destinations, such as Russia and China. These computers have both civilian and military (dual-use) applications, and the recent technological advancements in computing power have been rapid. The Department of Commerce has primary responsibility for licensing these dual-use items and other agencies--State, Defense, and sometimes Energy--help to weigh promotion of commercial interests in exporting items against protection of national security interests. The regulations for high performance computer control thresholds are currently based on a computer's composite theoretical performance as measured in millions of theoretical operations per second (MTOPS).

We recently reported that the growing ability of other countries to cluster lower performance computers has made the current computer export control system ineffective in limiting countries of concern from obtaining high performance computing capabilities for military applications.[3] In that report, we also reported that MTOPS is an outdated and invalid means for determining

[1] *Export Controls: System for Controlling Exports of High Performance Computing is Ineffective (GAO-01-10, Dec. 18, 2000).*
[2] The Commerce Department considers a high performance computer to be one that exceeds a defined performance threshold, thus requiring an export license.
[3] See *Export Controls: System for Controlling Exports of High Performance Computing is Ineffective* (GAO-01-10, Dec. 2000).

whether individual high performance computers should be licensed for export. We recommended that executive branch agencies convene a panel of experts to (1) conduct a comprehensive assessment of available options to address weaknesses of computer export controls and (2) make a determination on what U.S. countermeasures, if any, are necessary to respond to any computing-related enhancements of military or proliferation capabilities in sensitive countries. The Departments of Commerce and Defense disagreed with the need to implement these recommendations because they said they were already engaged in interagency reviews of similar issues. However, when asked for documentation on how the agencies were pursuing the points covered in our recommendation, the agencies provided none. As a result, we believe our recommendations are still valid and we raised this matter to the attention of Congress in the December report.

On January 10, 2001, President Clinton announced a significant relaxation in export control licensing and notification thresholds for high performance computers and a proposal to eliminate almost all controls on exports of computer hardware. Today, I will discuss our observations about these changes, specifically, (1) our evaluation of the President's justification for changing the computer control thresholds, (2) our evaluation of the support for the President's policy proposal to shift the emphasis of controls from hardware to software controls, and (3) implications of these changes.

To assess the President's justification for changing the computer control thresholds and to evaluate the support for the President's policy proposal, we reviewed the President's January 2001 report to the Congress and announcement of computer control changes. We also reviewed Defense documents showing the results of calculations in support of the new control threshold. We interviewed officials from the Departments of Defense, Commerce, and State; and the national laboratories, Lawrence Livermore and Oak Ridge. We interviewed officials from major computer manufacturers, IBM, and SUN Microsystems, as well as the computer scientist responsible for the Top 500 List of the most advanced high performance computers in the world. We also reviewed a Defense Department technical report and interviewed its authors. In addition, we interviewed officials of the Commerce Department's Information Systems Technology Advisory Committee. To identify implications of the computer control threshold and policy changes, we reviewed the President's report to the Congress and White House fact sheet on computer control and policy changes. We also reviewed interagency inspector general reports on export controls. In addition, we interviewed officials of the Departments of

Commerce, Defense, and State. We also obtained and analyzed Commerce Department statistics on the disposition of notifications and license applications.

SUMMARY

The President's January 2001 changes in the export control thresholds for high performance computer exports are not adequately justified. While the President's report recognizes that high performance computing capabilities will become increasingly available to other countries through computer clustering, the report fails to address all militarily significant uses for computers at the new thresholds and assess the national security impact of such uses, as required by law. The inadequacies of the President's report are further compounded by continued use of a flawed measure for assessing computer performance.

The support for the President's policy proposal for relaxed U.S. computer controls also is not adequate. Although the new policy was based on a conclusion that computer hardware exports can no longer be controlled, the executive branch did not adequately assess alternative control options. Our prior report identified several other options.[4] In addition, the new policy would focus more attention on using new software controls to protect U.S. national security interests, even though such controls have yet to be identified and developed.

We identified several implications of the changes to the control thresholds and the proposed change in U.S. computer export control policy related to increased risks for U.S. national security.

- The inadequacies of the President's justifications again demonstrate the need for a comprehensive study of the issues involved.

- The new rules effectively eliminate routine prior U.S. government review of computer exports below the licensing threshold to sensitive countries. In the past, we found that establishing a notification threshold lower than the licensing threshold was useful in that it allowed the U.S. government to deny or defer some exports, or make other exports conditional upon additional safeguards.

[4] *Export Controls: System for Controlling Exports of High Performance Computing is Ineffective (GAO-01-10, Dec. 18, 2000).*

- Raising licensing control thresholds in January 2001 increases the risk that more powerful computers might be exported without a license to sensitive customers nearly a year before Defense projects that these customers could attain the same computing power by clustering less powerful computers.

- Defense and Commerce officials said that the U.S. government will have to rely more heavily on computer vendors to "know your customers" and assess their intentions to use computers for proliferation purposes. Past evidence has shown this reliance may be misplaced.

- The policy proposal would reduce information that might be useful in detecting patterns of exports to customers engaged in proliferation activities because it would eliminate an annual reporting requirement that provides information on end users.

BACKGROUND

High performance computers and related components (for example, processors) are controlled under the Export Administration Act and the implementing Export Administration Regulations.[5] The act authorizes the Commerce Department to require firms to obtain licenses for the export of sensitive items that may pose a national security or foreign policy concern. The Departments of State, Energy, and Defense assist Commerce, which administers the act, by reviewing export applications and supporting Commerce in its reviews of export control policy. Since 1993, the President has revised U.S. export control requirements for high performance computers six times, including the revisions announced in January 2001. Since 1996, the executive branch has organized countries into four computer "tiers," with each tier after tier 1 representing a successively higher level of concern related to U.S. national security interests.

- Tier 1. U.S. export control policy placed no license requirements on tier 1 countries, primarily those in Western Europe and Japan.
- Tier 2. Exports of computers above a specific performance level to tier 2 countries in Asia, Africa, Latin America, and Central and Eastern Europe required licenses.

[5] 50 U.S. C. App. sections 2401 and following and 15 C.F.R. sections 730 and following.

- Tier 3. Exports to countries such as Russia, China, India, Pakistan, and Israel required a license above a specified performance threshold and also required advance notification of a vendors' intent to export computers above a certain threshold.
- Tier 4. Exports of high performance computers to tier 4 countries, such as Iran, Iraq, and North Korea, were essentially prohibited.

As of January 2001, tiers 1 and 2 were combined.

To help inform congressional decision-makers about changes in U.S. export controls on computers, the National Defense Authorization Act of 1998[6] requires the President to report to the Congress the justification for changing the notification thresholds for exports of high performance computers to certain sensitive countries.[7] The report must, at a minimum, (1) address the extent to which high performance computers with capabilities between the established level and the new proposed level of performance are available from other countries, (2) address all potential uses of military significance to which high performance computers at the new levels could be applied, and (3) assess the impact of such uses on U.S. national security interests.

The Act also requires computer exporters to notify the Commerce Department in advance of any proposed high performance computer exports to sensitive "tier 3" countries[8] that pose a concern for military or proliferation reasons. Since the threshold for notifications was set lower than the threshold for licensing, it served as a "tripwire" for triggering advanced U.S. government review of exports to potentially sensitive end users. Under this procedure, exporters must apply for a license if any executive branch agency in the licensing process objects to a proposed computer export. In addition, the Act requires an annual report to the Congress, which includes a list of all computer exports to tier 3 countries, including information on the end use and end user of computers.

On January 10, 2001, the President announced that the control threshold above which computers exported to countries like Russia and China would need a license would be raised from 28,000

[6] Public Law 105-85.
[7] The President's Report is prepared by the Departments of Defense, Commerce, State, and Energy, under the coordination of the National Security Council.
[8] Currently, there are 52 countries in tier 3, including China, Russia, India, and Israel.

MTOPS[9] to 85,000 MTOPS, effective immediately.[10] He further announced that the performance threshold requiring notifications of computer exports also would be raised from 28,000 MTOPS to 85,000 MTOPS. The new notification threshold will take effect on Tuesday, March 20.

INADEQUACIES IN THE ANALYSIS USED TO SUPPORT CHANGES IN COMPUTER CONTROL THRESHOLDS

The President's January 2001 decision to raise the licensing and notification thresholds from 28,000 MTOPS to 85,000 MTOPS for high performance computer exports were not adequately justified in that they did not meet all three criteria of the law. The President's report addresses the first criterion—the worldwide availability of high performance computers–by recognizing that other countries could be expected to achieve computing capabilities through computer clustering. The President also set a licensing control threshold of 85,000 MTOPS based on the availability of clustering technologies projected to be available by the end of 2001. In our December 2000 report, we noted that high performance computing up to about 70,000 MTOPS is attainable by clustering.

However, the President's report fails to meet the last two criteria in that it did not address all computer uses of military significance to which high performance computers could be applied at the new thresholds and did not assess the national security impact of such uses at the new control threshold, as required by law. The report's section on the computer uses of military significance is based largely on Defense- and Commerce- sponsored studies issued in 1995 and 1998 and addresses only selected examples of military significance; it does not address or even identify all known military uses to which high performance computers up to the new control threshold could be applied. The President's report did not address all such computer uses, even though this information was available from the 1998 Department of Defense- and Commerce-sponsored study that was used as the basis for these sections of the report. For example, the report does not note that applications for 3-dimensional modeling of armor and anti-armor and 3-dimensional modeling of submarines can be run on computers at about 70,000 MTOPS. The President's report does not state that computers rated up to 85,000 MTOPS could operate all but four of the 194 militarily significant applications identified in the 1998 Defense- and Commerce-

[9] By comparison, a personal computer with a Pentium III processor with speed of 1.13 GigaHertz would be calculated to have a performance level of 2,637 MTOPS. A personal computer with a new Pentium 4 processor with a speed of 1.5 GigaHertz would have a performance level of about 4000 MTOPS.

sponsored study. Moreover, new information that we obtained from Defense since the January President's report was issued suggests that there may be between 300 to 500--not 194--militarily significant computer applications used by the Defense Department today.

Furthermore, the President's report makes no reference to how specific identified uses at the new threshold would affect U.S. national security; hence, it does not clearly identify the national security risks to be addressed as countries of concern acquire high performance computing capabilities. For example, the report did not discuss the national security impacts on the United States of Russia, China, or other countries obtaining high performance computing up to the new control thresholds, even for those applications identified. Without a clear analysis and explanation of the national security interest in controlling the export of high performance computers, it is difficult to determine what militarily critical computer applications need to be protected.

The inadequacies of the President's report are further compounded by continued use of a flawed measure--MTOPS--that is no longer valid for measuring individual computer performance found in today's computers. The executive branch continues to use MTOPS because current law calls for use of this measure for notification purposes. In our December 2000 report, we stated that the MTOPS measure does not account for new designs of individual processors or for clustering computers to achieve high performance computing levels.

SUPPORT FOR PROPOSED
POLICY SHIFT NOT ADEQUATE

On January 10, 2001, the President also proposed a new high performance computing control policy that shifts the emphasis of the controls from hardware-based controls to stronger software controls. If implemented, the policy would (1) remove controls on computer exports to all but seven countries,[11] (2) eliminate notification and reporting requirements of the National Defense Authorization Act, and (3) increase awareness within industry and government of, and develop stronger controls over, critical national security software applications.

[10] Advance notification to Commerce of an exporter's intent to export high performance computers rose from a threshold of 12,500 MTOPS to 28,000 MTOPS, effective on February 26, 2001.
[11] The seven countries are Cuba, Iran, Iraq, Libya, Sudan, North Korea, and Syria.

The President's January 2001 proposal for a new high performance computing control policy is based on a conclusion that exports of computer hardware can no longer be controlled. However, the executive branch did not conclusively demonstrate that there are no viable options for replacing the discredited MTOPS measure as the basis for continued hardware controls. Defense Department officials we interviewed could not document or support conclusions in a key Defense technical report[12] that was identified as the analytical basis for the broad policy change. For example, DOD officials, when asked could not provide evidence to support their conclusions that there is necessary technical expertise in tier 3 countries to cluster to *any* performance level. According to computer experts we interviewed, performance levels of clustered computer systems depend on which applications are to be used; the report did not address this fact. In addition, this report rejected some options for new measures because they would be too costly and complex to implement yet the report's authors developed no cost data or estimates to support this conclusion. Even though the new policy would focus more attention on using new software controls to protect U.S. national security interests, these software controls have yet to be identified and developed. Also, awareness of current software controls would need to be strengthened within industry and government to make these software controls more effective, according to Defense Department officials.

IMPLICATIONS OF ANNOUNCED THRESHOLD AND POLICY CHANGES

We identified several implications of the announced changes to computer licensing and notification thresholds and proposed policy change to eliminate hardware controls over computers and develop stronger controls over sensitive military applications software.

- The inadequacies of the President's justifications for raising the performance thresholds to 85,000 MTOPS at this time and for eventually abandoning computer hardware export controls demonstrates the need for further study of the issues involved before the United States commits to the President's proposals. This is especially critical given that new software controls are untested. In our December 2000 report on high performance computers, we recommended that executive branch agencies comprehensively assess ways of addressing the shortcomings of computer export controls (including the development of new

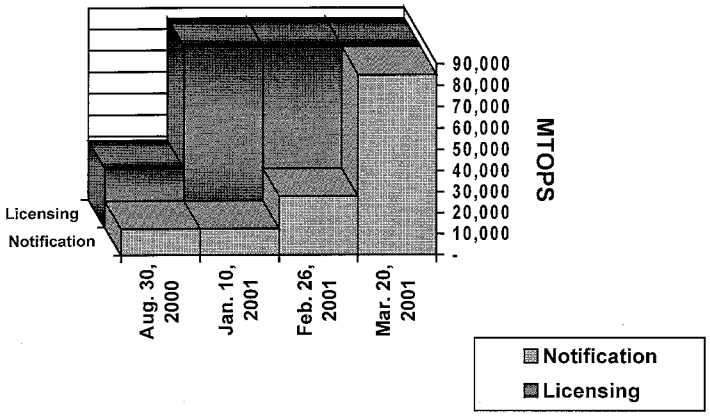
[12] Defense Science and Technology Report, *Export Control of High Performance Computing: Analysis and Alternatives Strategies*, February 2, 2001, Office of the Deputy Under Secretary of Defense (Science and

performance measures) and of countering the negative effects on U.S. national security of increased availability of high performance computing. Although Commerce and Defense did not agree with this recommendation, we believe this recommended course of action is still valid. Unless the executive branch implements these recommendations and the reporting requirements of the National Defense Authorization Act, the United States will not be prepared to fully assess and mitigate the risks it may face by adopting the President's proposals for revising U.S. high performance computer export controls.

Technology).

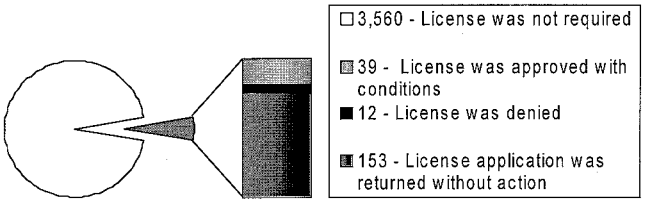
- Since the announced changes set a licensing and advance notification threshold at the same level for the first time, the new rules effectively eliminate routine prior U.S. government review of any computer exports below the licensing threshold--now 85,000 MTOPS--to sensitive tier 3 countries. (See figure 1.)

Figure 1: Computer Tier 3 Export Control Thresholds for Licensing and Notifications (August 2000 to March 2001



In the past, the presence of a notification threshold lower that the licensing threshold has given the United States the opportunity to block some exports and to condition others on the inclusion of specific conditions. [13] For example, between February 3, 1998 (when procedures implementing the law went into effect) and September 30, 2000, the U.S. government received 3,764 completed notifications of intent to export computers.[14] As shown in figure 2, the Department of Commerce responded to 204 of these notifications by asking the vendors to submit license applications before proceeding with the exports. We found that 165 of those applications did not result in approved export licenses. Of these 165, the Department of Commerce denied 12 of the applications and returned the other 153 applications to the vendor without approving the license. According to Commerce officials, these applications were returned for various reasons, including concerns over end-users and incomplete information. The Department conditioned its approval of the 39 remaining applications on the inclusion of certain conditions. Without a comprehensive assessment of the potential national security impacts of the proliferation of high performance computing, it is impossible to assess the significance of these 165 unapproved license applications.

Figure 2: Disposition of Notifications of Proposed Computer Exports (February 1998 to September 2000)



[13] Common conditions include limitations on computer uses without Commerce approval, requirements for security measures to protect the computer facility, and restrictions on access to the computer by foreign nationals of designated countries.

[14] The Department also received another 93 notifications that it classified as "incomplete" and returned to the exporter.

- Because the President has raised the licensing threshold to 85,000 MTOPS almost one year before the date that DOD estimates that other countries would be able to achieve such performance levels, tier 3 countries would be able to freely obtain American high performance computers almost a year before they would be able to assemble comparable cluster systems. According to the Defense Department, high performance computers are important enabling technology for military and proliferation purposes, which can reduce the time and resources needed to develop such capabilities.

- As part of the proposed policy change to eliminate hardware controls on computer exports to tier 3 countries, the U.S. government would eliminate licensing controls on computer exports to most countries. This change would require the U.S. government to rely more on computer vendors' ability and willingness to "know your customers" and assess their intentions to use computers for proliferation. In the past, computer vendors' inability or unwillingness to do so has resulted in shipments or diversions of computers to Russia and China in violation of the law.[15] For example, on July 31, 1998, the Department of Justice announced that IBM East Europe/Asia Ltd. entered a guilty plea and received the maximum allowable fine of $8.5 million for violating 17 counts of U.S. export laws in shipping computers to Russia.

- As part of the proposed policy change, the executive branch would seek to repeal the statutory requirement for an annual report on all computer exports to potentially sensitive destinations, thus reducing information that might be useful in detecting patterns of exports to customers engaged in proliferation activities. The inspector generals of Commerce, Defense, Energy, and State said in 1999 that the U.S. government lacks an overall mechanism for assessing the cumulative effect of patterns of exports or technology transfers.[16]

Mr. Chairman, this concludes my prepared testimony. I would be happy to respond to any questions you or other members may have.

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[15] See *Export Controls: Information on the Decision to Revise High Performance Computer Controls (September 16, 1998, GAO-NSIAD-98-196).*
[16] *Interagency Review of the Export Licensing Processes for Dual-use Commodities and Munitions, Volume 1* (June 18, 1999).

CONTACT AND ACKNOWLEDGEMENT

For future contacts regarding this testimony, please contact me at (202) 512-4128. Individuals making key contributions to this testimony included, Stephen M. Lord, Jeffrey D. Phillips, Claude T. Adrien, Pierre R. Toureille, Hai Tran, and Richard Seldin.

(320026)

QUESTIONS FOR THE RECORD SUBMITTED BY SENATOR THOMPSON
WITH RESPONSES FROM MS. WESTIN

Hearing on
"High Performance Computer Export Controls"
Additional Questions for Witnesses
March 15, 2001

1. Based on your testimony, you seem to be telling me that the United States has continued to relax its national security export controls on high performance computers over the last couple years without ever really conducting a national security risk assessment. Is that so?

   That is correct. As you know, the National Defense Authorization Act (NDAA) of 1998 requires the President's report to provide an assessment of the impact on U.S. national security interests of all potential computer uses at the new control levels. That was to have been addressed elsewhere in the report. However, none of the five reports that we reviewed has done so.

2. Based on your testimony, is it accurate to say that while the GAO has determined that MTOPS is no longer an effective metric to measure computing power, you are not recommending abandoning *hardware* controls altogether?

   We do not have sufficient basis to recommend abandoning hardware controls on computers. We believe that a serious and comprehensive assessment of alternatives to export controls must be completed before concluding that hardware controls have no utility at all. Policymakers would benefit from having such information when deciding on the utility of continuing or eliminating computer hardware controls.

   --Would you recommend doing away with the MTOPS standard, because it is imperfect, before replacing it with a better standard to control hardware?

   We would not recommend this course of action. If the MTOPS measure were eliminated before a suitable replacement could be identified and implemented, then there would be *no* controls on computer hardware at all. Furthermore, reimposing controls on computers that had already become available would likely prove to be impractical and unpopular.

3. In its January report on HPC export controls, the Clinton Administration proposed replacing

hardware controls, such as MTOPS licensing, with controls only on computer software. Did the Administration propose a system for controlling software, and is it true that even then, these controls would only apply to government-owned or controlled software?

The executive branch proposed controlling software by raising user awareness of existing regulatory controls on software. The executive branch also proposed to begin research into ways to enhance the physical protection of software. The second proposal would involve only government-owned or -controlled software. Such research is in its earliest stages.

—It seems reasonable that the best approach to safeguarding U.S. national security is by employing a combination of hardware and software controls. In fact, in your December 2000 report on export controls, the GAO discussed nearly a dozen alternatives to the current MTOPs metric. Can you discuss some of these ideas?

We identified 12 ideas for addressing shortcomings to the current export control system. These ideas have not been comprehensively evaluated by the U.S. government. The government/computer industry Information Systems Technical Advisory Committee (ISTAC), under Commerce Department auspices, considered three ideas we describe in our December report. We also presented nine additional ideas identified through our research and discussions with experts. These ideas have not been assessed for their feasibility to replace the current export control mechanism; moreover, most of them would not address the challenge created by advances in clustering technology.

- **Counting Processors Instead of Using MTOPS: Using this approach, computers would be controlled by counting the number of processors in each computing system. For example, a license might be required if a computer to be exported to tier 3 countries contained eight or more processors, while computers with fewer processors could be exported without a license. Presumably, the precise number of processors for each tier would be determined as the details of such a proposal were finalized.**

- **Indexing Control Thresholds to a Common Benchmark: Computer export control levels could be set by using a common performance benchmark. The May 2000 ISTAC paper on alternative control measures also identified one**

benchmark, Linpack, that it called an accepted industry standard for performance measurements. The paper suggested continued study of the benchmark, which might have more relevance to higher performance computers (at 100,000 MTOPS) in the future.

In addition to ideas to replace MTOPS discussed above, ideas were identified from studies and discussions with government and industry experts as other ways to protect U.S. national security interests relative to high performance computer exports. These included

- **Tagging and Remote Monitoring: Tagging and remote monitoring is an idea that has been discussed in export control literature for several years. It is achieved by attaching a monitoring system to the item that is to be exported. The active system would both monitor the object tagged and communicate that information to the United States.**

- **Controlling Computer Systems Based on Bandwidth: A concept discussed in the Department of Defense would develop a methodology to control computer systems by some measure of processor-to-main-memory bandwidth (the amount of data that can be transmitted in a fixed amount of time.) and potentially the number of processors in each system. The methodology would need to distinguish between commodity systems and the traditional class of supercomputers characterized by specialized processors. Such computer systems typically have a single processor and require a high level of bandwidth, such as those manufactured by Cray, NEC, and Fujitsu.**

- **Implementing Countermeasures to Military Advantages Gained by Countries of Concern From Acquiring More Advanced Computer Exports: Using this option, DOD would design countermeasures to deal with the implications of wider computer availability. One purpose of export controls is to maintain the U.S. technological lead in military capabilities by denying transfers of advanced technology to countries of concern. As technological advances in high performance computing make this purpose more difficult for export controls to achieve, it may become necessary to explore other options to maintain the U.S. technology lead.**

4. In your written testimony, you state that the Clinton Administration, and more specifically

the Departments of Defense and Commerce, made national security determinations with regard to further relaxing export controls, assessed the military significance of these changes, and recommended completely new approaches to export controls without providing one shred of evidence that they conducted any type of rigorous, empirical analysis?

—Does their lack of supporting evidence lead you to believe that their assessment consisted of an "in house" discussion of the issues with heavy input from the computer industry?

The principal Defense Department authors of the study that was cited as the basis for the President's policy proposal said their effort was not accorded a high priority and was completed in addition to their regular duties and with no additional resources. They described discussions that they had had within their own office and with computer industry officials but could not document the list of experts with whom they spoke.

5. On page four of your written testimony, you seem to suggest that, because the president's policy proposals recommended relying more on vendors to know their customers and would eliminate an annual reporting requirement that provides information on end users, these changes would cause harm to our nonproliferation efforts. Is that an accurate statement?

Elimination of these requirements would reduce the amount of useful information available to the U.S. government regarding end users of concern and would place a greater burden on computer vendors to assess customer intentions. However, without a risk assessment of the impact of greater availability of high performance computing to tier 3 countries on U.S. national security interests, it is impossible to determine whether or how much U.S. nonproliferation efforts would be harmed by eliminating these reporting requirements.

—In your written testimony you discuss some past examples wherein relying on computer vendors has resulted in serious diversions of U.S. HPCs. Can you elaborate more on this part of your testimony?

On July 31, 1998, the Department of Justice announced that IBM East Europe/Asia Ltd. entered a guilty plea and received the maximum allowable fine of $8.5 million for violating 17 counts of U.S. export laws.

More recent examples include the following:

- **On March 27, 2000, a Miami-based computer exporting company was convicted on federal charges relating to the illegal export of U.S. origin goods to embargoed destinations in tier 4 countries and ordered to pay a criminal fine of $250,000.**
- **On March 20, 2000, a freight forwarder in San Francisco settled allegations that it had arranged for a shipment of computers to the People's Republic of China in violation of a condition on the Commerce export license and agreed to pay a civil penalty of $20,000.**
- **On August 3, 2000, a Massachusetts computer company was ordered to pay a civil penalty of $13,000 for exporting computer equipment to Israel in 1995 without the required authorization.**
- **In addition, an ongoing investigation of Silicon Graphics is examining whether a violation of law occurred in a sale of high performance computers to a Russian nuclear weapons laboratory in the mid-1990s.**

6. Of course, now, for the first time, that the notification level has been raised to the same level as the licensing threshold, the government clearly no longer has any visibility, let alone any ability to act, on any computer exports to questionable to end users or end uses. This is certainly a big blow to our nonproliferation efforts. Would you agree?

- **The merging of the licensing and notification levels has implications for U.S. nonproliferation efforts based on the "catch-all" controls that allow the U.S. government to restrict exports of any items to end users engaged in proliferation activities. By eliminating advance notifications to the Commerce Department on computer exports to tier 3 countries, potentially useful end user information will be eliminated.**

—In your written testimony, you cite over 200 cases between February 1998 and September 2000, where, because the notification level was set lower than the licensing threshold, the government was either able to place conditions on a license, return them without action, or deny them outright for either national security or other reasons. Are we to assume, therefore, that because of this recent policy change, HPCs will probably be

shipped legally to bad end users in the future?

Whether or not HPCs will be shipped to bad end users depends on the ability and willingness of computer vendors to "know your customer" and assess their intentions. However, the record clearly shows that vendors are not always able or willing to make those assessments. If the U.S. government can prove that a computer exporter knows or has reason to know that an end user would utilize a computer for proliferation purposes, then the export sale would be deemed illegal if exported without a license.

7. One of the former president's justifications for raising licensing thresholds for HPCs was based on the argument that clustering of widely-available, less-capable computers gives you equivalent power. However, the GAO's December 2000 report on HPC export controls states that although readily-available computers can be clustered to achieve a computing power of 70,000 MTOPs, these systems have several limitations. Can you please elaborate on the limitations of clustered computers?

There are several limitations on using clustered computers for a wide array of applications.

The time needed to operate an application might be longer on a clustered system because of delays in communicating between processors and in moving information into and out of memory storages.

Adapting and rewriting applications software to run on a clustered system—if not already adapted for parallel computing systems—could require considerable resources and time, sometimes up to 3 to 5 years, according to computer experts.

Adequately supporting computer functions requires an efficient schedule for running hundreds of separate problems and operations among a computer, its local disks, networks, and archival storage. Without vendor-supplied software to automate these functions, everything must be done manually, making production computing a labor-intensive operation. U.S. practice is to pay computer vendors to supply this support. Foreign countries, such as India and China, where skilled labor is plentiful and low cost, may find

providing this support less of a problem.

On the other hand, clustered computing systems are significantly less expensive than more traditional vendor-supplied computers (measured in tens of thousands vs. millions of dollars), and the performance gap between these types of systems has been closing in recent years.

—How significant are these differences when you look at systems such as real-time data links and battlefield management?

- **These differences might be significant when considering running such applications on clustered computer systems. For research and development applications, where long-term results might be measured in months or even years, an operator might be able to afford the lengthier time sometimes required to complete an application on a clustered computer system. On the other hand, it is more difficult to use clustered computer systems in certain operational applications, such as battlefield management activities, that require real-time or near real-time functions.**

—In your written testimony, you state that because of the President's January changes, "tier 3 countries would be able to freely obtain American high performance computers almost a year before they would be able to assemble comparable cluster systems." Based on this assessment, we are literally giving potential adversaries our leading-edge technologies and aren't even trying to "slow them down." Would you agree?

- **The January threshold of 85,000 MTOPS was derived from an estimate of a computing system based on Pentium 4 processors and other components that are expected to be commercially available and mass marketed by the end of 2001. As such, these do not represent American leading-edge technologies, such as would be available with more advanced commercially available processors (such as the newer "Itanium" microprocessor). However, given that control thresholds are being designed to rise in advance of the technology's availability, there appears to be no attempt to slow down tier 3 countries' access to such computing.**

—Furthermore, even if tier 3 countries were able to "cluster" comparable systems,

another important advantage to *legally* buying a single HPC from a U.S. manufacturer is that you get the parts, servicing, and expert assistance that comes along with this sale. If we want to "slow down" our potential adversaries, doesn't it seem to make sense to deny them with these types of services?

This would be a policy decision that would depend on a quantifiable assessment of the amount of time that a given tier 3 country might reasonably be expected to devote to maintaining and operating a clustered system while operating specific militarily significant applications. The Congress directed the Defense Department to report on such information in section 1406 of the fiscal year 2000 National Defense Authorization Act. We understand that this report is awaiting signature for release to the Congress.

8. If you accept the argument that HPCs are so widely available that we shouldn't control exports to tier 3 countries, then why should we even try to control computer exports to the tier 4 rogue states?

The recent changes notwithstanding, there may be reasons to maintain the controls on exports to tier 4 countries. For example, export controls on computers serve U.S. foreign policy interests by denying technology to proliferators and states sponsors of terrorism. In order to determine the value of maintaining or abandoning these controls, a thorough review of U.S. security interests would be needed to determine the best means of achieving our goals in the current environment. We believe that this is an analysis that should have been included in the national security assessment that we recommended in our 1998 report.

In addition, abandoning computer controls to tier 3 countries entirely promises to make enforcement of controls against tier 4 rogue states more difficult. The current and proposed changes will significantly increase the number of countries that have access to supercomputing capabilities, and, therefore, could act as transshipment points into tier 4 countries.

9. In your December report, the GAO stated that the president's report was inadequate because it only addressed 22 of the 172 known military uses of HPCs at the new threshold, even though this information was available. Now you seem to be telling us that this latest threshold change (to 85,000 MTOPS) will allow potential adversaries all but 4 of the 194

militarily significant applications identified in a 1998 DoD report, and that even more recent information the GAO obtained suggests that there may be between 300 to 500—not 194—militarily significant applications computer applications out there. Can you comment on the significance of these findings?

The executive branch has continued to base export control and national security decisions on information that is increasingly incomplete and outdated. The new administration lacks the information, data, and analyses it needs to make adjustments to U.S. strategy, even as a number of factors are rendering the traditional export control regime less effective, as implemented. Consequently, the U.S. government is hindered in its ability to formulate a strategy for the continued use of export controls or the use of any alternative means that may be necessary to protect relevant U.S. national security interests.

10. In your written testimony, when discussing the implications of the announced changes, you state that "the inadequacies of the president's justifications for raising the performance thresholds to 85,000 MTOPS at this time and for eventually abandoning computer hardware export controls demonstrates the need for further study of the issues involved before the United States commits to the President's proposals. This is especially critical given that new software controls are untested?" This is pretty strong language. What you seem to be saying is that we need to put a freeze on any further changes to HPC export control policies, and possibly even roll some of them back, until we can conduct a thorough national security risk assessment. Is this accurate?

The changes announced in January 2001 were intended to remain in place until the end of the year, effectively "freezing" controls at the January level. Nonetheless, the need for a thorough national security risk assessment is indeed critical for a number of reasons raised by the committee during the hearing. For example, there has not been a comprehensive evaluation of the national security implications of the increased use of dual-use items in military procurement in recent years. Consequently, the lengthy deliberations and controversy surrounding changes to export controls on high performance computers may be duplicated annually, as more and more previously controlled items are drawn from mass-market sources. Also, the U.S. government needs an assessment of these issues now to formulate and implement a new strategy as quickly as possible, and integrate it within the broader multilateral nonproliferation arrangements to which the United States is a party.

11. In your written testimony, you state that repeal of the statutory requirements for annual reports on all computer exports to potentially sensitive destinations, and suggest that other

measures required by the National Defense Authorization Act of 1998 might be detrimental to our nonproliferation efforts. Is that an accurate summary of your testimony, and if so, are you recommending that the FY '98 NDAA provisions related to HPC export controls not be repealed?

- **Policymakers should carefully consider the implications of reducing the amount of information on computer exports that is currently available to the U.S. government. The loss of information from these reports would make the current export control system less effective, insofar as the government relies on information both before and after computer shipments to implement effective regulations and enforce them. As envisioned, the revised system will be based almost totally on *vendor* assessments, rather than prior *government* reviews, of end users. Shifting the governmental responsibility of end user review to industry in light of past difficulties in implementing this responsibility is not without risk to U.S. nonproliferation interests.**

12. For decades, foreign availability has been defined under U.S. law as "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." While this standard has worked to protect U.S. national security without ceding overseas markets to foreign producers, the computer industry and others are now using the term "widely available" as a possible substitute to "foreign available." In fact, the Commerce Department has described this as an outdated Cold War concept. Can you explain the significance of the differences between these two terms, particularly as it applies to export controls and U.S. national security?

- **The most significant difference between the two concepts of availability is that the "foreign availability" standard sets a more stringent test for determining availability than does "widely available." In addition, "foreign availability" is supposed to consider (1) items produced *by* foreign suppliers and (2) the export controls of the country to which they are subject. Determinations based on the "widely available" concept are not required to consider either.**

  Specifically, the Export Administration Act states, "In accordance with the provisions of this Act, the President shall not impose export controls for foreign policy or national security purposes on the export from the United States of goods or technology which he determines are available without restriction from sources

outside the United States in sufficient quantities and comparable in quality to those produced in the United States so as to render the controls ineffective in achieving their purposes, unless the President determines that adequate evidence has been presented to him demonstrating that the absence of such controls would prove detrimental to the foreign policy or national security of the United States." [50 U.S.C. App. Section 2403(c)] Furthermore, regulations provide criteria to be used and procedures to be followed in making a determination of foreign availability.

In contrast, the term "widely available" is not defined in either law or regulation. The executive branch applied this term to use as a criterion for relaxing high performance computer export controls beginning in 1996. Generally, the executive branch has referred to computers as "widely available" when they were to be available from any source, including the United States. Consequently, according to Commerce, "controllability" of computers would depend on the volume of production, types of microprocessors used in HPC configurations, and extent to which such multi-processor configurations and components could be easily assembled into finished computers and maintained by foreign end users. To determine how "widely available" high performance computers are, the executive branch gathered information from U.S. computer and microprocessor manufacturers on microprocessor production and marketing schedules and the availability of other core components (many of which are produced outside of the United States), according to the Commerce Department Under Secretary for Export Administration.

—While it may be true that the U.S. needs to "run faster" by investing more into research and development of advanced computer and IT systems, would you agree that some controls on hardware can be effective in "slowing down" potential adversaries with no material impact on U.S. businesses?

Yes. Requiring export controls on high performance computing hardware could force entities in countries of concern to build and operate clusters to achieve military or proliferation purposes or to seek to acquire vendor-supplied machines from other sources with less stringent controls than the United States. To the degree that clusters or non-American high performance computers required additional time and resources to achieve results, then the country of concern would be "slowed down" to some undetermined level. If policymakers had sound information on the

amount of additional time it would take to run particular applications on clustered systems, then policymakers might have an informed basis on which to determine the relevant costs of "slowing down" potential adversaries. Similarly, industry should be expected to demonstrate with verifiable data where export controls have had a material impact on businesses so that policymakers might also factor such data into their decisions.

—In fact, last May the computer industry argued for decontrol because it claimed its new Itanium microprocessor would be on the market by the Fall of 2000. Yet nearly a year later, I am told that the Itanium chip won't be on the market now until the end of 2001. Can you comment on this?

The latest information we have seen indicates a late 2001 introduction for the Itanium microprocessor.

13. In addition to facilitating the control of items leaving the United States, export licenses provide the government with other important uses, such as audit trails and the ability to conduct cumulative effects analyses. Can you elaborate on the importance of export licenses to these and other law enforcement and nonproliferation activities?

In general, having more information is better than less, especially when trying to determine whether end users and end uses for an item will be appropriate. Licenses are one source of such information, as are advance notifications pursuant to the National Defense Authorization Act of 1998. Other information used for export enforcement purposes, including investigations of potential violations of law are derived from various reports, including NDAA reports, Shippers' Export Declarations (which we have found to be incomplete and unreliable in the past), and post-shipment verification visits. As to the full potential value of export control data on sensitive items, that determination would be better made within the context of a thorough national security risk assessment that would flesh out the ends and means of national security interests in this area.

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