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IMPACTS OF U.S. EXPORT CONTROL POLICIES ON SCIENCE AND TECHNOLOGY ACTIVITIES AND COMPETITIVENESS

HEARING

BEFORE THE

COMMITTEE ON SCIENCE AND TECHNOLOGY
HOUSE OF REPRESENTATIVES

ONE HUNDRED ELEVENTH CONGRESS

FIRST SESSION

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IMPACTS OF U.S. EXPORT CONTROL POLICIES ON SCIENCE AND TECHNOLOGY ACTIVITIES AND COMPETITIVENESS

WEDNESDAY, FEBRUARY 25, 2009

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
Washington, DC.

The Committee met, pursuant to call, at 10:09 a.m., in Room 2318 of the Rayburn House Office Building, Hon. Bart Gordon [Chair of the Committee] presiding.

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES
WASHINGTON, DC 20515

Hearing on

Impacts of U.S. Export Control Policies on Science and Technology Activities and Competitiveness

February 25, 2009
10:00 a.m. – 12:00 p.m.
2318 Rayburn House Office Building

WITNESS LIST

Lt. General Brent Scowcroft (USAF, Ret.)
President
The Scowcroft Group

Mr. A. Thomas Young
Lockheed Martin Corporation (Ret.)

Dr. Claude Canizares
Vice President for Research and Associate Provost
Massachusetts Institute of Technology

Gen. Robert Dickman
Executive Director
American Institute of Aeronautics and Astronautics

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HEARING CHARTER

COMMITTEE ON SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

Impacts of U.S. Export Control Policies on Science and Technology Activities and Competitiveness

WEDNESDAY, FEBRUARY 25, 2009
10:00 A.M.—12:00 P.M.
2318 RAYBURN HOUSE OFFICE BUILDING

Purpose

On Wednesday, February 25, 2009 at 10:00 a.m. in Room 2318, Rayburn House Office Building, the Committee on Science and Technology will hold a hearing to review the impacts of current export control policies on U.S. science and technology activities and competitiveness and to examine the findings and recommendations of the National Academies study, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World.*

Witnesses

Lt. General Brent Scowcroft (Ret.), Co-Chair, National Academies Committee on Science, Security and Prosperity, and President and Founder, The Scowcroft Group

Mr. A. Thomas Young, Co-Chair, Center for Strategic and International Studies Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls, and Lockheed Martin Corporation (Ret.)

Dr. Claude R. Canizares, Vice President for Research and Associate Provost, Massachusetts Institute of Technology

Maj. General Robert Dickman (Ret.), Executive Director, American Institute of Aeronautics and Astronautics

Issues

Some of the issues the hearing will explore include:

- What are the implications and unintended consequences of current export control policies for the conduct of United States Government and commercial science and technology activities and national security?
- How does U.S. export control policy affect U.S. scientific and technological competitiveness?
- What are the principal findings and recommendations of the National Academies report, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World,* as they relate to the conduct of U.S. Government and commercial science and technology activities and U.S. global science and technology competitiveness?
- What is required to implement the National Academies' report recommendations and what are the most significant challenges in doing so?
- U.S. export control policies have an impact on the conduct of the U.S. commercial space industry and government civil space activities. What particular issues and unintended consequences do the current export control policies present for U.S. civil and commercial space activities, including space-based research and human space flight activities? How serious are those issues and what must be done to address the unintended consequences?
- What are the most critical issues relevant to U.S. civil government and commercial space activities that should be considered in any potential review of U.S. export control policies?
- What effect, if any, do the unintended consequences of U.S. export control policies have on U.S. leadership in space in the near-term and long-term?

INTRODUCTION

The Cold War sparked the United States to make historic investments in scientific research and development that could serve our national security needs, including the support of university, government, and industrial research institutions. Those Cold War investments created a robust science and engineering workforce, drove innovation, fueled economic growth, and established the United States' preeminence in science and technology.

The Soviets, however, sought access to U.S. technologies for potential military applications. In response, the U.S. instituted mechanisms aimed at preventing the transfer of certain U.S.-developed components, systems, and information to the Soviet Union and other adversaries. These national security controls include the classification system, export controls, limitations on the transfer of knowledge about technologies, visa controls, and measures to restrict the dissemination of certain government-funded research that could threaten national security.

Export controls, which are the focus of this hearing, are directed by the *Arms Export Control Act of 1968* and the *Export Administration Act of 1979*. The *Arms Export Control Act* governs the export of components and systems that are listed as defense articles; the Department of State administers the International Traffic in Arms Regulations (ITAR), which are the regulations to implement the Act. The U.S. Munitions List (USML) comprises the list of defense articles regulated under the ITAR; and that list includes such categories of items as tanks and military vehicles, aircraft and associated equipment, military electronics, optical and guidance and control equipment, toxicological agents, and spacecraft systems and associated equipment. ITAR also controls technical data, including data for the design and development of defense articles, and defense services, which are *"The furnishing of assistance (including training) to foreign persons, whether in the United States or abroad in the design, development, engineering, manufacture, production, assembly, testing, repair, maintenance, modification, operation, demilitarization, destruction, processing or use of defense articles"* [International Traffic in Arms Regulations, Section 120.9(a)(1)].

The *Export Administration Act* governs the export of dual-use items—those that have military and as well commercial applications—including software and technology. The Act is implemented through the Export Administration Regulations (EAR), which are administered by the Department of Commerce. The EAR controls the export of dual-use items on the Commerce Control List, including software, hardware, and other systems subject to the EAR. The EAR also controls *"Any release of technology or source code subject to the EAR to a foreign nation. Such release is deemed to be an export to the home country or countries of the foreign national."* [EAR Part 734] These "deemed exports" include technology or software released through

> *"(i) visual inspection by foreign nationals of U.S.-origin equipment and facilities;*
>
> *(ii) oral exchanges of information in the United States and abroad; or*
>
> *(iii) the application to situations abroad of personal knowledge or technical experience acquired in the United States."* [EAR Part 734]

The *Export Administration Act* has *"lapsed several times,"* according to the National Academies report, *Beyond "Fortress America,"* and presidential authorities have sustained EAR requirements by using the *International Economic Emergency Powers Act of 1977, "on the grounds that the expiration of the act poses an 'unusual and extraordinary threat to the national security, foreign policy and economy of the United States',"* according to the report.

What these controls mean in practice is that an institution such as a company or university may need to apply for an export control license to export controlled hardware or software (for example as part of an international space research mission or sale of a product or components abroad). The institution may also need to obtain a license to share designs, conduct training related to the controlled item, or discuss information about the item with a non-U.S. citizen who is abroad or working in the U.S. Export control licenses, especially ITAR licenses, require a significant review and interagency approval process that may take months.

During the late 1990s, the implementation of export control policies tightened in response to findings about the unintentional transfer of controlled defense technologies and information to China. Since those changes, the time required to approve ITAR licenses, in particular, has put stress on the federal agency systems for processing licenses and on the applicants for those licenses. In 2007, the Government Accountability Office (GAO) commented that the time required for processing export licenses *"increased from a median of 13 days in 2002 to 26 days in 2006."* And by late 2006, *"State's backlog of applications reached its highest level of more*

than 10,000 open cases." The time involved in obtaining Technical Assistance Agreements (TAAs), which are required to discuss ITAR-controlled technologies, has also increased.

These delays mean that commercial companies may lose the opportunity to respond to a bid while waiting for a license, and that government projects may be delayed and incur cost increases. Other impacts of export controls pertain to researchers who may not be able to discuss ideas or research equipment with foreign colleagues at an international conference for fear of inadvertently transmitting controlled information. Failure to comply with the ITAR and EAR can carry fines and criminal penalties. The later sections of this charter provide additional examples of the unintended consequences of the policies and the challenges in implementing them.

A large number of organizations have made statements, released positions, led studies, and issued recommendations for improvements to the export control system. Some of those institutions include The Aerospace Industries Association, the Space Enterprise Council of the U.S. Chamber of Commerce, the Universities Space Research Association [an association of 102 universities], the Space Foundation, the Association of American Universities, the Council on Governmental Relations, the Center for Strategic and International Studies, and the Coalition for Security and Competitiveness [which includes the Aerospace Industries Association, American Association of Exporters and Importers, American Electronics Association, The Association for Manufacturing Technology, Business Roundtable, Chamber of Commerce Space Enterprise Council, Coalition for Employment Through Exports, Electronic Industries Alliance, General Aviation Manufacturing Association, Government Electronics and Information Technology Association, Industrial Fasteners Institute, Information Technology Industry Council, National Association of Manufacturers, National Defense Industrial Association, National Foreign Trade Council, Satellite Industries Association, Space Foundation and U.S. Chamber of Commerce.]

The Department of State has taken some steps to increase the efficiency of processing export control licenses. However, a 2007 GAO report commented that *"Despite efforts to improve efficiency, State's median processing times of license applications have been increasing since 2003."* In January 2008, the Bush Administration issued U.S. Export Control Reform Directives to *"ensure the United States' export control policies and practices support the National Security Strategy of 2006, while facilitating the United States' continued international economic and technological leadership,"* according to a release issued by the White House Office of the Press Secretary. A fact sheet released by the State Department's Bureau of Political-Military Affairs noted that the directives included making additional resources available to handle defense trade licenses, upgrading an electronic licensing system, and improving dispute resolution and enforcement.

During the 110th Congress, the House passed H.R. 5916, the *Security Assistance and Arms Export Control Reform Act,* which directed the President *"to conduct a comprehensive and systematic review and assessment of the United States arms export controls system in the context of the national security interests and strategic foreign policy objectives of the United States,"* among other provisions. However, the bill never became law. During the 110th Congress, the House also passed H.R. 6063, the *NASA Authorization Act of 2008,* which was introduced by Rep. Mark Udall, chairman of the Subcommittee on Space and Aeronautics, Committee on Science and Technology. H.R. 6063 directed the Office of Science and Technology Policy to carry out a study of export control policies related to civil and commercial space activities. The House-passed provision did not make it into law. Other legislation on export controls was introduced during the 110th Congress but was not acted upon.

In addition, during his campaign, then-candidate Barack Obama issued a white paper, "Advancing the Frontiers of Space Exploration," in which he stated that he would *"direct a review of the ITAR to reevaluate restrictions imposed on American companies, with a special focus on space hardware that is currently restricted from commercial export."* His paper also stated that he would revise the licensing process, without impact to American national security, to ensure that American aerospace supplier companies are competitive in the global market.

THE CHANGING ENVIRONMENT

The geopolitical landscape has changed dramatically since national security controls were put into place. Advances in communications technologies have facilitated the growth of a global marketplace of goods and ideas. In addition, science and technology, which is increasingly international, has become a primary agent of the Nation's national and economic security. Recently, studies sponsored by both government and non-government institutions have called for reexamining national security

controls in light of their impacts on our global scientific, technological, and economic competitiveness.

In its January 2007 report, the GAO identified the export control system as a new high risk area. In July 2007 the GAO released a report in which it found that *"Given the importance of the system in protecting U.S. national security, foreign policy, and economic interests, it is necessary to assess and rethink what type of system is needed to best protect these interests in a changing environment."* And in January 2009 the GAO reported on the status of the government's progress in implementing GAO recommendations. Their report, *Ensuring the Effective Protection of Technologies Critical to U.S. National Security Interests,* found that

> *"Over the years, GAO has identified weaknesses in the effectiveness and efficiency of government programs designed to protect critical technologies while advancing U.S. interests. Since this area was designated high risk in 2007, the agencies responsible for administering these programs, including the Departments of Commerce, Defense, Justice, State and the Treasury, have made improvements in several areas. However, vulnerabilities continue to exist, and agencies have yet to take action to address GAO's major underlying concern, which is the need for a fundamental re-examination of current government programs to determine how they can collectively achieve their mission and to evaluate the need for alternative approaches."*

The need for new approaches to the export control system was the thrust of the recently released National Academies report, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World.* The report considered the multiple dimensions of national security controls including *"the changing requirements of national security from the Cold War era, the impact of economic globalization on the U.S. economy, the impact of the globalization of science and technology on the U.S. economy and on its S&T leadership . . .."*

The National Academies report took a broad look at dual-use export controls—those technologies that may have both commercial and military applications—and science and technology competitiveness. The National Academies committee also considered visa policies given the importance, as discussed in the report, of the U.S. being engaged in science and technology internationally and learning from the best and brightest outside the U.S. The report did not address the classification system, existing statutes, or policies that may prohibit technology transfers to a particular nation. In addition, the committee did not make recommendations on multilateral export control regimes or consider how individual agencies manage and administer export control regulations. The report specifically focused on issues that could be addressed through Executive authority.

In general, the report recommends significant changes to foster *"openness and engagement"* and that would require the government to provide a *"rational basis"* for restrictions on dual-use items planned to be exported. The report recommends that the President make some structural and policy changes by issuing an Executive Order under the authority of the *International Economic Emergency Powers Act of 1977.* According to the report, the Act allows the President to *"structure the regulatory framework of the dual-use export controls system."*

The National Academies committee, co-chaired by John L. Hennessy, President, Stanford University and Lt. General Brent Scowcroft (ret.),former National Security Advisor, concluded:

> *"As a nation, we cannot, and should not abandon well-conceived efforts to keep dangerous technology and scientific know-how out of the hands of those who would use this knowledge to create weapons of mass destruction and other, equally dangerous military systems. However, these represent a very narrow and limited set of goods, technology, and knowledge. Our former unilateral strategy of containment and isolation of our adversaries is, under current conditions, a self-destructive strategy for obsolescence and declining economic competitiveness. A strategy of international engagement is a path to prosperity that can be coupled with a smarter approach to security using an adaptive system of government regulation and incentives. The committee recommends the issuance of an Executive Order that implements the recommendations it has outlined as one of the first orders of business in January 2009."*

Some of the elements of the Order would include:

- Establishing a process for removing every item on a control list after 12 months unless there is a strong case for keeping it;

- An economic competitiveness exemption that *"eliminates export controls on dual-use technologies where they, or their functional equivalents, are available without restriction in open markets outside the United States"*;
- Establishing a coordinating center for export controls that would receive license applications, determine the appropriate jurisdiction for those licenses (i.e., Commerce or State), ensure the efficient processing of licenses, and manage an appeals process;
- Creating an independent export license appeals panel; and
- Ensuring support for excluding fundamental research from export controls.

The complete list of report recommendations is included in Attachment A and a list of the members of the study committee is provided in Attachment B.

While the National Academies report addressed the broad and interrelated issues of national security controls, economic security, and science and technology competitiveness, certain sectors of scientific research and commercial activity are particularly affected by the export control system. All satellites are export-controlled by the ITAR, and the implications of the regulations has been a matter of concern for the industries, universities, and other institutions that are involved in commercial and civil space activities. A number of studies have examined the unintended consequences of export controls on the U.S. civil and commercial space sectors, and the results of those studies and the issues they raise are detailed in later sections of this charter.

Questions related to the National Academies report include such things as what, in specific terms, would be involved in implementing the National Academies' recommendations? At what point after an Executive Order is in place should we expect to see improvements in the export control system? What, specifically, does the recommended Executive Order address? What, if anything, is missing from the Order? What areas does Congress need to address? How would implementing the recommendations mitigate the impacts raised in specific sectors such as civil and commercial space? What is the outlook if the National Academies' recommendations are not implemented?

NATIONAL SECURITY

The National Academies report, *"Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World,"* stated in the first finding of the report:

> *"Designed for the Cold War when the U.S. had global dominance in most areas of science and technology, the current system of export controls now harms our national and homeland security, as well as our ability to compete economically."*

The report also states:

> *". . . the export control system enforced in the U.S. today has failed to evolve with changing global conditions, and now produces significant harm to U.S. military capability, to homeland security, and to the Nation's economic competitiveness."*

The Department of Defense (DOD) examined the impact of export control policies on the health of the U.S. space industrial base and issued a report in 2007. The report, *Defense Industrial Base Assessment: U.S. Space Industry Final Report,* which will be discussed in later sections of this charter, states that *"The National Security Space Industrial Base (NSSIB) is critical to U.S. success in developing and deploying national security space assets."* As part of the conclusions, the report states that: *"To maintain and enhance the U.S. competitive position in the global market, ITAR processes need to be frequently reviewed and adjusted, as appropriate."*

In response to direction in P.L. 109–364, the *John Warner National Defense Authorization Act for Fiscal Year 2007,* the Institute for Defense Analyses produced a report, *Leadership, Management, and Organization for National Security Space.* The report, which was prepared by an Independent Assessment Panel chaired by Mr. A. Thomas Young, was accompanied by a letter to the Honorable Carl Levin, Chairman, Senate Committee on Armed Services that in part stated:

> *"Today, U.S. leadership in space provides a vital national advantage across the scientific, commercial, and national security realms. In particular, space is of critical importance to our national intelligence and war-fighting capabilities. The panel members nevertheless are unanimous in our conviction that, without significant improvements in the leadership and management of NSS [national*

security space] programs, U.S. space preeminence will erode to the extent that space ceases to provide a competitive national security advantage."

The Independent Assessment Panel (IAP) referenced a study by the Center for Strategic and International Studies (CSIS) on the health of the U.S. space industrial base, and noted that *"The IAP supports the recommendations of the CSIS panel to revisit the ITAR and relax those aspects that are counterproductive to U.S. competitiveness."* The findings of the CSIS study are discussed in later sections of this charter.

CONTROVERSIES ABOUT EXPORT CONTROL REFORM

According to the Congressional Research Service report, *The Export Administration Act: Evolution, Provisions, and Debate,* as updated on January 15, 2009, debate on export administration legislation tends to involve a conflict between national security and commercial concerns:

> *"These concerns are not mutually exclusive . . .. For example, nearly everyone favors reform of the current system, yet no one considers themselves opposed to national security. Generally, however, many who favor reform of the current export control accept the business perspective that such reform would assist U.S. business to compete in the global marketplace. Others view the issue more from a national security perspective. To this group, reform should be concerned less with the abilities of U.S. industry to export and more with the effective controls placed on potential exports to countries that threaten the security of the United States, terrorists, violators of human rights, and proliferators of weapons of mass destruction. From these different perspectives, controversies arise regarding the controllability of technology, the effectiveness of multinational regimes, the bureaucratic structure of the licensing process and the impact of export controls on the U.S. economy."*

ISSUES AND UNINTENDED CONSEQUENCES RELATED TO SCIENCE AND TECHNOLOGY COMPETITIVENESS

Overarching Findings of National Academies Report

The National Academies report identifies a number of specific findings that argue for revamping the current export control systems:

- *"U.S. national security, including the protection of the homeland, is not well served by the current controls.*
- *The single technology base that today supports both U.S. commercial and military capabilities is constrained from expanding into new fields and from applying new scientific developments.*
- *Entire international markets are denied to U.S. companies because they are forbidden to ship their technologically sophisticated products to foreign countries.*
- *Obsolete lists of controlled components prevent U.S. companies from exporting products built from prior generation technologies not likely to harm national security.*
- *U.S. scientists are hobbled by rules that prevent them from working with world-class foreign scientists and with advanced laboratories located overseas, making it less likely that valuable discoveries and inventions will occur in the U.S.*
- *The government's rules are driving jobs abroad—knowledge-intensive jobs critical to the future of the U.S. economy.*
- *The government's rules are accelerating the development of technologies in capable research centers outside the U.S."*

Impeding the Exchange of People and Ideas

The health of the U.S. science and technology depends on the free exchange and transport of *"people, ideas, materials, and equipment,"* as described in the National Academies report. Increasingly, science and technology competitiveness is dependent on having the ability to draw on the talent and capabilities of non-U.S. persons.

According to the report,

- *". . . with increasing frequency, important discoveries are made by scientists who work in teams and who have access to the best work going on in scientific centers around the world and state-of-the-art instrumentation."*

- *"Similarly, in a world in which breakthroughs can happen anywhere, being competitive requires being aware of—and capitalizing on—developments in other places . . ."*
- *"A new scientific breakthrough, or a newly developed technological capability, can stimulate additional research in laboratories around the world. Although science does depend on the ability of researchers to validate previously published results, the scientific reward system—and the allocation of competitively awarded resources—strongly favors the first to publish. Speed is equally critical in bringing high-technology products to market."*

U.S. visa policy governs our ability to benefit from non-U.S. scientific talent. The policy uses lists that identify certain areas of academic research, particular countries of concern, and specific research activities that require applicants to undergo special review. Visa policies were tightened after 9–11. Although *"the most draconian rules affecting graduate students were ameliorated"* the report notes, *"significant barriers still remain for scholars and researchers seeking visas to attend conferences or for other short-term professional trips in the United States."*

In light of the challenges and implications of export control and visa policies for carrying out fundamental research, the National Academies report finds that:

> *"The best practices that underpin successful competition in research and technology advancement* [freedom of inquiry, freedom to pursue knowledge at the scientist's own discretion, freedom to collaborate without limitation, pluralistic and meritocratic support of science, and freedom to publish] *are undermined by government regulation that restricts the flow of information and people participating in fundamental research."*

These impediments can have negative effects on the competitiveness of the U.S. scientific infrastructure within the global environment. For instance, the report notes that:

- *"Breakthrough discoveries in science often come when supporting advancements in related fields have occurred in sufficient numbers or new types of instrumentation have become available. If one researcher or laboratory 'misses' a new advance, it is likely that a competitive researcher elsewhere will make the discovery soon thereafter."*
- *". . . export controls and 'deemed export' rules make U.S. universities less able to attract the most capable foreign researchers or to retain some of the most creative faculty members. Important discoveries may be hindered, or may simply occur elsewhere."*
- *"Licensing requirements inevitably lead to delays, and they may deter or even eliminate the spontaneous discoveries that arise from serendipitous interactions and spur-of-the moment collaborations, most of which are impossible under 'deemed export' rules."*
- *"The best foreign universities now have the research equipment and infrastructure to compete with the best U.S. research universities for students and researchers. Where limitations exist on foreigners studying or working in the U.S. system, foreign universities are well positioned to extend competing offers."*

Implications for America COMPETES Act

The issues noted above have implications for the Nation's innovation and competitiveness and the types of actions directed in the *America COMPETES Act* [P.L. 110–69], which has as its three primary goals: 1) increasing research investment, 2) strengthening educational opportunities in science, technology, engineering, and mathematics; and 3) developing an innovation infrastructure. The National Academies report, *Rising Above the Gathering Storm,* which provided the basis for the Act, recognized the impacts of export controls and recommended that the current system of "deemed exports" be reformed:

> *"The new system should provide international students and researchers engaged in fundamental research in the United States with access to information and research equipment in U.S. industrial, academic, and national laboratories comparable with the access provided to U.S. citizens and permanent residents in a similar status . . . In addition, the effect of deemed export regulations on the education and fundamental research work of international students and scholars should be limited . . .."*

Using Lists to Control Exports

Using lists such as the Commerce Control List and the U.S. Munitions Control List, according to the National Academies report, are ineffective ways to control technology transfer because the technologies and information on the lists are, in many cases, available for sale on the open market from non-U.S. sources. The lists can also have the effect of advancing indigenous science and technology capabilities and competitiveness elsewhere. For example, the report notes that foreign nations may use the lists to prioritize research and development investments, because they anticipate that U.S. companies and institutions may face challenges in exporting those controlled technologies abroad. The case of U.S. commercial communications satellite development exemplifies this point. As a result of ITAR hurdles, Europe began to develop satellite components itself and to produce satellites that do not use U.S.-developed technologies rather than purchase the components, which are ITAR-controlled, from the U.S.

The lists also affect how U.S. researchers make decisions on the type of research they pursue. The National Academies report notes that *"Some avoid research in areas that are affected by federal controls out of an apprehension that significant work may not be published or that students or researchers needed for first-rate laboratories will not be available. Breakthroughs will thereby be thwarted."*

The recommendation from the National Academies is to: "Apply 'sunset' requirements to all items on export control lists that are controlled unilaterally by the U.S., and require findings to be made every 12 months that removing controls on an item would present a substantial risk to national security."

Fundamental Research Exemptions

In 1985, President Reagan issued National Security Decision Directive (NSDD) 189, which recognizes that *"our leadership position in science and technology is an essential element in our economic and physical security"* and *"The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component."* To that end, NSDD 189 states:

> *"It is the policy of this Administration that, to the maximum extent possible, the products of fundamental research remain unrestricted. It is also the policy of this Administration that, where the national security requires control, the mechanism for control of information generated during federally-funded fundamental research in science, technology and engineering at colleges, universities and laboratories is classification."*

During the late 1990s, however, the implementation of export control policies tightened in response to findings about the unintentional transfer of controlled defense technologies and information to China, and those changes raised questions about the fundamental research protections under NSDD 189.

In 2001, former National Security Advisor Condoleezza Rice reaffirmed the Directive, and in 2002 the State Department modified the ITAR as it applies to defense articles developed at U.S. universities for use in fundamental research. Section 123.16(10) of the ITAR states that:

> *"Port Directors of U.S. Customs and Border Protection shall permit, without a license, the permanent export, and temporary export and return to the United States, by accredited U.S. institutions of higher learning of articles fabricated only for fundamental research purposes."*

The exemption includes several conditions, including:

- *"The export is to an accredited institution of higher learning, a governmental research center or an established government funded private research center located within countries of the North Atlantic Treaty Organization"* or that have been designated as a non-NATO ally.
- *"All of the information about the article(s), including its design, and all of the resulting information obtained through fundamental research involving the article will be published and shared broadly within the scientific community, and is not restricted for proprietary reasons or specific U.S. Government access and dissemination controls or other restrictions accepted by the institutions or its researchers on publication of scientific and technical information resulting from the project or activity . . .."*

Despite the attempts to address the matter, the fundamental research exclusion *"has not had the effect of precluding all such restrictions"* according to the National

Academies report. The Council on Governmental Relations and the Association of American Universities has conducted surveys of U.S. research universities to gauge the problem of restrictive clauses on research. According to their report, *Restrictions on Research Awards: Troublesome Clauses 2007/2008,* issued in July 2008,

> *". . . federal agencies are expanding the type of controls they impose in award terms and conditions and are using more sophisticated (and varying) technical language and approaches for implementing restrictions that affect university research projects. Particularly alarming is the spread of restrictive award terms by federal agencies beyond contracts to federal assistance mechanisms, such as grants."*

Universities maintain that the export control regulations are confusing with respect to fundamental research, especially given that research usually involves participation by non-U.S. persons in American universities or abroad, and interactions with them may be considered exports.

The National Academies committee "recommends that the Fundamental Research Exemption be maintained, adhered to, and properly implemented. Universities and other research institutions have worked under this regime successfully and have in place the necessary mechanisms to comply with the exemption."

ISSUES AND UNINTENDED CONSEQUENCES FOR U.S. GOVERNMENT CIVIL AND COMMERCIAL SPACE ACTIVITIES

Commercial and civil space activities make significant contributions to the economy and the Nation's science and technology capabilities. In 2008, global sales for U.S. aerospace companies totaled $204 billion of which $33 billion was for the U.S. sales of space systems, according to the Aerospace Industries Association. Universities, federal laboratories, research institutions, along with private industry, conduct the Nation's space-based research activities. These commercial and research activities help engage and train the next generation of scientists and engineers and develop innovative technologies that contribute to our economic competitiveness.

The aerospace industry, especially the satellite manufacturing industry, has long maintained that export controls have led to decreasing competitiveness and loss of market share in the global market. In addition, space science researchers have identified unintended consequences of the ITAR on fundamental space research. Government officials have also questioned whether export controls are affecting the health of the space and defense industry. Recent studies have examined the impacts of export controls on these space sectors.

In 2007, the DOD completed a study, *Defense Industrial Base Assessment: U.S. Space Industry Final Report,* which involved gathering quantitative data on the U.S. space industrial base and reviewing whether export controls were affecting the industry. The study involved a survey of companies and business units that included prime contractors that sell products to commercial and/or government institutions (Tier 1), subcontractors that provide major components and systems to prime contractors (Tier 2), and lower tier companies that sell subassemblies, structures, materials and less complex components as well as engineering and other services (Tier 3). The DOD *Industrial Base Assessment* found that ITAR is having an impact on industry sales and competitiveness; examples of these impacts are provided in the sections below.

In 2008, the CSIS issued a *Briefing of the Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls,* which reviewed the results of the 2007 DOD *Defense Industrial Base Assessment,* interviewed and collected data from across the government, industry, and other experts, and examined the findings of other reports on export controls. The findings of the CSIS study echo many of the issues affecting the broader areas of science and technology that were raised in the National Academies report. The CSIS report concludes, for example, that:

- U.S. policies are not controlling the rapid proliferation of non-U.S. space capabilities and in some cases the policies are encouraging them;
- U.S. preeminence in space is being challenged;
- Current export control policies are restricting U.S. international space activities and partnerships; they have led to separation between U.S. and emerging non-U.S. space actors;
- Certain elements of export controls are in variance with U.S. National Space Policy; and

- U.S. market share in foreign space markets is declining and it is harder for U.S. companies to compete in non-U.S. markets, particularly for the lower tier companies.

The implications of these conclusions are described further in the sections below.

The National Academies held a workshop on the implications of the ITAR and space science. In 2008, the Academies released, *Space Science and the International Traffic in Arms Regulations: Summary of a Workshop.* The workshop summary pointed to the disconnect between the ITAR regulations, the fundamental research exemption, and the way in which space-based research is conducted. The ambiguities and uncertainties in the interpretation of and application of the ITAR requirements are leading academic institutions to be overly conservative in their actions. This results in concerns over loss of competitiveness in scientific research and education at U.S. institutions of higher learning, according to the report.

Increasing Foreign Capability and Diminished U.S. Leadership in Space

The CSIS report found that *"United States preeminence in space in under challenge in many areas."* Export controls have not thwarted the increasing capabilities of foreign space programs.

- According to the CSIS report, Chinese and Indian space programs have continued to make considerable progress including the launching of indigenous high resolution imaging satellites, lunar probes, and China's successful launch of a human into outer space and the successful execution of its first human space-walk activity.
- The report also notes that the number of nations with their own space-based positioning and navigation systems has tripled since 1999; the number of countries possessing earth observation and reconnaissance satellites has doubled since 1999; at least twelve nations are capable of launching their own satellites; and 38 countries can control the operations of their own communication satellites.
- According to CSIS, the capabilities of non-U.S. space countries participating in the commercial market has also grown. Non-U.S. companies are now capable of producing commercial communications satellites that are on par with those of the U.S.
    - As noted in the CSIS report, *"Since 1998, European and Asian manufacturers of satellites have gone from delivering satellites that were smaller, had fewer transponders, lesser payload power and shorter lives to manufacturing satellites of equal weight, number of transponders, payload power and lifespan."*
    - Europe has developed ITAR-free components and systems.
    - According to a news item of the European Space Agency, the European Commission, the European Space Agency, and the European Defense Agency *"have agreed to join forces in order to develop critical space technologies in Europe. The aim is to ensure that Europe can rely on a technical and industrial capacity for accessing space, in particular in the area of the manufacturing of satellites and launchers."*
- Foreign innovation and human capital are important to U.S. leadership in space but are increasingly harder to access. The U.S. has benefited from foreign innovation and talent. Foreign students obtain more than half of the Ph.D.s in science, technology, and engineering and workers born outside of the U.S. account for more than a quarter of the science and technology workforce in the U.S., according to the CSIS report. Export controls make it more difficult to take advantage of this talent pool, as noted in the CSIS report.

Conflicts with Objectives of U.S. National Space Policy

In 1996, the Clinton Administration issued a National Space Policy in which the policy's commercial space guidelines stated:

> *"The fundamental goal of U.S. commercial space policy is to support and enhance U.S. economic competitiveness in space activities while protecting U.S. national security and foreign policy interests. Expanding U.S. commercial space activities will generate economic benefits for the Nation and provide the U.S. Government with an increasing range of space goods and services."*

In 2006, the Bush Administration issued a U.S. National Space Policy, which superseded the 1996 policy, and states that:

"The United States Government will pursue, as appropriate, and consistent with U.S. national security interests, international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of space."

The 2006 Policy also supports the use of effective export policies and states that *"space-related exports that are currently available or are planned to be available in the global marketplace shall be considered favorably."*

The goals of the space policy include:

- *"Strengthen the Nation's space leadership and ensure that space capabilities are available in time to further U.S. national security, homeland security, and foreign policy objectives;"*
- *"Enable a dynamic, globally competitive domestic commercial space sector in order to promote innovation, strengthen U.S. leadership, and protect national, homeland, and economic security;"*
- *"Encourage international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of space, as well as to advance national security, homeland security, and foreign policy objectives."*

The CSIS report found that aspects of current export control policies and regulations are at variance with the national space policy. For instance, the export control system does not enable cooperation while also denying capabilities to adversaries. Placing satellites on the USML has encouraged the development of non-U.S. space capabilities, and ITAR regulations have had negative impacts for U.S. industry. CSIS also notes that export controls have interfered with a legacy of beneficial collaboration with foreigners and have made it difficult for international partners to resolve anomalies in collaborative space activities.

Issues for Fundamental Research Using Space-Based Hardware

In response to concerns about the transfer of export controlled hardware and information to China during the 1990s, the *Strom Thurmond National Defense Authorization Act for Fiscal Year 1999* [P.L. 105–261] transferred *"all satellites and related items that are on the Commerce Control List of dual-use items . . . to the United States Munitions List and controlled under section 38 of the Arms Export Control Act . . .."*

In 2002, the Department of State revised the ITAR language concerning scientific satellites for fundamental research. ITAR licenses are not required for scientific research satellites when specific conditions are met. Space researchers, however, report confusion about the application of that exemption to space research projects.

The summary report of the National Academies workshop on space science and ITAR noted that regulations are applied differently to institutions involved in a single space project—national labs, universities, industry, and government. In addition, researchers are unclear about the type of information that can be placed in the public domain, including in the classroom. Moreover, the fundamental research exclusion in the ITAR applies only to *"accredited U.S. institutions of higher learning."* There is also a lack of clarity about involving foreign students and researchers in space research projects that may use ITAR-controlled technology. Researchers are also unclear about what information regarding a satellite project they can share with non-U.S. individuals or students in an academic environment.

In the absence of clarity, universities and researchers interpret regulations conservatively and may add burdens that are not necessary and lead to decisions that affect university engagement in space research. For example, according to the National Academies' workshop summary, universities and researchers may make decisions not to pursue projects requiring ITAR licenses or to allow non-U.S. researchers and students to participate in space research projects. In addition, the report says that *"uncertainties are leading some professors to 'dumb down' course content rather than risk ITAR violations by discussing their research in the classroom setting."*

The workshop summary on space science and ITAR also notes that compliance *"creates a significant unfunded mandate for universities, because they operate with capped overhead costs . . .."* In addition, universities bear the costs of educating faculty and contracting and grants officers, maintaining documentation, handling negotiations with the State Department, and *"the substantial costs of delays in securing approvals for activities that fall under ITAR,"* according to the report.

Reduced Competitiveness of Space Industry

Both the CSIS study and the Defense Industrial Base Assessment make findings about the increasing challenges that U.S. space companies face in being competitive in foreign markets. According to the results of the DOD-initiated space industrial survey, *"Defense Industrial Base Assessment: U.S. Space Industry Final Report,"* several companies voluntarily commented that ITAR was an issue in being competitive in foreign space markets. For example, the *Assessment* notes that:

> *"Over two-thirds of the survey respondents felt strongly enough to add narrative comments with over a quarter of those encountering difficulties in export markets. Some companies have self-eliminated from foreign markets to focus on the domestic only market."*
>
> *"There have been a number of firms in all tiers that have not applied for export licenses (half of the companies surveyed) due to real or perceived problems with navigating the licensing process."*

One company commented that it chose to forgo space business because that business has not been profitable and some foreign customers will not procure items that require ITAR licenses.

- Of the companies that participated in the survey for the DOD *Assessment,* 58 percent listed export controls as the number one barrier to entry when attempting to market products abroad.
- According to the DOD *Assessment, "Companies reported $2.35B of ITAR-related potential sales lost due to the licensing process from 2003–2006, an average of $588M annually. This loss represents about one percent of total U.S. space revenues."* [Note that the $588M figure is a best estimate and does not include opportunities that were not pursued or that were lost due to ITAR. It may also involve some double-counting among competitors.]
- The cost of managing compliance with export controls is another challenge. *"Space industry-wide compliance costs averaged $49M per year in 2003–2006,"* according to the DOD Assessment, and created a significant financial burden, especially for smaller companies.

The CSIS recommendation is to "Remove from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use; provide safeguards by having Defense Department identify critical space components and technologies that should always require licensing and referral. Have the appropriate executive departments conduct a study to see if other space technologies should be removed from the list."

Pronounced Impacts on Competitiveness of Smaller and New Commercial Space Companies

The Assessment and the CSIS report found, in particular, that the burden of ITAR is *"more pronounced"* for smaller companies (the lower tiers) in terms of compliance costs and exports to foreign systems for example. It is the lower tier companies that are often the sources of innovation. The CSIS study found that *"Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the second and third tier. And it is the 2nd/3rd tier of the industry that is the source of much innovation, and is normally the most engaged in the global market place in the aerospace/defense sector."* In addition, the President and CEO of the General Aviation Manufacturers Association (GAMA) stated at a March 2008 forum on export controls that *"small companies where much of the innovation takes place* [are] *leary of participating in a program that could put them in a position of inadvertently violating export control rules."*

One space company that is aiming to sell access to a commercial space habitat found that the modular inflatable technology that forms the basis of its space habitat is export controlled. The company also ran into ITAR problems with a basic technical stand. As the company President, Robert Bigelow, reported in a February 2008 article in *Space News, "A wonderful example of the irrationality of the current regime is the 'technical stand' from our Genesis campaigns. This simple aluminum stand is composed of a circular base with several legs sticking out. If you were to turn the stand upside down it would literally be indistinguishable from a common coffee table. However, under the current export control regime, the stand was considered 'ITAR hardware' and we were required to have two security officers guarding the stand on a 24/7 basis while at our launch base in Russia."*

Lost Revenue in Satellite Manufacturing Market

The CSIS report notes that *"Study after study shows the same results, an erosion of U.S. share of the global commercial satellite market since the late 1990s."*

In addition, the DOD *Assessment,* shows that, based on Satellite Industry Association reports in 2004 and 2006,

- *"The U.S. share of global satellite manufacturing has decreased since the ITAR changes were implemented in 1999."*
- *"U.S. market share dropped from 63 percent in 1996–1998 to 52 percent in 1999–2001 and 42 percent in 2002–2006."*
- *"Revenues dropped in real terms as well from an average of $6.6B in the first period, to $5.5B in the transition period, and $4.2B in the most recent period of the data."*
- *"U.S. share of GEO [geostationary] commercial communications satellites manufactured has decreased 10 percent since 1998."*

Challenges for Government-Sponsored International Space Activities

Much of the Nation's civil space activities are international given the global nature of the marketplace, the benefits of commercial strategic partnerships, and the legacy of cooperation in NASA's space-based scientific research and human exploration mission programs. Export controls hinder these activities and may introduce safety concerns. The NASA director for export control noted at a March 2008 Aerospace States Association forum on Export Controls that:

> *"Unfortunately, certain provisos requiring separate and specific government review and approval for any collaborative anomaly resolution activity may impede the ability of NASA's contractors to expeditiously take action to assure operations safety and mission success, including during real-time operations, where an anomaly could be encountered." He said "Rendezvous and docking of the European Automated Transfer Vehicle (ATV) and Japanese H–II Transfer Vehicle (HTV) with the International Space Station are time-critical operations that require timely exchange of information for effective operations. In the event of an on-orbit problem, for the safety of the Space Station and its crew, ATV and HTV engineers must be able to quickly and easily share technical data—in real-time—with U.S. engineers . . .."*

Along those same lines, a 2007 report of the International Space Station Independent Safety Task Force (IISTF) explained that *"Currently the ITAR restrictions and the IP's objections to signing technical assistance agreements are a threat to the safe and successful integration and operations of the Station."* The study recommended that the State Department grant relief to NASA contractors working directly with the International Space Station (ISS) international partners and their contractors to enable engineering and safety reviews, program management interactions, and to handle anomaly resolution among other specific activities and that the *"Executive and Legislative Branches of the government should conduct a comprehensive and thorough review of government policies and procedures related to ITAR and related export controls as soon as practical."*

The CSIS recommendation on anomaly resolution is that: *"The Secretary of Defense and NASA Administrator, in addition to the Secretary of State, should have the authority to grant real-time, case-by-case, specific time period exemptions for anomaly resolutions deemed to be in the national interest based on criteria from the National Space Policy."*

The NASA export control director also commented that the State Department has *"advised NASA to seek legislative authority as a prerequisite to the Department's promulgation of an exemption to facilitate the implementation of NASA's programs, including the U.S. Space Exploration Policy."* The Bush Administration did not send any proposed legislation to Congress regarding this export control matter.

A significant portion of NASA's science missions involve international cooperation in which export controls apply. At a hearing of the House Committee on Science and Technology, Subcommittee on Space and Aeronautics, held in March 2008 to examine NASA's science programs, Dr. Jack Burns, a professor from the University of Colorado noted: *". . . we need to be looking at more international cooperation because sharing the costs and the risks associated with these large projects in astrophysics . . . The ITAR restrictions are making it more difficult than they need to be."* Another witness at the hearing, Dr. Steven Squyres of Cornell University, the Principal Investigator for the Mars Exploration Rovers (Spirit and Opportunity), testified that *"many talented students come and want to work on the mission. These are students and post-docs from Denmark and Canada, and we have had to turn*

away people because of the restrictions on ITAR. And these are people who can materially advance a U.S. space mission and make it a better mission."

In addition, the National Academies workshop summary on space science and ITAR raised concern over the ability to continue international collaborations, especially as projects become increasingly more complicated. The workshop summary notes that:

> *"The costs and delays imposed by ITAR processing requirements coupled with other nations' reluctance to be made subject to restrictions derived from U.S. law and regulations, are making the United States less and less desirable as a partner to its foreign collaborations. The implications for continued international collaboration are grave."* The workshop summary also said that *"International participants in the workshop went so far as to speculate that without high-level U.S. Government relief on ITAR, the development of highly integrated infrastructure programs, such as those envisioned for human space exploration, will be impossible."*

ATTACHMENT A

National Academies, Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World, 2009

Excerpt from the Executive Summary

"Recommendations

The committee structured its recommendations into three areas: reforming the export control process, ensuring scientific and technological competitiveness, and improving the non-immigrant visa system that regulates the entry into the United States of foreign science and engineering students, scholars, and professionals.

In the committee's view, it is important to act immediately, within the boundaries of the President's authority to ameliorate the policy logjam that is the unintended consequence of Congress's inaction over dual-use export controls. The new President needs to make the changes that will stem a serious decline affecting broad areas of the Nation's security and economy.

Recommendation 1. *The President should restructure the export control process within the federal government so that the balancing of interests can be achieved more efficiently and harm can be prevented to the Nation's security and technology base; in addition to promoting U.S. economic competitiveness.*

Restructuring the export control process does not involve abandoning all export controls. Rather, the committee recommends that two policy changes and two structural changes be made to retain needed export controls while shedding the largest obstacles to an efficient system. With these changes implemented in an expedient manner, the United States will stem the loss of technological and economic competitiveness and begin to benefit from carefully targeted and calibrated controls that reflect and meet current challenges that the country faces in protecting both our national security and our economic well-being.

Action Items

A. Recognize the interdependence of national security and economic competitiveness factors in making export control decisions with respect to individual requests for licenses through a principle-based system.

When the licensing agency applies principles to decisions about export controls, the focus will stay on why items should or should not continue to be controlled, rather than on adding to otherwise static lists of controlled items. This kind of governance system can assess each decision in terms of whether an item should be controlled against the governing principles that have been established within the system. Doing so can ensure that the remaining controlled items are relevant to rapidly changing global conditions. It can also help ensure that decisions are made in a timely manner. The following are the principles that the committee recommends:

1. *Maintain the value of protecting traditional U.S. national security in export control policy.*
2. *Recognize that today this value must be balanced against the equally important value of maintaining and enhancing the scientific and technological competitiveness of the United States.*
3. *Allow openness and engagement to prevail unless a compelling case can be made for restrictions.*
4. *Articulate a rational basis for each restriction. Restrictions on unclassified technology should be implemented only when:*
    a. *The U.S. alone, or the U.S. and cooperating allies, possess technology that leads not only to identifiable military advantage, but to an advantage that is likely to persist for a significant period of time (i.e., the time needed to field a system based on that technology);*
    b. *The U.S., or the U.S. acting together with allies, control the technology such that they can prevent it from moving into the hands of possible adversaries;*
    c. *The restrictions do not impose costs and inefficiencies that are disproportionate to the restrictions' security benefits; and*

d. Restrictions are re-examined and re-adjusted periodically to ensure they remain appropriate.

5. Protect the capability to "run faster."

6. Treat weapons separately—but define them narrowly and precisely.

7. Recognize the "global public good" nature of health-related technologies.

B. Apply "sunset" requirements to all items on export control lists that are controlled unilaterally by the U.S., and require findings to be made every 12 months that removing controls on an item would present a substantial risk to national security. No version of the current control system should survive without an effective method for pruning items from the control lists when they no longer serve a significant definable national security interest.

C. Establish as a new administrative entity a coordinating center for export controls, with responsibilities for coordinating all interfaces with persons or entities seeking export licenses and expediting agency processes with respect to the granting or denial of export licenses.

This small coordinating entity would be responsible for:

- *Receiving all applications for export licenses;*
- *Determining whether the Department of Commerce or the Department of State should handle the license application and dispatch the application to the appropriate agency for a decision;*
- *Maintaining timetables for decision-making on license applications so that applications do not languish;*
- *Receiving decisions on applications from the designated agencies and distributing these decisions to applicants;*
- *Receiving appeals of licensing decisions and petitions for review of sunset decisions, and delivering these to the appellate panel (see description below);*
- *Maintaining timetables for decisions on appeal;*
- *Receiving decisions on appeals and distributing these decisions to applicants;*
- *Providing administrative support to the appellate panel (see description below); and*
- *Monitoring and oversight of the sunset process.*

D. Establish an independent export license appeals panel to hear and decide disputes about whether export licenses are required, whether particular decisions to grant or deny licenses were made properly, and whether sunset requirements have been carried out properly. An independent, neutral decision-making authority is required to break the logjams in the system caused by philosophical differences and varying interpretations of statutory, regulatory, and executive order language. Two kinds of issues can be resolved quickly and effectively using an appellate decision-making panel:

- *First, if the agency makes a decision (either requiring or not requiring a license), and a party or a government agency believes the matter was wrongly decided, there is an avenue to resolve these differences.*
- *Second, if the agency fails to remove an item or category of items from the control list under the sunset requirement, or does not act at all within the one-year time period for review of each item on the list, an affected party could appeal either to reverse the agency's determination, or to require the agency to act in a timely way to make the necessary determination.*

The committee recommends that an independent export license appeals panel be constituted, appointed by the President or the National Security Advisor Panel members would serve a five-year term. [NB: It is at times difficult to get presidential action on appointments in a timely way, particularly at the beginning of an administration when there are many competing concerns. For that reason, the President's Executive Order would allow 90 days from the date of issuance of the Order for the appointments to be made through the presidential processes, and after that, the appointments would be made by the Chief Judge of the Federal Court of Appeals for the District of Columbia Circuit within 30 days. Replacement judges would be selected in the same way. No Senate confirmation would be required because this is not a "court"; it is an administrative panel assembled by the President to assist agencies in carrying out their responsibilities. This panel makes decisions among competing interests of agencies the same way the National Security Council's staff makes decisions about the competing interests of the Departments of State and Defense.] *The panel would be co-located with the coordinating center and would be*

housed, for administrative purposes, under the same organizational umbrella. Appeals panels such as this one are not "directed" by an administrative authority. This kind of panel acts independently and neutrally to resolve disputes. It has no operational responsibility other than to hear disputes and issue opinions.

The best organizational home for the proposed coordinating center and the export license appeals panel would be within the National Security Council structure, with the coordinating center's director reporting directly to the National Security Adviser. This placement in the White House structure will ensure the coordinating center's independence and will establish its relationship to the President. The coordinating center and the export license appeals panel would not necessarily be co-located with the NSC. This would not be required for an effective exercise of its powers under the Executive Order.

The committee weighed several options before making the recommendation for a new coordinating center and an export license appeals panel and locating them within the NSC. The option to create an interagency group was rejected because experience supports the conclusion that this would devolve into just another debating society and would not constitute a practical means to improve the present export control system. The option to use a group made up of private sector members was rejected because that alternative would not be acceptable to the government agencies involved. The option to place this responsibility with the Department of Defense was rejected, because the department, through its management of the Militarily Critical Technologies List, is an important player in the export control regime. Similarly, any placement within any other cabinet-level department involved in licensing would also compromise the independence of the proposed center. The option to place these administrative functions in the Office of Management and Budget was also considered. Although neither the National Security Council nor the Office of Management and Budget is an operational agency, the committee thinks that the NSC provides the better fit, because of its focus on national security and economic policy. In addition, the chain of command would have the coordinating center's director reporting directly to the National Security Advisor. This would not only signify the importance of these issues, in terms of both national security and economic policy, it would also serves as a brake on the director in terms of choosing his or her battles carefully.

Recommendation 2. *The President should direct that executive authorities under the* Arms Export Control Act *and the* Export Administration Act *be administered to assure the scientific and technological competitiveness of the United States, which is a prerequisite for both national security and economic prosperity.*

Action Items

A. Maintain the Fundamental Research Exemption that protects unclassified research, as provided by National Security Decision Directive 189, and ensure that it is properly implemented.

B. Create an economic competitiveness exemption that eliminates export controls on dual-use technologies where they, or their functional equivalents, are available without restriction in open markets outside the United States.

Recommendation 3. *The President should maintain and enhance access to the reservoir of human talent from foreign sources to strengthen the U.S. science and technology base. Traditionally, the United States had to worry about science and technology flowing out of the country. In today's conditions, the U.S. must make sure that advanced science and technology will continue to flow into the country. For this reason, the U.S. visa regulations as applied to credentialed foreign scientists should ensure that the U.S. has access to the best talent. Science and engineering degree holders who prefer, after graduation, to work in the U.S. should have ready access to permission for long-term stays. Granting this access for highly trained technical and scientific personnel is an important way of augmenting a critical segment of the workforce. The U.S. cannot protect U.S. jobs by denying entry to foreign professionals; jobs will simply go abroad. It is important for both the national security and economic prosperity to maintain the flow of human talent into the United States.*

Action Items

A. Streamline the visa process for credentialed short-term visitors in science and technology fields.

The committee recommends the President's Executive Order require that a non-immigrant visa applicant who is a graduate student, researcher, or professional in any field of science or technology and whose application is supported by a qualified university, scientific body, or corporation should receive a determination on his or her

visa application within 30 days. This will allow access for credentialed academic researchers to work with U.S.-based colleagues and in U.S.-based programs, and will facilitate work done in U.S. science laboratories.

B. Extend the duration of stay for science and engineering graduates with advanced degrees.

The committee recommends the President's Executive Order provide a one-year automatic visa extension to international students to remain in the United States to seek employment or acceptance into further advanced study on receipt of advanced degrees in science, technology, engineering, mathematics, or other fields of national need at qualified U.S. institutions. If these students are offered jobs by U.S.-based employers and pass security screening measures, they should be provided automatic work permits and expedited residence status. If students are unable to obtain employment within one year, their visas would expire.

C. Include expert vouching by qualified U.S. scientists in the non-immigrant visa process for well known scholars and researchers.

The committee recommends that the President's Executive Order allow qualified U.S. scientists, as part of the visa application process, to vouch for the technical credibility and legitimacy of visa applicants who are in the same or in a similar field. A more interactive application review procedure would permit those with expertise in relevant scientific and technology fields (and personal knowledge of the expertise of the individual whose application is being reviewed) to aid consular officials in accurately and efficiently determining the existence of a real security threat.

D. Institute skills-based preferential processing with respect to visa applications.

The committee recommends that the President's Executive Order institute a new skills-based, preferential processing with respect to visa applications. The visa applications of scientists and engineers should be given priority. Graduate-level education and science and engineering skills should substantially raise an applicant's chances and confer priority in obtaining residence permits and U.S. citizenship.

In Conclusion

As a nation, we cannot, and should not abandon well-conceived efforts to keep dangerous technology and scientific know-how out of the hands of those who would use this knowledge to create weapons of mass destruction and other, equally dangerous military systems. However, these represent a very narrow and limited set of goods, technology, and knowledge. Our former unilateral strategy of containment and isolation of our adversaries is, under current conditions, a self-destructive strategy for obsolescence and declining economic competitiveness. A strategy of international engagement is a path to prosperity that can be coupled with a smarter approach to security using an adaptive system of government regulation and incentives. The committee recommends the issuance of an Executive Order that implements the recommendations it has outlined as one of the first orders of business in January 2009."

ATTACHMENT B

Members of National Academies
Committee on Science, Security and Prosperity

John L. Hennessy (Co-Chair), President, Stanford University, Palo Alto, CA

Brent Scowcroft (Co-Chair), President and founder, The Scowcroft Group, Washington, DC

Ronald Atlas, Professor of Biology and Public Health, and Co-Director of the Center for Health Hazards Preparedness, University of Louisville, Louisville, KY

William F. Ballhaus, Jr., Retired, President and CEO, The Aerospace Corporation, El Segundo, CA

Alfred R. Berkeley, III, Chairman, Pipeline Trading, New York, NY

Claude R. Canizares, Vice President for Research and Associate Provost, Massachusetts Institute of Technology, Cambridge, MA

Gail H. Cassell, Vice President, Scientific Affairs and Distinguished Lilly Research Scholar for Infectious Diseases, Eli Lilly and Company, Indianapolis, IN

France A. Córdova, President, Purdue University, West Lafayette, IN

Ruth A. David, President and Chief Executive Officer, Analytic Services Inc., Arlington, VA

Gerald L. Epstein, Senior Fellow for Science and Security, Homeland Security Program, Center for Strategic and International Studies, Washington, DC

John Gage, Partner, Kleiner, Perkins, Caufield & Byers, Menlo Park, CA

B.R. Inman, LBJ Centennial Chair in National Policy, University of Texas, Austin, TX

Anita Jones, Lawrence R. Quarles Professor of Engineering and Applied Science, School of Engineering and Applied Science, University of Virginia, Charlottesville, VA

Judith A. Miller, Sr. Vice President & General Counsel, Bechtel Group, Inc., San Francisco, CA

Norman P. Neureiter, Director, Center for Science, Technology and Security Policy, American Association for the Advancement of Science, Washington, DC

Elizabeth Rindskopf Parker, Dean, McGeorge School of Law, University of the Pacific, Sacramento, CA

John S. Parker, Senior Vice President, Science Applications International Corp., Alexandria, VA

Suzanne D. Patrick, Independent Consultant, Washington, DC

Deanne Siemer, Managing Director, Wilsie Co. LLC, Washington, DC

Mitchel B. Wallerstein, Dean, The Maxwell School, Syracuse University, Syracuse, NY

Chair GORDON. This hearing will come to order, and good morning. Welcome to today's hearing entitled the *Impacts of U.S. Export Control Policies on Science Technology Activity and Competitiveness.* I would like to begin by welcoming our panel of distinguished witnesses and look forward to your testimony. And let me just put everyone on notice that General Scowcroft, who is an important part of this panel, is immortal and he got stuck in the long lines. And we tried to in respect to those folks who are here on time, get started on time, and as he comes in, he will join us welcomely and discreetly. And so we will just let everyone know that.

The Nation's export controls system and the related International Traffic in Arms Regulations, also known as ITAR, were put into place to help protect America's sensitive technologies from falling into the hands of those who might do harm to this nation.

In short, the export controls were supposed to strengthen our national security.

However, in recent years there has been a growing chorus of concern about some of the unintended consequences of the current system of export controls for both the Nation's competitiveness in the global economy and for the Nation's science and technology enterprise.

Equally troubling, there are also increasing expressions of concern from experts in the national security industry and academic communities to the effect that the current system of export controls is actually weakening our national security, not strengthening it, while undermining the health of our science and technology enterprise.

In that regard, let me quote from the recent National Academies report authored by a distinguished panel under the co-chairmanship of Gen. Scowcroft, one of witnesses at today's hearing, and I quote: "The national security controls that regulate access to and export of science and technology are broken. As currently structured, many of these controls undermine our national and homeland security and stifle American engagement in the global economy, and in science and technology. Fixing these controls does not mean putting an end to them, but implementing reforms based on the realities of the risks and opportunities of today's threats to our nation."

The panel then goes on to make an equally sobering statement, and once again I quote: "The export controls and visa regulations that were crafted to meet conditions the United States faced over five decades ago now quietly undermine our national security and our national economic well-being."

Those are very serious statements from a group of very knowledgeable individuals, and I think that they warrant our close consideration.

In addition, there have been a growing number of reports that have focused on the impact of the current export controls regime on America's civil and commercial space programs and space research activities.

Those reports have also reached some of the same troubling conclusions.

For example, the Center for Strategic and International Studies Working Group on the Health of the U.S. Space Industrial Base

and the Impact of Export Controls, which was co-chaired by another one of our witnesses today, Thomas Young, quoted, and again I will quote: "The current export control policy is constricting U.S. engagement and partnerships with the rest of the global space community, and is feeding a growing separation between the U.S. space community and an emerging non-U.S. space community."

And they go further to say, "Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the second and third tier. And it is the second and third tier of the industry that is the source of much innovation, and is normally the most engaged in the global market place in the aerospace/defense sector."

Findings such as those led this committee last year to include a provision in the House-passed *NASA Authorization Act of 2008* directing the Director of the Office of Science and Technology Policy to carry out a comprehensive study of the impact of current export control policies on our civil and commercial aerospace enterprise.

While that provision did not make it into the final public law, I am encouraged that President Obama called for a similar review during his Presidential campaign, and I am optimistic that such a study will be initiated and I will be in written contact with the Administration making that request.

In closing, I think that it is time for Congress to take another look at the Nation's export controls regime to ensure that it is working effectively and without unintended adverse impacts.

As part of that look, we want to understand any negative effects that the current export controls regime may be having on our efforts to stimulate the economy and promote long-term growth through the investment of science and technology.

This committee is starting the process with today's hearing, and I hope and anticipate that other committees will be following up in the coming weeks and months with further oversight of other aspects of the export controls issue.

With that, I again welcome our witnesses, and I will now turn to my friend, Mr. Hall, for any opening remarks that he cares to make.

[The prepared statement of Chair Gordon follows:]

PREPARED STATEMENT OF CHAIR BART GORDON

I would like to begin by welcoming our panel of witnesses to this morning's hearing. We look forward to your testimony.

The Nation's export controls system and the related International Traffic in Arms Regulations—also known as ITAR—were put into place to help protect America's sensitive technologies from falling into the hands of those who might do harm to this nation.

In short, export controls were supposed to help strengthen our national security.

However, in recent years there has been a growing chorus of concern about some of the unintended consequences of the current system of export controls for both the Nation's competitiveness in the global economy and for the Nation's science and technology enterprise.

Equally troubling, there are also increasing expressions of concern from experts in the national security, industrial, and academic communities to the effect that the current system of export controls is actually weakening our national security—not strengthening it—while undermining the health of our science and technology enterprise.

In that regard, let me quote from the recent National Academies report authored by a distinguished panel under the co-chairmanship of Gen. Scowcroft, one of witnesses at today's hearing:

"The national security controls that regulate access to and export of science and technology are broken. As currently structured, many of these controls undermine our national and homeland security and stifle American engagement in the global economy, and in science and technology.

Fixing these controls does not mean putting an end to them, but implementing reforms based on the realities of the risks and opportunities of today's threats to the Nation."

The panel then goes on to make an equally sobering statement:

"The export controls and visa regulations that were crafted to meet conditions the United States faced over five decades ago now quietly undermine our national security and our national economic well-being."

Those are serious statements from a group of very knowledgeable individuals, and I thus think that they warrant our close attention.

In addition, there have been a growing number of reports that have focused on the impact of the current export controls regime on America's civil and commercial space programs and space research activities.

Those reports have also reached some troubling conclusions.

For example, the Center for Strategic and International Studies Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls, which was co-chaired by another of today's witnesses, Thomas Young, found that:

"The current export control policy is constricting U.S. engagement and partnership with the rest of the global space community, and is feeding a growing separation between the U.S. space community and an emerging non-U.S. space community."

And

"Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the second and third tier. And it is the second/third tier of the industry that is the source of much innovation, and is normally the most engaged in the global market place in the aerospace/defense sector."

Findings such as those led this committee last year to include a provision in the House-passed *NASA Authorization Act of 2008* directing the Director of the Office of Science and Technology Policy to carry out a comprehensive study of the impact of current export control policies on our civil and commercial aerospace activities.

While that provision did not make it into the final public law, I am encouraged that President Obama called for a similar review during his Presidential campaign and I am thus optimistic that such a study will be initiated.

In closing, I think that it is time for Congress to take another look at the Nation's export controls regime to ensure that it is working effectively and without unintended adverse impacts.

As part of that look, we want to understand any negative effects that the current export controls regime may be having on our efforts to stimulate the economy and promote long-term growth through investments in science and technology.

This committee is starting the process with today's hearing on the current export controls' impacts on science and technology, and I hope and anticipate that other committees will be following up in the coming weeks and months with further oversight of other aspects of the export controls issue.

With that, I again want to welcome our witnesses, and I will now turn to Mr. Hall for any opening remarks he would care to make.

Mr. HALL. Mr. Chair, thank you. I will skip over the paragraph where I brag on you for a couple of three minutes, and also I won't need to thank the distinguished panel. You have done a good job of that, but I just want to say that export controls are crucial and necessary to prevent the proliferation of militarily-useful technologies from falling into the wrong hands, and it is critically important that we continue, to the best of our abilities, to deny the transfer of these technologies to our adversaries.

In today's global marketplace, as our witnesses will soon point out, it is equally important that export control regulations recognize technologies that are no longer ours alone to control, and to

permit the rapid sharing of emerging R&D technologies with our friends and allies. Based on a number of scholarly studies, including the National Academies' *Beyond Fortress America* report, it is clear to me that the current export control regime fails I think to meet these standards.

Industry and academia endure enormous costs in an effort to comply with ITAR. The price of direct compliance is fairly easy to calculate, but the more difficult cost is the self-imposed conservatism put into place by industry and academia because they do not understand what is and what is not a violation of clear and evolving standards. Technology is constantly shifting the landscape. What is cutting edge today may be outmoded in six months or a year from now. So too are the threats posed by our adversaries, and for that matter, the adversaries themselves.

As a consequence of these uncertainties and the lack of transparency within the exporting licensing bureaus, industry and academia are shying away from bringing products and ideas into the international arena or collaborating with our friends and allies. This result is less business and less engagement with leading researchers the entire world over. It is, in essence, a system that is designed to slowly erode our technological superiority which we don't want.

The current system has no transparency, and as a result, export licensing is bogging down the very same R&D enterprise that made our economy the largest in the world.

And as I stated just a moment ago, we have to continue to deny our adversaries access to emerging technologies, but I am convinced the current export control regime is working against our own national self-interest.

So I am anxious to hear from these gentlemen who put long hours in taking their time to come before us. I yield back my time. Yes, I am sorry, Mr. Chair. I yield to the gentleman from California the remaining time I have which is three or four minutes.

[The prepared statement of Mr. Hall follows:]

PREPARED STATEMENT OF REPRESENTATIVE RALPH M. HALL

Thank you, Mr. Chairman, for calling today's hearing on the implementation of the International Traffic in Arms Regulations (ITAR) program, and the serious, unanticipated consequences it has imposed on our industry, academia, national security, and technological readiness.

First I want to thank our distinguished panel of witnesses for taking time out of their busy schedules to appear before the Committee. I know you have put in long hours to prepare for your appearance this morning, and we are grateful for the wisdom and insights you bring to today's discussion.

Mr. Chairman, export controls are crucial and necessary to prevent the proliferation of militarily-useful technologies from falling into the wrong hands, and it's critically important that we continue, to the best of our abilities, to deny the transfer of these technologies to our adversaries.

In today's global marketplace, as our witnesses will soon point out, it's equally important that export control regulations recognize technologies that are no longer ours alone to control, and to permit the rapid sharing of emerging R&D technologies with our friends and allies. Based on a number of scholarly studies, including the National Academies' *Beyond Fortress America* report, it is clear to me that the current export control regime fails to meet these standards.

Industry and academia endure enormous costs in an effort to comply with ITAR. The price of direct compliance is easy to calculate, but the more difficult cost is the self-imposed conservatism put into place by industry and academia, because they do not understand what is—and is not—a violation of unclear and evolving standards. Technology is a constantly shifting landscape; what is cutting-edge today may be

outmoded six months or a year from now. So too are the threats posed by our adversaries, and for the matter, the adversaries themselves.

As a consequence of these uncertainties and the lack of transparency within the export licensing bureaus, industry and academia are shying away from bringing products and ideas into the international arena—or collaborating with our friends and allies. The result is less business and less engagement with leading researchers the world over. It is, in essence, a system that is designed to slowly erode our technological superiority.

The current system has no transparency, and as a result, export licensing is bogging down the very same R&D enterprise that made our economy the largest in the world.

As I stated a moment ago, we must continue to deny our adversaries access to emerging technologies, but I am convinced the current export control regime is working against our own national self-interest.

Thank you, Mr. Chairman.

Mr. ROHRABACHER. Thank you very much, Mr. Chair, and Ranking Member Hall. Clearly, America needs to nurture its aerospace and—we are going to welcome General Scowcroft here. America needs to nurture its aerospace and space technology-related industries. This is vital to the security of our country to have these industries on the cutting edge of technology but also to be competitive with their competition overseas. And everyone understands that there is a big problem and has been a big problem for a long time with the ITAR regulations. And everyone agrees that reform is needed. But we, when discussing this issue, need to make sure that our high-tech exports, again, number one, the regulations are not strangling the industry but at the same time, these high-tech exports are not going to potential enemies of the United States, are not going to countries which proliferate weapons of mass destruction in a way that would be detrimental to our security and the security of other western democracies.

We know exactly who the nations are that are proliferators. We also have a good understanding about which nations pose a potential threat to the United States, who are our potential enemies versus who are not our potential enemies. So whatever changes that we enact into ITAR and other export regulations should basically differentiate between the scofflaw and rogue nations or potential enemies on one hand and those countries that pose no threat to us and in fact, the largest numbers of countries that are just wishing to be trading partners. But let us note, there is a difference between the People's Republic of China, which is the world's worst human rights abuser and also a potential enemy of the United States, versus countries like Brazil or Belgium or any number of other countries that we could name. North Korea is not equivalent to The Netherlands. Well, neither is the People's Republic of China equivalent to India.

Ten years ago the Cox Report clearly demonstrated that U.S. technology transfers to the People's Republic of China helped improve and enhance the efficiency of China's arsenal of missiles that are aimed at the United States. As a consequence, we passed the Strom Thurmond Act which established requirements that before any satellite technology could be exported to China, the President of the United States had to first certify to Congress that the tech transfer was not against our national security interests or our domestic launch for satellite industries. Since the Strom Thurmond Act became law 10 years ago, not a single such certification by the President of the United States has been made, and as a con-

sequence, no western satellite payloads have been flown in Chinese rockets. Let us note that when we see the progress that is very clearly now evident in the Chinese rockets and missiles, that could probably be traced back to the transfer of technology from the United States. Ironically, perhaps even worse, tragically, that money that was taken from the American taxpayer's pocket for research and missile technology has now ended up in the hands of not only our competitors, but a potential enemy that aims missiles at the United States of America.

So just as our Secretary of State Hillary Clinton was visiting the People's Republic of China, let us note that European satellite operator, Eutelsat, was cutting a deal with Beijing to launch a satellite on a Long March rocket. Again, a Long March rocket system that benefited greatly in its development from the technology transfer from the United States two decades ago.

Incidentally, the Eutel Satellite Corporation, these satellites also make millions of dollars worth of profit from selling satellite services to the United States Government through defense contracts. These things are vitally important, but Mr. Chair, as we discuss this issue, I hope that we keep in mind the history of this issue as well as the potential problems that lie ahead and not simply look about the aerospace industry and technology today but where America will be in the future. Thank you very much.

[The prepared statement of Mr. Rohrabacher follows:]

PREPARED STATEMENT OF REPRESENTATIVE DANA ROHRABACHER

Mr. Chairman:

America needs a vibrant Aerospace and Space Technology industry. Everyone agrees ITAR reform needs to happen. We need to make sure that our high tech experts aren't strangled by regulations. On the other hand, we need to remain vigilant that our advanced technology doesn't end up in the hands of potential enemies or nations which proliferate weapons of mass destruction. We know exactly which nations these are, and we must make absolutely sure that whatever changes we enact to ITAR and other export regulations, that these scofflaw and rogue nations are barred from receiving our high tech systems. Chief among them is the Peoples Republic of China.

Ten years ago, the Cox Report clearly demonstrated that U.S. technology transfers to the Peoples Republic of China helped to improve and enhance the efficiency of China's arsenal of missiles that were aimed at us. As a consequence, we passed the *Strom Thurmond Act,* which established the requirement that before any satellite technology could be exported to China, the President of the United States had to first certify to Congress that the tech transfer was not inimical to our national security or our domestic launch or satellite industries. Since the *Strom Thurmond Act* became law 10 years ago, not a single such certification has been made by any Administration, and as a consequence no Western satellite payload has flown on a Chinese rocket.

But the resolve of the Obama Administration is now being tested in this area. Just as our Secretary of State, Hillary Clinton was visiting the Peoples Republic of China, European satellite operator Eutelsat was cutting a deal with Beijing for a launch on a Long March rocket. Incidentally, Eutelsat sells tens of millions of dollars worth of satellite services to the U.S. Government through DISA contracts. Clearly, this is the beginning of a game of chicken between Eutelsat and the Obama Administration. If the Obama Administration does nothing, the message is clear: transferring technology to proliferators of weapons of mass destruction like the Peoples Republic of China is a perfectly acceptable business model. Surely we can make sensible changes to ITAR and other export regulations, but we must not go so far as to make them at the expense of our national security. Let us reward our friends with openness in trade; and conversely let us be as single-minded as possible in stopping items from the United States Munitions List—like Eutelsat payloads—from falling into the hands of the Peoples Republic of China and other proliferators.

Chair GORDON. Thank you. If there are Members who wish to submit additional opening statements, including Mr. Rohrabacher, your statements will be added to the record at this point.

[The prepared statement of Mr. Costello follows:]

PREPARED STATEMENT OF REPRESENTATIVE JERRY F. COSTELLO

Thank you, Chairman Gordon, for convening this hearing on U.S. export control policies and continuing to keep this committee's focus on our nation's technological competitiveness in a global market.

This committee has held numerous hearings on global competitiveness in the science and technology fields and recently spent a great deal of effort on the COMPETES Act, which commits a renewed investment into our children's education in math and science. During the last session of Congress, this committee heard from Bill Gates, Chairman of the Microsoft Corporation, on the many obstacles that face a hi-tech giant due to this country's falling position in the global competitive market.

Despite the work of this committee to pass the COMPETES Act and other federal investments in research and development initiatives, our national security controls on science and technology remain so antiquated that they severely restrict commercial and academic innovation in these fields. If our scientists cannot share information, cannot receive licenses, cannot expand their field of research because of government restrictions in the name of national security, no amount of investment dollars will allow this country to regain its competitive edge in the global marketplace.

I look forward to a constructive dialogue on this issue and the recently released report, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World.* Thank you, Mr. Chairman for your leadership of this committee and for my time, I yield back.

[The prepared statement of Ms. Johnson follows:]

PREPARED STATEMENT OF REPRESENTATIVE EDDIE BERNICE JOHNSON

Good morning, Mr. Chairman and Ranking Member.

Today's hearing on exports controls has significant impacts on the space and defense industries.

As you know, the space and aeronautics industry is an important economic driver in Texas.

Johnson Space Center and NASA contractors provide jobs and facilitate innovation in our state and around the Nation.

Investments in human space exploration and development have been responsible for valuable new technologies, and at the center of many of these innovations is the Johnson Space Center.

Johnson Space Center's combined workforce in the Bay Area of Houston alone accounts for more than 16,000 jobs.

When the economic multiplier effect of these jobs is considered, the total impact from the space center and Texas exceeds more than 26,000 employees with personal incomes of more than $2.5 billion; and total spending exceeds $3.5 billion.

Truly, the space and aeronautics industries have dynamic and broad based impacts on the economic, educational and quality of life on the entire State of Texas.

NASA provides $72 million for grants and contracts to Texas universities and colleges as well as $44 million to Texas non-profit organizations.

NASA is so important for our nation and the State of Texas.

Since the Cold War, investments in NASA and other agencies have created a robust science and engineering workforce, driven innovation, fueled economic growth, and established the United States' preeminence in science and technology.

Mr. Chairman, I will be interested to know whether America's friends and allies perceive a climate of export controls that is conducive for long-term international collaborations to expand human and robotic presence in the solar system.

I would like to welcome all of today's witnesses.

It is my hope that they can help the Committee assess the implications and unintended consequences of current export control policies for the conduct of United States Government science and technology activities.

Thank you, Mr. Chairman. I yield back the balance of my time.

[The prepared statement of Ms. Giffords follows:]

PREPARED STATEMENT OF REPRESENTATIVE GABRIELLE GIFFORDS

I want to thank our distinguished witnesses for appearing here today to share their insights on a very important topic—the impacts of our export control system on U.S. science and technology activities and competitiveness. Export control is not a subject that Americans discuss at the dinner table, but it is something that affects every American, because the intent of the policies is to help protect the Nation from harm.

Today, our witnesses will shed light on the importance of science and technology to our economic and national security and on the need to ensure that the Nation's export control policies and procedures do not inadvertently undermine that security as well as weaken our competitiveness in science and technology in a very challenging global economy. In that regard, I am especially interested our witnesses' perspectives on the implications of current U.S. export control policies for our nation's civil and commercial space activities, because many of the technologies and information involved in space activities are regulated by export control policies.

Space is increasingly a global undertaking, with new space-faring nations emerging that will provide both competition and opportunities for cooperation in the coming years. As a study of the Center for Strategic and International Studies noted, *"Other space-faring nations continue to make strides whether they have access to U.S. technology or not"* and *"United States preeminence in space is under challenge in many areas."* We need to make sure that our export control policies are structured to enable us to meet that challenge while still protecting our legitimate security needs.

I am particularly concerned about the challenges that current export control policies present to the effective conduct of fundamental space research. According to a National Academies workshop summary on space science and the International Traffic in Arms Regulations (ITAR), some researchers report that ITAR makes it difficult to develop space research projects, which are typically conducted in partnership with industry, government labs, and international institutions. Some researchers are also uncertain about whether they can discuss their research in a university classroom that includes non-U.S. students. Our universities are a significant source of innovation for our science and technology enterprise, for our space program, and for our economic strength. I think it is important that we look carefully at the impacts of current U.S. export controls policies on our universities and take whatever steps are appropriate to mitigate the unintended consequences.

In closing, I am pleased that the Science and Technology Committee is taking the lead in addressing these important issues. I hope that this hearing will be the first step in a thorough review of our current export control system by Congress, including the House Armed Services and House Foreign Affairs Committees on which I also serve and which have important oversight and legislative roles to play with regard to these issues.

[The prepared statement of Mr. Mitchell follows:]

PREPARED STATEMENT OF REPRESENTATIVE HARRY E. MITCHELL

Thank you, Mr. Chairman.

Today we will review the impacts of current export control policies on U.S. science and technology activities and competitiveness.

As we addressed last year with the *America COMPETES Act,* it is critical to ensure that our nation is prepared to lead in science and technology in an increasingly globalized economy.

However, export control policies, which were established decades ago, fail to consider the present-day realities of a global economy.

As the National Academies report, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World* states, "the export control system enforced in the U.S. today has failed to evolve with changing global conditions and now produces significant harm to U.S. military capability, to homeland security, and to the Nation's economic competitiveness."

While we work to establish export control policies that reflect present day realities, we must also be careful to ensure that these policies continue to protect U.S. national security.

I look forward to hearing more from our witnesses on the commercial and national security concerns related current export control policies.

Chair GORDON. At this time, I would like to introduce our witnesses. First up we have Lieutenant General Brent Scowcroft who is the Co-Chair of the National Academies Committee on Science

Security and Prosperity and former National Security Advisor for Presidents Gerald Ford and George H. W. Bush. And General Scowcroft, I had a sick daughter and got caught in traffic this morning, so I was late for my first meeting. They couldn't start without me, but we could start without you. And so we didn't think you would mind. Mr. Thomas Young is the Co-Chair of the Center for Strategic and International Studies Working Group on the health of the U.S. Space Industrial Base and the Impact of Export Controls. Dr. Claude Canizares is the Vice President for Research and Associate Provost and the Bruno Rossi Professor of Physics at the Massachusetts Institute of Technology, MIT. And finally, we have Major General Robert Dickman who is the Executive Director for the American Institute of Aeronautics and Astronautics.

As our witnesses should know, you each have five minutes for your spoken testimony. Your written testimony will be included in the record for the hearing, and when you have completed your spoken testimony, we will begin our questions. Each Member then will have five minutes for their questions. As the former Chair Sherry Boehlert used to frequently say, although we have five minutes, this is a very important issue and we do not want you to feel that you have to cut off mid-sentence. So we do want to hear from you.

So we will start with Lieutenant General Scowcroft.

STATEMENT OF LIEUTENANT GENERAL BRENT SCOWCROFT (USAF, RET.), PRESIDENT AND FOUNDER, THE SCOWCROFT GROUP

Lieutenant General SCOWCROFT. Thank you very much, Mr. Chair, Mr. Hall, Members of the Committee. I appreciate the opportunity to appear before you as a Co-Chair of the National Research Council's Committee on Science, Security and Prosperity.

The study we have done on export controls and technology in a globalized world concludes that the national security controls on science and technology are broken. They harm our national security and reduce our economic competitiveness. These controls which were established during the Cold War work well as long as three conditions prevail. The U.S. science and technology establishment has only one significant competitor, the Soviet Union, and that was a weak competitor. Two, military research and development production took place separately from the commercial sector and generally led it by a great degree. And third, a common sense of purpose existed among the United States and its allies regarding the nature of the threat.

These three conditions no longer obtain. First, the United States has competition in most areas of advanced research and development, including military-related science and technology. The number of access points to advanced science and technology has grown considerably and perhaps more to the point, outside the control of the United States.

Second, most military production in the United States is now commercially based, thus blurring the distinction between commercial grade and weapons grade for thousands of so-called dual-use goods and technologies. And third, the alliance has lost its Cold War consensus. As a result, we are not hurting ourselves both in terms of science and technology and economic competitiveness.

The Fortress America approach of current controls cuts us off from information and technologies that we need for our national security.

There is clearly a better way to manage the application of American science and technology abroad that protects our national security and our competitiveness. We need to change the mindset, and we need an agile system of security controls that can adapt quickly to the changing political and technological landscapes. Our mindset is now negative. Don't let anything out which might be of use abroad or don't let any H–1 visa applicants in who might be a problem. We need to turn to an open mindset. Export unless there is a reason not to. Let H–1 visa applicants in unless there is a reason not to. And to improve our ability, the committee recommends the establishment of two administrative entities, perhaps within the National Security Council. The first would be a coordinating center for export controls that would be a one-stop shop for people seeking export licenses. This would determine whether the Commerce Department or the State Department should handle the application. Now, the applicant has to decide, and if he guesses wrong, there is months of delay in determining it. The second entity is an appeals panel that would hear and decide disputes about whether export licenses are required and whether particular decisions to grant or deny those licenses were properly made and also hear appeals on sunset requirements and how they are being carried out. Our committee proposes that sunset requirements be applied to all items on the export control list and reviewed annually.

Another recommendation dealing with the mindset proposes the administration of existing export control statutes should assure the science and technological competitiveness of the United States as a prerequisite to both national security and economic prosperity. To assure the conditions for scientific and technological competitiveness, the committee has recommended that the fundamental research exemption, also known as NSDD–189 should be maintained and properly implemented.

The committee also proposes the establishment of an economic competitiveness exemption that eliminates export controls on dual-use technologies where they or their functional equivalent are available without restriction in open markets outside the United States.

The final recommendation addresses the need to maintain and enhance access to the reservoir of human talent from foreign sources through H–1 visas to strengthen the U.S. science and technology base. The committee recommends that the President issue an executive order to put these provisions into effect. This order would not and cannot contravene current law, rather it would govern the exercise of Presidential authorities established under existing law. The executive order would not affect anything that is protected by the national security classification system, nor would it address export controls that the State Department imposes strictly on foreign policy grounds. As a first step in overhauling the overall system of controls, putting these provisions into effect would create a record and experience base that the Congress can evaluate and modify as it sees fit at such time as new export control legislation can be successfully addressed.

Perhaps the most significant challenge to implementing these recommendations is to help the relevant agencies understand that these reforms will not micro-manage their own licensing procedures or challenge agency expertise.

In closing, I am grateful for the interest that the Committee on Science and Technology has taken in this report and hope that your Members will continue to be involved in this issue. Thank you, Mr. Chair.

[The prepared statement of Lieutenant General Scowcroft follows:]

PREPARED STATEMENT OF LIEUTENANT GENERAL BRENT SCOWCROFT

Chairman Gordon, Ranking Member Hall, and other Members of the Committee on Science and Technology, thank you for this opportunity to appear before you this morning to discuss the effects of U.S. export control policies on science and technology activities and competitiveness.

I am President of the Scowcroft Group, an international business advisory firm. I speak before you today as Co-Chair of the National Research Council's Committee on Science, Security and Prosperity. I am here to discuss the findings and recommendations of this committee's report, *Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World.*

The national security controls on science and technology are broken. They were established during the Cold War to help maintain the United States' superiority in military-related science and technology. These controls worked fairly well as long as the following three conditions held:

(1) The U.S. S&T establishment had only one significant competitor—and we knew that they had a weak R&D base. This meant that we did not have to look much beyond ourselves to find the most advanced S&T. (2) Military research, development and production took place separately from the commercial sector. Thus denying the transfer of military goods did not affect the commercial economy. (3) A common sense of purpose existed among the United States and its allies regarding the nature of the threat and the means to manage it; thus the West was largely unified about denying weapons-grade materials and technologies to its adversaries.

These three conditions no longer obtain. First, today the United States has competition in most areas of advanced research and development, including military-related S&T. Advances in science and technology now occur throughout Europe, in Russia and Japan, and also in the developing economies of China, India and Brazil. Thus the number of access points to advanced science and technology have grown considerably and perhaps more to the point, outside the control of the United States. Second, most military production in the U.S. is now commercially based, thus blurring the distinction between commercial grade and weapons grade for thousands of so called "dual-use" goods and technologies. And third, the Western alliance has lost its Cold War consensus; NATO member countries and Japan no longer agree on what countries need to be controlled, what items should be controlled, and what kinds of controls are needed. Together, these changes make it much more difficult for the United States to successfully control the transfer of goods and technologies that have both commercial and military applications. As a result, many national security controls on science and technology no longer work in the ways they were intended. We endanger our own national security in thinking that unilaterally controlling dual-use items here prevents others from obtaining them elsewhere.

Because science and technology research, development and production have become a global enterprise, the "Fortress America" approach of current controls cuts us off from information and technologies that we need for our national security. If we sustain these export control and visa barriers, we will increasingly lose touch with the cutting edge of science and technology, and we risk missing emerging national security threats.

Following are just a few of the unintended consequences that the inappropriate application of export controls have on our national security and our economic competitiveness:

- At a time when battlefield inter-operability is increasingly the norm, the licensing process can prevent repair at facilities closest to the theater of operation.

- Export controls constrain both U.S. commercial and military capabilities from expanding into new fields and from applying new scientific developments.
- The government's rules are accelerating the development of technologies in capable research centers outside the United States.
- As foreign companies and governments fill these competitive gaps, valuable technical developments occur outside the U.S. to which the U.S. military and intelligence agencies then have no access.
- U.S. scientists are hobbled by rules that prevent them from working with world-class foreign scientists and laboratories located overseas, making it less likely that valuable discoveries and inventions will occur in the U.S.
- The government's rules are driving jobs abroad-knowledge-intensive jobs that are critical to the U.S. economy.

There is clearly a better way to manage the application of American science and technology abroad that protects our national security and our competitiveness. This report articulates the need for the U.S. S&T sector to "run faster" by anticipating and capitalizing on research breakthroughs more quickly than those who would use these advances to harm us or compete against us economically, and by developing qualitatively better products and services with the best talent available. In policy terms, running faster means having an agile system of national security controls that can adapt quickly to the changing geopolitical and technological landscapes.

The first recommendation proposes the establishment of two administrative entities, possibly within the National Security Council. The first is a coordinating center for export controls that will constitute a "one-stop-shop" for all export-license applications. The chief role of this small coordinating center is to determine whether the Department of Commerce or the Department of State should handle the license application and then dispatch the application to the appropriate place for decision.

The second entity is an appeals panel, possibly composed of retired federal judges, that will hear and decide disputes about whether export licenses are required, and whether particular decisions to grant or deny licenses were made properly. This panel will also hear appeals on whether "sunset" requirements have been carried out properly. The committee proposes that "sunset" requirements be applied to all items on U.S. export control lists, and it would require findings to be made every 12 months that removing controls on an item would present a substantial risk to national security.

The second recommendation proposes that the administration of existing export control statutes—the *Arms Export Control Act* and the *Export Administration Act*—should assure the scientific and technological competitiveness of the United States as a prerequisite for both national security and economic prosperity. To assure the conditions for scientific and technological competitiveness, the committee has recommended that the Fundamental Research Exemption (also known as National Security Decision Directive 189), which has been in effect since 1985 and reaffirmed by then National Security Advisor, Condoleezza Rice in November 2001, be maintained and properly implemented.

In addition, the committee proposes the establishment of an economic competitiveness exemption that eliminates export controls on dual-use technologies where they, or their functional equivalents, are available without restriction in open markets outside the United States. Just as NSDD–189 precludes the conduct and reporting of unclassified information from being restricted, the economic competitiveness exemption would preclude the export of so called "dual-use" items that are, or soon will be, legally available in open markets overseas, from being restricted.

The third recommendation addresses the need to maintain and enhance access to the reservoir of human talent from foreign sources to strengthen the U.S. science and technology base. Put simply, this will help ensure that the United States remains the destination of choice for the world's "best and brightest."

These innovations can help to bring transparency, efficiency and consistency to a system that is now lacking all three of these qualities. They will help to protect what needs to be protected without harming the economy or our scientific leadership. The committee recommends that the President sign an Executive Order in early 2009 that will put these provisions into effect ninety days hence.

This Executive Order will be fully consistent with existing legislation. It would not and cannot contravene current law, but rather would govern the exercise of Presidential authorities established under existing law. The Executive Order would not affect anything that is protected by national security classification, which is addressed by a separate Executive Order, nor would it address export controls that the State Department imposes strictly on foreign policy grounds. The Executive Order signifies that the President will bring discipline into a process over which he

already has primary authority. As a first step in overhauling the national security controls over science and technology, putting these provisions into effect will create a record and experience base that Congress can evaluate—and modify as it sees fit—at such time as export control legislation can be successfully addressed.

Perhaps the most significant challenge to implementing these recommendations is to help the relevant agencies understand that these reforms will not micro-manage their own licensing procedures or challenge agency expertise. They will, however, bring consistency and efficiency to the application process, and transparency to the agencies' decisions.

If these reforms are not implemented, the system will continue to bog down, with multiplying negative effects to our national security and competitiveness. There will be nothing to prevent the continued erosion of our defense industrial base; the loss of market-share globally in advanced technologies; the off-shoring of knowledge intensive jobs; the bureaucratic wrangling among the agencies to name a few.

In closing, I am grateful for the interest that the Committee on Science and Technology has taken in this report and hope that your Members will remain involved in these efforts, particularly in helping to assure the scientific and technological competitiveness of the United States.

BIOGRAPHY FOR BRENT SCOWCROFT

As President and founder of The Scowcroft Group and one of the country's leading experts on international policy, Brent Scowcroft provides Group clients with unparalleled strategic advice and assistance in dealing in the international arena.

Brent Scowcroft has served as the National Security Advisor to both Presidents Gerald Ford and George H.W. Bush. From 1982 to 1989, he was Vice Chairman of Kissinger Associates, Inc., an international consulting firm. In this capacity, he advised and assisted a wide range of U.S. and foreign corporate leaders on global joint venture opportunities, strategic planning, and risk assessment.

His prior extraordinary twenty-nine-year military career began with graduation from West Point and concluded at the rank of Lieutenant General following service as the Deputy National Security Advisor. His Air Force service included Professor of Russian History at West Point; Assistant Air Attaché in Belgrade, Yugoslavia; Head of the Political Science Department at the Air Force Academy; Air Force Long Range Plans; Office of the Secretary of Defense International Security Assistance; Special Assistant to the Director of the Joint Chiefs of Staff; and Military Assistant to President Nixon.

Out of uniform, he continued in a public policy capacity by serving on the President's Advisory Committee on Arms Control, the Commission on Strategic Forces, and the President's Special Review Board, also known as the Tower Commission.

He currently serves on numerous corporate and nonprofit boards. He earned his Master's and doctorate in international relations from Columbia University.

Chair GORDON. Mr. Young, you are recognized for five minutes.

STATEMENT OF MR. A. THOMAS YOUNG, LOCKHEED MARTIN CORPORATION (RET.); CO-CHAIR, CENTER FOR STRATEGIC AND INTERNATIONAL STUDIES (CSIS), WORKING GROUP ON THE HEALTH OF THE U.S. SPACE INDUSTRIAL BASE AND THE IMPACT OF EXPORT CONTROLS

Mr. YOUNG. Thank you, Mr. Chair, Mr. Hall, Committee Members, I greatly appreciate the opportunity to provide the views of the committee I co-chair on the impact of export controls on our space endeavors.

One of the things we highlighted is that we strongly support the United States' need for export controls that really do two things, one, protect technologies that are critical to our national security and two, maximize the opportunity to maintain our leadership in critical areas. It is our overarching view that our current export controls have an adverse impact on our national security, a negative impact on our industrial base, particularly at the second and third tier of the base and they complicate the relationships necessary to mutually-beneficial, international cooperative endeavors.

These deficiencies are both serious and correctable. We found that we are controlling technologies that are not critical to our national security and are readily available in the global marketplace. The most obvious are commercial communications satellite systems which are a globally available commodity today. The result of this over-control is that our space industry loses international sales, second and third level suppliers which depend upon the international market have questionable viability, other countries have determined that it is in their best interest to develop indigenous capabilities rather than be dependent upon the United States as a supplier. For cooperative endeavors, the United States ceases to be the partner of choice. Our access to international innovation is greatly diminished. This is extraordinarily important because the United States has always been a technology vacuum cleaner. We are incredibly good at taking technology no matter where it comes from and turning it to our military and our economic benefit. And we are cutting ourselves off from having access to some of the world's best human capital.

In summary, this over control by our current export control policies and procedures have accelerated the development of an international space community resulting in the United States' preeminence being challenged in many areas. It has resulted in us becoming somewhat insular which always results in a technological decline. Our national security and our space community have been adversely impacted. Without change, our export control policies and regulations for space will continue to erode as both a national security and an economic advantage.

The recommendations in the report that General Scowcroft talked about, Fortress America, are consistent with the recommendations in our report and they would help to mitigate the adverse impact of export controls on the space sector.

Our current export controls need major correction by both the Administration and the Congress to reconcile the strategic intent. Items that are globally available such as commercial communication satellite systems should be removed from the controls. The process of implementation of the controls should be user-friendly for both the public and the private sectors. The process and procedures must be structured in a manner that allows access to international technology and human capital with minimum restrictions. We must change the policies and procedures that affect the way we treat our partners in international cooperative programs. Such programs allow us to be a full participant in the international space community resulting in knowing what is going on, having access to technology, and builds relationships with some of the world's best minds.

Thank you.

[The prepared statement of Mr. Young follows:]

PREPARED STATEMENT OF A. THOMAS YOUNG

Chairman Gordon and Mr. Hall,

It is a privilege to appear before this distinguished committee to present the findings and recommendations of an independent Working Group from the Center on Strategic and International Studies (CSIS) on the Health of the U.S. Space Industrial Base and the Impact of Export Controls.

It was my honor to co-chair this expert study group with Dr. William Ballhaus, The Aerospace Corporation, and Mr. Pierre Chao, Senior Associate, CSIS. The other distinguished members of our Working Group were:

Richard Albrecht, Moog
Jeffrey Bialos, Johns Hopkins
Lincoln Bloomfield Jr., Palmer Coates
David Danzillio, Emcore Photovoltaics
John Douglas, Aerospace Industries Association
Paul Kaminski, Technovation
John Klineberg, Consultant
Lon Levin, SkySeven Ventures
Tom Marsh, Lockheed Martin, retired
Tom Moorman, Booz, Allen Hamilton
J.R. Thompson, Orbital Sciences
John Tilelli, Cypress International
Robert Walker, Wexler & Walker Public Policy Associates

Our task was as follows:

- 1) Review previous and ongoing studies on export-controls and the U.S. space-industrial base and 2) assess the health of the U.S. space-industrial base and determine if there is any adverse impact from export controls, particularly on the lower-tier contractors.
- Review the results of the economic survey of the U.S. space industrial base conducted by the Department of Commerce and analyzed by the Air Force Research Laboratory (AFRL).
- Integrate the findings of the study group with the result of the AFRL/Department of Commerce survey to determine overall conclusions and recommendations regarding the impact of export controls on the U.S. space-industrial base.

The methodology we used to meet this task was:

- Leverage a broad set of interviews and data from:
  - the U.S. Government
    - Department of State, Department of Defense (OSD/Policy, OSD/AT&L, DTSA, STRATCOM, General Council{??}), NRO, Department of Commerce, NASA, FAA, and GAO
    - the U.S. Congress
  - Foreign Governments and agencies (Asia and Europe)
  - U.S. industry
    - Boeing, Lockheed Martin, Northrop Grumman, ATK, Moog, Swales, GeoEye and SES Americom
  - Other experts
    - IDA, Aerospace Corporation, Booz Allen Hamilton, Satellite Industry Association, Space Foundation, U.S. Chamber of Commerce, CSIS, and Aviation Week
- Leverage the comprehensive survey of space-industrial base undertaken by AFRL/Department of Commerce

In doing this study, we were guided by the following set of principles:

- Space is critically important to U.S. national security
- Global leadership in space is a national imperative
- Similarly, sustaining technological superiority in space is a U.S. national interest
- Given the interdependence between the defense, intelligence, civil and commercial sectors of space, U.S. leadership in all four is important
- A strong space-industrial base is important
- A prudent export control policy is necessary to control sensitive technologies, and
- The U.S. must have unimpeded access to the technologies (global and domestic) needed for national space systems

Mr. Chairman and distinguished Members of the Committee, the Working Group recognizes that the United States must have export controls that protect technologies critical to our national security and maximize the opportunity to maintain our leadership in critical areas. However, it was the overarching conclusion of our study that our current export controls have had an adverse impact on our national security, a negative impact on our industrial base, most particularly at the second and third tiers of the industry, and has complicated the relationships necessary for mutually-beneficial, international cooperative endeavors.

It is our view though that all of the deficiencies in our export control processes can be corrected without an adverse impact on our national security. It is also our view that correcting these deficiencies will have a positive impact on our national security.

We found not only that the intent of current export controls was not being realized, but it was also having an adverse impact on the health of the space-industrial base. Specifically, we are controlling technologies that are not critical to our national security and are readily available in the global marketplace. Most obvious are commercial communications satellite systems that are a widely available commodity today. There are clearly others, such as some aspects of weather satellites. The result of this over-control is that our space industry loses international sales; other countries conclude it is more advantageous to develop indigenous capabilities rather than be subject to our export control requirements; and countries that throughout the space age have been our partners in space exploration no longer consider the U.S. the partner of choice.

Instead of maintaining our leadership, this over-control has been a catalyst for other nations to develop their own capabilities. An example is India. Clearly, U.S. export controls have been a motivation for their current most impressive development of a comprehensive national space program. In the last decade, the space community has grown from a very exclusive Club X into a very broad array of countries with substantial space capabilities. As an example, a dozen nations are able to launch their own satellites, and 38 countries have operational control over their own communications satellites. Although this expansion of space capabilities would have eventually occurred, U.S. export controls have caused it to accelerate to the degree that today, the U.S. does not control its proliferation, and U.S. preeminence in space is under challenge in many areas. Other unintended consequences of our over-control are that we have become insular, meaning we are not a full player in international space, and consequently we have somewhat diminished our access to foreign innovation and human capital.

Our report presents 13 findings and nine recommendations, which are summarized below.

Finding 1: Overall financial health of the top-tier manufacturers in the space industrial base is "good," but there are areas of concern within the broader health of the industry.

Finding 2: As earlier studies have documented, the ability of the government and industry to meet program-execution commitments remains inadequate.

Finding 3: The U.S. space-industrial base is largely dependent on the U.S. defense/national security budget.

Finding 4: There are rapidly emerging foreign space capabilities, and the U.S. does not control their proliferation.

Finding 5: U.S. preeminence in space is under challenge in many areas.

Finding 6: The current export-control policy has not prevented the rise of foreign space capabilities and in some cases has encouraged it (International Traffic in Arms Regulations (ITAR)-free space products).

Finding 7: U.S. leadership in space benefits significantly from access to foreign innovation and human capital. That access is becoming increasingly difficult.

Finding 8: The current export control policy is constricting U.S. engagement and partnership with the rest of the global space community and is feeding a growing separation between the U.S. space community and an emerging, non-U.S. space community.

Finding 9: Some elements of the export-control laws are in conflict with the U.S. National Space Policy, which has as one of its goals to "encourage international cooperation with foreign nations on space activities that are of mutual benefit" and states that "space-related exports that are currently available or are planned to be available in the global marketplace shall be considered favorably."

Finding 10: The U.S. share of the global space markets is steadily declining, and U.S. companies are finding it increasingly difficult to participate in foreign space markets.

Finding 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the second and third tiers. And it is the second and third tiers of industry that is the source of much innovation, and is normally the most engaged in the global marketplace in the aerospace/defense sector.

Finding 12: A U.S. export-control policy that protects sensitive security space capabilities is important.

Finding 13: There is unanimous agreement that the export-control process can be improved without adversely affecting national security.

Working Group Recommendations

1. The Administration and Congress should review and reconcile the strategic intent of space export controls.
2. Critical space technologies should be identified and should remain on the Munitions List and under the State Department ITAR process.
3. Remove from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use; provide safeguards by having the Department of Defense identify critical space components and technologies that should always require licensing and referral. Have the appropriate Executive branch departments conduct a study to see if other space technologies should be removed from the Munitions List (e.g., weather satellites).
4. Annually review the appropriateness of designating specific satellite and other space systems, components, and capabilities as Munitions List items based on criticality of items and on their availability outside the U.S.
5. Additionally, Congress could amend the legislation related to satellite export licensing and adopt some of the best practices being used in other processes—set timelines, technology thresholds, *de minimus* rules, and special licensing vehicles.
6. The Secretary of Defense and NASA Administrator, in addition to the Secretary of State, should have the authority to grant real-time, case-by-case, specific time period exemptions for anomaly resolutions deemed to be in the national interest based on criteria from the National Space Policy.
7. Create a special program authority to permit timely engagement of U.S. participants in multinational space projects.
8. Increase the dollar threshold for satellite exports, increase Congressional notification and establish a mechanism to enable the threshold to adjust with inflation.
9. Relevant space-related government agencies should collaboratively undertake an annual assessment of their industrial base.

Mr. Chairman, I have attached a copy of the Working Group's full report [*see Appendix 2: Additional Material for the Record*] and I look forward to your questions.

BIOGRAPHY FOR A. THOMAS YOUNG

Mr. Young retired from Lockheed Martin Corp. in 1995 after having served as an executive vice president from March 1995 to July 1995.

Prior to its merger with Lockheed Corporation, Young served as the President and Chief Operating Officer of Martin Marietta Corp. from 1990 to 1995.

Mr. Young is on the Board of Directors of the Goodrich Corporation and Science Applications International Corporation.

Chair GORDON. Thank you. Professor Canizares.

STATEMENT OF DR. CLAUDE R. CANIZARES, VICE PRESIDENT FOR RESEARCH AND ASSOCIATE PROVOST, BRUNO ROSSI PROFESSOR OF PHYSICS, MASSACHUSETTS INSTITUTE OF TECHNOLOGY

Dr. CANIZARES. Thank you, Mr. Chair, Mr. Hall, and distinguished Members. I greatly appreciate the opportunity to appear before you today.

Allow me to begin by quoting one sentence: "The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component."

This sentence comes from President Ronald Reagan's National Security Decision Directive NSDD–189 which establishes as national policy, and I quote, "that, to the maximum extent possible, the products of fundamental research remain unrestricted." Promulgated in 1985 and still in force today, the directive provides the basis for the so-called Fundamental Research Exclusion that is embodied in current export control regulations.

Our report described by General Scowcroft, *Beyond Fortress America,* finds that freedom of scientific inquiry and the free exchange of technical information are even much more important now than they were in 1985. He alluded to this, and I will cite four reasons.

First, whatever dominance we might have enjoyed in our scientific leadership in 1985, we are now clearly one among many international players in nearly every technical field.

Second, even within our borders, a significant fraction of our scientific and engineering workforce is international. By the year 2000, nearly a quarter of the science and engineering workers in the U.S. were foreign nationals. I imagine it was considerably higher today. Two-thirds of the post-doctoral researchers in the United States are international.

Third, thanks to the Internet, both the pace of scientific communications is now instantaneous and geography is global. The Internet does not have national boundaries.

And fourth, in the present national security and economic climate, a vigorous and innovative research community is more much important than ever. Universities are the prime performers of basic research in the U.S., and they are also the source of our future scientific and technical workforce, both of which are essential for both national security and for economic prosperity of our country.

As one measure of economic impact from my own institution, MIT, a Kauffman Foundation report released just last week estimates that approximately 26,000 currently active companies were founded by MIT alumni employing over three million workers with annual world revenues over $2 trillion.

For universities, the primary area of concern regarding export controls involves restrictions on the sharing of technical information about controlled items with non-U.S. persons within the United States often referred to as deemed exports. The scope of regulated technologies is broad and includes many that are available outside the U.S. as my colleagues have already mentioned.

Despite a Presidential directive protecting fundamental research, export controls continue to inhibit, retard or eliminate university

research projects, and there are hundreds of stories of sand in the gears because of export controls.

While several positive actions have been taken in recent years by the Department of Commerce and the Department of Defense, our report suggests that a more systematic and fundamental change is required, to move from a philosophy of containment and retrenchment to one of prudent engagement. Specifically, the report recommends as General Scowcroft has mentioned, this Fundamental Research Exemption be maintained but also that it be properly implemented which has not always been the case.

We also recommend an Economic Competitiveness Exemption and the adjustment of visa policies to access the reservoir of human talent in science and technology.

Because you asked, Mr. Chair, for specific recommendation for this committee, allow me personally to respectfully suggest that this committee, through its oversight of key science agencies, could play a very important role by endorsing the change in philosophy that was recommended in our report as well as the detailed recommendations and by maintaining that each federal agency under your oversight must implement a plan and periodically report how it is addressing these issues.

Thank you for your attention.

[The prepared statement of Dr. Canizares follows:]

PREPARED STATEMENT OF CLAUDE R. CANIZARES

Mr. Chairman and distinguished Members, thank you for taking up this very important topic and for your invitation. I am honored to be sitting with two very distinguished co-panelists, Gen. Scowcroft and Mr. Young.

I am Vice President for Research at MIT and a space scientist. For over 35 years I have designed, built and used space instrumentation for scientific research. Although I represent the university community on this panel, I also have experience with matters of national security. I have served on the Scientific Advisory Board of the U.S. Air Force, and I currently oversee MIT's Lincoln Laboratory, a facility that does classified national security research. I am also a Director of L–3 Communications, a Fortune 200 corporation. And I was privileged to contribute to the recently released National Academies' report *"Beyond Fortress America,"* summarized by Gen. Scowcroft. My testimony is based in part on that report.

Allow me to begin by quoting one sentence: "The strength of American science requires a research environment conducive to creativity, an environment in which the free exchange of ideas is a vital component." [National Security Decision Directive 189, 1985]

This sentence comes from President Ronald Reagan's National Security Decision Directive 189. NSDD 189 establishes as national policy "that, to the maximum extent possible, the products of fundamental research remain unrestricted."

Reagan's NSDD 189 was promulgated in 1985, reaffirmed in 2001, and is still in force today. It provides the basis for the so-called Fundamental Research Exclusion embodied in current export control regulations in order to protect the enormous benefits derived from the "free exchange of ideas."

Our report finds that freedom of scientific inquiry and the free exchange of technical information are even much more important now than they were over 20 years ago when President Reagan signed his directive.

Let me cite four points:

First, whatever dominance we might have enjoyed in our scientific leadership in 1985, we are now one among many international players in nearly every technical field. In my own discipline of physics, both the world's biggest fusion energy facility, ITER, and the most powerful particle accelerator, the Large Hadron Collider, are located abroad. In our own, U.S. Physics journals in 2006, 70 percent of the publications now come from international authors—ten years ago it was 50 percent. In 2006 international inventors accounted for one half of the patents filed with the U.S. Patent Office [*Beyond Fortress America*, p. 30]. No doubt both figures are higher now.

Second, even within our borders, a significant fraction of our scientific and engineering workforce comes from overseas. "The percentage of science and engineering workers in the U.S. who are foreign nationals increased from 14 percent to 22 percent from 1990–2000. In 2006 more than half the doctorate-level graduating engineers in the United States were foreign-born, as were 45 percent of the Ph.D. recipients in the physical sciences, computer sciences, and life sciences" [*Beyond Fortress America,* p. 34].

Universities, like MIT, are international melting pots. Roughly one-third of MIT's current faculty were born outside the U.S. Forty percent of MIT's 6,000 graduate students are international, and each year approximately 1,600 international scholars bring their skills to MIT.

Third, thanks to the Internet, both the *pace* and *geography* of scientific communications have exploded since 1985—the *pace* is now *instantaneous* and the *geography* is *global.* This rapid and pervasive interchange of ideas and innovation fuels remarkable advances. For example, the information technology revolution of the 1990's was a significant factor in fueling a remarkable three percent annual growth in U.S. productivity.

My fourth point is to suggest that, in the present national security and economic climate, a vigorous and innovative research community is more important than ever.

Universities are the primary performers of basic research in the U.S., and they are also the source of our future scientific and technical workforce. This human and intellectual capital is essential contributors to the national security and economic prosperity of the United States.

As a measure of economic impact, MIT research results in roughly 125 licenses for new technology and spawns 20–25 new start-up companies each year. A great many more companies, nearly 1,000, are founded each year by MIT alumni. A Kauffman Foundation report on MIT Entrepreneurship released last week gives a conservative estimate that if a nation were formed from the active companies founded by MIT alumni, it would have the 17th largest economy in the world. The real number is plausibly higher: 26,000 MIT alumni-founded companies employing over three million workers with annual world revenues over $2 trillion, comparable to the 11th largest Nation's economy. Interestingly, half the companies formed by our non-U.S.-citizen alumni are located in the U.S., employing over 100,000 people [Roberts & Eesley, *Entrepreneurial Impact: The Role of MIT,* Kauffman Foundation, 2009]. Nationwide, roughly two-thirds of internationals receiving Ph.D.s in the U.S. stay in our country [*Nature* Vol. 457, p. 522, 2009].

For universities, the primary area of concern regarding export controls involves restrictions on the sharing of technical data and information about controlled items with non-U.S. persons *within* the U.S. or abroad. These are often referred to as "deemed exports." There has always been considerable ambiguity around how or when NSDD 189's protection of fundamental research applies and whether—despite clear language to that effect in NSDD 189—it covers the conduct as well as the products of research. Moreover, because the exclusion applies to universities, it does not facilitate interactions between universities and industry or national laboratories.

So, despite a Presidential directive protecting fundamental research, export controls continue to inhibit, retard or eliminate research projects that do not involve militarily relevant technology. Just last year one MIT research group abandoned a fruitful international space astronomy mission because of export-control impediments. The foreign partners are proceeding with out us, thereby leaving us out of the advances in science and technology they will be making on their own. Many more projects have been delayed by many months as control issues are sorted out. One colleague, leader of a major NASA mission, had to wait 18 months for a Technical Assistance Agreement so her French graduate student could access Mars data from a NASA computer system. There are hundreds of such stories of "sand in the gears" from export controls [e.g., see *Space Science and the International Traffic in Arms Regulations: A Workshop,* National Academies Press, 2008; *The Deemed Export Rule in the Era of Globalization,* Department of Commerce, 2007; *Science and Security in a Post 9/11 World,* National Academies Press 2007].

A major difficulty is the broad scope of the export control regulations. For example, the State Department controls virtually all spacecraft systems, associated equipment and data, regardless of their actual military utility. And both State and Commerce often control technologies that are widely available outside the U.S. For many categories of the Commerce Control List, one-third to one-half of the items are controlled *only* by the U.S. [*Beyond Fortress America,* p. 34, p. 86]. And most importantly, none of the other countries has a provision comparable to our deemed export regulation [*The Deemed Export Rule in the Era of Globalization,* Department of Commerce, 2007, p. 6].

Several positive actions have been taken in recent years. The Department of Commerce formed the Deemed Export Advisory Committee (DEAC) and the Emerging Technology and Research Advisory Committee (ETRAC), on which I serve. And last June, Undersecretary of Defense John Young reaffirmed the fundamental research exclusion in DOD sponsored activities. But when I recently asked a senior Pentagon official if the John Young letter was having an effect, he replied that it was "too soon to tell."

Our report suggests that a more systematic and fundamental change is required, to move from a philosophy of *containment* and *retrenchment* to one of *prudent engagement.*

As Gen. Scowcroft describes, *Beyond Fortress America* recommends maintenance and proper implementation of the Fundamental Research Exemption. Proper implementation is critical, as numerous forces continue to eviscerate the spirit and letter of Reagan's NSDD 189. We also recommend the creation of an Economic Competitiveness Exemption to eliminate controls on dual-use technologies that are readily available outside the U.S. And we recommend steps for adjusting visa policies that will enhance our access to the reservoir of human talent in science and technology from foreign sources.

Your invitation, Mr. Chairman, asked me what your committee might do to address the negative effects of export controls. Allow me to respectfully suggest that this committee, through its oversight of key science agencies, could play a very important role by endorsing the change in philosophy as well as the detailed recommendations in our report, and by mandating that each federal agency under your oversight must formulate, implement a plan to carry them out and report to you on its progress.

Thank you for your attention.

BIOGRAPHY FOR CLAUDE R. CANIZARES

Professor Canizares is the Vice President for Research and Associate Provost and the Bruno Rossi Professor of Physics at MIT. He has overall responsibility for research activity and policy at the Institute. He oversees more than a dozen interdisciplinary research laboratories and centers, including the MIT Lincoln Laboratory, the Broad Institute, the Plasma Science and Fusion Center, the Research Laboratory of Electronics, the Institute for Soldier Nanotechnology, the Singapore-MIT Alliance for Research & Technology, the Francis Bitter Magnet Laboratory,the Haystack Observatory and the Division of Health Sciences and Technology. The Technology Licensing Office, the International Scholars Office and the Division of Comparative Medicine, among others, report to Professor Canizares. He also has policy oversight for the Office of Sponsored Programs. In addition, Professor Canizares is a member of several MIT committees: Academic Council and the Academic Appointments committee, the Committee for Renovation and Space Planning, the Conflict of Interest Management Group, and the Research Policy Committee.

Professor Canizares earned his BA, MA and Ph.D. in physics from Harvard University. He came to MIT as a postdoctoral fellow in the Physics Department in 1971 and joined the faculty as an Assistant Professor of Physics in 1974. He progressed to an Associate Professor of Physics in 1978, to a Professor of Physics in 1984, and to his current position as the Bruno Rossi Professor of Experimental Physics in 1997. From 1988 to 1992 he was the Head of the Astrophysics Division in the Physics Department; from 1990 to 2002 he was the Director of the Center for Space Research (since named the Kavli Institute for Astrophysics and Space Research); and from 2001 to 2006 he was Associate Provost. Professor Canizares is currently the Associate Director of the Chandra X-ray Observatory Center and a principal investigator on NASA's Chandra X-ray Observatory, having led the development of the Chandra High Resolution Transmission Grating Spectrometer. He has also worked on several other space astronomy missions, including as Co-investigator on the Einstein Observatory (HEAO–2). Professor Canizares' main research interests are high resolution x-ray spectroscopy and plasma diagnostics of supernova remnants and clusters of galaxies, X-ray studies of dark matter, X-ray properties of quasars and active galactic nuclei, and observational cosmology. He is author or co-author of more than 218 scientific papers.

His service outside MIT includes the Department of Commerce's Emerging Technology and Research Advisory Committee and the National Research Council (NRC) committees on Science Engineering and Public Policy and on Science Communication and National Security. His past service includes the National Academy of Sciences Governing Council, the Air Force Scientific Advisory Board, the NASA Advisory Council, chair of the Space Studies Board of the NRC and of NASA's Space Science Advisory Committee. He is a member of the of L–3 Communications, Inc.,

Board of Directors and he served on the Board of Trustees of the Associated Universities Inc. Professor Canizares is a member of the National Academy of Sciences and the International Academy of Astronautics and is a fellow of the American Academy of Arts & Sciences, the American Physical Society, and the American Association for the Advancement of Science. Professor Canizares has also received several awards including decoration for Meritorious Civilian Service to the United States Air Force, a NASA Public Service Medal for his service to the NASA Advisory Council, a NASA Public Service Medal for his contributions to the Chandra X-ray Observatory, and the Goddard Medal of the American Astronautical Society.

Chair GORDON. Thank you, sir. General Dickman.

STATEMENT OF MAJOR GENERAL ROBERT S. DICKMAN, EXECUTIVE DIRECTOR, AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS

Major General DICKMAN. Mr. Chair, Mr. Hall, Members of the Committee, I thank you for the opportunity to be with you today to represent our members as we address this extremely important issue.

Each year many of AIAA's 30,000 professional and 6,000 student members visit the Congress to express our views on issues important to the aerospace profession. Last year for the first time the subject of export controls had become such an important concern to our individual members that it was on our key issue list, along with such topics as the overall level of R&D funding and creating an integrated aerospace workforce development strategy. It is again on the list that we will address when we are back for our 2009 visit three weeks from today.

My words about whom I represent are carefully chosen. General Scowcroft, Mr. Young, and Dr. Canizares have drawn an enormous amount of information from government, industry and academic sources. There is little I can add to what they say, but what I do have to add reflects the views expressed by aerospace professionals. AIAA is the largest technical society in the world serving the global aerospace workforce. The vast majority of our members are scientists and engineers who are involved day to day in designing, developing, and building the miraculous systems that fly in air and space, serving commercial travelers, scientific research and national security. Export controls are a major concern to this workforce.

Almost continually since the dawn of man's space flight and certainly shortly after the beginning of the space age, the United States has enjoyed global technological leadership in air and space systems. Even today in many areas of space capabilities, our competencies are unmatched. However, as you have heard, that leadership is being challenged in many areas and has been lost in some. There isn't a single class of space systems, launch vehicles, imaging and signals intelligence collection, position navigation and timing, mobile and fixed communications, environmental sensing, tactical warning, and even space tourism where there isn't a qualified foreign competitor. All of these systems have national security implications, and all are available for purchase on the global market.

Not only are there competitors, one of the attributes often touted by foreign suppliers is that they have no U.S. components. They don't phrase it quite that way, though. What they say is they are ITAR free. Our arms control regulations as applied to space sys-

tems not only have failed to meet the goals of slowing proliferation of technologies with national security application, they fostered the international development of comparable technologies and severely impacted the ability of U.S. firms to sell commercial products on the world market.

Each year AIAA administers about 25 technical conferences across the whole spectrum of aerospace. In 2008 over 5,300 technical papers were published in our conference proceedings. Every one of these conferences has a requirement, that all papers comply with ITAR. How much collaboration, how much information wasn't exchanged because of that limitation? On the one hand you could say that the authors were appropriately protecting information important to our national security, and in many cases, I am sure that was correct. On the other hand, we also weren't getting insight into what is being done overseas. When our companies can't sell to overseas manufacturers, we will lose understanding of what else is in those foreign systems. When a company or individual is reluctant to even discuss the design of a simple commercial component in a spacecraft and enter into technical dialogue with an international colleague because of the very real criminal penalties associated with ITAR, we lose a source of information that simply isn't available any other way.

As you have heard, our export policies also ripple directly into the workforce, into our ability to hire foreign nationals to work on U.S. space systems. Let there be no doubt that these individuals are still receiving the best aerospace education in the world at universities around the United States, including that of my distinguished colleague. However, unlike several decades ago when many of the best and brightest stayed in the United States because the work was more interesting and compensation was better, now most have no choice but to return home. We will train them, but we can't put them to work on our most challenging problems, not while they are graduate students and not while they can enter the workforce later, either. In a very real sense, we the American taxpayer, are subsidizing the development of a technical workforce that is building the systems that are taking business away from U.S. companies and threatening our security.

I am not an advocate for protectionist policies. However, we obviously should restrict access to technologies, software and hardware, that are critical to national security. On the other hand, I think we are doing far more harm than good with a blanket approach to export control to space systems that is in place today.

We at AIAA know this is a busy time for the Congress, and we appreciate you holding this hearing. We look forward to your questions and offer our help in any way we can serve.

[The prepared statement of Major General Dickman follows:]

PREPARED STATEMENT OF MAJOR GENERAL ROBERT S. DICKMAN

Chairman Gordon, Representative Hall, Members of the Committee, I want to thank you for this opportunity to address this extremely important issue today. This is a timely and necessary discussion, and I applaud your willingness to address the topic.

U.S. trade and visa policies put in place to provide additional layers of national security are having severe and long-term effects on advanced systems technology sectors and the professional workforce that serve them. As a result industries are

faltering, innovation is stifled, competencies are withering, and the technology workforce is becoming less competitive in the global marketplace.

As Executive Director of the American Institute of Aeronautics and Astronautics, I represent a constituency of nearly 30,000 aerospace professionals, located in all fifty states and in 80 countries internationally. These are the men and women who are "in the trenches" and see first hand everyday the effects of export controls policies and International Trafficking in Arms Restrictions (ITAR). This is an area of great concern for our members.

I also sit before you as a retired military officer with 37 years of service to our nation and am deeply committed to its security. I have seen the effects that these policies have had from the acquisitions side as well. I understand the need to protect our current advantages in capabilities.

We all understand the reasons why our export control policies were put in place. We have enjoyed technical superiority from decades of investment in education and RDT&E, and from producing and attracting generations of the best intellectual talent pool the world has ever seen. To maintain that superiority, these policies were established to insulate our advantages from the rest of the world, and specifically from regimes that maintain a different and adversarial world view from our own.

However, we need to make a realistic evaluation of how these policies are being implemented, and what effects they are having. We need to be willing to act if these policies are falling short, if these policies have become detrimental to our goals. Today, the reality is that these policies are counterproductive to their stated objectives.

We need to begin corrective steps so that we do not continue to exacerbate the crisis the current policies have created that are actually harming our national security as key vendors in our technology sectors go out of business due to lack of export opportunities thus denying us the very technology we are trying to protect. We need to make certain that we develop and implement integrated policies and holistic strategies that enable us to remain technologically superior to threats against our national security, embrace participation in the international science community, and regain competitiveness in the global marketplace.

There are things we can begin to do in the current regimen that will reestablish some faith in the system and that will enable us to adapt rather than start from scratch with an entirely new set of policies. At the very least this will enable us to correct some of the more detrimental aspects of the current policy while developing the next generation of export policies.

As a point of departure, we need to reevaluate the technologies and their components listed that we believe provide us with a distinct advantage in the national security arena. This needs to be done on a regular basis so that the list can keep up with changes and advances in technologies and capabilities. One problem with the current lists is that they have not been examined comprehensively since their inception. What we now have are broad lists of components with little rationale for why many of these items were originally restricted and whether that rationale is still correct. There is also a lack of explanation for how a component is evaluated for export release and how decisions are made in the certification process. It is frustrating to both venders and purchasers to have so many unknowns up-front in the process.

Recommendation 1 in the National Academies' *"Fortress America"* report focuses on balancing interests and objectives. Several of the action items included in the recommendation revolve around this idea of evaluating the components on the lists, individually justifying inclusion both on a basis of what makes the item unique in capability and in what way its export would present a substantial national security risk. In other words, technologies and components would be restricted from export on a "by exemption" basis, rather than the current approval for export on an individual basis. This recommendation also stresses the need to regularly examine these lists, and goes so far as to recommend "sunsetting" the list and starting over as often as every 12 months.

At AIAA, we are performing an independent evaluation of satellite components similar to the suggestions in the *"Fortress America"* report. We have drawn on subject matter experts for this evaluation, and have created a process to analyze components based on several criteria. Our objective is to produce a survey, and a well-developed process that will be helpful in developing a regular evaluation of listed components.

The first step is to re-evaluate whether these components are truly commercial use, dual use, or exclusively military use. This will mean developing a definition of what each of these categories involves, and then providing a compelling national interest for listing components within these categories. I think we would all agree that those components that fall into that last category should remain restricted, and a

number of the components that fall into that second category should also remain restricted. A major part of the problem today is that many dual-use items with little or no unique military value are controlled. However, because the state-of-the-art changes, and the evolution of the commercial marketplace, we must continually re-evaluate whether each component remains correctly categorized. This is really a process that should take place within the national security community as an honest discussion, not a protectionist blanket.

Second, we need to examine whether the manufacturing capacity, either domestic or foreign, offers some strategic advantage. By this I mean we should examine whether the ability to produce a component or system provides some military advantage, and then determine which other nations have that capability. This is to provide a criterion for determining whether the ability to produce a particular component merits greater security restrictions than would just the capabilities of that component.

These first two steps should help us to narrow the list of components that are subject to the third step, which is to evaluate the performance of those components on this shortened list, and compare them to the capabilities of foreign manufacturers. In some of the recent reports and studies on this issue some examples have been provided of foreign technology far out-pacing its U.S. counterpart and have revealed the absurdity of applying ITAR restrictions unilaterally on all satellite components. These include instances where the performance of multiple foreign designed and manufactured components' performance exceed the capabilities of the U.S. equivalent, and are readily available in the global marketplace. However, while the U.S. product may enjoy some economically competitive advantages such as costs associated with the manufacturing process, the U.S. product is put at a disadvantage in this marketplace because it remains subject to ITAR and the export control licensing process. The *"Fortress America"* report well describes this in the following terms: "(t)he artificial limitations on trade imposed by lists of controlled technologies have had predictable results with respect to the U.S. position in global markets. With U.S. companies prevented by export controls from competing in certain markets, foreign competitors . . . spring to fill these competitive gaps. As these competitors have proliferated, U.S. companies have suffered challenges in the marketplace that would not have been present but for export controls."

Fourth, we need to evaluate the trends in capabilities of foreign components. While we may still maintain the state-of-the-art capabilities, we need to examine how far equivalent components' capabilities have come and project when we may expect those capabilities to surpass our own.

I understand that there are practical constraints that limit this process. I know that the licensing office within the Department of State has been streamlined, and that they have become much more efficient in processing licensing applications. However, they are still limited in the human capital available to perform these evaluations, and I understand it would be placing an unrealistic burden upon that staff to complete periodic comprehensive evaluations of the components that they may not possess the expertise to perform, and while still maintaining their workload. To make the problem manageable, the list must be shortened carefully but quickly. I also believe that the Directorate of Defense Trade Controls can be instrumental in working with policy-makers to develop a defined standard that is used in the evaluation of applications, and I do think that it would be very helpful for both the venders and the purchasers to understand the standard when assessing the utility of moving forward with a licensing application.

CONCLUSION

There are some encouraging signs. Just five years ago nobody was having this conversation in the public forum even though the problem clearly existed. Our policy-makers did not seem ready to accept the realities of the effects of current export control policies, and they certainly did not want to open up the possibility of loosening restrictions on sensitive technologies during these uncertain and unsettling times. Industry leaders were concerned with drawing further scrutiny on their applications, were reluctant to be seen as badgering their largest customer, the U.S. Government, and were frankly timid on this issue because they did not want to be accused of putting their bottom line before national security. Now, however, there is widespread agreement that the time has come to fully address these issues, and I believe this is in large part attributable to these studies that have been mentioned, as well as other reports that have also discussed the direct decline in national security caused by these and other restrictive national policies on export of technologies.

The effects we are seeing are troubling. It is a multi-faceted issue, and the current state in each of these areas is alarming. Early on, we noticed the economic impacts

of ITAR and export controls. The belief at the time was that we should endure the economic costs to preserve national security. Nobody can fault the philosophy of putting national security before economics. However, this is clearly a situation where it was not an either/or dynamic. The policies that we have put in place are having severe impacts on both.

In recent years, this committee has focused on America's ability to compete as the world continues its transformation into the information age. How we approach educating and developing our workforce is just as important as the approach we take to global trade. We need to increase and improve our investments into RDT&E to ensure that these programs continue to attract the best minds, capture the imagination and creativity of the next generation, and provide the technological return on investment that we are enjoying by the foresight put in our investments in these areas 20 to 30 years ago and longer.

While these are not irreversible trends, further inaction will put us dangerously close to the point were it may well be. Our course moving forward must be proactive. We must change the process and the philosophy that we used in restricting technology sales. We should look beyond technology restrictions, and improve the intellectual discourse in R&D in our universities, our industry programs, and our federal research facilities. We should focus on preparing the next generation workforce to compete in advanced technology industry. This includes loosening visa constraints, and encouraging the worlds' brightest minds to come to the U.S. We must also be willing to make long-term investments in R&D and the infrastructure that supports it.

QUESTIONS POSED BY THE HOUSE COMMITTEE ON SCIENCE AND TECHNOLOGY

1. What are the implications and unintended consequences of current export control policies and regulations on U.S. science and technology competitiveness, including its space research activities?

I believe some of the more obvious include the reverse "brain drain," the loss of institutional knowledge, the stifling of industrial advantages and entrepreneurial success, and the strengthening of foreign industrial competitors with the direct reduction in our own industrial capacity. For example, I think you are also seeing U.S. industrial space research become even more risk averse because of the reduction of profit margins for

U.S. technologies caused by the increased competition and reduction of foreign markets for U.S. products.

In 2008, the Center for Strategic and International Studies released *Health of the U.S. Space Industrial Base and the Impact of Export Controls,* which reported the findings of a study specifically focused on this topic. I know Tom Young co-chaired this study. That working group did an outstanding job of examining the many implications that export controls have had on the space industry. The conclusions of this study were startling. The study also identified seven principles, or truths about the role of space science and technology, and the national space industrial base as they apply to our national security.

This committee, the Congress and the Administration must consider what is happening to the U.S. industrial base and look at it from more than the economic perspective, which in itself have been detrimental. It really needs to be viewed from a more inclusive holistic view of our national security perspective. Do our export control policies help or hinder our ability to design and build the capabilities that we would need to defend ourselves, no matter the adversary?

I think it is important that our national security goals should also ensure a robust and sustainable aerospace sciences, technology, and industrial base. When you examine those principles defined in the CSIS study, you cannot help but to realize how imperative this point is. We must stop looking at these issues from a standpoint of what it will cost, or what we will lose control of. Instead, it must become a matter of what it will cost to not to take bold action, and what will we have left to maintain.

Whether we are talking about creating this change of course in months, or over the next several years, the one thing that is clear is that it serves us no good to do this piecemeal. There has to be some real strategy with a defined intended outcome.

2. The National Academies recently issued a report, Beyond "Fortress America": National Security Controls on Science and Technology in a Globalized World. To what extent would action on the report's recommendations help mitigate the unintended consequences of export

controls on trade, and research and education, including space research?

I don't want to go into a long discussion about visa policy since that is not the focus of this hearing. However, that is a conversation this committee needs to continue having. I bring it up because of the influence of these federal policies on foreign technology professionals and the adverse effects these policies have had on our science and engineering research base. I sincerely believe that for changes to either technology or the human capital associated with technology to be successful, you must also make modifications to the both. The 2007 National Academies report, *Rising Above the Gathering Storm,* that study group made several recommendations to improve national visa policy that would increase the flow of intellectual talent coming to and remaining in the U.S. to train, work, and teach. If we are going to regain our role as the recognized leader in research and development then we must reverse the barriers to foreign technology professionals thriving in the U.S. to create the advantage of the international "brain drain" from overseas that we enjoyed from the 1940s through the 1970s.

In Recommendation 3 of the *"Fortress America"* report, the authors specified action items that mirror those earlier recommendations from the *Gathering Storm* report. We need to provide the opportunities for foreign talent to come and stay in the U.S. as part of our R&D strategy, and we must ensure that there is a pathway for them to enter and remain to take advantage of these opportunities.

I believe the recommendations in this report to be sound, and a good foundation for the fundamental changes that we must adopt if the U.S. is to remain competitive. As I mentioned earlier, I believe that the correct approach will consist of adopting changes in several areas of federal policy including trade, RDT&E investment, and visa policies. That approach must be integrated, and we must be willing to make long-term investments of time and funding to ensure that these policies bring about those intended objectives for national security and economic stability. I think we have a lot of supporting documentation, and the real task before us is incorporating many of these recommendations into a cohesive comprehensive strategy.

3. In your view, what are the most critical issues regarding the export control system that the Committee on Science and Technology should consider as part of its oversight responsibilities for the Nation's civil and commercial space programs? What actions, if any, would you expect the Committee to take?

I realize there are limitations due to oversight jurisdictions placed on this committee and by jurisdiction given to other congressional committees, and that not all of the changes that are needed can originate here. But given the role that this committee fills and comparing that especially to *"Fortress America,"* but also with the *Rising Above the Gathering Storm* report, I would recommend starting in four areas. These are not in order of importance, but more in order with what is practical and can be implemented more rapidly.

First, we need to make certain that we are committed to the ideals of initiatives such as the *America COMPETES Act,* and really invest in our education system and workforce. We need to create and support programs and facilities that captivate our students at a young age with hands-on instruction and training, so that we are developing a home-grown workforce that is enthusiastic and capable in science, technology, engineering, and mathematics. They will be the foundation for our nation's ability to compete and excel in an evermore-competitive global marketplace. We must ensure that future generations of the U.S. technology workforce are able to sustain and build upon the advances that our nation has achieved.

Next, I believe this committee can encourage global engagement in science and technology. We need to once again invest in our research & test facilities to make them attractive to international collaborators and researchers. We need to develop policies that allow and encourage U.S. researchers to talk and share ideas, findings, and recommendations without a fear of violating U.S. trade policy. We need to make certain that the U.S. is once again considered a valued and necessary research partner in international collaborations.

Third, I believe that the Committee can support appropriate changes to current visa policies to promote access and inclusion of international students and researchers into U.S. colleges and universities, industry research programs, and federal research programs and facilities. This will help us to insure that the talent pool participating in U.S. research continues to be drawn from among the brightest in the world, so as to reduce the capable talent available to foreign competitors, and challenge the perspectives and paradigms of American-produced scientists and engineers, improving the overall quality of their research.

Finally, and most directly related to the export control system, I think the Committee can be instrumental in prescribing a process by which the Administration can review and update technology and their components lists on a regular basis, streamline the several lists for some uniformity, and standardize licensing considerations and requirements. I agree with the report's recommendation that this needs to be done with a focus on understanding why items should or should not continue to be controlled, rather than on adding components to an increasingly restrictive and misunderstood list.

4. In the absence of any changes to export control policies and regulations, what is the outlook for the competitiveness of our space industry, our ability to execute U.S. Government-funded space programs, and our overall leadership in space over the next five years?

Without a change of course, we will certainly witness dramatic changes in our competitiveness and level of superiority. We are really talking about generational effects, well beyond five years.

When the European Union brokered an agreement on aerospace R&D, European Vision 2020 was designed with the goal of developing an aerospace sector that would be unrivaled even by the U.S. Their partnerships and collaborative agreements have allowed Europeans access to state-of-the-art facilities where world-class research is being conducted. When this was first brokered, American aerospace executives believed their hold on aerospace markets to be too great to be concerned by the Europeans' aspirations. It took a decade from their original declaration for Airbus to surpass Boeing in annual global sales.

"ITAR-free" marketing is designed specifically to compete with U.S. systems and components with contracts that have much less regulation, and can be completed in a much shorter timeline. These are policies developed specifically to make the European manufacturers a more attractive alternative to U.S. industry and the marketing has been very successful, even for almost purely commercial products. The effect has been a dwindling U.S. industrial base largely dependent on government contracts to keep production lines open.

The policies we have implemented that have sent us on this path were not established for a five-year course. As we have ceded superiority in space technologies, we have seen growth of competencies around the world increase significantly. While it has taken some of these federal policies 20 and in some cases 40 years to take their real toll, now that we are at this point, we are now seeing rapid technology gains around the world and more rapid deterioration within our own industrial base. Nations and companies no longer need to come to the U.S. for our knowledge, facilities, or technology because our restrictions and their own advancing technology. As they continue to institutionalize their education, research, and manufacturing capacity, they will gain a greater edge. To be direct, we will be noticeably less competitive in five years without a change in course and far more so in ten, 15, 20 years and beyond. The issue is whether the U.S. is willing to invest in regaining that superiority or whether we will continue to shield our eyes from this glaring problem, and see our capacity and capabilities continue to whither.

BIOGRAPHY FOR ROBERT S. DICKMAN

Bob Dickman is the Executive Director of the American Institute of Aeronautics and Astronautics, a professional membership technical society with more than 36,000 members in 80 countries.

Mr. Dickman was born in Brooklyn, N.Y., grew up in New Jersey and entered the Air Force in 1966 as a distinguished graduate of the ROTC program at Union College, Schenectady, N.Y. His military career spans the space business from basic research in particle physics to command of the 45th Space Wing and Director of the Eastern Range at Cape Canaveral, FL. He served as the Air Force's Director of Space Programs, the Department of Defense Space Architect and the senior military officer at the National Reconnaissance Office. He retired from active duty in 2000 as a major general. From 2002 to 2005, he was the Under Secretary of the Air Force's Deputy for Military Space.

Mr. Dickman has graduate degrees in Space Physics and Management and is a distinguished graduate of the Air Command and Staff College and the Naval War College.

He is a member of the Air Force Scientific Advisory Board and the DOT Commercial Space Transportation Advisory Committee. He has been recognized by Union College with its Nott Medal, was the National Space Club's Astronautics Engineer of the Year, was selected as one of *Space News* "100 Who Made a Difference" and is a Fellow of the American Institute of Aeronautics and Astronautics.

Bob, his wife Barbara and their son, Tad, live in Springfield, Virginia.

DISCUSSION

Chair GORDON. Thank you, General Dickman. Unfortunately, we are going to be having a series of votes coming up soon, and this is a very, very important hearing. But I am going to try to expedite things for everybody's convenience. So I had my say, although I have some questions, but I am going to skip myself now and move to Ms. Giffords and recognize her for first questions.

EXECUTIVE ORDER RELATING TO RELIEF FOR UNIVERSITIES

Ms. GIFFORDS. Thank you, Mr. Chair. I appreciate your bringing such a distinguished panel of speakers today on this incredibly important topic. I know that export controls is not the subject that most Americans are having around their dining room table every night. However, they probably should be because as the testimony from the gentlemen today really indicated, this is an incredibly important aspect of our economy, our national security, and the way we became as prosperous as a nation because of its focus on space and exploration and certainly science and technology.

My first question is for Dr. Canizares. In terms of the National Academy report that identified several challenges that export controls present for universities in carrying out the fundamental research and education for the next generation, if President Obama implements the recommendations of the National Academy's report, can you talk about how much relief will actually be provided to the universities?

Dr. CANIZARES. Thank you for the question. I think that the recommendations in the report would be a very important step. However, the real issue with the implementation of the fundamental research exclusion is how it gets implemented over and over and over again in numerous contracts, awards, technical interchanges. And one of the difficulties has been that with the philosophy, as General Scowcroft indicated, of primarily sort of trying to contain everything, we have managed to do what was described in the report that Norm Augustine put out recently from the Department of Commerce who quoted George Bundy saying if you protect your diamonds and your toothbrushes with equal zeal, you will lose fewer toothbrushes but more diamonds. And I think in that sense, unfortunately, that is largely what has happened. And so in the case of ITAR, we have many space projects where technical information simply on, you know, where to put the screw holes to attach your scientific instruments to a satellite is ITAR-controlled and not available to a graduate student who would be normally be drilling the holes.

And therefore, I think the real key will be to have a change in mindset that encourages all the contracting officers, all the agencies, to really implement with proper attention the intent of keeping as much open as can be kept open. That will be a difficult, long process, but with the attention of this committee and we hope of many others in the government, it is achievable but it will take some time.

INTERNATIONAL DUAL-USE TECHNOLOGY BALANCE

Ms. GIFFORDS. Following that for members of the panel, I know that we will not be able to take a go-it-alone approach when it comes to space initiatives that we plan to pursue, including the human exploration of the moon, beyond obviously the Mars sample return, global climate change. I am curious about the balance of our desire to cooperate with emerging space-faring nations like China and perhaps India on specific projects against concerns about that dual-use nature of some of those nations' activities. And certainly we have seen other countries, specifically Iran for example, launch a satellite, and we know that the quest of those who control the skies control the battlefields. If members of the panel could talk about that balance?

Mr. YOUNG. I will try and then others may want to comment. I think in my opening remarks, there are things that need to be controlled, and so I don't want to leave the impression that, you know, we are advocating abolishing controls. But the advantages of international cooperation are enormous, not only technologically but above and beyond as a policy, part of our foreign policy. I think if we go back and take a look at even at the height of the Cold War, as General Scowcroft was talking about, our cooperative arrangements with the Soviet Union on things like Apollo-Soyuz and other programs were extraordinarily mutually beneficial. And I think that, you know, we gave us a stronger appreciation of some of the things that were going on with their programs and vice versa without compromising our national security. So I think relative to adversaries, I personally am an advocate that we cooperate there but we do it in a very thoughtful manner which is what you are suggesting.

But equally important is—our current controls have really an adverse impact on cooperating with our friends, and I will give you, you know, a few examples. One is that if we sat down today and developed a relationship with the most friendly of countries for a space program and after we had reached all the conclusions, then we give this country a raft of documents, I guess technical assistant agreements. And if you scan through them, you know, they sure don't communicate that this partner is a true partner. And they sign away an awful lot. You know, partners say why in the world after I have reached all these agreements, you know, do I need to go through that aspect of it?

Let me give you one more example. Today on the Atlas 5, we use a Russian engine called the RD–180. The people who were doing that program selected it because they concluded it was one of the world's best engines. You might say it fit my earlier comment of being a technology vacuum cleaner in that regard. But if we have a launch problem, we cannot sit down—this is a Russian-developed, Russian-produced engine, we cannot sit down with them and have a discussion as to what the problem is without having a new license to establish it. It goes even further if I may just add one other. Tommy Holloway who many of you know who managed both the shuttle program and the International Space Station program, chaired a study recently and said that this inability to do problem resolution in a real-time fashion added enormously to the risk asso-

ciated with flying on the International Space Station. I could go on and on.

Chair GORDON. Yes, well, thank you, Mr. Young. We were going to try to beat the bells. Mr. Hall, you are recognized for five minutes.

DIFFERENTIATING MILITARY WEAPONS AND DUAL-USE TECHNOLOGY

Mr. HALL. Thank you, Mr. Chair. I want to ask some of you about the military components. The Fortress America report recommends that export controls, "treat weapons separately but define them narrowly and precisely." I guess my question is how does this process distinguish between a weapons system and a component that might be integral to the system? I remember somehow about the CAT scan and when it came aboard. Medical production and medical people and maybe some folks that think different to others of us that don't recognize barters. They want to share breakthroughs like that with the nations of the world because it is medical and it helps everybody in the world. But I believe I remember and either you generals might remember or you other men, when the CAT scan came on, we didn't share that with anyone because about 15 percent of the technology there was involved in the M–1 bomb or the M–2 bomb or whatever it was that was powerful at that time. It is shared with the world now, but that is just the kind of thing I am asking about, how this might distinguish between a weapons system and any components that might be integral to the system like that part of the CAT scan was. General, do you want to give that——

Lieutenant General SCOWCROFT. Well, Mr. Hall, let me take a crack at it.

Mr. HALL. I remember it, and I remember Phil Barnaro, too——

Lieutenant General SCOWCROFT. What our study is dealing with is not items that are under the military classification system, a weapons system or essential component parts, if it is a screw that holds things together. That is something else, but only those dual-use items where they have a commercial use and they have a valid military use. And our tendency now is not to let anything out.

Mr. HALL. That describes the CAT scan.

Lieutenant General SCOWCROFT. Well, it does describe the CAT scan.

Mr. HALL. But we found a way, or someone found a way to share that with the world, and I don't object to that because I think the secrecy of the type bomb mechanism is outside our borders, too.

Lieutenant General SCOWCROFT. Look, we are not going to solve all of these problems, and there are problems to distinguish. What we are saying is let us try to make those distinctions clear and more apparent and not simply say we put the blanket over everything and we don't let everything go unless you can demonstrate——

Mr. HALL. General, thank you. Thank you, sir.

Lieutenant General SCOWCROFT.—where it should go.

Mr. HALL. I have used three minutes. Could I yield my two minutes to Mr. Rohrabacher? He is hurting.

Chair GORDON. Sure.

Mr. ROHRABACHER. Thank you very much, and thank you both, the Chair and the Ranking Member, for this very important hearing and the courtesy they have displayed to me to let me have a chance to ask a couple questions and to give an opening statement.

DUAL-TRACK EXPORT CONTROL SYSTEMS

First and foremost, let me just note I represent a district that is very rich in aerospace technology, and I take the employment of my constituents very seriously. And I realize the issues that you brought up today are risking—we are putting at risk our aerospace industry and the jobs of all of my people by having an irrational ITAR regulation system. We understand that. What direction are we going to go, how do we get out of it is a whole other issue and quite frankly, I believe that we have had these restrictions because there was a transfer of technology 20 years ago during the 1990's to a potential enemy of the United States, China. And all of your suggestions about how we need to work with the people overseas is absolutely correct for the health of our industry. But I take it that none of you believe that the United States should be working and having this possibility of transferring technology in order to get a contract or to build your industries at the expense of building up the capabilities of Iran or North Korea or some enemy like that which is clearly an enemy of the United States. But with China, no one wants to face that. Let me just ask down the line, would you be willing to try, in order to open up trade, high-tech industries and the type of business that we need to do to keep our aerospace industry and other high-tech industries competitive. Would you be willing to have a dual-track system which places heavier restrictions on trade with non-democratic countries like China, and including China, versus having just the idea that we have to open up and loosen up the controls for everybody?

Chair GORDON. Mr. Hall's time is up, so if you would, I think that deserves an answer but if you could move forward maybe with an answer.

Mr. ROHRABACHER. Could I just have a yes or no from the panel? Would you be willing to have tougher controls on China and other potential enemies versus ITAR that would have to be opened, just overall change?

Lieutenant General SCOWCROFT. I don't want to answer yes or no because I think it is a more complicated question.

Mr. ROHRABACHER. Okay. I don't think it is, General. I am sorry. What would be your answer? This is not a complicated issue. Why don't we have tighter controls on an issue that poses a potential danger to our country than we do with democratic countries?

Dr. CANIZARES. Yes, I believe we should, and certainly all the export regulations have that, and in fact the recommendations of our report also allow for it.

Mr. ROHRABACHER. So we should still have controls——

Dr. CANIZARES. I will not decide which countries—it is not at all appropriate for me to decide which countries should be on the list. However——

Mr. ROHRABACHER. All right. So the answer is yes, we should have a dual system.

Dr. CANIZARES. Yes.

Mr. ROHRABACHER. Mr. Young.

Mr. YOUNG. Yes, I think we should have a dual system, but like General Scowcroft, it is more involved in the answer——

EXPORT CONTROL DANGERS WITH THE CHINESE

Mr. ROHRABACHER. Nobody wants to say China. The bottom line is our major industries are making billions of dollars off of trade with China that could potentially cause damage to our national security. When our businessmen acknowledge that, we are going to have some progress on this. Until then, we are going to have controls because the American people can't count on our big businessmen to watch out for the security interests of our country over temporary and short-term profit.

Mr. HALL. I yield back my time.

Mr. ROHRABACHER. That is what this is all about.

Lieutenant General SCOWCROFT. Mr. Rohrabacher, if the Chinese can get the same product from the British or the French that they could get from us, then we don't solve your problem but we injure the American economic competitiveness. That is why it is a complicated answer.

Mr. ROHRABACHER. I will tell you——

Chair GORDON. Mr. Rohrabacher, if you would yield, it is really a——

Mr. ROHRABACHER.—in aiding Adolf Hitler because the French have been aiding Adolf Hitler——

Chair GORDON. Thank you, Mr. Rohrabacher. There are a lot of nuances to this, and it is unfortunate that we are under this gun because this does need to be discussed more. But we are going to try to keep some regular order.

Ms. Dahlkemper, did you have a question that you wanted to—okay. Mr. Smith, did you have a—well, Mr. Rohrabacher, would you like to rant just a little bit longer?

Mr. ROHRABACHER. Listen, again, my people are aerospace employees, and I am very concerned about the issues they brought up.

Chair GORDON. Why don't you—okay. Why don't we—Mr. Young?

Mr. YOUNG. Yeah, I would like to respond because I think the comments are quite good. I really want to highlight the fact that the reason, the primary reason in my view for making the changes we are talking about, is not American industry, it is national security. And our concern, when we really got into this, and it is no matter what country we are dealing with, the way we are currently implementing our export controls is having a detrimental effect on our national security. In other words, I think if we make a mistake, I would be in favor of making a mistake on the conservative side relative to not harming national security. But what alarmed us, when we really got into this, is that the way we are currently going about it, including even with adversaries, is we are doing it in a manner that has a negative impact on our national security. If I could just add one item, not an adversary, but we had various foreign governments come in and talk to us. Indian government came in and talked to us. They said the best thing that ever happened to them was ITAR, that it accelerated their program beyond what would have ever been possible if it had not been for U.S. export

controls. The reason I point that out is that that really is a broad way that it is being implemented.

Chair GORDON. Thank you, Mr. Young.

Mr. ROHRABACHER. But don't you think——

Chair GORDON. Mr. Rohrabacher, if I could just——

Mr. ROHRABACHER. I thought I was going to rant some more.

CONCLUSION OF HEARING

Chair GORDON. Well, you had your opportunity. We only have four minutes and 45 seconds to go. As I said earlier, this really is just not fair. I mean, this is such an important question. There are lots of nuances. As we stated earlier, though, this is sort of the opening, and I am glad that hopefully we can, this committee hearing, has put it on the table. There needs to be other hearings. This needs to be something that is talked about. I am going to contact the President and ask him to—once again, as we sit in this, in our earlier to our authorization last year is that they need to take a quick look at this, or not a quick look, I mean they need to quickly start to take a serious look at this. But as today, I am afraid that we are going to have to come to conclusion. The record will remain open for two weeks for additional statements for Members and for answers to any of the follow-up questions the Committee might ask. And Mr. Rohrabacher, the witnesses would welcome you to go down and have a conversation as we continue with going to vote.

Mr. ROHRABACHER. All right.

Chair GORDON. And again, I thank all of you. The witnesses are excused.

[Whereupon, at 11:05 a.m., the Committee was adjourned.]

Appendix 1:

Answers to Post-Hearing Questions

ANSWERS TO POST-HEARING QUESTIONS

Responses by Lieutenant General Brent Scowcroft (USAF, Ret.), President and Founder, The Scowcroft Group

Questions submitted by Chair Bart Gordon

Q1. In discussing the Presidential Executive Order recommended by your committee, the report states: "Not only will these reforms support economic vitality and promote national security, but they will create a track record and experience base that Congress can evaluate—and modify as it sees fit." *What should Congress look for in evaluating the effectiveness of changes to the export control system directed in such an Executive Order, should the President decide to issue one?*

a. At what point after the proposed Order is put into effect should Congress expect to see improvements?

A1. The changes that the report proposes are intended to make the export licensing system easier to navigate because the "one-stop-shop" coordinating center will reduce the bureaucratic ambiguity that both industry and the agencies currently experience. Over time, these should lead to such quantifiable improvements as shorter license-processing times, increased defense industry cooperation among allies, and up-to-date controls lists (both the CCL and the USML). The report does not specify when improvements should become evident; however, in my view, nine-months from the time that the system is fully operational should be sufficient to begin to see positive changes.

Q2. Your prepared statement notes that "the most significant challenge to implementing these [National Academies] recommendations is to help the relevant agencies understand that these reforms will not micro-manage their own licensing procedures or challenge agency expertise." *Do you have any specific suggestions on how to address this challenge?*

A2. Although the report does not address this issue, members of the committee are conducting briefings throughout the relevant agencies to explain that the new processes do not change how each agency conducts its own licensing reviews. This explanation should be included in any materials that accompany the launch of the coordinating center and licensing appeals panel.

Q3. Dr. Canizares' testimony suggests that some of the actions our committee could take to address the impacts of export controls include 1) endorsing the recommendations in the National Academies report and 2) requiring that each agency under our jurisdiction develop and implement a plan to execute the recommendations and report to Congress on their progress. Do you agree with Dr. Canizares' suggestions? Are there other actions this committee could take, within its jurisdiction, to address the impacts of export controls on science and technology competitiveness and to ensure America's leadership in space?

A3. It would certainly be beneficial for this committee to endorse these recommendations.

Dr. Canizares has explained what he meant by the part of his testimony that would require "each agency under our jurisdiction [to] develop and implement a plan to execute the recommendations and report to Congress on their progress." He was not referring to agencies that administer and enforce export controls, but rather to those that conduct and support research (at universities and industry). He gave as an example, the 2008 John Young Memo that reaffirmed "free scientific exchanges and dissemination of research results to the maximum extent possible." He would like to see agencies being asked to explicitly meet our recommendation for reaffirming the Fundamental Research Exemption (NSDD 189). I think this is a very good idea.

Q4. Your committee's report recommends that sunset requirements be applied to all items on export control lists that are controlled unilaterally by the U.S. Who did the committee think should review the lists to be in compliance with the report's recommendation for sunsetting?

a. Does this recommendation for sunsetting apply only to the Commerce Control List or does it also apply to the ITAR?

b. Would satellites be covered under the sunset requirements? If not, did the Committee consider what actions are necessary to assess the effectiveness of export controls for satellites and satellite components?

A4. The report proposes that the coordinating committee should have oversight of the "sunset" process but does not get more specific than that regarding who ought to participate in the process. In my view, the technical expertise of those who are directly involved in research (from university, national and commercial laboratories) is an essential component of this process. While the report is not specific as to who should participate, it discusses an approach that includes several of the principles listed in Recommendation #1 and the proposed Economic Competitiveness Exemption.

The sunset process is intended to be applied to both the Commerce Control List and the International Traffic in Arms Regulations. The report does not discuss satellites per se because they are covered by statute, but in my own view, yes, they should be included under sunset requirements.

Q5. The National Academies report recommends the creation of a Coordinating Center for Export Controls to receive applications, determine agency jurisdiction, maintain timetables on license application processing, and managing the appeals process, for example. How big of an operation would this be? What is required for the Center to be successful?

a. If both the federal agencies that administer export control regulations and the export control license applicants can appeal decisions on licenses and on whether sunset requirements have been properly implemented, what measures are in place to ensure that the appeals process recommended in the report does not become overly burdened and time-consuming?

A5. Although it is not discussed in the report, the committee recommends that the coordinating center should be a small administrative office. In order for the coordinating center to be successful, the report specifies that the coordinating center's director should have binding authority (1) to determine which agency—Commerce or State—will review a particular application, and (2) to establish default-to-decision orders with respect to licensing decision timetables and sunsetting timetables.

The report does not discuss in detail how to prevent the appeals process from becoming over-burdened. However, the committee believes that the establishment of an appeals process that does not reside in Commerce, State or Defense and does reside in the National Security Council will dampen the tendency to abuse the appeals process.

Q6. During the hearing, Congressman Rohrabacher stated that "the American people can't count on our big businessmen to watch out for the security interests of our country over temporary and short-term profit." *How, if at all, would implementation of the recommendations in your report address this concern?*

A6. The report does not recommend an end to export controls, but to implement "reforms based on the realities of the risks and opportunities of today's threats to the Nation." Nor does the report recommend putting industrial stakeholders in charge of any aspect of the export control process. Indeed, the recommendations proposed in the report would not make it any easier for American businessmen to ignore or undermine export control policy. In fact, the system would very likely close some loopholes that currently exist because of the multi-agency application process. Also, many businesses would no longer be compelled to build research laboratories outside the United States in order to get around export controls.

Q7. To what extent do current American export controls prevent China from gaining access to advanced technologies?

a. How would the approach recommended in Beyond "Fortress America" *protect U.S. technologies from being exploited by China?*

A7. The United States and its allies do not see eye-to-eye on selling advanced "dual-use" goods and technologies to China. For example, as stated in the report: "despite U.S. protests on the transfer of dual-use technology, the European Union signed an agreement with China in 2003 that allowed China to invest 230 million Euros in the European Union's satellite navigation system." Furthermore, China is able to buy U.S. products from third country manufacturers who are the original legal buyers; there are no international legal restraints to prevent this. Thus it is a mistake to think that withholding U.S. products from the Chinese actually prevents them from getting the same advanced "dual-use" goods elsewhere.

The report does not deal specifically with China's efforts to gain access to American advanced technologies that could have a military purpose. However, it articulates the need to redesign the multi-lateral regimes, such as the Wassenaar Arrangement, in ways that will better respond to today's globalized and threat-diffuse world.

Questions submitted by Representative Gabrielle Giffords

Q1. Your testimony states that "If we sustain these export control and visa barriers, we will increasingly lose touch with the cutting edge of science and technology, and we risk missing emerging national security threats." *Could you elaborate on this point, especially with respect to emerging national security threats?*

A1. The emerging threats in my statement refer to technological advances taking place elsewhere that could weaken America's position in the battlefield, and to technologies that could have catastrophic consequences if unleashed on the American population. As the report states, "[w]hile the United States remains a world leader in advanced science and technology, it no longer dominates; it is now among the leaders. We are increasingly interdependent with the rest of the world." Therefore advanced science and technology will develop in the United States, but also, for example, in China, Germany, India, and Russia. If export controls prevent foreign scientists from coming here to study, or from collaborating with American scientists, the United States will lose vital information about what is going on elsewhere.

Q2. The State Department maintains a Technology Alert List (TAL) which establishes a list of major fields of technology transfer concern. That list expanded greatly after 9/11, and some have argued that it is too exhaustive. As a result, consular officers with little or no scientific training of their own will request an additional review, called a Visa Mantis review, for the overwhelming majority of visa applicants with advanced science and engineering degrees. However, what is being recommended in the National Academies report seems to be the opposite approach: preferential treatment for those with advanced STEM degrees, with no discussion at all of security concerns or of how to achieve improvements within the current system. Can you elaborate on how you approached your recommendations with respect to visas?

A2. With all due respect, the question is a mischaracterization of the committee's recommendations with regard to visas. The report does not seek in any way to end the screening process, but to make it more rational, so that *"legitimate and qualified* students and researchers" (emphasis added) can attend school, attend conferences, and ultimately seek employment. For example, see Recommendation 4 which states that "The committee recommends the President's Executive Order require that a non-immigrant visa applicant who is a graduate student, researcher, or professional in any field of science or technology, and whose application is supported by a qualified university, scientific body, or corporation *receive a determination on the visa application* within 30 days" (emphasis added). The recommendation also affirms that graduates should be eligible for employment only after the "pass security screening measures." The vouching process that is recommended is not meant to replace screening measures, but to augment them.

As has been the case throughout its history, "It is important to both the national security and to our country's economic prosperity to maintain the flow of human talent into the United States."

Q3. One of the visa recommendations in the National Academies report calls for an executive order requiring determination on visa applications for scientists and engineers within 30 days provided the application is supported by a U.S. university, scientific body, or corporation. In the report, it is noted that this is already common practice and few reviews slip beyond 30 days. If that is the case, are there more specific recommendations to the relevant agencies to mitigate those few delays that do still occur?

A3. The current system works for 95 percent of visa applications; however, the difficult five percent is precisely the population with which the report is concerned—scientific students, researchers and professionals. The report does not specify actions that the relevant agencies need to take.

Questions submitted by Representative Ralph M. Hall

Q1. You state that the export control system is "broken," that it is slowly wiping away any technological advantages we may have once had, and is crippling our ability to maintain superiority. The Fortress America *report proposes changes that could be implemented using existing Executive authorities to improve the export license process. If the Administration were to embrace the report's recommendations, from the applicants' perspective, what improvements would likely result?*

A1. The changes recommended in the report will bring about greater transparency, openness, consistency and agility, all of which are lacking in the current system. The "one-stop-shop" will reduce licensing timetables and therefore promote consistency and agility. The appeals process, which recommends publication of decisions, will promote transparency and openness. A process that applies principled and consistent sunset requirements will be able to bring about consistency and rationality. The Economic Competitiveness Exemption will make the system more realistic because it takes into account the fact that the U.S. gains no significant protection by prohibiting legitimate U.S. companies from exporting dual-use items that are, or soon will be, legally available in open markets overseas.

Q2. What would be the best approach to conduct the first round of 'sunset' reviews for items currently on export control lists? Presumably, it would be a massive undertaking. Who should populate such a review committee?

A2. The report does not address the specifics for how to manage the first round of "sunset" reviews, although the committee members agree that the initial pruning of the list will be "arduous."

Technical experts currently working in their fields (see the answer to Chairman Gordon's fourth question) will be essential. Per my colleague, Claude Canizares' answer to Ranking Member Hall's first question, "the Emerging Technology and Research Advisory Committee (ETRAC) recently established by the Department of Commerce's is currently working to define a methodology that may well be relevant to reviewing the Commerce Control List and possibly also sections of the Munitions Control List." I would propose consideration of their recommendation as it becomes available.

Q3. Foreign satellite builders have been openly marketing satellites as being "ITAR-free." What has been the record of their marketing efforts? Is there any evidence that they are taking away sales from U.S. builders? Technologically, how do their satellites compare to ours?

A3. I would like to refer you to the 2008 CSIS report, *"Health of the U.S. Space Industrial Base and the Impact of Export Controls."*

Q4. Since imposition of export controls decades ago, is there a public record of opinions on licenses that would give industry and academia roadmaps about what is acceptable, and what isn't. How transparent and consistent is the licensing process? To what degree can applicants cite previous license approvals to gain quick consideration of similar, pending applications?

A4. It is unlikely that such a record exists. The current system is anything but transparent. Because technologies are in a constant state of change, precedents are not necessarily a useful guide.

Questions submitted by Representative Pete Olson

Q1. What are examples of capabilities in satellite and launch systems where the U.S. excels and should hold tight to the underlying technologies?

A1. This issue is not dealt with directly in the report, nor are satellites my area of expertise. This is a question that is best put to space scientists.

Q2. In statements presented during the hearing, several witnesses cited difficulties engaging in collaborative space research missions, given that all U.S. satellites are controlled by the State Department's munitions list. Yet the State Department claims they have streamlined the licensing process. From your vantage point, has the Department made real improvements, or is the system still weighed down with too many uncertainties, making future science collaborations a difficult proposition?

A2. The State Department has made some changes in response to President Bush's January 2008 Presidential Directives designed to streamline and improve export control policies and procedures. These include moving to an online application system and correcting the severe backlog of applications from 2006–7. However, their efforts have not addressed either the lack of transparency or "commodity jurisdiction" issues—issues that are dealt with in the committee's recommendations. Thus while the improvements are real and necessary, they are not sufficient.

ANSWERS TO POST-HEARING QUESTIONS

Responses by A. Thomas Young, Lockheed Martin Corporation (Ret.); Co-Chair, Center for Strategic and International Studies (CSIS), Working Group on the Health of the U.S. Space Industrial Base and the Impact of Export Controls

Questions submitted by Chair Bart Gordon

Q1. Dr. Canizares' testimony suggests that some of the actions our committee could take to address the impacts of export controls include 1) endorsing the recommendations in the National Academies report and 2) requiring that each agency under our jurisdiction develop and implement a plan to execute the recommendations and report to Congress on their progress. Do you agree with Dr. Canizares' suggestions? Are there other actions this committee could take, within its jurisdiction, to address the impacts of export controls on science and technology competitiveness and to ensure America's leadership in space?

A1. I agree with Dr. Canizares' recommendations.

Q2. The first recommendation of the CSIS working group is: "The Administration and Congress should review and reconcile the strategic intent of space export controls." *What specifically do you think needs to occur in such a.strategic review and what entity should lead that effort? Does the strategic intent of space export controls need to be resolved before any structural changes to the export control system are put into place, such as those recommended by the National Academies?*

A2. Our view is that the strategic intent of space export controls should be uniquely to protect the national security of the U.S. Current controls are so broad and unfocused that the net result is an erosion of our national security. The administration and Congress should together make the changes to space export controls to assure the objective stated above is accomplished.

While it would be useful, this issue does not have to be resolved before other important structural changes are implemented.

Q3. What specifically does the CSIS recommend to address concerns about the impact of export controls on the commercial sale and use of satellites for research purposes?

A3. Specifically, the law that makes satellites controlled items should be repealed and only those elements of satellites that are critical to our national security should be controlled.

Q4. The CSIS study, as noted in your testimony, refers to the negative impact of export controls on the second and third tiers of the aerospace industry, which is where much of the innovation and global engagement in the industry occurs. How serious are the impacts to innovation at this level of industry? What does CSIS recommend to mitigate these impacts?

a. Do you have a perspective on whether any weaknesses in our supplier base are causing U.S. companies to increase dependencies on non-U.S. suppliers?

A4. The impact on second and third tier companies is severe. These companies require both domestic and international sales to be viable and to be able to invest in innovation. Today, we are becoming dependent on, non-U.S. suppliers in areas such as traveling wave tubes and batteries.

Q5. One of the recommendations of the CSIS study is for relevant space-related government agencies to collaborate on conducting an assessment of the space industrial base on an annual basis. Could you elaborate on why an annual assessment is needed? How would this information be used in informing export control regulations? How feasible would it be to carry out such assessments every year?

A5. The CSIS study had a dual objective to assess the health of the space industrial base and the impact of export controls. A conclusion of the study is that government funding directly defines the health of the base. Periodic assessments are necessary to assure the base continues to be healthy at the prime contractor level and that appropriate corrective action is being effective at the second and third times.

Q6. The CSIS working group recommended that "a special program authority to permit timely engagement of U.S. participants in multinational space projects" *be created. Could you please elaborate on the nature of such a program author-*

ity and how, in practice, it would work? How broad or narrow should the special program authority be?

A6. When the U.S. participates in a multinational space project export controls have a chilling effect on the partnership. International partners are required to approve onerous documents above and beyond the international agreements that define the project. Anomaly resolution cannot take place without further approvals. Meetings and meeting attendees are affected. These are some examples of the adverse impact of space export controls that cause potential international partners to no longer consider the U.S. as the partner of choice.

A solution would be to include export controls that are critical to the U.S. national security, as well as those of our partners, in the project defining documents with implementing responsibility assigned to the U.S. organization lead for the project.

Questions submitted by Representative Gabrielle Giffords

Q1. The CSIS study on export controls that you co-chaired noted concerns regarding the negative impact of export controls on selected areas of the space supplier base such as solar cell and solar cell substrate technologies. These would appear to be space technologies that could have applications for the development of advanced renewable energy technologies for civil applications. Can you elaborate on the basis of those concerns?

a. Are you aware of any broader implications of export controls for achieving the Nation's objectives to invest in "green technologies" and renewable energies?

A1. We did not examine the impact of space export controls on "green technologies" and renewable energies; thus, I cannot elaborate on these concerns.

Questions submitted by Representative Ralph M. Hall

Q1. What would be the best approach to conduct the first round of 'sunset' reviews for items currently on export control lists? Presumably, it would be a massive undertaking. Who should populate such a review committee?

A1. The conduct of the first round of "sunset" reviews would be a massive undertaking but critical to our national security. It should include those organizations responsible for implementing space export controls, such as the Department of State, and those organizations with the capability of assessing technologies critical to our national security, such as DOD and the NRO.

Q2. Foreign satellite builders have been openly marketing satellites,as being "ITAR-free." What has been the record of their marketing efforts? Is there any evidence that they are taking away sales from U.S. builders? Technologically, how do their satellites compare to ours?

A2. Foreign commercial communication satellites today have comparable capability to U.S. satellites. Foreign sales have grown at the expense of U.S. builders.

Q3. Since imposition of export controls decades ago, is there a public record of opinions on licenses that would give industry and academia roadmaps about what is acceptable, and what isn't: How transparent and consistent is the licensing process? To what degree can applicants cite previous license approval to gain quick consideration of similar, pending applications?

A3. The licensing process is not very transparent, is very time consuming, and while the reported approval rate is very high most approvals come with required change. Large companies have learned to deal with these difficulties and consider the associated impacts as a "cost of doing business." Again, the critical impact is to second and third tier companies.

Questions submitted by Representative Pete Olson

Q1. What are examples of capabilities in satellite and launch systems where the U.S. excels and should hold tight to the underlying technologies?

A1. Capabilities that are critical to our national security should be determined by our defense and intelligence organizations.

Q2. In statements presented during the hearing, several witnesses cited difficulties engaging in collaborative space research missions, given that all U.S. satellites are controlled by the State Department's munitions list. Yet the State Depart-

ment claims they have streamlined the licensing process. From your vantage point, has the Department made real improvements, or is the system still weighed down with too many uncertainties, making future science collaborations a difficult proposition?

A2. The State Department has made progress; however, when we conducted our review the process continued to be very onerous.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Claude R. Canizares, Vice President for Research and Associate Provost, Bruno Rossi Professor of Physics, Massachusetts Institute of Technology

Questions submitted by Chair Bart Gordon

Q1. Your testimony identifies "deemed exports" as particularly problematic for the academic environment. What types of impacts have "deemed exports" had in the university environment?

a. Does National Academies study recommend any actions to mitigate these effects? If so, please discuss them.

Q2. Your testimony notes that "Despite a Presidential directive protecting fundamental research, export controls continue to inhibit, retard or eliminate university research projects." *Can you provide examples of the negative impacts to clarify the extent of the problem?*

a. The National Academies report recommends that the Fundamental Research Exemption be maintained and implemented properly. Your testimony refers to the need for a "change in mindset that encourages all the contracting officers, all the agencies, to really implement with proper attention the intent of keeping as much open as can be kept open." *What are your thoughts on any specific actions that could be taken to help change the mindset?*

A1, 2. Because of the similarity of Questions 1 and 2, I believe it would be appropriate to provide a single answer that attempts to address all the issues raised in both questions.

First, allow me to note that I use the term "deemed export" in its generic sense to encompass both the Department of Commerce Export Administration Regulations (EAR) and the Department of State International Traffic in Arms Regulations (ITAR). In ITAR, transfer of technical information to a non-U.S. person within or outside the U.S. is referred to as a "defense service."

While there has never been a systematic study of the impacts of deemed exports on universities, university researchers have reported serious negative impacts in numerous workshops and other informal venues. For example, see *"Space Science and the International Traffic in Arms Regulations"* [National Academies Press, 2008]. That workshop report lists, for example, the following categories of impact in the space science arena alone (pp. 16ff): (i) Controls at odds with international character of science; (ii) Diminishing U.S. access to foreign expertise; (iii) Handicaps on effective space-mission designs; (iv) compromising the quality of student experience; (v) effects of regulatory uncertainties on faculty and staff; (vi) costs and administrative burden; In fact, many of these same factors also apply to other areas of deemed export controls (such as the control of "use technology" by the EAR). Item (v) above deserves special mention: The "chilly climate" engendered by deemed export controls dissuades researchers and students from undertaking forefront research projects that might otherwise yield important results for the Nation. I gave one such example in my testimony, involving a putative space mission to detect extra-solar planets that was not conducted because of ITAR's perceived impediments. In that sense, a significant part of the impact resembles Sherlock Holmes' "dog not barking in the night." It is true that these impacts are not easily quantifiable, but all of us in the research university community who deal with this issue are convinced that the aggregate impacts are substantial.

The potential impact of a stricter application of deemed export regulations by the Department of Commerce is even more problematic, as it could cover hundreds to thousands of pieces of equipment on university campuses and require thousands of licenses. This impact was chronicled in hundreds of comments received by DOC in response to a Notice of Public Rule Making several years ago. This response led DOC to form the Deemed Export Advisory Committee, and more recently the Emerging Technology and Research Advisory Committee. As a member of ETRAC, I am hopeful that some of the potentially very negative effects that had been foreseen might be mitigated by actions that DOC can undertake to simplify and limit the application of deemed export rules.

Our report, *"Beyond Fortress America,"* recommends maintaining the "Fundamental Research Exemption (FRE)" which has permitted universities to operate with relative freedom, and "ensur[ing] that it is properly implemented." As I noted in my testimony, that last phrase is essential. There is a natural tendency for individual contracting officers to always take the most conservative interpretation of any situation and to find reasons why the FRE should NOT apply, rather than the

other way around. An example is the continual struggle that all universities have had with funding agencies, particularly those in the Department of Defense and NASA, to apply "inappropriate contract clauses" to research activities that do not contain any classified components. This practice has been described in several reports of the American Association of Universities and the Council on Government Relations. In my personal opinion proper implementation of the FRE will require each cognizant agency to issue appropriate direction to all contracting officers, and establish a process of review and, if necessary, appeal of their actions. In this regard, the letter issued last June by the Undersecretary of Defense (AT&L), Mr. John Young, appears to be a positive step.

Q3. Satellites are directed by law to be regulated as exports under the ITAR. What particular challenges does this designation of satellites as defense articles have for conducting fundamental space research? What would you recommend be done to mitigate those challenges?

A3. Our report did not focus on this issue, although it certainly constitutes one of the significant areas of concern for research universities. Some of the points in the previous answer also apply here, so I will not repeat them (see the referenced National Academies workshop report). A major concern for universities has been ITAR's overly broad categorization of virtually all spacecraft systems, associated equipment and data as subject to control, regardless of their actual military utility or their widespread availability outside the U.S. This is particularly problematic when, as is usually the case, universities must work together with industry in order to accommodate a space science instrument on a research satellite. Even the dimension of the screws used to attach a piece of hardware will generally be marked "ITAR Controlled." Fundamental science data is also affected, as I noted in the example in my testimony of the 18 months it took a French graduate student to gain access to data about Mars.

Our report's recommendation regarding the Fundamental Research Exclusion, if properly implemented, could mitigate some of the negative effects of ITAR on space research. In the future, a more systematic approach to addressing this matter could be undertaken by Congress and the Department of State.

One personal suggestion would be for the Department of State to provide a "carve-out" for scientific instruments developed in an open university setting, and which extends to the necessary interface information required to accommodate such scientific instruments on a spacecraft. I understand that the Department's Directorate of Defense Trade Controls is indeed considering new definitions that might accomplish such a carve-out. DTC's Defense Trade Advisory Committee has been tasked to undertake a review of ITAR definitions.

Questions submitted by Representative Gabrielle Giffords

Q1. Your prepared statement as well as various reports and materials note that export controls may be hurting or preventing the U.S. from participating in international collaborations on space research and encouraging other nations to seek partnerships that do not include the U.S. Could you give us some examples of how export controls have affected existing or potential space research collaborations?

a. If universities, companies or other institutions lose opportunities for international space activities, are not invited to participate, or opt out of collaborative projects, what are the broad consequences?

b. Are there any national security impacts?

A1. Please see answer #1 to the questions posed by Chairman Gordon, which I believe addresses the first part of this question. As to the consequences, the most extreme result is the exclusion of U.S. researchers from forefront research areas that are instead advanced by other, international partners. The U.S. has long attempted to retain a position of significant leadership across the spectrum of the sciences and engineering. As a result of globalization, as our report states, we may no longer be the sole leader in some fields, but our economic, social and political strength requires us to at least maintain our position at the forefront along with a small number of other advanced nations. Keeping that place is by no means easy nor is it assured. To voluntarily cede that place in return for no apparent gain, as we are doing by overly strict application of export controls, is unwise and counterproductive. Because the technical information involved does not deal explicitly with national security information, I believe that our security will actually be improved by following the recommendations of our report.

Q2. How might qualified U.S. scientists go about vouching for the credentials of foreign scientists seeking visas, as recommended in the National Academies report? Is it sufficient for any U.S. university professor to send a letter to the appropriate consulate on behalf of an applicant?

a. Does it make sense to set up a more formal process through a single credible institution such as the National Academies or some other entity? Was the panel able to explore possible mechanisms for implementing this recommendation?

A2. Our panel chose not make a more detailed recommendation about about how best to implement the proposed vouching for foreign scientists. We believe that the implementation details should be defined jointly by the appropriate government agencies working together with scientific representatives. Those representatives could well be organized through the National Academies, as you suggest, as well as several other national professional scientific associations and societies.

Questions submitted by Representative Ralph M. Hall

Q1. What would be the best approach to conduct the first round of 'sunset' reviews for items currently on export control lists? Presumably, it would be a massive undertaking. Who should populate such a review committee?

A1. Our panel did not attempt to specify a mechanism for carrying out such a review, but I note that the Emerging Technology and Research Advisory Committee (ETRAC) recently established by the Department of Commerce is currently working to define a methodology that may well be relevant to reviewing the Commerce Control List and possibly also sections of the Munitions Control List. It is important that any review committee include appropriate technical expertise and representatives from several stakeholders, including universities. It would also be important that the charge to such a committee reflect the concept of a "culture of openness and engagement," as articulated in our report, rather than the "culture of containment" represented by our current export control regime.

Q2. Since imposition of export controls decades ago, is there a public record of opinions on licenses that would give industry and academia roadmaps about what is acceptable, and what isn't? How transparent and consistent is the licensing process? To what degree can applicants cite previous license approvals to gain quick consideration of similar, pending applications?

A2. With all respect, I believe that these questions should really be answered by the appropriate offices in the Departments of Commerce and State. Both agencies have indeed made attempts to reach out to their constituencies in order to facilitate the licensing process. And both have attempted to shorten the time for review and approval of licenses. However, the primary problem for universities is Deemed Export. If licenses were routinely required even for so-called "use technology," thousands of licenses would be needed to accommodate the large number of international students and the thousands of pieces of equipment on the campuses of our research universities. The administrative burden on both the universities and the federal agencies would be substantial, with little or no gain in national security.

Questions submitted by Representative Pete Olson

Q1. What are examples of capabilities in satellite and launch systems where the U.S. excels and should hold tight to the underlying technologies?

A1. I do not feel qualified to identify specific capabilities, but feel confident that an appropriately composed panel of industry, academic and government experts would be able to do so.

Q2. In statements presented during the hearing, several witnesses cited difficulties engaging in collaborative space research missions, given that all U.S. satellites are controlled by the State Department's munitions list. Yet the State Department claims they have streamlined the licensing process. From your vantage point, has the Department made real improvements, or is the system still weighed down with too many uncertainties, making future science collaborations a difficult proposition?

A2. I do believe that the State Department, like the Commerce Department, has made good faith efforts to streamline the licensing process. However, there are still many stories of excessive delays (such as the one I mentioned in my testimony, in

which it took 18 months for a graduate student to get permission to download Mars data). Furthermore, while expedited licensing might make sense for the physical export of a piece of hardware, it is generally not practical for the implied "deemed export" or "defense service" associated with the transfer of technical information. The major difficulty is that scientific research is normally conducted in an open environment with a diverse population of students, visiting scientists, and often with international collaborators. It is simply impractical to obtain large numbers of licenses nor is it even known which license might be needed at which time. Finally, one might ask why we should go through such a licensing process in the first place if the technology in question is, in fact, of no national security importance or widely available outside the U.S.

ANSWERS TO POST-HEARING QUESTIONS

Responses by Major General Robert S. Dickman, Executive Director, American Institute of Aeronautics and Astronautics

Questions submitted by Chair Bart Gordon

Q1. Dr. Canizares' testimony suggests that some of the actions our committee could take to address the impacts of export controls include 1) endorsing the recommendations in the National Academies report and 2) requiring that each agency under our jurisdiction develop and implement a plan to execute the recommendations and report to Congress on their progress. Do you agree with Dr. Canizares' suggestions? Are there other actions this committee could take, within its jurisdiction, to address the impacts of export controls on science and technology competitiveness and to ensure America's leadership in space?

A1. I believe Dr. Canizares is correct to endorse the recommendations of the *"Fortress America"* report. These recommendations are designed to provide more consistency to the regimen, account for changes in the marketplace, encourage ingenuity, and ensure strategic competitiveness. I also agree that Congress should place accountability on federal agencies that impact, and that are impacted by export control policies. This is necessary to gauge the effectiveness of any changes in policy and evaluate whether agencies are implementing the kinds of changes Congress may call for. It may also help to indicate when and where future changes are needed.

There are other areas within the jurisdiction of the House Science Committee where actions can be taken to address the impacts of export controls. With its oversight responsibilities over federal scientific research, development, and demonstration, there are opportunities to examine, adjust and affect policies that restrict collaborative research and access to research. As I mentioned in my testimony before the Committee, I believe the House Science Committee possesses the jurisdiction to encourage global engagement in science and technology. We need to invest in our research & test facilities to ensure that we maintain the state-of-the-art in capabilities in those areas. If visa policies are indeed changed to provide more access for foreign scientist and students, we must make certain that we have the infrastructure and programs in place that capture their passions and imaginations once they are here so as to increase our available talent pool at the expense of the talent pool foreign competitors have to draw from.

I certainly would not want to see the Committee limited to these suggestions. I believe that as new policies are put in place, more obvious opportunities will also present themselves for the Committee to examine and enact. The first step is taking the first step, and I believe that the Committee has already committed to that through its efforts to examine where improvements can be made in the current export control regimens.

Q2. Your testimony states that "We need to make certain that we develop and implement integrated policies and holistic strategies that enable us to remain technologically superior to threats against our national security, embrace participation in the international science community, and regain competitiveness in the global marketplace." *That sounds like a pretty challenging task. How in practical terms should we go about doing that? What entity should be involved in leading the development and implementation of an integrated policy and strategy?*

A2. While the challenge is not insignificant, it simply proposes is that we regain a position we held for many decades—that we do the things that got us there in the first place. The process should begin with defining core principles that serve as a foundation for policies and programs that are developed. Whether in government, academia, or industry, it is a common business practice to define a core mission and goals and then develop a strategic plan around those defining principles. Over the course of time, it is necessary to step back and evaluate what you are doing strategically, moving towards evolving opportunities, and retiring outdated pursuits. The key is having that core mission and associated values to act as an axis for the strategic plan and its subsequent evolutions to revolve around.

I believe that this needs to take place at a sufficiently high level so as to have the authority to provide coordination and cohesion among the many departments, agencies and offices involved. The National Security Council (NSC) comes to mind because of the level of the office and its ability to coordinate policies and initiatives through the Office of Science and Technology Policy, the Office of the United States

Trade Representative, and the President's Intelligence Advisory Board and Intelligence Oversight Board.

Of course, policies have little practical effect without the support of implementing authorization and appropriation.

Q3. What specifically does the AIAA recommend for addressing concerns about the impact of export controls on the commercial sale and use of satellites for research purposes?

A3. As I elaborated upon in my testimony before the Committee, I believe we need to take on the task of evaluating why we are protecting capabilities, and then examine those capabilities that are currently restricted to ensure that we are not building the fence higher than is necessary to protect national security at the expense of the innovation and industrial base we are depending on to provide those national security capabilities. I think it is important that our national security goals should also ensure a robust and sustainable aerospace sciences, technology and industrial base.

Once that bar has been set, the same constraints should apply to specific components of research satellites as are applicable to commercial service satellites (e.g., communications satellites). Once the components are in foreign hands, there is really no further control regarding their application.

Q4. You testified that the AIAA is undertaking an independent effort to create a process for evaluating the list of controlled satellite components on a regular basis. Could you please elaborate on the process you envision creating? What is the timetable for AIAA to complete its work? Who should conduct those regular evaluations?

A4. AIAA has a cataloguing effort underway that is analyzing components of the communications satellite. What we are currently examining is just a start of what is necessary, and it will have its limitations. To begin with, we understand that Congress will need to provide authority to someone within the executive branch to make determinations on how to use the findings of an examination such as what belongs on which list, and to what degree a component should be subjected to restrictions. We also are working with unclassified data. Certainly there are going to be directorates and offices within our national security agencies that have control of data that is not and should not be publicly available. That can include anything from alloy characteristics and structural traits to capabilities and manufacturing technologies that would give a domestic component a national security-designated advantage.

For our purposes, we started with just the satellite bus, and broke it down by component. We then worked throughout our membership to identify appropriate subject matter experts (SMEs) who could examine those components in a comparison with commercially available foreign designed and manufactured components. We use a series of criteria that include metric for performance, analyze the range of U.S. suppliers, compare against the best non-U.S. component, and make a determination of whether or not a competitive advantage exist for the U.S. component. Finally, we analyze whether there is a discriminating value between military and non-military applications. Once an SME has completed, documented and submitted a survey, it is then subjected to a peer review process that evaluates both the conclusion of the survey, and the process and support provided by the SME in making these determinations.

Our timeline for this process is to complete this initial examination and have a compilation of surveys completed by early summer. This will not be a formal report, and is only intended to provide supporting data for a much larger process.

I would suggest that the cataloguing process and the determinations on which control list components should be placed should reside somewhere within the national security community where there is access to current classified data on components, capabilities and uses, both domestic and foreign. That office must consist of a highly-technical, highly-competent workforce, and the staff should be rotated regularly to maintain an appropriate mix of individuals from government, industry and academia who have a strong familiarity with current research, technology and capabilities in this area. The review committee should include relevant discipline experts from a number of different organizational entities to provide a balanced perspective and should include at least the Department of Defense, NASA, the National Security Agency, the Department of Commerce, the National Security Space Office (NSSO), National Reconnaissance Office (NRO), the Office of the Director of National Intelligence (ODNI), and some recognized non-governmental organizations with resident experts on applicable technologies.

Q5. In your prepared statement, you recommend that "we need to evaluate the trends in capabilities of foreign components . . . examine how far equivalent components' capabilities have come and project when we may expect those capabilities to surpass U.S. components to inform periodic reevaluation of technologies." *Could you please discuss this evaluation process? Is the data on foreign component capabilities available to allow an evaluation of foreign capabilities? Who should have responsibility for regular evaluations of foreign capabilities?*

A5. Once a systematic evaluation survey process is established with qualified and confirmed data and SMEs capable of executing those evaluations with sufficient peer review, the goal of this recommendation becomes institutionalized. As part of that survey, we should be evaluating the progression in foreign capabilities perhaps building a timeline that shows that progression that corresponds with the surveys. A ratio between the metric that measures the capability with correlating timeline that competitors have achieved progressing levels of capability would illustrate those trends. That is much easier said than done, but it is not so difficult that we cannot complete this initial step in a reasonable timeframe.

After that point, it is a matter of continuing to invest resources and maintaining oversight so that this survey office does not develop a culture similar to other parts of the export control sector where decisions can be arbitrary and become unnecessarily conservative in their approach to moving technologies and services off the most rigid control lists, or, conversely, overly aggressive in removing sensitive technologies off those same lists. It really becomes a balancing act at that level, and the key will be sufficient oversight from Congress and upper levels within the Administration.

I would refer to my response for Question 4 on much of this. I believe that the U.S. national security community has and does collect much of this data, however, I am not able to venture a guess on whether a centralized clearinghouse for this type of highly sensitive classified information exists, or whether it would involve several individual collections of data housed among several agencies and offices. For the sake of consistency in the process, the same individuals charged with examining the U.S. capabilities should probably examine those foreign capabilities and progression trends.

Questions submitted by Representative Gabrielle Giffords

Q1. The CSIS study on export controls noted concerns regarding the negative impact of export controls on selected areas of the space supplier base such as solar cell and solar cell substrate technologies. These would appear to be space technologies for civil applications. From your AIAA perspective, are you aware of any implications of export controls on our ability to achieve the Nation's objectives to invest in "green technologies" and renewable energy capabilities?

A1. Excluding nuclear power sources and perhaps state-of-the-art high efficiency, space-qualified solar cells, I know of no reason why satellite power system technologies should be sufficiently sensitive from a national security perspective to be on the ITAR list. To the extent that these technologies can contribute to cost-effective means for supplying renewable energy, it is in the national interest to assure they get maximum use. Achieving the maximum potential to reduce greenhouse gas emissions globally using space-derived renewable energy technologies can only be realized with minimum restriction on their export. Applying the ITAR regimen to these technologies will inhibit realization of that objective.

An example of the effects of export controls have had in limiting the ability of technology, though not a green technology, would be Magnetic Resonance Imaging (MRI) medical equipment. While this technology has shown great benefit to the medical community, it was slow to gain exclusion from export controls because of its advanced technology systems that were subject to those controls. It is a medical technology that has improved the human condition worldwide. However, it has only become widely available after an exclusion was included in Category 3 of the Commercial Control list.

As has long been the case with aerospace and aerospace systems technologies, we are bound to discover civil and commercial "green technology" uses well beyond the original design intent through technology transfers as we look to reduce our consumption of carbon-based fuels. In that process, it should be expected that there will be export control obstacles. The hope is that as innovation progresses, we will be able to overcome many of those hurdles and bring those technologies to bear in our efforts to reduce our carbon footprint.

Q2. Stories have appeared in the foreign press regarding the possible repatriation of foreign-born scientist and engineers being lured by the promise of expanding space programs in their native countries. From your position in AIAA, what does this mean for the workforce of agencies such as NASA and for the U.S. aerospace industry? What types of incentives do foreign scientists and engineers educated or working in the U.S. have for staying in the U.S. as opposed to taking their talent and experience overseas?

A2. The U.S. remains the leader in many science, technology and engineering research disciplines. In many instances, there remains considerable esteem for being a part of U.S. research and development, in U.S. innovation. About 15 percent of the membership of AIAA is made up of foreign aerospace professionals. There are measurable benefits that they receive for that membership, but first and foremost they come to us for the esteem of being a part of the American Institute of Aeronautics and Astronautics.

For all the faults that 'experts' find in U.S. science and technology policy and programs, we are a stable base for innovation and research. Many foreign scientist and students continue to come to the U.S. to be apart of that. What often gets lost in the budget discussions is that, while the percentages of our federal budget designated for research and development has waned, we are still investing more in this area than any other single country in the world. That investment goes a long way in influencing foreign scientist and students to be apart of the U.S. system.

Questions submitted by Representative Ralph M. Hall

Q1. What would be the best approach to conduct the first round of 'sunset' reviews for items currently on export control lists? Presumably, it would be a massive undertaking. Who should populate such a review committee?

A1. We must first examine the principles for why we restrict technologies and build a sound strategy for examining and listing the technologies based on those principles. As I've previously mentioned, once a systematic evaluation survey process is established with qualified and confirmed data and SMEs capable of executing those evaluations with sufficient peer review, the goal of this recommendation becomes institutionalized. As part of that survey, we should be evaluating the progression in foreign capabilities, building a timeline that shows the progression that corresponds with the surveys.

I don't believe that we should have the same people who evaluate the applications also performing this technical analysis of the capabilities of technologies and services. I would suggest that the cataloguing process and the determinations on which control list components should be place should reside somewhere within the national security community where there is access to current highly classified data on components, capabilities and uses, both domestic and foreign. That office must consist of a highly-technical, highly-competent workforce, and the staff should be rotated regularly to maintain an appropriate mix of individuals from government. industry and academia who have strong familiarity with current research, technology and capabilities in this area. The review committee should include relevant discipline experts from a number of different organizational entities to provide a balanced perspective and should include at least the Department of Defense, NASA, the National Security Agency, the Department of Commerce, the National Security Space Office (NSSO), National Reconnaissance Office (NRO), the Office of the Director of National Intelligence (ODNI), and some recognized non-governmental organizations with resident experts on applicable technologies.

Q2. Foreign satellite builders have been openly marketing satellites as being "ITAR-free." What has been the record of their marketing efforts? Is there any evidence that they are taking away sales from U.S. builders? Technologically, how do their satellites compare to ours?

A2. I believe there are six specific cases where the stated determining factor in the decision to use a foreign manufactured satellite was "ITAR-free" marketing. However, the real impact is being felt downstream in the second and third tier companies who design, manufacture and sell satellite and launch components and services. This is where satellite manufacturers have become very vocal about their intent to seek "ITAR-free" components, and this is where the U.S. is beginning to see a real consolidation and reduction in the industrial base. Our primes are still delivering enough hardware to the U.S. Government, that they have been able to sustain market share losses in other markets due to ITAR and other export control regulations up to this point.

Unfortunately, much of the innovation that drives this sector of the economy comes from these second and third tier companies. As these areas fade away, so does the culture that is willing to take on risk in their research, design, & development, and that is able to adapt to changes and challenges in the marketplace at the fastest pace.

I believe that in most instances, U.S. satellites still lead the world in design and capability. However, where we are losing footing is in the components that make up those satellites. As this happens, it is only a matter of time before we begin to see the playing field in the satellites begin to level.

Q3. Since imposition of export controls decades ago, is there a public record of opinions on licenses that would give industry and academia roadmaps about what is acceptable, and what isn't? How transparent and consistent is the licensing process? To what degree can applicants cite previous license approvals to gain quick consideration of similar, pending applications?

A3. The roadmap question is an interesting one. In the National Academies report, Recommendation 1.a states, "(The President should) Recognize the interdependence of national security and economic competitiveness factors in making export control decisions with respect to individual requests for licenses through a principle-based system." Recommendation 1.c continues, "(The President should) Establish as a new administrative entity, a coordinating center for export controls, with responsibilities for coordinating all interfaces with persons or entities seeking export licenses and expediting agency processes with respect to the granting or denial of export licenses." Recommendation 1.d concludes, " (The President should) Establish an independent export license appeals panel to hear and decide disputes about whether export licenses are required, whether particular decisions to grant or deny licenses were made properly, and whether sunset requirements have been carried out properly.

From the book *United States Export Controls, Fifth Edition,* which appears in Appendix F of the *"Fortress America"* report, Table 1–1 lists the U.S. Government entities with statutory authority to control exports. This table lists 16 departments and agencies, under 35 different regulations, many with similar areas of controlling authority. Further, Table 1–3 shows the decision tree for determining agency jurisdiction. This table shows 17 steps, many with several substeps to use in determining whether an export is subject to a control regimen, and, if so, where. Much of the delay in the application process is a matter of figuring out under just exactly which jurisdiction a particular product or service falls. These two tables well illustrate the lack of transparency and clarity in the current process. If Recommendation 1.c is enacted establishing a central clearinghouse, much of this confusion in the front end of the process would be removed, and businesses could have a single source to seek information on what controlling authority exists for a given product or service, and to which their application is filed.

Recommendations 1.a and 1.d both address the question about the citation of previous applications in the consideration of similar pending applications. Currently, no standards or precedence exist that are used in processing applications. Each new application is viewed in a vacuum that creates much of the uncertainty of the process. By creating a principled-based system that uses standards and precedence in the certification process, we can remove much of the current ambiguity in the process, and reduce the time spent in the evaluation of the applications. It further streamlines the process for appeals with a governing entity to hear those appeals using guiding principles to do so.

Questions submitted by Representative Pete Olson

Q1. What are examples of capabilities in satellite and launch systems where the U.S. excels and should hold tight to the underlying technologies?

A1. The list of what falls in this category is getting shorter all the time as other nations independently make advances to achieve the same technical prowess we have been trying to protect. While probably not limited to these, the following are some specific areas where we still selectively excel and may therefore want to restrict export for national security reasons:

- Some very specific features of engines and fuel containment systems for the following:
    1. LH2-based propulsion
    2. Hypergolic propulsion
    3. Solid propellant propulsion

4. Advanced electric and magnetohydrodynamic propulsion

- Precision inertial navigation systems
- Re-entry guidance and control algorithms
- Communication encryption systems
- Advanced data processing, reduction, and compression algorithms
- Advanced observation devices
- Optical wave-front control technologies
- High slew-rate momentum transfer devices

Q2. In statements presented during the hearing, several witnesses cited difficulties engaging in collaborative space research missions, given that all U.S. satellites are controlled by the State Department's munitions list. Yet the State Department claims they have streamlined the licensing process. From your vantage point, has the Department made real improvements, or is the system still weighed down with too many uncertainties, making future sciences collaborations a difficult proposition?

A2. The fact is that the Department of State has been able to reduce processing times and reduce the pending caseload for certification licenses. However, I don't believe that they have improved the lot of the applicants. The approval rate for applications has historically been relatively high assuming the correct application was completed and filed to the correct oversight agency. However, under the previous system, applications could sit for months before any review took place. Once the appropriate jurisdiction had been established, it could take several more weeks or possibly months before an evaluation of the application was completed and a determination made.

Under the new system, the application processing times have been greatly reduced, and most reviews are completed in weeks or just a few months. Now, however, companies are reporting that most applications return with qualifying language that place more uncertainty than was experienced under the previous system. So while the State Department has streamlined its processes, these caveats often place reporting and verification obligations on the companies that they have no ability to satisfy, and the certification is for naught, leaving the companies in no better position than they were under the longer waiting periods.

Appendix 2:

Additional Material for the Record

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Briefing of the Working Group on the

Health of the U.S. Space Industrial Base and the Impact of Export Controls

February 2008

1

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Preamble

- "In order to increase knowledge, discovery, economic prosperity, and to enhance the national security, the United States must have robust, effective, and efficient space capabilities."
  - U.S. National Space Policy (August 31, 2006).

2

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Statement of Task

- Empanel an expert study group to [1] review previous and ongoing studies on export controls and the U.S. space industrial base and [2] assess the health of the U.S. space industrial base and determine if there is any adverse impact from export controls, particularly on the lower-tier contractors.
- The expert study group will review the results of the economic survey of the U.S. space industrial base conducted by the Department of Commerce and analyzed by the Air Force Research Laboratory (AFRL).
- Integrate the findings of the study group with the result of the AFRL / Department of Commerce survey to arrive at overall conclusions and recommendations regarding the impact of export controls on the U.S. space industrial base.
- Prepare a report and briefing of these findings

3

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Working Group

- Thomas Young, Consultant, Co-Chair
- Bill Ballhaus, Aerospace Corp , Co-Chair
- Pierre Chao, Center for Strategic and International Studies, Co-Chair

- Richard Albrecht, Moog
- Jeffrey Bialos, Johns Hopkins
- Lincoln Bloomfield Jr., Palmer Coates
- David Danzillio, Emcore Photovoltaics
- John Douglas, Aerospace Industries Association
- Paul Kaminski, Technovation
- John Klineberg, Consultant
- Lon Levin, SkySeven Ventures
- Tom Marsh, Lockheed Martin, retired
- Tom Moorman, Booz Allen Hamilton
- J.R. Thompson, Orbital Sciences
- John Tilelli, Cypress International
- Robert Walker, Wexler & Walker Public Policy Associates

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Methodology

- Leveraged broad set of interviews and data from:
  - US government
    - Department of State, Department of Defense (OSD/Policy, OSD/AT&L, DTSA, STRATCOM, General Council), NRO, Department of Commerce, NASA, FAA, GAO
    - Congress
  - Foreign governments and agencies (Asia and Europe)
  - US industry
    - Boeing, Lockheed Martin, Northrop Grumman, ATK, Moog, Swales, GeoEye, SES Americom
  - Other experts
    - IDA, Aerospace Corp., Booz Allen Hamilton, Satellite Industry Association, Space Foundation, US Chamber of Commerce, CSIS, Aviation Week
- Leveraged comprehensive survey of space industrial base undertaken by AFRL/Department of Commerce
- Working group generated consensus set of findings and recommendations

5

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Principles

1. Space is critically important to U.S. national security
2. Global leadership in space is a national imperative
3. Similarly, sustaining technological superiority in space is a U.S. national interest
4. Given the interdependence between the defense, intelligence, civil and commercial sectors of space, U.S. leadership in all four is important [see chart, p.42]
5. A strong space industrial base is important
6. A prudent export control policy is necessary to control sensitive technologies
7. The U.S. must have unimpeded access to the technologies (global and domestic) needed for national security space systems

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Executive Summary

The Health of the Space Industrial Base:

Finding 1: Overall financial health of the top tier manufacturers in the space industrial base is "good", but there are areas of concern within the broader health of the industry

Finding 2: As earlier studies have documented, the ability of the government and industry to meet program execution commitments remains inadequate

Finding 3: The U.S. space industrial base is largely dependent on the U.S. defense/ national security budget.

The implication is that the national security community "owns" the U.S. space (manufacturing) industry, and must either provide for the health of the industry ("arsenal strategy") or encourage it (and enable it) to participate more in the global market place to broaden its economic base

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Executive Summary (continued)

The International Landscape and the Impact of Export Controls (1/3):

- The U.S. and its space industrial base is operating/competing in an increasingly globalized and interconnected environment
  - **Finding 4**: There are rapidly emerging foreign space capabilities and the U.S. does not control their proliferation.
  - **Finding 5**: U.S. preeminence in space is under challenge in many areas.
  - **Finding 6**: The current export control policy has not prevented the rise of foreign space capabilities and in some cases has encouraged it (ITAR-free space products).

  The grand strategic intent of the space export controls is not being achieved

- In some cases, the space export control policy is running counter to the national space policy
  - **Finding 7**: U.S. leadership in space benefits significantly from access to foreign innovation and human capital. That access is becoming increasingly difficult.

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Executive Summary (continued)

The International Landscape and the Impact of Export Controls (2/3):

- In some cases, the space export control policy is running counter to the national space policy (continued)

  Finding 8: The current export control policy is constricting U.S. engagement and partnership with the rest of the global space community, and is feeding a growing separation between the U.S. space community and an emerging non-U.S. space community.

  Finding 9: Some elements of the export controls laws are in conflict with U.S. National Space Policy, which has as one of its goals to "encourage international cooperation with foreign nations on space activities that are of mutual benefit" and states that "space-related exports that are currently available or are planned to be available in the global marketplace shall be considered favorably".

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Executive Summary (continued)

The International Landscape and the Impact of Export Controls (3/3):

- U.S. industry is losing share in the international market and turning away from those markets, with the greatest burden being borne by the 2nd and 3rd tier of the industry

Finding 10: The U.S. share of the global space markets is steadily declining, and U.S. companies are finding it increasingly difficult to participate in foreign space markets.

Finding 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the 2nd and 3rd tier.

And it is the 2nd/3rd tier of the industry that is the source of much innovation, and is normally the most engaged in the global market place in the aerospace/defense sector

- The goal is to bring space export control policy in line with the national space policy, achieve its strategic intent while not creating unintended negative consequences to industry

Finding 12: A U.S. export control policy that protects sensitive security space capabilities is important.

Finding 13: There is unanimous agreement that the export control process can be improved without adversely affecting national security.

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Executive Summary - Recommendations

1. The Administration and Congress should review and reconcile the strategic intent of space export controls. [Findings 6,7,8,9]
2. Critical space technologies should be identified and should remain on the Munitions List and under the State Department ITAR process. [Findings 4,5,9, 12]
3. Remove from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use; provide safeguards by having Defense Department identify critical space components and technologies that should always require licensing and referral. Have the appropriate executive branch departments conduct a study to see if other space technologies should be removed from the USML (e.g., weather satellites). [Findings 4,5,7,10, 11, 12, 13]
4. Annually review the appropriateness of designating specific satellite and other space systems, components, and capabilities as Munitions List items based on criticality of items and on their availability outside the U.S. [9,13]
5. Additionally, Congress could amend the legislation related to satellite export licensing and adopt some of the best practices being used in other processes – set timelines, technology thresholds, de minimus rules, and special licensing vehicles. [Findings 8, 9, 10, 11, 12, 13]
6. The Secretary of Defense and NASA Administrator, in addition to the Secretary of State, should have the authority to grant real-time, case-by-case, specific time period exemptions for anomaly resolutions deemed to be in the national interest based on criteria from the National Space Policy. [Findings 8,9]
7. Create a special program authority to permit timely engagement of U.S. participants in multinational space projects. [Findings 7,8,9]
8. Increase the dollar threshold for satellite exports Congressional notification and establish a mechanism to allow the threshold to adjust with inflation. [Findings 8, 10, 11, 13]
9. Relevant space-related government agencies should collaboratively undertake an annual assessment of their industrial base. [Findings 1, 3]

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Health of the Space Industrial Base

Findings 1: Overall financial health of the top tier manufacturers in the space industrial base is "good", but there are areas of concern within the broader health of the industry

Findings 2: As earlier studies have documented, the ability of the government and industry to meet program execution commitments remains inadequate

Findings 3: The space industrial base is largely dependent on U.S. defense/ national security budgets

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Findings 1: Overall financial health of the top tier manufacturers in the space industrial base is "good", but there are areas of concern within the broader health of the industry

- "For at least the last decade, the space industry has experienced high volatility, high risk, market bubbles and financial losses" Space Foundation White Paper, April 4, 2006
- There is currently a recovery under way in the space industry, particularly as the national security space sector undertakes the upgrading/replacement of virtually every type of capability in orbit
- The financial health of the space manufacturers has recovered, but margins remain thin and below the average for the general aerospace/defense industry – particularly the 2nd and 3rd tier [see chart of manufacturer's profits, p. 43]
  - AFRL survey shows average margins of primes has recovered from deep losses in 2003/2004 to reporting 2.5% net margins in 2006
  - …and average net margins of 5% at the 2nd/3rd tier
  - Note this stands in contrast to average net margins of 5% for primes and 6-8% for the 2nd/3rd tiers in the defense sector; let alone 9% in the high technology manufacturing sectors of the general economy

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Findings 1: Overall health of the industrial base (Continued)

The areas of concern about the space industrial base include:

•Identified weaknesses in the 2nd and 3rd tier of the industry - e.g. where there is only one domestic supplier, financially weak supplier, etc.

Selected Areas of Concern in the Space Supplier Base

- Solar Cells
- Li-Ion Batteries
- Travelling Wave Tubes
- Visual Imagers
- Optical Coatings
- Read-out Integrated Circuits
- Infrared Focal Plane Arrays
- Solar Cell Substrates

Source: Aerospace Corp analysis, 2006

- Note: a healthy 2nd/3rd tier is important given the role it plays in generating innovation

- …and well reported looming issues with the space-related workforce, particularly with the next generation [see chart from OSD report, p. 44]

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Findings 2: As earlier studies have documented, the ability of the government and industry to meet program execution commitments remains inadequate

- The issue of program management and systems engineering skill shortages in government and industry have been well identified in numerous studies over the last five years [see detailed comments from reports, p. 45]
  - "Lack of specific objectives and milestones"
  - "Shortfalls in experience levels"
  - "critical skill shortages in program management, systems engineering, and software development", etc.
- The problem has been recognized, and there are initiatives in place to address this situation (but it is too early to determine effect). However, the desire to build complex, system-of-systems exacerbates the skills issue. Furthermore, it takes up to 10 years to "grow" systems engineers and multiple program experiences are critical (given the limited number of new starts participation in all space sectors or internationally is therefore important)

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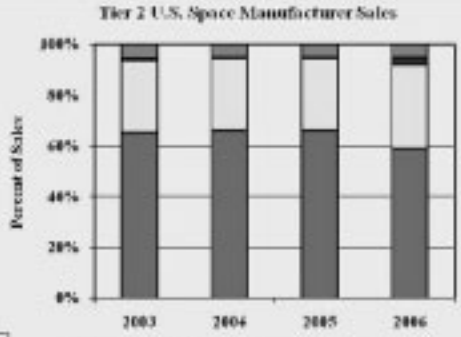
Findings 3: The space industrial base is largely dependent on U.S. defense/national security budgets



Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

- Percent of market dominated by U.S. defense/national security/government customers more akin to naval shipbuilding or tanks, than aerospace or other parts of aerospace/defense

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Health of the U.S. Space Industrial Base

Implies that the national security community "owns" the U.S. space industrial base, and must either provide for the health of the industry ("arsenal strategy") or encourage it (and enable it) to participate more in the global market place to broaden its economic base

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International Landscape and the Impact of Export Controls

- The Global Landscape
- National Space Policy and Export Control
- U.S. Industry, the International Markets and Export Control Policy
- Export Control Policy

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The Global Landscape

Findings 4: There are rapidly emerging foreign space capabilities and the U.S. does not control their proliferation

Findings 5: United States preeminence in space is under challenge in many areas

Findings 6: The current export control policy has not prevented the rise of foreign space capabilities and in some cases has encouraged it.

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Findings 4: There are rapidly emerging foreign space capabilities and the U.S. does not control their proliferation
Findings 5: United States preeminence in space is under challenge in many areas

- Where the U.S. was once part of a very exclusive club, the number of nations active in space continues to grow
  - Triple the number of countries with their own positioning/navigation systems since 1999
  - Double the number of countries with their own reconnaissance/earth observation satellites since 1999
  - A dozen countries able to launch their own satellites
  - 38 countries with operational control over their own communication satellites

[See detailed chart for more info, p. 46]

- Furthermore, the sophistication of overseas and commercial capabilities continues to increase
  - Example: Russia, France, Israel, Korea and India all possess commercial imaging satellites of one meter resolution or better
  - Example: Canada, European Space Agency, Italy, Germany and Japan possess civil radar imaging satellites; soon India and Argentina will join the list; China has launched two military radar imaging satellites

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Findings 4 & 5: Rapidly emerging foreign space capabilities and U.S. preeminence in space is under challenge (continued)

- In the global commercial communications satellite market, where the U.S. had a technical and qualitative lead over the international competition in the 1990s, that competition has significantly closed the gap in the last decade
  - Since 1998, European and Asian manufacturers of satellites have gone from delivering satellites that were smaller, had fewer transponders, lesser payload power and shorter lives to manufacturing satellites of equal weight, number of transponders, payload power and lifespan

[see detailed table comparing U.S., European and Asian satellite capabilities , p. 47]

- As much as the U.S. would like to control this spreading of capabilities, international activity continues
  - Sino-Russian cooperation
  - Russian-European cooperation
  - Russian-Indian discussions

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Findings 4 & 5: Rapidly emerging foreign space capabilities and U.S. preeminence in space is under challenge (continued)

- Other space faring nations continue to make strides, whether they have access to U.S. technology or not [see detailed chart of Chinese and Indian space milestones, p. 43]
- Since 1999 China has:
  - Launched an indigenous navigation system
  - Launched first 3m satellite
  - Conducted its first manned spaceflight
  - Tested an ant-satellite missile
  - Sold the first Chinese built satellite to a foreign buyer (Nigeria)
  - Launched first lunar probe

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Findings 6: The current export control policy has not prevented the rise of foreign space capabilities and in some cases has encouraged it.

- For years, China has chafed at efforts by the United States to exclude it from full membership in the world's elite space club. So lately **China seems to have hit on a solution: create a new club**. (NY Times, May 23, 2007)
- "It's a shame, but it's not for me to comment on U.S. law, only to note its effects, and for the Rover, ITAR would have made cooperation too complicated to be feasible. … **We are now obliged to develop our autonomy in various areas, which is no bad thing** … We may also find partners besides NASA" – Daniel Sacotte, head of ESA's Human Spaceflight program (May 30, 2005)
- "It is a matter of particular pride that **international technology denial regimes have not impeded your efforts — in fact, they have spurred you to greater heights**", Indian Prime Minister to ISRO (Indian Space Research Organization), September 21, 2005
- Other examples include:
  - European Space Agency spending funds to develop a European supplier of solenoid valves, in order to remove that U.S. part from European space propulsion systems
  - CASA of Spain, which had limited capability as supplier of reflectors, funded to develop reflectors by non-U.S. satellite primes as part of ITAR-free movement. Now a global competitor in reflectors.

The grand strategic intent of the space export controls is not being achieved

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National Space Policy and Export Controls

Findings 7: U.S. leadership in space benefits significantly from access to foreign innovation and human capital, but access is becoming increasingly difficult

Findings 8: The current export control policy is constricting U.S. engagement and partnership with the rest of the global space community, and is feeding a growing separation between the U.S. space establishment and an emerging non-U.S. space establishment.

Findings 9: Some elements of the export controls laws are in conflict with U.S. National Space Policy

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Findings 7: U.S. leadership in space benefits significantly from access to foreign innovation and human capital, but access is becoming increasingly difficult

- The U.S. has historically employed a successful model of being a "vacuum cleaner" of the world's best innovation, technology and human capital; and then turning this raw technology into value-added space and defense systems
  - U.S. has been leveraging foreign innovation/human capital in space for 60 years
    - From Werner von Braun to use of the Russian RD-180 engines on the U.S. Atlas IIIA
    - "The key to maintaining U.S. technological preeminence is to encourage open and collaborative basic research. **The linkage between the free exchange of ideas and scientific innovation, prosperity, and national security is undeniable**"
      - National Security Advisor Rice (2001)
    - Given that foreign students earn more than half of the science, technology and engineering PhD's and foreign-born workers make up more than a quarter of the U.S. ST&E workforce – the inability to access this group automatically shrinks the available talent pool
  - Furthermore the total applications of foreign graduate students to U.S. universities was down 19% in 2004-2007

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Findings 8: The current export control policy is constricting U.S. engagement and partnership with the rest of the global space community, and fed a growing separation between the U.S. and an emerging non-U.S. space community.

- **"Collaboration between U.S. and European scientists is harder now** than it was before U.S. technology-transfer rules were tightened in 1999 … U.S. government officials charged with reviewing bilateral or multilateral science projects have been so worried about being accused of letting sensitive technologies slip into the wrong hands that they have overcompensated" – Nobel laureate George F. Smoot (*Space News*, February 8, 2007)

- "[Export Control rules cause] problems between us and our international partners that are **really more of a problem than the benefit** we are gaining by having the ... restrictions in there," – William Gerstenmaier, NASA's associate administrator for space operations (*Space News* May 21, 2007)

- "[A] contractor workforce comprises the majority of the [International Space Stations] operations workforce and must be able to have a direct interface with the IP operations team to assure safe and successful operations. Their interactions and their ability to exchange and discuss technical data relevant to vehicle operations or severely hampered by the current ITAR restrictions."…"**Currently the ITAR restrictions and the IPs' objections to signing technical assistance agreements are a threat to the safe and successful integration and operations of the Station.**" – Tommy Holloway, Chair, International Space Station (ISS) Independent Safety Task Force (House S&T Committee, 7/24/2007)

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Findings 8: The current export control policy is constricting U.S. engagement and partnership (Continued)

- One specific area where export controls are constraining U.S. engagement related to Technical Assistance Agreements. TAA's which are critical for partnerships and marketing are taking longer to approve, from average of 52 days in 2003 to 106 days in 2006 (in competitive situations, 60 days response time to RFP's is not unusual)

[see table for detailed data, p.49]

- Another area of concern regarding U.S. international engagement and partnership is the ability to conduct anomaly resolution

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Findings 9: Some elements of the export controls laws are in conflict with U.S. National Space Policy

- One of the goals of the National Space Policy is to "encourage international cooperation with foreign nations on space activities that are of mutual benefit"; it also states that "space-related exports that are currently available or are planned to be available in the global marketplace shall be considered favorably".

Among the unintended consequences:	Corresponding section in US National Space Policy:
• The munitions list is not consistent with the current assessment of which space technologies that should be controlled	• "As a [effective export policy] guideline, space-related exports that are currently available or are planned to be available in the global marketplace shall be considered favorably"
• The U.S. space export control regime does not match its goals of both enabling cooperation with allies and denial of capabilities to opponents. The current regime does not provide policy makers with the nuance or flexibility needed to serve the National Space Policy	• "Develop and deploy space capabilities that sustain U.S. advantage and support defense and intelligence transformation. . . . Develop capabilities, plans, and options to ensure freedom of action in space, and, if directed, deny such freedom of action to adversaries"
• Satellites and their components were placed on the U.S. Munitions List due to Congressional action with the intent of limiting the spread of space technology. However, this has had the unintended consequence of encouraging the proliferation of space capabilities, has not prevented the rise of other space powers but has impacted U.S. competitiveness	• "Refrain from conducting activities that preclude, deter, or compete with U.S. commercial space activities, unless required by national security or public safety"
• There has been an adverse industrial and technological impact to the U.S. ITAR implementation introduces a friction for U.S. companies competing in the global market, as much as $600 million a year, which in turn feeds space development that the U.S. is not involved in	• "A robust science, technology, and industrial base is critical for U.S. space capabilities. . . Use U.S. commercial space capabilities and services to the maximum practical extent"
• The continuation of our legacy of beneficial collaboration with foreigners has been impeded, as has our ability to do anomaly	• "Encourage international cooperation with foreign nations and/or consortia on space activities that are of mutual benefit and that further the peaceful exploration and use of space, as well as to advance national security, homeland security, and foreign policy objectives"

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U.S. Industry, the International Markets and Export Control Policy

Findings 10: The U.S. share of the foreign space markets is steadily declining, and U.S. companies are finding it increasingly difficult to participate in foreign markets

Findings 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business, particularly the 2nd and 3rd tier.

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Findings 10: The U.S. share of the foreign space markets is steadily declining, and U.S. companies are finding it increasingly difficult to participate in foreign markets

- Study after study shows the same results, an erosion of U.S. share of the global commercial satellite market since the late 1990s [see detailed charts for examples, p. 50-52]
  - FAA, Institute for Defense Analyses, Satellite Industries Association, NASIC
- "One European aerospace executive said export customers were asking for systems which were 'ITAR free.'" Defense News (June 19, 2007)
- "We will not buy from U.S. due to export controls." Canadian TELESAT
- Other examples where U.S. components and technology are being designed out include:
  - Creation of ITAR-free European apogee motor
  - ITAR-free European thruster control valves
  - ITAR-free European star tracker
  - Microwave components from the Astrium Megha-Tropiques mission instruments
  - Alcatel satellite bus
  - zGRACE mission where U.S. systems integrator was replaced by a foreign contractor

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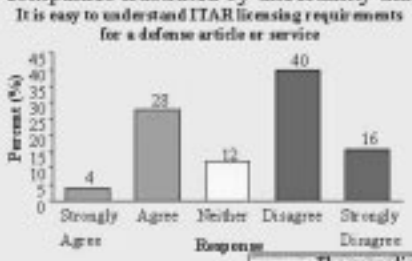
Findings 10: …and U.S. companies are finding it increasingly difficult to participate in foreign markets (cont'd)

- US companies frustrated by uncertainty that ITAR involves



Source: Booz Allen survey of U.S. industry executives, May 2006

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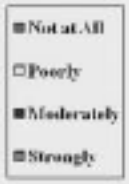
Findings 10: …and U.S. companies are finding it increasingly difficult to participate in foreign markets (cont'd)

- So much so, that it impacts the space industry's confidence in being able to compete in foreign markets

Will your company be well positioned to compete in the (domestic/foreign) markets in the 2008-2012 period?

Company Perspective on Being Competitive in Domestic Market (All Tiers)



Company Perspective on Being Competitive in Foreign Market (All Tiers)

Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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Findings 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business - particularly the 2nd and 3rd tier.

- U.S. is the only country that classifies commercial communications satellites as a "munition"
- U.S. export controls are cited as the #1 barrier to foreign markets by industry [see detailed chart, p. 53]
- An average $600 million per year of lost revenues due to licensing issues has been cited by industry (Caveat 1: there may be double counting between industry competitors; Caveat 2: the data does not include competitions that were not pursued by US industry due to ITAR) [see detailed table, p. 54]
- The burden on the 2nd and 3rd tier of the industry is particularly heavy
  - Compliance costs averaged $50M per year for the industry [see detailed chart, p. 55]
  - Costs have increased 28% since 2003
  - As a percent of foreign sales, the cost burden on Tier 3 companies is nearly 8 times that of Tier 1 firms (Less resources = less investment)

Total costs of compliance divided by foreign sales

	Total Export Control Burden			
	2003	2004	2005	2006
Tier 1	0.9%	0.9%	1.6%	1.1%
Tier 2	2.0%	2.1%	3.1%	1.9%
Tier 3	8.0%	7.6%	6.2%	7.7%

Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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Findings 11: Export controls are adversely affecting U.S. companies' ability to compete (Continued)

- Once commercial satellites were placed on the Munitions List, given the structure of the ITAR (any component on a munitions list item is a munition), the 2nd and 3rd tier of the industry were impacted… intended or not

> **"We never wanted to control parts and components."**
>
> Former Director, Space Monitoring Division of DoD Defense Threat Reduction Agency, speech at Satellite 2007 conference (reported by The Space Review, February 26, 2007)

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Export Control Policy

Findings 12: A U.S. export control policy that protects sensitive security space capabilities is important.

Findings 13: There is unanimous agreement that the export control process can be improved without adversely affecting national security.

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Findings 12: A U.S. export control policy that protects sensitive security space capabilities is important.

"Exports of **sensitive or advanced** technical data, systems, technologies, and components, shall be approved only rarely, on a case-by-case basis. These items include systems engineering and systems integration capabilities and techniques or enabling components or technologies **with capabilities significantly better** than those achievable by current or near-term foreign systems."

– National Space Policy (2006)

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Findings 13: There is unanimous agreement that the export control process can be improved without adversely affecting national security.

- The Departments of State, Defense and Commerce are all undertaking reform exercises to reduce processing times and streamline the export control licensing process
- There are numerous broad export control reform efforts under way

President Bush's Technology Agenda:

"The current high tech export control system is awkwardly structured, hindering U.S. businesses, while failing to strengthen our national security."

Coalition for Security and Competitiveness: Recommendations for Modernizing Export Controls on Munitions List Items (2007):

"[T]he U.S. export control system must be modernized so that it is better able to respond quickly and effectively to evolving security threats, and promote our nation's continued economic and technological leadership." (p. 1)
***Recommendations*: Provide more resources and high level attention while streamlining the process.**

Studies by National Academies of Sciences, Defense Science Board, NATO Industrial Advisory Group, Hudson Institute, Heritage Foundation, CSIS and others

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Findings 13: There is unanimous agreement that the export control process can be improved without adversely affecting national security (continued)

- State Department International Security Advisory Board – Report on Space Policy, April 25, 2007

From the State Department International Security Advisor Board Report:

"The Department of State should be prepared to **facilitate international cooperation in the use of space through U.S. export policies.** The Department of State, therefore, in its regulation of satellite exports, should focus on ways to **streamline the licensing process**. While it is obviously essential to protect U.S. national security and space control, the current process damages U.S. cooperation with friends and allies and weakens the U.S. commercial space satellite industry and the underlying industrial base that develops civil, commercial, military, and intelligence space assets.

The **current International Traffic in Arms Regulations (ITAR) list is too broad.** It includes too much technology that is widely available internationally. Moreover, a single international transaction involving commercial space technology now often requires multiple licenses. Licenses often come with extensive restrictions that make resubmission necessary, causing further **delay and uncertainty** for U.S. manufacturers in the commercial international market place.

State ISAB Recommendation #10: The State Department should review the technology in the International Traffic in Arms Regulations (ITAR) list with a view toward regulating key technologies and exporters. The State Department needs to move toward issuing licenses that are sufficiently broad to enable the process to move forward more quickly.

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Recommendations

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Recommendations

1. The Administration and Congress should review and reconcile the strategic intent of space export controls.
2. Critical space technologies should be identified and should remain on the Munitions List and under the State Department ITAR process.
3. Remove from the Munitions List commercial communications satellite systems, dedicated subsystems, and components specifically designed for commercial use; provide safeguards by having Defense Department identify critical space components and technologies that should always require licensing and referral. Have the appropriate executive branch departments conduct a study to see if other space technologies should be removed from the USML (e.g., weather satellites).
4. Annually review the appropriateness of designating specific satellite and other space systems, components, and capabilities as Munitions List items based on criticality of items and on their availability outside the U.S.
5. Additionally, Congress could amend the legislation related to satellite export licensing and adopt some of the best practices being used in other processes – set timelines, technology thresholds, de minimus rules, and special licensing vehicles.
6. The Secretary of Defense and NASA Administrator, in addition to the Secretary of State, should have the authority to grant real-time, case-by-case, specific time period exemptions for anomaly resolutions deemed to be in the national interest based on criteria from the National Space Policy.
7. Create a special program authority to permit timely engagement of U.S. participants in multinational space projects.
8. Increase the dollar threshold for satellite exports Congressional notification and establish a mechanism to allow the threshold to adjust with inflation.
9. Relevant space-related government agencies should collaboratively undertake an annual assessment of their industrial base.

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Detailed Data Backup

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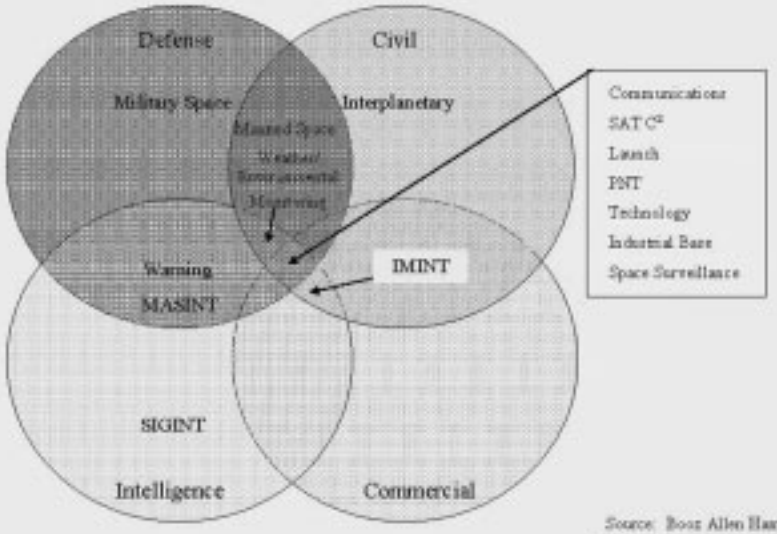
Principles – Space Sector Interdependence



Source: Booz Allen Hamilton

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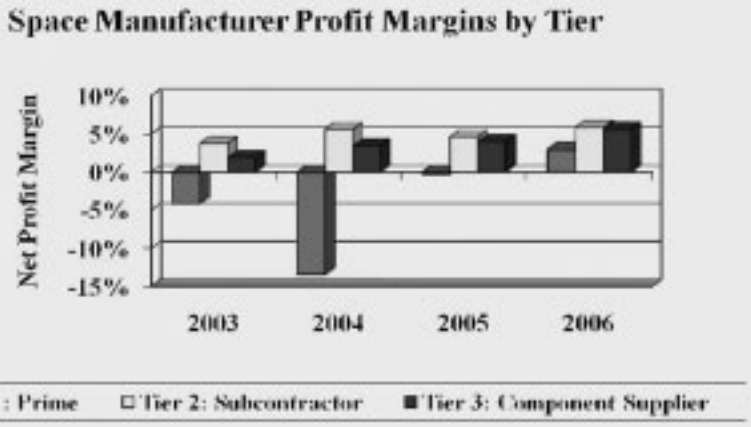
Data for Findings 1: Overall financial health…



Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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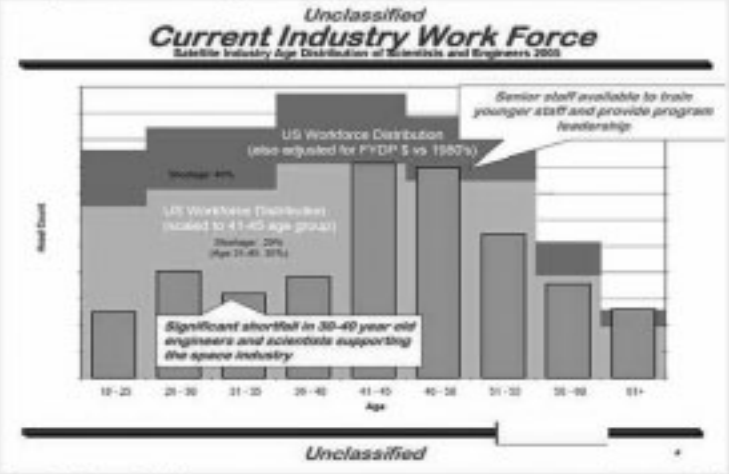
Data for Findings 1: Overall financial health… (Continued)

- There continue to be looming issues with the space-related workforce, particularly with the next generation



Source: OSD report, 2006

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Data for Findings 2: As earlier studies have documented, the ability of the government and industry to meet program execution commitments remains inadequate

- Commentary from various studies:
  - "DOD has not established specific space objectives that are linked to overall program goals and resource requirements, nor has it established specific performance goals or other mechanisms to measure program outcomes…the services do not have clearly defined space objectives and milestones to guide their initiatives, nor does DOD have a mechanism to ensure successful accomplishment of integrated efforts without gaps and duplications" (GAO, *Defense Space Activities: … Further Management Actions Needed*, 2003, pp. 19-20).
  - "The authority of program managers and other working-level acquisition officials subsequently eroded to the point where it reduced their ability to succeed on development programs … Widespread shortfalls exist in the experience level of government acquisition managers, with too many inexperienced personnel and too few seasoned professionals … The lack of dedicated career field management for space and acquisition personnel has exacerbated this situation" (DSB, *Acquisition of National Security Space Programs*, 2003, p. 3).
  - "DOD's major weapon system program managers and program executive officers … pointed to critical skill shortages in program management, systems engineering, and software development" (p.1). "The majority of major acquisition programs in DOD's space portfolio have experienced problems during the past two decades that have driven up cost and schedules and increased technical risks." (p. 7). (GAO, *Space Acquisition: Actions Needed to Expand and Sustain Use of Best Practices*, 2007).

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Data for Findings 4: There are rapidly emerging foreign space capabilities and the U.S. does not control their proliferation

Findings 5: United States preeminence in space is under challenge in many areas

# of countries / Time period	Launch own satellites	Launched human spaceflight	Own positioning/ navigation system	Launched own recon / earth observation sat.	Control over own COMSAT
1980	10	2	2	3	17
1999	12 (+Ukraine, Brazil)	2	2	14	32
2007-8	12	3 (+China)	6(+China, India, EU, Japan)	27	38
2010-2025	Steady growth	India, ESA and Japan active	Full operationalization of EU, Asian systems	Steady growth	Steady growth

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Data for Findings 4 & 5: Rapidly emerging foreign space capabilities and U.S. preeminence under challenge (cont'd)

Comparison of Satellite Capabilities (1990s vs 2000s)

1994-1998 / 2004-2007	Hughes / Boeing	Lockheed Martin	Loral	Aerospatiale / Alcatel Alenia	Matra Marconi / EADS Astrium	Chinese (CASC)	Mitsubishi Elec. Corp
Bus	HS-601 / Boeing 702	A2100 / A2100AX	LS-1300 / LS-1300	Spacebus 2000 / Spacebus 4000	Eurostar 2000+ / Eurostar 3000	DFH-3 / DFH-4	No comm sats built / DS-2000
Select or Representative Spacecraft	ASTRA-1G / AsiaSat 2	AMC-1 / AMC-11	Intelsat 709 / SATMEX 6	AMC-5 / KoreaSat 5	ST-1 / AsiaSat-1	Chinasat 6 / NigeriaSat 1	/ Superbird 7
Launched	1997 / 2004	1996 / 2004	1996 / 2006	1998 / 2006	1998 / 2005	1997 / 2007	-- / planned 2008
In-orbit reliability/failure	25 built before first malfunction in 1998 / 75% of fleet had insurance claim	Named by Frost & Sullivan as "most reliable" for most apps.			88% up before reliability after 10 years.	2 satellites reported as malfunctioning (1 lost as a result); / Solar panel failure took out first	
# of transponders	32 / 102	24 / 48	36 / 60	16 / 36 (up to 112)	30 / 64	24 / 28	0 / 26
Life span (years)	15 / <10	15 / 15	15 / 15	10 / 15	15 / 15	8 / 15	0 / 15
Payload power (EOL kW)	6.6-8 / 16	7 / 6.5	3.9 / 14	-- / 9-16	6.5-7 / 16	4 / 7-10	
Weight (EOL lbs)	5,467 / 8,390	3,820 / 8,099	4,880 / 8,082	1,692	3,380 / 6,490	2,320-2,740 / 8,000	
Total production by 2006	72 / 16	21 / 16	56 (all models)	12 / 7	7 / 13	8 / 3	

Source: CSIS

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Data for Findings 4 & 5: Rapidly emerging foreign space capabilities and U.S. preeminence under challenge (cont'd)

Indian Space Milestones

- 1962: Space program started by Vikram Sarabhai
- 1975: First satellite launch ("Aryabhata")
- 1979: First (experimental) earth observation satellite ("Bhaskara-1")
- 1980: First indigenous satellite launch ("Robini-1")
- 1984: First manned space mission (part of Soviet mission)
- 1997: First satellite launched using indigenous polar satellite launch vehicle
- 1999: Satellites returned to U.S. Munitions List
- 2001: First "high resolution" (~1m) imaging satellite
- 2004: Partners with Russia on GLONASS navigation system
- 2007: Initial operational capability of indigenous GAGAN navigation system
- 2007: First launch and retrieve of (unmanned) spacecraft

Chinese Space Milestones

- 1956: Space program started by Qian Xuesen
- 1970: First satellite launch ("The East Is Red")
- 1971: First (store and forward) communications satellite
- 1973: Manned spaceflight program started
- 1975: First successful recon satellite launch
- 1990: "Biosat" containing 60 animals and plants
- 1990: First commercial satellite launch (Asiasat-1)
- 1999: Satellites returned to U.S. Munitions List
- 1999: First launch and retrieve of (unmanned) spacecraft (Shenzhou-1)
- 2000: Initial operational capability of indigenous Beidou navigation system
- 2000: First "high resolution" (~3m) imaging satellite
- 2003: First manned spaceflight (Shenzhou-5)
- 2005: Two astronauts in orbit perform experiments (Shenzhou -6)
- 2007: Anti-satellite missile launch
- 2007: First Chinese built satellite for a foreign buyer (COMSAT for Nigeria)
- 2007: First lunar probe launched

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Source: CSIS

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Data for Findings 8: The current export control policy is constricting U.S. engagement and partnership

	TAA Submitted	TAA Approved	% Approved	TAA avg. time (days)
2003	508	439	86%	52
2004	610	565	93%	59
2005	829	722	87%	85
2006	698	627	90%	106

Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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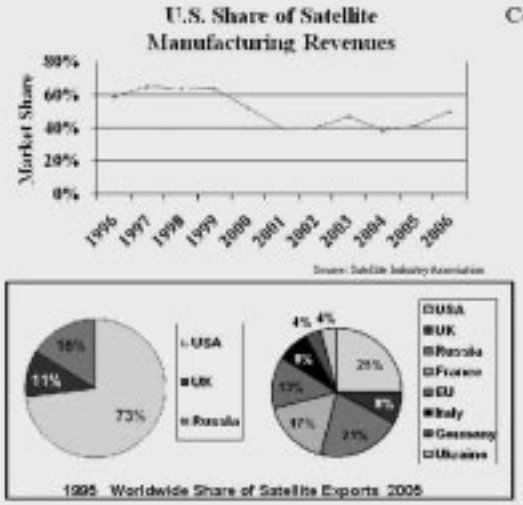
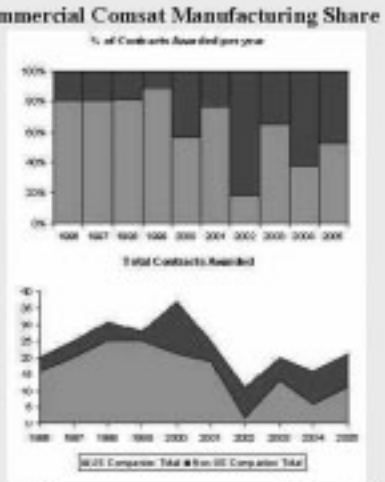
Data for Findings 10: The U.S. share of the foreign space markets is steadily declining





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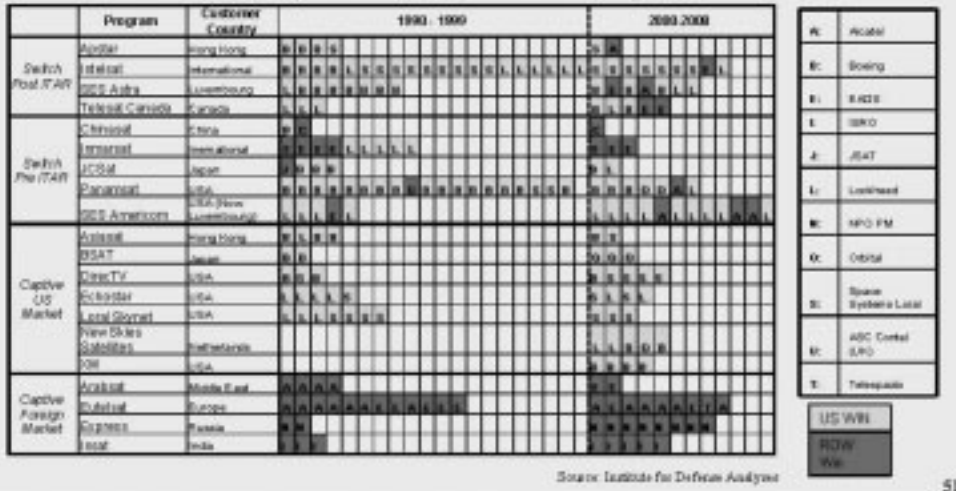
Data for Findings 10: The U.S. share of the foreign space markets is steadily declining (Continued)

Major Commercial GEO Satellite Programs



Source: Institute for Defense Analyses

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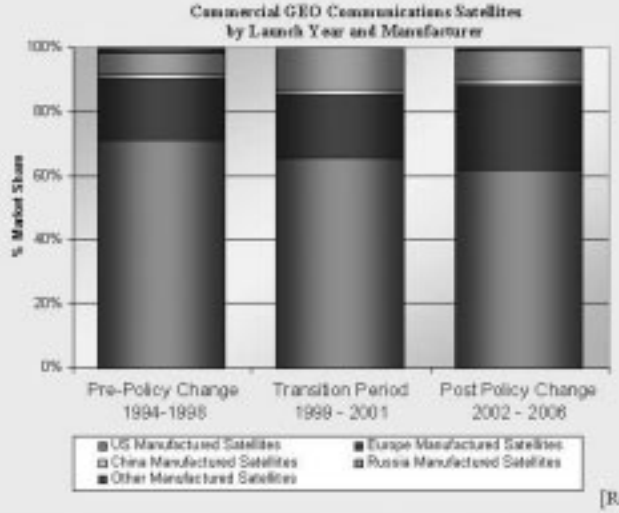
Data for Findings 10: The U.S. share of the foreign space markets is steadily declining (Continued)



Source: FAA Office of Commercial Space Transportation Database

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Data for Findings 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business -particularly the 2nd and 3rd tier.

- U.S. export controls are cited as the #1 barrier to foreign markets by industry

Barriers to Foreign Markets – Top 5 Countries

Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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Data for Findings 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business -particularly the 2nd and 3rd tier.

- An average $600 million per year of lost revenues due to licensing issues has been cited by industry (Caveat 1: there may be double counting between industry competitors; Caveat 2: this figure does not include competitions that were not pursued by US industry due to ITAR)

	Total Sales Subject to Licensing ($Millions)		Lost Sales Attributed to Licensing ($Millions)		Lost Sales as a % of Opportunities (Total Sales + Lost Sales)	
	ITAR	EAR	ITAR	EAR	ITAR	EAR
2003	$1,569	$64	$712	$0	31.2%	0.0%
2004	2,342	19	502	0	17.6%	0.0%
2005	6,166	118	628	0.4	9.2%	0.3%
2006	3,226	8	511	0.25	13.7%	3.0%

Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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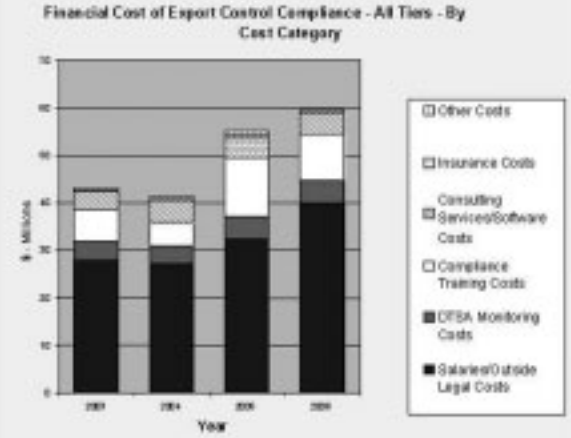
Data for Findings 11: Export controls are adversely affecting U.S. companies' ability to compete for foreign space business -particularly the 2nd and 3rd tier.

- The burden on the 2nd and 3rd tier of the industry is particularly heavy



Source: Air Force Research Laboratory analysis of survey of 202 space companies/business units, 2007

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Appendix

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Strom Thurmond National Defense Authorization Act for Fiscal Year 1999

Title XV, Subtitle B – Satellite Export Controls

SEC. 1511. SENSE OF CONGRESS.

It is the sense of Congress that--

(1) United States business interests must not be placed above United States national security interests;

(2) United States foreign policy and the policies of the United States regarding commercial relations with other countries should affirm the importance of observing and adhering to the Missile Technology Control Regime (MTCR);

(3) the United States should encourage universal observance of the Guidelines to the Missile Technology Control Regime;

(4) the exportation or transfer of advanced communication satellites and related technologies from United States sources to foreign recipients should not increase the risks to the national security of the United States;

(5) due to the military sensitivity of the technologies involved, it is in the national security interests of the United States that United States satellites and related items be subject to the same export controls that apply under United States law and practices to munitions;

(6) the United States should not issue any blanket waiver of the suspensions contained in section 902 of the Foreign Relations Authorization Act, Fiscal Years 1990 and 1991 (Public Law 101-246), regarding the export of satellites of United States origin intended for launch from a launch vehicle owned by the People's Republic of China;

(7) the United States should pursue policies that protect and enhance the United States space launch industry; and

(8) the United States should not export to the People's Republic of China missile equipment or technology that would improve the missile or space launch capabilities of the People's Republic of China.

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Strom Thurmond National Defense Authorization Act for Fiscal Year 1999

Title XV, Subtitle B – Satellite Export Controls (Continued)

SEC. 1513. SATELLITE CONTROLS UNDER THE UNITED STATES MUNITIONS LIST.

(a) Control of Satellites on the United States Munitions List.--Notwithstanding any other provision of law, all satellites and related items that are on the Commerce Control List of dual-use items in the Export Administration Regulations (15 C.F.R. Part 730 et seq.) on the date of the enactment of this Act shall be transferred to the United States Munitions List and controlled under section 38 of the Arms Export Control Act (22 U.S.C. 2778).

SEC. 1516. RELATED ITEMS DEFINED.

In this subtitle, the term ``related items'' means the satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and non-embedded solid propellant orbit transfer engines described in the report submitted to Congress by the Department of State on February 6, 1998, pursuant to section 38(f) of the Arms Export Control Act (22 U.S.C. 2778(f)).

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ITAR Regulations – 22 CFR 120-130

§ 120.1 General authorities and eligibility

(a) Section 38 of the Arms Export Control Act (22 U.S.C. 2778) authorizes the President to control the export and import of defense articles and defense services. The statutory authority of the President to promulgate regulations with respect to exports of defense articles and defense services was delegated to the Secretary of State by Executive Order 11958, as amended. This subchapter implements that authority. By virtue of delegations of authority by the Secretary of State, these regulations are primarily administered by the Deputy Assistant Secretary for Defense Trade Controls and Managing Director of Defense Trade Controls, Bureau of Political-Military Affairs.

§ 120.2 Designation of defense articles and defense services.

The Arms Export Control Act (22 U.S.C. 2778(a) and 2794(7)) provides that the President shall designate the articles and services deemed to be defense articles and defense services for purposes of this subchapter. The items so designated constitute the United States Munitions List and are specified in part 121 of this subchapter. Such designations are made by the Department of State with the concurrence of the Department of Defense. For a determination on whether a particular item is included on the U.S. Munitions List *see* §120.4(a).

ITAR Regulations – 22 CFR 120-130

§ 120.3 Policy on designating and determining defense articles and services.
An article or service may be designated or determined in the future to be a defense article (see §120.6) or defense service (see §120.9) if it:

(a) Is specifically designed, developed, configured, adapted, or modified for a military application, and
  (i) Does not have predominant civil applications, and
  (ii) Does not have performance equivalent (defined by form, fit and function) to those of an article or service used for civil applications; or

(b) Is specifically designed, developed, configured, adapted, or modified for a military application, and has significant military or intelligence applicability such that control under this subchapter is necessary.

The intended use of the article or service after its export (*i.e.* , for a military or civilian purpose) is not relevant in determining whether the article or service is subject to the controls of this subchapter. Any item covered by the U.S. Munitions List must be within the categories of the U.S. Munitions List. The scope of the U.S. Munitions List shall be changed only by amendments made pursuant to section 38 of the Arms Export Control Act (22 U.S.C. 2778).

§ 121.1 General. The United States Munitions List.
(a) The following articles, services and related technical data are designated as defense articles and defense services pursuant to §§38 and 47(7) of the Arms Export Control Act (22 U.S.C. 2778 and 2794(7)).…

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ITAR Regulations – 22 CFR 120-130

§ 121.1 General. The United States Munitions List (Continued)
Category XV—Spacecraft Systems and Associated Equipment

*(a) Spacecraft, including communications satellites, remote sensing satellites, scientific satellites, research satellites, navigation satellites, experimental and multi-mission satellites.

*Note to paragraph(a): Commercial communications satellites, scientific satellites, research satellites and experimental satellites are designated as SME only when the equipment is intended for use by the armed forces of any foreign country.

(b) Ground control stations for telemetry, tracking and control of spacecraft or satellites, or employing any of the cryptographic items controlled under category XIII of this subchapter.

(c) Global Positioning System (GPS) receiving equipment specifically designed, modified or configured for military use; or GPS receiving equipment with any of the following characteristics:

(1) Designed for encryption or decryption (e.g., Y-Code) of GPS precise positioning service (PPS) signals;
(2) Designed for producing navigation results above 60,000 feet altitude and at 1,000 knots velocity or greater;
(3) Specifically designed or modified for use with a null steering antenna or including a null steering antenna designed to reduce or avoid jamming signals;
(4) Designed or modified for use with unmanned air vehicle systems capable of delivering at least a 500 kg payload to a range of at least 300 km.

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ITAR Regulations – 22 CFR 120-130

§ 121.1 General. The United States Munitions List
Category XV—Spacecraft Systems and Associated Equipment (Continued)

(d) Radiation-hardened microelectronic circuits that meet or exceed all five of the following characteristics:

(1) A total dose of 5×10^5 Rads (Si);
(2) A dose rate upset threshold of 5×10^8 Rads (Si)/sec;
(3) A neutron dose of 1×10^{14} n/cm^2 (1 MeV equivalent);
(4) A single event upset rate of 1×10^{-10}errors/bit-day or less, for the CREME96 geosynchronous orbit, Solar Minimum Environment;
(5) Single event latch-up free and having a dose rate latch-up threshold of 5×10^8 Rads (Si).

(e) All specifically designed or modified systems or subsystems, components, parts, accessories, attachments, and associated equipment for the articles in this category, including the articles identified in section 1516 of Public Law 105–261: satellite fuel, ground support equipment, test equipment, payload adapter or interface hardware, replacement parts, and non-embedded solid propellant orbit transfer engines (see also Categories IV and V in this section).

Note: This coverage by the U.S. Munitions List does not include the following unless specifically designed or modified for military application (see §120.3 of this subchapter):

(1) Space qualified travelling wave tubes (also known as helix tubes or TWTs), microwave solid state amplifiers, microwave assemblies, and travelling wave tube amplifiers operating at frequencies equal to or less than 31GHz.

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ITAR Regulations – 22 CFR 120-130

§ 121.1 General. The United States Munitions List
Category XV—Spacecraft Systems and Associated Equipment (Continued)

(2) Space qualified photovoltaic arrays having silicon cells or having single, dual, triple junction solar cells that have gallium arsenide as one of the junctions.
(3) Space qualified tape recorders.
(4) Atomic frequency standards that are not space qualified.
(5) Space qualified data recorders.
(6) Space qualified telecommunications systems, equipment and components not designed or modified for satellite uses.
(7) Technology required for the development or production of telecommunications equipment specifically designed for non-satellite uses.
(8) Space qualified focal plane arrays having more than 2048 elements per array and having a peak response in the wavelength range exceeding 300nm but not exceeding 900nm.